

# Agilent LCR Meters, Impedance Analyzers and Test Fixtures

Selection Guide



Material, Semiconductor, Component and In-Circuit Measurement Solutions



# Achieve Success with The Industry Standard for Impedance Measurements

Hewlett Packard and Agilent have contributed innovations and product excellence in impedance analysis for over half a century. Whether your application is in R&D, production, quality assurance, or incoming inspection, we take pride in contributing to your success. We strive to deliver complete solutions to meet your needs, from impedance analyzers to a wide variety of test accessories. Achieve success with Agilent's impedance measurement solutions. Agilent offers:

**Superior product performance:** Agilent products provide the best in class accuracy and the repeatability with the fast measurement speed. Three types of impedance measurement solutions as shown in Table 1 are available meeting the various measurement needs.

Complete solution: Covering frequencies from 5 Hz to 3 GHz along with the wide variety of test accessories, Agilent's impedance product line offers you the widest selection of equipment for your application. This selection guide gives an overview of all the products and accessories you can choose from.

#### Appropriate frequency range for your application:

Agilent products provide the best performance in the industry with frequency options to meet your needs at an affordable price. You can select the most appropriate frequency range for your application. Flexible frequency upgrade options are also available. You can choose just what you require today with the least amount of investment and upgrade later as needs arise.

**Technical expertise:** Agilent has decades of experience providing impedance measurement solutions. Years of experience and continuing technical innovations go into the design and manufacturing of each Agilent LCR meter and impedance analyzer.

# Advanced measurement techniques for a wide range of applications

Figure 1 is a comparison of different measurement techniques used in Agilent's LCR meters and impedance analyzers. As you can see, each technique has special measurement advantages:

 Auto-balancing bridge offers widest impedance measurement range with typical frequency range of 20 Hz to 120 MHz. This technique is best for low-frequency, general-purpose testing.

# Agilent's impedance analyzers/LCR meters measuremant technique comparison 10% accuracy range

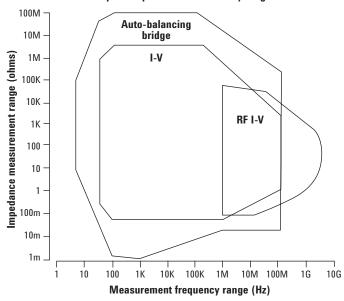


Figure 1. Impedance measurement techniques of impedance analyzers/LCR meters

Table 1. Impedance measurement product type

		Product Type	
Product Highlights	LCR Meter	Impedance Analyzer	Network Analyzer
Frequency Sweep Capability	Spot/List	Continuous (Start/Stop, Center/Span)	Continuous (Start/Stop, Center/Span)
Display	Numeric Only	Graphics	Graphics
Others	Handler interface, comparator	Equivalent circuit analysis built in, material measurements, in-circuit measurements	Equivalent circuit analysis built in, multiple function in one instrument
Advantages	Low-cost solution, ease of use, high speed	Widest measurement range, resonant analysis, circuit modeling	Cost-effective, versatile, compact size

- I-V technique covers from 20 Hz to 120 MHz with a more focused impedance measurement range. I-V technique also allows probing for in-circuit testing.
- RF I-V, an enhancement of the I-V technique, offers some of the high-frequency benefit of network analysis while retaining some of the impedance measurement range of the I-V technique. Designed for accuracy and high-frequency performance, the RF I-V technique is excellent for RF component analysis, especially for small inductance and capacitance values.
- In addition, Agilent's network analyzer offers an impedance measurement solution using the combination of three measurement techniques (reflection, series-thru, and shunt-thru) based on the S-parameter and gain-phase measurements.

### How to use this selection guide

Table 2 is a summary of all of Agilent's impedance products. It is designed to assist you in better comparing Agilent's wide range of instrumentation and in choosing possible solutions for your applications, depending on your requirements in the following areas:

- · Test frequency range
- · Device type or application type
- Accuracy requirement (measurement technique)
- · Any other special needs

If you find several possible solutions for your application, go to the corresponding pages to find more details about each product.

Table 2. Agilent impedance measurement products

Product Type	Freq. range	Positioning	Model	Frequency range (Hz)	Basic Z accuracy <sup>1</sup> (%)	Measurement display range (Ω)	Feature <sup>4</sup>	Measurement technique <sup>5</sup>	Main application
Impedance analyzer	RF	High peformance/ material/high temperature	E4991B	1 M to 3 G	0.65	120 m to 52 k <sup>3</sup>	A,B	RF-IV	LCR component, material, semiconductor
		Multi function	E5061B Option 3L5/005	5 to 3 G	2 (typical)	1 to 2 k/5 to 20 k/1 m to 5 <sup>3</sup> (typical)	A,B	Ref/Series/ Shunt	LCR component, PDN
	LF/HF	High peformance/material/C-V	E4990A	20 to 120 M	0.08 (0.045 typical)	25 m to 40 M <sup>3</sup>	A,B	ABB	LCR component, material, semiconductor
		In-circuit (grounded), C-V	E4990A with 42941A	20 to 120 M	1	50 m to 4 M <sup>3</sup>	A,B	IV	In-circuit, semiconductor
LCR meter	RF	High performance/ high speed measurement	E4982A	1M to 3G	0.8	140 m to 4.8 k <sup>3</sup>	С	RF I-V	LCR component
	HF	High performance/ material/C-V	4285A	75 k to 30 M	0.1	0.1 to 10 M <sup>3</sup>	D	ABB	LCR component, material, semiconductor
	LF	High performance/ material/C-V	E4980A	20 to 2 M	0.05	4 m to 100 M <sup>3</sup>	D	ABB	LCR component, material, semiconductor
Application specific	LF	For capacitor/ high speed measurement	E4981A	120, 1 k and 1M only	0.07	10 fF to 2 mF <sup>3</sup>	D	ABB	MLCC

ABB: Auto-balancing bridge e: I-V: I-V method RF I-V: RF I-V method

Ref: Reflection method Series: Series-thru method Shunt: Shunt-thru method

Basic Z accuracies are best-case values and vary depending on measurement conditions. See product data sheet for detail.

Capacitance measurement only.

<sup>3.</sup> Z range shows the 10% accuracy range.

<sup>4.</sup> Feature code: A: Built-in equivalent circuit analysis

B: Frequency sweep with color LCD display

C: Spot frequency with color LCD display
D: Spot frequency with LCD display

<sup>5.</sup> Measurement technique code:

# **Impedance Analyzers**

Only Agilent impedance analyzers provide unparalleled accuracy from mOhm to Mohm, from 5 Hz to 3 GHz. You can select the appropriate frequency range for your application.

- Frequency, DC bias, and AC voltage/current sweep capability lets you customize where and how test data will be taken.
- Built-in equivalent-circuit analysis computes a multielement circuit model of the device under test.
- Advanced calibration and compensation methods reduce measurement errors.
- Accessories for permittivity & permeability of materials, hightemperature characterization, various passive components, and impedance probe for grounded measurements available



## E4991B impedance analyzer

- Three frequency options: 1 MHz to 500 M/1 G/3 GHz, upgradable
- $\pm 0.65\%$  basic accuracy and 120 m $\Omega$  to 52 k $\Omega$  impedance range (10% measurement accuracy range)
- \* Measurement parameters: |Z|, |Y|, 0, R, X, G, B, L, C, D, Q, | $\Gamma$ |,  $\Gamma$ X,  $\Gamma$ Y, 0 $\Gamma$ , Vac, Iac, Vdc  $^1$ , Idc  $^1$
- Built-in DC bias (Option 001): 0 V to ±40 V, 0 A to ±100 mA
- · 4-chnannel & 4-trace on 10.4 inch color LCD with touch screen
- Data analysis function: Equivalent circuit analysis, limit line test
- Dielectric/magnetic material measurement (Option 002): |εr|, εr', εr'', tanδ(ε), |μr|, μr'', tanδ(μ)
- Temperature characteristics measurement (Option 007) and reliable on -wafer measurement (Option 010) capabilities



### **E4990A** impedance analyzer

- Five frequency options; 20 Hz to 10/20/30/50/120 MHz, upgradable
- ±0.08% (typical ±0.045%) basic impedance measurement accuracy
- 25 m $\Omega$  to 40 M $\Omega$  wide impedance measurement range (10% measurement accuracy range)
- Measurement parameters: |Z|, |Y|, 0, R, X, G, B, L, C, D, Q, Complex Z, Complex Y, Vac, Iac, Vdc, Idc
- Built-in DC bias range: 0 V to ±40 V, 0 A to ±100 mA
- 4-chnannel & 4-trace on 10.4 inch color LCD with touch screen
- · Data analysis function: Equivalent circuit analysis, limit line test
- In-circuit or grounded measurement with the 42941A impedance probe (Option 120 only)
- 7-mm test fixtures combined with 42942A Terminal Adapter (Option 120 only)

<sup>1.</sup> Option 001 is required.

# **Network Analyzer**



### E5061B-3L5 LF-RF network analyzer

The E5061B-3L5 LF-RF network analyzer with the option 005 impedance analysis function offers the network and impedance analysis capabilities in a single instrument. The E5061B-3L5/005 is a versatile and cost-effective solution suitable for general R&D use where various kinds of electronic components and circuits need to be evaluated:

- \* S-parameter test port (5 Hz to 3 GHz) and gain-phase test port (5 Hz to 30 MHz, 1 M  $\Omega/50~\Omega$  inputs)
- The E5061B-005 supports reflection, series-thru, and shunt-thru
  methods using the S-parameter test port or gain-phase test
  port. These methods are suitable for low-to-middle,
  middle-to-high, and very low milliohm impedance ranges,
  respectively. <sup>1</sup>
- Agilent's 7 mm type and 4-terminal pair type component test fixtures can be used in the reflection method (at the S-parameter test port) and the series-thru method (at the gainphase test port).
- Impedance measurement parameters:
   |Z|, |Y|, 0, R, X, G, B, C, L, D, Q
- Built-in DC voltage bias source (0 to ±40 V, max ±100 mA)

<sup>1.</sup> For details about each method's impedance measurement range, refer to "E5061B-3L5 LF-RF Network Analyzer with Option 005 Impedance Analysis Function, Data Sheet" (5990-7033EN).

### **LCR Meters**

The Agilent LCR meters provide the best combination of accuracy, speed, and versatility at an affordable price for both R&D and production applications.

- · Wide frequency range from 20 Hz to 3 GHz
- Frequency list sweep for continuous testing at multiple frequency points
- Unparalleled measurement accuracy at both high and low impedance range
- With the widest variety of accessories, great for testing of leaded components, surface-mount components, semiconductors, and materials
- Fast measurement speed with superior measurement repeatability
- Handler interface with BIN sorting function for easy test automation in production environment



## **4285A precision LCR meter**

- 75 kHz to 30 MHz
- 0.1% basic accuracy
- · List sweep measurements
- · Option 001 adds ±40 V dc bias voltage
- Measurement parameters: |Z|, |Y|, 0, R, X, G, B, C, L, D, Q



### E4982A LCR meter

- 1 MHz to 3 GHz with 100 kHz resolution
- High speed measurement: selectable from 0.9 ms (Mode 1), 2.1 ms (Mode 2), and 3.7 ms (Mode 3)
- 0.8% basic accuracy
- RF I-V technique provides a wide impedance range (0.14  $\Omega$  to 4.8 k $\Omega$ )
- Highly stable measurement of low-inductance and excellent Q accuracy for meeting chip inductor test requirements
- · Handler interface suitable for production testing
- Measurement parameter |Z|, |Y|, 0, R, X, G, B, L, C, D, Q, Rdc, Idc, Vdc, in user-definable combinations of parameters (up to 4 parameters)
- · Versatile PC connectivity GPIB, LAN, USB



### **E4980A** precision LCR meter

- · 20 Hz to 2 MHz with 4-digit resolution
- 0.05% basic accuracy with superior measurement repeatability at low and high impedance
- Measurement time (at 1MHz): 5.6 ms (SHORT), 88 ms (MED), 220 ms(LONG)
- Option E4980A-001 adds ±20 Vrms/±100 mArms test signal, ±40 V/±100 mA internal dc bias, 2nd DC source, and Vdc/ldc measuremnet
- Option 201 and 301 add handler interface and scanner interface respectively
- \* Measurement parameters:  $|Z|, |Y|, \theta, R, X, G, B, L, C, D, Q, Rdc, Vdc$  <sup>1</sup>, Idc <sup>1</sup>
- Versatile PC connectivity, LAN, USB (memory/USBTMC), GPIB

### **E4980AL** precision LCR meter

- 20 Hz to 300 kHz/500 kHz/1 MHz with 4-digit resolution
- 0.05% basic accuracy with superior measurement repeatability at low and high impedance
- Measurement time (at 1MHz): 12 ms (SHORT), 118 ms (MED), 343 ms(LONG)
- Option 201 and 301 add handler interface and scanner interface respectively
- Measurement parameters:
   |Z|, |Y|, θ, R, X, G, B, L, C, D, Q, Rdc
- Versatile PC connectivity, LAN, USB (memory/USBTMC), GPIB

<sup>1.</sup> Option E4980A-001 is required.



# E4981A 120 Hz/1 kHz/1 MHz capacitance meter

- 120 Hz, 1 kHz and 1 MHz test frequencies
- High speed measurement: 2.3 ms (1 MHz), 3.0 ms (1 kHz), 11.0 ms (120 Hz)
- Basic accuracy C: 0.07%, D: 0.0005
- Handler and scanner interfaces suitable for production testing
- Measurement parameters: C, D, Q, ESR, G
- SLC feature provides constant test voltage for high-value capacitor measurements.

# **Test Fixtures and Accessories (Four-Terminal-Pair)**

#### **Basic test fixtures**



16034E SMD/chip test fixture

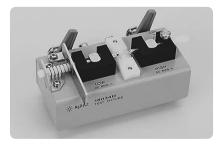
Frequency: ≤ 40 MHz Maximum dc bias: ±42 V peak max



16034G small SMD/chip test fixture

Frequency: ≤ 120 MHz

Maximum dc bias: ±42 V peak max



16034H SMD/chip test fixture

Frequency: ≤ 120 MHz

Maximum dc bias: ±42 V peak max

Suitable for array-type devices



16044A SMD Kelvin contact test fixture

*Frequency:* ≤ 10 MHz

Maximum dc bias: ±42 V peak max



16334A SMD/chip tweezers test fixture

Frequency: ≤ 15 MHz

Maximum dc bias: ±42 V peak max



16047A axial & radial test fixture

Frequency: A: ≤ 13 MHz (Kelvin contact)

Maximum dc bias: A: ±42 V peak max



16047E test fixture

*Frequency:*  $\leq$  120 MHz

Maximum dc bias: ±42 V peak max



16089A/B/C/D clip leads

Clip type: A/B/C: Kelvin

D: Alligator

Frequency: 5 Hz to 100 kHz Cable length: A/B/C/D: 0.94 m

E: 1.3 m

Maximum dc bias: ±42 V peak max

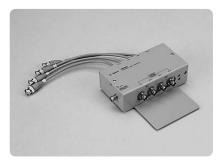
# **Test Fixtures and Accessories (Four-Terminal-Pair)**

### **External DC bias fixtures**



16065A axial and radial test fixture with safety cover

Frequency: 50 Hz to 2 MHz Maximum external dc bias:  $\pm 200$  V Blocking capacitor of 5.6  $\mu$ F is connected in series with the Hc terminal



16065C external bias adapter

Frequency: 100 Hz to 1 MHz Maximum external dc bias:  $\pm 40$  V Blocking capacitor of  $50~\mu F$  is connected in series with the Hc terminal

### **Test leads**



16048A/D/E BNC test leads

**Frequency:** A:  $\leq$  30 MHz, D:  $\leq$  30 MHz, E:  $\leq$  2 MHz

Cable length: A: 0.94 m, D: 1.89 m,

E: 3.8 m

*Maximum dc bias:* ±42 V peak max



16048G/H BNC test leads

Frequency: ≤ 120 MHz

Cable length: G: 1 m, H: 2 m

Maximum dc bias: ±42 V peak max

Use with only 4294A/E4990A

### **Terminal adapters**



42942A four-terminal-pair to 7 mm terminal adapter

Frequency: ≤ 120 MHz

Maximum dc bias: ±42 V peak max Use with only 4294A/E4990A

# **Test Fixtures and Accessories (Four-Terminal-Pair)**

### **Material measurements**



16451B dielectric test fixture

#### Measurement parameters:

capacitance (C), dissipation factor (D), and dielectric constant (Er', Er'')

#### Material-under-test size:

thickness: ≤ 10 mm diameter: 10 to 56 mm *Frequency:* ≤ 30 MHz



16452A liquid test fixture

#### Measurement parameter:

capacitance (C), dielectric constant (Er', Er'') Liquid sample

**Quantity:** ≤ 6.8 ml

Frequency: 20 Hz to 30 MHz

### **Others**



42941A impedance probe kit

Frequency: ≤ 120 MHz

Maximum dc bias: ±42 V peak max

**Probe cable length:** 1.5 m **Use with only 4294A/E4990A** 

# **Test Fixtures and Accessories (7-mm Terminal)**

## **RF SMD/chip components**



16196A/B/C/D SMD test fixture

Coaxial fixture for parallel electrode SMDs.

Frequency: dc to 3 GHz

*Maximum dc bias:* ±42 V peak max

Applicable SMD size:

16196A: 1.6 mm x 0.8 mm 16196B: 1.0 mm x 0.5 mm

16196C: 0.6 mm x 0.3 mm 16196D: 0.4 mm x 0.2 mm



16197A bottom-electrode SMD test fixture

Frequency: dc to 3 GHz

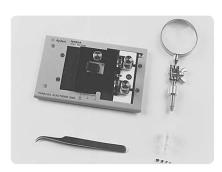
Maximum dc bias: ±42 V peak max



16092A axial, radial, and SMD test fixture

*Frequency:* ≤ 500 MHz

Maximum dc bias: ±42 V peak max



16192A parallel-electrode SMD test fixture

Frequency: dc to 2 GHz

Maximum dc bias: ±42 V peak max



16194A high temperature component test fixture

Frequency: dc to 2 GHz

Maximum dc bias: ±42 V peak max

Operating temperature: -55 °C to +200 °C



16200B external DC bias adapter

Frequency: 1 MHz to 1 GHz

Maximum external dc bias: Up to 5 A, ±40 V

#### **Material measurements**



16453A dielectric test fixture

Frequency: 1 MHz to 1 GHz
Sample size (smooth sheets only):
thickness: 0.3 mm to 3 mm

diameter: ≥ 15 mm



16454A magnetic test fixtures

Frequency: 1 kHz to 1 GHz
Sample size (toroids only):

height:  $\leq 8.5$  mm inner diameter:  $\geq 3.1$  mm outer diameter:  $\leq 20$  mm

# **Test Fixtures and Accessories (E5061B)**



16201A N-type to 7 mm terminal adapter

Frequency: ≤ 3 GHz Maximum dc bias: ±40 V Use with only E5061B

# **Simplify and Improve Your Measurements** with Agilent's **Test Accessories**

Selecting a test fixture is as important as selecting the right instrument. Agilent offers a wide range of accessories for axial, radial, and SMD/Chip devices. In addition, a variety of test leads are available to simplify remote testing and systems applications. External test fixtures with safety covers are also available.

You will improve your measurement results with the proper test fixture.

- · more reliable and repeatable measurement
- · higher through-put
- · fewer handling errors
- · tighter test limits
- · better measurement accuracy

Accessories W	roduct information and literature, visit our leb site: www.agilent.com/find/accessories		E4980A/AL	4285A	E4981A	E4982A	E4990A Option 120	E4990A LF Option	E4991B	E5061B Option 3L5/005
16034E	SMD/chip test fixture	DC-40 MHz	•	•	•		•	•		•
16034G	SMD/chip test fixture, small	DC-120 MHz	•	•	•		•	•		•
16034H	SMD/chip test fixture, for Array-type	DC-120 MHz	•	•	•		•	•		
16044A	SMD/chip test fixture, Kelvin contacts	DC-10 MHz	•	•	•		•	•		
16047A	Axial and radial test fixture	DC-13 MHz	•	•	•		•	•		
16047E	Axial and radial test fixture	DC-120 MHz	•	•	•		•	•		•
16048A	One meter test leads, BNC	DC-30 MHz	•	•	•					
16048D	Two meter test leads, BNC	DC-30 MHz	•	•	•					
16048E	Four meter test leads, BNC	DC-2 MHz	•							
16048G	One meter test leads, BNC	DC-120 MHz					•	•		
16048H	Two meter test leads, BNC	DC-120 MHz					•	•		
16065A	Ext. voltage bias with safety cover (≤ 200 Vdc)	50 Hz-2 MHz	•	•	•		•	•		
16065C	External bias adapter (≤ 40 Vdc)	100 Hz-1 MHz	•	•	•					
16089A/B/C/D	Kelvin clip leads	5 Hz-100 kHz	٠	•	•		•	•		
16092A	RF spring clip: axial, radial and SMD	DC-500 MHz				•1	•2		٠	•3
16192A	Parallel electrode SMD test fixture	DC-2 GHz				•1	•2		•	•3
16194A	High temperature component test fixture	DC-2 GHz				•1	•2		٠	•3
16196A/B/C/D	Parallel electrode SMD test fixture	DC-3 GHz				•1	•2		•	•3
16197A	Bottom electrode SMD test fixture	DC-3 GHz				•1	•2		٠	•3
16200B	External DC bias adapter	1 MHz-1 GHz				•1	•2		•	•3
16201A	N-type to 7 mm terminal adapter	5 Hz to 3 GHz								•
16334A	SMD/chip tweezers test fixture	DC-15 MHz	•	•	•		•	•		
16451B	Dielectric material test fixture	DC-30 MHz	•	•	•		•	•		
16452A	Liquid test fixture	20 Hz-30 MHz	•	•			•	•		
16453A	Dielectric material test fixture	1 MHz-1 GHz							٠	
16454A	Magnetic material test fixture	1 kHz-1 GHz					•		•	
42941A	Impedance probe kit	DC-120 MHz					•			
42942A	Four-terminal pair to 7-mm adapter	DC-120 MHz					•			

Note: Refer to the accessory descriptions for frequency and operational limits.

<sup>1. 3.5-</sup>mm (M) to 7-mm adapter is required

<sup>2. 42942</sup>A is required.

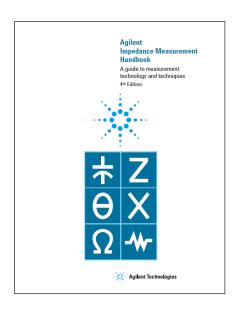
<sup>3.</sup> Compatible when used in conjunction with 16201A.

# **Helping You Make Better Measurements**

Agilent's application knowledge can help you make better measurements.

**Impedance Measurement Handbook** (P/N 5950-3000) is a comprehensive guide to impedance measurements. The handbook covers from basics to applications and you can learn valuable measurement techniques to support your test challenges.

- 1. Impedance Measurement Basics
- 2. Impedance Measurement Instruments
- 3. Fixturing and Cabling
- 4. Measurement Error and Compensation
- 5. Impedance Measurement Applications and Enhancements



# **Complementary Products and Accessories**

To help you find a complete solution, we have listed the following companies that make complementary products or specialized accessories for Agilent's impedance measurement products. Please contact each company directly if you are interested in its products. (Agilent does not make any special endorsement of these companies' products; this list is for reference only.)

Company name	Product specialty/expertise	Web site address
All-Ring Tech (ART)	Component testing, sorting and taping machine	www.allring-tech.com.tw
ArumoTech	Custom test fixtures	www.arumotech.co.jp
Axisnet	Impedance measurement system under high power condition	www.axisnetinc.com
Beta LaserMike	Automated LAN cable test system	www.betalasermike.com
BH Electronics	Wideband transformers	www.bhelectronics.com
Cascade Microtech	RF and microwave probers and accessories for semiconductor and IC applications.	www.cascademicrotech.com
Electro Scientific Industries (ESI)	Component testing, sorting and taping machine	www.esi.com
ESPEC	Temperature chamber for component and material testing.	www.espec.com
HCUNI	Material measurement solutions	www.hcuni.com
Humo Laboratory	Capacitor and crystal device testing and sorting machine	www.humo.co.jp
Inter-Continental Microwave (ICM)	Automated device handling systems, RF and microwave test fixtures and non-coaxial calibration standards.	www.icmicrowave.com
Kanto Electronic Application and Development (KEAD)	Materials measurement solutions	www.kead.co.jp
KEYCOM	Materials measurement solutions	www.keycom.co.jp
Material-Wave Interactions (MWI) Laboratories	Material measurement solutions	www.mwilab.com
North Hills Signal Processing	Wide-band transformers (baluns) for balanced measurement.	www.northhills-sp.com
Seiwa Giken	Energy and battery test solution	www.seiwa-giken.co.jp
Systemhouse Sunrise	C-V test solution for solar cells	www.ssunrise.co.jp
SUMTEC	Materials measurement solutions	www.sumtec.biz
Sine Yo Feng (SYF)	Component testing and taping machine	www.syfpt.com.tw
TOKYO WELD	Component testing, sorting and taping machine	www.tokyoweld.com

# **Agilent Web Resources**

LCR Meters/Impedance Analyzers: www.agilent.com/find/impedance

LCR Meter & Impedance Measurement Product Accessories: www.agilent.com/find/impedance-accessory

RF & MW test accessories:

www.agilent.com/find/accessories



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#### www.lxistandard.org

LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. Agilent is a founding member of the LXI consortium.





#### www.agilent.com/find/ThreeYearWarranty

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#### www.agilent.com/quality

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United States	(800) 829 4444

#### **Asia Pacific**

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China	800 810 0189
Hong Kong	800 938 693
India	1 800 112 929
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 375 8100

#### **Europe & Middle East**

Belgium	32 (0) 2 404 93 40
Denmark	45 45 80 12 15
Finland	358 (0) 10 855 2100
France	0825 010 700*
	*0.125 €/minute
Germany	49 (0) 7031 464 6333
Ireland	1890 924 204
Israel	972-3-9288-504/544
Italy	39 02 92 60 8484
Netherlands	31 (0) 20 547 2111
Spain	34 (91) 631 3300
Sweden	0200-88 22 55
United Kingdom	44 (0) 118 927 6201

For other unlisted countries:

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