

## LCR METER Series

Component measuring instruments



## From Production Lines to Research and Development A New Series of LCR Meters to Meet Your Applications

New **LCR METER** Models **IM3523**, **IM3533**, and **IM3533-01** are highly cost-effective testers that provide greater performance and better functionality than previous HIOKI models, such as a high basic accuracy of  $\pm 0.05\%$ , a wide measurement frequency from 1 mHz (40 Hz for the IM3523) to 200 kHz, high-speed measurement of up to 2 ms, highly reliable measurement using the contact-check function, and measurement of turn ratio and mutual inductance. Select the best model according to your application, from production lines to research and development.



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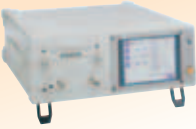


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## ■ LCR Meter Series Full Product Lineup

| Model                                       | Measurement speed<br>(Basic value)                                                  |       | Measurement capabilities/ Frequency range                                                                                                                                                                                                    |
|---------------------------------------------|-------------------------------------------------------------------------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                             |                                                                                     |       | Applications and measurement object                                                                                                                                                                                                          |
| LCR METER<br>IM3533-01                      |    | 2ms   | <p>DC 1mHz 200kHz</p> <p>High-end model of the IM3523 and IM3533 with sweep measurement<br/>For electrochemistry applications, research and development and production lines of electronic components</p>                                    |
| LCR METER<br>IM3533                         |    | 2ms   | <p>DC 1mHz 200kHz</p> <p>Capable of special measurements of transformers including turn ratio and mutual inductance<br/>Particularly useful in production lines and research and development of transformers, coils, etc.</p>                |
| LCR METER<br>IM3523                         |    | 2ms   | <p>DC 40Hz 200kHz</p> <p>Extremely cost-effective model suitable for production lines including integration into automated machinery<br/>For C-D and ESR measurement of electrolytic capacitors and L-Q and DCR measurement of inductors</p> |
| LCR HiTESTER<br>3535                        |   | 6ms   | <p>100kHz 120MHz</p> <p>High-frequency measurement at 120 MHz<br/>Ideal for production lines of ferrite beads and inductors<br/>*Requires the 9700-10 Head Amp</p>                                                                           |
| IMPEDANCE<br>ANALYZER<br>IM3570             |  | 0.5ms | <p>DC 4Hz 5MHz</p> <p>LCR meter integrated with impedance analyzer<br/>Measure the frequency characteristics of piezo-electric devices, functional polymer capacitors, and power inductors</p>                                               |
| CHEMICAL<br>IMPEDANCE<br>ANALYZER<br>IM3590 |  | 2ms   | <p>DC 1mHz 200kHz</p> <p>Supports LCR impedance measurements for Cole-Cole plots and equivalent-circuit analyses<br/>Measure electrochemical components, materials, batteries, and electric double-layer capacitors (EDLCs)</p>              |
| LCR HiTESTER<br>3532-50                     |  | 5ms   | <p>42Hz 5MHz</p> <p>General-purpose LCR meter at 5 MHz<br/>Measure electronic components such as capacitors and inductors</p>                                                                                                                |
| LCR HiTESTER<br>3511-50                     |  | 5ms   | <p>120Hz 1kHz</p> <p>Compact LCR meter with single function<br/>For production lines of aluminum electrolytic capacitors</p>                                                                                                                 |
| C METER<br>3506-10                          |  | 1.5ms | <p>1kHz 1MHz</p> <p>C meter for low-capacity capacitors<br/>Ideal for testing taping machines and sorters</p>                                                                                                                                |
| C HiTESTER<br>3504-10/50/100                |  | 2ms   | <p>120Hz 1kHz</p>                                                                                                                                                                                                                            |

# LCR METER IM3523

## Ideal for Production Lines and Automated Testing

- $\pm 0.05\%$  accuracy with wide measurement range (DCR testing, 40Hz to 200kHz, 5mV to 5V, 10uA to 50mA)
- Non-stop testing over mixed measurement conditions such as C-D and ESR at 10 times the speed of previous models
- Built-in comparator and BIN functions
- Rapid 2msec test time



Note: This product is not supplied with measurement probes or test fixtures. Please select and purchase the measurement probe or test fixture options appropriate for your application separately. All probes are constructed with a 50 $\Omega$  coaxial cable. For an RS-232C connection: A crossover cable for interconnection can be used. You can use the RS-232C CABLE 9637 without hardware flow control.

# LCR METER IM3533 IM3533-01

## From R&D Applications to Windings, Coil and Transformer Manufacturing

- $\pm 0.05\%$  accuracy with wide measurement range (DCR testing, 1mHz to 200kHz, 5mV to 5V, 10uA to 50mA)
- Non-stop testing over mixed measurement conditions such as C-D and ESR at 10 times the speed of previous models
- Built-in low impedance high precision mode effective for testing low inductance or the ESR of aluminum electrolysis capacitance (10x the measurement speed and dramatic improvements in repeatability and stability over the previous model 3522-50)
- Dedicated modes for measuring transformer winding ratio, mutual inductance and temperature compensated DCR
- Frequency sweep testing (IM3533-01 only)
- 2m/4m cable setting in addition to the standard 0m/1m (IM3533-01 only)
- Built-in comparator and BIN functions
- Rapid 2msec test time



### Basic specifications (Accuracy guaranteed for 1 year)

|                          |                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measurement modes        | LCR, Continuous testing                                                                                                                                                                                                                                                                                                                              |
| Measurement parameters   | Z, Y, $\theta$ , Rs (ESR), Rp, DCR (DC resistance), X, G, B, Cs, Cp, Ls, Lp, D (tan $\delta$ ), Q                                                                                                                                                                                                                                                    |
| Measurement range        | 100m $\Omega$ to 100M $\Omega$ , 10 ranges (All parameters defined in terms of Z.)                                                                                                                                                                                                                                                                   |
| Displayable range        | Z, Y, Rs, Rp, Rdc, X, G, B, Ls, Lp, Cs, Cp : $\pm (0.00000 [\text{unit}] \text{ to } 9.99999 [\text{unit}])$<br>Real value display for Z and Y only<br>$\theta$ : $\pm (0.000^\circ \text{ to } 999.999^\circ)$ , D: $\pm (0.00000 \text{ to } 9.99999)$<br>Q: $\pm (0.00 \text{ to } 9999.99)$ , $\Delta\%$ : $\pm (0.000\% \text{ to } 999.999\%)$ |
| Basic accuracy           | Z: $\pm 0.05\%$ rdg. $\theta$ : $\pm 0.03^\circ$                                                                                                                                                                                                                                                                                                     |
| Measurement frequency    | 40 Hz to 200 kHz (1 mHz to 10 Hz steps)                                                                                                                                                                                                                                                                                                              |
| Measurement signal level | Normal mode:<br>V mode, CV mode: 5 mV to 5 Vrms, 1 mVrms steps<br>CC mode: 10 $\mu$ A to 50 mArms, 10 $\mu$ Arms steps                                                                                                                                                                                                                               |
| Output impedance         | Normal mode: 100 $\Omega$                                                                                                                                                                                                                                                                                                                            |
| Display                  | Monochrome LCD                                                                                                                                                                                                                                                                                                                                       |
| Measurement time         | 2 ms (1kHz, FAST, representative value)                                                                                                                                                                                                                                                                                                              |
| Functions                | Comparator, Classification measurement (BIN function), Panel loading/saving, Memory function                                                                                                                                                                                                                                                         |
| Interfaces               | EXT I/O (handler), USB communication<br>Optional: Choose 1 from RS-232C, GP-IB, or LAN                                                                                                                                                                                                                                                               |
| Power supply             | 100 to 240 V AC, 50/60 Hz, 50 VA max.                                                                                                                                                                                                                                                                                                                |
| Dimensions and mass      | 260 mm (10.24 in) W $\times$ 88 mm (3.46 in) H $\times$ 203 mm (7.99 in) D<br>2.4 kg (84.7 oz)                                                                                                                                                                                                                                                       |
| Accessories              | Power cord $\times$ 1, Instruction manual $\times$ 1, CD-R (Includes PC commands and sample software) $\times$ 1                                                                                                                                                                                                                                     |

### OPTIONS

|                                                        |         |
|--------------------------------------------------------|---------|
| FOUR-TERMINAL PROBE                                    | 9500-10 |
| DC BIAS VOLTAGE UNIT                                   | 9268-10 |
| DC BIAS CURRENT UNIT                                   | 9269-10 |
| GP-IB INTERFACE                                        | Z3000   |
| RS-232C INTERFACE                                      | Z3001   |
| LAN INTERFACE                                          | Z3002   |
| FOUR-TERMINAL PROBE (DC to 5 MHz)                      | L2000   |
| FOUR-TERMINAL PROBE (DC to 200 kHz)                    | 9140-10 |
| PINCHER PROBE (cable length 1m, DC to 5 MHz)           | 9143-10 |
| TEST FIXTURE (cable length 1m, DC to 5 MHz)            | 9261-10 |
| TEST FIXTURE (direct connection type, DC to 5 MHz)     | 9262    |
| SMD TEST FIXTURE (direct connection type, DC to 5 MHz) | 9263    |
| SMD TEST FIXTURE (DC to 120 MHz)                       | 9677    |
| SMD TEST FIXTURE (DC to 120 MHz)                       | 9699    |
| GP-IB CONNECTION CABLE (2 m)                           | 9151-02 |

### Basic specifications (Accuracy guaranteed for 1 year)

|                          | IM3533                                                                                                                                                                                                                                                                                                                                                                                                | IM3533-01                                                                                                     |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Measurement modes        | LCR, Transformer testing (N, M, $\Delta$ L), Continuous testing (LCR mode)                                                                                                                                                                                                                                                                                                                            | LCR, Transformer testing (N, M, $\Delta$ L), Analyzer (sweep testing), Continuous Testing (LCR/Analyzer mode) |
| Measurement parameters   | Z, Y, $\theta$ , Rs (ESR), Rp, DCR (DC resistance), X, G, B, Cs, Cp, Ls, Lp, D (tan $\delta$ ), Q, N, M, $\Delta$ L, T                                                                                                                                                                                                                                                                                |                                                                                                               |
| Measurement range        | 100m $\Omega$ to 100M $\Omega$ , 10 ranges (All parameters defined in terms of Z.)                                                                                                                                                                                                                                                                                                                    |                                                                                                               |
| Displayable range        | Z, Y, Rs, Rp, Rdc, X, G, B, Ls, Lp, Cs, Cp : $\pm (0.00000 [\text{unit}] \text{ to } 9.99999 [\text{unit}])$ Real value display for Z and Y only<br>$\theta$ : $\pm (0.000^\circ \text{ to } 999.999^\circ)$ , D: $\pm (0.00000 \text{ to } 9.99999)$<br>Q: $\pm (0.00 \text{ to } 9999.99)$ , $\Delta\%$ : $\pm (0.000\% \text{ to } 999.999\%)$<br>T: $-10.0^\circ\text{C}$ to $99.9^\circ\text{C}$ |                                                                                                               |
| Basic accuracy           | Z: $\pm 0.05\%$ rdg. $\theta$ : $\pm 0.03^\circ$                                                                                                                                                                                                                                                                                                                                                      |                                                                                                               |
| Measurement frequency    | 1 mHz to 200 kHz (1 mHz to 10 Hz steps)                                                                                                                                                                                                                                                                                                                                                               |                                                                                                               |
| Measurement signal level | Normal mode:<br>V mode, CV mode: 5 mV to 5 Vrms, 1 mVrms steps<br>CC mode: 10 $\mu$ A to 50 mArms, 10 $\mu$ Arms steps<br>Low impedance high accuracy mode:<br>V mode, CV mode: 5 mV to 2.5 Vrms, 1 mVrms steps<br>CC mode: 10 $\mu$ A to 100 mArms, 10 $\mu$ Arms steps                                                                                                                              |                                                                                                               |
| Output impedance         | Normal mode: 100 $\Omega$ , Low impedance high accuracy mode: 25 $\Omega$                                                                                                                                                                                                                                                                                                                             |                                                                                                               |
| Display                  | 5.7-inch color TFT, display can be set to ON/OFF                                                                                                                                                                                                                                                                                                                                                      |                                                                                                               |
| Measurement time         | 2 ms (1 kHz, FAST, display OFF, representative value)                                                                                                                                                                                                                                                                                                                                                 |                                                                                                               |
| Functions                | DC bias measurement, DC resistance temperature compensation (converted reference temperature display), Comparator, Panel loading/saving, Memory function                                                                                                                                                                                                                                              |                                                                                                               |
| Interfaces               | EXT I/O (Handler), USB communication, USB memory<br>Optional: Choose 1 from RS-232C, GP-IB, or LAN                                                                                                                                                                                                                                                                                                    |                                                                                                               |
| Power supply             | 100 to 240 V AC, 50/60 Hz, 50 VA max.                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                               |
| Dimensions and mass      | 330 mm (12.99 in) W $\times$ 119 mm (4.69 in) H $\times$ 168 mm (6.61 in) D, 3.1 kg (109.3 oz)                                                                                                                                                                                                                                                                                                        |                                                                                                               |
| Accessories              | Power cord $\times$ 1, Instruction manual $\times$ 1, CD-R (Includes PC commands and sample software) $\times$ 1                                                                                                                                                                                                                                                                                      |                                                                                                               |

### OPTIONS

|                                                        |         |
|--------------------------------------------------------|---------|
| FOUR-TERMINAL PROBE                                    | 9500-10 |
| DC BIAS VOLTAGE UNIT                                   | 9268-10 |
| DC BIAS CURRENT UNIT                                   | 9269-10 |
| GP-IB INTERFACE                                        | Z3000   |
| RS-232C INTERFACE                                      | Z3001   |
| LAN INTERFACE                                          | Z3002   |
| FOUR-TERMINAL PROBE (DC to 5 MHz)                      | L2000   |
| FOUR-TERMINAL PROBE (DC to 200 kHz)                    | 9140-10 |
| PINCHER PROBE (cable length 1m, DC to 5 MHz)           | 9143-10 |
| TEST FIXTURE (cable length 1m, DC to 5 MHz)            | 9261-10 |
| TEST FIXTURE (direct connection type, DC to 5 MHz)     | 9262    |
| SMD TEST FIXTURE (direct connection type, DC to 5 MHz) | 9263    |

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# IMPEDANCE ANALYZER

# IM3570

## Single Device Solution for High Speed Testing and Frequency Sweeping

- LCR measurement, DCR measurement, sweep measurement, continuous measurement and high-speed testing achieved with one instrument
- High-speed testing, achieving maximum speeds of 1.5ms (1 kHz) and 0.5ms (100kHz) in LCR mode
- High-accuracy measurements, basic accuracy of Z parameter:  $\pm 0.08\%$
- Perform frequency sweeps, level sweeps, and time interval measurements in analyzer mode



**Note:** This product is not supplied with measurement probes or test fixtures. Please select and purchase the measurement probe or test fixture options appropriate for your application separately. For an RS-232C connection: A crossover cable for interconnection can be used. You can use the RS-232C cable 9638 without hardware flow control.

### ■ Basic specifications (Accuracy guaranteed for 1 year)

|                          |                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measurement modes        | LCR mode, Analyzer mode (Sweeps with measurement frequency and measurement level), Continuous measurement mode                                                                                                                                                                                                                                        |
| Measurement parameters   | Z, Y, $\theta$ , Rs (ESR), Rp, Rdc (DC resistance), X, G, B, Cs, Cp, Ls, Lp, D (tan $\delta$ ), Q                                                                                                                                                                                                                                                     |
| Measurement range        | 100 m $\Omega$ to 100 M $\Omega$ , 12 ranges (All parameters are determined according to Z)                                                                                                                                                                                                                                                           |
| Display range            | Z, Y, Rs, Rp, Rdc, X, G, B, Ls, Lp, Cs, Cp : $\pm(0.000000 \text{ [unit] to } 9.999999\text{G [unit]})$ , Absolute value display for Z and Y only<br>$\theta$ : $\pm(0.000^\circ \text{ to } 999.999^\circ)$ , D : $\pm(0.000000 \text{ to } 9.999999)$<br>Q : $\pm(0.00 \text{ to } 99999.99)$ , $\Delta$ % : $\pm(0.0000\% \text{ to } 999.9999\%)$ |
| Basic accuracy           | Z : $\pm 0.08\% \text{rdg.}$ , $\theta$ : $\pm 0.05^\circ$                                                                                                                                                                                                                                                                                            |
| Measurement frequency    | 4 Hz to 5 MHz (10 mHz to 100 Hz steps)                                                                                                                                                                                                                                                                                                                |
| Measurement signal level | <b>V mode/CV mode (normal mode):</b><br>50 mV to 5 Vrms, 1 mVrms steps (up to 1 MHz)<br>10 mV to 1 Vrms, 1 mVrms steps (over 1.0001 MHz)<br><b>CC mode (normal mode):</b><br>10 $\mu$ A to 50 mArms, 10 $\mu$ Arms steps (up to 1 MHz)<br>10 $\mu$ A to 10 mArms, 10 $\mu$ Arms steps (over 1.0001 MHz)                                               |
| Output impedance         | <b>Normal mode:</b> 100 $\Omega$ , Low impedance high accuracy mode: 10 $\Omega$                                                                                                                                                                                                                                                                      |
| Display                  | 5.7-inch color TFT, display can be set to ON/OFF                                                                                                                                                                                                                                                                                                      |
| Measurement time         | 0.5 ms (100 kHz, FAST, display OFF, representative value)                                                                                                                                                                                                                                                                                             |
| Measurement speed        | FAST/ MED/ SLOW/ SLOW2                                                                                                                                                                                                                                                                                                                                |
| Functions                | DC bias measurement, Comparator, Panel loading/saving, Memory function                                                                                                                                                                                                                                                                                |
| Interfaces               | EXT I/O, RS-232C, GP-IB, USB communication, USB memory, LAN                                                                                                                                                                                                                                                                                           |
| Power supply             | 90 to 264 V AC, 50/60 Hz, 150 VA max.                                                                                                                                                                                                                                                                                                                 |
| Dimensions and mass      | 330 mm (12.99 in) W $\times$ 119 mm (4.69 in) H $\times$ 307 mm (12.09 in) D, 5.8 kg (204.6 oz)                                                                                                                                                                                                                                                       |
| Accessories              | Instruction manual $\times$ 1, Power cord $\times$ 1, PC communication instruction manual (CD-R) $\times$ 1                                                                                                                                                                                                                                           |

### OPTIONS

|                                                        |         |
|--------------------------------------------------------|---------|
| EQUIVALENT CIRCUIT ANALYSIS FIRMWARE                   | IM9000  |
| FOUR-TERMINAL PROBE (DC to 5 MHz)                      | L2000   |
| FOUR-TERMINAL PROBE (DC to 200 kHz)                    | 9140-10 |
| PINCHER PROBE (cable length 1m, DC to 5 MHz)           | 9143-10 |
| TEST FIXTURE (cable length 1m, DC to 5 MHz)            | 9261-10 |
| FOUR-TERMINAL PROBE                                    | 9500-10 |
| DC BIAS VOLTAGE UNIT                                   | 9268-10 |
| DC BIAS CURRENT UNIT                                   | 9269-10 |
| TEST FIXTURE (direct connection type, DC to 5 MHz)     | 9262    |
| SMD TEST FIXTURE (direct connection type, DC to 5 MHz) | 9263    |
| SMD TEST FIXTURE (DC to 120 MHz)                       | 9677    |
| SMD TEST FIXTURE (DC to 120 MHz)                       | 9699    |
| GP-IB CONNECTION CABLE (2 m)                           | 9151-02 |

# LCR HiTESTER

# 3532-50

## Impedance meter with a wide test frequency range

- High speed measurement of 5 ms
- Higher frequency range : 42 Hz to 5 MHz
- Fourteen parameters measured (High resolution and high accuracy)
- Interactive touch panel operation
- Wide setting range for measurement voltage and current



**Note:** This product is not supplied with measurement probes or test fixtures. Please select and purchase the measurement probe or test fixture options appropriate for your application separately. For an RS-232C connection: You can use the RS-232C cable 9637 without hardware flow control.

### OPTIONS

|                                                                |      |
|----------------------------------------------------------------|------|
| FOUR-TERMINAL PROBE (DC to 100 kHz)                            | 9140 |
| PINCHER PROBE (DC to 5 MHz)                                    | 9143 |
| TEST FIXTURE (cable connection type, DC to 5 MHz)              | 9261 |
| TEST FIXTURE (direct connection type, DC to 5 MHz)             | 9262 |
| Note: Measurement ranges are limited when using the 9140, 9143 |      |

|                                                     |         |
|-----------------------------------------------------|---------|
| CONNECTION CORD (for 9268/9269; BNC to BNC, 1.5 m)  | 9165    |
| CONNECTION CORD (for 9268/9269; BNC to clip, 1.5 m) | 9166    |
| GP-IB CONNECTION CABLE (2 m)                        | 9151-02 |
| GP-IB INTERFACE                                     | 9518-01 |
| RS-232C INTERFACE                                   | 9593-01 |

### ■ Basic specifications (Accuracy guaranteed for 6 months)

|                                 |                                                                                                                                                                                                                                                                                                                        |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measurement parameters          | Z ,  Y , $\theta$ , Rp, Rs(ESR), G, X, B, Cp, Cs, Lp, Ls, D (tan $\delta$ ), and Q                                                                                                                                                                                                                                     |
| Measurement ranges              | 100 m $\Omega$ to 100 M $\Omega$ , 10 ranges (All parameters defined by  Z )                                                                                                                                                                                                                                           |
| Extent of Measurement Impedance | Z ,  R , X: 10.00 m $\Omega$ to 200.00 M $\Omega$ (depending on condition)<br>$\theta$ : -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<br>(Note: All measurement ranges except for  Z  are for reference only) |
| Basic accuracy                  | Z : $\pm 0.08\% \text{rdg.}$ , $\theta$ : $\pm 0.05^\circ$                                                                                                                                                                                                                                                             |
| Source frequency                | 42Hz to 5MHz (0.1Hz to 1kHz steps)                                                                                                                                                                                                                                                                                     |
| Measurement signal level        | 10 mV to 5 V rms (up to 1 MHz), 50 mV to 1 V rms (1 MHz to 5 MHz), (1 mV rms steps) 10 $\mu$ A to 100 mA rms (up to 1 MHz), 50 $\mu$ A to 20 mA rms (1 MHz to 5 MHz), (10 $\mu$ A rms steps)                                                                                                                           |
| Output resistance               | 50 $\Omega$                                                                                                                                                                                                                                                                                                            |
| Display                         | LCD with backlight display, 99999 (3, 4, or 5 digits unit setting possible)                                                                                                                                                                                                                                            |
| Measurement times               | FAST: 5 ms, NORMAL: 21 ms, SLOW1: 72 ms, SLOW2: 140 ms (typical values for displaying  Z )                                                                                                                                                                                                                             |
| DC bias                         | Superimposed DC voltage, DC current to source signal (used with the optional DC bias unit and constant voltage or current source equipment)                                                                                                                                                                            |
| Functions                       | Comparator, External input/Output (EXT. I/O), GP-IB or RS-232C interface (option)<br>(Note: RS-232C interface required if used with the Printer 9442.)                                                                                                                                                                 |
| Power supply                    | Selectable 100, 120, 220 or 240 V AC $\pm 10\%$ , 50/60 Hz<br>50 VA max.                                                                                                                                                                                                                                               |
| Dimensions and mass             | 348 mm (13.70 in)W $\times$ 113 mm (4.45 in)H $\times$ 273 mm (10.75 in)D, 5.7 kg (201.1 oz)                                                                                                                                                                                                                           |
| Accessories                     | Instruction manual $\times$ 1, Power cord $\times$ 1, Spare fuse $\times$ 1                                                                                                                                                                                                                                            |

# LCR HiTESTER | 3511-50

## Compact & powerful dedicated LCR measurement in 5m second timeframes

- High speed measurement : 5ms (1 kHz) or 13ms (120 Hz)
- Built-in high-speed comparator
- Measurement frequency : 1kHz/ 120Hz selectable



**Note:** This product is not supplied with measurement probes or test fixtures. Please select and purchase the measurement probe or test fixture options appropriate for your application separately. For an RS-232C connection: You can use the RS-232C cable 9637 without hardware flow control.

### ■ Basic specifications (Accuracy guaranteed for 6 months)

|                        |                                                                                                                                                                                                                                                                      |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measurement parameters | <b> Z , <math>\theta</math>, C, L, D, Q, R</b>                                                                                                                                                                                                                       |
| Measurement method     | Source : open terminal voltage 50mV, 500mV, 1Vrms (AC) sense: voltage, AC                                                                                                                                                                                            |
| Source frequency       | 120 Hz or 1 kHz                                                                                                                                                                                                                                                      |
| Measurement range      | <b> Z , R :</b> 10 m $\Omega$ to 200.00 M $\Omega$ (depending on condition)<br><b><math>\theta</math> :</b> -90.00 to +90.00°, <b>C :</b> 0.940 pF to 999.99 mF,<br><b>L :</b> 1.600 $\mu$ H to 200.00 kH, <b>D :</b> 0.0001 to 1.9900,<br><b>Q :</b> 0.85 to 999.99 |
| Basic accuracy         | <b> Z  :</b> $\pm 0.08\%$ rdg., <b><math>\theta</math> :</b> $\pm 0.05^\circ$                                                                                                                                                                                        |
| Measurement time       | <b>Fast :</b> 5 msec. to <b>Slow :</b> 300 msec. (at 1 kHz)<br><b>Fast :</b> 13 msec. to <b>Slow :</b> 400 msec. (at 120 Hz)                                                                                                                                         |
| Display                | 99999 full digits, LED                                                                                                                                                                                                                                               |
| Comparator functions   | <b>Setting :</b> Upper and lower limit, absolute value,<br><b>Output :</b> 3 levels (Hi, In, Lo), Open-collector, Isolated                                                                                                                                           |
| External printer       | 9442 (use with the 9443-02/9444)                                                                                                                                                                                                                                     |
| Power supply           | 100 to 240 V AC (selectable type), 50/60Hz                                                                                                                                                                                                                           |
| Dimensions and mass    | 210 mm(8.27 in)W $\times$ 100 mm(3.94 in)H $\times$ 168 mm(6.61 in)D,<br>2.5 kg (88.2 oz)                                                                                                                                                                            |
| Accessories            | Instruction manual $\times$ 1, Power cord $\times$ 1, Spare fuse $\times$ 1                                                                                                                                                                                          |

### OPTIONS

|                                                        |         |
|--------------------------------------------------------|---------|
| FOUR-TERMINAL PROBE (DC to 100 kHz)                    | 9140    |
| PINCHER PROBE (DC to 5 MHz)                            | 9143    |
| TEST FIXTURE (cable connection type, DC to 5 MHz)      | 9261    |
| TEST FIXTURE (direct connection type, DC to 5 MHz)     | 9262    |
| SMD TEST FIXTURE (direct connection type, DC to 5 MHz) | 9263    |
| DC BIAS VOLTAGE UNIT ( $\pm 40$ V DC max.)             | 9268    |
| DC BIAS CURRENT UNIT ( $\pm 2$ A DC max.)              | 9269    |
| CONNECTION CORD (for 9268/9269; BNC to BNC, 1.5 m)     | 9165    |
| CONNECTION CORD (for 9268/9269; BNC to clip, 1.5 m)    | 9166    |
| GP-IB CONNECTION CABLE (2 m)                           | 9151-02 |
| GP-IB INTERFACE                                        | 9151-01 |
| PRINTER                                                | 9442    |
| AC ADAPTER (for the 9442, for 200~240 V power lines)   | 9443-02 |
| CONNECTION CABLE (for the 3511-50/9442)                | 9444    |
| RECORDING PAPER (25 m, 10 rolls/ set, for the 9442)    | 1196    |

# CHEMICAL IMPEDANCE ANALYZER | IM3590

## Ideal for Measuring Electrochemical Impedance High-precision, Easy-to-use Operation

- 1mHz to 200kHz wide frequency source ideal for measuring ionic behavior and solution resistance
- High-speed LCR and continuous sweep testing with a single unit
- Measure the internal impedance of batteries in no-load state
- Fastest test speed of 2ms enables rapid sweep measurements
- Basic accuracy of  $\pm 0.05\%$  ideal for both component inspections and R&D
- Rich functions such as Cole-Cole plot and equivalent circuit analysis meet advanced applications in electrochemical and material impedance (LCR) testing



### ■ Basic specifications (Accuracy guaranteed for 1 year)

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measurement modes        | LCR mode, Analyzer mode (Sweeps with measurement frequency and measurement level), Continuous measurement mode                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Measurement parameters   | <b>Z, Y, <math>\theta</math>, Rs (ESR), Rp, Rdc (DC resistance), X, G, B, Cs, Cp, Ls, Lp, D (tan<math>\delta</math>), Q, T, <math>\delta</math>, <math>\epsilon</math></b>                                                                                                                                                                                                                                                                                                                                                                                          |
| Measurement range        | 100m $\Omega$ to 100M $\Omega$ , 10 ranges (All parameters are determined according to Z)                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Displayable range        | <b>Z, Y, Rs, Rp, Rdc, X, G, B, Ls, Lp, Cs, Cp, <math>\delta</math>, <math>\epsilon</math> :</b><br>$\pm (0.00000 [\text{unit}] \text{ to } 9.999999 [\text{unit}])$ Absolute value display for Z and Y only<br>Real value display for Z and Y only<br><b><math>\theta</math> :</b> $\pm (0.000^\circ \text{ to } 999.999^\circ)$ , <b>D :</b> $\pm (0.00000 \text{ to } 9.99999)$ ,<br><b>Q :</b> $\pm (0.00 \text{ to } 9999.99)$ , <b><math>\Delta\epsilon</math> :</b> $\pm (0.000\% \text{ to } 999.999\%)$ ,<br><b>T :</b> -10.0 $^\circ$ C to 99.9 $^\circ$ C |
| Basic accuracy           | <b>Z :</b> $\pm 0.05\%$ rdg., <b><math>\theta</math> :</b> $\pm 0.03^\circ$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Measurement frequency    | 1 mHz to 200 kHz (1 mHz to 10 Hz steps)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Measurement signal level | <b>Normal mode:</b><br>V mode/ CV mode: 5 mV to 5 Vrms, 1 mVrms steps<br>CC mode: 10 $\mu$ A to 50 mArms, 10 $\mu$ Arms steps<br><b>Low impedance high accuracy mode:</b><br>V mode/ CV mode: 5 mV to 2.5 Vrms, 1 mVrms steps<br>CC mode: 10 $\mu$ A to 100 mArms, 10 $\mu$ Arms steps                                                                                                                                                                                                                                                                              |
| Output impedance         | <b>Normal mode:</b> 100 $\Omega$<br><b>Low impedance high accuracy mode:</b> 25 $\Omega$                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Display                  | 5.7-inch color TFT, display can be set to ON/OFF                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Measurement time         | 2 ms (1kHz, FAST, display OFF, representative value)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Measurement speed        | <b>FAST/ MED/ SLOW/ SLOW2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Functions                | Comparator, Classification measurement (BIN function), Panel loading/saving, Memory function                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Interfaces               | EXT I/O (handler), USB communication, USB memory<br>Optional: Choose 1 from RS-232C, GP-IB, or LAN                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Power supply             | 100 to 240 V AC, 50/60 Hz, 50 VA max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Dimensions and mass      | 330 mm (12.99 in) W $\times$ 119 mm (4.69 in) H $\times$ 168 mm (6.61 in) D<br>3.1 kg (109.3 oz)                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Accessories              | Power cord $\times$ 1, Instruction manual $\times$ 1, CD-R (Communication instruction manual and sample software [Communications control, Accuracy calculation, and screen capture functionality] $\times$ 1)                                                                                                                                                                                                                                                                                                                                                       |

**Note:** Test fixtures are not supplied with the unit. Select an optional test fixture or probe when ordering. Probes are constructed with a coaxial cable with 50  $\Omega$  impedance characteristics. For an RS-232C connection: You can use the RS-232C cable 9637 without hardware flow control.

### OPTIONS

|                      |         |                                                        |         |
|----------------------|---------|--------------------------------------------------------|---------|
| FOUR-TERMINAL PROBE  | 9500-10 | PINCHER PROBE (cable length 1m, DC to 5 MHz)           | 9143-10 |
| DC BIAS VOLTAGE UNIT | 9268-10 | TEST FIXTURE (cable length 1m, DC to 5 MHz)            | 9261-10 |
| DC BIAS CURRENT UNIT | 9269-10 | TEST FIXTURE (direct connection type, DC to 5 MHz)     | 9262    |
| GP-IB INTERFACE      | 9300-10 | SMD TEST FIXTURE (direct connection type, DC to 5 MHz) | 9263    |

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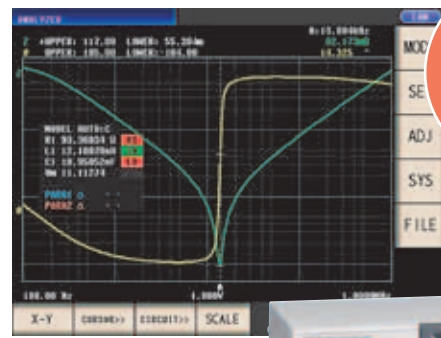
# EQUIVALENT CIRCUIT ANALYSIS FIRMWARE | IM9000

## Enabling Simple Circuit Analysis & Detailed Acceptance/Rejection Decision-Making

- The IM9000 can automatically select the equivalent circuit model from the five typical models to minimize the differences between the measured values and the ideal frequency characteristics derived from the analysis results.
- An acceptance/rejection decision can be made for the L, C, and R elements comprising a part and the resonance sharpness (mechanical quality coefficient).
- A detailed decision can be made on the elements using the resonance of a piezoelectric element or inductor.

*Note: The Equivalent circuit analysis firmware IM9000 is an optional function for the Impedance analyzer IM3570. The IM9000 is not included in the standard package. If you want to use the IM9000 function, specify the option upon purchase.*

*Customers who have purchased the Impedance analyzer IM3570 can add the Equivalent circuit analysis firmware IM9000 function. Please contact your local HIOKI representative.*

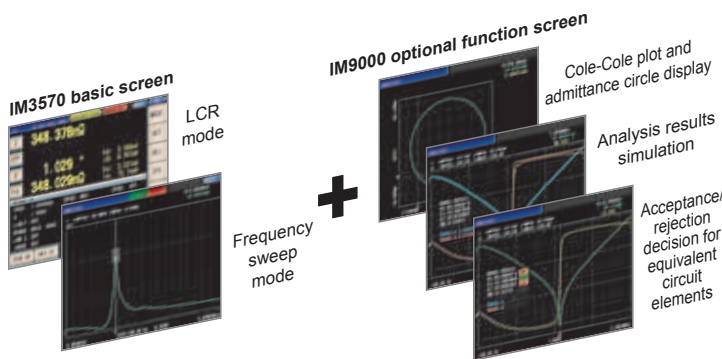


Impedance Analyzer IM3570 option

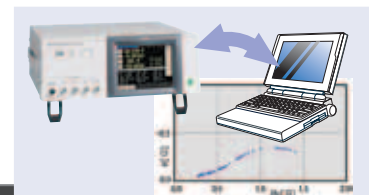
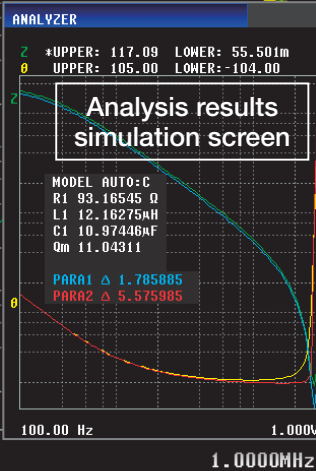
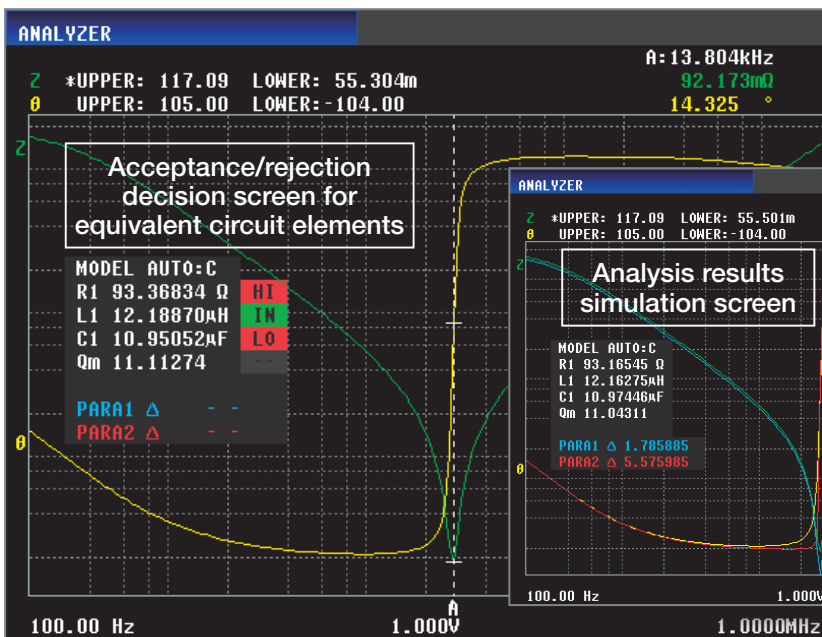
Impedance Analyzer IM3570



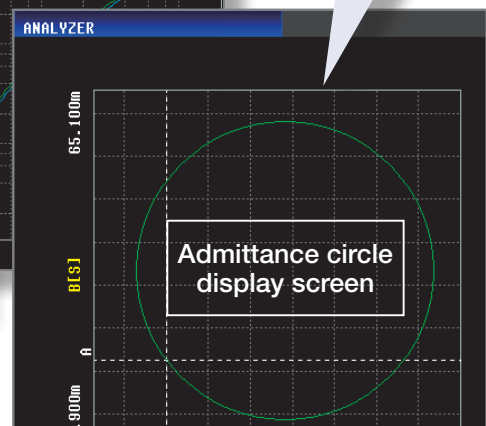
## The Equivalent Circuit Analysis Firmware IM9000 Provides an Optional Function to Perform a Variety of Equivalent Circuit Analysis and Display Graphs



- Five equivalent circuit analysis (Auto/Fixed) patterns
- Acceptance/rejection decision for equivalent circuit elements
- Analysis results simulation
- Cole-Cole plot and admittance circle display



Cole-Cole plot and admittance circle graphs that previously needed a PC to be displayed can now be shown on the IM3570 screen.





## ■ Features

### ● Simple:

#### Automatic Selection of Equivalent Circuit Model

The IM9000 can automatically select the equivalent circuit model from the five typical models to minimize the differences between the measured values and the ideal frequency characteristics derived from the analysis results.

### ● Detailed:

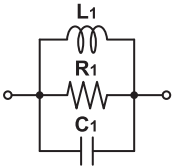
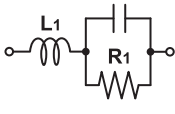
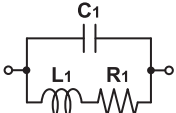
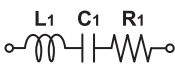
#### Acceptance/Rejection Decision for Elements Comprising Part

An acceptance/rejection decision can be made for the L, C, and R elements comprising a part and the resonance sharpness (mechanical quality coefficient). A detailed decision can be made on the elements using the resonance of a piezoelectric element or inductor.

## ■ Equivalent Circuit Analysis Firmware IM9000 Specifications

### ● Equivalent Circuit Model and Measurement Items

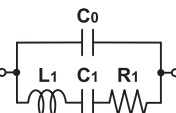
#### ■ Three-element model

|                                                                                             |                                                                                                                                 |                                                                                            |                                                                                                                                                             |
|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>A</b>   | <b>Coil:</b><br>Core loss is large while ESR is small                                                                           | <b>C</b>  | <b>Capacitor:</b><br>Impact of the leakage resistance is large<br><b>Resistance:</b><br>Resistance is large and impact of the floating capacitance is large |
| <b>B</b>  | <b>Coil:</b><br>ESR is relatively large<br><b>Resistance:</b><br>Resistance is small and impact of the wire inductance is large | <b>D</b>  | <b>Capacitor:</b><br>General capacitor                                                                                                                      |

#### ■ Measurement items (Three-element model)

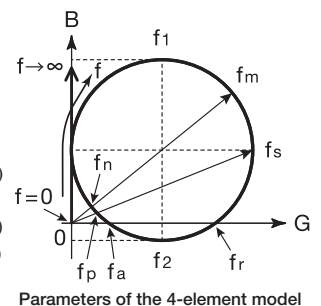
**L1** (Inductance)  
**C1** (Capacitance)  
**R1** (Resistance)  
**Qm** (Resonance sharpness)  
 fr (Resonance frequency) /  
 fa (Anti-resonance frequency)

#### ■ Four-element model

|                                                                                              |                              |
|----------------------------------------------------------------------------------------------|------------------------------|
| <b>E</b>  | <b>Piezoelectric element</b> |
|----------------------------------------------------------------------------------------------|------------------------------|

#### ■ Measurement items (Four-element model)

**L1** (Inductance)  
**C1** (Capacitance)  
**R1** (Resistance)  
**C0** (Parallel capacitance)  
**Qm** (Resonance sharpness or mechanical quality coefficient)  
 fr (Resonance frequency)  
 fa (Anti-resonance frequency)  
 fs (Series resonance frequency)  
 fp (Parallel resonance frequency)  
 fm (Maximum admittance frequency)  
 fn (Minimum admittance frequency)  
 f1 (Maximum susceptance frequency)  
 f2 (Minimum susceptance frequency)



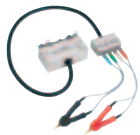
### ● Other functions

|                              |                                                                                                                                                                                                                           |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Circuit model selection      | AUTO (automatic selection) / HOLD (fixed)                                                                                                                                                                                 |
| Estimation execution         | AUTO (estimation is executed after frequency sweep ends) / MANUAL (estimation is executed by the user)                                                                                                                    |
| Sweep range using estimation | <b>Normal sweep:</b> Analysis is performed in the sweep range from the analysis start frequency to the analysis end frequency<br><b>Segment sweep:</b> Analysis is performed in the sweep range of the set segment number |
| Simulation                   | Enables displaying and comparing the ideal frequency characteristics graph derived from the analysis results or the values specified by the user                                                                          |

|                                        |                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Comparator                             | Runs a comparator on the analysis results and outputs the decision results to LCD, EXT. I/O<br><b>R1, L1, C1, C0, Qm:</b> HI/IN/LO, absolute value setting                                                                                                                                                                        |
| Display position of estimation results | Select the display position from upper, lower, left or right                                                                                                                                                                                                                                                                      |
| X-Y display                            | <b>Cole-Cole plot:</b><br>Set Rs to the first measurement item, X to the third measurement item, reverse the polarity of the third measurement item, and set correction coefficient A = -1 for scaling correction<br><b>Admittance circle display:</b><br>Set G to the first measurement item and B to the third measurement item |

## OPTIONS

### Probes and Test Fixtures for Lead Components



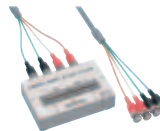
#### FOUR-TERMINAL PROBE L2000

Cable length 1 m (3.28 ft), DC to 5 MHz, impedance characteristics of 50  $\Omega$ , 4-terminal pair configuration, measurable conductor diameter:  $\phi$ 0.3 mm (0.01 in) to 5 mm (0.20 in)



#### FOUR-TERMINAL PROBE 9140-10

Cable length 1 m (3.28 ft), DC to 200 kHz, impedance characteristics of 50  $\Omega$ , 4-terminal pair configuration, measurable conductor diameter:  $\phi$ 0.3 mm (0.01 in) to 5 mm (0.20 in)



#### TEST FIXTURE 9261-10

Cable length 1 m (3.28 ft), DC to 5 MHz, impedance characteristics of 50  $\Omega$ , 4-terminal pair configuration, measurable conductor diameter:  $\phi$ 0.3 mm (0.01 in) to 1.5 mm (0.06 in)



#### FOUR-TERMINAL PROBE 9140

DC to 100kHz, 1 m (3.28 ft) length



#### TEST FIXTURE 9261

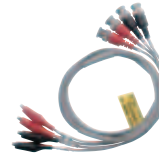
DC to 5MHz, Cable connecting type, 1m (3.28ft) length



#### TEST FIXTURE 9262

Direct connection type, DC to 5 MHz, measurable conductor diameter:  $\phi$ 0.3 mm (0.01 in) to 2 mm (0.08 in)

#### Four-Terminal Probe for Electrochemical Measurement



#### FOUR-TERMINAL PROBE 9500-10

Cable length 1 m (3.28 ft), DC to 200 kHz, impedance characteristics of 50  $\Omega$ , 4-terminal pair configuration, measurable conductor diameter:  $\phi$ 0.3 mm (0.01 in) to 2 mm (0.08 in)

### Test Fixtures for SMD



#### SMD TEST FIXTURE 9263

Direct connection type, DC to 5 MHz, Test sample dimensions: 1 mm (0.04 in) to 10 mm (0.39 in)



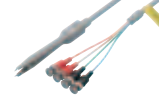
#### SMD TEST FIXTURE 9677

Direct connection type, For measuring SMDs with electrodes on the side; DC to 120MHz, test sample dimensions: 3.5mm  $\pm$  0.5mm (0.14in  $\pm$  0.02in)



#### SMD TEST FIXTURE 9699

Direct connection type, For measuring SMDs with electrodes on the bottom; DC to 120MHz, test sample dimensions: 1.0mm (0.04in) to 4.0mm (0.16in) wide, maximum 1.5mm (0.06in) high



#### PINCHER PROBE 9143-10

Cable length 1 m (3.28 ft), DC to 5 MHz, impedance characteristics of 50  $\Omega$ , 4-terminal pair configuration, tip electrode spacing: 0.3 mm (0.01 in) to 6 mm (0.24 in)



#### PINCHER PROBE 9143

DC to 5 MHz, Cable length 1 m (3.28 ft)

### DC Bias Unit



#### DC BIAS VOLTAGE UNIT 9268-10

Direct connection type, 40 Hz to 5 MHz, maximum applied voltage of DC  $\pm$ 40 V.



#### DC BIAS CURRENT UNIT 9269-10

Direct connection type, 40 Hz to 2 MHz, maximum applied current of DC 2 A (maximum applied voltage of DC  $\pm$ 40 V).



#### DC BIAS VOLTAGE UNIT 9268

42 Hz to 5 MHz, max. allowable voltage  $\pm$  40 V DC



#### DC BIAS VOLTAGE UNIT 9268-01

For HDMI, 42 Hz to 5 MHz, max. allowable voltage:  $\pm$ 4V DC



#### DC BIAS CURRENT UNIT 9269

42 Hz to 100 kHz, max. allowable current:  $\pm$ 2A DC

\*When using the DC Bias Unit, external constant-voltage and constant-current sources are required.

| HIOKI LCR Fixtures and Probes |                      |                            | 3506-10   | 3504S      | 3511-50    | 3532-50      | 3535             | IM3523         | IM3533         | IM3533-01      | IM3570      | IM3590         |
|-------------------------------|----------------------|----------------------------|-----------|------------|------------|--------------|------------------|----------------|----------------|----------------|-------------|----------------|
|                               |                      |                            | C         | C          | LCR        | LCR          | LCR              | LCR            | LCR            | LCR            | LCR         | LCR            |
|                               |                      |                            | 1kHz,1MHz | 120Hz,1kHz | 120Hz,1kHz | 42Hz to 5MHz | 100kHz to 120MHz | 40Hz to 200kHz | 1mHz to 200kHz | 1mHz to 200kHz | 4Hz to 5MHz | 1mHz to 200kHz |
| 9143                          | Pin Type Probe       | DC to 5 MHz, 75 $\Omega$   |           | ✓          | ✓          | ✓            |                  |                |                |                |             |                |
| 9140                          | 4-Terminal Probe     | DC to 100 kHz, 75 $\Omega$ |           | ✓          | ✓          | ✓            |                  |                |                |                |             |                |
| 9261-10                       | Test Fixture         | DC to 5MHz, 50 $\Omega$    | ✓         |            |            |              |                  | ✓              | ✓              | ✓              | ✓           | ✓              |
| 9143-10                       | Pin Type Probe       | DC to 5MHz, 50 $\Omega$    | ✓         |            |            |              |                  | ✓              | ✓              | ✓              | ✓           | ✓              |
| 9140-10                       | 4-Terminal Probe     | DC to 200kHz, 50 $\Omega$  | ✓         |            |            |              |                  | ✓              | ✓              | ✓              | ✓           | ✓              |
| L2000                         | 4-Terminal Probe     | DC to 5MHz, 50 $\Omega$    | ✓         |            |            |              |                  | ✓              | ✓              | ✓              | ✓           | ✓              |
| 9261                          | Test Fixture         | DC to 5 MHz, 75 $\Omega$   |           | ✓          | ✓          | ✓            |                  |                |                |                |             |                |
| 9262                          | Test Fixture         | DC to 5MHz                 | ✓         | ✓          | ✓          | ✓            |                  | ✓              | ✓              | ✓              | ✓           | ✓              |
| 9263                          | SMD Test Fixture     | DC to 5MHz                 | ✓         | ✓          | ✓          | ✓            |                  | ✓              | ✓              | ✓              | ✓           | ✓              |
| 9677                          | SMD Test Fixture     | DC to 120MHz               | ✓         | ✓          | ✓          | ✓            | ✓                | ✓              | ✓              | ✓              | ✓           | ✓              |
| 9699                          | SMD Test Fixture     | DC to 120MHz               | ✓         | ✓          | ✓          | ✓            | ✓                | ✓              | ✓              | ✓              | ✓           | ✓              |
| 9268                          | DC Bias Voltage Unit | 42Hz to 5MHz               |           |            | ✓*         | ✓*           |                  |                |                |                |             |                |
| 9268-01                       | DC Bias Voltage Unit | 42Hz to 5MHz               |           |            |            | ✓*           |                  |                |                |                |             |                |
| 9268-10                       | DC Bias Voltage Unit | 40Hz to 5MHz               |           |            |            |              |                  | ✓*             | ✓*             | ✓*             | ✓*          | ✓*             |
| 9269                          | DC Bias Current Unit | 42Hz to 100kHz             |           |            | ✓*         | ✓*           |                  |                |                |                |             |                |
| 9269-10                       | DC Bias Current Unit | 40Hz to 2MHz               |           |            |            |              |                  | ✓*             | ✓*             | ✓*             | ✓*          | ✓*             |
| 9500-10                       | 4-Terminal Probe     | DC to 200kHz, 50 $\Omega$  | ✓         |            |            |              |                  | ✓              | ✓              | ✓              | ✓           | ✓              |

\*External voltage or current power supply required

Note: Company names and Product names appearing in this catalog are trademarks or registered trademarks of various companies.

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