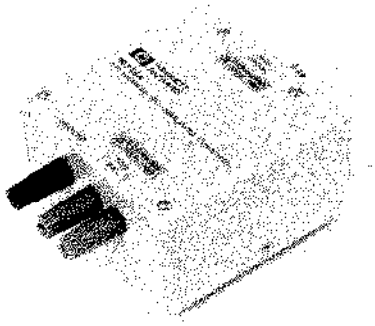
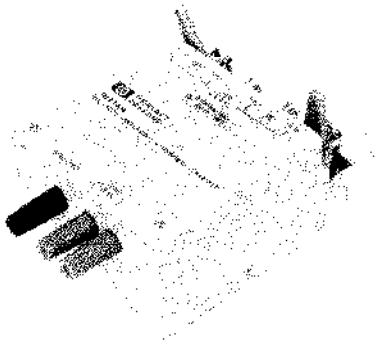
HEWLETT PACKARD

Balanced/Unbalanced Converters for Measuring Balanced Components or Circuits

HP 16314A/HP 16315A
HP 16316A/HP 16317A



HP 16315A 50Ω Bal/50Ω Unbalanced Converter



HP 16314A Balanced/Unbalanced 4-Terminal Converter

HP's Balanced/Unbalanced Converters are excellent interfaces for measuring balanced components or circuits. They can be used with HP's impedance or network analyzers (which are unbalanced system measurement instruments).

The need for measuring characteristic impedance, crosstalk, etc., of balanced components or circuits is increasing in the communication industry. Equipment such as Local Area Networks (LAN) or telephone systems require these measurements. HP's converters provide easy setup and accurate measurement of balanced devices.

Product Number	Description	Operating Frequency
HP 16314A	Balanced/Unbalanced 4-Terminal Converter	100 Hz to 10 MHz
HP 16315A	50Ω Bal/50Ω Unbal Converter	100 Hz to 10 MHz
HP 16316A	100Ω Bal/50Ω Unbal Converter	100 Hz to 10 MHz
HP 16317A	600Ω Bal/50Ω Unbal Converter	100 Hz to 3 MHz

HP 16314A Balanced/ Unbalanced 4-Terminal Converter

Features:

- The HP 16314A can be directly connected to a 4-terminal impedance analyzer or an LCR meter such as the HP 4194A. This direct connection simplifies the measurement setup required for measuring the impedance of balanced components or circuits.

- High accuracy impedance measurements of balanced devices can be obtained by using the Open/Short/Load correction. This unique feature of HP impedance analyzers and LCR meters is performed at the binding posts using the furnished shorting plate and 50-ohm load resistor.

- The wide frequency range of 100 Hz to 10 MHz covers applica tions from audio-frequency telephone equipment to high-frequency LAN, ISDN(Integrated Service Digital Network), video systems and more.

Typical Devices and Measurement Parameters

Devices:
Balanced components or circuits (such as balanced cables or balanced transformers used in the communication equipment in telephone, LAN, or ISDN systems).

Parameters:
Balanced impedance.
Characteristic impedance.
Propagation constants.

Recommended Measurement Instruments (Note 1):
HP 4194A Impedance/Gain-phase Analyzer
HP 4284A Precision LCR Meter
HP 4285A Precision LCR Meter

HP 16315A 50Ω Bal/50Ω Unbalanced Converter
HP 16316A 100Ω Bal/50Ω Unbalanced Converter
HP 16317A 600Ω Bal/50Ω Unbalanced Converter

Features:

- The transmission and reflection characteristics of balanced components or circuits can be measured with an HP network analyzer.

- The balanced impedance can be 50, 100, or 600 ohms by selecting the appropriate converter.

- High accuracy impedance mea surements of balanced devices can be realized by performing calibration at the binding posts using the furnished shorting plate and the load resistor (50, 100 or 600 ohms).

- Wide frequency range: 100 Hz to 10 MHz (the HP 16317A range is 100 Hz to 3 MHz)

Typical Devices and Measurement Parameters

Devices:
Balanced components or circuits (such as balanced cables, balanced transformers, etc.).

Differential amplifiers.

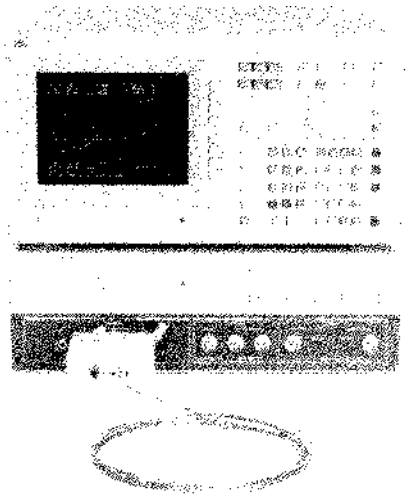
Parameters:
Insertion loss and crosstalk (transmission characteristics).
Balance impedance and return loss (reflection characteristics).

- Recommended Measurement Instruments:

HP 8751A Network Analyzer
HP 4195A Network/Spectrum Analyzer
HP 4396A Network/Spectrum Analyzer

Impedance Measurement of Balanced Components or Circuits

The picture below shows an example of a measurement configuration using the HP 4194A Impedance/Gain-phase Analyzer and the HP 16314A Balanced/Unbalanced 4-Terminal Converter. Because the HP 16314A can be connected directly to the HP 4194A, the measurement setup is quick and easy.



Quick and easy measurement set-up using the H 4194A and the HP 16314A.

Characteristic Impedance Measurement

The characteristic impedance of a balanced cable can be measured with the HP 4194A and the HP 16314A by using the Open-Short method shown in Figure 1. With this method, the characteristic impedance is calculated by using the open impedance and the short impedance of the cable. The characteristic impedance is obtained using the following equations:

$$|Z| = \sqrt{(|Zop| * |Zst|)} \quad \theta = (\theta op + \theta st)/2$$

Where:
|Z| and θ are the magnitude and phase of the characteristic impedance of the cable.
|Zop|, θop is the magnitude and phase of the open impedance.
|Zst|, θst is the magnitude and phase of the short impedance.

Figure 2 shows the characteristic impedance of a balanced cable using the Open-Short method (in the same measurement configuration shown.

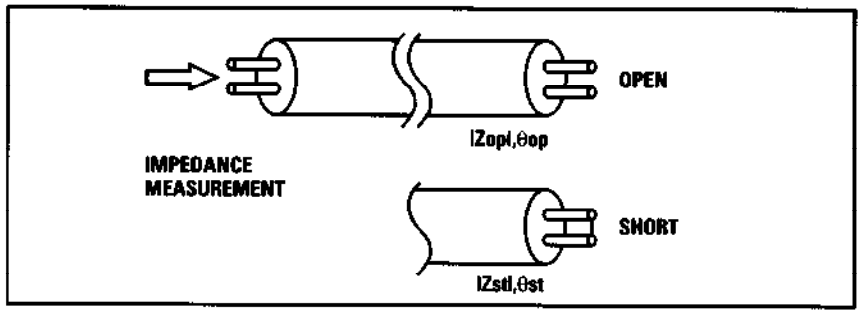


Figure 1. Open-Short Method

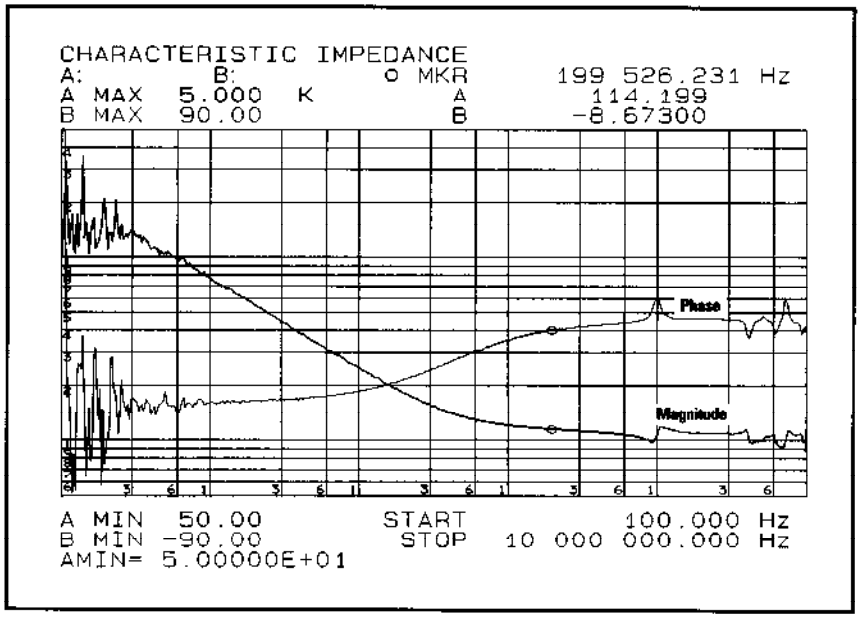
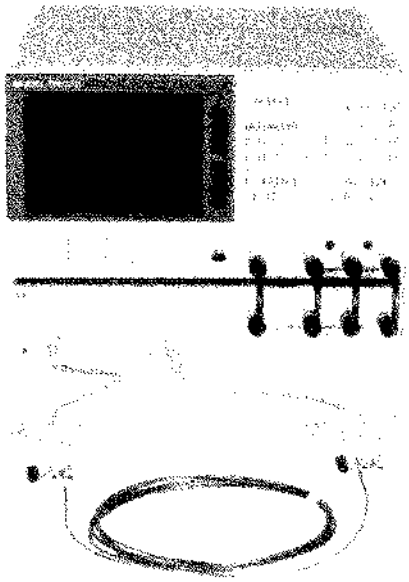


Figure 2. Characteristic Impedance of a Balanced Cable

Transmission/Reflection Characteristics Measurement of Balanced Components or Circuits

The configuration for transmission measurements of a 50Ω balanced cable with the HP 8751A network analyzer, HP 87511A 50-ohm S-parameter test set (note 2) and two HP 16316A 50-ohm Bal/ 50-ohm Unbal Converters is shown below. The balanced cable is connected to the binding post of two HP 16316As that are connected to the ports of the S-parameter test set by using two cables.

Reflection measurements only require one converter. Transmission measurements require two converters.



50Ω transmission/ reflection measurement using the HP 8751A, HP 87511A and two HP 16316A 50Ω balanced/ unbalanced converters

Crosstalk Measurements
Figure 3 shows the results of a crosstalk (near-end crosstalk) measurement of a 100-ohm balanced cable using the same configuration.

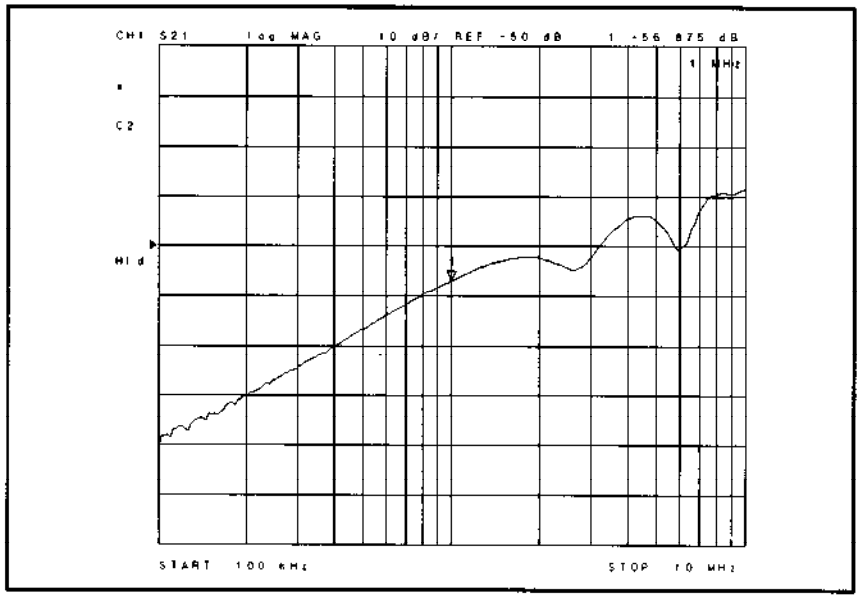


Figure 3. Crosstalk (Near-End Crosstalk) Measurement of a 100Ω Balanced Cable

Specifications

Specifications describe the instrument's warranted performance over the temperature range of 0° to 50° C (except where noted) and after 30-minute warm-up time. **Supplemental characteristics** are intended to provide information useful in applying the instrument by giving non-warranted performance parameters. These are denoted as "typical," "nominal" or "approximate."

Items \ Type		HP 16314A	HP 16315A	HP 16316A	HP 16317A
Terminal Configuration & Nominal Characteristic Impedanc e	Balanced Port	Binding Posts 2 Signal terminals & 1 ground terminal (Signal terminal spacing: 14.0mm)			
		50Ω	50Ω	100Ω	600Ω
	Unbalanced Port	4 BNC connectors	1 BNC connector		
		50Ω			
Size (mm)		89(W) X 56(H) X 133(D)	89(W) X 55(H) X 121(D)		
Weight (g)		400	350		
Operating Temperature		0 to 55°C			
Operating Humidity		≤ 95% RH (@ 40°C)			
Non-Operating Temperature		-40 to 70°C			
Non-Operating Humidity		≤ 90% RH (@ 65°C)			

Supplemental Characteristics

Items \ Type	HP 16314A	HP 16315A	HP 16316A	HP 16317A
Operating Frequency	100Hz to 10MHz			100Hz to 3MHz
Insertion Loss	≤ 1.0dB (@ 100kHz)			
Freq. Response	≤ ±1.0dB (relative to the insertion loss at 100kHz)			≤ ±1.5dB (relative to the insertion loss at 100kHz)
Return Loss	≥ 10dB (100Hz ≤ Freq < 300Hz) ≥ 20dB (300Hz ≤ Freq ≤ 7MHz) ≥ 17dB (7MHz < Freq ≤ 10MHz)			≥ 10dB (100Hz ≤ Freq < 300MHz) ≥ 20dB (300MHz ≤ Freq ≤ 1MHz) ≥ 15 dB (1 MHz < Freq ≤ 3 MHz)
Common Mode Loss	≥ 50dB (100Hz ≤ Freq ≤ 3MHz) ≥ 45dB (3MHz < Freq ≤ 5MHz) ≥ 40dB (5MHz < Freq ≤10MHz)			≥ 50dB (100Hz ≤ Freq ≤ 1MHz) ≥ 45dB (1MHz <Freq ≤ 3MHz)

Typical Additional Impedance Measurement Error for the HP 16314A

Figure 4 shows the typical additional measurement error when measuring impedance with the HP 4194A Impedance/Gain-phase analyzer.

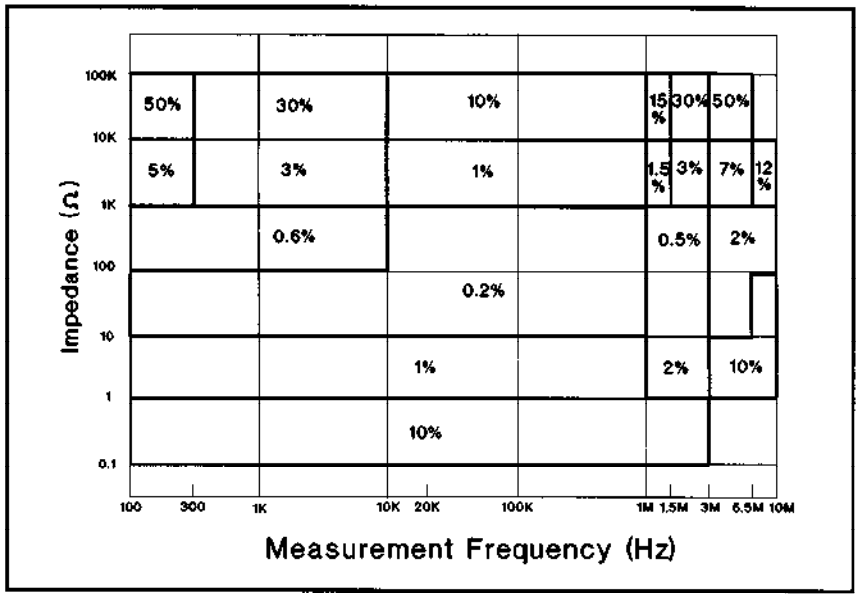


Figure 4. Typical Additional Measurement Error for the HP 16314A

Furnished Accessories

The accessories listed in Table 1-1 through Table 1-4 are supplied with each product.

Reference

Application Note 339-4 Measuring the Characteristic Impedance of Balanced Cables.
Application Note 380-2 Measuring Cable Parameters.

Notes:
1. The HP 4284A and HP 4285A can only perform the OPEN/SHORT/LOAD correction at specified measurement frequency points. Therefore, the HP 4194A is the preferred measurement instrument.
2. The HP 87511A cannot be used below 100 kHz. Use the HP 87512A 50Ω Transmission/Reflection test kit for test frequencies from 100 Hz to 10 MHz.

Table 1-1. HP 16314A

Description	Part Number	Quantity
50Ω Load Resistor	16315-60002	1
Shorting Plate	16315-60003	1
Operation and Service Manual	16315-60001	1

Table 1-2. HP 16315A

Description	Part Number	Quantity
50Ω Load Resistor	16315-60002	1
Shorting Plate	16315-60003	1
Operation and Service Manual	16315-60001	1

Table 1-3. HP 16316A

Description	Part Number	Quantity
100Ω Load Resistor	16316-60002	1
Shorting Plate	16315-60003	1
Operation and Service Manual	16315-60001	1

Table 1-4. HP 16317A

Description	Part Number	Quantity
600Ω Load Resistor	16317-60002	1
Shorting Plate	16315-60003	1
Operation and Service Manual	16315-60001	1

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