CALRIGHT INSTRUMENTS
The Right Source For Your Test & Measurement Needs

2232 Verus Street Suite D San Diego CA 92154 USA
Toll Free: 866.363.6634 Tel: 619.429.4545 Fax: 619.374.7012
Email: sales@calright.com http://www.calright.com

HIOKI

3535 LCR HiTESTER

Component measuring instruments

HEAD AMP UNIT

ISO 9001 JMI-0216
ISO14001 JQA-E-90091

Measure across the broad frequency range of 100kHz to 120MHz with the new Model **3535 LCR HiTESTER**. The 6ms high-speed measurement capability is particularly useful with the built-in comparator and load functions, and for BIN (classification) measurements, to suit a wide range of applications such as chip inductor and high speed magnetic head testing, as well as other related research needs. Achieve ultimate measurement flexibility by detaching the head amp unit from the main unit and placing it in proximity to the test object so as to minimize the effect of test leads on measurements. The 3535's low price, ideal size and light weight are all achieved by incorporating an automatically balanced bridge circuit with digital control. Never before has such an advanced precision instrument coupled with economical features been placed on the test and measurement market.

Detachable Head Amp

Detach the Head Amp Unit from the 3535 and extend its reach to the measurement object using a dedicated cable so as to minimize the effect of measurement leads.

Broad Frequency Measurement Range

The measurement frequency is set with four-digit resolution from 100 kHz to 120 MHz.

6-millisecond Minimum Measurement Time

Four sampling rates can be selected: FAST, NORMAL, SLOW and SLOW2. The minimum measurement time of about 6 ms (displaying |Z|) provides rapid sampling for optimum production line efficiency.
(The measurement frequency range depends on the measured parameter type).

14 Parameter Types

The following parameters can be measured, and selected parameters can be captured using a PC. |Z|, |Y|, θ, Rp, Rs (ESR), G, X, B, Lp, Ls, Cp, Cs, D (tan δ) and Q.

Adjust for Conditions While Measuring

Measurement frequency, signal level and other conditions can be changed while monitoring measurement values, showing the effects of trial measurements and test condition settings.

Store Measurement Data

Up to 200 measurement values can be stored in the main unit. Saved values can be transferred to a computer or printed all at once.

Zoom Display

Up to four parameters can be displayed enlarged, for easy observation of the measurement values on production lines and in other situations where the display has to be monitored from a distance.

Printer Output

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

BIN (Classification) Measurement

Using up to ten classifications of two measurements, measurement values can be easily classified by rank.

Continuous Measurements

Store up to 30 sets of measurement conditions. Of multiple conditions stored in memory, up to five measurements can be made sequentially per condition saved on the screen. With the comparator function, the results of a sequence of measurements can be logically ANDed and output from a single instrument.

Load Compensation Function

A standard component can be measured to obtain a compensation amount to be applied to subsequent measurement values. This function is useful for matching measurement values between different instruments.

For Changing Production Lines

Utilize the ability to store up to 30 sets of measurement conditions, including comparator values, to provide rapid response to frequent component changes on flexible production lines.

Simultaneously Measure up to 4 Parameters

Any four of fourteen parameter types can be selected for simultaneous measurement and display.

Correlation Compensation Function

The constants a and b can be set in the following compensation function expression:
Compensation value = a× measurement value + b

Automatically Balanced Bridge Circuit with Digital Control

■ EXT I/O

Externally control triggering and loading of measurement conditions, and for automated lines, configure output signals including comparator results and end-of-measurement signals at the touch of a button.

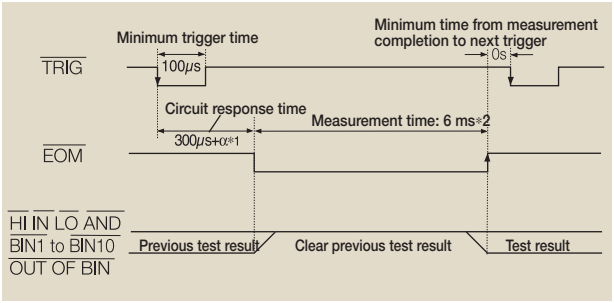
EXT I/O Signals

- Outputs
- **Internal DC Power (+5 V output)**
- **Comparator Results**
- **BIN (Classification) Measurement Results**
- **End-of-Measurement Signal**

- Inputs
- **External DC Power Supply (+5 to 24 V can be provided by an external source)**
- **External Trigger Signal**
- **Selection of Panels for Loading**

Timing Chart for EXT I/O Sequencing

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



□ 1. α depends on the component and trigger delay.
* 2. Reference value with FAST measurement speed, Averaging OFF and Z measurement selected.

External Control using a PC

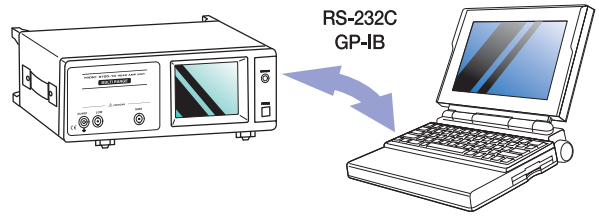
Both RS-232C and GP-IB interfaces are included for external control of all functions (except Power ON/OFF of the 3535 main unit) from a computer.

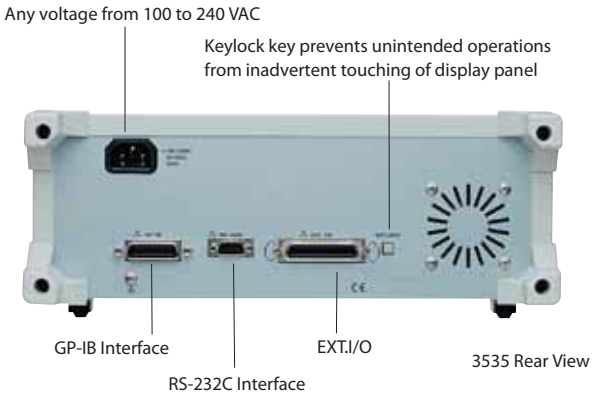
■ RS-232C Interface

Transfer Method: Communications Method:Full Duplex, Synchronization Method:Start-Stop Asynchronous
Transfer Speed: 9,600 or 19,200 bps
Data Length: 8 bits
Parity: none
Stop Bit: 1 bit
Delimiter: CR+LF or CR
Flow Control: none
Connector: 9-pin D-sub male, reverse wired

■ GP-IB Interface

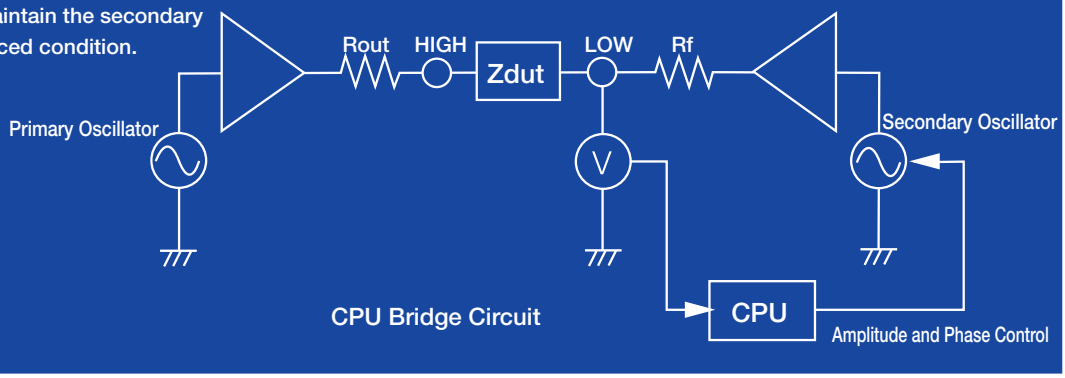
Supported Standard: IEEE-488.1 1987
IEEE-488.2 1987 common (required) commands can be used.





Measurement Principle — Automatically Balanced Bridge Circuit with Digital Control

The measurement signal is generated by a primary oscillator and applied to the component (DUT). The LOW terminal voltage is measured and used to control the phase and amplitude of a secondary oscillator so as to maintain a balanced condition (LOW terminal voltage being zero). The impedance Z and phase angle θ of the DUT are determined according to the amplitude and phase required to maintain the secondary oscillator in its balanced condition.



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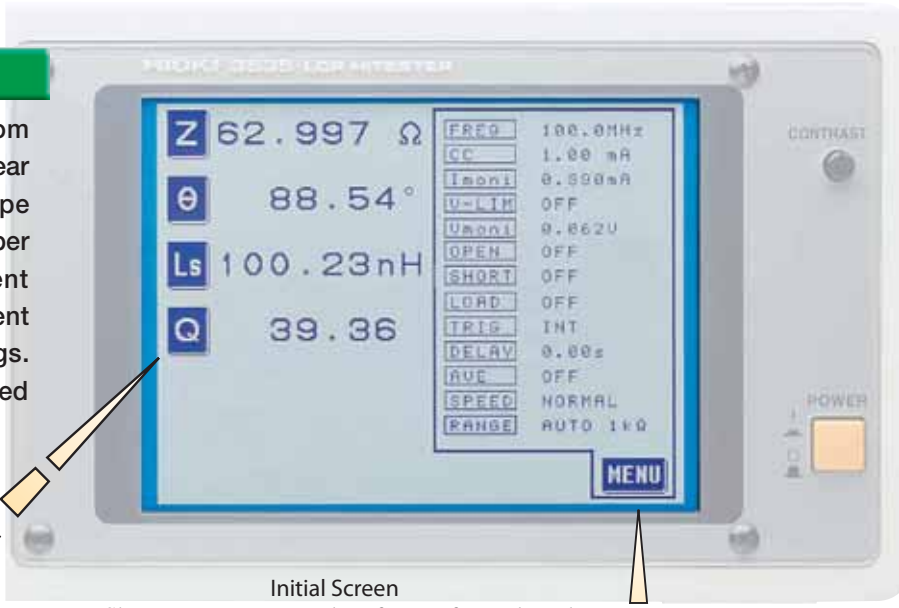
3 Changing Settings While Measuring

Simple Touch Panel Operation

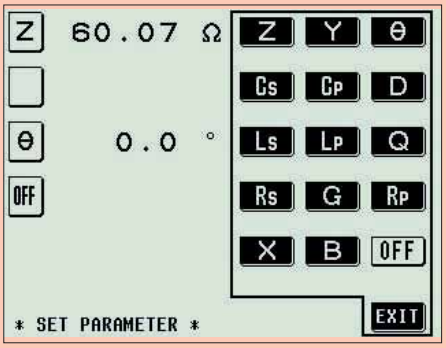
Make all measurement condition settings from the easy-to-use touch panel. Active keys appear in reverse video, providing simple, dialog-type operation by lightly touching the item or number to be set. Real-time display of measurement data on the settings screen provide convenient monitoring while changing test signal settings. Zoom display up to 4 parameters for enhanced visibility at a distance on production lines.

Note: The screens show typical examples on the 3535.

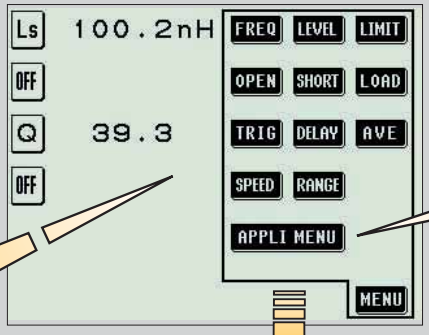


Initial Screen
Shows measurement values for any four selected parameters, and the current setting conditions.

Parameter Setting Screen
Select any four of the fourteen parameter types for display.



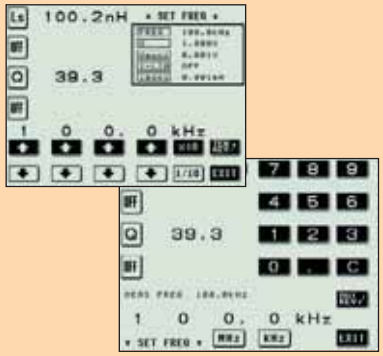
Menu Screen
Select an item to display the corresponding setting screen.

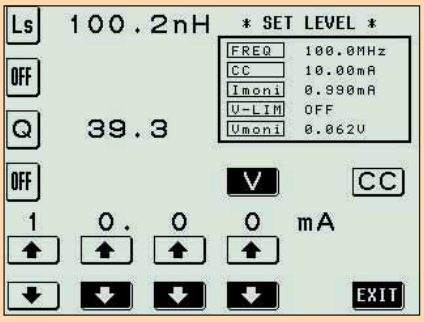


FREQ Measurement Frequency Setting Screen

LEVEL Measurement Level Setting Screen

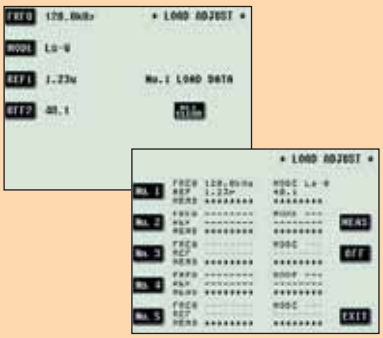
Use the numeric keypad or digit keys to enter values for changing the test frequency or level while monitoring the measurement. Choose from open-circuit voltage or constant current mode for the level setting.





LOAD Load Compensation Setting Screen

Set up five compensation constants for the function to correct measurement values.



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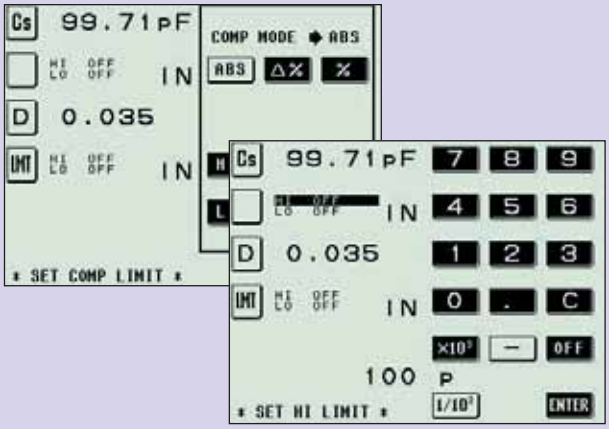
Multiple Functions for a Broad Range of Applications

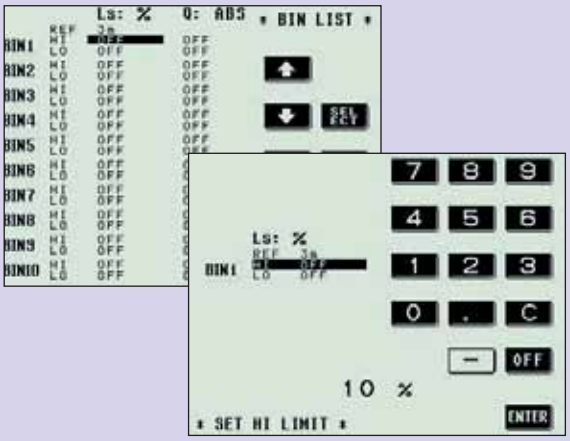
COMP ON Comparator

Compare two measurement items using the Comparator function. Input can be either the absolute value, percentage of standard value or its deviation percentage (Δ%).

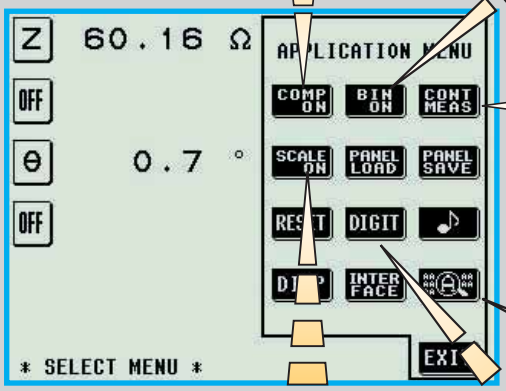


BIN ON BIN (Classification) Measurement

Classify 2 measurement items in up to 10 categories.

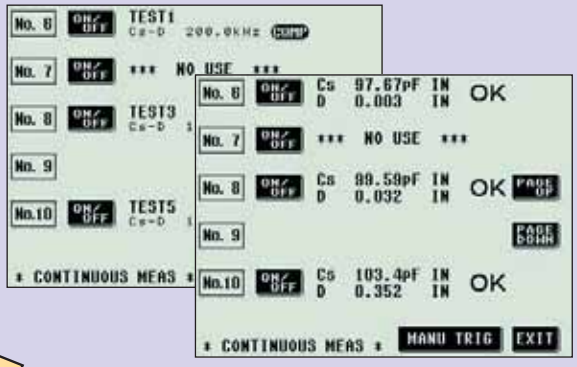


Application Setting Screen



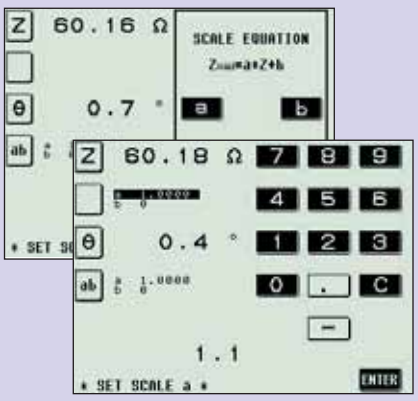
CONT MEAS Continuous Measurements

Measurement conditions saved by the Panel Save function can be used to continuously measure up to five conditions per page.



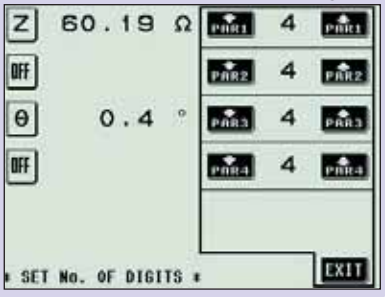
SCALE ON Scaling

Set constants a and b to apply compensation to measurement values.



DIGIT Numeric Digit Display

The number of significant digits of measured values of each parameter can be set to three, four or five digits.



Zoom Display

Enlarge the display of measurement data and comparator results.

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High Speed Testing of Chip Inductors and Magnetic Heads in Research and Development

3535 Specifications

Measurement Items	:	Z (impedance), Y (admittance), Rs (series-equivalent resistance, ESR), Rp (parallel-equivalent resistance), G (conductivity), X (reactance), B (susceptance), θ (phase angle), Ls (series-equivalent inductance), Lp (parallel-equivalent inductance), Cs (series-equivalent capacitance), Cp (parallel-equivalent capacitance), Q (Q factor), D (loss constant tanδ)
Measurement Frequency	:	Frequency Range: 100 kHz to 120 MHz Setting Resolution: Four digits (by front panel setting)* 100.0 kHz to 1.000 MHz: 100-Hz steps 1.000 MHz to 10.00 MHz: 1-kHz steps 10.00 MHz to 100.0 MHz: 10-kHz steps 100.0 MHz to 120.0 MHz: 100-kHz steps *1-Hz resolution with GP-IB or RS-232C interface Frequency Accuracy: less than ±0.005% of setting value
Output Impedance	:	50 ±10 μ(at 100 kHz)
Measurement Signal Level	:	Open-terminal voltage (V) mode Level Range: 5 mV to 1 V, 20 mA max. (up to 10.00 MHz) 5 mV to 500 mV, 10 mA max. (above 10.01 MHz) Setting Resolution: 1mV steps Setting Accuracy: ±(5% + 5 mV) × (2 + log f) where f is in MHz Constant Current (CC) mode Level Range: 200 μA to 20 mA: 1 V max. (up to 10.00 MHz) 200 μA to 10 mA: 0.5 V max. (above 10.01 MHz) Setting Resolution: 10 μA steps Setting Accuracy: ±(10% + 50 μA) × (2 + log f) where f is in MHz
Monitor Function	:	Monitor Voltage: 0.000 to 1.000 V Monitor Current: 0.000 to 20.00 mA
Limit Function	:	Current Limit (during V setting): 0.20 to 20.00 mA Voltage Limit (during CC setting): 0.005 to 1.000 V
Measurement Time	:	6 ± 1 ms (nominal) Actual time depends on measurement conditions, such as measurement speed and averaging.
Measurement Speed	:	FAST, NORMAL, SLOW and SLOW2
Average	:	OFF, 2, 4, 8, 16, 32 and 64
Trigger Function	:	Internal and external trigger sources can be selected. Trigger Delay function: 0.01 to 9.99 s with 0.01 s resolution
Load Compensation Function	:	Measure a standard component to establish a compensation value for subsequent measurements.
Key Lock Function	:	Temporarily disable touch panel operation using rear panel switch.
Comparator	:	Compares two measurement items. Input either the absolute value, percentage of standard value or its deviation percentage (Δ%). Note: for Δ%, the measurement value is displayed as the percentage of deviation from the standard value.
Classification (BIN) Measurement	:	Ranks two measurement items into ten classifications.
Correlation Compensation Function	:	Constants a and b are entered to compensate displayed values. [Compensated value] = a ×[measurement value] + b
Panel Save and Load	:	Memory Capacity: 30 Sets Load Method: Front panel key operation, External I/O connector, GP-IB, RS-232C
Measurement Value Storage	:	Memory Capacity: Up to 200 values Measurement values are stored in the main unit and transferred as a batch.
Zoom Display Function	:	Enlarge the display of measurement data and comparator results.
Continuous Measurements	:	Measurements are made continuously per conditions saved on the screen.
Audible Beeper	:	Beeping can be set ON/OFF for key entry and comparator results (IN or NG).
Numerical Display Digit Setting Function	:	Measurement values can be set to display as 3, 4 or 5 digits. Available settings depend on the parameter.
Display Setting Functions	:	Backlight and voltage/current monitor display can be set ON/OFF. Note: when the backlight is off, display refresh is disabled (during high-speed measurement).
Printer Functions	:	Hard copy printout of measurement values and screens. Note: requires 9442 and 9444
Interfaces	:	GP-IB, RS-232C and EXT I/O (standard)
Operating Temperature and Humidity	:	10 to 40°C, 80% rh or less, no condensation
Storage Temperature and Humidity	:	-10 to 55°C, 80% rh or less, no condensation
Operating Environment	:	Indoors, up to 2000 m ASL
Power	:	100 to 240 VAC, 50/60 Hz
Maximum Rated Power	:	50 VA
Dimensions and Mass	:	Approx. 360W × 130H × 360D mm, 8.3 kg
Conforming Standards	:	EMC: EN61326:1997+A1:1998+A2:2001 EN61000-3-2:2000 EN61000-3-3:1995+A1:2001 Safety: EN61010-1:2001 Pollution Degree 2

3535 LCR HITESTER

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Measurement Accuracy and Range

Accuracy is calculated using Z and θ, and other parameters are calculated from these.

Z Accuracy: calculated from the following formula

Accuracy [%] = basic accuracy × frequency constant × level constant × measurement speed constant × cable length constant × temperature constant

θ Accuracy: calculated from the following formula

Accuracy [degrees] = Z accuracy × 0.6

■ Basic Accuracy

Measurement Range	9700-10 HEAD AMP UNIT		
	1 k range	10 k range	100 k range
10 k to 300 k			A=2.00 B=0.20
1 k to 20 k		A=1.00 B=0.10	
100 to 2 k	A=0.50 B=0.10		
100 m to 100	A=0.50 B=0.10		

Upper end of range

$$\text{Basic accuracy} = A + B \times \left(\frac{Zm \times 10}{\text{range}} - 1\right)$$

Lower end of range

$$\text{Basic accuracy} = A + B \times \left(\frac{\text{range}}{Zm \times 10} - 1\right)$$

Zm = measurement value

■ Frequency Constant

log f+2 (f ≤ 10 MHz), where f is in MHz
10 × log f - 7 (f > 10 MHz), where f is in MHz

■ Cable Length Constant

1 (0m)
2 (2m, 9678)

■ Measurement Speed Constant

5 + 150/ V (FAST), where V is in mV
3 + 100/ V (NORMAL), where V is in mV
1.5 + 30/ V (SLOW), where V is in mV
1 (SLOW2)

■ Level Constant

10 - 3 × log V, where V is in mV

■ Temperature Constant

1 + 0.1 | T [°C] - 23 [°C] |

[Measurement Range: Reference Value]

	1 k range	10 k range	100 k range
Z • R*	100 to 2 k	1k to 20 k	10 k to 300 k
C*	0.66 pF to 15.9 μF	0.066 pF to 1.59 nF	4.4 fF to 159 pF
L*	0.133 nH to 3.18 mH	1.33 μH to 31.8 mH	13.3 μH to 477mH
θ	-180.00° to 180.00°		

*Ranges for R, C, and L measurement are based on the data calculated from the Z measurement range, and do not represent the guaranteed measurement ranges.

● Method of Acquiring Measurement Accuracy

Obtaining the basic accuracy of a capacitor. (Cs=100pF)

Measurement value: Z = 159.33, θ = -87.33° when measuring with the following conditions using 1 k range.

- Measurement Frequency: 10 MHz
- Measurement Speed: SLOW2
- Measurement Signal Level: 500 mV
- Cable Length: 0 m
- Temperature: 24°C

1. Acquire Z constants A and B from the basic accuracy table, and calculate the basic accuracy of Z.	From the basic accuracy table, the constants A and B are A = 0.50 and B = 0.10 Z basic accuracy = $0.50 + 0.10 \times \left(\frac{159.33 \times 10}{1000} - 1\right) = \pm 0.559\%$
2. Acquire the other constants from the measurement conditions.	Frequency constant = log(10) + 2 = 3 Level constant = 10 - 3 × log(500) ≈ 1.903 Measurement Speed constant = 1 Cable Length constant = 1 Temperature constant = 1 + 0.1 × |24 - 23| = 1.1
3. Acquire the accuracy of Z.	Z accuracy = 0.559 × 3 × 1.903 × 1 × 1 × 1.1 ≈ ±3.510%
4. Calculate the basic accuracy of θ from the basic accuracy of Z.	θ accuracy = 3.510 × 0.6 = ±2.106°
5. The range of possible values for Z and θ is acquired from the basic accuracy. The absolute value of θ is used.	Zmin = 159.33 × (1 - 3.510 / 100) ≈ 153.74 Zmax = 159.33 × (1 + 3.510 / 100) ≈ 164.92 θmin = 87.33 - 2.106 ≈ 85.224° θmax =87.33 + 2.106 ≈ 89.436°
6. The range of possible values for Cs is acquired from the range of Z and θ. X = Zsinθ, Cs = 1/ ωX	Csmin = 1 ÷ (ω × Zmax × sinθmax) ≈ 96.509 pF ...-3.491% Csmax = 1 ÷ (ω × Zmin × sinθmin) ≈ 103.883 pF ...3.883% ω = 2 × × f, where f is the measurement frequency in Hz Therefore, the basic accuracy of Cs is -3.491 to 3.883%.

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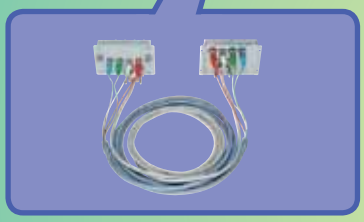
Options

Head Amp Unit must be factory adjusted for dedicated use with the 3535 before delivery.

9700-10 HEAD AMP UNIT

Measurement Range: 100 m to 300 k (3 ranges)



9678 CONNECTION CABLE

Cable Length: 2m

9677 SMD TEST FIXTURE

Operating Frequency : DC to 120 MHz
Measurable Object Size : 3.5 ±0.5 mm
Dimensions : Approx.103W × 37.1H × 47.6D mm
Mass : Approx. 135 g

*Please note that use of the 9677 with Model 3535 will NOT comply with CE mark requirements.

9699 SMD TEST FIXTURE

Operating Frequency : DC to 120 MHz
Measurable Object Size :
Width: 1.0 to 4.0mm; Height: less than 1.5mm
Dimensions : Approx.100.5W×28.6H×40.0Dmm
Mass : Approx. 125 g

9442 PRINTER

Printing Method : Thermal serial dot printer
Paper Width / Print Speed : 112 mm / 52.5 cps
Power Supply : 9443 AC Adapter or supplied NiMH battery (prints 3000 lines after full charge by 9443)
Dimensions : Approx. 160W × 66.5H × 170D mm
Mass : Approx. 580 g

Note: the 9444 Connection Cable and AC Adapter are required to connect the 9442 Printer.

3535 LCR HiTESTER

The Head Amp and Test Fixtures are not supplied with the unit.
Please order the appropriate options for your application.

• Options

9700-10 HEAD AMP UNIT
9677 SMD TEST FIXTURE
9699 SMD TEST FIXTURE
9678 CONNECTION CABLE
9637 RS-232C CABLE (9pin-9pin/cross/1.8m)
9638 RS-232C CABLE (9pin-25pin/cross/1.8m)
9151-02 GP-IB CONNECTION CABLE (2 m)
9151-04 GP-IB CONNECTION CABLE (4 m)
9442 PRINTER
9443-02 AC ADAPTER (for 9442, EU)
9443-03 AC ADAPTER (for 9442, USA)
9444 CONNECTION CABLE (for 9442)
1196 RECORDING PAPER (for 9442 / 25 m, 10 rolls)

Head Amp Unit must be factory adjusted for dedicated use with the 3535 before delivery.