FLUKE®
Calibration

5080A/MEG

Megohm Option

Users Manual

September 2010

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Introduction

The Megohm Calibration Option (the Megohm Option) provides functions that help you maintain some electrical safety testers, such as megohm meters/insulation testers. Some examples of these testers are:

- Megohm meters/Insulation testers
- Ground bond testers
- Loop testers
- Appliance testers
- Electrical installation testers
- Earth resistance meters

When this Megohm Option is installed in the 5080A Calibrator (the Calibrator), high and low resistance values and some high power low value resistances can be sourced at the Megohm Option terminals.

General Specifications

All specifications are valid after a warm-up period of 30 minutes, or twice the time since last warmed up, to a maximum of 30 minutes. For example, if the 5080A has been turned off for 5 minutes, the warm-up period is 10 minutes.

Specifications include stability, temperature coefficient, linearity, line and local regulation, and the traceability of the external standards used for calibration. It is not necessary to add anything to determine the total specification for the temperature range indicated.

Specification Confidence Level ..... 99 %

Warmup Time ..... Twice the time since last warmed up, to a maximum of 30 minutes.

Temperature

Operating	0 °C to 50 °C
Calibration (tcal)	15 °C to 35 °C
Storage	-20 °C to +70 °C

Temperature Coefficient ..... Temperature coefficient for temperatures outside tcal ±5 °C is 10 % of the stated specification per °C for temperatures in the range of 0 °C to 35 °C. Above 35 °C, the temperature coefficient is 20 % of the stated specification per °C.

Relative Humidity

Operating	<80 % to 30 °C, <70 % to 40 °C, <40 % to 50 °C.
Storage	<95 %, non-condensing

Altitude

Operating	2,000 m (6,500 ft) maximum
Non-operating	12,200 m (40,000 ft) maximum

Detailed Specifications

Low Resistance Source

Range ..... 1 Ω to 5.9 kΩ

Test Voltage Measurement

Resolution ..... 0.1 V

Specification ..... ±(1.2 % of input ±0.2 V)

Settling Time ..... 1 second for input deviations of <5 %

Test Current Measurement Specification ..... ±((1.2 % + RS %) of input ±0.2 V/R) A, where RS is the resistance specification, and R is the resistance

Nominal Value	Maximum Continuous Test Current [1]	Maximum Deviation from Nominal Value (± ±(% of value)	Specification of Characterized Value tcal ±5 °C, ±(% of value)	
			90 days	1 year
1 Ω	700 mA	20 %	1.10 %	1.10 %
1.8 Ω	610 mA	10 %	0.78 %	0.78 %
3.7 Ω	550 mA	7 %	0.57 %	0.57 %
5.9 Ω	510 mA	7 %	0.49 %	0.49 %
10 Ω	440 mA	5 %	0.45 %	0.45 %
18 Ω	330 mA	5 %	0.42 %	0.42 %
37 Ω	230 mA	5 %	0.41 %	0.41 %
59 Ω	170 mA	5 %	0.48 %	0.48 %
100 Ω	140 mA	5 %	0.45 %	0.45 %
180 Ω	105 mA	5 %	0.42 %	0.42 %
370 Ω	73 mA	5 %	0.41 %	0.41 %
590 Ω	53 mA	5 %	0.34 %	0.34 %
1 kΩ	44 mA	5 %	0.30 %	0.30 %
1.8 kΩ	30 mA	5 %	0.22 %	0.22 %
3.7 kΩ	15 mA	5 %	0.14 %	0.14 %
5.9 kΩ	9 mA	5 %	0.10 %	0.10 %

[1] Exceeding the maximum current limits will cause the Calibrator to disconnect the output terminals and display an error message.

High Resistance Source

Range ..... 10 kΩ to 10.05 GΩ

Resolution ..... 4 digits (continuously variable for 10 kΩ to 10.05 GΩ

Test Voltage Measurement

Range ..... 0 to 1575 V peak

Resolution ..... 1 V

Specification ..... ±(3.0 % of input ±5 V)

Settling Time ..... 2 seconds for input deviations of <5 %

Test Current Measurement Specification ..... ±(3.0 % + RS %) of input ±5 V/R A, where RS is the resistance specification, and R is the resistance

Specification and Maximum Ratings

Range	Resolution	Maximum Voltage [1]	Specification (tcal ±5 °C, ± of output)	
			90 days	1 year
10.00 to 19.99 kΩ	10 Ω	140 V	0.20%	0.20 %
20.00 to 39.99 kΩ	10 Ω	200 V	0.20 %	0.20 %
40.00 to 99.99 kΩ	10 Ω	400 V	0.20 %	0.20 %
100.0 to 499.9 kΩ	100 Ω	800 V	0.20 %	0.20 %
500.0 to 999.9 kΩ	100 Ω	1100 V	0.20 %	0.20 %
1.000 to 9.999 MΩ	1 kΩ	1575 V	0.30 %	0.30 %
10.00 to 99.99 MΩ	10 kΩ	1575 V	0.50 %	0.50 %
100.0 to 999.9 MΩ	100 kΩ	1575 V	0.50 %	0.50 %
1.000 to 10.050 GΩ	1 MΩ	1575 V	1.00 %	1.00 %

[1] Exceeding the maximum voltage limits will cause the Calibrator to disconnect the output terminals and display an error message.

18.24 GΩ Single-Value Output

Range ..... 18.24 GΩ single output

Test Voltage Measurement

Range ..... 0 to 1575 V peak

Resolution ..... 1 V

Specification ..... ±(3.0 % of input ±5 V)

Settling Time ..... 2 seconds for input deviations of <5 %

Test Current Measurement Specification ..... ±(3.1 % of input ±1 nA)

Specification and Maximum Ratings

Nominal Value	Maximum Voltage [1]	Maximum Deviation from Nominal Value	Specification, 1 year, tcal ±5 °C, ±(% of output)
18.24 GΩ	1575 V	±5 %	3.0 %

[1] Exceeding the maximum voltage limits will cause the Calibrator to disconnect the output terminals and display an error message.

Short Mode for Megohm Meters

Nominal Resistance ..... <100 Ω

Test Current Measurement

Range ..... 100 mA DC peak

Resolution ..... 0.1 mA

Specification ..... ±(1.8 % of input ±3.4 mA)

Settling Time ..... 1 second for input deviation of <5 %

Test Voltage Measurement Specification ..... ±(1.2 % of input ±0.2 V)

Note

Exceeding the maximum current limits will cause the Calibrator to disconnect the output terminals and display an error message.

How to Prepare the Calibrator for Operation

Refer to the *5080A Operators Manual* for calibrator warm-up times.

How to Calibrate Instruments

To activate or deactivate the Megohm Option, push [MEG Ω]. An indicator on the button illuminates when the Megohm Option is active. If the Megohm Option is not installed in the Calibrator, an error message is displayed when [MEG Ω] is pushed.

The Megohm Option has the following modes:

- High Resistance Source (HVR)
- Short Mode (for Megohm Meters)
- Low Resistance Source (LVR)
- 18.24 GΩ (single value)
- High Resistance Source x 1000 (MULTI)

The resistance for all five functions is sourced across the MEGOHM HI and LO terminals of the Calibrator. The LO terminal can be either floating or grounded. When grounded, the LO terminal is connected to earth ground through the ground in the AC power input module through an internal relay. Refer to the "When to Use EARTH" section of the 5080A Operators Manual for details about this feature. When floating, the LO terminal is connected to the earth ground through the protection parts. The voltage between the LO terminal and the earth ground should not be over 20 volts. Voltages higher than 20 volts will cause a measurement error due to the leakage current.

How to Set the High Resistance Source Output

To source a high resistance with the Megohm Option:

1. If not already active, push [MEG Ω].
2. Push the softkey labeled **MODE** until **hvr** appears above the right-most Calibrator softkey.
3. Type a value through the keypad or turn the rotary knob to set the resistance at the MEGOHM terminals.

Note

The 3-wire mode is sometimes necessary to improve calibration stability. This is especially true for resistances over 100 MΩ. The third terminal is usually connected to the guard or ground terminal on the UUT. If the UUT is equipped with a ground (GND) terminal, it should be connected to AUX EARTH GROUND terminal on the Calibrator's rear panel.

4. Connect the UUT's terminals to the Calibrator's MEGOHM terminals.
5. After confirming the settings and connections are correct, push [OPR] to connect the UUT to the selected resistance. See Figure 1 for simplified schematic of this connection.

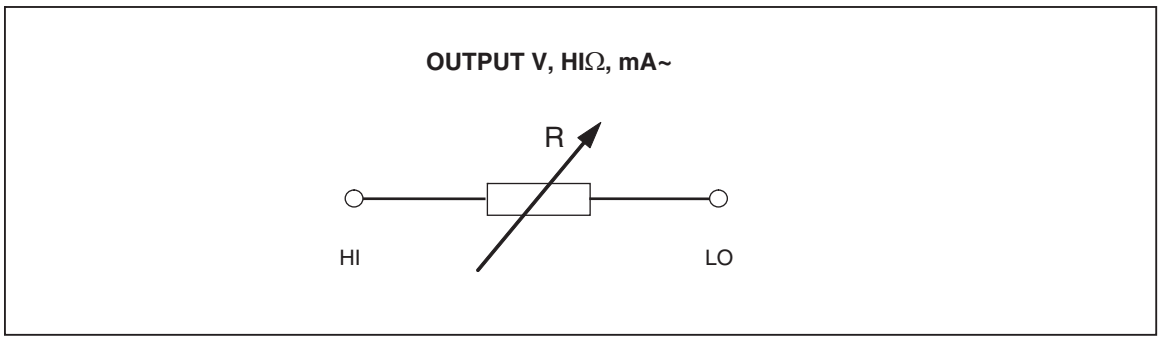

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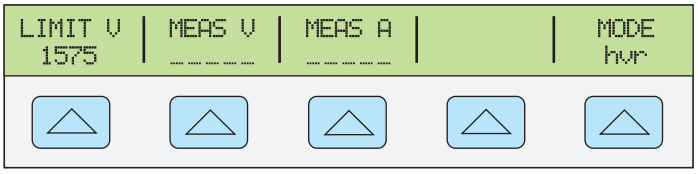
Figure 1. Simplified High Resistance Source Schematic

While connected to the UUT, the Calibrator monitors the voltage across the resistance (MEAS V) as well as the current through it (MEAS A). If the voltage across the resistance exceeds acceptable limits (LIMIT V), the Calibrator disconnects the output terminals and displays an error message.



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With the Calibrator in Operate mode, the resistance across the MEGOHM terminals can be changed through the keypad or the rotary knob.

6. Push STBY to put the Megohm function in standby and disconnect the UUT from the resistance. The MEAS V and MEAS A values change to "-----" when the Calibrator is in standby mode.

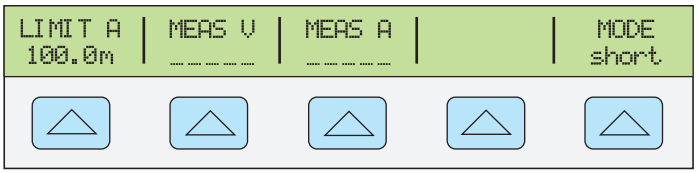
How to Set the Short Mode Output

The Short Mode shorts the Calibrator's MEGOHM terminals to test a UUT's maximum test current.

To set the Megohm Option to Short Mode:

1. If not already active, push MEGΩ.
2. Push the softkey labeled **MODE** until **short** appears above the right-most Calibrator softkey.
3. Connect the UUT's terminals to the Calibrator's terminals.
4. Push OPR to connect the UUT to the short.

   While connected to the UUT, the Calibrator monitors the voltage appearing across the short (MEAS V) as well as the current through it (MEAS A). If the current through the short exceeds acceptable limits (LIMIT A), the Calibrator disconnects the output terminals and displays an error message.



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5. Push STBY to put the Megohm function in standby and disconnect the UUT from the

short. The MEAS V and MEAS A values change to "-----" when the Calibrator is in standby mode.

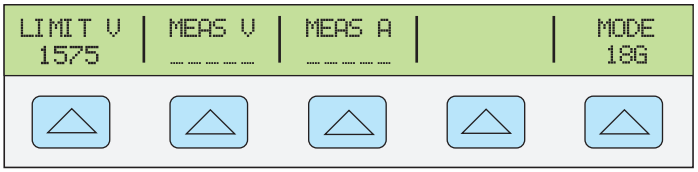
How to Set the Single Output Value

The Single Output Value mode places a resistance of 18.24 GΩ across the MEGOHM terminals.

To set the Megohm Option to the Single Output Value:

1. If not already active, push [MEG Ω].
2. Push the softkey labeled **MODE** until **18G** appears above the right-most Calibrator softkey.
3. Connect the UUT's terminals to the Calibrator's terminals.
4. Push [OPR] to connect the UUT to the resistance.

   While connected to the UUT, the Calibrator monitors the voltage appearing across the resistance (MEAS V) as well as the current through it (MEAS A). If the voltage across the resistance exceeds acceptable limits (LIMIT V), the Calibrator disconnects the output terminals and displays an error message.



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5. Push [STBY] to put the Megohm function in standby and disconnect the UUT from the resistance. The MEAS V and MEAS A values change to "-----" when the Calibrator is in standby mode.

How to Set the High Resistance Source Output with Multiplier

The Fluke 5320A High Resistance Multiplier extends the Calibrator's high resistance range to 10 TΩ. Before you use the resistance multiplier, the multipliers characteristic resistance values must be typed in to the Calibrator to calculate the correct resistance at the resistance multipliers input terminals.

How to Determine R1 and R2 Values of the Multiplier

To determine the correct R1 and R2 values for the multiplier:

1. With a Fluke 8508A Reference Multimeter or equivalent, set the meter to 2 GΩ range.
2. Connect the 2W HI meter input to the HI jack (HI Ω Multiplier) on the back of the HV Adapter/R Multiplier.
3. Connect the 2W LO meter input to the Input HI jack on the front of the HV Adapter/R Multiplier.
4. Record the measurement on the meter as R1.
5. Set the meter to the 2 MΩ range.
6. Move the lead connected to the 2W LO input of the meter from the Input HI jack to the COM/GUARD jack on the front of the HV Adapter/R Multiplier.
7. Record the measurement on the meter as R2.

Note

The Resistance Multiplier can only be used with insulation testers that have a third terminal, commonly called the Guard terminal.

1. If not already active, push MEGΩ.
2. Push the softkey labeled **MODE** until **multi** appears above the right-most Calibrator softkey.

Note

The minimum resistance value available in the multiplier mode is 350 MΩ.

There are two multiplier calibration constants the Calibrator uses to calculate output resistance to the resistance multiplier: R1 and R2. The current R1 and R2 values are shown in the multiplier mode window.

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If the values shown under the R1 and R2 are not correct:

1. Push SETUP.
2. Next, push the softkey labeled **INSTMT SETUP**.
3. Next, push the softkey labeled **OUTPUT SETUP**.
4. Next, push the softkey labeled **SET MULTI**.
5. Depending on which variable to set, push the softkey labeled **R1**, **R2**, or **Rs**.
6. Enter the variable value through the Calibrator keypad and push ENTER.

Repeat steps 5 and 6 for each variable you want to change.

Note

Rs sets the input resistance of the sense terminal of the UUT. For optimum performance, the factory default setting for Rs is 0 ohms.

To return to the multi menu, push PREV MENU multiple times until you reach the display.

Store or discard the changes after you change the setup parameters.

How to Set the High Resistance Output

To set the Megohm Option to the Multiplier mode:

1. If not already active, push MEGΩ.
2. Push the softkey labeled **MODE** until **multi** appears above the right-most Calibrator softkey.
3. Connect the multiplier to the Calibrator as shown in Figure 2.

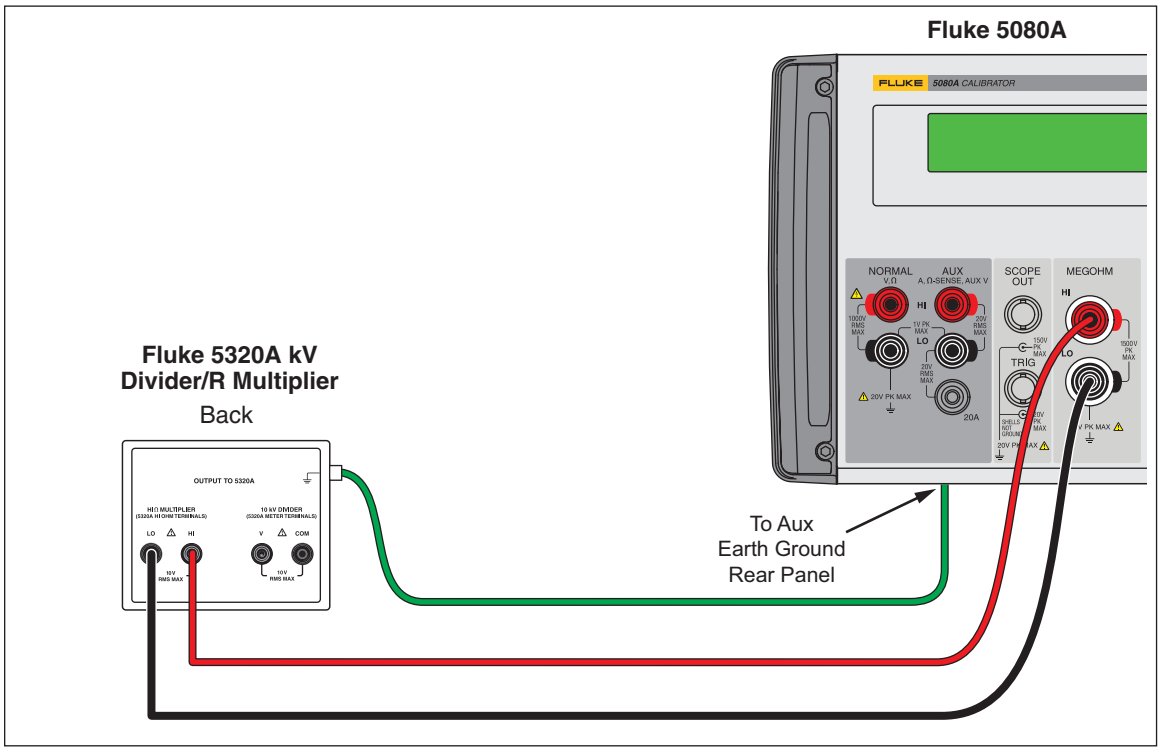

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Figure 2. Multiplier to Calibrator Connections

4. Connect the UUT's terminals to the Multiplier's input terminals.
5. Through the Calibrator keypad, type in the High Resistance Output value or the rotary knob until the value appears in the display.
6. Push [OPR] to connect the UUT to the resistance.

   With the Calibrator in Operate mode, the resistance across the multiplier terminals can be changed through the keypad or the rotary knob.
7. Push [STBY] to put the Megohm function in standby and disconnect the UUT from the resistance.

How to Set the Low Resistance Source Output

The Low Resistance Source Output mode places one of a number of discrete resistances across the MEGOHM terminals. See the Low Resistance Source uncertainty and maximum ratings table in the specifications section for the list of selectable resistances.

To set the Megohm Option to the Low Resistance Source mode:

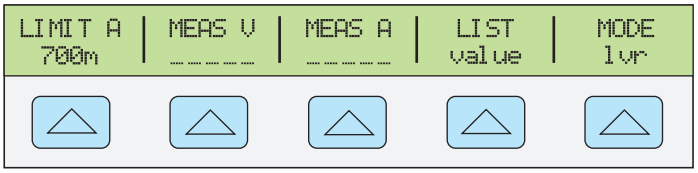
1. If not already active, push [MEG Ω].
2. Push the softkey labeled **MODE** until **lvr** appears above the right-most Calibrator softkey.
3. Connect the UUT's terminals to the Calibrator's MEGOHM terminals.
4. Type in one of the discrete resistance values through the Calibrator's keypad.

Note

*To review the list of valid resistance values, push the softkey labeled **LIST VALUE**. Once you decide on a resistance value, push [PREV MENU] to return to the **lvr** menu and type in the value.*

5. Push [OPR] to connect the UUT to the resistance.

While connected to the UUT, the Calibrator monitors the voltage appearing across the resistance (MEAS V) as well as the current through it (MEAS A). If the current across the resistance exceeds acceptable limits (LIMIT A), the Calibrator disconnects the output terminals and displays an error message.



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Note

The allowed resistance values are discrete values and therefore the rotary knob can not be used to change the resistance value at the MEGOHM terminals.

6. Push STBY to put the Megohm function in standby and disconnect the UUT from the resistance. The MEAS V and MEAS A values change to "-----" when the Calibrator is in standby mode.

Note

To show the UUT error using the rotary knob, refer to the Editing and Error Output Settings section in Chapter 4 of the 5080A Operators Manual.

Applications

This section shows several typical applications of the Megohm Calibration Option to help better understand how to use the Megohm Option.

How to Calibrate Continuity Testers

Continuity is a low-ohms function typically found on most electrical testers. Insulation testers and installation testers are two instruments that use a low-ohms function.

To perform a 2-wire resistance calibration:

1. Push MEG Ω.
2. Push the softkey labeled **MODE** until **lvr** appears above the right-most Calibrator softkey.
3. Connect the UUT to the Calibrator as shown in Figure 3.

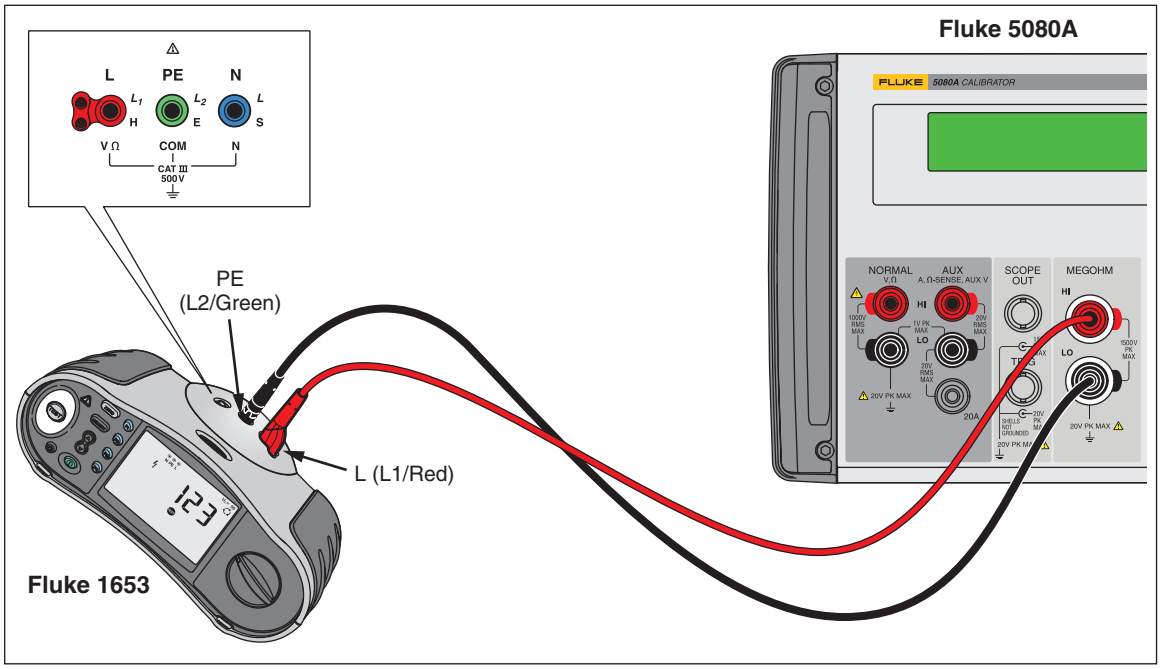

Figure 3. Resistance Calibration UUT Connections

4. Type in one of the discrete resistance values through the Calibrator's keypad.
5. Push [OPR].
6. Compare the measurement on the UUT with the standard value on the Calibrator's display.
7. Push [STBY] to put the Megohm function in standby and disconnect the UUT from the resistance.

How to Calibrate Insulation Testers

Use the High Resistance Source function to calibrate the insulation resistance function on insulation testers/megohm meters, installation testers, appliance testers, and electrical safety analyzers. Figures 4 through 8 shows how to connect the Calibrator to five different types of UUTs for an insulation resistance calibration.

To perform an Insulation Resistance calibration:

1. If not already active, push [MEG Ω].
2. Push the softkey labeled **MODE** until **hvr** appears above the right-most Calibrator softkey.
3. Depending on the type of UUT, connect the UUT to the Calibrator as shown in Figures 4 through 8.

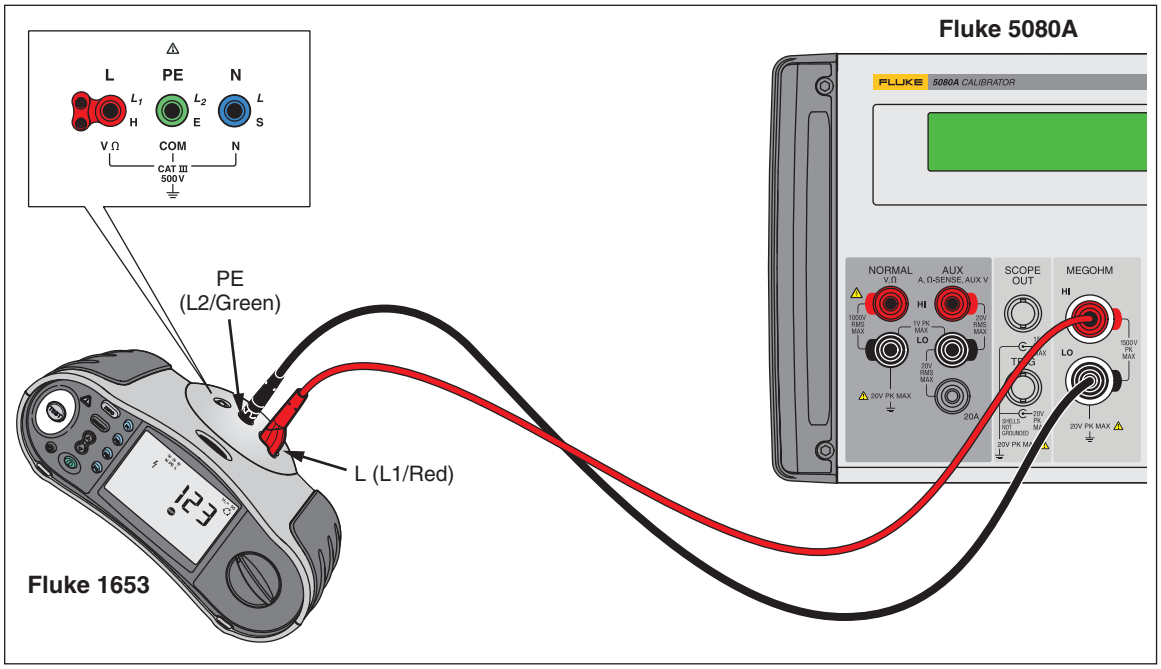

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Figure 4. Calibrating Insulation Resistance of an Insulation Tester

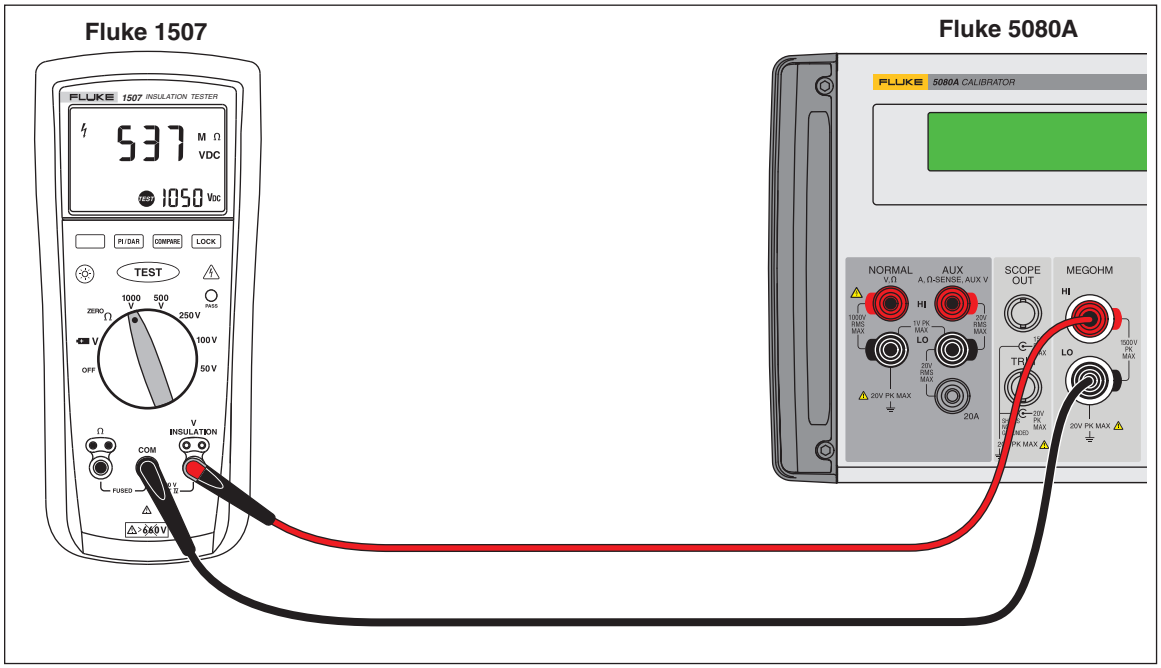

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Figure 5. Calibrating Insulation Resistance of a Handheld Insulation Tester

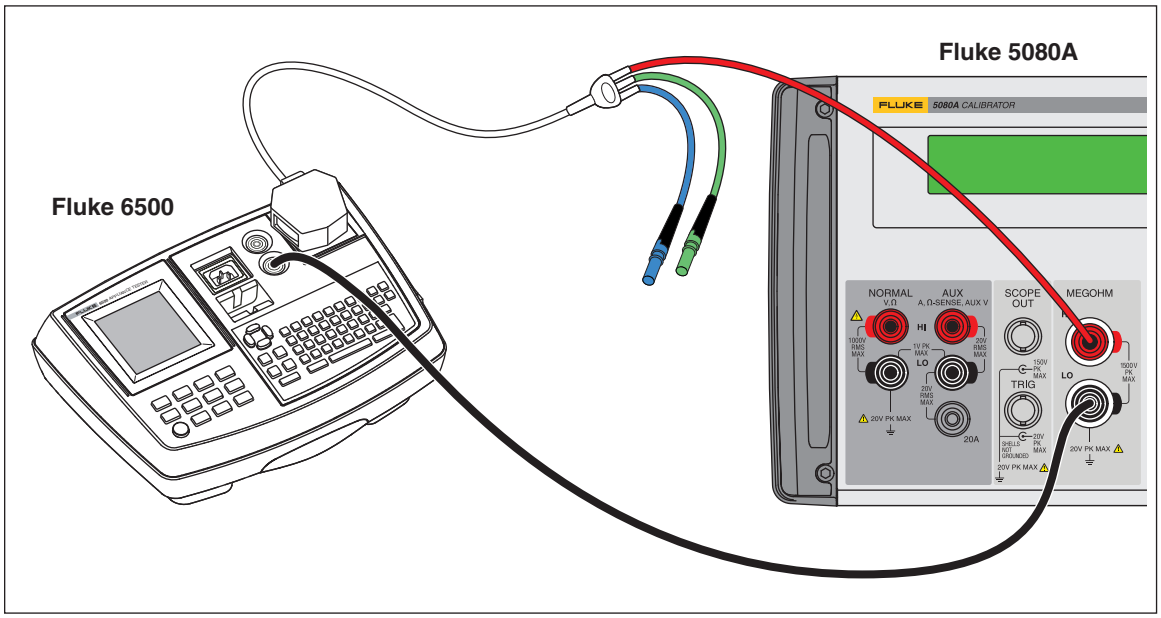

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Figure 6. Calibrating Insulation Resistance of a Portable Tester

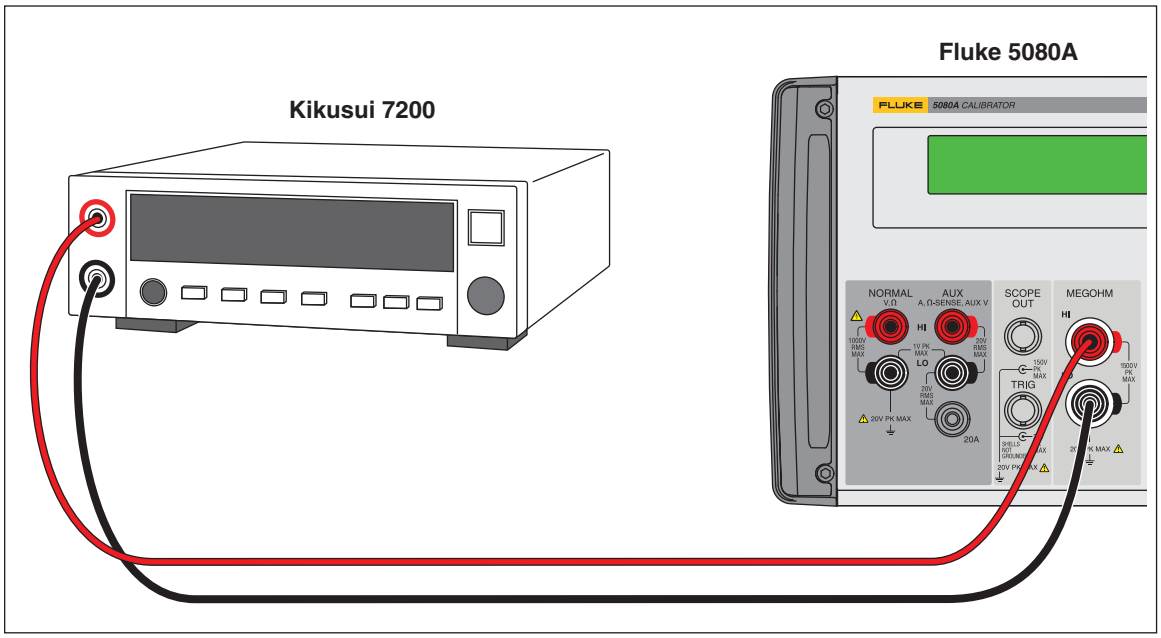

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Figure 7. Calibrating Insulation Resistance of an Electrical Safety Analyzer

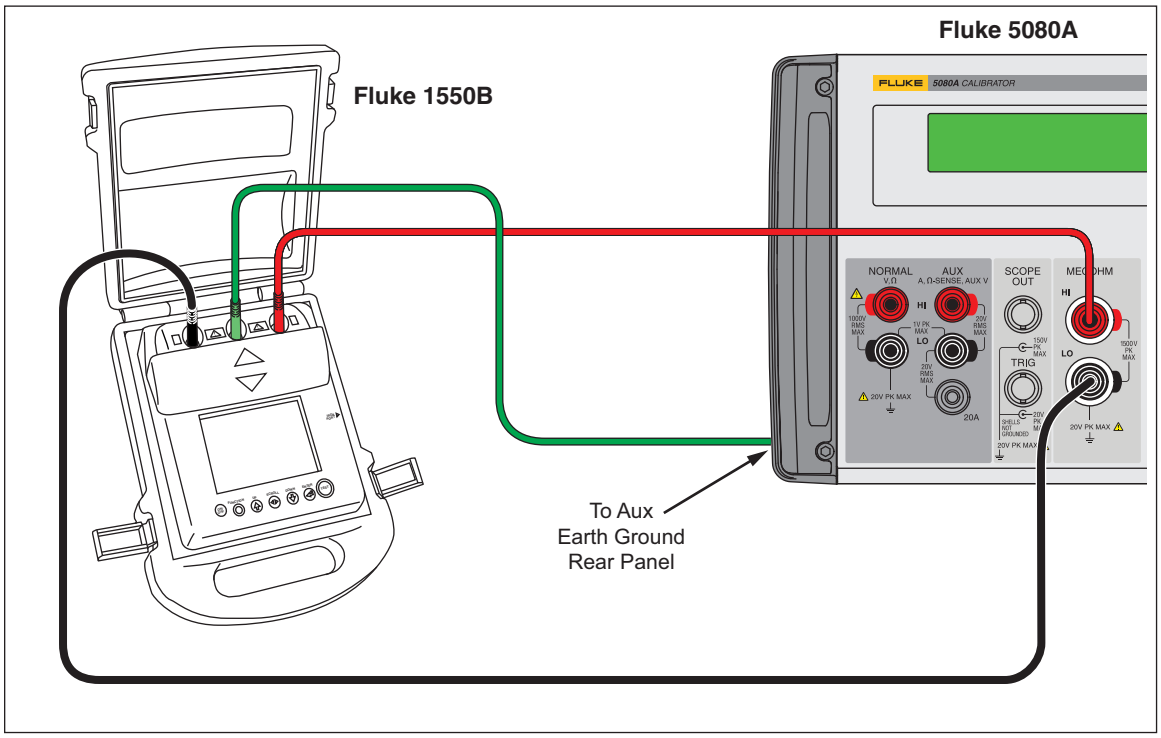

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Figure 8. Calibrating a Megohm Meter

Note

To avoid ground loops and noise, use only one earth ground-to-LO terminal connection in the system. Verify the EARTH annunciator is off, when the guard or the ground terminal of the UUT is connected to the AUX EARTH GROUND terminal on the rear-panel of the Calibrator.

4. Type in a value through the keypad or turn the rotary knob to set the resistance at the MEGOHM terminals.
5. Set the test voltage on the UUT.
6. Push OPR.
7. Push the UUT's start or test button to activate the measurement.

   The standard resistor is now applied to the output terminals. The test voltage and current generated by the UUT is measured by the Calibrator and shows in the display. Compare the measurement on the UUT with the standard value shown in the display of the Calibrator.
8. Stop the test by releasing the appropriate UUT test button.
9. Push STBY to disconnect the UUT from the Calibrator.

How to Calibrate Insulation Testers with the Resistance Multiplier

Note

For some megohmmeters, when you use the resistance multiplier adapter the HI terminal on the Calibrator must be attached to the LO terminal on the Multiplier. The LO terminal on the Calibrator must be attached to the HI terminal on the Multiplier. Earth must be activated when you swap HI and LO lead positions in the high ohms resistance function.

The Resistance Multiplier can only be used with megohm meters that have a third terminal, commonly called the Guard terminal.

Note

To avoid ground loops and noise, use only one earth ground-to-LO terminal connection in the system. Verify the EARTH annunciator is off, when the guard or the ground terminal of the UUT is connected to the AUX EARTH GROUND terminal on the rear-panel of the Calibrator.

To make an Insulation Resistance calibration with the Resistance Multiplier:

1. If not already active, push MEG Ω.
2. Push the softkey labeled **MODE** until **multi** appears above the right-most Calibrator softkey.
3. Depending on the type of UUT, connect the UUT to the Calibrator as shown in Figures 0-9 and 0-10.

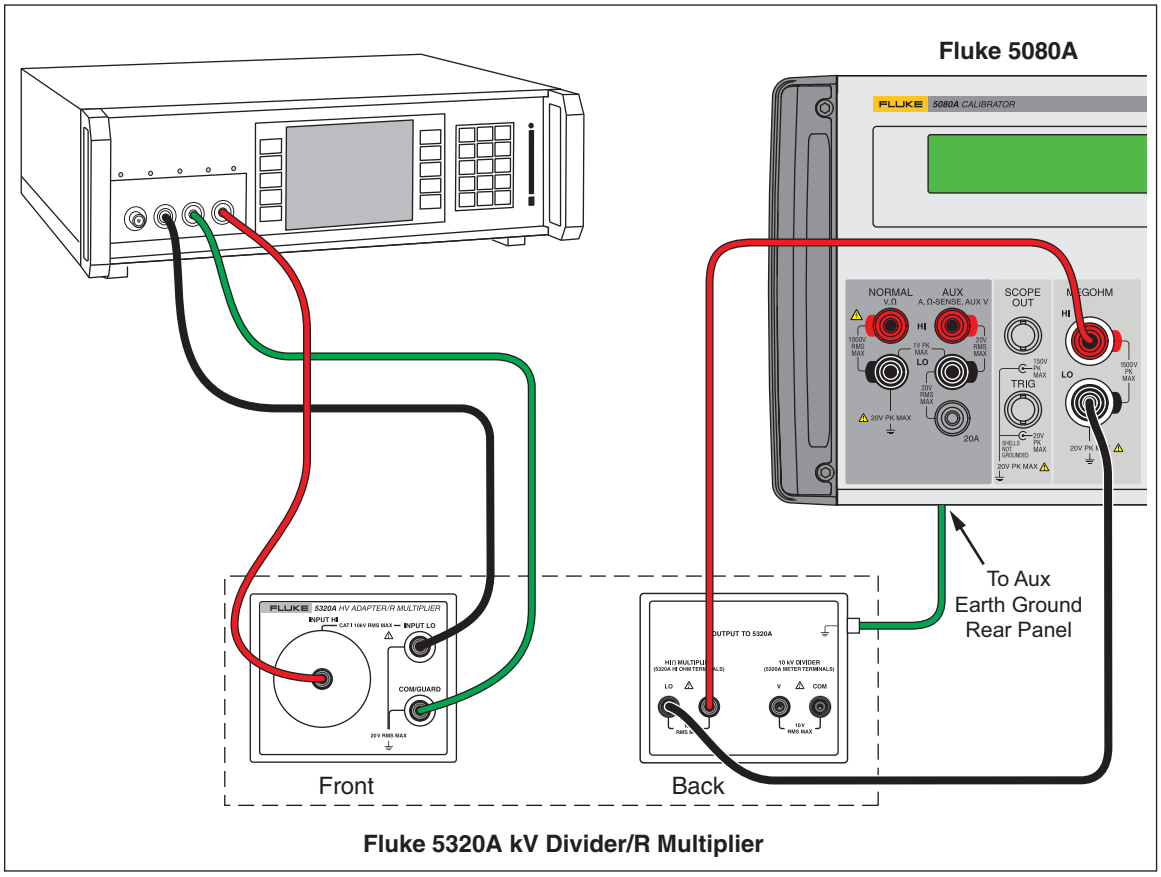

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Figure 9. Connections to Bench Tester with a Resistance Multiplier Adapter

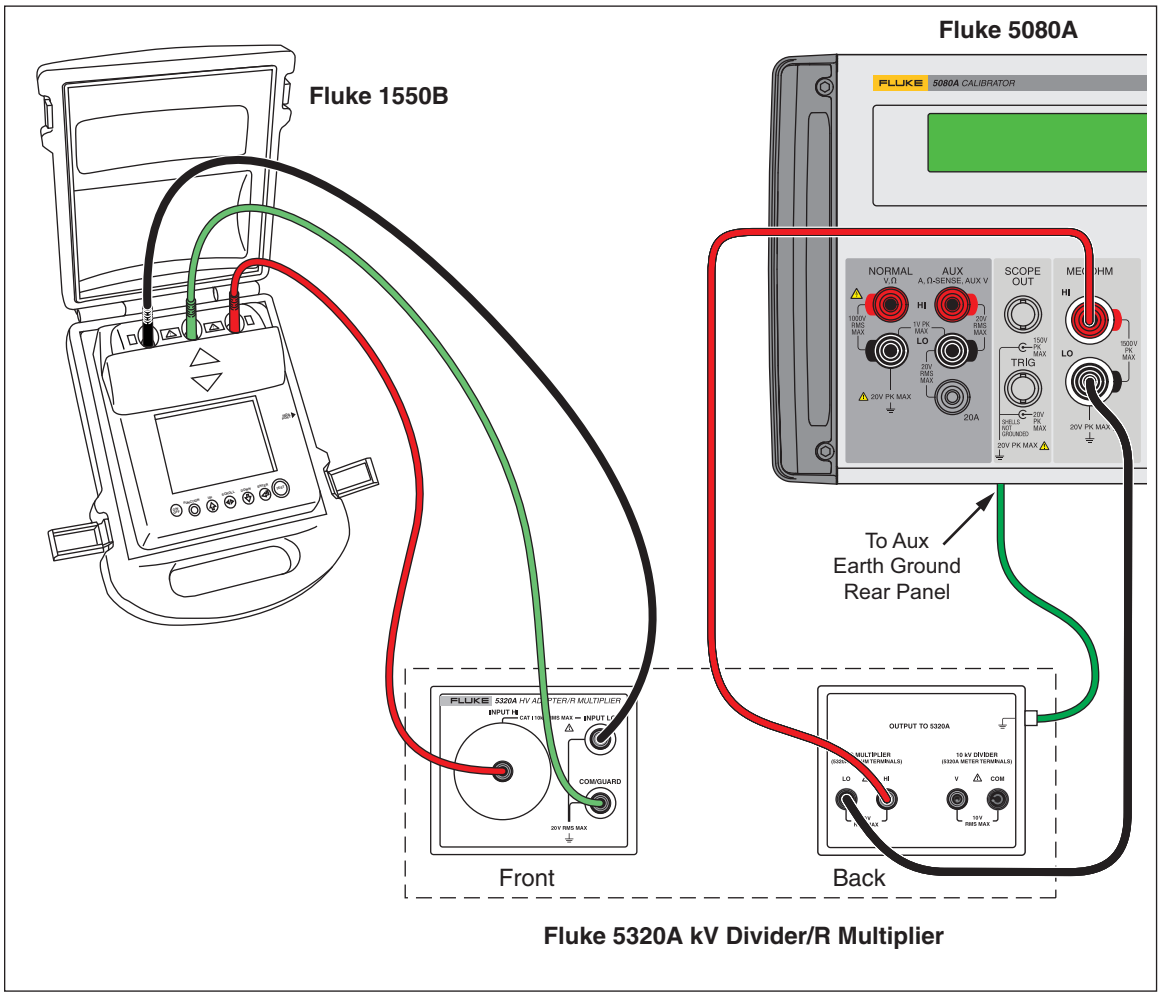

Figure 10. Connections to 1550B with a Resistance Multiplier Adapter

4. Type in the High Resistance Output value through the Calibrator keypad or turn the rotary knob until the value shows in the display.
5. Set the test voltage on the UUT.
6. Push OPR to connect the UUT to the resistance.
7. Push the UUT's start or test button to activate the measurement.

   The standard resistor is now applied to the output terminals. Compare the measurement on the UUT with the standard value shown in the display of the Calibrator.
8. Stop the test by releasing the appropriate UUT test button.
9. Push STBY to disconnect the UUT from the Calibrator.

Remote Commands and Queries

This section describes commands and queries that are used for the Megohm Option. Each command falls into one or more command categories: Sequential, Overlapped, or Coupled.

Sequential Commands – Commands executed immediately as they are encountered in the data stream are called sequential commands. For more information, see "Sequential Commands" in Chapter 5 of the 5080A Operators Manual.

Overlapped Commands – Commands that require additional time to execute are called overlapped commands because they can overlap the next command before completing execution. To be sure an overlapped command is not interrupted during execution, use the *OPC, *OPC?, and *WAI commands to detect command completion. See Table 6-8 for all the commands that are classified as overlapped. For more information, see "Overlapped Commands" in Chapter 5 of the 5080A Operators Manual.

Coupled Commands – These are called coupled commands (examples: CUR_POST and OUT) because they "couple" in a compound command sequence. Care must be taken to be sure the action of one command does not disable the action of a second command and thereby cause a fault. See Table 6-8 for all the commands that are classified as coupled. For more information, see "Coupled Commands" in Chapter 5 of the 5080A Operators Manual.

Table 1. Overlapped and Coupled Commands

Command	Overlapped	Coupled
MEGO(?)	Yes	No
MGSETUP(?)	No	No
MGMEAS?	No	No

MEGO(?) <value >

Description Programs the 5080A to use the Megohm Option, if installed.

Parameters <value> =

OFF	Turns the Megohm option off. Programs 0 V, 0 Hz output at the NORMAL terminals.
HVR	Sets High Voltage Resistance mode.
SHORT	Sets Short Circuit mode.
S18G	Sets Single Output Value mode.
MULTI	Sets Multiplier mode.
LVR	Sets Low Voltage Resistance mode.

Example `MEGO HVR` Sets the Megohm option to High Voltage Resistance mode.

Query `MEGO?` Returns the mode of the Megohm option (OFF, HVR, SHORT, S18G, MULTI, or LVR).

MGSETUP(?) <value >

Description Sets the parameters for the multiplier in the Megohm option.

Parameters <value> = R2 Value, R1 Value, Rs Value

Example `MGSETUP 300.0 KOHM, 300.0 MOHM, 0.0 MOHM`

Sets R2 to 300.0 kΩ, R1 to 300.0 MΩ, Rs to 0.0 Ω

Query `MGSETUP?` Returns the programmed parameters for the Megohm option.

Returns `3.000e+05, 3.000e+08, 0.000e+00`

MGMEAS?

Description Returns the measured values of the MegOhm option.

Query `MGMEAS?` Returns `1000, 0.100E-3`. That is 1000 V for MEAS V, and 0.1 mA for MEAS A.

MEGOHM Verification Tests

Before the Megohm Option leaves the Fluke factory, it is verified to meet its specifications. The verification test points provided in Tables 2 through 5 are to be used as a guide when re-verification is desired. There is no built-in factor for measurement uncertainty.

Note

Verification should be performed by qualified metrology personnel who have access to a properly equipped standards laboratory to test calibration equipment of this level of accuracy.

Table 2. Megohm Option LVR Verification Points

Nominal Value	Tolerance	Reading		Max. Deviation from Characterized Value
		Min.	Max.	
1 Ω	0.2 Ω	800.00 mΩ	1.2 Ω	±0.011 Ω
1.8 Ω	0.18 Ω	1.62 Ω	1.98 Ω	±0.014 Ω
3.7 Ω	0.259 Ω	3.441 Ω	3.959 Ω	±0.021 Ω
5.9 Ω	0.413 Ω	5.487 Ω	6.313 Ω	±0.029 Ω
10 Ω	0.5 Ω	9.5 Ω	10.50 Ω	±0.45 Ω
18 Ω	0.9 Ω	17.1 Ω	18.90 Ω	±0.075 Ω
37 Ω	1.85 Ω	35.15 Ω	38.85 Ω	±0.150 Ω
59 Ω	2.95 Ω	56.05 Ω	61.95 Ω	±0.28 Ω
100 Ω	5 Ω	95 Ω	105 Ω	±0.45 Ω
180 Ω	9 Ω	171 Ω	189 Ω	±0.75 Ω
370 Ω	18.5 Ω	351.5 Ω	388.5 Ω	±1.5 Ω
590 Ω	29.5 Ω	560.5 Ω	619.5 Ω	±2.0 Ω
1 kΩ	50 Ω	950 Ω	1.05 kΩ	±3.0 Ω
1.8 kΩ	90 Ω	1.71 kΩ	1.89 kΩ	±4.0 Ω
3.7 kΩ	185 Ω	3.515 kΩ	3.885 kΩ	±5.0 Ω
5.9 kΩ	295 Ω	5.605 kΩ	6.195 kΩ	±6.0 Ω

Table 3. Megohm Option Short Verification Points

Nominal Value	Reading	
	Min.	Max.
59.00 Ω	0.00 Ω	100 Ω

Table 4. Megohm Option HVR Verification Points

Nominal Value	Tolerance	Reading	
		Min.	Max.
10.00 kΩ	20.0 Ω	9.98 kΩ	10.02 kΩ
11.55 kΩ	23.1 Ω	11.5269 kΩ	11.5731 kΩ
21.00 kΩ	42.0 Ω	20.958 kΩ	21.042 kΩ
42.00 kΩ	84.0 Ω	41.916 kΩ	42.084 kΩ
80.85 kΩ	161.7 Ω	80.6883 kΩ	81.0117 kΩ
100.0 kΩ	200.0 Ω	99.8000 kΩ	100.2000 kΩ
150.2 kΩ	300.4 Ω	149.8996 kΩ	150.5004 kΩ
288.2 kΩ	576.4 Ω	287.9236 kΩ	288.7764 kΩ
499.9 kΩ	999.8 Ω	498.9002 kΩ	500.8998 kΩ
535.5 kΩ	1.0710 Ω	534.4290 kΩ	536.5710 kΩ
999.9 kΩ	1.9998 Ω	997.9002 kΩ	1.0019 MΩ
1.000 MΩ	2.000 kΩ	998.0000 kΩ	1.0020 MΩ
1.029 MΩ	3.087 kΩ	1.0259 MΩ	1.0321 MΩ
1.920 MΩ	5.760 kΩ	1.9142 MΩ	1.9258 MΩ
3.660 MΩ	10.980 kΩ	3.6490 MΩ	3.6710 MΩ
6.980 MΩ	20.940 kΩ	6.9591 MΩ	7.0009 MΩ
9.999 MΩ	29.997 kΩ	9.969 MΩ	10.029 MΩ
10.00 GΩ	30.00 kΩ	9.970 MΩ	10.030 MΩ
10.24 GΩ	51.20 kΩ	10.1888 MΩ	10.2912 MΩ
20.98 GΩ	104.90 kΩ	20.8751 MΩ	21.0849 MΩ
39.19 GΩ	195.95 kΩ	38.9941 MΩ	39.3860 MΩ
76.55 GΩ	382.75 kΩ	76.1673 MΩ	76.9328 MΩ
99.99 GΩ	499.95 kΩ	99.4901 MΩ	100.4900 MΩ
100.0 GΩ	500.00 kΩ	99.500 MΩ	100.500 MΩ
138.6 GΩ	693.00 kΩ	137.907 MΩ	139.293 MΩ
148.9 GΩ	744.50 kΩ	148.1555 MΩ	149.6445 MΩ
289.6 GΩ	1.4480 MΩ	288.152 MΩ	291.048 MΩ
559.6 GΩ	2.7980 MΩ	556.802 MΩ	562.398 MΩ
999.9 GΩ	4.9995 MΩ	994.9005 MΩ	1.0049 GΩ
1.000 TΩ	5.0000 MΩ	995.0000 MΩ	1.0050 GΩ
1.060 TΩ	10.600 MΩ	1.0494 GΩ	1.0706 GΩ
2.000 TΩ	20.000 MΩ	1.9800 GΩ	2.0200 GΩ

Table . Megohm Option HVR Verification Points (cont.)

Nominal Value	Tolerance	Reading	
		Min.	Max.
3.920 TΩ	39.200 MΩ	3.8808 GΩ	3.9592 GΩ
5.000 TΩ	50.000 MΩ	4.9500 GΩ	5.0500 GΩ
5.370 TΩ	53.700 MΩ	5.3163 GΩ	5.4237 GΩ
7.000 TΩ	70.000 MΩ	6.9300 GΩ	7.0700 GΩ
7.210 TΩ	72.100 MΩ	7.1379 GΩ	7.2821 GΩ
10.000 TΩ	100.000 MΩ	9.9000 GΩ	10.1000 GΩ

Table 5. Megohm Option S18G Verification Points

Nominal Value	Tolerance	Reading	
		Min.	Max.
18.24 GΩ	547.2 MΩ	17.6928 GΩ	18.7872 GΩ