

LCR HiTESTER 3532-50

Component measuring instruments



Shorten line tact time via high speed measuring power

Versatile LCR meters with 5 ms measurement capabilities

The LCR HiTESTER 3532-50 features variable measurement frequencies over broad ranges.

The 3532-50 can provide 42 Hz to 5 MHz, for measurements with precise $\pm 0.08\%$ basic accuracy. With this high performance, along with its ease of use, broad set of functions and low price, this LCR measurement instrument achieves outstanding cost performance.

The 3532-50 is especially suitable for laboratory applications such as for evaluating operating characteristics, and with its 5 ms fastest response, versatile interface options and comparator functions, this instrument is also ideal for a broad range of production line applications.

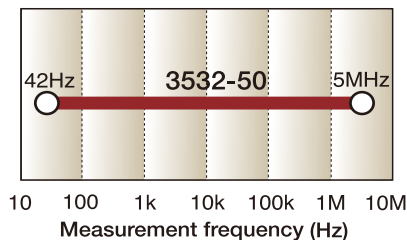
Covering Wide Frequency Range : 42 Hz to 5 MHz



3532-50 Features

■ Higher frequency range

The measurement frequency can be freely set to any value in the 42 Hz to 5 MHz range. In particular this makes it easy to test sample characteristics in the high frequency range.



■ High resolution and high accuracy

The measurement resolution provides a full five digits, with a basic measurement accuracy is $\pm 0.08\%$.

■ Fastest measurement time 5 ms

Four sampling rates can be selected: FAST, NORMAL, SLOW, and SLOW2. The most rapid measurement time of 5 ms (displaying $|Z|$) gives rapid sampling for improved production line efficiency.

(The measurement frequency range varies from one parameter to another.)

■ Fourteen parameters measured

The following parameters can be measured, and selected parameters can be captured by a computer: $|Z|$, $|Y|$, θ , R_p (DCR*), R_s (ESR, DCR*), G , X , B , L_p , L_s , C_p , C_s , D ($\tan \delta$), and Q .

■ Interactive touch panel operation

Operation is extremely simple: touch the item on the screen to be changed, and the possible settings appear in sequence. The neat and simple front panel eliminates all key switches, for a clutter-free design.

■ Wide setting range for measurement voltage and current

In addition to normal open-loop signal generation, the 3532-50 provides for voltage/current dependent evaluation, in constant voltage and constant current modes. The signal levels can be set over wide ranges, from 10 mV to 5 Vrms, and from 10 μ A to 100 mA (up to 1 MHz).

■ Simultaneous setting and measurement

Measurement frequency, measurement signal level, and other measurement conditions can be changed while monitoring the measurement results, enabling effective trial measurements and setting of evaluation conditions.

■ Memory for thirty sets of measurement conditions

Up to thirty sets of measurement conditions, including comparator values, provide rapid response to constantly changing components on flexible production lines. With multiple measurement conditions in memory, up to five different measurements can be made sequentially. The comparator function lets a single unit provide the logical AND result for this sequence of tests.

■ Four simultaneous measurement items

Any four of the fourteen parameters can be chosen for simultaneous measurement and display.

■ Enlarged display function

Up to four parameters can be displayed enlarged, for easy observation of the measurement values in production line and other situations where the unit is read at a distance.

■ Correlation correction function

The constants a and b can be set in the following correction function expression:

$$\text{Corrected value} = a \times \text{measurement value} + b$$

■ Printer output

With the optional PRINTER 9442, measurement values, comparator results, and screen printouts can be obtained.

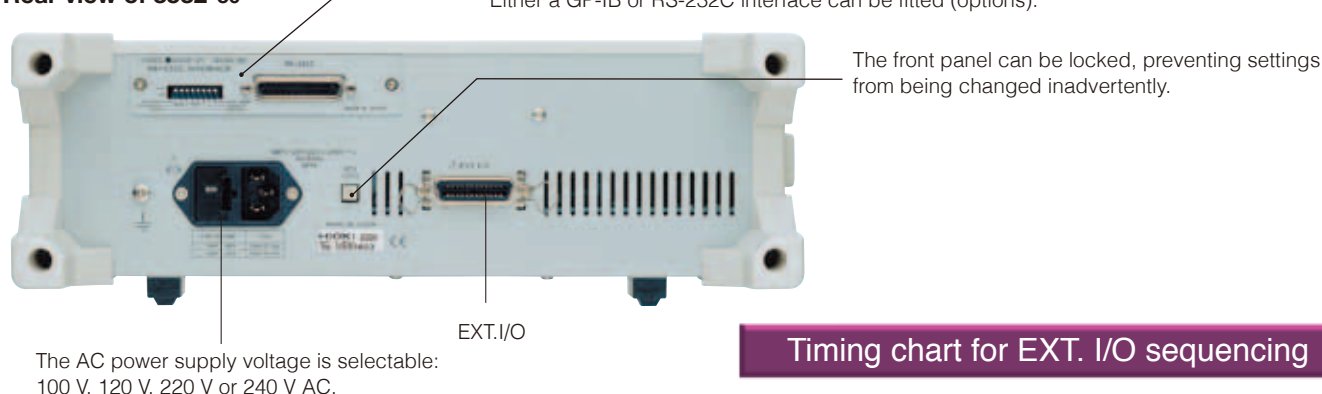
■ DC bias measurement

Using the optional DC BIAS UNIT 9268 (max. DC ± 40 V) or DC BIAS UNIT 9269 (max. DC ± 2 A), voltage and current bias measurements are simple.

External I/O interface

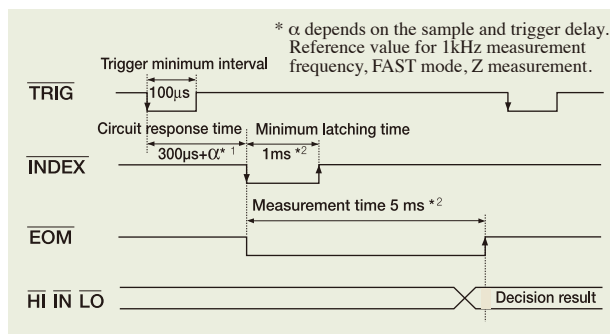
The EXT. I/O connector can input trigger signals, and provides a key lock on/off function, and remote control of the measurement condition loading. Output signals include comparator results and measurement completed signals, for complete line automation.

Rear view of 3532-50



Timing chart for EXT. I/O sequencing

The following chart shows the timing sequence of the trigger (TRIG), analog measurement completion (INDEX), and end-of-measurement (EOM) signals from the EXT. I/O connector.



EXT. I/O signals	
● Outputs	
• Internal DC power (+5 V output)	
• Comparator result	
• Analog measurement in progress	
• End-of-measurement	
● Inputs	
• External DC power supply (+5 V to +24 V can be supplied by external device)	
• External trigger signal	
• Key lock on/off function	
• Memory setting selection	

3532-50 specifications

	3532-50
Measurement parameters	$ Z $, $ Y $, θ , R_p , R_s (ESR), G , X , B , C_p , C_s , L_p , L_s , D ($\tan \delta$), Q
Measurement ranges $ Z $, R , X	10.00 m Ω to 200.00 M Ω (depending on measurement frequency and signal levels)
θ	-180.00° to +180.00°
C	0.3200 pF to 370.00 mF
L	16.000 nH to 750.00 kH
D	0.00001 to 9.99999
Q	0.01 to 999.99
$ Y $, G , B	5.0000 nS to 99.999 S
Basic accuracy	Z : $\pm 0.08\%$ rdg. θ : $\pm 0.05^\circ$
Measurement frequency	42 Hz to 5 MHz
Measurement signal levels	10 mV to 5 V rms / 10 μ A to 100 mA rms
Output impedance	50 Ω
Display screen	LCD with backlight / 99999 (full 5 digits)
Measurement time (typical values for displaying $ Z $)	FAST: 5 ms, NORMAL: 21 ms, SLOW 1 / 2: 72 ms / 140 ms
Settings in memory	Maximum 30 sets
Comparator functions	HI/IN/LO settings for two measurement parameters; percentage, $\Delta\%$, or absolute value settings
DC bias	External DC bias ± 40 V max.(option) (3522-50 used alone ± 10 V max./ using 9268 ± 40 V max.)
External printer	PRINTER 9442 (option)
External interfaces	GP-IB or RS-232C (selectable options), external I/O for sequencer use
Power source	100, 120, 220 or 240 V($\pm 10\%$) AC (selectable), 50/60 Hz
Maximum rated power	50 VA approx.

Measurement : All parameter ranges are determined by the $|Z|$ range.
ranges 100 m Ω , 1 Ω , 10 Ω , 100 Ω , 1 k Ω , 10 k Ω , 100 k Ω , 1 M Ω , 10 M Ω , 100 M Ω

Measurement frequency : 42 Hz to 5 MHz ($\pm 0.005\%$)
Up to 1 kHz (0.1 Hz steps); 1 kHz to 10 kHz (1 Hz); 10 kHz to 100 kHz (10 Hz); 100 kHz to 1 MHz (100 Hz); 1 MHz to 5 MHz (1 kHz)

Measurement levels :
[Voltage and constant voltage]
10 mV to 5 V rms (DC to 1 MHz)
50 mV to 1 V rms (1 MHz to 5 MHz)
Maximum short-circuit current 100 mA rms
1 mV steps

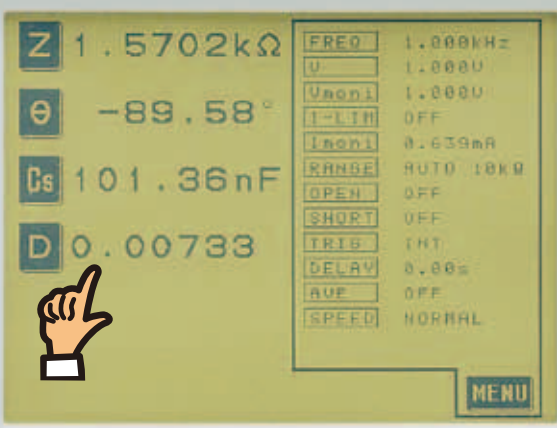
[Constant current]
10 μ A to 100 mA rms (DC to 1 MHz)
50 μ A to 20 mA rms (1 MHz to 5 MHz)
Maximum voltage 5 V rms
10 μ A rms steps

Dimensions and mass : 348W \times 113H \times 273D mm; 5.7 kg approx.
(13.86"W \times 4.48"H \times 10.75"D ; 229.68 oz. approx.)

Conforming standards :
EMC EN61326
EN61000-3-2
EN61000-3-3
Safety EN61010
Power supply: Pollution degree 2 Overvoltage Category II
(anticipated transient overvoltage 2500 V)
Test terminals; Pollution degree 2 Overvoltage Category I
(anticipated transient overvoltage 330 V)

Changing Settings During Measurement

Test conditions can now come closer to a component's operating conditions



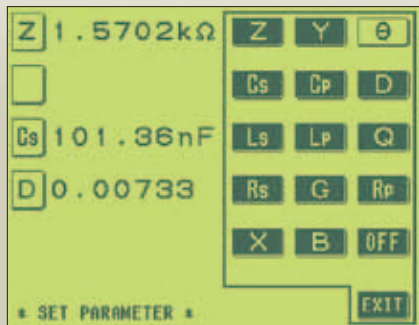
Simple touch panel operation

Setting and changing the test conditions have never been simpler with this intuitive touch panel. The keys which are active appear in reverse video, and a touch of the item or value to be changed is enough. Moreover, the setting screens also show the measurement values in real time, allowing flexible monitoring while changing test signal settings. The screen also provides an enlarged display for any four parameters, for increased visibility at a distance on production lines.

Initial screen
Shows measurement values for any selected four parameters, and current settings of conditions.

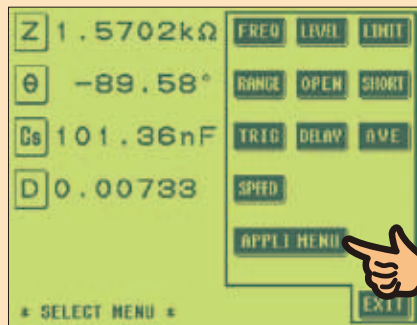
Parameter setting screen

Select any four of the parameters for display.



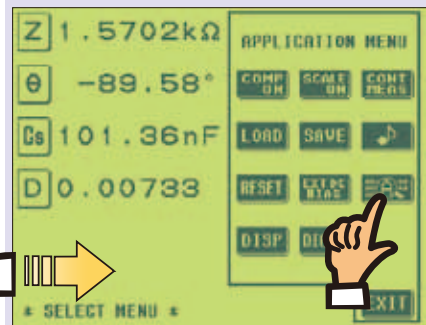
Menu screen

Select an item, and switch to the corresponding setting screen.



Application menu

Save and load measurement conditions, and set comparator execution, enlarged display, and so on.

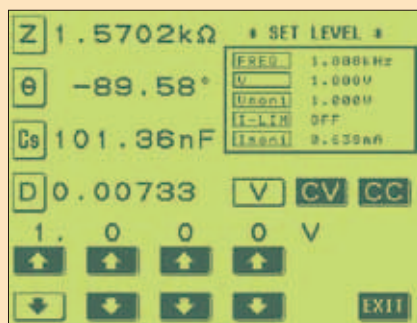


Measurement frequency

Use the numeric keypad or digit keys to enter the setting values, changing the test frequency or level while monitoring the measurement. The level setting can be open-circuit voltage, constant voltage, or constant current.

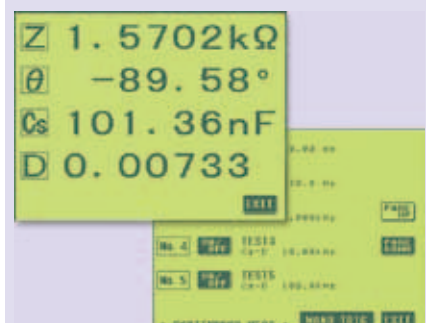


Level setting screens



Enlarged display and comparator setting screens

Set the enlarged display or select the settings saved in memory to execute continuous measurement.

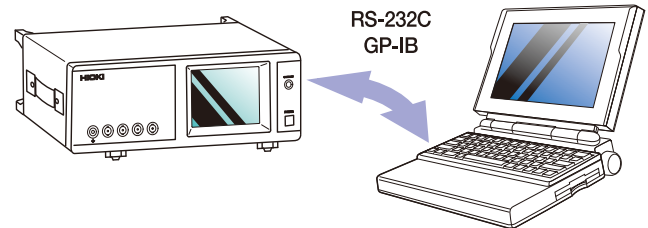


Personal computer link

Effective Analysis and Processing of Measurement Data

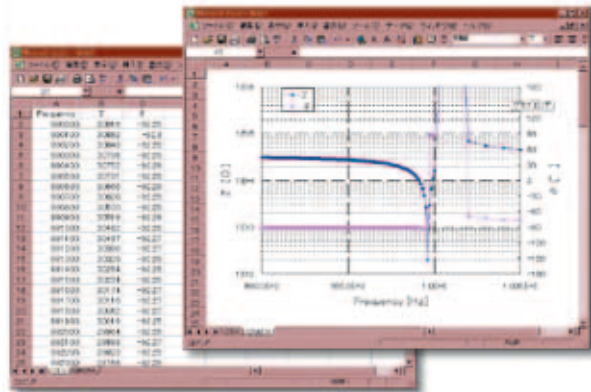
External control by computer

By installing the optional RS-232C INTERFACE 9593-01 or GP-IB INTERFACE 9518-01, all of the 3532-50 functions other than power on/off can be controlled from a computer.



Graphing with a spreadsheet program

Measurement data captured by a personal computer can be displayed graphically by using standard spreadsheet software. The example below uses the provision for continuously varying frequency to capture the frequency characteristics for a 1 MHz quartz oscillator measured with the 3532-50 into Excel, then presents the results graphically. The four-digit resolution for the frequency allows the characteristics of the steep resonance peak to be shown on the graph.



Similar to the main unit, you can also select up to 4 items to monitor. Data for the selected items will be filed.

Items such as the sweep frequency and data output directory can be set. In addition, the unit can also be set to output data whenever the return key is hit.

By utilizing the RS-232C interface, sample freeware that will enable measurement data to be output onto an Excel spreadsheet while the measured frequency is being swept is also available. Please inquire with your local HIOKI distributor.

■ RS-232C INTERFACE 9593-01 specification

Transmission method : Start-stop asynchronous
Transmission rates : 2,400/4,800/9,600 and 19,200 baud
Data bits : 7 or 8
Parity : Odd, even or none
Stop bits : 1 or 2

Delimiter : CR+LF, CR
Flow control : Hardware (According to DIP switch setting)
Connection : D-sub 25-pin, male/male connector, reverse connection

■ PRINTER 9442



The optional PRINTER 9442 allows measurement results and screen copies to be printed. This is convenient for permanent records of inspections and so forth.

(Connection requires the optional RS-232C INTERFACE 9593-01, CONNECTION CABLE 9446, and AC ADAPTER.)

Resulting measurement data can be output not only to a printer, but also other media such as a PC or sequencer. Using the RS-232C interface makes transferring the inspection data simple and convenient.

Example Print-out

```
Cs 984.16n F    D 0.00017
Cs 984.14n F    D 0.00017
Cs 984.10n F    D 0.00017
Cs 984.20n F    D 0.00034
```

```
Cs 983.91n F    LO D 0.00052    HI
Cs 983.89n F    LO D 0.00034    LO
Cs 984.03n F    IN D 0.00017    LO
Cs 983.89n F    LO D 0.00052    HI
Cs 983.95n F    LO D 0.00034    IN
Cs 983.95n F    LO D 0.00052    HI
```



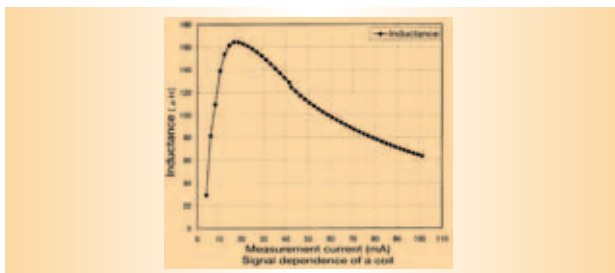
Applications

■ Evaluation of signal-dependent components

Since any test signal can be selected, it is possible to measure the inductance of winding, floating capacitance, characteristics at operating frequency, and low frequency resistance components.

Example of measuring signal dependence of coils

For chokes, transformers, and other components with an inductive core, the values depend on the measurement signal. By varying the measurement current, measurements showing the signal dependence of the coil can be shown as a graph.



The 3532-50 provides three modes for selecting the measurement signal according to the component characteristics: open-circuit voltage (V), constant voltage (CV), or constant current (CC).

V mode : set V_0

CV mode : set V_0 so that the voltage across the component is the CV value (V_{cv})

CC mode : set V_0 so that the current through the component is the CC value (I_{cc})

V_m : voltage monitor value

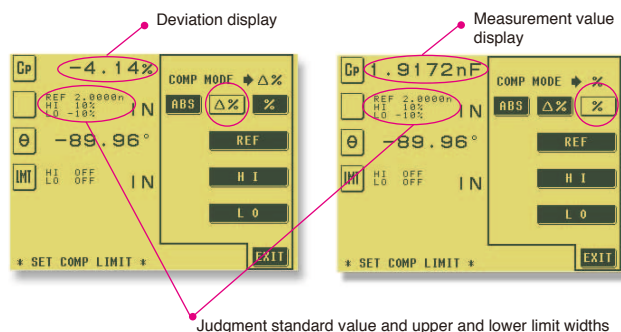
I_m : current monitor value

R_0 : output impedance (50 Ω constant)

Flexible Measurement Signals Widen Scope for Application



Comparator setting screen with additional $\Delta\%$ display



The screen at left shows an example of the $\Delta\%$ setting; The screen at right shows an example of the $\%$ setting from current models. In either, the judgement range is a percentage of the reference values. The $\Delta\%$ display is easy to interpret because the measurement value is displayed as a deviation.

V mode

$$\begin{aligned} I_m &= \frac{V_0}{|R_0 + Z|} \\ V_m &= \frac{|Z|}{|R_0 + Z|} V_0 \end{aligned}$$

CV mode

$$\begin{aligned} I_m &= \frac{V_{cv}}{|Z|} \\ V_m &= V_{cv} \end{aligned}$$

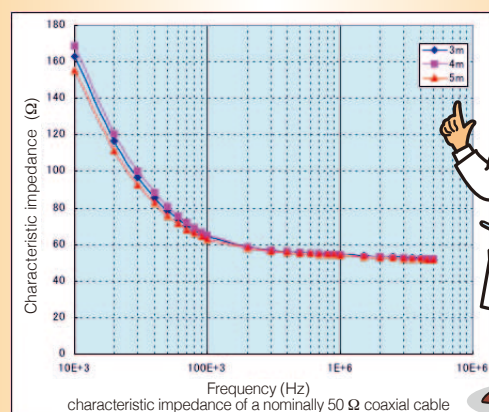
CC mode

$$\begin{aligned} I_m &= I_{cc} \\ V_m &= I_{cc} \times |Z| \end{aligned}$$

Pass-fail judgment of cables by characteristic impedance

To ensure reliable connections and communications, characteristic impedance and inter-conductor capacitance are typically specified for interfaces and cable connectors used to interconnect high frequency instruments. The 3532-50 supports pass-fail judgment of such cables and connectors intended for communications and interfaces.

The graph at the right shows actual measurement results of the characteristic impedance of a nominally 50 Ω coaxial cable.



Measurement accuracy and ranges *

Conditions : temperature range 23 °C ±5 °C (73 °F ±9 °F), 80% rh or less (no condensation)

After a 60-minute warm-up period, and open-circuit and short-circuit corrections are made.

Using the TEST FIXTURE 9262, and measurement signal level: 0.501 V to 1.000 V; measurement speed SLOW2.

* Measurement ranges and accuracy depend on the test fixture used, the measurement signal levels, and the measurement speed.

3532-50 Accuracy

Range	Impedance	42 to 99.99 Hz	100.0 Hz to 1.000 kHz	1.001 to 10.00 kHz	10.01 to 100.0 kHz	100.1 k to 1.000 MHz	1.001 to 5 MHz
100 MΩ	200 MΩ 10 MΩ	A=4 B=4 A=2.5 B=2	A=2 B=2 A=1 B=1.5				
10 MΩ	10 MΩ 1 MΩ	A=0.8 B=0.4 A=1 B=0.2	A=0.4 B=0.2 A=0.25 B=0.1		A=1 B=0.5 A=1 B=0.5		
1 MΩ	1 MΩ 100 kΩ	A=0.4 B=0.05 A=0.3 B=0.1	A=0.15 B=0.05 A=0.15 B=0.02		A=0.3 B=0.08 A=0.3 B=0.08	A=3 B=1 A=3 B=0.5	
100 kΩ	100 kΩ 10 kΩ	A=0.35 B=0.01 A=0.25 B=0.01	A=0.08 B=0.01 A=0.05 B=0.01	A=0.15 B=0.01 A=0.08 B=0.01	A=0.25 B=0.04 A=0.15 B=0.02	A=0.4 B=0.3 A=0.3 B=0.3	* A=2 B=0.5 A=2 B=0.3
10 kΩ	10 kΩ 1 kΩ	A=0.35 B=0.01	A=0.08 B=0.01		A=0.2 B=0.02	A=0.3 B=0.03	* A=1.5 B=0.2
1 kΩ	1 kΩ 100 Ω	A=0.25 B=0.005	A=0.05 B=0.005		A=0.08 B=0.02	A=0.15 B=0.02	A=1 B=0.2
100 Ω	100 Ω 10 Ω	A=0.35 B=0.02 A=0.25 B=0.01	A=0.08 B=0.02 A=0.05 B=0.01		A=0.2 B=0.02 A=0.08 B=0.02	A=0.3 B=0.03 A=0.15 B=0.02	* A=1.5 B=0.2 A=1 B=0.2
10 Ω	10 Ω 1 Ω	A=0.4 B=0.04 A=0.3 B=0.1	A=0.2 B=0.03 A=0.1 B=0.02		A=0.2 B=0.03 A=0.15 B=0.02	A=0.4 B=0.1 A=0.3 B=0.05	* A=2 B=1 A=2 B=0.5
1 Ω	1 Ω 100 mΩ	A=0.7 B=0.4 A=1 B=0.2		A=0.4 B=0.3 A=0.25 B=0.2		A=1 B=1 A=0.7 B=0.5	*1.001 MHz and above accuracy × $\frac{(f [MHz]+3)}{4}$
100 mΩ	100 mΩ 10 mΩ	A=4 B=4 A=2.5 B=2		A=3 B=2 A=2 B=1			

The expression for calculating accuracy is different in the ranges above 1 kΩ and below 100 Ω.

For details refer to the following expressions.

Range 1 kΩ and above...

$$\text{Accuracy} = A + \frac{B \times 10 \times Z_x - \text{range } 1}{\text{Range}}$$

Range 100 Ω and below...

$$\text{Accuracy} = A + \frac{B \times \text{range} - Z_x \times 10}{\text{Range}}$$

Z_x is the measured impedance of the sample (|Z|).

Upper figure A .. basic accuracy for |Z| (± % rdg.)
B is coefficient for sample impedance

Lower figure A .. basic accuracy for θ (± deg.)
B is coefficient for sample impedance

Method of determining accuracy

- The measurement accuracy can be calculated from the impedance of the sample, the measurement range, the measurement frequency, and the basic accuracy A and coefficient B from the above tables.
- The expression for calculating accuracy is different in the ranges above 1 kΩ and below 100 Ω.
- For C and L, find the basic accuracy A and coefficient B either by direct measurement of the impedance or by approximate calculation as follows.

$$|Z_x (\Omega)| \cong \omega L (H) (\theta \cong 90^\circ)$$

$$\cong \frac{1}{\omega C (F)} (\theta \cong -90^\circ)$$

$$\cong R (\Omega) (\theta \cong 0^\circ)$$

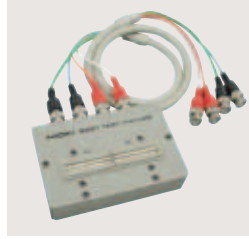
Options for a wide range of applications



FOUR-TERMINAL PROBE 9140
DC to 100 kHz



PINCHER PROBE 9143
DC to 5 MHz



TEST FIXTURE 9261
DC to 5 MHz



TEST FIXTURE 9262
DC to 5 MHz



SMD TEST FIXTURE 9263
DC to 5 MHz

* All cable lengths are 1 m (39.37").

Measurable object size: 1.0 to 10 mm



DC BIAS VOLTAGE UNIT 9268
Maximum applied voltage: ± 40 V DC
42 Hz to 5 MHz

DC BIAS VOLTAGE UNIT 9268-01
for HDMI
Maximum applied voltage: ± 4 V DC
42 Hz to 5 MHz

DC BIAS CURRENT UNIT 9269
Maximum applied current: ± 2 A DC
42 Hz to 100 kHz

Bias unit attached



PRINTER 9442



●Printing method Recording width:
Thermal serial dot printer/112 mm (4.41")
●Printing speed: 52.5 cps ●Power supply:
AC ADAPTER 9443 or supplied nickel-
hydrogen battery pack (prints 3000 lines on
full charge from 9443) ●Dimensions and
masst: 160W × 66.5H × 170D mm; 580 g
apprpx. (6.30"W × 2.62"H × 6.70"D; 20.46
oz. apprpx.)

* Connecting the PRINTER 9442 requires the optional RS-232C
INTERFACE 9593-01, CONNECTION CABLE 9446, and AC ADAPTER.

LCR HiTESTER 3532-50

(Standard accessories: power cord, spare power fuse (1 A for 100/120 V
rating, 0.5 A for 220/240 V rating))

**Test fixtures are not supplied with the unit.
Select an optional test fixture when ordering.**

■ Optional accessories

FOUR-TERMINAL PROBE 9140
PINCHER PROBE 9143
TEST FIXTURE 9261
TEST FIXTURE 9262 (direct connection type)
SMD TEST FIXTURE 9263 (direct connection type)
DC BIAS VOLTAGE UNIT 9268
DC BIAS VOLTAGE UNIT 9268-01 (for HDMI)
DC BIAS CURRENT UNIT 9269

CONNECTION CORD 9165 (for 9268/9269; BNC to BNC; 1.5 m/59.06")
CONNECTION CORD 9166 (for 9268/9269; BNC to clips; 1.5 m/59.06")
RS-232C INTERFACE 9593-01 *Not CE marked
GP-IB INTERFACE 9518-01
GP-IB CONNECTION CABLE 9151-02 (2 m/78.74")
PRINTER 9442
CONNECTION CABLE 9446 (for 9442)
RECORDING PAPER 1196 (for 9442 / 25 m/984.25", 10 rolls)
AC ADAPTER 9443-01 (for 9442, Japan)
AC ADAPTER 9443-02 (for 9442, EU)



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