

### HP 83480A Series Digital Communications Analyzer

## **Product Overview**

# One solution for all your digital communications waveform analysis needs

- Complete characterization of waveforms with automated "eye" measurements, mask/template testing, and continuous traces with HP Eyeline mode
- Most accurate and repeatable extinction-ratio measurement
- Calibrated/integrated optical channels with highest waveform fidelity and measurement accuracy
- Fastest measurement throughput
- Modular platform with an extensive family of plug-in modules including 155, 622, 1063, 1250, 2488, and 9953 Mbit/s optical reference receivers, 20 and 30 GHz BW optical channels, 20 and 50 GHz electrical modules, and TDR modules

# HP 83480A digital communications analyzer

The HP 83480A digital communications analyzer is a powerful instrument designed specifically to give you the highest accuracy, measurement speed, and ease-of-use for characterizing telecommunications and data communications waveforms. For research and design or production test, the HP 83480A and its broad family of plug-in modules provides the right answers at an astonishingly rapid rate.



Automatic mask testing and eye-diagram analysis



### Plug-in modules for the HP 83480A

The HP 83480A supports a large and growing family of plug-in modules. The HP 83480A mainframe can hold two plug-ins for a total of four measurement channels. An extensive description of each plug-in module is found in the specification section.

### HP 83481A optical channel/ electrical channel module:

The HP 83481A has an integrated optical channel with up to 3 GHz bandwidth, or automatically configured as a 155 Mbit/s and 622 Mbit/s calibrated SDH/SONET reference receiver. Independent of the optical channel is an electrical channel with 20/12.4 GHz bandwidth. The plug-in also has one trigger input port.

### HP 83482A optical channel/ electrical channel module: The HP 83482A provides an optical

channel with a full 30 GHz bandwidth. The electrical channel has a 40 GHz bandwidth. The plug-in has one trigger input port.

### HP 83483A dual electrical channel module (20 GHz):

The HP 83483A plug-in has two 20/12.4 GHz electrical channels and one trigger input port.

### HP 83484A dual electrical

**channel module (50 GHz):** The HP 83484A plug-in has two 50/26.5 GHz electrical channels and one trigger input port.

### HP 83484B single electrical

**channel module (50 GHz):** Similar to the HP 83484A, with a single 50/26.5 GHz electrical channel.

### HP 83485A optical channel/ electrical channel module:

The HP 83485A has an integrated, calibrated optical receiver with a 20 GHz bandwidth, or automatically configurable as a calibrated SDH/ SONET reference receiver with an internal, switchable filter. Independent of the optical channel is an electrical channel with 20/12.4 GHz bandwidth. The plug-in also has one trigger input port.

### HP 83485B optical channel/

**electrical channel module:** The HP 83485B is similar to the HP 83485A with both optical and electrical input channels. The optical channel can be configured as a 10 Gbit/s filtered reference receiver. The filter can be switched out for increased measurement bandwidth. The electrical channel has a 40 GHz bandwidth. The plugin also has one trigger input port.

#### HP 83486A optical channel/ electrical channel module:

Similar to the HP 83481A, except this module will accept both singlemode and multi-mode fibers. It can be configured with either 155 and 622 Mb/s or 1063 and 1250 Mb/s filters. The optical channel works over a 1000 to 1600 nm range.

### HP 83487A optical channel/ electrical channel module: Similar to both the HP 83481A and

HP 83486A, this module accepts both single-mode and multimode fibers. It operates over a 750 to 860 nm range and is configured with both 1063 and 1250 Mb/s filters.

All of the modules with optical channels have a built-in average power meter.

### **TDR modules:**

The HP 83480A accepts the HP 54753A/54754A TDR/TDT plugin modules with the HP 54755A firmware upgrade. Please refer to the HP 54750A Product Overview for further information.

### Waveform analysis

Eye-diagram and pulse waveforms are quickly and conveniently analyzed with a full range of automated statistical measurements. Standard measurements include:

Mean rise and fall time Jitter: pk-pk, RMS<sup>1</sup>

Eye-width Eye-height Overshoot Duty-cycle-distortion Crossing % Extinction Ratio

Extinction-ratio measurements are automated with a histogram-based algorithm. The integrated optical plug-in module yields the most accurate and repeatable extinction-ratio measurement of laser transmitters.

In addition to extensive communications waveform analysis, the HP 83480A also performs as a conventional high-speed sampling oscilloscope, performing the following automatic measurements. Equivalent power measurements are also made on optical signals.

| Duty cycle  | Delta time | +width           |
|-------------|------------|------------------|
| Period      | Frequency  | -width           |
| / amplitude | V rms      | V lower          |
| / base      | T fall     | FFT mag          |
| / top       | T rise     | FFT delta freq   |
| Preshoot    | T max      | FFT delta mag    |
| Overshoot   | T min      | TDR min refl     |
| / р-р       | T volt     | TDR max refl     |
| / time      | V average  | TDT prop delay   |
| / min       | V upper    | TDT gain         |
| / max       | V middle   | P avg (optic ch) |
|             |            |                  |

# Mask and template testing

### **Compliance tests**

The HP 83480A offers a full range of industry standard masks and templates for automated compliance testing. Masks instantly align and scale to the displayed waveform, or the waveform can be scaled and aligned to the mask. Exceptional measurement speed results in rapid compliance testing. Test conditions can be set according to the number of waveforms, number of samples, number of failed waveforms, or number of failed samples. For guardband testing, margin masks are easily created.

<sup>&</sup>lt;sup>1</sup> The HP 83480A jitter measurement is used to characterize the random jitter of a data waveform. Other jitter measurements such as jitter transfer and jitter tolerance are measured with instruments such as the HP 71501B/C or the HP 75000 Series 90/95.

### Standard masks available:

STM-0, 1, 4, 16/OC-1, 3, 12, 24, 48 STS-1 pulse, eye STS-3 pulse 1, 0, eye Fibre Channel 133, 266, 531, 1063 FDDI PDH 2.05, 8.45, 34.4, 139.3 Mb/s DS-1, 1C, 2, 3

### **Custom mask testing**

The HP 83480A has a built-in mask editor for creating and storing userdefined masks and templates. Up to eight polygons may be placed on the display defining regions where the waveform may not exist. Similar to standard masks, the HP 83480A will log failures for each of the displayed polygons. Masks may be created manually, over HP-IB, or downloaded from the internal disk drive.

### HP eyeline mode (option 001)

HP eyeline mode can be used with an HP 71603/4B or HP 71612A BERT/pattern generator to display continuous traces instead of a conventional 'dot' display. Eyeline mode can be used to show pattern dependent effects in transmitters or show the bit sequence leading to a mask violation. Eyeline mode also allows the use of averaging with an eye diagram. This can be used to extract a clean eye diagram from noisy, low-power signals without distorting the waveform.

### Color-graded histogram display

This is an infinite persistence display mode where color differentiates the number of times data at any individual screen pixel has been acquired. All points acquired are added to a database and then displayed as one of eight colors depending upon the number of acquisitions.

Automatic-parametric measurements may be made on the color-graded display allowing evaluation of multi-valued (i.e., eye-diagram) waveforms.



Mask testing using HP eyeline mode.

### **Limit testing**

Signals can be tested by up to four automatic parametric measurements and compared to user-defined test boundaries. Failure tolerances can be selected independently for each of the parametric tests.

On failure actions include:

- 1. Save channel data to memory, disk, or printer.
- 2. Save screen to pixel memory, disk, or printer.
- 3. Save a text log summary, of all failures with time tagging, to disk or printer.

Limit test can be set to run continuously for a user-selected number of waveforms, or a defined number of failures.

### **Histograms**

Time and voltage/power histograms may be taken with a user-specified number of samples or waveforms. Time or amplitude histograms are taken within a user-specified vertical and horizontal window.

Data is stored in a database derived from screen data. When operated in color-graded mode, scaling of the time or voltage/power windows can be accomplished instantaneously without the need to acquire more data.

Automatic-histogram measurements include:

| р-р        | median     | mean       |
|------------|------------|------------|
| std dev    | µ± 1 sigma | µ± 2 sigma |
| µ± 3 sigma | hits       | peak       |

### Save/recall/transfer

Up to 10 complete instrument setups may be stored in the internal non-volatile memory. Additional setups can be stored and retrieved with the internal MS-DOS compatible disk drive.

Four waveforms may be saved in four non-volatile memories. Waveforms may also be saved to a disk. Waveforms, including color-graded waveforms, may be saved to a disk and retrieved by the instrument for future analysis, similar to if the waveform were being measured directly.

For reports and documentation, waveforms, scaling information, and measurement results may be transferred directly to HP-IB or Centronics graphic printers.

Waveforms may also be saved on the internal disk in PCX, TIFF, COLOR TIFF, or GIF format and imported directly by a word processor.

### Conventional oscilloscope functions

### Waveform math functions:

A variety of functions can also be performed on signals:

| magnify  | invert    | add           |
|----------|-----------|---------------|
| subtract | multiply  | divide        |
| versus   | integrate | differentiate |
| min      | max       |               |

**Markers:** Dual voltage/power or time markers can be used for a variety of time and voltage/power measurements. Markers can be assigned to channel data, measurements, functions, FFTs, histograms, color-graded displays, and memories.

#### **Programmability**

Instrument settings and operating modes, including automatic measurement results, can be remotely programmed via HP-IB (IEEE 488.2). HP-IB programming complies with the recommendations of the IEEE 488.2 standards. The HP 83480A can be programmed to take data only at specified time points, or to return only measurement results (such as risetime, fall time, average optical power) to speed up the acquisition. The data transfer rate is typically 550 Kbytes/s and 25 automatic measurements per second.

### **Setup aids**

**Autoscale:** Pressing the autoscale key automatically adjusts the vertical scale of all channels, the horizontal scale factors, and the trigger level for a display appropriate for the applied signals.

**Channel autoscale:** This is useful for a quick vertical scaling of an individual channel without changing other user-selected settings.

#### Vertical software calibration:

Changes in environmental conditions can be accommodated by performing a software calibration on the plugin modules. The calibration resets the plug-in for the current plug-in and mainframe operating temperature. Software vertical calibration is recommended prior to taking measurements requiring the best possible accuracy.

#### **Time base configurations:**

Time base can be configured in units of time or according to data rate, thus making instrument setup straightforward and easy. For example, if viewing an STM-16/OC-48 signal transmitting at 2.488 Gbit/s, the data rate is selected and then the desired number of bits to be displayed. Waveform position can also be specified as a bit position as opposed to an absolute time value relative to the trigger event.

### FFT

Up to three fast Fourier transforms can be run simultaneously. The three built-in filters (Hanning, rectangular, and flattop) allow optimization of frequency resolution, transients, and amplitude accuracy. Automatic measurements can be made on frequency, delta frequency, magnitude, and delta magnitude.

### **Reflection (TDR) and transmission (TDT)** measurements

The HP 83480A can be configured as a time-domain reflectometer when using either the single-ended HP 54753A TDR/TDT module or the differential, two-channel HP 54754A TDR/TDT module. The HP 54755A firmware upgrade kit is required. Refer to the HP 54750A Product Overview for a detailed discussion and specifications.

### **Specifications**

**Specifications** describe the instrument's warranted performance over the +15 to +35°C range unless otherwise noted. **Typical** values and **supplementary characteristics** describe expected, but non-warranted performance. Vertical accuracy specifications assume less than 5°C temperature variation since latest user calibration.

### HP 83480A mainframe Time base (horizontal)

Scale factor: (Full scale is 10 divisions) Minimum: 10 ps/division Maximum: 1s/division

**Delay:** (Time offset relative to trigger) Minimum: 22 ns Maximum: 1000 screen diameters or 10 seconds, whichever is smaller

**Time interval accuracy:**  $\leq 8 \text{ ps} \pm 0.1\%$  of reading (Dual marker measurement)

**Time interval resolution:** ≤(screen diameter)/ (record length) or 62.5 fs, whichever is less

### Trigger, external input only

**Sensitivity** dc to 100 MHz: 40 mV peak-to-peak

100 MHz to 2.5 GHz: Increasing linearly from 40 mV at 100 MHz to 200 mV at 2.5 GHz

**Pulse width:** 200 ps, ≥200 mV

**Bandwidth limit:** Trigger bandwidth reducible to approximately 100 MHz

**Jitter:** (trigger and time base combined, one standard deviation)

 ${\leq}2.5$  ps + 5E-5 x delay setting (Tested using a 2.5 GHz synthesized source at 200 mV)

### Trigger input (on plug-in modules):

Maximum safe input: +16 dBm ac peak ± 2 V dc Nominal impedance: 50 Ohms Reflection: ≤ 10% for 10 ps risetime Connector type: 3.5 mm (male)

For measuring optical signals, where no electrical trigger signal is available, use the HP 83447A lightwave trigger receiver. The HP 83447A will tap 10% of the optical signal and generate an electrical signal for the HP 8348X trigger port.

**Edge trigger:** Trigger on the positive or negative edge of the trigger input signal (user-selectable).

Hysteresis: The trigger hysteresis can be set to one of two operating modes:

**Normal:** The trigger hysteresis is set to meet the trigger sensitivity specification.

**High-sensitivity:** Hysteresis is disabled to allow for highest sensitivity to high-frequency trigger signals. This mode is not recommended when using noisy, lowfrequency signals that may result in false triggers without hysteresis enabled.

**Bandwidth limit:** The trigger signal is put through a low-pass filter with an approximate 100 MHz bandwidth.

### Display

**Data display resolution:** 451 points horizontally by 256 points vertically.

**Graticules:** User-selectable as full grid, axes with tic marks, frame with no tic marks, or no graticule.

**Averaging:** The number of averages can be specified between 1 and 4096 using the numeric keypad. The INCrement/ DECrement keys or the knob will set averaging to 1, 2, 4, 16, 64, 256, 1024, 4096. On each acquisition, 1/n times the new data is added to (n-1)/n of the previous value at each time coordinate, n being the total number of trace acquisitions.

**Display colors:** May choose a default color selection, or select your own colors from the front panel, or via HP-IB. A wide variety of colors are available for display background, channels, functions, background text, highlighted text, advisories, markers, overlapping memories, and memories.

#### **Programmability**

Instrument settings and operating modes, including automatic measurements, may be remotely programmed via HP-IB (IEEE 488.2).

Data transfer rate: 550 Kbytes/s typical

**Measurement times:** 25 automatic measurements per second typical. (Several automatic measurements, such as eye-diagram measurements, are histogram based and require additional time for data acquisition).

Data record length: 4K points maximum per channel

#### FFT

Up to three fast Fourier transforms can be run simultaneously. The three built-in filters (Hanning, rectangular, flattop) allow optimization of frequency resolution, transients, and amplitude accuracy.

**Frequency span:** Sample rate/2 = record length/ (2x time base range)

Frequency resolution: Time base range/record length

### HP 83480A System characteristics

### **Channels (vertical):**

Vertical parameters and specifications are generally dictated by the plug-in module used with the mainframe. Please refer to the specifications for the individual module used. The following refers to parameters that are plug-in independent.

#### Scale factors

Adjusts in a 1-2-5-10 sequence from the front panel knob or the INC/DEC arrow keys; also adjustable over the available range from the numeric keypad.

### **Attenuation factors**

Factors may be entered to scale the analyzer for external attenuators or transducers (such as O/E converters) connected to either electrical or optical channel inputs. Attenuation range is from 0.0001:1 to 1,000,000:1 entered linearly or in dB. Transducer conversion units may be entered in volts, watts, amps, or user-defined units.

### **Digitizer converter**

12-bit successive approximation A/D converter.

### Resolution

Up to 15 bits with averaging. Variable IF gain sets minimum resolution to better than or equal to 9 bits on all ranges.

### Noise

Averaging reduces noise by  $1/(\sqrt{n})$ , where n is the number of averages, until a system limitation determined by the specifics of the plug-in module is reached. For noise reduction of multi-level signals such as eye diagrams, averaging can be used for noise reduction when using HP 83480A option 001 "HP Eyeline Mode" software.

### Channel-to-channel isolation >60 dB

### **Bandwidth control**

Some plug-in modules have high and low bandwidth settings (user selectable). Refer to plug-in specifications for actual bandwidth available.

### Time base (horizontal):

### **Delay between channels**

The difference in delay between channels can be nulled out with 1 ps resolution to compensate for differences in input cables or probe length. Up to 100  $\mu s$  of skew adjustment is available.

### **Reference location**

The reference point defines displayed time relative to the trigger and is offset from the trigger by the delay time. The reference point can be located at either the left edge or center of the display screen. The reference point is also the point that the time base sensitivity expands (or contracts) as the time base scale is changed.

### **Triggered mode**

In this mode the analyzer triggers synchronously to the trigger input signal.

### Freerun

In this mode the analyzer generates its own trigger, which is not correlated to any vertical channel inputs.

### **Typical timing accuracy**

The time base uses a series of 4 ns blocks. Time base linearity and small discontinuities across these blocks contribute to the 8 ps accuracy specification.

### **Plug-In modules**

The HP 83480A supports a large and growing family of plug-in modules. The HP 83480A mainframe can hold two plug-ins for a total of four measurement channels:

HP 83481A: 2.5 GHz/155/622 Mbit/s integrated optical reference receiver and 20 GHz electrical channel

**HP 83482A:** 30 GHz integrated optical channel and 40 GHz electrical channel

HP 83483A: Dual 20 GHz electrical channels

HP 83484A: Dual 50 GHz electrical channels

HP 83484B: Single 50 GHz electrical channel

**HP 83485A:** 20 GHz integrated optical channel/SDH SONET reference receiver and 20 GHz electrical channel

**HP 83485B:** 10 Gbit/s filtered reference receiver and 40 GHz electrical channel

**HP 83486A:** 2.5 GHz/155/622/1063/1250 Mbit/s multimode integrated optical reference receiver and 20 GHz electrical channel

**HP 83487A:** 2.5 GHz/1063/1250 Mbit/s multimode integrated optical reference receiver and 20 GHz electrical channel (750 to 860 nm wavelengths)

### HP 54753A/HP 54754A TDR modules:

The HP 83480A accepts the HP 54753A/54754A TDR/TDT plug-in modules with the HP 54750K firmware upgrade. Please refer to the HP 54750A Product Overview for further information.

# HP 83481A 2.5 GHz/155/622 Mb/s optical and 20 GHz electrical plug-in module:

- Integrated/calibrated optical channel with sensitivity to below –17 dBm
- Automatic/switchable SDH/SONET filters for compliance testing at both 155 and 622 Mb/s
- 20/12.4 GHz bandwidth electrical channel
- 2.5 GHz trigger channel

The HP 83481A provides the ideal measurement system for testing single-mode SDH/SONET signals operating at 155 or 622 Mb/s as well as other high-speed telecommunications signals. The calibrated, integrated optical receiver, with over 2.5 GHz bandwidth, allows for easy, precise measurements of optical signals. An average power meter is built-in. For compliance testing, a hardware filter for both 155 Mb/s or 622 Mb/s testing can automatically be switched in to create a calibrated SDH/SONET reference receiver. The switchable filter minimizes setup time while maximizing measurement repeatability.



Front panel of HP 83481A

HP 83481A Optical Receiver Section



HP 83481A block diagram

The companion electrical measurement channel, with up to 20 GHz bandwidth, is identical in performance to the HP 83483A plug-in module channels, may be used for measurements on tributary signals, optical receiver evaluation, or for general-purpose oscilloscope measurements. HP's wide variety of external optical receivers are compatible with the electrical channel of the HP 83481A. Simply enter in the responsivity factors to produce an effective optical channel.

# HP 83481A optical/electrical plug-in module

**Optical channel Bandwidth** (-3 dB): dc to 2.5 GHz (3 GHz typical)

### **Filtered bandwidth**

Measured response conforms to ITU-TS G.957 and TA-NWT-000253 for reference receivers for both STM-1/OC-3 and STM-4/OC-12 data rates

**Transition time:** (10% to 90%, calculated from Tr = 0.48/BW optical)  $\leq 160$  ps, unfiltered mode

**Maximum RMS noise:** <2.5 μW (<1.5 μW typical), 2.5 GHz or filtered mode

Scale factor: (full scale is eight divisions) Minimum: 2  $\mu$ W/div Maximum: 100  $\mu$ W/div

**dc accuracy** (Single marker, referenced to average power monitor, scale  $\leq$ 50  $\mu$ W/div):

 $\pm$  3% of (reading - channel offset)  $\pm$  0.4% of full scale  $\pm$  6  $\mu W$ 

**dc difference** (two marker accuracy, same channel referenced to avg. power monitor, scale  $\leq$ 50  $\mu$ W/div):

 $\pm 3\%$  of (reading - channel offset)  $\pm 0.4\%$  of full scale

**dc offset range:** +0.2 mW to -0.6 mW, referenced to two divisions above bottom of screen

Calibrated wavelengths: 1310 nm and 1550 nm

Wavelength range (characteristic) 1000 to 1600 nm

#### Average power monitor

Specified operating range: -30 dBm to +3 dBm(1µW to 2 mW)

Factory calibrated accuracy:  $\pm 5\%$  of reading  $\pm 100 \text{ nW} \pm$  connector uncertainty (20°C to 30°C)

User calibrated accuracy: ±2% of reading ±100 nW ± power meter uncertainty (<5°C temp. change)

### Inputs

Maximum specified input power: 0.4 mW Maximum safe input: 10 mW peak Connector type: 9/125 μm single mode, user selectable connector option Input return loss: 33 dB (HMS-10/HP connector)

### **Electrical channel** (identical to HP 83483A)

identical to The 05405A)

**Bandwidth** (-3dB): dc to 20 GHz or dc to 12.4 GHz (user-selectable)

**Transition time** (10% to 90%, calculated from  $T_{\Gamma} = 0.35$ /bandwidth, typical):  $\leq 17.5$  ps, 20 GHz mode,  $\leq 28.2$  ps, 12.4 GHz mode

**Maximum noise** (RMS): ≤0.5 mV (0.25 mV typical), 12.4 GHz mode, ≤1 mV (0.5 mV typical), 20 GHz mode

Scale factor: (full scale is eight divisions) Minimum: 1 mV/div Maximum: 100 mV/div

dc accuracy (single voltage marker):  $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm 2 \text{ mV} \pm 1.5\%$  of (reading-channel offset) 12.4 GHz mode

 $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm$  2 mV  $\pm$  3% of (reading-channel offset), 20 GHz mode

**dc difference** (two marker accuracy on the same channel): ±0.8% of full scale ±1.5% of delta marker reading, 12.4 GHz mode

 $\pm 0.8\%$  of full scale  $\pm 3\%$  of delta marker reading, 20 GHz mode

dc offset range: ±500 mV

### Inputs

**Dynamic range:** ±400 mV relative to channel offset **Maximum safe input voltage:** 16 dBm peak ac ±2V dc (characteristic) **Nominal impedance:** 50 ohm **Reflections:** ≤5% for 30 ps risetime **Connector:** 3.5 mm (m)

# HP 83482A optical/electrical plug-in module

- Integrated/calibrated optical channel with 30 GHz bandwidth
- 40 GHz bandwidth electrical channel
- 2.5 GHz trigger channel

The HP 83482A provides the widest bandwidth for measurements of very high-speed optical waveforms. The integrated, calibrated optical receiver allows for easy, precise analysis of optical signals. The flat frequency response provides low-distortion, high-fidelity measurements. An average power meter is built in. The companion electrical channel has over 40 GHz bandwidth.



Front panel of HP 83482A

### **Optical channel**

Bandwidth (-3 dB): dc to 30 GHz (characteristic)

**Transition time:** ≤13 ps (characteristic)

**Maximum RMS noise:** ≤30 µW (≤15 µW typical)

Scale factor: (full scale is eight divisions) Minimum: 20  $\mu$ W/div Maximum: 500  $\mu$ W/div

**dc accuracy:** (Optical channel referenced to average power meter) ±50 μW ±4% of (reading-channel offset)

**dc difference:** (two marker accuracy, same channel, referenced to avg. power monitor)

±4% of delta reading

**dc offset range:** 1 mW to –3 mW, referenced to two divisions above bottom of screen

Calibrated wavelengths: 1310 nm and 1550 nm

Wavelength range (characteristic): 1000 to 1600 nm

### Average power monitor

Specified operating range: –27 dBm to +3 dBm (2  $\mu W$  to 2 mW)

**Factory calibrated accuracy** (20°C to 30°C): ±5% of reading ±100 nW ±connector uncertainty

**User calibrated accuracy**: (<5°C temp. change): ±2% of reading ±100 nW ± power meter accuracy

**Maximum specified input power** (characteristic): 2 mW

Maximum safe input (characteristic): 10 mW peak

Connector type:  $9/125\ \mu m$  single mode, user selectable connector option

Input return loss: 30 dB (HMS-10/HP connector)

### **Electrical channel**

**Bandwidth** (-3 dB): dc to 40 GHz, or dc to 18 GHz (user selectable)

 $\begin{array}{l} \mbox{Transition time (10\% to 90\%, calculated from} \\ T_{\Gamma} = 0.35/bandwidth): \\ \leq 9 \mbox{ ps, 40 GHz BW mode} \\ \leq 19.5 \mbox{ ps, 18 GHz BW mode} \end{array}$ 

Maximum RMS noise: ≤0.5 mV (0.25 mV typical,) 18 GHz mode, 1.0 mV (0.5 mV typical) 40 GHz mode

Scale factor (full scale is eight divisions) Minimum: 1 mV/div Maximum: 100 mV/div

**dc accuracy:** (Single voltage marker)  $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm 2$  mV  $\pm 1.5\%$ , 18 GHz mode  $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm 2$  mV  $\pm 3\%$  of (reading-channel offset), 40 GHz mode

**dc difference:** (two marker accuracy, same channel,  $\pm 0.8\%$  of full scale  $\pm 1.5\%$  of delta reading (18 GHz mode)  $\pm 0.8\%$  of full scale  $\pm 3\%$  of delta reading (40 GHz mode)

dc offset range: ± 500 mV

### Inputs

**Dynamic range:** ± 400 mV relative to channel offset **Maximum safe input:** 16 dBm peak ac ± 2V dc voltage (characteristic) **Nominal impedance:** 50 ohm **Reflections:** ≤5% for 20 ps risetime **Connector:** 2.4 mm (m)

# HP 83483A dual 20 GHz electrical channel plug-in module

- Two electrical measurement channels
- 20 GHz and 12.4 GHz selectable bandwidth
- 2.5 GHz trigger port

The HP 83483A provides two accurate measurement channels with user-selectable bandwidths. For optimum noise performance when measuring small signals, the 12.4 GHz setting is used. For highest accuracy and fidelity when measuring high-speed signals, the 20 GHz bandwidth setting is used.



Front panel of HP 83483A

**Bandwidth** (-3 dB): dc to 20 GHz or dc to 12.4 GHz (user-selectable)

**Transition time** (10% to 90%, calculated from  $T_{\Gamma} = 0.35$ /bandwidth, typical): ≤17.5 ps, 20 GHz mode; ≤28.2 ps, 12.4 GHz mode

 $\label{eq:maximum noise} \begin{array}{l} \mbox{(RMS): $\le$0.5 mV (0.25 mV typical), $$12.4 GHz mode; $\le$1 mV (0.5 mV typical), $$20 GHz mode $$} \end{array}$ 

**Scale factor** (full scale is eight divisions): Minimum: 1 mV/div Maximum: 100 mV/div

dc accuracy (Single voltage marker):  $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm 2$  mV  $\pm 1.5\%$  of (reading-channel offset), 12.4 GHz mode

 $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm 2~mV$   $\pm 3\%$  of (reading-channel offset), 20 GHz mode

dc difference (two marker accuracy on the same channel):  $\pm 0.8\%$  of full scale  $\pm 1.5\%$  of delta marker reading, 12.4 GHz mode

 $\pm 0.8\%$  of full scale  $\pm 3\%$  of delta marker reading, 20 GHz mode

dc offset range: ±500 mV

### Inputs

**Dynamic range:** ±400 mV relative to channel offset **Maximum safe input voltage:** 16 dBm peak ac ±2V dc (characteristic) **Nominal impedance:** 50 ohm **Reflections:** ≤5% for 30 ps risetime **Connector:** 3.5 mm (m)

# HP 83484A dual 50 GHz electrical channel plug-in module

- Two electrical measurement channels
- 50 GHz and 26.5 GHz selectable bandwidth
- 2.5 GHz trigger port

# HP 83484B single 50 GHz electrical channel plug-in module

- One electrical measurement channel
- 50 GHz and 26.5 GHz selectable bandwidth
- 2.5 GHz trigger port

The HP 83484A/B plug-ins provide accurate, wide bandwidth measurement channels. For optimum noise performance when measuring small signals, the 26.5 GHz setting is used. For highest accuracy and fidelity when measuring very high-speed signals, the 50 GHz bandwidth setting is used.

**Bandwidth** (-3dB): dc to 50 GHz or dc to 26.5 GHz (user selectable)

**Transition time** (10% to 90%, calculated from  $T_r = 0.35$ /bandwidth):  $\leq$ 7.0 ps, 50 GHz mode,  $\leq$ 13.2 ps, 26.5 GHz mode **Maximum noise** (RMS):  $\leq 0.75$  mV, 26.5 GHz mode,  $\leq 1.5$  mV, 50 GHz mode

Scale factor (full scale is eight divisions): Minimum: 1 mV/div Maximum: 100 mV/div

dc accuracy (Single voltage marker):  $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm 2$  mV  $\pm 1.5\%$  of (reading-channel offset), 26.5 GHz mode

 $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm 2$  mV  $\pm 3\%$  of (reading-channel offset), 50 GHz mode

dc difference (two marker accuracy on the same channel):  $\pm 0.8\%$  of full scale  $\pm 3\%$  of delta marker reading, 26.5 GHz mode

 $\pm$  0.8% of full scale  $\pm 5\%$  of delta marker reading, 50 GHz mode

dc offset range: ±500 mV

### Inputs

**Dynamic range:** ±400 mV relative to offset **Maximum safe input voltage:** 16 dBm peak ac ±2V dc (characteristic) **Nominal impedance:** 50 ohm **Reflections:** ≤5% for 30 ps risetime **Connector:** 2.4 mm (m)





HP 83484A & HP 83484B front panels

# HP 83485A 20 GHz optical/electrical plug-in module

- Integrated/calibrated 20/12.4 GHz bandwidth optical channel
- Automatic/switchable SDH/SONET filter for compliance testing
- 20/12.4 GHz bandwidth electrical channel
- 2.5 GHz trigger channel

# HP 83485B 10 Gb/s optical/40 GHz electrical plug-in module

- Integrated/calibrated 10 Gbit/s filtered optical reference receiver
- 40/18 GHz bandwidth electrical channel
- 2.5 GHz trigger channel

The HP 83485A provides the ideal measurement system for testing SDH/SONET signals operating at 155, 622, or 2488 Mb/s as well as other high-speed telecommunications signals. The calibrated, integrated optical receiver, with 20 GHz bandwidth, allows for easy, precise measurements of optical signals.

An average power meter is built in. For compliance testing, a single hardware filter can automatically be switched in to create a calibrated SDH/SONET reference receiver. The switchable filter minimizes setup time while maximizing measurement repeatability. The HP 83485A yields the most accurate extinctionratio measurement system available.

The companion electrical measurement channel, identical in performance to the HP 83483A plug-in module, may be used for measurements on tributary signals, receiver evaluation, or for general-purpose oscilloscope measurements. The HP 83430A Lightwave Digital Source is an SDH/SONET compliant modulated DFB laser for optical receiver and system testing at rates up to 2.5 Gbit/s (STM-16/OC-48). HP's wide variety of external optical receivers are compatible with the electrical channel of the HP 83485A. Simply enter in the responsivity factors to produce an effective optical channel.

The HP 83485B is similar to the HP 83485A. The optical channel has a built-in filter to provide a calibrated reference receiver for characterization of transmitters used in STM-64/OC-192 10 Gbit/s systems. The filter can be switched out for increased channel speed (for example, during rise and fall time measurements). The unfiltered frequency response is not flat and can cause waveform distortion in very high-speed optical pulse measurements. (For highest bandwidth and waveform fidelity, the HP 83482A is recommended). The companion electrical channel has a greater than 40 GHz bandwidth.



# HP 83485A optical/electrical plug-in module

### **Optical channel**

**Bandwidth** (-3 dB): dc to 20 GHz or dc to 12.4 GHz (user-selectable)

### **Filtered bandwidth**

Measured response conforms to ITU-TS G.957 and TA-NWT-000253 for reference receivers: Option 30 (STM-1/OC-3), Option 32 (STM-4/OC-12), Option 34 (STM-16/OC-48)

**Transition time** (10% to 90%, calculated from Tr = 0.48/BW optical):  $\leq$ 25 ps, 20 GHz mode,  $\leq$ 40 ps, 12.4 GHz mode

**Maximum RMS noise:**  $\leq 12 \ \mu W \ (\leq 8 \ \mu W \ typical), 12.4$ GHz or filtered mode,  $\leq 25 \ \mu W \ (\leq 15 \ \mu W \ typical), 20$  GHz mode

**Scale factor** (full scale is eight divisions) Minimum: 20 μW/div Maximum: 500 μW/div

**dc accuracy:** (Single marker, referenced to average power monitor)

12.4 GHz or filtered mode:  $\pm 25~\mu W~\pm 2\%$  of (reading-channel offset)

20 GHz mode: ±25 µW ±4% of (reading-channel offset)

**dc difference:** (two marker accuracy, same channel, referenced to avg. power monitor)

12.4 GHz or filtered mode: ±2% of delta reading 20 GHz mode: ±4% of delta reading

**dc offset range:** 1 mW to –3 mW, referenced to two divisions above bottom of screen

Calibrated wavelengths: 1310 nm and 1550 nm

Wavelength range (characteristic): 1000 to 1600 nm

### Average power monitor

Specified operating range: -30 dBm to +3 dBm (1µW to 2 mW)

Factory calibrated accuracy: ±5% of reading ±100 nW ±connector uncertainty (20°C to 30°C)

User calibrated accuracy: ±2% of reading ±100 nW ±power meter accuracy (≤5°C temp. change)

Maximum specified input power: 2 mW

Maximum safe input: 10 mW peak

**Connector type:** 9/125 µm single mode, user selectable connector option

Input return loss: 33 dB (HMS-10/HP connector)

### **Electrical channel**

(identical to HP 83483A)

**Bandwidth** (-3dB): dc to 20 GHz or dc to 12.4 GHz (user-selectable)

**Transition time:** (10% to 90%, calculated from  $T_r = 0.35$ /bandwidth, typical)  $\leq$ 17.5 ps, 20 GHz mode,  $\leq$ 28.2 ps, 12.4 GHz mode

**Maximum noise** (RMS): ≤0.5 mV (0.25 mV typical), 12.4 GHz mode, ≤1 mV (0.5 mV typical), 20 GHz mode

Scale factor: (full scale is eight divisions) Minimum: 1 mV/div Maximum: 100 mV/div

dc accuracy (single voltage marker):

 $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm 2 \text{ mV} \pm 1.5\%$  of (reading-channel offset), 12.4 GHz mode

 $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm$  2 mV  $\pm$  3% of (reading-channel offset), 20 GHz mode

dc difference: (two marker accuracy on the same channel)

 $\pm$  0.8% of full scale  $\pm 1.5\%$  of delta marker reading, 12.4 GHz mode

 $\pm$  0.8% of full scale  $\pm 3\%$  of delta marker reading, 20 GHz mode

dc offset range: ±500 mV

### Inputs

**Dynamic range:** ± 400 mV relative to channel offset **Maximum safe input voltage:** 16 dBm peak ac ± 2V dc (characteristic) **Nominal impedance:** 50 ohm **Reflections:** ≤5% for 30 ps risetime **Connector:** 3.5 mm (m)

# HP 83485B optical/electrical plug-in module

### **Optical channel**

**Filtered bandwidth:** Fourth or Fifth Order Bessel-Thomson filter, 3 dB frequency 7.465 GHz

**Transition time:** ≤16 ps, unfiltered (characteristic)

**Maximum RMS noise:** ≤30 µW (≤15 µW typical)

Scale factor: (full scale is eight divisions) Minimum: 20  $\mu$ W/div Maximum: 500  $\mu$ W/div

dc accuracy: (Optical channel referenced to average power meter)  $\pm 50 \mu W \pm 4\%$  of (reading-channel offset)

**dc difference:** (two marker accuracy, same channel, referenced to avg. power monitor)

±4% of delta reading

dc offset range: 1 mW to -3 mW, referenced to two divisions above bottom of screen

Calibrated wavelengths: 1310 nm and 1550 nm

Wavelength range (characteristic): 1000 to 1600 nm

Average power monitor Specified operating range: -27 dBm to +3 dBm (2 µW to 2 mW)

**Factory calibrated accuracy** (20°C to 30°C): ±5% of reading ±100 nW ±connector uncertainty

**User calibrated accuracy**: (<5°C temp. change): ±2% of reading ±100 nW ± power meter accuracy

**Maximum specified input power** (characteristic): 2 mW

Maximum safe input (characteristic): 10 mW peak

Input return loss: 30 dB (HMS-10/HP connector)

### **Electrical channel**

**Bandwidth** (-3 dB): dc to 40 GHz, or dc to 18 GHz (user selectable)

**Transition time** (10% to 90%, calculated from T<sub>r</sub> = 0.35/bandwidth): ≤9 ps, 40 GHz BW mode ≤19.5 ps, 18 GHz BW mode

Maximum RMS noise: ≤0.5 mV (0.25 mV typical,) 18 GHz mode, 1.0 mV (0.5 mV typical) 40 GHz mode

**Scale factor** (full scale is eight divisions) Minimum: 1 mV/div Maximum: 100 mV/div

**dc accuracy:** (Single voltage marker)  $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm 2 \text{ mV} \pm 1.5\%$ , 18 GHz mode  $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm 2 \text{ mV} \pm 3\%$  of (reading-channel offset), 40 GHz mode

**dc difference:** (two marker accuracy, same channel,  $\pm 0.8\%$  of full scale  $\pm 1.5\%$  of delta reading (18 GHz mode)  $\pm 0.8\%$  of full scale  $\pm 3\%$  of delta reading (40 GHz mode)

dc offset range: ± 500 mV

### Inputs

**Dynamic range:** ± 400 mV relative to channel offset

**Maximum safe input:** 16 dBm peak ac ± 2V dc voltage (characteristic)

Nominal impedance: 50 ohm

**Reflections:** ≤5% for 20 ps risetime

Connector: 2.4 mm (m)

### HP 83486A 2.5 GHz/155/622/1063/1250 Mb/s optical and 20 GHz electrical plug-in module:

- Integrated/calibrated optical channel with sensitivity to below -20 dBm
- Automatic/switchable SDH/SONET filters for compliance testing at both 155 and 622 Mb/s or FC 1063 and Gbit Ethernet
- 20/12.4 GHz bandwidth electrical channel
- 2.5 GHz trigger channel

The HP 83486A provides the ideal measurement system for testing SDH/SONET signals operating at 155 or 622 Mb/s or Fibre Channel 1063 and Gigabit Ethernet rates. The calibrated, integrated optical receiver, with over 2.5 GHz bandwidth, allows for easy, precise measurements of single-mode or multimode optical signals. An average power meter is built-in. For compliance testing, a hardware filter for both 155 Mb/s and 622 or 1063 and 1250 Mb/s testing can automatically be switched in to create a calibrated reference receiver. The switchable filter minimizes setup time while maximizing measurement repeatability.

The companion electrical measurement channel, with up to 20 GHz bandwidth, is identical in performance to the HP 83483A plug-in module channels, may be used for measurements on tributary signals, optical receiver evaluation, or for general-purpose oscilloscope measurements. HP's wide variety of external optical receivers are compatible with the electrical channel of the HP 83486A. Simply enter in the responsivity factors to produce an effective optical channel.



Front panel of HP 83486A



HP 83486A block diagram

# HP 83486A optical/electrical plug-in module

Optical channel

Bandwidth (-3 dB): dc to 2.5 GHz (2.75 GHz typical)

### **Filtered bandwidth**

Measured response conforms to ITU-TS G.957 and TA-NWT-000253 for reference receivers for both STM-1/OC-3 and STM-4/OC-12 data rates (option 040), conforms to reference receiver specifications for Fibre Channel FC-1063 and projected Gigabit Ethernet standard (option 041).

**Transition time:** (10% to 90%, calculated from Tr = 0.48/BW optical)  $\leq 160$  ps, unfiltered mode

**Maximum RMS noise:** <1.5  $\mu$ W (<1.0  $\mu$ W typical), filtered mode (option 40), <2.5  $\mu$ W (<1.5  $\mu$ W typical), filtered mode (option 041)

Scale factor: (full scale is eight divisions) Minimum: 2  $\mu$ W/div Maximum: 100  $\mu$ W/div

**dc accuracy** (Single marker, referenced to average power monitor, scale  $\leq$ 50  $\mu$ W/div):

 $\pm$  3% of (reading - channel offset)  $\pm$  0.4% of full scale  $\pm$  6  $\mu W$ 

**dc difference** (two marker accuracy, same channel referenced to avg. power monitor, scale  $\leq$ 50  $\mu$ W/div):

 $\pm 3\%$  of (reading - channel offset)  $\pm \ 0.4\%$  of full scale

**dc offset range:** +0.2 mW to -0.6 mW, referenced to two divisions above bottom of screen

Calibrated wavelengths: 1310 nm and 1550 nm

Wavelength range (characteristic) 1000 to 1600 nm

### Average power monitor

Specified operating range: -30 dBm to +3 dBm (1µW to 2 mW)

Factory calibrated accuracy: ±5% of reading ±100 nW± connector uncertainty (20°C to 30°C)

User calibrated accuracy: ±2% of reading ±100 nW ± power meter uncertainty (<5°C temp. change)

### Inputs

Maximum specified input power: 0.4 mW Maximum safe input: 10 mW peak Connector type: 62.5/125 μm multimode, user selectable connector option Input return loss: 20 dB (HMS-10/HP connector fully filled fiber)

### **Electrical channel**

(identical to HP 83483A)

**Bandwidth** (-3dB): dc to 20 GHz or dc to 12.4 GHz (user-selectable)

**Transition time** (10% to 90%, calculated from  $T_r = 0.35$ /bandwidth, typical):  $\leq 17.5$  ps, 20 GHz mode,  $\leq 28.2$  ps, 12.4 GHz mode

**Maximum noise** (RMS): ≤0.5 mV (0.25 mV typical), 12.4 GHz mode, ≤1 mV (0.5 mV typical), 20 GHz mode

**Scale factor:** (full scale is eight divisions) Minimum: 1 mV/div Maximum: 100 mV/div

dc accuracy (single voltage marker):  $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm 2$  mV  $\pm 1.5\%$  of (reading-channel offset) 12.4 GHz mode

 $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm$  2 mV  $\pm$  3% of (reading-channel offset), 20 GHz mode

dc difference (two marker accuracy on the same channel):  $\pm 0.8\%$  of full scale  $\pm 1.5\%$  of delta marker reading, 12.4 GHz mode

 $\pm 0.8\%$  of full scale  $\pm 3\%$  of delta marker reading, 20 GHz mode

dc offset range: ±500 mV

### Inputs

Dynamic range: ±400 mV relative to channel offset Maximum safe input voltage: 16 dBm peak ac ±2V dc (characteristic) Nominal impedance: 50 ohm Reflections: ≤5% for 30 ps risetime Connector: 3.5 mm (m)

# HP 83487A 2.5 GHz/1063/1250 Mb/s optical and 20 GHz electrical plug-in module:

- Integrated/calibrated optical channel with sensitivity to below -17 dBm
- 750 to 860 nm wavelength range
- Automatic/switchable filters for compliance testing at both 1063 and 1250 Mb/s
- 20/12.4 GHz bandwidth electrical channel
- 2.5 GHz trigger channel

The HP 83487A provides the ideal measurement system for testing signals operating at 1063 or 1250 Mb/s as well as other high-speed telecommunications signals. The calibrated, integrated optical receiver, with over 2.5 GHz bandwidth, allows for easy, precise measurements of single-mode or multimode optical signals. An average power meter is built-in. For compliance testing, a hardware filter for both 1063 Mb/s or 1250 Mb/s testing can automatically be switched in to create a calibrated Fibre Channel or Gigabit Ethernet reference receiver. The switchable filter minimizes setup time while maximizing measurement repeatability.

The companion electrical measurement channel, with up to 20 GHz bandwidth, is identical in performance to the HP 83483A plug-in module channels, may be used for measurements on tributary signals, optical receiver evaluation, or for general-purpose oscilloscope measurements. HP's wide variety of external optical receivers are compatible with the electrical channel of the HP 83487A. Simply enter in the responsivity factors to produce an effective optical channel.



Front panel of HP 83487A



HP 83487A block diagram

# HP 83487A optical/electrical plug-in module

### **Optical channel**

Bandwidth (-3 dB): dc to 2.5 GHz (2.75 GHz typical)

#### **Filtered bandwidth**

Conforms to reference receiver specifications for Fibre Channel FC-1063 and projected Gigabit Ethernet standard

**Transition time:** (10% to 90%, calculated from Tr = 0.48/BW optical)  $\leq$ 160 ps, unfiltered mode

**Maximum RMS noise:** <2.5  $\mu$ W (<1.5  $\mu$ W typical), filtered or unfiltered mode

**Scale factor:** (full scale is eight divisions) Minimum: 2 μW/div Maximum: 100 μW/div

dc accuracy (Single marker, referenced to average power monitor, scale  $\leq$ 50  $\mu$ W/div):

 $\pm$  3% of (reading - channel offset)  $\pm$  0.4% of full scale  $\pm$  6  $\mu W$ 

**dc difference** (two marker accuracy, same channel referenced to avg. power monitor, scale  $\leq$ 50 µW/div):

 $\pm 3\%$  of (reading - channel offset)  $\pm 0.4\%$  of full scale

**dc offset range:** +0.2 mW to -0.6 mW, referenced to two divisions above bottom of screen

Calibrated wavelength: 850 nm

Wavelength range (characteristic) 750 to 860 nm

### Average power monitor

Specified operating range: –30 dBm to +3 dBm (1 $\mu$ W to 2 mW)

Factory calibrated accuracy: ±5% of reading ±100 nW± connector uncertainty (20°C to 30°C)

User calibrated accuracy: ±2% of reading ±100 nW ± power meter uncertainty (<5°C temp. change)

### Inputs

Maximum specified input power: 0.4 mW Maximum safe input: 10 mW peak Connector type: 62.5/125 μm multimode, user selectable connector option Input return loss: 20 dB (HMS-10/HP connector fully filled fiber)

#### **Electrical channel** (identical to HP 83483A)

**Bandwidth** (-3dB): dc to 20 GHz or dc to 12.4 GHz (user-selectable)

**Transition time** (10% to 90%, calculated from  $T_r = 0.35$ /bandwidth, typical):  $\leq$ 17.5 ps, 20 GHz mode,  $\leq$ 28.2 ps, 12.4 GHz mode

**Maximum noise** (RMS): ≤0.5 mV (0.25 mV typical), 12.4 GHz mode, ≤1 mV (0.5 mV typical), 20 GHz mode

**Scale factor:** (full scale is eight divisions) Minimum: 1 mV/div Maximum: 100 mV/div

**dc accuracy** (single voltage marker): ±0.4% of full scale or marker reading (whichever is greater) ± 2 mV ± 1.5% of (reading-channel offset) 12.4 GHz mode

 $\pm 0.4\%$  of full scale or marker reading (whichever is greater)  $\pm$  2 mV  $\pm$  3% of (reading-channel offset), 20 GHz mode

**dc difference** (two marker accuracy on the same channel):

 $\pm 0.8\%$  of full scale  $\pm 1.5\%$  of delta marker reading, 12.4 GHz mode

 $\pm 0.8\%$  of full scale  $\pm 3\%$  of delta marker reading, 20 GHz mode

dc offset range: ±500 mV

### Inputs

**Dynamic range:** ±400 mV relative to channel offset **Maximum safe input voltage:** 16 dBm peak ac ±2V dc (characteristic)

Nominal impedance: 50 ohm Reflections: ≤5% for 30 ps risetime Connector: 3.5 mm (m)

### **Environmental conditions**

### Temperature

**Operating:** +10°C to +40°C **Non-operating:** -40°C to +70°C

### Humidity

**Operating:** Up to 80% relative humidity (noncondensing) at +25°C **Non-operating:** Up to 80% relative humidity at +65°C

### Altitude

**Operating:** Up to 4,600 meters (15,000 ft.) **Non-operating:** Up to 15,300 meters (50,000 ft.)

### **Power Requirements**

**Voltage**: 90 to 132 or 198 to 264 Vac **Power**: 1200 VA, 650 W

### Weights and dimensions (approximate)

HP 83480A Net Weight: 24.5 kg. (54 lb.) Shipping Weight: 31.8 kg. (70 lb.)

**HP 83483A, 83484A/B** Net Weight: 1.1 kg. (2.4 lb.)

### Shipping Weight: 2.0 kg (4.4 lb.) HP 83481A, 83485A/B, 83486A, 83487A

Net Weight: 1.1 kg. (2.4 lb.) Shipping Weight: 2.0 kg (4.4 lb.)

### **Ordering information**

# HP 83480A digital communications analyzer mainframe

**Option 001** HP Eyeline Mode Software: Disk contains software loaded directly into the HP 83480A mainframe to control either the HP 71603B or HP 71612A error performance analyzer **Option 908** Rackmount kit without handles **Option 909** Rackmount kit with handles

**Option 0BW** Service manual

**Option 0B1** Additional set of user documentation

**Option 0B0** Delete user documentation

**Option UK6** Measured performance data

Option 047 Adds HP 83447A lightwave trigger receiver

### HP 83481A optical channel/electrical channel 155 Mb/s and 622 Mb/s plug-in module

**Option 001** Latest operating system firmware for the HP 83480A **Option 002** Latest operating system firmware for the HP 54750A Select one connector type for the optical channel: **Option 012** FC/PC Option 013 DIN Option 014 ST **Option 015** Biconic Option 017 SC Select configuration for the two internal, switchable filters: Option 040 Fourth order 155 Mb/s and fourth order 622 Mb/s filters Option 050 Fifth order 155 Mb/s and fifth order 622 Mb/s filters **Option 052** Fourth order 155 Mb/s and fifth order 155 Mb/s filters **Option 062** Fourth order 622 Mb/s and fifth order 622 Mb/s filters **Option 0B1** Add extra manual set Option UK6 Commercial calibration certificate with data HP 83482A optical channel/electical channel high-speed plug-in module **Option 001** Latest operating system firmware for the

HP 83480A Option 002 Latest operating system firmware for the HP 54750A Select one connector type for the optical channel: Option 011 HMS-10/HP Option 012 FC/PC Option 013 DIN Option 014 ST Option 015 Biconic Option 017 SC

Option UK6 Commercial calibration certificate with data

# HP 83483A dual channel 20 GHz electrical plug-in module

**Option 0BW** Service manual **Option 0B1** Additional set of user documentation **Option 0B0** Delete user documentation **Option UK6** Measured performance data

### HP 83484A dual channel 50 GHz electrical plug-in module

**Option 001** Latest operating system firmware for the HP 83480A

**Option 002** Latest operating system firmware for the HP 54750A

Option 0B1 Additional set of user documentation

## HP 83484B single channel 50 GHz electrical plug-in module

**Option 001** Latest operating system firmware for the HP 83480A

**Option 002** Latest operating system firmware for the HP 54750A

**Option 0B1** Additional set of user documentation

### HP 83485A optical channel/electrical channel 20 GHz plug-in module

Select one connector type for optical channel: Option 011 HMS-10/HP Option 012 FC/PC Option 013 DIN Option 014 ST Option 015 Biconic Option 017 SC Select one filter type for internal reference receiver: Option 030 STM-1/OC-3 Option 032 STM-4/OC-12 Option 034 STM-16/OC-48 Option 0B1 Add extra manual set Option UK6 Commercial calibration certificate with data

## HP 83485B optical channel/electrical channel high-speed plug-in module

**Option 001** Latest operating system firmware for the HP 83480A Option 002 Latest operating system firmware for the HP 54750A Select one connector type for optical channel: Option 011 HMS-10/HP Option 012 FC/PC Option 013 DIN Option 014 ST **Option 015** Biconic **Option 017** SC Select one filter type for internal reference receiver: Option 040 Fourth-order filter response for STM-64/OC-192 **Option 050** Fifth-order filter response for STM-64/OC-192 **Option 0B1** Add extra manual set Option UK6 Commercial calibration certificate with data

(continued)



## HP 83486A optical channel/electrical channel 155/622/1063/1250 Mbit/s plug-in module

**Option 001** Latest operating system firmware for the HP 83480 mainframe **Option 002** Latest operating system firmware for the HP 54750 mainframe Select on connector type for the optical channel: Option 011 HP/HMS-10 **Option 012** FC/PC Option 013 DIN Option 014 ST **Option 015** Biconic Option 017 SC Select configuration for the two internal, switchable filters<sup>.</sup> **Option 040** 155 and 622 Mbit/s filters Option 041 1063 and 1250 Mbit/s filters **Option UK6** Commercial calibration certificate with data

### HP 83487A optical channel/electrical channel 1063/1250 Mbit/s plug-in module

**Option 001** Latest operating system firmware for the HP 83480 mainframe **Option 002** Latest operating system firmware for the HP 54750 mainframe Select on connector type for the optical channel: **Option 011** HP/HMS-10 **Option 012** FC/PC **Option 013** DIN **Option 013** DIN **Option 014** ST **Option 015** Biconic **Option 017** SC **Option UK6** Commercial calibration certificate with data

### **Optional accessories**

HP 83446A/B lightwave clock and data receiver HP 83447A lightwave trigger receiver HP 11982A high-speed lightwave receiver HP 83440B/C/D high-speed lightwave receiver HP 54118A 500 MHz to 18 GHz trigger HP 54006A 6 GHz hand-held probe HP 10086A ECL terminator HP 83430A Lightwave Digital Source HP 11898A Plug-in module remote/extender For more information about Hewlett-Packard test and 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. (305) 267 4245/4220

#### Australia/New Zealand:

Hewlett-Packard Australia Ltd. 31-41 Joseph Street Blackburn, Victoria 3130, Australia 1 800 629 485

#### **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

Data Subject to Change Copyright © 1995, 1996 Hewlett-Packard Company Printed in U.S.A. 2/97 5964-2238E