HIOKI

# 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 ±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.

CE

ISO 9001 JMI-0216

ISO14001 JQA-E-90091

INTERNET HIOKI Website

www.hioki.com

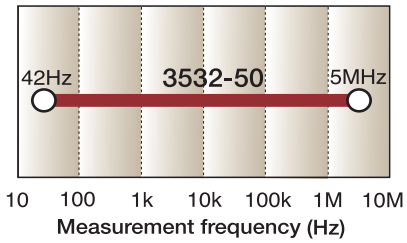
HIOKI company overview, new products, environmental considerations and other information are available on our website.

# 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 ± 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, Rp (DCR*), Rs (ESR, DCR*), G, X, B, Lp, Ls, Cp, Cs, D (tan δ), 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 μA 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:

**Corrected value = a × measurement value + b**

### ■ Printer output

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

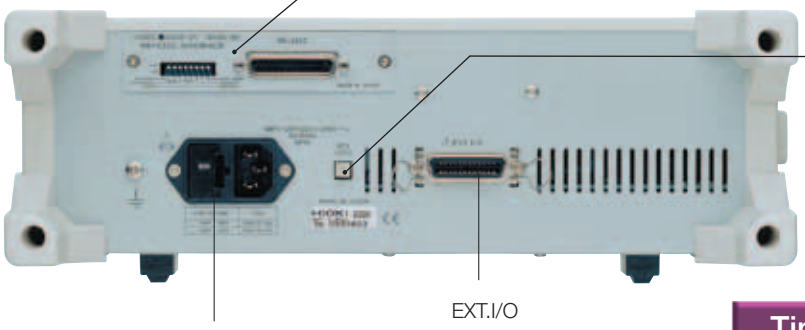
### ■ DC bias measurement

Using the optional **DC BIAS UNIT 9268** (max. DC ±40V) or **DC BIAS UNIT 9269** (max. DC ±2A) , 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**



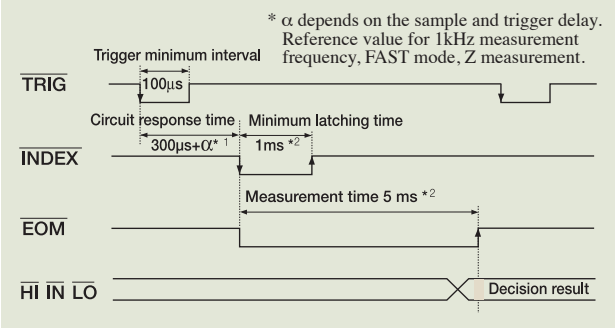

### EXT. I/O signals

● 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

## 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.




## ■ 3532-50 specifications

| | 3532-50 |
|---|---|
| Measurement parameters | \|Z\|, \|Y\|, θ, Rp, Rs (ESR), G, X, B, Cp, Cs, Lp, Ls, D (tan δ), Q |
| Measurement ranges \|Z\|, R, X | 10.00 mΩ to 200.00 MΩ (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 : ± 0.08% rdg. θ : ± 0.05° |
| Measurement frequency | 42 Hz to 5 MHz |
| Measurement signal levels | 10 mV to 5 V rms / 10µA 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, Δ%, 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(±10%) AC (selectable), 50/60 Hz |
| Maximum rated power | 50 VA approx. |

**Measurement ranges :** All parameter ranges are determined by the |Z| range.
100 mΩ, 1 Ω, 10 Ω, 100 Ω, 1 kΩ, 10 kΩ, 100 kΩ, 1 MΩ, 10 MΩ, 100 MΩ

**Measurement frequency :** 42 Hz to 5 MHz (± 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); 1MHz to 5 MHz (1 kHz)

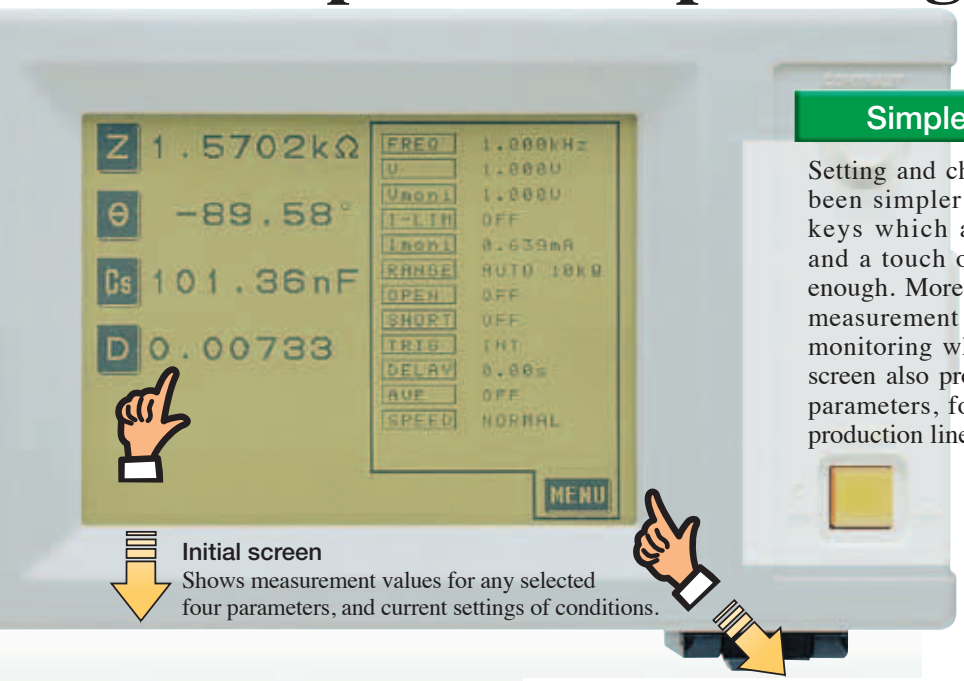
**Measurement levels :**
**[ Voltage and constant voltage ]**
10 mV to 5 V rms (DC to 1 MHz)
50 mV to 1 V rms (1 MHz to 5 MHz)
Maximum short-circuit current 100 mA rms
1 mV steps

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

**Dimensions and mass :** 348W × 113H × 273D mm; 5.7 kg approx.
(13.86"W × 4.88"H × 12.72"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

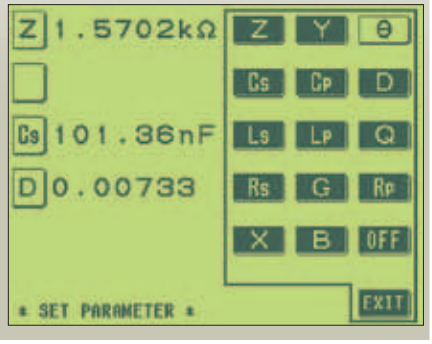



**Initial screen**
Shows measurement values for any selected four parameters, and current settings of conditions.

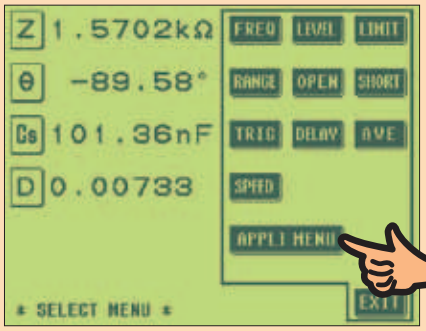
## Simple touch panel operation

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.

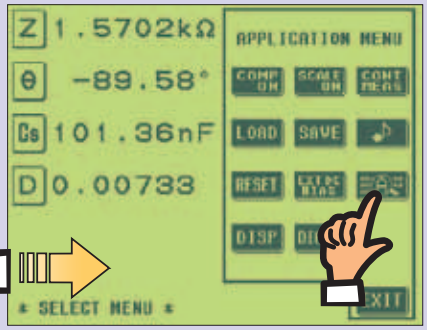
**Parameter setting screen**
Select any four of the parameters for display.




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

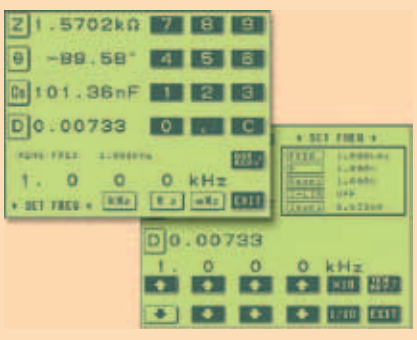



**Application menu**
Save and load measurement conditions, and set comparator execution, enlarged display, and so on.

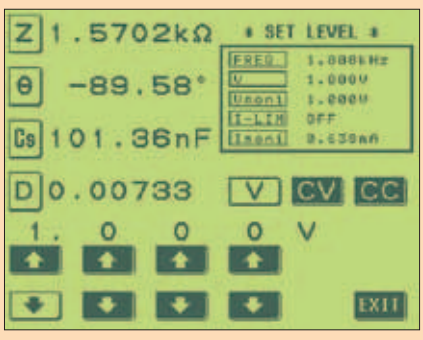



FREQ LEVEL

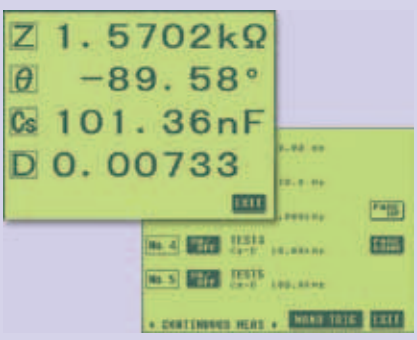
**Measurement frequency**
Use the numeric keypad or digit keys to enter the setting values, changing the test frequency or level while monitoring the measurement. The level setting can be open-circuit voltage, constant voltage, or constant current.




**Level setting screens**




**Enlarged display and comparator setting screens**
Set the enlarged display or select the settings saved in memory to execute continuous measurement.

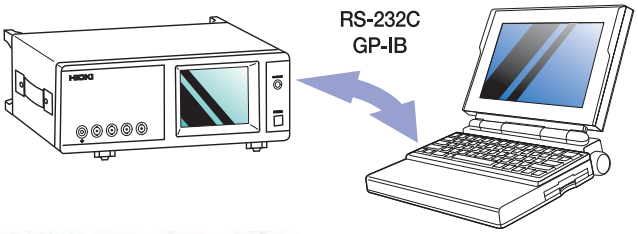


## Personal computer link

# Effective Analysis and Processing of Measurement Data

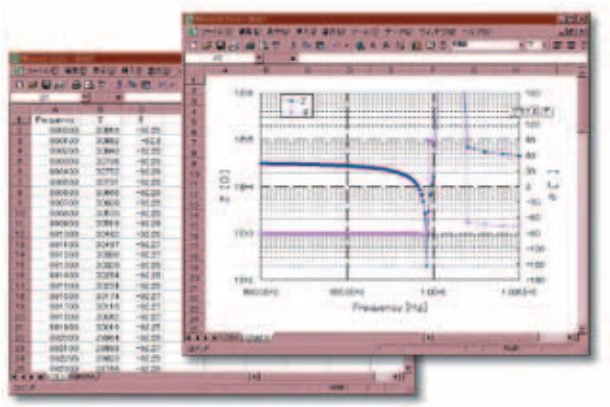
### External control by computer

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   IN
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
```

# Flexible Measurement Signals Widen Scope for Application

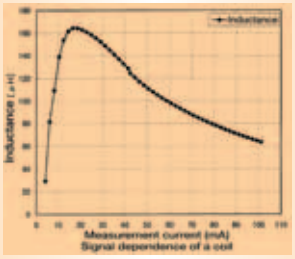
## Applications

### ■ 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.

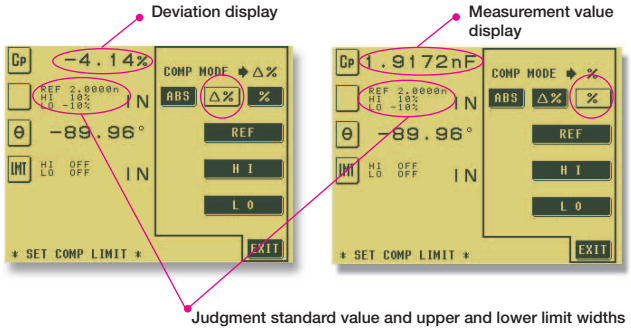



The **3532-50** provides three modes for selecting the measurement signal according to the component characteristics: open-circuit voltage (V), constant voltage (CV), or constant current (CC).

V mode : set V0
CV mode : set V0 so that the voltage across the component is the CV value (VCV)
CC mode : set V0 so that the current through the component is the CC value (ICC)
Vm : voltage monitor value
Im : current monitor value
R0 : output impedance (50 Ω constant)

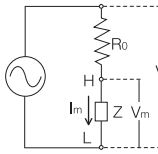



### Comparator setting screen with additional Δ% display




The screen at left shows an example of the Δ% 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 Δ% display is easy to interpret because the measurement value is displayed as a deviation.

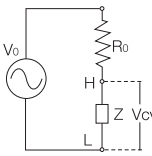
**V mode**




$$Im = \frac{V0}{|R0 + Z|}$$

$$Vm = \frac{|Z|}{|R0 + Z|} + V0$$

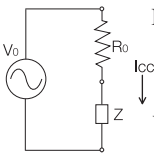
**CV mode**




$$Im = \frac{VCV}{|Z|}$$

$$Vm = VCV$$

**CC mode**

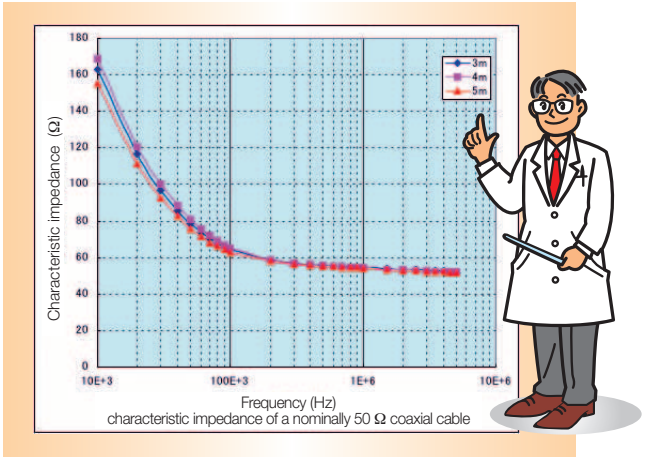



$$Im = ICC$$

$$Vm = ICC \times |Z|$$

### 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 | A=4 B=4 | A=2 B=2 | | | | |
| | 10 MΩ | A=2.5 B=2 | A=1 B=1.5 | | | | |
| 10 MΩ | 10 MΩ | A=0.8 B=0.4 | A=0.4 B=0.2 | | A=1 B=0.5 | | |
| | 1 MΩ | A=1 B=0.2 | A=0.25 B=0.1 | | A=1 B=0.5 | | |
| 1 MΩ | 1 MΩ | A=0.4 B=0.05 | A=0.15 B=0.05 | | A=0.3 B=0.08 | A=3 B=1 | |
| | 100 kΩ | A=0.3 B=0.1 | A=0.15 B=0.02 | | A=0.3 B=0.08 | A=3 B=0.5 | |
| 100 kΩ | 100 kΩ | A=0.35 B=0.01 | A=0.08 B=0.01 | A=0.15 B=0.01 | A=0.25 B=0.04 | A=0.4 B=0.3 | * A=2 B=0.5 |
| | 10 kΩ | A=0.25 B=0.01 | A=0.05 B=0.01 | A=0.08 B=0.01 | A=0.15 B=0.02 | A=0.3 B=0.3 | 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 | 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 | 100 Ω | A=0.35 B=0.02 | A=0.08 B=0.02 | | A=0.2 B=0.02 | A=0.3 B=0.03 | * A=1.5 B=0.2 |
| | 10 Ω | A=0.25 B=0.01 | A=0.05 B=0.01 | | A=0.08 B=0.02 | A=0.15 B=0.02 | A=1 B=0.2 |
| 10 Ω | 10 Ω | A=0.4 B=0.04 | A=0.2 B=0.03 | | A=0.2 B=0.03 | A=0.4 B=0.1 | * A=2 B=1 |
| | 1 Ω | A=0.3 B=0.1 | A=0.1 B=0.02 | | A=0.15 B=0.02 | A=0.3 B=0.05 | A=2 B=0.5 |
| 1Ω | 1 Ω | A=0.7 B=0.4 | A=0.4 B=0.3 | | | A=1 B=1 | |
| | 100 mΩ | A=1 B=0.2 | A=0.25 B=0.2 | | | A=0.7 B=0.5 | *1.001 MHz and above accuracy × $\frac{(f\ [MHz]+3)}{4}$ |
| 100 mΩ | 100 mΩ | A=4 B=4 | A=3 B=2 | | | | |
| | 10 mΩ | A=2.5 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...

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

Range 100 Ω and below...

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

Zx 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.

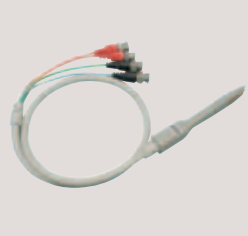
$$|Zx\ (\Omega)| \cong \omega L\ (H)\ (\theta \cong 90^\circ)$$

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

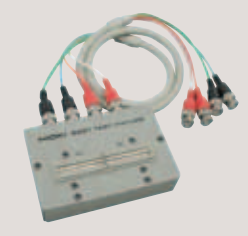
$$\cong R\ (\Omega)\ (\theta \cong 0^\circ)$$

## 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
Measurable object size: 1.0 to 10 mm

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

**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)

9443-02 (for EU)

9443-01 (for Japan)



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