EDU34450A
5½ Digit Digital Multimeter

KEYSIGHT

SERVICE GUIDE

TOC

Notices

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CAUTION

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2 Performance Verification

This chapter contains the performance verification procedures which verify that the EDU34450A is operating within its published specifications.

Performance Verification

Performance verification ensures that the instrument performs within the specifications stated in the data sheet (https://www.keysight.com/us/en/assets/3121-1002/data-sheets/EDU34450A-5-5-Digit-Dual-Display-Digital-Multimeter.pdf).

You can perform four different levels of performance verification tests:

- **Self test** A series of internal verification tests that give a high confidence that the instrument is operational.
- **Quick verification** A combination of the internal self tests and selected verification test.
- Performance verification tests An extensive set of tests that are recommended as an acceptance test when you first receive the instrument or after performing adjustments.
  - Zero offset verification
  - DC voltage gain verification
  - DC current gain verification
  - Ohms gain verification
  - Frequency gain verification
  - AC voltage verification
  - AC current verification
- Optional verification tests Tests not performed with every calibration. Perform these tests to verify additional specifications or functions of the instrument.
  - Capacitance verification

Recommended Test Equipment

The test equipments recommended for the performance verification and adjustment procedures are listed below. If the exact instrument is not available, use the accuracy requirements shown to select substitute calibration standards.

Application	Recommended equipment	Recommended accuracy requirement
Zero calibration	Fluke 5522A or Keysight 34172B DMM calibration short	
DC voltage	Fluke 5522A	1/5 instrument 1 year specification
DC current	Fluke 5522A	1/5 instrument 1 year specification
Resistance	Fluke 5522A	1/5 instrument 1 year specification
AC voltage	Fluke 5522A	1/5 instrument 1 year specification
AC current	Fluke 5522A	1/5 instrument 1 year specification
Frequency	Fluke 5522A	1/5 instrument 1 year specification
Capacitance	Fluke 5522A	1/5 instrument 1 year specification

Test Considerations

Errors may be induced by AC signals present on the input leads during a self test. Long test leads can also act as an antenna causing pick-up of AC signals.

For optimum performance, all procedures should comply with the following recommendations:

- Ensure that the calibration ambient temperature is stable between 18 °C and 28 °C. Ideally the calibration should be performed at 23 °C ±1 °C.
- Ensure ambient relative humidity is less than 60%.
- Allow a 90 minutes warm-up period for performance verification tests and two hours warm-up period for calibration with a shorting plug connected to the HI and LO input terminals.
- Use shielded twisted pair PTFE-insulated cables to reduce settling and noise errors. Keep the input cables as short as possible.
- Connect the input cable shields to earth ground. Except where noted in the procedures, connect the calibrator LO source to earth ground at the calibrator. It is important that the LO to earth ground connection be made at only one place in the circuit to avoid ground loops.

The instrument is capable of making very accurate measurements, special care must be taken to ensure that the calibration standards and test procedures do not introduce additional errors. Ideally, the standards used to verify and adjust the instrument should be an order of magnitude more accurate than each instrument range full- scale error specification.

For DC voltage, DC current, and resistance gain verification measurements, ensure that the calibrator's "0" output is accurate. Null the offset for each range of the measuring function being verified.

Input connections

Test connections to the instrument are best accomplished using the dual banana plug with copper wire shorted between two terminals for low-thermal offset measurement. Shielded, twisted-pair, PTFE insulated interconnect cables with minimum length are recommended between the calibrator and the multimeter. Cable shields should be earth ground referenced. This configuration is recommended for optimal noises and settling time performance during calibration.

Quick Performance Check

The quick performance check is a combination of internal self test and an abbreviated performance test (specified by the letter Q in the performance verification tests). This test provides a simple method to achieve high confidence in the instrument's ability to functionally operate and meet specifications. These tests represent the absolute minimum set of performance checks recommended following any service activity. Auditing the instrument's performance for the quick check points (designated by a Q) verifies performance for "normal" accuracy drift mechanisms. This test does not check for abnormal component failures.

To perform the quick performance check, do the following:

- Perform a self test. Refer to Self-Test Procedures.
- Perform only the performance verification tests indicated in the following tables with the letter Q.

If the instrument fails the quick performance check, adjustment or repair is required.

Performance Verification Tests

The performance verification tests are recommended as acceptance tests when you first receive the instrument. The acceptance test results should be compared against the one year test limits. After acceptance, you should repeat the performance verification tests at every calibration interval.

If the instrument fails performance verification, adjustment or repair is required.

Adjustment is recommended at every calibration interval. If adjustment is not made, guardbanding at no more than 80% of the specifications, as the verification limits.

NOTE Ensure that you have read Test Considerations before running the performance verification tests.

Zero offset verification

This test is used to check the zero offset performance of the instrument. Verification checks are only performed for those functions and ranges with unique offset calibration constants. Measurements are checked for each function and range as described in the procedure below.

Zero offset verification test

These tests verify that the voltage programming and the LAN or USB readback functions are within specifications. Note that the readback values over the remote interface should be identical to those displayed on the front panel, but with maximum resolution.

1. Connect the 5-pin Keysight 34172B DMM calibration short to the input terminals, where short is indicated. (see Input connections).
2. Select each function and range in the order shown in the table below. Make a measurement and observe the result. Compare measurement results to the appropriate test limits shown below:

Step	Function[a]	Range	Quick check	Error from nominal one year
Open	DC current	10 mA		±1.5 µA
		100 mA	Q	±7 µA
		1 A		±0.15 mA
		3 A		±0.21 mA
Open	Capacitance	10 nF		±0.15 nF (typ)
		100 nF		±0.5 nF
		1 µF		±5 nF
		10 µF		±0.05 µF
		100 µF		±0.5 µF
		1 mF		±5 µF
		10 mF		±0.05 mF
Short	DC Voltage	100 mV		±8 µV
		1 V		±50 µV
		10 V	Q	±0.5 mV
		100 V		±5 mV
		1000 V		±50 mV
Short	Resistance	100 Ω		±10 mΩ[b]
		1 kΩ		±80 mΩ[b]
		10 kΩ		±500 mΩ[b]
		100 kΩ	Q	±5 Ω
		1 MΩ		±50 Ω
		10 MΩ		±500 Ω
		100 MΩ		±5 kΩ

[a] Select 5½ digit (slow mode) measurement resolution, not applicable for Capacitance.

[b] Specifications are for 4W or 2W resistance function using the Null math function enabled to eliminate lead resistance. Without Null, add 0.2 Ω additional error to 2W resistance function.

typ = Typical performance

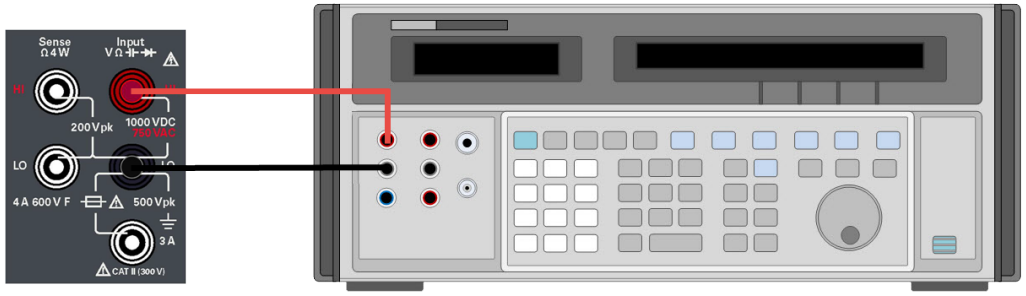
Q = Quick performance verification test points

Gain verification

This test checks the full-scale reading accuracy of the instrument. Verification checks are performed only for functions and ranges with unique gain calibration constants.

DC voltage gain verification test

Configuration: DC Voltage (CONFigure[:VOLTage][:DC])



EDU34450A **Calibrator**

1. Connect the calibrator to the front panel HI and LO input terminals as shown above.
2. Select each function and range in the order shown below. Provide the input voltage indicated below.
3. Make a measurement and observe the result. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling.)

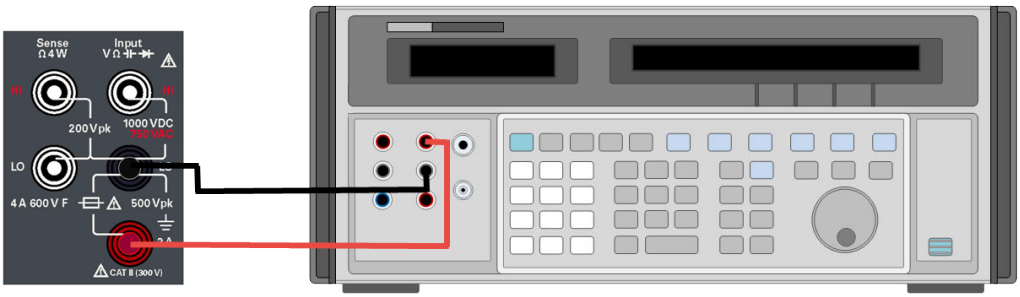
Input	Function[a]	Range	Quick check	Error from nominal one year
100 mV	DC voltage	100 mV		±26 µV
–100 mV		100 mV		±26 µV
1 V		1 V		±0.2 mV
–1 V		1 V	Q	±0.2 mV
10 V		10 V		±3 mV
100 V		100 V	Q	±30 mV
1000 V		1000 V		±0.32 V

[a] Select 5½ digit (slow mode) measurement resolution

Q = Quick performance verification test points

DC current gain verification test

Configuration: DC Current (CONFigure[:CURRent][:DC])



EDU34450A Calibrator

1. Connect the calibrator to the front panel 3A and LO input terminals as shown above.
2. Select each function and range in the order shown below. Provide the input current indicated below.
3. Make a measurement and observe the result. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling.)

Input	Function[a]	Range	Quick check	Error from nominal one year
10 mA	DC current	10 mA	Q	±11.5 µA
100 mA		100 mA		±107 µA
1 A		1 A	Q	±3.15 mA
2.99999 A		3 A		±9.21 mA

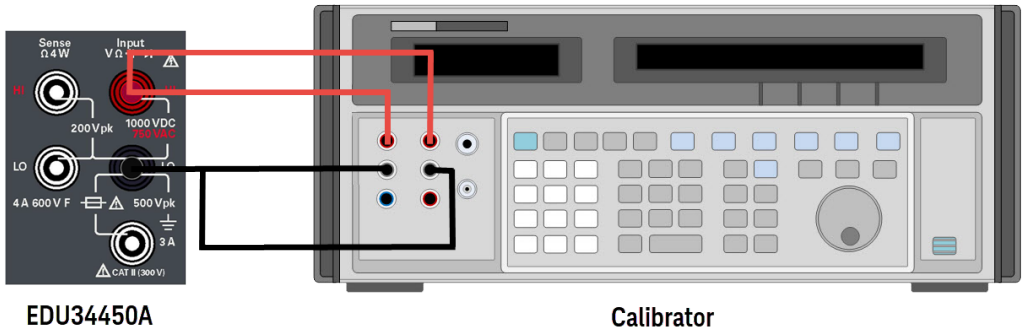
[a] Select 5½ digit (slow mode) measurement resolution

Q = Quick performance verification test points

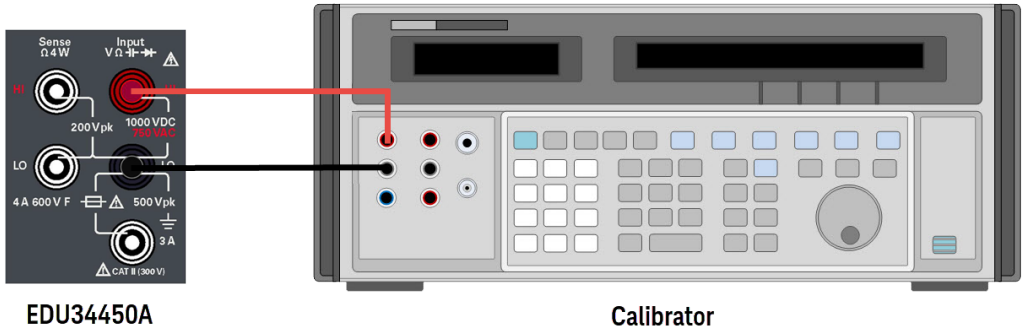
Ohms gain verification test

Configuration: 4W Resistance (CONFigure:FRESistance) or 2W Resistance (CONFigure:RESistance)

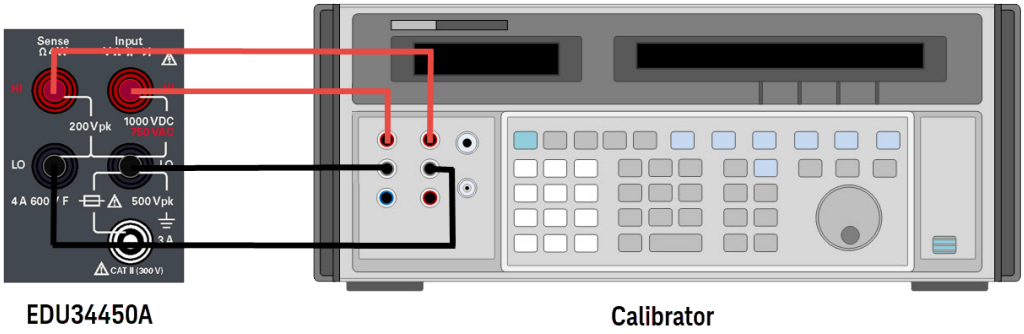
2W resistance with 2-wire compensation (For 100 Ω ~ 100 kΩ)



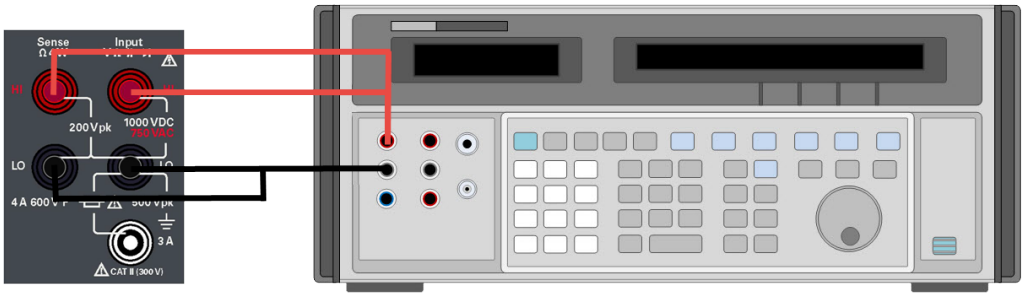
2W resistance without compensation (For 1 MΩ ~ 100 MΩ)



4W resistance with 4-wire compensation (For 100 Ω ~ 100 kΩ)



4W resistance without compensation (For 1 MΩ ~ 100 MΩ)



EDU34450A **Calibrator**

1. Connect the calibrator to the front panel HI and LO (2W/4W Resistance) and Sense HI and Sense LO (4W Resistance) input terminals as shown above.
2. Select the 4W Resistance or 2W Resistance function.
3. Select each range in the order shown below. Provide the input resistance value as indicated below.
4. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling)

Input	Function[a]	Range	Quick check	Error from nominal one year
100 Ω	Ohms	100 Ω		±75 mΩ[b]
1 kΩ		1 kΩ	Q	±730 mΩ[b]
10 kΩ		10 kΩ		±7 Ω[b]
100 kΩ		100 kΩ		±70 Ω
1 MΩ		1 MΩ		±700 Ω
10 MΩ		10 MΩ	Q	±30.5 kΩ
100 MΩ		100 MΩ		±2.005 MΩ

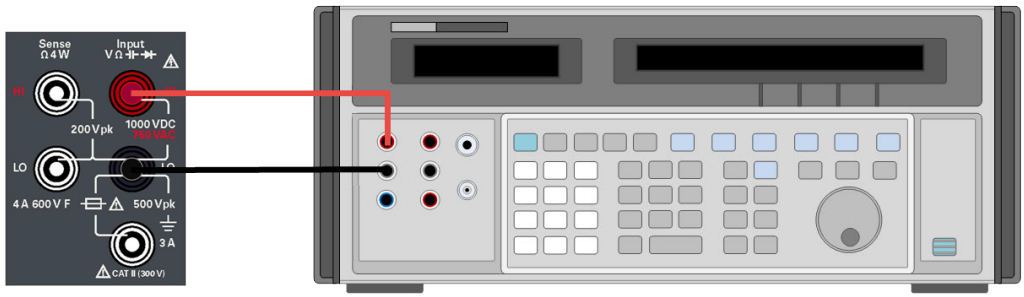
[a] Select 5½ digit (slow mode) measurement resolution

[b] Specifications are for 4W for 2W resistance function using the Null math function enabled to eliminate lead resistance. Without Null, add 0.2 Ω additional error to 2W resistance function.

Q = Quick performance verification test points

Frequency gain verification test

Configuration: Frequency (CONFigure:FREQuency)



EDU34450A **Calibrator**

1. Connect the calibrator to the front panel HI and LO input terminals as shown above.
2. Select the frequency function.
3. Select each range in the order shown below. Provide the input voltage and frequency as indicated below.
4. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling)

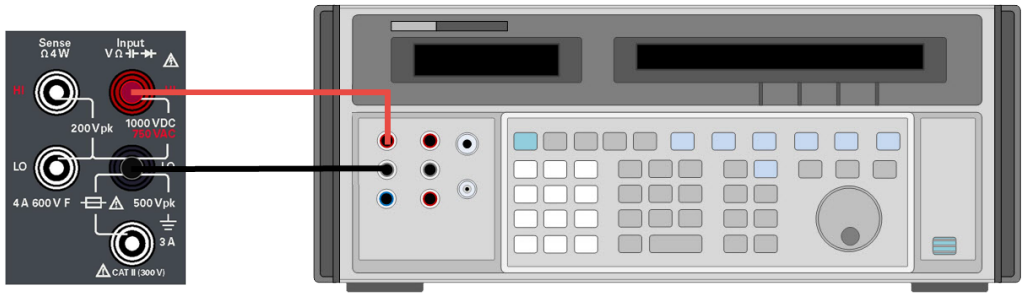
Voltage	Input frequency	Function[a]	Range	Quick check	Error from nominal one year
1 Vrms	1 kHz	Frequency	1 V	Q	±0.28 Hz
0.1 Vrms	20 Hz		1 V		±0.008 Hz

[a] Select 1 s gate time measurement resolution

Q = Quick performance verification test points

AC voltage verification test

Configuration: AC Voltage (CONFigure[:VOLTage]:AC)



EDU34450A **Calibrator**

1. Connect the calibrator to the front panel HI and LO input terminals as shown above.
2. Select the AC voltage function.
3. Select each range in the order shown below. Provide the input voltage and frequency as indicated below.
4. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling)

Vrms	Input frequency	Function[a]	Range	Quick check	Error from nominal one year
100 mV	20 Hz	AC voltage	100 mV		±1.1 mV
100 mV	45 Hz		100 mV		±0.3 mV
100 mV	1 kHz		100 mV		±0.3 mV
100 mV	10 kHz		100 mV		±0.3 mV
100 mV	30 kHz		100 mV		±1.8 mV
100 mV	100 kHz		100 mV		±6.3 mV (typ)
1 V	20 Hz		1 V		±11 mV
1 V	45 Hz		1 V		±3 mV
1 V	1 kHz		1 V	Q	±3 mV
1 V	10 kHz		1 V		±3 mV
1 V	30 kHz		1 V		±18 mV
1 V	100 kHz		1 V		±33 mV
10 V	20 Hz		10 V		±0.11 V
10 V	45 Hz		10 V		±30 mV
10 V	1 kHz		10 V		±30 mV
10 V	10 kHz		10 V		±30 mV
10 V	30 kHz		10 V	Q	±0.18 V
10 V	100 kHz		10 V		±0.33 V
100 V	45 Hz		100 V		±0.3 V
100 V	1 kHz		100 V		±0.3 V
100 V	10 kHz		100 V	Q	±0.3 V
100 V	30 kHz		100 V		±1.8 V
100 V	100 kHz		100 V		±3.3 V
750 V	45 Hz		750 V		±2.25 V
750 V	1 kHz		750 V		±2.25 V
750 V	10 kHz		750 V		±2.25 V

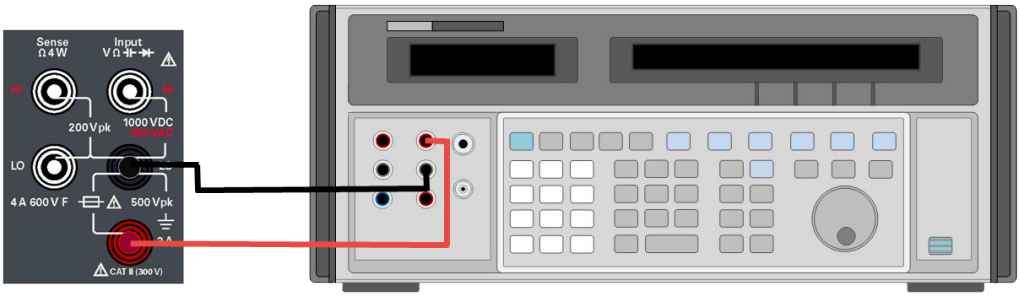
[a] Select 5½ digit (slow mode) measurement resolution

typ = Typical performance

Q = Quick performance verification test points

AC current verification test

Configuration: AC Current (CONFigure:CURRent:AC)



EDU34450A **Calibrator**

1. Connect the calibrator to the front panel 3A and LO input terminals as shown above.
2. Select the AC current function.
3. Select each range in the order shown below. Provide the input current and frequency as indicated below.
4. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling)

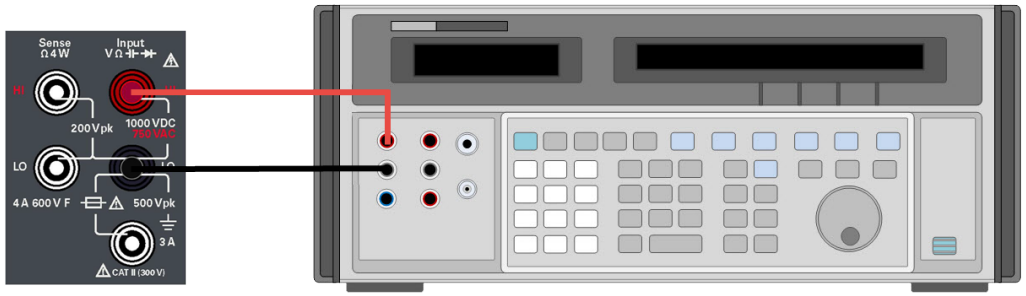
Input	Input frequency	Function[a]	Range	Quick check	Error from nominal one year
10 mA	20 Hz	AC current	10 mA		±160 µA
10 mA	45 Hz		10 mA		±60 µA
10 mA	1 kHz		10 mA	Q	±60 µA
10 mA	5 kHz		10 mA		±220 µA
10 mA	10 kHz		10 mA		±220 µA
100 mA	20 Hz		100 mA		±1.6 mA
100 mA	45 Hz		100 mA		±600 µA
100 mA	1 kHz		100 mA		±600 µA
100 mA	5 kHz		100 mA		±2.2 mA
100 mA	10 kHz		100 mA		±2.2 mA
1 A	20 Hz		1 A		±16 mA
1 A	45 Hz		1 A		±6 mA
1 A	1 kHz		1 A		±6 mA
1 A	5 kHz		1 A		±22 mA
2.99999 A	45 Hz		3 A		±18 mA
2.99999 A	1 kHz		3 A		±18 mA
2.99999 A	5 kHz		3 A		±66 mA

[a] Select 5½ digit (slow mode) measurement resolution

Q = Quick performance verification test points

Capacitance verification test

Configuration: Capacitance (CONFigure:CAPacitance)



EDU34450A **Calibrator**

1. Connect the calibrator to the front panel HI and LO input terminals as shown above. The cable capacitance between EDU34450A and calibrator must be impedance controlled with less than 100 pF of cable capacitance. For best accuracy, use only coaxial cable or shielded twisted-pair cable.
2. Select the Capacitance function.
3. Select each range in the order shown below. Provide the input capacitance value as indicated below.
4. Compare measurement results to the appropriate test limits shown in the table. (Be certain to allow for appropriate source settling)

Input capacitance	Range	Function[a]	Error from nominal one year
10 nF	10 nF	Capacitance	±0.25 nF (typ)
100 nF	100 nF		±1.5 nF
1 µF	1 µF		±15 nF
10 µF	10 µF		±0.15 µF
100 µF	100 µF		±1.5 µF
1 mF	1 mF		±15 µF
10 mF	10 mF		±0.25 mF

[a] For the best accuracy, take a zero null measurement with open test leads, to null out the test lead capacitance, before connecting the test leads to the calibrator.

typ = Typical performance

Q = Quick performance verification test points

3 Calibration Adjustments

This chapter contains information on adjustments performed after a performance verification fails.

Calibration Adjustment

This chapter includes calibration adjustment procedures for Keysight EDU34450A multimeter. Instructions are applicable for performing the procedures from either the front panel or a controller over the LAN or USB.

NOTE **Perform the verification tests before calibrating your instrument. If the instrument passes the verification tests, the unit is operating within its calibration limits and does not need to be re-calibrated.**

Closed–case electronic calibration

The instrument uses closed-case electronic calibration; no internal mechanical adjustments are required. The instrument calculates correction factors based on reference signals that you apply and stores the correction factors in non-volatile memory. This data is not changed by cycling power, *RST, or SYSTem:PRESet.

Keysight Technologies calibration services

When your instrument is due for calibration, contact your local Keysight Service Center for a low-cost re-calibration. The EDU34450A is supported on automated calibration systems, which allow Keysight to provide this service at competitive prices.

Calibration interval

The recommended calibration interval for Keysight EDU34450A multimeter is one year.

Time required for calibration

The EDU34450A can be automatically calibrated under computer control. With computer control, you can perform the complete calibration procedure and performance verification tests in less than 60 minutes once the instrument is warmed-up (see Test Considerations). Refer to the *EDU34450A Programming Guide* for more information.

Automating calibration procedures

The adjustment procedures provided in this Service Guide demonstrate front panel adjustment. You can automate the complete verification and adjustment procedures outlined in this manual. You can program the instrument configurations specified for each test over the remote interface. You can then enter read back verification data into a test program and compare the results to the appropriate test limit values. The instrument calibration must be unsecured to perform a calibration.

Calibration Adjustment Process

The following general procedure is recommended to complete a full calibration adjustment.

1. Adhere to the test considerations. See Performance Verification > Test considerations for details.
2. Perform the performance verification tests to characterize the instrument. See Performance Verification for details.
3. Unsecure the instrument for calibration. See Calibration Security for details.
4. Perform the calibration procedures. See Calibration Adjustment Procedure for details.
5. Secure the instrument against the calibration. See Calibration Security for details.
6. Take note of the security code and calibration count in the instrument's maintenance records.
7. Perform the performance verification tests to verify the calibration.

Calibration Security

The instrument has a calibration passcode to prevent accidental or unauthorized calibration. When you receive your multimeter, it is secured by a default passcode.

The default security passcode is EDU34450A. The security code cannot be changed by a power cycle or *RST.

You can change the passcode from both front panel and remote interface. You can enter a passcode of up to 12 characters. The first character must be a letter (A-Z), remaining may contains letters, numbers (0-9), or underscore "_". Blank spaces are not allowed.

From the front panel:

To unsecure the instrument:
1. Press [Shift] > [Store/Recall] | Utility > Instr. Setup > Calibration > Unlock.
2. Use Keyboard to enter the security passcode and press Apply.

You can also unsecure the instrument from the Security menu: Press [Shift] > [Store/Recall] | Utility > Instr. Setup > Security > Unlock.

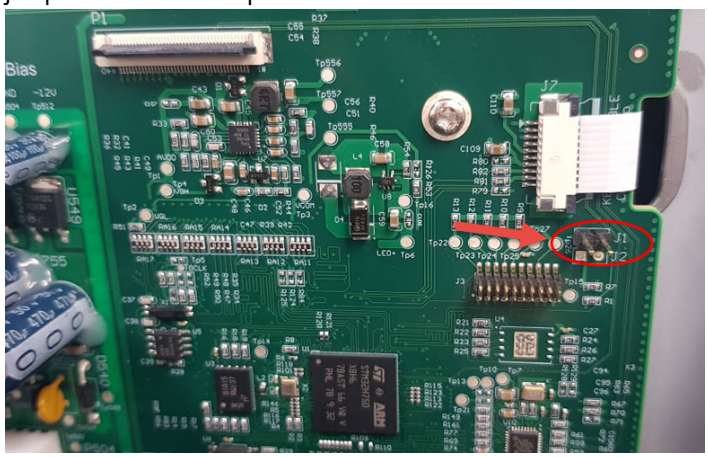
To change passcode:
1. Press [Shift] > [Store/Recall] | Utility > Instr. Setup > Security > Change Passcode.
2. Use Keyboard to enter the current passcode and your desired passcode.
3. Press Confirm.

From the remote interface:

To unsecure the instrument:
CAL:SEC:STAT 0, EDU34450A

To change a new passcode to K_EDU34450A:
CAL:SEC:CODE K_EDU34450A

NOTE To change a forgotten passcode to a new passcode, you can turn on the instrument after shorting CAL SECURE jumper J1 on the front panel board as shown below and send CAL:SEC:CODE <code> to change the passcode.



Calibration Count

You can query the instrument to determine how many calibrations have been performed. Note that your instrument was calibrated before it left the factory. When you receive your instrument, read the count to determine its initial value.

The count value increments by one for each calibration point, and a complete calibration will increase the value by many counts. The calibration count increments up to a maximum of 2^{32}-1 after which it rolls over to 0. The calibration count can be read either remotely or from the front panel.

From the front panel:

Press [Shift] > [Store/Recall] | Utility > Instr. Setup > Calibration. The display will show the calibration count.

From the remote interface:

CAL:COUN?

Calibration Message

You can use the CALibration:STRing command to store a message of up to 40 characters in calibration memory. For example, you could store the last calibration date, the calibration due date, or contact information for the person responsible for calibration. The calibration message is not affected by a power cycle or *RST.

You can only store the calibration message when the instrument is unsecured, but you can execute the CALibration:STRing? query regardless of whether the instrument is secured. A new calibration message overwrites the previous message, and messages over 40 characters are truncated.

Calibration Error

The following errors indicate failures that may occur during a calibration.

Error Code	Error Messages
702	Calibration secured
703	Invalid secure code
704	Secure code too long
708	Unable to store calibration data
709	No calibration for this function
720	DCV calibration failed
721	DCI calibration failed
722	RES calibration failed
723	CAP calibration failed
724	FRES calibration failed
725	FREQ calibration failed
726	ACV calibration failed
727	ACI calibration failed
732	ACV flatness calibration failed

Calibration Adjustment Procedure

You will need a test input cable and connectors set, and a shorting plug to adjust the instrument (see Input connections).

In the multimeter adjustment procedures from the front panel, all calibration point has been preset. You only need to select the calibration range to start the calibration process.

CAUTION **If you abort a calibration in progress, all calibration constants for the selected function range are lost. If power is turned off when the instrument is attempting to write new calibration constants to EEPROM, all calibration constants for the selected function range may also lost. Typically, upon re-applying power, the instrument will report Calibration Corrupt in the Questionable Data Register. Refer to the STAT:QUES:COND? command in the *EDU34450A Programming Guide* for more details. If this occurs, you should not use the instrument until a complete re-adjustment has been performed.**

Zero adjustments

Zero adjustment points are incorporated in gain adjustment procedures. They cannot be independently performed apart from gain adjustment points.

Gain adjustments

The instrument calculates and stores gain corrections for each input value. The gain constant is computed from the calibration value entered for the calibration command and from measurements made automatically during the adjustment procedure.

Most measuring functions and ranges have gain adjustment procedures. Adjustments for each function should be performed only in the order shown.

Gain adjustment considerations

- The zero adjustment procedure must have been recently performed prior to beginning any gain adjustment procedures.
- Be sure to allow the instrument to warm up and stabilize for two hours before performing the adjustments.
- Consider the thermal EMF effects when connecting test leads between the calibrator and multimeter. It is recommended to wait for one minute before starting the calibration after connecting the test leads.

CAUTION Never turn off the instrument during a gain adjustment. This may cause calibration memory for the present function to be lost.

Valid gain and frequency compensation input values.

Gain adjustment can be accomplished using the preset calibration points.

Function	Range	Valid amplitude input values
DC voltage	1 V	(0, ±0.2, ±0.4, ±0.6, ±0.8, ±1, ±1.2) x Full Scale
	100 mV, 10 V, 100 V, 1000 V	±1 x Full Scale
DC current	10 mA	(0, ±0.2, ±0.7, ±1) x Full Scale
	100 mA, 1 A, 3 A	(±0.2, ± 0.7, ± 1) x Full Scale
2W/4W resistance	100 Ω	(0, 0.2, 0.7, 1) x Full Scale
	1 kΩ, 10 kΩ, 100 kΩ, 1MΩ, 10 MΩ	(0.2, 0.7, 1) x Full Scale
	100 MΩ	10 MΩ and open
AC voltage	100 mV, 1 V, 10 V, 100 V	(0.1, 0.7, 1) x Full Scale, 1 kHz; 1 x Full Scale, 1 kHz, 10 kHz
	750 V	(75 V, 200 V, 750 V), 1 kHz, 200 V, 1 kHz, 10 kHz
AC current	10 mA, 100 mA, 1 A, 3 A	(0.1, 0.7, 1) x Full Scale, 1 kHz
Capacitance	1 nF	(0.4, 1) x Full Scale and Open
	10 nF, 100 nF, 1 µF, 10 µF, 100 µF, 1 mF, 10 mF	(0.1, 1) x Full Scale
Frequency	1 V, 1 kHz	1 Vrms, 1 kHz

DC voltage gain adjustment procedure

Review the Test considerations and Gain adjustment considerations before proceeding with this procedure.

Calibration mode: DC Voltage

1. Press Measurement to select DCV. The initial calibration range is 1 V.
2. The measurement displays the uncalibrated value and the Calibration Point displays the reference value.
3. Apply the input signal as indicated in the table below.
4. Press Calibration Run to start the adjustment. The calibration status is indicated as follows:
   - PASS: Successful completion of each adjustment value.
   - FAIL: An adjustment failure. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.
5. Repeat steps 3 through 4 for each gain adjustment point as indicated in the table below.
6. When the calibration has been completed for the selected range, you will be prompted "Calibration for this range is completed".
7. Press Calibration Store Value to store the calibration constants for an individual range.
8. Increase the range (Press Range to select the next range value) and continue the calibration by repeating steps 3 through 7.
9. Verify the DC voltage gain adjustments using DC voltage gain verification test.

Input	Instrument settings	
	Function	Range
0 mV[a]	DC voltage	1 V
0.2 V, 0.4 V, 0.6 V, 0.8 V, 1 V, 1.2 V, –0.2 V, –0.4 V, –0.6 V, –0.8 V, –1V, –1.2 V[b]		1 V
100 mV, –100 mV		100 mV
10 V, –10 V		10 V
100 V, –100 V		100 V
1000 V, –1000 V		1000 V
CAUTION: Set the calibrator output to STBY before disconnecting from the multimeter input terminals.		

[a] Use Keysight 34172B or configure calibrator to 0 mV. Cal Item 0 mV only calibrated once during DC voltage gain adjustment procedure. You need to re-calibrate once you exit calibration mode.

[b] Calibration need to be completed on the 1 V range first before proceeding to other ranges.

DC current gain adjustment procedure

Review the Test considerations and Gain adjustment considerations before proceeding with this procedure.

Calibration mode: DC Current

1. Press Measurement to select DCI. The initial calibration range is 10 mA.
2. The measurement displays the uncalibrated value and the Calibration Point displays the reference value.
3. Apply the input signal as indicated in the table below.
4. Press Calibration Run to start the adjustment. The calibration status is indicated as follows:

- PASS: Successful completion of each adjustment value.
- FAIL: An adjustment failure. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.

5. Repeat steps 3 through 4 for each gain adjustment point indicated in the table below.
6. When the calibration has been completed for the selected range, you will be prompted "Calibration for this range is completed".
7. Press Calibration Store Value to store the calibration constants for an individual range.
8. Increase the range (Press Range to select the next range value) and continue the calibration by repeating steps 3 through 7.
9. Verify the DC current gain adjustments using DC current gain verification test.

Input	Instrument settings	
	Function	Range
Input terminals open (0 A)[a]	DC current	Any
2 mA, 7 mA, 10 mA, –2 mA, –7 mA, –10 mA		10 mA
20 mA, 70 mA, 100 mA, –20 mA, –70 mA, –100 mA		100 mA
0.2 A, 0.7 A, 1 A, –0.2 A, –0.7 A, –1 A		1 A
0.6 A, 2.1 A, 3 A[b], -0.6 A, -2.1 A, -3 A[c]		3 A

[a] Cal Item OPEN only calibrated once during DC current gain adjustment procedure. You need to re-calibrate once you exit calibration mode.

[b] Set calibrator to output 2.99999 A to retain connection to Fluke 5522A's AUX HI+LO output terminals.

[c] Set calibrator to output -2.99999 A to retain connection to Fluke 5522A's AUX HI+LO output terminals.

NOTE Before initiating any gain adjustment procedures, perform the zero adjustment at any range first.

AC voltage gain adjustment procedure

Review the Test considerations and Gain adjustment considerations before proceeding with this procedure.

DC offset calibration and AC voltage flatness calibration have to be completed prior to performing the AC voltage gain adjustment procedure.

Calibration mode: AC voltage

1. Press Measurement to select ACV. The initial calibration range is 100 mV.
2. The measurement displays the uncalibrated value and the Calibration Point displays the reference value.
3. Apply the input signal as indicated in the table below.
4. Press Calibration Run to start the adjustment. The calibration status is indicated as follows:

- PASS: Successful completion of each adjustment value.
- FAIL: An adjustment failure. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.

5. Repeat steps 3 through 4 for each gain adjustment point indicated in the table below.
6. When the calibration has been completed for the selected range, you will be prompted "Calibration for this range is completed".
7. Press Calibration Store Value to store the calibration constants for an individual range.
8. Increase the range (Press Range to select the next range value) and continue the calibration by repeating steps 3 through 7.
9. Verify the AC voltage gain adjustments using AC voltage verification test.

Input		Instrument Settings		
AC Voltage, Sine (Vrms)	Frequency	Function	Range	Cal item
Short[a]		AC voltage	Any	DC Offset
1 × Full Scale 200 V	1 kHz 1 kHz		100 mV to 100 V 750 V	Flatness 1 kHz[b]
1 × Full Scale 200 V	10 kHz 10 kHz		100 mV to 100 V 750 V	Flatness 10 kHz[b]
10 mV, 70 mV, 100 mV	1 kHz		100 mV	Linearity
0.1 V, 0.7 V, 1 V	1 kHz		1 V	Linearity
1 V, 7 V, 10 V	1 kHz		10 V	Linearity
10 V, 70 V, 100 V	1 kHz		100 V	Linearity
75 V, 200 V, 750 V	1 kHz		750 V	Linearity
CAUTION: Set the calibrator output to STBY before d isconnecting from the multimeter input terminals.				

[a] Use Keysight 34172B or calibrator configured to 0 mV, DC voltage.

[b] AC voltage flatness calibration for 1 kHz and 10 kHz need to be completed for one range (example 100 mV) first before proceeding to another range (example 1 V).

AC current gain adjustment procedure

Review the Test considerations and Gain adjustment considerations before proceeding with this procedure.

AC voltage gain adjustment for 100 mV range calibration have to be completed prior to performing the AC current gain adjustments procedure.

Calibration mode: AC Current

1. Press Measurement to select ACI. The initial calibration range is 10 mA.
2. The measurement displays the uncalibrated value and the Calibration Point displays the reference value.
3. Apply the input signal as indicated in the table below.
4. Press Calibration Run to start the adjustment. The calibration status is indicated as follows:
   - PASS: Successful completion of each adjustment value.
   - FAIL: An adjustment failure. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.
5. Repeat steps 3 through 4 for each gain adjustment point indicated in the table below.
6. When the calibration has been completed for the selected range, you will be prompted "Calibration for this range is completed".
7. Press Calibration Store Value to store the calibration constants for an individual range.
8. Increase the range (Press Range to select the next range value) and continue the calibration by repeating steps 3 through 7.
9. Verify the AC current gain adjustments using AC current verification test.

Input		Instrument settings	
AC Current, Sine (Arms)	Frequency	Function	Range
1 mA, 7 mA, 10 mA	1 kHz	AC current	10 mA
10 mA, 70 mA, 100 mA	1 kHz		100 mA
0.1 A, 0.7 A, 1 A	1 kHz		1 A
0.3 A, 2.1 A, 3 A[a]	1 kHz		3 A

[a] Set calibrator to output 2.99999 A to retain connection to Fluke 5522A's AUX HI+LO output terminals.

Ohms gain adjustment procedure

Review the Test considerations and Gain adjustment considerations before proceeding with this procedure.

NOTE **Before initiating any gain adjustment procedures, perform the zero adjustment at any range first.**

Calibration mode: 2W Resistance/4W Resistance

1. Press Measurement to select Ω2W or Ω4W. The initial calibration range is 100 Ω .
2. The measurement displays the uncalibrated value and the Calibration Point displays the reference value.
3. Apply the input signal as indicated in the table below.
4. Press Calibration Run to start the adjustment. The calibration status is indicated as follows:

- PASS: Successful completion of each adjustment value.
- FAIL: An adjustment failure. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.

5. Repeat steps 3 through 4 for each gain adjustment point indicated in the table below.
6. When the calibration has been completed for the selected range, you will be prompted "Calibration for this range is completed".
7. Press Calibration Store Value to store the calibration constants for an individual range.
8. Increase the range (Press Range to select the next range value) and continue the calibration by repeating steps 3 through 7.
9. Verify the Ohms gain adjustments using the Ohms gain verification test.

Input	Instrument settings	
	Function	Range
0 Ω[a]	2W resistance/ 4W resistance	Any
20 Ω, 70 Ω, 100 Ω		100 Ω
0.2 kΩ, 0.7 kΩ, 1 kΩ		1kΩ
2 kΩ, 7 kΩ, 10 kΩ		10 kΩ
20 kΩ, 70 kΩ, 100 kΩ		100 kΩ
0.2 MΩ, 0.7 MΩ, 1 MΩ		1 MΩ
2 MΩ, 7 MΩ, 10 MΩ		10 MΩ
10 MΩ		100 MΩ
Input terminals open[b]	2W Resistance (only)	100 MΩ
Do not remove test lead[c]	4W Resistance (only)	100 MΩ

[a] Use Keysight 34172B or configure calibrator to 0 Ω, with 2-wire compensation (2W Resistance) or 4-wire compensation (4W Resistance) mode for better accuracy. Cal item 0 Ω only calibrated once during ohms gain adjustment procedure. You need to re-calibrate once you exit calibration mode.

[b] Remove test leads from EDU34450A's input terminals for 2-wire open calibration.

[c] Configure calibrator output to STBY and do not remove 4-wire connection from calibrator nor DUT for 4-wire resistance open calibration.

Capacitance gain adjustment procedure

Review the Test considerations and Gain adjustment considerations before proceeding with this procedure.

Calibration mode: Capacitance

1. Press Measurement to select CAP. The initial calibration range is 10 mF.
2. The measurement displays the uncalibrated value and the Calibration Point displays the reference value.
3. Apply the input signal as indicated in the table below.
4. Press Calibration Run to start the adjustment. The calibration status is indicated as follows:
   - PASS: Successful completion of each adjustment value.
   - FAIL: An adjustment failure. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.
5. Repeat step 3 through 4 for each gain adjustment point indicated in the table below.
6. When the calibration has been completed for each range, you will be prompted "Calibration for this range is completed".
7. Press Calibration Store Value to store the calibration constants for an individual range.
8. Continue the calibration for each range as indicated in the table below, by repeating steps 3 through 7.
9. Verify the Capacitance gain adjustments using the Capacitance verification test.

Input	Instrument settings[a]	
	Function	Range
1 mF, 10 mF	Capacitance	10 mF
0.1 mF, 1 mF		1 mF
10 µF, 100 µF		100 µF
1 µF, 10 µF		10 µF
0.1 µF, 1 µF		1 µF
10 nF, 100 nF		100 nF
1 nF, 10 nF		10 nF
0.4 nF, 1 nF		1 nF
Input terminal open (remove any connection from the input terminals)		1nF

[a] The cable capacitance between EDU34450A and calibrator must be impedance controlled with less than 100 pF of cable capacitance. For best accuracy, use only coaxial cable or shielded twisted-pair cable.

Frequency gain adjustment procedure

Review the Test considerations and Gain adjustment considerations before proceeding with this procedure.

Calibration mode: Frequency

1. Press Measurement to select FREQ.
2. The measurement displays the uncalibrated value and the Calibration Point displays the reference value.
3. Apply the input signal as indicated in the table below.
4. Press Calibration Run to start the adjustment. The calibration status is indicated as follows:
   - PASS: Successful completion of each adjustment value.
   - FAIL: An adjustment failure. Check the input value, range, function, and entered adjustment value to correct the problem and repeat the adjustment step.
5. When the calibration has been completed, you will be prompted "Calibration for this range is completed".
6. Press Calibration Store Value to store the calibration constants.
7. Verify the Frequency gain adjustments using the Frequency gain verification test.

Input	Frequency	Instrument settings	
		Function	Range
1 Vrms, Sine	1 kHz	Frequency	1 V, 1 kHz

Finishing the adjustments

1. Remove all shorting plugs and connections from the instrument.
2. Reset the Calibration Message (seeCalibration Message).
3. Record the new Calibration Count (see Calibration Count).
4. Press Back to exit Calibration Mode.
5. Secure the instrument with default security passcode or customized security pass code (see Calibration Security).

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