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User's Guide

Agilent 83483A,4A,4B and 54751A,2A,2B Plug-In Modules

FINAL TRIM SIZE : 7.5 in x 9.0 in

Agilent part number: 83483-90010 and 54751-97011
Printed in USA April 2000

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United Kingdom	01 344 366666
United States and Canada	(800) 403-0801

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Declaration of Conformity

DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name:	Hewlett-Packard Company
Manufacturer's Address:	1900 Garden of the Gods Road Colorado Springs , CO 80907 U.S.A.

Declares, That the product

Product Name:	HP 83483A, HP 54751A Electrical Plug-in
Model Number(s):	HP 83483A and HP 54751A
Product Options:	All

Conforms to the following Product Specifications:

Safety:	IEC 1010-1:1990+A1 / EN 61010-1:1993 UL 1301 CSA - C22.2 No. 1010.1:1993
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: 3 V/m, {1kHz 80% AM, 27-1000 MHz} IEC 801-4:1988 /EN 50082-1 1992: 0.5 kV Sig Lines, 1 kV Power Lines

Supplementary Information:
The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

Colorado Springs, 9/15/94

John Strathman, Quality Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH, Department ZQ / Standards Europe, Herrenberger Strasse 130, 71034 Böblingen Germany (FAX: +49-7031-143143)

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DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name:	Hewlett-Packard Company
Manufacturer's Address:	1900 Garden of the Gods Road Colorado Springs , CO 80907 U.S.A.

Declares, That the product

Product Name:	Digitizing Oscilloscope module
Model Number(s):	HP 83484A/B and HP 54752A/B
Product Options:	All

Conforms to the following Product Specifications:

Safety:	IEC 1010-1:1990+A1 / EN 61010-1:1993 UL 3111 CSA - C22.2 No. 1010.1:1993
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: 3 V/m, {1kHz 80% AM, 27-1000 MHz} IEC 801-4:1988 /EN 50082-1 1992: 0.5 kV Sig Lines, 1 kV Power Lines

Supplementary Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE marking accordingly.

This product was tested in a typical configuration with Hewlett-Packard test systems.

Colorado Springs, 6/01/95

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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.

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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.

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1

The Instrument at a Glance

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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

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 the instrument is properly earth-grounded to prevent buildup of static charge.

The electrical plug-in module provides two accurate measurement channels with user selectable bandwidths. The lower bandwidth mode provides excellent oscilloscope noise performance for accurate measurement of small signals. The high bandwidth mode provides high-fidelity display and measurement of very high-speed waveforms.

The Agilent 83483A or Agilent 54751A electrical plug-in module provides:

- User selectable 12.4 or 20 GHz bandwidth
- 2.5 GHz bandwidth trigger channel
- 3.5 mm (m) connectors

The Agilent 83484A,B or Agilent 54752A,B electrical plug-in module provides:

- User selectable 26.5 or 50 GHz bandwidth
- 2.5 GHz bandwidth trigger channel
- 2.4 mm (m) connectors

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Ordering information

Options

Option 0BW *Agilent 83483A, 83484A, B and Agilent 54751A, 54752A, B Service Guide*
Option 0B1 Additional set of user documentation
Option 0B0 Deletes the user documentation
Option UK6 Measured performance data

Optional accessories

Agilent 54006A 6 GHz divider probe
Agilent 54008A 22 ns delay line
Agilent 54118A 500 MHz to 18 GHz trigger
Agilent 10086A ECL terminator
SMA (f-f) adapter, Agilent part number 1250-1158
APC 2.4 (f-f) adapter, Agilent 11900B
APC 3.5 (f-f) adapter, Agilent part number 1250-1749

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Menu and Key Conventions

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

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value, use the general purpose knob located below the front-panel Measure section.

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The Agilent 83483A, 83484A,B and Agilent 54751A, 54752A,B Electrical Plug-In Module

The electrical plug-in module is one of several plug-in modules available for the Agilent 83480A, 54750A mainframes.

The purpose of the plug-in module

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 front panel of the plug-in module has two channel inputs and an external trigger input. The front panel also has two **Probe Power** connectors for Agilent 54700-series probes, an **Aux 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 for the selected input.

The front-panel **Probe Power** connectors allow automatic channel scaling and probe calibration with Agilent 54700 series probes. The front-panel **Aux Power** connector provides only power to Agilent 54700 series probes for use as a trigger input. Probe calibration and scaling are not required for a trigger input.

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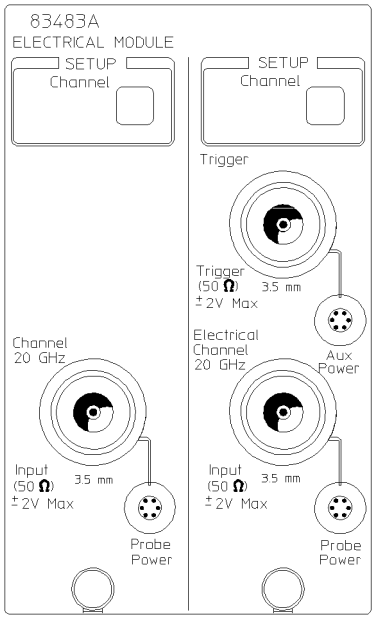


Figure 1-1. Front panel of the plug-in module.

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 when you move a plug-in module from one mainframe to another. Refer to Chapter 3 for information on performing a plug-in module vertical calibration.

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Installing the plug-in module

You do not need to turn off the mainframe to install or remove the plug-in modules. The plug-in module can be installed in slots 1 and 2 or 3 and 4 on the Agilent 83480A, 54750A mainframe. The plug-in module will *not* function if it is installed in slots 2 and 3.

To make sure the instrument 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).

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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 the instrument is properly earth-grounded to prevent buildup of static charge.

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2

Channel Setup Menu

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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 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 *Agilent 83480A, 54750A User's Quick Start Guide* supplied with the mainframe.

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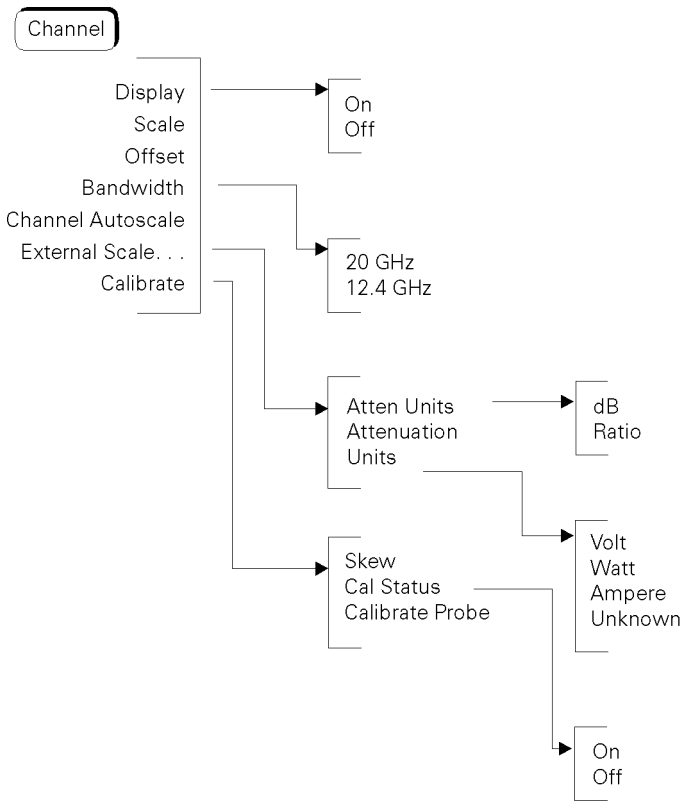


Figure 2-1. Electrical Channel Setup menu.

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Displaying the Channel Setup menu

To display the Channel Setup menu, press the Channel key.

Display

The Display softkey 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 instrument 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

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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, watts, amperes, or unknown.

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 is the voltage at the center of the graticule area, and the range of offset is 500 mV. You can use the knob, arrow keys, or keypad to change the offset setting. The fine mode also works with offset.

When an Agilent 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.

Key Path (Channel) Offset

FINAL TRIM SIZE : 7.5 in x 9.0 in

Bandwidth. . .

Agilent 83483A, 54751A only

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

Agilent 83484A,B 54752A,B only

You can use the Bandwidth function to select either the 26.5 GHz or the 50 GHz bandwidth.

Key Path (Channel) Bandwidth. . .

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

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External scale . . .

The External Scale function allows you to setup the instrument 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:

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

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`Attenuation`

The Attenuation function lets you select an attenuation that matches the device connected to the instrument. When the attenuation is set correctly, the instrument 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 corresponding 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 Chapter 3 for information on calibrating to the tip of the probe.

Key Path

(Channel) `External scale . . .` `Attenuation`

FINAL TRIM SIZE : 7.5 in x 9.0 in

`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 plug-in module, 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 on an electrical channel, 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`

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Calibrate

The calibrate menu allows you to null out any skew between probes or cables and check the present calibration status of the instrument.

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 $\approx +100$ μs. 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

FINAL TRIM SIZE : 7.5 in x 9.0 in

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

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

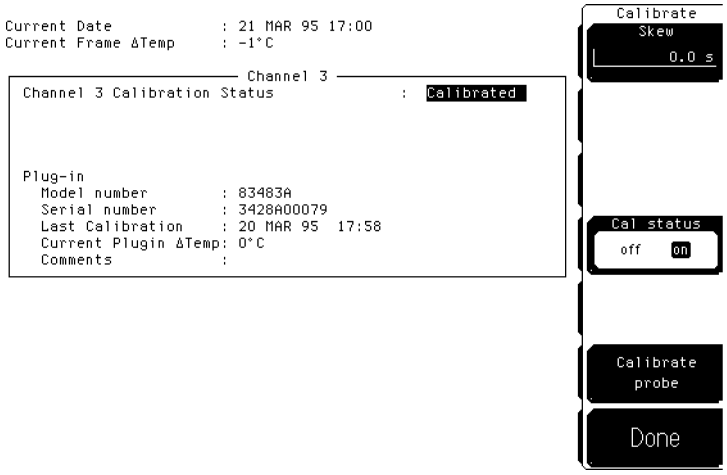


Figure 2-2. A typical Cal Status display.

`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.

FINAL TRIM SIZE : 7.5 in x 9.0 in

`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 if:

- The mainframe has cycled power.
- The plug-in has been repaired, reprogrammed, or removed from the mainframe.
- The instrument's operating temperature has changed and remains more than 5°C from the temperature at which the Plug-in calibration was performed.

`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.

`Calibrate probe`

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

`Calibrate probe`

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

Key Path

(Channel) `Calibrate` `Calibrate probe`

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3

Calibration Overview

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Calibration Overview

What you'll find in this chapter

Factory Calibrations
User Calibrations—Optical and Electrical
Complete Calibration

This chapter describes the calibration of the mainframe and the plug-in module. It is intended to give you, or the calibration laboratory personnel, an understanding of the various calibration procedures available, and how they were intended to be used.

Proper calibration is critical to measurement accuracy and repeatability. The Agilent 54750A/83480A and their associated modules and accessories require that both factory and user calibrations be implemented at the recommended intervals in order to perform measurements at their published specifications.

This chapter is divided into three sections. The first section describes factory calibrations. A factory calibration consists of verifying instrument performance to all specifications. If an instrument fails to meet specifications, adjustment or repair may be necessary. For most users, this will mean shipping the instrument back to an authorized service center. Some users may purchase the required instrumentation and perform the factory timebase calibrations themselves using the optional *Agilent 83480A, 54750A Service Guide* or the electrical module calibration using the optional *Agilent 83483A/4A/4B, 54751A/2A/2B Service Guide*.

The second part of the chapter addresses calibrations that are routinely performed by the end user. Subsections in each of the two main sections discuss the individual calibrations. In addition, there will be summary tables at the end of each of these sections summarizing the main areas addressed. The third part of the manual consists of a complete calibration summary table at the end of the chapter. Both factory and user calibrations must be

FINAL TRIM SIZE : 7.5 in x 9.0 in

performed regularly in order to ensure proper measurement accuracy and repeatability.

CAUTION

The input circuits can be damaged by electrostatic discharge (ESD). Avoid applying static discharges to the front-panel input connectors. Before connecting a coaxial cable to the connectors, momentarily short the center and outer connectors 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. It is strongly recommended that an antistatic mat and wristband be used when connecting to electrical channel inputs.

Calibration interval

Agilent Technologies recommends that the factory calibration be performed on a periodic basis. Agilent designs instruments to meet specifications over the recommended calibration interval provided that the instrument is operated within the specified operating environment. To maintain specifications, periodic recalibrations are necessary. We recommend that the plug-in module be calibrated at an Agilent Technologies service facility every 12 months. Users are encouraged to adjust the calibration cycle based on their particular operating environment or measurement accuracy needs.

Required warm-up time

The instrument requires a 1 hour warm-up period before any of the calibrations mentioned in this chapter are performed. It is not enough for the instrument to be in the standby setting. It must be turned on and running for the entire hour.

Remote operation

Remote programming commands for calibrations are included in the *Agilent 83480A/Agilent 54750A Programming's Guide*. Performing calibrations remotely is slightly different than the operation of front-panel calibrations.

FINAL TRIM SIZE : 7.5 in x 9.0 in

Factory Mainframe Calibrations

Mainframe calibration (performed at the factory) improves timebase accuracy. All timebase measurements such as rise time, fall time, eye width, jitter, and so forth are affected by the timebase accuracy. The calibration factors are stored in the nonvolatile RAM of the instrument. There is a switch on the back panel of the instrument that allows the mainframe calibration to be protected or unprotected. Next to the switch there is a drawing that shows each switch's function and protected position. Refer to the optional *Agilent 83480A, 54750A Service Guide* for more details about the mainframe calibration, and the position of the rear-panel memory protect switches.

Table 3-1. Factory Calibration Summary

Calibration	What is calibrated	Measurements Affected	Recommended Interval	Softkey Path

Mainframe Calibration	Accuracy and continuity of the timescale	All time base measurements such as rise time, fall time, eye width, and jitter.	Annually at Agilent Technologies service center or if operating temp has changed and remains 5°C or more from calibration temperature. See service manual.	Utility
				`Calibrate`
				`Calibrate frame`

CAUTION To prevent access to the mainframe calibration switch, place a sticker over the access hole to this switch.

CAUTION Do not attempt a Mainframe calibration without consulting the *Agilent 83480A, 54750A Service Guide*.

A mainframe calibration should be performed on a periodic basis, annually, or when the ambient operating temperature has changed by and remains 5°C different than the operating temperature at which the last mainframe calibration was performed. To see how much the operating temperature has changed since the last mainframe calibration and the date of the last mainframe calibration, check the Calibration status by pressing the following key sequence: Utility, `Calibrate`, and then `Cal status` on.

FINAL TRIM SIZE : 7.5 in x 9.0 in

The temperature change is displayed at the top of the display as shown in the following figure.

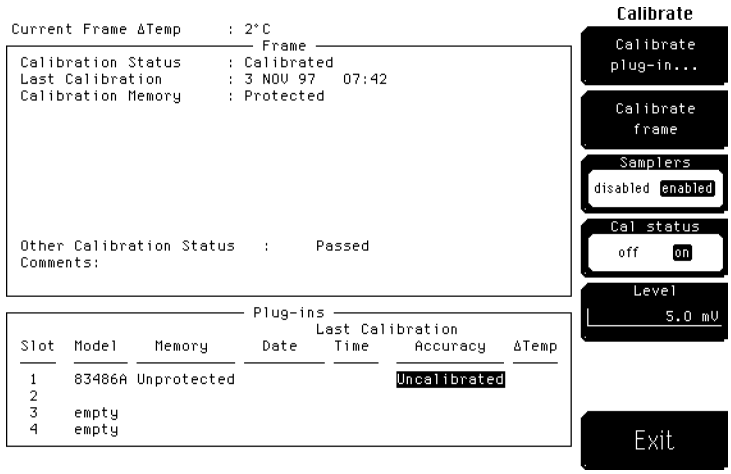


Figure 3-1. Current Frame ΔTemp condition

If the `Current Frame ΔTemp` listing is greater than ±5°C, then the mainframe should either be calibrated at the current operating temperature or be placed in an ambient air temperature that is within 5°C of the temperature of the current calibration.

FINAL TRIM SIZE : 7.5 in x 9.0 in

User Calibrations

The following calibrations can be performed by the user:

Plug-in Module Vertical Calibration
Dark Calibration
Probe Calibration
Channel Skew
External Scale

Electrical channels have calibration procedures for:

- adjusting timebase skew, for matching propagation delay between channels, probes, cables, and so forth
- using external probes

CAUTION

The input circuits can be damaged by electrostatic discharge (ESD). Avoid applying static discharges to the front panel input connectors. Before connecting a coaxial cable to the connectors, momentarily short the center and outer connectors of the cable together. Avoid touching the front panel input connectors without first touching the frame of the instrument. Be sure the instrument is properly earth-grounded to prevent buildup of static charge. An antistatic mat and wristband are strongly recommended.

Table 3-2. Electrical Channel User Calibration Summary

Calibration	What is calibrated	Measurements Affected	Recommended Interval	Key Path
Plug-in Vertical Calibration	Vertical offset and vertical scale accuracy.	Any electrical vertical measurements such as $V_{p\ to\ p}$, eye height, extinction ratio	Perform after any power cycle or once every 10 hours during continuous use or if operating temperature changes by more than 2°C.	(Utility) `Calibrate` `Calibrate Plug-in`
Dark Calibration	Dark calibration measures the channel offset signal without any light present and this value is used in the extinction ratio algorithm.	Channels affected: electrical with O/E converter. Extinction ratio.	Before extinction ratio measurements if the vertical scale or offset has changed since the last dark calibration or after a plug-in vertical calibration is performed.	(Shift), (Meas eye) `Extinction ratio` `Dark Cal`

Table 3-3. Miscellaneous User Calibration Summary

Calibration	What is calibrated	Measurements Affected	Recommended Interval	Key Path
Probe calibration	Probe Attenuation	Any electrical measurement taken with the probe	Whenever a probe is connected	Electrical Channel Setup Calibrate Calibrate probe
Channel Skew	Calibrates out the small differences in delay between channels. Useful for looking at timing differences between channels	Multiple channel measurements	Before multiple channel measurements when measuring timing differences between channels.	Channel Setup Calibrate Skew
External Scale	Compensates for gain or loss associated with external devices (calibrates vertical scale to external device)	Any measurement taken through an external device (component or transducer)	Whenever using external devices (component or transducer)	Channel Setup External Scale

Plug-in Module Vertical Calibration

The plug-in module vertical calibration allows the instrument to establish the calibration factors for a specific plug-in when the plug-in is installed in the mainframe. The plug-in calibration factors are valid only for the specific mainframe slot in which it was calibrated. The plug-in vertical calibration establishes vertical accuracy.

A plug-in vertical calibration should be done if:

- The mainframe has cycled power.
- The plug-in has been repaired, reprogrammed, or removed from the mainframe.
- The instrument's operating temperature has changed and remains more than 5°C from the temperature at which the Plug-in calibration was performed.

FINAL TRIM SIZE : 7.5 in x 9.0 in

To obtain the best measurement results, it is recommended that a user vertical calibration be performed after every 10 hours of continuous use or if the temperature has changed by greater than 2°C from the previous vertical calibration.

To view the temperature change

This procedure displays the temperature change that the instrument has undergone since the last Plug-in Vertical Calibration.

1. Press the front-panel channel (SETUP) key.
2. Press `Calibrate` and then `Cal status` on.

The current plug-in ΔTemp value is listed for each installed module.

To perform a plug-in module vertical calibration

No additional equipment is required to perform a plug-in vertical calibration. Reference signals are both generated and routed internally.

1. Remove any front-panel connections from electrical channels.
2. Press (Utility), `Calibrate. . .`, and then `Calibrate plug-in. . .`.
3. Select the plug-in module to be calibrated, press `1 and 2` or `3 and 4`.
4. Press `Start cal` to start the calibration.
5. Follow the on-screen instructions.

Dark Calibration

The dark calibration is for electrical measurements if an external O/E is being used. This calibration measures the optical channel offset signal when there isn't any light present and then uses this information in performing extinction ratio measurements. Dark calibrations should be done for the following conditions:

- Before any critical extinction ratio measurements are made
- After a plug-in vertical calibration
- If a module has been removed
- If the mainframe power has been cycled

FINAL TRIM SIZE : 7.5 in x 9.0 in

- If extinction ratio measurements are being made after the vertical scale or the offset has changed.

If the line power has been cycled, the dark calibration invokes either the offset zero calibration or plug-in vertical calibration as needed. This increases the time required for the dark calibration to complete. The `Dark cal` softkey is located within the Extinction ratio menu.

To initiate a dark calibration

1. Press the (Display) key. Press the `Color grade` softkey, and set its setting to `on`.

   Color grade must be enabled to perform an extinction ratio measurement and a Dark calibration. In addition, the dark level (amplitude when there is no signal present) must be on the screen to perform a Dark calibration.

2. Press the blue shift key, and then the `Meas eye` softkey which is located beneath the display.

3. Press `Extinction ratio ...` and then `Dark cal`.

Disconnect all inputs from the module, including the trigger signal, and block any ambient light to the photodetector with a connector plug. Follow the instructions on the screen.

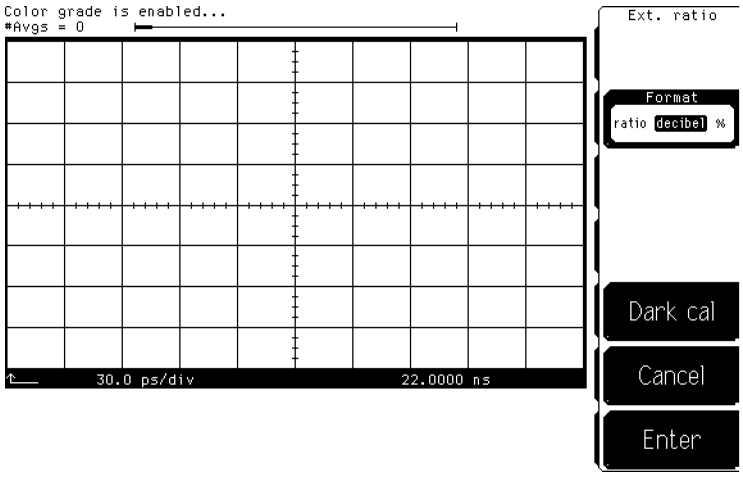


Figure 3-2. Dark calibration menu

FINAL TRIM SIZE : 7.5 in x 9.0 in

Channel Skew Calibration

The skew calibration changes the horizontal position of a waveform on the display. The skew calibration has a range of approximately 100 μs. You can use skew to compensate for the differences in cable or probe lengths. It also allows you to place the trigger 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. If you are interested in comparing the shapes of two waveforms rather than the actual timing difference, 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 that the rising edges are at about a 45° angle.
3. Press the plug-in module's front-panel channel (SETUP) key.
4. Press `Calibrate` and then `Skew`.
5. Adjust the skew on one of the channels so that the rising edges overlap at the 50% points.

Probe Calibration

For active probes such as the Agilent 54701A, which the instrument can identify through the probe power connector, the instrument automatically adjusts the channel vertical scale factors to the probe's nominal attenuation, even if a probe calibration is not performed.

For passive probes or non-identified probes, the instrument adjusts the vertical scale factors only if a probe calibration is performed. Probe calibration allows the instrument to establish the gain and offset of specific probes that are connected to a channel of the instrument, and then apply those factors to the calibration of that channel.

FINAL TRIM SIZE : 7.5 in x 9.0 in

The analyzer calibrates to the tip of the probe by setting the probe attenuation to the actual attenuation ratio of the probe. The CAL signal is internally routed to the probe tip for Agilent active probes.

The mainframe's CAL signal is a voltage source, therefore you can let the instrument compensate for the actual characteristics of your probe by letting the instrument calibrate to the tip of the probe. The instrument automatically calibrates to the tip of the probe, sets the probe attenuation, and compensates for any probe offset.

If you do not perform a probe calibration but want to use a passive probe, enter the attenuation factor using the following steps:

1. Press the plug-in module's front-panel channel (SETUP) key.
2. Press `External scale` and then `Attenuation`.

You can use the probe calibration to calibrate any network, including probes or cable assemblies. The instrument calibrates the voltage at the tip of the probe or the cable input.

To calibrate an Agilent identifiable probe

1. Press the plug-in module's front-panel-channel (SETUP) key.
2. Press `Calibrate` and then `Calibrate Probe`.

To calibrate a non-identifiable probe

1. Connect the voltage probe to the plug-in.
2. Attach the probe tip to the CAL hook that is located near the floppy disk drive.
3. Press the plug-in module's front-panel channel (SETUP) key.
4. Press `Calibrate` and then `Calibrate probe`.

If the probe being calibrated has an attenuation factor that allows the instrument to adjust the gain (in hardware) to produce even steps in the vertical scale factors, the instrument will do so. Typically, probes have standard attenuation factors such as divide by 10, divide by 20, or divide by 100.

FINAL TRIM SIZE : 7.5 in x 9.0 in

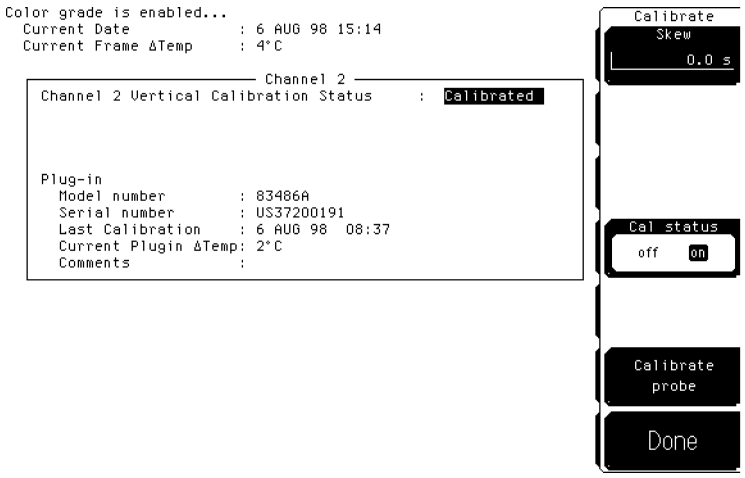


Figure 3-3. Electrical Channel Calibrate Menu

To calibrate other devices

Since 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.

1. Press the plug-in module's front-panel channel (SETUP) key.
2. Press `External scale`.
3. Press `Atten units` Ratio, `Attenuation` 1:1, and then `Units` Ampere (Volt, Watt, or Unknown).
4. Press `Ext gain`, and enter the actual gain characteristics of the probe or device.
5. Press `Ext offset`, and enter the offset introduced by the probe or device.

External Scale

There is an External scale setting which allows the user to enter in an offset value to compensate for gains or losses not associated with the device under test. This feature is useful for adjusting out the effects of devices such as test fixtures and attenuators so that the reading on the display gives the measurement value associated with only the actual device under test.

To adjust the external scale

1. Press the plug-in module's front-panel channel (SETUP) key.
2. Press `External scale`, and set the `Atten units` to "decibel".
3. Press `Attenuation`, and enter the appropriate values.

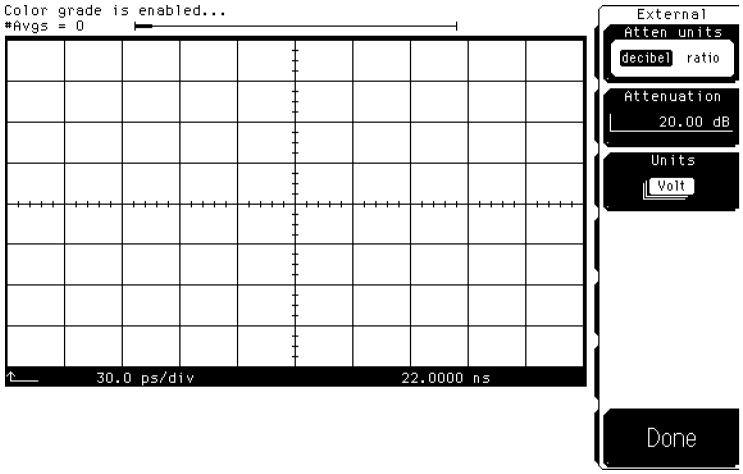


Figure 3-4. External Scale Menu

FINAL TRIM SIZE : 7.5 in x 9.0 in

Complete Calibration Summary

Table 3-4. Complete Calibration Summary

Calibration	What is calibrated	Measurements Affected	Recommended Interval	Key Path
Mainframe Calibration	Accuracy and continuity of the timescale	All time base measurements such as rise time, fall time, eye width, and jitter.	Annually at Agilent service center or if operating temp has changed and remains 5°C or more from calibration temperature. See service manual.	Utility Calibrate Calibrate frame
Plug-in Vertical Calibration	Vertical offset and vertical scale accuracy.	Any electrical vertical measurements such as $V_{p\ to\ p}$, eye height, extinction ratio	Perform after any power cycle or once every 10 hours during continuous use or if operating temperature changes by more than 2°C.	Utility Calibrate Calibrate Plug-in
Dark Calibration	Dark calibration measures the channel offset signal without any light present and this value is used in the extinction ratio algorithm.	Channels affected: electrical with O/E converter. Extinction ratio.	Before extinction ratio measurements if the vertical scale or offset has changed since the last dark calibration or after a plug-in vertical calibration is performed.	Shift, Meas eye Extinction ratio Dark Cal
Probe calibration	Probe Attenuation	Any electrical measurement taken with the probe	Whenever a probe is connected	Electrical Channel Setup Calibrate Calibrate probe
Channel Skew	Calibrates out the small differences in delay between channels. Useful for looking at timing differences between channels	Multiple channel measurements	Before multiple channel measurements when measuring timing differences between channels.	Channel Setup Calibrate Skew
External Scale	Compensates for gain or loss associated with external devices (calibrates vertical scale to external device)	Any measurement taken through an external device (component or transducer)	Whenever using external devices (component or transducer)	Channel Setup External Scale

FINAL TRIM SIZE : 7.5 in x 9.0 in

4

Specifications and Characteristics

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Specifications and Characteristics

This chapter lists the system specifications and characteristics of the Agilent 83483A, 83484A,B and the Agilent 54751A, 54752A,B electrical plug-in modules when combined with either the Agilent 83480A or Agilent 54750A mainframes. The specifications and characteristics for the mainframe are in the *Agilent 83480A, 54750A User's Guide*. Specifications apply over the temperature range +15° C to +35° C (unless otherwise noted) after the instrument's temperature has been stabilized after 60 minutes of continuous operation.

Specifications

Specifications described warranted performance. Unless otherwise noted, corrected limits are given when specifications are subject to minimization with error-correction routines.

Characteristics

Characteristics provide useful, nonwarranted, information about the functions and performance of the instrument. Characteristics are printed in italics.

Calibration cycle

Agilent Technologies designs instruments to meet specifications over the recommended calibration interval provided that the instrument is operated within the specified operating environment. To maintain specifications, periodic recalibrations are necessary. We recommend that the plug-in module be calibrated at an Agilent Technologies service facility every 12 months. Users are encouraged to adjust the calibration cycle based on their particular operating environment or measurement accuracy needs.

FINAL TRIM SIZE : 7.5 in x 9.0 in

Specifications

The following are specifications used to test the Agilent 83483A, 83484A,B and the Agilent 54751A, 54752A,B plug-in modules. Specifications are valid after a 1 hour warm-up period. Refer to the *Agilent 54701A Active Probe Service Guide* for complete probe specifications.

FINAL TRIM SIZE : 7.5 in x 9.0 in

Agilent 83483A and Agilent 54751A Vertical Specifications

Bandwidth (−3 dB)	dc to 12.4 or 20 GHz, user selectable
dc Accuracy—single marker[1]	
12.4 GHz bandwidth	±0.4% of full scale ±2 mV ±1.5% (reading − channel offset) ± (2%/°C) (ΔT_{cal}[2]) (reading) − 0.4%/hr (ΔTime[3]) (reading)
20 GHz	±0.4% of full scale ±2 mV ±3% (reading − channel offset) ± (2%/°C) (ΔT_{cal}[2]) (reading) − 0.4%/hr (ΔTime[3]) (reading)
dc Difference—two marker accuracy on same channel[1]	
12.4 GHz	±0.8% of full scale ±1.5% of delta marker reading ± (2%/°C) (ΔT_{cal}[2]) (reading) − 0.4%/hr (ΔTime[3]) (reading)
20 GHz	±0.8% of full scale ±3% of delta marker reading ± (2%/°C) (ΔT_{cal}[2]) (reading) − 0.4%/hr (ΔTime[3]) (reading)
Transition Time (10%–90%) characteristic, calculated from T=0.35/BW, electrical	
12.4 GHz bandwidth	*28.2 ps*
20 GHz bandwidth	*17.5 ps*
RMS Noise	
Typical	
12.4 GHz	*0.25 mV*
20 GHz	*0.5 mV*
Maximum	
12.4 GHz	0.5 mV
20 GHz	1.0 mV

1 It is recommended that a user vertical calibration be performed after every 10 hours of continuous use or if the temperature has changed by greater than 2°C from the previous vertical calibration.

2 Where ΔT_{cal} represents the temperature change in Celsius from the last user vertical calibration. Note that the temperature term goes to zero upon execution of a vertical calibration.

3 Where ΔTime represents the time since the last user vertical calibration. The uncertainty due to time typically stabilizes after 24 hours. This term goes to zero upon execution of a vertical calibration.

FINAL TRIM SIZE : 7.5 in x 9.0 in

Agilent 83483A and Agilent 54751A Vertical Specifications (continued)

Scale Factor	full scale is eight divisions
Minimum	1 mV/div
Maximum	100 mV/div
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	2
Dynamic Range/Maximum Specified Input Power	±400 mV relative to channel offset
Maximum Safe Input	±2V + peak ac (+16 dBm)

FINAL TRIM SIZE : 7.5 in x 9.0 in

Agilent 83484A,B and Agilent 54752A,B Vertical Specifications

Bandwidth (−3 dB)	dc to 26.5 or 50 GHz, user selectable
dc Accuracy—single marker[1]	
26.5 GHz bandwidth	±0.4% of full scale ±2 mV ±1.2% (reading − channel offset) ± (2%/°C) (ΔT_{cal}[2]) (reading)
50 GHz bandwidth	±0.4% of full scale ±2 mV ±2% (reading − channel offset) ± (2%/°C) (ΔT_{cal}) (reading)[2]
dc Difference—two marker accuracy on same channel[1]	
26.5 GHz bandwidth	±0.8% of full scale ±1.2% of delta reading ± (2%/°C) (ΔT_{cal}[2]) (reading)
50 GHz bandwidth	±0.8% of full scale ±2% of delta reading ± (2%/°C) (ΔT_{cal}) (delta reading)[2]
Transition Time (10%–90%) characteristic, calculated from T=0.35/BW, electrical	
26.5 GHz bandwidth	*13.2 ps*
50 GHz bandwidth	*7.0 ps*
RMS Noise	
Typical	
26.5 GHz	*0.46 mV*
50 GHz	*0.92 mV*
Maximum	
26.5 GHz	0.75 mV
50 GHz	1.5 mV
Scale Factor	full scale is eight divisions
Minimum	1 mV/div
Maximum	100 mV/div
dc Offset Range	±500 mV
Nominal Input Impedance	50 Ω

1 It is recommended that a user vertical calibration be performed after every 10 hours of continuous use or if the temperature has changed by greater than 2°C from the previous vertical calibration.

2 Where ΔT_{cal} represents the temperature change in Celsius from the last user vertical calibration. Note that the temperature term goes to zero upon execution of a vertical calibration.

FINAL TRIM SIZE : 7.5 in x 9.0 in

Agilent 83484A,B and Agilent 54752A,B Vertical Specifications (continued)

Connectors	
Trigger	3.5mm (m)
Channel	2.4mm (m)
Input Reflection/Return Loss	≤5% for 20 ps rise time
Number of Channels	2
Dynamic Range/Maximum Specified Input Power	±400 mV relative to channel offset
Maximum Safe Input	±2V + peak ac (+16 dBm)

Environmental specifications

Temperature	
Operating	15 °C to +35 °C
Non-operating	−40 °C to +70 °C
Humidity	
Operating	up to 90% relative humidity (non-condensing) at ≤35° C
Non-operating	up to 95% relative humidity (non-condensing) at ≤65° C

Power requirements

Supplied by mainframe.

Weight

Net	approximately 1.1 kg (2.4 lb.)
Shipping	approximately 2.0 kg (4.4 lb.)

FINAL TRIM SIZE : 7.5 in x 9.0 in

Characteristics

The following characteristics are typical for the Agilent 83483A, 83484A,B and the Agilent 54751A, 54752A,B electrical plug-in module. See the *Agilent 54701A Active Probe Service Guide* for complete probe characteristics.

Trigger Input Characteristics

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 *Agilent 83480A, 54750A User's Guide* for Trigger specifications.

FINAL TRIM SIZE : 7.5 in x 9.0 in

5

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 *Agilent 83483A, 54751A Service Guide* or the *Agilent 83484A,B and 54752A,B Service Guide*.

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.

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

FINAL TRIM SIZE : 7.5 in x 9.0 in

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 *Agilent 83480A, 54750A Service Guide* or return the mainframe to a qualified service department.

FINAL TRIM SIZE : 7.5 in x 9.0 in

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?
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...`

FINAL TRIM SIZE : 7.5 in x 9.0 in

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.

CAUTION

DO NOT use this procedure on an Agilent 83485A or other optical module. It will destroy the factory optical/electrical calibration factors.

a. To reinitialize the plug-in memory, press:
   Utility
   `Service`
   `Plug-in . . .`
b. Select the appropriate plug-in by selecting slot 1 and 2, or 3 and 4 by pressing:
   `Plug-in` 1 or 3
   `Initialize plug-in memory`

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 *Agilent 83483A, 54751A Service Guide* or *Agilent 83484A,B and 54752A,B Service Guide*, or return the plug-in module to a qualified service department.

FINAL TRIM SIZE : 7.5 in x 9.0 in

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 *Agilent 83483A, 54751A Service Guide* or the *Agilent 83484A,B and 54752A,B Service Guide* and *Agilent 83480A, 54750A Service Guide* for additional troubleshooting information.

Additional error messages are listed in the *Agilent 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.

FINAL TRIM SIZE : 7.5 in x 9.0 in

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 *Agilent 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 *Agilent 83483A, 54751A Service Guide* or *Agilent 83484A,B and 54752A,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.

FINAL TRIM SIZE : 7.5 in x 9.0 in

FINAL TRIM SIZE : 7.5 in x 9.0 in

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