

SECTION I GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This operating manual contains the information required to install, operate, and test the Hewlett-Packard Model 4275A Multi-frequency LCR Meter. Figure 1-1 shows the instrument and supplied accessories. This section covers specifications, instrument identification, description, options, accessories, and other basic information.

1-3. Listed on the title page of this manual is a microfiche part number. This number can be used to order 4 x 6 inch microfilm transparencies of the manual. Each microfiche contains up to 60 photo-duplicates of the manual pages. The microfiche package also includes the latest manual changes supplement as well as all pertinent service notes. To order an additional manual, use the part number listed on the title page of this manual.

1-4. DESCRIPTION.

1-5. The HP Model 4275A Multi-frequency LCR Meter is a high performance, fully automatic test instrument designed to measure the various component measurement parameter values of an impedance element in the relatively high frequency region. The 4275A measures inductance (L), capacitance (C), resistance (R), dissipation factor (D), quality factor (Q), conductance (G), susceptance (B), reactance (X) and, in addition, the absolute value of the vector impedance (|Z|) and phase angle (θ) over a wide range with high accuracy and speed. The wide range measurement capabilities of the model 4275A are enhanced by the 12 spot test frequencies selectable from 10kHz up to 10MHz in a 1-2-4-10 sequence, including two optional frequencies.

The test signal level can be flexibly set at the desired amplitude within the range of 1mV

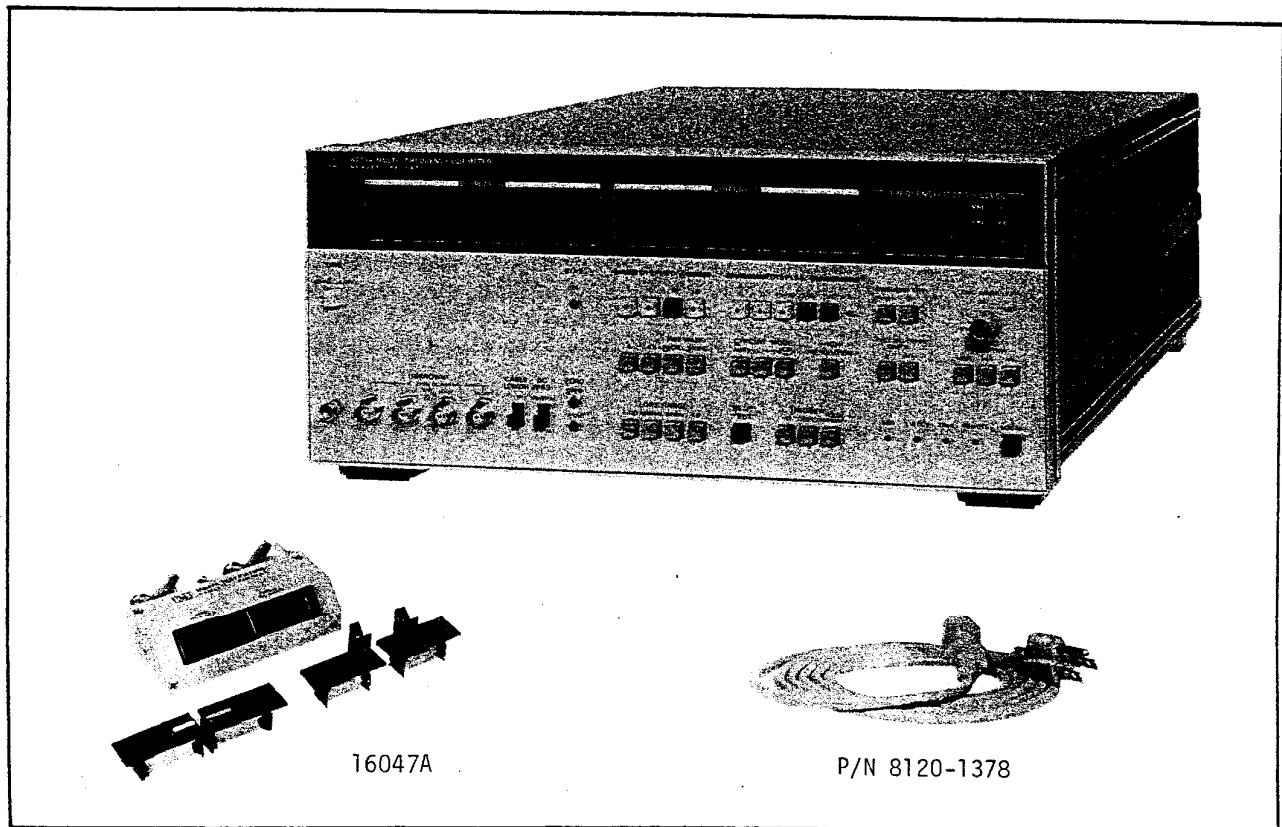


Figure 1-1. Model 4275A and Accessories.

1-9. SPECIFICATIONS.

1-10. Complete specifications of the Model 4275A Multi-frequency LCR Meter are given in Table 1-1. These specifications are the performance standards or limits against which the instrument is tested. The test procedures for the specifications are covered in Section IV Performance Tests. Table 1-2 lists general information. General information is not specifications but is typical characteristics included as additional information for the operator. When the 4275A Multi-frequency LCR Meter is shipped from the factory, it meets the specifications listed in Table 1-1.

1-11. SAFETY CONSIDERATIONS.

1-12. The Model 4275A Multi-frequency LCR Meter has been designed to conform to the safety requirements of an IEC (International Electromechanical Committee) Safety Class I instrument and is shipped from the factory in a safe condition.

1-13. This operating and service manual contains information, cautions, and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

1-14. INSTRUMENTS COVERED BY MANUAL

1-15. Hewlett-Packard uses a two-section nine character serial number which is marked on the serial number plate (Figure 1-2) attached to the instrument rear panel. The first four digits and the letter are the serial prefix and the last five digits are the suffix. The letter placed between the two sections identifies country where instrument was manufactured. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-16. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual

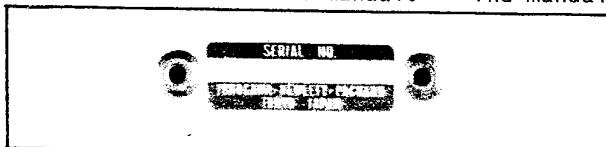


Figure 1-2. Serial Number Plate.

for this new instrument may be accompanied by a yellow Manual Changes supplement or have a different manual part number. This supplement contains "change information" that explains how to adapt the manual to the newer instrument.

1-17. In addition to change information, the supplement may contain information for correcting errors (called Errata) in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with this manual's print date and part number, both of which appear on the manual's title page. Complimentary copies of the supplement are available from Hewlett-Packard. If the serial prefix or number of an instrument is lower than that on the title page of this manual, see Section VII Manual Changes.

1-18. For information concerning a serial number prefix that is not listed on the title page or in the Manual Change supplement, contact your nearest Hewlett-Packard office.

1-19. OPTIONS.

1-20. A total of nine options for the Model 4275A are available for adding the following capabilities:

- Option 001: Internal DC Bias Supply (0-±35V).
- Option 002: Internal DC Bias Supply (0-±99.9V).
- Option 003: Battery Memory Backup. Memory data protection with standby battery in event instrument loses power.
- Option 004: 1-3-5 Step Test Frequency. Test frequency selection in 1-3-5-10 sequence steps instead of the standard 1-2-4-10 sequence step fashion.
- Option 101: HP-IB Compatibility.
- Options 907, 908 and 909 are handle or rack mount kits. See paragraph 1-36 for details.
- Option 910: Extra Manual.

NOTE

Option 001 and Option 002 are mutually exclusive.

1-21. OPTION 001.

1-22. The 4275A Option 001 adds an internal dc bias supply controllable from 0 to $\pm 35V$ by the HP 16023B bias controller or HP-IB control device (a calculator) through a rear panel connector. The bias voltage is set in three digits in three decade ranges as follows:

- $\pm(.000$ to $.999V)$
- $\pm(0.00$ to $9.99V)$
- $\pm(00.0$ to $35.0V)$

1-23. OPTION 002.

1-24. The 4275A Option 002 provides internal dc bias supply controllable from 0 to $\pm 99.9V$ by the HP 16023B bias controller or HP-IB control device through a rear panel connector. The bias voltage is set in three digits in one range from $\pm 00.0V$ to $\pm 99.9V$.

1-25. OPTION 003.

1-26. The 4275A Option 003 provides a stand-by battery for maintaining the volatile memory in event the instrument loses power. This continuous memory capability enables the instrument to preserve the memory of the desired front panel control settings and to recall these settings for repeated selection of the same settings anytime and every time the instrument is turned on.

1-27. OPTION 004.

1-28. The 4275A Option 004 provides 10 spot test frequencies selectable in a 1-3-5-10 sequence instead of the standard 1-2-4-10 sequence step fashion. Two extra frequencies are also optionally available along with Option 004.

1-29. OPTION 101.

1-30. The 4275A Option 101 provides an interfacing function for transferring measured data and for receiving remote control signals from HP Interface Bus lines (Hewlett-Packard's implementation of IEEE-STD-488-1975).

1-31. Special Frequency Options.

1-32. The 4275A Special Frequency Options and one or two test frequencies in addition to the standard 10 spot test frequencies. Option code numbers assign the specially installed test frequencies in the following manner:

Options	Frequency range
RXX	10.0kHz to 99.0kHz
SXX	100kHz to 990kHz
TXX	1.00MHz to 9.90MHz

The two digits of the option number following the alpha prefixes (R, S and T) indicate the first and second significant digits of the test frequency. When the option code is prefixed with an F, the option code numbers signify the following particular test frequencies:

Options	Test Frequency
F01	15.7kHz
F02	32.8kHz
F03	455kHz
F04	3.58MHz
F05	4.19MHz
F06	10.7MHz

1-33. OTHER OPTIONS.

1-34. The following options provide the mechanical parts necessary for rack mounting and hand carrying:

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

Installation procedures for these options are detailed in Section II.

1-35. The 4275A Option 910 provides an extra copy of the operating and service manual.

1-36. ACCESSORIES SUPPLIED.

1-37. Figure 1-1 shows the HP Model 4275A Multi-frequency LCR Meter, Model 16047A Test Fixture and power cord (HP Part No. 8120-1378). The 16047A and the power cord are furnished accessories. Additionally, a fuse (HP Part No. 2110-0059 or 2110-0360) is supplied as a service part.

1-38. ACCESSORIES AVAILABLE.

1-39. For convenience and ease of measurement, eight styles of test fixtures and leads are available. Each accessory is designed to be appropriate for a particular use of the instrument and/or the type of DUT. Accessory models and names are listed in Table 1-1. A brief description for each of these fixtures and leads is given in Table 1-3.

Table 1-1. Specifications (sheet 1 of 8).

SPECIFICATIONS

Parameters Measured: C, L, R, |Z|, D, Q, ESR, G, X, B, θ , Δ (deviation) and $\Delta\%$ (percent deviation) for C, L, R, |Z|.

Measurement Circuit Modes: Auto, Series and Parallel.

Parameter Combinations:

	C-D or Q or ESR
Series	L-D or Q or ESR
circuit mode	R-X or L
	Z - θ
	C-D or Q or G
Parallel	L-D or Q or G
circuit mode	R-B or C
	Z - θ

Display: Normal mode: 4-1/2 digit, maximum display 19999.
High resolution mode: 5-1/2 digit, maximum display 199999.

(Number of significant digits displayed changes depending on measurement frequency, test signal level and measurement range).

Measurement Terminals: Four terminal pair configuration (high and low terminals for current and potential terminals) with guard terminal.

Range Modes: Auto and Manual (up-down).

Measurement Frequencies: 10kHz, 20kHz, 40kHz, 100kHz, 200kHz, 400kHz, 1MHz, 2MHz, 4MHz and 10MHz $\pm 0.01\%$.

Test Signal Level: 1mV to 1Vrms, continuously variable in 3 ranges.

Test voltage and current can be monitored at front panel display.

Deviation Measurement: When REF VALUE STORE button is pressed, the existing measured value is stored as a reference value. Next, pressing Δ or $\Delta\%$ button offsets displayed value to zero. Deviation is displayed as the difference between the referenced value and subsequent result.

(Deviation spread in counts is -199999 to 199999 or from -199.99% to 199.99%).

Offset Adjustment: Stray capacitance, residual inductance, resistance and conductance of test fixture or test leads can be compensated for as follows:

C: up to 20pF
L: up to 2000nH
R: up to 0.5 Ω
G: up to 5 μ S

Self Test: Performs cyclic operation of internal function tests and displays diagnostic code sets (when any abnormality is detected).

DC Bias: Two external DC bias input connectors on rear panel, maximum ± 35 V and ± 200 Vdc.

Bias input characteristics:
100 $\Omega \pm 10\%$, 0.1A max (for max ± 35 V input).
150k $\Omega \pm 10\%$, 1.3mA max (for max ± 200 V input).

DC Bias Monitor: Bias voltage monitor output (for both internal and external biases), BNC connector, output impedance 30k Ω .

Trigger: Internal, external or manual.

GENERAL

Operating Temperature and Humidity: 0°C to 55°C at 95% RH (to 40°C).

Power Requirements: 100/120/220V $\pm 10\%$, 240V +5% - 10%, 48 - 66Hz.

Power Consumption: 165VA max with any option.

Dimensions:

425.5(W) x 188 (H) x 574 (D) mm
(16-3/4" x 7-3/8" x 22-5/8")

Weight: Approximately 18kg (Std).

Table 1-1. Specifications (sheet 2 of 8).

Range and Accuracy:

Accuracies apply under the following measurement conditions for all test parameters:

- 1) Warm-up time: at least 30 minutes.
- 2) Test signal level setting:
MULTIPLIER: X 1 or X 0.1
OSC LEVEL: Fully clockwise
- 3) CABLE LENGTH switch setting:
"0" position.
- 4) ZERO offset adjustment appropriately completed.
- 5) Environmental temperature:
23°C ±5°C
(At 0°C to 55°C, error doubles).

6) Significant display readout should be more than 20 counts.

7) Measurement ranges in normal mode except those specifically noted.

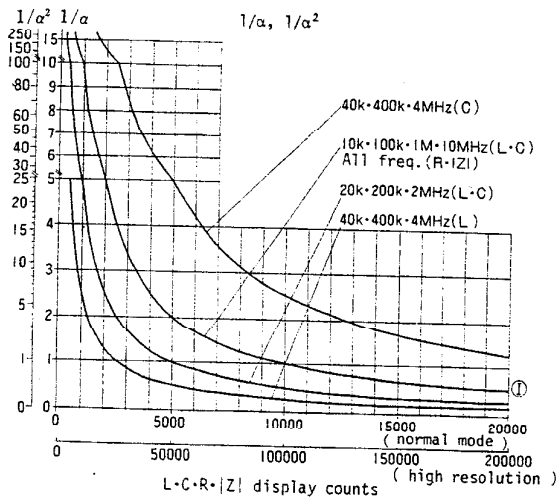
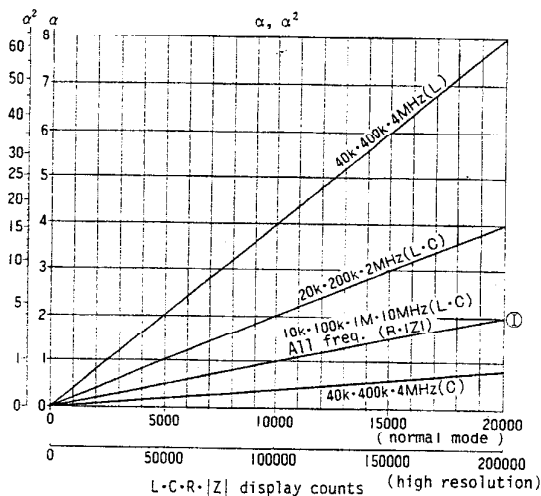
Accuracy in table is ±(% of rdg + error counts + residual counts) except for D and θ:

D accuracy:
±(% of rdg + D error value + count)

θ accuracy:
±degrees

Error count applies to significant display readouts (neglects less significant digit data).

ACCURACY COEFFICIENTS



{ Horizontal axis scales represent display counts in DISPLAY A and vertical axis scales represent accuracy coefficients α , α^2 , $1/\alpha$ and $1/\alpha^2$. }

Table 1-1. Specifications (sheet 3 of 8).

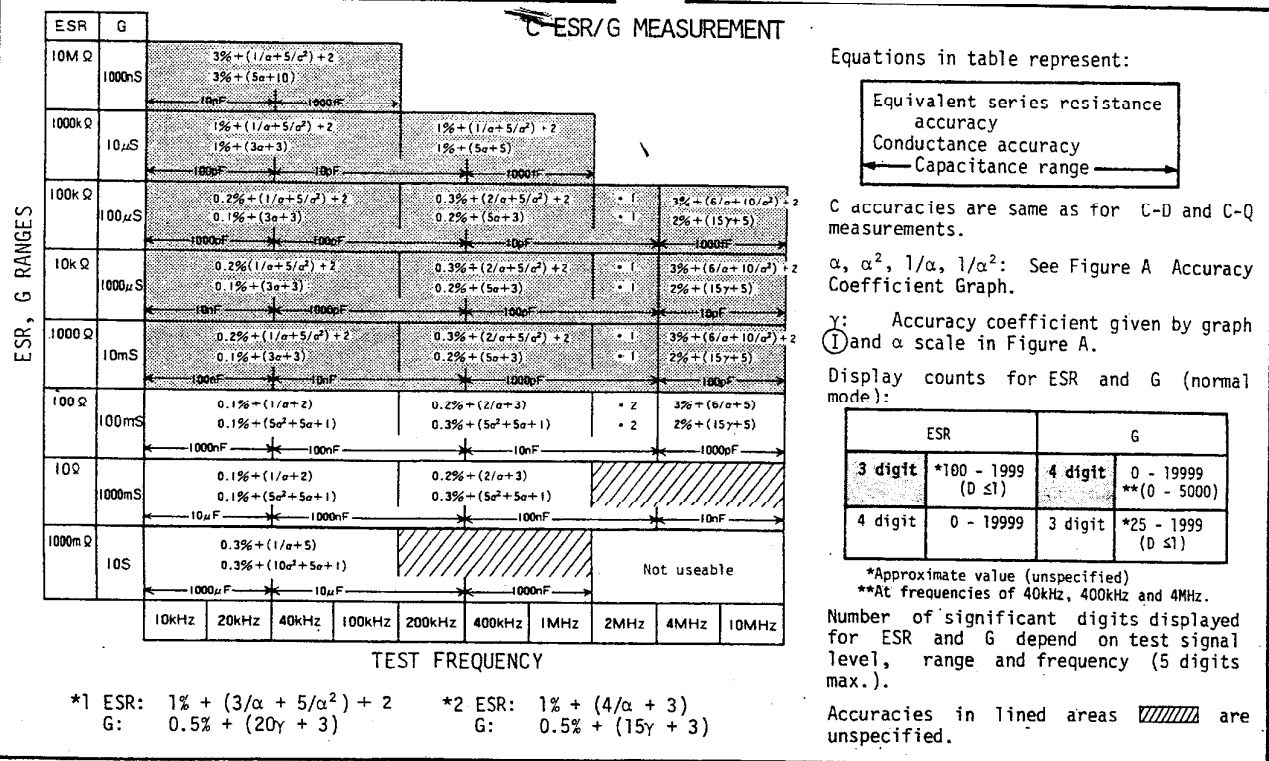
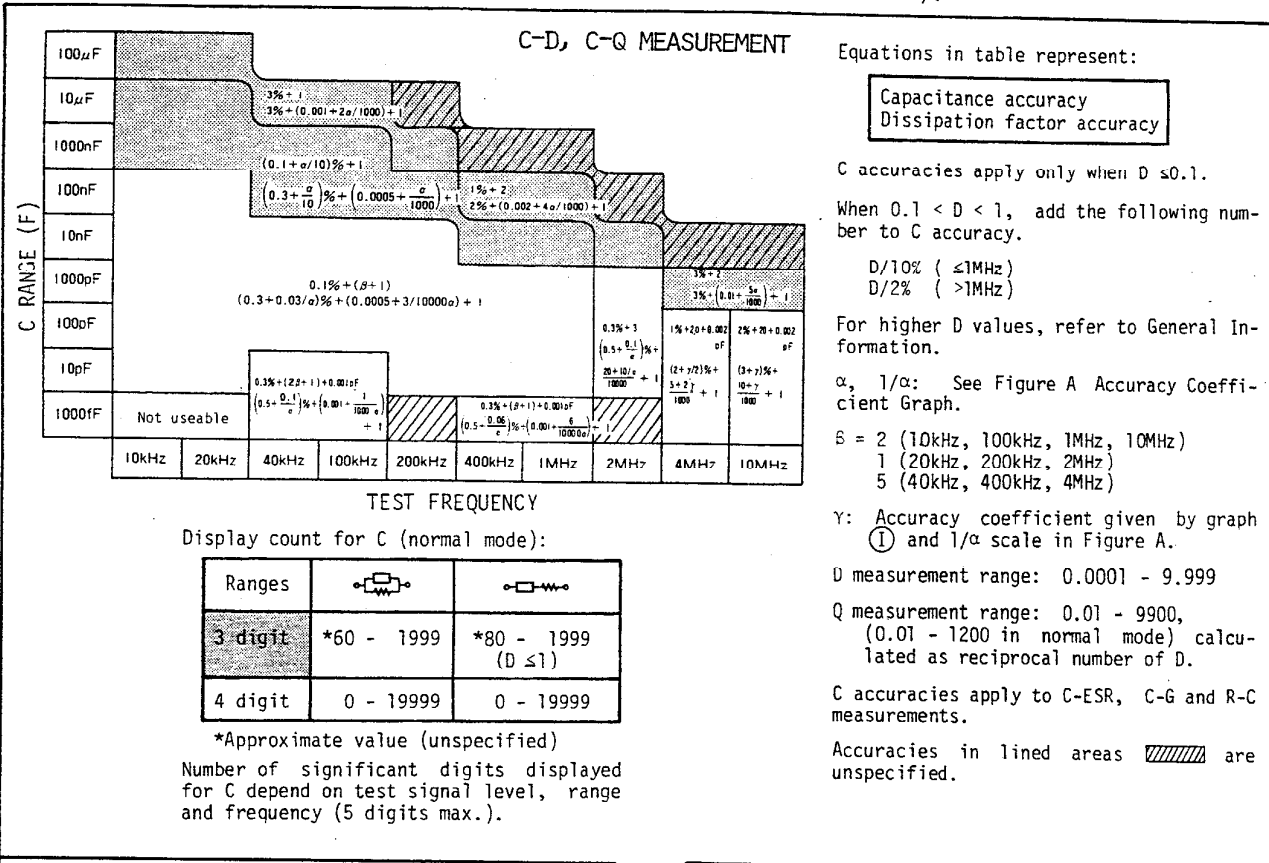


Table 1-1. Specifications (sheet 4 of 8).

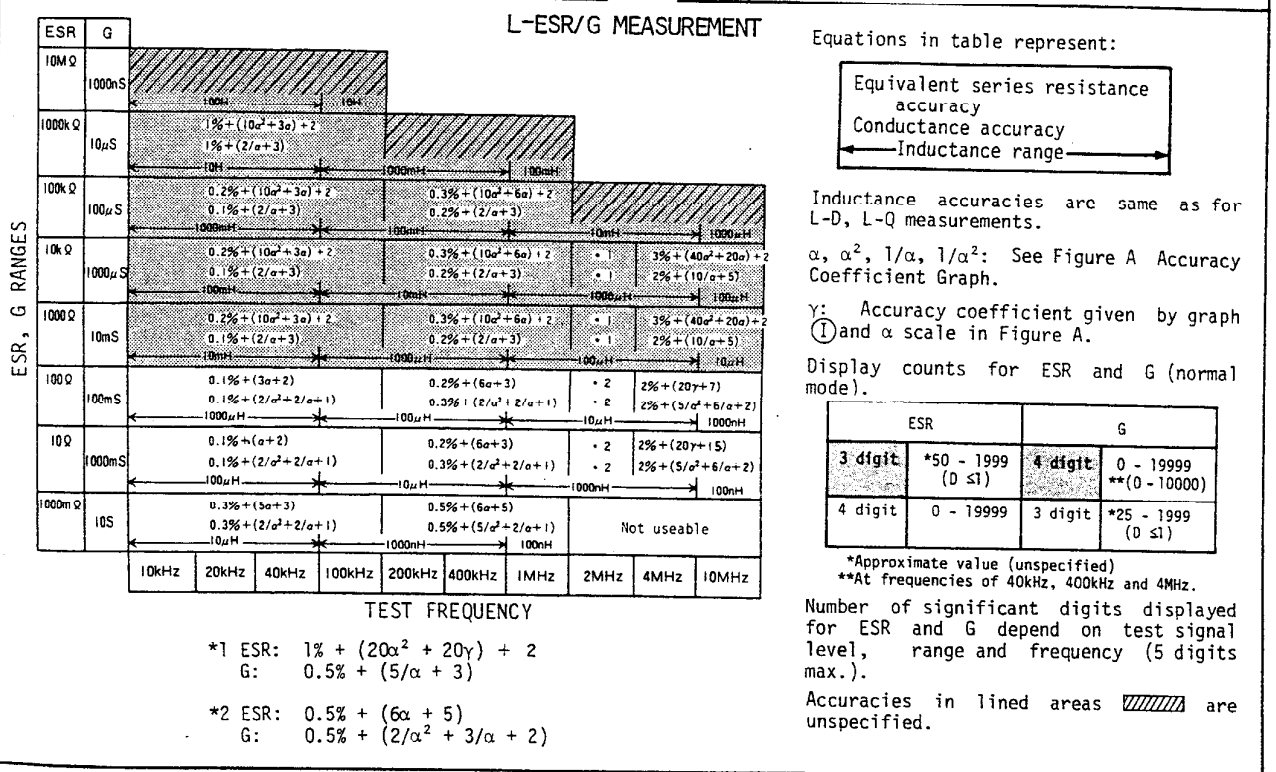
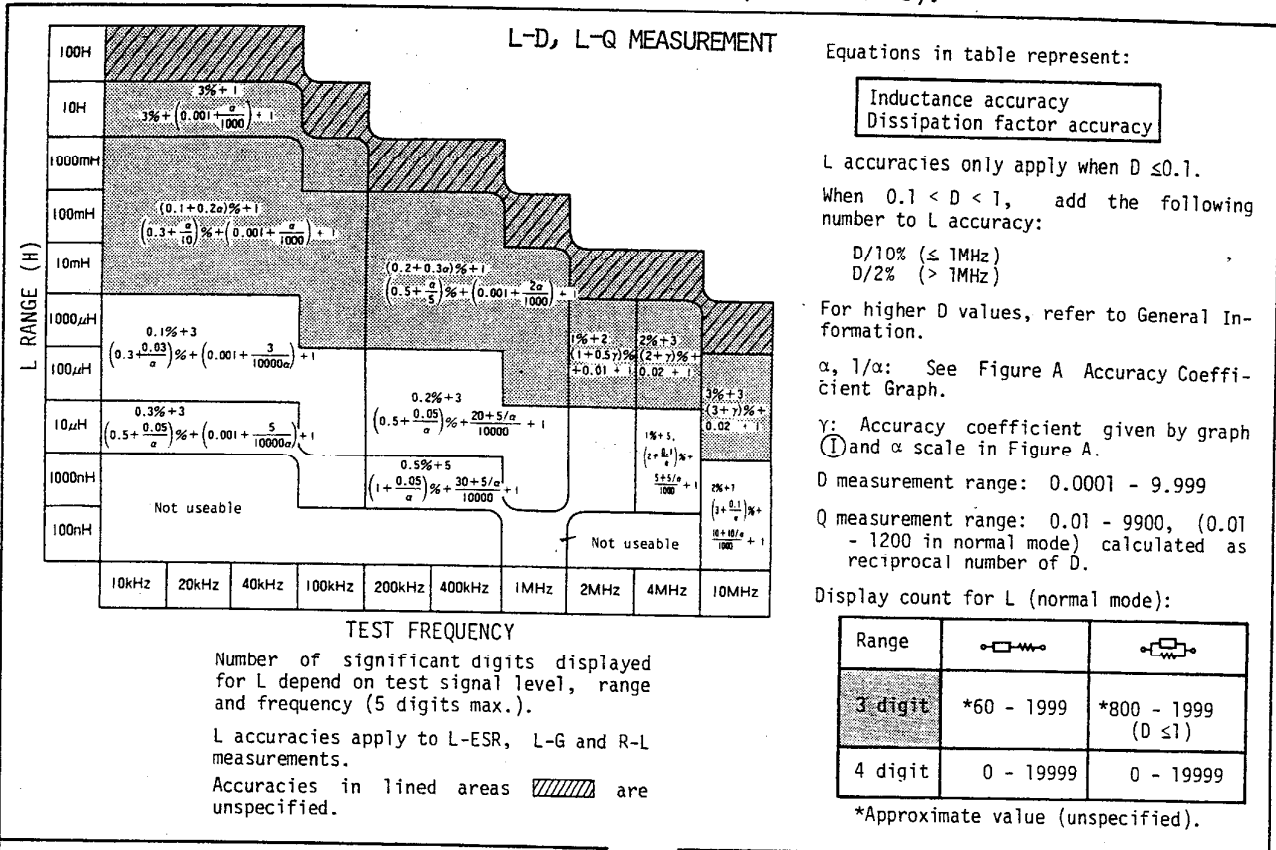


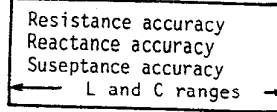
Table I-1. Specifications (sheet 5 of 8).

R-X/B & R-L/C MEASUREMENTS

R	X	B	Accuracy		Frequency Range
10M	10M	1000n	5% + 1	5% + (20α² + 5α + 1)	100Hz - 10kHz
			3% + (2/α + 10)		100Hz - 10kHz
					100Hz - 10kHz
1000k	1000k	10μ	3% + 1	3% + (20α² + 5α + 1)	100Hz - 1000Hz
			1% + (2/α + 3)	1% + (2/α + 5)	100Hz - 1000Hz
					100Hz - 1000Hz
100k	100k	100μ	(0.1 + 0.2α)% + 1	0.2 + 0.2α)% + 1	100Hz - 1000Hz
			(0.1 + 0.2α)% + (20α² + 3α + 1)	(0.2 + 0.2α)% + (20α² + 10α + 1)	100Hz - 1000Hz
			0.1% + (2/α + 3)	0.2% + (2/α + 3)	100Hz - 1000Hz
10k	10k	1000μ	(0.1 + 0.2α)% + 1	(0.2 + 0.2α)% + 1	100Hz - 1000Hz
			(0.1 + 0.2α)% + (20α² + 3α + 1)	(0.2 + 0.2α)% + (20α² + 10α + 1)	100Hz - 1000Hz
			0.1% + (2/α + 3)	0.2% + (2/α + 3)	100Hz - 1000Hz
1000	1000	10m	(0.1 + 0.2α)% + 1	(0.2 + 0.2α)% + 1	100Hz - 1000Hz
			(0.1 + 0.2α)% + (20α² + 3α + 1)	(0.2 + 0.2α)% + (20α² + 10α + 1)	100Hz - 1000Hz
			0.1% + (2/α + 3)	0.2% + (2/α + 3)	100Hz - 1000Hz
100	100	100m	0.1% + 3	0.2% + 3	100Hz - 1000Hz
			0.1% + (10α + 3)	0.2% + (10α + 3)	100Hz - 1000Hz
			0.1% + (2/α² + 2/α + 1)	0.2% + (2/α² + 2/α + 1)	100Hz - 1000Hz
10	10	1000m	0.1% + 3	0.2% + 3	100Hz - 1000Hz
			0.1% + (10α + 3)	0.2% + (10α + 3)	100Hz - 1000Hz
			0.1% + (2/α² + 2/α + 1)	0.2% + (2/α² + 2/α + 1)	100Hz - 1000Hz
1000m	10	1000m	0.3% + 3	0.5% + 5	100Hz - 1000Hz
			0.3% + (10α + 5)	0.5% + (10α + 5)	100Hz - 1000Hz
			0.3% + (2/α² + 2/α + 1)	0.5% + (3α² + 3/α + 1)	100Hz - 1000Hz

TEST FREQUENCY

Equations in table represent:



R accuracies apply only when Q ≤ 0.1 (D ≥ 10). For higher Q values, refer to General Information.

α, α², 1/α, 1/α²: See Figure A Accuracy Coefficient Graph.

δ: $\frac{X \text{ rdg}}{10000}$ (normal mode)

$\frac{X \text{ rdg}}{100000}$ (high resolution mode)

(X rdg - reactance reading in counts).

C accuracies are same as for C-D, C-Q measurements.

L accuracies are same as for L-D, L-Q measurements.

Display counts for R, X, B, L and C (normal mode):

	3 digit	4 digit
Rs	*36 - 1999	0 - 19999
X		
Rp	*50 - 1999 (Q ≤ 1)	0 - 19999
L	*56 - 1999	0 - 19999 (D ≤ 2)

	4 digit	3 digit
B	0 - 19999	*36 - 1999
C	0 - 1999 (3 digit)	*56 - 1999 **(140 - 1999)

*Approximate value (unspecified).
**At frequencies of 40kHz, 400kHz, and 4MHz.

Subscripts s and p signify series and parallel modes, respectively.

Number of significant digits displayed for R, X and B depend on test signal level, range and frequency (5 digits max.).

Accuracies in lined areas are unspecified.

*1 X: $1\% + (20\alpha^2 + 20\alpha + 1)$
B: $0.5\% + (3/\alpha^2 + 3/\alpha + 1)$

*2 X: $1\% + (20\alpha^2 + 20\alpha + 1)$
B: $0.5\% + (2/\alpha + 3)$

*3 X: $0.5\% + (10\alpha + 5)$
B: $0.5\% + (2/\alpha + 3)$

Table 1-1. Specifications (sheet 6 of 8).

|Z| - θ MEASUREMENT

Z RANGE	10M Ω	5% + 1 0.1° + 0.1°/α									
	1000k Ω	3% + 1 0.05° + 0.1°/α									
	100k Ω	(0.1 + 0.2α)% + 1 0.05° + 0.05°/α		(0.2 + 0.2α)% + 1 0.05° + 0.05°/α							
	10k Ω					1% + 2 0.1° + 0.1°/α		3% + 3 0.4° + 0.4°/α			
	1000 Ω										
	100 Ω	0.1% + 3 0.05° + 0.05°/α		0.2% + 3 0.05° + 0.05°/α				2% + 7 0.4° + 0.4°/α			
	10 Ω							2% + 15 0.4° + 0.4°/α			
	1000m Ω	0.3% + 5 0.1° + 0.1°/α		0.5% + 5 0.1° + 0.1°/α		Not useable					
		10kHz	20kHz	40kHz	100kHz	200kHz	400kHz	1MHz	2MHz	4MHz	10MHz

Equations in table represent:

Impedance accuracy
Phase angle accuracy

α, 1/α: See Figure A Accuracy Coefficient Graph.

θ measurement range:

-180.000° - +180.000°

Display counts for |Z| and θ (normal mode):

Ranges	Z	θ
	*36 - 1999	0 - 18000
	0 - 19999	0 - 18000

*Approximate value (unspecified).

Number of significant digits displayed for |Z| and θ depend on test signal level, range and frequency (5 digits max.).

Accuracies in lined areas are unspecified.

OPTIONS

Option 001: Internal dc bias source remotely controllable from 0V to ±35V in 1mV (minimum) steps.

Bias control range and accuracy:

Range	step	Accuracy
±(.000 - .999)V	1mV	±(0.5% of rdg + 2mV)
±(1.00 - 9.99)V	10mV	±(0.5% of rdg + 4mV)
±(10.0 - 35.0)V	0.1V	±(0.5% of rdg + 20mV)

*Accuracies apply when DC BIAS switch is set to: INT 35V/100V (≤.1μF) position. In INT 35V/100V (≤2F) position, ±(2% of setting + 20mV) on all ranges.

Bias output characteristics:

220Ω +10%, 40mA max. (C ≤ 0.1μF)
1050Ω ±10%, 10mA max. (C ≤ 200μF)

Control: Remote control by HP 16023B DC Bias Controller or by HP-IB controller.

Control input: 24 pin connector input for 16023B or HP-IB connector. Mating connector: HP part number 1251-0292, AMPHENOL 57-40240.

Option 002: Internal dc bias source remotely controllable from 0V to ±99.9V in 0.1V (minimum) steps.

Bias control range: ±(00.0V - 99.9V), 0.1V steps.

Accuracy: ±(2% of setting + 40mV)

Bias output characteristics:

50kΩ ±10%, 2mA max.

Control: same as Option 001.

Control input: same as Option 001.

Option 003: Provides continuous memorization of control settings powered by stand-by battery. Memorizes the following data and control settings:

- 1) Front panel pushbutton control settings (except SELF TEST function).
- 2) Offset control values for test fixture or leads.