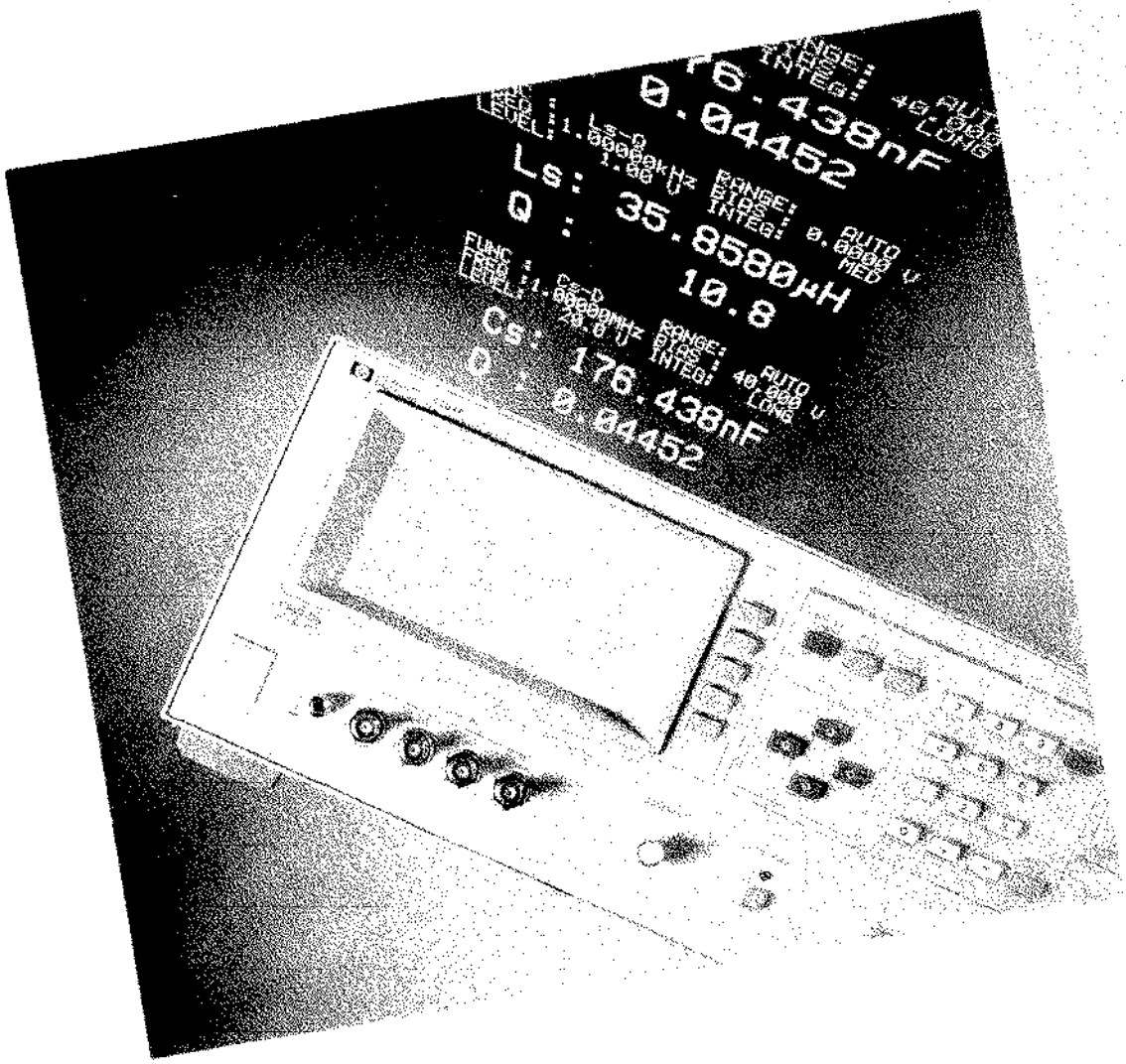
HEWLETT PACKARD

HP 4284A/HP 4285A

HP Precision LCR Meter Family

20 Hz to 1 MHz
75 kHz to 30 MHz

A New Standard For Precise Component, Semiconductor and Material Measurements



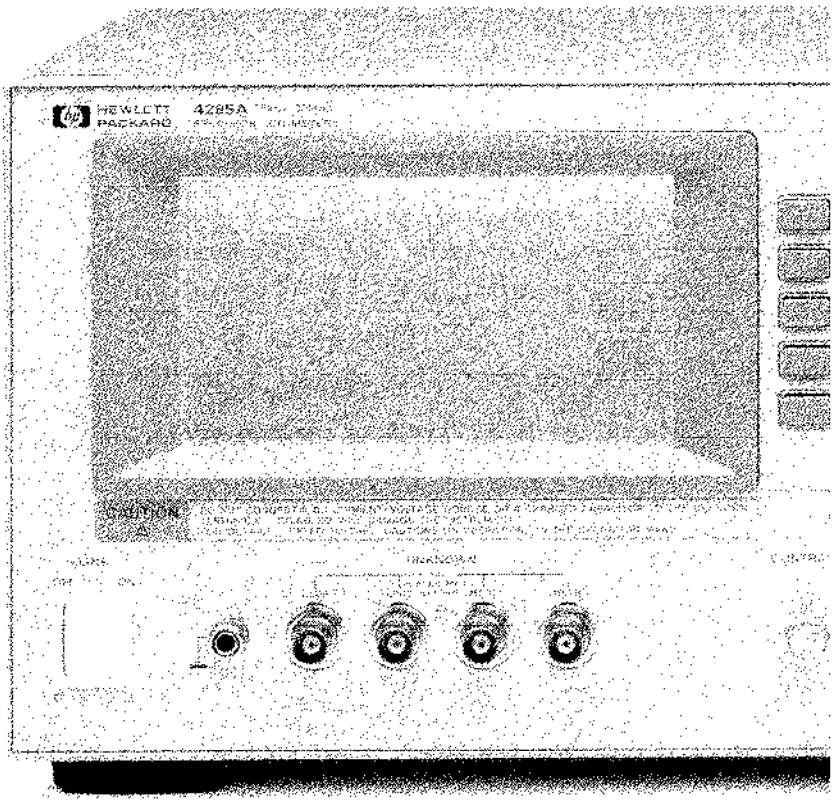
HP Precision LCR Meter Family

Utilize State-of-the-Art Measurement Technologies

- 6-digits of Resolution at any Range
- Basic Accuracies of 0.05% (HP 4284A) and 0.1% (HP 4285A)
- 20 Impedance parameters to access and measure
- Digital Q Measurements
- Constant V or I Test Signal Level
- 20 Vrms Test Signal Level (HP 4284A)

Move Your Process Toward Error-Free Operation

- Instrument Setup State Storage
- Instrument Memory Cards
- Comparator Functions
- Selectable Frequency Error Corrections
- Scanner Interface Removes Parasitics



Key Specifications

HP 4284A Precision LCR Meter

Test Frequency	20 Hz to 1 MHz, over 8600 selectable frequencies
Measurement Range*	[Z],R,X: 0.01 mΩ to 99.9999 MΩ [Y],G,B: 0.01 nS to 99.9999 S C: 0.01 fF to 9.99999 F L: 0.01 nH to 99.9999 kH D: 0.000001 to 9.99999 Q: 0.01 to 99999.9
Basic Accuracy	[Z], C and L: 0.05% D: 0.0005
Test Signal Level Range	Voltage: 5 mVrms to 2 Vrms Current: 50 μArms to 20 mArms
Constant Test Signal Level Range	Voltage: 10 mVrms to 1 Vrms Current: 100 μArms to 10 mArms
Measurement Time†	39 ms/190 ms/830 ms at 1 KHz

HP 4284A with Option 001

Test Signal Level Range	Voltage: 5 mVrms to 20 Vrms Current: 50 μArms to 200 mArms
Constant Test Signal Level Range	Voltage: 10 mVrms to 10 Vrms Current: 100 μArms to 100 mArms
Internal DC Bias	±40 V with 0.1% accuracy

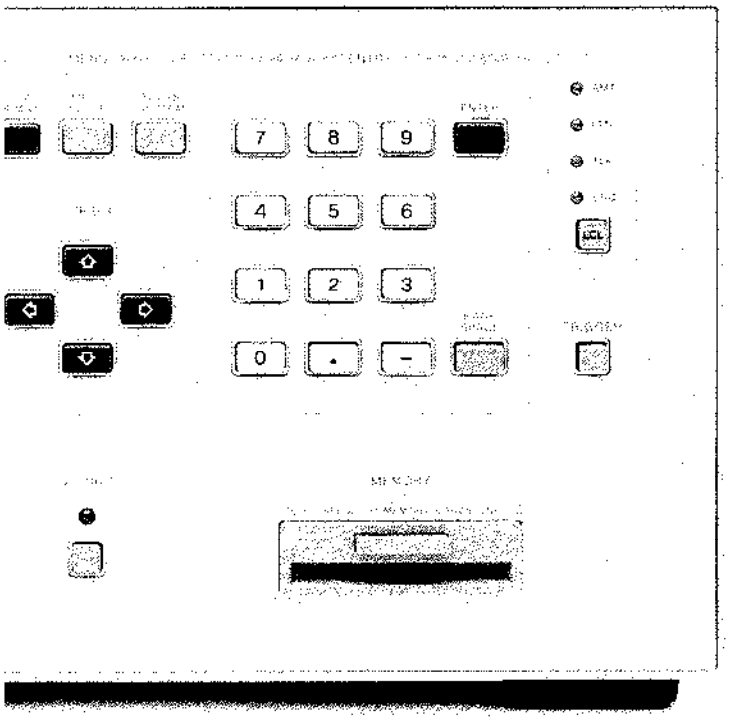
HP 4284A with Option 002 and HP 42841A

DC Current Bias	0.01 A to 20 A. Maximum of 40 A with paralleled HP 42841As and HP 42842B.

†Supplemental Information Only

*Refer to specifications for complete accuracy.

Satisfying Your Performance Needs



Adapt Instrument Configurations To Fit Your Test

- Internal Voltage Biasing up to ±40 Vdc
- High Current Biasing up to 40 A dc
- Wide Range of Frequencies, 20 Hz to 30 MHz
- BINning and Comparator Functions for Handlers
- SMD, Axial and Radial Test Fixtures

Simplify Your System Development and Integration

- Standard Instrument Programming Language
- Mouse-driven Software for the HP 1284A
- Test Port Extensions
- Identical Operation for the Entire Family of Products
- Scanner Interface

Key Specifications

HP 4285A Precision LCR Meter

Test Frequency	75 kHz to 30 MHz with 100 Hz resolution
Measurement Range*	|Z|,R,X: 0.01 mΩ to 99.9999 MΩ |Y|,G,B: 0.01 nS to 99.9999S C: 0.01 fF to 999.999 μF L: 0.001 nH to 99.9999H D: 0.000001 to 9.99999 Q: 0.01 to 99999.9
Basic Accuracy	|Z|,C and L: 0.1% D:0.001
Test Signal Level Range	Voltage: 5 mVrms to 2 Vrms Current: 200 μA ms to 20 mArms
Constant Test Signal Level Range	Voltage: 10 mVrms to 1 Vrms Current: 100 μArms to 20 mArms
Measurement Time[1]	30 ms/65 ms/200 ms

HP 4285A with Option 001

Internal DC Bias	±40 V with 0.1% accuracy

HP 4285A with Option 002 and HP 42841A and HP 42842C

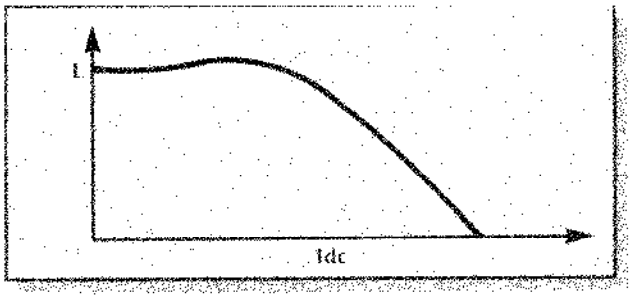
DC Current Bias	0.01A to 10A

HP 4285A with Option 002 and HP 42851A

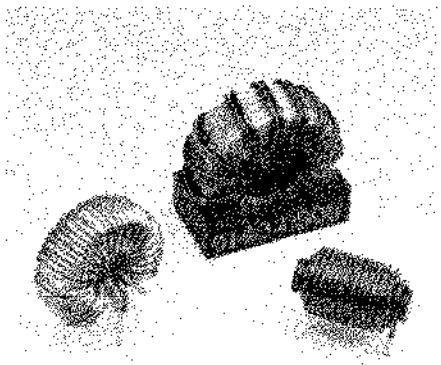
Measurement Function	Q-L/C
Q Measurement Range	5.00 to 999.99
Q Display Range[2]	0.01 to 99999.9
Basic Accuracy[1]	±5%
Test Signal Level[1]	≤ 1.0 Vrms
Automatic Tuning Time[1]	75 ms to 1.5 s

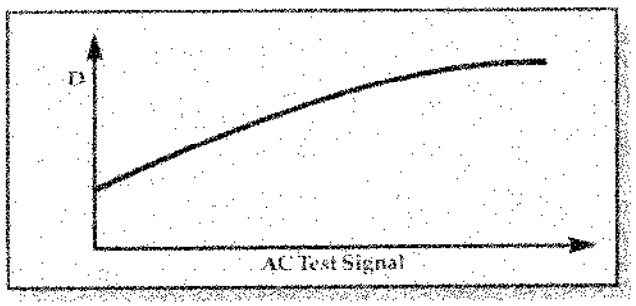
[1] Supplemental Information Only [2] The range of Q values derived by calculation

*Refer to specifications for complete accuracy.

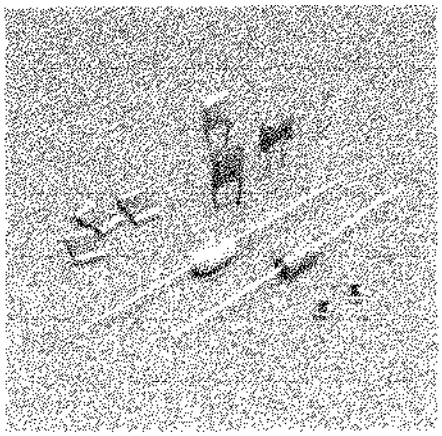


Inductance rolloff due to high DC current bias.





Dissipation factor rise due to high AC signal.



Characterize Inductive Devices

- Simulate High Current Conditions
- Identify Device Properties Precisely
- Test To RF Frequencies

Low Frequency Measurements: HP 4284A

Inductive devices can now be accurately characterized from 20 Hz to 1 MHz with a dc bias current up to 40 A dc.

High Frequency Measurements: HP 4285A

The HP 4285A's wide 75 kHz to 30 MHz range allow you to test RF inductors with improved accuracy and 0.001 nH resolution. Magnetic heads, ferrite-cores, and power inductors that need to be tested at a specified current signal level can be easily tested with the HP 4285A.

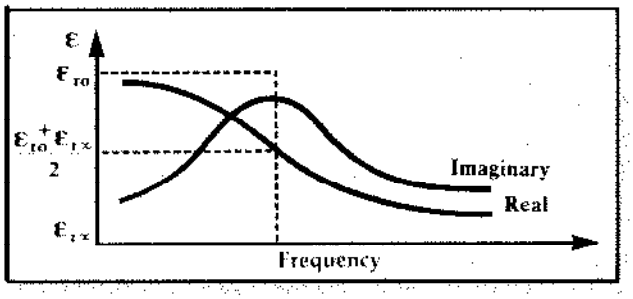
Precise Ceramic Capacitor Measurements

- Test at 1 kHz and 1 MHz
- Resolve Measurements to Low Values
- Maintain Constant Signal Levels

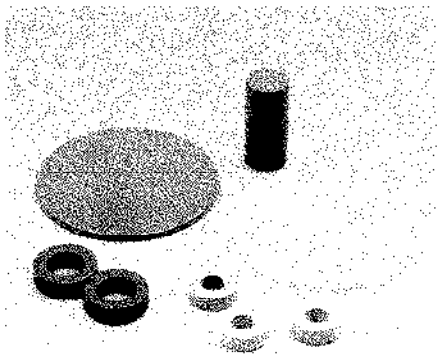
1 kHz and 1 MHz are the primary testing frequencies for ceramic materials and capacitors. The HP 4284A can provide these test frequencies while maintaining an equally excellent accuracy and 6 digits of measurement resolution.

1 MHz accuracies of capacitance (0.05%) and dissipation factor (0.0005) are essential for characterizing DUT s with low dissipation factors. Dissipation factors can change as a function of the applied test signal level to the DUT. For reliable and consistent measurements, the HP 4284A can maintain a constant voltage test signal level.

Adaptable Parameter Testing



A material's characteristics versus frequency.

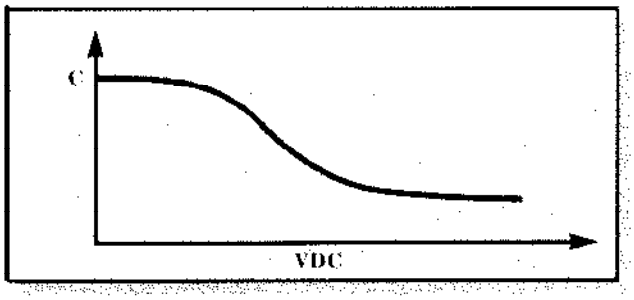


Discover New Material Properties

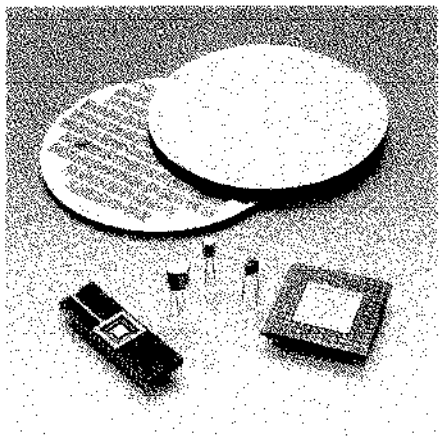
- High Accuracy and Precise Measurements
- Wide Frequency Ranges
- High Test Signal Levels
- HP 16451B Dielectric Test Fixture

The HP Precision LCR Meter Family provides the accuracy, resolution, high test signal and bias levels required for material measurements. Using the HP 16451B Dielectric Test Fixture provides you with accurate dielectric and dissipation factor measurements.

The ability to output a constant test signal level permits repeatable and accurate magnetic/dielectric measurements. Both the HP 4284A and HP 4285A offer variable voltage and current test signal level control.



C-V characteristics sample—MOS diode



Semiconductor Testing

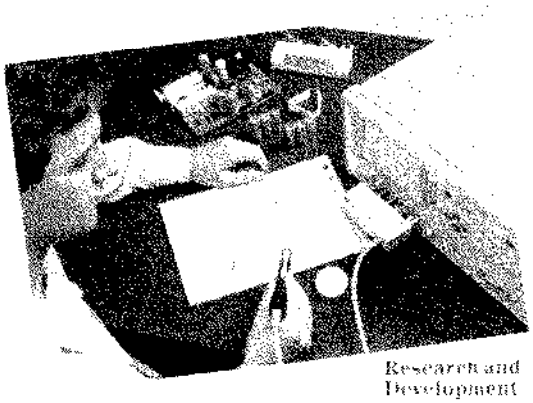
- Extend the Test Cable to the DUT
- Detect Small Parameter Changes
- Rapidly Acquire Data
- Test at Multiple Frequencies

Both instruments allow you to extend the front panel measurement port through test cables, switches, and probers directly to the DUT. The 6-digits of resolution give you the ability to sense and identify changes not normally seen by conventional LCR meters.

The accuracies of the HP 4284A at key test frequencies up to 1 MHz permit complete DUT evaluation for either production or laboratory needs.

For high speed device testing at frequencies above 1MHz, the best solution is the HP 4285A.

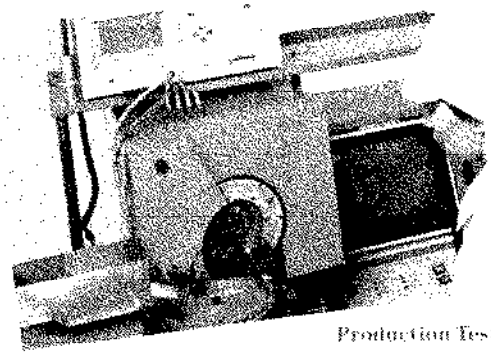
One Family for Your Product's Life Cycle



Research and Development

Research Tomorrow's Products Now

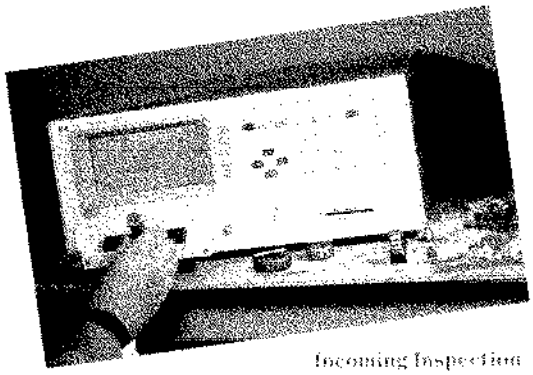
- **Increase Measurement Confidence**
  The basic accuracies are: HP 4284A 0.05% and HP 4285A 0.1%.
- **Detect 1 PPM Changes**
  The six digits of resolution permit you to measure differences in materials not detectable before.
- **Fit the Instrument to Your Test Needs**
  For low frequency applications the HP 4284A is the ideal tool. For testing at RF frequencies the HP 4285A is the best solution.



Production Test

Reduce Production Test Factors

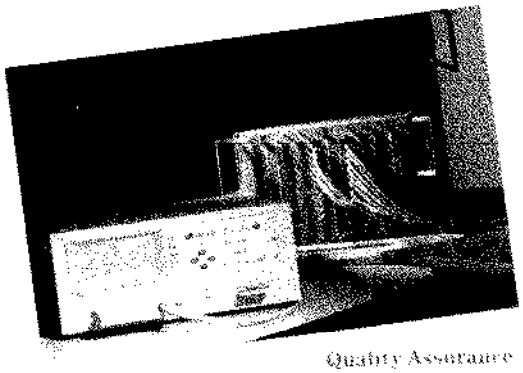
- **Increase Test Throughput**
  The Precision LCR Meter Family reduces testing costs by providing accurate high throughput testing.
- **Interface Easily to Handlers**
  Built-in comparator, cable compensation, and interfaces permit system integration.
- **Minimize Operator Error**
  Instrument state storage minimizes costly setup errors.



Incoming Inspection

Comprehensive Incoming Inspection

- **Wide Frequency Range**
  The HP 4284A has a range of 20 Hz to 1 MHz while that of the HP 4285A extends from 75 kHz to 30 MHz.
- **Voltage and Current Biasing**
  Both instruments have accessories and options that can bias high levels of Vdc or Idc.
- **Fixtures For Many Types of DUT s**
  HP offers a variety of fixtures for axial, radial, and SMD components.



Quality Assurance

Automated Quality Assurance

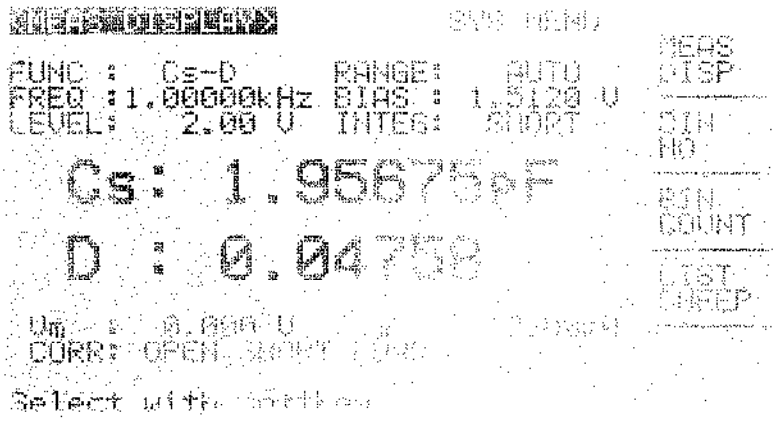
- **Reduce Your System Development Time**
  The HP 4284A and HP 4285A are designed to be used as elements in systems. This means HP IB programming and the ability to interface with scanners.
- **Painlessly Integrate The System**
  HP IB and a scanner interface allow the instruments to easily integrate into system configurations.
- **Leverage Your Programming Experience**
  Learning to program one instrument automatically means you learn both.

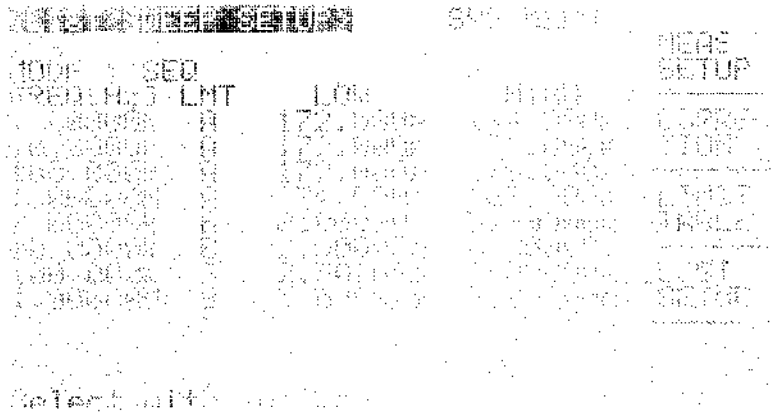
Simple Front Panel Operation

- Clearly View the Display
- See All Instrument Settings
- Interactive Softkeys For Simple Control

Directly view all instrument settings and measurement results on the large LCD display. This simplifies operation and improves operator efficiency by minimizing readout error.

The softkeys simplify front panel operation by allowing the user to easily change instrument states by moving the LCD cursor with the cursor keys. The softkeys will automatically change to reflect the cursor's position. This minimizes the number of menus and key strokes.





Customize test frequencies

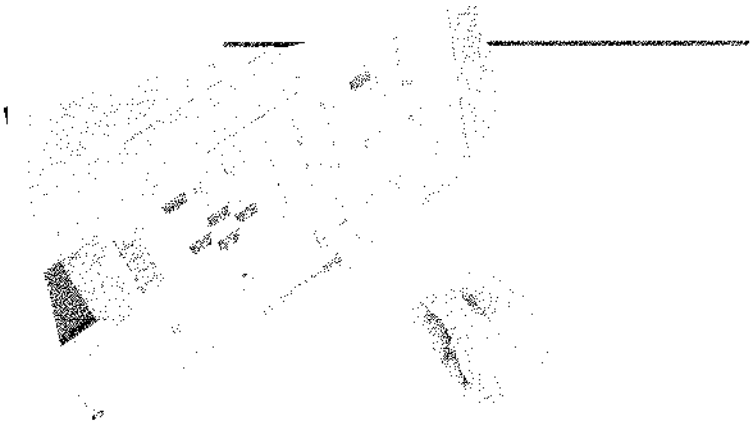
Non-Volatile Memory

- Eliminate Costly Setup Errors
- Increase User Productivity
- Archive Tests

The instruments contain two types of user accessible memory; internal and external (memory cards). The memory can easily be used to store measurement setups. Later, a setup can be loaded back into the instrument. This reduces test setup errors and increases the user's productivity.

The memory can store 10 different instrument states, complete with correction data and system configuration. Entire setups including limit information can now be stored and loaded using either the internal memory or the memory card.

The memory card system is completely electronic and is based on EEPROM.



Inserting the Memory Card

Testing with the Proper Tools

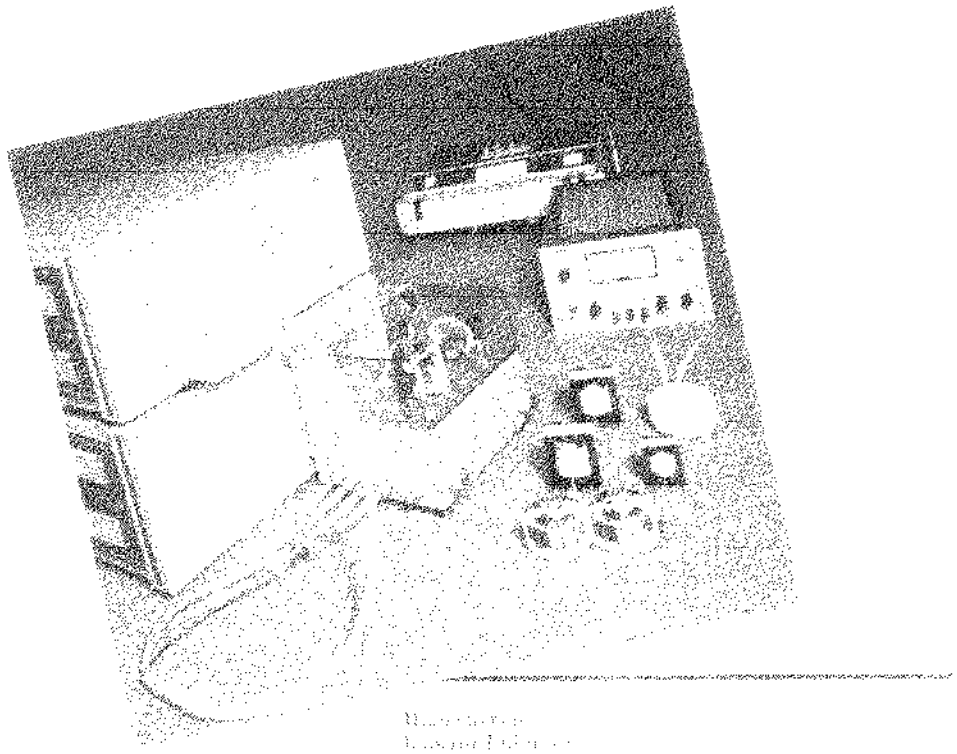
Measure Your Power Supply's Components Performance

- Test Your Components Under Load Conditions
- Bias Inductive Devices with High Currents
- Satisfy Your Needs with the Right Instrument

Designing advanced switching power supplies require the use of inductors and transformers that operate in the RF regions.

For low frequencies, the HP 4284A Precision LCR Meter with the HP 42841A Bias Current Source, and the 42842A/B Bias Current Test Fixtures all combine to form a 40 A dc test system.

Where a high frequency measurement is required, use a HP 4285A, a HP 42842C Bias Current Test Fixture, and a HP 42841A Bias Current Source to achieve up to 10 A dc biasing with measurements at 30 MHz.



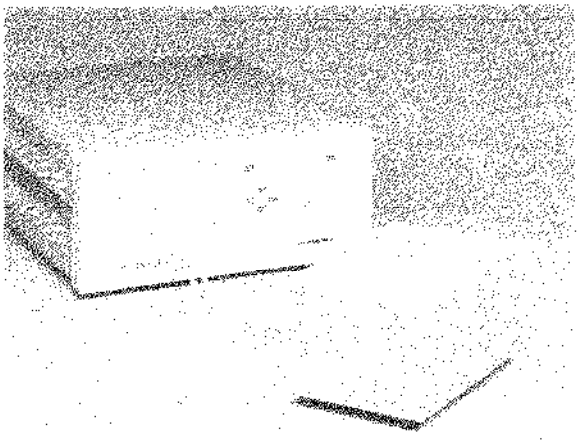
Perform Direct Q Measurements with the HP42851A Precision Q Adapter

- Accurate For Materials and Components
- Convenient and Fast Measurements
- Reliable and Simple Operation

The resolution and frequency range of the HP 4285A address many commercial and military requirements for inductor testing, particularly MIL-STD-C-15305D.

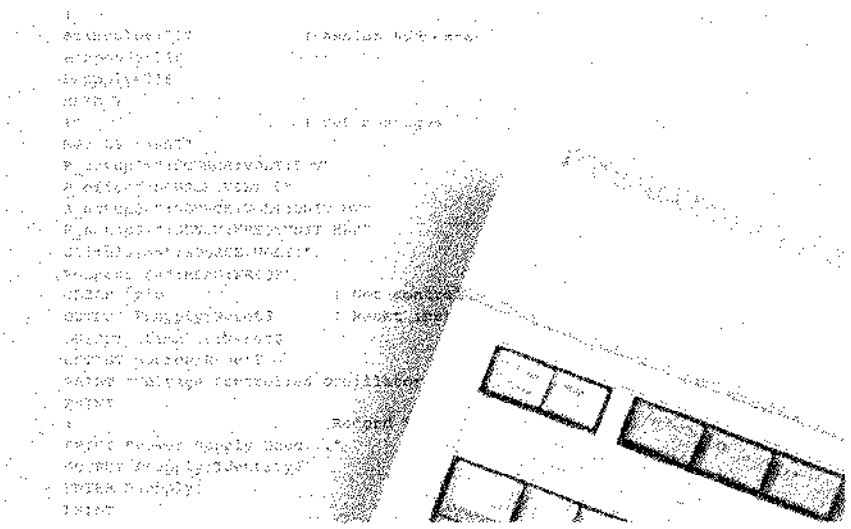
The HP 4285A and HP 42851A provide you with excellent Q accuracy at the resonant frequency. Tuning operation, calculation of measured values, and compensation are fully automated, thus improving measurement efficiency and reliability.

The instrument directly measures Q factors up to 1,000 with 0.01 resolution. To measure high Q factors greater than 1000, the HP 4285A derives Q values up to 100,000 through calculation using data from simple routine measurements. Automatic tuning operation minimizes errors, giving you faster, more reliable measurements.



HP 4285A and HP 42851A Precision Q Adapter

Reduce System Development Time



Code Generation Made Easy

A Standardized and Universal Instrument Language

- Leverage Your Programming Experience
- Upgrade Systems Easily
- Protect Software Investments

The HP Precision I/O Software Family underscores the instrument programming language Standard Commands for Programmable Instruments (SCPI).

SCPI eliminates troublesome instrument programming problems by defining a common language for all instruments. SCPI gives you the ability to program different instruments from different manufacturers using the same commands. Now you will be able to upgrade to the latest system instrument without changing the production test program. With SCPI you know the HP 12C4A and HP 75000's language before ever seeing the instrument or a manual.

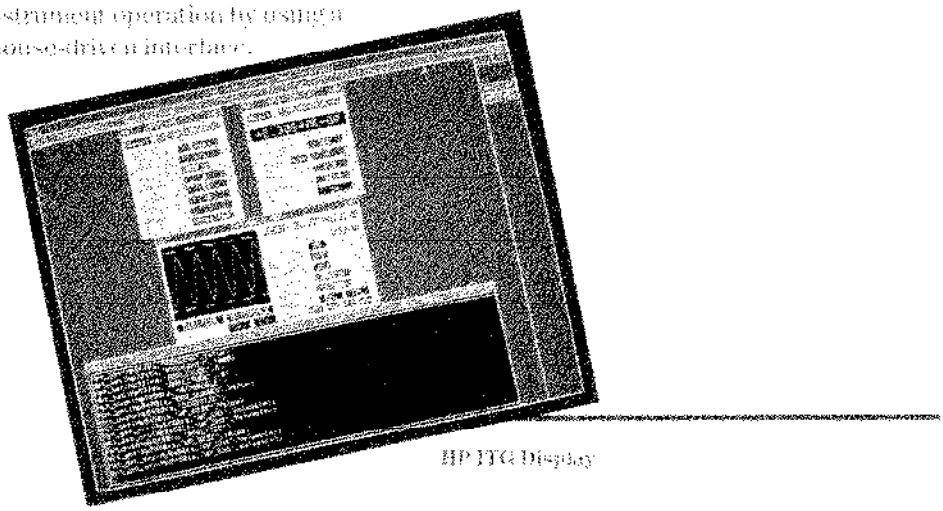
HP Interactive Test Generator Software Gets You Up and Running... Fast

- Create Measurement Procedures Quickly
- Reduce Coding Tasks
- Use the Strengths of HP Basic

HP 12C4A Instrument Drivers for HP ITG are available as HP E2091A Instrument Drivers.

HP Interactive Test Generator (HP ITG) provides a mouse-driven environment designed for instrument control. Using pre-written software instrument panels, you can change individual control settings or entire instrument states. No longer will you need to search through manuals for commands. HP ITG chooses the command and sends it automatically. With instruments connected to the HP IB, you can develop your measurement procedures interactively.

Automatic code generation translates your measurements into an application program quickly without additional effort. As you adjust controls and make measurements, your actions are logged as HP BASIC code in a text window. You can perform editing and store the code to disc while in HP ITG. HP ITG instrument drivers provide an environment for communicating to HP IB instruments. These drivers simplify instrument operation by using a mouse-driven interface.



HP ITG Display

Specifications

All specifications are common to the HP 4284A and HP 4285A unless otherwise noted.

Measurement Functions

Measurement Parameters:
|Z| (impedance), |Y| (admittance), θ (phase), R (resistance), X (reactance), G (conductance), B (susceptance), L (inductance), C (capacitance), Q (quality factor), D (dissipation factor), ESR (equivalent series resistance) and R_p (parallel resistance).

20 parameter combinations are available

Equivalent Circuit Modes: Series and Parallel

Mathematical Functions: Deviation and Percent Deviation

Trigger: Internal, External and Manual

Delay Time: 0 to 60.000 s in 1 ms steps

Measurement Terminals: Four-Terminal Pair

Test Cable Lengths:
HP 4284A-Standard: 0 and 1 meter
Option 006: adds 2 and 4 meter extention
HP 4285A-Standard: 0, 1,and 2 meters

Integration Time: Short, Medium and Long

Test Signal

Test Frequency:
HP 4284A: 20Hz to 1MHz, 8610 selectable frequencies
HP 4285A: 75kHz to 30MHz, 100Hz steps

Frequency Accuracy: ±0.01%

Output Impedance:
HP 4284A: Standard: 100 ohms ±3%
Option 001: 100 ohms ±6%
HP 4285A: (25 + 0.5fm) ohms ±10%@1MHz, ±30%@30 MHz, fm=test frequency in MHz

AC Test Signal Modes:
Normal: Programs selected voltage or current at the measurement terminals when they are opened or shorted,respectively.
Constant: Maintains selected voltage or current at the device under test independent of changes in the device's impedance.

AC Test Signal
HP 4284A Standard:

		Range	Accuracy
Normal	V	5 m Vrms to 2 Vrms	±(10% + 1 mVrms)
	I	50 μArms to 20 mArms	±(10% + 10 μArms)
Constant	V	10 m Vrms to 1 Vrms	±(6% + 1 mVrms)
	I	100 μArms to 10 mArms	±(6% + 10 μArms)

HP 4284A with Option 001:

		Range	Accuracy
Normal	V	5 m Vrms to 20 Vrms	±(10% + 1 mVrms)
	I	50 μArms to 200 mArms	±(10% + 10 μArms)
Constant	V	10 m Vrms to 10 Vrms	±(10% + 1 mVrms)
	I	100 μArms to 100 mArms	±(10% + 10 μArms)

HP 4285A Standard:

		Range	Accuracy
Normal	V	5 m Vrms to 2 Vrms	±(8% + 0.4fm% + 1 mVrms)
	I	200 μArms to 20 mArms	±(8% + 1fm% + 40 μArms)
Constant	V	10 m Vrms to 1 Vrms	±(6% + 0.2fm% + 1 mVrms)
	I	100 μArms to 20 mArms	±(6% + 0.2fm% + 40 μArms)

fm: test frequency in MHz

DC Bias:
Standard: 0 V, 1.5 V and 2 V (not provided on HP 4285A)
With Option 001: 0 V to ±40 V. Rear Panel DC Bias Monitor, BNC connector.

Range	Resolution	Accuracy
±(0.000 to 4.000) V	1 mV	±(0.1% + 1 mV)
±(4.002 to 8.000) V	2 mV	±(0.1% + 2 mV)
±(8.005 to 20.000) V	5 mV	±(0.1% + 5 mV)
±(20.01 to 40.00) V	10 mV	±(0.1% + 10 mV)

Measurement Range

Parameter	Range*
|Z|,R,X:	0.01 mΩ to 99.9999 MΩ
|Y|,G,B:	0.01 nS to 99.9999 S
C:	HP 4284A: 0.01 fF to 9.99999 F HP 4285A: 0.01 fF to 999.999 μF
L:	HP 4284A: 0.01 nH to 99.9999 kH HP 4285A: 0.001 nH to 99.9999 H
D:	0.000001 to 9.99999
Q:	0.01 to 99999.9
θ:	-180.000 to 180.000
Δ%:	-999.999% to 999.999%

* Refer to Measurement Accuracy

Display

LCD Dot-matrix type display. Capable of displaying: measured values, control settings, comparator limits and decisions, list sweep tables, self test messages and annunciations.

Correction Function

Zero OPEN/SHORT: Eliminates measurement errors due to stray parasitic impedances in the test fixture.

Load: Improves measurement accuracy by using a calibrated device as a reference.

List Sweep Function

A maximum of ten frequencies or test levels can be programmed. Single or sequential testing can be performed. When Option 001 is installed, DC voltage bias testing can also be performed.

Comparator Function

Ten bin sorting for the primary measurement parameter, IN/OUT for the secondary measurement parameter.

Bin Count: 0 to 999999

Other Functions

STORE/LOAD: Ten instrument setups can be stored/loaded from the internal non-volatile memory.

HP-IB: All instrument control settings, measured values, comparator limits, list sweep tables, and self test results. The direct print mode is available for HP ThinkJet printers.

Options

Option 001: Power Amplifier/DC Bias

This option cannot be operated simultaneously with Option 002.

HP 4284A: Increases the AC test signal to 20 Vrms/0.2 Arms. Extends bias range to variable ±40 Vdc. Rear panel BNC for DC voltage monitor.

HP 4285A: Adds variable ±40 Vdc. Rear panel BNC for DC voltage monitor and current monitor.

Option 002: Accessory Control Interface/Bias Current Interface

Allows the HP Precision LCR meter to control the HP 42841A Bias Current Source. Also allows the HP 4285A to control the HP 42851A Precision Q-Adaptor. This option cannot be operated simultaneously with Option 001.

Option 006: 2m/4m Cable Length Operation

Increases test cable length capability. Adds 2 and 4 meter operation. Note that this option cannot be installed into the HP 4285A.

Option 109: Delete HP-IB Interface

Option 201: Handler Interface

This is a general purpose comparator/handler interface. Nine sets of High/Low limits can be input allowing 10-bin sorting for L, C, or IZI. The handler interface enables systemization with an automatic component sorting machine. All signals are optically isolated.

Option 202: Handler Interface

This comparator/handler interface is specifically designed to be used with the following handlers:

Palomar Model M16	Ismeca 83
Palomar Model M11	EA Model M015
Q-Corporation RTR2	

General

Power Requirements: 100/120/220 V ±10%, 240 V +5%/-10%, 47 to 66Hz.

Power Consumption: 200 VA

Operating Temperature and Humidity: 0° C to 55° C, <95% RH at 40° C

Size: 426(W) x 177(H) x 498(D) mm

Weight: 16 kg (35.2 lb.)

Supplemental Performance Characteristics
(Not Guaranteed)

HP 4284A:

Stability: MEDIUM integration and constant operating temperature of 23 ±5°C.

IZI,IYI,L,C,R <0.01%/day
D<0.0001/day

Temperature Coefficient: MEDIUM integration and 23 ±5°C.

Test Signal Level	IZI,IYI,L,C,R	D
≥ 20 mVrms	<0.0025%/°C	<0.000025/°C
<20 mVrms	<0.0075%/°C	<0.000075/°C

HP 4285A:

Stability: LONG integration and constant operating temperature of 23 ±5° C.

	≤ 1 MHz	30 MHz
IXI,IYI,L,C,R	0.01%/day	<0.05%/day
D	0.0001/day	<0.0005/day

Temperature Coefficient: LONG integration, test signal voltage ≥20 mVrms and 23 ±5° C.

	≤ 1 MHz	30 MHz
IXI,IYI,L,C,R	<0.004%/deg C	<0.05%/deg C
D	<0.00004/deg C	<0.0005/deg C

Settling Time:
Frequency:
4284A: <70 ms; $f_m \geq 1$ kHz
<120 ms; 100 Hz ≤ f_m <1 kHz
<160 ms; f_m <100 Hz

4285A: <50 ms

Test Signal: <120 ms

Range: <50 ms/range shift; $f_m \geq 1$ KHz

Input Protection: Internal circuit protection, when a charged capacitor is connected to the Unknown terminals. The maximum capacitor voltage is:

$V_{max} = 1/\sqrt{C}$ where: Vmax ≤200 V
C is in Farads

Measurement Time: Time interval from a trigger command to the EOM (End of Measurement) signal output at the handler interface port.

HP 4284A

	100 Hz	1 KHz	10 kHz	1 MHz
Short	270 ms	40 ms	30 ms	30 ms
Medium	400 ms	190 ms	180 ms	180 ms
Long	1040 ms	830 ms	820 ms	820 ms

HP 4285A

Integration Period	Time
Short	30 ms
Medium	65 ms
Long	200 ms

Option 001: DC Bias Current Output: 100 mA max

Measurement Accuracy (HP 4284A Only)

The following conditions must be met:

1. Warm up time : ≥30 minutes
2. Ambient temperature: 23 ±5°C

3. Test signal voltage: 0.3 Vrms to 1 Vrms
4. Test cable length: 0 m
5. OPEN and SHORT corrections have been performed
6. D ≤0.1 for C, L, X and B measurements
   Q ≤0.1 for R and G measurements

See Operation Manual for additional conditions.

Accuracies are relative to calibrated standards. Absolute accuracies are given as: (HP 4284A's relative accuracy + calibration uncertainty of standards).

Accuracy Equations

|Z|, |Y|,L, C, R, X, G and B accuracies are given as:

$$\pm [A + (K_a + K_b + K_c)*100] \text{ (\% of reading)}$$

where: 1. A is basic accuracy as shown in Figure 1
2. K_a and K_b are impedance proportional factors given in Table 2. The K_a term is negligible for impedances above 500Ω. The K_b term is negligible for impedances below 500Ω.
3. K_c is the calibration interpolation factor given in Table 1.

D accuracy is given as:

$$\pm \left[\frac{A_e}{100} \right] \text{ (absolute D value)}$$

where: 1. $A_e = [A + (K_a + K_b + K_c)*100]$

Q accuracy is given as (when $Q_x * D_e < 1$):

$$\pm \left[\frac{(Q_x^2 * D_e)}{(1 \mp (Q_x * D_e))} \right] \text{ (absolute Q value)}$$

where: 1. Q_x is the measured Q value
2. D_e is the D accuracy

θ accuracy is given as:

$\pm [(180/\pi)*(A_e/100)]$ (absolute degrees)

where: 1. $A_e = [A + (K_a + K_b + K_c)*100]$

Additional Error Due to Temperature:
Multiply the measurement accuracy by the following temperature factors.

Temp °C	0	8	18	28	38	55
Factor		x4	x2	x1	x2	x4	

Example C and D Accuracy Calculation

Measurement conditions:
Frequency: 1 KHz — Capacitance value: 100 nF
Test signal level: 1 Vrms — Integration time: MEDIUM

Calculation:
Step 1: Use Figure 1 to determine A and Z_m.
a. Find the frequency along the x-axis.
b. Find the capacitance value along a diagonal.
c. Note the intersection of the values from steps a and b. Interpolation may be necessary.
d. Each shaded area has two values for A; the upper number is for MEDIUM and LONG integrations, the lower number is for SHORT integration. A = 0.05%. Find Z_m by extrapolating horizontally to the y-axis (impedance axis). Z_m = 1590 ohms

Step 2: Use Tables 1 and 2 to find K_a, K_b and K_c.
a. Use the equations in Table 2 to find K_a and K_b.

$$k_a = \left(\frac{1 \times 10^{-3}}{|Z_m|} \right) \left(1 + \frac{200}{V_s} \right) = \left(\frac{1 \times 10^{-3}}{1590} \right) \left(1 + \frac{200}{1000} \right) = 7.5 \times 10^{-7}$$

$$k_b = (|Z_m|)(1 \times 10^{-9}) \left(1 + \frac{50}{V_s} \right) = (1590)(1 \times 10^{-9}) \left(1 + \frac{50}{1000} \right) = 1.67 \times 10^{-6}$$

b. Use Table 1 to find K_c for the given frequency.

$K_c = 0$

Step 3: Calculate C and D accuracy.

$$C = \pm[A+(K_a+K_b+K_c)(100)]\% = \pm[0.05+(7.5\times10^{-7}+1.67\times10^{-6}+0)(100)]\% = \pm0.05\%$$

$$D = \pm \left[\frac{A_e}{100} \right] = \pm \left[\frac{0.05}{100} \right] = \pm 0.0005$$

Table 1. K_c: Calibration Interpolation Factor

Frequency	K_c
Direct Correction Frequencies	0
All Other Frequencies	0.0003

Note: Direct calibration frequencies are 20, 25, 30, 40, 50, 60, 80, 100, 120, 150, 200 Hz. Sequence repeats for each decade up to 1 MHz. 48 frequencies total.

Table 2. K_a and K_b: Impedance Proportional Factors

Integ Time	Frequency	K_a	K_b
MEDIUM and LONG	f_m<100Hz	$\left(\frac{1\times10^{-3}}{\lvert Z_m\rvert}\right)\left(1+\frac{200}{V_s}\right)\left(1+\sqrt{\frac{100}{f_m}}\right)$	$\left(\lvert Z_m\rvert\right)\left(1\times10^{-9}\right)\left(1+\frac{70}{V_s}\right)\left(1+\sqrt{\frac{100}{f_m}}\right)$
	100Hz ≤ f_m ≤100kHz	$\left(\frac{1\times10^{-3}}{\lvert Z_m\rvert}\right)\left(1+\frac{200}{V_s}\right)$	$\left(\lvert Z_m\rvert\right)\left(1\times10^{-9}\right)\left(1+\frac{70}{V_s}\right)$
	100kHz <f_m ≤300kHz	$\left(\frac{1\times10^{-3}}{\lvert Z_m\rvert}\right)\left(2+\frac{200}{V_s}\right)$	$\left(\lvert Z_m\rvert\right)\left(3\times10^{-9}\right)\left(1+\frac{70}{V_s}\right)$
	300kHz <f_m ≤1MHz	$\left(\frac{1\times10^{-3}}{\lvert Z_m\rvert}\right)\left(3+\frac{200}{V_s}+\frac{V_s^2}{10^8}\right)$	$\left(\lvert Z_m\rvert\right)\left(10\times10^{-9}\right)\left(1+\frac{70}{V_s}\right)$
SHORT	f_m<100Hz	$\left(\frac{2.5\times10^{-3}}{\lvert Z_m\rvert}\right)\left(1+\frac{400}{V_s}\right)\left(1+\sqrt{\frac{100}{f_m}}\right)$	$\left(\lvert Z_m\rvert\right)\left(2\times10^{-9}\right)\left(1+\frac{100}{V_s}\right)\left(1+\sqrt{\frac{100}{f_m}}\right)$
	100Hz ≤ f_m ≤100kHz	$\left(\frac{2.5\times10^{-3}}{\lvert Z_m\rvert}\right)\left(1+\frac{400}{V_s}\right)$	$\left(\lvert Z_m\rvert\right)\left(2\times10^{-9}\right)\left(1+\frac{100}{V_s}\right)$
	100kHz <f_m ≤300kHz	$\left(\frac{2.5\times10^{-3}}{\lvert Z_m\rvert}\right)\left(2+\frac{400}{V_s}\right)$	$\left(\lvert Z_m\rvert\right)\left(6\times10^{-9}\right)\left(1+\frac{100}{V_s}\right)$
	300kHz <f_m ≤1MHz	$\left(\frac{2.5\times10^{-3}}{\lvert Z_m\rvert}\right)\left(3+\frac{400}{V_s}+\frac{V_s^2}{10^8}\right)$	$\left(\lvert Z_m\rvert\right)\left(20\times10^{-9}\right)\left(1+\frac{100}{V_s}\right)$

Notes: 1. f_m is the test frequency in (Hz)
2. $|Z_m|$ is the device's impedance
3. V_s is the test signal level in (mVrms)

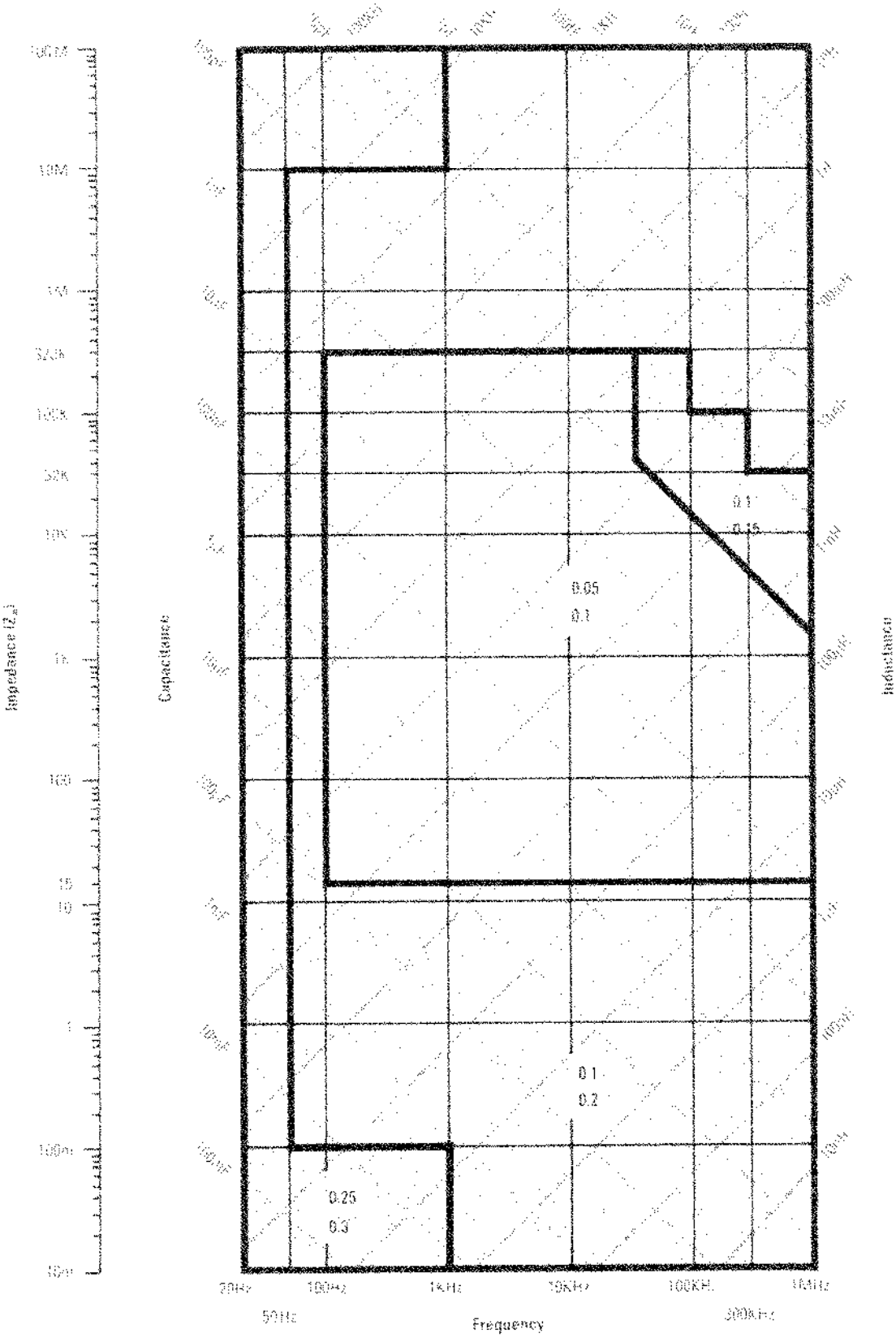


Figure 1. Baseline Accuracy Factor
(For additional accuracy information refer to the Impedance Accuracy Equation on Page 12)

Notes: 1. Test signal level: 0.3 volts to 1Vrms
2. Upper number: MEDIUM and LONG integration
3. Lower number: SHORT integration

Measurement Accuracy (HP 4285A Only)

Accuracy is specified for the following conditions:

1. Warm up time: ≥30 minutes
2. Ambient temperature: 23 ±5°C
3. Test signal level voltage: 0.2 Vrms to 1 Vrms
4. Test cable correction completed
5. OPEN and SHORT corrections have been completed
6. D ≤0.1 for C, L, X and B measurements
   Q ≤0.1 for R and G measurements
7. For test frequencies above 10 MHz and DUT impedance ≥5kΩ, the test signal level must be between 0.5 Vrms and 1 Vrms

These accuracies are absolute and include the calibration uncertainties of standards. Refer to the Operation Manual for additional setup conditions.

Accuracy Equations

|Z|,|Y|,L,C,R,X,G and B accuracies are given as:

$\pm(A_n + B)$ as a percent of the reading

where: 1. A_n is the accuracy equation as specified by Figure 2 and Tables 3 and 4. A_n ranges from A_1 to A_8.
2. B is the test cable length factor in Table 5.

Table 3. Accuracy Equations

MEDIUM/SHORT Integration Period

$$A_1 = N_1\% + \left[\left(\frac{f}{30}\right)^2 \cdot 3\%\right] + \frac{100}{|Z_m|}\left[0.02\% + \left(\frac{f}{30}\right)\cdot 0.1\%\right]$$

$$A_2 = N_2\% + \left[\left(\frac{f}{30}\right)^2 \cdot 3\%\right] + \frac{|Z_m|}{25}\left[0.02\% + \left(\frac{f}{30}\right)\cdot 0.05\%\right]$$

$$A_3 = N_3\% + \left[\left(\frac{f}{5}\right)^2 \cdot 0.1\%\right] + \frac{|Z_m|}{250}\left[0.02\% + \left(\frac{f}{30}\right)\cdot 0.05\%\right]$$

$$A_4 = 0.3\% + \left[\left(\frac{f}{30}\right)^2 \cdot 3\%\right] + \frac{|Z_m|}{500}\left[0.05\% + \left(\frac{f}{30}\right)\cdot 0.1\%\right]$$

$$A_5 = 0.18\% + \left[\left(\frac{|Z_m|}{5k}\right)\cdot 0.04\%\right]$$

$$A_6 = 0.18\% + \left[\left(\frac{f}{30}\right)^2 \cdot 3\%\right] + \frac{|Z_m|}{2.5k}\left[0.02\% + \left(\frac{f}{10}\right)\cdot 0.03\%\right]$$

$$A_7 = 0.5\% + \left[\left(\frac{f}{30}\right)^2 \cdot 3\%\right] + \frac{|Z_m|}{2.5k}\left[\left(\frac{f}{30}\right)\cdot 0.2\%\right]$$

$$A_8 = 0.18\% + \left[\left(\frac{|Z_m|}{50k}\right)\cdot 0.06\%\right]$$

LONG Integration Period

$$A_1 = N_1\% + \left[\left(\frac{f}{30}\right)^2 \cdot 3\%\right] + \frac{50}{|Z_m|}\left[0.02\% + \left(\frac{f}{30}\right)\cdot 0.1\%\right]$$

$$A_2 = N_2\% + \left[\left(\frac{f}{30}\right)^2 \cdot 3\%\right] + \frac{|Z_m|}{50}\left[0.02\% + \left(\frac{f}{30}\right)\cdot 0.05\%\right]$$

$$A_3 = N_3\% + \left[\left(\frac{f}{5}\right)^2 \cdot 0.1\%\right] + \frac{|Z_m|}{500}\left[0.02\% + \left(\frac{f}{30}\right)\cdot 0.05\%\right]$$

$$A_4 = 0.3\% + \left[\left(\frac{f}{30}\right)^2 \cdot 3\%\right] + \frac{|Z_m|}{500}\left[0.05\% + \left(\frac{f}{30}\right)\cdot 0.1\%\right]$$

$$A_5 = 0.18\% + \left[\left(\frac{|Z_m|}{5k}\right)\cdot 0.02\%\right]$$

$$A_6 = 0.18\% + \left[\left(\frac{f}{30}\right)^2 \cdot 3\%\right] + \frac{|Z_m|}{5k}\left[0.02\% + \left(\frac{f}{10}\right)\cdot 0.03\%\right]$$

$$A_7 = 0.5\% + \left[\left(\frac{f}{30}\right)^2 \cdot 3\%\right] + \frac{|Z_m|}{5k}\left[\left(\frac{f}{30}\right)\cdot 0.2\%\right]$$

$$A_8 = 0.18\% + \left[\left(\frac{|Z_m|}{50k}\right)\cdot 0.03\%\right]$$

D accuracy is given as:

$$\pm\left[\frac{A_e}{100}\right] \text{ (absolute D value)}$$

Note: $A_e = (A_n + B)$

Q accuracy is given as:

$$\pm\left[\frac{(Q_x^2 \cdot D_e)}{(1 \mp (Q_x \cdot D_e))}\right] \text{ (absolute Q value)}$$

Note: Specification valid only when $Q_x D_e < 1$. Q_x is the measured value of Q. D_e is the computed D accuracy.

θ accuracy is given as:

$\pm[(180/\pi) \cdot (A_e/100)]$ (absolute degrees)

Note: $A_e = (A + B)$

Additional error due to temperature:
Multiply the measurement accuracy by the following temperature factors.

Temp °C	0	8	18	28	38	48	55
Factor		x3	x2	x1	x2	x3	x4	

Example L and Q Accuracy Calculation

Measurement Conditions:

Frequency: 500 kHz
Test signal level: 1 Vrms
Cable length: 0 meters
L value measured: 2 mH
Integration time: Long
Q value measured (Q_x): 200

Calculation:

Step 1: Use Figure 2 to determine A_n and Z_m.
a. Find the frequency along the x-axis.
b. Find the inductance value along one of the diagonals.
c. Note the intersection of steps a and b. In this case $A_n = A_5$. Refer to the equations in Table 3.
d. Note that in step c Z_m is 6.3 kohms.

Step 2: Use Tables 3 and 4 to determine A_n and B.
a. A_n is equation A_5 for Long Integration times:

$0.18\% + [(|Z_m|/5k) \times 0.02\%]$

b. A_5 yields a value of 0.21%
c. Table 4 indicates that B has a value of 0.
d. L accuracy is $\pm(A_n + B) = 0.21\%$
e. Determine D accuracy (D_e): $(A_n + B)/100 = 0.0021$
f. Q accuracy: (ΔQ)

$$\pm[(Q_x^2 \cdot D_e)/(1 \mp (Q_x \cdot D_e))]$$

g. ΔQ yields a value of -57 to 133, Actual Q: 143 to 333

N_1, N_2 and N_3 are the following numbers:

Table 4. N Accuracy Factors

Frequency (f)	N_1, N_2	N_3
75kHz ≤ f ≤200kHz	0.15	0.15
200kHz <f ≤3MHz	0.08	0.08
3MHz <f ≤5MHz	0.15	0.15
5MHz <f ≤30MHz	0.3	

Table 5. Cable Length Correction

B	Test Cable Length
0	0 meters
$f_m/15$	1 meter (HP 16048A)
$f_m/15$	2 meter (HP 16048D)

(f: f_m: Test frequency in MHz)

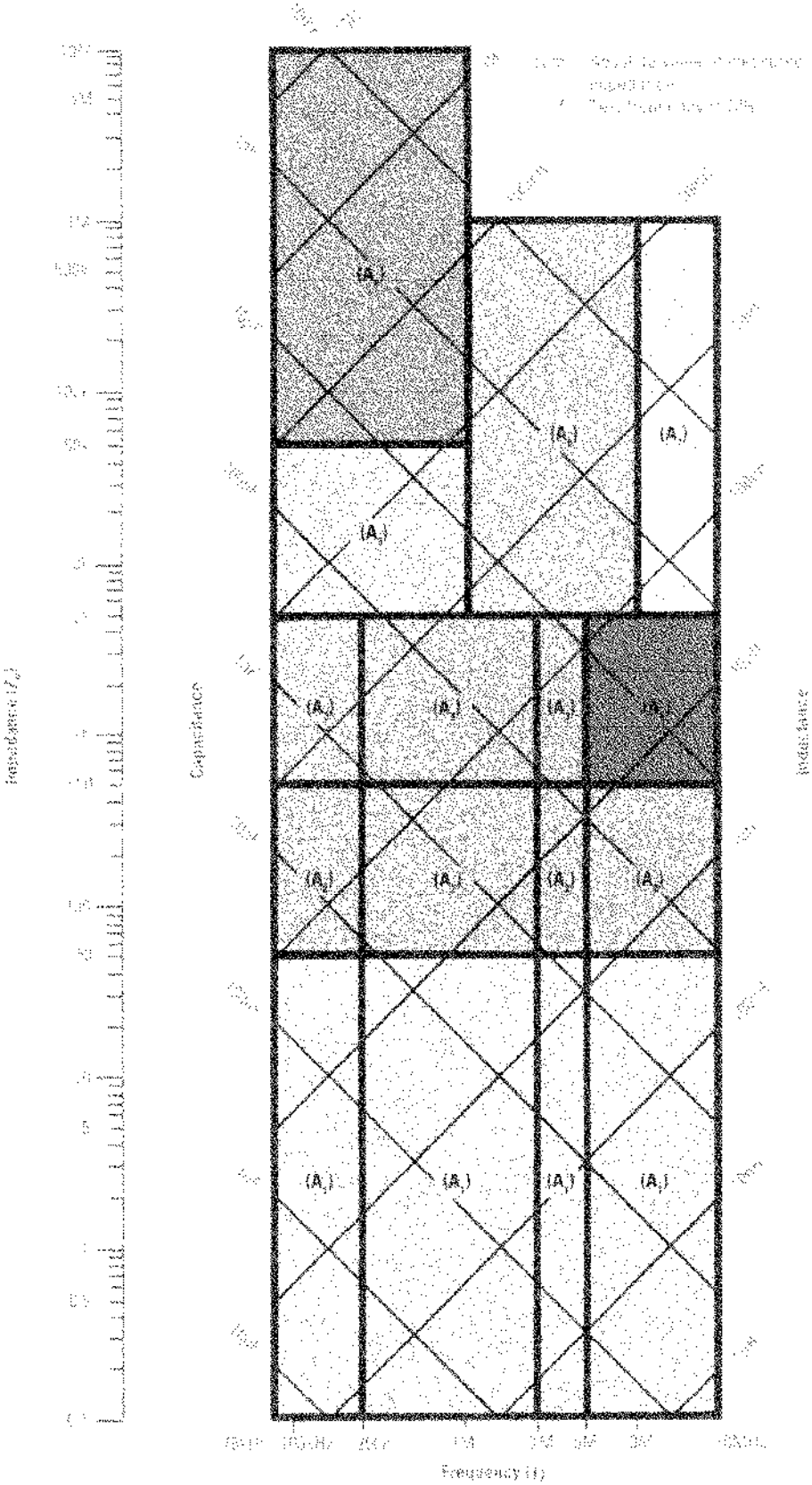
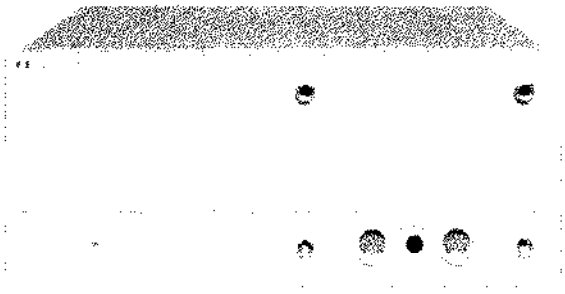


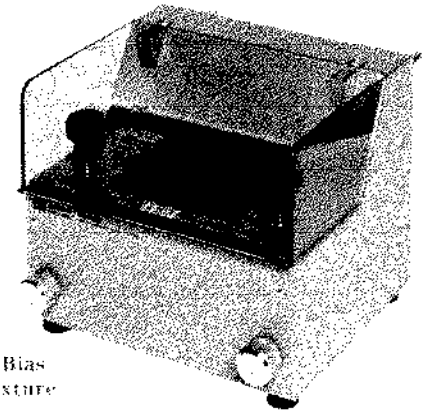
Figure 2. Accuracy Equation (A_n) Frequency and Impedance Range



HP 42841A Bias Current Source

The HP 42841A is used with either the HP 4284A or HP 4285A for high DC current bias measurements.

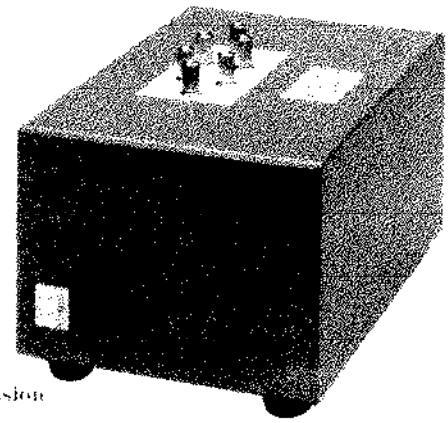
Bias Current Output: Up to 20 Adc maximum, 0.01 Adc steps
Current Accuracy: ± 1% to 1A, ± 2% to 5A, ± 3% to 20A
Output Voltage: 38 Vdc maximum
Frequency Range: HP 4284A: 20 Hz to 1 MHz
HP 4285A: Up to 30 MHz when combined with the HP 42842C Bias Current Fixture.
Test Signal Voltage: 0.5 Vrms to 2 Vrms
Basic Impedance Accuracy: HP4284A: 2% for ≤ 1 kHz, 1% for 1 kHz to 1 MHz
HP4285A: $\sqrt{fm}$% + HP4285A accuracy (fm = test frequency in MHz).
Interface: Custom, directly controllable by the HP4284A/4285A with Option 002.



HP 42842A/B/C Bias Current Test Fixture

The HP 42842A/B/C are fixtures designed to interface from the HP 42841A Bias Current Source to inductive DUT's.

Basic Impedance Accuracy: Refer to HP 42841A specifications
HP 42842A: Up to 20 Adc maximum, used only with the HP4284A
HP 42842B: Up to 40 Adc maximum, used only with the HP4284A
Component Dimensions (Maximum): 80mm (W) x 80mm (H) x 80mm (D)
HP 42842C: Up to 10 Adc maximum, used only with the HP4285A. Option 001 adds the SMD Test Fixture.
Component Dimensions (Maximum): 60mm (W) x 50mm (H) x 60mm (D)



HP 42851A Precision Q Adapter

The HP42851A is used with the HP4285A/Option 002 to perform automatic resonant Q factor measurements.

Measurement Function: Q (Quality factor), L (Inductance), C (Capacitance)
Q Measurement Range: 5.00 to 999.99
Basic Q Accuracy: 5%
Test Signal Level: ≤ 1.0 Vrms
Automatic Tuning Time: 200 ms to 1 s
Interface: Custom, directly controllable by the HP4285A with Option 002.
Weight: 4.1 kg
Dimensions: 180mm (W) x 166mm (H) x 290mm (D)
Option 001: SMD Test Fixture

HP 42843A Bias Current Cable
This cable is used with the HP 4284A for configurations greater than 20 Adc. Refer to the configuration table in the Ordering Information section.

Surface Mount Device Fixtures

HP 16034E Test Fixture

Frequency: 3 GHz
Maximum DC
Bias Voltage: 40 V

HP 16034A Test Fixture

Tweezer-style test fixture
Frequency: 1.5 MHz
Cable Length: 1 meter
Maximum DC
Bias Voltage: ± 42 V

HP 42851-61100 SMD Test Fixture

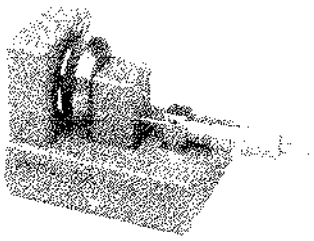
Frequency: 1 - 30 MHz
Maximum DC Bias
Voltage: ± 40 V
DC Bias Current: ± 2
Adc Maximum

To be used only with the HP 42842C or HP 42851A Series as Option 002.

Dielectric Test Fixture

HP 16451B Dielectric Test Fixture

Maximum Voltage: ± 1.5 V peak
Frequency: 1 MHz
Function: Dielectric constant and Dissipation Factor
Dielectric Constant
Accuracy: ± 1%
Dissipation Factor Accuracy:
± (0.5% + 0.005)



Test Leads

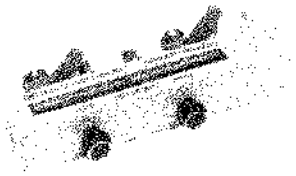
HP 16048C Test Leads

Alligator Style Test Fixture
Cable Length: 1 meter
Frequency: 100 MHz
Maximum DC
Bias Voltage: ± 42 V

Radial and Axial Lead Fixtures

HP 16047C Test Fixture

Frequency: 30 MHz
Maximum DC
Bias Voltage: ± 42 V

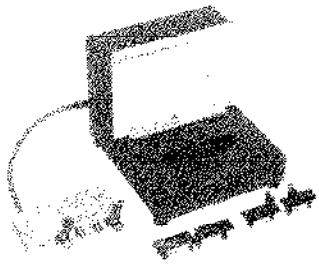


HP 16047A/D Test Fixture

Frequency:
HP 16047A:
1 - 1.8 MHz
HP 16047D:
100 Hz to 1 MHz
Maximum DC
Bias Voltage: ± 42 V

HP 16065A External Voltage Bias Fixture

Frequency: 50 Hz to 1 MHz
Maximum External DC
Bias Voltage: ± 40 V



Cable Test Leads

HP 16048A/E Test Leads

Connector Type: BNC
Cable Length:
HP 16048A
0.91 meters
HP 16048D
1 meter
HP 16048E
0.5 meters
Frequency: 30 MHz
Maximum DC
Bias Voltage: ± 40 V

HP 16048B Test Leads

Connector Type: SMC
Cable Length:
0.5 meters
Frequency: 1 GHz
Maximum DC
Bias Voltage: ± 40 V

Ordering Information

HP 4284A 20 Hz–1 MHz Precision LCR Meter .....

Note: No test fixture is supplied with the HP 4284A, refer to page 19.
Furnished Accessories: Operation Manual (04284-90000),
1 Memory Card (04278-89001), Power Cable.

Options:

Option 001: Power Amplifier/40V DC Bias (See Note 1) .....
Option 002: Bias Current Interface (See Note 1, 2) .....
Option 006: 2m/4m Cable Length Operation .....
Option 008: Add Japanese Operation Manual .....
Option 009: Delete Operation Manual .....
Option 109: Delete HP-IB Interface .....
Option 201: General Purpose Handler Interface (See Note 2, 3) .....
Option 202: Specific Handler Interface (See Note 2, 3) .....
Option 301: Scanner Compensation (See Note 2) .....
Option 910: Extra Operation Manual .....
HP4284A+W30: Three Year Customer Return Repair Coverage .....
HP4284A+W32: Three Year Customer Return Calibration Coverage .....

Note 1: Options 001 and 002 do not operate simultaneously.
Note 2: A maximum of 2 (3 with Opt 109) of the following may be installed at one time:
Options 002, 201, 202, 301.
Note 3: Select either Option 201 or 202.

HP 4285A 75 kHz–30 MHz Precision LCR Meter .....

Note: No test fixture is supplied with the HP 4285A, refer to page 19.
Furnished Accessories: Operation Manual (04285-90000),
1 Memory Card (04278-89001), Power Cable.

Options:

Option 001: 40V DC Bias (See Note 1) .....
Option 002: Accessory Control Interface (See Note 1,2) .....
Option 008: Add Japanese Operation Manual .....
Option 009: Delete Operation Manual .....
Option 109: Delete HP-IB Interface .....
Option 201: General Purpose Handler Interface (See Note 2,3) .....
Option 202: Specific Handler Interface (See Note 2,3) .....
Option 301: Scanner Compensation (See Note 2) .....
Option 910: Extra Operation Manual .....
Option 915: Add Service Manual .....
HP4285A+W30: Three Year Customer Return Repair Coverage .....
HP4285A+W32: Three Year Customer Return Calibration Coverage .....

Note 1: Options 001 and 002 do not operate simultaneously.
Note 2: A maximum of 2 (3 with Opt 109) of the following may be installed at one time:
Options 002, 201, 202, 301.
Note 3: Select either Option 201 or 202.

Cabinet Options (HP 4284A and HP 4285A)

Option 907: Front Handle Kit .....
Option 908: Rack Mount Kit .....
Option 909: Rack Flange and Handle Kit .....

Ordering Information

HP 42851A Precision Q Adapter .....
Option 001: Surface Mount Device (SMD) Test Fixture (p/n 42851-61100)
Option 008: Add Japanese Operation Manual .....
Option 009: Delete Operation Manual .....
Option 910: Extra Operation Manual .....
Option 915: Add Service Manual .....
HP42851+W30: Three Year Customer Return Repair Coverage .....
HP42851+W32: Three Year Customer Return Calibration Coverage .....

Refer to the HP 42851A data sheet (p/n 5080-0236) for details.

Bias Current Accessories:
HP 42841A Bias Current Source .....
HP 42842A 20 Adc Bias Current Test Fixture .....
HP 42842B 40 Adc Bias Current Test Fixture .....

Refer to the HP 42841A data sheet (p/n 5950-2363) for details.

HP 42842C (10 Adc @ 30 MHz) Bias Current Test Fixture .....
Option 001: Surface Mount Device (SMD) Test Fixture (p/n 42851-61100)

HP 42843A Bias Current Cable .....

Test Fixtures:
HP 16034E Test Fixture (SMD components) .....
HP 16047A Test Fixture (Axial and Radial) .....
HP 16047C Test Fixture (Axial and Radial) .....
HP 16047D Test Fixture (Axial and Radial) .....
HP 16048A Test Leads (0.94 meters/BNC) .....
HP 16048B Test Leads (0.94 meters/SMC) .....
HP 16048C Test Leads (1 meter/Alligator Clip) .....
HP 16048D Test Leads (1.89 meters/BNC) .....
HP 16048E Test Leads (3.8 meters/BNC) .....
HP 16065A External Voltage Bias Fixture .....
HP 16334A Test Fixture (Tweezer contacts) .....
HP 16451B Dielectric Test Fixture .....

Other Accessories:
HP 10503A 50 ohm cable, BNC(m)-BNC(m), 122 cm, UG-88C/U .....
HP 16270A Memory Card Set (Contains 10 Memory Cards) .....
HP 16380A Standard Capacitor Set (1, 10, 100, 1000 pF) .....
HP 16380C Standard Capacitor Set (10, 100, 1000 nF) .....
HP 16389A Terminal Adapter
(4 terminal conversion to 1 GR900 connecter) .....
HP 16389B Terminal Adapter
(4 terminal conversion to 2 GR874 connectors) .....
HP 42100A Four-Terminal Pair Resistor Set (Open, Short, 100 ohm) .....
The resistor set is needed for HP 4285A cable length compensation of 1 and 2 meters.

Note: **HP printers capable of the following are usable with HP 4284A/4285A:**
1. HP-IB Interface
2. Listen Only mode

Instrument Configurations:

0–10 Amps dc Bias Configuration (HP 4285A only)
HP 4285A with Option 002, 1 ea.
HP 42841A Bias Current Source, 1 ea.
HP 42842C Bias Test Fixture, 1 ea.
Option 001 adds SMD Test Fixture
HP 16048A Test Fixture, 1 ea.

0–20 Amps dc Bias Configuration (HP 4284A only)
HP 4284A with Option 002, 1 ea.
HP 42841A Bias Current Source, 1 ea.
HP 42842A or HP 42842B Bias Test Fixture, 1 ea.
HP 16048A Test Leads, 1 ea.

0–40 Amps dc Bias Configuration (HP 4284A only)
HP 4284A with Option 002, 1 ea.
HP 42841A Bias Current Source, 2 ea.
HP 42842B Bias Test Fixture, 1 ea.
HP 42843A Bias Current Cable, 1 ea.
HP 16048A Test Leads, 1 ea.

Direct Q Measurement Configuration (HP 4285A only)
HP 4285A with Option 002, 1 ea.
HP 42851A Q Adapter, 1 ea.
Option 001 adds SMD Test Fixture
HP 10503A BNC-BNC Cable, 2 ea.

HEWLETT PACKARD

For more information, call your local HP sales office listed in your telephone directory or an HP regional office listed below for the location of your nearest sales office.

United States:
Hewlett-Packard Company
4 Choke Cherry Road
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Lomas De Chapultepec
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Italy:
(02) 92 36 91

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(02) 24 60 90

Spain:
900 123 123

Sweden:
(08) 750 20 00

Switzerland:
(057) 31 21 11 (Head office)
(022) 780 41 11 (Suisse Romande)
(046) 05 15 05 (Customer Information Center)

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