

Agilent U1251B and U1252B Handheld Digital Multimeter

User's and Service 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 like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

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

Safety Symbols

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

	Direct current (DC)		Off (supply)
	Alternating current (AC)		On (supply)
	Both direct and alternating current		Caution, risk of electric shock
	Three-phase alternating current		Caution, risk of danger (refer to this manual for specific Warning or Caution information)
	Earth (ground) terminal		Caution, hot surface
	Protective conductor terminal		Out position of a bi-stable push control
	Frame or chassis terminal		In position of a bi-stable push control
	Equipotentiality	CAT III 1000 V	Category III 1000 V overvoltage protection
	Equipment protected throughout by double insulation or reinforced insulation	CAT IV 600 V	Category IV 600 V overvoltage protection

Safety Information

This meter is safety-certified in compliance with EN/IEC 61010-1:2001, UL 61010-1 Second Edition and CAN/CSA 22.2 61010-1 Second Edition, CAT III 1000 V/ CAT IV 600 V Overvoltage Protection, Pollution Degree II. Use with standard or compatible test probes.

General Safety Information

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 of design, manufacture, and intended use of the instrument. Agilent Technologies assumes no liability for the customer's failure to comply with these requirements.

WARNING

- When working above 70V DC, 33 V AC RMS or 46.7 V peak, exercise caution – such range pose a shock hazard.
- Do not measure more than the rated voltage (as marked on the meter) between terminals, or between terminal and earth ground.
- Double-check the meter's operation by measuring a known voltage.
- For current measurement, turn off circuit power before connecting the meter to the circuit. Always place the meter in series with the circuit.
- When connecting probes, always connect the common test probe first. When disconnecting probes, always disconnect the live test probe first.
- Detach test probes from the meter before you open the battery cover.
- Do not use the meter with the battery cover or part of the cover removed or loose.
- Replace the battery as soon as the low battery indicator  flashes on screen. This is to avoid false readings, which may lead to possible electric shock or personal injury.
- Do not operate the product in an explosive atmosphere or in the presence of flammable gases or fumes.
- Inspect the case for cracks or missing plastic. Pay extra attention to the insulation surrounding the connectors. Do not use the meter if it is damaged.
- Inspect the test probes for damaged insulation or exposed metal, and check for continuity. Do not use the test probe if it is damaged.
- Do not use any other AC charger adaptor apart from the one certified by Agilent with this product.
- Do not use repaired fuses or short-circuited fuse-holders. For continued protection against fire, replace the line fuses only with fuses of the same voltage and current rating and recommended type.
- Do not service or perform adjustments alone. Under certain condition, hazardous voltages may exist, even with the equipment switched off. To avoid dangerous electric shock, service personnel must not attempt internal service or adjustment unless another person, capable of rendering resuscitation or first aid, is present.
- Do not substitute parts or modify equipment to avoid the danger of introducing additional hazards. Return the product to Agilent Technologies Sales and Service Office for service and repair to ensure the safety features are maintained
- Do not operate damaged equipment as the safety protection features built into this product may have been impaired, either through physical damage, excessive moisture, or any other reason. Remove power and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to Agilent Technologies Sales and Service Office for service and repair to ensure the safety features are maintained.

CAUTION

- Turn off circuit power and discharge all high-voltage capacitors in the circuit before you perform resistance, continuity, diodes, or capacitance tests.
- Use the correct terminals, function, and range for your measurements.
- Never measure voltage when current measurement is selected.
- Use only recommended rechargeable battery. Ensure proper insertion of battery in the meter, and follow the correct polarity.
- Disconnect test leads from all the terminals during battery charging.

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/electronic product in domestic household waste.
C SA US	The CSA mark is a registered trademark of the Canadian Standards Association.		

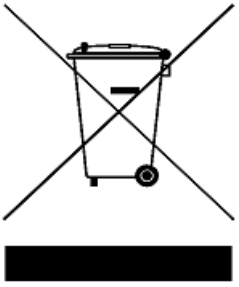
Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

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



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To return this unwanted instrument, contact your nearest Agilent Technologies, 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 Web site. You can search the DoC by its product model or description.

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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1 Getting Started Tutorial

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This chapter contains a brief description of the front panel of the Agilent U1251B and U1252B Handheld Digital Multimeter.

Introducing the Agilent U1251B and U1252B Handheld Digital Multimeter

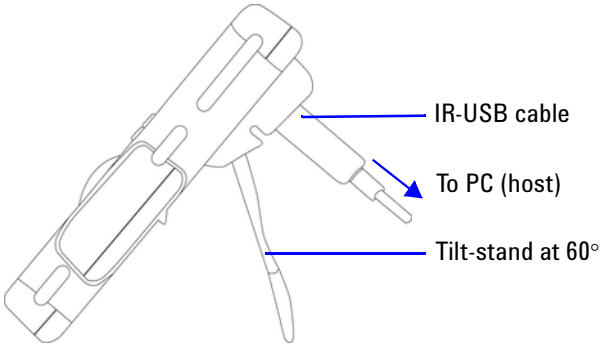
The handheld digital multimeter's key features are:

- DC, AC and AC + DC (only U1252B) voltage and current measurements.
- True-RMS measurement for both AC voltage and current
- Rechargeable Ni-MH battery with built-in charging capability (only for U1252B)
- Ambient temperature on second display
- Battery capacity indicator
- Bright orange LED backlight
- Resistance measurement up to 50 MΩ (for U1251B) and 500 MΩ (for U1252B)
- Conductance measurement from 0.01 nS (100 GΩ) ~50 nS
- Capacitance measurement up to 100 mF
- Frequency counter up to 20 MHz (only U1252B)
- The % scale readout for 4-20 mA or 0-20 mA measurement
- dBm with selectable reference impedance
- 1 ms Peak Hold to catch inrush voltage and current easily
- Temperature test with selectable 0 °C compensation (without ambient temperature compensation).
- K-type (for U1251B) and J/K-types temperature measurement (for U1252B)
- Frequency, duty cycle and pulse width measurements
- Dynamic Recording for min, max and average readings
- Data Hold with manual or auto trigger and Null mode
- Diode and audible continuity tests
- Square wave generator with selectable frequency, pulse width and duty cycle (only U1252B)
- Agilent GUI Application Software (IR-USB cable sold separately)
- Closed case calibration

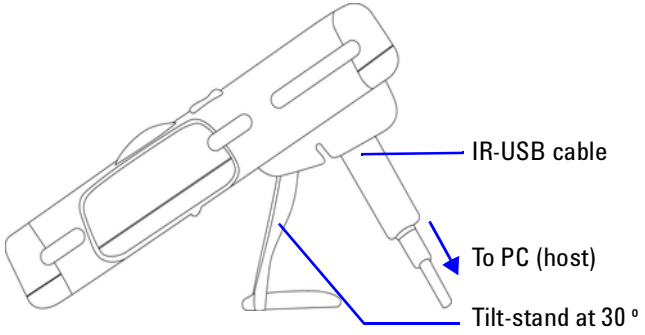
- 50,000 count precision true RMS digital multimeter, designed to meet IEC61326-1:2005 / EN61326-1:2006 Category III 1000 V/ CAT IV 600 V Overvoltage Protection, Pollution Degree II standards

Adjusting the Tilt-Stand

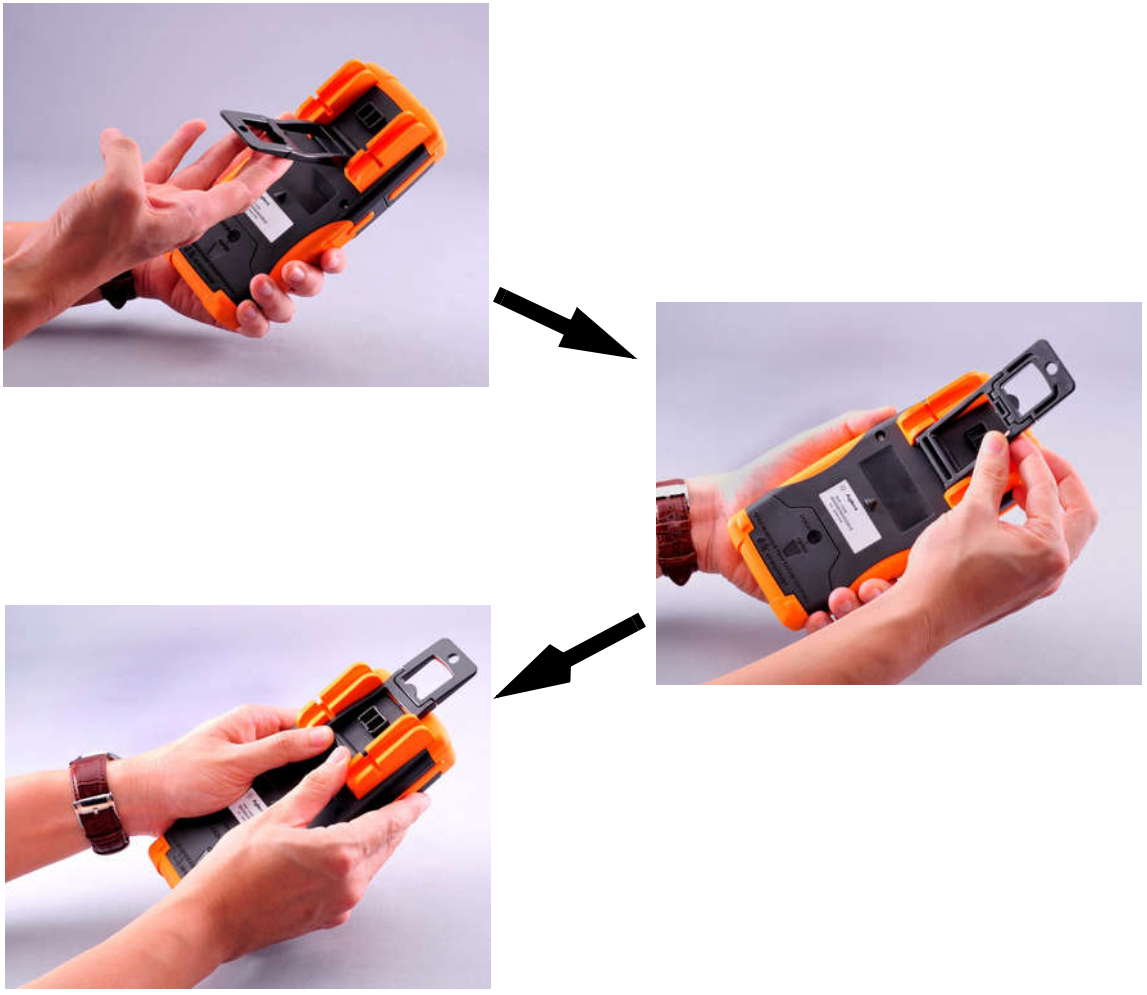
To adjust the meter to a 60° standing position, pull the tilt-stand outwards to its maximum reach.



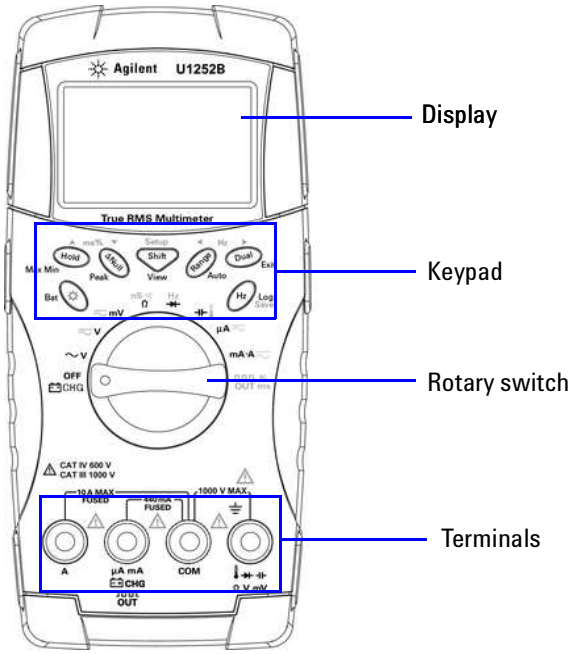
To adjust the meter to a 30° standing position, bend the tip of the stand so that it is parallel to the ground before pulling the stand outwards to its maximum reach.



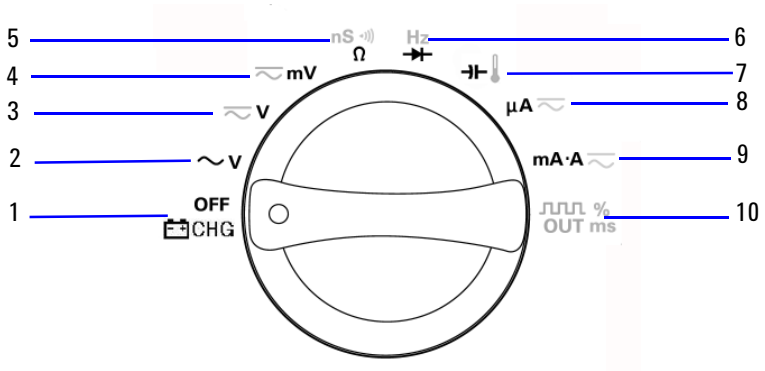
To adjust the meter to a hanging position, flip the stand upwards and over its maximum reach until it is detached from its hinge. Then flip the stand over so that the stand's inner surface is facing the meter's rear. Now, press the stand down into its hinge. Follow the step by step pictorial instructions below.



The Front Panel at a Glance



The Rotary Switch at a Glance



Legend:

No.	Description / Function
1	Charge mode [U1252B only] or OFF
2	AC V
3	DC voltage or DC+AC voltage [U1252B only]
4	DC mV, AC mV, AC+DC mV [U1252B only]
5	Resistance (Ω), Continuity, and Conductance (nS)
6	Frequency counter [U1252B only] or Diode
7	Capacitance or Temperature
8	DC µA and AC µA
9	DC mA, DC current, AC mA or AC current
10	Square-wave output, Duty cycle or Pulse width output [for U1252B] and OFF [for U1251B]

The Keypad at a Glance

The operation of each key is shown below. Pressing a key illuminates a related symbol on the display and sounds the beeper. Turning the rotary switch to another position resets the current operation of the key.

Figure below shows the keypad of the U1252B. The **ms%** (Pulse width/Duty cycle), ◀ **Hz** ▶, and frequency counter functions are only available on the U1252B.

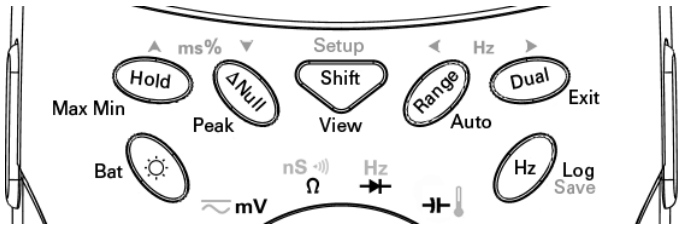


Table 1-1 Keypad Desciption/Functions

		Function when pressed for less than 1 second	Function when pressed for more than 1 second
1		acts as a toggle switch to turn backlit ON/OFF. Backlit automatically turns off after 30s (default) (1).	displays the battery capacity for 3 seconds
2	Hold	freezes the measured value. In Data Hold mode, press again to trigger hold of the next measured value. In Refresh Hold mode, reading updates automatically once reading is stable and count setting is exceeded (1).	enters Dynamic Recording mode. Press again to scroll through Max, Min, Avg and present readings (indicated by MAXMINAVG on display) .
3	ΔNull	saves displayed value as a reference to be subtracted from subsequent measurements. Press again to see the relative value that has been saved.	enters 1 ms Peak Hold mode. Press to scroll through Max and Min peak readings.

		Function when pressed for less than 1 second	Function when pressed for more than 1 second
4		Shift scrolls through the measuring function(s) at a particular rotary switch position.	Shift enters Log Review mode. Press Shift to switch to manual or interval logging data. Press ◄ or ► to view first or last logged data respectively. Press ▲ or ▼ to scroll up or down logged data. Press Shift for more than 1 second to exit mode.
5		Range scrolls through available measuring ranges (except when rotary switch is set at or at Hz [for U1252B] position) (2).	Range sets to Auto Range mode.
6		Dual scrolls through available dual-combination displays (except when rotary switch is set at or [for U1252B] position, or when meter is in 1 ms peak hold or dynamic recording mode) (3).	Dual exits Hold, Null, Dynamic Recording, 1 ms Peak Hold and dual display modes.
7		enters Frequency Test mode for current or voltage measurements. Press Hz to scroll through frequency (Hz), duty cycle (%) and pulse width (ms) functions. In duty cycle (%) and pulse width (ms) tests, press Hz to switch to positive or negative pulse.	Hz enters logging mode. In manual data logging, press Hz to log data manually into memory. In automatic data logging, data logs automatically (1). Press Hz for more than 1 second to exit auto data logging mode.

NOTE

1. See Table 4-1, "Available setting options in Setup mode," on page 71 for details of available options.
2. When rotary switch is at , press Range to switch to °C or °F display. When rotary swtich is at Hz, press Range to switch to division of signal frequency by 1 or 100.
3. When rotary switch is at , ETC is ON by default. You may press Dual to disable ETC (Environment Temperature Compensation), 0°C will appear on display. For pulse and duty cycle measurement, press Dual to switch trigger slope to positive or negative. When meter is in peak or dynamic-recording mode, press Dual to restart 1 ms peak hold or dynamic recording mode.

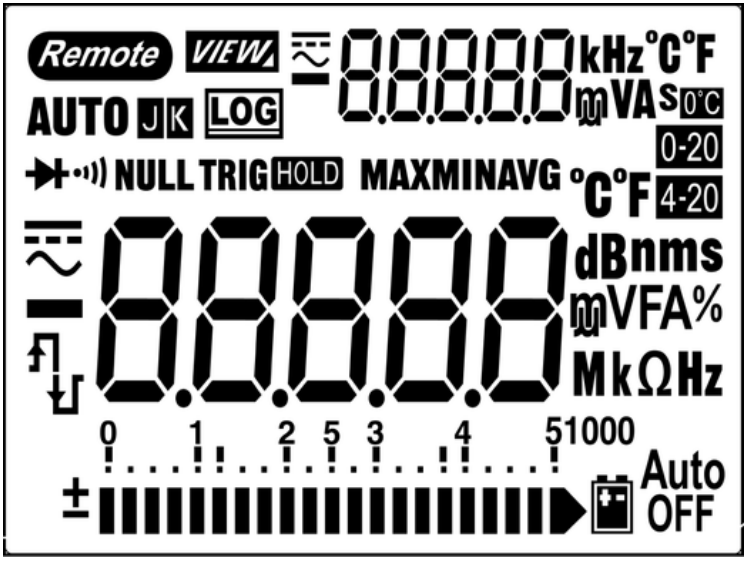
The Display at a Glance

To view the full display (with all segments illuminated),

press and hold Hold button while turning the rotary switch from OFF to any non-OFF position. After you are done viewing the full display, press any button to resume normal functionality based on the rotary switch position. This is followed by a wake-up feature.

The meter will then enter power save mode once auto power off (APF) is enabled. To wake the meter up:

1. Turn the rotary switch (knob) to OFF position, and then turn it back on again.
2. Press any button for rotary switch position that is not at square wave output position. This is only available for the U1252B.
3. For the U1252B only, to set the rotary switch at square wave out position, press only the Dual, Range and Hold buttons or turn the rotary switch to another position.



The LCD signs are described on pages 10, 11 and 12.

LCD Sign	Description
Remote	Remote control
K J	Thermocouple types: K (K-type) J (J-type)
NULL	Null math function
	Diode / Audible continuity
	Audible continuity for resistance
VIEW	View mode for checking logged data
LOG	Data logging indication
	Square wave output (only U1252B)
	• Positive slope for pulse width (ms) and duty cycle (%) measurement • Charging capacitor as capacitance measurement
	• Negative slope for pulse width (ms) and duty cycle (%) measurement • Discharging capacitor as capacitance measurement
	Low battery indication
Auto OFF	Auto power off enable
HOLD	Refresh (auto) Hold
TRIG HOLD	Trigger (manual) Hold
MAXMINAVG	Dynamic Recording mode: Present value on primary display
MAX	Dynamic Recording mode: Maximum value on primary display
MIN	Dynamic Recording mode: Minimum value on primary display
AVG	Dynamic Recording mode: Average value on primary display
HOLD MAX	1 ms Peak Hold mode: Positive peak value on primary display
HOLD MIN	1 ms Peak Hold mode: Negative peak value on primary display

The primary display signs are described below.

LCD Sign	Description
AUTO	Auto range
	AC + DC
	DC
	AC
	Polarity, digits and decimal points for primary display
dBm	Decibel unit relative to 1 mW
dBV	Decibel unit relative to 1 V
MkHz	Frequency units: Hz, kHz, MHz
MkΩ	Resistance units: Ω, kΩ, MΩ
nS	Conductance unit
mV	Voltage units: mV, V
µmA	Current units: µA, mA, A
%	Duty cycle measurement
ms	Pulse width unit
µmnF	Capacitance units: nF, µF, mF
°C	Celsius temperature unit
°F	Fahrenheit temperature unit
 %	Percentage scale readout proportional to DC 0–20 mA
 %	Percentage scale readout proportional to DC 4–20 mA

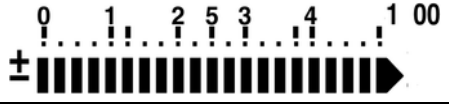
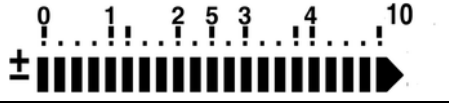
The secondary display signs are described below.

LCD Sign	Description
	AC + DC
	DC
	AC
	Polarity, digits and decimal points for secondary display
kHz	Frequency units: Hz, kHz
	No ambient temperature compensation, just thermocouple measurement
°C	Celsius ambient temperature unit
°F	Fahrenheit ambient temperature unit
mV	Voltage units: mV, V
µmA	Current units: µA, mA, A
s	Elapsed time unit: s (second) for Dynamic Recording and 1 ms Peak Hold modes

The analog bar graph is like the needle on an analog meter, except without the overshoot being displayed. When measuring peak on null adjustments and viewing fast-changing inputs, the bar graph provides a useful indication because it has faster update rates for fast response application.

The bar graph is not used for square wave output, frequency, duty cycle, pulse width, 4–20 mA% scale, 0–20 mA% scale and temperature measurements. When frequency, duty cycle and pulse width are indicated on the primary display during voltage or current measurement, the bar graph represents the voltage or current value. When 4–20 mA% scale or 0–20 mA% scale is indicated on the primary display, the bar graph represents the current value.

The “+” or “–” sign is indicated when the positive or negative value has been measured or calculated. Each segment represents 2500 or 500 counts depending on the range indicated on the peak bar graph. See the table below.

Range	Counts / Segment	Used for the Function
	2500	V, A, Ω, Diode
	2500	V, A, Ω
	2500	V, A, Ω, nS
	500	V, A, ⊣⊢
	500	⊣⊢
	500	⊣⊢

Selection of Display by Hz Button

The frequency measurement feature helps to 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. Press Hz to access the Frequency measurement mode for current or voltage measurements — voltage or current on secondary display and frequency on primary display. Alternatively, pulse width (ms) or duty cycle (%) can appear on the

primary display by pressing Hz again. This enbles the simultaneous monitoring of real-time voltage and current with frequency, duty cycle or pulse width. Voltage or current resumes on primary display after you press and hold Dual for more than 1 second.

Rotary switch position (Function)	Primary display	Secondary display
~V ≂V for U1252B (DC voltage)	Frequency (Hz)	AC V
	Pulse width (ms)	
	Duty cycle (%)	
⎓V for U1251B ≂V for U1252B (DC voltage)	Frequency (Hz)	DC V
	Pulse width (ms)	
	Duty cycle (%)	
≂V for U1252B (AC + DC voltage)	Frequency (Hz)	AC + DC V
	Pulse width (ms)	
	Duty cycle (%)	
≂mV (AC voltage)	Frequency (Hz)	AC mV
	Pulse width (ms)	
	Duty cycle (%)	
≂mV (DC voltage)	Frequency (Hz)	DC mV
	Pulse width (ms)	
	Duty cycle (%)	
≂mV (AC + DC voltage)	Frequency (Hz)	AC + DC mV
	Pulse width (ms)	
	Duty cycle (%)	
µA≂ (AC Current) [for U1252B]	Frequency (Hz)	AC µA
	Pulse width (ms)	
	Duty cycle (%)	
µA≂ (DC current)	Frequency (Hz)	DC µA
	Pulse width (ms)	
	Duty cycle (%)	

µA ≈ (AC + DC current) [for U1252B]	Frequency (Hz)	AC + DC µA
	Pulse width (ms)	
	Duty cycle (%)	
mA·A ≈ (AC current)	Frequency (Hz)	AC mA or A
	Pulse width (ms)	
	Duty cycle (%)	
mA·A ≈ (DC current)	Frequency (Hz)	DC mA or A
	Pulse width (ms)	
	Duty cycle (%)	
mA·A ≈ (AC + DC current) [for U1252B]	Frequency (Hz)	AC + DC mA
	Pulse width (ms)	
	Duty cycle (%)	
Hz (Frequency counter) - press Range to select frequency division by 1 [for U1252B]	Frequency (Hz)	- 1 -
	Pulse width (ms)	
	Duty cycle (%)	
Hz (Frequency counter) - press Range to select frequency division by 100 [for U1252B]	Frequency (Hz)	- 100 -

Selection of Display by Dual Button

Press Dual to select different combinations of dual display. Normal single display resumes after you press and hold Dual for more than 1 second. See table below.

Rotary switch position (Function)	Primary display	Secondary display
~ V (AC voltage)	AC V	Hz (AC coupling)
	dBm or dBV (select by pressing Shift)	AC V
	AC V	Ambient temperature °C or °F
≂ V for U1252B (AC voltage)	AC V	Hz (AC coupling)
	dBm or dBV [1]	AC V
	AC V	DC V
	AC V	Ambient temperature °C or °F
⎓ V for U1251B/ ≂ V for U1252B (DC voltage)	DC V	Hz (DC coupling)
	dBm or dBV [1]	DC V
	DC V	AC V [for U1252B]
	DC V	Ambient temperature °C or °F
≂ V for U1252B (AC + DC voltage)	AC + DC V	Hz (AC coupling)
	dBm or dBV [1]	AC + DC V
	AC + DC V	AC V
	AC + DC V	DC V
	AC + DC V	Ambient temperature °C or °F
≂ mV (AC voltage)	AC mV	Hz (AC coupling)
	dBm or dBV [1]	AC mV
	AC mV	DC mV
	AC mV	Ambient temperature °C or °F
≂ mV (DC voltage)	DC mV	Hz (DC coupling)
	dBm or dBV [1]	DC mV
	DC mV	AC mV
	DC mV	Ambient temperature °C or °F

NOTE [1] Reading of dBm or dBV depends on the last review on AC V. If the last review is dBV, the following display will also remain in dBV.

mV (AC + DC voltage) [for U1252B]	AC + DC mV	Hz (AC coupling)
	dBm or dBV	AC + DC mV
	AC + DC mV	AC mV
	AC + DC mV	DC mV
	AC + DC mV	Ambient temperature °C or °F
µA (DC current)	DC µA	Hz (DC coupling)
	DC µA	AC µA
	DC µA	Ambient temperature °C or °F
µA (AC current)	AC µA	Hz (AC coupling)
	AC µA	DC µA
	AC µA	Ambient temperature °C or °F
µA (AC + DC current) [for U1252B]	AC + DC µA	Hz (AC coupling)
	AC + DC µA	AC µA
	AC + DC µA	DC µA
	AC + DC µA	Ambient temperature °C or °F
mA·A (DC current)	DC mA	Hz (DC coupling)
	DC mA	AC mA
	%(0–20 or 4–20)	DC mA
	DC mA	Ambient temperature °C or °F
mA·A (AC current)	AC mA	Hz (AC coupling)
	AC mA	DC mA
	AC mA	Ambient temperature °C or °F
mA·A (AC + DC current) [for U1252B]	AC + DC mA	Hz (AC coupling)
	AC + DC mA	AC mA
	AC + DC mA	DC mA
	AC + DC mA	Ambient temperature °C or °F
mA·A (DC current)	DC A	Hz (DC coupling)
	DC A	AC A
	DC A	Ambient temperature °C or °F

mA·A ~ (AC current)	AC A	Hz (AC coupling)
	AC A	DC A
	AC A	Ambient temperature °C or °F
mA·A ~ (AC + DC current) [for U1252B]	AC + DC A	Hz (AC coupling)
	AC + DC A	AC A
	AC + DC A	DC A
	AC + DC A	Ambient temperature °C or °F
⊣⊢ (Capacitance) ⊣▶⊢ (Diode)/ Ω (Resistance)/ nS (Conductance)	nF / V / Ω / nS	Ambient temperature °C or °F
(Temperature)	°C (°F)	Ambient temperature °C or °F
	°C (°F)	Ambient temperature °C or °F / 0°C compensation (select by pressing Dual)

Selection of Display by Shift Button

The table below shows selection of primary display, with respect to measuring function (rotary switch position), using the Shift button.

Rotary switch position (Function)	Primary display
~V (AC Voltage)	AC V
	dBm (in dual display mode) (1)
	dBV (in dual display mode) (1)
⎓V for U1251B	DC V
~V for U1252B (AC + DC Voltage)	DC V
	AC V
	AC + DC V

V for U1252B (AC + DC Voltage)	DC mV
	AC mV
	AC + DC mV
Ω	Ω
	Ω
	nS
	Diode
	Hz
/	Capacitance
	Temperature
µA	DC µA
	AC µA
	AC + DC µA [for U1252B]
mA·A	DC mA
	AC mA
	AC + DC mA
	%(0–20 or 4–20)
mA·A	DC A
	AC A
	AC + DC A [for U1252B]
Square wave output for U1252B	Duty cycle (%)
	Pulse width (ms)

NOTE

1. Press Shift to switch between dBm and dBV measurement. Press Dual for more than 1 second to return to AC V measurement only.

The Terminals at a Glance

WARNING **To avoid damaging this device, do not exceed the input limit.**

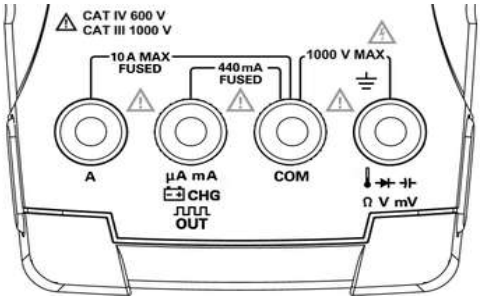


Figure 1-1 U1252B Connector terminals

Table 1-2 Terminal connections for different measuring functions

Rotary switch position	Input terminal		Overload protection
V	Ω V mV	COM	1000 V R.M.S.,
V for U1252B V for U1251B			
mV			1000 V R.M.S. for short circuit <0.3 A
Ω			
µA mA·A	µA . mA	COM	440 mA / 1000 V 30 kA fast-acting fuse
mA·A	A	COM	11 A / 1000 V 30 kA fast-acting fuse
% OUT ms for U1252B	% OUT ms	COM	
CHG	CHG	COM	440 mA / 1000 V fast-acting fuse

The Rear Panel at a Glance

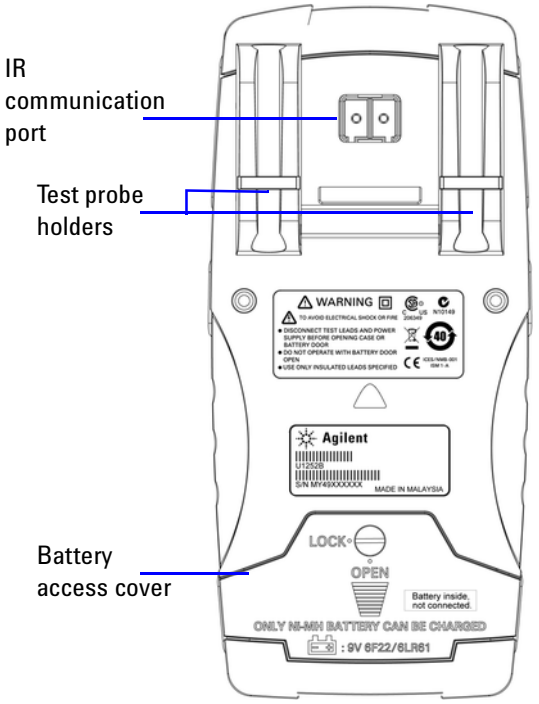


Figure 1-2 Rear panel of U1252B

2
Making Measurements

Measuring Voltage 24
Measuring AC voltage 24
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This chapter contains detailed information on how measurements are taken using this handheld digital multimeter. It builds on information you have learned in the Quick Start Guide.

Measuring Voltage

The meter offers true-RMS readings for AC measurements that are accurate for sine waves, square waves, triangle waves, staircase waves and other waveforms without any DC offset.

For AC with DC offset, use AC + DC measurement on ≂V or ≂mV rotary switch location. This applies only to U1252B.

WARNING **Ensure that the terminal connections are correct for that particular measurement before proceeding with the measurement. To avoid damaging the device, do not exceed the input limit.**

Measuring AC voltage

1. Set the rotary switch to ∼V, ≂V or ≂mV.
2. Connect the red and black test leads to the input terminals **V.mV** and **COM** respectively.
3. Alternatively, press Dual to display frequency on secondary display.
4. Probe the test points and read the display.

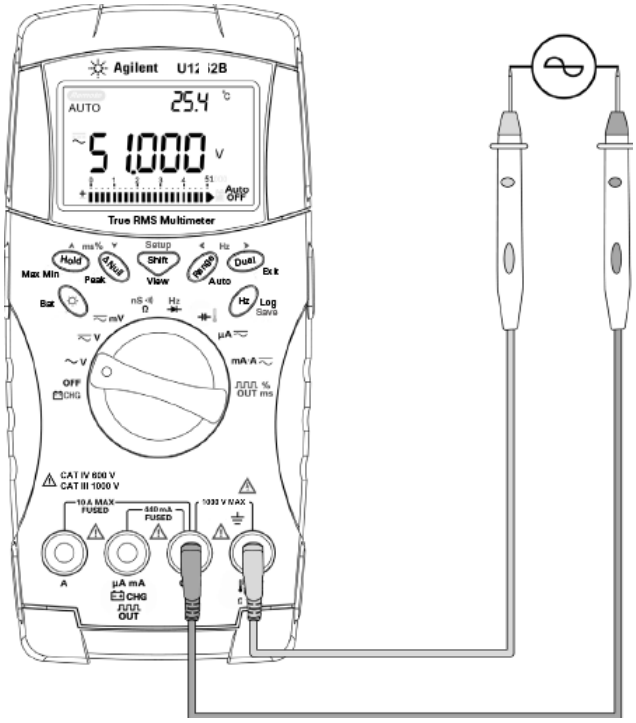

Figure 2-1 Measuring AC voltage

Measuring DC voltage

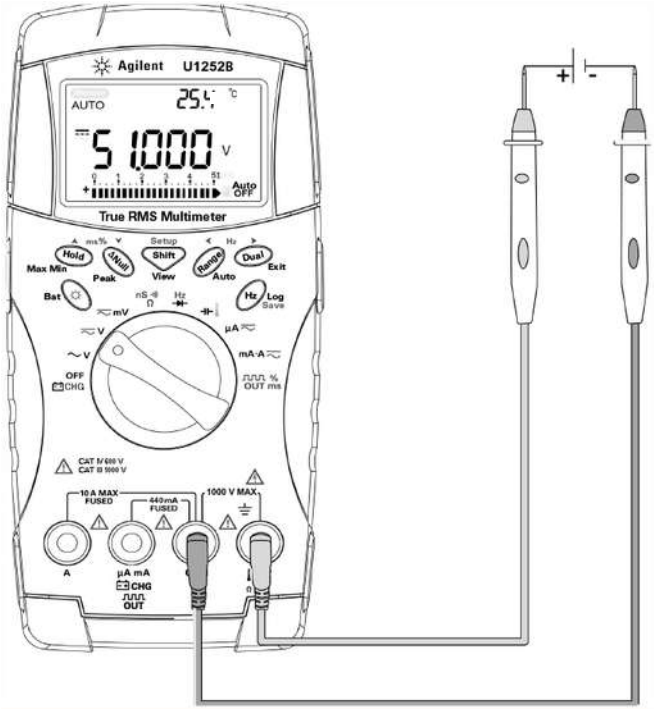

Figure 2-2 Measuring DC voltage

1 Set the rotary switch to ≈V and ≈mV.
2 Connect the red and black test leads to the input terminals **V.mV** and **COM** respectively.
3 Probe the test points and read the display.

Measuring Current

µA & mA Measurement

1 Set the rotary switch to mA·A.

2 Connect the red and black test leads to the input terminals **µA.mA** and **COM** respectively.

3 Probe the test points in series with the circuit, and read the display.

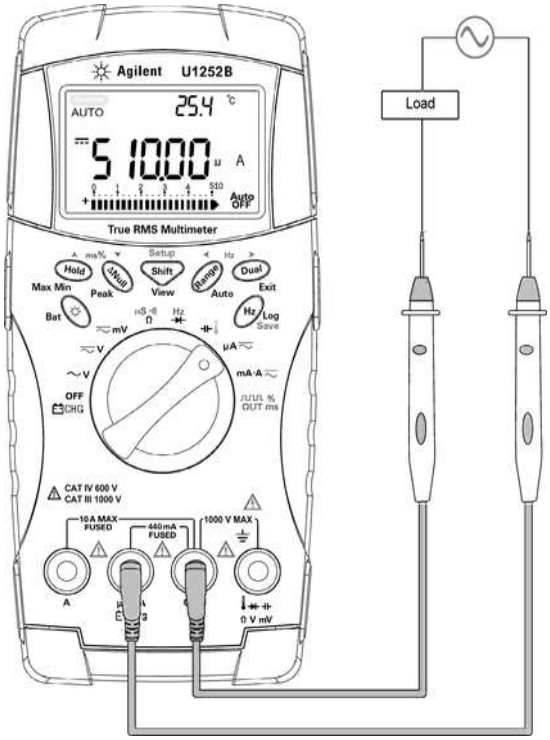

Figure 2-3 Measuring µA and mA current

% Scale of 4–20 mA

The % scale for 4–20 mA or 0–20 mA is calculated using its corresponding DC mA measurement. The meter will optimize the best resolution automatically as shown in the table below. The Range and bar graph is used for ranging 50 mA and 500 mA. The % scale for 4–20 mA or 0–20 mA is set to two ranges as follows:

% (0–20 or 4–20 mA) Always auto range	DC mA Auto or manual range
999.99%	50 mA, 500 mA
9999.9%	

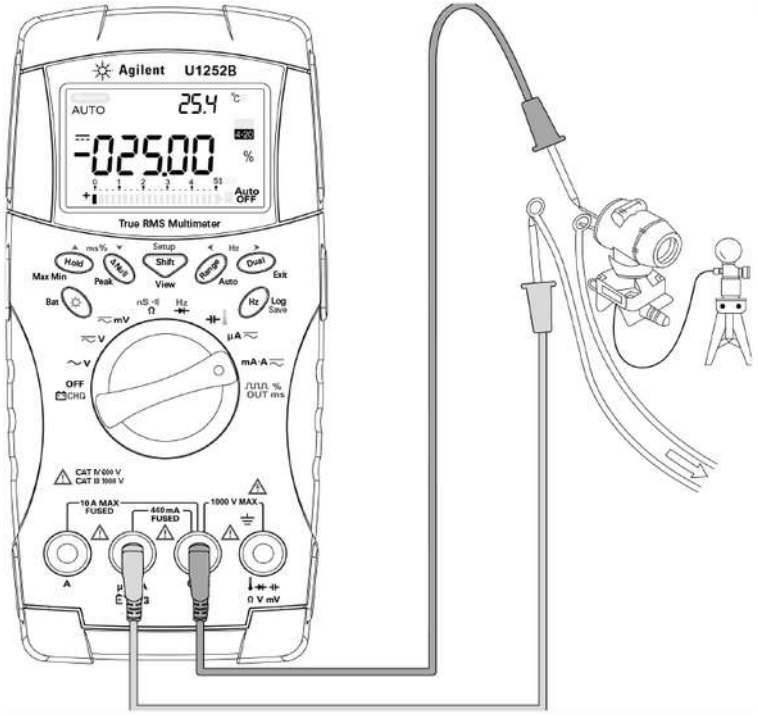

Figure 2-4 Measuring scale of 4-20 mA

A measurement

1 Set the rotary switch to mA·A ~ .

2 Connect the red and black test leads to the 10A input terminal **A** and **COM** respectively. The meter is set to A measurement automatically when the red test lead is plugged into the **A** terminal.

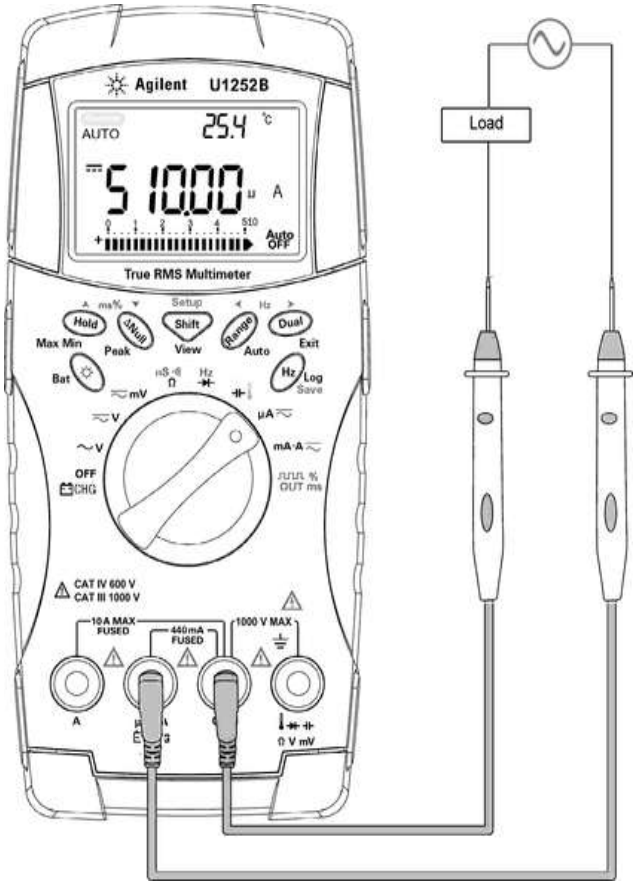

Figure 2-5 A measurement

Frequency Counter

WARNING

- **Use the frequency counter for low voltage applications only. Never use the frequency counter for line power system.**
- **For input more than 30 Vpp, you are required to use frequency measurement mode available under the current or voltage measurement instead of frequency counter.**

---

1 Set the rotary switch to Hz.

2 Press Shift to select the Frequency counter (Hz) function. "-1-" on the secondary display means the input signal frequency is divided by 1. This accommodates for a higher frequency range of up to 985 kHz.

3 Connect the red and black test leads to the input terminals **V** and **COM** respectively.

4 Probe the test points and read the display.

5 If the reading is unstable or is zero, press Range to select the division of the input signal frequency by 100. This accommodates for a higher frequency range of up to 20 MHz.

6 The signal is out of range if the reading is still unstable after Step 5.

While the secondary display shows "-1-", you may scroll through the pulse width (ms), duty cycle (%) and frequency (Hz) measurements by pressing Hz.

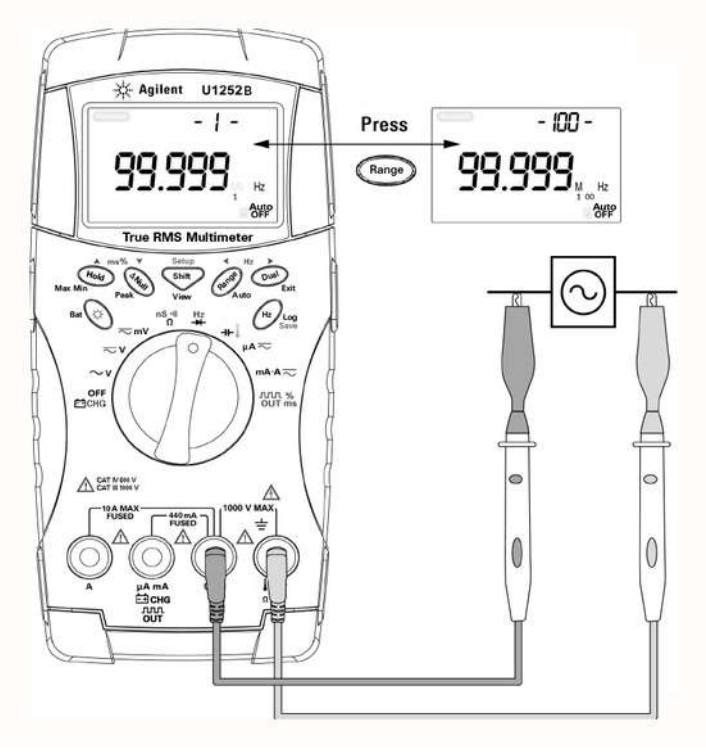

Figure 2-6 Measuring frequency

Measuring Resistance, Conductance and Testing Continuity

CAUTION Disconnect the circuit power and discharge all high-voltage capacitors before measuring the resistance to any prevent possible damage to the meter or the device under test.

1. Set the rotary switch to nS Ω .
2. Connect the red and black test leads to the input terminals Ω and **COM** respectively.
3. Probe the test points (by shunting the resistor) and read the display.

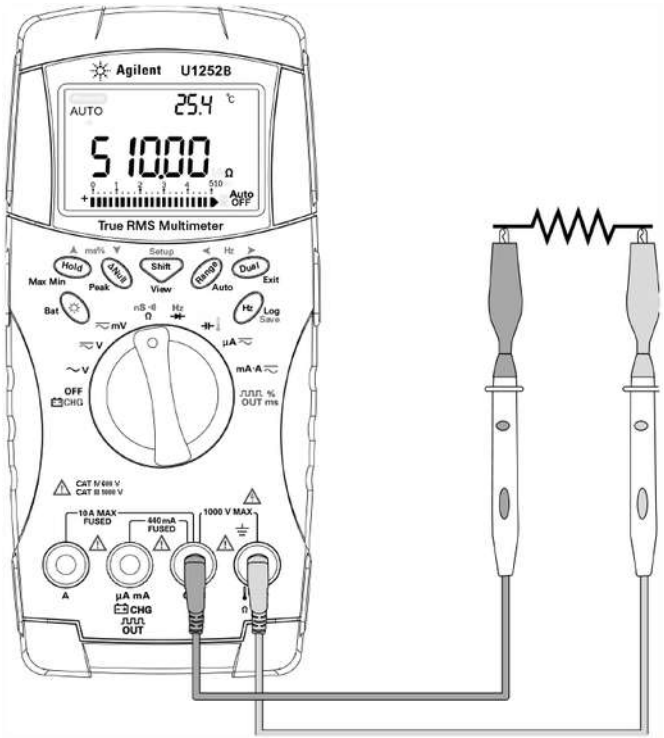

Figure 2-7 Measuring resistance

4 Press  to scroll through audible continuity, conductance and resistance tests as shown in Figure 2-8.

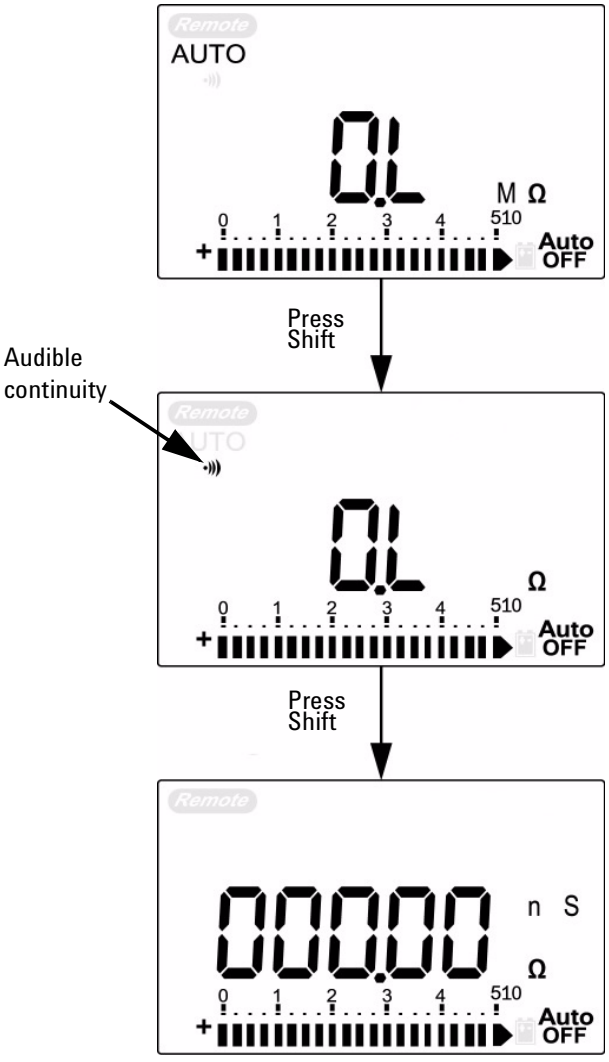

Figure 2-8 Audible continuity, conductance and resistance test.

In the range of 0–500 Ω, the beeper will sound if the resistance value falls below 10 Ω. For other ranges, the beeper will sound if the resistance falls below the typical values indicated in the table below.

Measuring range	Beeper sounds when
500.00 Ω	Ω < 10
5.0000 kΩ	Ω < 100
50.000 kΩ	Ω < 1k
500.00 kΩ	Ω < 10k
5.0000 MΩ	Ω < 100k
50.000 MΩ	Ω < 1M
500.00 MΩ	Ω < 10M

The conductance measurement enables the measurement of very high resistance of up to 100 GΩ. As the high-resistance readings are susceptible to noise, you can capture the average readings by using the Dynamic Recording mode. See Figure 3-1 on page 47.

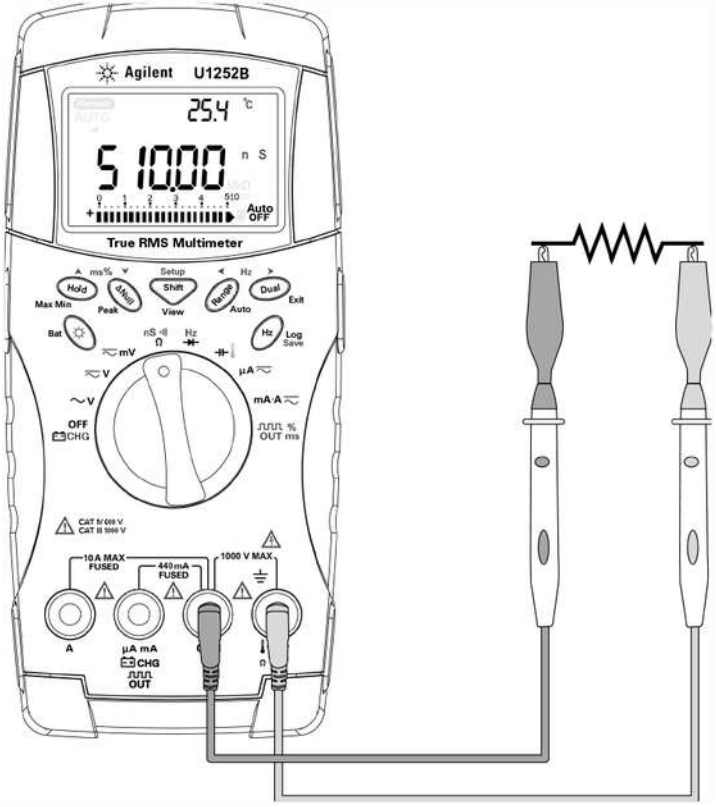

Figure 2-9 Conductance measurement

Testing Diodes

CAUTION Disconnect the circuit power and discharge all the high-voltage capacitors before testing the diodes to prevent any possible damage to the meter.

To test the diodes, turn the circuit power off, and remove the diodes from the circuit. Then proceed as follows:

1 Set the rotary switch to →|←.

2 Connect the red and black test leads to the input terminals →|← and **COM** respectively.

3 Use the red probe lead on the positive terminal (anode) and use the black probe lead on the negative terminal (cathode).

NOTE The cathode is the side with band(s).

4 Read the display.

NOTE The meter can display the diode's forward bias of up to approximately 2.1 V. A typical diode's forward bias is between the range of 0.3 V to 0.8 V.

5 Reverse the probes and measure the voltage across the diodes again. The diode's test result is based on the following:

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

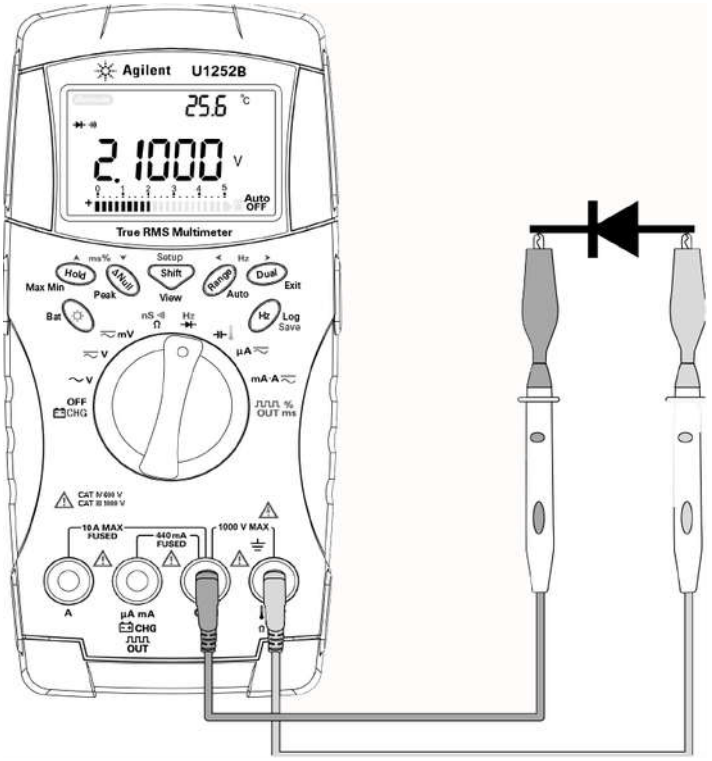

Figure 2-10 Measuring forward bias of diode

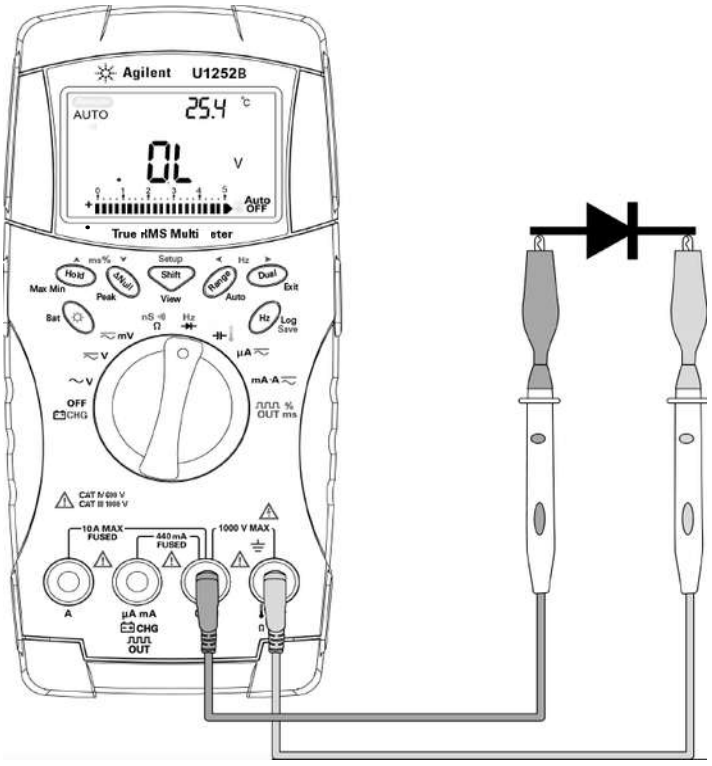

Figure 2-11 Measuring reverse bias of diode

Measuring Capacitance

CAUTION Disconnect the circuit power and discharge all the high-voltage capacitors before measuring the capacitance to prevent any possible damage to the meter or the device under test. To confirm that the capacitors have discharged, use the DC voltage function.

The meter measures capacitance by charging the capacitor with a known current for a period of time, measuring the voltage and then calculating the capacitance. The larger the capacitor, the longer is the charging time.

Measuring tips:

- For measuring capacitances greater than 10,000µF, discharge the capacitor first, then select a suitable range for the measurement. This will speed up measuring time in order to obtain the correct capacitance value.
- For measuring small capacitances, press ΔNull with the test leads open to subtract any residual capacitance from the meter or the leads.

NOTE means the capacitor is charging. means the capacitor is discharging.

1 Set the rotary switch to ⊣⊢.

2 Connect the red and black test leads to the input terminals ⊣⊢ and **COM** respectively.

3 Use the red probe lead on the positive terminal of the capacitor and use the black probe lead on the negative terminal.

4 Read the display.

Measuring Temperature

CAUTION Do not bend the thermocouple leads at sharp angles. Repeated bending over a period of time may break the leads.

The bead type thermocouple probe is suitable for making temperature measurements between –20 °C to 200 °C in Teflon compatible environments. Above this temperature, the probe may emit a toxic gas. Do not immerse this thermocouple probe in liquids. For best results, use a thermocouple probe designed for each application – an immersion probe for liquid or gel and an air probe for air measurements. Observe the following measuring techniques:

- Clean the measurement surface and make sure the probe is securely touching the surface. Remember to disable the applied power.
- When measuring above the ambient temperature, move the thermocouple along the surface until you get the highest temperature reading.
- When measuring below ambient temperature, move the thermocouple along the surface until you get the lowest temperature reading.
- Place the meter in the operating environment for at least 1 hour as using non-compensation transfer adaptor with miniature thermal probe.
- For a quick measurement, use the 0 °C compensation to see the temperature variation of the thermocouple sensor. The 0 °C compensation assists in measuring the relative temperature immediately.

1 Turn the rotary switch to position.
2 Press 

to select the temperature measurement.
3 Plug the thermocouple adapter (with the thermocouple probe connected to it) into the input terminals and **COM**.

4 Touch the measurement surface with the thermocouple probe.

5 Read the display.

If you are working in a varied environment, where the ambient temperature is not constant, do the following:

1 Press Dual to select 0 °C compensation. This gives a quick measurement of the relative temperature.

2 Avoid contact between the thermocouple probe and the measurement surface.

3 After a constant reading is obtained, press ΔNull to set the reading as the relative reference temperature.

4 Touch the measurement surface with the thermocouple probe.

5 Read the display for the relative temperature.

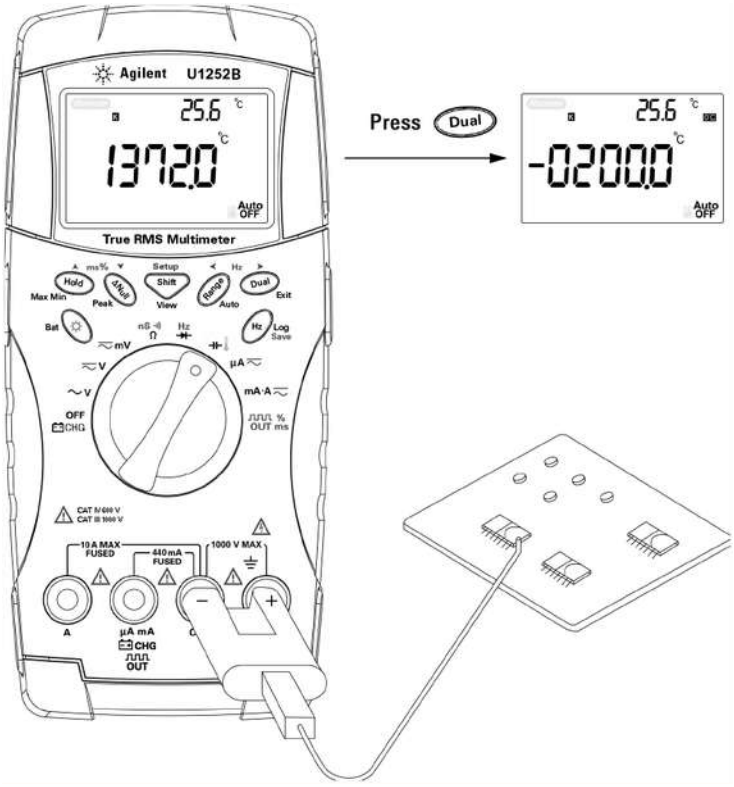

Figure 2-12 Surface temperature measurement

Alerts and Warning During Measurement

Overload Alert

WARNING **For your safety, look out for this alert. When you are alerted, immediately remove the test leads from the measuring source.**

The meter provides an overload alert for voltage measurement in both auto and manual range modes. The meter beeps periodically once the measuring voltage exceeds 1010 V. For your safety, please be aware of this alert.

Input Warning

The meter sounds an alert beep when the test lead is inserted into the **A** input terminal but the rotary switch is not set to the corresponding **mA.A** location. The primary display indicates a flashing "**A- Err**" until the test lead is removed from the **A** input terminal. See Figure 2-13.

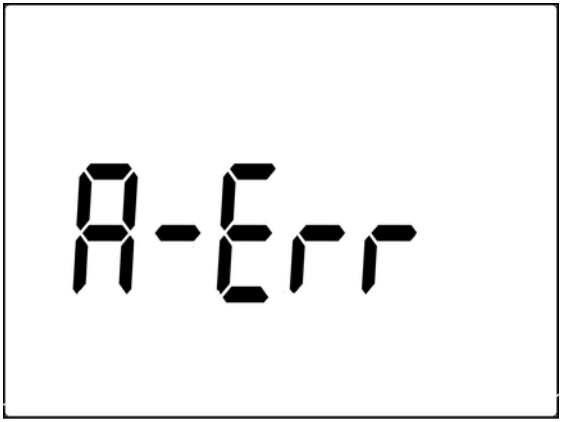

Figure 2-13 Input terminal warning

Charge Terminal Alert

The meter sounds an alert beep when the CHG terminal detects a voltage level of more than 5 V and the rotary switch is not set to the corresponding OFF CHG location. The primary display indicates a flashing "**Ch.Err**" until the lead is removed from the CHG input terminal. See Figure 2-14.



Figure 2-14 Charge terminal alert

3 Features and Functions

Dynamic Recording 46
Data Hold (Trigger Hold) 48
Refresh Hold 49
Null (Relative) 51
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1 ms Peak Hold 55
Data Logging 57
- Manual Logging 57
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Square Wave Output (for U1252B) 63
Remote Communication 67

This chapter contains detailed information on the features and functions that are available in this meter.

Dynamic Recording

The Dynamic Recording mode detects intermittent turn on or turn off voltage or current surges and verifies the measuring performance without the user being present during any particular period of time. You can take readings simultaneously while performing other task.

Use the average reading procedure to even out unstable inputs, estimating the percentage in time a circuit is operated, and verifying the circuit performance. The secondary display shows the time lapse. The maximum time is 99,999 seconds. When this maximum time is exceeded, the display indicates "**OL**".

1. Press Hold for more than 1 second to enter Dynamic Recording mode. The meter is now in continuous mode or non-data hold (non-trigger) mode. "**MAXMINAVG**" and present value of measurement are displayed. The beeper sounds when a new maximum or minimum value is recorded.
2. Press Hold to cycle through maximum, minimum, average and present readings. The **MAX**, **MIN**, **AVG** and **MAXMINAVG** indicators light up, corresponding to the displayed readings.
3. Press Hold or Dual for more than 1 second to exit Dynamic Recording mode.

NOTE

- Press Dual to restart the dynamic recording.
- The average value is the true average of all the measured values taken in the Dynamic Recording mode. If an overload is recorded, the averaging function will stop and the average value becomes "**OL**"(overload). Auto OFF is disabled in Dynamic Recording mode.

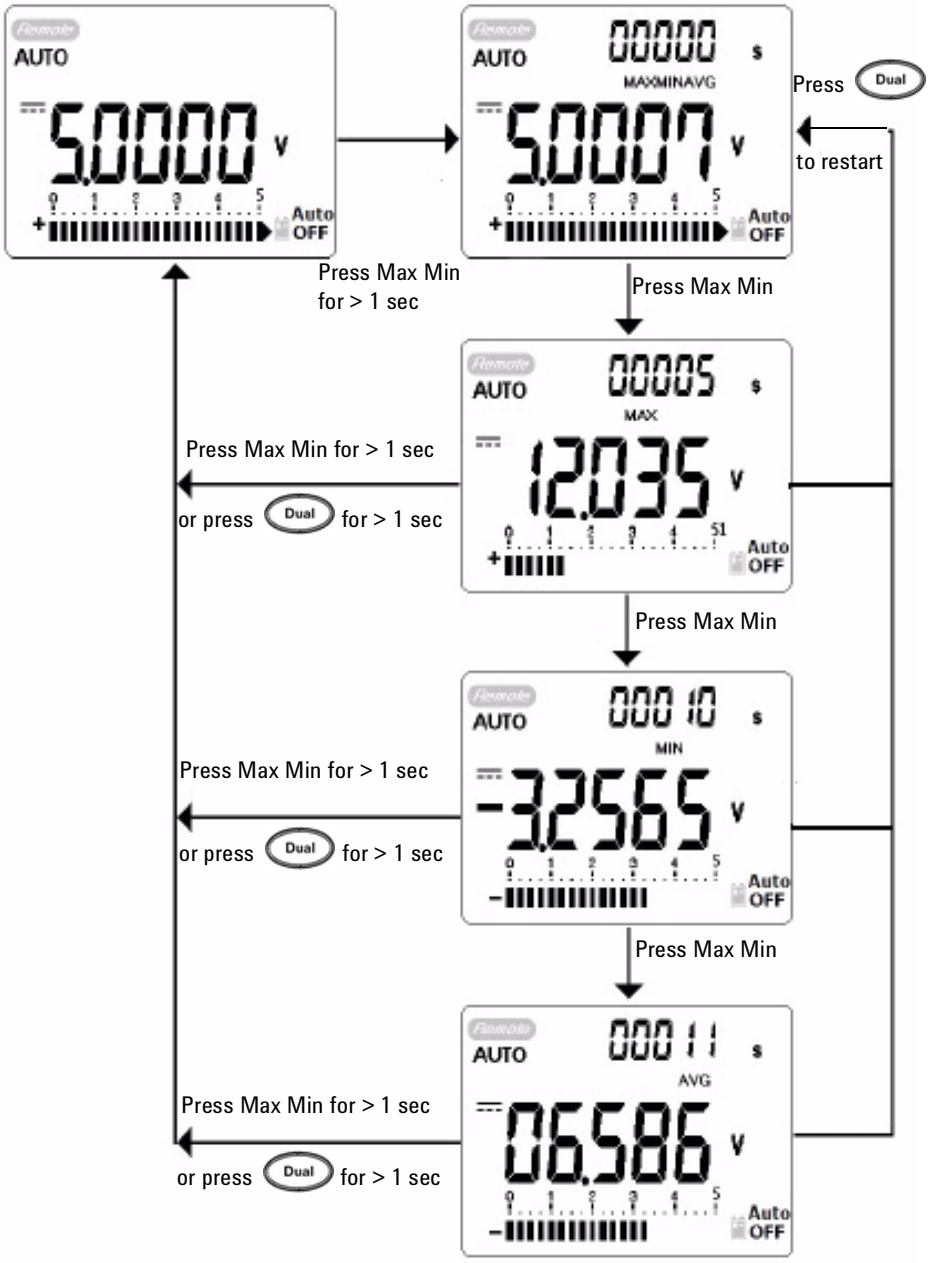

Figure 3-1 Dynamic recording mode operation

Data Hold (Trigger Hold)

The data hold function allows the user to freeze the displayed digital value.

1 Press Hold to freeze the displayed value and to enter the manual trigger mode. **TRIG** HOLD is displayed.

2 Press Hold again to freeze the next value being measured. **TRIG** flashes before the new value is updated on the display.

3 Press and hold Hold or Dual for more than 1 second to quit this mode.

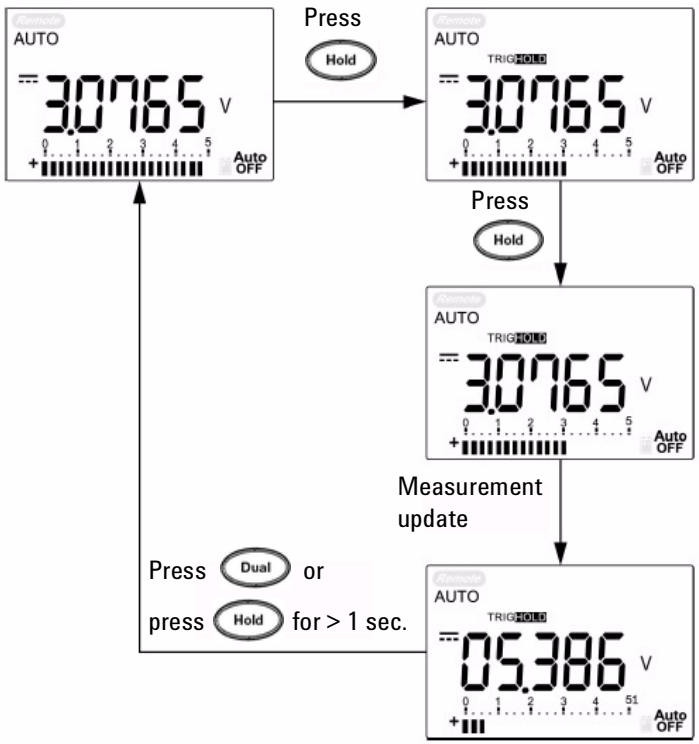

Figure 3-2 Data hold mode operation

Refresh Hold

The hold function allows the user to hold the displayed digital value. The bar-graph is not held, fix proportional to real measurement value. Use the setup mode to activate the **Refresh Hold** when working on a difficult measuring field. This function will auto trigger or update the Hold value with a new measuring value, and sound a tone to remind the user.

Press Hold to enter the Refresh Hold mode. The present value holds, and the sign HOLD lights up. It is ready to hold a new measuring value once the variation of measuring value exceeds the setting of variation count, and the sign HOLD flashes. The hold value is updated until the measuring value is stable. Then HOLD stops flashing, lights up and sounds a tone to alert the user. Press Hold again to disable this function.

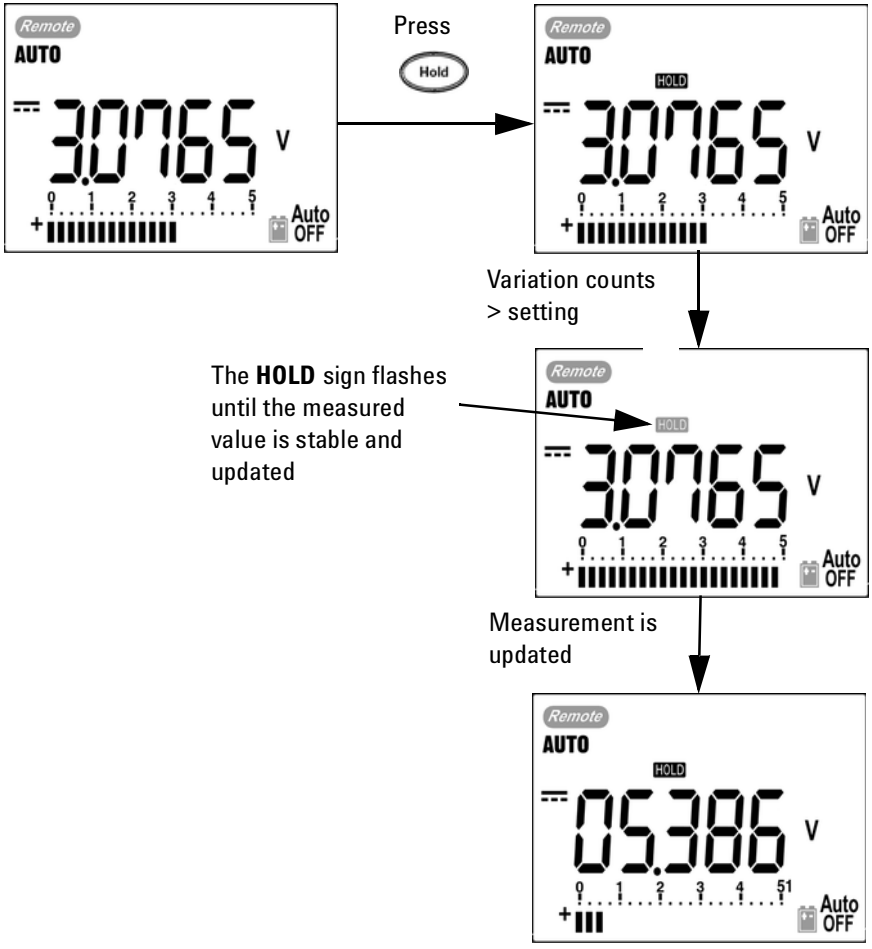

Figure 3-3 Refresh hold mode operation

NOTE

- For voltage and current measurements, the holding value will not be updated if the reading is below 500 counts.
- For resistance and diode measurements, the holding value will not be updated if the reading is in "**OL**" (open state).
- The holding value may not be updated when the reading does not reach a stable state for all measurements.

Null (Relative)

The Null function subtracts a stored value from the present measurement and displays the difference between the two.

1 Press 

to store the displayed reading as the reference value to be subtracted from subsequent measurements and to set the display to zero. **NULL** is displayed.

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

2 Press 

to see the stored reference value. **NULL** flashes for 3 seconds before the display returns to zero.

3 To exit this mode, press 

while **NULL** is flashing on the display.

NOTE

- When taking a resistance measurement and the meter reads a non-zero value due to the presence of test leads, use the Null function to adjust the display to zero.
- When taking a DC voltage measurement, the thermal effect will influence the accuracy. Short the test leads and press Null once the displayed value is stable in order to zero out the display.

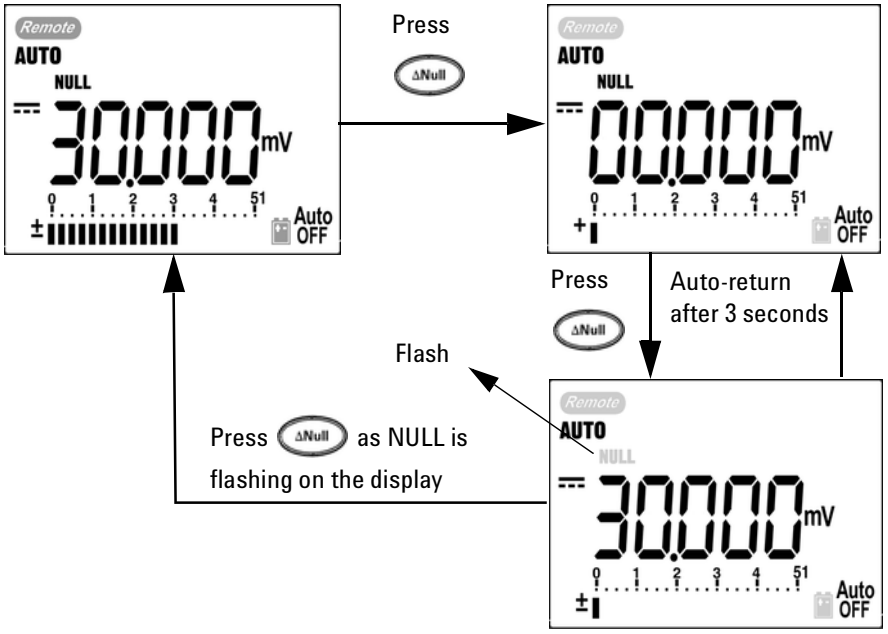

Figure 3-4 Null (relative) mode operation

Decibel Display

The dBm operation calculates the power delivered to a reference resistance relative to 1 mW, and can be applied to DC V, AC V and AC + DC V measurements for decibel conversion. The voltage measurement is converted to dBm by using the following formula:

$$dBm = 10 \log_{10} \left[\frac{1000 \times (\text{measuring value})^2}{\text{reference impedance}} \right]$$

The reference resistance may be selected from 1~9999Ω in Setup mode. The default value is 50 Ω.
The decibel of voltage is calculated with respect to 1 V. The equation for the voltage measurement is as follows:
dBV = 20 $\log_{10}$ Vin

1 At the ~V, ≂V or ≂mV rotary switch position, press Dual to scroll to the dBm measurement on the primary display. The secondary display indicates the AC voltage measurement.

NOTE If the rotary switch is at the "~ V" position, press Shift to switch between the dBV and the dBm measurements. The dBm or the dBV measurements can be selected at the ACV position. The selection will be the reference for other voltage measurements.

2 Press Dual for more than 1 second to exit this mode.

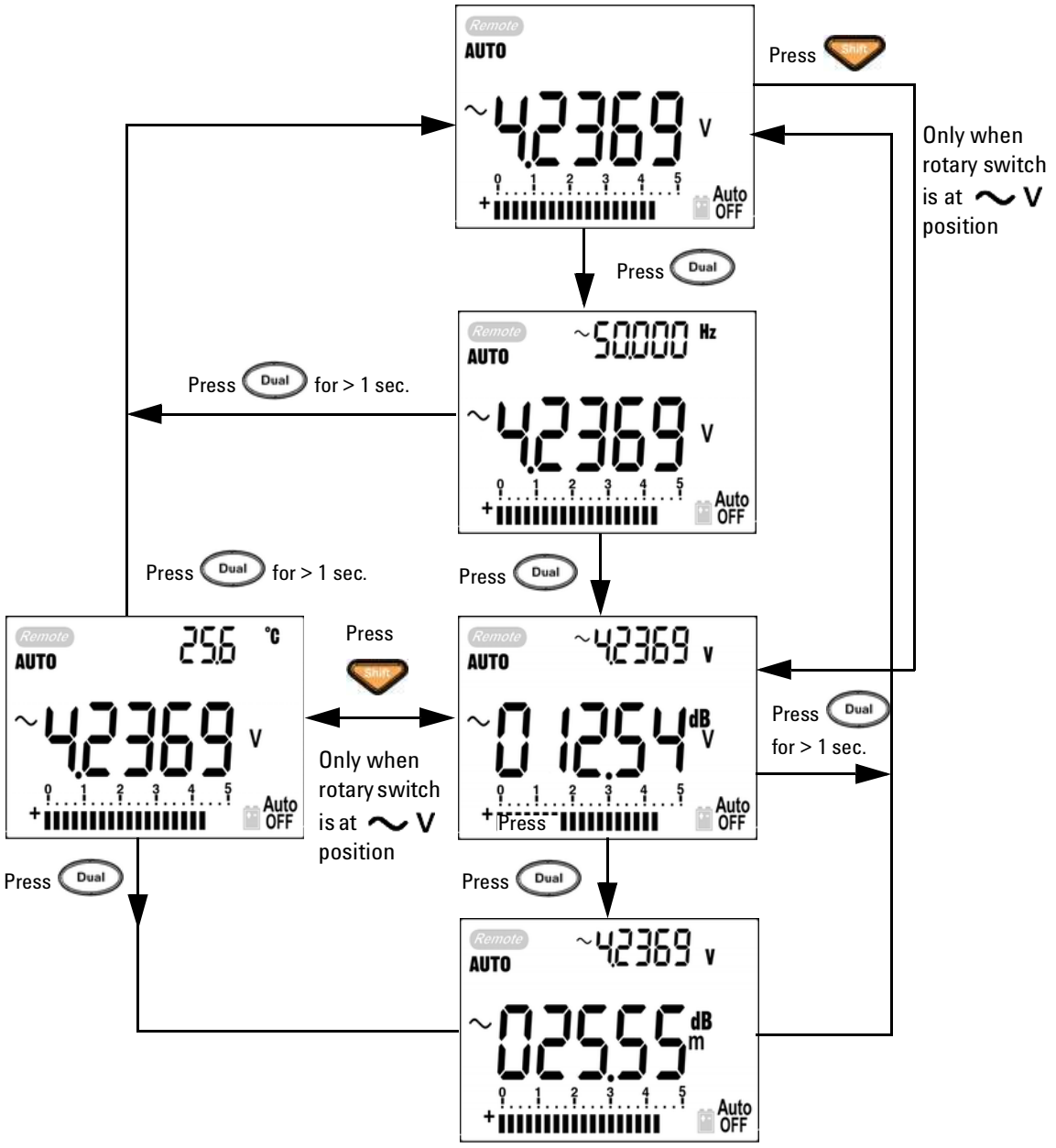

Figure 3-5 dBm/dBV display mode operation

1 ms Peak Hold

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

Crest factor = Peak value/True RMS value

1 Press ΔNull for more than 1 second to toggle 1 ms Peak Hold mode ON / OFF.

2 Press Hold to scroll through maximum and minimum peak readings. HOLD **MAX** indicates the maximum peak, while HOLD **MIN** indicates the minimum peak.

NOTE

- If the reading is "**OL**", press Range to change the measuring range and to re-start the peak-recording measurement.
- If you need to re-start the peak recording, press Dual

3 Press Dual or ΔNull for more than 1 second to exit this mode.

4 According to the measurements in Figure 3-6 on the next page, the crest Factor will be 2.5048/1.768 =1.416.

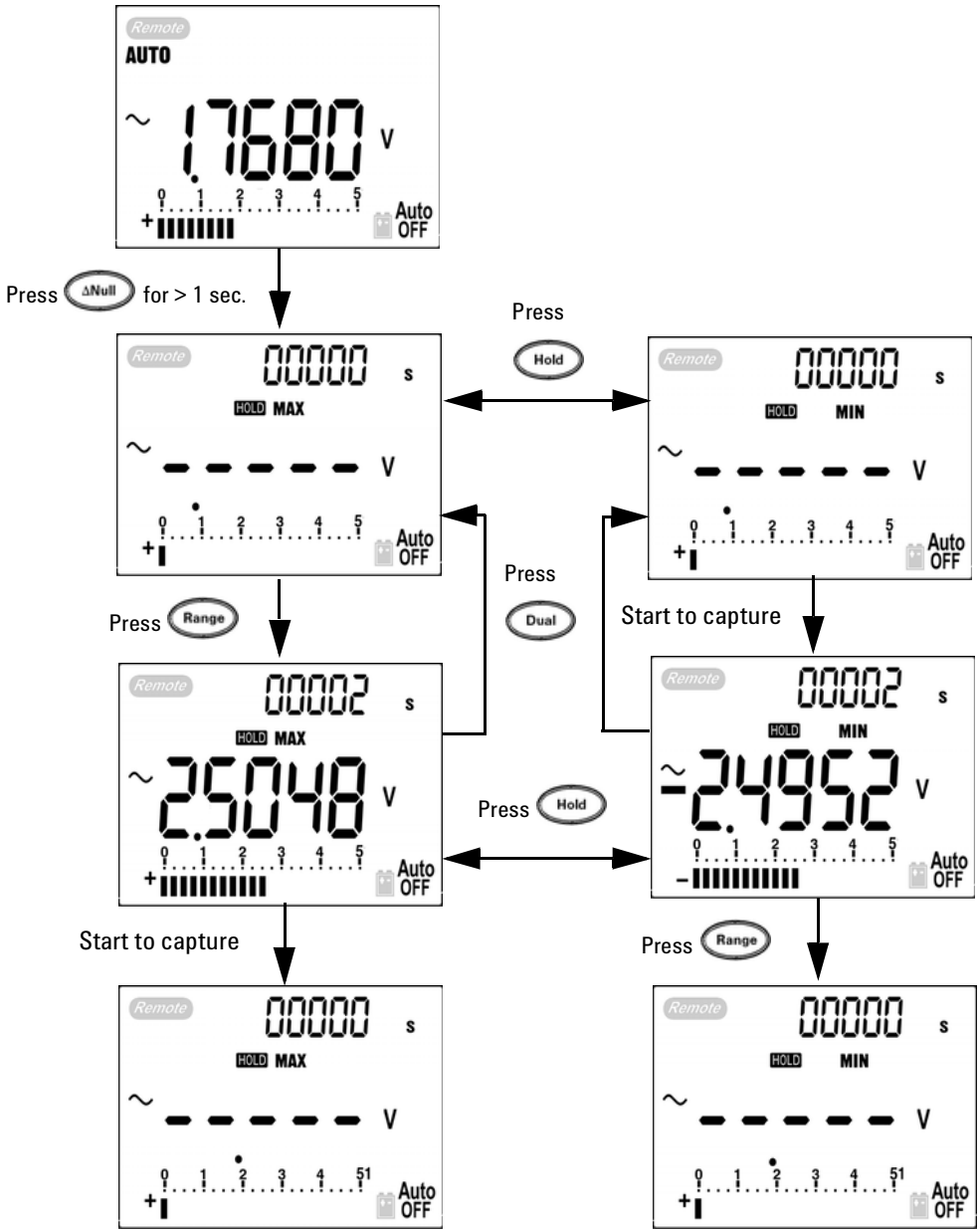

Figure 3-6 1 ms peak hold mode operation

Data Logging

The Data logging function makes it easy to record test data for future review or analysis. Since data are stored in the non-volatile memory, they are retained when the meter is turned OFF or when the battery is changed. There are two options - hand (manual) logging and interval (automatic) logging. Data logging records the values on primary display only.

Manual Logging

Hand (Manual) logging can be specified in Setup mode.

1 Press Hz for more than 1 second to store the present value and function on the primary display to the non-volatile memory. LOG and the logging index are indicated. The logging index flashes on the secondary display for 3 seconds before returning to normal display.

2 Press Hz again to save the next value into the permanent memory.

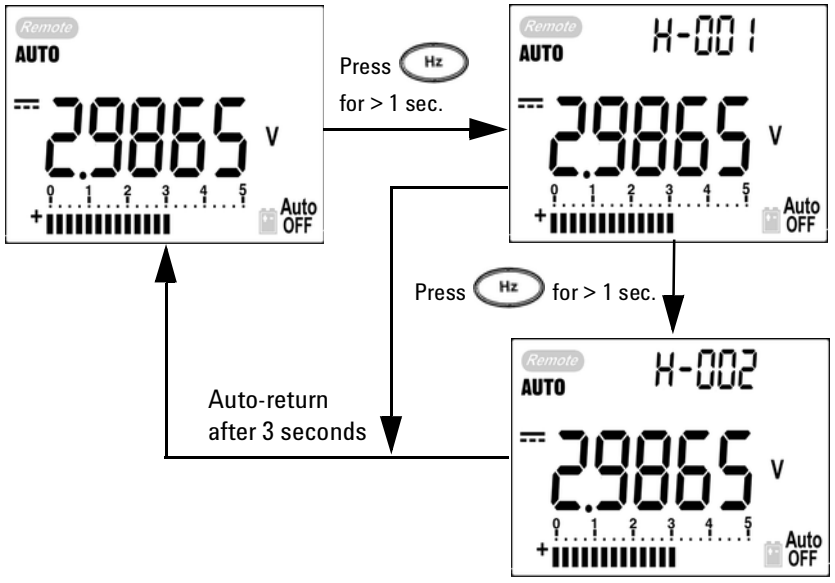

Figure 3-7 Hand (Manual) logging mode operation

NOTE The maximum data that can be stored is 100 entries. When the 100 entries are filled, the secondary display indicates "**FULL**", as shown in Figure 3-8.

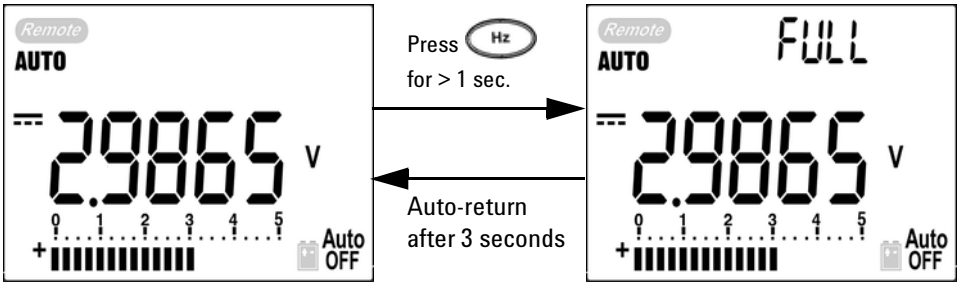

Figure 3-8 Full Log

3 Press Hz for more than 1 second to exit this mode.

Interval Logging

Interval (automatic) logging mode can be specified in the Setup mode.

1 Press Hz for more than 1 second to store the present value and function on the primary display into the non-volatile memory. LOG and the logging index are indicated. The readings are automatically saved into the permanent memory at intervals set using the Setup mode.

NOTE The maximum data that can be stored is 200 entries. When the 200 entries are filled, "**FULL**" is indicated on the secondary display.

2 Press Hz for more than 1 second to exit this mode.

NOTE When interval (automatic) logging is enabled, all keypad operations are disabled, except for the Log function.

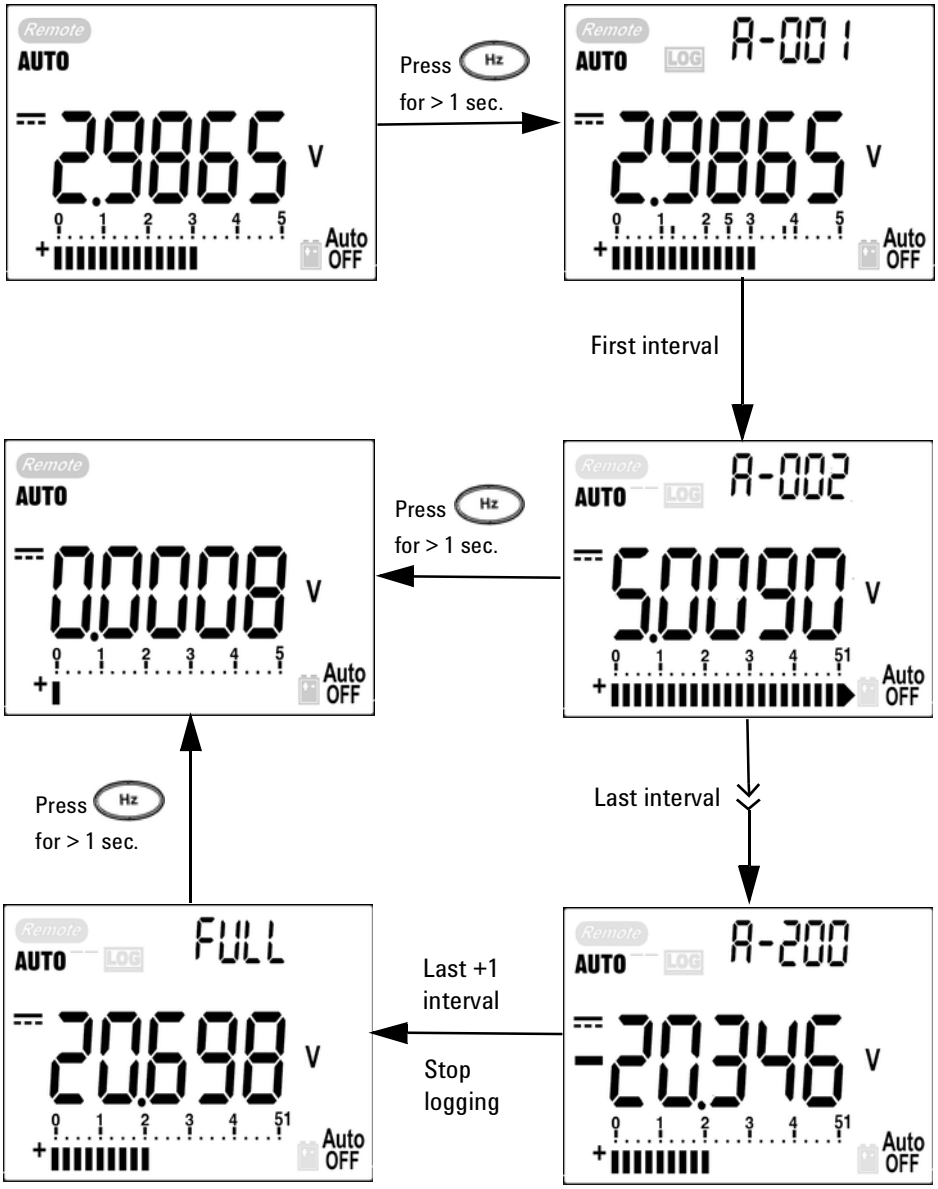

Figure 3-9 Interval (Automatic) logging mode operation

Reviewing Logged Data

1 Press  for more than 1 second to enter the Log Review mode. The last recorded entry and the last logging index are displayed.

2 Press  to switch between hand (manual) and interval (automatic) logging review mode.

3 Press ▲ to ascend or ▼ to descend through the logged data. Press ◀ to select the first record and press ▶ to select the last record for quick navigation.

4 Press  for more than 1 second at the respective Log Review mode to clear logged data.

5 Press  for more than 1 second to exit mode.

During the data review in either manual or interval logging mode, Press  for more than one second to clear all the logged values.

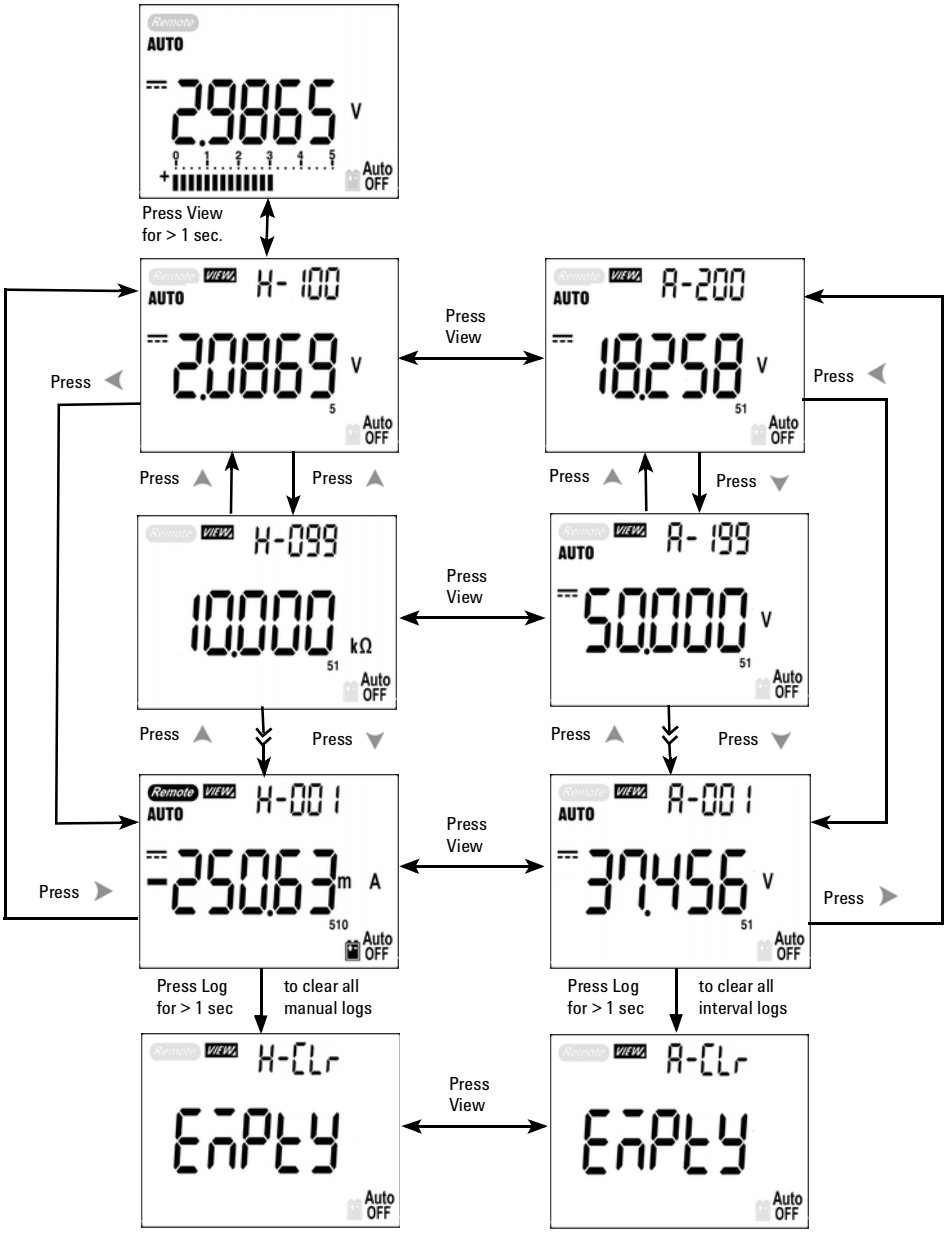

Figure 3-10 Log review mode operation

Square Wave Output (for U1252B)

The square wave output is a unique function for many applications, such as PWM (Pulse Width Modulation) output, adjustable voltage control, and synchronic clock (baud rate generator). You can also use this function to check and calibrate flow-meter displays, counters, tachometers, oscilloscopes, frequency converter, frequency transmitter and other frequency input devices.

1 Turn the rotary switch to OUT % ms position. The default display setting is 600 Hz on the secondary display and 50% duty cycle on the primary display.

2 Press ◀ or ▶ to scroll through the available frequencies (choose from the available 28 frequencies):

Frequency (Hz)
0.5, 1, 2, 5, 10, 15, 20, 25, 30, 40, 50, 60, 75, 80, 100, 120, 150, 200, 240, 300, 400, 480, 600, 800, 1200, 1600, 2400, 4800

NOTE Pressing Hz is the same as pressing ▶.

3 Press Shift to select the duty cycle (ms) on the primary display.

4 Press ▲ or ▼ to adjust the duty cycle. Duty cycle can be set for 256 steps and each step is 0.390625%. The display only indicates the best resolution with 0.001%.

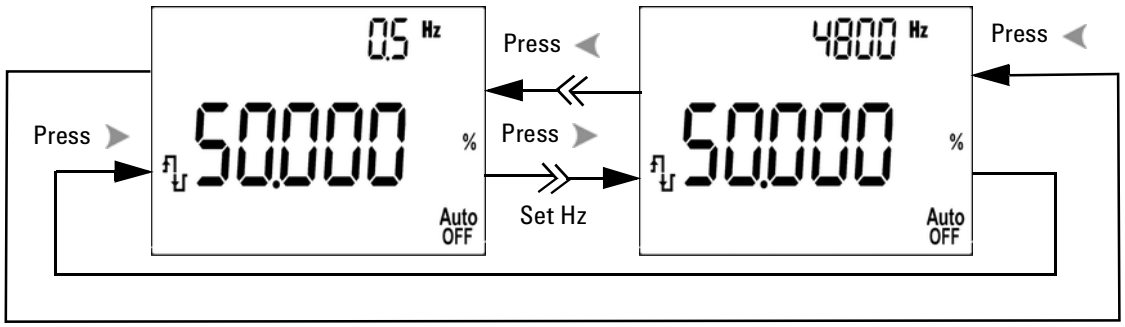

Figure 3-11 Frequency adjustment for square wave output

5 Press Shift to select the pulse width (%) on the primary display.

6 Press ▲ or ▼ to adjust the pulse width. The pulse width can be set for 256 steps and each step is 1/ (256 x Frequency). The display range automatically adjusts in the range of 9.9999~9999.9 ms.

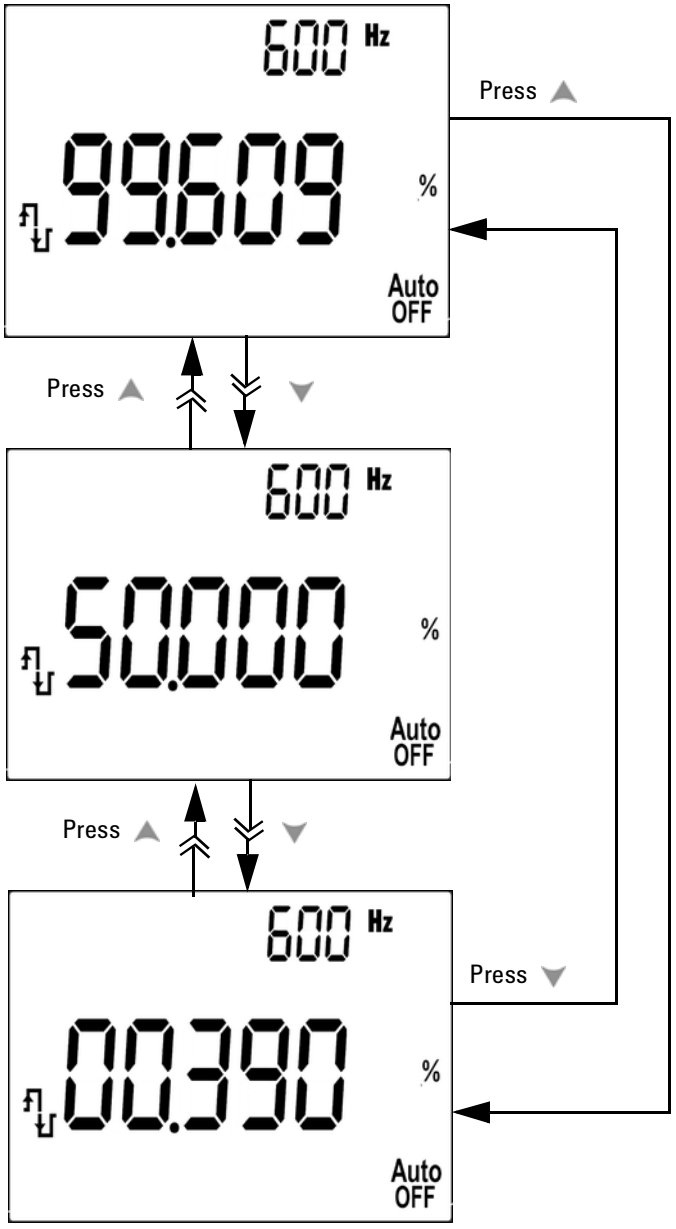

Figure 3-12 Duty cycle adjustment for square wave output

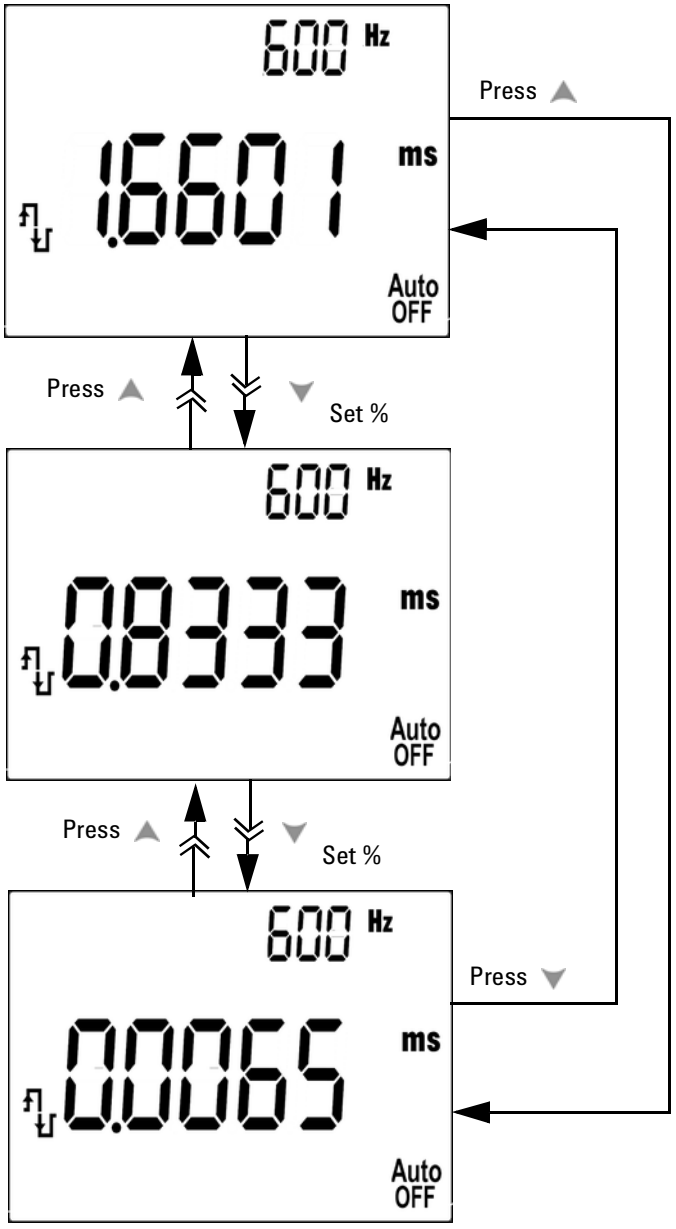

Figure 3-13 Pulse width adjustment for square wave

Remote Communication

The meter has a bi-directional (full duplex) communication capability that speeds data storing from the meter to the PC. To use this feature, you require the optional IR-USB cable, to be used with an application software that is downloadable from the Agilent Web site.

For details on performing PC-meter remote communication, click on Help after launching the Agilent GUI Data Logger Software.

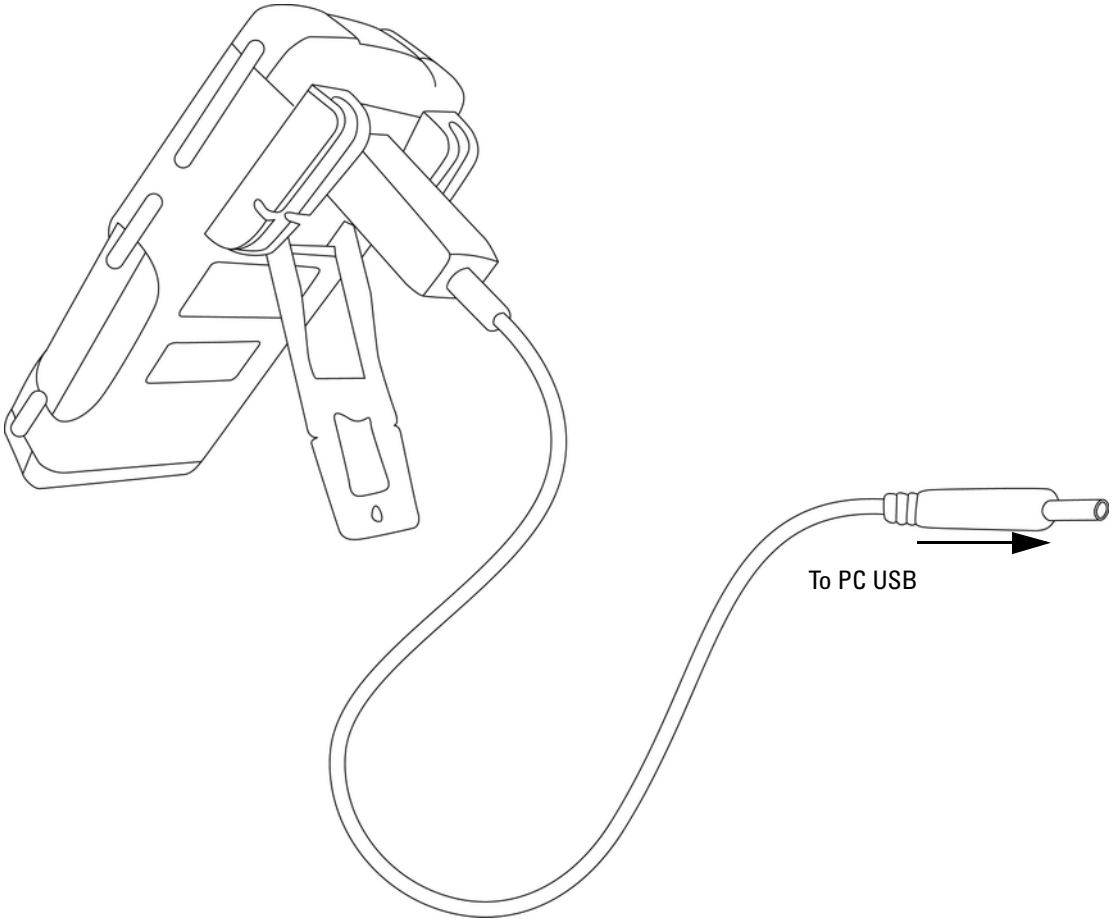

Figure 3-14 Cable connection for remote communication

4 Changing The Default Setting

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This chapter describes how to change the default settings of the handheld digital multimeter, which includes data logging and other setting features.

Selecting Setup Mode

To enter the Setup mode, perform the following steps:

1 Turn the meter OFF.

2 From the OFF position, press and hold 

while turning the rotary switch to any non-OFF position.

NOTE When you hear a beep, the meter is in Setup mode and you can release 

.

To change a menu item setting in Setup mode, perform the following steps:

1 Press ◀ or ▶ to scroll through the menu items.

2 Press ▲ or ▼ to scroll through the available settings. See Table 3, “Available setting options in Setup mode,” for details of available options.

3 Press 

to save changes. These parameters will remain in the non-volatile memory.

4 Press 

for more than 1 second to exit Setup mode.

Table 4-1 Available setting options in Setup mode

Menu item		Available setting options		Default factory setting
Display	**Description**	**Display**	**Description**	
rHoLd (1)	Refresh Hold	OFF	Enables Data Hold (manual trigger)	500
		100–1000	Sets the variation count that determines Refresh Hold (auto trigger)	
d-LoG	Data logging	Hand	Enables manual data logging	Hand
		1–9999 s (2)	Sets the interval for automatic data logging	
t.CoUP	Thermocouple	tYPE	Sets the thermocouple type to K-type	tYPE
		tYPE (3)	Sets the thermocouple type to J-type	
rEF	Reference impedance for dBm measurement	1–9999 Ω (2)	Sets the reference impedance for dBm measurement	50 Ω
FrEq	Minimum frequency that can be measured	0.5 Hz, 1 Hz, 2 Hz, 5 Hz	Sets the minimum frequency that can be measured	0.5 Hz
APF	Auto power off	1–99 m	Sets the timer for auto power off	10 m
		OFF	Disables auto power off	
PErnt	Percentage scale	0–20 mA, 4–20 mA	Sets the % scale readout	4–20 mA
bEEP	Frequency of beep sound of meter	2400 Hz, 1200 Hz, 600 Hz, 300 Hz	Sets the frequency of the meter's beep sound	2400 Hz
		OFF	Disables the meter's beep sound	
b-Lit	Backlit display	1–99 s	Sets the timer for the auto turn-off for the backlit display	30 s
		OFF	Disables the auto turn-off for the backlit display	
bAUd	Baud rate	2400 Hz, 4800 Hz, 9600 Hz, 19200 Hz	Sets the baud rate for the remote communication (remote control with PC)	9600 Hz
PArtY	Parity check	En, Odd, nOnE	Sets the even, odd or no parity check for the remote communication (remote control with PC)	nOnE
dAtAb	Data bits	7-bit, 8-bit	Sets the data bit length for the remote communication (remote control with PC)	8-bit
ECHO	Echo	On, OFF	Enables the return of characters to the PC when set to On	OFF

Menu item		Available setting options		Default factory setting
Display	**Description**	**Display**	**Description**	
Print	Print	On, OFF	Enables auto send of data to the PC continuously when set to On	OFF
rESEt	Reset	dEFAU	Enables the reset of factory settings by pressing and holding Hz for more than 1 second	dEFAU
tEmP	Temperature (4)	d-CF	Sets the temperature measurement to °C but pressing Range swaps the display to °F	d-C
		d-F	Sets the temperature measurement to °F	
		d-FC	Sets the temperature measurement to °F but pressing Range swaps display to °C	
		d-C	Sets the temperature measurement to °C	
bAtt	Battery voltage	7.2 V, 8.4 V	Selects battery voltage to either 7.2 V or 8.4 V	7.2 V
FiLtE	DC filter	On, OFF	Enables DC filter when set to On	OFF

NOTE

1. This is the first display once the meter enters the Setup mode.
2. For d-LoG and rEF menu items, press Shift to select the digit to be adjusted.
3. J-type thermocouple applies to U1252B.
4. To view the tEmP menu item, press ☼ for more than 1 second.

Setting Data Hold/Refresh Hold Mode

1 Set OFF to enable the Data Hold mode (manual trigger by key or bus via the remote control).

2 Set the variation count within the 100~1000 range to enable the Refresh Hold mode (automatic trigger). When the variation of the measuring value exceeds the setting of the variation count, the Refresh Hold will be ready to trigger.

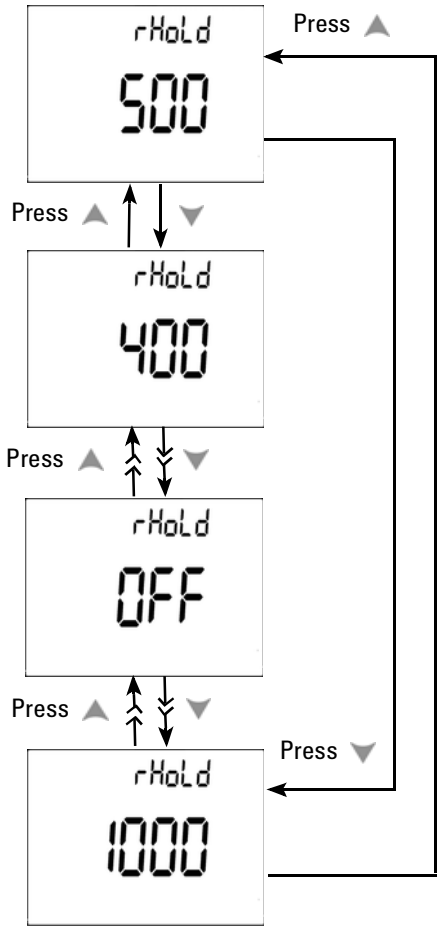


Figure 4-1 Data hold/Refresh hold setup

Setting Data Logging Mode

1 Set to “Hand” to enable the hand (manual) data logging mode.

2 Set the interval within 0001~9999 seconds to enable interval (automatic) data logging mode.

3 Press ◀ or ▶ to switch between manual and interval data logging setup.

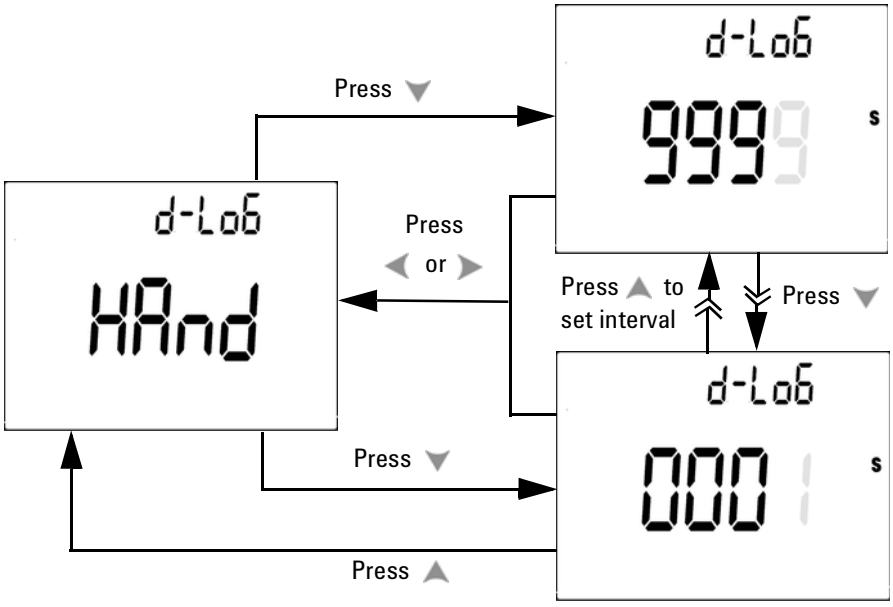


Figure 4-2 Data logging setup

Setting Thermocouple Types (for U1252B)

The types of thermocouple sensor that can be selected are the J and the K types. The default type is the K type. Press ▲ or ▼ to switch between the J and the K type.

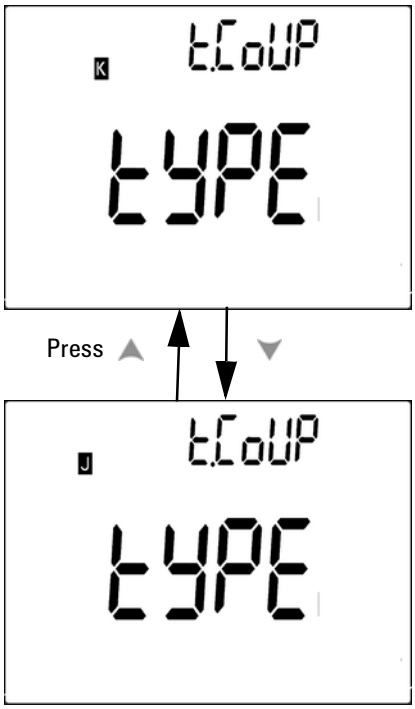


Figure 4-3 Thermocouple type setup

Setting Reference Impedance for dBm Measurement

The reference impedance can be set from 1 to 9999 Ω . The default value is 50 Ω.

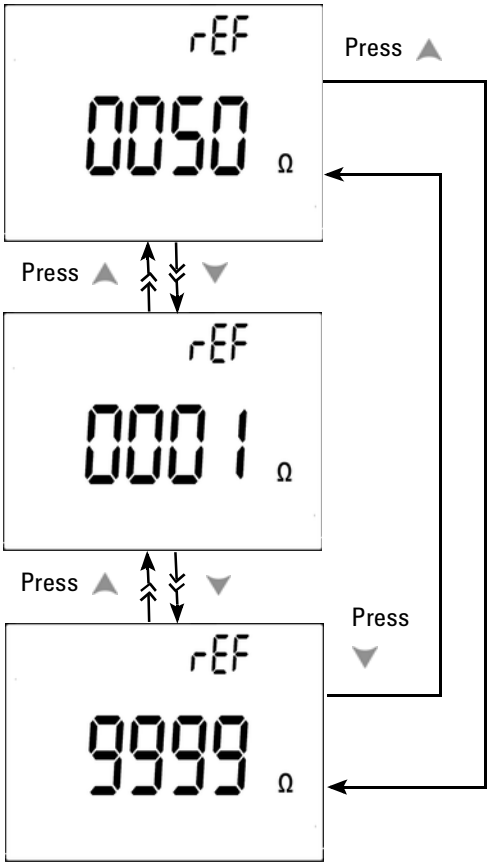


Figure 4-4 Reference impedance for dBm measurement setup

Setting Minimum Frequency Measurement

The minimum frequency setup influences the measuring rates for frequency, duty cycle, and pulse width. The typical measuring rate defined at the general specification is based on the minimum frequency of 1 Hz.

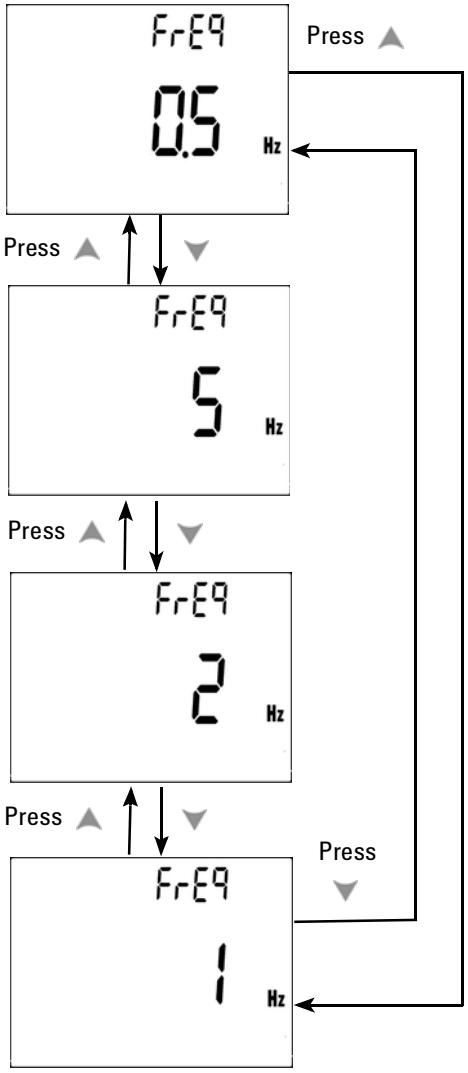


Figure 4-5 Minimum frequency setup

Setting Temperature Unit

Four combination displays are available:

- Celsius only (°C on primary display) single display setting
- Celsius-Fahrenheit (d-CF) and Fahrenheit-Celsius (d-FC) dual display setting.

NOTE Primary-Secondary Display can be swapped by pressing 

.

- Fahrenheit only (°F on primary display) single display setting.

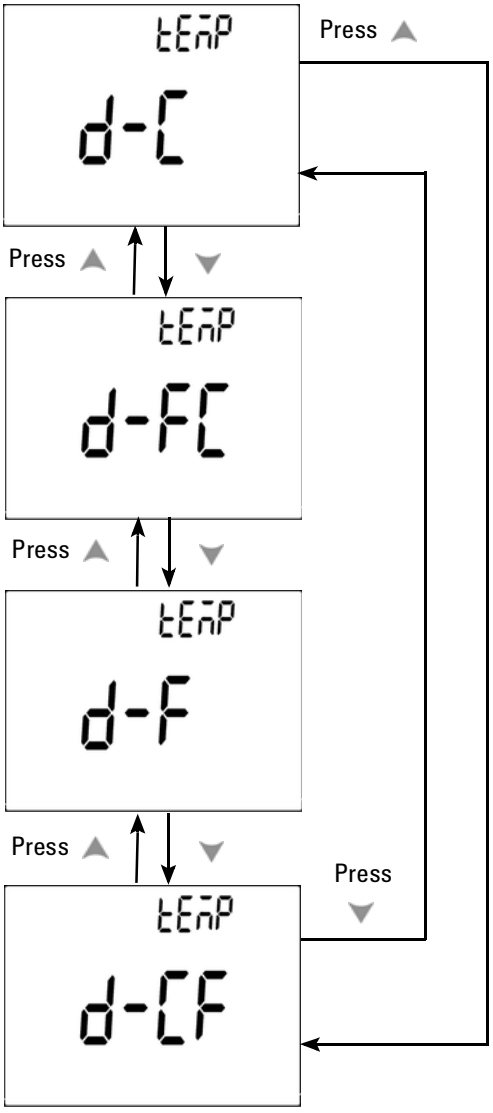


Figure 4-6 Temperature unit setup

Setting Auto Power Saving Mode

- The timer for APF (Auto Power OFF) can be set for the range of 1~99 minutes. To activate the meter after it has “auto power off”, turn the rotary switch to the OFF position, then turn it back on again.
- “OFF” disables APF. Auto OFF is indicated on the display during subsequent measurements.

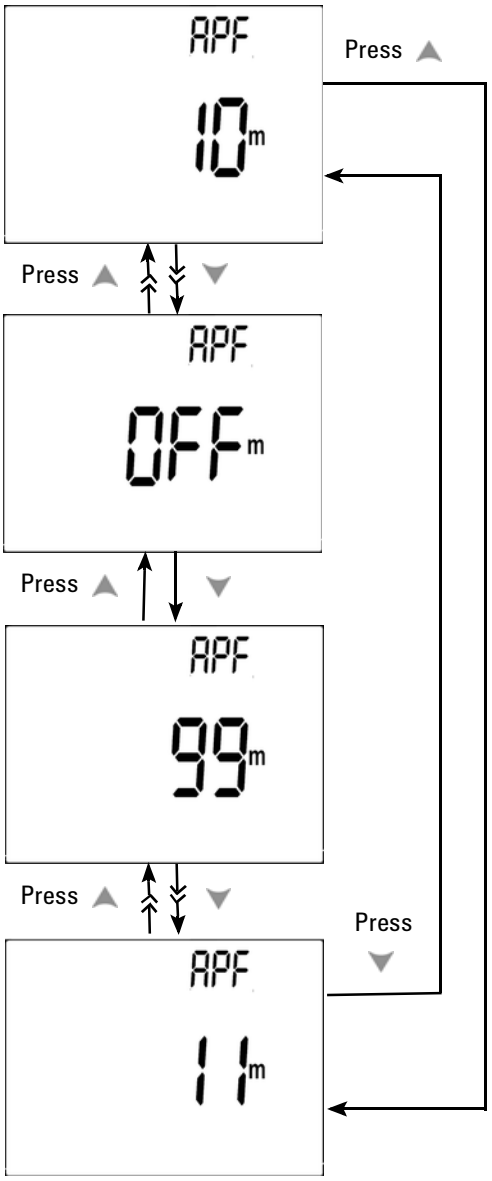


Figure 4-7 Auto power saving setup

Setting % Scale Readout

This setting converts the DC current measuring display to % scale readout – 4-20 mA or 0-20 mA as proportional to 0~100%. The 25% scale readout represents DC 8 mA at 4-20 mA and DC 5 mA at 0-20 mA.

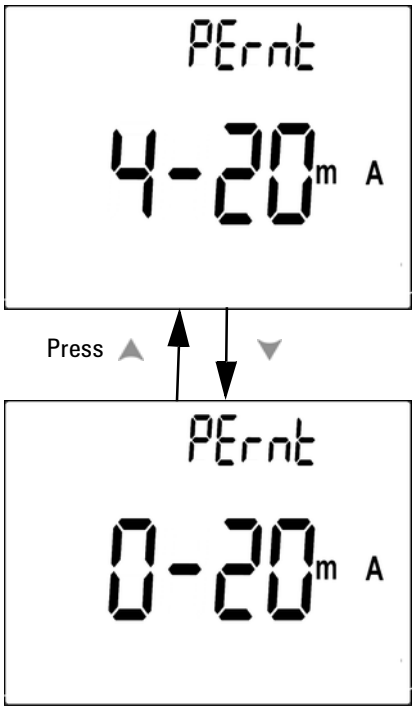


Figure 4-8 % scale readout setup

Setting Beep Frequency

- The driving frequency can be set to 2400, 1200, 600 or 300 Hz. “OFF” disables beep.

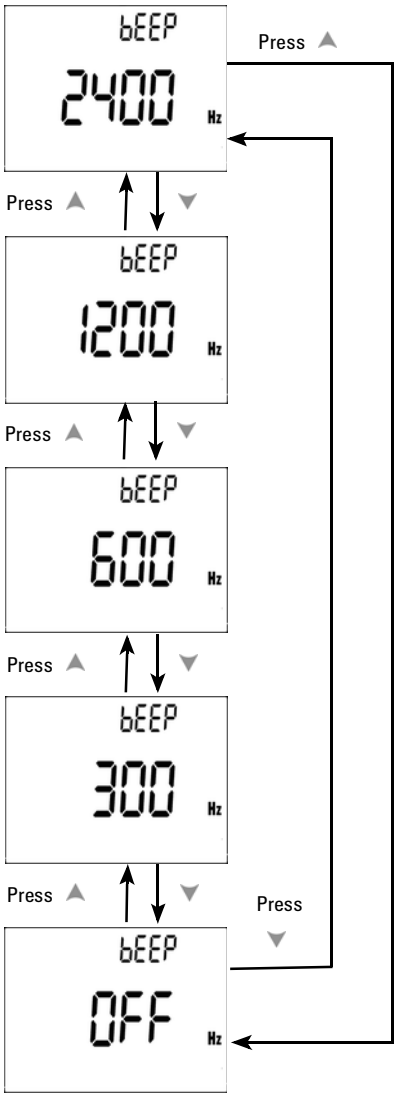


Figure 4-9 Beep frequency setup

Setting Backlit Timer

- The timer can be set to 1~99 seconds. Backlit turns off automatically after the set period.
- "0FF" disables turning off backlit automatically.

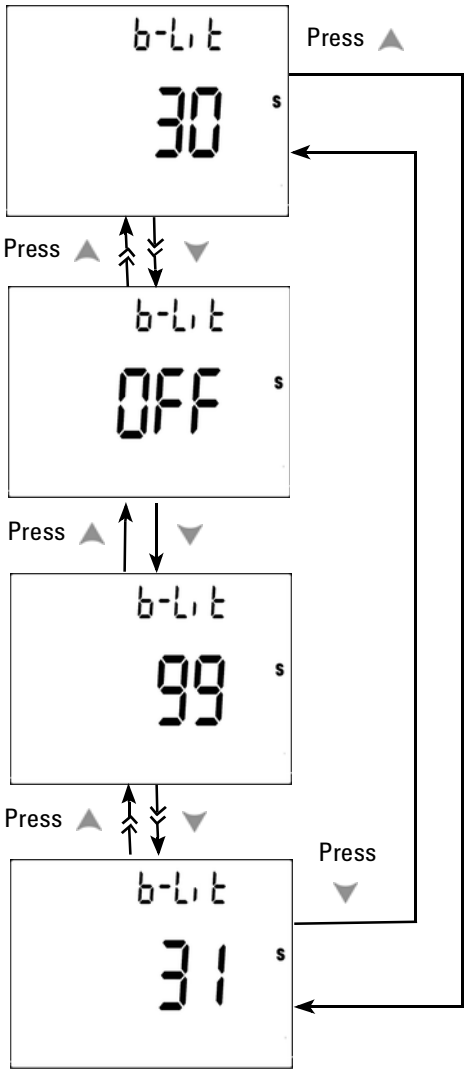


Figure 4-10 Backlit timer setup

Setting Baud Rate

Select the baud rate for remote control. The available settings are 2400, 4800, 9600 and 19200 Hz.

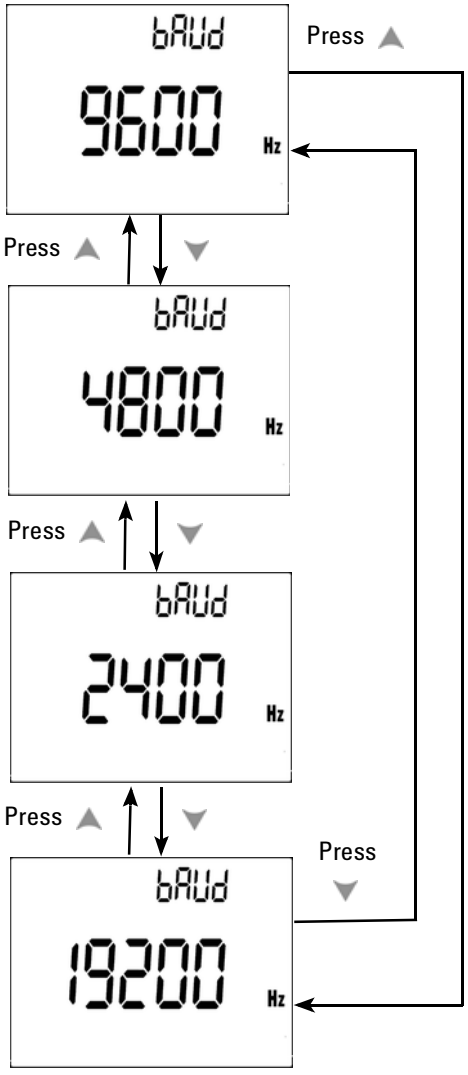


Figure 4-11 Baud rate setup remote control

Setting Parity Check

Select the parity check for remote control. It can be set to none, even or odd bit.

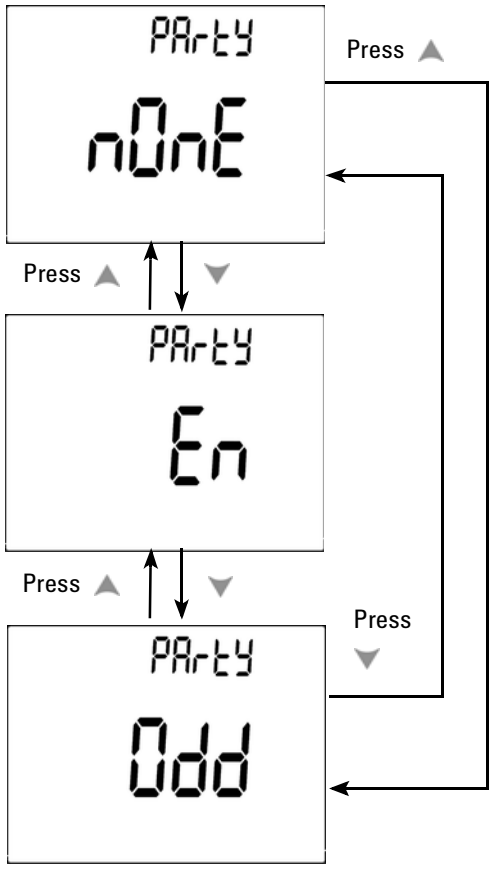


Figure 4-12 Parity check setup

Setting Data Bit

Select the data bit for remote control. It can be set to either 8 or 7 bits.

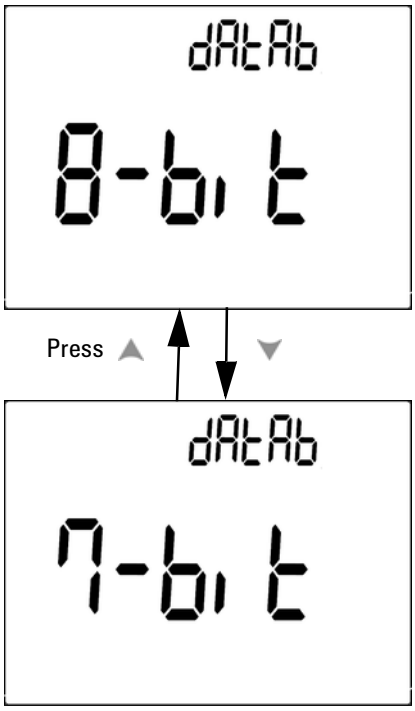


Figure 4-13 Data bit setup for remote control

Setting Echo Mode

- Echo ON enables the return of characters to the PC in remote communication.
- Echo OFF disables the return of characters to the PC.

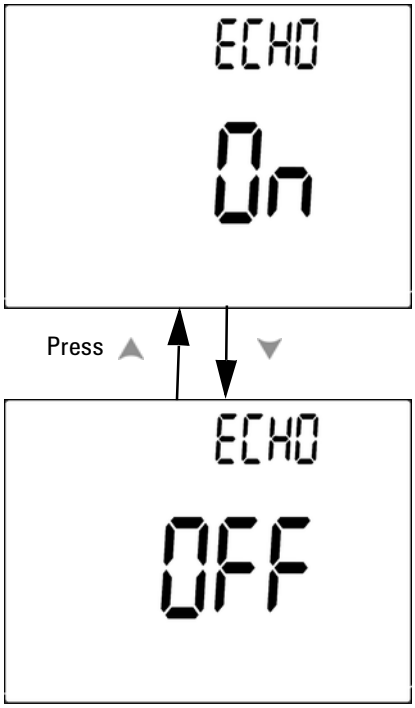


Figure 4-14 Echo mode setup for remote control

Setting Print Mode

Print ON enables the print out of measured data to the PC when the measuring cycle is completed. In this mode, the meter automatically sends the newest data to the host continuously but does not accept any commands from thehost. Remote flashes during the Print operation.

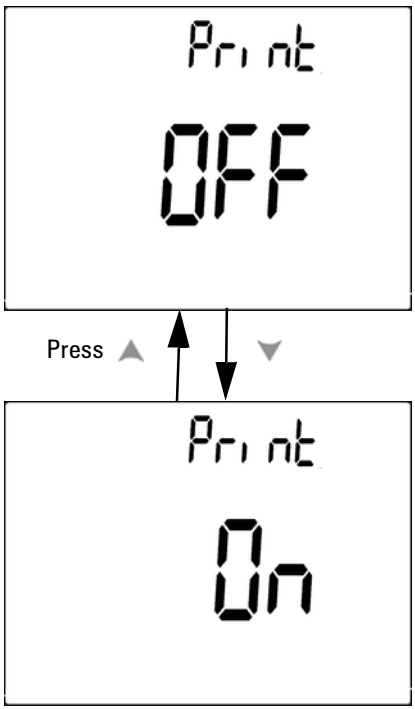


Figure 4-15 Print mode setup for remote control

Returning to Default Factory Settings

- Press Hz for more than 1 second to reset to the default factory settings except the Temperature setting.
- The Reset menu item automatically reverts to Refresh Hold menu item after reset has taken place.

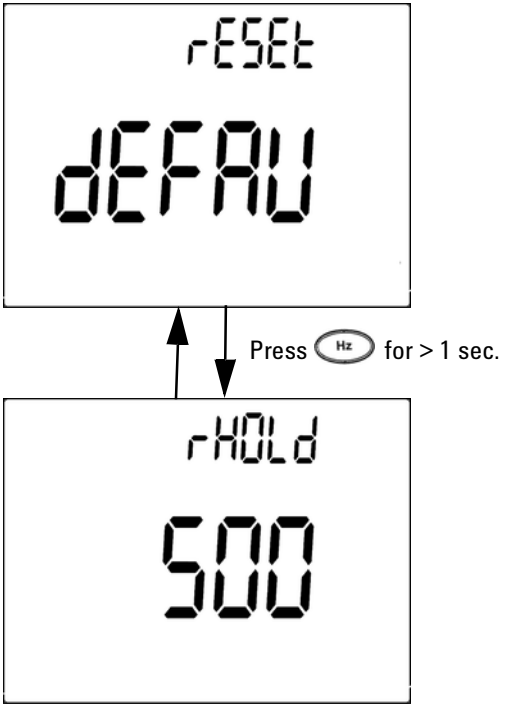


Figure 4-16 Reset setup

Setting the Battery Voltage

The battery type for the multimeter can be set to either 7.2 V or 8.4 V.

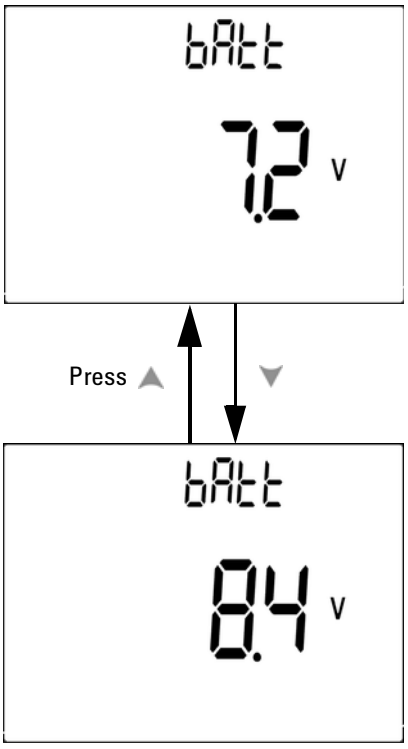


Figure 4-17 Battery voltage selection

Setting the DC Filter

This setting is used to filter AC signal in DC measuring path. The DC filter is set to “OFF” by default. To enable this function, set this to “On”.

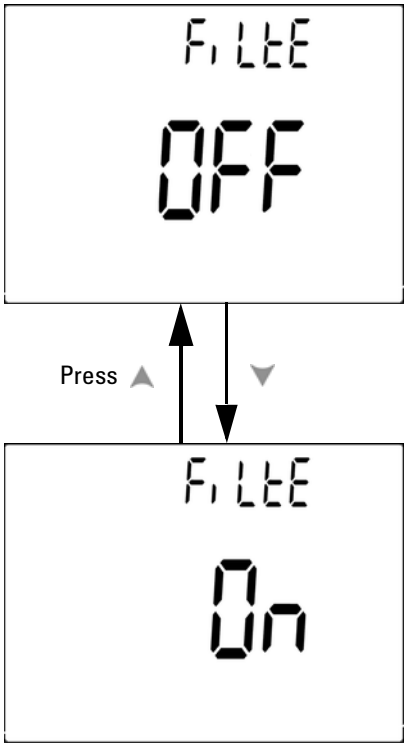


Figure 4-18 DC filter

NOTE

- When DC filter is enabled, the measurement speed may decrease during DC voltage measurement.
- During AC or Hz measurement (on primary or secondary display), DC filter will be automatically disabled.

5 Maintenance

Introduction 94
General Maintenance 94
Replacing the Battery 95
Charging the Battery 97
Replacing the Fuse 103
Troubleshooting 105

This chapter helps you to troubleshoot a failing handheld digital multimeter.

Introduction

Repair or service which is not covered in this manual should only be performed by a qualified personnel.

General Maintenance

WARNING **Ensure that the terminal connections are correct for that particular measurement before proceeding. To avoid damaging the device, do not exceed the input limit.**

Besides the above hazard, dirt or moisture in the terminals can distort readings. The steps for cleaning are as follows:

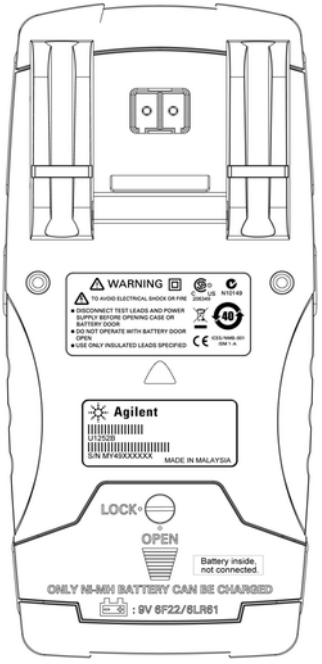
1. Turn the meter off and remove the test leads.
2. Turn the meter over and shake out any dirt that may have accumulated in the terminals.
3. Wipe the case with a damp cloth and a mild detergent – do not use abrasives or solvents. Wipe the contacts in each terminal with a clean swab dipped in alcohol.

Replacing the Battery

WARNING Never discharge the battery by shorting it or by reverse polarity in any subjects. Make sure that the battery is the rechargeable type before charging it. Never rotate the rotary switch when the battery is being charged as DC at 24 V is being applied to the charging terminals.

The meter is powered by a 7.2 V battery. Use only the specified type. To ensure that the correct battery type is used, replace the battery immediately when the low battery sign flashes. If your meter has the rechargeable battery type, refer to the section “Charging The Battery”. The procedures for battery replacement are listed below:

1 At the rear panel, turn the screw on the battery cover from the LOCK to the OPEN position (counterclockwise).



2 Slide down the battery cover.

3 Lift the battery cover up.

4 Replace the specified battery.

5 Reverse the above procedures to close the cover.

NOTE

List of compatible batteries for the Agilent U1251B :

- 9V Alkaline non-chargeable battery (ANSI/NEDA 1604A or IEC 6LR61)
- 9V Carbon-zinc non-chargeable battery (ANSI/NEDA 1604D or IEC6F22)

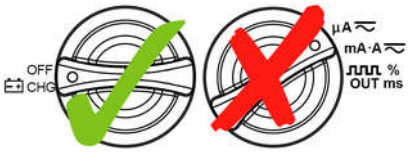
List of compatible batteries for the Agilent U1252B :

- 7.2V 300mAH Ni-MH Rechargeable battery, 9V size
- 8.4V 300mAH Ni-MH rechargeable battery, 9V size
- 9V Alkaline non-chargeable battery (ANSI/NEDA 1604A or IEC 6LR61)
- 9V Carbon-zinc non-chargeable battery (ANSI/NEDA 1604D or IEC6F22)

Charging the Battery

WARNING Never discharge the battery by shorting it or by reverse polarity in any subjects. Make sure the battery is the rechargeable type before charging it. Never rotate the rotary switch when the battery is being charged as DC at 24 V is being applied to the charging terminals.

CAUTION



- Do not rotate the rotary switch from OFF CHG position when charging the battery.
- Perform battery charging only with 7.2 V or 8.4 V NiMH rechargeable battery, 9 V size.
- Disconnect test leads from all the terminals when charging the battery.
- Ensure proper insertion of battery in the multimeter, and follow the correct polarity.

NOTE For the battery charger, the mains supply voltage should not fluctuate by plus or minus 10%.

This meter is powered by a 7.2 V NiMH rechargeable battery. Use the specified accessory, the 24 V DC adaptor to charge the battery. Remember never to turn the rotary switch of the meter when its battery is being charged. Use the following procedures to charge the battery:

1 Remove and disconnect the test leads from the meter.

2 Turn the rotary switch to the OFF CHG position. Connect the power cord to the DC adapter.

3 Plug the Red (+)/ Black (-) banana terminals of the DC adapter to the CHG and the "**COM**" terminals

respectively. The DC adaptor can be replaced with a DC power supply in order to set the 24 V DC output and the over current limitation to a value more than 0.5 A. Ensure that the polarity of the connection is correct.

4 The primary display indicates “bAt” and the ‘SbY” flashes on the secondary display and a short tone sounds to remind you whether to charge the battery or not. Press Shift to start charging the battery, or the meter will automatically start the self-test after the 24 V supply is applied. We recommend not to charge the battery if its capacity is over 90%.

Condition	Battery Voltage	Proportional Percentage
Trickle (SBY)	6.0 V ~ 8.2 V	0% ~ 100%
Under charging	7.2 V ~ 10.0 V	0% ~ 100%

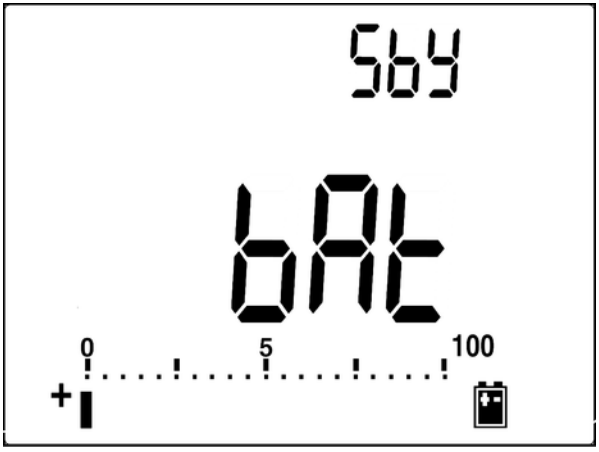


Figure 5-1 Battery capacity display as trickle

5 After pressing Shift or when the self-test starts, the meter performs a self-test to check if the battery in the meter is the rechargeable type. The self-test takes about 2 to 3 minutes. Avoid pressing any button during the self-test. A message is diplayed as shown below.

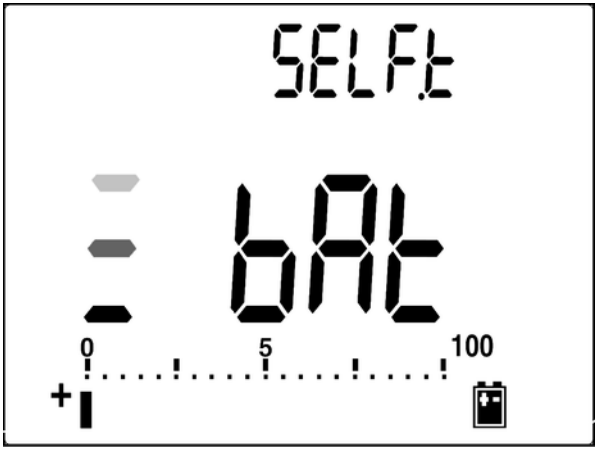
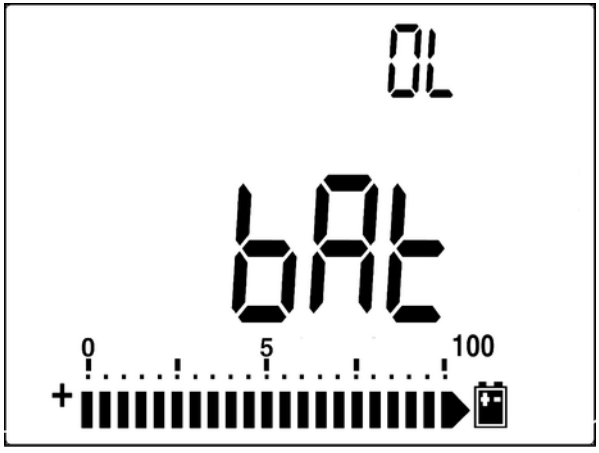


Figure 5-2 Self test

Error Condition	Secondary Display
OL • No battery in the meter • Battery failing • Battery is full	

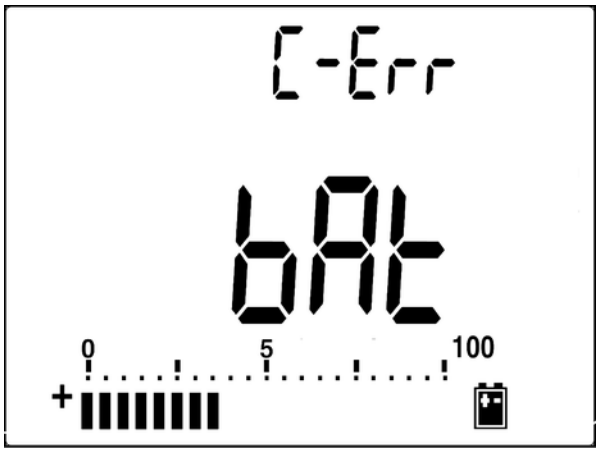
Error Condition	Secondary Display
C-Err • No rechargeable battery inside • Battery failing	

Figure 5-3 Error messages

NOTE

- If the **OL** message appears while the battery is inside, do not charge the battery.
- If the **C-Err** message appears, check if the battery is the specified type. Use the battery as specified in this guide. Ensure that the battery is the correct rechargeable type before charging it again. After replacing with the correct rechargeable battery, press Shift to perform the self-test again. If the C-Err message reappears, replace with a new battery,

The smart charging mode will start if the meter passes the self-test. The charging time is limited to not more than 220 minutes. The secondary display will count down the charging time. During charging, no buttons can be pressed. The error message may appear during charging to alert any overcharging of the battery.

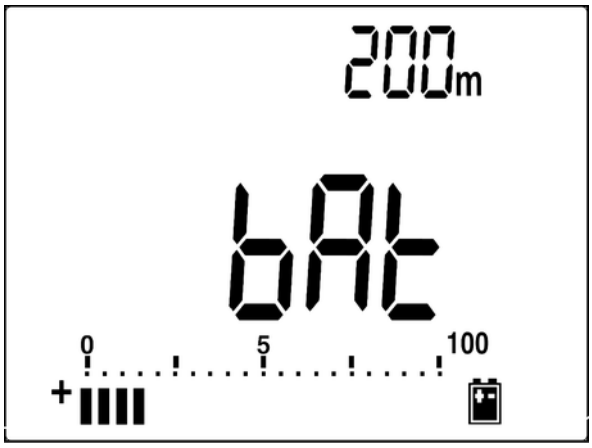


Figure 5-4 Charging mode

6 The charge end message (C–End) appears on the secondary display once charging is completed. The trickle charging current is provided to maintain the battery capacity. The flashing signs of and appear to show the trickle state.

7 Remove the DC adapter when the C–End message appears on the secondary display. Do not turn the rotary switch before removing the adapter from the terminals.

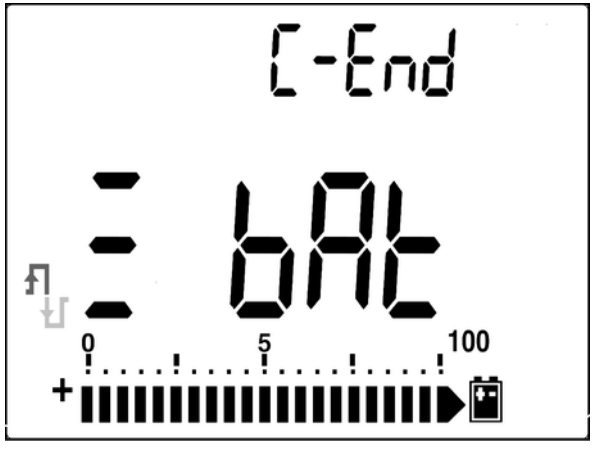


Figure 5-5 Charge end and trickle state

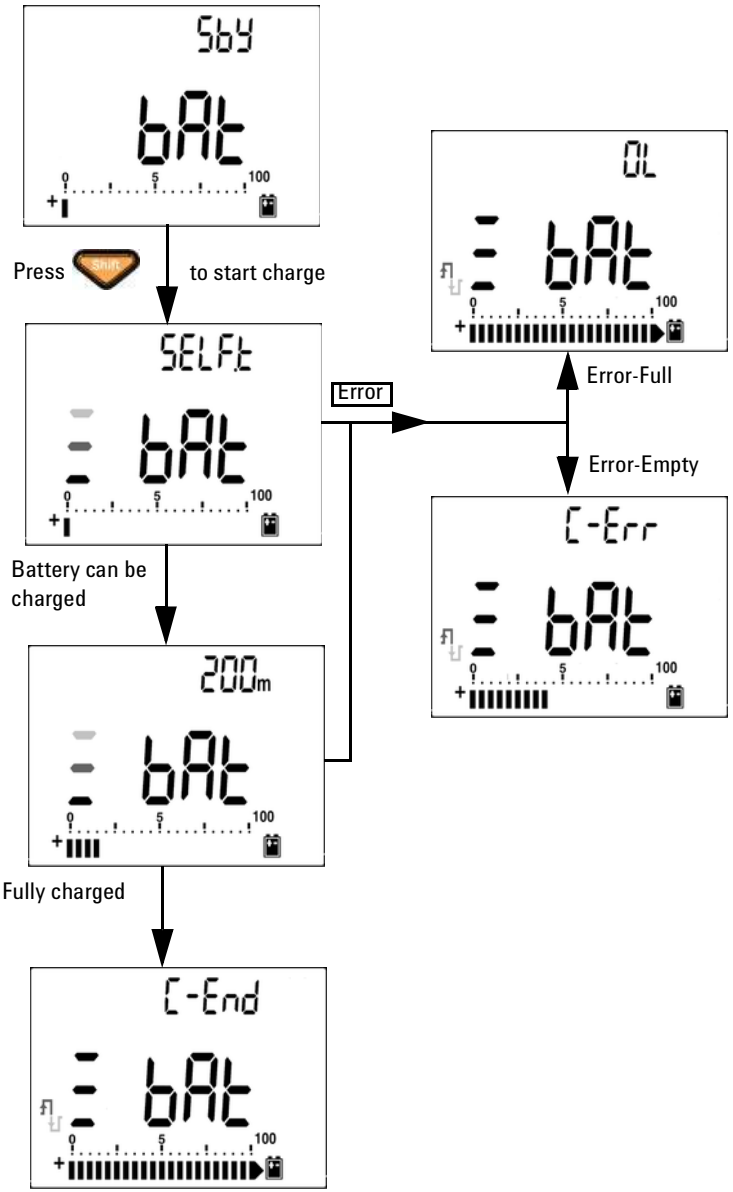


Figure 5-6 Battery charging procedures

Replacing the Fuse

NOTE This manual provides only the fuse replacement procedures, but not the fuse replacement markings.

Follow the procedures below to replace the fuse.

1. Turn the meter off and disconnect the test leads from the external equipment. Make sure to remove the adaptor.
2. Wear clean/dry gloves and do not touch any other component except the fuse and plastic parts. The current calibration is considered shunt only, so do not recalibrate the meter after replacing the fuse.
3. Remove the battery cover compartment to replace the fuse.
4. Loosen the two screws on the bottom case and remove the cover.
5. Loosen the two screws on the top corners to lift the circuit board.
6. Gently remove the defective fuse by prying one end of the fuse loose and removing it out of the fuse bracket.
7. Replace with a new fuse of the same size and rating. Make sure the new fuse is centered in the fuse holder.
8. Ensure that the rotary switch on the top case and the circuit board switch stay on the OFF position.
9. Then re-fasten the circuit board and the bottom cover.
10. Refer to the table below for the part number, rate and size of the fuses.

Fuse	Agilent Part Number	Rating	Size	Type
1	2110-1400	440mA/1000V	10 mm x 35 mm	Fast blow Fuse
2	2110-1402	11A/1000V	10 mm x 38 mm	

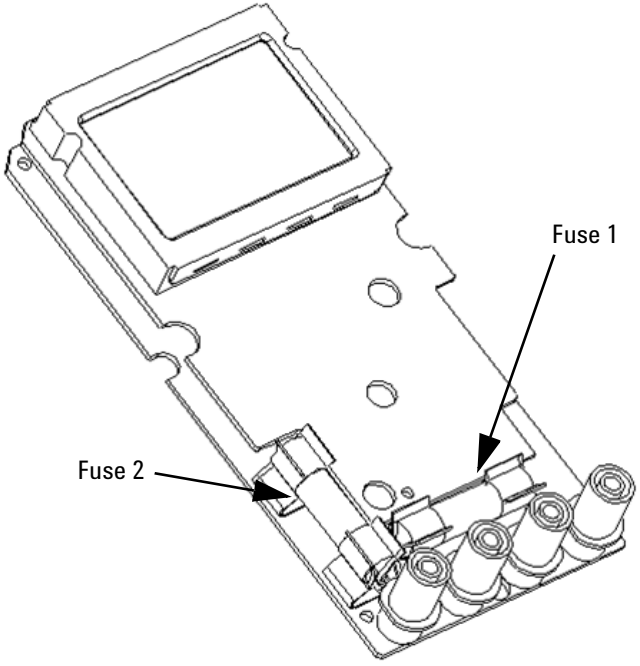


Figure 5-7 Fuse replacement

Troubleshooting

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

If the instrument fails to operate, check the battery and the test leads. Replace them if necessary. And if the instrument still does not function, check the operating procedures in this manual. When servicing, use only specified replacement parts. The table below will assist you to identify some basic problems.

Malfunction	Identification
No LCD display after power ON	• Check the battery. Charge or replace it.
No beeper tone	• Check the setup mode to verify if the beeper is set to OFF. Then select the desired driving frequency.
Fail on current measurement	• Check the fuse.
No charging indication	• Check the external adaptor to verify if the output is DC 24 V and the adaptor is plugged into the charging terminals completely. • Line power voltage (100V~240V AC 50Hz/ 60Hz)
Fail on Remote control	• Check that the optical side of the cable is connected to the meter and the text side of the cover is up. • Check the baud rate, parity, Data bit, Stop bit (default is 9600, n, 8, 1) • Driver install for IR-USB.

5 Maintenance

6
Performance Tests and Calibration

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Basic Operating Test 111
Test Considerations 114
Performance Verification Tests 116
Calibration Security 124
Calibration Process 128
Adjustments Consideration 130

This chapter contains the performance test procedures and the adjustment procedures. The performance test procedures allow you to verify that the handheld digital multimeter is operating within its published specifications.

Calibration Overview

This manual contains procedures to verify the instrument's performance and adjustment (calibration).

NOTE Make sure you have read the "Test Considerations" on page 114 before calibrating the instrument.

Closed-case Electronic Calibration

This instrument features closed-case electronic calibration. No internal mechanical adjustments are required. The instrument calculates correction factors based upon the input reference value you set. The new correction factors are stored in the non-volatile memory until the next calibration adjustment is performed. The non-volatile EEPROM calibration memory is retained when the power is off.

Agilent Technologies Calibration Services

When your instrument is due for calibration, contact your local Agilent Service Center for a low-cost recalibration.

Calibration Interval

A 1-year interval is adequate for most applications. Accuracy specifications are warranted only if adjustment is made at regular calibration intervals. Accuracy specifications are not warranted beyond the 1-year calibration interval. Agilent does not recommend extending calibration intervals beyond 2 years for any application.

Adjustment is Recommended

Specifications are only guaranteed within the period stated from the last adjustment. Agilent recommends that readjustment should be performed during the calibration process for best performance. This will assure that the U1251B/U1252B will remain within the specifications for the next calibration interval. This criterion for the re-adjustment provides the best long–term stability.

Performance data are measured during the Performance Verification Tests but this does not guarantee that the instrument will remain within these limits unless the adjustments are performed.

Refer to the section "To Read the Calibration Count" on page 139 and verify that all the adjustments have been performed.

Recommended Test Equipment

The test equipment recommended for the performance verification and adjustment procedures is listed below. If the exact instrument is not available, substitute calibration standards of equivalent accuracy.

A suggested alternative method would be to use the Agilent 3458A 8½ -Digit Digital Multimeter to measure less accurate yet stable sources. The output value measured from the source can be entered into the instrument as the target calibration value.

Table 6-1 Recommended Test Equipment

Application	Recommended Equipment	Recommended Accuracy Requirements
DC Voltage	Fluke 5520A	<1/5 instrument 1 year spec
DC Current	Fluke 5520A	<1/5 instrument 1 year spec
Resistance	Fluke 5520A	<1/5 instrument 1 year spec
AC Voltage	Fluke 5520A	<1/5 instrument 1 year spec
AC Current	Fluke 5520A	<1/5 instrument 1 year spec
Frequency	Agilent 33250A	<1/5 instrument 1 year spec
Capacitance	Fluke 5520A	<1/5 instrument 1 year spec
Duty Cycle	Fluke 5520A	<1/5 instrument 1 year spec
Nanosiemens	Fluke 5520A	<1/5 instrument 1 year spec
Diode	Fluke 5520A	<1/5 instrument 1 year spec
Frequency Counter	Agilent 33250A	<1/5 instrument 1 year spec
Temperature	Fluke 5520A	<1/5 instrument 1 year spec
Square Wave	Agilent 53131A and Agilent 34401A	<1/5 instrument 1 year spec
Short	Shorting Plug - Dual banana plug with copper wire short between 2 terminal	<1/5 instrument 1 year spec

Basic Operating Test

The Basic Operating Test is to test the basic operability of the instrument. Repair is required if the instrument fails the Basic Operating Test.

Backlit Test

Press the Bat button to test the backlight. It will momentarily toggle backlit ON and OFF.

Testing the Display

Press the Hold button and turn on the Meter to view all segments of the display. Compare the display with the example in Table 6-1.



Figure 6-1 LCD display

Current Terminal Test

This test determines if the input warning of the current terminal test is functioning properly.

The meter sounds an alert beep when the test lead is inserted into the A terminal but the rotary switch is not set to mA.A function. The primary display will indicate “A-Err”. It is shown in Figure 55. The primary display will keep flashing unless the test lead is removed from “A” terminal.

NOTE Before conducting this test, make sure the beep function is not disabled in setup.

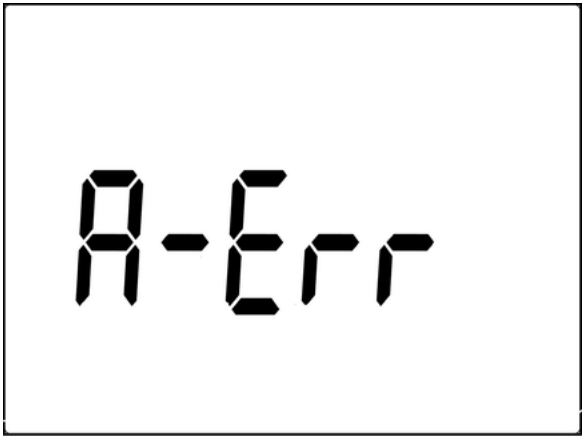

Figure 6-2 Input warning

Charge Terminal Alert Test

This test determines if the charge terminal alert is operating properly.

The meter sounds an alert when the OFF CHG terminal detects a voltage level of more than 5 V and the rotary switch is not set to the OFF CHG position. The meter sounds an alert beep and the primary display flashes the “Ch.Err” until the lead is removed from the CHG terminal.



Figure 6-3 Charge terminal alert

NOTE Before conducting this test, make sure the beep function is not disabled at setup.

Test Considerations

Long test leads can also act as antennas which may pick up AC signals.

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

- Ensure that the calibration ambient temperature is stable and is between 18 °C and 28 °C. Ideally the calibration should be performed at 23 °C ± 1 °C.
- Ensure that the ambient relative humidity is less than 80%.
- Allow a warm-up period of five minutes with a Shorting Plug connected to the V and COM input terminals.
- Use shielded twisted pair Teflon-insulated cables to reduce settling and noise errors. Keep the input cables as short as possible.
- Connect the input cable shields to earth ground. Except where noted in the procedures, connect the calibrator LO source to earth ground at the calibrator. It is important that the LO to earth ground connection be made at only one place in the circuit to avoid ground loops.

Please ensure that the calibration standards and test procedures used do not introduce additional errors. Ideally, the standards used to verify and adjust the instrument should be of an order of magnitude more accurate than each instrument range full-scale error specification.

For the DC voltage, DC current, and resistance gain verification measurements, ensure that the calibrator's "0" output is correct. You will need to set the offset for each range of the measuring function being verified.

Input Connections

Test connections to the instrument are best accomplished using the dual banana plug with copper wire short between the two terminals for low-thermal offset measurement. We recommend the use of shielded, twisted-pair, Teflon interconnect cables of minimum length between the calibrator and the multimeter. The cable shields should be earth ground referenced. This configuration is recommended to attain optimal noises and settling time performance during calibration.

Performance Verification Tests

Use the Performance Verification Tests to verify the easurement performance of the instrument. The performance verification tests use the instrument's specifications listed in the U1251B/U1252B Data Sheet.

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

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

NOTE Make sure you have read the "Test Considerations" on page 114 before doing the performance verification tests.

Perform the verification test steps in the following Table 6-2:

Table 6-2 Verification Test

Step	Test Function	Range	5520A Output	Error from nominal 1 year	
				U1251B	U1252B
1	Turn the rotary switch to the ~ V position [1]	5 V	5 V, 1 kHz	± 32.5 mV	± 22.5 mV
			5 V, 10 kHz	± 52.5 mV	± 32.5 mV
			5 V, 20 kHz	N/A	± 79.0 mV
			5 V, 30 kHz	± 84 mV	N/A
			5 V,100 kHz	N/A	± 187mV
		50 V	50 V,1 kHz	± 325 mV	± 225 mV
			50 V,10 kHz	± 525 mV	± 225 mV
			50 V, 20 kHz	N/A	± 790 mV
			50 V, 30 kHz	± 840 mV	N/A
			50 V, 100 kHz	N/A	± 1.87 V
		500 V	500 V, 1 kHz	± 3.25 V	± 2.25 V
			500 V, 10 kHz	± 5.25 V	± 2.25V
		1000 V	1000 V, 1 kHz	± 10 V	± 8.0 V
2	Press Hz button to go to frequency mode	9.9999kHz	0.48 V, 1 kHz	± 500 mHz	± 500 mHz
3	Press Hz button to go to Duty Cycle mode	0.01% – 99.99%	5.0 Vpp @ 50%, Square Wave, 50 Hz	± 0.315%	± 0.315%

Step	Test Function	Range	5520A Output	Error from nominal 1 year	
				U1251B	U1252B
4	Turn the rotary switch to ~ V position (for model U1252B), to ⎓ V position (for model U1251B)	5 V	5 V	± 2 mV	±1.75 mV
		50 V	50 V	± 20 mV	± 17.5 mV
		500 V	500 V	± 200 mV	± 200 mV
		1000 V	1000 V	± 800 mV	± 800 mV
5	Press Shift button to go to the ~ V mode [1]	5 V	5 V,1 kHz	N/A	± 22.5 mV
			5 V, 10 kHz	N/A	± 32.5 mV
			5 V, 20 kHz	N/A	± 79.0 mV
			5 V, 100 kHz	N/A	± 187 mV
		50 V	50 V, 1 kHz	N/A	± 225 mV
			50 V, 10 kHz	N/A	± 225 mV
			50 V, 20 kHz	N/A	± 790 mV
			50 V, 100 kHz	N/A	± 1.87 V
		500 V	500 V, 1 kHz	N/A	± 2.25 V
			500 V, 10 kHz	N/A	± 2.25 V
		1000 V	1000 V, 1 kHz	N/A	± 8.0 V

Step	Test Function	Range	5520A Output	Error from nominal 1 year	
				U1251B	U1252B
6	Turn the rotary switch to the mV position	50 mV	50 mV	± 75 µV [2]	± 75 µV [2]
		500 mV	500 mV	± 0.2 mV	± 0.175 mV
			–500 mV	± 0.2 mV	± 0.175 mV
		1000 mV	1000 mV	± 0.8 mV	± 0.75 mV
			–1000 mV	± 0.8 mV	± 0.75 mV
7	Press Shift button to go to the mV mode [1]	50 mV	50 mV, 1 kHz	± 0.34 mV	± 0.24 mV
			50 mV, 10 kHz	± 0.54 mV	± 0.39 mV
			50 mV, 20 kHz	N/A	± 0.415 mV
			50 mV, 30 kHz	± 0.86 mV	N/A
			50 mV, 100 kHz	N/A	± 1.87 mV
		500 mV	500 mV, 45 Hz	± 5.6 mV	± 8.1 mV
			500 mV, 1 kHz	± 3.25 mV	± 2.25 mV
			500 mV, 10 kHz	± 5.4 mV	± 2.25 mV
			500 mV, 20 kHz	N/A	± 4.15 mV
			500 mV, 30 kHz	± 8.6 mV	N/A
			500 mV, 100 kHz	N/A	± 18.7 mV
		1000 mV	1000 mV, 1 kHz	± 8.5 mV	± 6.5 mV
			1000 mV, 10 kHz	± 12.5 mV	± 6.5 mV
			1000 mV, 20 kHz	N/A	± 11.5 mV
			1000 mV, 30 kHz	± 20.0 mV	N/A
			1000 mV, 100 kHz	N/A	± 47.0 mV

Step	Test Function	Range	5520A Output	Error from nominal 1 year	
				U1251B	U1252B
8	Turn the rotary switch to the Ω position	500 Ω	500 Ω	± 500 mΩ [3]	± 350 mΩ [3]
		5 kΩ	5 kΩ	± 4.5 Ω [3]	± 3 Ω [3]
		50 kΩ	50 kΩ	± 45 Ω	± 30 Ω
		500 kΩ	500 kΩ	± 450 Ω	± 300 Ω
		5 MΩ	5 MΩ	± 10.5 kΩ	± 8 kΩ
		50 MΩ [4]	50 MΩ	± 0.510 MΩ	± 0.505 MΩ
		500 MΩ	500 MΩ	N/A	± 40.1 MΩ
9	Press Shift button to go to ns mode	500 nS [5]	50 nS	± 0.7 nS	± 0.6 nS
10	Turn the rotary switch to the Hz/ ⊣⊢ position (for model U1252B), to ⊣⊢ position (for model U1251B)	Diode	1 V	± 1 mV	± 1 mV
			33250A Output		
11	Press Shift button to go to frequency counter mode [6]	999.99 kHz	200 mVrms, 100 kHz	N/A	± 52 Hz
12	Press Range button to go to frequency counter mode divide by 100	99.999 MHz	600 mVrms, 10 MHz	N/A	± 5.2 kHz
			5520A Output		
13	Turn the rotary switch to the 🌡 / ⊣⊢ position [7]	10.000 nF	10.000 nF	± 0.108 nF	± 0.108 nF
		100.00 nF	100.00 nF	± 1.05 nF	± 1.05 nF
		1000.0 nF	1000.0 nF	± 10.5 nF	± 10.5 nF
		10.000 µF	10.000 µF	± 0.105 µF	± 0.105 µF

Step	Test Function	Range	5520A Output	Error from nominal 1 year	
				U1251B	U1252B
		100.00 µF	100.00 µF	± 1.05 µF	± 1.05 µF
		1000.0 µF	1000.0 µF	± 10.5 µF	± 10.5 µF
		10.00 mF	10.00 mF	± 0.105 mF	± 0.105 mF
		100.00 mF	10.00 mF	± 0.4 mF	± 0.4 mF
14	Press Shift button to go to mode[8]	–200 °C until 1372 °C	0 °C	± 3 °C	± 3 °C
			100 °C	± 3.3 °C	± 3.3 °C
15	Turn the rotary swich to the µA position	500 µA	500 µA	± 0.55 µA[9]	± 0.3 µA[9]
		5000 µA	5000 µA	± 5.5 µA[9]	± 3 µA[9]
16	Press Shift button to go to µA mode [1]	500 µA	500 µA, 1 kHz	± 4.2 µA	± 3.7 µA
			500 µA, 20 kHz	± 15.8 µA	± 3.95 µA
		5000 µA	5000 µA, 1 kHz	± 42 µA	± 37.0 µA
			5000 µA, 20 kHz	± 0.156 mA	± 39.5 µA
17	Turn the rotary switch to the mA·A position	50 mA	50 mA	± 0.105 mA[9]	± 80 µA[9]
		440 mA	400 mA	± 0.93 mA[9]	± 0.71 mA[9]
18	Press Shift button to go to mA mode [1]	50 mA	50 mA, 1 kHz	± 0.42 mA	± 0.37 mA
			50 mA, 20 kHz	± 1.56 mA	± 0.395 mA
		440 mA	400 mA, 45 Hz	± 6.4 mA	± 4.2 mA
			400 mA, 1 kHz	± 3.4 mA	± 3.0 mA
	Caution: Connect the calibrator to handheld multimeter's A and COM terminals before applying 5A and 10A				
		5 A	5 A	± 16 mA	± 16 mA
		10 A[10]	10 A	± 40 mA	± 35 mA

Step	Test Function	Range	5520A Output	Error from nominal 1 year	
				U1251B	U1252B
19	Press Shift button to go to ~ A mode	5 A	5 A, 1 kHz	± 42 mA	± 37 mA
		3A	3 A, 5 kHz	± 96 mA	± 96 mA
		10 A[11]	10 A, 1 kHz	± 100 mA	± 90 mA
		Square Wave Output	**Use 53131A**		
20	Turn the rotary switch to the OUT % ms position	120 Hz @ 50%		N/A	± 26 mHz
		4800 Hz @ 50%		N/A	± 260 mHz
	OUT % ms Duty Cycle	100 Hz @ 50%		N/A	± 0.398%[12]
		100 Hz @ 25%		N/A	± 0.398%[12]
		100 Hz @ 75%		N/A	± 0.398%[12]
			Use 34410A		
	OUT % ms Amplitude	4800 Hz @ 99.609%		N/A	± 0.2V

[1] The additional error to be added as frequency > 20 kHz and signal input < 10% of range: 300 counts of LSD per kHz.

[2] The accuracy could be 0.05% + 10, always use relative function to zero thermal effect (short test leads) before measuring the signal.

[3] The accuracy of 500 Ω and 5kΩ is specified after the Null function.

[4] For range of 50 MΩ/500 MΩ, the RH is specified for < 60%.

[5] The accuracy is specified for < 50nS and after Null function as open test lead.

[6] All frequency counters are susceptible to error when measuring low voltage, low-frequency signals. Shielding inputs from external noise pickup is critical for minimizing measurement errors.

[7] Use the Null mode to zero residual

[8] The accuracy does not include the tolerance of the thermocouple probe.

The thermal sensor plugged into the meter should be placed in the operating enviroment for at least an hour.

Use the Null function to reduce the thermal effect.

[9] Always use relative function to zero the thermal effect with open test lead before measuring the signal.

If you do not use Relation function, add 20 digits for accuracy purposes.

[10] 10A continuous, and additional 0.5% to specified accuracy when measuring a signal greater than 10 A~20 A for 30 seconds maximum.

After measured current for > 10 A, to cool down the meter for twice the measuring time you applied before low current measurement.

[11] The current can be measuring from 2.5A to 10A continuous, and the additional of 0.5% to specified accuracy as measure the signal greater than 10A~20A for 30 seconds maximum.

After measured current for > 10A, to cool down the meter for 2 times of measuring time you applied before low current measurement

[12] For signal frequency greater than 1 kHz, additional 0.1% per kHz to be added to accuracy

Calibration Security

The calibration security code prevents accidental or unauthorized adjustments to the instrument. When you first receive your instrument, it is secured. Before you can adjust the instrument, you must unsecure it by entering the correct security code (see "Unsecuring the Instrument for Calibration" on page 125).

The security code is set to 1234 when the instrument is shipped from the factory. This code is stored in non-volatile memory, and does not change when power is turned off .

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

The security code may contain up to 4 numeric characters.

NOTE See "To Unsecure the Instrument Without the Security Code" on page 127 if you forget your security code.

Unsecuring the Instrument for Calibration

Before you can adjust the instrument, you must unsecure it by entering the correct security code. The security code is set to 1234 when the instrument is shipped from the factory. The security code is stored in non-volatile memory, and does not change when power is off.

To Unsecure the Instrument from the Front Panel

1 Turn the rotary switch to ~V .

2 Press 

and 

button simultaneously to enter the Calibration Security Code entry mode.

3 The primary display shows 5555 and the secondary display show SECUr.

4 Use the editing keys 

and 

to step each character in the code.

Use the 

and 

to select each character.

5 Press 

(Save) when done.

6 If the correct security code is entered, the secondary display will show PASS.

To Change the Instrument Calibration Security Code from the Front Panel

1 When the multimeter is in the unsecured mode, press  for more than 1 second to enter the Calibration Security Code setting mode.

2 The factory default calibration security code 1234 will be displayed on the primary display.

3 Use the editing keys  and  to step each character in the code.

4 Use the  and  to change each character in the code.

5 Press  (Save) to store the new calibration security code.

6 If the new calibration security code has been successfully stored, the secondary display will show PASS.

To Unsecure the Instrument Without the Security Code

To unsecure the instrument without the correct security code, follow the steps below.

NOTE If you do not have a record of the security code, you can try 1234 (the factory default code) using the front panel or the remote interface.

1 Record the last 4 digits of the multimeter's serial number.

2 Turn the rotary switch to ~V.

3 Press 

and 

simultaneously to enter the Calibration Security Code entry mode.

The primary display shows 5555 and the secondary display shows SECUr.

4 Press  for more than 1 second to enter the Set Default Security Code mode. The secondary display shows SEr.no and the primary display shows 5555.

5 Use the editing keys 

and 

to step each character in the code.

6 Use 

and 

to select each character.

7 Set the code, same as the last 4 digits of the instrument's serial number.

8 Press 

(Save) to confirm the entry.

9 If the 4 digits entered are correct, the secondary display will show PASS.

Now you can use 1234 as the security code. If you want to enter a new security code, see "To Change the Instrument Calibration Security Code from the Front Panel" on page 126. Make sure you record the new security code.

Calibration Process

To complete a full instrument calibration use following general procedures:

1. Read "Test Considerations" on page 114.
2. Perform the verification tests to characterize the instrument (incoming data).
3. Unsecure the instrument for calibration (see "Calibration Security" on page 124).
4. Perform the adjustment procedures (see "Adjustments Consideration" on page 130).
5. Secure the instrument against calibration.
6. Note the new security code and calibration count in the instrument's maintenance records.

NOTE Make sure to quit the Adjustment Mode before turning off the instrument.

Using the Front Panel for Adjustments

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

Selecting the Adjustment Mode

To unsecure the instrument, see "Unsecuring the Instrument for Calibration" on page 125 or "To Unsecure the Instrument Without the Security Code" on page 127. Once unsecured, the reference value will be indicated on the primary display.

Entering Adjustment Values

Use the following adjustment procedure to enter an input calibration value from the front panel:

1 Use the edit keys 

and 

to select each digit in the primary display.

2 Use the 

and the 

arrow keys to advance through the digits 0 through 9.

3 Press 

when done to start calibration.

Adjustments Consideration

You will need a test input cable, a connectors set, and a Shorting Plug to adjust the instrument (see "Input Connections" on page 115).

NOTE After each adjustment, the secondary display briefly shows PASS. If the calibration fails, the handheld multimeter sounds a beep, and an error number is shown in the secondary display. Calibration error messages are described on page 140. In the event of a calibration failure, correct the problem and repeat the procedure.

Adjustments for each function should be performed only in the order shown below.

1. Allow the instrument to warm up and stabilize for 5 minutes before performing the adjustments.
2. Ensure that during the adjustments, the low battery indicator does not appear. Replace the batteries as soon as possible to avoid false reading.
3. Consider the thermal effects as you are connecting test leads to the calibrator and handheld multimeter. It is recommended to wait for one minute before you begin the calibration after connecting the test leads.
4. During ambient temperature adjustment, be sure to turn on the instrument for at least 1 hour with the K-type thermocouple connected between the instrument and the calibration source.

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

Valid Adjustment Input Values

Adjustment can be accomplished using the following input values below.

Table 6-3 Valid adjustment input values

Function	Range	Valid Amplitude Input Values
~ V	5V, 50 V, 500 V, 1000 V	0.9 to 1.1 x Full Scale
⎓ V (for U1251B)	5 V, 50 V, 500 V, 1000 V	0.9 to 1.1 x Full Scale
≂ V (for U1252B)	5 V, 50 V ,500 V, 1000 V	0.9 to 1.1 x Full Scale
≂ mV	50 mV, 500 mV, 1000 mV	0.9 to 1.1 x Full Scale
µA ≂	500 µA, 5000 µA	0.9 to 1.1 x Full Scale
mA·A ≂	50 mA, 440 mA, 5 A, 10 A	0.9 to 1.1 x Full Scale
Ω	500 Ω, 5kΩ, 50 kΩ,500 kΩ, 5MΩ, 50 MΩ	0.9 to 1.1 x Full Scale
→|←	Diode	0.9 to 1.1 x Full Scale
⊣⊢ / 🌡	10 nF, 100 nF, 1000 nF, 10 µF, 100 µF, 1000 µF, 10 mF / 0 °C	Make sure to provide 0 °C with ambient compensation

Adjustment Procedure

Review the sections "Test Considerations" on page 114 and "Adjustments Consideration" on page 130 before proceeding with this procedure.

1 Turn the rotary switch to "Test Function" position as shown in the adjustment table.

2 After unsecuring the instrument, the instrument goes into the adjustment mode.(See "Unsecuring the Instrument for Calibration" on page 125)

NOTE The instrument will be in the adjustment mode, unless you press Shift and Hz simultaneously to exit the adjustment mode.

3 The primary display will show the reference value of the Cal Item.

4 Configure each Cal Item.

5 Use the Hold and the Null arrow keys to select the Cal Range.

6 Apply the input signal shown in the Input column of the table. The bar graph will display the Input reading. There is no bar graph display for temperature adjustment.

NOTE Always complete the tests in the same order as shown in the appropriate table.

7 Enter the actual applied input (see "Entering Adjustment Values" on page 129).

8 Press Hz to start the adjustment. The CAL flashes in the secondary display to indicate that the calibration is in progress.

For an adjustment that is successful, the secondary display will briefly show PASS. An adjustment failure is indicated by a long beep and a calibration error number appears in the secondary display. The primary display remains at the current Cal Item. Check the input value, range, function, and entered adjustment value to fix the problem. Repeat the adjustment procedure.

9 Repeat steps 1 through 8 for each adjustment point.

10 Verify the adjustments using the "Performance Verification Tests" on page 116. Verify the adjustments using Table 6-4:

Table 6-4 Adjustment table

Step	Test Function	Cal Range	Input	Cal Item	
				U1251B	U1252B
1	Turn the rotary switch to the ~ V position	5V	0.3 V,1 kHz	0.3000 V	0.3000 V
			3 V, 1 kHz	3.0000 V	3.0000 V
			3 V, 10 kHz	3.0000 V	3.0000 V
		50V	3 V, 1 kHz	03.000 V	03.000 V
			30 V, 1 kHz	30.000 V	30.000 V
			30 V, 10 kHz	3.0000 V	30.000 V
		500V	30 V,1 kHz	030.00 V	030.00 V
			300 V,1 kHz	300.00 V	300.00 V
			300 V, 10 kHz	3.0000 V	300.00 V
		1000V	30 V, 1 kHz	0030.0 V	0030.0 V
			300 V, 1 kHz	0300.0 V	0300.0 V
			300 V, 10 kHz	3.0000 V	0300.0 V
2	Turn the rotary switch to ≂ V position (for model U1252B), to ⎓ V position (for model U1251B)	Short	Dual Banana Plug with copper wire short between 2 terminals	SHort	SHort
		5V	3 V	3.0000 V	3.0000 V
		50V	30 V	30.000 V	30.000 V
		500V	300 V	300.00 V	300.00 V
		1000V	1000 V	1000.0 V	1000.0 V

Step	Test Function	Cal Range	Input	Cal Item	
				U1251B	U1252B
3	Press Shift button to go to the ~ V mode	5 V	0.3 V, 1 kHz	N/A	0.3000 V
			3 V, 1 kHz	N/A	3.0000 V
			3 V, 10 kHz	N/A	3.0000 V
		50 V	3 V, 1 kHz	N/A	03.000 V
			30 V, 1 kHz	N/A	30.000 V
			30 V, 10 kHz	N/A	30.000 V
		500 V	30 V, 1 kHz	N/A	030.00 V
			300 V, 1 kHz	N/A	300.00 V
			300 V, 10 kHz	N/A	300.00 V
		1000 V	30 V, 1 kHz	N/A	0030.0 V
			300 V, 1 kHz	N/A	0300.0 V
			300 V, 10 kHz	N/A	0300.0 V
4	Turn the rotary switch to the ~ mV position	Short	Dual Banana Plug with copper wire short between 2 terminals	SHort	SHort
		50 mV	30 mV	30.000 mV	30.000 mV
		500 mV	300 mV	300.00 mV	300.00 mV
		1000 mV	1000 mV	1000.0 mV	1000.0 mV

Step	Test Function	Cal Range	Input	Cal Item	
				U1251B	U1252B
5	Press Shift button to go to the ~ mV mode	50mV	3 mV, 1 kHz	03.000 mV	03.000 mV
			30 mV, 1 kHz	30.000 mV	30.000 mV
			30 mV, 10 kHz	30.000 mV	30.000 mV
		500mV	30 mV, 1 kHz	030.00 mV	030.00 mV
			300 mV, 1 kHz	300.00 mV	300.00 mV
			300 mV, 10 kHz	30.000 mV	300.00 mV
		1000mV	30 mV, 1 kHz	0030.0 mV	0030.0 mV
			1000 mV, 1 kHz	1000.0 mV	1000.0 mV
			1000 mV, 10 kHz	30.000 mV	1000.0 mV
6	Turn the rotary switch to the Ω position [1]	Short	Dual Banana Plug with copper wire short between 2 terminals	SHort	SHort
		50 MΩ	Input terminal open (remove any test leads and Short Plugs from the input terminal)	oPEn	oPEn
			10 MΩ	10.000 MΩ	10.000 MΩ
		5 MΩ	3 MΩ	3.0000 MΩ	3.0000 MΩ
		500 kΩ	300 kΩ	300.00 kΩ	300.00 kΩ
		50 kΩ	30 kΩ	30.000 kΩ	30.000 kΩ
		5 kΩ	3k Ω	3.0000 kΩ	3.0000 kΩ
		500 Ω	300 Ω	300.00 Ω	300.00 Ω

Step	Test Function	Cal Range	Input	Cal Item	
				U1251B	U1252B
7	Turn the rotary switch to the Hz/ position (for model U1252B), to position (for model U1251B)	Short	Dual banana shorting plug with copper wire	SHORT	SHORT
		2 V	2 V	2.0000 V	2.0000 V
8	Turn the rotary switch to the / position	Open	Input terminal open (remove any test leads and Short Plugs from the input terminal)	oPEn	oPEn
		10 nF	3 nF	03.000 nF	03.000 nF
			10 nF	10.000 nF	10.000 nF
		100 nF	10 nF	010.00 nF	010.00 nF
			100 nF	100.00 nF	100.00 nF
		1000 nF	100 nF	0100.0 nF	0100.0 nF
			1000 nF	1000.0 nF	1000.0 nF
		10 µF	10 µF	10.000 µF	10.000 µF
		100 µF	100 µF	100.00 µF	100.00 µF
		1000 µF	1000 µF	1000.0 µF	1000.0 µF
		10 mF	10 mF	10.000 mF	10.000 mF
9	Press Shift button to go to mode	N/A	0 °C	0000.0 °C	0000.0 °C
10	Turn the rotary swich to the µA position	OPEN	Input terminal open (remove any test leads and Short Plugs from the input terminal)	oPEn	oPEn
		500 µA	300 µA	300.00 µA	300.00 µA
		5000 µA	3000 µA	3000.0 µA	3000.0 µA

Step	Test Function	Cal Range	Input	Cal Item	
				U1251B	U1252B
11	Press Shift button to go to ∿ µA mode	500 µA	30 µA,1 kHz	030.00 µA	030.00 µA
			300 µA,1 kHz	300.00 uA	300.00 µA
		5000 µA	300 µA,1 kHz	0300.0 µA	0300.0 µA
			3000 µA, 1 kHz	3000.0 µA	3000.0 µA
12	Turn the Rotary Switch to the mA·A ≂ position	Open	Input terminal open (remove any test leads and Short Plugs from the input terminal)	oPEn	oPEn
		50 mA	30 mA	30.000 mA	30.000 mA
		440 mA	300 mA	300.00 mA	300.00 mA
	Move the test lead from uA.mA and COM terminal to A and COM terminal				
	Caution: Connect the calibrator to hanheld multimeter's A and COM terminals before applying 3A and 10A				
		5 A	3 A	3.0000 A	3.0000 A
		10 A	10 A	10.000 A	10.000 A
	Move the test lead from A and COM terminal to uA.mA and COM terminal				
13	Press Shift button to go to ∿ mA mode	50 mA	3 mA, 1 kHz	03.000 mA	03.000 mA
			30 mA, 1 kHz	30.000 mA	30.000 mA
		440 mA	30 mA, 1 kHz	030.00 mA	030.00 mA
			300 mA, 1 kHz	300.00 mA	300.00 mA
	Move the test lead from uA.mA and COM terminal to A and COM terminal				
	Caution: Connect the calibrator to hanheld multimeter's A and COM terminals before applying 3A and 10A				
14	Press Shift button to go to ∿ A mode	5 A	0.3 A, 1 kHz	0.3000 A	0.3000 A
			3 A, 1 kHz	3.0000 A	3.0000 A
		10 A	3 A, 1 kHz	3.0000 A	3.0000 A
			10 A, 1 kHz	10.000 A	10.000 A

[1] Be sure to recalibrate “Short” using the dual banana plug with copper wire after performing calibration for resistance.

Finishing the Adjustment

1 Remove all the shorting plugs and connectors from the instrument.

2 Record the new Calibration Count.

3 Press  and  simultaneously to exit the Adjustment Mode. Power off and on again. The instrument will then be secured.

To Read the Calibration Count

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

NOTE Your instrument was calibrated before it left the factory.

When you receive your instrument, read the count to determine its initial value.

The count value increases by one for each calibration point, and a complete calibration will increase the value by many counts. The calibration count increments up to a maximum of 65535 after which it is set at 0. The calibration count can be read from the front panel after the instrument has been unsecured. Use the following procedure to read the calibration count from the front panel.

1 Press  Adjustment Mode. The primary display shows the calibration count.

2 Take note of the count.

3 Press  again to exit the calibration count mode.

Calibration Errors

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

Number	Recommended Accuracy Requirements
200	Calibration error: Calibration mode is secured
002	Calibration error: Secure code invalid
003	Calibration error: Serial number code invalid
004	Calibration error: Calibration aborted
005	Calibration error: Value out of range
006	Calibration error: Signal measurement out of range
007	Calibration error: Frequency out of range
008	EEPROM write failure

7 Specifications

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This chapter lists the specifications of the handheld digital multimeter. When using the multimeter in an environment where there are electromagnetic interferences or significant electrostatic charges, the accuracy of measurement may be reduced.

DC Specifications

Table 7-1 DC Accuracy ± (% of reading + No. of Least Significant Digit)

Function	Range	Resolution	Test Current/ Burden Voltage	Accuracy	
				U1251B	U1252B
Voltage[1]	50.000 mV	0.001 mV	-	0.05+50[2]	0.05+50[2]
	500.00 mV	0.01 mV	-	0.03+5	0.025+5
	1000.0 mV	0.1 mV	-		
	5.0000 V	0.0001 V	-		
	50.000 V	0.001 V	-		
	500.00 V	0.01 V	-		0.03+5
	1000.0 V	0.1 V	-		
Resistance[8]	500.00 Ω[3]	0.01 Ω	1.04 mA	0.08+10	0.05+10
	5.0000 kΩ[3]	0.0001 kΩ	416 µA	0.08+5	0.05+5
	50.000 kΩ	0.001 kΩ	41.2 µA		
	500.00 kΩ	0.01 kΩ	4.12 µA		
	5.0000 MΩ	0.0001 MΩ	375 nA	0.2+5	0.15+5
	50.000 MΩ[4]	0.001 MΩ	187 nA	1+10	1+5
	500.00 MΩ[4]	0.01 MΩ	187 nA	-	3+10<200MΩ/ 8+10>200MΩ
	500.00 nS[5]	0.01 nS	187 nA	1+20	1+10
Current	500.00 µA	0.01 µA	0.06 V (100 Ω)	0.1+5[6]	0.05+5[6]
	5000.0 µA	0.1 µA	0.6 V (100 Ω)	0.1+5[6]	0.05+5[6]
	50.000 mA	0.001 mA	0.09 V (1 Ω)	0.2+5[6]	0.15+5[6]
	440.00 mA	0.01 mA	0.9 V (1 Ω)	0.2+5[6]	0.15+5[6]
	5.0000 A	0.0001 A	0.2 V (0.01 Ω)	0.3+10	0.3+10
	10.000 A[7]	0.001 A	0.4 V (0.01 Ω)	0.3+10	0.3+5
Diode Test[8]	-	0.1 mV	1.04 mA	0.05 + 5	

[1] Input impedance: Refer to Table 7-6.

[2] The accuracy could be 0.05 %+10 for U1251B and 0.05 %+5 for U1252B. Always use the Null function to zero out the thermal effect before measuring the signal.

[3] The accuracy of 500 Ω and 5 kΩ is specified after Null function, which is used to subtract the test lead resistance and the thermal effect

[4] For the range of 50 Ω/500 MΩ, the R.H. is specified for <60 %.

[5] The accuracy is specified for <50 nS and after Null function with open test lead.

[6] Always use the Null function to zero out thermal effect with open test lead before measuring the signal. If the Null function is not used, add 20 counts to the DC current accuracy. Thermal effect could occur due to the following:

Wrong procedures used to measure the high voltage of 50 V to 1000 V for resistance, diode, and mV measurements.

After battery-charging has completed.

After measuring current greater than 440 mA. Thus we recommend that the meter be left to cool down for a period which is twice the measuring time used.

[7] Current can be measured up to 10 A continuously. Add 0.5 % to the specified accuracy if the signal measured is in the range of 10 A to 20 A and for a period of up to 30 seconds. After measuring current > 10 A, leave the meter to cool down for twice the measuring time used before application of low current measurement.

[8] Maximum open voltage: <+4.2 V.

U1251B AC Specifications

Table 7-2 U1251B AC Accuracy ± (% of reading + No. of Least Significant Digit)

Function	Range	Resolution	Frequency			
			30 Hz to **45 Hz**	**45 Hz** to **1 kHz**	**1 kHz** to **10 kHz**	**10 kHz** to **30 kHz**
True RMS AC Voltage [1][2]	50.000 mV	0.001 mV	1+60	0.6+40	1.0+40	1.6+60
	500.00 mV	0.01 mV	1+60	0.6+25	1.0+40	1.6+60
	1000.0 mV	0.1 mV	1+60	0.6+25	1.0+25	1.6+40
	5.0000 V	0.0001 V	1+60	0.6+25	1.0+25	1.6+40
	50.000 V	0.001 V	1+60	0.6+25	1.0+25	1.6+40
	500.00 V	0.01 V	1+60	0.6+25	1.0+25	1.6+40[3]
	1000.0 V	0.1 V	1+60	0.6+40	1.0+40	N/A

Function	Range	Resolution	Frequency		
			30 Hz to **45 Hz**	**45 Hz** to **2 kHz**	**2 kHz** to **20 kHz**
True RMS AC Current [2]	500.00 µA[4]	0.01 µA	1.5+50	0.8+20	3+80
	5000.0 µA	0.1 µA	1.5+40	0.8+20	3+60
	50.000 mA	0.001 mA	1.5+40	0.8+20	3+60
	440.00 mA	0.01 mA	1.5+40	0.8+20	3+60
	5.0000 A	0.0001 A	2+40[6]	0.8+20	3+60 <3 A/5 kHz
	10.000 A[5]	0.001 A	2+40[6]	0.8+20	

[1] Input impedance: Refer to Table 7-6.

[2] AC mV/V and AC µA/mA/A specifications are true RMS AC coupled, valid from 5% to 100% of range. The crest factor may be up to 3 at full scale, up to 5 at half-scale, except for 1000 mV and 1000 V ranges, where the crest factor is 1.5 at full scale and 3 at half scale.

[3] The input signal is lower than the product of 20,000,000 V-Hz (product of voltage and frequency).

[4] Input current >35 µArms.

[5] Current can be measured from 2.5 A up to 10 A continuously. Add 0.5% to the specified accuracy if the signal measured is in the range of 10 A to 20 A and for a period of up to 30 seconds. After measuring current >10 A, leave the meter to cool down for a period that is twice the measuring time used before application of low current measurement.

[6] Input current < 3 Arms.

U1252B AC Specifications

Table 7-3 U1252B AC Accuracy ± (% of reading + No. of Least Significant Digit)

Function	Range	Resolution	Frequency				
			20 Hz – 45 Hz	45 Hz – 1 kHz	1 kHz – 10 kHz	10 kHz – 20 kHz	20 kHz – 100 kHz[1]
True RMS AC Voltage [2][7]	50.000 mV	0.001 mV	1.5+60	0.4+40	0.7+40	0.75+40	3.5+120
	500.00 mV	0.01 mV	1.5+60	0.4+25	0.4+25	0.75+40	3.5+120
	1000.0 mV	0.1 mV	1.5+60	0.4+25	0.4+25	0.75+40	3.5+120
	5.0000 V	0.0001 V	1.5+60	0.4+25	0.6+25	1.5+40	3.5+120
	50.000 V	0.001 V	1.5+60	0.4+25	0.4+25	1.5+40	3.5+120
	500.00 V	0.01 V	1.5+60	0.4+25	0.4+25	1.5+40	3.5+120[3]
	1000.0 V	0.1 V	1.5+60	0.4+40	0.4+40	1.5+40[3]	N/A

Function	Range	Resolution	Frequency[7]			
			20 Hz – 45 Hz	45 Hz – 1 kHz	1 kHz – 20 kHz	20 kHz – 100 kHz[1]
True RMS AC Current [7]	500.00 µA[4]	0.01 µA	1.0+20	0.7+20	0.75+20	5+80
	5000.0 µA	0.1 µA	1.0+20	0.7+20	0.75+20	5+80
	50.000 mA	0.001 mA	1.0+20	0.7+20	0.75+20	5+80
	440.00 mA	0.01 mA	1.0+20	0.7+20	1.5+20	5+80
	5.0000 A	0.0001 A	1.5+20[6]	0.7+20	3+60 <3 A/5 kHz	N/A
	10.000 A[5]	0.001 A	1.5+20[6]	0.7+20		

[1] The additional error to be added as frequency >20 kHz and signal input<10% of range: 3 counts of LSD per kHz.

[2] Input impedance: Refer to Table 7-6.

[3] The input signal is lower than the product of 20,000,000 V-Hz (product of voltage and frequency).

[4] Input current >35 µArms.

[5] Current can be measured from 2.5 A up to 10 A continuously. Add 0.5% to the specified accuracy if the signal measured is in the range of 10 A to 20 A and for a period of up to 30 seconds. After measuring current >10 A, leave the meter to cool down for a period that is twice the measuring time used before application of low current measurement.

[6] Input current < 3 Arms.

[7] Crest factor ≤ 3.0 at full scale, 5.0 at half scale except the 1000 mV and 1000 V ranges where it is 1.5 at full scale, 3.0 at half scale. For non-sinusoidal waveform, add 0.1% of reading ± 0.3% of range.

U1252B AC+DC Specifications

Table 7-4 U1252B AC Accuracy ± (% of reading + No. of Least Significant Digit)

Function	Range	Resolution	Frequency				
			30 Hz – 45 Hz	45 Hz – 1 kHz	1 kHz – 10 kHz	10 kHz – 20 kHz	20kHz – 100kHz[1]
Voltage[2]	50.000 mV	0.001 mV	1.5+80	0.4+60	0.7+60	0.8+60	3.5+220
	500.00 mV	0.01 mV	1.5+65	0.4+30	0.4+30	0.8+45	3.5+125
	1000.0 mV	0.1 mV	1.5+65	0.4+30	0.4+30	0.8+45	3.5+125
	5.0000 V	0.0001 V	1.5+65	0.4+30	0.6+30	1.5+45	3.5+125
	50.000 V	0.001 V	1.5+65	0.4+30	0.4+30	1.5+45	3.5+125
	500.00 V	0.01 V	1.5+65	0.4+30	0.4+30	1.5+45	3.5+125[3]
	1000.0 V	0.1 V	1.5+65	0.4+45	0.4+45	1.5+45[3]	N/A

Function	Range	Resolution	Frequency		
			30 Hz – 45 Hz	45 Hz – 1 kHz	1 kHz – 20 kHz
Current	500.00 µA[4]	0.01 µA	1.1+25	0.8+25	0.8+25
	5000.0 µA	0.1 µA	1.1+25	0.8+25	0.8+25
	50.000 mA	0.001 mA	1.2+25	0.9+25	0.9+25
	440.00 mA	0.01 mA	1.2+25	0.9+25	0.9+25
	5.0000 A	0.0001 A	1.8+30[6]	0.9+30	3.3+70 <3 A/5 kHz
	10.000 A(5)	0.001 A	1.8+30[6]	0.9+25	

[1] The additional error to be added as frequency >20 kHz and signal input <10 %of range: 3 counts of LSD per kHz.

[2] Input impedance: Refer to Table 7-6.

[3] The input signal is lower than the product of 20,000,000 V-Hz (product of voltage and frequency).

[4] Input current >35 µArms.

[5] Current can be measured from 2.5 A up to 10 A continuously. Add 0.5% to the specified accuracy if the signal measured is in the range of 10 A to 20 A and for a period of up to 30 seconds. After measuring current >10 A, leave the meter to cool down for a period that is twice the measuring time used before application of low current measurement.

[6] Input current < 3 Arms.

Temperature and Capacitance Specifications

Function	Thermocouple Type	Range	Resolution	Accuracy ± (% of reading + No. of Least Significant Digit)
Temperature[1]	K	-200 – 1372 °C/ -328 – 2502 °F	0.1 °C/ 0.1 °F	0.3 % +3 °C/ 0.3 %+6 °F
	J[2]	-210 – 1200 °C/ -346 – 2192 °F	0.1 °C/ 0.1 °F	0.3 % +3 °C/ 0.3 %+6 °F

Function	Range	Resolution	Accuracy ± (% of reading + Offset Error)	Measuring Rate At Full Scale	Max. Display
Capacitance	10.000 nF	0.001 nF	1 %+8	4 times/sec.	11000 counts
	100.00 nF	0.01 nF	1 %+5		
	1000.0 nF	0.1 nF			
	10.000 µF	0.001 µF			
	100.00 µF	0.01 µF			
	1000.0 µF	0.1 µF		1 time/sec.	
	10.000 mF	0.001 mF		0.1 times/sec.	
	100.00 mF	0.01 mF	3 %+10	0.01 times/sec.	

[1] The accuracy is suject to the following conditions:

The accuracy does not include the tolerance of the thermocouple probe. The thermal sensor plugged into the meter should be placed in the operating environment for at least an hour.

Use the Null function to reduce the thermal effect. Before using the Null function, set the meter to the no ambient compensation (0°C) mode and keep the thermocouple probe as close to the meter as possible, avoiding contact with any surface that has a different temperature from the ambient temperature.

When measuring temperature with respect to any temperature calibrator, try to set both the calibrator and the meter with an external reference (without internal ambient compensation). If both the calibrator and the meter are set with internal reference (with internal ambient compensation), deviation may show between the readings of the calibrator and the meter, due to differences in ambient compensation between the calibrator and the meter.

[2] Only available in U1252B.

U1251B & U1252B Frequency Specifications [1]

Range	Resolution	Accuracy ± (% of reading + No. of Least Significant Digit)	Min. Input Frequency
99.999 Hz	0.001 Hz	0.02%+3 <600 kHz	1 Hz
999.99 Hz	0.01 Hz		
9.9999 kHz	0.0001 kHz		
99.999 kHz	0.001 kHz		
999.99 kHz	0.01 kHz		

U1251B Frequency Sensitivity During Voltage Measurement

Input Range	Minimum Sensitivity (R.M.S. Sine-Wave)		Trigger Level For DC Coupling	
(Maximum input for specified accuracy = 10 x Range or 1000 V)	20 Hz – 100 kHz	>100 kHz – 200 kHz	< 100 kHz	>100 kHz – 200 kHz
50.000 mV	10 mV	15 mV	10 mV	15 mV
500.00 mV	25 mV	35 mV	60 mV	70 mV
1000.0 mV	40 mV	50 mV	100 mV	150 mV
5.0000 V	0.25 V	0.5 V	0.5 V / 1.25 V (< 100 Hz)	0.6 V
50.000 V	2.5 V	5 V	5 V	6 V
500.00 V	25 V	N/A	50 V	N/A
1000.0 V	50 V	N/A	300 V	N/A

U1252B Frequency Sensitivity During Voltage Measurement

Input Range	Minimum Sensitivity (R.M.S. Sine-Wave)		Trigger Level For DC Coupling	
(Maximum input for specified accuracy = 10 x Range or 1000 V)	20 Hz – 200 kHz	>200 kHz – 500 kHz	< 100 kHz	>100 kHz – 500 kHz
50.000 mV	10 mV	25 mV	10 mV	25 mV
500.00 mV	70 mV	150 mV	70 mV	150 mV
1000.0 mV	120 mV	300 mV	120 mV	300 mV
5.0000 V	0.3 V	1.2 V	0.6 V	1.5 V
50.000 V	3 V	5 V	6 V	15 V
500.00 V	30 V < 100 kHz	N/A	60 V	N/A
1000.0 V	50 V < 100 kHz	N/A	120 V	N/A

[1] The input signal is lower than the product of 20,000,000 V-Hz.

U1251B & U1252B Frequency Sensitivity During Current Measurement

Input Range	Minimum Sensitivity (R.M.S. Sine-Wave) 20 Hz – 20 kHz
500.00 µA	100 µA
5000.0 µA	250 µA
50.000 mA	10 mA
440.00 mA	25 mA
5.0000 A	1 A
10.000 A	2.5 A

Duty Cycle [1]

MODE	RANGE	ACCURACY AT FULL SCALE
DC Coupling	0.01 % – 99.99 %	0.3 % per kHz + 0.3 %

Pulse Width [1]

MODE	RANGE	ACCURACY AT FULL SCALE
500 ms	0.01 ms	0.2 % + 3
2000 ms	0.1 ms	0.2 % + 3

[1] Positive or negative pulse width must be greater than 10 µs and the range of duty cycle should be considered. The range of pulse width is determined by the frequency of the signal.

U1252B Frequency Counter Specifications

Divide 1 (secondary display "-1-")

Range	Resolution	Accuracy ± (% of reading + No. of Least Significant Digit)	Sensitivity	Min. Input Frequency
99.999 Hz	0.001 Hz	0.02%+3[2]	100 mV R.M.S.	0.5 Hz
999.99 Hz	0.01 Hz	0.002%+5, <985 kHz		
9.9999 kHz	0.0001 kHz			
99.999 kHz	0.001 kHz			
999.99 kHz	0.01 kHz		200 mV R.M.S.	
9.9999 MHz	0.0001 MHz			

Divide 100 (secondary display "-100-")

Range	Resolution	Accuracy ± (% of reading + No. of Least Significant Digit)	Sensitivity	Min. Input Frequency
9.9999 MHz	0.0001 MHz	0.002 %+5, <20 MHz	400 mV R.M.S.	1 MHz
99.99 MHz	0.001 MHz		600 mV R.M.S.	

PEAK HOLD (Capturing changes)

SIGNAL WIDTH	ACCURACY FOR DC mV/VOLTAGE/CURRENT
Single event > 1 ms	2% + 400 for all ranges
Repetitive > 250 µs	2% + 1000 for all ranges

[1] The maximum measurement level is < 30 Vpp.

[2] All frequency counters are susceptible to error when measuring low-voltage, low-frequency signals. Shielding inputs from picking up external noise is critical for minimizing measurement errors. For non-square wave signals, an additional 5 counts need to be added.

[3] The minimum measurement frequency of low frequency is set by power-on option to speed up the measurement rate.

U1252B SQUARE WAVE OUTPUT

OUTPUT[1]	RANGE	RESOLUTION	ACCURACY
FREQUENCY	0.5, 1, 2, 5, 10, 15, 20, 25, 30, 40, 50, 60, 75, 80, 100, 120, 150, 200, 240, 300, 400, 480, 600, 800, 1200, 1600, 2400, 4800 Hz	0.01Hz	0.005% +2
DUTY CYCLE[2] [4]	0.39% – 99.60%	0.390625%	0.4% of full scale[3]
PULSE WIDTH[2][4]	1/Frequency	Range/256	0.2 ms + Range/256
AMPLITUDE	Fixed 0 to +2.8 V	0.1 V	0.2 V

[1] Output impedance: 3.5 kΩ maximum.

[2] The positive or negative pulse width must be greater than 50 µs for adjusting the duty cycle or the pulse width under different frequencies. Otherwise the accuracy and the range will be different from the definition.

[3] For signal frequencies greater than 1 kHz, add 0.1% per kHz to the accuracy.

[4] The accuracy for duty cycle and pulse width is based on a 5 V square wave input without dividing signal.

Operating Specifications

Measuring rate

Table 7-5 Measuring rate

Function	Times/second
ACV	7
ACV + dB	7
DCV	7
ACV	7
AC + DC V	2
Ω/nS	14
Diode	14
Capacitance	4 (< 100 µF)
DCI	7
ACI	7
AC + DC I	2
Temperature	6
Frequency	1 (>10 Hz)
Duty cycle	0.5 (>10 Hz)
Pulse width	0.5 (>10 Hz)

Input Impedance

Table 7-6 Input impedance

Function	Range	Input Impedance
DC Voltage[1]	50.000 mV	10.00 MΩ
	500.00 mV	10.00 MΩ
	1000.0 mV	10.00 MΩ
	5.0000 V	11.10 MΩ
	50.000 V	10.10 MΩ
	500.00 V	10.01 MΩ
	1000.0 V	10.001 MΩ
AC Voltage[2]	50.000 mV	10.00 MΩ
	500.00 mV	10.00 MΩ
	1000.0 mV	10.00 MΩ
	5.0000 V	10.00 MΩ
	50.000 V	10.00 MΩ
	500.00 V	10.00 MΩ
	1000.0 V	10.00 MΩ
AC + DC Voltage[2]	50.000 mV	10.00 MΩ
	500.00 mV	10.00 MΩ
	1000.0 mV	10.00 MΩ
	5.0000 V	11.10 MΩ || 10 MΩ
	50.000 V	10.10 MΩ || 10 MΩ
	500.00 V	10.01 MΩ || 10 MΩ
	1000.0 V	10.001 MΩ || 10 MΩ

[1] For 5 V to 1000 V range, the specified input impedance in parallel with 10 MΩ at dual display.

[2] The specified input impedance (nominal) in parallel with <100 pF.

General Specifications

Display
- Both primary and secondary displays are 5-digit liquid crystal display (LCD) with maximum reading of 50,000 counts. Automatic polarity indication.

Power Consumption
- 105 mVA / 420 mVA (with backlit) maximum (U1251B)
- 165 mVA / 480 mVA (with backlit) maximum (U1252B)

Operating Environment
- Full accuracy at –20 °C to 55 °C
- Full accuracy to 80 % RH for temperature up to 35 °C, decreasing linearly to 50 % RH at 55 °C

Altitude:
- 0 - 2000 meters per IEC 61010-1 2nd Edition CAT III, 1000 V/CAT IV, 600 V

Storage Compliance
- – 40 °C to 70 °C, with battery removed

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

EMC Compliance
- Certified to IEC61326-1:2005 / EN61326-1:2006
- CISPR 11:2003 / EN 55011:2007 Group 1 Class A
- Canada: ICES-001:2004
- Australia/New Zealand: AS/NZS CISPR11:2004

Common Mode Rejection Ratio (CMRR)
- > 90 dB at DC, 50/60 Hz + 0.1 % (1 kΩ unbalanced)

Normal Mode Rejection Ratio (NMRR)
- > 60 dB at DC, 50/60 Hz + 0.1 %

Temperature Coefficient
- 0.15 * (specified accuracy)/ °C (from -20 °C to 18 °C or 28 °C to 55 °C)

Shock and Vibration
- Tested to IEC/EN 60068-2

Dimension (HxWxD)
- 203.5 mm x 94.4 mm x 59.0 mm

Weight
- 504±5 grams with battery (U1251B)
- 527±5 grams with battery (U1252B)

Charging Time (only U1252)
- < 220 minutes approx. at the environment of 10 °C to 30 °C.

Warranty

- 3 years for main unit
- 3 months for standard accessories unless otherwise specified

7 Specifications

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Contact us

To obtain service, warranty or technical support assistance, contact us at the following phone numbers:

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