

# HP 83475B Lightwave Communications Analyzer

# **Technical Specifications**



# Automated Pulse and Eye-Diagram Mask Conformance Measurements

- Integrated Multi-Mode Optical Channel, 780-1600 nm Wavelength Range
- Built-In Calibrated SDH/SONET Reference Receiver for Mask and Extinction-Ratio Tests
- Two-Channel, 500 MHz General-Purpose Oscilloscope
- Built-In Average Optical Power Meter

The HP 83475B combines a calibrated, low-distortion optical receiver with two electrical measurement channels. With a single connection, measure average optical power and view the instantaneous digital waveform in optical watts versus time.

# HP 83475B Lightwave Communications Analyzer

The HP 83475B is an easy-to-use measurement tool for your lightwave and electrical digital communication applications. It provides comprehensive measurement capabilities in an affordable and convenient platform. The HP 83475B measures waveform compliance to a variety of optical and electrical communication standard mask and template specifications. Custom mask tests can be created and loaded into instrument memory through HP-IB or RS-232 remote control. The 62.5/125  $\mu$ m optical input of the HP 83475B measures lightwave datacom and telecom signals at wavelengths ranging from 780 nm up to 1600 nm. With its low distortion, PIN-based optical receiver and low instrument noise floor, the HP 83475B accurately measures the important parameters of laser and LED transmitters for SDH/SONET, ATM, Fibre Channel and FDDI.

# Conformance Testing to Lightwave and Electrical Digital Communication Standards

The integrated optical channel of the HP 83475B can function as a fully compliant reference receiver for SDH/SONET OC-1 and STM-1/OC-3 and Fibre Channel 133 conformance testing. With the appropriate filter option attached, the HP 83475B provides SDH/SONET and Fibre Channel transmitter compliance testing of mask conformance, extinction ratio, and output power.

With the aid of a statisticalbased algorithm, the instrument performs highly repeatable extinction-ratio measurements at the bit rate of operation. Furthermore, the HP 83475B not only conducts conformance tests to SDH/SONET and Fibre Channel masks but also performs automatic tests to a variety of other standard masks and templates specified on the ANSI T1.102 and the ITU (formerly CCITT) G.703 standards.

The HP 83475B also measures signal compliance to user-created mask tests. Through HP-IB or RS-232 remote control, userdefined mask geometries can be down loaded to the HP 83475B non-volatile memory.











Conveniently test signal compliance to preliminary or in-house standards through user-defined mask tests.

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# **Waveform Analysis**

The HP 83475B provides advanced functionality for the characterization and analysis of digital communication waveforms. Quickly and accurately obtain essential information about the performance of your lightwave systems and components. Histogram algorithms are available, at the push of a button, to measure important parameters for both single-valued pulse waveforms and multi-valued eye diagrams.

#### **Eye-Diagram Measurements**

An eye diagram provides valuable insight into the performance of a communications system. With its high throughput architecture, the HP 83475B quickly and accurately measures the critical parameters needed to optimize and troubleshoot transmitter and/or system performance. The HP 83475B measures a series of eye-diagram parameters at the push of a button. Some of these include jitter, noise, overshoot, eye height, and eye crossing %.

## General Waveform Measurements

Statistical measurements are also provided for single valued or pulsed waveforms. Histogram based algorithms are utilized to accurately and quickly analyze the important characteristics of your data.

# A Powerful General-Purpose Oscilloscope

The HP 83475B Lightwave Communications Analyzer also offers you superior generalpurpose oscilloscope capabilities. Two electrical channels are available to meet your generalpurpose needs. With its analog



Automatically perform optical extinction-ratio measurements on lightwave transmitters.



Characterize general pulsed waveforms with automatic push-button measurements.





# look and feel and high display update rates, the HP 83475B enhances your ability to troubleshoot and measure your analog and digital circuits.

Obtain bright, crisp displays at all sweep speeds and delayed sweep magnifications. Storage is as simple as pressing a button. Negative time lets you view events that occurred before the trigger.

With either HP-IB or RS-232 interface options the HP 83475B provides remote control, additional measurements such as FFT, and hard copy output to a printer or plotter.

# **Performance Characteristics**

The performance characteristics describe the performance capabilities of the HP 83475B Lightwave Communications Analyzer. Some of the characteristics are marked as tested. These are guaranteed performance specifications and they can be verified with performance tests. Unless noted, performance characteristics are given at the calibration temperature  $\pm 10$  °C.

```
Optical Input Channel<sup>3</sup>
    Bandwidth<sup>1</sup>: DC to 500 MHz (-3 dB)
    Optical Input: 62.5/125 um fiber
    Calibrated Wavelengths: 780 nm, 1310 nm,
           1550 nm (Actual calibration may be ±20 nm
          from the specified wavelengths)
    Range: 2 µW/div to 50 µW/div @ 1310/1550 nm
          20 µW/div to 500 µW/div @ 780 nm
    Vertical Power Scale Accuracy<sup>7</sup>:
          1-cursor: @ 1310/1550 nm<sup>1,4,8</sup>; ±7.5%
                       (±4.7% typical)
                    @ 780 nm<sup>8</sup>; ±4.9%
          2-cursor: @ 1310/1550 nm^{1,5,8};\,\pm 6.5\%
                       (±3.7% typical)
                    @ 780 nm<sup>8</sup>; ±4.1%
    Optical Return Loss<sup>1</sup>: 27 dB (30 dB typical)
    Noise (rms): @ 1310/1550 nm
          0.8 μW (≤20 μW/div)
          2.0 µW (>20 µW/div)
    Optical Attenuation Correction:
          Readout of 0 to 20 dB attenuation correction
    Damage Input Power Level: +4 dBm (2.5 mW)
Optical Power Meter<sup>3,2</sup>
    Accuracy<sup>7,9</sup>:
          1310^{1} nm, 1550^{1} nm : \pm 6.0\% of reading
          (\pm 2.5\% typical)
          780 nm : ±4.1% of reading
    Dynamic Range:
          780 nm: -10 dBm to 0 dBm
          1310 nm: -24 dBm to -3 dBm
          1550 nm: -24 dBm to -3 dBm
Electrical Channels 1 and 2
    Bandwidth<sup>1</sup>:
          DC to 500 MHz
          AC coupled, 10 Hz to 500 MHz
    Math Functions: + and -
    Range: 2 mV/div to 5 V/div
    Accuracy<sup>1</sup>: ±2.0%
    Verniers<sup>1</sup>: Fully calibrated, accuracy
          ±2.0% of reading
    Cursor Accuracy 1,6:
          Single cursor accuracy: vertical accuracy
          \pm 1.2\% of full scale \pm 0.5\% of position value.
          Dual cursor accuracy: vertical accuracy
```

5 Vrms into 50  $\Omega$ Probe Correction: Readout of 1X, 10X, and 100X probe correction External Attenuation Correction: Readout of external attenuation correction up to 40 dB or 100 x linear ratio **Horizontal System** Sweep Speeds: 5 s/div to 1 ns/div Accuracy: ±0.01% of reading Vernier (Both main and delayed sweep): Accuracy: ±0.05% of reading **Cursor Accuracy**<sup>1</sup> ( $\Delta$  t and 1/ $\Delta$  t): ±0.01% ±0.2% of full scale ±200 ps Delay Jitter: 10 ppm Horizontal Resolution: 25 ps **Delay Range Pre-Trigger Delay (negative time):** ≥10 div Post-Trigger (positive time): The greater of 2560 divisions or 50 ms, but not to exceed 100s. **Trigger System** Sources: Channel 1, 2, line, and external **Internal Trigger** Modes: Auto, Autolevel, Normal, Single, and TV Holdoff: Adjustable from 200 ns to ~13 s Sensitivity<sup>1</sup>: DC to 25 MHz 0.35 div or 3.5 mV DC to 500 MHz 1 div or 10 mV **External Trigger** Range: ±18 V when used for Channel 1 or Channel 2 500 mV pk-pk max input when used for optical input channel **Sensitivity<sup>1</sup>:** DC to 100 MHz <75 mV DC to 500 MHz <150 mV **Input Resistance:** 1 M $\Omega$  shunted by 12 pF or 50  $\Omega$ **Trigger View:** External trigger input can be displayed, BW >300 MHz Max Safe Input: 250 V (DC + peak AC) into  $1 M\Omega$ 5 Vrms into 50  $\Omega$ **Acquisition System Maximum Sample Rate:** 20 MSa/s single channel, single shot 10 MSa/s dual channels, single shot 10 GSa/s equivalent sampling, repetitive **Resolution:** 8 bits **Record Length:** 4,000 points (2,000 single shot) Maximum Update Rate: 1,000,000 samples/s with sufficient trigger rate Acquisition Modes: Normal, peak detect,

and Average

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Max Safe Input: 250 V (DC + peak AC) into 1 MΩ

Coupling: AC, DC, and ground Input Resistance: 1 M $\Omega$  shunted by 8 pF or 50  $\Omega$ 

±0.4% of full scale.

## Supplemental Characteristics

Optical Accuracy Drift Optical Power Meter: ±0.41%/°C Optical CW Vertical Scale: (one cursor) 0.045%/°C of full scale @ 1310 and 1550 nm

**Offset Voltage Drift at Demod Output:** 0.2 mV/°C (into 50 Ω)

**Optical System Vertical Gain Drift with no Input:** 0.075% of full screen/°C @ 1310/1550 nm

BW Drift: -2 MHz/°C

**Offset Voltage at Demod Output:**  $\leq \pm 3 \text{ mV}$ (Into 50  $\Omega$ )

Return Loss at Demod Output: >15 dBe (DC to 500 MHz)

**Demod Output Impedance:** 50  $\Omega$  (nominal)

**Optical Vertical Gain 1 dB Compression:** –5 dBm @ 1310/1550 nm

# **Physical Characteristics**

Weight: 7.25 Kg. (16.0 lbs.)

**Dimensions:** 172.7 mm H x 322.6 mm W x 317.5 mm D (6.89" H x 21.7" W x 12.5" D)

Power: 100 to 240 VAC, 45 Hz to 440 Hz

#### **Mask/Template Measurements**

Automatic testing, scaling, and placement of mask and templates for the following standards:

# SONET/SDH (ITU-TS G.957 and Bellcore

GR-253-CORE) : OC-1, 51.84 Mb/s OC-3/STM-1, 155.52 Mb/s STS-1 Eye, 51.84 Mb/s STS-1 Pulse, 51.84 Mb/s STS-3, 155.52 Mb/s STM-1 one, 155.52 Mb/s STM-1 zero, 155.52 Mb/s

### ANSI T1.102:

DS-1, 1.544 Mb/s DS-1c, 3.152 Mb/s DS-2, 6.312 Mb/s DS-3, 44.736 Mb/s

#### ITU-T G.703:

E1, 2.048 Mb/s E2, 8.448 Mb/s E3, 34.368 Mb/s E4 one, 139.264 Mb/s E4 zero, 139.264 Mb/s

### ANSI X3.88:

Fibre Channel 133 MBaud Fibre Channel 266 MBaud

#### Reference Receivers (Options 050, 051, 052):

Provide measured compliance to the SDH/SONET and/or Fiber Channel reference receiver specifications. A compliance calibration is provided for the combination of the Optical Channel and a hardware filter. The frequency response of the system is measured to make sure it meets the standard specified tolerance window. The appropriate hardware filter is provided with each of the options.

SONET OC-1, 51.84 Mb/s SDH/SONET STM-1/OC-3, 155.52 Mb/s Fibre Channel 133 MBaud

# **Automatic Measurements**

#### **Eye-Diagram Measurements:**

Time: Rise/Fall Time, Bit Rate, Bit Period, Duty Cycle Distortion, Jitter (rms and pk-pk)
Voltage/Power: Extinction Ratio, Amplitude, Overshoot, Eye Height, Noise (rms and pk-pk), One Level, Zero Level, Max Level, Min Level, Eye Crossing %

#### **General Waveform Measurements:**

**Time:** Rise/Fall Time, Frequency, Period, +width, -width, Delay, Phase, Duty Cycle

Voltage/Power: Amplitude, Max Level, Min Level, Pk-Pk, Top Level, Base Level, Average, RMS, Preshoot, Overshoot

#### Additional Measurements With Option 201 or 202: Custom Mask Test Generation FFT

Math: Differentiation, Integration, Multiplication Non-Volatile Trace Memories

- $^2$  Higher power levels can be measured if user calibrations are performed with a higher power source.
- <sup>3</sup> When temperature is at 23° ±5°C.
- $^4$  Use a full scale of 48  $\mu W$  for less than 6  $\mu W/div$  range and add  $\pm 0.5\%$  of position value.
- $^5$  Use a full scale of 48  $\mu W$  for less than 6  $\mu W/div$  range.
- $^{6}$  Use a full scale of 40 mV for <5 mV/div ranges.
- <sup>7</sup> Does not include optical input connector repeatability.
- <sup>8</sup> As a percentage of full screen.
- $^9$  Measured with a 50/125  $\mu m$  fiber and an HMS-10 diamond connector.

All technical information is subject to change without notice.

<sup>&</sup>lt;sup>1</sup> Tested specification.



# HP 83475B Lightwave Communications Analyzer Ordering Information

- **HP 83475B** Lightwave Communications Analyzer Includes one connector option, operating and service manual, and one year warranty.
- **Option 050** Optical Channel SONET OC-1 Reference Receiver Calibration
- **Option 051** Optical Channel SDH/SONET STM-1/OC-3 Reference Receiver Calibration
- **Option 052** Optical Channel Fibre Channel 133 MBaud Reference Receiver Calibration

*Note:* Options 050, 051 and 052 provide measured compliance to the SDH/SONET and/or Fibre Channel reference receiver specifications.

- **Option 053** Fibre Channel 266 Filter *Note:* The hardware filter option is provided for diagnostic testing of 266 MBaud fibre channel signals.
- Option 102 Add one HP 10073A 10:1 ohm Probe
- **Option 201** HP-IB Interface Module
- **Option 202** RS-232 Interface Module

Option UK6 Calibration and Measured Performance Data

# **Connector Interface Options (Choose One)**

- **Option 011** Diamond HMS-10/HP Connector
- **Option 012** FC/PC Connector
- **Option 013** DIN 47256 Connector
- **Option 014** ST Connector
- **Option 015** Biconic Connector
- **Option 017** SC Connector

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 Test and Measurement Organization 5301 Stevens Creek Blvd. Bldg. 51L-SC Santa Clara, CA 95052-8059 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

Japan:

Yokogawa-Hewlett-Packard Ltd. Measurement Assistance Center 9-1, Takakura-Cho, Hachioji-Shi, Tokyo 192, Japan (81) 426 48 0722

#### Latin America:

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

#### Australia/New Zealand:

Hewlett-Packard Australia Ltd. 31-41 Joseph Street Blackburn, Victoria 3130, Australia Melbourne Caller 272 2555 (008) 13 1347

#### **Asia Pacific:**

Hewlett-Packard Asia Pacific Ltd. 17-21/F Shell Tower, Time Square, 1 Matherson Street, Causeway Bay, Hong Kong (852) 599 7070

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