# Agilent U1273A Handheld Digital Multimeter

## User's Guide

**Agilent Technologies**

# Notices

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## Safety Notices

### CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the likes of 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 likes of 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 which must be taken to maintain safe operation of the instrument.

| | | | |
|---|---|---|---|
| ⎓ | Direct current (DC) | ⚠ | Caution, risk of electric shock |
| ∼ | Alternating current (AC) | ⚠ | Caution, risk of danger (refer to this manual for specific Warning or Caution information) |
| ⩯ | Both direct and alternating current | **CAT III 1000 V** | Category III 1000 V overvoltage protection |
| ⏚ | Earth (ground) terminal | **CAT IV 600 V** | Category IV 600 V overvoltage protection |
| ▣ | Equipment protected throughout by double insulation or reinforced insulation | | |

# Safety Considerations

Read the information below before using this multimeter. The descriptions and instructions in this manual apply to the Agilent U1273A Handheld Digital Multimeter (hereafter referred to as the multimeter).

| | |
|---|---|
| **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.

| | |
|---|---|
| **WARNING** | • **Do not use the multimeter if it is damaged. Before you use the multimeter, 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 multimeter.**
- **Do not operate the multimeter around explosive gas, vapor, or wet environments.**
- **Do not apply more than the rated voltage (as marked on the multimeter) between terminals, or between terminal and earth ground.**
- **Never use the multimeter in wet conditions or when there is water on the surface. If the multimeter is wet, ensure that the multimeter is dried only by trained personnel.**

**WARNING**

- Before use, verify the multimeter's operation by measuring a known voltage.

- When measuring current, turn off the circuit power before connecting the multimeter in the circuit. Remember to place the multimeter in series with the circuit.

- When servicing the multimeter, 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.

- Be aware of the presence of hazardous voltage before using the Low Pass Filter (LPF) function for voltage measurement. Voltages measured are usually greater than the values indicated on the multimeter as the voltages with higher frequencies have been filtered through the LPF function.

- Do not use the Z$_{LOW}$ (low input impedance) function to measure voltages in circuits that could be damaged by this function's low input impedance of 2 k$\Omega$.

- 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 multimeter before you open the battery cover.

- Do not operate the multimeter 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.

# Environmental Conditions

This instrument 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 –20 °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 70 °C |
| Altitude | Up to 2000 meters |
| Pollution degree | Pollution degree II |

**NOTE**

The U1273A Handheld Digital Multimeter complies with the following safety and EMC requirements:
- EN/IEC 61010-1:2001
- ANSI/UL 61010-1:2004
- CAN/CSA-C22.2 No. 61010-1-04
- IEC61326-1:2005/EN61326-1:2006

# 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. | N10149 | The C-tick 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 confomre 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. |
| CSA C US | The CSA mark is a registered trademark of the Canadian Standards Association. | 40 | 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 Agilent Service Center, or visit

www.agilent.com/environment/product

for more information.

# Declaration of Conformity (DoC)

The Declaration of Conformity (DoC) for this instrument is available on the Agilent website. You can search the DoC by its product model or description at the web address below.

http://regulations.corporate.agilent.com/DoC/search.htm

| NOTE | If you are unable to search for the respective DoC, please contact your local Agilent representative. |
|------|------|

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# Table of Contents

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# List of Tables

# 1

# Introduction

This chapter lists the package contents for the U1273A handheld digital multimeter and teaches you how to set up your multimeter for the first time. An introduction to all the features of the multimeter is also given.

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# About This Manual

## Documentation map

The following manuals and software are available for your multimeter. For the very latest version, please visit our website at http://www.agilent.com/find/hhTechLib.

Check the manual revision on the first page of each manual.

- **User's Guide.** This manual.
- **Quick Start Guide.** Printed copy for outdoor use, included with shipment.
- **Service Guide.** Free download at the Agilent website.
- **Agilent GUI Data Logger Software, Help, and Quick Start Guide.** Free download at the Agilent website.

## Safety notes

The following safety notes are used throughout this manual. Familiarize yourself with each of the notes and its meaning before operating your multimeter. More pertinent safety notes for using this product are located under the "Safety Symbols" section.

| **CAUTION** | Caution denotes a hazard. It calls attention to a procedure that, if not correctly performed or adhered to, could result in damage to or destruction of the product. Do not proceed beyond a caution notice until the indicated conditions are fully understood and met. |
|---|---|

| **WARNING** | **Warning denotes a hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a warning note until the indicated conditions are fully understood and met.** |
|---|---|

# Preparing Your Multimeter

## Check the shipment

When you receive your multimeter, check the shipment according to the following procedure.

1  Inspect the shipping container for damage. Signs of damage may include a dented or torn shipping container or cushioning material that indicates signs of unusual stress or compacting. Save the packaging material in case the multimeter needs to be returned.

2  Carefully remove the contents from the shipping container, and verify that the standard accessories and your ordered options are included in the shipment according to the standard shipped items list found in the printed copy of the *U1273A Quick Start Guide.*

3  For any question or problems, refer to the Agilent contact numbers on the back of this manual.

## Install the batteries

Your multimeter is powered by four 1.5 V AAA alkaline batteries (included with the shipment). When you receive your multimeter, the AAA alkaline batteries are not installed.

Use the following procedure to install the batteries.

| CAUTION | Before you proceed with the batteries installation, remove all cable connections to the terminals and ensure that the rotary switch is at the OFF position. Use only the battery type specified in the "Product Characteristics" on page 128. |
|---------|---|

1 **Open the battery cover.** Lift the tilt stand, loosen the screws with a suitable Phillips screwdriver, and remove the battery cover as shown in Figure 1-1.

2 **Insert the battery.** Observe the proper battery polarity. The terminal ends of each battery are indicated inside the battery compartment.

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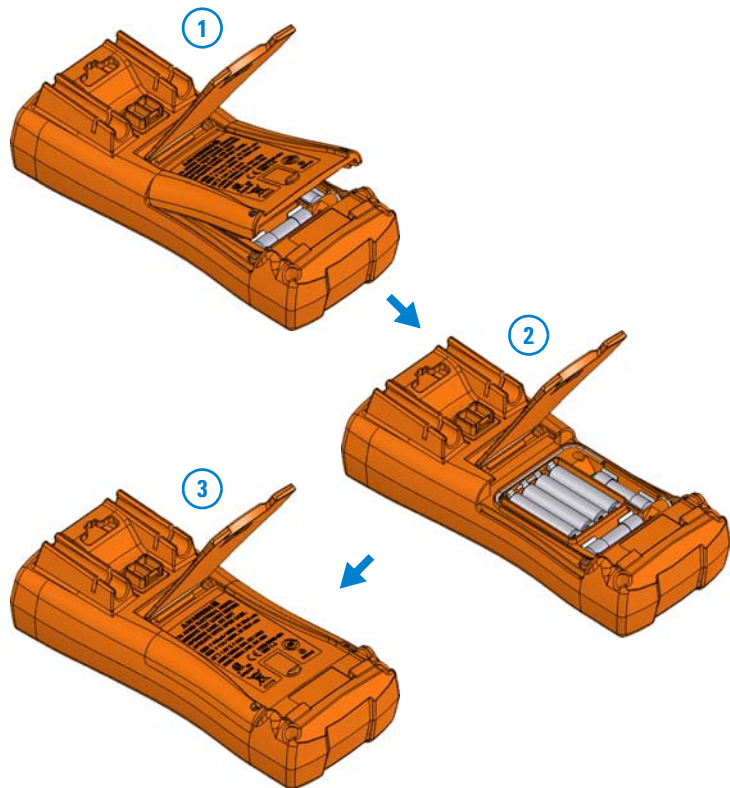


**Figure 1-1**    Installing the batteries

The battery level indicator in the lower left-hand corner of the display indicates the relative condition of the batteries. Replace the batteries as soon as possible when the low battery indicator (▭ ↔ ▨) is shown.

When the **Change Battery** warning (Figure 1-2) is shown on the display, the multimeter will power-off automatically after 5 seconds (even if the APO feature is disabled).
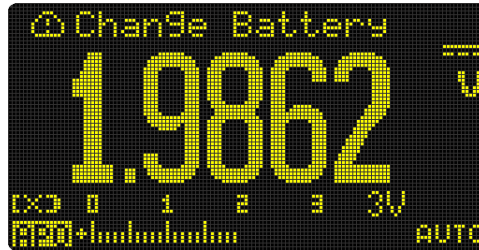


**Figure 1**-2    Change battery display

| WARNING | **To avoid false readings, which could lead to possible electric shock or personal injury, replace the battery as soon as the low battery indicator appears. Do not discharge the battery by shorting the battery or reverse the battery polarity in any of the subjects.** |
|---|---|

| CAUTION | To avoid instruments being damage from battery leakage: |
|---|---|

- Always remove dead batteries immediately.
- Always remove the batteries and store them separately if the multimeter is not going to be used for a long period.

## Turn on your multimeter

To power ON your multimeter, turn the rotary switch to any other position.



**Figure 1-3**    Start-up display

To power OFF your multimeter, turn the rotary switch to the **OFF** position.

## Automatic power-off

Your multimeter automatically turns off if the rotary switch is not moved or a key is not pressed for 10 minutes (default). Pressing any key will turn the multimeter back on after it is powered off automatically.

To change the timer period or completely disable the automatic power-off, refer to "Changing the auto power-off (APO) timer" on page 116.

## OLED Auto Dim function

Your multimeter's OLED automatically dims if the rotary switch is not moved or a key is not pressed for 90 seconds (default). This auto dim behavior is enabled by default. Pressing any key or changing the rotary switch position will cancel this effect and reset the auto dim timer.

To disable the auto dim, refer to "Changing the OLED behavior" on page 117.

## Increase the OLED brightness

| NOTE | The auto dim function is enabled by default. Refer to "Changing the OLED behavior" on page 117 to disable the auto dim function before you can manually change the OLED brightness. |
|---|---|

If viewing the display becomes difficult in low-light conditions, press 🔅 to change the OLED brightness.

The **LOW**, **MEDIUM**, or **HIGH** setting must be selected in the multimeter's setup (browse to **Menu 3 > BACKLIT**) prior to this action.

Pressing 🔅 repeatedly will increase the OLED brightness from low to medium to high (and back to low again).

You are advised to select an suitable brightness level based on your needs to conserve battery life if you wish to control the OLED brightness level manually.

# Select the range

The multimeter's selected range is always displayed above the right-hand end of the bar graph, as the range indicator. Pressing ⌧ switches the multimeter between manual and auto-ranging. It also cycles through the available multimeter ranges when manual ranging is enabled.

Auto-ranging is convenient because the multimeter automatically selects an appropriate range for sensing and displaying each measurement. However, manual ranging results in better performance, because the multimeter does not have to determine which range to use for each measurement.

| **NOTE** | The range is fixed for diode tests, temperature, and $Z_{LOW}$ measurements. |
|---|---|

In auto-range, the multimeter selects the lowest range to display the highest available precision (resolution) for the input signal. If manual range is already enabled, press ⌧ for more than 1 second to enter the auto-ranging mode.

If auto-ranging is enabled, press ⌧ to enter the manual range mode.

Each additional press of ⌧ sets the multimeter to the next higher range, unless it is already in the highest range, at which point the range switches to the lowest range.

# Alerts and warnings during measurement

**Voltage alert**

| **WARNING** | For your own safety, please do not ignore the voltage alert. When the multimeter cautions you with a voltage alert, you are advised to take note of the high voltage existence and to use precautions when performing measurements. |
|---|---|

Your multimeter provides a voltage alert for voltage measurements in both auto-ranging and manual range modes. The multimeter starts beeping periodically once the measured voltage exceeds the alert value (regardless of polarity) set in the setup menu.

By default, this feature is turned off. Be sure to set the alert voltage according to your test requirements. To change the alert voltage level, refer to "Enabling the overvoltage alert" on page 122.

### Hazardous voltage indication

The multimeter will also display the hazardous voltage (⚡) symbol as an early precaution when the measured voltage is equal to or greater than 30 V in all voltage measurement modes.

### Input warning

**CAUTION**    To avoid circuit damage and possibly blowing the multimeter's current fuse, do not place the probes across (in parallel with) a powered circuit when a lead is plugged into a current terminal. This causes a short circuit because the resistance through the multimeter's current terminals is very low.

The multimeter emits a continuous beep and displays **Error ON A INPUT** or **Error ON mA INPUT** when the test lead is inserted into the **µA mA** or **A** input terminal but the rotary switch is not set to the correct current position.

**Figure 1-4**    Input warning display (A INPUT)



**Figure 1-5**    Input warning display (mA INPUT)

This warning is intended to stop you from attempting to measure voltage, continuity, resistance, capacitance, diode, or temperature values when the leads are plugged into a current terminal.

## Adjust the tilt stand

To adjust the multimeter to a 60° standing position, pull the tilt-stand outward to its maximum reach.



To PC (host)

**IR-USB cable**

Pull until maximum reach
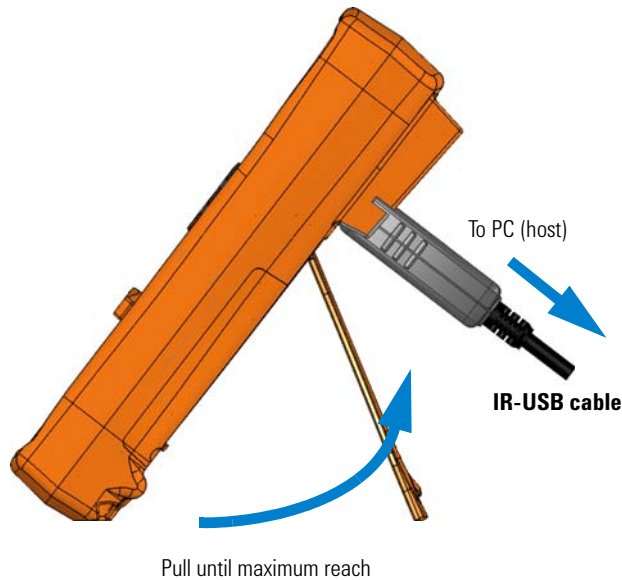
**Figure 1-6**     Tilt-stand adjustment and IR-USB cable connection

## Connect the IR-USB cable

You can use the IR communication link (IR communication port, located at the rear panel) and the Agilent GUI Data Logger software to control your multimeter remotely, perform data logging operations, and transfer the contents of your multimeter's memory to a PC.

Ensure that the Agilent logo on the U1173A IR-USB cable (purchased separately) connected to the multimeter is facing up. Firmly push the IR head into the multimeter's IR communication port until it snaps into place (see Figure 1-6).

Refer to the *Agilent GUI Data Logger Software Help* and *Quick Start Guide* for more information on the IR communication link and the Agilent GUI Data Logger software.



**Figure 1-7**    Agilent GUI Data Logger Software

The Agilent GUI Data Logger software and its supporting documents (Help and Quick Start Guide) are available for free download at http://www.agilent.com/find/hhTechLib.

You may purchase a U1173A IR-USB cable from an Agilent Sales Office nearest to you.

# Power-on options

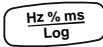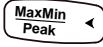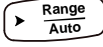Some options can be selected only while you turn the multimeter on. These power-on options are listed in the table below. To select a power-on option, press and hold the specified key while turning the rotary switch to any other position (OFF to ON). Power-on options remain selected until the multimeter is turned off.

**Table 1-1**   Power-on options

| Key | Description |
| --- | --- |
| △Null / Scale | Checks firmware version. The multimeter's firmware version will be shown on the primary display. Press any key to exit this mode. |
| Hz % ms / Log | Simulates the Auto Power-Off (APO) mode. Press any key to turn the multimeter back on and resume normal operation. |
| Dual / Exit / ▲ | Displays the factory default power-on greeting. Press any key to exit this mode. |
| MaxMin / Peak ◄ | Auto Power-Off (APO) is disabled until the multimeter is turned off. To permanently disable APO, see "Changing the auto power-off (APO) timer" on page 116. |
| ► Range / Auto | Displays the user-defined power-on greeting. Press any key to exit this mode. |
| Trig / Auto Hold | Tests the OLED. All OLED pixels are lighted. Use this mode to verify that there are no dead OLED pixels. Press any key to exit this mode. |
| Esc Shift / View | Smooth is enabled until the multimeter is turned off. To permanently enable Smooth, see "Enabling smooth mode" on page 124. |

# Your Multimeter in Brief

## Dimensions

**Front view**



**Figure 1-8**    Width dimensions

**Rear and side view**
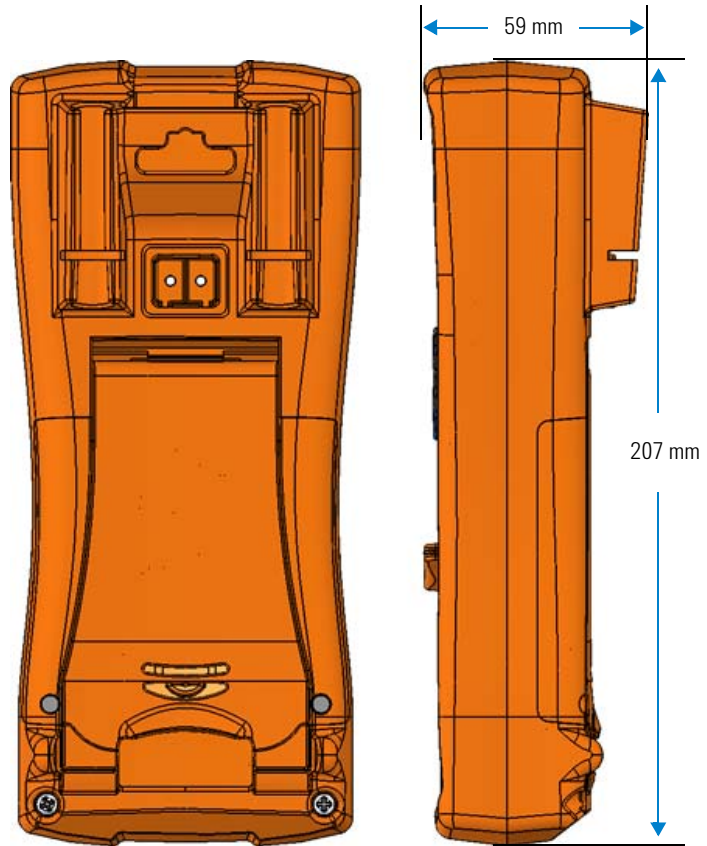


**Figure 1-9** Height and depth dimensions

# Overview

### Front panel

The front panel parts of your multimeter are described in this section. Click the respective "Learn more" pages for more information on each part.



**Figure 1**-**10**  Front panel

**Table 1**-**2**  Front panel parts

| Legend | Description | Learn more on: |
|--------|-------------|----------------|
| **1** | Display screen | page 24 |
| **2** | Keypad | page 20 |
| **3** | Rotary switch | page 18 |
| **4** | Terminals | page 30 |

**Rear panel**

The rear panel parts of your multimeter are described in this section. Click the respective "Learn more" pages for more information on each part.
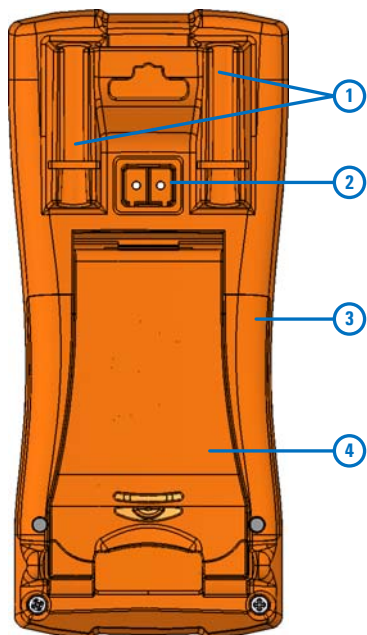


**Figure 1-11**  Rear panel

**Table 1-3**  Rear panel parts

| Legend | Description | Learn more on: |
|--------|-------------|----------------|
| **1** | Test probe holders | - |
| **2** | IR communication port | page 11 |
| **3** | Battery and fuse access cover | page 3 |
| **4** | Tilt stand | page 11 |

## Rotary switch

The measurement functions for each rotary switch position are described in Table 1-4. Turning the rotary switch changes the measurement function and resets all other measurement options.

Click the respective "Learn more" pages for more information on each function.

| NOTE | Some rotary switch positions have a *shifted* function printed in **orange**. Press 〔Esc Shift View〕 to switch between the shifted and default function. See page 23 for more information on the 〔Esc Shift View〕 key. |
|---|---|

| WARNING | **Remove the test leads from the measuring source or target before changing the rotary switch position.** |
|---|---|
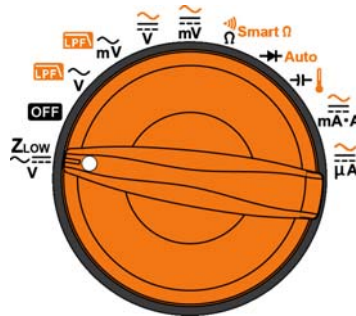


**Figure 1-12**  U1273A rotary switch

Each position of the U1273A rotary switch (shown in Figure 1-12) is described in Table 1-4.

**Table 1-4**   U1273A rotary switch functions

| Legend | Description | Learn more on: |
|---|---|---|
| $\underset{\sim \overline{\overline{V}}}{Z_{Low}}$ | Low impedance AC or DC voltage measurement for eliminating ghost voltages | page 45 |
| **OFF** | Off | page 6 |
| **LPF** $\underset{V}{\sim}$ | AC voltage measurement with Low Pass Filter | page 34 and page 36 |
| **LPF** $\underset{mV}{\sim}$ | AC voltage measurement (up to millivolts) with Low Pass Filter | |
| $\underset{\overline{\overline{V}}}{\sim}$ | AC, DC, or AC+DC voltage measurement | page 34, page 38, and page 40 |
| $\underset{\overline{\overline{mV}}}{\sim}$ | AC, DC, or AC+DC voltage measurement (up to millivolts) | |
| $\underset{\Omega}{^{_{\text{۵))}}} \text{Smart } \Omega$ | Resistance measurement, Continuity test, or Resistance measurement with offset compensation | page 47, page 50, and page 53 |
| →+ Auto | Diode test or Auto-diode test | page 56 and page 60 |
| ⊣⊢ 🌡 | Capacitance or Temperature measurement | page 62 and page 64 |
| $\underset{\overline{\overline{mA \cdot A}}}{\sim}$ | AC, DC, or AC+DC current measurement | page 68 and page 40 |
| $\underset{\overline{\overline{\mu A}}}{\sim}$ | AC, DC, or AC+DC current measurement (up to microamperes) | |

# Keypad

The operation of each key is explained below. Pressing a key enables a function, displays a related symbol, and emits a beep. Turning the rotary switch to another position resets the current operation of the key. Click the respective "Learn more" pages for more information on each function.



**Figure 1-13**  Keys

**Table 1-5**  Keypad functions

| Legend | Function when pressed for: | | Learn more on: |
|---|---|---|---|
| | **Less than 1 second** | **More than 1 second** | |
| △Null Scale | Sets the Null/Relative mode.<br><br>• The displayed value is saved as a reference to be subtracted from subsequent measurements.<br>• While in Null mode, press △Null Scale again to view the stored reference value that has been saved. The display will return to normal after 3 seconds.<br>• Pressing △Null Scale while the relative value is being displayed will cancel the Null mode. | Sets the Scale mode for the specified ratio and unit display. (Only applicable for voltage measurements.)<br><br>• The most recently saved (or default) ratio and unit will be shown on the primary and secondary displays.<br>• Press △Null Scale while the **SCALE** symbol is flashing to cycle through the available ratio and unit displays.<br>• Press Hz % ms Log while the **SCALE** symbol is flashing to save the selected ratio and unit and to start the conversion, or<br>• While the **SCALE** symbol is flashing, if no activity is detected after 3 seconds, the conversion will begin (with the specified ratio and unit shown on the primary display).<br>• Press △Null Scale for more than 1 second to cancel the Scale transfer mode. | <span style="color:blue">page 84</span> and <span style="color:blue">page 86</span> |

**Table 1-5**  Keypad functions (continued)

| Legend | Function when pressed for: | | Learn more on: |
|---|---|---|---|
| | **Less than 1 second** | **More than 1 second** | |
| MaxMin Peak ◄ | Starts the MaxMin recording.<br><br>• Press (MaxMin Peak ◄) again to cycle through maximum (**REC MAX**), minimum (**REC MIN**), average (**REC AVG**), and present (**REC NOW**) readings.<br>• Press (MaxMin Peak ◄) for more than 1 second to exit this mode. | Starts and stops the Peak recording.<br><br>• Press (MaxMin Peak ◄) again to switch between the maximum (**P-HOLD+**) and minimum (**P-HOLD–**) peak readings.<br>• Press (MaxMin Peak ◄) for more than 1 second to exit this mode. | page 88 and page 90 |
| Trig Auto Hold | Freezes the present reading in the display (**T-HOLD** mode).<br><br>• In TrigHold mode, press (Trig Auto Hold) to manually trigger the holding of the next measured value.<br>• Press (Trig Auto Hold) for more than 1 second to exit this mode. | Automatically freezes the present reading once the reading is stable (**A-HOLD** mode)<br><br>• In AutoHold mode, the reading is updated automatically once the reading is stable and the count setting is exceeded.<br>• Press (Trig Auto Hold) for more than 1 second to exit this mode. | page 92 |
| Dual Exit ▲ | Switches between the dual-combination displays (if available). | Exits the Hold, Null, MaxMin, Peak, frequency test, and dual display modes. | page 153 |
| ☼ Setup ▼ | Changes the OLED brightness when **LOW**, **MEDIUM**, or **HIGH** setting is selected in the multimeter's setup. | Enters or exits the setup menu.<br><br>• In the setup menu, press (MaxMin Peak ◄) or (► Range Auto) to navigate through the menu pages. Press (Dual Exit ▲) or (☼ Setup ▼) at each menu page to move the cursor to a specific menu item.<br>• Press (Hz % ms Log) to edit the selected menu item. The menu item's value will flash to indicate that you can now change the value shown. Use the arrow keys to change the values shown.<br>• Press (Hz % ms Log) to save the new settings or values and exit the editing mode, or press (Esc Shift View) to exit the editing mode without saving.<br>• Press (☼ Setup ▼) for more than 1 second to exit this mode. | page 7 and page 101 |

**Table 1-5** Keypad functions (continued)
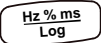
| Legend | Function when pressed for: | | Learn more on: |
| --- | --- | --- | --- |
| | **Less than 1 second** | **More than 1 second** | |
| Hz % ms / Log | Measures the frequency for the current or voltage measurement. <br><br> • Press (Hz % ms Log) to scroll through the frequency (**Hz**), pulse width (**ms**), and duty cycle (**%**) measurements. <br> • In duty cycle and pulse width measurements, press (Dual Exit) to switch between the positive or negative edge trigger. <br> • Press (Dual Exit) for more than 1 second to exit this mode. | Starts and stops the Data Logging. <br><br> • If data logging is set as **HAND** (manual data logging), pressing (Hz % ms Log) for more than 1 second will log the present reading into the memory. The display will return to normal after a short while (≈ 1 second). To manually log another reading, press (Hz % ms Log) again for more than 1 second. <br> • If data logging is set as **AUTO** (automatic data logging), pressing (Hz % ms Log) for more than 1 second will enter the automatic data logging mode, where data is logged at the interval defined in the multimeter's setup. <br> • If data logging is set as **TRIG** (event data logging), pressing (Hz % ms Log) for more than 1 second will enter the event data logging mode, where data is logged each time a triggering condition is satisfied. <br> • Press (Hz % ms Log) for more than 1 second to exit the automatic or event data logging mode. | page 76 and page 93 |
| Range / Auto | • Sets a manual range and disables auto-ranging. Press (Range Auto) again to cycle through each available measurement range. <br> • During temperature measurements, if Celsius-Fahrenheit (**°C-°F**) or Fahrenheit-Celsius (**°F-°C**) is selected as the default temperature unit, pressing (Range Auto) changes the temperature measurement unit between Celsius (°C) and Fahrenheit (°F). See "Changing the temperature unit" on page 113 for more information. | Enables auto-ranging. | page 8 and page 113 |

**Table 1-5**   Keypad functions (continued)

| Legend | Function when pressed for: | | Learn more on: |
|---|---|---|---|
| | **Less than 1 second** | **More than 1 second** | |
| Esc Shift View | Switches between the default and *shifted* measurement function (icon printed in **orange** above the rotary switch position — if available). Press [Esc Shift View] again to switch back to the default measurement function. | Enters the Log Review menu.<br>• Press [Esc Shift View] again to cycle through the previously recorded manual (**VIEW H**), interval (**VIEW A**), or event (**VIEW E**) logging data.<br>• Press [MaxMin Peak] or [Range Auto] to view first or last logged data respectively. Press [Dual Exit] or [Setup] to scroll through the logged data.<br>• Press [Hz % ms Log] for more than 1 second to clear all the logged data for the selected logging mode.<br>• Press [Esc Shift View] for more than 1 second to exit this mode. | page 18 and page 98 |

# Display screen

The display annunciators of your multimeter are described in this section. See also "Measurement units" on page 28 for a list of available measurement signs and notations and "Analog bar graph" on page 29 for a tutorial on the analog bar graph located at the bottom of your display screen.

## General display annunciators

The general display annunciators of your multimeter are described in the table below. Click the respective "Learn more" pages for more information on each annunciator.
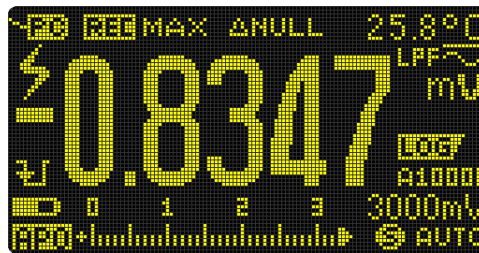


**Figure 1-14**  Display screen example (single display)
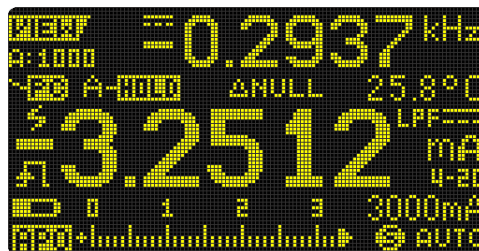


**Figure 1-15**  Display screen example (dual display)

**Table 1-6** General annunciators

| Legend | Description | Learn more on: |
|---|---|---|
| ▼RⅢⅢ | Remote control enabled | page 11 |
| BiAS LEAK | Bias voltage or leakage current indication for Smart Ω measurements | page 53 |
| LOG | Data logging in progress | page 93 |
| SCALE | Scale transfer enabled | page 86 |
| VIEW | View mode for reviewing previously logged data | page 98 |
| -0123 | Secondary measurement display | - |
| ∿ = ∿ | AC, DC, and AC+DC indication for secondary display | page 42, page 45, and page 76 |
| 00001 S | Elapsed time for Peak and Recording mode | page 90 and page 93 |
| LPF∿ | Low-pass filter enabled for AC measurement | page 36 |
| ⚡ | Hazardous voltage sign for measuring voltage ≥30 V or overload | page 8 |
| T-HOLD | Trigger hold enabled | page 92 |
| A-HOLD | Auto hold enabled | |
| P-HOLD+ | Peak hold (maximum value) enabled | page 90 |
| P-HOLD− | Peak hold (minimum value) enabled | |

**Table 1-6**   General annunciators (continued)
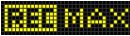
| Legend | Description | Learn more on: |
|---|---|---|
| REC MAX | Maximum reading shown on primary display | |
| REC MIN | Minimum reading shown on primary display | page 88 |
| REC AVG | Averaged reading shown on primary display | |
| REC NOW | Present reading shown on primary display | |
| ΔNULL | Relative (Null) enabled | page 84 |
| Δ'BASE | Relative value when Null is enabled | page 84 |
| ◄))) | Audible continuity test selected | page 50 |
| ⊥⊥ | Normal open continuity indication | page 50 |
| ⊥⊥ | Normal close continuity indication | page 50 |
| J | J-type thermocouple selected | page 65 |
| K | K-type thermocouple selected | |
| °C | Temperature measurement without ambient compensation selected | page 67 |
| % 4-20 | 4-20 mA % scale mode selected | page 73 |
| % 0-20 | 0-20 mA % scale mode selected | |
| ▬▬ | DC (direct current) | page 38 and page 68 |

**Table 1-6**   General annunciators (continued)

| Legend | Description | Learn more on: |
|--------|-------------|----------------|
|  | AC (alternating current) | page 34 and page 68 |
|  | AC+DC | page 40 |
|  | • Capacitor is charging (during capacitance measurement)<br>• Positive slope for pulse width (**ms**) and duty cycle (**%**) measurements | page 62 and page 76 |
|  | • Capacitor is discharging (during capacitance measurement)<br>• Negative slope for pulse width (**ms**) and duty cycle (**%**) measurements | |
| -0123 | Primary measurement display | - |
|  | Battery capacity indication | page 3 |
|  | APO (Auto Power-Off) enabled | page 6 |
|  | Tone enabled | - |
| 0 2 4 6 8 10 12 | Analog bar graph | page 29 |
| AUTO | Auto-ranging enabled or Auto-diode enabled | page 8 |
|  | Diode test selected | page 56 |
|  | Smooth mode enabled | page 13 and page 124 |
| OL | Overload (the reading exceeds the display range) | - |

### Measurement units

The available signs and notations for each measurement function in your multimeter are described in Table 1-7. The units listed below are applicable to the primary display and secondary display measurements of your multimeter.

**Table 1-7**   Measurement units display

| Sign/Notation | Description |
|---|---|
| M | Mega     1E+06 (1000000) |
| k | kilo     1E+03 (1000) |
| n | nano     1E–09 (0.000000001) |
| μ | micro    1E–06 (0.000001) |
| m | milli    1E–03 (0.001) |
| dBm | Decibel unit relative to 1 mW |
| dBV | Decibel unit relative to 1 V |
| mV, V | Voltage, units for voltage measurement |
| A, mA, μA | Ampere, units for current measurement |
| nF, μF, mF | Farad, units for capacitance measurement |
| Ω, kΩ, MΩ | Ohm, units for resistance measurement |
| MHz, kHz, Hz | Hertz, units for frequency measurement |
| ms | Millisecond, unit for pulse width measurement |
| % | Percent, unit for duty cycle measurement |
| °C | Degree Celsius, unit for temperature measurement |
| °F | Degree Fahrenheit, unit for temperature measurement |
| s | Seconds, unit for Peak and Recording mode elapsed time |

**Analog bar graph**

The analog bar emulates the needle on an analog multimeter, without displaying the overshoot. When measuring peak or null adjustments and viewing fast-changing inputs, the bar graph provides a useful indication because it has a faster updating rate[1] to cater for fast-response applications.

For frequency, duty cycle, pulse width, 4-20 mA % scale, 0-20 mA % scale, dBm, dBV, and temperature measurements, the bar graph does not represent the primary display value.

For example, when frequency, duty cycle, or pulse width is displayed on the primary display during voltage or current measurement, the bar graph represents the voltage or current value (not the frequency, duty cycle, or pulse width value). Another example is when 4-20 mA % scale or 0-20 mA % scale is displayed on the primary display, the bar graph represents the current value and not the percentage value.

The "+" or "–" sign indicates whether the measured or calculated value is positive or negative. Each segment represents 1000 or 500 counts depending on the range indicated on the peak bar graph.

**Table 1-8**  Analog bar graph display

| Range | Counts/ Segments | Used for the function |
|---|---|---|
|  | 500 | V, A, ⊣⊢ |
|  | 1000 | V, A, Ω, ⊣⊢ |

[1] The analog bar graph measurement rate is approximately 50 times/second for DC voltage, current, and resistance measurements.

An unstable bar graph and unmatched primary display when measuring DC voltage usually means the presence of AC voltages in the circuit.

# Input terminals

The terminal connections for the different measurement functions of your multimeter are described in the table below. Observe the rotary switch position of your multimeter before connecting the test leads to the connector terminals.
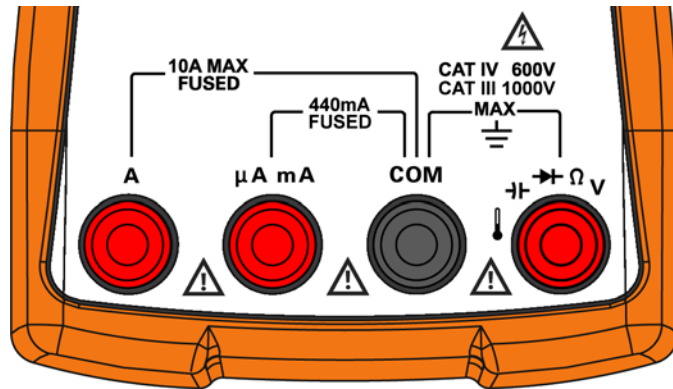


**Figure 1-16**  Connector terminals

**Table 1-9**  Terminal connections for different measuring functions

| Rotary switch position | Input terminals | Overload protection |
|---|---|---|
| LPF $\underset{V}{\sim}$ | | 1000 VRMS |
| $\underset{\overline{\overline{V}}}{\sim}$ | | |
| $\underset{V}{\overset{Z_{LOW}}{\sim\overline{\overline{\cdot}}}}$ | | 1000 VRMS for short circuit <0.3 A |
| LPF $\underset{mV}{\sim}$ | | |
| $\underset{\overline{\overline{mV}}}{\sim}$ | | |
| $\underset{\Omega}{^{\text{ı))}}$Smart Ω | | |
| ➔⊢ Auto | | |
| ⊣⊢ ! | | |
| $\underset{\overline{\overline{mA} \cdot A}}{\sim}$ | A  COM | 11 A/1000 V, fast-acting fuse |
| $\underset{\overline{\overline{mA} \cdot A}}{\sim}$ | μA mA  COM | 440 mA/1000 V, fast-acting fuse |
| $\underset{\overline{\overline{\mu A}}}{\sim}$ | | |

# Cleaning Your Multimeter

**WARNING**    **To avoid electrical shock or damage to the multimeter, ensure that the insides of the casing stay dry at all times.**

Dirt or moisture in the terminals can distort readings. Follow the steps below to clean your multimeter.

**1**  Turn the multimeter off, and remove the test leads.

**2**  Turn the multimeter over, and shake out any dirt that may have accumulated in the terminals.

Wipe the case with a damp cloth and mild detergent — do not use abrasives or solvents. Wipe the contacts in each terminal with a clean swab dipped in alcohol.

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# 2
# Making Measurements

The following sections describe how to take measurements with your multimeter.

# Measuring AC Voltage

Set up your multimeter to measure AC voltage as shown in Figure 2-2. Probe the test points, and read the display.

**Table 2-1**   Rotary switch positions allowing AC voltage measurements

| Legend | Default function | Function when Esc Shift View is pressed |
|---|---|---|
| LPF $\sim$ V | AC V | AC V with LPF |
| LPF $\sim$ mV | AC mV | AC mV with LPF |
| $\approx$ V | DC V | Cycles between<br>• AC V,<br>• AC+DC V, or<br>• DC V |
| $\approx$ mV | DC mV | Cycles between<br>• AC mV,<br>• AC+DC mV, or<br>• DC mV |

| NOTE | AC voltage measurements measured with this multimeter are returned as true RMS (root mean square) readings. These readings are accurate for sinusoidal waves and other waveforms with no DC offset, such as square waves, triangle waves, and staircase waves. |
|---|---|
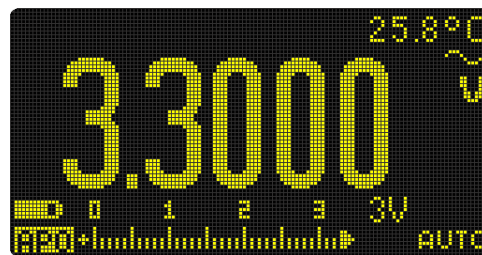


**Figure 2-1**    AC voltage display

| NOTE | • For measuring AC voltage signals with DC offset, refer to the "Measuring AC and DC Signals" section later in this manual. |

- Press (Dual Exit) to cycle through the available dual display combinations. See Appendix B, "Dual Display Combinations Using the Dual Key," starting on page 153 to learn more.

- Press (Hz % ms Log) to measure the frequency of the AC voltage source. See "Measuring Frequency" on page 76 to learn more.



**Figure 2-2**   Measuring AC voltage

# Using the LPF (Low Pass Filter) function

Your multimeter is equipped with an AC low-pass filter to help reduce unwanted electronic noise when measuring AC voltage or AC frequency.

**Table 2-2**   Rotary switch positions allowing AC voltage measurements with LPF

| Legend | Default function | Function when [Esc Shift View] is pressed |
|--------|------------------|-------------------------------------------|
| [LPF] $\widetilde{V}$ | AC V | AC V with LPF |
| [LPF] $\widetilde{mV}$ | AC mV | AC mV with LPF |

Set up your multimeter to measure AC voltage as shown in Figure 2-2. Press [Esc Shift View] to activate the LPF option. Your multimeter continues measuring in the chosen AC mode, but now the signal diverts through a filter that blocks unwanted voltages above 1 kHz. Probe the test points, and read the display.
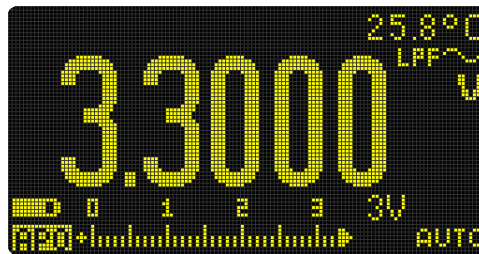


**Figure 2-3**   AC voltage with LPF display

**WARNING**   **To avoid possible electric shock or personal injury, do not use the LPF option to verify the presence of hazardous voltages. Voltages greater than what is indicated may be present. First, make a voltage measurement without the filter to detect the possible presence of hazardous voltages. Then, select the filter option.**

The low-pass filter can improve measurement performance on composite sine waves that are typically generated by inverters and variable frequency motor drives.

### Using LPF for DC coupling for voltage/current measurements

You can also enable the low-pass filter for DC coupling of voltage and/or current measurements. See "Enabling the filter" on page 126 for more information.

Enable the low-pass filter to block and attenuate AC signals to help you read the DC offset with high AC voltage signal presence, which exceeds the measuring range (for example, AC 100 V/220 V applied to the 3 V range).

# Measuring DC Voltage

Set up your multimeter to measure DC voltage as shown in Figure 2‑5. Probe the test points, and read the display.

**Table 2‑3**   Rotary switch positions allowing DC voltage measurements

| Legend | Default function | Function when Esc Shift/View is pressed |
|--------|------------------|------------------------------------------|
| $\widetilde{\overline{\overline{V}}}$ | DC V | Cycles between<br>• AC V,<br>• AC+DC V, or<br>• DC V |
| $\widetilde{\overline{\overline{mV}}}$ | DC mV | Cycles between<br>• AC mV,<br>• AC+DC mV, or<br>• DC mV |

| NOTE | This multimeter displays DC voltage values as well as their polarity. Negative DC voltages will return a negative sign on the left of the display. |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------|
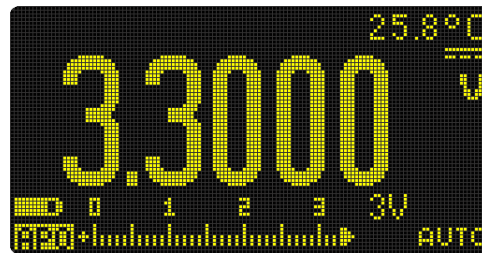


**Figure 2‑4**   DC voltage display

| NOTE | • For measuring AC voltage signals with DC offset, refer to the "Measuring AC and DC Signals" section later in this manual. |
|------|---|

• Press 🔘 to cycle through the available dual display combinations. See Appendix B, "Dual Display Combinations Using the Dual Key," starting on page 153 to learn more.

• Press 🔲 to measure the frequency of the DC voltage source. See "Measuring Frequency" on page 76 to learn more.
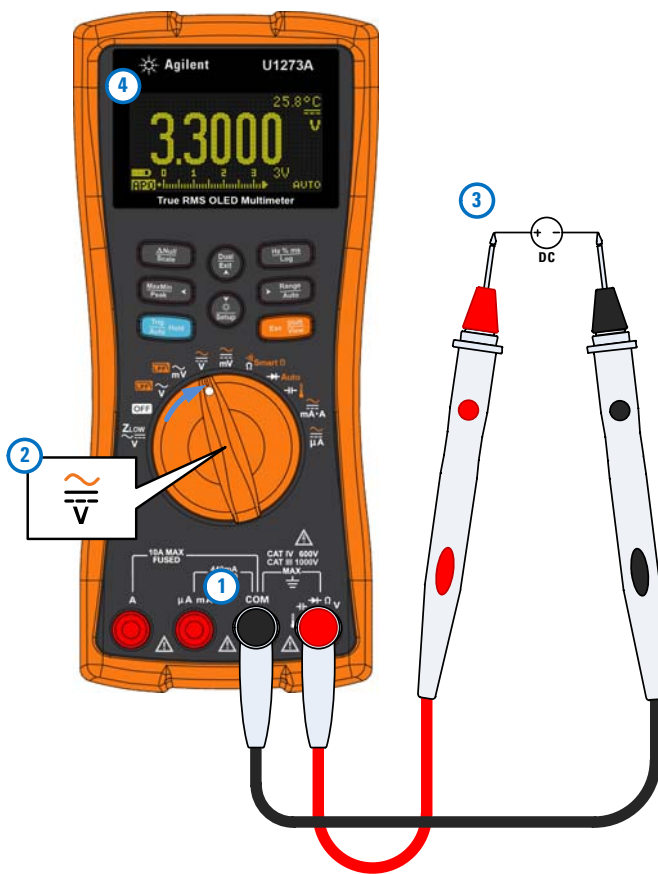


**Figure 2-5**   Measuring DC voltage

# Measuring AC and DC Signals

Your multimeter is capable of displaying both AC and DC
signal components, voltage or current, as two separate
readings or one AC+DC (RMS) value combined.

**Table 2-4**  Rotary switch positions allowing AC+DC signal measurements

| Legend | Default function | Function when [Esc/Shift View] is pressed |
|:---:|:---:|:---|
| $\widetilde{\overline{\underline{V}}}$ | DC V | Cycles between<br>• AC V,<br>• AC+DC V, or<br>• DC V |
| $\widetilde{\overline{\underline{mV}}}$ | DC mV | Cycles between<br>• AC mV,<br>• AC+DC mV, or<br>• DC mV |
| $\widetilde{\overline{\underline{mA\cdot A}}}$ | DC A (or mA) | Cycles between<br>• AC A (or mA),<br>• AC+DC A (or mA), or<br>• DC A (or mA) |
| $\widetilde{\overline{\underline{\mu A}}}$ | DC µA | Cycles between<br>• AC µA,<br>• AC+DC µA, or<br>• DC µA |

Set up your multimeter according to your desired
measurement (voltage or current measurement). Press the
[Esc/Shift View] key twice to cycle the measurement function to the
AC+DC option. Probe the test points, and read the display.
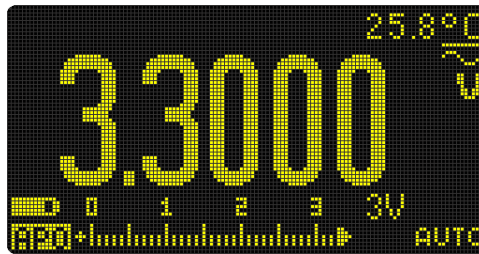
**Figure 2-6**    AC+DC voltage display
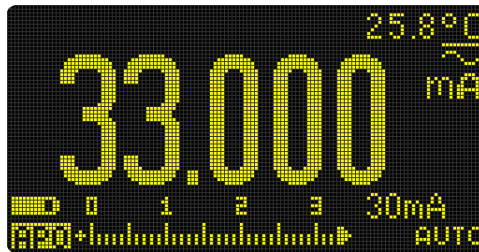


**Figure 2-7**    AC+DC current display

| NOTE |

• For better accuracy when measuring the DC offset of an AC voltage, measure the AC voltage first. Note the AC voltage range, then manually select a DC voltage range equal to or higher than the AC range. This procedure improves the accuracy of the DC measurement by ensuring that the input protection circuits are not activated.

• Press (Dual Exit ▲) to cycle through the available dual display combinations. See Appendix B, "Dual Display Combinations Using the Dual Key," starting on page 153 to learn more.

• Press (Hz % ms Log) to measure the frequency of the AC+DC voltage source. See "Measuring Frequency" on page 76 to learn more.

# Making dB Measurements

Your multimeter is capable of displaying voltage as a dB value, either relative to 1 milliwatt (dBm) or a reference voltage of 1 volt (dBV).

### Displaying dBm values

To set the multimeter to display voltage values in dBm, first set up your multimeter to measure voltage as shown in Figure 2-2 or Figure 2-5. Probe the test points, and read the display. Then, press (Dual/Exit) until the voltage measurements are displayed as a dBm value.
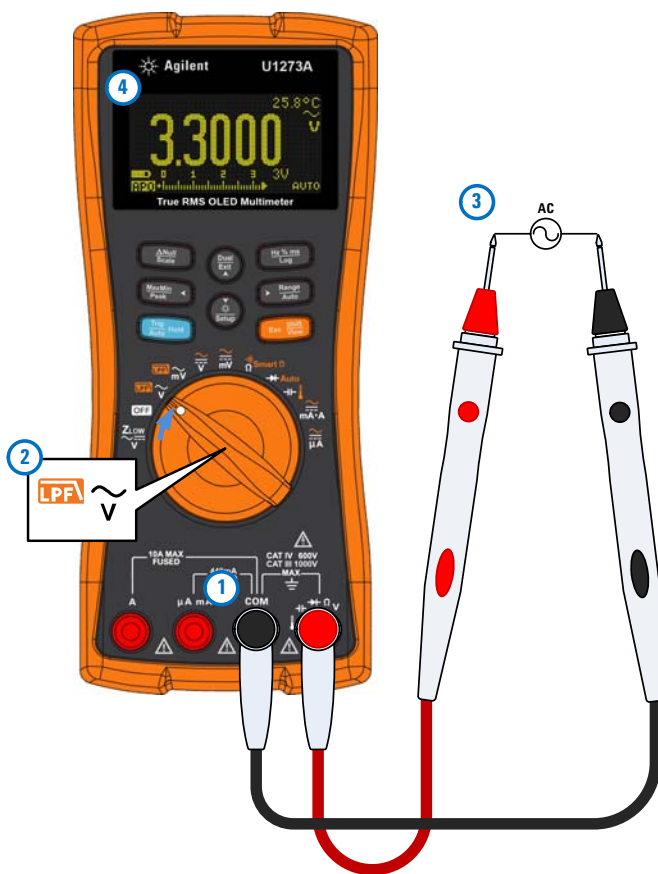
**Table 2-5**   Rotary switch positions allowing dBm measurements

| Legend | Default function | Function when (Esc Shift/View) is pressed |
|---|---|---|
| LPF $\overset{\sim}{V}$ | AC V | AC V with LPF |
| LPF $\overset{\sim}{mV}$ | AC mV | AC mV with LPF |
| $\overset{\sim}{\underset{V}{=}}$ | DC V | Cycles between<br>• AC V,<br>• AC+DC V, or<br>• DC V |
| $\overset{\sim}{\underset{mV}{=}}$ | DC mV | Cycles between<br>• AC mV,<br>• AC+DC mV, or<br>• DC mV |

**NOTE**  A dBm measurement must use a reference impedance (resistance) to calculate a dB value based on 1 milliwatt. The reference impedance is set to 50 Ω by default. To select another reference value, see the "Changing the custom dBm reference impedance" on page 111.
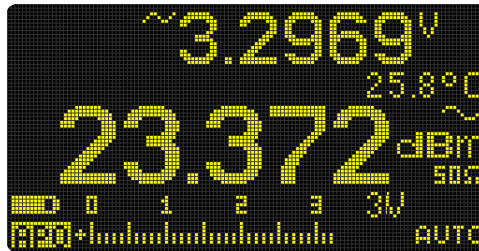
**Figure 2-8**    dBm display

Press 〔Dual Exit A〕 for more than 1 second to exit the dBm function.

### Displaying dBV values

To set the multimeter to display voltage values in dBV, first change the **dB** (decibel) display from **dBm** to **dBV** in the setup menu. See "Changing the decibel display" on page 111 to learn more.

| NOTE | This change is permanent. To set the multimeter to display voltage values in dBm again, you will need to change the **dB** display from **dBV** back to **dBm** in the setup menu. |
|------|------|

Next, set up your multimeter to measure voltage as shown in Figure 2-2 or Figure 2-5. Probe the test points, and read the display. Then, press 〔Dual Exit A〕 until the voltage measurements are displayed as a dBV value.

**Table 2-6**   Rotary switch positions allowing dBV measurements

| Legend | Default function | Function when ⌈Esc Shift/View⌉ is pressed |
|--------|------------------|-------------------------------------------|
| 🔳LPF ∿ V | AC V | AC V with LPF |
| 🔳LPF ∿ mV | AC mV | AC mV with LPF |
| ≃ V | DC V | Cycles between<br>• AC V,<br>• AC+DC V, or<br>• DC V |
| ≃ mV | DC mV | Cycles between<br>• AC mV,<br>• AC+DC mV, or<br>• DC mV |

<table>
<tr><td>NOTE</td><td>A dBV measurement uses a 1 volt reference voltage to compare the present measurement against a stored relative value. The difference between the two AC signals is displayed as a dBV value. The reference impedance setting is not part of a dBV measurement.</td></tr>
</table>
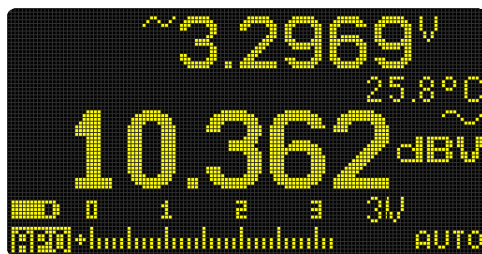


**Figure 2-9**   dBV display

Press ⌈Dual/Exit A⌉ for more than 1 second to exit the dBV function.

# Using $Z_{LOW}$ for Voltage Measurements

| CAUTION | Do not use the $Z_{LOW}$ function to measure voltages in circuits that could be damaged by this function's low impedance ($\approx 2$ k$\Omega$). |
|---|---|

The $Z_{LOW}$ function in your multimeter presents a low impedance across the leads to obtain a more accurate measurement.

**Table 2-7**   Rotary switch positions allowing $Z_{LOW}$ measurements

| Legend | Default function | Function when Esc/Shift View is pressed |
|---|---|---|
| $Z_{LOW}$ $\sim\overline{\underline{\cdots}}$ V | $Z_{LOW}$ (AC/DC) V | - |

To set up your multimeter to make a $Z_{LOW}$ (low input impedance) voltage measurement, first set up your multimeter to measure voltage as shown in Figure 2-2 or Figure 2-5. Probe the test points, and read the display.

| NOTE | The AC voltage measurement is shown in the primary display and the DC voltage measurement is shown in the secondary display. Press ⊛ to exchange the AC and DC voltage indication on the primary and secondary displays. |
|---|---|

| NOTE | **Use the $Z_{LOW}$ (low input impedance) function to remove ghost or induced voltages from your measurements**<br><br>Ghost voltages are voltages present on a circuit that should not be energized. Ghost voltages can be caused by capacitive coupling between energized wiring and adjacent unused wiring. The $Z_{LOW}$ function can remove ghost voltages from your measurements by dissipating the coupling voltage. Use the $Z_{LOW}$ function to reduce the possibility of false readings in areas where the presence of ghost voltages are suspected. |
|---|---|

**Figure 2-10** $Z_{LOW}$ display

| NOTE | During $Z_{LOW}$ measurements, autoranging is disabled and the multimeter's range is set to 1000 V in the manual ranging mode. The analog bar graph represents the AC+DC voltage value combined. |

### Use $Z_{LOW}$ to test a battery's health

Aside from reading a battery's voltage level using the DC voltage measurement function, you can also use the $Z_{LOW}$ function to test a battery's health.

If you detect that the measured battery's voltage shown in the $Z_{LOW}$ function is declining gradually, this means that the capacity of the battery-under-test is not enough to support regular functions. Use this simple and quick test to determine if a battery has enough voltage capacity to support regular activities.

| NOTE | Prolonged used of the $Z_{LOW}$ function will consume the capacity of the battery-under-test. |

# Measuring Resistance

Set up your multimeter to measure resistance as shown in Figure 2-12. Probe the test points, and read the display.

**Table 2-8**   Rotary switch position allowing resistance measurements

| Legend | Default function | Function when Esc Shift View is pressed |
|---|---|---|
| ⁝))) Ω Smart Ω | Resistance measurement (Ω) | Cycles between<br>• Continuity test (◄•••),<br>• Smart Ω measurement, or<br>• Resistance measurement (Ω) |

**CAUTION**   To avoid possible damage to your multimeter or to the equipment under test, disconnect the circuit power and discharge all high-voltage capacitors before measuring resistance.

**NOTE**   Resistance (opposition to the current flow) is measured by sending a small current out through the test leads to the circuit under test. Because this current flows through all possible paths between the leads, the resistance reading represents the total resistance of all paths between the leads. Resistance is measured in ohms (Ω).
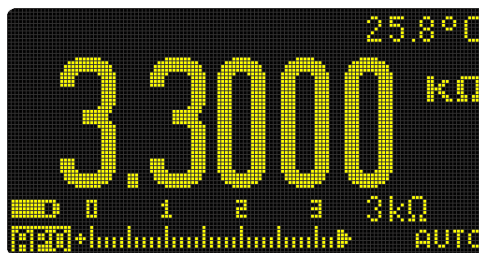


**Figure 2-11**   Resistance display
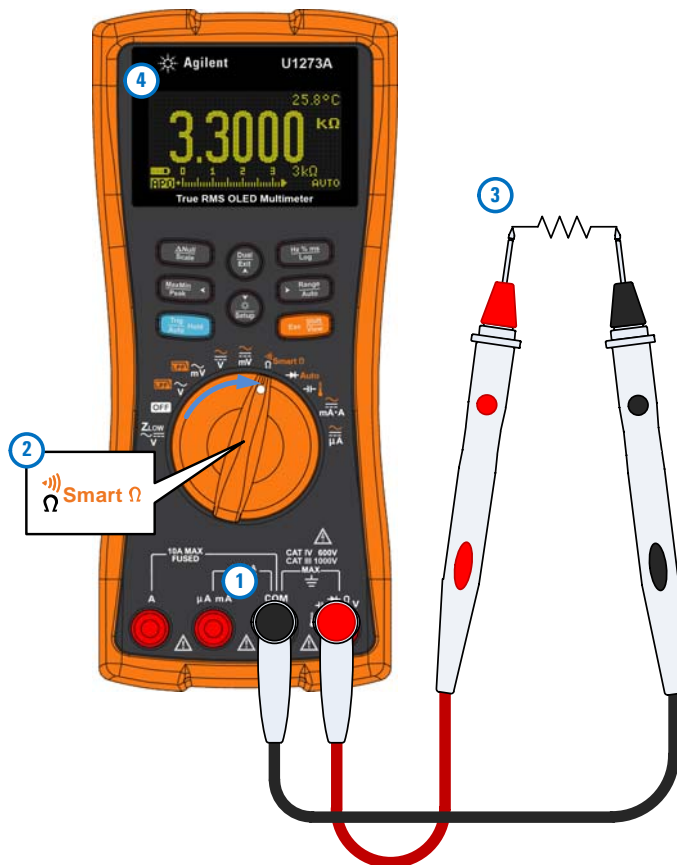
**Figure 2-12** Measuring resistance

| NOTE | Keep the following in mind when measuring resistance. |
|------|------|

- The test leads can add 0.1 Ω to 0.2 Ω of error to resistance measurements. To test the leads, touch the probe tips together and read the resistance of the leads. To remove lead resistance from the measurement, hold the test lead tips together and press ⟨△Null/Scale⟩. Now the resistance at the probe tips will be subtracted from all future display readings.

- Because the multimeter's test current flows through all possible paths between the probe tips, the measured value of a resistor in a circuit is often different from the resistor's rated value.

- The resistance function can produce enough voltage to forward-bias silicon diode or transistor junctions, causing them to conduct. If this is suspected, press ⟨▸ Range/Auto⟩ to apply a lower current in the next higher range.

## Measuring conductance

Conductance is the reciprocal of resistance. High values of conductance correspond to low values of resistance. Conductance is measured in Siemens (S). The 300 nS range measures conductance in nano-Siemens (1 nS = 0.000000001 Siemens). Because small conductance values correspond to extremely high resistance values, the nS range allows you to easily calculate and determine the resistance of components up to 100 GΩ (0.01 nS resolution)

To measure conductance, set up your multimeter to measure resistance as shown in Figure 2-12. Press ⟨▸ Range/Auto⟩ until the conductance measurement is selected (**nS** unit shown). Probe the test points, and read the display.

High-resistance readings are susceptible to electrical noise. Use averaging to smooth out most of the noisy readings. Refer to "Capturing Maximum and Minimum Values (MaxMin)" on page 88.

# Testing for Continuity

Set up your multimeter to test for continuity as shown in Figure 2-14. Probe the test points, and read the display.

**Table 2-9**   Rotary switch position allowing continuity tests

| Legend | Default function | Function when Esc Shift/View is pressed |
|--------|------------------|------------------------------------------|
| ⏄Ω Smart Ω | Resistance measurement (Ω) | Cycles between<br>• Continuity test ( ),<br>• Smart Ω measurement, or<br>• Resistance measurement (Ω) |

**CAUTION**    To avoid possible damage to your multimeter or to the equipment under test, disconnect the circuit power and discharge all high-voltage capacitors before testing for continuity.

**NOTE**    Continuity is the presence of a complete path for current flow. The continuity test features a beeper that sounds as long as a circuit is complete, if normal open is selected (or broken, if normal closed is selected). The audible alert allows you to perform quick continuity tests without having to watch the display.

In continuity, a short means a measured value is less that the threshold resistance values listed in Table 2-10.

**Table 2-10** Threshold resistance values

| Measuring range | Threshold resistance |
|-----------------|----------------------|
| 30.000 Ω | <25 ± 10 Ω |
| 300.00 Ω | <25 ±10 Ω |
| 3.0000 kΩ | <250 ±100 Ω |
| 30.000 kΩ | <2.5 ± 1 kΩ |
| 300.00 kΩ | <25 ± 10 kΩ |

**Table 2-10** Threshold resistance values (continued)

| Measuring range | Threshold resistance |
|---|---|
| 3.0000 MΩ | <120 ± 60 kΩ |
| 30.000 MΩ | <120 ± 60 kΩ |
| 300.00 MΩ | <120 ± 60 kΩ |

The beeper will sound as a continuity indication. Press (Dual Exit A) to switch between normal open (━━) and normal close (━━) contacts.

- **Normal open**: Circuit is normally open, the beeper will sound when a short is detected.

- **Normal closed**: Circuit is normally closed, the beeper will sound when an open is detected.



Press (Esc Shift View) to enable the continuity test function.

Press (Dual Exit A) to switch between the normal open and normal closed states.

Circuit open.

Open detected, beeper sounds.

**Start to capture**

Short detected, beeper sounds.

Circuit complete.
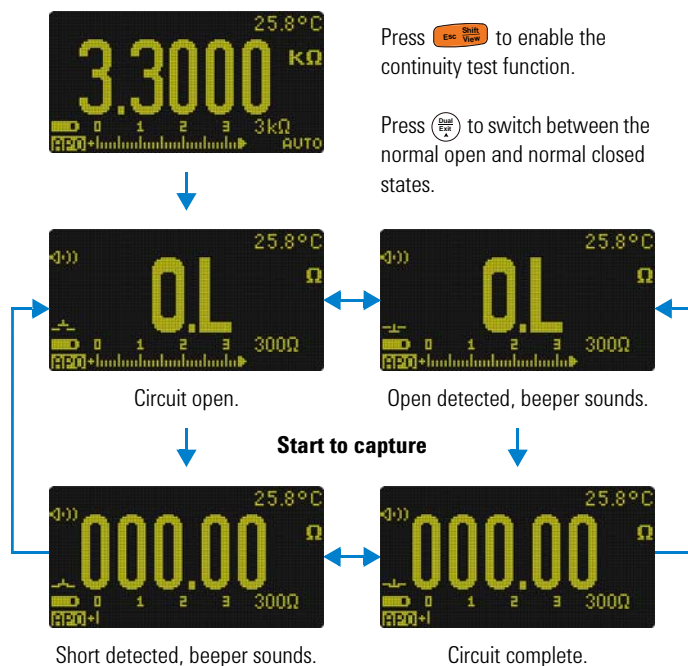
**Figure 2-13** Continuity operation

| NOTE | • | The continuity function detects intermittent shorts and opens lasting as short as 1 ms. A brief short or open causes the multimeter to emit a short beep. |
|---|---|---|
| | • | You can enable or disable the audible alert via the multimeter's setup. See "Changing the beep frequency" on page 116 for more information on the audible alert option. |
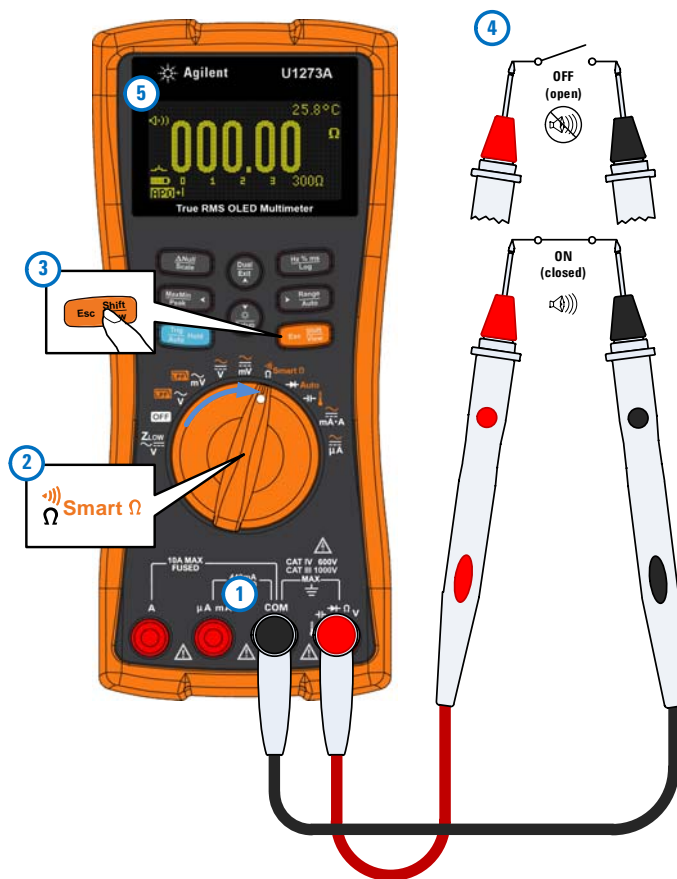


**Figure 2-14**  Testing for continuity

# Using Smart Ω for Resistance Measurements

To use the Smart Ω function, set up your multimeter to test for resistance as shown in Figure 2-15. Probe the test points, and read the display.

**Table 2-11** Rotary switch position allowing Smart Ω measurements

| Legend | Default function | Function when [Esc Shift View] is pressed |
|---|---|---|
| )) Ω Smart Ω | Resistance measurement (Ω) | Cycles between<br>• Continuity test ( ⊲·))),<br>• Smart Ω measurement, or<br>• Resistance measurement (Ω) |

> **NOTE**
>
> • Smart Ω (offset compensation) removes unexpected DC voltages within the instrument, at the input or at the circuit being measured, which will add to resistance measurement errors. The bias voltage or leakage current is shown on the secondary display.
>
> • Using the offset compensation method, the multimeter takes the difference between two resistance measurements when two different test currents are applied to determine if there are any offset voltages in the input circuitry. The resultant displayed measurement corrects this offset, giving a more accurate resistance measurement.

The resistance measurement and the bias voltage measurement is shown in the primary and secondary displays respectively.

Press (Dual A) to switch between the leakage current (**LEAk**) or bias voltage (**BiAS**) display.

> **NOTE**
>
> • The Smart Ω is applicable for the 30 Ω, 300 Ω, 3 kΩ, 30 kΩ, and 300 kΩ resistance range only. The maximum correctable offset/bias voltage is +50 mV/−30 mV for the 30 Ω range and +1.0 V/−0.2 V for the 300 Ω, 3 kΩ, 30 kΩ, and 300 kΩ ranges.
>
> • If the DC voltage on the resistor is over the maximum correctable offset/bias voltage, **OL** is shown on the secondary display.
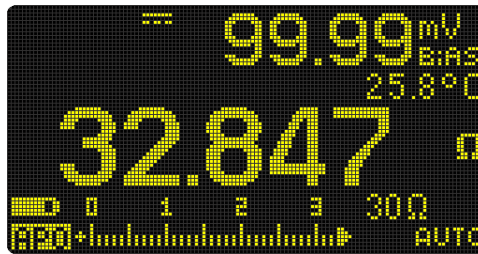
**Figure 2-15**  Smart Ω (with bias voltage) display
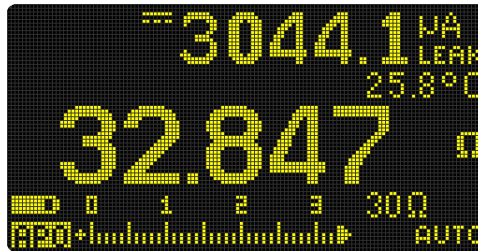


**Figure 2-16**  Smart Ω (with leakage current) display

### Use Smart Ω to measure the resistance of a thermocouple sensor

It is useful to measure the resistance of a thermocouple temperature sensor. The thermovoltage is proportional to the temperature and the impact of the resistance measurement. Using the Smart Ω function will help you achieve precise readings regardless of the temperature.

### Use Smart Ω to measure leakage current

Use the Smart Ω function to measure leakage current or reverse current for junction diodes. Such leakage currents are negligible and are usually measured in units of µA or nA. Instead of having to source a high-precision multimeter with a 1 nA or 0.1 nA accuracy or a precision shunt, you can measure the leakage current using the Smart Ω function with just a resistor from 100 kΩ to 300 kΩ.
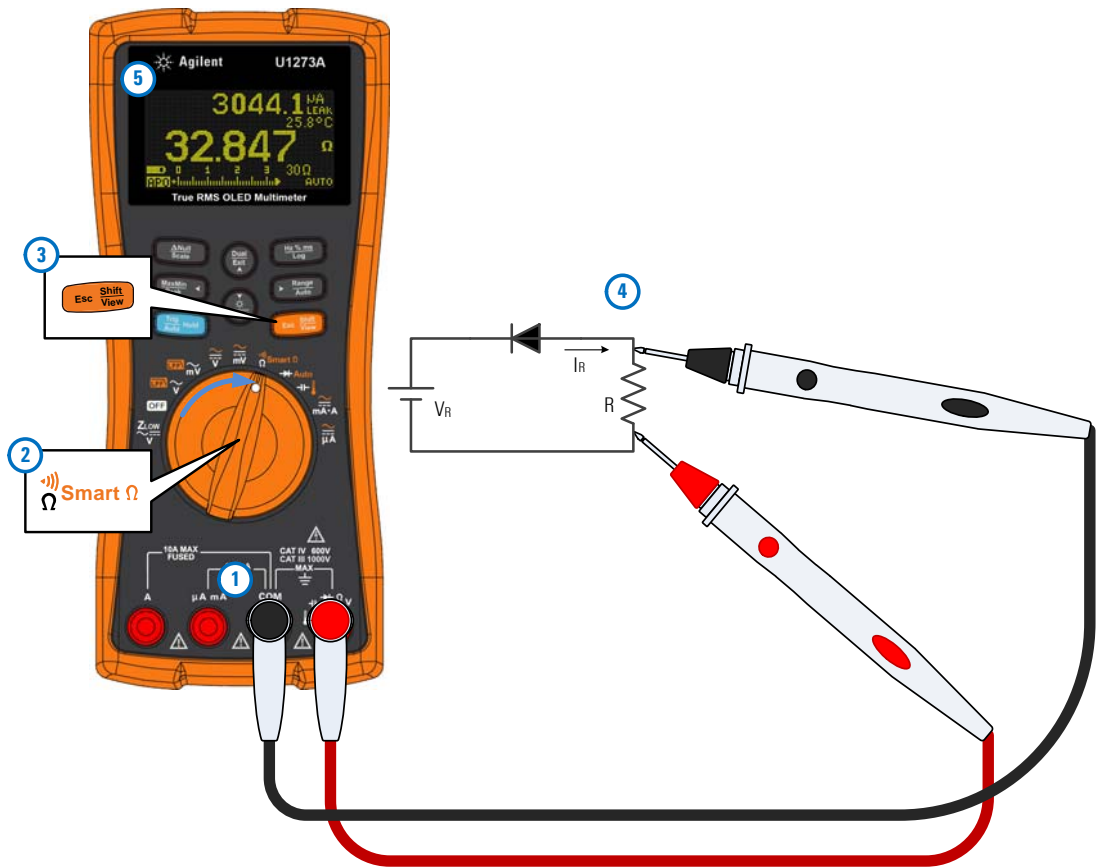
**Figure 2-17** Measuring leakage current

# Testing Diodes

Set up your multimeter to test diodes as shown in Figure 2-20. Probe the test points, and read the display.

**Table 2-12** Rotary switch position allowing diode tests

| Legend | Default function | Function when [Esc Shift View] is pressed |
|--------|------------------|-------------------------------------------|
| ⇥Auto | Diode test | Auto-diode test |

<table>
<tr><td>**CAUTION**</td><td>To avoid possible damage to your multimeter or to the equipment under test, disconnect the circuit power and discharge all high-voltage capacitors before testing diodes.</td></tr>
</table>

<table>
<tr><td>**NOTE**</td><td>

• Use the diode test to check diodes, transistors, silicon controlled rectifiers (SCRs), and other semiconductor devices. A good diode allows current to flow in one direction only.

• This test sends a current through a semiconductor junction, and then measures the junction's voltage drop. A typical junction drops 0.3 V to 0.8 V.

• Connect the red test lead to the positive terminal (anode) of the diode and the black test lead to the negative terminal (cathode). The cathode of a diode is indicated with a band.

</td></tr>
</table>
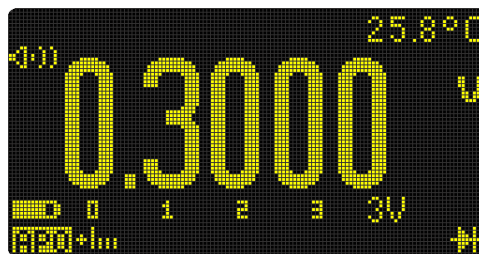


**Figure 2-18**  Diode display

| NOTE | • Your multimeter can display diode forward-bias of up to approximately 3.1 V. The forward-bias of a typical diode is within the range of 0.3 V to 0.8 V; however, the reading can vary depending on the resistance of other pathways between the probe tips. |
|---|---|
|  | • If the beeper is enabled during diode test, the multimeter will beep briefly for a normal junction and sound continuously for a shorted junction, below 0.050 V. See "Changing the beep frequency" on page 116 to disable the beeper. |

Reverse the probes (as shown in Figure 2-21) and measure the voltage across the diode again. Assess the diode according to the following guidelines:

- A diode is considered good if the multimeter displays **OL** in reverse-bias mode.

- A diode is considered shorted if the multimeter displays approximately 0 V in both forward- and reverse-bias modes, and the multimeter beeps continuously.

- A diode is considered open if the multimeter displays **OL** in both forward- and reverse-bias modes.
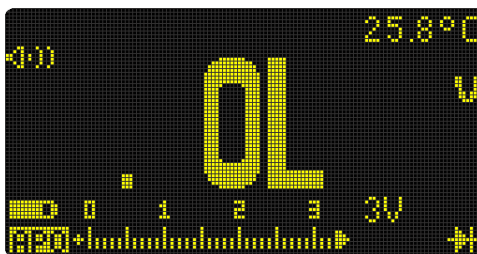


**Figure 2-19**  Open diode display
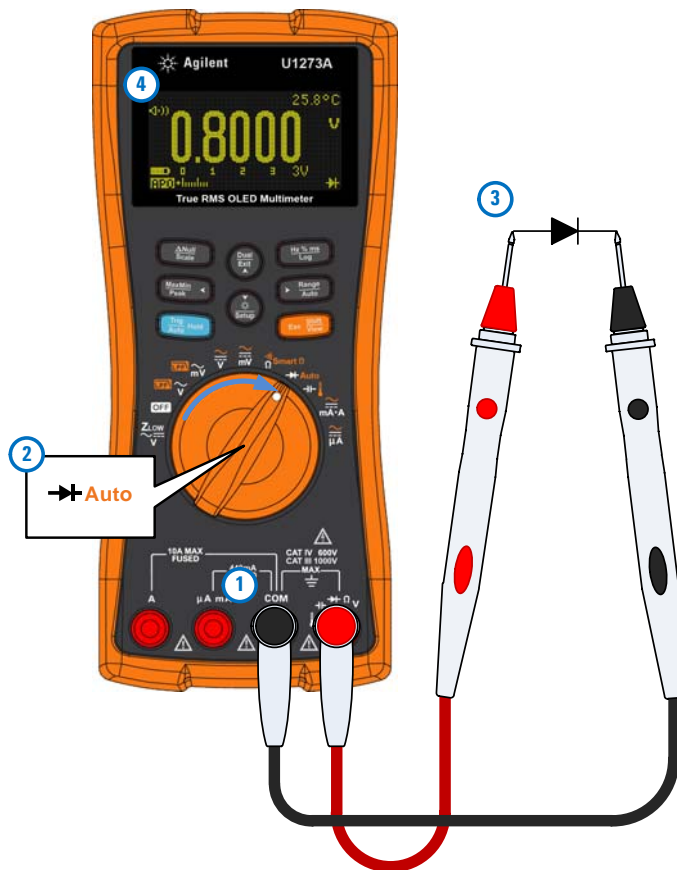
**Figure 2-20**  Testing a forward-bias diode

**Figure 2-21** Testing a reverse-bias diode

# Using Auto-diode for Diode Tests

Set up your multimeter to test diodes as shown in Figure 2-20. Probe the test points, and read the display.

**Table 2-13** Rotary switch position allowing auto-diode tests

| Legend | Default function | Function when <span>Esc Shift View</span> is pressed |
|--------|------------------|------------------|
| ⤻Auto | Diode test | Auto-diode test |

> **NOTE**
>
> The auto-diode function will help you test both forward- and reverse-bias directions simultaneously. You do not need to change the measuring direction to identify the diode's status.

**Table 2-14** Auto-diode voltage thresholds

| Forward voltage | Reverse voltage | Diode status | |
|-----------------|-----------------|------|---------|
| Primary display | Secondary display | Good | No Good |
| OL or <0.3 V or >0.8 V | −OL or >−0.3 V or <−0.8 V | | ✘ |
| Within 0.3 V to 0.8 V | −OL | ✔ | |
| OL | Within −0.3 V to −0.8 V | ✔ | |

> **NOTE**
>
> The open condition will not be alerted as **OL** on both directions if the auto-diode function is used.

The primary display shows the forward-bias voltage value. The reverse-bias voltage value is shown in the secondary display.

- **GOOD** is shown briefly (along with a single beep) on the secondary display if the diode is in a good condition.
- **NGOOD** is shown briefly (along with two beeps) if the diode is out of the thresholds.
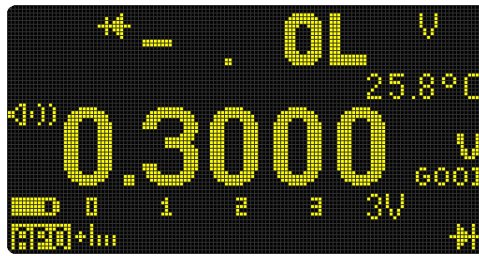
**Figure 2-22**  Auto-diode display (GOOD status)
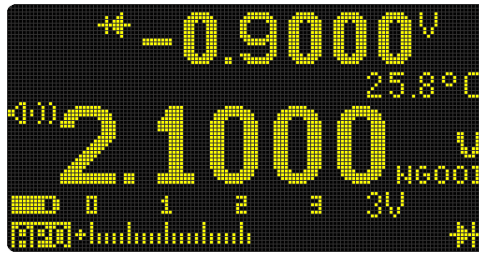


**Figure 2-23**  Auto-diode display (NGOOD status)

# Measuring Capacitance

Set up your multimeter to measure capacitance as shown in Figure 2-25. Probe the test points, and read the display.

**Table 2-15** Rotary switch position allowing capacitance measurements

| Legend | Default function | Function when ⬚ Esc Shift View is pressed |
|--------|------------------|-------------------------------------------|
| ⊣⊢🌡 | Capacitance measurement | Temperature measurement |

**CAUTION**

To avoid possible damage to the multimeter or to the equipment under test, disconnect circuit power and discharge all high-voltage capacitors before measuring capacitance. Use the DC voltage function to confirm that the capacitor is fully discharged.

**NOTE**

• The multimeter measures capacitance by charging the capacitor with a known current for a known period of time, measuring the resulting voltage, and then calculating the capacitance.

• 🔲 is shown on the bottom left of the display when the capacitor is charging, and 🔲 is shown when the capacitor is discharging.
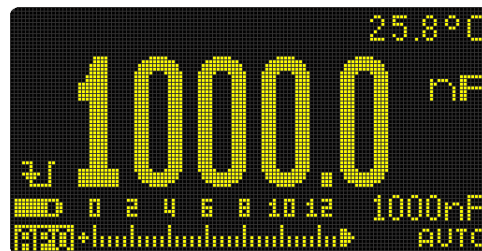


**Figure 2-24**  Capacitance display

**NOTE**

To improve measurement accuracy of small value capacitors, press ⬚ ΔNull Scale with the test leads open to subtract the residual capacitance of the multimeter and leads.

| NOTE | For measuring capacitance values greater than 1000 µF, discharge the capacitor first, then select a suitable range for measurement. This will speed up the measurement time and also ensure that the correct capacitance value is obtained. |
| --- | --- |
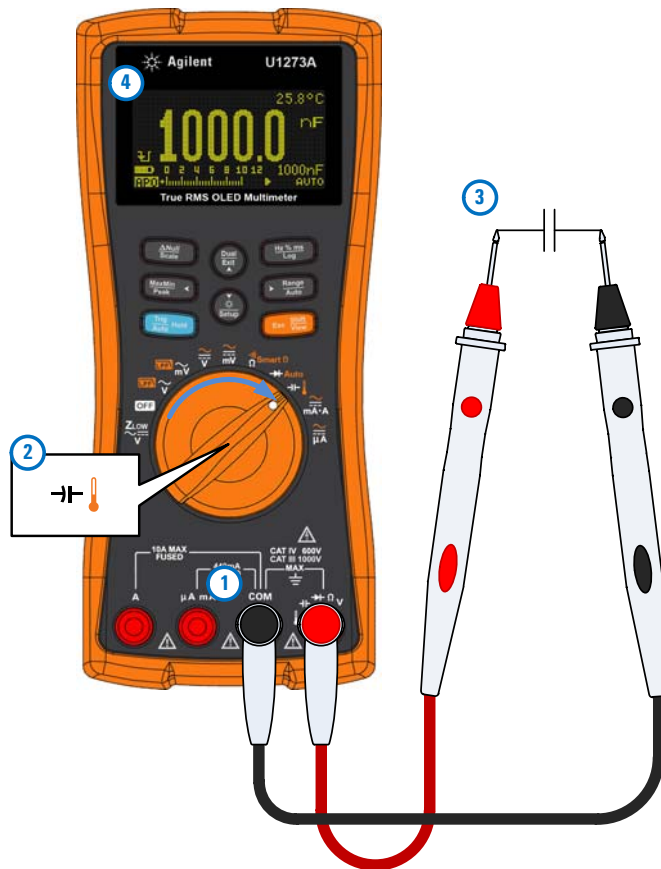


**Figure 2-25** Measuring capacitance

# Measuring Temperature

| **WARNING** | **Do not connect the thermocouple to electrically live circuits. Doing so will potentially cause fire or electric shock.** |
| --- | --- |

| **CAUTION** | Do not bend the thermocouple leads at sharp angles. Repeated bending over a period of time can break the leads. |
| --- | --- |

The multimeter uses a type-K (default setting) temperature probe for measuring temperature. To measure temperature, set up your multimeter as shown in Figure 2-27.

**Table 2-16** Rotary switch position allowing temperature measurements

| Legend | Default function | Function when `Esc Shift View` is pressed |
| --- | --- | --- |
| ⊣⊢ 🌡 | Capacitance measurement | Temperature measurement |

Probe the test points, and read the display. The primary display normally shows temperature or the message **OL** (open thermocouple). The open thermocouple message may be due to a broken (open) probe or because no probe is installed into the input jacks of the multimeter.



**Figure 2-26**  Temperature display

Press `Range Auto` to change the temperature units between °C or °F (you must first change the temperature unit to switch between °C and °F or °F and °C). See "Changing the temperature unit" on page 113 for more information.

| CAUTION | The option to change the temperature unit is locked for certain regions. Always set the temperature unit display per the official requirements and in compliance with the National laws of your region. |
| --- | --- |

| NOTE | • Shorting the 🌡 terminal to the **COM** terminal will display the temperature at the multimeter's terminals.<br><br>• To change the default thermocouple type from type-K to type-J, see "Changing the thermocouple type" on page 112 for more information. |
| --- | --- |

| NOTE | The bead-type thermocouple probe is suitable for measuring temperatures from −40 °C to 204 °C (399 °F) in Teflon-compatible environments. Do not immerse this thermocouple probe in any liquid. For best results, use a thermocouple probe designed for each specific application — an immersion probe for liquid or gel, and an air probe for air measurement. |
| --- | --- |

Observe the following measurement techniques:

- Clean the surface to be measured, and ensure that the probe is securely touching the surface. Remember to disable the applied power.

- When measuring above ambient temperatures, move the thermocouple along the surface until you get the highest temperature reading.

- When measuring below ambient temperatures, move the thermocouple along the surface until you get the lowest temperature reading.

- Place the multimeter in the operating environment for at least 1 hour as the multimeter is using a non-compensation transfer adapter with miniature thermal probe.

For quick measurement, use the ▮▮▮ compensation to view the temperature variation of the thermocouple sensor. The ▮▮▮ compensation assists you in measuring relative temperature immediately.
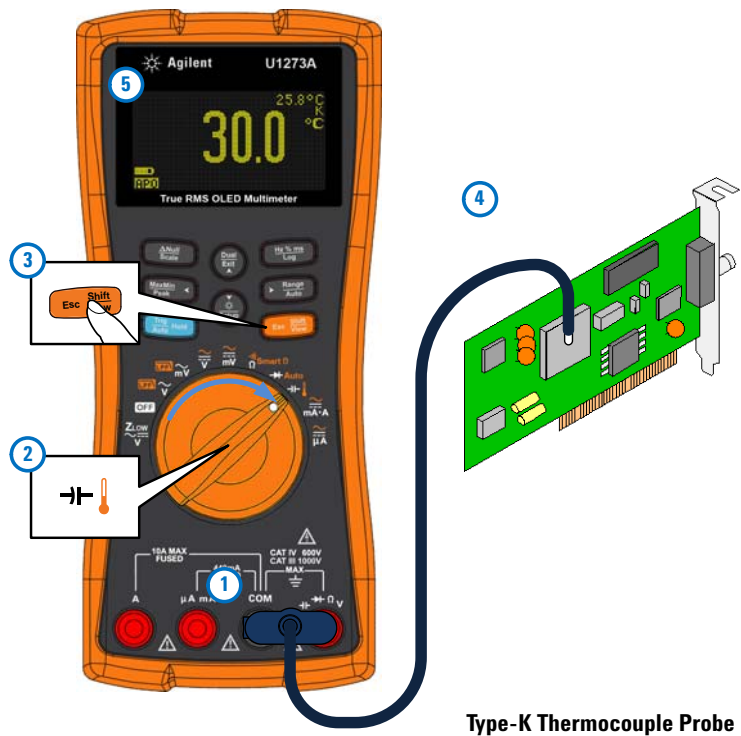
**Figure 2-27**  Measuring surface temperature

**Temperature measurement without ambient compensation**

If you are working in a constantly varying environment, where ambient temperatures are not constant, do the following:

**1** Press (Dual Exit ^) to select [□□□] compensation. This allows a quick measurement of the relative temperature.

**2** Avoid contact between the thermocouple probe and the surface to be measured.

**3** After a constant reading is obtained, press (△Null Scale) to set the reading as the relative reference temperature.

**4** Touch the surface to be measured with the thermocouple probe and read the display.



**Figure 2-28**  Temperature measurement without ambient compensation

# Measuring AC or DC Current

Set up your multimeter to measure AC or DC current as shown in Figure 2-30 and Figure 2-31. Open the circuit path to be tested. Probe the test points, and read the display.

**Table 2-17** Rotary switch positions allowing current measurements

| Legend | Default function | Function when Esc Shift View is pressed |
|--------|-----------------|-----------------------------------------|
| $\sim$ $\overline{\overline{mA\cdot A}}$ | DC A (or mA) | Cycles between<br>• AC A (or mA),<br>• AC+DC A (or mA)<br>• % Scale of 4-20 mA (or 0-20 mA), or<br>• DC A (or mA) |
| $\sim$ $\overline{\overline{\mu A}}$ | DC μA | Cycles between<br>• AC μA,<br>• AC+DC μA, or<br>• DC μA |

**WARNING**  **Never attempt an in-circuit current measurement where the open-circuit potential to earth is greater than 1000 V. Doing so will cause damage to the multimeter and possible electric shock or personal injury.**

**CAUTION**  To avoid possible damage to the multimeter or to the equipment under test:

• Check the multimeter's fuses before measuring current.

• Use the proper terminals, function, and range for your measurement.

• Never place the probes across (in parallel with) any circuit or component when the leads are plugged into the current terminals.

<table>
<tr>
<td>NOTE</td>
<td>

• To measure current, you must open the circuit under test, then place the multimeter in series with the circuit.

• Turn off power to the circuit. Discharge all high-voltage capacitors. Insert the black test lead into the **COM** terminal. Insert the red test lead in an input appropriate for the measurement range.

  • If you are using the **A** terminal, set the rotary switch to ⌇⌇.
  • If you are using the **µA mA** terminal, set the rotary switch to ⌇⌇ for currents below 5000 µA (5 mA), or ⌇⌇ for currents above 5000 µA.

• Press ⌷ to cycle between DC current measurement, AC current measurement, AC+DC current measurement, or % scale current measurements.

• Reversing the leads will produce a negative reading, but it will not damage the multimeter.

</td>
</tr>
</table>
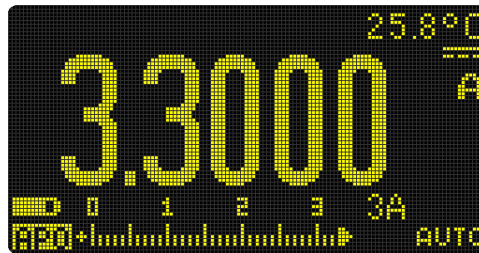


**Figure 2-29**  DC current display

<table>
<tr>
<td>CAUTION</td>
<td>

• To avoid blowing the multimeter's 440 mA fuse, use the **µA mA** terminal only if you are sure the current is less than 400 mA. See Figure 2-32 for test lead connections and function selection. Refer to the "Input warning" section for information on the alerts the multimeter uses when leads are not used correctly for current measurements.

• Placing the probes across (in parallel with) a powered circuit when a lead is plugged into a current terminal can damage the circuit you are testing and blow the multimeter's fuse. This happens because the resistance through the multimeter's current terminals are very low, resulting in a short circuit.

</td>
</tr>
</table>

| NOTE | • For measuring AC current signals with DC offset, refer to the "Measuring AC and DC Signals" section later in this manual. |

• Press (Dual Exit A) to cycle through the available dual display combinations. See Appendix B, "Dual Display Combinations Using the Dual Key," starting on page 153 to learn more.

• Press (Hz % ms Log) to measure the frequency of the AC or DC current source. See "Measuring Frequency" on page 76 to learn more.
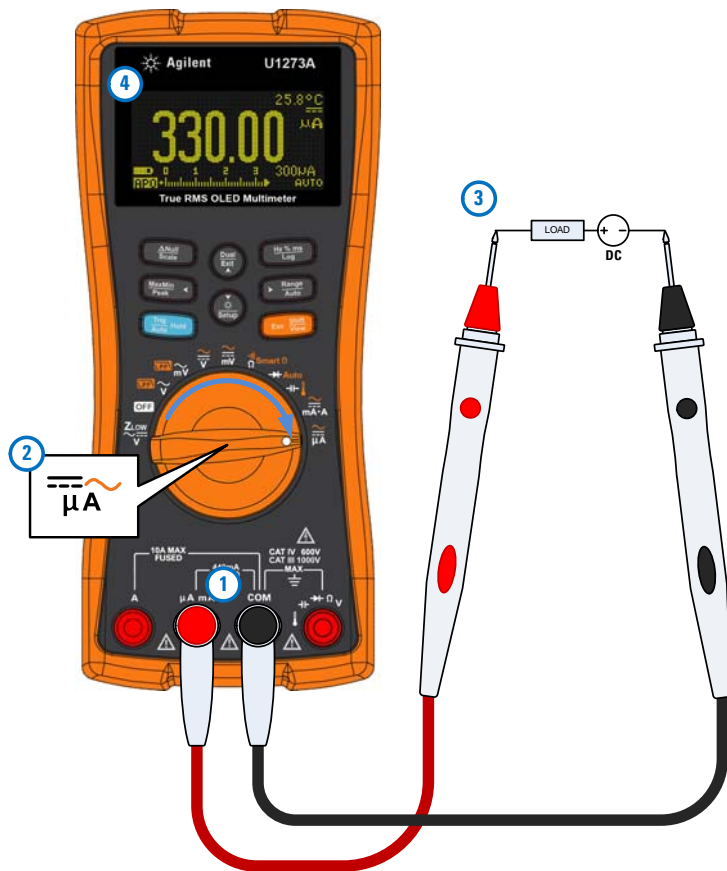


**Figure 2-30**  Measuring DC current
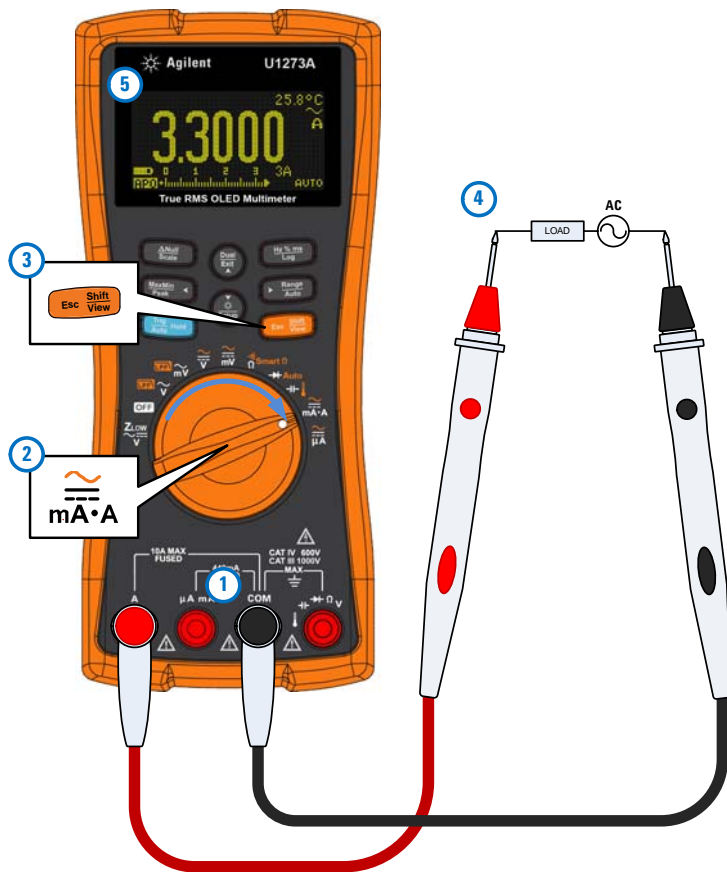
**Figure 2-31**  Measuring AC current
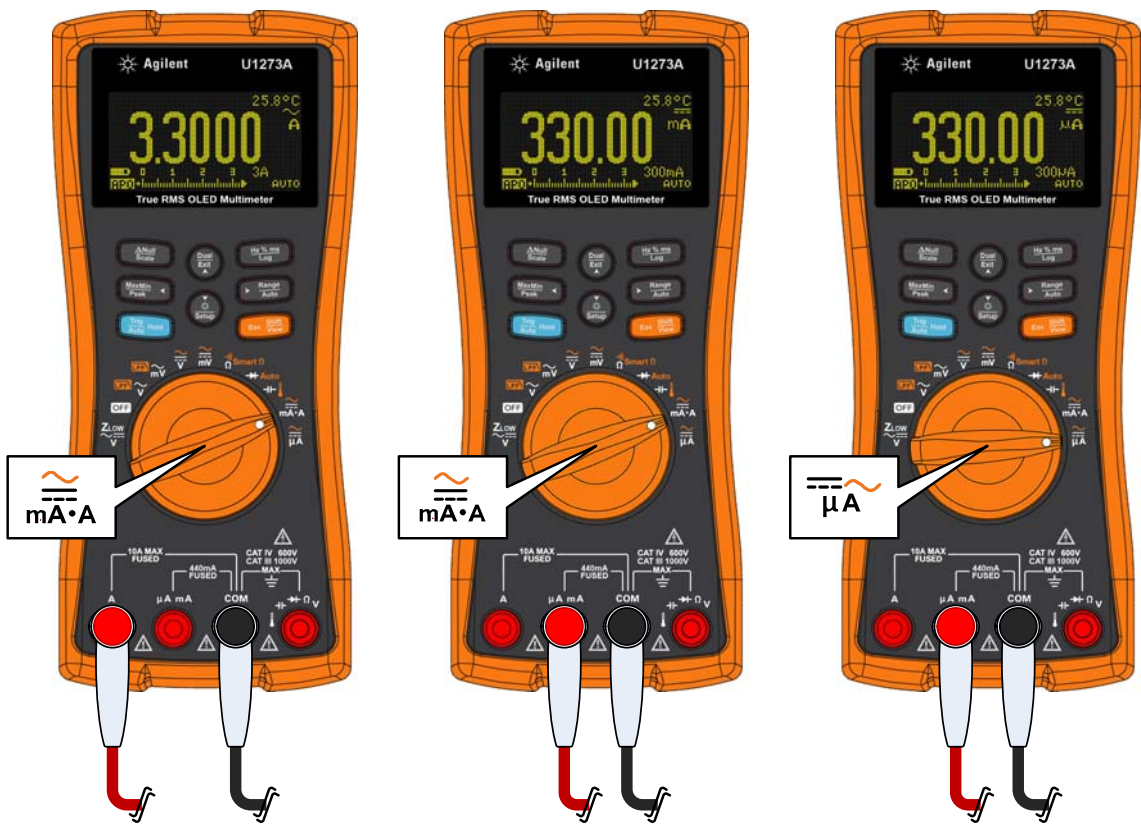
**Figure 2-32**  Current measurement setup

# % Scale of 4-20 mA or 0-20 mA

To display the current measurement in % scale, position your multimeter's rotary switch position to $\widetilde{\overline{\text{mA·A}}}$ and set up your multimeter to measure DC current by following the steps listed in the "Measuring AC or DC Current" section.

**Table 2-18** Rotary switch positions allowing current measurements

| Legend | Default function | Function when Esc Shift View is pressed |
|--------|------------------|------------------------------------------|
| $\widetilde{\overline{\text{mA·A}}}$ | DC A (or mA) | Cycles between<br>• AC A (or mA),<br>• AC+DC A (or mA)<br>• % Scale of 4-20 mA (or 0-20 mA), or<br>• DC A (or mA) |

NOTE

- The 4-20 mA current loop output from a transmitter is a type of electrical signal that is used in a series circuit to provide a robust measurement signal that is proportional to the applied pressure, temperature, or flow in process control. The signal is a current loop where 4 mA represents the zero percent signal and 20 mA represents the 100 percent signal.

- The % scale for 4-20 mA or 0-20 mA in this multimeter is calculated using its corresponding DC mA measurement. The multimeter will automatically optimize the best resolution for the selected measurement. Two ranges are available for the % scale as shown in Table 2-19.
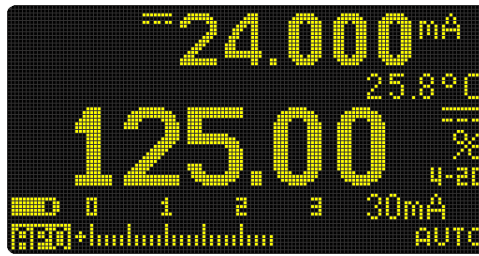
**Figure 2-33**  4-20 mA % Scale display

The analog bar graph displays the current measurement value. (In the example above, 24 mA is represented as 125% in the 4-20 mA % scale.)

**Table 2-19** % Scale measurement range

| % Scale of 4-20 mA or 0-20 mA | DC mA measurement range |
|---|---|
| 999.99% | 30 mA or 300 mA[1] |
| 9999.9% | |

[1] Applies to both autoranging and manual range selection.

You can change the % scale range (4-20 mA or 0-20 mA) by accessing the multimeter's setup. See "Changing the % scale range" on page 114 for more information.

Use the % scale with a pressure transmitter, a valve positioner, or other output actuators to measure pressure, temperature, flow, pH, or other process variables.
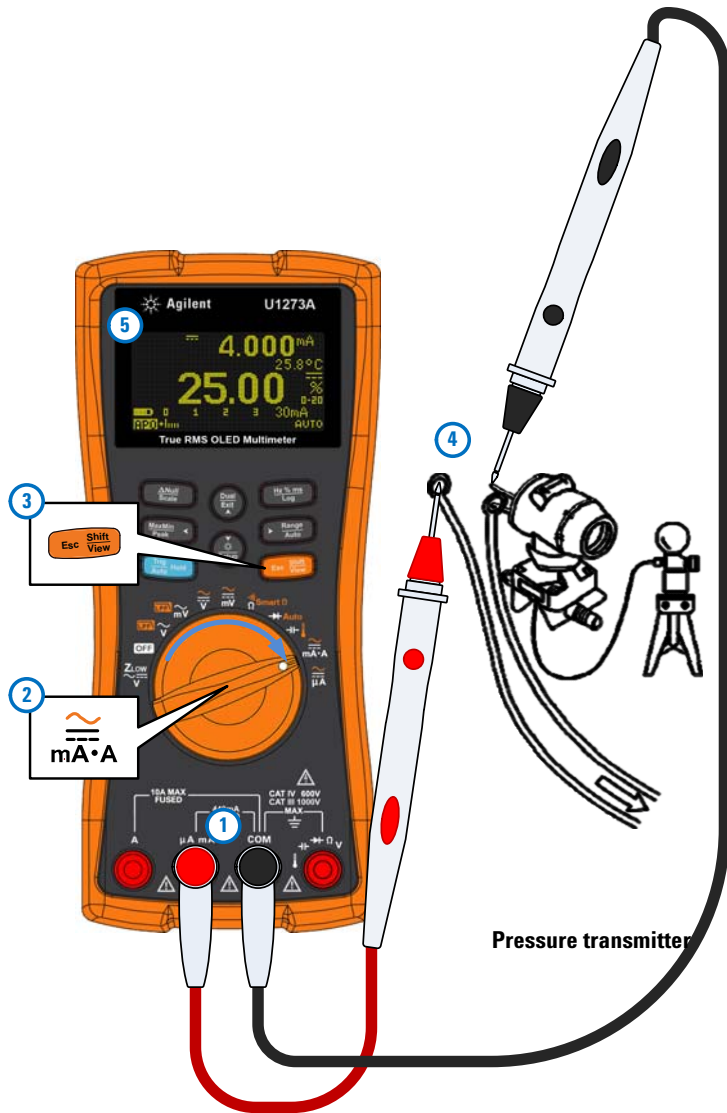
**Figure 2-34** Measuring DC current using the 0-20 mA % scale

# Measuring Frequency

| WARNING | **Never measure the frequency where the voltage or current level exceeds the specified range. Manually set the voltage or current range if you want to measure frequencies below 20 Hz.** |
|---|---|

Your multimeter allows simultaneous monitoring of real-time voltage or current with frequency, duty cycle, or pulse width measurements. Table 2-20 highlights the functions allowing frequency measurements in your multimeter.

**Table 2-20** Rotary switch positions allowing frequency measurements

| Legend | Default function | Function when ⬤ Esc Shift View is pressed |
|---|---|---|
| LPF $\widetilde{V}$ | AC V | AC V with LPF |
| LPF $\underset{mV}{\sim}$ | AC mV | AC mV with LPF |
| $\underset{V}{\widetilde{\equiv}}$ | DC V | Cycles between <br> • AC V, <br> • AC+DC V, or <br> • DC V |
| $\underset{mV}{\widetilde{\equiv}}$ | DC mV | Cycles between <br> • AC mV, <br> • AC+DC mV, or <br> • DC mV |
| $\underset{mA \cdot A}{\widetilde{\equiv}}$ | DC A (or mA) | Cycles between <br> • AC A (or mA), <br> • AC+DC A (or mA) <br> • % Scale of 4-20 mA (or 0-20 mA), or <br> • DC A (or mA) |
| $\underset{\mu A}{\widetilde{\equiv}}$ | DC µA | Cycles between <br> • AC µA, <br> • AC+DC µA, or <br> • DC µA |

•    Measuring the frequency of a signal helps detect the presence of harmonic currents in neutral conductors and determines whether these neutral currents are the result of unbalanced phases or non-linear loads.

•    Frequency is the number of cycles a signal completes each second. Frequency is defined as 1/Period. Period is defined as the time between the middle threshold crossings of two consecutive, like-polarity edges, as shown in Figure 2-35.

•    The multimeter measures the frequency of a voltage or current signal by counting the number of times the signal crosses a threshold level within a specified period of time.
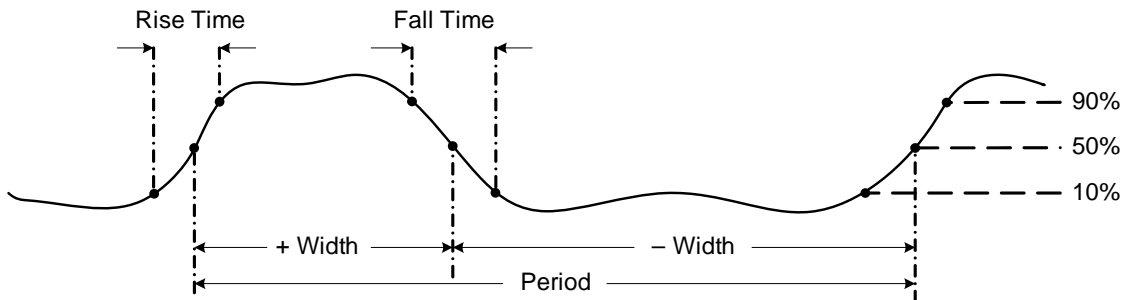


**Figure 2-35**  Frequency, pulse width, and duty cycle measurements

Pressing ⟮ Range Auto ⟯ controls the input range of the primary function (voltage or ampere) and not the frequency range.

**1**  To measure frequency, rotate the switch to one of the primary functions allowing frequency measurements highlighted in Table 2-20.

To obtain the best measuring results for frequency measurements, please use the AC measuring path.

**2**  Press ⟮ Hz % ms Log ⟯. Probe the test points, and read the display.
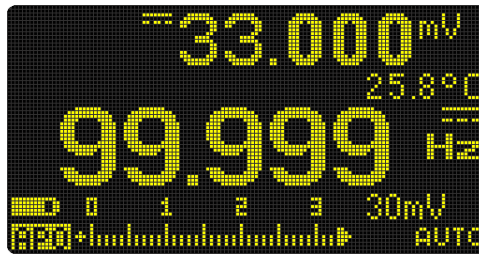
**Figure 2-36**  Frequency display

The frequency of the input signal is shown in the primary display. The voltage or ampere value of the signal is shown in the secondary display. The bar graph does not indicate frequency but indicates the voltage or ampere value of the input signal.

| NOTE | Observe the following measurement techniques: |
| --- | --- |

- If a reading shows as 0 Hz or is unstable, the input signal may be below or near the trigger level. You can usually correct these problems by manually selecting a lower input range, which increases the sensitivity of the multimeter.

- If a reading seems to be a multiple of what you expect, the input signal may be distorted. Distortion can cause multiple triggerings of the frequency counter. Selecting a higher voltage range might solve this problem by decreasing the sensitivity of the multimeter. In general, the lowest frequency displayed is the correct one.

Press 🔲 to cycle through the frequency, pulse width, and duty cycle measurements.

Press 🔘 for more than 1 second to exit the frequency measurement function.

# Measuring pulse width

The pulse width function measures the amount of time a signal is high or low, as shown in Figure 2-35. It is the time from the middle threshold of the rising edge to the middle threshold of the next falling edge. The measured waveform must be periodic; its pattern must repeat at equal time intervals.

1 To measure pulse width, position the rotary switch to one of the functions allowing frequency measurements shown in Table 2-20.

2 Press ( Hz % ms / Log ) until the measurements are shown in the millisecond (**ms**) unit. Probe the test points, and read the display.
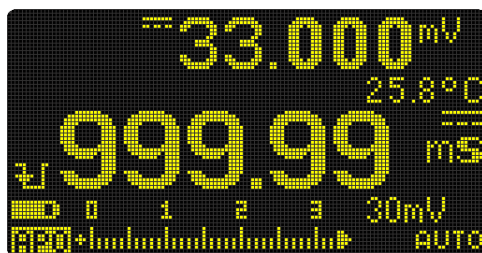


**Figure 2-37**  Pulse width display

The pulse width of the input signal is shown in the primary display. The voltage or ampere value of the signal is shown in the secondary display. The bar graph does not indicate duty cycle but indicates the voltage or ampere value of the input signal.

The pulse width polarity is displayed to the left of the duty cycle value. �... indicates a positive pulse width and ⏌⏌ indicates a negative pulse width. To change the polarity being measured, press ( Dual / Exit ).

Press ( Hz % ms / Log ) to cycle through the frequency, pulse width, and duty cycle measurements.

Press ( Dual / Exit ) for more than 1 second to exit the pulse width measurement function.

## Measuring duty cycle

The duty cycle (or duty factor) of a repetitive pulse train is the ratio of the positive or negative pulse width to the period expressed as a percentage, as shown in Figure 2-35.

The duty-cycle function is optimized for measuring the on or off time of logic and switching signals. Systems such as electronic fuel injection systems and switching power supplies are controlled by pulses of varying width, which can be checked by measuring the duty cycle.

**1** To measure the duty cycle, position the rotary switch on one of the functions allowing frequency measurements shown in Table 2-20.

**2** Press $\boxed{\tiny{Hz\% ms \atop Log}}$ until the measurements are displayed as a percentage (**%**). Probe the test points, and read the display.
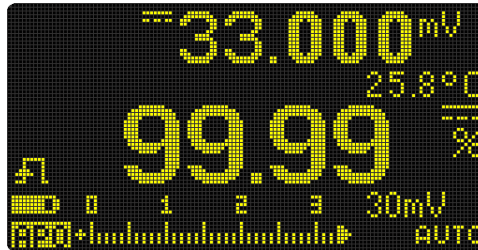


**Figure 2-38** Duty cycle display

The duty cycle percentage of the input signal is shown in the primary display. The voltage or ampere value of the signal is shown in the secondary display. The bar graph does not indicate duty cycle but indicates the voltage or ampere value of the input signal.

The pulse polarity is displayed to the left of the duty cycle value. ![icon] indicates a positive pulse and ![icon] indicates a negative pulse. To change the polarity being measured, press $\boxed{\tiny{Dual \atop Exit \atop A}}$.

Press ⌷Hz % ms Log⌷ to cycle through the frequency, pulse width, and duty cycle measurements.

Press ⌷Dual Exit ▲⌷ for more than 1 second to exit the duty cycle measurement function.

# 3
# Multimeter Features

The following sections describe the additional features available in your multimeter.

# Making Relative Measurements (Null)

When making null measurements, also called relative, each reading is the difference between a stored (selected or measured) null value and the input signal.

One possible application is to increase the accuracy of a resistance measurement by nulling the test lead resistance. Nulling the leads is also particularly important prior to making capacitance measurements.

| NOTE | Null can be set for both auto and manual range settings, but not in the case of an overload. |
| --- | --- |

**1** To activate the relative mode, press the 〔△Null Scale〕 key. The measurement value at the time that when Null ( △NULL ) is enabled, is stored as the reference value.
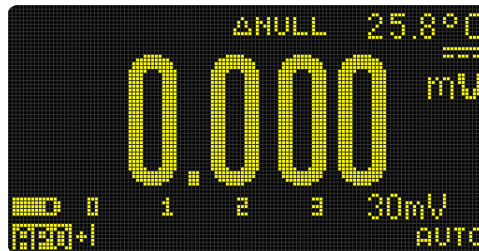


**Figure 3-1**    Null display

**2** Press 〔△Null Scale〕 again to view the stored reference value ( △'BASE ). The display will return to normal after 3 seconds.

**3** To disable the Null function, press 〔△Null Scale〕 while the stored reference value is shown (step 2).

For any measurement function, you can directly measure and store the null value by pressing 〔△Null Scale〕 with the test leads open (nulls the test lead capacitance), shorted (nulls the test lead resistance), or across a desired null value circuit.

| NOTE | • In resistance measurement, the multimeter will read a non-zero value even when the two test leads are in direct contact, because of the resistance of these leads. Use the null function to zero-adjust the display. |
|------|---|
|  | • For DC voltage measurements, the thermal effect will influence the accuracy of the measurements. Short the test leads and press $\boxed{\text{△Null Scale}}$ when the displayed value is stable to zero-adjust the display. |

Press $\boxed{\text{△Null Scale}}$ to enable the Null function.



Press $\boxed{\text{△Null Scale}}$

Display returns to normal after 3 seconds

Press $\boxed{\text{△Null Scale}}$ again to disable the Null function.
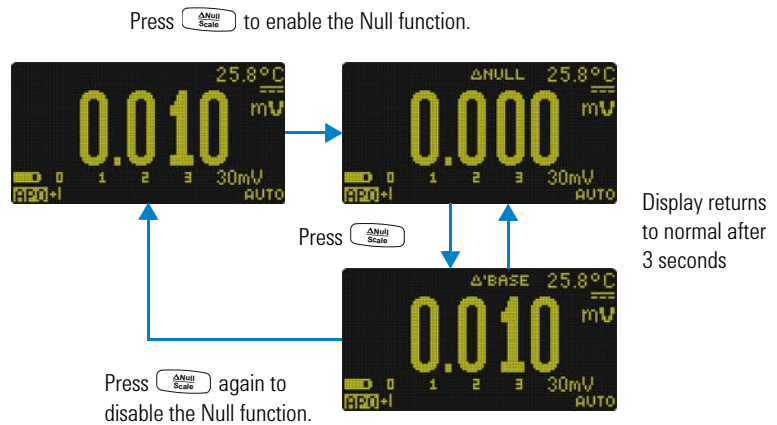
**Figure 3-2**    Null operation

# Making Scale Transfers (Scale)

The Scale operation emulates a transducer by helping you to convert the measured readings proportionally to the specified ratio and unit display. Use Scale to transfer voltage readings to proportional readings when using clamp-on current probes or high voltage probes. The available scale conversions are shown in the table below.

**Table 3-1**  Available scale conversions

| Scale conversion | | Multiplier[1] | Unit | Related units |
|---|---|---|---|---|
| 1 kV/V[2] | 1000 V/V | 1000.0 | V | V, kV |
| 1 A/mV | 1000 A/V | 1000.0 | A | A, kA |
| 1 A/10 mV | 100A/V | 100.0 | A | A, kA |
| 1 A/100 mV | 10 A/V | 10.0 | A | mA, A, kA |

[1] The transfer formula used is: Display = Multiplier $\times$ Measurement

[2] This value and unit can be adjusted from the multimeter's setup. See "Changing the user scale conversion value and unit" on page 123 for more information.

**1**  Press and hold $\boxed{\substack{\Delta\text{Null}\\ \text{Scale}}}$ for more than 1 second to enable the Scale operation.

**2**  The most recently saved (default: 1 kV/V, ×1000.0) ratio and unit will be shown on the primary and secondary displays. Press $\boxed{\substack{\Delta\text{Null}\\ \text{Scale}}}$ while the **SCALE** symbol is flashing to cycle through the available ratio and unit displays.

**3**  Press $\boxed{\substack{\text{Hz \% ms}\\ \text{Log}}}$ while the **SCALE** symbol is flashing to save the selected ratio and unit and start the conversion. The selected ratio and unit will be used as the default ratio and unit the next time Scale is enabled.

**4**  Or, while the **SCALE** symbol is flashing, if no activity is detected after 3 seconds, the conversion will begin (with the specified ratio and unit shown on the primary display).

**5**  Press and hold $\boxed{\substack{\Delta\text{Null}\\ \text{Scale}}}$ for more than 1 second to cancel the Scale operation.

| NOTE | The ⟨Hz % ms Log⟩ is disabled during Scale operations. Press ⟨Dual Exit ▲⟩ to measure the frequency of the voltage and current source during Scale operations. |
|------|--------------------------------------------------------------------------------------------------------------|
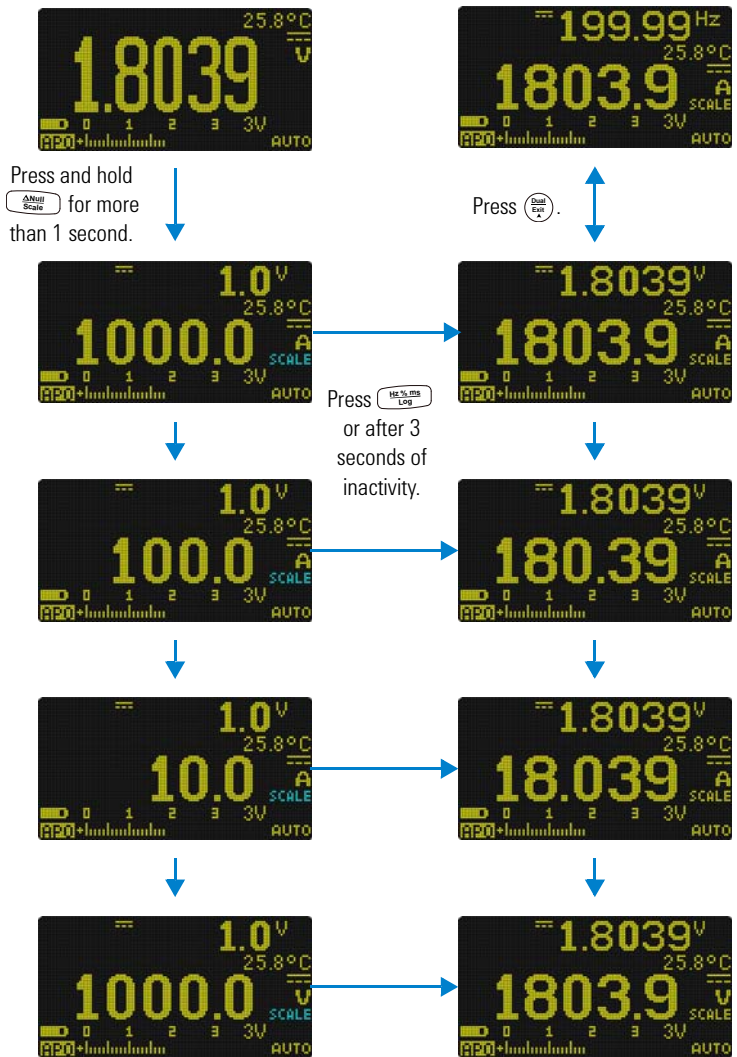


**Figure 3-3** Scale operation

# Capturing Maximum and Minimum Values (MaxMin)

The MaxMin operation stores the maximum, minimum, and average input values during a series of measurements.

When the input goes below the recorded minimum value or above the recorded maximum value, the multimeter beeps and records the new value. The elapsed time since the recording session was started is stored and shown on the display at the same time. The multimeter also calculates an average of all readings taken since the MaxMin mode was activated.

From the multimeter's display, you can view the following statistical data for any set of readings:

- **REC MAX**: highest reading since the MaxMin function was enabled
- **REC MIN**: lowest reading since the MaxMin function was enabled
- **REC AVG**: average or mean of all readings since the MaxMin function was enabled
- **REC NOW**: present reading (actual input signal value)

1  Press $\boxed{\substack{\text{MaxMin}\\\text{Peak}}}$ to enable the MaxMin operation.

2  Press $\boxed{\substack{\text{MaxMin}\\\text{Peak}}}$ again to cycle through the **MAX**, **MIN**, **AVG**, or **NOW** (present) input values.
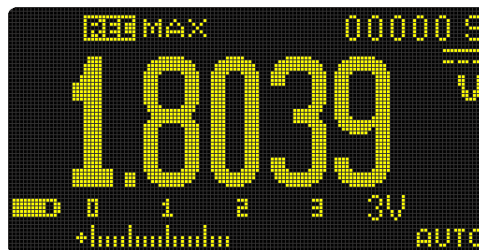


**Figure 3-4**    MaxMin display

**3** The elapsed time is shown on the secondary display. Press 🔘 to restart the recording session.

**NOTE**
• Changing the range manually will also restart the recording session.

• You can also use the MaxMin function while measuring frequency (see "Measuring Frequency" on page 76). If the measured frequency shown is not reflected accurately, press 🔘 again to restart the recording session.

• If an overload is recorded, the averanging function will be stopped. **OL** is shown in place of the average value.

• The APO (auto power-off) function is disabled when MaxMin is enabled.

• The maximum recording time is 99999 seconds (1 day, 3 hours, 46 minutes, 39 seconds). **OL** is shown if the recording exceeds the maximum time.

**4** Press 🔘 or 🔘 for more than 1 second to disable the MaxMin function.

This mode is useful for capturing intermittent readings, recording minimum and maximum readings unattended, or recording readings while equipment operation keeps you from observing the multimeter display.

The true average value displayed is the arithmetic mean of all readings taken since the start of recording. The average reading is useful for smoothing out unstable inputs, calculating power consumption, or estimating the percentage of time a circuit is active.

# Capturing Peak Values (Peak)

This function allows the measurement of peak voltage for analysis of such components as power distribution transformers and power factor correction capacitors. The peak voltage obtained can be used to determine the crest factor using this formula:

$$Crest\ factor\ =\ \frac{Peak\ value}{True\ RMS\ value}$$

**1** To activate the peak mode, press the ⌷MaxMin Peak⌷ key for more than 1 second.

**2** Press ⌷MaxMin Peak⌷ again to display the maximum (**P-HOLD+**) or minimum (**P-HOLD–**) peak values along with their respective time stamps.
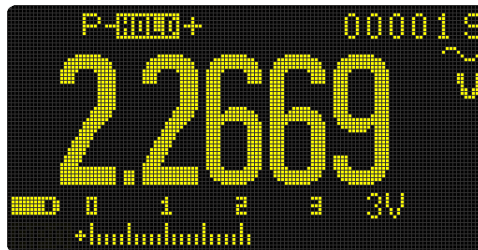


**Figure 3-5**    Peak display

**3** If **OL** (overload) is shown, press the ⌷Range Auto⌷ key to change the measurement range. This action will also restart the recording session.

**4** Press ⌷Dual Exit⌷ to restart the recording session without changing the measurement range.

**5** Press ⌷Dual Exit⌷ or ⌷MaxMin Peak⌷ for more than 1 second to disable the Peak function.

When the peak value of the input signal goes below the recorded minimum value or above the recorded maximum value, the multimeter beeps and records the new value.

At the same time, the elapsed time since the peak recording session was started is stored as the recorded value's time stamp.

| NOTE | The APO (auto power-off) function is disabled when Peak is enabled. |

**To calculate the crest factor:**

Crest factor is a measure of signal distortion and is calculated as a signal's peak value over its RMS value. This is an important measurement when looking at power quality issues. In the measurement example shown below (Figure 3-6), the crest factor is calculated as:

$$Crest\ factor = \frac{Peak\ value}{True\ RMS\ value} = \frac{2.2669\ V}{1.6032\ V} = 1.414$$



Press $\boxed{\text{MaxMin/Peak}}$ for more than 1 second to start the Peak Hold recording session.

Start to capture

Press $\boxed{\text{Dual/Exit}}$ to reset the recording session.

Press $\boxed{\text{MaxMin/Peak}}$ to switch between the maximum and minimum peak values.
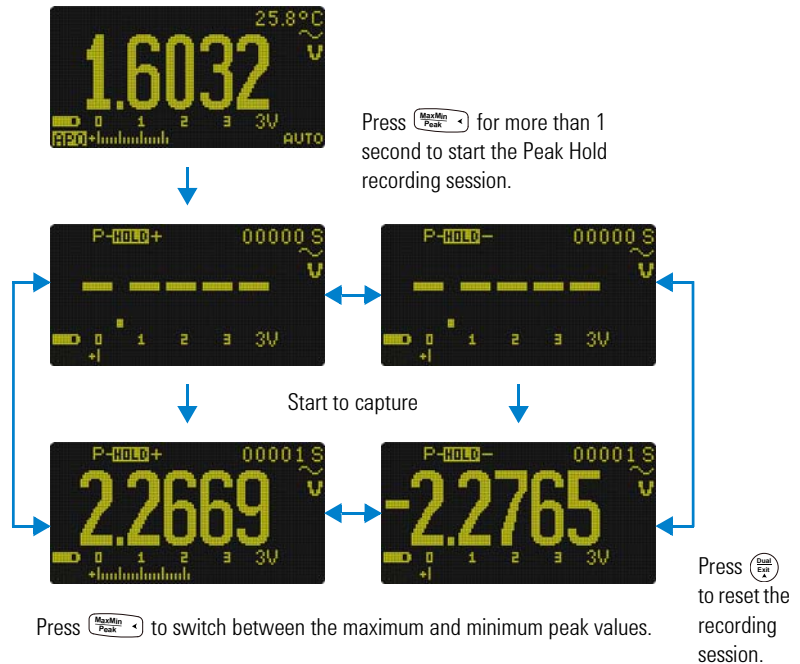
**Figure 3-6**    Peak mode operation

# Freezing the Display (TrigHold and AutoHold)

### TrigHold operation

To freeze the display for any function, press the [Trig Hold Auto] key.

### AutoHold operation

Pressing the [Trig Hold Auto] for more that 1 second activates the AutoHold if the multimeter is not in the MaxMin, Peak, or Data Logging recording modes.

AutoHold operation monitors the input signal and updates the display and, if enabled, emits a beep, whenever a new stable measurement is detected. A stable measurement is one that does not vary more than a selected adjustable (AutoHold threshold) variation count for at least one second (default 500 counts). Open lead conditions are not included in the update.

To change the default AutoHold threshold count see "Changing the variation count" on page 109 for more information.

| NOTE | If the reading value is unable to reach a stable state (when exceeding the preset variation), the reading value will not be updated. |
|---|---|

# Recording Measurement Data (Data Logging)

The Data Logging function provides you the convenience of recording test data for future review or analysis. Since data is stored in the nonvolatile memory, the data remains saved even when the multimeter is turned OFF or if the battery is replaced.

The Data Logging feature collects measurement information over a user-specified duration. There are three data logging options that can be used to capture measurement data: manual (**HAND**), interval (**AUTO**), or event (**TRIG**).

- A manual log stores an instance of the measured signal each time $\boxed{\text{Hz % ms}\atop\text{Log}}$ is pressed. See page 94.
- An interval log stores a record of the measured signal at a user-specified interval. See page 94.
- An event log stores a record of the measured signal each time a trigger condition is satisfied. See page 96.

**Table 3-2** Data logging maximum capacity

| Data logging option | Maximum capacity for saving |
|---|---|
| Manual (**HAND**) | 100 |
| Interval (**AUTO**) | 10000 |
| Event (**TRIG**) | *Shares the same memory with Interval logging* |

Before starting a recording session, set up the multimeter for the measurements to be recorded.

To change the data logging option see "Changing the recording option" on page 109 for more information.

## Performing manual logs (HAND)

Ensure that **HAND** is selected as the data logging option in the multimeter's setup.

**1** Press $\boxed{\text{Hz % ms} \atop \text{Log}}$ for more than 1 second to store the present input signal value.

**LOG** and the log entry number are displayed at the right of the display. The display will return to normal after a short while (around 1 s).



**Figure 3-7**    Manual log display

**2** Repeat step 1 again to save the next input signal value.

The maximum number of readings that can be stored for the manual log is 100 entries. When all entries are occupied, **H : FULL** will be shown when $\boxed{\text{Hz % ms} \atop \text{Log}}$ is pressed.

See the "Reviewing Previously Recorded Data (View)" section later in this manual to review or erase the recorded entries.

## Performing interval logs (AUTO)

Ensure that **AUTO** is selected as the data logging option in the multimeter's setup.

The default recording interval duration is 1 second. To change the recording interval duration, see "Changing the sample interval duration" on page 110 for more information.

The duration set in the multimeter's setup will determine how long each recording interval takes. The input signal value at the end of each interval will be recorded and saved into the multimeter's memory.

### Start the interval log mode

**1** Press ⌈ Hz % ms Log ⌉ for more than 1 second to start interval log mode.

▮▮▮▮ and the log entry number are displayed at the right of the display. Subsequent readings are automatically recorded into the multimeter's memory at the interval specified in the setup menu.
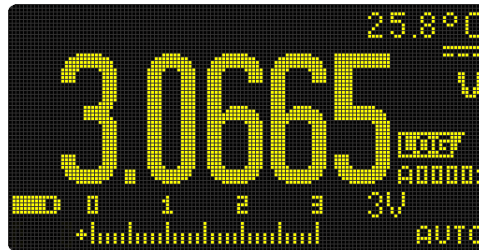


**Figure 3**-8    Interval log display

**2** Press ⌈ Hz % ms Log ⌉ for more than 1 second to exit the interval log mode.

The maximum number of readings that can be stored for the interval log is 10000 entries. When all entries are occupied, **A : FULL** will be shown when ⌈ Hz % ms Log ⌉ is pressed.

The interval and event log share the same memory buffer. Increased usage of the interval log entries will lead to the decrease of the maximum entries for the event log, and vice versa.

See the "Reviewing Previously Recorded Data (View)" section later in this manual to review or erase the recorded entries.

| NOTE | When the interval log recording session is running, all other keypad operations are disabled; except for ⌷Hz % ms/Log⌷, which, when pressed for more than 1 second, will stop and exit the recording session. Furthermore, APO (auto power-off) is disabled during the recording session. |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

# Performing event logs (TRIG)

Ensure that **TRIG** is selected as the data logging option in the multimeter's setup.

Event logs are used only with the following modes:

- TrigHold and AutoHold (page 92)
- MaxMin recording (page 88)
- Peak recording (page 90)

Event records are triggered by the measured signal satisfying a trigger condition set by the measurement function used in the following modes:

**Table 3-3**   Event log trigger conditions

| Modes | Trigger condition |
|-------|-------------------|
| | *The input signal value is recorded:* |
| TrigHold | Each time ⌷Trig Auto Hold⌷ is pressed. |
| AutoHold | When the input signal varies more than the variation count. |
| MaxMin | When a new maximum (or minimum) value is recorded. The average and present readings are not recorded in the Event log. |
| Peak | When a new peak (maximum or minimum) value is recorded. |

**Start the event log mode**

**1** Select one of the four modes stated in Table 3-3.

**2** Press $\boxed{\scriptstyle{\text{Hz \% ms} \atop \text{Log}}}$ for more than 1 second to start event log mode.

 ▣▣▣ and the log entry number are displayed at the right of the display. Subsequent readings are automatically recorded into the multimeter's memory every time the trigger condition specified in Table 3-3 is satisfied.
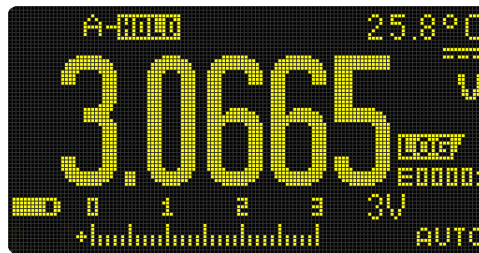


**Figure 3-9**    Event log display

**3** Press $\boxed{\scriptstyle{\text{Hz \% ms} \atop \text{Log}}}$ for more than 1 second to exit the event log mode.

The maximum number of readings that can be stored for the event log is 10000 entries. When all entries are occupied, **E : FULL** will be shown when $\boxed{\scriptstyle{\text{Hz \% ms} \atop \text{Log}}}$ is pressed.

The event and interval log share the same memory buffer. Increased usage of the event log entries will lead to the decrease of the maximum entries for the interval log, and vice versa.

See the "Reviewing Previously Recorded Data (View)" section later in this manual to review or erase the recorded entries.

| NOTE | APO (auto power-off) is disabled during the recording session. |
|------|----------------------------------------------------------------|

# Reviewing Previously Recorded Data (View)

Viewing data stored in the multimeter's memory is performed through the [Esc Shift View] key.

**1** Press [Esc Shift View] for more than 1 second to enter the multimeter's View mode. Press [Esc Shift View] again to cycle through the manual (**H**), interval (**A**), or event (**E**) previously stored records.



**Figure 3-10**  View display

If nothing has been recorded, **H : Void**, **A : Void**, or **E : Void** will be displayed instead.



**Figure 3-11**  Empty view display

**2** Select the desired recording category to view its entries.

   **i** Press (MaxMin Peak ◂) to jump to the first stored entry.

   **ii** Press (▸ Range Auto) to jump to the last stored entry.

   **iii** Press (Dual Exit ▴) to view the next stored entry. The index number increases by one.

   **iv** Press (☼ Setup ▾) to view the previous stored entry. The index number decreases by one.

   **v** Press (Hz % ms Log) for more than 1 second to clear all entries for the selected log type.

**3** Press (Esc Shift View) for more than 1 second to exit the View mode.

## Sanitizing the Log Memories

You have the option to sanitize the log memories of your multimeter. This operation erases the log memories of your multimeter thoroughly. The data stored in the multimeter's memory will not be able to be reconstructed in any way after the data sanitization operation.

Prior to sanitizing the log memories, ensure that all manual (**H**), interval (**A**), or event (**E**) entries have been cleared (see step v).

When all entries are cleared (**H : Void**, **A : Void**, and **E : Void**), press and hold (ΔNull Scale) for more than 1 second.

**CAUTION**  The data sanitization operation may take up to 30 seconds to complete. Do not press any keys or turn the rotary switch until the data sanitization operation is completed.

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# 4

# Multimeter Setup Options

The following sections describe how to change the preset features of your multimeter.
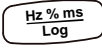
# Using the Setup Menu

The multimeter's setup menu allows you to change a number of nonvolatile preset features. Modifying these settings affects the general operation of your multimeter across several functions. Select a setting to edit to perform one of the following actions:

- Switch between two values, such as on or off.
- Cycle through multiple values from a predefined list.
- Decrease or increase a numerical value within a fixed range.

The contents of the setup menu are summarized in Table 4-2 on page 104.

**Table 4-1** Setup menu key functions

| Legend | Description |
|---|---|
|  ▼ ☼ **Setup** | Press (Setup) for more than 1 second to access the setup menu.<br><br>Press and hold (Setup) until the multimeter restarts to exit the setup menu. |
| **MaxMin Peak** ◄ ► **Range Auto** | Press (MaxMin Peak ◄) or (► Range Auto) to browse each menu page. |
| **Dual Exit** ▲ ▼ ☼ **Setup** | Press (Dual Exit) or (Setup) at each menu page to move the cursor to a specific menu item. |
| **Hz % ms Log** | Press (Hz % ms Log) to edit the selected menu item. The menu item's value will flash to indicate that you can now change the value shown.<br><br>Press (Dual Exit) or (Setup) again to switch between two values, to cycle through multiple values from a list, or to decrease or increase a numerical value.<br><br>Press (Hz % ms Log) to save your changes. |
| Esc **Shift View** | While the menu item's value is flashing, press (Esc Shift View) to discard your changes. |

## Editing numerical values

When editing numerical values, use the $\boxed{\text{MaxMin Peak} \triangleleft}$ and $\boxed{\triangleright \text{ Range Auto}}$ to position the cursor on a numerical digit.

- Press $\boxed{\text{MaxMin Peak} \triangleleft}$ to move the cursor to the left, and
- Press $\boxed{\triangleright \text{ Range Auto}}$ to move the cursor to the right.

When the cursor is positioned over a digit, use the $\boxed{\text{Dual Exit}}$ and $\boxed{\text{Setup}}$ keys to change the numerical digit.

- Press $\boxed{\text{Dual Exit}}$ to increment the digit, and
- Press $\boxed{\text{Setup}}$ to decrement the digit.

When you have completed your changes, save the new numerical value by pressing $\boxed{\text{Hz \% ms Log}}$. (Or alternatively, if you wish to discard the changes you made, press $\boxed{\text{Esc Shift View}}$.)

Press and hold $\boxed{\text{Setup}}$ for more than 1 second to enter the setup menu.

Press $\boxed{\text{Hz \% ms Log}}$ to edit the selected menu item's value.

Press $\boxed{\text{MaxMin Peak} \triangleleft}$ or $\boxed{\triangleright \text{ Range Auto}}$ to move the cursor left or right.
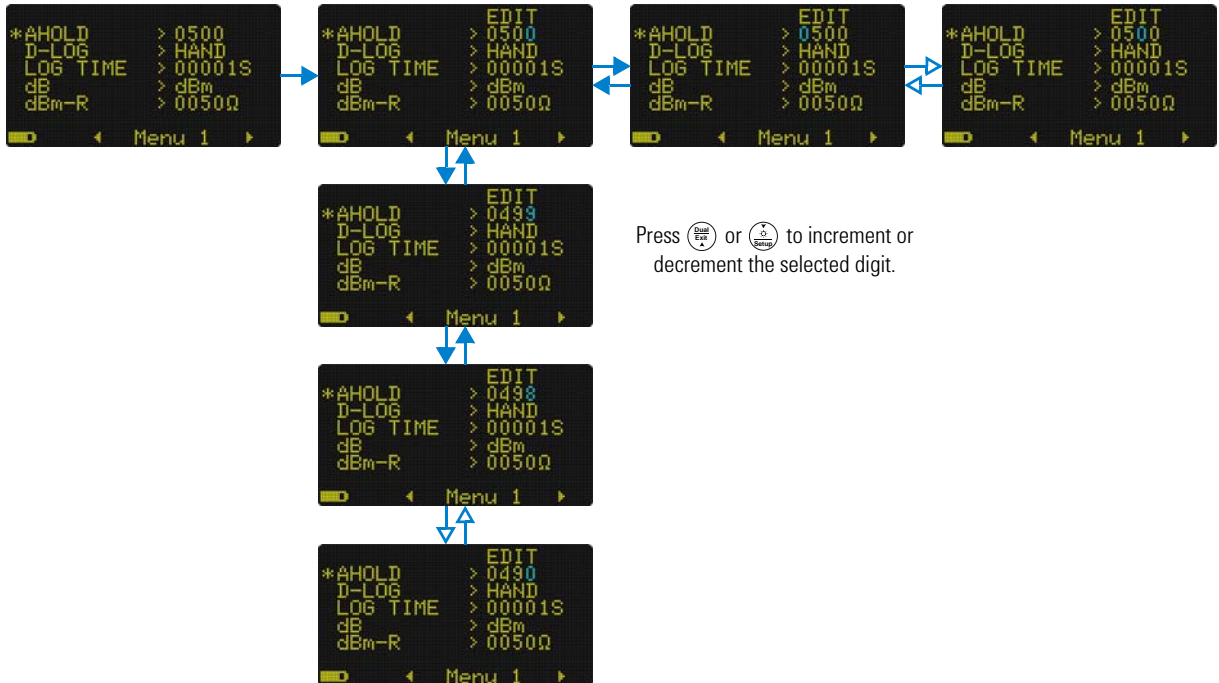


Press $\boxed{\text{Dual Exit}}$ or $\boxed{\text{Setup}}$ to increment or decrement the selected digit.

# Setup Menu Summary

The setup menu items are summarized in the table below. Click the respective "Learn more" pages for more information on each menu item.

**Table 4-2**  Setup menu item descriptions

| Menu | Legend | Available settings | Description | Learn more on: |
|---|---|---|---|---|
| | AHOLD | 0050 to 9999 | Set the multimeter's AutoHold threshold count from 50 to 9 999 counts. <br><br> Default is 500 counts. | page 92 and page 109 |
| | D-LOG | HAND, AUTO, or TRIG | Set the multimeter's data logging option (HAND: manual log, AUTO: interval log, or TRIG: event log). <br><br> Default is manual log. | page 93 and page 109 |
| MENU 1 | LOG TIME | 00001 S to 99999 S | Set the logging duration for interval logs from 1 to 99999 seconds (1 day, 3 hours, 46 minutes, 39 seconds). <br><br> Default is 1 second. | page 94 and page 110 |
| | dB | dBm, dBV, or OFF | Set the multimeter to display voltage as a dB value (dBm or dBV). You can also disable this feature (off). <br><br> Default is dBm. | page 42 and page 111 |
| | dBm-R | 0001 $\Omega$ to 9999 $\Omega$ | Set the dBm reference impedance value from 1 $\Omega$ to 9999 $\Omega$. <br><br> Default is 50 $\Omega$. | page 42 and page 111 |

**Table 4-2** Setup menu item descriptions (continued)

| Menu | Legend | Available settings | Description | Learn more on: |
|---|---|---|---|---|
| MENU 2 | T-TYPE | J or K | Set the multimeter's thermocouple type (type J or type K).<br><br>Default is type K. | page 64 and page 112 |
| | T-UNIT | °C, °F/°C, °C/°F, or °F | Set the multimeter's temperature unit (Celsius, Fahrenheit/Celsius, Celsius/Fahrenheit, or Fahrenheit).<br><br>Default is °C (Celsius). | page 64 and page 113 |
| | mA SCALE | 0-20 mA, 4-20 mA, or OFF | Set the multimeter's % scale selection (0-20 mA or 4-20 mA). You can also disable this feature (off).<br><br>Default is 4-20 mA. | page 73 and page 114 |
| | CONTINUITY | SINGLE, TONE, or OFF | Set the multimeter to sound a single beep or a tone during continuity alerts. You can also disable this feature (off).<br><br>Default is single. | page 50 and page 114 |
| | MIN-Hz | 0.5 Hz or 10 Hz | Set the minimum measurement frequency (0.5 Hz or 10 Hz).<br><br>Default is 0.5 Hz. | page 76 and page 115 |

**Table 4-2**  Setup menu item descriptions (continued)

| Menu | Legend | Available settings | Description | Learn more on: |
|------|--------|--------------------|-------------|----------------|
| MENU 3 | BEEP | 3200 Hz, 3491 Hz, 3840 Hz, 4267 Hz, or OFF | Set the multimeter's beep frequency from 3200 Hz to 4267 Hz. You can also disable this feature (off). Default is 3491 Hz. | page 116 |
| | APO | 01 M to 99 M (E or D) | Set the auto power-off timer period from 1 to 99 minutes (1 hour, 39 minutes). You can also disable this feature (D). Default is 10 minutes (10 M-E). | page 6 and page 116 |
| | BACKLIT | LOW, MEDIUM, HIGH, or AUTO | Set the default OLED behavior from low to high. You can also set the OLED to auto-dim instead (AUTO). Default is auto-dim. | page 6 and page 117 |
| | MELODY | FACTORY, USER, or OFF | Set the multimeter's power-on melody to the factory default or user-defined. You can also disable this feature (off). Default is factory. | page 5 and page 118 |
| | GREETING | FACTORY, USER, or OFF | Set the multimeter's power-on greetings to the factory default or user-defined. You can also disable this feature (off). Default is factory. | page 5 and page 118 |

**Table 4-2**  Setup menu item descriptions (continued)

| Menu | Legend | Available settings | Description | Learn more on: |
|---|---|---|---|---|
| MENU 4 | BAUD | 9600 or 19200 | Set the baud rate for remote communication with a PC (9600 or 19200).<br>Default is 9600. | page 10 and page 119 |
| | DATA BIT | 7 or 8 | Set the data bit length for remote communication with a PC (7-bit or 8-bit).<br>Default is 8-bit. | page 10 and page 120 |
| | PARITY | NONE, EVEN, or ODD | Set the parity bit for remote communication with a PC (none, even, or odd).<br>Default is none. | page 10 and page 120 |
| | ECHO | OFF or ON | Set the multimeter to echoes (returns) all the characters it receives.<br>Default is disabled (off). | page 10 and page 121 |
| | PRINT | OFF or ON | Set the multimeter to print out the measured data when the measuring cycle is completed.<br>Default is disabled (off). | page 10 and page 121 |
| MENU 5 | REVISION | - | Displays the multimeter's firmware revision. | - |
| | S/N | - | Displays the multimeter's serial number (for the last eight digits). | - |
| | V-ALERT | 000.01 V to 999.99 V (D or E) | Set the multimeter's voltage alert value from 0.01 V to 999.99 V. You can also disable this feature (D).<br>Default is disabled (030.00-D). | page 8 and page 122 |
| | USER SCALE | 0000.1 V to 1000.0 V | Set the scale conversion value from (0000.1) to (1000.0). The scale conversion unit can be set to V/V, A/V, or (no unit)/V.<br>Default is (1000.0) V/V. | page 86 and page 123 |
| | SMOOTH | 0001 to 9999 (D or E) | Set the primary display's settling value from 0001 to 9999. You can also disable this feature (D).<br>Default is disabled (0009-D). | page 12 and page 124 |

**Table 4-2**  Setup menu item descriptions (continued)

| Menu | Legend | Available settings | Description | Learn more on: |
|---|---|---|---|---|
| | DEFAULT | YES or NO | Reset the multimeter to its factory default settings. | page 125 |
| MENU 6 | BATTERY | PRI or SEC | Change the battery selection from primary to secondary. <br><br> Default is primary. | page 3 and page 125 |
| | FILTER | ON or OFF | Enable the low-pass filter for DC voltage and DC current measuring paths. <br><br> Default is off. | page 37 and page 126 |

# Setup Menu Items

## Changing the variation count

This setting is used with the multimeter's AutoHold feature (see page 92). When the variation of the measured value exceeds the value of the variation count, the AutoHold feature will be ready to trigger.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| AHOLD | (50 to 9999) counts | 0500 |

To change the variation count:

**1** Press (⚙Setup) for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 1 > AHOLD**, and press (Hz % ms / Log) edit the value.

**3** Use the arrow keys to change the variation count.

**4** Press (Hz % ms / Log) to save your changes (or press (Esc / Shift View) to discard your changes).

**5** Press and hold (⚙Setup) until the multimeter restarts to return to normal operation.

## Changing the recording option

This setting is used with the multimeter's Data Logging feature (see page 93). There are three available recording options for the multimeter's Data Logging feature.

- HAND: Manual log
- AUTO: Interval log
- TRIG: Event log

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| D-LOG | HAND, AUTO, or TRIG | HAND |

To change the recording option:

**1** Press ⟨Setup⟩ for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 1 > D-LOG**, and press ⟨Hz % ms / Log⟩ edit the value.

**3** Use the arrow keys to change the recording option.

**4** Press ⟨Hz % ms / Log⟩ to save your changes (or press ⟨Esc Shift / View⟩ to discard your changes).

**5** Press and hold ⟨Setup⟩ until the multimeter restarts to return to normal operation.

# Changing the sample interval duration

This setting is used with the multimeter's Interval Data Logging feature (see page 94). The multimeter will record a measurement value at the beginning of every sample interval.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| LOG TIME | (1 to 99999) s | 00001 S |

To change the sample interval duration:

**1** Press ⟨Setup⟩ for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 1 > LOG TIME**, and press ⟨Hz % ms / Log⟩ edit the value.

**3** Use the arrow keys to change the sample interval duration.

**4** Press ⟨Hz % ms / Log⟩ to save your changes (or press ⟨Esc Shift / View⟩ to discard your changes).

**5** Press and hold $\left(\begin{smallmatrix} \dot{\circ} \\ \text{Setup} \end{smallmatrix}\right)$ until the multimeter restarts to return to normal operation.

## Changing the decibel display

This setting is used with dB measurements (see ). You can enable the multimeter to display voltage as a dB value, either relative to 1 milliwatt (dBm) or a reference voltage of 1 volt (dBV).

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| dB | dBm, dBV, or OFF | dBm |

To change the decibel display:

**1** Press $\left(\begin{smallmatrix} \dot{\circ} \\ \text{Setup} \end{smallmatrix}\right)$ for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 1 > dB**, and press $\boxed{\frac{\text{Hz \% ms}}{\text{Log}}}$ edit the value.

**3** Use the arrow keys to change the decibel display. Select **OFF** to disable the decibel display.

**4** Press $\boxed{\frac{\text{Hz \% ms}}{\text{Log}}}$ to save your changes (or press $\boxed{\text{Esc} \ \text{Shift} \ \text{View}}$ to discard your changes).

**5** Press and hold $\left(\begin{smallmatrix} \dot{\circ} \\ \text{Setup} \end{smallmatrix}\right)$ until the multimeter restarts to return to normal operation.

## Changing the custom dBm reference impedance

This setting is used with dB measurements (see ). The dBm function is logarithmic, and is based on a calculation of power delivered to a reference impedance (resistance), relative to 1 mW.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| dBm-R | (1 to 9999) $\Omega$ | 0050 $\Omega$ |

To change the dBm reference impedance value:

**1** Press ⊙ for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 1 > dBm-R**, and press ⌈Hz % ms Log⌉ edit the value.

**3** Use the arrow keys to change the dBm reference impedance value.

**4** Press ⌈Hz % ms Log⌉ to save your changes (or press ⌈Esc Shift View⌉ to discard your changes).

**5** Press and hold ⊙ until the multimeter restarts to return to normal operation.

# Changing the thermocouple type

This setting is used with temperature measurements (see page 64). Select a thermocouple type that matches the thermocouple sensor you are using for temperature measurements.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| T-TYPE | Type-J or Type-K | K |

To change the thermocouple type:

**1** Press ⊙ for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 2 > T-TYPE**, and press ⌈Hz % ms Log⌉ edit the value.

**3** Use the arrow keys to change the thermocouple type.

**4** Press ⌈Hz % ms Log⌉ to save your changes (or press ⌈Esc Shift View⌉ to discard your changes).

**5** Press and hold ⊙ until the multimeter restarts to return to normal operation.

# Changing the temperature unit

**CAUTION** This setup item is locked for certain regions. Always set the temperature unit display per the official requirements and in compliance with the National laws of your region.

This setting is used with temperature measurements (see page 64). Four combinations of displayed temperature unit(s) are available:

- Celsius only: Temperature measured in °C.
- Fahrenheit/Celsius: During temperature measurements, press ⌈ Range/Auto ⌉ to switch between °F and °C.
- Celsius/Fahrenheit: During temperature measurements, press ⌈ Range/Auto ⌉ to switch between °C and °F.
- Fahrenheit only: Temperature measured in °F.

Press and hold ⌈ Esc Shift/View ⌉ for more than 1 second to unlock this setting.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| T-UNIT | °C, °F/°C, °C/°F, or °F | °C |

To change the temperature unit:

**1** Press ⌈ Setup ⌉ for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 2 > T-UNIT**. Press and hold ⌈ Esc Shift/View ⌉ for more than 1 second to unlock this setting, then press ⌈ Hz % ms/Log ⌉ edit the value.

**3** Use the arrow keys to change the temperature unit.

**4** Press ⌈ Hz % ms/Log ⌉ to save your changes (or press ⌈ Esc Shift/View ⌉ to discard your changes).

**5** Press and hold ⌈ Setup ⌉ until the multimeter restarts to return to normal operation.

# Changing the % scale range

This setting is used with % scale current measurements (see page 73). The multimeter converts DC current measurements to a percentage scale readout of 0% to 100% based on the selected range in this menu. For example, a 25% readout represents a DC current of 8 mA on the 4-20 mA % scale, or a DC current of 5 mA on the 0-20 mA % scale.

| Parameter | Range | Default setting |
|---|---|---|
| mA SCALE | 4-20 mA, 0-20 mA, or OFF | 4-20 mA |

To change the % scale range:

**1** Press 🔘 for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 2 > mA SCALE**, and press ⌧ edit the value.

**3** Use the arrow keys to change the % scale range. Select **OFF** to disable the % scale readout.

**4** Press ⌧ to save your changes (or press ⌧ to discard your changes).

**5** Press and hold 🔘 until the multimeter restarts to return to normal operation.

# Changing the continuity alert

This setting is used with continuity tests (see page 50). The multimeter will beep to alert users to the presence of circuit continuities.

| Parameter | Range | Default setting |
|---|---|---|
| CONTINUITY | SINGLE, TONE, or OFF | SINGLE |

To change the continuity alert:

**1** Press (☼/Setup) for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 2 > CONTINUITY**, and press (Hz%ms/Log) edit the value.

**3** Use the arrow keys to change the continuity alert. Select **OFF** to disable the continuity alert.

**4** Press (Hz%ms/Log) to save your changes (or press (Esc Shift/View) to discard your changes).

**5** Press and hold (☼/Setup) until the multimeter restarts to return to normal operation.

## Changing the minimum measurable frequency

This setting is used with frequency tests (see page 76). Changing the minimum measurable frequency will influence the measurement rates for frequency, duty cycle, and pulse width measurements. The typical measurement rate as defined in the specification is based on a minimum measurable frequency of 10 Hz.

| Parameter | Range | Default setting |
|-----------|-------------------|-----------------|
| MIN-Hz | 0.5 Hz or 10 Hz | 0.5 Hz |

To change the minimum measurable frequency:

**1** Press (☼/Setup) for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 2 > MIN-Hz**, and press (Hz%ms/Log) edit the value.

**3** Use the arrow keys to change the minimum measurable frequency.

**4** Press (Hz%ms/Log) to save your changes (or press (Esc Shift/View) to discard your changes).

**5** Press and hold (☼/Setup) until the multimeter restarts to return to normal operation.

# Changing the beep frequency

The multimeter's beeper alerts users to the presence of circuit continuities, operator errors such as incorrect lead connections for the selected function, and newly sensed values for MaxMin and Peak recordings.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| BEEP | 3200 Hz, 3491 Hz, 3840 Hz, 4267 Hz, or OFF | 3491 Hz |

To change the beep frequency:

**1** Press $\overset{\cdot \circ \cdot}{\text{Setup}}$ for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 3 > BEEP**, and press $\overset{\text{Hz \% ms}}{\text{Log}}$ edit the value.

**3** Use the arrow keys to change the beep frequency. Select **OFF** to disable the beeper.

**4** Press $\overset{\text{Hz \% ms}}{\text{Log}}$ to save your changes (or press $\overset{\text{Shift}}{\text{Esc  View}}$ to discard your changes).

**5** Press and hold $\overset{\cdot \circ \cdot}{\text{Setup}}$ until the multimeter restarts to return to normal operation.

# Changing the auto power-off (APO) timer

The multimeter's APO (see page 6) feature uses a timer to determine when to automatically turn the multimeter off.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| APO | • (1 to 99) minutes<br>• E(nabled) or D(isabled) | 10 M-E |

To change the APO timer period:

**1** Press 🔘 for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 3 > APO**, and press ⬚ edit the value.

**3** Use the arrow keys to change the APO timer period. Select **D** to disable the APO feature.

**4** Press ⬚ to save your changes (or press ⬚ to discard your changes).

**5** Press and hold 🔘 until the multimeter restarts to return to normal operation.

## Changing the OLED behavior

The multimeter's OLED is set to auto-dim by default. However, you can manually control the OLED brightness by changing the values in this setup item.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| BACKLIT | AUTO, LOW, MEDIUM, or HIGH | AUTO |

To change the OLED behavior:

**1** Press 🔘 for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 3 > BACKLIT**, and press ⬚ edit the value.

**3** Use the arrow keys to change the OLED behavior. Select **AUTO** to enable the auto-dim feature.

**4** Press ⬚ to save your changes (or press ⬚ to discard your changes).

**5** Press and hold 🔘 until the multimeter restarts to return to normal operation.

# Changing the power-on melody

The multimeter's plays a melody when it is powered on. You can download your own melody by using the IR-USB cable. See "Connect the IR-USB cable" on page 10 for more information.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| MELODY | FACTORY, USER, or OFF | FACTORY |

To change the power-on melody:

**1** Press 🔆 for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 3 > MELODY**, and press `Hz % ms Log` edit the value.

**3** Use the arrow keys to change the power-on melody. Select **OFF** to disable the power-on melody.

**4** Press `Hz % ms Log` to save your changes (or press `Esc Shift View` to discard your changes).

**5** Press and hold 🔆 until the multimeter restarts to return to normal operation.

# Changing the power-on greetings

The multimeter's displays the Agilent logo when it is powered on. You can download your own message or image by using the IR-USB cable. See "Connect the IR-USB cable" on page 10 for more information.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| GREETING | FACTORY, USER, or OFF | FACTORY |

To change the power-on greetings:

**1** Press (Setup) for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 3 > GREETING**, and press (Hz % ms Log) edit the value.

**3** Use the arrow keys to change the power-on greetings. Select **OFF** to disable the power-on greetings.

**4** Press (Hz % ms Log) to save your changes (or press (Esc Shift View) to discard your changes).

**5** Press and hold (Setup) until the multimeter restarts to return to normal operation.

## Changing the baud rate

This setting changes the baud rate for remote communications with a PC.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| BAUD | (9600 or 19200) bits/second | 9600 |

To change the baud rate:

**1** Press (Setup) for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 4 > BAUD**, and press (Hz % ms Log) edit the value.

**3** Use the arrow keys to change the baud rate.

**4** Press (Hz % ms Log) to save your changes (or press (Esc Shift View) to discard your changes).

**5** Press and hold (Setup) until the multimeter restarts to return to normal operation.

# Changing the data bits

This setting changes the number of data bits (data width) for remote communications with a PC. The number of stop bit is always 1, and this cannot be changed.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| DATA BIT | 8-bit or 7-bit | 8 |

To change the data bit:

**1** Press (Setup) for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 4 > DATA BIT**, and press (Hz % ms / Log) edit the value.

**3** Use the arrow keys to change the data bit.

**4** Press (Hz % ms / Log) to save your changes (or press (Esc Shift View) to discard your changes).

**5** Press and hold (Setup) until the multimeter restarts to return to normal operation.

# Changing the parity check

This setting changes the parity check for remote communications with a PC.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| PARITY | NONE, EVEN, or ODD | NONE |

To change the parity check:

**1** Press (Setup) for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 4 > PARITY**, and press (Hz % ms / Log) edit the value.

**3** Use the arrow keys to change the parity check.

**4** Press ⌨ (Hz % ms / Log) to save your changes (or press ⌨ (Esc / Shift View) to discard your changes).

**5** Press and hold ⌨ (Setup) until the multimeter restarts to return to normal operation.

## Enabling the echo feature

When the echo feature is enabled, the multimeter echoes (returns) all the characters it receives when it is connected to a remote PC.

| Parameter | Range | Default setting |
|-----------|-----------|-----------------|
| ECHO | OFF or ON | OFF |

To enable the echo feature:

**1** Press ⌨ (Setup) for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 4 > ECHO**, and press ⌨ (Hz % ms / Log) edit the value.

**3** Use the arrow keys to enable the echo feature.

**4** Press ⌨ (Hz % ms / Log) to save your changes (or press ⌨ (Esc / Shift View) to discard your changes).

**5** Press and hold ⌨ (Setup) until the multimeter restarts to return to normal operation.

## Enabling the print feature

When the print feature is enabled, the multimeter will print out the measured data when the measuring cycle is complete. The multimeter will automatically send new data to the remote PC host continuously. The multimeter does not accept any commands from the PC host when this feature is enabled.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| PRINT | OFF or ON | OFF |

To enable the print feature:

**1** Press 🔘 for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 4 > PRINT**, and press 🔘 edit the value.

**3** Use the arrow keys to enable the print feature.

**4** Press 🔘 to save your changes (or press 🔘 to discard your changes).

**5** Press and hold 🔘 until the multimeter restarts to return to normal operation.

# Enabling the overvoltage alert

This setting is used with the multimeter's overvoltage alert (see page 8). The multimeter's will start beeping periodically once the measured voltage exceeds the value set, regardless of polarity.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| V-ALERT | • (0.01 to 999.99) V<br>• D(isabled) or E(nabled) | (030.00-D) V |

To enable the overvoltage's alert:

**1** Press 🔘 for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 5 > V-ALERT**, and press 🔘 edit the value.

**3** Use the arrow keys to change the value of the overvoltage's alert. Select **E** to enable the overvoltage alert value.

**4** Press ⌗ to save your changes (or press ⌗ to discard your changes).

**5** Press and hold ⌗ until the multimeter restarts to return to normal operation.

## Changing the user scale conversion value and unit

You can set the user scale conversion value and unit. The ratio can be set from 0000.1 to 1000.0 and the unit can be set to V/V, A/V, or (no unit/V). The default is 1000 V/V. See "Making Scale Transfers (Scale)" on page 86 for more information on the Scale operation.

| Parameter | Range | Default setting |
|---|---|---|
| USER SCALE | (0000.1 to 1000.0) V/V, A/V, or (no unit/V) | 1000.0 V(/V) |

To set the user scale conversion value and unit:

**1** Press ⌗ for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 5 > USER SCALE**, and press ⌗ edit the value.

**3** Use the arrow keys to change the user scale conversion value and unit.

**4** Press ⌗ to save your changes (or press ⌗ to discard your changes).

**5** Press and hold ⌗ until the multimeter restarts to return to normal operation.

# Enabling smooth mode

Smooth is used to smoothen the refresh rate of the readings in order to reduce the impact of unexpected noise and to help you achieve a stable reading.

The smooth refresh rate can be set from 0001 to 9999. The smooth time is defined as the set value +1. Smooth will be restarted when the variation count is exceeded, when the range is changed, or after a multimeter function or feature is enabled. The variation count is set to the value used for the AutoHold feature (see "Changing the variation count" on page 109).

You can enable Smooth by holding <kbd>Esc Shift View</kbd> while turning on the multimeter ("Power-on options" on page 12). This method, however, is temporary and Smooth will be turned off when you cycle the multimeter's power. You can permanently enable Smooth from the setup menu.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| SMOOTH | • 0001 to 9999<br>• D(isabled) or E(nabled) | 0009-D(isabled) |

To change the smooth refresh rate:

**1** Press <kbd>Setup</kbd> for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 5 > SMOOTH**, and press <kbd>Hz % ms Log</kbd> edit the value.

**3** Use the arrow keys to change the smooth refresh rate. Select **E** to enable the Smooth feature.

**4** Press <kbd>Hz % ms Log</kbd> to save your changes (or press <kbd>Esc Shift View</kbd> to discard your changes).

**5** Press and hold <kbd>Setup</kbd> until the multimeter restarts to return to normal operation.

# Resetting the multimeter's setup options

The multimeter's setup options can be reset to its default values through the setup menu.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| DEFAULT | YES or NO | NO |

**1** Press ⊛ for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 6 > DEFAULT**, and press ⌷ edit the value.

**3** Use the arrow keys to select **YES**.

**4** Press and hold ⌷ for more than 1 second to perform the reset. The multimeter will beep once and return to the first setup menu page. Or, alternatively press ⌷ to discard your changes.

# Changing the battery type

If you are using rechargeable batteries to power your multimeter, change the battery type from **PRI** to **SEC** for the multimeter to accurately reflect the battery capacity indication.

| Parameter | Range | Default setting |
|-----------|-------|-----------------|
| BATTERY | PRI or SEC | PRI |

To change the battery type:

**1** Press ⊛ for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 6 > BATTERY**, and press ⌷ edit the value.

**3** Use the arrow keys to change the battery type.

**4** Press (Hz % ms / Log) to save your changes (or press (Esc / Shift View) to discard your changes).

**5** Press and hold (Setup) until the multimeter restarts to return to normal operation.


# Enabling the filter

This setting is used to enable the filter for DC coupling of voltage and/or current measurements. **LPF** will be shown during the measurement.

| Parameter | Range | Default setting |
|-----------|-----------|-----------------|
| FILTER | ON or OFF | OFF |

To enable the filters:

**1** Press (Setup) for more than 1 second to enter the multimeter's setup menu.

**2** Browse to **Menu 6 > FILTER**, and press (Hz % ms / Log) edit the value.

**3** Use the arrow keys to enable the filter.

**4** Press (Hz % ms / Log) to save your changes (or press (Esc / Shift View) to discard your changes).

**5** Press and hold (Setup) until the multimeter restarts to return to normal operation.

**5**

# Characteristics and Specifications

This chapter lists the characteristics, assumptions, and specifications of the U1273A handheld digital multimeter.

**Agilent Technologies**

# Product Characteristics

**POWER SUPPLY**

Battery type:

- 4 × 1.5 V Alkaline battery (ANSI/NEDA 24A or IEC LR03), or
- 4 × 1.5 V Zinc Chloride battery (ANSI/NEDA 24D or IEC R03)

Battery life:

- Based on new Alkaline batteries for DC voltage measurement:
  - 30 hours typical at high brightness
  - 45 hours typical at medium brightness
  - 60 hours typical at low brightness
- Low battery indicator will flash when the battery voltage drops below
  - For non-rechargeable batteries: 4.4 V (approximately)
  - For rechargeable batteries: 4.5 V (approximately)

**POWER CONSUMPTION**

180 mVA maximum (with maximum brightness)

**FUSE**

- 10 × 35 mm 440 mA/1000 V fast-acting fuse
- 10 × 38 mm 11 A/1000 V fast-acting fuse

**DISPLAY**

Organic LED (OLED) (with maximum reading of 33000 counts)

**OPERATING ENVIRONMENT**

- Operating temperature from −20 °C to 55 °C, 0% to 80% RH
- Full accuracy up to 80% RH for temperatures up to 30 °C, decreasing linearly to 50% RH at 55 °C
- Altitude up to 2000 meters
- Pollution degree II

**STORAGE COMPLIANCE**

−40 °C to 70 °C, 0% to 80% RH

**SAFETY COMPLIANCE**

EN/IEC 61010-1:2001, ANSI/UL 61010-1:2004, and CAN/CSA-C22.2 No. 61010-1-04

**MEASUREMENT CATEGORY**

CAT III 1000 V/CAT IV 600 V

**ELECTROMAGNETIC COMPATIBILITY (EMC)**

Commercial limits compliance with EN61326-1

**IP RATING**

IP-54

**TEMPERATURE COEFFICIENT**

0.05 × (specified accuracy) / °C (from –20 °C to 18 °C, or 28 °C to 55 °C)

**COMMON MODE REJECTION RATIO (CMRR)**

>120 dB at DC, 50/60 Hz ± 0.1% (1 kΩ unbalanced)

**NORMAL MODE REJECTION RATION (NMRR)**

>60 dB at 50/60 Hz ± 0.1%

**DIMENSIONS (W × H × D)**

92 × 207 × 59 mm

**WEIGHT**

500 grams (with batteries)

**WARRANTY**

Please refer to http://www.agilent.com/go/warranty_terms

• Three years for the product
• Three months for the product's standard accessories, unless otherwise specified
• Please take note that for the product, the warranty does not cover:
    • Damage from contamination
    • Normal wear and tear of mechanical components
    • Manuals, fuses, and standard disposable batteries

**CALIBRATION CYCLE**

One year

# Specification Assumptions

- Accuracy is given as ±(% of reading + counts of least significant digit) at 23 °C ± 5 °C, with relative humidity less than 80% RH.

- AC V and AC µA/mA/A specifications are AC coupled, true RMS and are valid from 5% of range to 100% of range.

- The crest factor may be up to 3.0 at full-scale except for the 1000 V range where it is 1.5 at full scale.

- For non-sinusoidal waveforms, add (2% reading + 2% full scale) typical, for crest factors up to 3.

- After $Z_{LOW}$ (low input impedance) voltage measurements, wait at least 20 minutes for thermal impact to cool before proceeding with any other measurement.

# Measurement Category

The Agilent U1273A handheld digital multimeter has a safety rating of CAT III, 1000 V and CAT IV, 600 V.

## Measurement category definition

**Measurement CAT I**    are for 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**    are 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**     are 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**     are measurements performed at the source of the low- voltage installation. Examples are electricity meters and measurements on primary over current protection devices and ripple control units.

# Electrical Specifications

| NOTE | Specification assumptions are given on page 129. |
|------|--------------------------------------------------|

## DC specifications

**Table 5-1**   DC specifications

| Function | Range | Resolution | Accuracy | Test current | Burden voltage | Input impedance |
|----------|-------|------------|----------|--------------|----------------|-----------------|
| | | | | | *(where applicable)* | |
| Voltage | 30 mV[1] | 0.001 mV | 0.05% + 20 | - | - | 10 MΩ |
| | 300 mV[1] | 0.01 mV | 0.05% + 5 | - | - | 10 MΩ |
| | 3 V | 0.0001 V | 0.05% + 5 | - | - | 11.11 MΩ |
| | 30 V | 0.001 V | 0.05% + 2 | - | - | 10.1 MΩ |
| | 300 V | 0.01 V | 0.05% + 2 | - | - | 10 MΩ |
| | 1000 V | 0.1 V | 0.05% + 2 | - | - | 10 MΩ |
| | $Z_{LOW}$ (low input impedance) enabled, applicable for 1000 V range and resolution only[2] | | 1% + 20 | - | - | 2 kΩ |

**Notes for DC voltage specifications:**

**1** The accuracy of the 30 mV to 300 mV range is specified after the Null function is used to subtract the thermal effect (by shorting the test leads).
**2** For $Z_{LOW}$ measurements, autoranging is disabled and the multimeter's range is set to 1000 V in the manual ranging mode.

**Table 5-1**  DC specifications (continued)

| Function | Range | Resolution | Accuracy | Test current | Burden voltage | Input impedance |
|---|---|---|---|---|---|---|
| | | | | | *(where applicable)* | |
| Resistance | 30 Ω | 0.001 Ω | 0.2% + 10 | 0.65 mA | - | - |
| | 300 Ω[4] | 0.01 Ω | 0.2% + 5 | 0.65 mA | - | - |
| | 3 kΩ[4] | 0.0001 kΩ | 0.2% + 5 | 65 μA | - | - |
| | 30 kΩ | 0.001 kΩ | 0.2% + 5 | 6.5 μA | - | - |
| | 300 kΩ | 0.01 kΩ | 0.2% + 5 | 0.65 μA | - | - |
| | 3 MΩ | 0.0001 MΩ | 0.6% + 5 | 93 nA// 10 MΩ | - | - |
| | 30 MΩ [5] | 0.001 MΩ | 1.2% + 5 | 93 nA// 10 MΩ | - | - |
| | 100 MΩ[5][6] | 0.01 MΩ | - | 93 nA// 10 MΩ | - | - |
| | 300 MΩ[6][7] | 0.01 MΩ | 2.0% +10 @ <100 MΩ  8.0% +10 @ >100 MΩ | 93 nA// 10 MΩ | - | - |
| | 300 nS | 0.01 nS | 1% + 10 | 93 nA// 10 MΩ | - | - |

**Notes for resistance specifications:**

**1**  Overload protection: 1000 VRMS for short circuits with <0.3 A current
**2**  Maximum open voltage is <+3.3 V.
**3**  Built-in buzzer beeps when the resistance measured is less than 25 Ω ± 10 Ω. The multimeter can capture intermittent measurements longer than 1 ms.
**4**  The accuracy of the 30 Ω to 3 kΩ range is specified after the Null function is used to subtract the test lead resistance and thermal effect (by shorting the test leads).
**5**  For the ranges of 30 MΩ and 100 MΩ, the RH is specified for <60%.
**6**  The accuracy for ranges <50 nS is specified after the Null function is used on an open test lead.
**7**  The temperature coefficient of the 100 MΩ and 300 MΩ range is 0.1 × (specified accuracy)/°C (from −20 °C to 18 °C or 28 °C to 55 °C).

**Table 5-1** DC specifications (continued)

| Function | Range | Resolution | Accuracy | Test current | Burden voltage | Input impedance |
|----------|-------|------------|----------|--------------|----------------|-----------------|
| | | | | | *(where applicable)* | |
| Diode | 3 V[3] | 0.0001 V | 0.5% + 5 | Approx. 1 mA to 2 mA | - | - |
| | Auto[4] | 0.0001 V | 0.5% + 5 | Approx. 0.1 mA to 0.3 mA | - | - |

**Notes for diode specifications:**

1 Overload protection: 1000 V$_{RMS}$ for short circuits with <0.3 A current
2 Built-in buzzer beeps continuously when the voltage measured is less than 50 mV and beeps once for forward-biased diode or semiconductor junctions measured between 0.3 V and 0.8 V (0.3 V ≤ reading ≤ 0.8 V).
3 Open voltage for diode: <+3.3 V$_{DC}$
4 Open voltage for Auto-diode: <+2.5 V$_{DC}$ and >−1.0 V$_{DC}$

| Function | Range | Resolution | Accuracy | Test current | Burden voltage | Input impedance |
|----------|-------|------------|----------|--------------|----------------|-----------------|
| Current | 300 μA[1] | 0.01 μA | 0.2% + 5 | - | <0.04 V | - |
| | 3000 μA[1] | 0.1 μA | 0.2% + 5 | - | <0.4 V | - |
| | 30 mA[1] | 0.001 mA | 0.2% + 5 | - | <0.08 V | - |
| | 300 mA[1][3] | 0.01 mA | 0.2% + 5 | - | <1.00 V | - |
| | 3 A[2] | 0.0001 A | 0.3% + 10 | - | <0.1 V | - |
| | 10 A[2][4] | 0.001 A | 0.3% + 10 | - | <0.3 V | - |

**Notes for DC current specifications:**

1 Overload protection for 300 μA to 300 mA range: 0.44 A/1000 V; 10 × 35 mm fast-acting fuse
2 Overload protection for 3 A to 10 A range: 11 A/1000 V; 10 × 38 mm fast-acting fuse
3 Specification for 300 mA range: 440 mA continuous
4 Specification for 10 A range: 10 A continuous. Add 0.3% to the specified accuracy when measuring signals >10 A to 20 A for 30 seconds maximum. After measuring currents >10 A, cool down the multimeter for twice the duration of the measured time before proceeding with low current measurements.

# AC specifications

**Table 5-2**  True RMS AC voltage specifications

| Function | Range | Resolution | Accuracy | | | | |
|---|---|---|---|---|---|---|---|
| | | | 45 Hz to 65 Hz | 20 Hz to 45 Hz<br><br>65 Hz to 1 kHz | 1 kHz to 5 kHz | 5 kHz to 20 kHz | 20 kHz to 100 kHz[5] |
| Voltage | 30 mV | 0.001 mV | 0.6% + 20 | 0.7% + 25 | 1.0% + 25 | 1.0% + 40 | 3.5% + 40 |
| | 300 mV | 0.01 mV | 0.6% + 20 | 0.7% + 25 | 1.0% + 25 | 1.0% + 40 | 3.5% + 40 |
| | 3 V | 0.0001 V | 0.6% + 20 | 1.0% + 25 | 1.5% + 25 | 2.0% + 40 | 3.5% + 40 |
| | 30 V | 0.001 V | 0.6% + 20 | 1.0% + 25 | 1.5% + 25 | 2.0% + 40 | 3.5% + 40 |
| | 300 V | 0.01 V | 0.6% + 20 | 1.0% + 25 | 1.5% + 25 | 2.0% + 40 | - |
| | 1000 V | 0.1 V | 0.6% + 20 | 1.0% + 25 | 1.5% + 25 | - | - |
| | LPF (low-pass filter) enabled, applicable for all voltage ranges and resolution | | 0.6% + 20 | 1.0% + 25 @ <200 Hz<br><br>5.0% + 25 @ <440 Hz | - | - | - |
| | $Z_{LOW}$ (low input impedance) enabled, applicable for 1000 V range and resolution only[4] | | 2% + 40 | 2% + 40 @ <440 Hz | - | - | - |

**Notes for AC voltage specifications:**

**1** Overload protection: 1000 VRMS (for millivolt measurements, 1000 VRMS for short circuits with <0.3 A current)
**2** Input impedance: 10 MΩ (nominal) in parallel with <100 pF
**3** The input signal is lower than the product of 20,000,000 V×Hz.
**4** $Z_{LOW}$ impedance: 2 kΩ (nominal). For $Z_{LOW}$ measurements, autoranging is disabled and the multimeter's range is set to 1000 V in the manual ranging mode.
**5** For 20 kHz to 100 kHz accuracy: Three counts of the LSD per kHz of additional error is to be added for frequencies >20 kHz and signal inputs <10% of range.

**Table 5-3**  True RMS AC current specifications

| Function | Range | Resolution | Accuracy | | Burden voltage |
|---|---|---|---|---|---|
| | | | **45 Hz to 65 Hz** | **20 Hz to 45 Hz** / **65 Hz to 2 kHz** | |
| Current | 300 μA[1] | 0.01 μA | 0.6% + 25 | 0.9% + 25 | <0.04 V |
| | 3000 μA[1] | 0.1 μA | 0.6% + 25 | 0.9% + 25 | <0.4 V |
| | 30 mA[1] | 0.001 mA | 0.6% + 25 | 0.9% + 25 | <0.08 V |
| | 300 mA[1][3] | 0.01 mA | 0.6% + 25 | 0.9% + 25 | <1.00 V |
| | 3 A[2] | 0.0001 A | 0.8% + 25 | 1.0% + 25 | <0.1 V |
| | 10 A[2][4] | 0.001 A | 0.8% + 25 | 1.0% + 25 | <0.3 V |

**Notes for AC current specifications:**

**1**  Overload protection for 300 μA to 300 mA range: 0.44 A/1000 V; 10 × 35 mm fast-acting fuse
**2**  Overload protection for 3 A to 10 A range: 11 A/1000 V; 10 × 38 mm fast-acting fuse
**3**  Specification for 300 mA range: 440 mA continuous
**4**  Specification for 10 A range: 10 A continuous. Add 0.3% to the specified accuracy when measuring signals >10 A to 20 A for 30 seconds maximum. After measuring currents >10 A, cool down the multimeter for twice the duration of the measured time before proceeding with low current measurements.

# AC+DC specifications

**Table 5-4**   True RMS AC+DC voltage specifications

| Function | Range | Resolution | Accuracy | | | | |
|---|---|---|---|---|---|---|---|
| | | | **45 Hz to 65 Hz** | **20 Hz to 45 Hz** / **65 Hz to 1 kHz** | **1 kHz to 5 kHz** | **5 kHz to 20 kHz** | **20 kHz to 100 kHz**[3] |
| Voltage | 30 mV | 0.001 mV | 0.7% + 40 | 0.8% + 45 | 1.1% + 45 | 1.1% + 60 | 3.6% + 60 |
| | 300 mV | 0.01 mV | 0.7% + 25 | 0.8% + 30 | 1.1% + 30 | 1.1% + 45 | 3.6% + 45 |
| | 3 V | 0.0001 V | 0.7% + 25 | 1.1% + 30 | 1.6% + 30 | 2.1% + 45 | 3.6% + 45 |
| | 30 V | 0.001 V | 0.7% + 25 | 1.1% + 30 | 1.6% + 30 | 2.1% + 45 | 3.6% + 45 |
| | 300 V | 0.01 V | 0.7% + 25 | 1.1% + 30 | 1.6% + 30 | 2.1% + 45 | - |
| | 1000 V | 0.1 V | 0.7% + 25 | 1.1% + 30 | 1.6% + 30 | - | - |

**Notes for AC+DC voltage specifications:**

**1**   Overload protection: 1000 VRMS (for millivolt measurements, 1000 VRMS for short circuits with <0.3 A current)

**2**   Input impedance: 10 MΩ (nominal) in parallel with <100 pF

**3**   For 20 kHz to 100 kHz accuracy: Three counts of the LSD per kHz of additional error is to be added for frequencies >20 kHz and signal inputs <10% of range.

**Table 5-5**  True RMS AC+DC current specifications

| Function | Range | Resolution | Accuracy | | Burden voltage |
|----------|-------|------------|----------|---|----------------|
| | | | **45 Hz to 65 Hz** | **20 Hz to 45 Hz** <br> **65 Hz to 2 kHz** | |
| Current | 300 µA[1] | 0.01 µA | 0.8% + 30 | 1.1% + 30 | <0.04 V |
| | 3000 µA[1] | 0.1 µA | 0.8% + 30 | 1.1% + 30 | <0.4 V |
| | 30 mA[1] | 0.001 mA | 0.8% + 30 | 1.1% + 30 | <0.08 V |
| | 300 mA[1][3] | 0.01 mA | 0.8% + 30 | 1.1% + 30 | <1.00 V |
| | 3 A[2] | 0.0001 A | 0.9% + 35 | 1.3% + 30 | <0.1 V |
| | 10 A[2][4] | 0.001 A | 0.9% + 35 | 1.3% + 30 | <0.3 V |

**Notes for AC+DC current specifications:**

**1**  Overload protection for 300 µA to 300 mA range: 0.44 A/1000 V; 10 × 35 mm fast-acting fuse

**2**  Overload protection for 3 A to 10 A range: 11 A/1000 V; 10 × 38 mm fast-acting fuse

**3**  Specification for 300 mA range: 440 mA continuous

**4**  Specification for 10 A range: 10 A continuous. Add 0.3% to the specified accuracy when measuring signals >10 A to 20 A for 30 seconds maximum. After measuring currents >10 A, cool down the multimeter for twice the duration of the measured time before proceeding with low current measurements.

# Capacitance specifications

**Table 5-6**  Capacitance specifications

| Range | Resolution | Accuracy | Measuring rate (at full scale) |
|---|---|---|---|
| 10 nF | 0.001 nF | 1% + 5 | 4 times/second |
| 100 nF | 0.01 nF | 1% + 2 | |
| 1000 nF | 0.1 nF | 1% + 2 | |
| 10 μF | 0.001 μF | 1% + 2 | |
| 100 μF | 0.01 μF | 1% + 2 | |
| 1000 μF | 0.1 μF | 1% + 2 | 0.5 times/second |
| 10 mF | 0.001 mF | 1% + 2 | 0.3 times/second |

**Notes for capacitance specifications:**

**1**  Overload protection: 1000 VRMS for short circuits with <0.3 A current
**2**  The accuracy of 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).

# Temperature specifications

**Table 5-7**  Temperature specifications

| Thermal type | Range | Resolution | Accuracy |
|:---:|:---:|:---:|:---:|
| K | −200 °C to 1372 °C | 0.1 °C | 1% + 1 °C |
|  | −328 °F to 2502 °F | 0.1 °F | 1% + 1.8 °F |
| J | −200 °C to 1200 °C | 0.1 °C | 1% + 1 °C |
|  | −328 °F to 2192 °F | 0.1 °F | 1% + 1.8 °F |

**Notes for temperature specifications:**

1  The specifications above is specified after 60 minutes of warm-up time.
2  The accuracy does not include the tolerance of the thermocouple probe.
3  Do not allow the temperature sensor to contact a surface that is energized above 30 V<sub>RMS</sub> or 60 V<sub>DC</sub>. Such voltages poses a shock hazard.
4  Ensure that the ambient temperature is stable within ±1 ºC and that the Null function is used to reduce the test lead's thermal effect and temperature offset. Before using Null function, set the multimeter to measure temperature without ambient compensation ( ) and keep the thermocouple probe as close to the multimeter as possible (avoid contact with any surface that has a different temperature from the ambient temperature).
5  When measuring temperature with respect to any temperature calibrator, try to set both the calibrator and multimeter with an external reference (without internal ambient compensation). If both the calibrator and multimeter are set with internal reference (with internal ambient compensation), some deviations may show between the readings of the calibrator and multimeter, due to differences in ambient compensation between the calibrator and multimeter. Keeping the multimeter close to the output terminal of calibrator will help reduce the deviation.
6  The temperature calculation is specified according to the safety standards of EN/IEC-60548-1 and NIST175.

# Frequency specifications

**Table 5-8**   Frequency specifications

| Range | Resolution | Accuracy | Minimum input frequency |
|---|---|---|---|
| 99.999 Hz | 0.001 Hz | 0.02% + 5 | |
| 999.99 Hz | 0.01 Hz | 0.005% + 5 | |
| 9.9999 kHz | 0.0001 kHz | 0.005% + 5 | |
| 99.999 kHz | 0.001 kHz | 0.005% + 5 | 0.5 Hz |
| 999.99 kHz | 0.01 kHz | 0.005% + 5 | |
| >1 MHz | 0.1 kHz | 0.005% + 5 @ <1 MHz | |

**Notes for frequency specifications:**

**1**   Overload protection: 1000 V; input signal is <20,000,000 V × Hz (product of voltage and frequency).

**2**   The frequency measurement is susceptible to error when measuring low-voltage and low-frequency signals. Shielding inputs from external noise pickup is critical for minimizing measurement errors. Turning on the low-pass filter may help you to filter out the noise and achieve a stable reading.

# Duty cycle and pulse width specifications

**Table 5-9**   Duty cycle and pulse width specifications

| Function | Mode | Range | Resolution | Accuracy at full scale |
|---|---|---|---|---|
| Duty cycle | DC coupling | 99.99% | - | 0.3% per kHz + 0.3% |
| | AC coupling | 99.99% | - | 0.3% per kHz + 0.3% |

**Notes for duty cycle specifications:**

**1**   The accuracy for duty cycle and pulse width measurements is based on a 3 V square wave input to the DC 3 V range. For AC couplings, the duty cycle range can be measured within the range of 10% to 90% for signal frequencies >20 Hz.

**2**   The range of the duty cycle is determined by the frequency of the signal:
$\{10\ \mu s \times frequency \times 100\%\}$ to $\{[1 - (10\ \mu s \times frequency)] \times 100\%\}$

**Table 5-9**   Duty cycle and pulse width specifications (continued)

| Function | Mode | Range | Resolution | Accuracy at full scale |
|---|---|---|---|---|
| Pulse width | - | 999.99 ms | 0.01 ms | (duty cycle accuracy/frequency) + 0.01 ms |
| | - | 2000.0 ms | 0.1 ms | (duty cycle accuracy/frequency) + 0.1 ms |

**Notes for pulse width specifications:**

**1** The accuracy for duty cycle and pulse width measurements is based on a 3 V square wave input to the DC 3 V range.
**2** The pulse width (positive or negative) must be >10 µs. The range of the pulse width is determined by the frequency of the signal.

## Calculation example

**Table 5-10** Duty cycle and pulse width calculation example

| Frequency | Duty cycle range[1] | | Accuracy | |
|---|---|---|---|---|
| | **From** | **To** | **Duty cycle[2]** | **Pulse width[3]** |
| 100 Hz | 0.1% | 99.9% | 0.33% | 0.043 ms |
| 1 kHz | 1% | 99% | 0.6% | 0.016 ms |

**Notes for duty cycle and pulse width calculation example:**

**1** The range of the duty cycle is determined from this equation:
   {10 µs × frequency × 100%} to {[1 − (10 µs × frequency)] × 100%}
**2** The accuracy of the duty cycle is determined from this equation: [0.3% × (frequency kHz)] + 0.3%
**3** The accuracy of the pulse width is determined from this equation: (duty cycle accuracy/frequency) + 0.01 ms

# Frequency sensitivity specifications

## For voltage measurements

**Table 5-11** Frequency sensitivity and trigger level specifications for voltage measurements

| Input range[1] | Minimum sensitivity (RMS sine wave) | | | Trigger level for DC coupling |
|---|---|---|---|---|
| | 15 Hz to 100 kHz | 0.5 Hz to 15 Hz  100 kHz to 200 kHz | Up to 1 MHz | 0.5 Hz to 200 kHz |
| 30 mV | 3 mV | 3 mV | - | 5 mV |
| 300 mV | 7 mV | 8 mV | 38 mV | 15 mV |
| 3 V | 0.12 V | 0.12 V | 0.48 V | 0.15 V |
| 30 V | 0.8 V | 0.8 V | 3.5 V | 1.5 V |
| 300 V | 6.7 V | 8 V @ <100 kHz | - | 11 V @ <100 kHz |
| 1000 V | 67 V | 67 V @ <100 kHz | - | 110 V @ <100 kHz |

 **Notes for frequency sensitivity and trigger level specifications for voltage measurements:**

**1**  Maximum input for specified accuracy, refer to *"AC specifications"* on page 136.

## For current measurements

**Table 5-12** Frequency sensitivity specifications for current measurements

| Input range[1] | Minimum sensitivity (RMS sine wave) |
|---|---|
| | 2 Hz to 30 kHz |
| 300 µA | 70 µA |
| 3000 µA | 120 µA |
| 30 mA | 1.2 mA |
| 300 mA | 12 mA |

 **Notes for frequency sensitivity specifications for current measurements:**

**1**  Maximum input for specified accuracy, refer to *"AC specifications"* on page 136.

**Table 5-12** Frequency sensitivity specifications for current measurements (continued)

| Input range[1] | Minimum sensitivity (RMS sine wave) |
|:---:|:---:|
| | 2 Hz to 30 kHz |
| 3 A | 0.12 A |
| 10 A | 1.2 A |

 **Notes for frequency sensitivity specifications for current measurements:**

**1** Maximum input for specified accuracy, refer to "AC specifications" on page 136.

# Peak hold specifications

**Table 5-13** Peak hold specifications for DC voltage and current measurements

| Signal width | Accuracy for DC voltage and current |
|:---:|:---:|
| Single event >1 ms | Specified accuracy + 400 |
| Repetitive >250 μs | Specified accuracy + 1000 |

# Decibel (dB) specifications

**Table 5-14** Decibel specifications

| dB base | Reference | Default reference |
|:---:|:---:|:---:|
| 1 mW (dBm) | 1 Ω to 9999 Ω | 50 Ω |
| 1 V (dBV) | 1 V | 1 V |

 **Notes for decibel specifications:**

**1** The reading of dBm is indicated in decibels of power above or below 1 mW, or decibels of voltage above or below 1 V. The formula is calculated according to the voltage measurement and specified reference impedance. Its accuracy is depended on the accuracy of the voltage measurement. See Table 5-15.

**2** Auto-ranging mode is used.

**3** The bandwidth is according to voltage measurements.

### Decibel (dBV) accuracy specifications

**Table 5-15** Decibel accuracy specifications for DC voltage measurements

| | dBV range | | Accuracy | | | | |
|---|---|---|---|---|---|---|---|
| Range | Minimum | Maximum | 45 Hz to 65 Hz | 20 Hz to 45 Hz / 65 Hz to 1 kHz | 1 kHz to 5 kHz | 5 kHz to 20 kHz | 20 kHz to 100 kHz |
| 30 mV | −56.48 | −30.46 | 0.06 | 0.07 | 0.09 | 0.1 | 0.32 |
| 300 mV | −36.48 | −10.46 | 0.06 | 0.07 | 0.09 | 0.1 | 0.32 |
| 3 V | −16.48 | +9.54 | 0.06 | 0.09 | 0.14 | 0.19 | 0.32 |
| 30 V | +3.52 | +29.54 | 0.06 | 0.09 | 0.14 | 0.19 | 0.32 |
| 300 V | +23.52 | +49.54 | 0.06 | 0.09 | 0.14 | 0.19 | - |
| 1000 V | +33.98 | +60 | 0.06 | 0.09 | 0.14 | - | - |

# Display update rate (approximate)

**Table 5-16** Display update rate (approximate)

| Function | Times/second |
|---|---|
| AC V (V or mV) | 7 |
| DC V (V or mV) | 7 |
| Ω | 14 |
| Ω with offset compensation | 3 |
| Diode | 14 |
| Auto-diode | 3 |
| Capacitance | 4 (<100 μF) |
| DC A (μA, mA, or A) | 7 |
| AC A (μA, mA, or A) | 7 |

**Table 5-16** Display update rate (approximate) (continued)

| Function | Times/second |
|---|---|
| Temperature | 7 |
| Frequency | 2 (>10 Hz) |
| Duty cycle | 1 (>10 Hz) |
| Pulse width | 1 (>10 Hz) |

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**5    Characteristics and Specifications**

Electrical Specifications
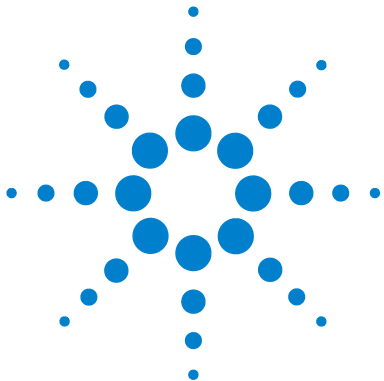
# Appendix A
# Shift Functions Using the Shift Key

The table below lists the function shown in the primary display when the [Esc Shift View] key is pressed, with respect to the multimeter's rotary switch position. Press [Esc Shift View] to cycle through the available shift functions.

**Table A-1**   U1273A default and shift functions

| Rotary switch position | Function shown in the primary display: | |
|---|---|---|
| | **Default** | **When [Esc / Shift View] is pressed** |
| $\underset{V}{\overset{Z_{LOW}}{\sim}}$ | Low impedance ($Z_{LOW}$) AC or DC voltage measurement (AC/DC V)[1] | - |
| [LPF] $\sim$ V | AC voltage measurement (AC V) | AC voltage measurement (AC V) with low-pass filter (LPF) |
| [LPF] $\sim$ mV | AC voltage measurement (AC mV) | AC voltage measurement (AC mV) with low-pass filter (LPF) |
| $\underset{V}{\cong}$ | DC voltage measurement (DC V) | AC voltage measurement (AC V) |
| | | AC+DC voltage measurement (AC+DC V) |
| $\underset{mV}{\cong}$ | DC voltage measurement (DC mV) | AC voltage measurement (AC mV) |
| | | AC+DC voltage measurement (AC+DC mV) |
| $\underset{\Omega}{\overset{\text{\tiny ))}}{}}$ Smart Ω | Resistance measurement (Ω) | Continuity test ( •))  Ω) |
| | | Resistance measurement (Ω) with offset compensation (Smart Ω) |
| ✈ Auto | Diode test (V) | Auto-diode test (V) |
| ⊣⊢ 🌡 | Capacitance measurement (F) | Temperature measurement (°C or °F) |
| $\underset{mA \cdot A}{\cong}$ With the positive probe inserted into the **µA mA** terminal | DC current measurement (DC mA) | AC current measurement (AC mA) |
| | | AC+DC current measurement (AC+DC mA) |
| | | % (0-20 or 4-20) mA |
| $\underset{mA \cdot A}{\cong}$ With the positive probe inserted into the **A** terminal | DC current measurement (DC A) | AC current measurement (AC A) |
| | | AC+DC current measurement (AC+DC A) |
| | | % (0-20 or 4-20) A |

**Table A-1**  U1273A default and shift functions (continued)

| Rotary switch position | Function shown in the primary display: | |
| --- | --- | --- |
| | **Default** | **When [Esc Shift View] is pressed** |
| $\underset{\mu A}{\overset{\sim}{=}}$ | DC current measurement (DC μA) | AC current measurement (AC μA) |
| | | AC+DC current measurement (AC+DC μA) |

[1] Press (Dual Foot A) to switch the function shown in the primary display (AC V) with the function shown in the secondary display (DC V). Press (Dual Foot A) again to switch back the displays.

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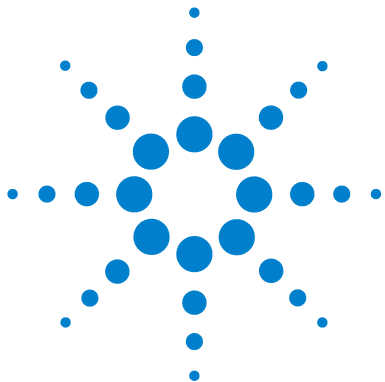
# Appendix B
# Dual Display Combinations Using the Dual Key

The table below lists the function shown in the secondary display when the (Dual/Exit) key is pressed, with respect to the multimeter's rotary switch position. Press (Dual/Exit) to cycle through the available dual display combinations. Press (Dual/Exit) for more than 1 second to return to the default secondary display function (ambient temperature measurement).

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**Table B-1**  U1273A dual display combinations

| Rotary switch position | Function shown (when 🔘 is pressed) in the: | |
|---|---|---|
| | **Primary display** | **Secondary display** |
| $\underset{\sim}{Z_{LOW}}$ V | Low impedance ($Z_{LOW}$) AC voltage measurement (V) | Low impedance ($Z_{LOW}$) DC voltage measurement (V) |
| | *Press 🔘 to switch the function shown on the primary display (AC V) with the function shown on the secondary display (DC V). Press 🔘 again to switch back the functions.* | |
| LPF $\sim$ V | AC voltage measurement (AC V) | AC coupling frequency measurement (Hz) |
| | AC voltage decibel display (dBm) is enabled when 🔘 is pressed. | AC voltage measurement (AC V) |
| | AC voltage measurement (AC V) with low-pass filter (LPF) | AC coupling frequency measurement (Hz) |
| | AC voltage decibel display (dBm) with low-pass filter (LPF) is enabled when 🔘 is pressed. | AC voltage measurement (AC V) with low-pass filter (LPF) |
| LPF $\sim$ mV | AC voltage measurement (AC mV) | AC coupling frequency measurement (Hz) |
| | AC voltage decibel display (dBm) is enabled when 🔘 is pressed. | AC voltage measurement (AC mV) |
| | AC voltage measurement (AC mV) with low-pass filter (LPF) | AC coupling frequency measurement (Hz) |
| | AC voltage decibel display (dBm) with low-pass filter (LPF) is enabled when 🔘 is pressed. | AC voltage measurement (AC mV) with low-pass filter (LPF) |

**Table B-1**  U1273A dual display combinations (continued)

| Rotary switch position | Function shown (when (Dual Exit) is pressed) in the: | |
| --- | --- | --- |
| | **Primary display** | **Secondary display** |
| $\overset{\sim}{\underset{\overline{\underline{\vee}}}{}}$ | DC voltage measurement (DC V) | DC coupling frequency measurement (Hz) |
| | | AC voltage measurement (AC V) |
| | DC voltage decibel display (dBm) is enabled when (Dual Exit) is pressed. | DC voltage measurement (DC V) |
| | AC voltage measurement (AC V) | AC coupling frequency measurement (Hz) |
| | | DC voltage measurement (DC V) |
| | AC voltage decibel display (dBm) is enabled when (Dual Exit) is pressed. | AC voltage measurement (AC V) |
| | AC+DC voltage measurement (AC+DC V) | AC coupling frequency measurement (Hz) |
| | | AC voltage measurement (AC V) |
| | | DC voltage measurement (DC V) |
| | AC+DC voltage decibel display (dBm) is enabled when (Dual Exit) is pressed. | AC+DC voltage measurement (AC+DC V) |
| $\overset{\sim}{\underset{\overline{\underline{mV}}}{}}$ | DC voltage measurement (DC mV) | DC coupling frequency measurement (Hz) |
| | | AC voltage measurement (AC mV) |
| | DC voltage decibel display (dBm) is enabled when (Dual Exit) is pressed. | DC voltage measurement (DC mV) |
| | AC voltage measurement (AC mV) | AC coupling frequency measurement (Hz) |
| | | DC voltage measurement (DC mV) |
| | AC voltage decibel display (dBm) is enabled when (Dual Exit) is pressed. | AC voltage measurement (AC mV) |
| | AC+DC voltage measurement (AC+DC mV) | AC coupling frequency measurement (Hz) |
| | | AC voltage measurement (AC mV) |
| | | DC voltage measurement (DC mV) |
| | AC+DC voltage decibel display (dBm) is enabled when (Dual Exit) is pressed. | AC+DC voltage measurement (AC+DC V) |

**Table B-1**  U1273A dual display combinations (continued)

| Rotary switch position | Function shown (when ⬚ is pressed) in the: | |
|---|---|---|
| | **Primary display** | **Secondary display** |
| ))) Ω Smart Ω | Resistance measurement (Ω) | Ambient temperature (°C)[1] |
| | Continuity test ( •))) Ω) | *Press* ⬚ *to switch between the normal open or normal closed state.* |
| | Resistance measurement (Ω) with offset compensation (Smart Ω) | *Press* ⬚ *to switch between the leakage current and bias voltage display.* |
| ✈ Auto | Diode test (V) | Ambient temperature (°C)[1] |
| | Auto-diode test (V) | |
| ⊣⊢🌡 | Capacitance measurement (F) | Ambient temperature (°C)[1] |
| | Temperature measurement (°C or °F) | Ambient temperature (°C)[2] |
| ∼‾ mA•A  With the positive probe inserted into the **µA mA** terminal | DC current measurement (DC mA) | DC coupling frequency measurement (Hz) |
| | | AC current measurement (AC mA) |
| | AC current measurement (AC mA) | AC coupling frequency measurement (Hz) |
| | | DC current measurement (DC mA) |
| | AC+DC current measurement (AC+DC mA) | AC coupling frequency measurement (Hz) |
| | | AC current measurement (AC mA) |
| | | DC current measurement (DC mA) |
| | % (0-20 or 4-20) DC mA | DC current measurement (DC mA)[1] |
| ∼‾ mA•A  With the positive probe **A** inserted into the terminal | DC current measurement (DC A) | DC coupling frequency measurement (Hz) |
| | | AC current measurement (AC A) |
| | AC current measurement (AC A) | AC coupling frequency measurement (Hz) |
| | | DC current measurement (DC A) |
| | AC+DC current measurement (AC+DC A) | AC coupling frequency measurement (Hz) |
| | | AC current measurement (AC A) |
| | | DC current measurement (DC A) |
| | % (0-20 or 4-20) DC A | DC current measurement (DC A)[1] |

**Table B-1**  U1273A dual display combinations (continued)

| Rotary switch position | Function shown (when 🔘 is pressed) in the: | |
| --- | --- | --- |
| | **Primary display** | **Secondary display** |
| ∼̿ μA | DC current measurement (DC μA) | DC coupling frequency measurement (Hz) |
| | | AC current measurement (AC μA) |
| | AC current measurement (AC μA) | AC coupling frequency measurement (Hz) |
| | | DC current measurement (DC μA) |
| | AC+DC current measurement (AC+DC μA) | AC coupling frequency measurement (Hz) |
| | | AC current measurement (AC μA) |
| | | DC current measurement (DC μA) |

[1] Alternative dual display combination not available for this function.

[2] When 🔘 is pressed, temperature measurement without ambient compensation ( ⏚⏚⏚ ) is enabled.

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