Errata

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HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this manual copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

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User's Guide

HP 83485A/B Optical/Electrical Plug-In Module

HP part number: 83485-90011
Printed in USA August 1995

In This Book

This book is a User's Guide for the HP 83485A/B optical/electrical plug-in module. The book contains the following chapters:

Chapter 1	provides a brief overview of the plug-in module.
Chapter 2	describes the Channel Setup menu and describes the softkeys.
Chapter 3	lists the system specifications and characteristics of this plug-in when it is combined with the mainframe.
Chapter 4	provides a list of suggestions for you to follow if the plug-in module fails to operate. A list of messages that may be displayed is also included.

For HP-IB programming information, refer to the *HP 83480A, 54750A Programmer's Guide* supplied with the mainframe. For service information, refer to the optional *HP 83485A/B Service Guide.*

Safety Symbols

The following safety symbols are used throughout this manual. Familiarize yourself with each of the symbols and its meaning before operating this instrument.

CAUTION

The *caution* sign denotes a hazard to the instrument. It calls attention to a procedure which, if not correctly performed or adhered to, could result in damage to or destruction of the instrument. Do not proceed beyond a *caution* sign until the indicated conditions are fully understood and met.

WARNING

The *warning* sign denotes a life-threatening hazard. It calls attention to a procedure which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a *warning* sign until the indicated conditions are fully understood and met.

Instruction Manual

The **instruction manual** symbol. The product is marked with this symbol when it is necessary for the user to refer to the instructions in the manual.

General Safety Considerations

WARNING

Before this instrument is switched on, make sure it has been properly grounded through the protective conductor of the ac power cable to a socket outlet provided with protective earth contact.

Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal can result in personal injury.

WARNING

There are many points in the instrument which can, if contacted, cause personal injury. Be extremely careful.

Any adjustments or service procedures that require operation of the instrument with protective covers removed should be performed only by trained service personnel.

WARNING

If this instrument is not used as specified, the protection provided by the equipment could be impaired. This instrument must be used in a normal condition (in which all means for protection are intact) only.

CAUTION

Before this instrument is switched on, make sure its primary power circuitry has been adapted to the voltage of the ac power source.

Failure to set the ac power input to the correct voltage could cause damage to the instrument when the ac power cable is plugged in.

CAUTION

Electrostatic discharge (ESD) on or near input connectors can damage circuits inside the instrument. Repair of damage due to misuse is *not* covered under warranty.

Before connecting any cable to the electrical input, momentarily short the center and outer conductors of the cable together. Personnel should be properly grounded, and should touch the frame of the instrument before touching any connector.

Assistance

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For assistance, contact your nearest Hewlett-Packard Sales and Service Office.

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Typeface conventions

(Front-Panel Key)	This represents a key physically located on the instrument.
`Softkey`	This indicates a "softkey," a key whose label is determined by the firmware of the instrument.
`Screen Text`	This indicates text displayed on the instrument's screen.

WARNING This symbol will appear along with bold print to highlight a warning.

CAUTION This symbol will appear when special care is required.

NOTE

This symbol will appear to call attention to an important point in the text.

Warranty

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by Hewlett-Packard. Buyer shall prepay shipping charges to Hewlett-Packard and Hewlett-Packard shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to Hewlett-Packard from another country.

Hewlett-Packard warrants that its software and firmware designated by Hewlett-Packard for use with an instrument will execute its programming instructions when properly installed on that instrument. Hewlett-Packard does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error-free.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

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The Instrument at a Glance

The Instrument at a Glance

What you'll find in this chapter

This chapter describes:

- options and accessories
- the key conventions used in this manual
- the front panel, rear panel and keys that do *not* display menus on the screen
- lightwave connector care

Understanding the information in this chapter will help you successfully operate the instrument.

CAUTION

The input circuits can be damaged by electrostatic discharge (ESD). Therefore, avoid applying static discharges to the front-panel input connectors. Before connecting any coaxial cable to the connectors, momentarily short the center and outer conductors of the cable together. Avoid touching the front-panel input connectors without first touching the frame of the instrument. Be sure that the instrument is properly earth-grounded to prevent buildup of static charge.

The HP 83485A optical/electrical plug-in module incorporates two measurement channels, one optical and one electrical. Each channel has two selectable bandwidth settings. In the lower bandwidth modes of 12.4 GHz, oscilloscope noise performance is excellent, while the 20 GHz mode allows greater fidelity for high speed signals.

The HP 83485B optical/electrical plug-in module incorporates a 30 GHz optical measurement channel and a 40 GHz electrical channel. The electrical channel also has a reduced-bandwidth setting of 18 GHz for improved noise performance.

The integrated optical channel reduces mismatch loss variation by eliminating signal distorting cables and connectors associated with the use of external receivers in order to accurately characterize optical waveforms. The optical channel is calibrated at 1310 nm and 1550 nm to provide both accurate display of the received optical waveform in optical power units and measurement of the signal's average power. In addition, the User Cal feature provides for consistent accuracy at any wavelength between 1200 nm and 1600 nm using a source and power meter.

The HP 83485A optical/electrical plug-in module also is a calibrated SONET/SDH reference receiver that is measured to comply to ITU-TS (formerly CCITT) G.957 and Bellcore GR-253-CORE frequency response requirements for transmitter compliance testing. By either pressing a front-panel button or issuing an HP-IB command, a fourth-order Bessel-Thomson filter is inserted into or removed from the measurement channel by a very repeatable HP microwave switch. The switch removes the potential variability and the time wasted by manually inserting and removing the filter when alternating between high-fidelity waveform characterization and SONET/SDH compliance testing.

The HP 83485B optical/electrical plug-in module includes a reference receiver path, similar to the HP 83485A, for 10 Gb/s transmitter test. Although no industry standards exist for 10 Gb/s testing, the HP 83485B has been designed to meet anticipated future standards.

The electrical measurement channel may be used to perform measurements on tributary electrical signals, to evaluate receiver performance in transceiver testing, for measurements with HP's wide range of external optical receivers, or for general purpose measurements.

The HP 83485A optical/electrical plug-in module provides:

- 12.4 GHz and 20 GHz optical channel
- 12.4 GHz and 20 GHz electrical channel
- Switchable SDH/SONET filter for transceiver compliance testing
- Trigger channel input to the mainframe

The HP 83485B optical/electrical plug-in module provides:

- 30 GHz optical channel
- 18 GHz and 40 GHz electrical channel
- Switchable SDH/SONET filter for transceiver performance testing
- Trigger channel input to the mainframe

Ordering information

HP 83485A options

Option 030 Built-in STM-1/OC-3 155 Mb/s SDH/SONET reference receiver
Option 032 Built-in STM-4/OC-12 622 Mb/s SDH/SONET reference receiver
Option 034 Built-in STM-16/OC-48 2.488 Gb/s SDH/SONET reference receiver
Option 0BW *HP 83485A/B Service Guide*
Option 0B1 Additional set of user documentation
Option 0B0 Deletes the user documentation
Option UK6 Measured performance data

HP 83485B options

Option 001 Latest operating system firmware for the HP 83480A mainframe
Option 002 Latest operating system firmware for the HP 54750A mainframe
Option 040 Fourth order filter/10 Gb/s reference receiver
Option 050 Fifth order filter/10 Gb/s reference receiver

Optical connector interface options

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

Optional accessories

HP 54006A 6 GHz divider probe
HP 54008A 22 ns delay line
HP 54118A 500 MHz to 18 GHz trigger
HP 10086A ECL terminator

Connection devices

SMA (f-f) adapter, HP part number 1250-1158
APC 3.5 (f-f) adapter, HP part number 1250-1749
HP 81000AI Diamond HMS-10/HP connector interface
HP 81000FI FC/PC/SPC/APC connector interface
HP 81000KI SC connector interface
HP 81000SI DIN 47256/4108.6 connector interface
HP 81000VI ST connector interface
HP 81000WI Biconic

The keys labeled Trigger, Disk, and Run are all examples of front-panel keys. Pressing some front-panel keys accesses menus of functions that are displayed along the right side of the display screen. These menus are called softkey menus.

Softkey menus list functions other than those accessed directly by the front-panel keys. To activate a function on the softkey menu, press the unlabeled key immediately next to the annotation on the screen. The unlabeled keys next to the annotation on the display are called softkeys.

Additional functions are listed in blue type above and below some of the front-panel keys. These functions are called shifted functions. To activate a shifted function, press the blue front-panel Shift key and the front-panel key next to the desired function.

Throughout this manual front-panel keys are indicated by a box around the key label, for example, [Timebase]. Softkeys are indicated by shading on the key label, for example, **Mask Align**. The softkeys displayed depend on the front-panel key pressed and which menu is selected. Shifted functions are indicated by the front-panel [Shift] key followed by the shaded shifted function, for example the Local function (above the [Stop/Single] front-panel key) will be shown as [Shift], [Local].

A softkey with On and Off in its label can be used to turn the softkey's function on or off. To turn the function on, press the softkey so On is highlighted. To turn the function off, press the softkey so Off is highlighted. An On or Off softkey function will be indicated throughout this manual as: **Test** On.

A softkey such as `Sweep Triggered Freerun` offers you a choice of functions. In this case you could choose Triggered by pressing the softkey until Triggered is highlighted, or choose Freerun by pressing the softkey until Freerun is highlighted. A choices softkey will be indicated throughout this manual as: `Sweep Triggered Freerun` Triggered.

When some softkeys, such as `Calibrate probe`, are pressed the first time, a measurement will be made and the result will be provided. Some softkeys, such as `Offset` require the entry of a numeric value. To enter or change the value, use the general purpose knob located below the front-panel Measure section.

The HP 83485A/B Optical/Electrical Plug-In Module

The HP 83485A/B optical/electrical plug-in modules are two of several plug-in modules available for the HP 83480A, 54750A mainframes. Their main features are:

- Integrated, calibrated optical channel.
- Optical channel includes switchable SONET/SDH filter.
- Electrical measurement channel.
- 2.5 GHz trigger channel.
- Both optical and electrical measurement channels have user selectable bandwidths of 12.4 or 20 GHz. (*HP 83485A only*)
- 30 GHz optical channel bandwidth and user selectable 18 or 40 GHz electrical channel bandwidth. (*HP 83485B only*)
- 3.5 mm (m) connectors on electrical measurement channel and trigger channel. (*2.4 mm (m) connector on electrical channel of HP 83485B.*)
- One probe power connector.
- One auxiliary power connector.
- Optical channel has an HP universal adapter for 9/125 μm single-mode fiber input.

NOTE

If you wish to use the HP 83485A/B optical plug-in module in an HP 54750A digitizing oscilloscope, a firmware upgrade must first be installed. Order the HP 83480K communications firmware kit and follow the installation instructions.

The purpose of the plug-in module is to provide measurement channels, including sampling, for the mainframe. The plug-in module scales the input signal, sets the bandwidth of the system, and allows the offset to be adjusted so the signal can be viewed. The output of the plug-in module is an analog signal that is applied to the ADCs on the acquisition boards inside the mainframe. The plug-in module also provides a trigger signal input to the time base/trigger board inside the mainframe.

Front panel of the plug-in module

The plug-in module takes up two of the four mainframe slots. The optical channel provides calibrated measurement of optical waveforms in power units. Bandwidths are selectable on both channels to optimize sensitivity and bandwidth.

The front panel of the plug-in module has two channel inputs and an external trigger input. The front panel also has a probe power connector for HP 54700-series probes, an auxiliary power connector for general purpose use, and a key for each channel that displays the softkey menu. The softkey menu allows you to access the channel setup features of the plug-in module.

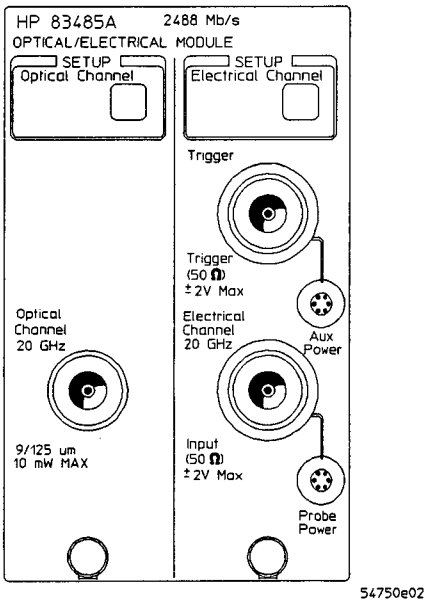

Figure 1-1. Front panel of the plug-in module.

Getting the best performance

To ensure you obtain the specified accuracy, you must perform a plug-in module vertical calibration. The calibration must also be performed when you move a plug-in module from one slot to another, or from one mainframe to another. Refer to "Performing a plug-in module vertical calibration" in Chapter 2 for information on performing a plug-in module vertical calibration.

Installing the plug-in module

You do not need to turn off the mainframe to install or remove the plug-in modules.

NOTE

If you wish to use the HP 83485A/B optical plug-in module in an HP 54750A digitizing oscilloscope, a firmware upgrade must first be installed. Order the HP 83480K communications firmware kit and follow the installation instructions.

The plug-in module can be installed in slots 1 and 2 or 3 and 4 on the HP 83480A, 54750A mainframe. The plug-in module will *not* function if it is installed in slots 2 and 3.

To make sure the analyzer meets all of the published specifications, there must be a good ground connection from the plug-in module to the mainframe. The RF connectors on the rear of the plug-in module are spring loaded, so finger-tighten the knurled screw on the front panel of the plug-in module to make sure the plug-in is securely seated in the mainframe.

CAUTION Do not use extender cables to operate the plug-in module outside of the mainframe. The plug-in module using extender cables can be damaged by improper grounding when using extender cables.

Trigger

The external trigger level range for this plug-in module is ±1 V. The trigger source selection follows the slots the plug-in module is installed in. For example, if the plug-in module is installed in slots 1 and 2, then the trigger source is listed as trigger 2. If it is installed in slots 3 and 4, then the trigger source is listed as trigger 4.

CAUTION The maximum safe input voltage is ±2 V + peak ac (+16 dBm).

CAUTION The input circuits can be damaged by electrostatic discharge (ESD). Therefore, avoid applying static discharges to the front-panel input connectors. Before connecting any coaxial cable to the connectors, momentarily short the center and outer conductors of the cable together. Avoid touching the front-panel input connectors without first touching the frame of the instrument. Be sure that the instrument is properly earth-grounded to prevent buildup of static charge.

Cleaning Connections for Accurate Measurements

Accurate and repeatable measurements require clean connections. Use the following guidelines to achieve the best possible performance when making measurements on a fiber-optic system:

- Keep connectors covered when not in use.
- Use dry connections whenever possible.
- Use the cleaning methods described in this section.
- Use care in handling all fiber-optic connectors.
- When inserting a fiber-optic connector into a front-panel adapter, make sure that the fiber end does not touch the outside of the mating connector or adapter.

Because of the small size of cores used in optical fibers, care must be used to ensure good connections. Poor connections result from core misalignment, air gaps, damaged fiber ends, contamination, and improper use and removal of index-matching compounds.

Use dry connections. Dry connectors are easier to clean and to keep clean. Dry connections can be used with physically contacting connectors (for example, Diamond HMS-10/HP, FC/PC, DIN, and ST). If a dry connection has 40 dB return loss or better, making a wet connection will probably not improve (and can degrade) performance.

CAUTION

Hewlett-Packard strongly recommends that index matching compounds NOT be applied to their instruments and accessories. Some compounds, such as gels, may be difficult to remove and can contain damaging particulates. If you think the use of such compounds is necessary, refer to the compound manufacturer for information on application and cleaning procedures.

Cleaning Accessories

Item	HP Part Number
Isopropyl alcohol	8500-5344
Cotton swabs	8520-0023
Small foam swabs	9300-1223
Compressed dust remover (non-residue)	8500-5262

Dust Caps Provided with Lightwave Instruments

Item	HP Part Number
Laser shutter cap	08145-64521
FC/PC dust cap	08154-44102
Biconic dust cap	08154-44105
DIN dust cap	5040-9364
HMS10/HP dust cap	5040-9361
ST dust cap	5040-9366

Inspecting Fiber-Optic Cables

Consistent measurements with your lightwave equipment are a good indication that you have good connections. However, you may wish to know the insertion loss and/or return loss of your lightwave cables or accessories. If you test your cables and accessories for insertion loss and return loss upon receipt, and retain the measured data for comparison, you will be able to tell in the future if any degradation has occurred.

Connector (or insertion) loss is one important performance characteristic of a lightwave connector. Typical values are less than 1 dB of loss, and sometimes as little as 0.1 dB of loss with high performance connectors. Return loss is another important factor. It is a measure of reflection: the less reflection the better (the larger the return loss, the smaller the reflection). The best physically contacting connectors have return losses better than 50 dB, although 30 to 40 dB is more common.

You can visually inspect your cables

Although it is not necessary, visual inspection of fiber ends can be helpful. Contamination or imperfections on the cable end face can be detected as well as cracks or chips in the fiber itself. Use a microscope (100X to 200X magnification) to inspect the entire end face for contamination, raised metal, or dents in the metal as well as any other imperfections. Inspect the fiber for cracks and chips. Visible imperfections not touching the fiber core may not affect performance (unless the imperfections keep the fibers from contacting).

To clean a non-lensed connector

CAUTION Do not use any type of foam swab to clean optical fiber ends. Foam swabs can leave filmy deposits on fiber ends that can degrade performance.

1. Apply isopropyl alcohol to a clean lint-free cotton swab or lens paper.

   Cotton swabs can be used as long as no cotton fibers remain on the fiber end after cleaning.

2. Before cleaning the fiber end, clean the ferrules and other parts of the connector.
3. Apply isopropyl alcohol to a new clean lint-free cotton swab or lens paper.
4. Clean the fiber end with the swab or lens paper. Move the swab or lens paper back and forth across the fiber end several times.

   Some amount of wiping or mild scrubbing of the fiber end can help remove particles when application of alcohol alone will not remove them. This technique can remove or displace particles smaller than one micron.

5. Immediately dry the fiber end with a clean, dry, lint-free cotton swab or lens paper.
6. Blow across the connector end face from a distance of 6 to 8 inches using filtered, dry, compressed air. Aim the compressed gas at a shallow angle to the fiber end face.

   Nitrogen gas or compressed dust remover can also be used.

CAUTION Do not shake, tip, or invert compressed air canisters, because this releases particles in the can into the air. Refer to instructions provided on the compressed air canister.

7. As soon as the connector is dry, connect or cover it for later use.

To clean an adapter

1. Apply isopropyl alcohol to a clean foam swab.

   Cotton swabs can be used as long as no cotton fibers remain after cleaning. The foam swabs listed in this section's introduction are small enough to fit into adapters.

   Although foam swabs can leave filmy deposits, these deposits are very thin, and the risk of other contamination buildup on the inside of adapters greatly outweighs the risk of contamination by foam swabs.

2. Clean the adapter with the foam swab.
3. Dry the inside of the adapter with a clean, dry, foam swab.
4. Blow through the adapter using filtered, dry, compressed air.

   Nitrogen gas or compressed dust remover can also be used.

CAUTION Do not shake, tip, or invert compressed air canisters, because this releases particles in the can into the air. Refer to instructions provided on the compressed air canister.

To test insertion loss

Use an appropriate lightwave source and a compatible lightwave receiver to test insertion loss. Examples of test equipment configurations include the following equipment:

- HP 71450A or 71451A optical spectrum analyzers with Option 002 built-in white light source
- HP 8702 or 8703 lightwave component analyzer system
- HP 83420 lightwave test set with an HP 8510 network analyzer
- HP 8153 lightwave multimeter with a source and power sensor module

To test return loss

Use an appropriate lightwave source, a lightwave receiver, and lightwave coupler to test return loss. Examples of test equipment configurations include the following equipment:

- HP 8703 lightwave component analyzer
- HP 8702 analyzer with the appropriate source, receiver, and lightwave coupler
- HP 8504 precision reflectometer
- HP 8153 lightwave multimeter with a source and power sensor module in conjunction with a lightwave coupler
- HP 81554SM dual source and HP 81534A return loss module

Channel Setup Menu

Channel Setup Menu

What you'll find in this chapter

This chapter describes the Channel Setup menu. A key tree and description of the available functions is included.

CAUTION

The input circuits can be damaged by electrostatic discharge (ESD). Therefore, avoid applying static discharges to the front-panel input connectors. Before connecting any coaxial cable to the connectors, momentarily short the center and outer conductors of the cable together. Avoid touching the front-panel input connectors without first touching the frame of the instrument. Be sure that the instrument is properly earth-grounded to prevent buildup of static charge.

At the top of the plug-in module are the (Channel) keys. These keys give you access to the Channel Setup menu for each input. The Channel Setup menu is displayed on the right side of the screen when the (Channel) key is pressed. There are several types of softkeys available. A description of the different softkeys and their functions is provided in the *HP 83480A, 54750A User's Quick Start Guide* supplied with the mainframe.

NOTE

The plug-in module has both an electrical channel and an optical channel. Although many of the softkeys are similar, some differences exist. The examples in this book use the optical channel and note when the user would see differences if using the electrical channel.

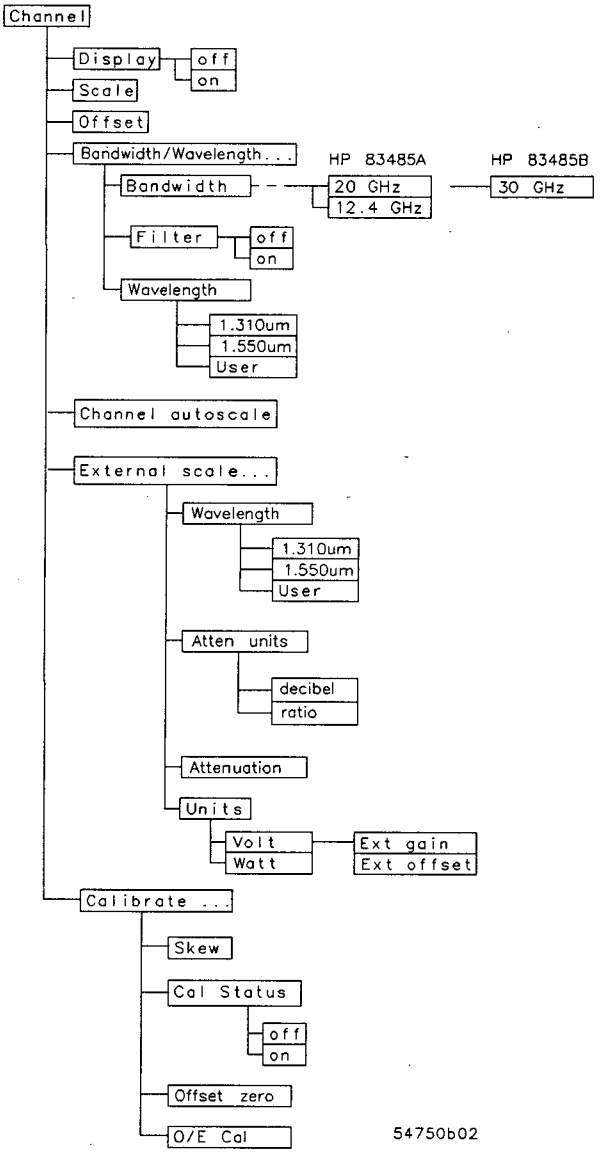

Figure 2-1. Optical Channel Setup menu.

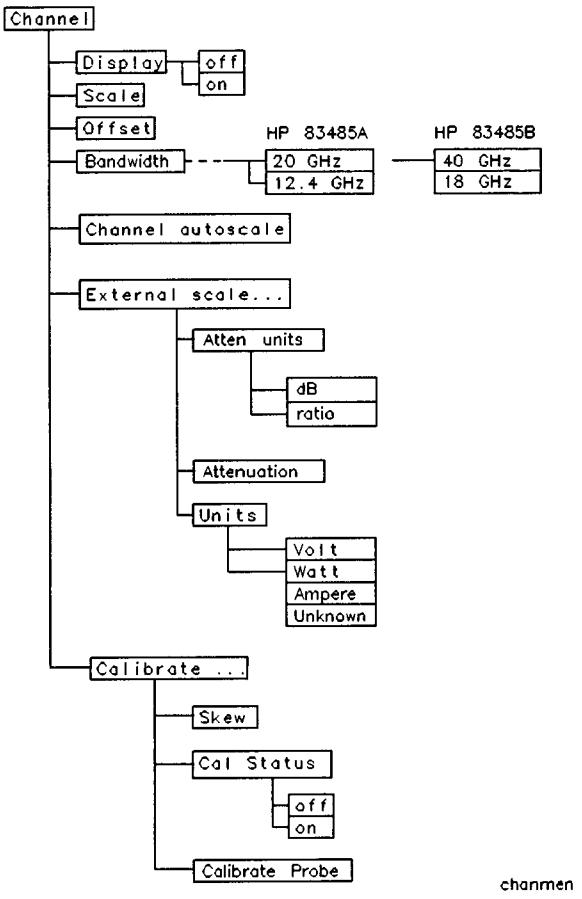

Figure 2-2. Electrical Channel Setup menu.

Displaying the Channel Setup menus

To display the optical Channel Setup menu, press the optical (Channel) key.

To display the electrical Channel Setup menu, press the electrical (Channel) key.

Display

The Display function turns the channel display off and on. When the channel display is on, a waveform is displayed for that channel, unless the offset is adjusted so the waveform is clipped off of the display.

The channel number, vertical scaling, and offset are displayed at the bottom left of the waveform area. They remain on the display until the channel is turned off, or an automatic measurement is performed. The automatic measurement results share the same area of the display as the channel setups.

When the channel display is off, the waveform display for that channel is turned off, pulse parameter measurements are stopped and acquisition on that channel is stopped, unless it is needed as an operand for waveform math functions.

Even though the channel display is off, you can still use the plug-in as a trigger source or as a function source in the Math menu. However, the analyzer will not trigger unless one or more of the other channel displays are turned on, or unless a math function is using one of the channels.

Key Path (Channel) Display

Scale

The Scale softkey controls the vertical scaling of the waveform. If the fine mode is off, then the knob and arrow keys change the vertical scaling in a 1-2-5 sequence. When fine mode is on, the knob and arrow keys change the vertical scaling in 1 mV increments. You can also use the keypad to enter values in 1 mV increments, independent of the fine mode selection.

The units the scale is displayed in depend on the unit of measure selected with the Units softkey. The choices for units are volts or watts. (Amperes, or unknown are available on electrical channels only.)

Key Path (Channel) Scale

Offset

The Offset softkey moves the waveform vertically. It is similar to the position control on analog oscilloscopes. The advantage of digital offset is that it is calibrated. The offset voltage for electrical channels is the voltage at the center of the graticule area, and the range of offset is ±12 times the full resolution channel scale. For optical channels, the offset wattage is the wattage two graticule divisions above the bottom of the screen. This is set because, unlike voltage displays, "negative" power levels do not exist but the zero power level can be viewed clearly when the offset is set to zero watts. You can use the knob, arrow keys, or keypad to change the offset setting. The fine mode also works with offset.

When an HP 54700-series active probe is used with the plug-in module and is connected to the probe power connector adjacent to the channel input, the offset control adjusts the external scale factor and offset of the hybrid inside the active probe. A probe connected to the auxiliary power connector adjacent to the trigger input will function, but the channel scale factor will not be adjusted automatically.

The optical channel displays the value in watts and the electrical channel displays the value in volts.

Key Path (Channel) Offset

Bandwidth/Wavelength. . .

You can use the Bandwidth/Wavelength. . . softkey to change the bandwidth and wavelength settings and turn the filter on and off on the optical channel.

`Bandwidth`

HP 83485A: This function is available on the electrical channel and on the optical channel only when the filter is switched off.

You can use the Bandwidth function to select either the 12.4 GHz or the 20 GHz bandwidth.

HP 83485B: This function is available on the electrical channel only.

You can use the Bandwidth function to select either the 18 GHz or 40 GHz bandwidth.

Key Path (Channel) `Bandwidth/Wavelength. . .` `Bandwidth`

`Filter On Off`

The Filter function allows a SONET/SDH Bessel-Thomson filter to be switched into the channel to create a SONET/SDH reference receiver.

HP 83485A: Option 030 is 155 Mb/s STM-1/OC-3. Option 32 is 622 Mb/s STM-4/OC-12. Option 34 is 2.488 Gb/s STM-16/OC-48.

HP 83485B: Option 40 is 10 Gb/s fourth-order filter. Option 050 is 10 Gb/s fifth-order filter.

Key Path (Channel) `Bandwidth/Wavelength. . .` `Filter Off On`

`Wavelength`

This function is only available on the optical channel.

The Wavelength function selects the desired wavelength for calibrated measurements. Factory calibrated wavelengths are 1310 nm and 1550 nm. A user-calibrated wavelength is also available and can be calibrated in the range from 1000 nm to 1600 nm. Refer to "Performing an O/E calibration" for additional information on performing a calibration.

Key Path (Channel) `Bandwidth/Wavelength. . .` `Wavelength`

Channel autoscale

The Channel Autoscale function provides a convenient and fast method for determining the standard vertical scale setting with the highest resolution that will not clip the waveform. Timebase and trigger settings are not affected.

This function is useful in manufacturing environments where the timebase and trigger settings remain constant and only the vertical scale needs to be adjusted for signal level variations in multiple DUTs.

Key Path (Channel) Channel autoscale

External scale . . .

The External Scale function allows you to setup the analyzer to use external optical-to-electrical converters or attenuators. Scaling is automatically adjusted to account for the external device.

Key Path (Channel) External scale . . .

Atten units The Atten Units function lets you select how you want the probe attenuation factor represented. The choices are either decibel or ratio. The formula for calculating decibels is:

$$20\ log\frac{V_{out}}{V_{in}} or\ 10\ log\frac{P_{out}}{P_{in}}$$

Attenuation

The Attenuation function lets you select an attenuation that matches the device connected to the analyzer. When the attenuation is set correctly, the analyzer maintains the current scale factors if possible. All marker values and voltage or wattage measurements will reflect the actual signal at the input to the external device.

The attenuation range is from 0.0001:1 to 1,000,000:1. When you connect a compatible active probe to the probe power connector, adjacent to the channel input, the instrument automatically sets the attenuation. For all other devices, set the probe attenuation with the knob, arrow keys, or keypad.

> **NOTE**
>
> Refer to "Calibrating voltage probes" for information on calibrating to the tip of the probe.

Key Path (Channel) External scale . . . Attenuation

Units

The Units function lets you select the unit of measure appended to the channel scale, offset, trigger level, and vertical measurement values. For the optical channel these units are Volts or Watts. For the electrical channel the units are Volts, Amperes, Watts, or unknown. Use Volt for voltage probes, Ampere for current probes, Watt for optical-to-electrical (O/E) converters, and unknown when there is no unit of measure or when the unit of measure is not one of the available choices.

Key Path (Channel) External scale . . . Units

Ext gain and Ext offset

When you select Ampere, Watt, or unknown, two additional functions become available: External Gain and External Offset. These two additional functions allow you to compensate for the actual characteristics of the probe rather than its ideal characteristics. For example, you might have an amplified lightwave converter with ideal characteristics of 300 V/W with 0 V offset. But, its actual characteristics are 324 V/W with 1 mV of output offset. Therefore, set the External Gain to 324 V/W and the External Offset to 1 mV.

Key Path

(Channel) External scale . . . Units Volt Ext gain or Ext Offset

(Channel) External scale . . . Units Watt Ext gain or Ext Offset

(Channel) External scale . . . Units Unknown Ext gain or Ext Offset

Calibrate

The calibrate menu allows you to null out any skew between probes or cables, remove the effects of offsets in the internal O/E converter, recalibrate the responsivity of the O/E converter, and check the present calibration status of the analyzer.

Key Path

(Channel) Calibrate

Skew

The Skew function changes the horizontal position of a waveform on the display. The Skew function has a range of $\approx +100\ \mu s$. You can use skew to compensate for differences in cable or probe lengths. It also allows you to place the triggered edge at the center of the display when you are using a power splitter connected between the channel and trigger inputs. Another use for skew is when you are comparing two waveforms that have a timing difference between them. If you are more interested in comparing the shapes of two waveforms rather than the actual timing difference between them, you can use Skew to overlay one waveform on top of the other waveform.

To skew two channels

1. Turn both channels on and overlay the signals vertically.
2. Expand the time base so the rising edges are about a 45 degree angle.
3. Adjust the skew on one of channels so that the rising edges overlap at the 50 percent points.

Key Path (Channel) Calibrate Skew

Cal status The Cal Status function displays a screen similar to Figure 2-3.

Key Path (Channel) **Calibrate Cal Status**

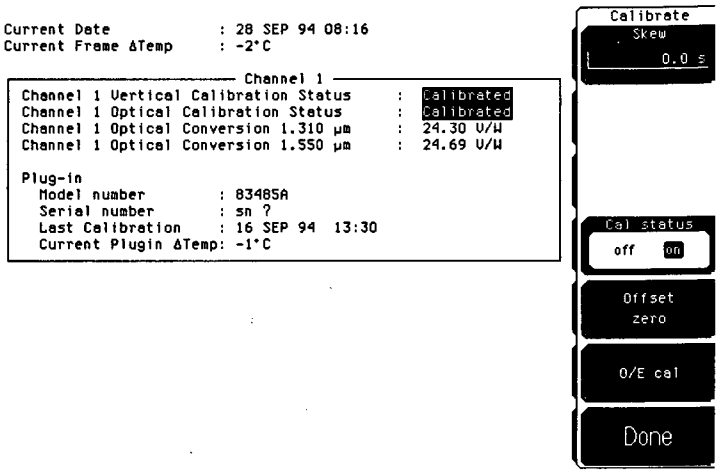

Figure 2-3. A typical Cal Status display.

Current Date This is the current date and time. You can compare this to the last plug-in module calibration time. That way you will know how long it has been since the last plug-in module calibration was performed.

Current Frame ΔTemp This is the temperature change on the inside of the instrument since the last mainframe calibration was performed. A positive number indicates how many degrees warmer the mainframe is currently as compared to the temperature of the mainframe at the last mainframe calibration.

Channel 1 Calibration Status The instrument displays **Calibrated** or **Uncalibrated**, depending on whether the last plug-in module calibration is still valid. A calibration can be invalidated by:

- removing and reinstalling a plug-in module in another slot
- a temperature change $\geq \pm 5°C$ since the last calibration

Uncalibrated indicates the plug-in module vertical calibration is invalid.

`Plug-in`

The Plug-in function lists the model number, serial number, date, time, and temperature delta. The temperature Δ is the temperature change from the temperature of the mainframe when the last calibration was performed. If this temperature Δ is greater than ±5°C since the last mainframe calibration, then you must perform a plug-in module calibration to achieve the specified dc accuracy.

`Offset zero`

The Offset Zero function performs a quick offset calibration on the optical channel. Since the primary source of calibration error on the optical channel is offset drift, this function is useful:

after the plug-in module vertical calibration described in "Performing a plug-in module vertical calibration" has been performed,

and

if the plug-in module has not been removed and reinstalled.

Performing an Offset Zero calibration is much faster than performing a complete vertical calibration.

Key Path (Channel) `Calibrate` `Offset zero`

`O/E cal`

The plug-in module is provided with factory optical calibrations at 1310 nm and 1550 nm. The O/E Calibration function allows you to calibrate the instrument for use at one additional user-defined wavelength between 1200 nm and 1600 nm. This calibration does not affect the factory calibrations.

`Calibrate probe`

Connect a voltage probe to the plug-in and then press:

`Calibrate probe`

The analyzer calibrates to the tip of the probe by setting the probe attenuation to the actual attenuation ratio of the probe. The analyzer also automatically compensates for any offset the probe may introduce. The CAL signal is internally routed to the probe tip for HP probes.

Key Path (Channel) `Calibrate` `Calibrate probe`

Calibration Procedures

What you'll find in this section

This sections contains procedures for performing:

- a plug-in module vertical calibration
- an O/E calibration
- calibration of voltage probes
- calibration of other devices

Performing a plug-in module vertical calibration

1. To perform a plug-in module vertical calibration, press:

   (Utility)

   `Calibrate . . .`

   `Calibrate plug-in . . .`

2. Select the plug-in module to be calibrated by pressing:

   `1 and 2` or `3 and 4`

3. Start the calibration procedure by pressing:

   `Start cal`

4. Follow the on-screen instructions.

Performing an O/E calibration

To perform an O/E calibration, a CW optical source with a *known* optical output power level between 200 μW and 2 mW is required.

NOTE

A minimum source power of 400 μW is recommended to assure specified performance over the instrument's full dynamic range.

NOTE

The optical channel calibration accuracy is heavily dependent on the accuracy to which you know the optical source power. For best results measure the optical source power with an optical power meter such as the HP 8153A.

Start the O/E calibration by pressing:

(Channel)
Calibrate
O/E cal

Follow the on-screen instructions.

Calibrating voltage probes

Because the mainframe's CAL signal is a voltage source, you can let the instrument compensate for the actual characteristics of your probe by letting the instrument calibrate to the tip of the probe.

Performing the calibration

To calibrate a voltage probe to the probe tip, set the instrument as follows:

`Atten units` ratio

`Units` Voltage

`Calibrate Probe`

The instrument automatically calibrates to the tip of the probe, sets the probe attenuation and compensates for any probe offset.

Calibrating other devices

Because the mainframe's CAL signal is a voltage source, it cannot be used to calibrate to the probe tip when the units are set to Ampere, Watt, or Unknown. Instead, set the external gain and external offset to compensate for the actual characteristics of the probe or device. If you do not know the actual characteristics, you can refer to the typical specifications that came with the probe or device.

Performing the calibration

To compensate for the actual characteristics of the probe or device, set the instrument as follows:

`Atten units` ratio

`Attenuation` 1:1

`Units` Ampere (Watt or unknown)

`Ext gain` ..... actual gain characteristics of the probe or device

`Ext offset` ..... offset introduced by the probe or device

Specifications and Regulatory Information

Specifications and Regulatory Information

What you'll find in this chapter

This chapter lists the system specifications and characteristics of the HP 83485A/B optical/electrical plug-in module when it is combined with either the HP 83480A or HP 54750A mainframes. The specifications and characteristics for the mainframe are in the *HP 83480A, 54750A User's Guide*.

In addition, you'll find a declaration relating to regulatory information.

Definitions of terms

The distinction between specifications, *characteristics*, typical performance, and nominal values is described as follows:

- Specifications describe warranted performance over the temperature range +15°C to +35°C (unless otherwise noted). All specifications apply after the instrument's temperature has been stabilized after 60 minute continuous operation. Unless otherwise noted, corrected limits are given when specifications are subject to minimization with error-correction routines.
- *Characteristics* provide useful, but nonwarranted information about the functions and performance of the instrument. *Characteristics are printed in italics.*
- Typical Performance, where listed, is not *warranted*, but indicates performance which most units will exhibit. *Typical performance is printed in italics.*
- Nominal Value indicates the expected, but not *warranted*, value of the parameter.

Specifications

The following are specifications used to test the HP 83485A/B plug-in module. Specifications are valid after a 1 hour warm-up period. See the *HP 54701A Active Probe Service Guide* for complete probe specifications.

Vertical specifications

HP 83485A Electrical Channel Vertical Specifications

Bandwidth (−3 dB) on electrical or optical channel	dc to 12.4 or 20 GHz, user selectable
dc Accuracy—single marker (<5°C temp. change from last user vertical cal.)	
12.4 GHz	±0.4% of full scale ±2 mV ±1.5% of reading-channel offset
20 GHz	±0.4% of full scale ±2 mV ±3% of (reading-channel offset)
dc Difference—two marker accuracy on same channel (<5°C temp. change from last user vertical cal.)	
12.4 GHz	±0.8% of full scale ±1.5% of delta reading
20 GHz	±0.8% of full scale ±3% of delta reading
Transition Time (10%–90%) characteristic, calculated from T=0.35/BW, electrical	
12.4 GHz	*28.2 ps*
20 GHz	*17.5 ps*
Maximum RMS Noise	
12.4 GHz	0.5 mV (0.25 mV typical)
20 GHz	1.0 mV (0.5 mV typical)
Scale Factor	full scale is eight divisions
Minimum	1 mV/div
Maximum	100 mV/div
Display Resolution	256 points
dc Offset Range	±500 mV
Nominal Input Impedance	50 Ω
Connectors	3.5mm (m), channel and trigger
Input Reflection/Return Loss	≤5% for 30 ps rise time
Number of Channels	1
Dynamic Range/Maximum Specified Input Power	±400 mV relative to channel offset
Maximum Safe Input	±2V + peak ac (+16 dBm)

HP 83485A Optical Channel Vertical Specifications

Bandwidth (−3 dB) on electrical or optical channel	dc to 12.4 or 20 GHz (user selectable)
dc Accuracy—single marker (<5°C temp. change from last user vertical cal.)	
12.4 GHz, filtered[1]	±25 μW ±2% of reading-channel offset
20 GHz,[1]	±25 μW ±4% of reading-channel offset
dc Difference—two marker accuracy on same channel (<5°C temp. change from last user vertical cal.)	
12.4 GHz, filtered[1]	±2% of delta reading
20 GHz[1]	±4% of delta reading
Transition Time (10%–90%) characteristic, calculated from T=0.48/BW, optical	
12.4 GHz	*40 ps*
20 GHz	*25 ps*
STM-16/OC-48 filter	*190 ps*
STM-4/OC-12 filter	*750 ps*
Maximum RMS Noise	
12.4 GHz, filtered	12 μW (8 μW typical)
20 GHz	25 μW (15 μW typical)
Scale Factor	full scale is eight divisions
Minimum	20 μW/div
Maximum	500 μW/div
Display Resolution	256 points
dc Offset Range	+1 to −3 mW (referenced two divisions below center screen)
Connectors	User selected option, 9/125 μm single mode fiber
Input Reflection/Return Loss	>33 dB for HMS-10/HP interface connector
Filtered Response	Measured response conforms to ITU-TS G.957 and GR-253-CORE for STM-16, OC-48 (Option 034) or STM-4, OC-12 (Option 032)

1 Referenced to average power meter.

HP 83485A Optical Channel Vertical Specifications (continued)

Calibrated Wavelengths	1310 nm and 1550 nm
Average power Monitor	
Specified Operating Range	−30 dBm to +3 dBm (1 μW to 2 mW)
Factory Calibrated Accuracy (20° C-30° C)	±5% of reading ±100 nW ± connector uncertainty
User Calibrated Accuracy[1] <5° C temp change	±2% of reading ±100 nW ± power meter accuracy
Number of Channels	1
Dynamic Range/Maximum Specified Input Power	2 mW
Maximum Safe Input	10 mW peak
Wavelength Range	1200-1600 nm

1 A user calibration can be performed with average optical power levels from 100 to 2000 μW, however, the instrument optical accuracy specification is only vaild for average optical calibration powers form 500 to 2000 μW.

HP 83485B Electrical Channel Vertical Specifications

Bandwidth (−3 dB)	dc to 40 GHz, or dc to 18 GHz (user selectable)
dc Accuracy — single voltage marker	
18 GHz	±0.4% of full scale or marker reading (whichever is greater) ±2 mV ±1.5% of (reading-channel offset).
40 GHz	±0.4% of full scale or marker reading (whichever is greater) ±2 mV ±3% of (reading-channel offset).
Transition Time (10% to 90%, calculated from T=0.35/bandwidth)	*≤9 ps (40 GHz BW)* *≤19.5 ps (18 GHz BW)*
Maximum RMS Noise	
18 GHz	≤0.5 mV (0.25 mV typical)
40 GHz	1.0 mV (0.5 mV typical)
Scale Factor (full scale is eight divisions)	
Minimum	1 mV/div
Maximum	100 mV/div
dc Offset Range	±500 mV
Inputs:	
Dynamic Range	±400 mV relative to channel offset
Maximum Safe Input Voltage	*16 dBm peak ac ±2V dc*
Nominal Impedance	50 Ω
Reflections	≤5% for 20 ps rise time
Connector	2.4mm (m)

HP 83485B Optical Channel Vertical Specifications

Bandwidth (−3 dB)	dc to 30 GHz
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 average power monitor)	±4% of delta reading
Transition Time (10% to 90%), calculated from T=0.48/bandwidth, optical	*<16 ps*
Maximum RMS Noise	<30 μW (<15 μW typical)
Scale Factor (full scale is eight divisions)	
Minimum	20 μW/div
Maximum	500 μW/div
dc Offset Range	+1 mW to −3 mW, referenced to two divisions above bottom of screen
Connector Type	9/125 μm single mode, user selectable connector option
Input Return Loss	30 dB (HMS-10/HP connector)
Filtered Bandwidth	Fourth or fifth order Bessel-Thomson filter, 3 dB frequency 7.465 GHz
Calibrated Wavelengths	1310 nm and 1550 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 uncertainty
Maximum Specified Input Power	*2 mW*
Maximum Safe Input	*10 mW peak*
Wavelength Range	*1000 to 1600 nm*

Environmental specifications

Electrical and Optical Channels	
Temperature	
Operating	15°C to +35°C
Non-operating	−40°C to +70°C
Humidity	
Operating	up to 90% relative humidity at ≤35°C
Non-operating	up to 90% relative humidity at <35°C

Power Requirements
Supplied by mainframe.

Weight	
Net	approximately 1.2 kg (2.6 lb.)
Shipping	approximately 2.1 kg (4.6 lb.)

Characteristics

The following characteristics are typical for the HP 83485A/B optical/electrical plug-in module. See the *HP 54701A Active Probe Service Guide* for complete probe characteristics.

Trigger input characteristics

Electrical and Optical Channels

Nominal Impedance	*50 Ω*
Input Connector	*3.5 mm (m)*
Trigger Level Range	*±1 V*
Maximum Safe Input Voltage	*±2 Vdc + ac peak (+16 dBm)*
Percent Reflection	*≤10% for 100 ps rise time*

Refer to the *HP 83480A, 54750A User's Guide* for trigger specifications.

Declaration of Conformity

DECLARATION OF CONFORMITY
according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name:	Hewlett-Packard Co.
Manufacturer's Address:	1400 Fountaingrove Parkway Santa Rosa, California 95403 U.S.A.

Declares that the product:

Product Name:	Optical/Electrical plug-in module
Model Numbers:	HP 83485A, HP 83485B
Product Options:	This declaration covers all options of the above products.

Conforms to the following product specifications:

Safety:	IEC 1010-1:1990 + A1/EN 61010-1:1993 CAN/CSA-C22.2 No. 1010.1-92
EMC:	CISPR 11:1990 /EN 55011:1991, Group 1 Class A IEC 801-2:1991 /EN 50082-1:1992, 4 kV CD, 8 kV AD IEC 801-3:1984 /EN 50082-1:1992, 3V/m, 27-500 MHz IEC 801-4:1988 /EN 50082-1:1992, 500 V signal, 1000 V AC

Supplementary Information:

This product was tested in an HP 83480A mainframe.
This product complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

Santa Rosa, California — 7/17/95 — Dixon Browder

Location — **Date** — **Dixon Browder / Quality Manager**

European Contact:
Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department ZQ/Standards Europe, Herrenberger Straße 130, D-71034 Boblingen (FAX: +49-7031-14-3143)

In Case of Difficulty

In Case of Difficulty

What you'll find in this chapter

This chapter provides a list of suggestions for you to follow if the plug-in module fails to operate. A list of messages that may be display is also included.

For complete service information, refer to the optional *HP 83485A/B Service Guide*.

Review the procedure being performed when the problem occurred. Before calling Hewlett-Packard or returning the unit for service, a few minutes spent performing some simple checks may save waiting for your instrument to be repaired.

If the mainframe does not operate

Please make the following checks:

- ☐ Is the line fuse good?
- ☐ Does the line socket have power?
- ☐ Is the unit plugged in to the proper ac power source?
- ☐ Is the mainframe turned on?
- ☐ Is the rear-panel line switch set to on?
- ☐ Will the mainframe power up *without* the plug-in module installed?

If the mainframe still does not power up, refer to the optional *HP 83480A, 54750A Service Guide* or return the mainframe to a qualified service department.

If the plug-in does not operate

1. Make the following checks:
   - ☐ Is the plug-in module firmly seated in the mainframe slot?
   - ☐ Are the knurled screws at the bottom of the plug-in module finger-tight?
   - ☐ Is a trigger signal connected to a trigger input?
   - ☐ If other equipment, cables, and connectors are being used with the plug-in module are they connected properly and operating correctly?
   - ☐ Review the procedure for the test being performed when the problem appeared. Are all the settings correct? Can the problem be reproduced?
   - ☐ Are the connectors clean? See "Cleaning Connections for Accurate Measurements" in Chapter 1 for more information about cleaning the connectors.
2. Perform the following procedures:
   - ☐ Make sure the instrument is ready to acquire data by pressing **Run**.
   - ☐ Find any signals on the channel inputs by pressing (Autoscale).
   - ☐ See if any signals are present at the channel inputs by pressing:

     (Trigger)
     Sweep
     freerun

     After viewing the signal, press **triggered**.
   - ☐ Make sure Channel Display is on by pressing:

     (Channel)
     Display on off on
   - ☐ Make sure the channel offset is adjusted so the waveform is not clipped off the display.
   - ☐ If you are using the plug-in module only as a trigger source, make sure at least one other channel is turned on.

     If all of the channels are turned off, the mainframe will not trigger.

- ☐ Make sure the mainframe identifies the plug-in module by pressing:

  (Utility)
  `System config...`

  The calibration status of the plug-in modules is listed near the bottom of the display, in the box labeled "**Plug-ins**". If the model number of the plug-in module is listed next to the appropriate slot number, then the mainframe has identified the plug-in.

  If "**~known**" is displayed instead of the model number of the plug-in module, remove and reinsert the plug-in module in the same slot. If "**~known**" is still displayed, then the memory contents of the plug-in module are corrupt. Refer to the optional *HP 83485A/B Service Guide* or contact a qualified service department.

If all of the above steps check out okay, and the plug-in module still does not operate properly, then the problem is beyond the scope of this book. Refer to the optional *HP 83485A/B Service Guide* or return the plug-in module to a qualified service department.

Error Messages

The following error messages are for the plug-in module. Typically, the error messages indicate there is a problem with either the plug-in or the mainframe.

This section explains what the messages mean and offers a few suggestions that might help resolve the error condition. If the suggestions do not eliminate the error message, then additional troubleshooting is required that is beyond the scope of this book. Refer to the optional *HP 83485A/B Service Guide* and *HP 83480A, 54750A Service Guide* for additional troubleshooting information.

Additional error messages are listed in the *HP 83480A, 54750A User's Guide* for the mainframe.

Memory error occurred in plug-in _ : Try reinstalling plug-in

The mainframe could not correctly read the contents of the memory in the plug-in.

1. Remove and reinstall the plug-in module.

   Each time a plug-in is installed, the mainframe rereads the plug-in module's memory.
2. Verify the plug-in module is firmly seated in the mainframe slot.
3. Verify the knurled screws at the bottom of the plug-in module are finger-tight.
4. Install the plug-in in a different slot in the mainframe.

Busy timeout occurred with plug-in _ : Try reinstalling plug-in

The mainframe is having trouble communicating with the plug-in module. Make sure there is a good connection between the mainframe and the plug-in module.

1. Remove and reinstall the plug-in module.
2. Verify the plug-in module is firmly seated in the mainframe slot.
3. Verify the knurled screws at the bottom of the plug-in module are finger-tight.
4. Install the plug-in in a different slot in the mainframe.

Communication failure exists at slot _ : Service is required

An illegal hardware state is detected at the mainframe to plug-in module interface of the specified slot.

If the slot is empty, there is a mainframe hardware problem. Refer to the *HP 83480A, 54750A Service Guide.*

If a plug-in is installed in the slot, there is a plug-in module hardware problem. Refer to the optional *HP 83485A/B Service Guide.*

ID error occurred in plug-in _ : Service is required

The information read from the plug-in module's memory does not match the hardware in the plug-in module. This can be caused by a communication problem between the mainframe and the plug-in module. Make sure there is a good connection between the mainframe and the plug-in.

1. Remove and reinstall the plug-in module.
2. Verify the plug-in module is firmly seated in the mainframe slot.
3. Verify the knurled screws at the bottom of the plug-in module are finger-tight.
4. The HP 54750A mainframe does not accept the HP 83485A/B optical/electrical plug-in module. To use the optical plug-in modules, a firmware upgrade must first be installed. Order the HP 83480K communications firmware kit and follow the installation instructions.
5. The HP 83480A, 54750A mainframes do not accept plug-in modules designed for use with the HP 54710A, 54720A.

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