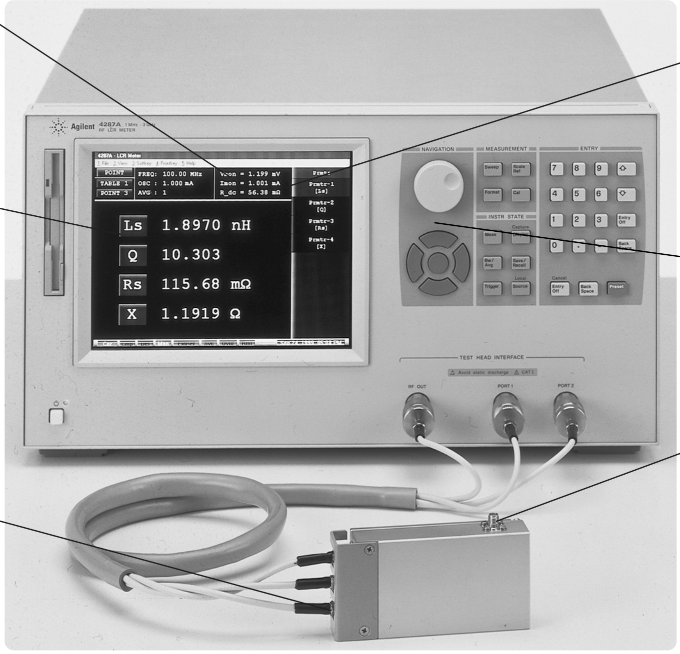
Agilent Technologies
4287A RF LCR Meter

Product Overview

Agilent Technologies
Innovating the HP Way

High-speed RF LCR meter anticipating next generation test needs

The Agilent 4287A is a high performance RF LCR meter best fit to production line testing of devices such as SMD inductors and EMI filters, where impedance testing at high frequencies is required.



Signal-level monitor function
Monitors the test signal voltage or current applied to the device under test.

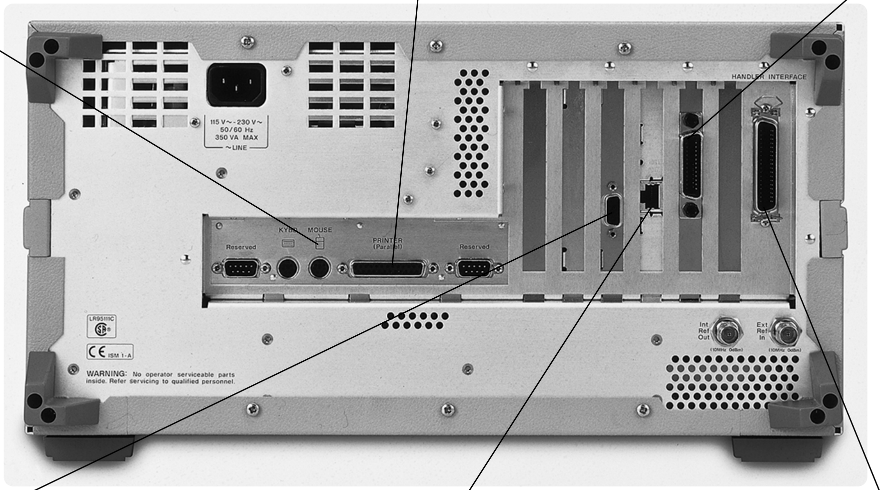
8.4 inch color LCD display
Selectable measurement parameters (4 parameters can be displayed simultaneously)

Small test head with 1m test cable
Extension to an automated component handler without introducing additional error

Rdc (DC resistance) measurement function
For contact check

Navigation keys and rotary knob
Support front panel operation without the mouse

3.5mm (female) test port



Mouse and keyboard
Ease-of-use by simplifying measurement setup and programming

Centronics printer interface

GPIB interface

VGA monitor

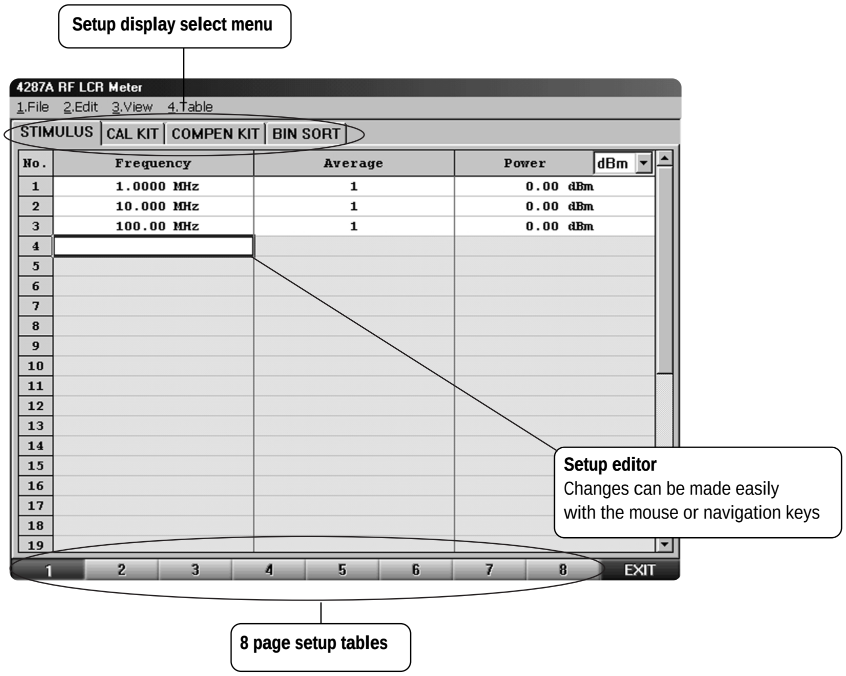
LAN interface
For remote system control and transfer of data

Opto-isolated handler interface
Easy integration with an automatic component handler

The 4287A greatly increases manufacturing testing efficiency with fast measurement speeds (9msec/point) and a statistical analysis function, among the other powerful functions, such as the built-in comparator function. In addition, the 4287A improves upon the measurement accuracy and impedance measurement range of previous RF LCR meters. These improvements are realized by advanced techniques in analog-circuit design. The 4287A achieves better measurement repeatability and stability, even at the low test-signal levels required for SMD inductor testing.

User-friendly interface

An object-oriented user interface that is navigable using the mouse, panel keys or keyboard simplifies complicated measurement setup procedures. Setups, including test frequency, signal level (also when using list-sweep), and limits for the multi-function comparator, can be performed and verified easily by editing the setup-tables. The setup editor has eight page tablesand can store eight different setups. After the setup tables have been established, the active measurement setup can be chosen simply by selecting the corresponding number (1 through 8).



No.	Frequency	Average	Power dBm
1	1.0000 MHz	1	0.00 dBm
2	10.000 MHz	1	0.00 dBm
3	100.00 MHz	1	0.00 dBm
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			

Setup display select menu

Setup editor
Changes can be made easily
with the mouse or navigation keys

8 page setup tables

Figure 1. List sweep setup display

Key Specifications

Test Frequency	1 MHz - 3 GHz with 100 kHz resolution. With list-sweep, up to 32 points per sweep is available.
Impedance Parameters	|Z|, θz (rad), θz (deg), |Y|, θy (rad), θy (deg) , X, G, B, Ls, Lp, Cs, Cp, Rs, Rp, Q, D
Display Resolutions	5 digits
Test Siganal Level	V (open condition): 4.47mVrms - 502mVrms (447mVrms when >1 GHz) I (short condition): 0.0894mArms - 10mArms (8.94mArms when >1 GHz)
Basic Accuracy	± 1.0%
Measurement Range	200m Ω to 3k Ω (@1MHz, accuracy ≤10%)
Measurement Time	9msec per point (max. speed)
Measurement Terminal	3.5mm (female)
Calibration and Compensation	Open/short/load/low-loss capacitor calibration, fixture electrical length compensation, open/short compensation
Rdc Measurement Function	for contact check (on/off selectable)
Data Strage Devices	30Mbyte solid-state mass storage (flash memory) or 2Gbyte internal hard disk (Select one of them as an option), and 1.44Mbyte floppy disk
Interface	GPIB, LAN (10base-T/100base-TX automatically switched), and Opto-isolated handler interface

Improving throughput and quality in production line testing

Accurate impedance measurement using the RF I-V measurement method

The 4287A uses the RF I-V measurement method for measuring impedance by measuring the current flowing through a device under test (DUT) and the voltage applied across the DUT. These measurements of current and voltage can be made over the entire measurement frequency range (to 3GHz). RF I-V enables accurate measurement over a wide impedance range. The impedance measurement range is much wider than that of network analyzers. For a very small inductance, on the order of a few nH, this is a big advantage.

Stable measurements at low signal levels with high speed

SMD inductors require testing with test currents on the order of 100 micro-amps. It is difficult to maintain high test-throughput with previous RF LCR meters, since many sequential measurements are required when averaging to reduce measurement variation. Measurement stability at low-test signal levels is improved with the 4287A making highly repeatable measurements possible. The 4287A can increase test throughput due to the decrease of the averaging factor.

Contact check using the Rdc measurement function

Contact failure between a DUT and the measurement plane of an automatic component handler is a factor for bin sorting error in production line testing. Contact check using the built-in DC resistance measurement function improves the accuracy and efficiency of bin sorting.

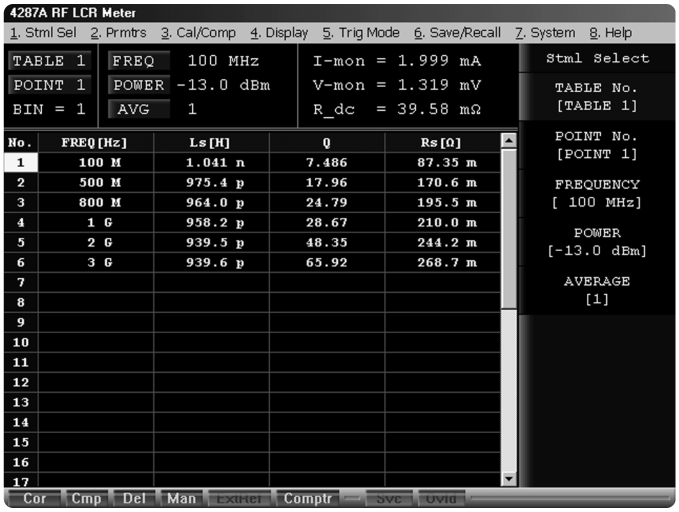
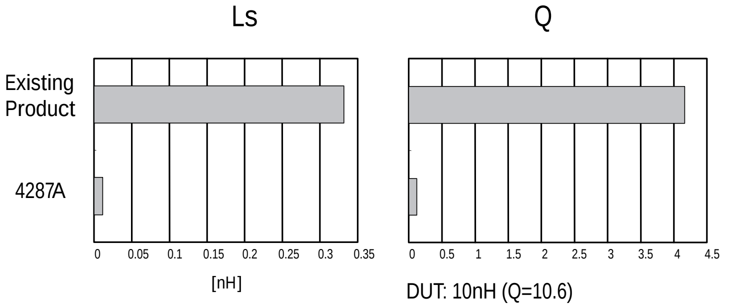


TABLE 1
POINT 1
BIN = 1
FREQ 100 MHz
POWER -13.0 dBm
AVG 1
I-mon = 1.999 mA
V-mon = 1.319 mV
R_dc = 39.58 mΩ

TABLE No. [TABLE 1]
POINT No. [POINT 1]
FREQUENCY [100 MHz]
POWER [-13.0 dBm]
AVERAGE [1]

No.	FREQ[Hz]	Ls[H]	Q	Rs[Ω]
1	100 M	1.041 n	7.486	87.35 m
2	500 M	975.4 p	17.96	170.6 m
3	800 M	964.0 p	24.79	195.5 m
4	1 G	958.2 p	28.67	210.0 m
5	2 G	939.5 p	48.35	244.2 m
6	3 G	939.6 p	65.92	268.7 m
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				

Figure 2. Accurate multiple frequency impedance measurements



DUT: 10nH (Q=10.6)
Conditions:
100 MHz, 200µA, AVG=1
3 Sigma when 100 times measurements

Figure 3. Stability comparison at low signal level

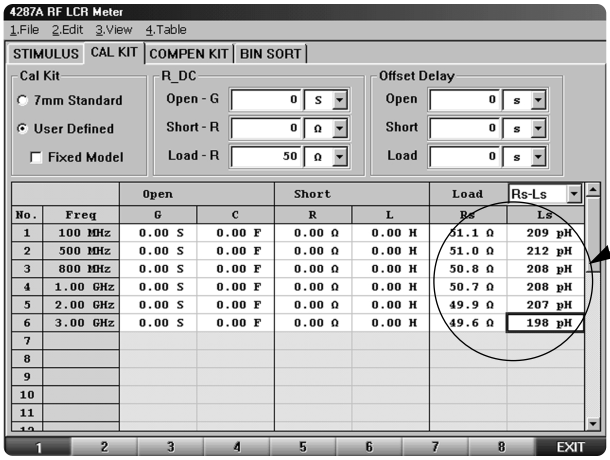
Accurate automated testing by advanced calibration

It is very important to eliminate complicated error elements caused from the use of test fixtures and cables that extend the test head of the 4287A. This is especially true for measurements that use an automated component handler. Accurate measurements, which correlate well with results obtained from manual testing, can be achieved at the measurement plane of a test fixture by performing open/short/load calibration with a "working" load standard.

In other words, open/short/load calibration, at the measurement plane is dependent solely on the value assigned to the "working standard" by manual testing of that component. Since different calibration standard reference values can independently be set at each list sweep frequency, multi-frequency measurements can be made accurately with this reliable calibration function

Multi-function comparator

The 4287A is equipped with a multi-function comparator to meet a wide variety of testing needs. The comparator setup display is formatted as a table. Each row represents a bin number, and each column represents the sorting conditions for each bin. When all sorting conditions set for a bin are satisfied, the judgement result is sorted to the bin. There are thirteen bins, with four limit values for each bin. Conditions such as frequency and measurement parameters can be set independently in each column, enabling the 4287A to meet various sorting needs, including different parameters at different measurement frequencies.



Cal Kit
○ 7mm Standard
● User Defined
☐ Fixed Model

R_DC
Open - G: 0 S
Short - R: 0 Ω
Load - R: 50 Ω

Offset Delay
Open: 0 s
Short: 0 s
Load: 0 s

		Open		Short		Load	Rs-Ls
No.	Freq	G	C	R	L	Rs	Ls
1	100 MHz	0.00 S	0.00 F	0.00 Ω	0.00 H	51.1 Ω	209 pH
2	500 MHz	0.00 S	0.00 F	0.00 Ω	0.00 H	51.0 Ω	212 pH
3	800 MHz	0.00 S	0.00 F	0.00 Ω	0.00 H	50.8 Ω	208 pH
4	1.00 GHz	0.00 S	0.00 F	0.00 Ω	0.00 H	50.7 Ω	208 pH
5	2.00 GHz	0.00 S	0.00 F	0.00 Ω	0.00 H	49.9 Ω	207 pH
6	3.00 GHz	0.00 S	0.00 F	0.00 Ω	0.00 H	49.6 Ω	198 pH
7							
8							
9							
10							
11							

Different calibration reference values can independently be set at each list sweep frequency

Figure 4. Calibration standard data setup display

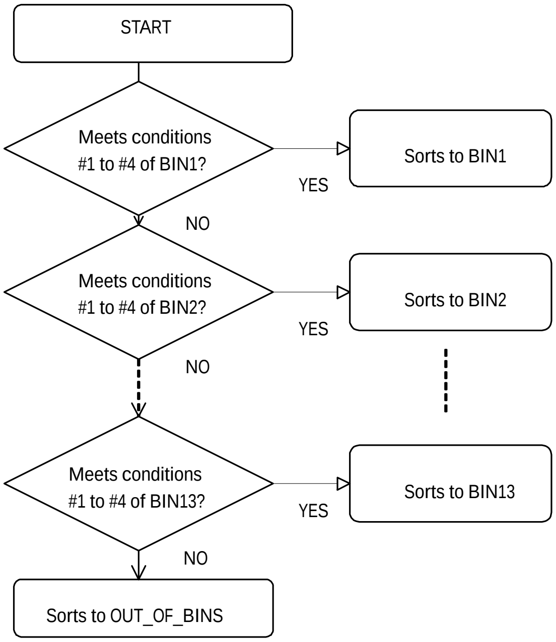


Figure 5. Bin-sort sequence

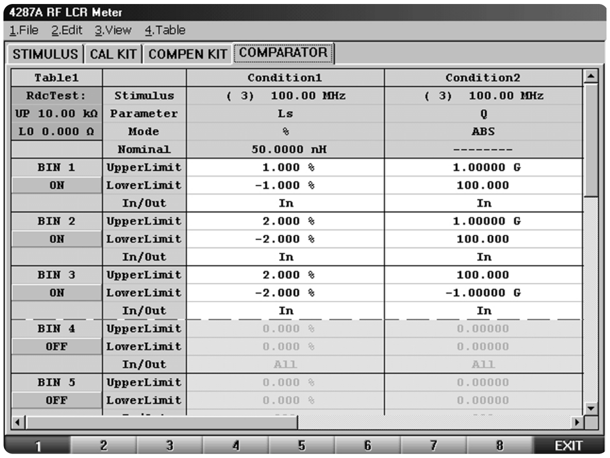


Table1		Condition1	Condition2
RdcTest:	Stimulus	(3) 100.00 MHz	(3) 100.00 MHz
UP 10.00 kΩ	Parameter	Ls	Q
LO 0.000 Ω	Mode	%	ABS
	Nominal	50.0000 nH	--------
BIN 1	UpperLimit	1.000 %	1.00000 G
ON	LowerLimit	-1.000 %	100.000
	In/Out	In	In
BIN 2	UpperLimit	2.000 %	1.00000 G
ON	LowerLimit	-2.000 %	100.000
	In/Out	In	In
BIN 3	UpperLimit	2.000 %	100.000
ON	LowerLimit	-2.000 %	-1.00000 G
	In/Out	In	In
BIN 4	UpperLimit	0.000 %	0.00000
OFF	LowerLimit	0.000 %	0.00000
	In/Out	All	All
BIN 5	UpperLimit	0.000 %	0.00000
OFF	LowerLimit	0.000 %	0.00000

Figure 6. Comparator setup display

Statistical functions

The 4287A is equipped with functions to statistically analyze data. These functions improve the efficiency of the data acquisition required in quality control.

The statistical analysis function calculates the following statistical parameters for as many as 240000 measurement points. Original measurement results for the statistical analysis function can be obtained via LAN interface.

- Examples of normal data (non-failure)
  Cumulative normal samples, mean, maximum, minimum, standard deviation, and 3σ/mean
- Examples of failure analysis
  Cumulative failure samples, cumulative Rdc failures, cumulative overload samples
- Total number of normal/failure data

Data storage

The 4287A built-in data storage includes a 3.5 inch floppy disk drive as well as either a solid-state mass storage device (flash memory) or a hard disk drive. These powerful storage devices permit save and recall of measurement setup parameters (instrument state) and measurement data. In addition, measurement setup parameters and data can be transferred between the 4287A and an external computer via the GPIB or LAN interface.

Interfacing with an automated component handler

The measurement plane can be extended from the front panel of the instrument to the measurement stage with the 1m test cable and the small size test head. Note that the measurement accuracy is specified at the test head. It is possible to extend the test cable an additional meter with a 1m extension cable. In addition, connection to an external computer or an automated component handler can be accomplished via the GPIB interface and the opto-isolated handler interface. The LAN interface enables network communication, and greatly empowers massive data transfer to a remote computer.

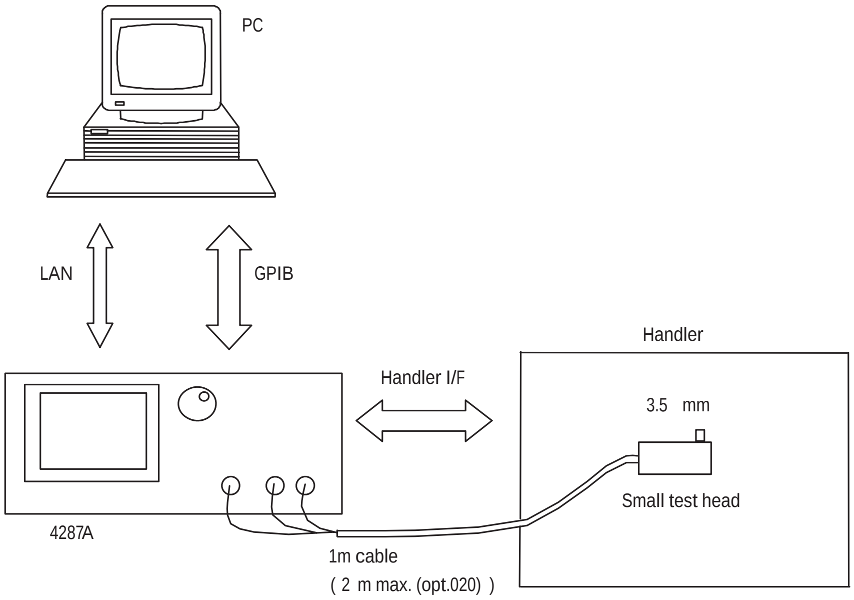


Figure 7. Handler system example with the 4287A

Research and development of next generation devices and improving reliable quality control

The accurate impedance measurement capability of the 4287A with the various kinds of test accessories offers you total measurement solutions for the areas of research and development, as well as quality control.

Accurate impedance evaluation up to 3GHz

Characterization of components at operating frequencies in excess of 2GHz is becoming common due to the development and evaluation of RF SMD inductors used in wireless communication equipment. The 4287A employs the RF I-V measurement method of measuring impedance by measuring the current flowing through a device under test (DUT) and the voltage applied across the DUT. The 4287A enables accurate measurement over an impedance range much wider than that of network analyzers (reflection coefficient method).

Total measurement solution

When electronic components are evaluated, the test accessories should be suitable for their shape and size for accurate impedance measurements. Agilent offers various kinds of 7mm test fixtures, which are compatible with the 4287A. You can select the appropriate one for your device's size, shape, and application. The new 16196A, B and C SMD test fixtures, developed with a co-axial structure, make RF impedance measurements to 3GHz possible. The 16196A, B and C correspond to the chip sizes, 1608(mm) / 0603(inch), 1005 (mm) / 0402 (inch), and 0603 (mm) / 0201 (inch), respectively.

The repeatable DUT positioning capability and reliable contacts enable stable measurement results, and reduce the possibility of operator induced error. Evaluation of SMD inductors to 3GHz, which has been difficult to implement so far, can easily be performed with good repeatability by using the 4287A with the 16196A/B/C test fixtures. When the 16200A is used with the 4287A, a 7mm test fixture, and an external dc bias source, dc bias current can be applied to devices such as the EMI filter (up to 1GHz).

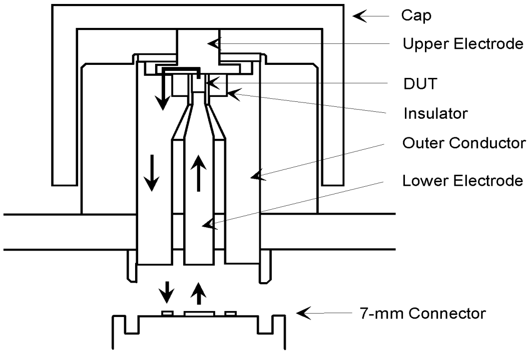


Figure 8. Cross-sectional drawing of 16196A/B/C

Figure 9. Total measurement solution example (with 16196A)

Advanced features for precise and versatile analysis

Powerful calibration and compensation functions

For manual measurements, a low-loss capacitor as a phase calibration standard, in addition to open/short/load calibration, improves the accuracy of Q measurements as shown. In addition to calibration, electrical length compensation for a fixture with open/short compensation fully correct measurement error caused by use of a test fixture. These functions realize high absolute measurement accuracy at the measurement plane, which in turn empowers accurate measurement of working standards.

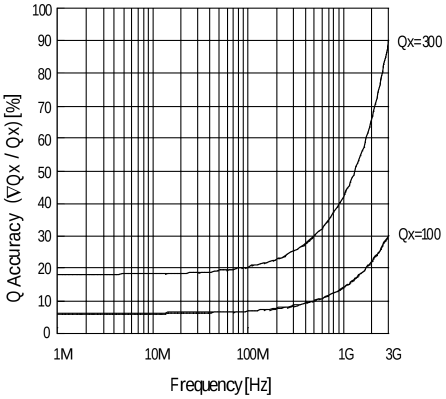
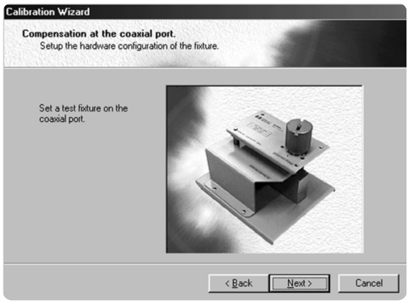


Figure 10. Q accuracy @ 7mm port (typical)

Calibration wizard function

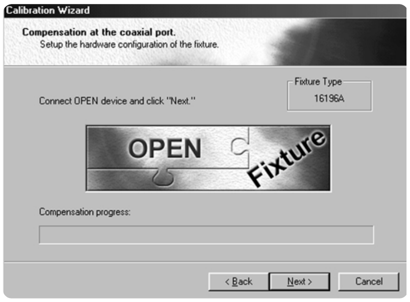
The 4287A offers you the sophisticated calibration/compensation method, calibration wizard function. The calibration wizard function eliminates errors of troublesome calibration/compensation procedures, and it allows you to easily make the 4287A ready to measure accurately.



Compensation at the coaxial port.
Setup the hardware configuration of the fixture.

Set a test fixture on the coaxial port.

Figure 11. Calibration wizard (fixture connection after calibration)



Compensation at the coaxial port.
Setup the hardware configuration of the fixture.

Connect OPEN device and click "Next."

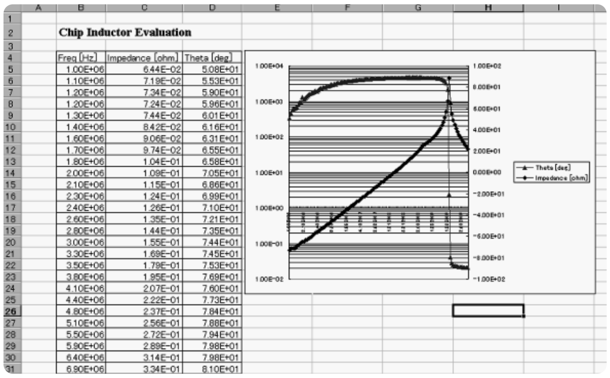
Fixture Type: 16196A

Compensation progress:

Figure 12. Calibration wizard (open compensation)

Frequency characteristics by using list sweep function

In the area of research and development, the frequency characteristics of the device can be required for their circuit demands. The 4287A's list sweep functions enable impedance measurements at a maximum of 256 multiple frequency points (=32 points max./table x 8 table max.). By using an external PC, spreadsheet software, and LAN interface, the frequency characteristics can be plotted in a graph as shown below.



Chip Inductor Evaluation

Freq [Hz]	Impedance [ohm]	Theta [deg]
1.00E+06	6.44E-02	5.08E+01
1.10E+06	7.19E-02	5.53E+01
1.20E+06	7.34E-02	5.90E+01
1.20E+06	7.24E-02	5.96E+01
1.30E+06	7.44E-02	6.01E+01
1.40E+06	8.42E-02	6.16E+01
1.60E+06	9.06E-02	6.31E+01
1.70E+06	9.74E-02	6.55E+01
1.80E+06	1.04E-01	6.58E+01
2.00E+06	1.09E-01	7.05E+01
2.10E+06	1.15E-01	6.86E+01
2.30E+06	1.24E-01	6.99E+01
2.40E+06	1.26E-01	7.10E+01
2.60E+06	1.35E-01	7.21E+01
2.80E+06	1.44E-01	7.35E+01
3.00E+06	1.55E-01	7.44E+01
3.30E+06	1.69E-01	7.45E+01
3.50E+06	1.79E-01	7.53E+01
3.80E+06	1.95E-01	7.69E+01
4.10E+06	2.07E-01	7.60E+01
4.40E+06	2.22E-01	7.73E+01
4.80E+06	2.37E-01	7.84E+01
5.10E+06	2.56E-01	7.88E+01
5.50E+06	2.72E-01	7.94E+01
5.90E+06	2.89E-01	7.98E+01
6.40E+06	3.14E-01	7.98E+01
6.90E+06	3.34E-01	8.10E+01

Figure 13. Frequency characteristics plot using spreadsheet software

Ordering Information

Agilent 4287A 1 MHz – 3 GHz RF LCR meter

Furnished Accessories:
- 1m Test cable with test head
- 16195B 7mm Calibration kit[1]
- Test fixture stand
- 3.5mm-to-7mm adapter
- Keyboard
- Mouse
- Power cable
- Operation Manual
(No test fixture is supplied with the 4287A.)

Options

001 Delete 16195B Calibration kit
002 Delete Test fixture stand
003 Delete 3.5mm-to-7mm Adapter
004 Add Working standard set[2]
010 Hard disk drive mass storage
011 Solid-state mass storage
(Must choose either 010 or 011.)
020 Test head extension cable
1A2 Delete Keyboard
1CS Delete Mouse
UK6 Commercial calibration certificate with test data

Manual options

ABA English localization
0B0 Delete Operation Manual
0B1 Add Operation Manual
0BW Add Service Manual

Cabinet options

1CM Rack flange kit
1CN Front handle kit
1CP Handle/rack kit

Note:
[1] The 16195B is used to calibrate the 4287A at the 7mm calibration plane by using the 3.5mm-7mm adapter. It consists of open, short, load, and low-loss capacitor standards.
[2] This is used to calibrate the 4287A at the handler DUT contacts. It consists of shorting bars, and 51.0 Ω chip resistors. (SMD size: 1.0 x 0.5 mm, 1.6 x 0.8 mm, 2.0x1.2 mm, 3.2 x 1.6 mm)

Accessories

16196A/B/C SMD test fixture

- Frequency range: DC to 3GHz
- Connector: 7mm
- Operating temperature range:
  -55°C to +85°C
- Accommodate SMD sizes:
- 16196A: 1608(mm) / 0603(inch)
- 16196B: 1005(mm) / 0402(inch)
- 16196C: 0603(mm) / 0201(inch)

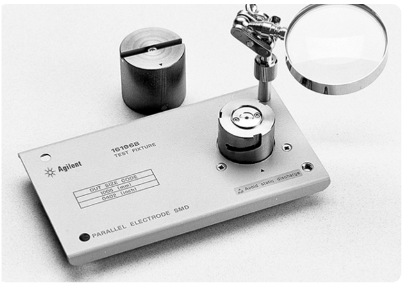


Figure 14. 16196A/B/C

16191A/16192A/16193A SMD test fixture

- Operating frequency: DC to 2GHz
- Accommodated SMD size:
  See Figure 15.

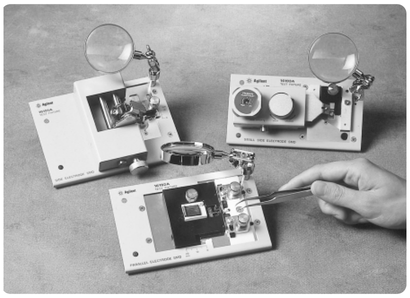


Figure 15. 16191A/16192A/16193A

16194A High temperature test fixture

- Operating frequency: DC to 2GHz
- Operating temperature range: -55°C
  to +200°C
- Accommodated SMD size:
  See Figure 16.

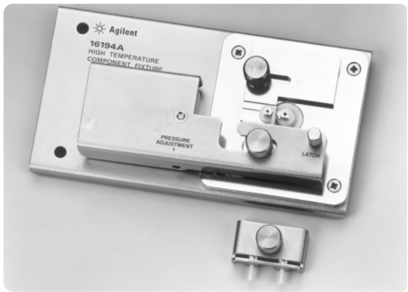


Figure 16. 16194A

16200A External DC bias adapter

- Operating frequency: 1MHz to 1GHz
- External DC Bias: 5A max, 40V
  (at the BNC connector from the
  external dc bias source)
- Operating temperature range:
  0°C to +55°C

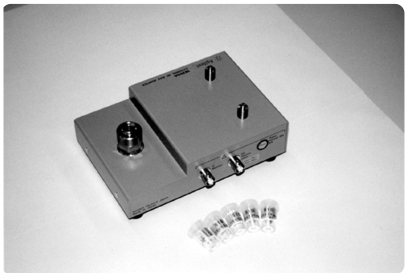
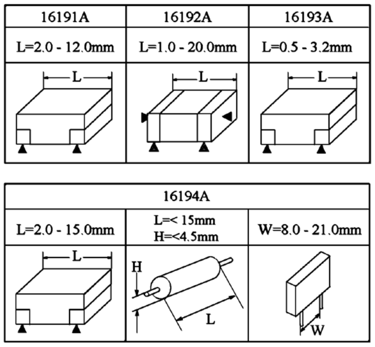


Figure 17. 16200A



16191A	16192A	16193A
L=2.0 - 12.0mm	L=1.0 - 20.0mm	L=0.5 - 3.2mm

16194A		
L=2.0 - 15.0mm	L=< 15mm H=<4.5mm	W=8.0 - 21.0mm

Figure 18. Accommodated SMD size

Ordering Information

Accessories

16196A	SMD test fixture
001	Delete magnifying lens and tweezers
16196B	SMD test fixture
001	Delete magnifying lens and tweezers
16196C	SMD test fixture
001	Delete magnifying lens and tweezers
16191A	Side electrode SMD fixture
001	Delete magnifying lens and tweezers
010	Add EIA and EIAJ standard chip size short bar set
011	Delete furnished short bar set
16192A	Parallel electrode SMD fixture
001	Delete magnifying lens and tweezers
010	Add EIA and EIAJ standard chip size short bar set
011	Delete furnished short bar set
16193A	Small side electrode SMD fixture
001	Delete magnifying lens and tweezers
010	Add EIA and EIAJ standard chip size short bar set
011	Delete furnished short bar set
16194A	High temperature test fixture
010	Add EIA and EIAJ standard chip size short bar set
011	Delete furnished short bar set
16200A	External DC bias adapter
16190B	Performance test kit*

* This kit includes an open, a short, a 50 Ω terminations, and an air line for the performance test to verify the impedance accuracy.

For more information about Agilent Technologies test and measurement products, applications, services, and for a current sales office listing, visit our web site:

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(tel) 0 800 738 378 (New Zealand)
(fax) (64 4) 802 6881

Asia Pacific:
Agilent Technologies
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