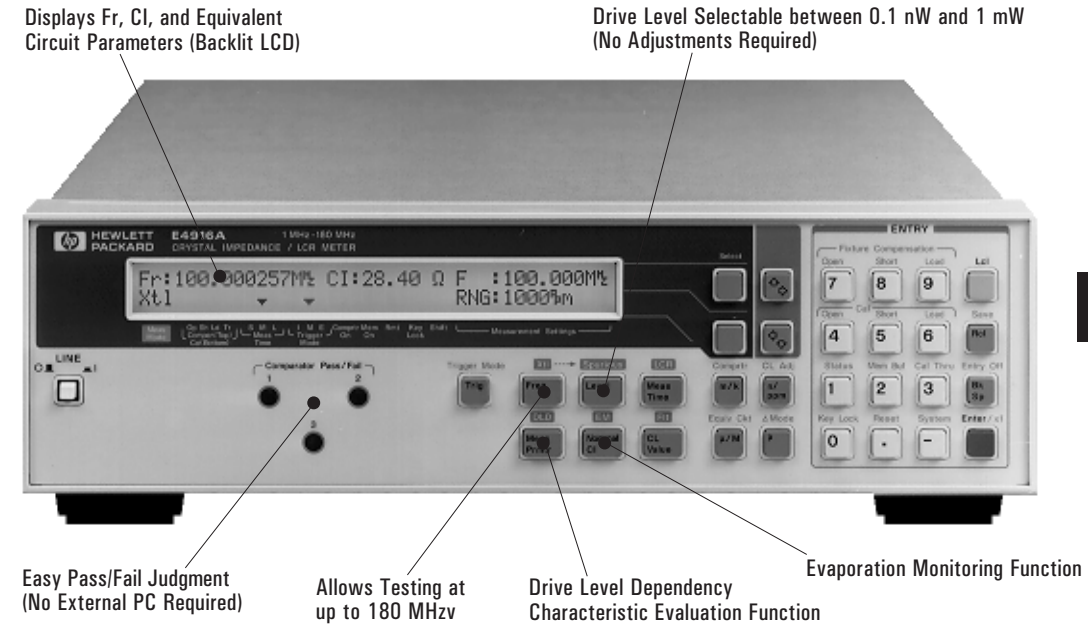
HEWLETT PACKARD
Expanding Possibilities

For Testing Crystal Resonators and Evaluating Their PerfoArmance Characteristics

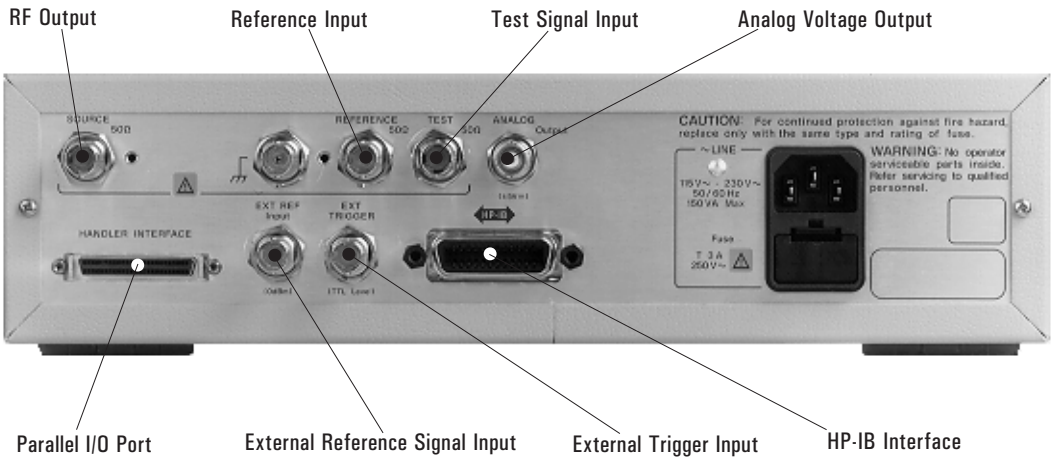
HP E4916A
Crystal Impedance Meter

PRODUCT OVERVIEW

- Meets IEC Standard through the Transmission π Network Method
- Allows Testing at up to 180 MHz
- Enables Applying 0.1 nW Low Drive Level
- Automates Testing and Evaluation through HP-IB and Parallel I/O Interfaces



Front View



Rear View

Mobile radios and communicators are increasingly expanding their applications into homes and offices. This makes the evaluation of crystal resonator characteristics at higher frequencies and/or lower drive levels more critical. However, conventional crystal impedance meters based on the oscillation method cannot properly meet the current measurement needs due to the following limitations on:

- High-end measurement frequency (60 MHz or below)
- Applicable power level

The HP E4916A is a crystal impedance meter based on the transmission π network method which enables you to:

- Test at high frequencies (1 MHz to 180 MHz)
- Apply low drive level (0.1 nW to 1 mW, when testing a 25 Ω DUT with the π circuit).

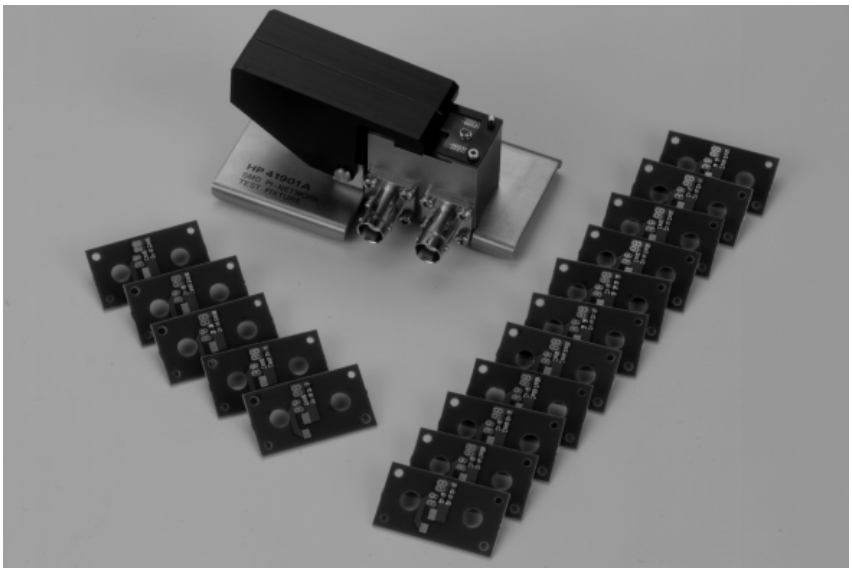
The HP E4916A yet provides a cost effective solution, comparable enough to conventional CI meters.

In addition to Fr and CI measurements, the HP E4916A offers a variety of testing capabilities including the equivalent circuit analysis and the drive level dependency characteristic evaluation (DLD) through easy-to-follow steps. It comes with the HP-IB and parallel I/O interfaces for easy connection to external equipment, thus allowing an automatic testing system to be configured.

Key Features

- Based on the transmission π network method recommended by the IEC444 standard.
- Wide frequency range (1 MHz to 180 MHz)
- Easy to change the drive level (0.1 nW to 1 mW)
- Applies up to 20 mW to the DUT when used in combination with the optional impedance probe (option 001)
- Allows you to use the same test fixtures as those for the network analyzer.
- Provides the π calibration to correct errors resulting from the extension of the cable.
- Saves and recalls up to 10 patterns of the system settings together with calibration data.

Meets a Variety of Measurement Needs on the Production Lines



HP 41901A SMD π Network and its Load Capacitances

For Intermediate Inspection:

- Consistent testing with final inspection. Based on the same measurement method as that for the network analyzer, the HP E4916A provides measurement results that can properly correlate with those obtained with the network analyzer used for final inspection.
- Simple operation. The HP E4916A simply requires trigger inputs to provide the desired parameters.
- Space saving. The HP E4916A can fit anywhere in the clean room. Also, it operates stand alone: no need to use a PC for testing.
- Self-contained. The HP E4916A requires no external devices for Fr (FL) and CI measurements and Pass/Fail judgment.

For Frequency Adjustments:

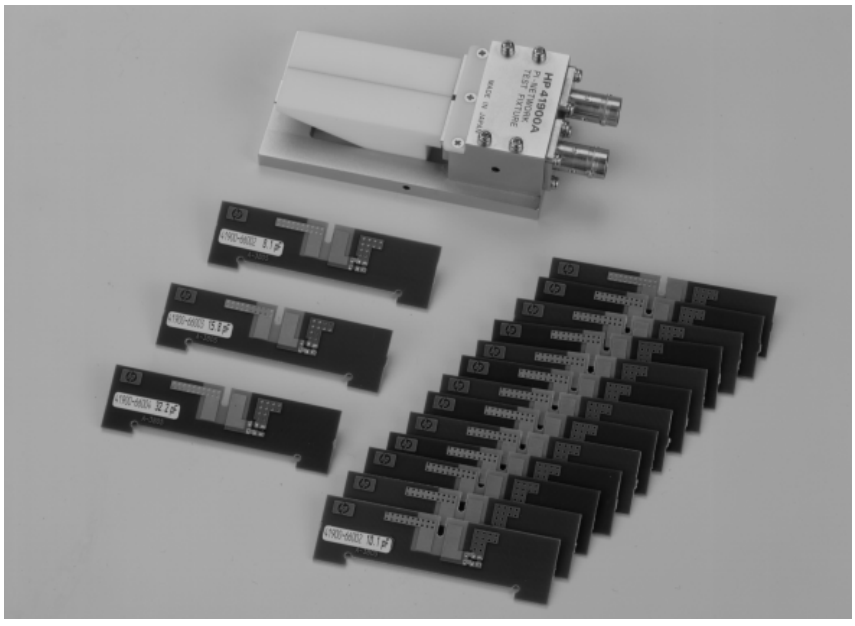
- EM (evaporation monitoring) mode. The HP E4916A comes with the EM mode for high-speed monitoring.
- Frequency trapping for automated evaporation. You can specify multiple trap frequencies to determine the transition of the resonance frequency. The HP E4916A detects in real time when the resonance frequency falls into each of the trap frequencies and outputs the results through the handler interface for proper controlling of the evaporator operation.

For Final Inspection:

- DLD (drive level dependency) characteristic measurement. The HP E4916A offers the DLD characteristic measurement function for efficient determination of variations in resonance frequency and impedance resulting from variations in drive level.
- Centralized data management. The HP-IB interface allows testing to be performed automatically and measurement data to be managed collectively.
- Integration to a handler. The handler interface allows connection between an external handler and the HP E4916A.

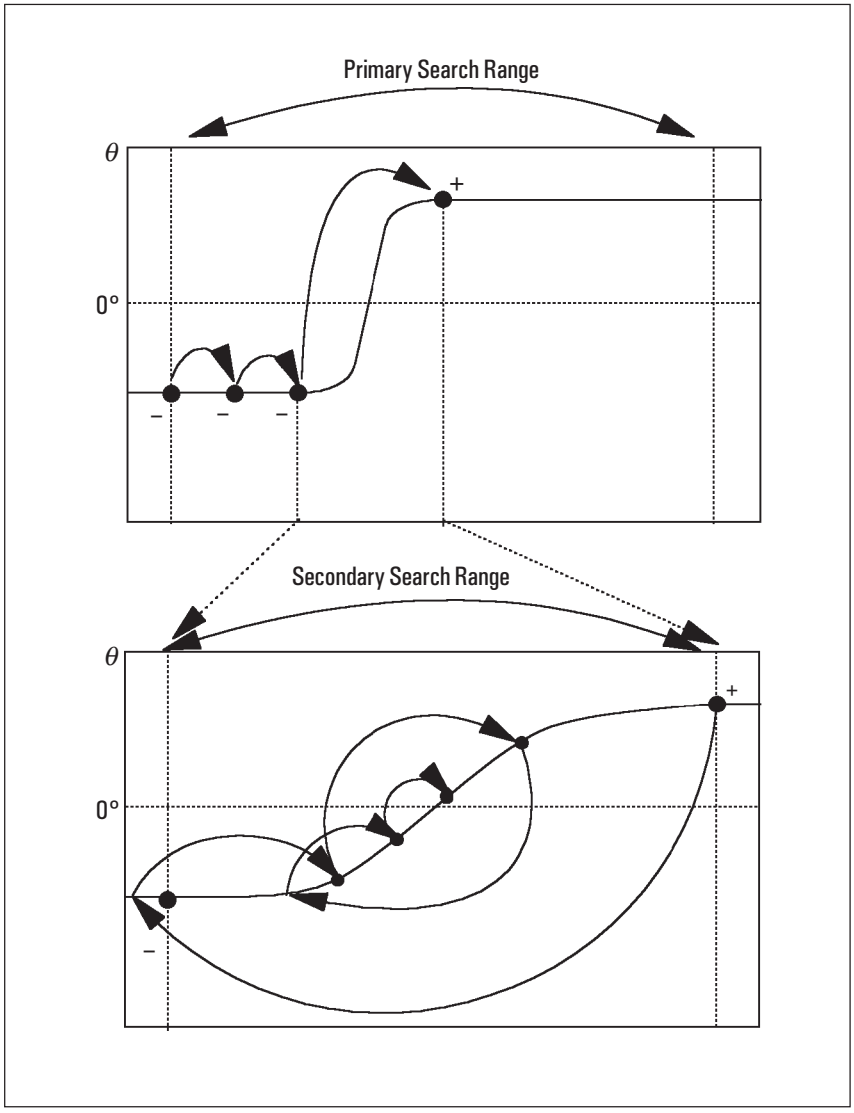
For Measurement with Load Capacitance:

- Consistent testing with network analyzer. When measuring a DUT with load capacitance, the HP E4916A can make it easy to correlate your results with those obtained with network analyzer, for which same test fixtures and load capacitance can be used.



HP 41900A π Network Test Fixture and its Load Capacitances

Resonance Point Determination by Recursive Search



CL boards with fixed capacitors are available as well as the CL board with the trimmer. Around 20 different CL boards with fixed C and a target capacitance trimming function will make your measurement with load capacitance easier to handle and much more reliable with substantially less error components than other solutions currently in use.

With the HP E4916A, you can measure a DUT with load capacitance using the same test fixtures and load capacitance as those for the network analyzer. Thus no correction is required to correlate your results to those obtained with network analyzer.

Unlike other conventional network analyzers, the HP E4916A searches for the resonance point (zero-phase point) in a unique manner for improved efficiency.

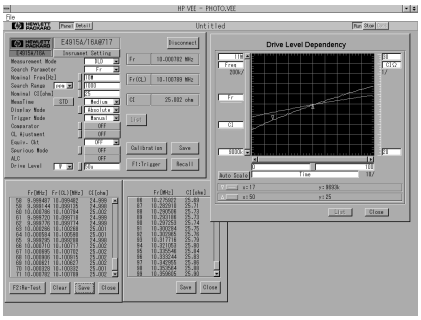
It begins to measure the phase at the lower end of the search range and continues its search by changing the frequency at specific intervals. The resonance point lies somewhere between the two adjacent points at which the phase for one point is negative and that for the other point positive. This is the primary search. Then, the HP E4916A slightly goes back in the search range and changes the frequency at smaller intervals such that the phase becomes closer to 0. The HP E4916A repeats its measurements until the phase is sufficiently close to 0. This is the secondary search.

Benefit:

This method provides constant frequency resolution regardless of the measurement time, because there are no needs to specify the number of measurement points. In addition, the power level is not interpolated. Therefore, the specified power is exactly applied to the DUT at the resonance point.

Sample Programs for Versatile Needs

HP VEE Control Program



The control program is available as standard with the HP E4916A. This program runs on the HP VEE and ensures easy evaluation of crystal resonator performance. (The instrument driver is not provided: this program controls the HP E4916A via direct I/O.)

This program allows you to:

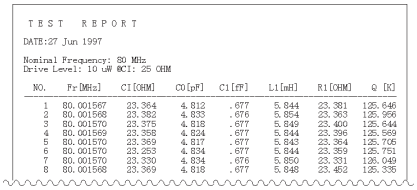
- obtain the best possible results during acceptance and quality assurance inspection,
- control the HP E4916A operation on the PC,
- graphically display the drive level characteristics, and
- save measurement data in the ASCII format.

This program is supplied with the run-only versions of VEE3.21 (Windows 95). (This program does not run on VEE4.0.)

HP BASIC Sample Programs

HP BASIC sample programs are available as standard with the HP E4916A for efficient crystal resonator testing on production lines. These sample programs allow you to:

- control the operation of two or more HP E4916As on a single PC,
- automatically document your measurement results and send it to a printer,
- save data in a format that can be loaded into a spreadsheet program such as Microsoft Excel, and Lotus 1-2-3.
- save and recall multiple patterns of the system settings together with calibration data on the PC.



T E S T R E P O R T

DATE:27 Jun 1997

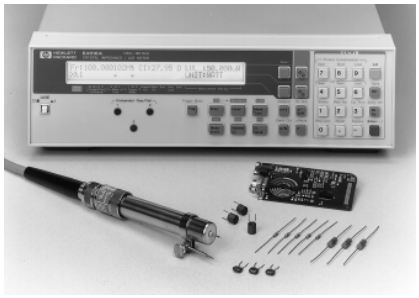
Nominal Frequency: 80 MHz
Drive Level: 10 uW @C1: 25 OHM

NO.	Fr [MHz]	C1 [OHM]	C0 [pF]	C1 [fF]	L1 [mH]	R1 [OHM]	Q [K]
1	80.001567	23.364	4.812	.677	5.844	23.381	125.646
2	80.001568	23.382	4.833	.676	5.854	23.363	125.956
3	80.001570	23.375	4.818	.677	5.849	23.400	125.644
4	80.001569	23.358	4.824	.677	5.844	23.396	125.569
5	80.001570	23.369	4.817	.677	5.843	23.364	125.706
6	80.001570	23.253	4.834	.677	5.844	23.359	125.751
7	80.001570	23.330	4.834	.676	5.850	23.331	126.049
8	80.001568	23.369	4.818	.677	5.848	23.452	125.338

Creating a documentation using HP BASIC sample program

System Requirements (Recommended)

- Processor: Pentium 90 MHz or higher
- Memory: 32 MB or more
- Disk space: 20 MB or more
- HP-IB interface (82335B, 82340, 82341C or D)



Option 001: Add Impedance Probe Kit

This kit allows you to

- apply up to 20 mW to the DUT (resonator) when used in place of the π network test fixture,
- use the HP E4916A as a powerful LCR meter when the option 010 (LCR measurement feature) is used, and
- vuse a variety of test fixtures for HP 4291A Impedance Analyzer (the HP 16099A is required).

(See the accessory guide for more information on the text fixtures that can be used in combination with the 16099A.)

Outline of Options 001 and 010
Measurement parameters: Z, Y, θ, R, X, G, B, L, C, D, Q
Measurement range: 0.2 to 10 kΩ
DC bias: ±30V max. (an external power supply is required)

Specifications

Measurement parameters:
Fr, Fs, Fa, FL, CI, Q, C0, C1, L1, R1, R0, G0, spurious, DLD, EM, filter bandwidth
(Note that Fr and Fs represent the frequencies at which the phase is 0 degree and the maximum conductance is attained, respectively. You can also set up the HP E4916A to search for Fr at which |Z| is minimal.)

Output
Frequency range: 1 MHz to 180 MHz/ 1 mHz resolution
Frequency accuracy: 2 ppm (can be improved up to 0.2 ppm through external reference input)
Inputs (typical)
Measurement range: 1 MHz to 180 MHz/1 mHz resolution
Impedance: 5 to 125 Ω/10 mΩ resolution
Return loss: 20 dB
Max. input level: 0 dBm
Damage level: 25 Vdc, 20 dBm
Average noise level: -130 dBm/Hz
Cross talk: -100 dB
Dynamic accuracy:

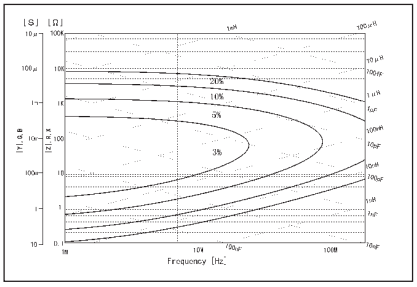
Input level	Level accuracy	Phase accuracy
0 to -20 dBm	0.5 dB	5°
-20 to -30 dBm	0.4 dB	3°
-30 to -40 dBm	0.1 dB	0.6°
-40 to -50 dBm	0.05 dB	0.3°
-50 to -60 dBm	0.05 dB	0.3°
-60 to -70 dBm	0.1 dB	0.6°
-70 to -80 dBm	0.5 dB	5°
-80 to -90 dBm	1.0 dB	10°

General Specifications
Power supply: 90 to 132 V or 198 to 264V, 47 to 63 Hz, 100 VA max.
Operating temperature/humidity: 0 to 55 °C/15 to 95%
Outer dimensions: 320W × 100H × 450D mm
Weight: 5.3 kg

Others
Interface: HP-IB interface, handler interface
External reference input: 1/2/5/10 MHz, ±10 ppm
Equipment supplied with the HP E4916A:
2 BNC cables (120 cm), 1 operation manual, 1 user's guide, 4 sample program disks (VEE run-only versions included), 1 power cable

Measurement Accuracy
Resonator testing:
Fr: 2 ppm (SPC: Supplemental Performance Characteristics)
CI: 5% (SPC)

LCR measurements:
Basic accuracy: 3% (SPC)



Impedance measurement range (SPC)

Measurement time (SPC):
The duration of time between the triggering of the HP E4916A and the completion of the measurement was measured. (The time required to transfer data is not included. The DLD measurement was made at 5 points; 10 nW, 100 nW, 1 µW, 10 µW, and 100 µW.)

Frequency	Q	Fr,CI	Fr,CI + EQV	DLD	MEAS TIME
100 MHz	83,000	240 ms	1.02 s	890 ms	SHORT
60 MHz	110,000	190 ms	730 ms	775 ms	SHORT
24 MHz	135,000	146 ms	680 ms	705 ms	SHORT
2 MHz	40,000	280 ms	1.64 s	--	MEDIUM
2 MHz	--	--	--	2.57 s	LONG

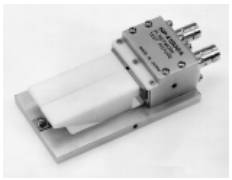
Note: Measurement time may vary depending on the resonance frequency even if two resonators of the same type are tested.

Accessories and Other Equipment

HP E4915A Crystal Impedance Meter

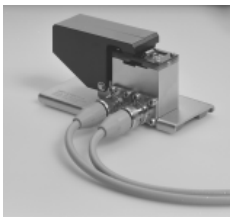
Inexpensive model (no variable power function available with the HP E4916A)
Frequency range: 1 MHz to 180 MHz
Output power: -5dBm fixed
Comes with all HP E4916A measurement capabilities other than DLD, EM, and LCR measurement functions.

HP 41900A π Network Test Fixture



Meets the IEC444 and JIS standards. Ideal for final and acceptance inspections. Can test resonators with load capacitance when used in combination with option 001.

HP41901A SMD π Network Test Fixture



SMD type π network test fixture that offers superb repeatability. Ideal for final and acceptance inspections. Supports 6 types of QIAJ (Quartz Crystal Industry Association of Japan) SMDs.

Ordering Information

HEWLETT PACKARD
Expanding Possibilities

HP E4916A Crystal Impedance Meter

Options:
001: Add Impedance Probe Kit
010: Add LCR Measurement Feature
0B0: Delete Instruction Manual
0B1: Add Instruction Manual
ABA: English Instruction Manual
ABJ: Japanese Instruction Manual
UK6: Inspection Record
W30: 3-year Repair and Replacement Service (from the date of delivery)
W32: 3-year Regular Calibration Service (from the date of delivery)
ICM: Rack Mount Kit
ICN: Front Handle Kit

Upgrade Kit

This kit appends optional features to the HP E4916A that has been purchased.

HP E4916U Upgrade Kit
001: Add Impedance Probe*
010: Add LCR Measurement Feature*
UK6: Inspection Record
(*:Applicable to the HP E4916A only.)

HP E4915A Crystal Impedance Meter

Options:
0B0: Delete Instruction Manual
0B1: Add Instruction Manual
ABA: English Instruction Manual
ABJ: Japanese Instruction Manual
UK6: Inspection Record
W30: 3-year Repair and Replacement Service (from the date of delivery)
W32: 3-year Regular Calibration Service (from the date of delivery)
ICM: Rack Mount Kit
ICN: Front Handle Kit

Accessories

HP 41900A π Network Test Fixture

Standard:
16 CL boards with fixed capacitance, Calibration standards (50 Ω and SHORT)
Option:
001: Variable Load Capacitance Adapter Kit
includes 1 CL board with the trimmer, and SMD capacitors

HP 41901A SMD π Network Test Fixture

Options:
010: Attachment Kit: QIAJ-QS06, 4 Terminals
020: Attachment Kit: QIAJ-QS06, 2 Terminals
030: Attachment Kit: QIAJ-QS07, 4 Terminals
040: Attachment Kit: QIAJ-QS07, 2 Terminals
050: Attachment Kit: QIAJ-QS08, 4 Terminals
060: Attachment Kit: QIAJ-QS08, 2 Terminals
* Supplied with the following parts: 22 CL boards with fixed capacitance, 1 Contact board, 1 Device positioning plate, and Calibration standards (50 Ω and SHORT)

A variable load capacitance (CL with the trimmer) board, supplied with a single option number before, should now be ordered with a combination of the above and below options.

011: Variable Load Capacitance Adapter Kit: QIAJ-QS06, 4 Terminals
021: Variable Load Capacitance Adapter Kit: QIAJ-QS06, 2 Terminals
031: Variable Load Capacitance Adapter Kit: QIAJ-QS07, 4 Terminals
041: Variable Load Capacitance Adapter Kit: QIAJ-QS07, 2 Terminals
051: Variable Load Capacitance Adapter Kit: QIAJ-QS08, 4 Terminals
061: Variable Load Capacitance Adapter Kit: QIAJ-QS08, 2 Terminals
* Supplied with the following parts: 1 CL board with the trimmer, and SMD capacitors

LCR Measurement Accessories

HP 16099A APC-7 Adapter
HP 16092A RF Spring Clip
HP 16093A RF Two-Terminal Binding Post
HP 16191A Side Electrode SMD Test Fixture
HP 16192A Parallel Electrode SMD Test Fixture
HP 16193A Small Side Electrode SMD Test Fixture
HP 16194A Widae Temperature SMD Test Fixture

Note:
See the Accessories Selection Guide For Impedance Measurements (P/N 5965-4792E) for more information on HP 16xxxA.

For more information about Hewlett-Packard test & measurement products, applications, services, and for a current sales office listing, visit our web site, http://www.hp.com/go/tmdir. You can also contact one of the following centers and ask for a test and measurement sales representative.

United States:
Hewlett-Packard Company
Test and Measurement Call Center
P.O. Box 4026
Englewood, CO 80155-4026
1 800 452 4844

Canada:
Hewlett-Packard Canada Ltd.
5150 Spectrum Way
Mississauga, Ontario
L4W 5G1
(905) 206 4725

Europe:
Hewlett-Packard
European Marketing Centre
P.O. Box 999
1180 AZ Amstelveen
The Netherlands
(31 20) 547 9900

Japan:
Hewlett-Packard Japan Ltd.
Measurement Assistance Center
9-1, Takakura-Cho, Hachioji-Shi,
Tokyo 192, Japan
Tel: (81) 426 56 7832
Fax: (81) 426 56 7840

Latin America:
Hewlett-Packard
Latin American Region Headquarters
5200 Blue Lagoon Drive
9th Floor
Miami, Florida 33126
U.S.A.
Tel: (305) 267-4245
(305) 267-4220
Fax: (305) 267-4288

Australia/New Zealand:
Hewlett-Packard Australia Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
Australia
Tel: 1 800 629 485 (Australia)
0800 738 378 (New Zealand)
Fax: (61 3) 9210 5489

Asia Pacific:
Hewlett-Packard Asia Pacific Ltd.
17-21/F Shell Tower, Times Square,
1 Matheson Street, Causeway Bay,
Hong Kong
Tel: (852) 2599 7777
Fax: (852) 2506 9285

Printed in U.S.A. 11/98
5967-6115E