Agilent U1190A Series Handheld Clamp Meters

User's Guide

Agilent Technologies

Notices

Manual Part Number

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Agilent Technologies, Inc.
5301, Stevens Creek Blvd.
Santa Clara, CA 95051 USA

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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.

	DC (Direct current or voltage)		Caution, risk of danger (refer to this manual for specific Warning or Caution information)
	AC (Alternating current or voltage)		Application around and removal from HAZARDOUS LIVE conductors is permitted
	Both direct and alternating current	**400 A MAX**	**U1191A/U1192A:** Maximum allowable current measurement is 400 A
	Earth (ground) terminal	**600 A MAX**	**U1193A/U1194A:** Maximum allowable current measurement is 600 A
	Equipment protected throughout by double insulation or reinforced insulation	**CAT III 600 V**	Category III 600 V overvoltage protection
	Caution, risk of electric shock	**CAT IV 300 V**	Category IV 300 V overvoltage protection

Safety Considerations

Read the information below before using this instrument.

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

CAUTION

- Disconnect circuit power and discharge all high-voltage capacitors before testing resistance, continuity, diodes, or capacitance.
- Use the proper terminals, function, and range for your measurements.
- This device is for use at altitudes of up to 2,000 m.
- Never measure voltage when current measurement is selected.
- Always use the specified battery type. The power for the meter is supplied with two 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 meter if it is damaged. Before you use the meter, inspect the case. Look for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.**
- **Inspect the test leads for damaged insulation or exposed metal. Check the test leads for continuity. Replace damaged test leads before you use the meter.**
- **Do not operate the meter around explosive gas, vapor, or wet environments.**
- **Do not apply more than the rated voltage and current (as marked on the meter) between the terminals or between the terminal and the earth ground.**

WARNING

- **Never use the meter in wet conditions or when there is water on the surface. If the meter is wet, ensure that the meter is dried only by trained personnel.**
- **Before use, verify the meter's operation by measuring a known voltage. Use caution when working above 60 V DC, 30 V AC RMS, or 42.4 V peak. Such voltages pose a shock hazard.**
- **When measuring current, turn off the circuit power before connecting the meter in the circuit. Remember to place the meter in series with the circuit.**
- **When measuring temperature, keep the thermocouple probe as close to the meter as possible, and avoid contact with surfaces above 60 V DC, 30 V AC RMS, or 42.4 V peak. Such voltages pose a shock hazard.**
- **When servicing the meter, use only the specified replacement parts.**
- **When using the probes, keep your fingers behind the finger guards on the probes.**
- **Connect the common test lead before you connect the live test lead. When you disconnect the leads, disconnect the live test lead first.**
- **Remove the test leads from the meter before you open the battery cover. Do not operate the meter with the battery cover or portions of the cover removed or loosened.**
- **To avoid false readings, which may lead to possible electric shock or personal injury, replace the battery as soon as the low battery indicator appears and flashes.**
- **Use the meter only as specified in this guide. Otherwise, the protection provided by the meter may be impaired.**
- **Individual protective equipment must be used if hazardous live parts in the installation are accessible where measurement is to be carried out.**
- **The tactile indicator or barrier, indicates the limit of safe access of the handheld part.**

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	–10 °C to 50 °C
Operating humidity	Up to 80% RH (relative humidity) for temperature up to 30 °C, decreasing linearly to 50% RH at 50 °C
Storage temperature	–40 °C to 60 °C, 40% to 80% RH (without batteries)
Altitude	Up to 2000 meters
Pollution degree	Pollution degree 2

NOTE

The U1190A Series Handheld Clamp Meter complies with the following safety and EMC requirements:

- IEC 61010-1:2001/EN 61010-1:2001
- IEC 61010-2-032:2002/EN 61010-2-032:2002
- CAN/CSA-C22.2 No. 61010-1-04
- CAN/CSA-C22.2 No. 61010-2-032-04
- ANSI/UL Std. No. 61010-1:2004
- IEC61326-1:2005/EN61326-1:2006
- Canada: ICES/NMB-001: Issue 4, June 2006
- Australia/New Zealand: AS/NZS CISPR 11:2004

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.
C SA US	The CSA mark is a registered trademark of the Canadian Standards Association.		This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.

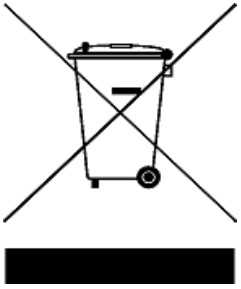
Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

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

Product Category:

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

The affixed product label is as shown below.



Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest 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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List of Tables

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1 Introduction

This chapter teaches you how to set up your clamp meter for the first time. An introduction to all the features of the clamp meter is also given.

About This Manual

The descriptions and instructions in this manual apply to the Agilent U1191A, U1192A, U1193A, and U1194A handheld clamp meters (hereafter referred to as the clamp meter).

The model U1194A appears in all illustrations.

Documentation map

The following manuals and software are available for your clamp meter. 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.

Safety notes

Safety notes are used throughout this manual (see the "Safety Notices" section for format examples). Familiarize yourself with each of the notes and its meaning before operating your clamp meter.

More pertinent safety notes for using this product are located under the "Safety Considerations" section.

Do not proceed beyond a safety notice until the indicated conditions are fully understood and met.

Preparing Your Clamp Meter

Checking the shipment

When you receive your clamp meter, 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 clamp meter 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 *U1190A Series Quick Start Guide*.
3. For any question or problems, refer to the Agilent contact numbers on the back of this manual.

Installing the batteries

Your clamp meter is powered by two 1.5 V AAA alkaline batteries (included with the shipment). When you receive your clamp meter, 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 62.

1 **Open the battery cover.** Loosen the screw with a suitable Phillips screwdriver and remove the battery cover as shown in Figure 1-1.

2 **Insert the batteries.** 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 screw.

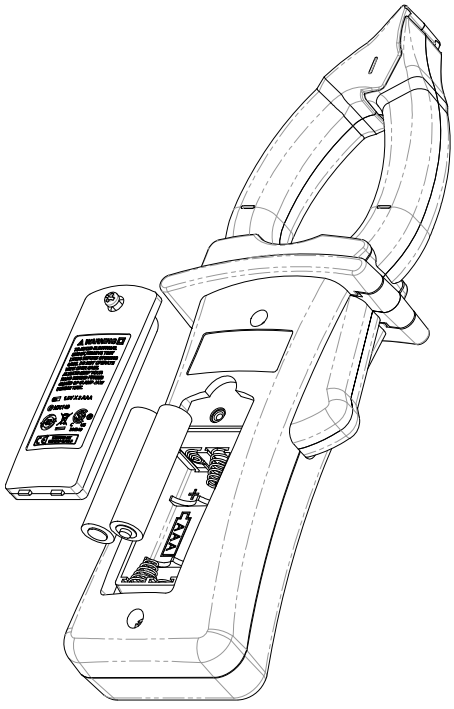


Figure 1-1 Installing the batteries

The battery level indicator in the lower left-hand corner of the display indicates the relative condition of the batteries. Table 1-1 describes the various battery levels the indicator represents.

Table 1-1 Battery level indicator

Indication	Battery capacity
	Full capacity
	2/3 capacity
	1/3 capacity
 *(Flashing periodically)*	Almost empty[1]

[1] Batteries change advised. Always use the specified battery type listed in the "Product Characteristics" on page 62.

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

CAUTION To avoid instruments being damage from battery leakage:

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

Turning on your clamp meter

To power ON your clamp meter, turn the rotary switch from the **OFF** position to any other position.

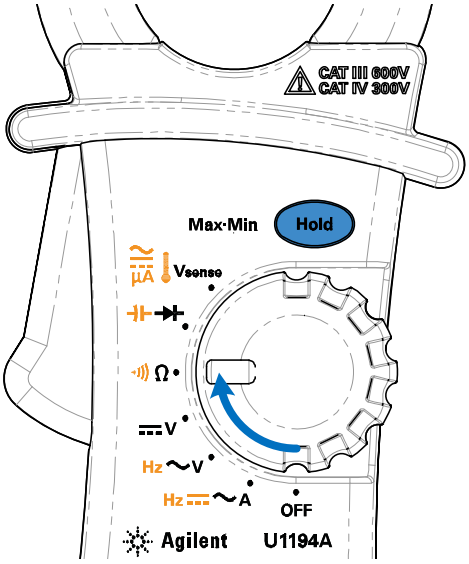


Figure 1-2 Powering on the clamp meter

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

Automatic Power-Off (APO)

Your clamp meter automatically turns off if the rotary switch is not moved or a key is not pressed for 15 minutes (default). The clamp meter will beep thrice before it powers off. Pressing any key or turning the rotary switch to a new position will turn the clamp meter back on after it is powered off automatically.

The APO symbol is shown on the bottom left of the display when the automatic power-off function is enabled.

Follow the steps below to change the timer period or completely disable the automatic power-off.

1. Press and hold Shift while powering on the clamp meter to enter the Setup menu.
2. The automatic power-off (**A #**) timer period is the first Setup item shown.
3. Press Hold to make changes to the **A #** value.

   Press ✳/LPF or △ to change the timer period (from **A 01** to **A 99** minutes) or to completely disable the automatic power-off function (**AoFF**).
4. Press Hold to save the changes, or press Shift to discard the changes and proceed to the next Setup item.
5. Cycle the clamp meter's power to exit the Setup menu.

Enabling the backlight

If viewing the display becomes difficult in low-light conditions, press ✳/LPF (on the U1192A/U1193A/U1194A models) or ✳ (on the U1191A model) to activate the LCD backlight.

Press ✳/LPF/✳ again to deactivate the LCD backlight.

NOTE To conserve battery life, a user-adjustable timer controls how long the backlight stays on. The default timer period is 15 seconds.

Follow the steps below to change the timer period or completely disable the backlight timer.

1 Press and hold Shift while powering on the clamp meter to enter the Setup menu.

2 Press Shift again. The backlight (**b #**) timer period is the second Setup item shown.

3 Press Hold to make changes to the **b #** value.

   Press ✳/Esc or △ to change the timer period (from **b 01** to **b 99** seconds) or to completely disable the backlight timer function (**boFF**).

4 Press Hold to save the changes, or press Shift to discard the changes and proceed to the next Setup item.

5 Cycle the clamp meter's power to exit the Setup menu.

Enabling the flashlight

This feature is applicable for U1192A, U1193A, and U1194A models only.

If you are using the clamp meter in dark places, press and hold ✳/Esc for more than 1 second to activate the LED flashlight for greater visibility on your test points. This is not applicable to the U1191A model.

Press ✳/Esc for more than 1 second to deactivate the LED flashlight.

WARNING

VISION ADVISORY CLAIM

It is advised that you do not look directly into the light source of the LED flashlight. As with any source of bright light, prolonged exposure can damage the eye.

NOTE

To conserve battery life, a user-adjustable timer can be set to control how long the flashlight stays on. This function is disabled by default.

Follow the steps below to change the timer period or completely disable the flashlight timer.

1 Press and hold Shift while powering on the clamp meter to enter the Setup menu.

2 Press Shift twice. The flashlight (**t #**) timer period is the third Setup item shown.

3 Press Hold to make changes to the **t #** value.

   Press ☼/Exit or △ to change the timer period (from **t 01** to **t 99** seconds) or to completely disable the flashlight timer function (**toFF**).

4 Press Hold to save the changes, or press Shift to discard the changes and proceed to the next Setup item.

5 Cycle the clamp meter's power to exit the Setup menu.

Alerts and warnings during measurement

Voltage alert

WARNING

For your own safety, please do not ignore the voltage alert. When the clamp meter cautions you with a voltage alert, you are advised to take note of the existence of high voltage and pay closer attention when performing measurements.

Your clamp meter provides a voltage alert for voltage measurements. The clamp meter starts beeping periodically once the measured voltage exceeds the alert value (regardless of polarity) set.

Hazardous voltage indication

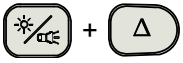
The clamp meter will also display the hazardous voltage (⚡) symbol as an early precaution when the measured voltage is equal to or greater than 30 V in all voltage measurement modes.

Power-on options

Some options can be selected only while you turn the clamp meter on. These power-on options are listed in the table below.

To select a power-on option, press and hold the specified key in Table 1-2 while turning the rotary switch from the **OFF** position to any other position.

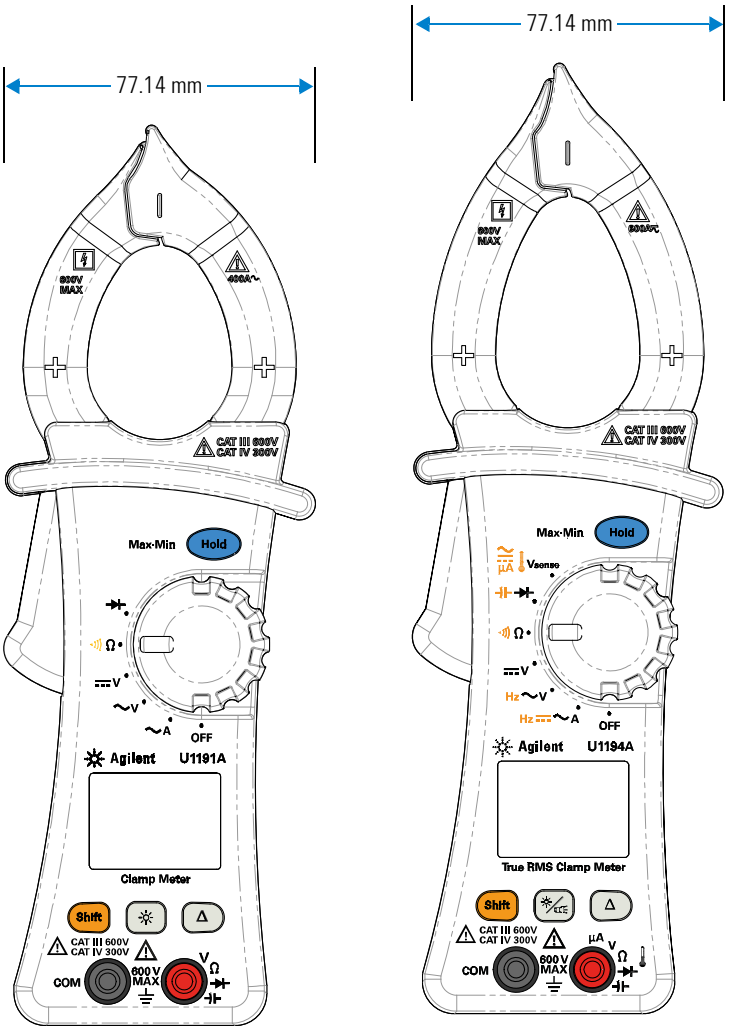
Table 1-2 Power-on options

Key	Description
	Tests the LCD. All annunciators are displayed in the LCD for 10 seconds. Cycle the clamp meter's power to exit this mode, or wait 10 seconds for the clamp meter to return to normal operation.
	Checks the firmware version. The clamp meter's firmware version will be shown on the primary display. Cycle the clamp meter's power to exit this mode.
	Enters the clamp meter's Setup menu. See the following topics for more information on each respective Setup menu item. • "Automatic Power-Off (APO)" on page 7 • "Enabling the backlight" on page 7 • "Enabling the flashlight" on page 8 • "Changing the continuity visual alert" on page 37 Cycle the clamp meter's power to exit the Setup menu.
	Enters the unit selection menu for temperature measurements (U1194A only). See "Changing the default temperature unit" on page 46 for more information. Cycle the clamp meter's power to exit this menu.

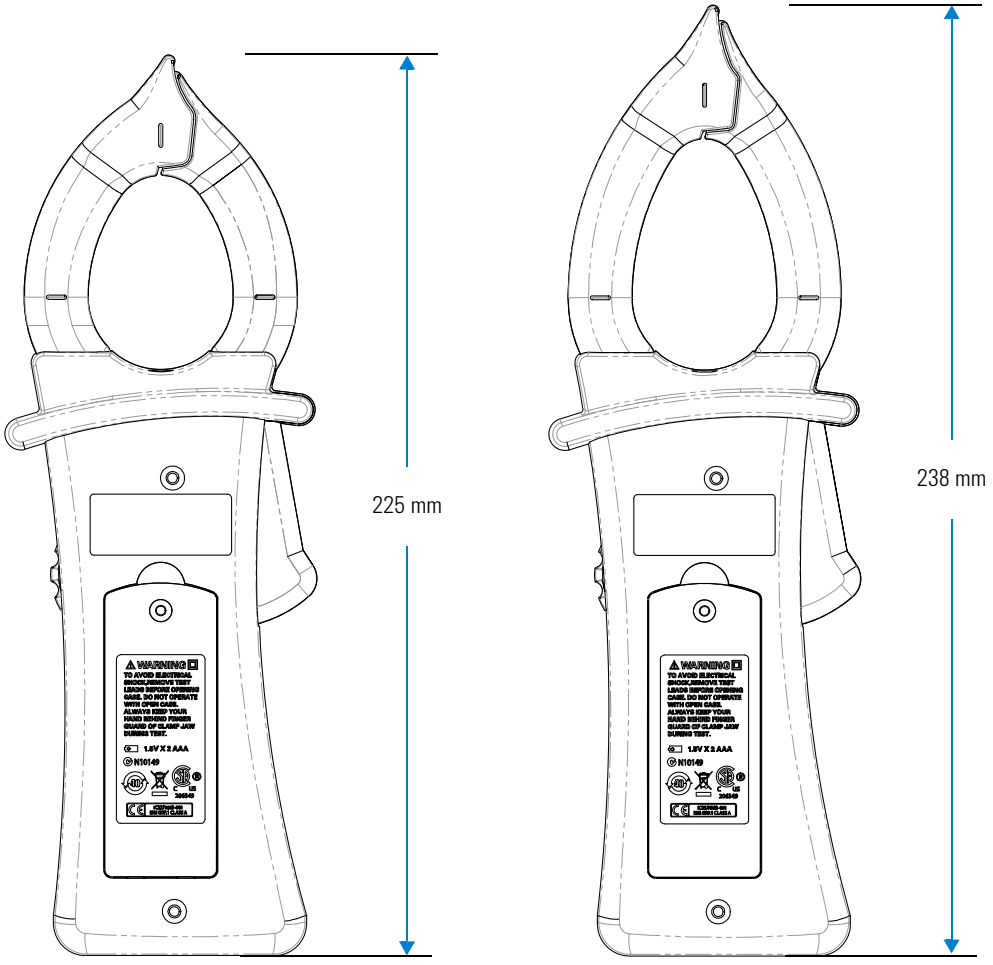
Your Clamp Meter in Brief

Dimensions

Front view



Rear view



Overview

Front panel

The front panel parts of your clamp meter are described in this section.

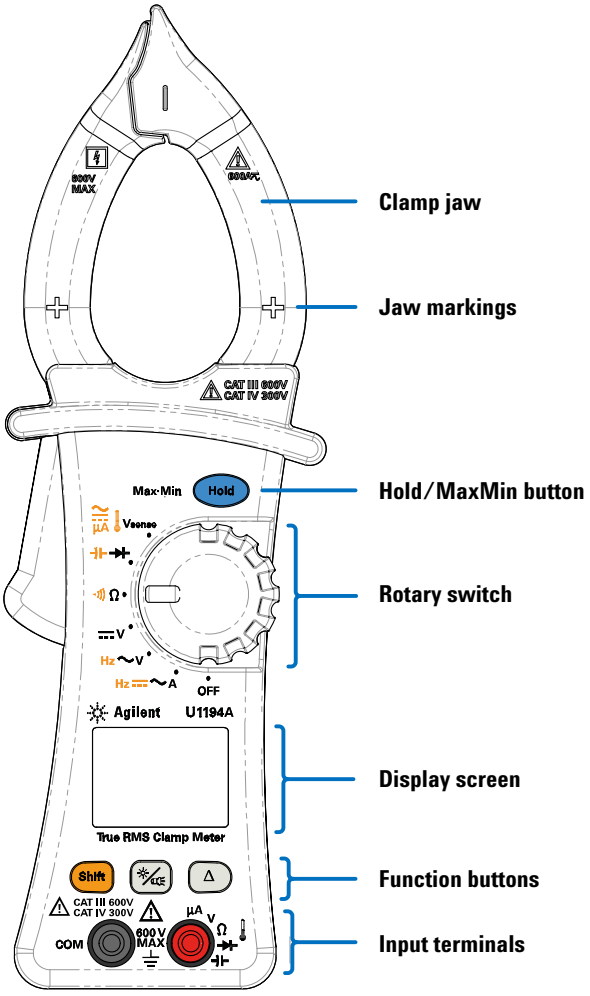


Figure 1-3 Front panel

Rear panel

The rear panel parts of your clamp meter are described in this section.

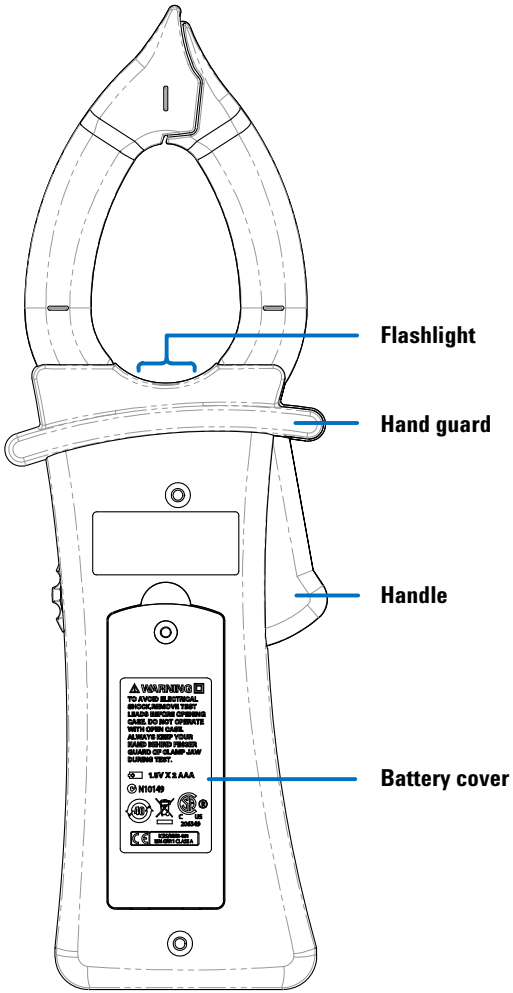


Figure 1-4 Rear panel

Rotary switch

The measurement functions for each rotary switch position are described in Table 1-3 on page 16. Turning the rotary switch changes the measurement function and resets all other measurement options.

NOTE

Some rotary switch positions have a *shifted* function printed in **orange**. Press Shift to switch between the shifted and primary function.

WARNING

Remove the test leads from the measuring source or target before changing the rotary switch position.

Each position of the U1191A, U1192A, U1193A, and U1194A rotary switches (shown in Figure 1-3) is described in Table 1-3. Click the respective “Learn more” pages for more information on each function.

NOTE

A list of some of the abbreviations used in Table 1-3 is given below.

- **AC A**: AC current measurement
- **DC A**: DC current measurement
- **AC V**: AC voltage measurement
- **DC V:** DC voltage measurement
- **AC µA**: AC current measurement (up to microamperes)
- **DC µA**: DC current measurement (up to microamperes)

Table 1-3 Rotary switch functions

Legend	Functions shown in the primary display	U1194A	U1193A	U1192A	U1191A	Learn more on:
OFF	Off	✔	✔	✔	✔	page 6
Hz ⎓ ~ A	AC A	✔	✔	✔	✔	page 26
	DC A	✔	-	-	-	
	Frequency (current path)	✔	✔	✔	-	page 50
Hz ~ V	AC V	✔	✔	✔	✔	page 30
	Frequency (voltage path)	✔	✔	✔	-	page 50
⎓ V	DC V	✔	✔	✔	✔	page 32
Ω	Resistance	✔	✔	✔	✔	page 34
	Continuity	✔	✔	✔	✔	page 36
	Diode	✔	✔	✔	✔	page 39
	Capacitance	✔	✔	✔	-	page 43
	Non-contact voltage detector	✔	✔	✔	-	page 54
Vcontact	Temperature	✔	-	-	-	page 45
µA	DC µA	✔	-	-	-	page 48
	AC µA	✔	-	-	-	

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.

Table 1-4 Keypad functions

Legend	Function when pressed for:		Learn more on:
	Less than 1 second	More than 1 second	
	Freezes the present reading in the display.	Records the maximum, minimum, or average value.	page 60
	Switches between the **primary** and **shifted** (icons printed in **orange**) functions.	-	page 15
	Turns the LCD backlight on or off.	Turns the LED flashlight on or off.	page 7 and page 8
	**U1191A only**: Turns the LCD backlight on or off.	-	page 7
	Sets the null/relative mode.	-	page 57

Display screen

The display annunciators of your clamp meter are described in this section. See also "Measurement units" on page 20 for a list of available measurement signs and notations.

General display annunciators

The general display annunciators of your clamp meter are described in the table below.

Table 1-5 General annunciators

Legend	Description	Learn more on:
	Hazardous voltage sign for measuring voltage ≥30 V or overload	page 9
Hold	Hold enabled	page 60
Auto	Auto-ranging enabled	-
Max	Maximum reading shown on primary display	page 58
Min	Minimum reading shown on primary display	
Avg	Averaged reading shown on primary display	
Max Min Avg	Present reading shown on primary display	
	Relative (Null) enabled	page 57
	Diode test selected	page 39
	Audible continuity test selected	page 36
	DC (direct current) indication	page 26 and page 32
	AC (alternating current) indication	page 26 and page 30

Table 1-5 General annunciators (continued)

Legend	Description	Learn more on:
	Battery capacity indication	page 5
	APO (Auto Power-Off) enabled	page 7
	Primary measurement display	-
	Measuring units	page 20
	Overload (the reading exceeds the display range)	-

Measurement units

The available signs and notations for each measurement function in your clamp meter are described in Table 1-6. The units listed below are applicable to the primary display measurements of your clamp meter.

Table 1-6 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)
mV, V	Voltage units for voltage measurement	
µA, mA, A	Ampere units for current measurement	
nF, µF, mF	Farad units for capacitance measurement	
Ω, kΩ, MΩ	Ohm units for resistance measurement	
Hz, kHz, MHz	Hertz units for frequency measurement	
°C	Degree Celsius, unit for temperature measurement	
°F	Degree Fahrenheit, unit for temperature measurement	

Input terminals

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

WARNING **Ensure that the probe accessories are connected to the correct input terminals for the selected measurement function before starting any measurement.**

CAUTION To avoid damaging this device, do not exceed the rated input limit.

Table 1-7 Terminal connections for different measuring functions

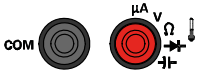
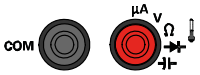
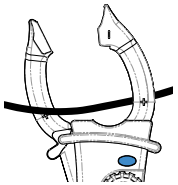
Legend	Functions	U1194A	U1193A	U1192A	U1191A	Input terminals	Overload protection
Hz ~V	AC V	✔	✔	✔	✔		600 Vrms
	Frequency (voltage path)	✔	✔	✔	-		
⎓V	DC V	✔	✔	✔	✔		
	Diode	✔	✔	✔	✔		600 Vrms for short circuit current <0.3 A
	Capacitance	✔	✔	✔	-		
Ω	Resistance	✔	✔	✔	✔		
	Continuity	✔	✔	✔	✔		
Vsense	Non-contact voltage detector	✔	✔	✔	-		
	Temperature	✔	-	-	-		

Table 1-7 Terminal connections for different measuring functions

Legend	Functions	U1194A	U1193A	U1192A	U1191A	Input terminals	Overload protection
	DC µA	✔	-	-	-		CAT III 600 V
	AC µA	✔	-	-	-		
	AC A	✔	✔	✔	✔		600 Arms
	DC A	✔	-	-	-		
	Frequency (current path)	✔	✔	✔	-		

Cleaning Your Clamp Meter

WARNING **To avoid electrical shock or damage to the clamp meter, 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 clamp meter.

1 Turn the clamp meter off, and remove the test leads.

2 Turn the clamp meter 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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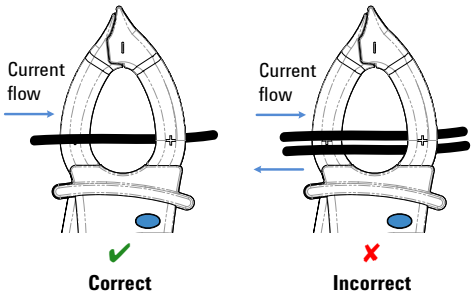
2
Making Measurements

This chapter describes how to take measurements with your clamp meter.

Measuring AC or DC Current

WARNING **Ensure that the test leads are disconnected from the input terminals when measuring current with the clamp jaws.**

CAUTION Ensure that the clamp meter measures only one conductor at a time. Measuring multiple conductors may cause inaccuracy in measurement readings due to the vector sum of currents flowing in the conductors.



For best accuracy during current measurements, align the cable with the jaw markings.

Use the wire separator to separate individual wires or cables from a mesh of wires or cables. See "Using the wire separator and hook" on page 28 for more information.

Set up your clamp meter to measure AC current or DC current (U1194A model only) as shown in Figure 2-2. Clamp the wire/cable, and read the display.

NOTE Press Shift to measure the frequency of the AC current source (U1192A, U1193A, and U1194A models only). See "Measuring Frequency" on page 50 to learn more.

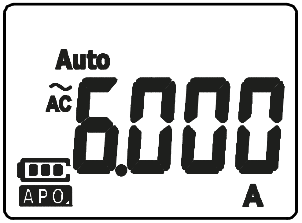


Figure 2-1 AC current display

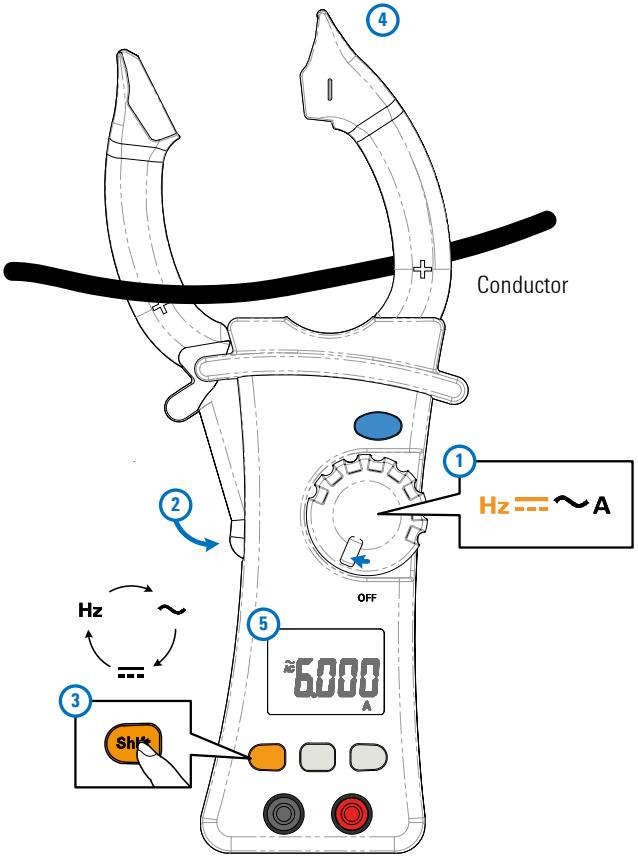


Figure 2-2 Measuring AC current

Using the wire separator and hook

Your clamp meter's design has a wire separator and hook feature (see Figure 2-3) that can be used to separate individual wires or cables for measurements from a mesh of wires or cables.

Use the wire separator and hook to avoid touching live wires or cables without the necessary insulation protection or powering off the voltage or current source.

Follow the instructions below to use the wire separator and hook feature.

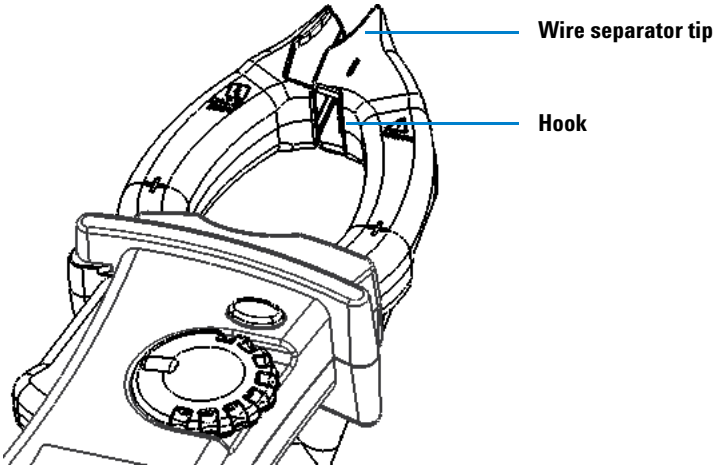
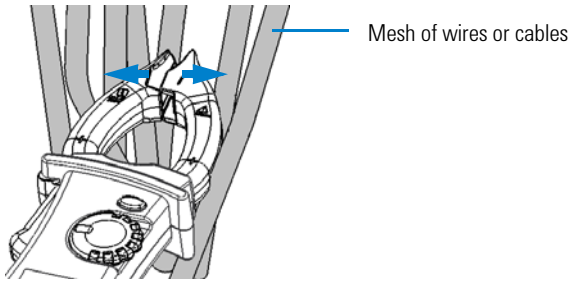
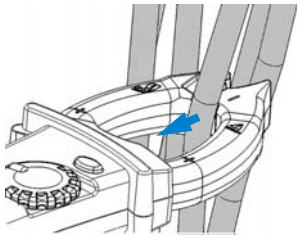


Figure 2-3 Wire separator and hook design

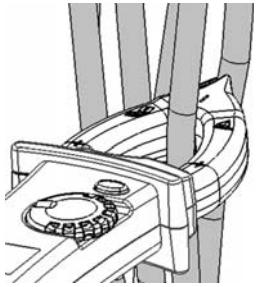
1 Open the clamp jaw slightly to reveal the wire separator tip. Use the wire separator tip to locate the desired wire or cable.



2 Separate the wire or cable by hooking it in the clamp jaw securely and pulling it back.



3 Close the clamp jaw to secure the wire or cable, and read the measurement.



Measuring AC Voltage

NOTE Reversing the leads will produce a negative reading, but it will not damage the clamp meter.

Set up your clamp meter to measure AC voltage as shown in Figure 2-5. Probe the test points, and read the display.

NOTE

For U1193A and U1194A models:

AC voltage measurements measured with this clamp meter are returned as true RMS (root mean square) readings. These readings are accurate for sinusoidal waves. For non-sinusoidal waveforms, please refer to the "Specification Assumptions" on page 64.

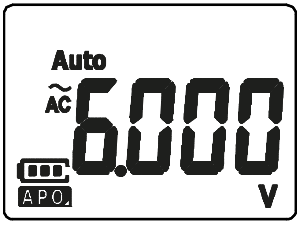


Figure 2-4 AC voltage display

NOTE Press Shift to measure the frequency of the AC voltage source (U1192A, U1193A, and U1194A models only). See "Measuring Frequency" on page 50 to learn more.

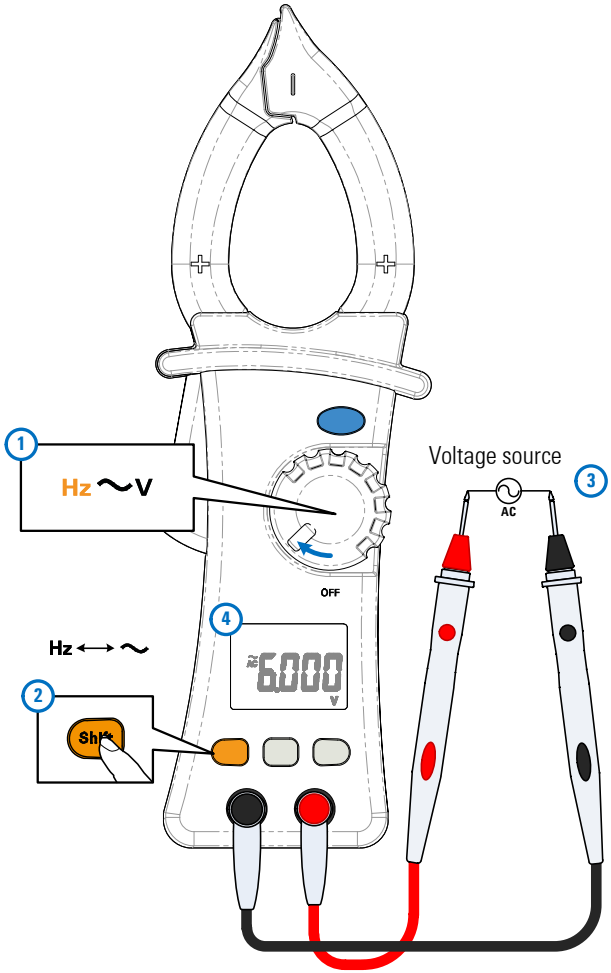


Figure 2-5 Measuring AC voltage

Measuring DC Voltage

Set up your clamp meter to measure DC voltage as shown in Figure 2-7. Probe the test points, and read the display.

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

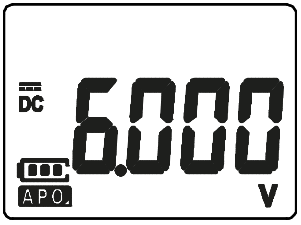


Figure 2-6 DC voltage display

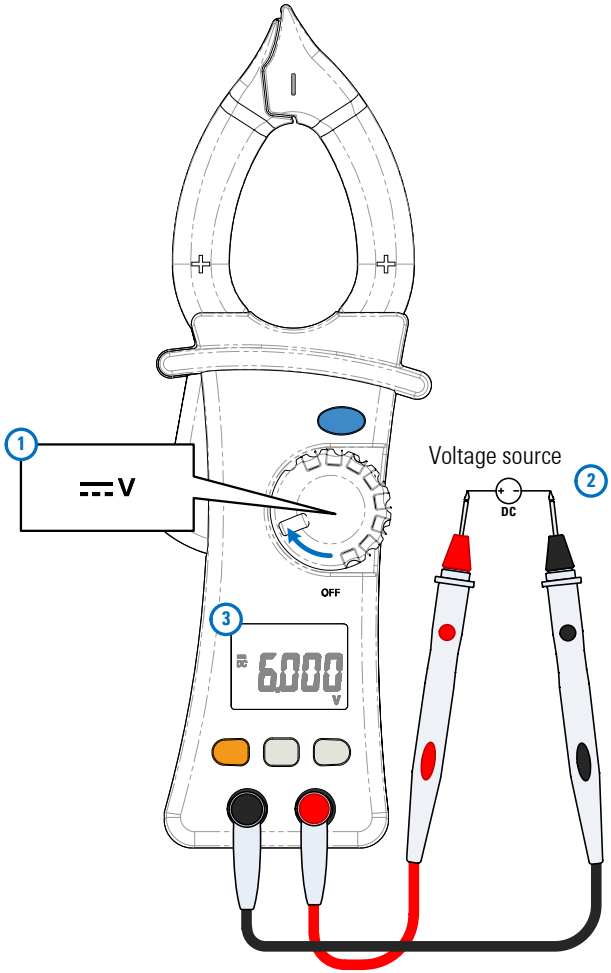


Figure 2-7 Measuring DC voltage

Measuring Resistance

Set up your clamp meter to measure resistance as shown in Figure 2-9. Probe the test points, and read the display.

CAUTION To avoid possible damage to your clamp meter 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).

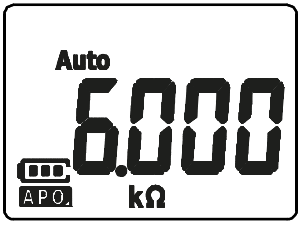


Figure 2-8 Resistance display

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.
- Because the clamp meter'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 diodes or transistor junctions, causing them to conduct.

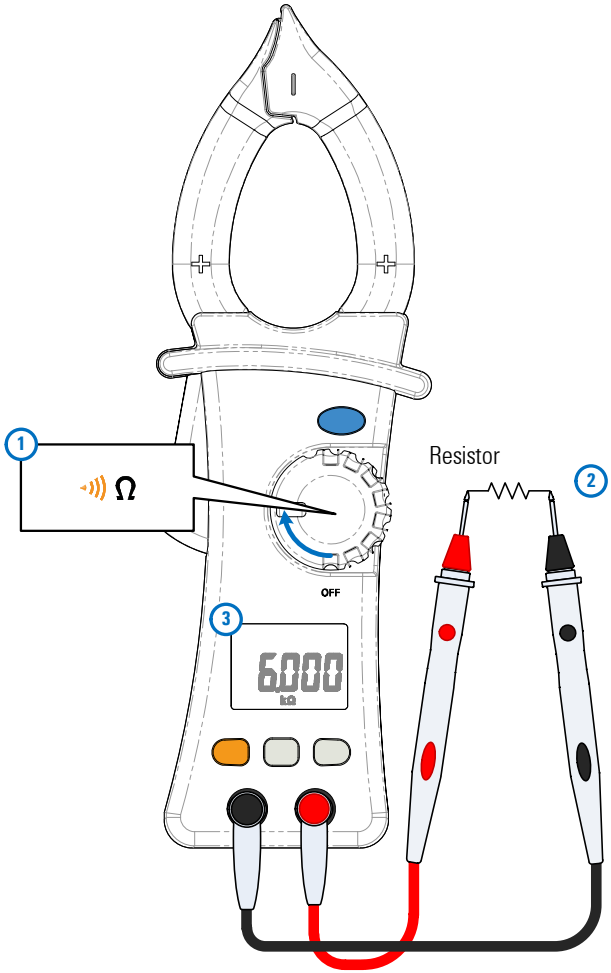


Figure 2-9 Measuring resistance

Testing for Continuity

Set up your clamp meter to test for continuity as shown in Figure 2-12. Probe the test points, and read the display.

CAUTION To avoid possible damage to your clamp meter 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 and a backlight that flashes as long as a circuit is complete. The audible and visual alert allows you to perform quick continuity tests without having to watch the display.

Press Shift to switch between resistance measurement, or continuity test. See Figure 2-12 to learn more.

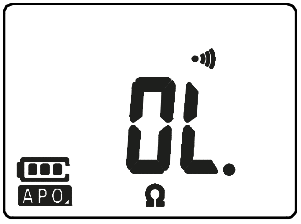


Figure 2-10 Open continuity display

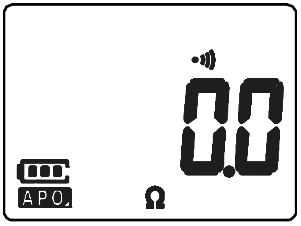


Figure 2-11 Closed continuity display

NOTE

- You can set the beeper to sound and the backlight to flash as a continuity indication whether the circuit-under-test is less than (short) the threshold resistance.
- The continuity function detects intermittent shorts lasting as short as 1 ms. A brief short causes the multimeter to emit a short beep and flash.
- You can enable or disable the visual alert via the Setup menu. See "Changing the continuity visual alert" on page 37 for more information.

Changing the continuity visual alert

You can set the backlight to flash along with the beeper sound as a continuity indication whether the circuit-under-test is less than the threshold resistance.

Follow the steps below to enable or disable the continuity visual alert.

1. Press and hold Shift while powering on the clamp meter to enter the Setup menu.
2. Press Shift again. The continuity visual alert (•)) is the fourth Setup item shown.
3. Press Hold to make changes to the continuity visual alert.

   Press ☀/Hz or △ to enable or to disable the continuity visual alert (the backlight turns on or off).
4. Press Hold to save the changes, or press Shift to discard the changes and proceed to the next Setup item.
5. Cycle the clamp meter's power to exit the Setup menu.

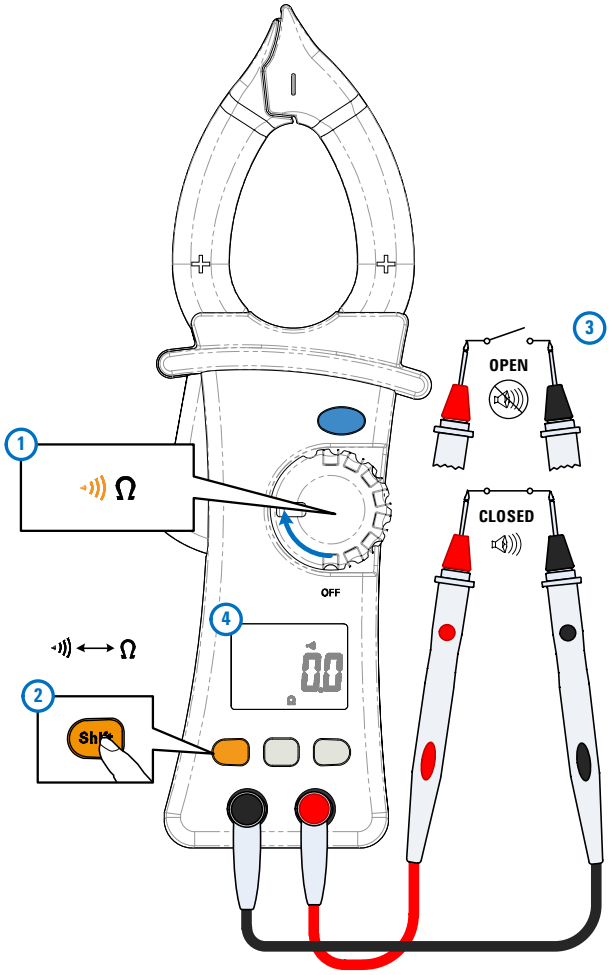


Figure 2-12 Testing for continuity

Testing Diodes

Set up your clamp meter to test diodes as shown in Figure 2-15. Probe the test points, and read the display.

CAUTION To avoid possible damage to your clamp meter or to the equipment under test, disconnect the circuit power and discharge all high-voltage capacitors before testing diodes.

NOTE

- 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.
- 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.

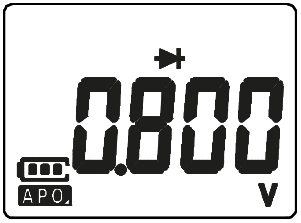


Figure 2-13 Diode display

NOTE Your clamp meter can display the forward-bias of a diode up to approximately 1.8 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.

NOTE If the beeper is enabled during diode test, the clamp meter will beep briefly for a normal junction and sound continuously for a shorted junction.

Reverse the probes (as shown in Figure 2-16) and measure the voltage across the diode again. Assess the diode according to the following guidelines:

- A diode is considered good if the clamp meter displays OL in reverse-bias mode.
- A diode is considered shorted if the clamp meter displays approximately 0 V in both forward and reverse-bias modes, and the clamp meter beeps continuously.
- A diode is considered open if the clamp meter displays OL in both forward- and reverse-bias modes.

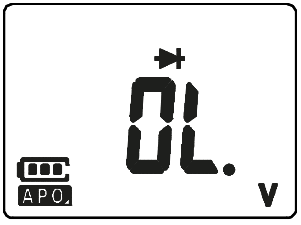


Figure 2-14 Open diode display

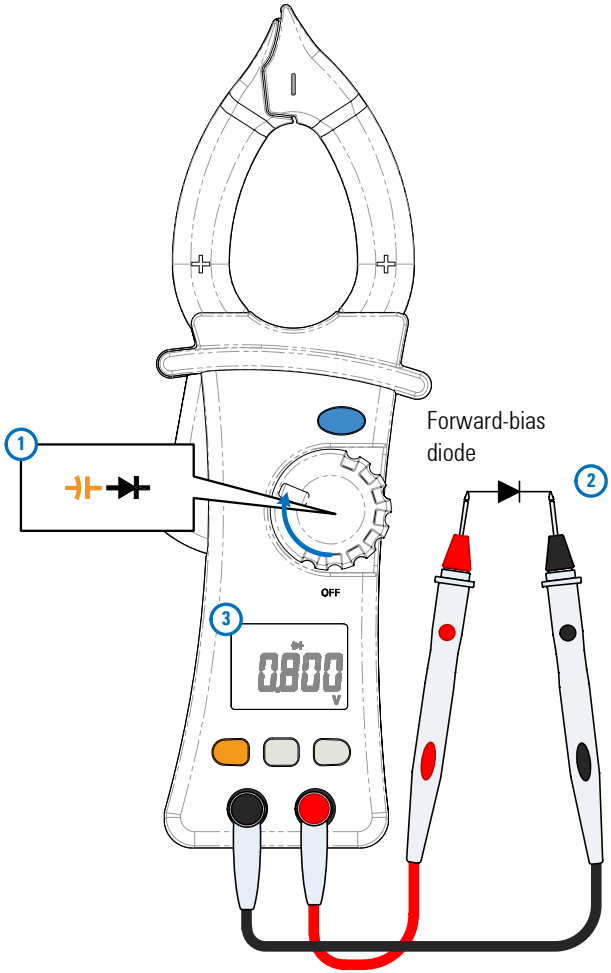


Figure 2-15 Testing forward-bias diode

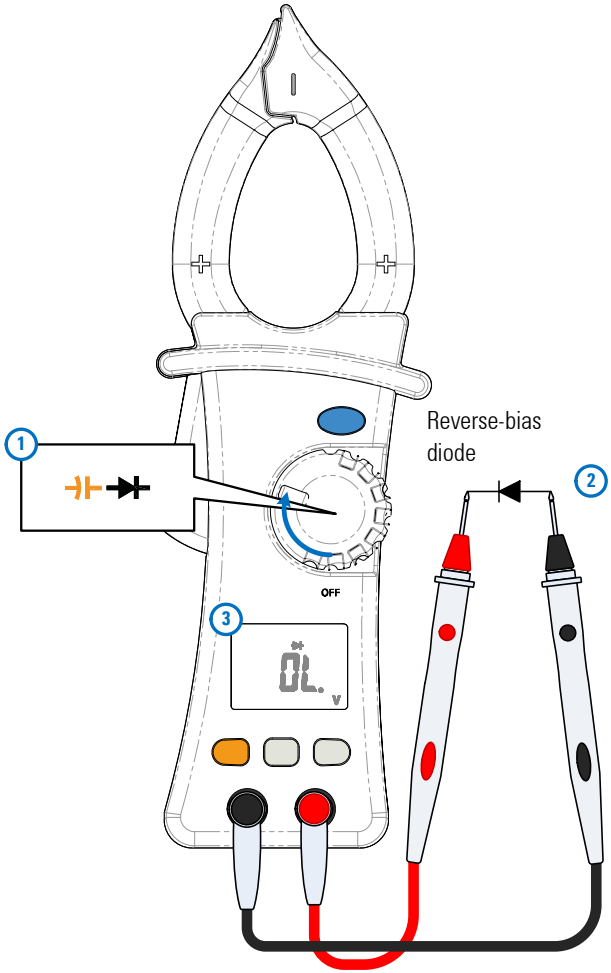


Figure 2-16 Testing reverse-bias diode

Measuring Capacitance

This measurement function is applicable for U1192A, U1193A, and U1194A models only.

Set up your clamp meter to measure capacitance as shown in Figure 2-18. Probe the test points, and read the display.

CAUTION To avoid possible damage to the clamp meter 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 clamp meter 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.

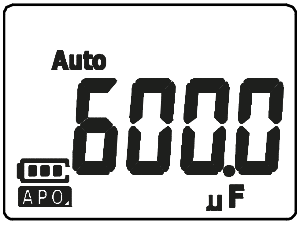


Figure 2-17 Capacitance display

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.

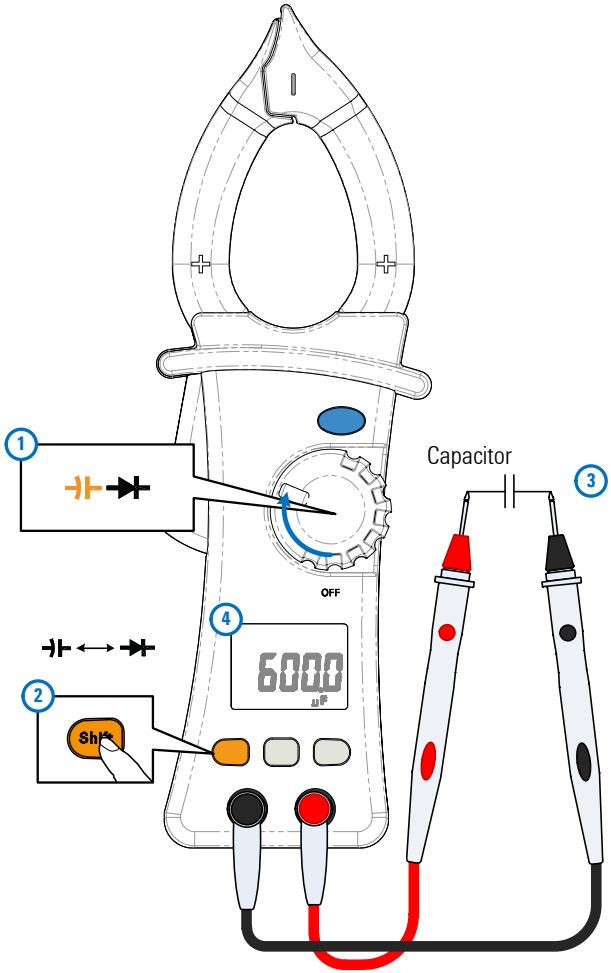


Figure 2-18 Measuring capacitance

Measuring Temperature

This measurement function is applicable for the U1194A model only.

Set up your clamp meter to measure temperature as shown in Figure 2-20. Probe the test points, and read the display.

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.

NOTE

- The clamp meter uses the type-K thermocouple probe (included in the standard shipped items of a U1194A model) for measuring temperature.
- The approximate ambient temperature (cold-junction compensation) is shown on the display when you have an 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 clamp meter.
- Shorting the terminal to the terminal will display the temperature at the clamp meter's terminals.

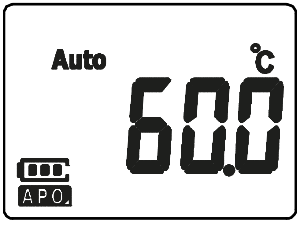


Figure 2-19 Temperature display

Changing the default temperature unit

Follow the steps below to change the temperature unit between Celsius (°C) or Fahrenheit (°F).

1 Press and hold [Min/Max] and [Δ] while powering on the clamp meter to enter the temperature unit selection menu.

2 Press [Hold] to make changes to the temperature unit.

Press [Min/Max] or [Δ] to change the temperature unit (**°C** or **°F**).

3 Press [Hold] to save the changes.

Cycle the clamp meter's power to exit the temperature unit selection menu.

CAUTION Always set the temperature unit display per the official requirements and in compliance with the national laws of your region.

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

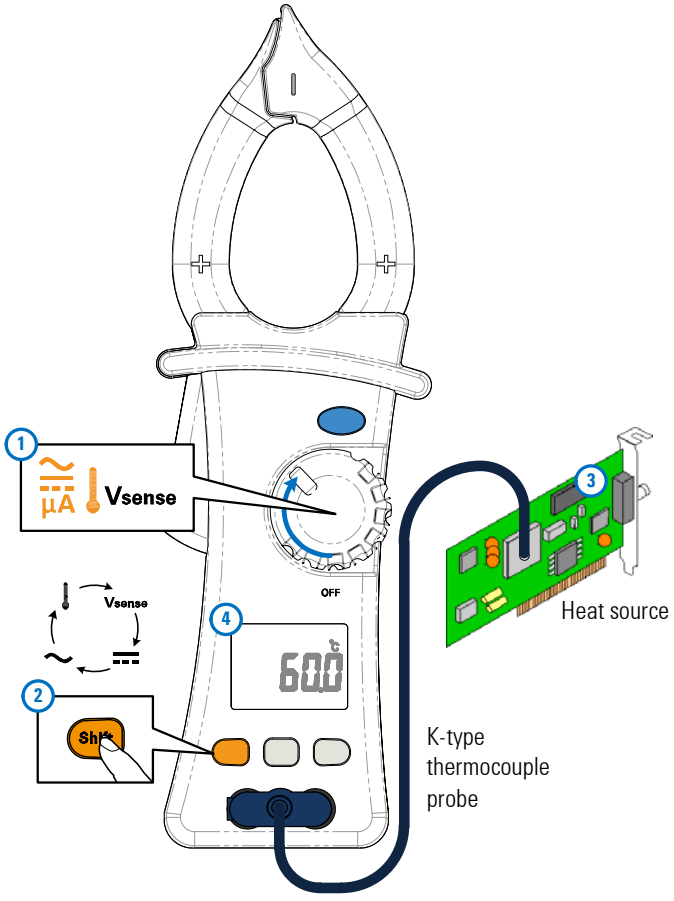


Figure 2-20 Measuring the surface temperature

Measuring AC or DC Current (up to 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 clamp meter and possible electric shock or personal injury.**

CAUTION

- To avoid possible damage to the clamp meter or to the equipment under test, use the proper terminals, function, and range for your measurement. Use the clamp jaw for currents above 600 µA.
- To measure current, you must open the circuit under test, then place the clamp meter in series with the circuit. Never place the probes across (in parallel with) any circuit or component when the leads are plugged into the current terminals.
- 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. This happens because the resistance through the clamp meter's current terminals is very low, resulting in a short circuit.

This measurement function is applicable for the U1194A model only.

Set up your clamp meter to measure AC or DC current (up to µA) as shown in Figure 2-22. Probe the test points, and read the display.

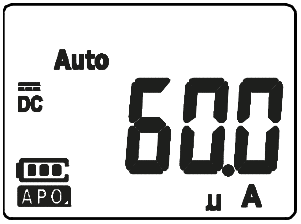


Figure 2-21 DC current display

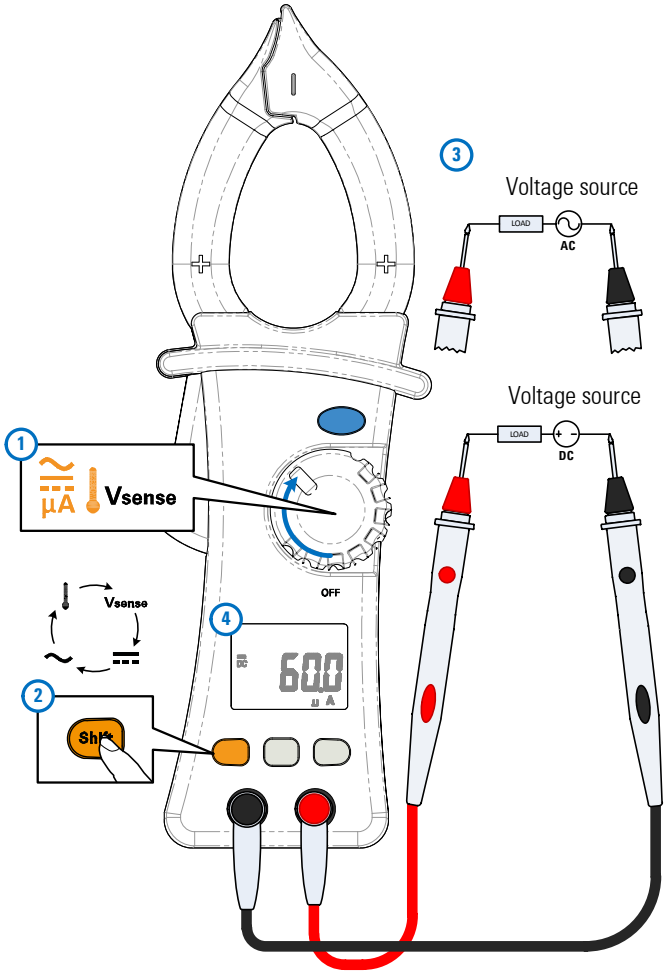


Figure 2-22 Measuring AC/DC current (up to µA)

Measuring Frequency

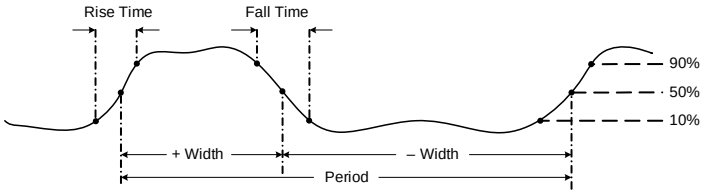
WARNING **Never measure the frequency where the voltage or current level exceeds the specified range.**

This measurement function is applicable for U1192A, U1193A, and U1194A models only.

Your clamp meter allows simultaneous monitoring of real-time voltage or current with frequency measurements.

NOTE

- 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 the figure below.



- The clamp meter 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.

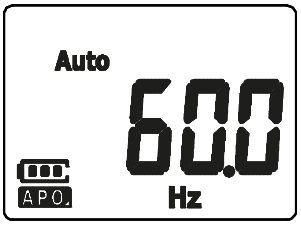


Figure 2-23 Frequency display

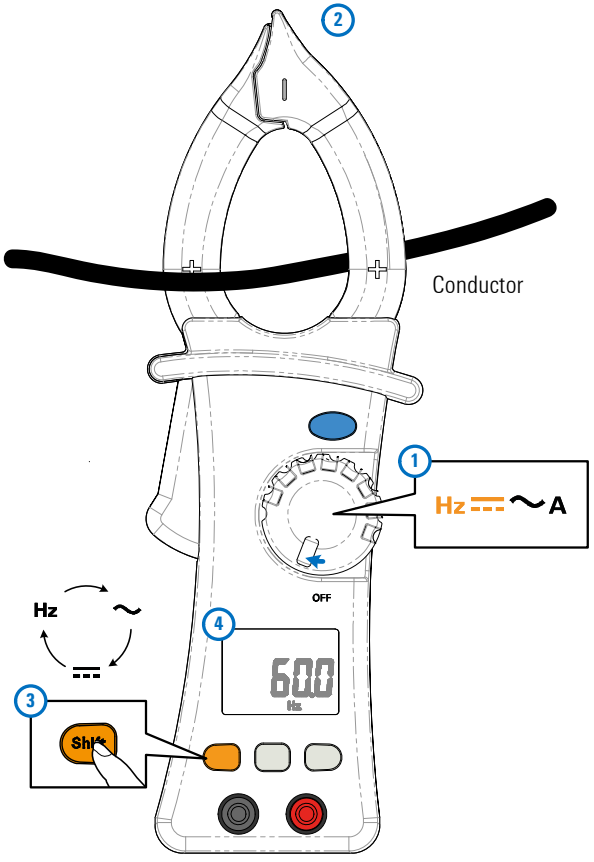


Figure 2-24 Measuring frequency

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3
Clamp Meter Features

The chapter describes the additional features available in your clamp meter.

Detecting AC Voltage Presence (Vsense)

WARNING

- **You are advised to test on a known live circuit within the rated AC voltage range of this product before and after each use to ensure that the Vsense detector works.**
- **Voltage could still be present even if there is no Vsense alert indication. Do not rely on the Vsense detector with shielded wire. Never touch live voltage or conductor without the necessary insulation protection or power off the voltage source.**
- **The Vsense detector may be affected by differences in socket design, insulation thickness, and insulation type.**

CAUTION

You are advised to measure voltage by using test leads through the AC V or DC V function after using the Vsense function, even if there is no alert indication.

This measurement function is applicable for U1192A, U1193A, and U1194A models only.

The Vsense detector is a non-contact voltage detector that detects the presence of AC voltages nearby.

Set up your clamp meter to enable the Vsense function as shown in Figure 3-3.

NOTE

If the presence of AC voltage is sensed, the clamp meter's beeper will sound. The audible alert allows you to easily sense nearby AC voltage presence.

No resolution and accuracy of voltage measurement will be displayed in this mode.

NOTE

- Place the top of the clamp meter close to a conductor when sensing for AC voltages (as low as 24 V in the **Hi.SE** setting).
- The low sensitivity setting can be used on flush mounted wall sockets or outlets and various power strips or cords.
- The high sensitivity setting allows for AC voltage sensing on other styles of recessed power connectors or sockets where the actual AC voltage is recessed within the connector itself.

Press Hold to toggle the Vsense detector's sensitivity between **Hi.SE** (high sensitivity) or **Lo.SE** (low sensitivity).

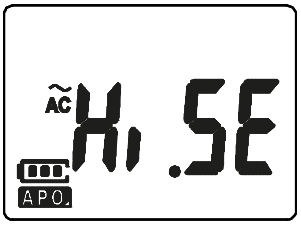

Figure 3-1 Vsense (high sensitivity) display

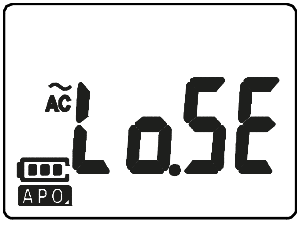

Figure 3-2 Vsense (low sensitivity) display

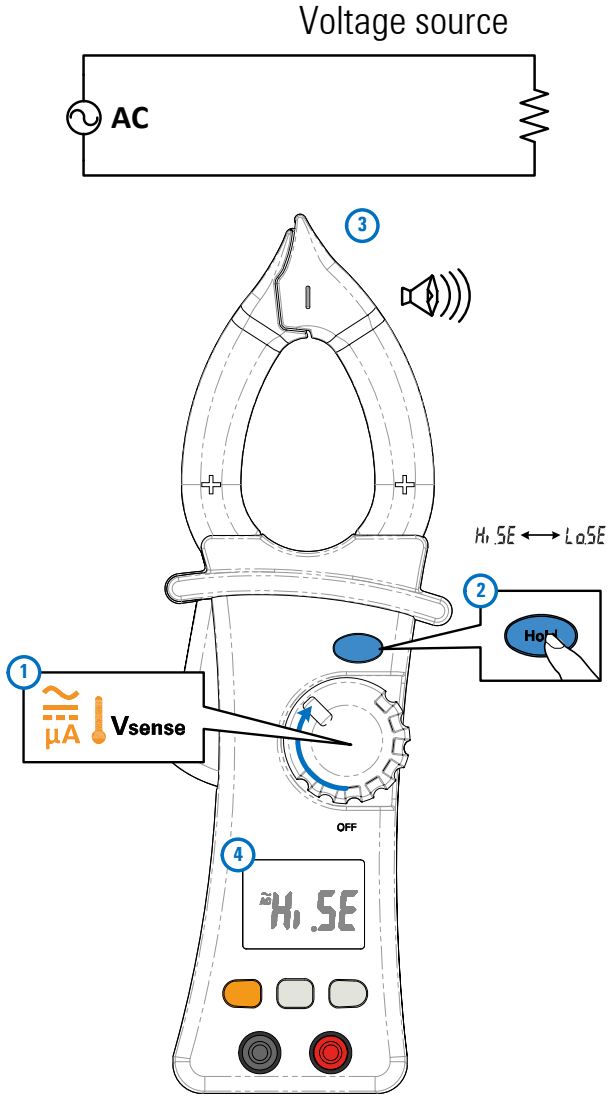

Figure 3-3 Detecting voltage presence

Making Relative Measurements (Null)

When making Null measurements, also called relative, each reading is the difference between a stored (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.

1 To activate the relative mode, press the Δ key. The measurement value at the time, when Null is enabled, is stored as the reference value.

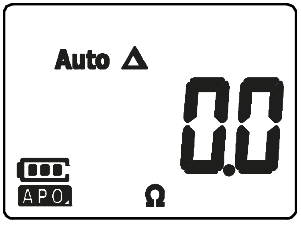

Figure 3-4 Null display

2 To disable the Null function, press Δ again.

For any measurement function, you can directly measure and store the null value by pressing Δ 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 clamp meter 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 Δ when the displayed value is stable to zero-adjust the display.

Capturing Maximum and Minimum Values (Max.Min)

The Max.Min 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 clamp meter beeps and records the new value. The clamp meter also calculates an average of all readings taken since the Max.Min mode was activated.

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

- Max: highest reading since the Max.Min function was enabled
- Min: lowest reading since the Max.Min function was enabled
- Avg: average or mean of all readings since the Max.Min function was enabled
- MaxMinAvg: present reading (actual input signal value)

1 Press and hold Hold for more than 1 second to enable the Max.Min operation.

2 Press Hold again to cycle through the Max, Min, Avg, or present (MaxMinAvg) input values.

3 Press Hold for more than 1 second to disable the Max.Min function.

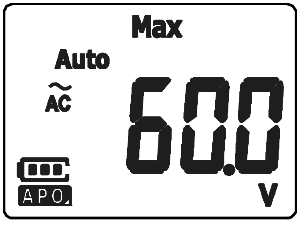

Figure 3-5 Max.Min display

NOTE If an overload is recorded, the averaging function will be stopped. OL is shown in place of the average value.

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 clamp meter 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.

Freezing the Display (Hold)

To freeze the display for any function, press the Hold key.

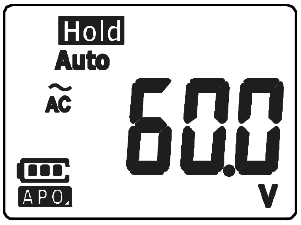

Figure 3-6 Hold display

Press Hold again to disable this function.

4
Characteristics and Specifications

This chapter lists the characteristics, assumptions, and specifications of the U1191A, U1192A, U1193A, and U1194A handheld clamp meters.

Product Characteristics

NOTE Product characteristics specified in the table below are applicable for U1191A, U1192A, U1193A, and U1194A models unless stated otherwise.

POWER SUPPLY

Battery type:

- 2 × 1.5 V AAA Alkaline battery (IEC LR03)

Battery life:

- 200 hours typical (based on new Alkaline batteries, for continuous DC voltage measurement, with backlight disabled)
- 40 hours typical (based on new Alkaline batteries, with backlight enabled)
- Low battery indicator will flash when the battery voltage drops below 2.5 V (approximately)

POWER CONSUMPTION

- 9 mVA maximum (based on new Alkaline batteries, for continuous DC voltage measurement, with backlight disabled)
- 42 mVA maximum (based on new Alkaline batteries, for continuous DC voltage measurement, with backlight enabled)

DISPLAY

Liquid crystal display (LCD) with backlight (maximum reading of 6000 counts)

OPERATING ENVIRONMENT

- Operating temperature from –10 °C to 50 °C, 0% to 80% RH
- Up to 80% RH for temperatures up to 30 °C, decreasing linearly to 50% RH at 50 °C
- Altitude up to 2000 meters
- Pollution degree 2

STORAGE COMPLIANCE

–40 °C to 60 °C, 40% to 80% RH (without batteries)

SAFETY COMPLIANCE

- IEC 61010-1:2001/EN 61010-1:2001
- IEC 61010-2-032:2002/EN 61010-2-032:2002
- CAN/CSA-C22.2 No. 61010-1-04
- CAN/CSA-C22.2 No. 61010-2-032-04
- ANSI/UL Std. No. 61010-1:2004

MEASUREMENT CATEGORY

CAT III 600 V and CAT IV 300 V (for digital multimeter and current clamp portions)

ELECTROMAGNETIC COMPATIBILITY (EMC)

- IEC61326-1:2005/EN61326-1:2006
- Canada: ICES/NMB-001: Issue 4, June 2006
- Australia/New Zealand: AS/NZS CISPR 11:2004

TEMPERATURE COEFFICIENT

0.1 × (specified accuracy) / °C (from 0 °C to 18 °C, or 28 °C to 50 °C)

COMMON MODE REJECTION RATIO (CMRR)

>60 dB at DC, 60 Hz in the AC V function

>120 dB at DC, 50/60 Hz in the DC V function

NORMAL MODE REJECTION RATION (NMRR)

>60 dB at 50/60 Hz

DIMENSIONS (W × H × D)

- U1191A/U1192A: 77.14 × 225 × 38.56 mm
- U1193A/U1194A: 77.14 × 238 × 38.56 mm

WEIGHT

- U1191A/U1192A: 320 grams (with batteries)
- U1193A: 334 grams (with batteries)
- U1194A: 348 grams (with batteries)

MAXIMUM CONDUCTOR SIZE

- U1191A/U1192A: Up to 27 mm diameter for 500 MCM cable
- U1193A/U1194A: Up to 35 mm diameter for 750 MCM cable

MAXIMUM JAW OPENING

- U1191A/U1192A: Up to 31 mm
- U1193A/U1194A: Up to 37 mm

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 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 A specifications for U1193A and U1194A models 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 (4000 counts)
- For non-sinusoidal waveforms, add (2% reading + 2% full scale) typically.
- In the EMC RF field of 3 V/m, the total accuracy is specified as the specified accuracy ± 30 digits for all functions.

Measurement Category

The Agilent U1190A Series Handheld Clamp Meters have a safety rating of CAT III, 600 V and CAT IV, 300 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 building installations. 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 low-voltage installations. 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 64.

DC specifications

Table 4-1 DC specifications

Function	Range	Resolution	Accuracy				Test current	Open voltage
			U1191A	U1192A	U1193A	U1194A	*(where applicable)*	
Voltage	60.00 V	0.01 V	-	0.5% + 3	0.5% + 3	0.5% + 3	-	-
	600.0 V	0.1 V	0.5% + 3	0.5% + 3	0.5% + 3	0.5% + 3	-	-

Notes for DC voltage specifications:

1 Overload protection: 600 Vdc.
2 Input impedance: 10 MΩ (nominal) in parallel with <100 pF

Resistance	600.0 Ω	0.1 Ω	0.8% + 5	0.8% + 5	0.8% + 5	0.8% + 5	≈95 µA	1.4 V
	6.000 kΩ	0.001 kΩ	0.8% + 3	0.8% + 3	0.8% + 3	0.8% + 3	≈95 µA	1.4 V
	60.00 kΩ	0.01 kΩ	-	0.8% + 3	0.8% + 3	0.8% + 3	≈95 µA	0.7 V

Notes for resistance specifications:

1 Overload protection: 600 Vrms for short circuits with <0.3 A current
2 Maximum open voltage is <1.4 V
3 The accuracy is specified after the Null function is used to subtract the test lead resistance and thermal effect (by shorting the test leads).

Table 4-1 DC specifications (continued)

Function	Range	Resolution	Accuracy				Test current	Open voltage
			U1191A	U1192A	U1193A	U1194A	*(where applicable)*	
Continuity	600.0 Ω	0.1 Ω	0.8% + 5	0.8% + 5	0.8% + 5	0.8% + 5	≈95 µA	≈1.4 V

Notes for continuity specifications:

1 Overload protection: 600 Vrms for short circuits with <0.3 A current
2 Built-in buzzer beeps continuously when the resistance measured is less than 30 Ω. Resistance measurements above 200 Ω are considered open. For resistance measured between 30 Ω and 200 Ω (30 Ω ≤ reading ≤ 200 Ω), the built-in buzzer may beep depending on the device-under-test.
3 Continuity indicator: 2.7 kHz tone buzzer

Diode	1.500 V	0.001 V	1.0% + 3	1.0% + 3	1.0% + 3	1.0% + 3	≈0.3 mA	1.8 V

Notes for diode specifications:

1 Overload protection: 600 Vrms for short circuits with <0.3 A current
2 Built-in buzzer beeps continuously when the voltage measured is less than 100 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).

Current	60.00 µA	0.01 µA	-	-	-	1.0% + 5	-	-
	600.0 µA	0.1 µA	-	-	-	1.0% + 5	-	-
	60.00 A	0.01 A	-	-	-	2.0% + 5	-	-
	600.0 A	0.1 A	-	-	-	2.0% + 5	-	-

Notes for DC current specifications:

1 60 A to 600 A ranges are for current clamp measurements.
2 60 µA to 600 µA ranges are for digital multimeter measurements.
3 Overload protection for 60 A to 600 A range: 600 Arms
4 Input impedance for 60 µA to 600 µA range: ≈4.2 kΩ
5 Position error: 1% from reading
6 The accuracy is specified after the Null function is used to subtract the test lead resistance and thermal effect (by shorting the test leads).

AC specifications

AC voltage specifications

Table 4-2 AC voltage specifications

Range	Resolution	Accuracy				Input impedance
		U1191A	U1192A	U1193A	U1194A	
		45 Hz to 500 Hz				
60.00 V	0.01 V	-	1.2% + 5	1.2% + 5	1.2% + 5	10 MΩ
600.0 V	0.1 V	1.2% + 5	1.2% + 5	1.2% + 5	1.2% + 5	10 MΩ

Notes for AC voltage specifications:

1 Overload protection: 600 Vrms
2 Input impedance: 10 MΩ (nominal) in parallel with <100 pF
3 Frequency response: 45 Hz to 500 Hz (sinusoidal waveform)
4 AC conversion type:
- U1191A and U1192A: Average sensing, RMS indication
- U1193A and U1194A: RMS sensing, RMS indication

AC current specifications

Table 4-3 AC current specifications

Range	Resolution	Accuracy							
		U1191A		U1192A		U1193A		U1194A	
		45 Hz to 65 Hz	65 Hz to 500 Hz	45 Hz to 65 Hz	65 Hz to 500 Hz	45 Hz to 65 Hz	65 Hz to 500 Hz	45 Hz to 65 Hz	65 Hz to 500 Hz
60.00 µA	0.01 µA	-	-	-	-	-	-	1.0% + 5	1.0% + 5
600.0 µA	0.1 µA	-	-	-	-	-	-	1.0% + 5	1.0% + 5
60.00 A	0.01 A	-	-	2.0% + 5	3.0% + 5	2.0% + 5	3.0% + 5	2.0% + 5	3.0% + 5
400.0 A	0.1 A	2.0% + 5	3.0% + 5	2.0% + 5	3.0% + 5	-	-	-	-

Table 4-3 AC current specifications (continued)

Range	Resolution	Accuracy							
		U1191A		U1192A		U1193A		U1194A	
		45 Hz to 65 Hz	65 Hz to 500 Hz	45 Hz to 65 Hz	65 Hz to 500 Hz	45 Hz to 65 Hz	65 Hz to 500 Hz	45 Hz to 65 Hz	65 Hz to 500 Hz
600.0 A	0.1 A	-	-	-	-	2.0% + 5	3.0% + 5	2.0% + 5	3.0% + 5

Notes for AC current specifications:

1 Overload protection:
- U1191A and U1192A: 400 Arms
- U1193A and U1194A: 600 Arms

2 Input impedance for 60 µA to 600 µA range: ≈4.2 kΩ

3 Frequency response: 45 Hz to 500 Hz (sinusoidal waveform)

4 Position error: 1% from reading

5 AC conversion type:
- U1191A and U1192A: Average sensing, RMS indication
- U1193A and U1194A: RMS sensing, RMS indication

6 For non-sinusoidal waveform, add an additional accuracy of (2% of reading + 2% of full scale) typically for crest factor ≥ 3.0.

Capacitance specifications

Table 4-4 Capacitance specifications

Range	Resolution	Accuracy				Measuring rate (at full scale)
		U1191A	U1192A	U1193A	U1194A	
600.0 µF	0.1 µF	-	2.0% + 4	2.0% + 4	2.0% + 4	2 times/second
6.00 mF	0.001 mF	-	2.0% + 4	2.0% + 4	2.0% + 4	1 time/9 seconds

Notes for capacitance specifications:

1 This function is only applicable for U1192A, U1193A, and U1194A models.

2 Overload protection: 600 Vrms for short circuits with <0.3 A current

3 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 test lead resistance and thermal effect (by opening the test leads).

Temperature specifications

Table 4-5 Temperature specifications

Thermal type	Range	Resolution	Accuracy
			U1194A
K	–40 °C to 400 °C	0.1 °C	1.0% + 2.0 °C
	400 °C to 1200 °C	1.0 °C	1.0% + 2.0 °C
K	–40 °F to 752 °F	0.1 °F	1.0% + 3.6 °F
	752 °F to 2192 °F	1.0 °F	1.0% + 3.6 °F

Notes for temperature specifications:

1. This function is only applicable for the U1194A model.
2. The specification above is specified after the clamp meter has been left stationary in the same operating environment for 1 hour at least. If the unit is exposed during storage in a high humidity (condensing) environment, ensure that the clamp meter has been in the same operating environment for 2 hours at least.
3. The accuracy does not include the tolerance of the thermocouple probe.
4. Do not allow the temperature sensor to contact a surface that is energized above 30 Vrms or 60 V DC. Such voltages pose a shock hazard.
5. The temperature calculation is specified according to the safety standards of EN/IEC-60548-1 and NIST175.
6. The accuracy specification assumes the surrounding temperature is stable with ±1 °C. For the surrounding temperature changes of ±3 °C, the rated accuracy applies after two hours.

Frequency specifications

Table 4-6 Frequency specifications

Range	Resolution	Accuracy				Minimum input frequency
		U1191A	U1192A	U1193A	U1194A	
99.99 Hz	0.01 Hz	0.5% + 3	0.5% + 3	0.5% + 3	0.5% + 3	10 Hz
999.9 Hz	0.1 Hz	0.5% + 3	0.5% + 3	0.5% + 3	0.5% + 3	
9.999kHz	0.001 kHz	0.5% + 3	0.5% + 3	0.5% + 3	0.5% + 3	
99.99 kHz	0.01 kHz	0.5% + 3	0.5% + 3	0.5% + 3	0.5% + 3	

Notes for frequency specifications:

1 This function is only applicable for U1192A, U1193A, and U1194A models.
2 Overload protection: 600 V

Frequency sensitivity specifications

For voltage measurements

Table 4-7 Frequency sensitivity and trigger-level specifications for voltage measurements

Input range	Minimum sensitivity (RMS sine wave)	
Maximum input for specified accuracy	10 Hz to 10 kHz	10 kHz to 60 kHz
60 V	6 V	30 V
600 V	60 V	-

Notes for frequency sensitivity specifications for voltage measurements:

1 This function is only applicable for U1192A, U1193A, and U1194A models.
2 Maximum input for specified accuracy, refer to "AC specifications" on page 68.

For current measurements

Table 4-8 Frequency sensitivity and trigger level specifications for current measurements

Input range	Minimum sensitivity (RMS sine wave)
Maximum input for specified accuracy	**45 Hz to 1 kHz**
60 A	6.0A
600 A	60 A

Notes for frequency sensitivity specifications for voltage measurements:

1 This function is only applicable for U1192A, U1193A, and U1194A models.
2 Maximum input for specified accuracy, refer to "AC specifications" on page 68.

Display update rate (approximate)

Table 4-9 Display update rate (approximate)

Function	Times/second			
	U1191A	**U1192A**	**U1193A**	**U1194A**
AC V	3	3	3	3
DC V	3	3	3	3
Ω	2	2	2	2
Diode	3	3	3	3
Capacitance	-	2 times/1 second (600 µF) 1 time/9 seconds (6 mF)	2 times/1 second (600 µF) 1 time/9 seconds (6 mF)	2 times/1 second (600 µF) 1 time/9 seconds (6 mF)
Temperature	-	-	-	2
DC A (µA or A)	-	-	-	3
AC A (µA or A)	3	3	3	3
Frequency	-	3 (>10 Hz)	3 (>10 Hz)	3 (>10 Hz)

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