Keysight U1231A, U1232A, and U1233A Handheld Digital Multimeter

KEYSIGHT TECHNOLOGIES

Service Guide

Notices

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Safety Information

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Safety Symbols

The following symbols on the instrument and in the documentation indicate precautions that must be taken to maintain safe operation of the instrument.

	DC (Direct current or voltage)		Caution, risk of danger (refer to this manual for specific Warning or Caution information)
	AC (Alternating current or voltage)		Equipment protected throughout by double insulation or reinforced insulation
	Earth (ground) terminal	**CAT III 600 V**	Category III 600 V overvoltage protection

Safety Considerations

Read the information below before using this instrument.

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards for design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

CAUTION

- Disconnect circuit power and discharge all high-voltage capacitors before testing resistance, continuity, diodes, or capacitance.
- Use the proper terminals, function, and range for your measurements.
- This device is for use at altitudes of up to 2,000 m.
- Never measure voltage when current measurement is selected.
- Always use the specified battery type. The power for the meter is supplied with four standard AAA 1.5 V batteries. Observe the correct polarity markings before you insert the batteries to ensure proper insertion of the batteries in the meter.
- You are advised to use low leakage batteries when changing to new batteries. Please remember to remove the batteries when the meter is not in use for a long period of time. Warning on the risk of battery leakage.
- To avoid damage to the instrument from battery leakage:
  - Always remove dead batteries immediately.
  - Always remove the batteries and store them separately if the instrument is not going to be used or is being stored for a long period of time.

WARNING

- Do not use the meter if it is damaged. Before you use the meter, inspect the case. Look for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.
- Inspect the test leads for damaged insulation or exposed metal. Check the test leads for continuity. Replace damaged test leads before you use the meter.
- Do not operate the meter around explosive gas, vapor, or wet environments.
- Do not apply more than the rated voltage (as marked on the meter) between terminals, or between terminal and earth ground.
- Never use the meter in wet conditions or when there is water on the surface. If the meter is wet, ensure that the meter is dried only by trained personnel.
- Before use, verify the meter's operation by measuring a known voltage.
- When measuring current, turn off the circuit power before connecting the meter in the circuit. Remember to place the meter in series with the circuit.
- When servicing the meter, use only the specified replacement parts.
- Use caution when working above 60 V DC, 30 V AC rms, or 42.4 V peak. Such voltages pose a shock hazard.
- Do not use the VZ_{LOW} (low input impedance) function to measure voltages in circuits that could be damaged by this function's low input impedance of 3 kΩ (nominal).
- When using the probes, keep your fingers behind the finger guards on the probes.
- Connect the common test lead before you connect the live test lead. When you disconnect the leads, disconnect the live test lead first.
- Remove the test leads from the meter before you open the battery cover.

WARNING

- Do not operate the meter with the battery cover or portions of the cover removed or loosened.
- To avoid false readings, which may lead to possible electric shock or personal injury, replace the battery as soon as the low battery indicator appears and flashes.

Measurement Category

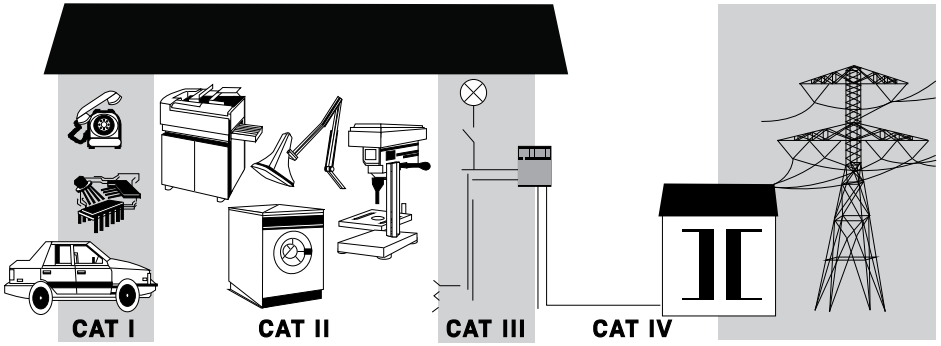
The U1231A, U1232A, and U1233A has a safety rating of CAT III, 600 V.

Measurement CAT I Measurements performed on circuits not directly connected to the AC mains. Examples are measurements on circuits not derived from the AC mains and specially protected (internal) mains-derived circuits.

Measurement CAT II Measurements performed on circuits directly connected to a low-voltage installation. Examples are measurements on household appliances, portable tools, and similar equipment.

Measurement CAT III Measurements performed in the building installation. Examples are measurements on distribution boards, circuit- breakers, wiring, including cables, bus-bars, junction boxes, switches, socket outlets in the fixed installation, and equipment for industrial use, and some other equipment including stationary motors with permanent connection to the fixed installation.

Measurement CAT IV Measurements performed at the source of the low-voltage installation. Examples are electricity meters and measurements on primary overcurrent protection devices and ripple control units.



Environmental Conditions

This U1231A, U1232A, and U1233A is designed for indoor use and in an area with low condensation. The table below shows the general environmental requirements for this instrument.

Environmental conditions	Requirements
Operating temperature	Full accuracy from –10 °C to 55 °C
Operating humidity	Full accuracy up to 80% RH (relative humidity) for temperature up to 30 °C, decreasing linearly to 50% RH at 55 °C
Storage temperature	–40 °C to 60 °C
Altitude	Up to 2000 meters
Pollution degree	Pollution degree II

NOTE

The U1231A/U1232A/U1233A Handheld Digital Multimeter complies with the following safety and EMC requirements:

- EN 61010-1 (IEC 61010-1:2001) for CAT III 600 V
- ANSI/UL 61010-1:2004
- CAN/CSA-C22.2 No. 61010-1-04
- Commercial limits compliance with EN61326-1

Regulatory Markings

CE ISM 1-A	The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.		The RCM mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australia EMC Framework regulations under the terms of the Radio Communication Act of 1992.
ICES/NMB-001	ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.		This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.
	The CSA mark is a registered trademark of the Canadian Standards Association.		This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.

Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.

Product Category:

With reference to the equipment types in the WEEE directive Annex 1, this instrument is classified as a “Monitoring and Control Instrument” product.

The affixed product label is as shown below.

Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit http://about.keysight.com/en/companyinfo/environment/takeback.shtml for more information.

Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/u1230dmm
  (product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
  (worldwide contact information for repair and service)

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1 Calibration Procedures

This chapter contains procedures for verifying the instrument performance, as well as procedures for making adjustments (calibration) where necessary.

Keysight Calibration Services

When your instrument is due for calibration, contact your local Keysight Service Center for recalibration. See "Types of Service Available" on page 53 for more information on the various calibration services offered.

Closed case calibration

The U1231A/U1232A/U1233A handheld digital multimeter features closed-case electronic calibration. In other words, no internal electro-mechanical adjustment is required. This instrument calculates correction factors based on the input reference signals you feed into it during the calibration process. The new correction factors are stored in nonvolatile EEPROM memory until the next calibration (adjustment) is performed.

The contents of this nonvolatile EEPROM memory will not change even when the power is switched off.

Calibration interval

The instrument should be calibrated on a regular interval determined by the measurement accuracy requirements of your application.

A one-year interval is adequate for most applications.

Accuracy specifications are warranted only if calibration is performed at regular intervals. Accuracy specifications are not warranted beyond the one-year calibration interval.

Keysight does not recommend extending calibration intervals beyond two years for any application.

Other recommendations for calibration

Specifications are only guaranteed within the specified period from the last calibration. Keysight recommends that readjustment should always be performed at whatever calibration interval you select. This will ensure that the instrument remains within its specifications until the next calibration. This calibration criterion provides the best long-term stability.

During performance verification tests, only the performance data is collected; these tests do not guarantee that the instrument will remain within the specified limits. The tests are only for identifying which functions need adjustment.

Please refer to the "Calibration Count" on page 43 and verify that all adjustments have been performed.

Recommended Test Equipment

The test equipment recommended for the performance verification and adjustment procedures is listed below in Table 1-1. If the exact instrument is not available, substitute with another calibration standard of equivalent accuracy.

Table 1-1 Recommended test equipment

Application	Recommended equipment	Recommended accuracy requirements
DC voltage	Fluke 5520A	<20% of the instrument accuracy specification
DC current	Fluke 5520A	<20% of the instrument accuracy specification
Resistance	Fluke 5520A	<20% of the instrument accuracy specification
AC voltage	Fluke 5520A	<20% of the instrument accuracy specification
AC current	Fluke 5520A	<20% of the instrument accuracy specification
Frequency	Fluke 5520A	<20% of the instrument accuracy specification
Capacitance	Fluke 5520A	<20% of the instrument accuracy specification
Diode	Fluke 5520A	<20% of the instrument accuracy specification
Temperature	Fluke 5520A	<20% of the instrument accuracy specification
	TM Electronics KMPC1MP (K-Type thermocouple extension)	–
Short	Pomona MDP-S	–

Basic Operating Test

The tests listed below are used to test the basic operability of the instrument. Repair is required if the instrument fails the any of the tests.

- "Backlight test"
- "Display test"

Backlight test

Power-on the multimeter and press the ☼/🔦 key once. Check that the LCD backlight is turned on. Press the ☼/🔦 key again to turn the LCD backlight off.

Next, press and hold the ☼/🔦 key for more than 1 second. Check that the LED flashlight is turned on. Press and hold the ☼/🔦 key for more than 1 second again to turn the LED flashlight off.

Display test

Press and hold the Trig Hold Auto Log key while turning the rotary switch to any other position (OFF to ON). Check that all the annunciators are displayed in the LCD. Compare the display with the example shown in Figure 1-1. Press any key to exit this mode.

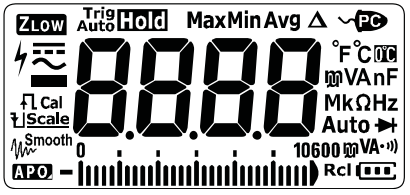

Figure 1-1 LCD display screen

Calibration Process

1. Prior to performing the verification tests, see the "Test Considerations" on page 23.
2. Perform the verification tests to characterize the multimeter; see "Performance Verification Tests" on page 24.
3. Unsecure the multimeter for calibration; see "Calibration Security" on page 28.
4. Prior to performing the adjustments, see the "Adjustment considerations" on page 34.
5. Perform the adjustment procedure; see "Adjustment procedure" on page 35.
6. Secure the multimeter against unauthorized calibration; see "Exiting the adjustment mode" on page 42. Ensure that the multimeter has quit the adjustment mode and is turned off.
7. Record the new security code and calibration count in the multimeter's maintenance records.

Test Considerations

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

- The performance verification test or adjustment should be performed under a laboratory condition, where the ambient temperature can be controlled.
- Ensure that the calibration ambient temperature is stable and is between 18 °C and 28 °C. Ideally the calibration should be performed at 23 °C ± 1 °C.
- Ensure that the ambient relative humidity is less than 80%.
- The instrument should be in the laboratory environment for at least 1 hour prior.
- Allow a warm-up period of 3 minutes.
- Use shielded twisted-pair PTFE-insulated cables to reduce settling and noise errors. Keep the input cables as short as possible.

Performance Verification Tests

Use the performance verification tests to verify the measurement performance of the instrument. The performance verification tests use the instrument's specifications listed in the *U1231A/U1232A/U1233A User's Guide* (available for download at www.keysight.com/find/hhTechLib).

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 multimeter fails the performance verification tests, adjustment or repair is required.

NOTE Ensure that you have read the "Test Considerations" on page 23 before running the performance verification tests.

Table 1-2 Performance verification tests

Step	Test function	Range	5520A input	Error from nominal 1 year		
				U1231A	U1232A	U1233A
1	Z_{LOW} Turn the rotary switch to the V_{ZLow} position.	600 V	30 V	±0.9 V	±0.9 V	±0.9 V
2	ACV Turn the rotary switch to the ~V Hz position.	600 mV	600 mV, 45 Hz	±6.3 mV	±6.3 mV	±6.3 mV
			600 mV, 1 kHz	±12.3 mV	±12.3 mV	±12.3 mV
		6 V	6 V, 45 Hz	±0.063 V	±0.063 V	±0.063 V
			6 V, 1 kHz	±0.123 V	±0.123 V	±0.123 V
		60 V	60 V, 45 Hz	±0.63 V	±0.63 V	±0.63 V
			60 V, 1 kHz	±1.23 V	±1.23 V	±1.23 V
		600 V	600 V, 45 Hz	±6.3 V	±6.3 V	±6.3 V
			600 V, 1 kHz	±12.3 V	±12.3 V	±12.3 V

Table 1-2 Performance verification tests (continued)

Step	Test function	Range	5520A input	Error from nominal 1 year		
				U1231A	U1232A	U1233A
3	**Frequency** While the rotary switch is in the ~V Hz position, press the Esc Shift key once.	9.999 kHz	1 kHz, 0.12 V	±0.003 kHz	±0.003 kHz	±0.003 kHz
4	**DCV** Turn the rotary switch to the ⎓V position.	600 mV[a]	600 mV	±3.2 mV	±3.2 mV	±3.2 mV
		6 V	6 V	±0.032 V	±0.032 V	±0.032 V
		60 V	60 V	±0.32 V	±0.32 V	±0.32 V
		600 V	600 V	±3.2 V	±3.2 V	±3.2 V
[a] The accuracy is specified after the Null function is used to subtract the thermal effect (by shorting the test leads) before measuring the signal.						
5	**Resistance** Turn the rotary switch to the Ω position.	600 Ω[b][d]	600 Ω	±5.7 Ω	±5.7 Ω	±5.7 Ω
		6 kΩ[b][d]	6 kΩ	±0.057 kΩ	±0.057 kΩ	±0.057 kΩ
		60 kΩ[d]	60 kΩ	±0.57 kΩ	±0.57 kΩ	±0.57 kΩ
		600 kΩ	600 kΩ	±5.7 kΩ	±5.7 kΩ	±5.7 kΩ
		6 MΩ[c]	6 MΩ	±0.057 MΩ	±0.057 MΩ	±0.057 MΩ
		60 MΩ[c]	60 MΩ	±0.93 MΩ	±0.93 MΩ	±0.93 MΩ
[b] The accuracy of the 600 Ω to 6 kΩ range is specified after the Null function is used to subtract the test lead resistance and thermal effect (by shorting the test leads). Apply a 0 Ω calibrator output and allow the multimeter to settle before you press the Null Recall key.						
[c] The RH is specified for <60%.						
[d] With a 2-wire connection and compensation enabled at calibrator.						
6	**Diode** Turn the rotary switch to the ⇥ position.	2 V	2 V	0.020 V	0.020 V	0.020 V

Table 1-2 Performance verification tests (continued)

Step	Test function	Range	5520A input	Error from nominal 1 year		
				U1231A	U1232A	U1233A
7	Capacitance[e] Turn the rotary switch to the ⊣⊢, ⊣⊢ 🌡, or ⊣⊢ 🌡AUX position.	1000 nF	1000 nF	±21 nF	±21 nF	±21 nF
		10 µF	10 µF	±0.21µF	±0.21µF	±0.21µF
		100 µF	100 µF	±2.1 µF	±2.1 µF	±2.1 µF
		1000 µF	1000 µF	±21 µF	±21 µF	±21 µF
		10 mF	10 mF	±0.21 mF	±0.21 mF	±0.21 mF
[e] The accuracy for all ranges is specified based on a film capacitor or better, and after the Null function is used to subtract the residual values (by opening the test leads).						
8	Scale[f] While the rotary switch is in the ⏦ ⎓ Hz AUX or ⊣⊢ 🌡AUX position, press the Esc Shift key (until mV is shown on the display).	600 mV	600 mV	3.2 mV	3.2 mV	-
		600 mV	600 mV, 70 Hz	6.3 mV	6.3 mV	-
[f] AC/DC mV measurement must be enabled prior to this step. Refer to the "Enable the AC/DC mV measurement" section of Chapter 4, "Multimeter Setup Options" in the *U1231A/U1232A/U1233A User's Guide* for further information on how to enable the AC/DC mV measurement.						
9	Temperature[g] While the rotary switch is in the ⊣⊢ 🌡 or ⊣⊢ 🌡AUX position, press the Esc Shift key once.	–40 °C to 1372 °C	0 °C	-	-	± 1.0 °C

[g] Only available in U1233A.

Set both calibrator and multimeter to internal reference.

To perform the measurement, connect the K-type thermocouple extension (with miniature thermocouple connector on both ends) between the calibrator's TC output and multimeter via a TC-to-banana adapter.

Allow at least 1 hour for the multimeter to stabilize before measurements are taken.

The error limit does not include the error contributed by the thermocouple extension. To eliminate the thermocouple error, compensation of the calibrator output through a reference thermometer is recommended.

Ensure that the ambient temperature is stable within ± 1°C. Make sure that the multimeter is placed in a controlled environment for at least 1 hour. Keep the multimeter away from any ventilation exit. Do not touch the thermocouple test lead after connecting it to the calibrator. Allow the connection to stabilize for at least another 15 minutes before performing the measurement.

Table 1-2 Performance verification tests (continued)

Step	Test function	Range	5520A input	Error from nominal 1 year		
				U1231A	U1232A	U1233A
10	DCA[h] Turn the rotary switch to the ⎓A ~Hz position.	6 A	6 A	-	±0.063 A	±0.063 A
		10 A	10 A	-	±0.13 A	±0.13 A
[h] **CAUTION:** Connect the calibrator to the multimeter's **A** and **COM** terminals before applying the 6 A and 10 A input.						
11	ACA While the rotary switch is in the ⎓A ~Hz position, press the Esc Shift key once.	6 A	6 A, 500 Hz	-	±0.093 A	±0.093 A
		10 A	10 A, 500 Hz	-	±0.18 A	±0.18 A
12	DCµA Turn the rotary switch to the ⎓µA ~Hz position.	60 µA	60 µA	-	±0.62 µA	±0.62 µA
		600 µA	600 µA	-	±6.2 µA	±6.2 µA
13	ACµA While the rotary switch is in the ⎓µA ~Hz position, press the Esc Shift key once.	60 µA	60 µA, 500 Hz	-	±0.93 µA	±0.93 µA
		600 µA	600 µA, 500 Hz	-	±9.3 µA	±9.3 µA

Calibration Security

The calibration security code prevents accidental or unauthorized adjustments to the instrument. When you first receive your instrument, it is secured. Before you can adjust the instrument, you must unsecure it by entering the correct security code (see "Unsecuring the Instrument for Calibration" on page 29).

NOTE **The security code can only be changed after the instrument has been unsecured. You can unsecure the instrument from its front panel.**

The security code is set to "1234" when the instrument is shipped from the factory. The security code is stored in nonvolatile memory, and does not change when power has been turned off.

The security code may contain up to 4 numeric characters.

Unsecuring the Instrument for Calibration

Before you can adjust the instrument, you must unsecure it by entering the correct security code.

The default security code is set to 1234.

NOTE

- If you forget your security code, see "To reset the calibration security code to its factory default" on page 32.
- The auto power-off (APO) feature will be disabled after you unsecure the instrument.

To unsecure the instrument from the front panel

1. Power-on the multimeter and press the Esc Shift and Trig Hold Auto Log keys simultaneously for more that 1 second to enter the calibration security code entry mode.
2. **SECU** is shown on the display briefly, followed by the calibration security code.

Figure 1-2 SECU display

Figure 1-3 Calibration security code display

3 Press Δ Null Recall or Range Auto to move the cursor to the right or to the left.

4 Press Max Min or ☼/B to increment or decrement the digit.

5 Press Trig Hold Auto Log when you are done.

If the correct security code is entered, **PASS** is shown in the display briefly, after which the instrument will enter the adjustment mode.

If the incorrect security code is entered, an error code will appear on the display briefly, after which the calibration security code entry mode will appear again.

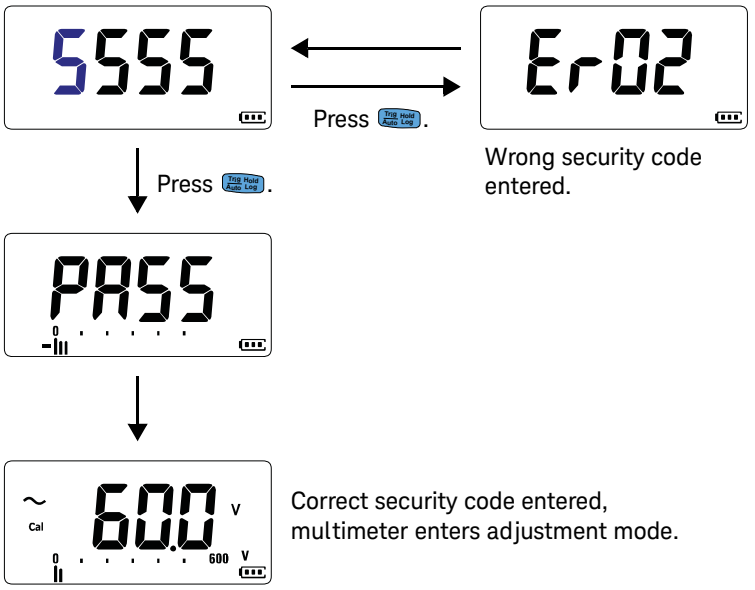

Figure 1-4 Calibration security code operation

To change the calibration security code

1 After the instrument has been unsecured, press Esc Shift for more than 1 second to enter the calibration security code setting mode.

2 **CSEC** is shown on the display briefly, followed by the factory default calibration security code **1234**.

Figure 1-5 CSEC display

Figure 1-6 Factory default calibration security code display

3 Set your new calibration security code.

Press Null Recall or Range Auto to move the cursor to the right or to the left.

Press Max Min or ☼/B to increment or decrement the digit.

4 Press Trig Hold Auto Log to save the new calibration security code.

5 If the new calibration security code has been successfully stored, the display will show **PASS**. Record down your new calibration security code and store it in a safe location.

To reset the calibration security code to its factory default

If you have forgotten the correct calibration security code, you may follow the steps below to reset the calibration security code to the factory default code (**1234**).

NOTE **If you do not have a record (or have lost the record) of the security code, first try the factory default code, 1234 from the front panel.**

1. Before you begin, note down the last four digits of the multimeter's serial number (located to the left of the multimeter's flashlight, under the bumpers).
2. Power-on the multimeter and press the Esc Shift and Trig Hold Auto Log keys simultaneously for more that 1 second to enter the calibration security code entry mode.
3. **SECU** is shown on the display briefly, followed by the calibration security code.
4. Press Esc Shift for more than 1 second to enter the calibration security code reset mode. **SErn** is shown on the display briefly, followed by the calibration security code.

Figure 1-7 SErn display

Figure 1-8 Calibration security code display

5 Set the code to the same as the last four digits of the instrument's serial number.

Press Null/Recall or Range/Auto to move the cursor to the right or to the left.

Press Max/Min or ∗/ß to increment or decrement the digit.

6 Press Trig/Auto Hold/Log to confirm the entry.

7 If the four digits entered are correct, the display will show **PASS** briefly. The calibration security code is now set to the its factory default code, **1234**.

If you want to enter a new security code, see "To change the calibration security code" on page 31. Ensure that you record down the new security code.

Using the Front Panel for Adjustments

This section describes the procedures to perform adjustments from the front panel.

To unsecure the instrument, see "To unsecure the instrument from the front panel" on page 29. Once unsecured, the reference value will be indicated on the display.

Adjustment considerations

NOTE **After each adjustment, the display shows PASS briefly. If the calibration fails, the multimeter sounds a beep, and an error number is shown in the display briefly. Calibration error messages are described in "Calibration Error Codes" on page 44.**

1. Allow the instrument to warm up and stabilize for 3 minutes before performing the adjustments.
2. Check that the battery levels are at least at two bars before performing any adjustments. This ensures that during the adjustments, the low battery indicator does not appear.

   If the low battery indicator appears, replace the batteries as soon as possible to avoid false readings.
3. Consider the thermal effects as you are connecting the test leads to the calibrator and handheld multimeter. It is recommended to wait for 1 minute before you begin the calibration after connecting the test leads.
4. Before proceeding with the ambient temperature adjustment, be sure to turn on the multimeter for at least 1 hour with the K-type thermocouple connected.

CAUTION **Never turn off the multimeter during an adjustment. This may delete the calibration memory for the present function.**

Adjustment procedure

NOTE Review the "Test Considerations" and "Adjustment considerations" before beginning the adjustment procedures.

1 Turn the rotary switch to the respective test function position as shown in the adjustment input values table (Table 1-3 on page 37).

2 Unsecure the instrument to enter the adjustment mode. (See "Unsecuring the Instrument for Calibration" on page 29).

NOTE While in the adjustment mode, press Esc Shift and Trig Hold Auto Log simultaneously to exit the adjustment mode.

3 The display will show the reference value of the calibration item.

Figure 1-9 Calibration reference value display

4 Configure each calibration item.

5 Use the arrow keys to select the calibration range.

6 Apply the input signal shown in the Reference Value column of Table 1-3. The analog bar graph displays the input reading. There is no bar graph display for temperature adjustment.

NOTE You are highly recommended to complete the adjustments in the same order as shown in the appropriate table.

7 Use the arrow keys to enter the actual applied input values.

8 Press Trig Hold Auto Log to start the adjustment. **Cal** flashes in the display to indicate that the calibration is in progress.

9 Upon completion of each adjustment value, the display will show **PASS** briefly.

If the adjustment fails, the multimeter will sound a long beep and the calibration error number appears in the display briefly. The display will then return to the current calibration item.

NOTE **If the adjustment fails, check the input value, range, function, and entered adjustment value before repeating the adjustment steps.**

10 Turn the rotary switch to the next function according to the Test Function column shown in Table 1-3. Repeat step 3 to step 8 for each adjustment point shown in the adjustment table.

11 Verify the adjustments using the "Performance Verification Tests" on page 24.

Valid adjustment input values

Adjustment can be accomplished using the following input values below.

Table 1-3 Adjustment input values

Test function	Step	Reference value	Valid reference input
ACV	600 mV	40.0 mV (70 Hz)	0.9 to 1.1 × Reference value
		600.0 mV (70 Hz)	0.9 to 1.1 × Reference value
		600.0 mV (1 kHz)	0.9 to 1.1 × Reference value
	6 V	0.600 V (70 Hz)	0.9 to 1.1 × Reference value
		6.000 V (70 Hz)	0.9 to 1.1 × Reference value
		6.000 V (1 kHz)	0.9 to 1.1 × Reference value
	60 V	6.00 V (70 Hz)	0.9 to 1.1 × Reference value
		60.00 V (70 Hz)	0.9 to 1.1 × Reference value
		60.00 V (1 kHz)	0.9 to 1.1 × Reference value
	600 V	60.0 V (70 Hz)	0.9 to 1.1 × Reference value
		600.0 V (70 Hz)	0.9 to 1.1 × Reference value
		600.0 V (1 kHz)	0.9 to 1.1 × Reference value
Vsense	Hi.10	10 V (55 Hz)	-
	Lo.30	30 V (55 Hz)	-
Note: Refer to the "Vsense functional test (for U1233A model only)" on page 40. Place the multimeter with the top area as close to the signal source as possible. Ensure that the calibrator's Earth function is turned on.			
Resistance	SHORT	SHor	SHORT Ω/COM terminals
	60 MΩ	oPEn	OPEN terminals
		10.00 MΩ	0.9 to 1.1 × Reference value
	600 kΩ	600.0 kΩ	0.9 to 1.1 × Reference value
	60 kΩ	60.00 kΩ	0.9 to 1.1 × Reference value
	6 kΩ	6.000 kΩ	0.9 to 1.1 × Reference value
	600 Ω	600.0 Ω	0.9 to 1.1 × Reference value

Table 1-3 Adjustment input values (continued)

Test function	Step	Reference value	Valid reference input
DCV	SHORT	SHor	SHORT V/COM terminals
	600 mV	600.0 mV	0.9 to 1.1 × Reference value
	6 V	6.000 V	0.9 to 1.1 × Reference value
	60 V	60.00 V	0.9 to 1.1 × Reference value
	600 V	600.0 V	0.9 to 1.1 × Reference value
Diode	SHORT	SHor	SHORT V/COM terminals
	3 V	2.000 V	0.9 to 1.1 × Reference value
Capacitance	OPEN	oPEn	OPEN terminals
	1000 nF	100 nF	0.9 to 1.1 × Reference value
		1000 nF	0.9 to 1.1 × Reference value
	10 μF	10.00 μF	0.9 to 1.1 × Reference value
	100 μF	100.0 μF	0.9 to 1.1 × Reference value
	1000 μF	1000 μF	0.9 to 1.1 × Reference value
	10 mF	10.00 mF	0.9 to 1.1 × Reference value
DCmV (Scale/ Transducer)	SHORT	SHor	SHORT V/COM terminals
	600 mV	600.0 mV	0.9 to 1.1 × Reference value
ACmV (Scale/ Transducer)	600 mV	30.0 mV (70 Hz)	0.9 to 1.1 × Reference value
		600.0 mV (70 Hz)	0.9 to 1.1 × Reference value
Temperature	K type	0.0 °C	0 °C with ambient compensation required

Note: Ensure the multimeter is turned on and stabilized for at least 60 minutes with the K-type thermocouple connected between the multimeter and the calibrator output terminal.

- Set the 5520A to internal reference.
- Prior to performing adjustment, connect one end of the K-type thermocouple (with miniature TC connector on both ends) to the 5520A TC output, and the other end to a precision thermometer to verify that the source outputs the desired value. Adjust the source accordingly if necessary.
- To perform the adjustment, connect one end of the K-type thermocouple (with miniature TC connector on both ends) to the 5520A TC output, and the other end to the multimeter via a TC-to-banana adapter. Allow at least 1 hour for the multimeter to stabilize.

Table 1-3 Adjustment input values (continued)

Test function	Step	Reference value	Valid reference input
DCμA	OPEN	oPEn	OPEN terminals
	60 μA	60.00 μA	0.9 to 1.1× Reference value
	600 μA	600.0 μA	0.9 to 1.1 × Reference value
ACμA	60 μA	30.00 μA (70 Hz)	0.9 to 1.1 × Reference value
		60.00 μA (70 Hz)	0.9 to 1.1 × Reference value
	600 μA	60.0 μA (70 Hz)	0.9 to 1.1 × Reference value
		600.0 μA (70 Hz)	0.9 to 1.1 × Reference value
DCA	OPEN	oPEn	OPEN terminals
	6 A	6.000 A	0.7 to 1.3 × Reference value
	10 A	10.00 A	0.7 to 1.3 × Reference value
ACA	6 A	0.300 A (70 Hz)	0.7 to 1.3 × Reference value
		6.000 A (70 Hz)	0.7 to 1.3 × Reference value
	10 A	3.00 A (70 Hz)	0.7 to 1.3 × Reference value
		10.00 A (70 Hz)	0.7 to 1.3 × Reference value

Functional tests

Use the functional tests to verify the measurement functionality of the instrument.

Z_{LOW} functional test

Use the following procedure to verify that Z_{LOW} is functional.

1. Connect the **COM** and Ω terminals of the U1252B (or equivalent) to the **COM** and **V** terminals of the multimeter under test.
2. Turn the U1231A/U1232A/U1233A rotary switch to the VZLOW position before proceeding with the following Z_{LOW} functional test.

Step	Test function	Range	5520A input	Error from nominal 1 year		
				U1231A	U1232A	U1233A
1	Z_{LOW} Turn the rotary switch to the VZLOW position.	600 V	2.97 kΩ	±0.702 kΩ	±0.702 kΩ	±0.702 kΩ

3. Repair is required if the multimeter fails the Z_{LOW} functional test.

Vsense functional test (for U1233A model only)

Use the following procedure to verify that Vsense is functional.

NOTE

- Keep the multimeter away from electrical noise sources during the tests (that is, florescent lights, dimmable lights, motors, and so on). These sources can trigger the Vsense alert and invalidate the test.
- It may be necessary to slightly adjust the multimeter's position for maximum signal strength, in order to get the multimeter's beeper to sound continuously.

1 Connect a dual banana plug to the output voltage terminals of the calibrator.

2 Hold the multimeter so that the top of the multimeter is vertically and horizontally centered and in contact with the banana plug's Hi terminal.

CAUTION Do not touch the dual banana plug with your hand while the calibrator output is turned on.

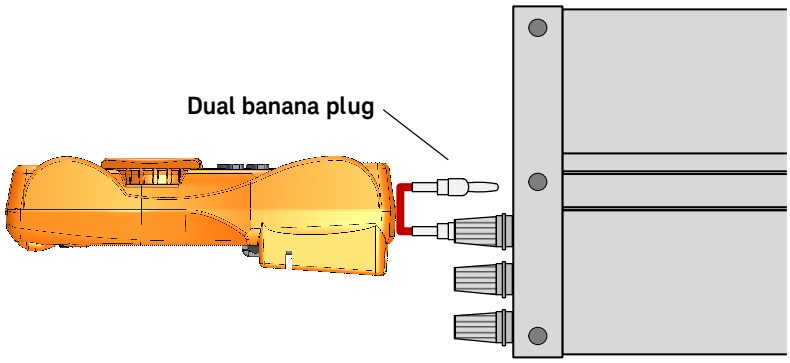

Figure 1-10 Vsense functional test

Step	Test function	Range	5520A input	Vsense alert status
1	Vsense Turn the rotary switch to the ⏦ V Hz position. Press and hold Esc Shift for more than 1 second.	Hi.SE	Output off	No alert
			10 V, 55 Hz	Alert on
		Lo.SE	5 V, 55 Hz	No alert
			15 V, 55 Hz	Alert on

3 Adjustment or repair is required if the multimeter fails any of the Vsense functional test.

Exiting the adjustment mode

1. Remove all the shorting plugs and connectors from the instrument.
2. Record the new Calibration Count.
3. Press Esc Shift and Trig Hold Auto Log simultaneously to exit the Adjustment Mode.
4. Power off and on again. The instrument will then be secured.

Calibration Count

You can query the instrument to determine how many adjustments have been performed.

NOTE **The multimeter was calibrated before it left the factory. You are recommended to record the initial value of the calibration count once you receive the multimeter.**

The count value increases by one for each calibration point, from 0000 up to the maximum of 19999. After the maximum count, the calibration count will reset to 0. The calibration count can be read from the front panel after the multimeter has been unsecured.

1. In adjustment mode, press and hold Trig Hold Auto Log for more than 1 second to view the calibration count. The calibration count value is shown on the display.
2. Take note of the calibration count to keep track of the number of calibrations that have been performed.
3. Press and hold Trig Hold Auto Log for more than 1 second again to exit the calibration count mode.

Calibration Error Codes

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

Table 1-4 Calibration error codes

Code	Descriptions
Er002	Calibration error: secure code invalid
Er003	Calibration error: serial number code invalid
Er004	Calibration error: calibration aborted
Er005	Calibration error: value out of range
Er006	Calibration error: signal measurement out of range
Er007	Calibration error: frequency out of range
Er008	EEPROM write failure

2 Service and Maintenance

This chapter will help you troubleshoot a failing instrument. It also describes how to obtain repair services and lists the replaceable assemblies.

Troubleshooting

WARNING To avoid electrical shock, do not perform any service unless you are qualified to do so.

If the instrument fails to operate, check the batteries and the test leads. Replace them if necessary. And if the instrument still does not function, check the operating procedures in this manual. When servicing, use only the specified replacement parts.

The table below will assist you in identifying some basic malfunctions.

Table 2-1 Operating checklist

Malfunction	Identification
No display when powered ON using the rotary switch	? Verify the batteries health and replace batteries as necessary.
No beeper tone	? Verify that the beeper is enabled in the multimeter's Setup mode.
Failed on current measurement (U1232A or U1233A models only)	? Verify the fuses health and replace the fuses as necessary (see "Checking the Fuse" on page 47).
Failed on remote control	? Verify the optical side of of the IR-USB cable connected to multimeter – the Keysight logo should be facing up. ? Verify the baud rate, data bit, stop bit, and parity settings in the multimeter's Setup mode. (Default values are 9600, 8, 1, and none.) ? Verify that the driver for the IR-USB interface is installed.

Checking the Fuse

This procedure is applicable for U1232A and U1233A models only.

It is recommended that you check the fuse(s) of the multimeter before using it. Follow the instructions below to test the fuses inside the multimeter.

1. Turn the rotary switch to the Ω position and connect the red test lead to the Ω input terminal.
2. To test the fuse, place the tip of the test probe on the top half of **A** input terminal. Ensure that the probe tip touches the metal inside the **A** input terminal, as shown in Figure 2-1.
3. Observe the reading on the instrument's display. Refer to Table 2-2 below for the possible readings that could appear. Replace the fuse when **OL** is displayed.

Table 2-2 Fuse displayed readings

Current input terminal	Part number	Fuse rating	Displayed readings	
			Fuse healthy	Replace fuse
A	2110-1402	11 A/1000 V	≈0.0 Ω	OL

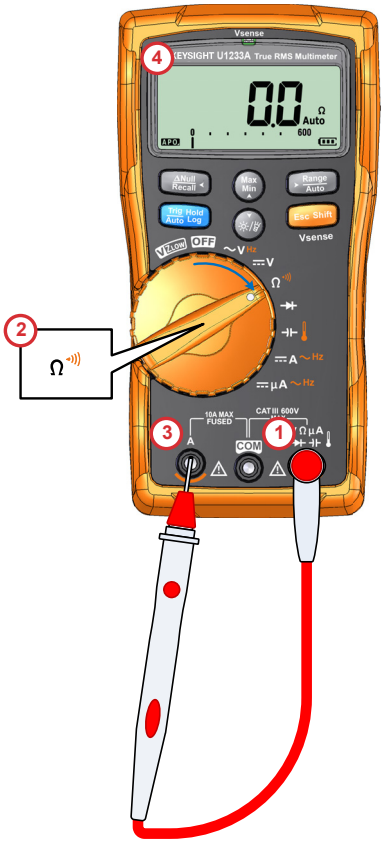

Figure 2-1 Testing the fuse

Fuse Replacement

NOTE No recalibration is required after replacing the fuse.

The current input terminals of your multimeter are fuse protected. The fuses are located next to the battery compartment.

The terminal is protected by a 10 × 38 mm, 11 A/1000 V, 30 kA fast-acting fuse (Fuse 1).

If you are certain that the fuse is faulty, replace it with one of the same size and rating.

CAUTION Before you proceed with the fuse replacement, remove all cable connections to the terminals and ensure that the rotary switch is at the OFF position.

1 **Open the battery cover.** Lift the tilt stand and loosen screws with a suitable Phillips screwdriver and remove the battery cover.

2 **Locate the faulty fuse.** The fuse is located at the bottom of the batteries (see Figure 2-2).

Gently remove the defective fuse by prying one end of the fuse with a flathead screwdriver and removing it out of the fuse bracket. Replace a new fuse of the same size and rating into the center of the fuse holder.

3 **Close the batter cover.** Place the battery cover back in its original position and tighten the screws.

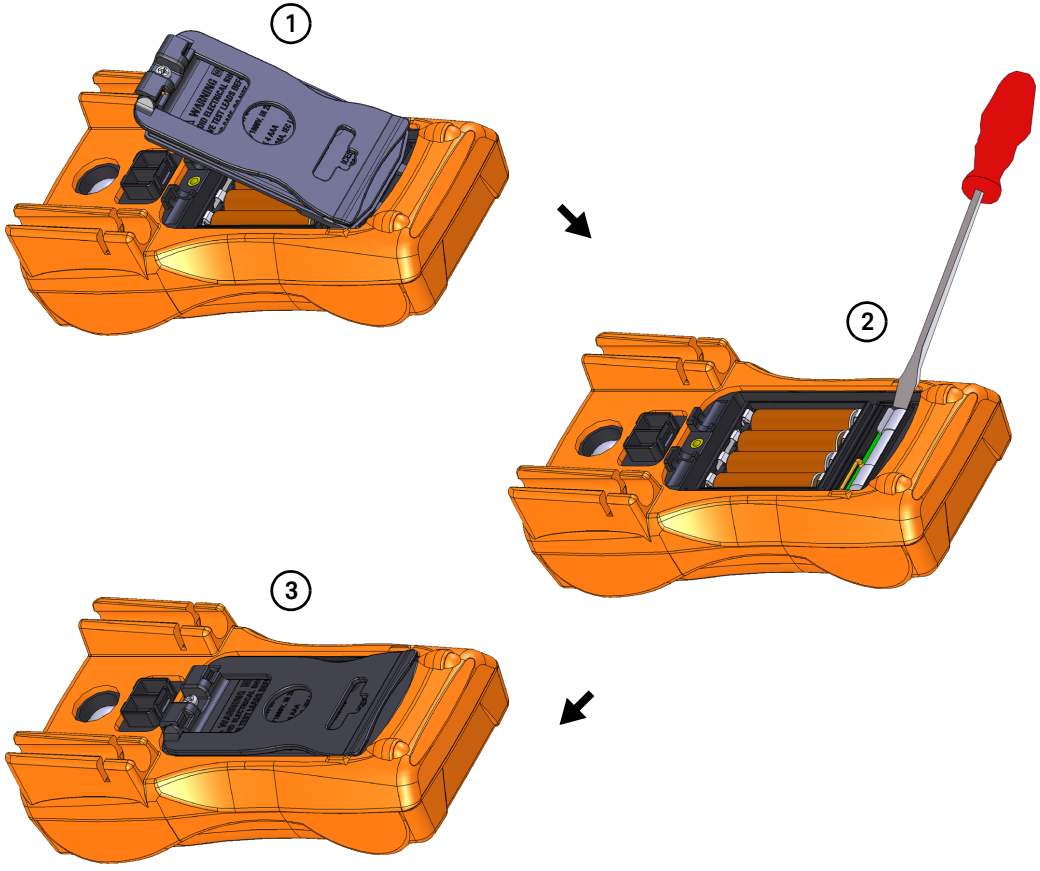

Figure 2-2 Replacing the fuse

Returning the Instrument for Service

Before shipping your instrument for repair or replacement, Keysight recommends that you acquire the shipping instructions from the Keysight Technologies Service Center. A clear understanding of the shipping instructions is necessary to secure your product for shipment.

1. Attach a tag to the instrument with following information:
   - Name and address of owner
   - Instrument model number
   - Instrument serial number
   - Description of the service required or failure indications
2. Remove all accessories from the instrument. Do not include accessories unless they are associated with the failure symptoms.
3. Place the instrument in its original container with appropriate packaging material for shipping.

If the original shipping container is not available, place your unit in a container which will ensure at least 4 inches of compressible packaging material around all sides for the instrument. Use static-free packaging materials to avoid additional damage to your unit.

NOTE Keysight suggests that you always insure your shipments.

Replaceable Parts

This section contains information for ordering replacement parts for your instrument. You can find the instrument support part list in the *Keysight's Test & Measurement Parts Catalog* at http://www.keysight.com/find/parts

The parts lists include a brief description of each part with applicable Keysight part number.

To order replaceable parts

You can order replaceable parts from Keysight using the Keysight part number. Note that not all parts listed are available as field-replaceable parts.

To order replaceable parts from Keysight, do the following:

1. Contact your nearest Keysight Sales Office or Service Center.
2. Identify the parts by the Keysight part number shown in the support parts list.
3. Provide the instrument model number and serial number.

Types of Service Available

If your instrument fails during the warranty period, Keysight Technologies will repair or replace it under the terms of your warranty.

Extended service contracts

Many Keysight products are available with optional service contracts that extend the covered period after the standard warranty expires. If you have such a service contract and your instrument fails during the covered period, Keysight Technologies will repair or replace it in accordance with the contract.

Obtaining Repair Service (Worldwide)

To obtain service for your instrument (in-warranty or under service contract), contact your nearest Keysight Technologies Service Center. They will arrange to have your unit repaired or replaced, and can provide warranty information where applicable.

To obtain warranty, service, or technical support information you can contact Keysight Technologies at one of the following telephone numbers:

- In the United States: (800) 829-4444
- In Europe: 31 20 547 2111
- In Japan: 0120-421-345

Or use our Web link for information on contacting Keysight worldwide: www.keysight.com/find/assist

Or contact your Keysight Technologies Representative.

Before shipping your instrument, ask the Keysight Technologies Service Center to provide shipping instructions, including what components to ship. Keysight recommends that you retain the original shipping carton for use in such shipments.

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