

# Model 2110 5½ Digit Multimeter

## Calibration Manual

2110-905-01 Rev. C / August 2013



2110-905-01

A Greater Measure of Confidence

**KEITHLEY**

A Tektronix Company

Model 2110  
5½ Digit Multimeter  
Calibration Manual

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The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with nonhazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the user documentation for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product warranty may be impaired.

The types of product users are:

**Responsible body** is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

**Operators** use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

**Maintenance personnel** perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the user documentation. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

**Service personnel** are trained to work on live circuits, perform safe installations, and repair products. Only properly trained service personnel may perform installation and service procedures.

Keithley Instruments products are designed for use with electrical signals that are measurement, control, and data I/O connections, with low transient overvoltages, and must not be directly connected to mains voltage or to voltage sources with high transient overvoltages. Measurement Category II (as referenced in IEC 60664) connections require protection for high transient overvoltages often associated with local AC mains connections. Certain Keithley measuring instruments may be connected to mains. These instruments will be marked as category II or higher.

Unless explicitly allowed in the specifications, operating manual, and instrument labels, do not connect any instrument to mains.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30 V RMS, 42.4 V peak, or 60 VDC are present. A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 V, no conductive part of the circuit may be exposed.

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance-limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, ensure that the line cord is connected to a properly-grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

For safety, instruments and accessories must be used in accordance with the operating instructions. If the instruments or accessories are used in a manner not specified in the operating instructions, the protection provided by the equipment may be


impaired.


Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with the same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as protective earth (safety ground) connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.


If a  screw is present, connect it to protective earth (safety ground) using the wire recommended in the user documentation.

The  symbol on an instrument means caution, risk of danger. The user must refer to the operating instructions located in the user documentation in all cases where the symbol is marked on the instrument.

The  symbol on an instrument means caution, risk of electric shock. Use standard safety precautions to avoid personal contact with these voltages.

The  symbol on an instrument shows that the surface may be hot. Avoid personal contact to prevent burns.

The  symbol indicates a connection terminal to the equipment frame.

If this  symbol is on a product, it indicates that mercury is present in the display lamp. Please note that the lamp must be properly disposed of according to federal, state, and local laws.

The **WARNING** heading in the user documentation explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in the user documentation explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits — including the power transformer, test leads, and input jacks — must be purchased from Keithley Instruments. Standard fuses with applicable national safety approvals may be used if the rating and type are the same. Other components that are not safety-related may be purchased from other suppliers as long as they are equivalent to the original component (note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product). If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water-based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., a data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

Safety precaution revision of January 2013.

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# Calibrating and adjusting the Model 2110

## In this section:

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## Introduction

This manual provides calibration and verification procedures for the Keithley Instruments Model 2110 5-1/2-Digit Multimeter. The procedures are performed using remote programming (SCPI commands) over the USB interface using the KI-Tool software.

## Control software

### NOTE

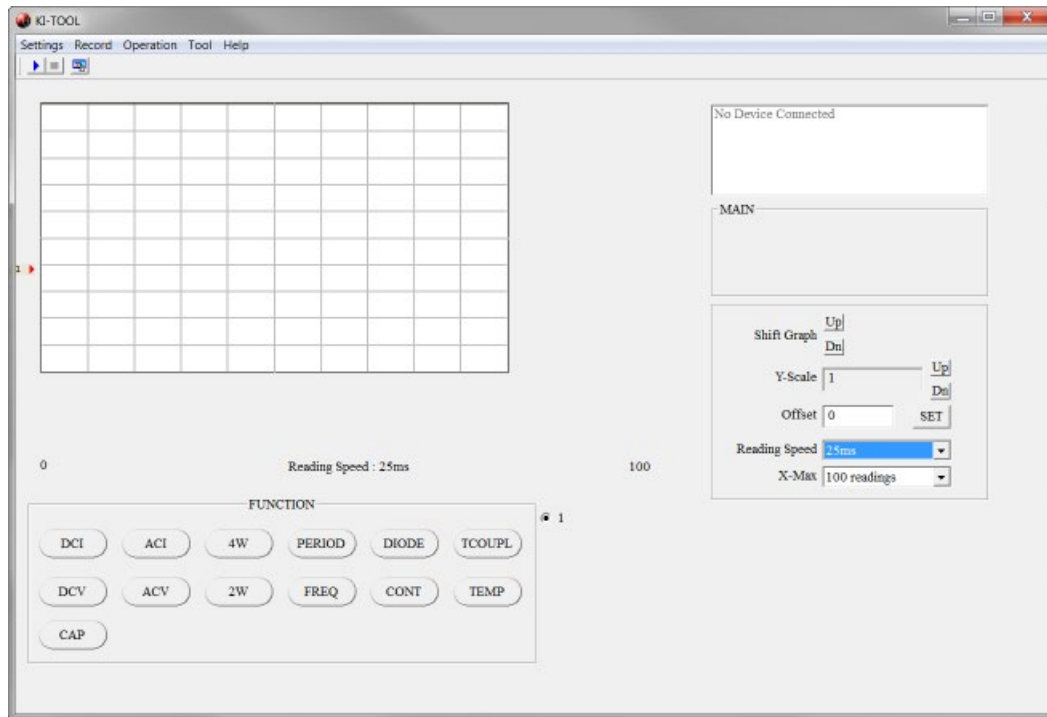
You must have one of the following items installed on the remote interface in order to obtain the proper VISA layer:

- Keithley I/O Layer 5.0 or greater (included on the CD-ROM that came with your Model 2110)
- NI-VISA 3.1 or greater
- Agilent I/O Library Suite 14.2 or greater

1. Install the USB device driver and KI-Tool software from the Keithley Instruments Model 2110 Product Information CD.
2. Connect the Model 2110 to the USB port and launch the KI-Tool software.
3. Verify that correct model number is displayed in the upper right-hand corner of the tool. See Figure 1 for details.
4. Test the communications link between the Model 2110 and the control software by clicking several function buttons and verify that the Model 2110 responds accordingly. See the figure below for more details.



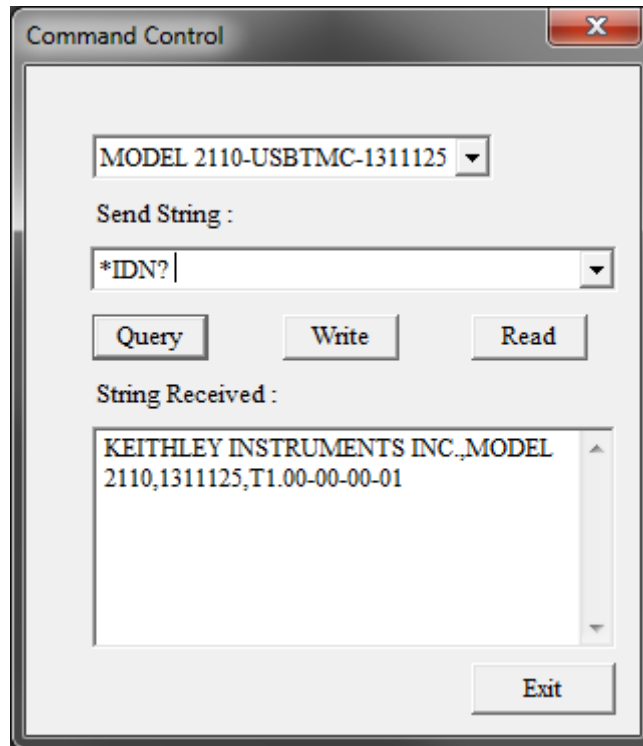
Figure 1: Model 2110 KI-TOOL software



5. The procedure consists of connecting the Fluke 5700A/5725A and 5520A/5522A output to the Model 2110 front panel input, setting up appropriate ranges, and performing calibration by sending specific SCPI commands. These commands are entered into the Send String field followed by clicking the Write button. To access the command control window, click Tool > Command Control.

## NOTE

The figure below shows the Command Control window. Ensure that the correct model number is selected before sending any SCPI commands.

**Figure 2: Command Control window**

## Environmental conditions

Perform the calibration procedures in an environment that has:

- An ambient temperature of 18 °C to 28 °C
- A relative humidity of less than 80 percent unless otherwise noted.

## Calibration considerations

When performing the calibration procedure:

- Make sure that the equipment is properly warmed up and connected to the appropriate input jacks.
- Make sure the calibrator is in OPERATE before you complete each calibration step.
- Do not connect test equipment to the Model 2110 through a scanner or other switching equipment.
- If an error occurs during calibration, the Model 2110 will generate an appropriate error message. Please refer to The Model 2110 Reference Manual for error code descriptions.
- During the adjustment process, the Model 2110 may not display the correct amplitude of the applied signal. This condition is normal.
- After the adjustment procedures are completed, perform the performance verification in Section 3 to verify that the Model 2110 is within manufacturer's specifications.

## Recommended test equipment

Use the Fluke 5700A Calibrator and the Fluke 5725A Amplifier (or the equivalent or better) and the Fluke 5520A/5522A for temperature and capacitance to calibrate the Model 2110.

## Calibration code

To unlock and initiate calibration:

1. Unlock calibration by sending the following command:

```
CAL:PROT:CODE <up to 8-character string>
```

The default command is:

```
CAL:PROT:CODE 123456
```

2. Initiate calibration by sending the following command:

```
CAL:PROT:INIT
```

## Adjustment

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## Voltage function adjustment (DC and AC)

The ranges for DC voltage (DCV) adjustment are 100 mV, 1 V, 10 V, 100 V, and 1000 V. For AC voltage (ACV) adjustment, the ranges are 100 mV, 1 V, 10 V, 100 V, and 750 V RMS at 1 kHz.

### WARNING

*Do not apply more than 1000 V (peak) to the Model 2110. Applying excess voltage may damage your Model 2110 and create a shock hazard that could result in injury or death.*

### NOTE

To eliminate the thermal EMFs due to the differences between two metals, use copper leads to connect your source signal to the DMM.

## DCV range adjustment

1. Set the Model 5700A for 0 V DC using AUTO RANGE. Set the output to the STANDBY mode.
2. Using shielded, low thermal EMF cables, connect the Fluke 5700A output HI and LO to the Model 2110 input HI and LO terminals. Allow connections to stabilize for a minimum of five minutes before proceeding.
3. Set the Model 2110 to the 100mV DC voltage range by sending the following command:

```
CONF:VOLT:DC 0.1
```

4. Set the Model 5700A output mode to OPERATE.
5. Adjust the input offset by sending the following command:

```
CAL:PROT:DC:STEP 1,0
```

6. Wait until the following message is displayed on the Model 2110:  
Cali OK

7. Set the Model 5700A to output 100mVDC.
8. Adjust for full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,0.1`
9. Wait until the following message is displayed on the Model 2110:  
Cali OK
10. Set the 5700A to output -100mVDC.
11. Adjust for full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,-0.1`
12. Wait until the following message is displayed on the Model 2110:  
Cali OK
13. Set the Model 5700A output mode to STANDBY.
14. Set the Model 2110 to the 1 V range by sending the following command:  
`CONF:VOLT:DC 1`
15. Set the Model 5700A for 0 V DC and set the output to the OPERATE mode.
16. Adjust the input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`
17. Wait until the following message is displayed on the Model 2110:  
Cali OK
18. Set the Model 5700A output to 1 V DC.
19. Adjust for full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,1`
20. Wait until the following message is displayed on the Model 2110:  
Cali OK
21. Set 5700A output to -1 V DC.
22. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,-1`
23. Wait until the following message is displayed on the Model 2110:  
Cali OK
24. Set the Model 5700A output mode to STANDBY.
25. Set the Model 2110 to the 10 V range by sending the following command:  
`CONF:VOLT:DC 10`
26. Set the Model 5700A to 0 V DC and the output mode to OPERATE.
27. Adjust input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`
28. Wait until the following message is displayed on the Model 2110:  
Cali OK

29. Set the Model 5700A output to -10 V DC.
30. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,-10`
31. Wait until the following message is displayed on the Model 2110:  
Cali OK
32. Set the Model 5700A output mode to STANDBY.
33. Configure the Model 2110 for the 100 V range by sending the following command:  
`CONF:VOLT:DC 100`
34. Set the Model 5700A to 0 V DC and set the output mode to OPERATE.
35. Adjust input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`
36. Wait until the following message is displayed on the Model 2110:  
Cali OK
37. Set the Model 5700A output to 100 V DC.
38. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,100`
39. Wait until the following message is displayed on the Model 2110:  
Cali OK
40. Set the Model 5700A output to -100 V DC.
41. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,-100`
42. Wait until the following message is displayed on the Model 2110:  
Cali OK
43. Set the Model 5700A output mode to STANDBY.
44. Configure the Model 2110 for the 1000 V range by sending the following command:  
`CONF:VOLT:DC 1000`
45. Set the Model 5700A to 0 V DC and set the output mode to OPERATE.
46. Adjust input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`
47. Wait until the following message is displayed on the Model 2110:  
Cali OK
48. Set the Model 5700A output to 1000 V DC.
49. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,1000`
50. Wait until the following message is displayed on the Model 2110:  
Cali OK
51. Set the Model 5700A output to -1000 V DC.
52. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,-1000`
53. Wait until the following message is displayed on the Model 2110:  
Cali OK
54. Set the Model 5700A to 0 V DC and the output mode to STANDBY.

## ACV range adjustment

1. Set the Model 5700A to 0.01 V at 1 kHz and the output mode to STANDBY.
2. Using coaxial cable with dual banana terminals connect the Fluke 5700A output HI and LO to the Model 2110 input HI and LO terminals. Allow connections to stabilize for a minimum of five minutes before proceeding.
3. Configure the Model 2110 for the 0.1 V range by sending the following command:

```
CONF:VOLT:AC 0.1
```

4. Set the Model 5700A output mode to OPERATE.
5. Adjust to 10 percent of range by sending the following command:

```
CAL:PROT:AC:STEP 1,0.01
```

6. Wait until the following message is displayed on the Model 2110:  
Cali OK

7. Set the Model 5700A output to 0.1 V.
8. Adjust full scale measurement by sending the following command:

```
CAL:PROT:AC:STEP 2,0.1
```

9. Wait until the following message is displayed on the Model 2110:  
Cali OK

10. Set the Model 5700A output mode to STANDBY.
11. Configure the Model 2110 for the 1 V range by sending the following command:

```
CONF:VOLT:AC 1
```

12. Set the Model 5700A to 0.1 V and the output mode to OPERATE.
13. Adjust to 10 percent of range by sending the following command:

```
CAL:PROT:AC:STEP 1,0.1
```

14. Wait until the following message is displayed on the Model 2110:  
Cali OK

15. Set the Model 5700A output to 1 V.
16. Adjust full scale measurement by sending the following command:

```
CAL:PROT:AC:STEP 2,1
```

17. Wait until the following message is displayed on the Model 2110:  
Cali OK

18. Set the Model 5700A output mode to STANDBY.
19. Configure the Model 2110 for the 10 V range by sending the following command:

```
CONF:VOLT:AC 10
```

20. Set the Model 5700A to 1 V and the output mode to OPERATE.
21. Adjust to 10 percent of range by sending the following command:

```
CAL:PROT:AC:STEP 1,1
```

22. Wait until the following message is displayed on the Model 2110:  
Cali OK

23. Set the Model 5700A output to 10 V.
24. Adjust full scale measurement by sending the following command:

```
CAL:PROT:AC:STEP 2,10
```

25. Wait until the following message is displayed on the Model 2110:  
Cali OK

26. Set the Model 5700A output mode to STANDBY.
27. Configure the Model 2110 for the 100 V range by sending the following command:  
`CONF:VOLT:AC 100`
28. Set the Model 5700A to 10 V and the output mode to OPERATE.
29. Adjust to 10 percent of range by sending the following command:  
`CAL:PROT:AC:STEP 1,10`
30. Wait until the following message is displayed on the Model 2110:  
Cali OK
31. Set the Model 5700A output to 100 V.
32. Adjust full scale measurement by sending the following command:  
`CAL:PROT:AC:STEP 2,100`
33. Wait until the following message is displayed on the Model 2110:  
Cali OK
34. Set the Model 5700A output mode to STANDBY.
35. Configure the Model 2110 for the 750 V range by sending the following command:  
`CONF:VOLT:AC 750`
36. Set the Model 5700A to 75 V and the output mode to OPERATE.
37. Adjust to 10 percent of range by sending the following command:  
`CAL:PROT:AC:STEP 1,75`
38. Wait until the following message is displayed on the Model 2110:  
Cali OK
39. Set the Model 5700A output to 750 V.
40. Adjust full scale measurement by sending the following command:  
`CAL:PROT:AC:STEP 2,750`
41. Wait until the following message is displayed on the Model 2110:  
Cali OK
42. Set the Model 5700A output mode to STANDBY. Press RESET on the Model 5700A front panel to reset the calibrator to its default settings.

## Frequency range adjustment

1. Set the Model 5520A/5522A to 1 VAC 1 kHz: output to STANDBY mode.
2. Using shielded, low thermal EMF cables, connect the Fluke 5520A/5522A output HI and LO to the Model 2110 input HI and LO terminals. Allow connections to stabilize for a minimum of five minutes before proceeding.
3. Configure the Model 2110 for the 1 kHz range by sending the following command:  
`CONF:FREQ`
4. Configure the Model 2110 for 1 V range and an aperture of 1 by sending the following commands.  
`FREQ:VOLT:RANGE 1`  
`FREQ:APER 1`



5. Set the the Model 5520A/5522A to OPERATE.
6. Adjust input offset by sending the following command:  

```
CAL:PROT:AC:STEP 0,1E3
```
7. Wait until the following message is displayed on the Model 2110:  
 Cali OK
8. Set the Model 5520A/5522A output mode to STANDBY. Press RESET on the Model 5520A/5522A front panel to reset the calibrator to its default settings.

## Ohms function adjustment

### Ohms, low range adjustment (100Ω - 10MΩ) 2 wire

1. Set the Model 5700A to 0Ω, 2 WIRE COMP ON, EX SNS off, EX GRD off, and the output mode to STANDBY.
2. Using shielded, low thermal EMF cables, connect the Fluke 5700A output HI and LO to the Model 2110 input HI and LO terminals. Allow connections to stabilize for a minimum of five minutes before proceeding.
3. Configure the Model 2110 for 2-wire, 100 Ω resistance measurements by sending the following command:

```
CONF:RES 1E2
```

4. Set the measurement rate to 10 PLC by sending the following command:

```
RES:NPLC 10
```

5. Disable the average function by sending the following command:

```
AVERAGE:STAT OFF
```

6. Set the Model 5700A output mode to OPERATE.
7. Adjust input offset by sending the following command:

```
CAL:PROT:DC:STEP 1,0
```

8. Wait until the following message is displayed on the Model 2110:

Cali OK

9. Set the Model 5700A output to 100 Ω.
10. Adjust full scale measurement by sending the following command:

```
CAL:PROT:DC:STEP 2,<ACTUAL CALIBRATOR OUTPUT>
```

### NOTE

Enter actual output value in scientific notation format.

Example: if calibrator's display shows 99.99615 Ohms, enter this value as:

```
CAL:PROT:DC:STEP 2,.9999615E2
```

11. Wait until the following message is displayed on the Model 2110:  
 Cali OK
12. Set the Model 5700A output mode to STANDBY.
13. Configure the Model 2110 for 2-wire, 1 kΩ resistance measurements by sending the following command:

```
CONF:RES 1E3
```

14. Set the measurement rate to 10 PLC by sending the following command:

```
RES:NPLC 10
```

15. Set the Model 5700A output mode to OPERATE.

16. Adjust input offset by sending the following command:

```
CAL:PROT:DC:STEP 1,0
```

17. Wait until the following message is displayed on the Model 2110:

```
Cali OK
```

18. Set the Model 5700A output to 1 k $\Omega$ .

19. Adjust full scale measurement by sending the following command:

```
CAL:PROT:DC:STEP 2,<ACTUAL CALIBRATOR OUTPUT>
```

20. Wait until the following message is displayed on the Model 2110:

```
Cali OK
```

21. Set the Model 5700A output mode to STANDBY.

22. Configure the Model 2110 for 2-wire, 10 k $\Omega$  resistance measurements by sending the following command:

```
CONF:RES 1E4
```

23. Set the measurement rate to 10 PLC by sending the following command:

```
RES:NPLC 10
```

24. Set the Model 5700A to 0 $\Omega$  and the output mode to OPERATE.

25. Adjust input offset by sending the following command:

```
CAL:PROT:DC:STEP 1,0
```

26. Wait until the following message is displayed on the Model 2110:

```
Cali OK
```

27. Set the Model 5700A output to 10k $\Omega$ .

28. Adjust full scale measurement by sending the following command:

```
CAL:PROT:DC:STEP 2,<ACTUAL CALIBRATOR OUTPUT>
```

29. Wait until the following message is displayed on the Model 2110:

```
Cali OK
```

30. Set the Model 5700A output mode to STANDBY.

31. Configure the Model 2110 for 2-wire, 100 k $\Omega$  resistance measurements by sending the following command:

```
CONF:RES 1E5
```

32. Set the measurement rate to 10 PLC by sending the following command:

```
RES:NPLC 10
```

33. Set the Model 5700A to 0 $\Omega$  and the output mode to OPERATE.

34. Adjust input offset by sending the following command:

```
CAL:PROT:DC:STEP 1,0
```

35. Wait until the following message is displayed on the Model 2110:

```
Cali OK
```

36. Set the Model 5700A output to 100kΩ.

37. Adjust full scale measurement by sending the following command:

```
CAL:PROT:DC:STEP 2,<ACTUAL CALIBRATOR OUTPUT>
```

38. Wait until the following message is displayed on the Model 2110:

```
Cali OK
```

39. Set the Model 5700A output mode to STANDBY.

40. Configure the Model 2110 for 2-wire, 1MΩ resistance measurements by sending the following command:

```
CONF:RES 1E6
```

41. Set the measurement rate to 10 PLC by sending the following command:

```
RES:NPLC 10
```

42. Set the Model 5700A to 0Ω and the output mode to OPERATE.

43. Adjust input offset by sending the following command:

```
CAL:PROT:DC:STEP 1,0
```

44. Wait until the following message is displayed on the Model 2110:

```
Cali OK
```

45. Set the Model 5700A output to 1 MΩ.

46. Adjust full scale measurement by sending the following command:

```
CAL:PROT:DC:STEP 2,<ACTUAL CALIBRATOR OUTPUT>
```

47. Wait until the following message is displayed on the Model 2110:

```
Cali OK
```

48. Set the Model 5700A output mode to STANDBY.

49. Configure the Model 2110 for 2-wire, 10 MΩ resistance measurements by sending the following command:

```
CONF:RES 1E7
```

50. Set the measurement rate to 10 PLC by sending the following command:

```
RES:NPLC 10
```

51. Set the Model 5700A to 0Ω and the output mode to OPERATE.

52. Adjust input offset by sending the following command:

```
CAL:PROT:DC:STEP 1,0
```

53. Wait until the following message is displayed on the Model 2110:

```
Cali OK
```

54. Set the Model 5700A output to 10MΩ.

55. Adjust full scale measurement by sending the following command:

```
CAL:PROT:DC:STEP 2,<ACTUAL CALIBRATOR OUTPUT>
```

56. Wait until the following message is displayed on the Model 2110:

```
Cali OK
```

57. Set the Model 5700A output mode to STANDBY.

## Ohms, low range adjustment (100Ω - 10MΩ) 4 wire

1. Set the Model 5700A to 0Ω, EX SNS on, EX GRD off, and the output mode to STANDBY.
2. Using shielded, low thermal EMF cables, connect the Fluke 5700A output HI and LO to the Model 2110 input HI and LO terminals. Allow connections to stabilize for a minimum of five minutes before proceeding.
3. Configure the Model 2110 for 4-wire, 100 Ω resistance measurements by sending the following command:

```
CONF:FRES 1E2
```

4. Set the measurement rate to 10 PLC by sending the following command:

```
FRES:NPLC 10
```

5. Disable the average function by sending the following command:

```
AVERAGE:STAT OFF
```

6. Set the Model 5700A output mode to OPERATE.
7. Adjust input offset by sending the following command:

```
CAL:PROT:DC:STEP 1,0
```

8. Wait until the following message is displayed on the Model 2110:  
Cali OK

9. Set the Model 5700A output to 100Ω.

10. Adjust full scale measurement by sending the following command:

```
CAL:PROT:DC:STEP 2,<ACTUAL CALIBRATOR OUTPUT>
```

11. Wait until the following message is displayed on the Model 2110:  
Cali OK

12. Set the Model 5700A output mode to STANDBY.

13. Configure the Model 2110 for 4-wire, 1 kΩ resistance measurements by sending the following command:

```
CONF:FRES 1E3
```

14. Set the measurement rate to 10 PLC by sending the following command:

```
FRES:NPLC 10
```

15. Set the Model 5700A output mode to OPERATE.

16. Adjust input offset by sending the following command:

```
CAL:PROT:DC:STEP 1,0
```

17. Wait until the following message is displayed on the Model 2110:  
Cali OK

18. Set the Model 5700A output to 1kΩ.

19. Adjust full scale measurement by sending the following command:

```
CAL:PROT:DC:STEP 2,<ACTUAL CALIBRATOR OUTPUT>
```

20. Wait until the following message is displayed on the Model 2110:  
Cali OK

21. Set the Model 5700A output mode to STANDBY.
22. Configure the Model 2110 for 4-wire, 10 k $\Omega$  resistance measurements by sending the following command:  
`CONF:FRES 1E4`
23. Set the measurement rate to 10 PLC by sending the following command:  
`FRES:NPLC 10`
24. Set the Model 5700A to 0 $\Omega$  and the output mode to OPERATE.
25. Adjust input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`
26. Wait until the following message is displayed on the Model 2110:  
Cali OK
27. Set the Model 5700A output to 10k $\Omega$ .
28. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,<ACTUAL CALIBRATOR OUTPUT>`
29. Wait until the following message is displayed on the Model 2110:  
Cali OK
30. Set the Model 5700A output mode to STANDBY.
31. Configure the Model 2110 for 4-wire, 100 k $\Omega$  resistance measurements by sending the following command:  
`CONF:FRES 1E5`
32. Set the measurement rate to 10 PLC by sending the following command:  
`FRES:NPLC 10`
33. Set the Model 5700A to 0 $\Omega$  and the output mode to OPERATE.
34. Adjust input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`
35. Wait until the following message is displayed on the Model 2110:  
Cali OK
36. Set the Model 5700A output to 100k $\Omega$ .
37. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,<ACTUAL CALIBRATOR OUTPUT>`
38. Wait until the following message is displayed on the Model 2110:  
Cali OK
39. Set the Model 5700A output mode to STANDBY.
40. Configure the Model 2110 for 4-wire, 1 M $\Omega$  resistance measurements by sending the following command:  
`CONF:FRES 1E6`
41. Set the measurement rate to 10 PLC by sending the following command:  
`FRES:NPLC 10`
42. Set the Model 5700A to 0 $\Omega$  and the output mode to OPERATE.
43. Adjust input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`
44. Wait until the following message is displayed on the Model 2110:  
Cali OK

45. Set the Model 5700A output to 1M $\Omega$ .
46. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,<ACTUAL CALIBRATOR OUTPUT>`
47. Wait until the following message is displayed on the Model 2110:  
Cali OK
48. Set the Model 5700A output mode to STANDBY.
49. Configure the Model 2110 for 4-wire, 10 M $\Omega$  resistance measurements by sending the following command:  
`CONF:FRES 1E7`
50. Set the measurement rate to 10 PLC by sending the following command:  
`FRES:NPLC 10`
51. Set the Model 5700A to 0  $\Omega$  and the output mode to OPERATE.
52. Adjust input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`
53. Wait until the following message is displayed on the Model 2110:  
Cali OK
54. Set the Model 5700A output to 10 M $\Omega$ .
55. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,<ACTUAL CALIBRATOR OUTPUT>`
56. Wait until the following message is displayed on the Model 2110:  
Cali OK
57. Set the Model 5700A output mode to STANDBY.

## Ohms, high range adjustment (100 M $\Omega$ )

1. Set the Model 5700A to 0  $\Omega$ , 2 WIRE COMP OFF, EX SNS off, EX GRD off, and the output mode to STANDBY.
2. Using shielded, low thermal EMF cables, connect the Fluke 5700A output HI, output LO, sense HI, and sense LO terminals to the Model 2110 input HI, input LO, sense HI, and sense LO terminals. Allow connections to stabilize for a minimum of five minutes before proceeding.
3. Configure the Model 2110 for 2-wire, 100 M $\Omega$  resistance measurements by sending the following command:  
`CONF:RES 1E8`
4. Set the measurement rate to 10 PLC by sending the following command:  
`RES:NPLC 10`
5. Set the Model 5700A output to 10 M $\Omega$
6. Set the Model 5700A output mode to OPERATE.
7. Adjust to 10 percent of scale by sending the following command:  
`CAL:PROT:DC:STEP 1,<ACTUAL CALIBRATOR OUTPUT>`
8. Wait until the following message is displayed on the Model 2110:  
Cali OK

9. Set the Model 5700A output to 100 MΩ.
10. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,<ACTUAL CALIBRATOR OUTPUT>`
11. Wait until the following message is displayed on the Model 2110:  
Cali OK
12. Set the Model 5700A output mode to STANDBY.

## Current function adjustment (DC and AC)

### DC current range adjustment

1. Set the Model 5700A to 0A, CURRNT OUTPUT: 5725, RANGE: AUTO, and the output mode to STANDBY.
2. Using shielded, low thermal EMF cables, connect the Fluke 5725A current output HI and output LO to the Model 2110 input AMPS and input LO terminals. Allow connections to stabilize for a minimum of five minutes before proceeding.
3. Configure the Model 2110 to 0.1A DC current range by sending the following command:  
`CONF:CURR:DC 0.1`
4. Set the measurement rate to 10 PLC by sending the following command:  
`CURR:NPLC 10`
5. Set the Model 5700A output mode to OPERATE.
6. Adjust front input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`
7. Wait until the following message is displayed on the Model 2110:  
Cali OK
8. Set the Model 5700A output to 0.1A DC.
9. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,0.1`
10. Wait until the following message is displayed on the Model 2110:  
Cali OK
11. Set the Model 5700A output mode to STANDBY.
12. Set the Model 5700A output to -0.1A DC.
13. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,-0.1`
14. Wait until the following message is displayed on the Model 2110:  
Cali OK
15. Set the Model 5700A output mode to STANDBY.
16. Configure the Model 2110 to 1A DC current range by sending the following command:  
`CONF:CURR:DC 1`
17. Set the measurement rate to 10 PLC by sending the following command:  
`CURR:NPLC 10`
18. Set the Model 5700A to 0A and the output mode to OPERATE.
19. Adjust front input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`

20. Wait until the following message is displayed on the Model 2110:  
Cali OK
21. Set the Model 5700A output to 1A DC.
22. Adjust full scale measurement by sending the following command:  
CAL:PROT:DC:STEP 2,1
23. Wait until the following message is displayed on the Model 2110:  
Cali OK
24. Set the Model 5700A output mode to STANDBY. .
25. Set the Model 5700A output to -1A DC.
26. Adjust full scale measurement by sending the following command:  
CAL:PROT:DC:STEP 2,-1
27. Wait until the following message is displayed on the Model 2110:  
Cali OK
28. Set the Model 5700A output mode to STANDBY.

## DC high current adjustment

1. Connect the Model 2110 3 A input jack to the 5725A 11A output (white to red on the Model 5725 and black of the Model 2110 to black of the Model 5725. Configure the Model 5700 to output current to the Model 5725A.
2. Configure the Model 2110 for the 3 A DC current range by sending the following command:  
CONF:CURR:DC 3
3. Set the measurement rate to 10 PLC by sending the following command:  
CURR:NPLC 10
4. Set the Model 5700A to 0 A and the output mode to OPERATE.
5. Adjust front input offset by sending the following command:  
CAL:PROT:DC:STEP 1,0
6. Wait until the following message is displayed on the Model 2110:  
Cali OK
7. Set the Model 5700A output to 3 A DC.
8. Adjust full scale measurement by sending the following command:  
CAL:PROT:DC:STEP 2,3
9. Wait until the following message is displayed on the Model 2110:  
Cali OK
10. Set the Model 5700A output mode to STANDBY.
11. Set the Model 5700A output to -3 A DC.
12. Adjust full scale measurement by sending the following command:  
CAL:PROT:DC:STEP 2,-3
13. Wait until the following message is displayed on the Model 2110:  
Cali OK



14. Set the Model 5700A output mode to STANDBY.
15. Configure the Model 2110 for the 10 A DC current range by sending the following command:  
`CONF:CURR:DC 10`
16. Set the measurement rate to 10 PLC by sending the following command:  
`CURR:NPLC 10`
17. Set the Model 5700A to 0 A and the output mode to OPERATE.
18. Adjust front input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`
19. Wait until the following message is displayed on the Model 2110:  
Cali OK
20. Set the Model 5700A output to 3 A DC.
21. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,10`
22. Wait until the following message is displayed on the Model 2110:  
Cali OK
23. Set the Model 5700A output mode to STANDBY. .
24. Set the Model 5700A output to -3 A DC.
25. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,-10`
26. Wait until the following message is displayed on the Model 2110:  
Cali OK
27. Set the Model 5700A output mode to STANDBY. Press RESET on the Model 5700A front panel to reset the calibrator to its default settings.

## AC current range adjustment

1. Set the Model 5700A to 0.1 A at 1 kHz, CURRENT OUTPUT: 5725, and the output mode to STANDBY.
2. Using coaxial cable with dual banana terminals, connect the Fluke 5725A current output HI and LO to the Model 2110 input AMPS and LO terminals. Allow connections to stabilize for a minimum of five minutes before proceeding.
3. Configure the Model 2110 for the 1A AC current range by sending the following command:  
`CONF:CURR:AC 1`
4. Set the Model 5700A output mode to OPERATE.
5. Adjust to 10 percent of range by sending the following command:  
`CAL:PROT:AC:STEP 1,0.1`
6. Wait until the following message is displayed on the Model 2110:  
Cali OK
7. Set the Model 5700A output to 1 A at 1 kHz.
8. Adjust full scale range by sending the following command:  
`CAL:PROT:AC:STEP 2,1`
9. Wait until the following message is displayed on the Model 2110:  
Cali OK
10. Set the Model 5700A output mode to STANDBY.

## AC high current adjustment

1. Connect the Model 2110 3 A input jack to the 5725A 11A output (white to red on the Model 5725A and black of the Model 2110 to black of the Model 5725A). Configure the Model 5700 to output current to the Model 5725A.
2. Configure the Model 2110 for the 3 A, 1 kHz current range by sending the following command:  

```
CONF:CURR:AC 3
```
3. Set the Model 5700A to 0 A and the output mode to OPERATE.
4. Adjust front input offset by sending the following command:  

```
CAL:PROT:AC:STEP 1,0
```
5. Wait until the following message is displayed on the Model 2110:  
Cali OK
6. Set the Model 5700A output to 300 mA 1 kHz.
7. Adjust full scale measurement by sending the following command:  

```
CAL:PROT:AC:STEP 2,0.3
```
8. Wait until the following message is displayed on the Model 2110:  
Cali OK
9. Set the Model 5700A output mode to STANDBY. .
10. Set the Model 5700A output to 3 A, 1 kHz.
11. Adjust full scale measurement by sending the following command:  

```
CAL:PROT:AC:STEP 2,3
```
12. Wait until the following message is displayed on the Model 2110:  
Cali OK
13. Set the Model 5700A output mode to STANDBY.
14. Configure the Model 2110 for the 10 A DC current range by sending the following command:  

```
CONF:CURR:AC 10
```
15. Set the Model 5700A to 1 A, 1 kHz and set the output mode to OPERATE.
16. Adjust front input offset by sending the following command:  

```
CAL:PROT:AC:STEP 1,1
```
17. Wait until the following message is displayed on the Model 2110:  
Cali OK
18. Set the Model 5700A output to 10 A, 1 kHz.
19. Adjust full scale measurement by sending the following command:  

```
CAL:PROT:AC:STEP 2,10
```
20. Wait until the following message is displayed on the Model 2110:  
Cali OK

## Temperature function adjustment

1. Set the Model 5520A/5522A to 0 Deg C, and the output mode to STANDBY.
2. Using Type K thermocouple wire with TC jacks on both ends, connect the Fluke 5520A/5522A TC output to the Model 2110 input TC terminals. Allow connections to stabilize for a minimum of five minutes before proceeding.
3. Configure the Model 2110 for the type K by sending the following command:  

```
CONF:TCOUPLE
```
4. Set the Model 5520A/5522A output to 0 Deg C, type K Thermocouple, and the output mode to OPERATE.
5. Adjust the upper region of the range by sending the following command:  

```
CAL:PROT:DC:STEP 1,0
```
6. Wait until the following message is displayed on the Model 2110:  
CALI OK
7. Set the Model 5520A/5522A output mode to STANDBY. Press RESET on the Model 5520A/5522A front panel to reset the calibrator to its default settings.

## Capacitance function adjustment

1. Set the Model 5520A/5522A to 1  $\mu$ F range and the output mode to STANDBY.
2. Using shielded, low thermal EMF cables, connect the Fluke 5700A output HI and LO to the Model 2110 input HI and LO terminals. Allow connections to stabilize for a minimum of five minutes before proceeding.
3. Configure the Model 2110 for the 1  $\mu$ F capacitance range by sending the following command:  

```
CONF:CAP 1E-6
```
4. Set the Model 5520A/5522A output mode to STANDBY.
5. Adjust input offset by sending the following command:  

```
CAL:PROT:DC:STEP 1,0
```
6. Wait until the following message is displayed on the Model 2110:  
Cali OK
7. Set the Model 5520A/5522A output to 1UF.
8. Adjust full scale measurement by sending the following command:  

```
CAL:PROT:DC:STEP 2,1E-6
```
9. Wait until the following message is displayed on the Model 2110:  
Cali OK
10. Configure the Model 2110 for the 10  $\mu$ F Capacitance range by sending the following command:  

```
CONF:CAP 1E-5
```
11. Set the Model 5520A/5522A output mode to STANDBY.
12. Adjust input offset by sending the following command:  

```
CAL:PROT:DC:STEP 1,0
```
13. Wait until the following message is displayed on the Model 2110:  
Cali OK

14. Set the Model 5520A/5522A output to 10UF.
15. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,1E-5`
16. Wait until the following message is displayed on the Model 2110:  
Cali OK
17. Configure the Model 2110 for the 100  $\mu$ F capacitance range by sending the following command:  
`CONF:CAP 1E-4`
18. Set the Model 5520A/5522A output mode to STANDBY.
19. Adjust input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`
20. Wait until the following message is displayed on the Model 2110:  
Cali OK
21. Set the Model 5520A/5522A output to 100  $\mu$ F.
22. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,1E-4`
23. Wait until the following message is displayed on the Model 2110:  
Cali OK
24. Configure the Model 2110 for the 1 mF capacitance range by sending the following command:  
`CONF:CAP 1E-3`
25. Set the Model 5520A/5522A output mode to STANDBY.
26. Adjust the input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`
27. Wait until the following message is displayed on the Model 2110:  
Cali OK
28. Set the Model 5520A/5522A output to 1 mF.
29. Adjust the full-scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,1E-3`
30. Wait until the following message is displayed on the Model 2110:  
Cali OK
31. Configure the Model 2110 for the 10 mF Capacitance range by sending the following command:  
`CONF:CAP 1E-2`
32. Set the Model 5520A/5522A output mode to STANDBY.
33. Adjust the input offset by sending the following command:  
`CAL:PROT:DC:STEP 1,0`
34. Wait until the following message is displayed on the Model 2110:  
Cali OK
35. Set the Model 5520A/5522A output to 10 mF.
36. Adjust full scale measurement by sending the following command:  
`CAL:PROT:DC:STEP 2,1E-2`
37. Wait until the following message is displayed on the Model 2110:  
Cali OK

## Calibration date

1. Update the calibration date by sending the following command:

```
CAL:PROT:DATE <"MM/DD/YYYY">
```

### NOTE

The date <string> must be enclosed in double quotes ("<string>").

Example: If calibration date is 5 Apr 2012, send the following command:

```
CAL:PROT:DATE "04/05/2012"
```

Calibration due date is automatically calculated for 12 months.

2. Save calibration constants in EEPROM by sending the following command:

```
CAL:PROT:SAVE
```

3. Lock calibration by sending the following command:

```
CAL:PROT:LOCK
```

## Performance verification

### In this section:

Performing accuracy verification ..... 3-1

### Performing accuracy verification

#### NOTE

After calibration is completed, the Model 2110 should be verified to ensure that its performance is within the manufacturer's specifications.

Perform accuracy verifications using the Fluke 5700A/5725A and 5520A/5522A standards. Refer to the following tables for accuracy limits for the specified ranges.

### DC voltage accuracy verification

DC VOLTAGE ACCURACY VERIFICATION			
Range	Test Point	Accuracy Limits	
		Upper Limit	Lower Limit
100 mV	50.0000 mV	50.010 mV	49.990 mV
	90.0000 mV	90.015 mV	89.985 mV
1 V	0.500000 V	0.50001 V	0.49992 V
	0.900000 V	0.90001 V	0.89988 V
10 V	5.0000 V	5.0008 V	4.9992 V
	9.0000 V	9.0013 V	8.9987 V
100 V	50.000 V	50.008 V	49.992 V
	90.000 V	90.013 V	89.987 V
1000 V	500.00 V	500.09 V	499.91 V
	900.00 V	900.14 V	-899.86 V

Specifications valid after 2-hour warm-up:

- ADC set for continuous trigger operation.
- Input bias current < 30 pA at 25 °C.
- Input protection 1000 V all ranges (2-W input).
- Measurement rate set to 1 PLC.
- Repeat the checks above for negative polarity.

## AC voltage accuracy verification

AC VOLTAGE ACCURACY VERIFICATION			
Range	Test Point	Accuracy Limits	
		Upper Limit	Lower Limit
100 mV	100.0000 mV @ 10 Hz	100.170 mV	99.830 mV
	100.0000 mV @ 30 kHz	100.300 mV	99.700 mV
	100.0000 mV @ 75 kHz	100.730 mV	99.270 mV
	100.0000 mV @ 300 kHz	105.000 mV	95.000 mV
1 V	1.000000 V @ 10 Hz	1.002 V	0.998 V
	1.000000 V @ 30 kHz	1.003 V	0.998 V
	1.000000 V @ 75k Hz	1.007 V	0.993 V
	1.000000 V @ 300 kHz	1.050 V	0.950 V
10 V	10.00000 V @ 10 Hz	10.02 V	9.98 V
	10.00000 V @ 30 kHz	10.03 V	9.97 V
	10.00000 V @ 75 kHz	10.07 V	9.93 V
	10.00000 V @ 300 kHz	10.50 V	9.50 V
100 V	100.0000 V @ 10 Hz	100.17 V	99.83 V
	100.0000 V @ 30 kHz	100.30 V	99.70 V
	100.0000 V @ 75 kHz	100.73 V	99.27 V
	100.0000 V @ 200 kHz	105.00 V	95.00 V
750 V	700.000 V @ 40 Hz	701.22 V	698.79 V
	700.00 V @ 30 kHz	702.13 V	697.88 V
	700.00 V @ 75 kHz	705.15 V	694.85 V
	700.00 V @ 100 kHz	735.25 V	664.75 V
Specifications valid for 2-hour warm-up at 5-1/2 digits: a. Slow ac filter (3 Hz bandwidth). b. Pure sine wave input greater than 5% of range. c. 750 V range limited to 100 kHz.			

## Resistance accuracy verification

RESISTANCE ACCURACY VERIFICATION			
Range	Test Point	Accuracy Limits	
		Upper Limit	Lower Limit
100 $\Omega$	100.0000 $\Omega$	100.025 $\Omega$	99.9755 $\Omega$
1 k $\Omega$	1.000000 k $\Omega$	1.00022 k $\Omega$	0.99978 k $\Omega$
10 k $\Omega$	10.00000 k $\Omega$	10.0022 k $\Omega$	9.9978 k $\Omega$
100 k $\Omega$	100.0000 k $\Omega$	100.022 k $\Omega$	99.978 k $\Omega$
1 M $\Omega$	1.000000 M $\Omega$	1.00024 M $\Omega$	0.99976 M $\Omega$
10 M $\Omega$	10.00000 M $\Omega$	10.0104 M $\Omega$	9.9896 M $\Omega$
100 M $\Omega$	100.0000 M $\Omega$	101.505 M $\Omega$	98.495 M $\Omega$

Specifications for 4-W ohms mode:  
 a. (For 2-W ohms, use zero null or subtract lead resistance from displayed reading.)  
 b. Max lead resistance 10% of range per lead for 100  $\Omega$  and 1 k $\Omega$  ranges;  
 Add 1 k $\Omega$  per lead for all other ranges.

## DC current accuracy verification

DC CURRENT ACCURACY VERIFICATION			
Range	Test Point	Accuracy Limits	
		Upper Limit	Lower Limit
10 mA	5.0000 mA	5.0045 mA	4.9955 mA
	9.0000 mA	9.0065 mA	8.9935 mA
100 mA	50.000 mA	50.035 mA	49.965 mA
	90.000 mA	90.055 mA	89.945 mA
1 A	0.50000 A	0.50095 A	0.49905 A
	0.90000 A	0.90155 A	0.89845 A
3 A	1.50000 A	1.50390 A	1.49610 A
	2.70000 A	2.70630 A	2.69370 A
10 A	5.0000 A	5.0175 A	4.9825 A
	9.0000 A	9.0275 A	8.9725 A

Specifications valid after 2-hour warm-up:  
 a. ADC set for continuous trigger operation.  
 b. Input bias current < 30 pA at 25 °C.  
 c. Input protection 1000 V all ranges (2-W input).  
 e. Repeat the checks above for negative polarity.



## AC current accuracy verification

AC CURRENT ACCURACY VERIFICATION			
Range	Test Point	Accuracy Limits	
		Upper Limit	Lower Limit
1 A	0.90000 A @ 60 Hz	0.90220 A	0.89780 A
	0.90000 A @ 5 kHz	0.90220 A	0.89780 A
3 A	2.70000 A @ 60 Hz	2.7099 A	2.6901 A
	2.70000 A @ 5 kHz	2.7099 A	2.6901 A
10 A	9.0000 A @ 60 Hz	9.0570 A	8.9430 A
	9.0000 A @ 5 kHz	9.0570 A	8.9430 A

Specifications valid for 2-hour warm-up at 5-1/2 digits:  
a. Slow ac filter (3 Hz bandwidth).  
b. Pure sine wave input greater than 5% of range.

## Frequency accuracy verification

FREQUENCY ACCURACY VERIFICATION			
Range	Test Point	Accuracy Limits	
		Upper Limit	Lower Limit
10-40 Hz	20.0000 Hz @ 1 Vpp	20.006 Hz	19.994 Hz
40-300 kHz	200.000 kHz @ 1 Vpp	200.04 kHz	199.96 kHz

Specifications valid for 2-hour warm-up at 5-1/2 digits:  
a. Slow ac filter (3 Hz bandwidth).  
b. Pure sine wave input greater than 5% of range.

## Temperature accuracy verification

TEMPERATURE ACCURACY VERIFICATION			
Range	Test Point	Accuracy Limits	
		Upper Limit	Lower Limit
TC Type K	100.000 °C	101.000 °C	99.000 °C
	0.000 °C	1.000 °C	-1.000 °C
	-100.000 °C	99.000 °C	-101.000 °C
Specifications valid after 2-hour warm-up at 5-1/2 digits: a. ADC set for continuous trigger operation. b. Input bias current < 30 pA at 25 °C. c. Input protection 1000 V. d. Measurement rate set to 10 PLC (fixed).			

## Capacitance accuracy verification

CAPACITANCE ACCURACY VERIFICATION			
Range	Test Point	Accuracy Limits	
		Upper Limit	Lower Limit
1 nF	1.00000 nF	1.02800 nF	0.97200 nF
10 nF	10.0000 nF	10.1500 nF	9.8500 nF
100 nF	100.000 nF	101.500 nF	98.500 nF
1 µF	1.00000 µF	1.01500 µF	0.98500 µF
10 µF	10.0000 µF	10.1500 µF	9.8500 µF
100 µF	100.000 µF	101.500 µF	98.500 µF
1 mF	1.00000 mF	1.01500 mF	0.98500 mF
10 mF	10.0000 mF	10.2500 mF	9.7500 mF
Specifications valid after 2-hour warm-up at 5-1/2 digits: a. ADC set for continuous trigger operation. b. Input test current: 10 µA (1 nF to 10 nF), 100 µA (100 nF to 10 µF), and 1 mA (10 µF to 100 µF). c. Input protection 1000 V all ranges and 1 mA (10 µF to 10 mF)			

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