

---

## User's Reference

Publication number 54721-97001  
First edition, December 1993

For Safety information, Warranties, and Regulatory information, see the pages behind the index

© Copyright Hewlett-Packard Company 1992, 1993  
All Rights Reserved

---

**HP 54721A**  
**Amplifier Plug-In**

---

## Amplifier Plug-In for the HP 54720 or HP 54710 Mainframes

The HP 54721A Amplifier is one of several plug-ins for the HP 54720 or HP 54710 mainframes. Use this plug-in when you need the highest sample rate for single-shot applications. Its main features are:

- 1-GHz single-shot capability
- 4-GSa/s sample rate when combined with a mainframe
- 32K memory depth when combined with an A model mainframe, and 128K memory depth when combined with a D model mainframe
- 1.1-GHz bandwidth
- 1-GHz external trigger and 1-GHz internal trigger
- N-type (f) channel and trigger connectors
- Two probe-power connectors for two active probes
- 10-mV/div maximum sensitivity with software expansion down to 1 mV/div.

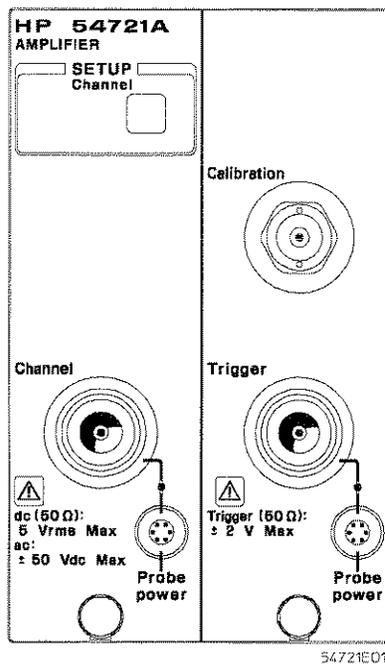
### **What is the purpose of a plug-in?**

The purpose of a plug-in is analog signal conditioning. A plug-in scales the input signal, sets the bandwidth of the system, and allows you to choose input coupling and input impedance. The output of the plug-in is an analog signal that is applied to the ADCs that are on the acquisition boards inside of the mainframe. A plug-in also provides a trigger signal sync to the time base/trigger board inside of the mainframe.

### Front panel of the plug-in

The plug-in takes up two mainframe slots. You are trading channel count for increased sample rate, increased record length, and increased single-shot bandwidth.

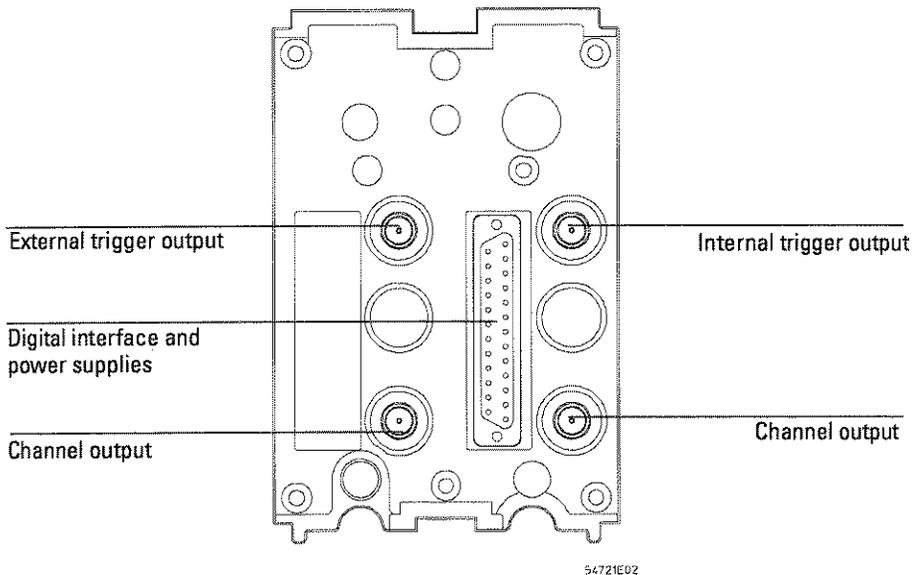
The front panel of the plug-in has a channel input, an external trigger input, and a calibration output signal. The calibration signal has a pulse width of about 500 ps, which is used for performing a best accuracy calibration on the plug-in. The front panel also has two probe power connectors for HP 54700-series probes, and one hardkey that brings up a softkey menu on the display. The softkey menu allows you to access to the channel features of the plug-in.



### Rear panel of the plug-in

The rear panel has both internal and external trigger output signals. One digital interface connector that has the control signals for the attenuator ranges, channel setup hardkey, softkey selections, and power supply lines.

You may notice that there are two channel output connectors. The 4-GSa/s sample rate is achieved by interleaving two sampler hybrids inside of the mainframe. There is a channel output for each of the two hybrids, and that is why the plug-in takes up two slots on the mainframe.



**Getting the best performance from the plug-in**

To obtain the 1 percent dc accuracy specifications, you must perform a best accuracy calibration. Also, when you move a plug-in from one slot to another slot, you must repeat the best accuracy calibration to retain the 1 percent accuracy specifications. See "Calibrate to Best Accuracy" on page 17.

The best accuracy calibration also performs the sampler interleave calibration, which must be performed for the plug-in to function correctly at 4 GSa/s.

**Installing the plug-in**

You do not need to turn off the mainframe to install or remove any plug-ins, and you can install a plug-in into any slot on the HP 54720 mainframe. However, on the HP 54710 mainframe only slots 1 and 2 have channel acquisition hardware, but you can still use slots 3 and 4 as trigger sources.

You can install this plug-in in slots 1 and 2, 2 and 3, or 3 and 4.

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

**Trigger menu**

You may notice a couple of differences in the trigger menu on the mainframe when you are using this plug-in. The external trigger level range for this plug-in is  $\pm 1$  V. Also, the trigger source selection follows the slots that the plug-in is installed in. For example, if the plug-in is installed in slots 2 and 3, then the internal trigger source is listed as channel 2, and the external trigger source is listed as trigger 3.

---

**In this book**

This book is a User's Reference for the HP 54721A Amplifier Plug-in. The book contains three chapters:

Chapter 1, "Channel Setup Menu," takes you through the channel setup menu and gives you a description of each softkey.

Chapter 2, "Specifications and Characteristics," lists the system specifications and characteristics of this plug-in when it is combined with a mainframe.

Chapter 3, "In Case of Difficulty," gives you a few simple checks that you can make in case the plug-in does not appear to be operating properly.

For HP-IB programming information, refer to the Programmer's Reference supplied with the mainframe, and for service information refer to the Service Guide.

---

## Contents

### **1 Channel Setup Menu**

Display 12  
Scale 12  
Offset 13  
Input 13  
Output 13  
Probe 14  
Calibrate 17

### **2 Specifications and Characteristics**

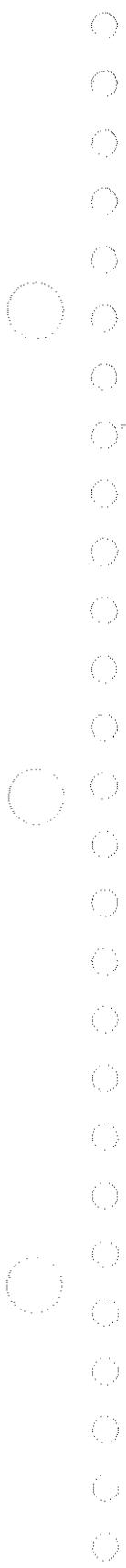
Specifications 22  
Characteristics 23  
General Characteristics 26

### **3 In Case of Difficulty**

If the mainframe does not power up 28  
If the plug-in does not operate correctly 29  
Error messages 30

**Glossary** 33

**Index** 35



---

1

---

**Channel Setup Menu**

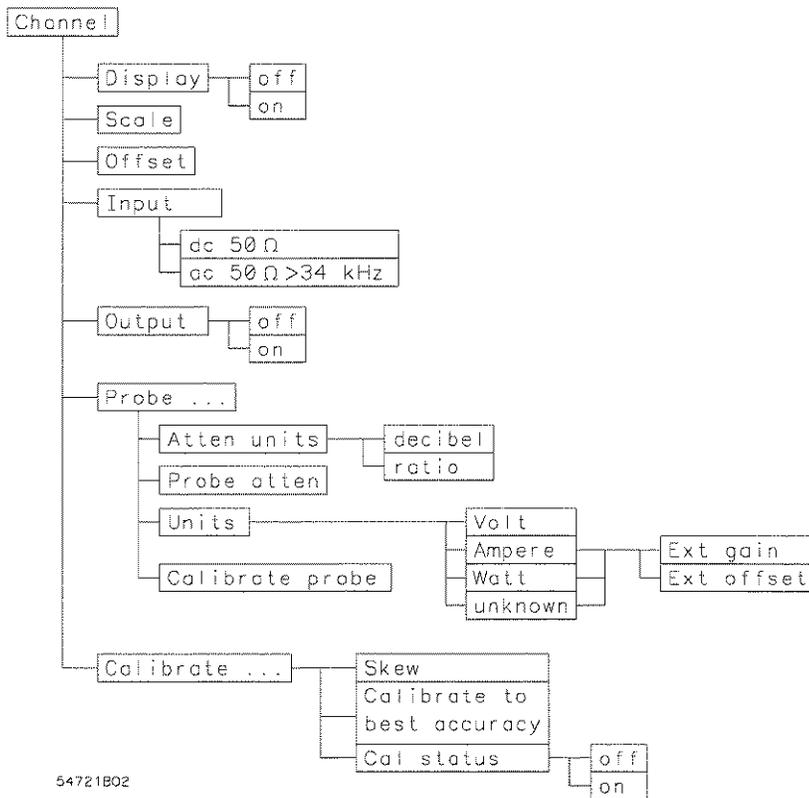
---

## Channel Setup Menu

At the top of the plug-in is the Channel-Setup hardkey. This hardkey gives you access to the channel menu for the plug-in. The channel menu is a softkey menu that comes up on the right side of the display when you press the Channel-Setup hardkey. You will also notice that there are several types of softkeys available. A description of how each softkey functions is given in the User's Quick Start Guide that was supplied with the mainframe.

Figure 1 is the menu map of the channel-setup hardkey.

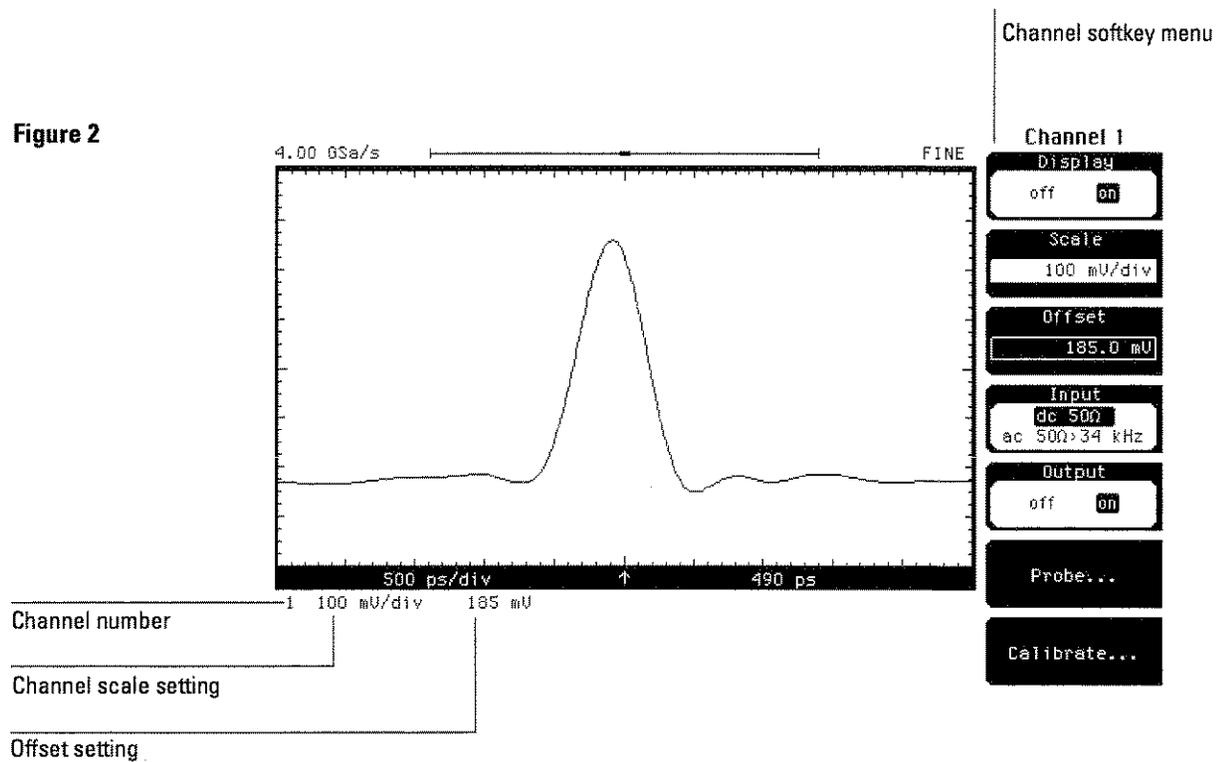
Figure 1



Channel Setup Menu

When you press the Channel-Setup hardkey on the plug-in, the softkey menu shown in figure 2 is displayed. This chapter gives you a description of the function of each channel softkey. Some of the softkeys bring up additional menus on the display. A picture of each additional menu is included along with a description of the menu.

Figure 2



## Channel Setup Menu

### Display

---

## Display

Display 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 that the waveform is clipped off the display. Also, the channel number, vertical scaling, and offset are displayed at the bottom left of the waveform area. They stay displayed until the channel is turned off, or until 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. Also, acquisition on that channel is stopped, unless it is needed as an operand for waveform math functions, and any pulse parameter measurements are stopped.

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 oscilloscope 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.

---

## Scale

Scale controls the vertical scaling of the signal. If the fine mode is off, then the knob and arrow keys change the vertical scaling in a 1-2-5 sequence. When the fine mode is on (shift-down arrow), the knob and arrow keys change the vertical scaling in 1-mV increments. You can always use the keypad to enter values in 1-mV increments independent of the fine mode selection. Software expansion is used to obtain the scale values not in the 1-2-5 sequence, and from 1 mV/div to 10 mV/div.

---

## Offset

Offset moves the waveform vertically. It is similar to the position control on analog oscilloscopes. A feature of digital offset is that it is always calibrated. The offset voltage is the voltage at the center of the display, and the range of offset is  $\pm 12$  times the full resolution channel scale. You can use the knob, arrow keys, or keypad to change the offset setting.

When an HP 54700-series active probe is used with the plug-in, the offset control adjusts the offset of the hybrid inside the active probe.

---

## Input

You can use the Input softkey to change the input coupling of the plug-in. Use dc  $50\ \Omega$  for connecting to devices use a standard  $50\ \Omega$  transmission line. Use ac  $50\ \Omega$  to remove the dc component from signals, which allows you to use more sensitive scale settings to view an ac signal that is riding on a dc voltage.

---

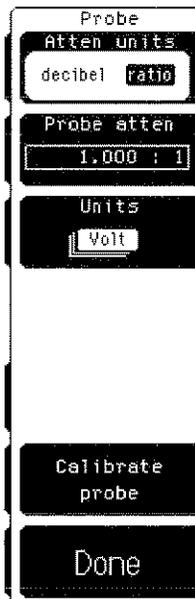
## Output

You use the Output softkey to turn on and off the front-panel Calibration signal on the plug-in. The calibration signal is used to interleave the samplers during the best accuracy calibration of the plug-in.

You should set the Output softkey to off when you are not using the calibration signal. This reduces the possibility of stray radiation from the calibration signal causing noise or crosstalk on the other channel inputs.

## Channel Setup Menu

### Probe



## Probe

The Probe menu allows you to set up the oscilloscope so that the screen displays the channel scale, offset, and voltage measurements that correspond to the probe.

When you press the Probe softkey, the menu at the left is displayed.

### Atten units

Attenuation units lets you pick how you want to represent the probe attenuation factor. Set the attenuation units to decibel for attenuators and to ratio for probes.

### Probe atten

Probe attenuation lets you select a probe attenuation that matches the probe or device connected to the oscilloscope. When the probe attenuation is set correctly, the oscilloscope maintains the current scale factors if possible. All marker values and voltage measurements will reflect the actual voltage at the tip of the probe.

The probe attenuation range is from 0.0001:1 to 1,000,000:1.

When you connect an active probe power connector to the plug-in, the oscilloscope automatically sets the probe attenuation. For all other probes, set the probe attenuation with the knob, arrow keys, keypad, or use the Calibrate probe softkey.

### See Also

Calibrate Probe in this chapter for information on how to calibrate to the tip of the probe when you are using voltage probes.

Channel Setup Menu  
Probe**Units**

Units lets you select Volt, Ampere, Watt, or unknown as the unit of measure for the channel scale, offset, and vertical measurement values. The unit you select is appended to these numeric values. You would 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.

**Ext gain and Ext offset**

When you select Ampere, Watt, or unknown, two additional softkeys are available, external gain and external offset. These two additional softkeys allow you to compensate for a transducer's actual characteristics as compared to its ideal characteristics. For example, you might have an amplified lightwave converter whose ideal characteristics are 300 V/W with 0 V of output offset. But, its actual characteristics are 324 V/W with 1 mV of output offset. Set the external gain to 324 V/W and the external offset to 1 mV.

**Example  
Voltage probes**

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

- 1 Set the **Atten units** softkey to **ratio**.
- 2 Set the **Units** softkey to **Voltage**.
- 3 Connect the probe to the front-panel CAL signal
- 4 Press the **Calibrate Probe** softkey.

The oscilloscope automatically calibrates to the tip of the probe, setting the probe attenuation and compensating for any probe offset.

## Channel Setup Menu

### Probe

---

#### Example Other devices

Because the mainframe's CAL signal is a voltage source, you cannot use it to calibrate to the probe tip when units is set to Ampere, Watt, or unknown. Instead, you 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. The following steps show you how to do this.

- 1 Set the **Atten units** softkey to **ratio**.
- 2 Set the **Probe atten** softkey to **1:1**.
- 3 Set the **Units** softkey to **Ampere, Watt, or unknown**.
- 4 Set the **Ext gain** softkey to the actual gain characteristics of the probe or device.
- 5 Set the **Ext offset** softkey to the offset that is introduced by the probe or device.

---

#### Calibrate probe

Connect a voltage probe from the plug-in to the CAL signal on the mainframe, then press the Calibrate probe softkey. The oscilloscope calibrates to the tip of the probe by setting the probe attenuation to the actual attenuation ratio of the probe. The oscilloscope also automatically compensates for any offset that the probe may introduce.

---

## Calibrate

### Skew

Skew changes the horizontal position of a waveform on the display. Skew lets you 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 two waveforms than the actual timing difference between them, you can overlay one waveform on top of the other waveform by using Skew.

The range of Skew is about  $\pm 100 \mu\text{s}$ .

### Calibrate to best accuracy

Calibrate to best accuracy allows you to achieve the 1 percent accuracy specifications. A best accuracy calibration is valid for a specific plug-in, in a specific slot, in a specific mainframe. It is valid as long the temperature of the mainframe is within  $\pm 5 \text{ }^\circ\text{C}$  of the temperature of when it was last calibrated, the temperature of the mainframe is within  $\pm 5 \text{ }^\circ\text{C}$  of when the last best accuracy calibration was done, and the best accuracy calibration was performed within the last 24 hours.

The best accuracy calibration factors are stored in the mainframe's memory. The calibration factors are retained until another best accuracy calibration is performed in this slot.

If you perform another best accuracy calibration on that plug-in in a different slot or mainframe, when you bring the plug-in back into the original slot, and as long as another best accuracy calibration was not performed in that slot, the original best accuracy calibration factors are retained.



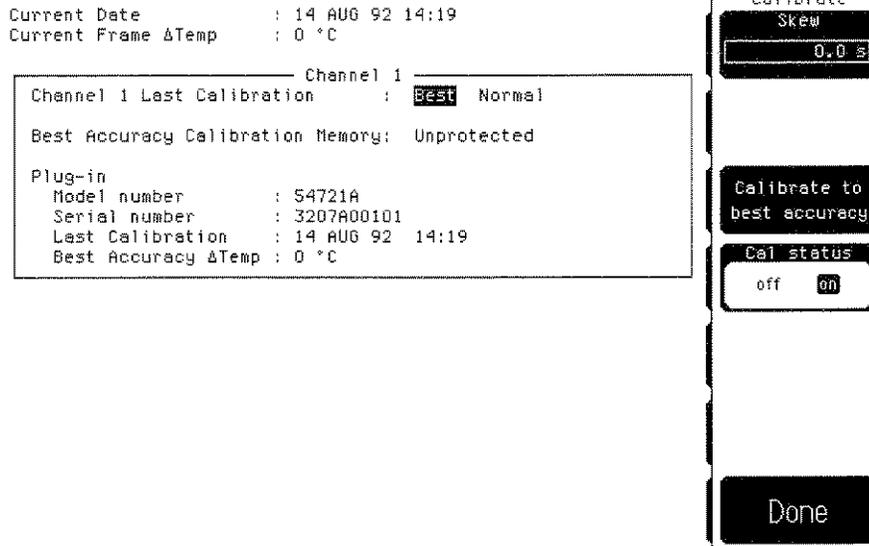
## Channel Setup Menu

### Calibrate

#### Cal status

Pressing the Cal status softkey brings up the display in figure 3.

Figure 3



**Current Date** This is the current date and time. You can compare this to the "Last Calibration" time. That way you will know how long it has been since the last best accuracy calibration or normal plug-in calibration was performed.

Channel Setup Menu  
Calibrate

**Current Frame  $\Delta$ Temp** This is the temperature change, of the inside of the instrument, since the last mainframe calibration was performed. A positive number indicates how many degrees warmer the mainframe is now compared to the temperature of the mainframe at the last mainframe calibration. A best accuracy calibration is valid as long as the mainframe temperature  $\Delta$  is within  $\pm 5$  °C of the temperature at which it was calibrated. If the temperature  $\Delta$  is more than  $\pm 5$  °C of the temperature at which it was calibrated, you must perform a mainframe calibration before performing a best accuracy calibration to ensure that the best accuracy calibration is valid.

**Channel 1 Last Calibration** The oscilloscope displays Best, Normal, or Uncalibrated, depending on what calibration was last performed on the plug-in.

Best indicates that a best accuracy calibration was performed on the plug-in, and that the best accuracy calibration factors are retained in the mainframe's memory. For the best accuracy to remain valid, the internal temperature of the mainframe needs to be  $\pm 5$  °C of when the last best accuracy calibration was performed, and no more than 24 hours has elapsed.

Normal indicates that the plug-in is not calibrated for best accuracy. Either the best accuracy calibration factors were cleared from the mainframe's memory, or a best accuracy calibration has not yet been performed in this slot. But normal does indicate that the normal plug-in calibration is still valid for this plug-in, and all you have to do to gain back the 1 percent dc accuracy specifications is to perform a best accuracy calibration.

Uncalibrated means that the normal plug-in calibration is invalid. You must calibrate the plug-in to normal accuracy before performing a best accuracy calibration. To calibrate the plug-in, see the Service Guide that is supplied with the plug-in.

## Channel Setup Menu Calibrate

**Best accuracy Calibration Memory** The oscilloscope displays either Protected or Unprotected. Protected means that the mainframe memory is write protected, so you cannot perform a best accuracy calibration. If you try to perform a best accuracy calibration when the memory is protected, the message "Best accuracy calibration memory protected" is displayed at the top of the screen. You must set the best cal switch on the rear panel of the mainframe to Unprotected before a best accuracy calibration is allowed.

**Plug-in** This lists the model number, serial number, date and time of the plug-in's last calibration, and the temperature  $\Delta$  from the mainframe's temperature when the last best accuracy calibration was performed. If this temperature  $\Delta$  is more than  $\pm 5$  °C, then you must perform a new best accuracy calibration to make sure that your measurement results are to the 1 percent dc accuracy specifications.

---

2

---

**Specifications and  
Characteristics**

---

---

## Specifications

This chapter lists the system specifications and characteristics of the HP 54721A plug-in when it is combined with either the HP 54720 or HP 54710 mainframes. The specifications and characteristics for the mainframe are in the *HP 54720 and HP 54710 Oscilloscope User's Reference*.

---

### Specifications

The following are specifications used to test the HP 54721A plug-in. Specifications are valid after a 20 minute warm-up period. See the HP 54701A Active Probe service guide for complete probe specifications.

#### Channel

**Analog Bandwidth (-3 dB)** dc to >1.1 GHz

**Bandwidth (-3 dB) with HP 54701A Active probe** dc to >1 GHz

**dc Voltage Measurement Accuracy** (Best Accuracy calibration only)<sup>1</sup>

**Single Marker** ±(gain accuracy + offset accuracy)

**Dual Marker** ±[gain accuracy + (2 × resolution)]

**Input Resistance** 50 Ω ±1.5%

#### Internal Trigger

**Trigger Sensitivity**<sup>2</sup>

**High Sensitivity** 0.1 div at 100 MHz; 0.3 div at 1 GHz

**Normal Sensitivity** 0.5 div at 100 MHz; 1.5 div at 1 GHz

**Noise Reject** 1 div at 100 MHz; 3.0 div at 1 GHz

**Minimum Pulse Width at Normal Sensitivity**<sup>2</sup> ≤500 ps at ≥1 div'

#### External Trigger

**Trigger Sensitivity**

**High Sensitivity** 6 mV<sub>p-p</sub> at 100 MHz; 20 mV<sub>p-p</sub> at 1 GHz

**Normal Sensitivity** 30 mV<sub>p-p</sub> at 100 MHz; 90 mV<sub>p-p</sub> at 1 GHz

**Noise Reject** 60 mV<sub>p-p</sub> at 100 MHz; 150 mV<sub>p-p</sub> at 1 GHz

**Minimum Pulse Width at Normal Sensitivity** ≤500 ps at ≥60 mV<sub>p-p</sub>

Specifications and Characteristics  
**Characteristics**

**Interleave Cal  
Output**

**Pulse Width (FWHM)** 475 ps

**Amplitude** 550 mV<sub>p-p</sub> ±150 mV

**Frequency** 152.1 MHz ±0.05%

1) Best Accuracy Cal specifications apply for 24 hours to plug-ins that are calibrated with Best Accuracy Cal and remain in the same slot. Otherwise, normal accuracy characteristics apply. Best Accuracy Cal specifications are valid within 5°C of the best accuracy calibration temperature while also within 5°C of the mainframe calibration temperature.

2) Characteristics apply to full resolution channel scales. Use the next lower full-resolution sensitivity for intermediate channel scale settings.

---

**Characteristics**

The following characteristics are typical for the HP 54721A plug-in. See the *HP 54701A Active Probe Service Guide* for complete probe characteristics.

**Channel**

**Number of Channels** 1

**Number of Mainframe Slots** 2

**Max Sample Rate to Analog Bandwidth** 3.64:1

**Digital Bandwidth Limit** dc to (sample rate/20) in the real-time mode only

**Rise Time** 318 ps

**Channel Scale (8 divisions full screen)**<sup>1</sup> 1 mV/div to 1 V/div

**Channel Scale with HP 54701A Active Probe**<sup>2</sup> 10 mV/div to 10 V/div

**Full Resolution Channel Scales** 10, 20, 50, 100, 200, 500, 1000 mV/div

**Vertical Resolution**

**Real Time** 8 bits (0.4%), increasing to 8.6 bits (0.1%) with digital bandwidth limit turned on.

**Equivalent Time** 8 bits (0.4%). This can be improved, by averaging, to >12 bits.

Specifications and Characteristics  
**Characteristics**

**dc Gain Accuracy**<sup>3</sup>

**Normal Accuracy**  $\pm 3\%$  of full screen

**Best Accuracy Cal**  $\pm 1\%$  of full screen

**With HP 54701A Active Probe**<sup>4</sup>  $\pm 2\%$  of full screen

**Offset Accuracy**<sup>3</sup>

**Normal Accuracy**  $\pm(3\%$  of offset setting +  $3\%$  of full screen)

**Best Accuracy Cal**  $\pm(0.5\%$  of offset setting +  $1\%$  of full screen)

**With HP 54701A Active Probe**<sup>4</sup>  $\pm(0.5\%$  of offset setting +  $2\%$  of full screen)

**dc Offset Range**  $\pm 12$  times the full resolution channel scale

**RMS Noise (Max Sensitivity)**  $< 300 \mu\text{V}$

**Input Connector** N-type (f) (Previous HP 54721A plug-ins with serial prefix 3210A shipped with a BNC input connector.)

**Input Coupling (cutoff Frequency)** dc, ac (34kHz)

**Maximum Safe Input Voltage**

**dc** 5 Vrms (+27 dBm)

**ac**  $\pm 50 \text{ Vdc}$   $\pm 5 \text{ Vac}$ , rms

**Probe Power** Yes

Specifications and Characteristics  
**Characteristics**

**Time base****Maximum Sampling Rate****Real Time** 4 GSa/s**Equivalent Time**<sup>5</sup> 500 MSa/s**Record Length (per plug-in slot)**<sup>6</sup> 16 to 32,768 points in the A model mainframes, and up to 64,536 points in the D model mainframes**Max Record Duration at Max Sample Rate****A model mainframes** 8.192  $\mu$ s**D model mainframes** 32.768  $\mu$ s**Internal Trigger****RMS Jitter** <6 ps  $\pm$ 0.005% of delay setting**Trigger Level Range**  $\pm$ 1.5 full resolution screen diameters from center screen**External Trigger****Input Resistance** 50  $\Omega$ **Input Connector** N-type (f) (Previous HP 54721A plug-ins with serial prefix 3210A shipped with a BNC input connector.)**RMS Jitter** <6 ps  $\pm$ 0.005% of delay setting**Trigger Level Range**  $\pm$ 1 V**Max Safe Input Voltage**  $\pm$ 1.5 V**Probe Power** Yes

- 1) Adjustable in 1 mV/div steps up to 1 V/div and 10 mV/div steps above 1 V/div
- 2) The probe attenuation factor is automatically set to 10:1 when the probe's power cable is connected to the plug-in. The plug-in input coupling is automatically set to dc and 50  $\Omega$ .
- 3) Characteristics apply to full resolution channel scales. Use the next lower full-resolution sensitivity for intermediate channel scale settings.
- 4) These characteristics are valid after a Best Accuracy Cal and Probe Cal.
- 5) Multiple 500 MSa/s acquisitions are time-correlated into a single record with 1-ps resolution, yielding an effective sampling rate of 1 terasample/second.
- 6) All data points that fall within the waveform display area's time window are plotted to the screen.

Specifications and Characteristics  
**General Characteristics**

---

**Environmental  
Conditions**

**General Characteristics**

These general characteristics apply to the HP 54721A plug-in. The instrument meets Hewlett-Packard's environmental specifications (section 750) for class B-1 products with exceptions as described for temperature and condensation. Contact your local HP field engineer for complete details.

**Temperature**

**Operating** 10 °C to +40 °C (50 °F to +104 °F)

**Nonoperating** -40 °C to +70 °C (-40°F to +158 °F)

**Humidity**

**Operating** up to 95% relative humidity (noncondensing) at +40 °C (+104 °F)

**Nonoperating** up to 90% relative humidity at +65 °C (+149 °F)

**Altitude**

**Operating** up to 4,600 meters (15,000 ft.)

**Nonoperating** up to 15,300 meters (50,000 ft.).

**Vibration**

**Operating** Random vibration 5 to 500 Hz, 10 minutes per axis, 0.3 grms

**Non-operating** Random vibration 5 to 500 Hz, 10 minute per axis, 2.41 grms; Resonant search 5 to 500 Hz swept sine, 1 Octave/minute sweep rate, (0.75g), 5 minute resonant dwell at 4 resonances per axis.

**Power  
Requirements**

Supplied by mainframe.

**Weight**

**Net** approximately 1.4 kg (3.0 lb.)

**Shipping** approximately 2.3 kg (5.0 lb.)

---

3

---

**In Case of Difficulty**

---

---

## In Case of Difficulty

This chapter gives you a few helpful hints in case you are experiencing difficulty in getting your plug-in to operate. The simple check steps in this chapter are intended for you to perform. For complete service information, refer to the Service Guide that was supplied with the plug-in.

---

### If the mainframe does not power up

- Make sure that the mainframe is attached to a power source.
- Make sure that the power switch on the mainframe is set to On, and that the rear-panel line switch is set to On.
- Remove the plug-in to see if the mainframe will power up without it.

If the mainframe still does not power up, refer to the Service Guide that was supplied with the mainframe, or return the mainframe to your service department.

In Case of Difficulty  
If the plug-in does not operate correctly

---

## If the plug-in does not operate correctly

- Make sure that the plug-in is seated in the slot, and that the knurled screw at the bottom of the plug-in is finger-tight.
- Press the **Run** key to make sure the oscilloscope is ready to acquire data.
- Set the trigger to auto sweep.
  - 1 Press the **Trigger** key.
  - 2 Set the **Sweep** softkey to **auto**.
- Make sure that the channel **Display** softkey is set to **On**.
  - 1 Press the **Channel** key on the plug-in.
  - 2 Set the **Display** softkey to **On**.
- Make sure the channel offset is adjusted so the waveform is not clipped off the display.
- If you are using the plug-in as a trigger source only, make sure at least one other channel is turned on.

If all the channels are turned off, the mainframe will not trigger.
- Does the mainframe identify the plug-in?
  - 1 Press the **Utility** key.
  - 2 Press the **System config...** softkey.

The calibration status of the plug-ins is listed near the bottom of the display, in the box entitled "Plug-ins." If the model number of the plug-in is listed next to the appropriate slot number, then the mainframe has identified the plug-in. If all of the above steps check out okay, and the plug-in still does not operate correctly, then the problem is beyond the scope of this book. Refer to the Service Guide or return the plug-in to your service department.

If "~known" is displayed instead of the model number of the plug-in, then remove and reinsert the plug-in in the same slot. If "~known" is still displayed, then the memory contents of the plug-in are corrupt. Refer to the Service Guide or contact your service department.

In Case of Difficulty  
**Error messages**

---

## Error messages

The following five error messages are for the plug-in. 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 Service Guide that is supplied with the plug-in and the mainframe for troubleshooting information.

Additional error messages are listed in the User's Reference for the mainframe.

**Error message**

**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.

- Remove and reinstall the plug-in.**

Each time a plug-in is installed, the mainframe rereads the plug-in's memory.

- To make sure that the plug-in is seated correctly, finger tighten the knurled screw at the bottom of the plug-in.**
- Install the plug-in in a different slot in the mainframe.**

**In Case of Difficulty  
Error messages****Error message**

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

The mainframe is having trouble communicating with the plug-in. You want to make sure that there is a good connection between the mainframe and the plug-in.

- Remove and reinstall the plug-in into the mainframe.
- To make sure that the plug-in is seated correctly, finger-tighten the knurled screw at the bottom of the plug-in.
- Install the plug-in in a different slot in the mainframe.

**Error message**

Communication failure exists at slot \_\_. Service is required

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

- If the slot is empty, then there is a mainframe hardware problem. Refer to the Service Guide for the mainframe.
- If a plug-in is installed in the slot, then there is a plug-in hardware problem. Refer to the Service Guide for the plug-in.

**Error message**

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

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

- Remove and reinstall the plug-in into the mainframe.
- To make sure that the plug-in is seated correctly, finger-tighten the knurled screw at the bottom of the plug-in.

In Case of Difficulty  
**Error messages**

Error message

**Plug-in is not supported \_\_: System firmware upgrade is needed**

The system firmware in your mainframe does not support this plug-in. To upgrade your system firmware, contact you nearest Hewlett-Packard Sales Office, use the software update request form that is in the system firmware, or use the copy of this form that is in the User's Reference for the mainframe.

To print out the firmware update request form, follow these steps.

- 1 Connect a printer to the oscilloscope
- 2 Press the blue shift key on the keypad, then press the Setup print key (printed in blue above the Print key).
- 3 Press the **Print format** softkey. Use the knob, arrow keys, or softkeys to select the correct printer, then press the **Enter** softkey.
- 4 Press the **Destination** softkey. Then, select the correct destination for your printer.

If the destination is HP-IB, make sure you select the correct HP-IB address that matches your printer.

If you are unsure what the HP-IB address of the printer is, refer to the manual that was supplied with the printer.

- 5 Press the Utility key.
- 6 Press the **Firmware support...** softkey.
- 7 Press the **Firmware update request** softkey.

---

## Glossary

**Atten units** (attenuation units)  
Lets you set the probe attenuation units to either decibel or ratio.

**Calibrate probe** Automatically calibrates voltage probes to their tip so the oscilloscope takes into account the actual voltage attenuation factor of the probe and any offset introduced by the probe.

**Calibrate to best accuracy**  
When the plug-in is calibrated to best accuracy, you obtain the 1 percent dc accuracy specifications.

**Calibration status** Displays details on the calibration status of the plug-in.

**Decibel** Used for setting the probe attenuation when you are using an external attenuator instead of a voltage probe.

**Display** (channel) Turns the channel display off and on.

**Offset** Moves the waveform vertically on the display.

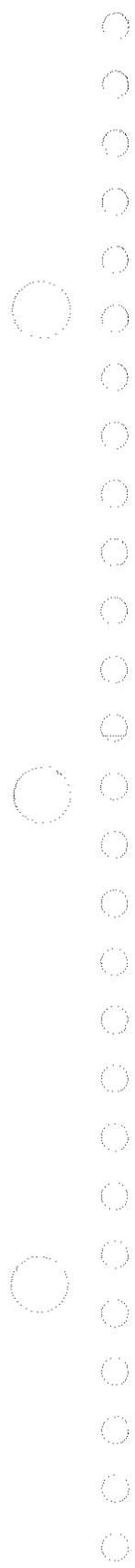
**Probe Atten** (probe attenuation)  
Allows you to set the probe-attenuation factor from 0.0001:1 to 1,000,000:1.

**Ratio** Used for setting the probe attenuation on voltage probes where the division factor is listed as a ratio.

**Scale** (channel scale) Scales the input signal with an internal attenuator. Software expansion is used on the scale settings between the attenuator ranges.

**Skew** Lets you compensate for differences in cable or probe lengths. You can also use Skew to overlay waveforms.

**Units** Lets you select Volt, Ampere, Watt, or unknown as the unit of measure for the channel scale, offset, and vertical measurement values.



---

## Index

---

- !**  
~known,29
- A**  
accuracy  
  best accuracy calibration,17  
  dc gain,24  
  dc voltage measurement,22  
  offset,24  
  specifications,17  
altitude for operation,26  
analog bandwidth,22  
Atten (attenuation) units softkey,14
- B**  
bandwidth  
  characteristics,23  
  specifications,22  
best accuracy calibration,17  
Best-accuracy calibration memory,20
- C**  
cable length compensation,17  
Cal (calibrated) status softkey,18  
Calibrate probe softkey,16  
Calibrate softkey,17  
Calibrate to best accuracy softkey,17  
calibration signal,3, 13  
channel  
  characteristics,23–25  
  display,12  
  noise,13  
  scale,12, 14  
  specifications,22  
Channel 1 (also 2,3,4) Last Calibration,19  
Channel-setup hardkey,10  
Channel-setup hardkey menu map,10  
characteristics  
  actual,15  
  channel,23–25  
  compensation,15  
  environmental,26  
  external trigger,25  
  general,26  
  ideal,15  
  internal trigger,25  
  power requirements,26  
  characteristics (continued)  
    time base,25  
    trigger,25  
    weight,26  
Current frame  $\Delta$  Temp,19
- D**  
date  
  current,18  
  of last calibration,20  
dc accuracy specifications,5  
dc component removing,13  
dc gain accuracy,24  
dc offset range,24  
dc voltage measurement accuracy,22  
difficulties resolution,29  
digital offset,13  
Display softkey,12
- E**  
environmental conditions,26  
error messages,30–32  
Ext (external) gain softkey,15  
Ext (external) offset softkey,15  
external trigger  
  characteristics,25  
  specifications,5, 22
- F**  
features,2  
fine mode,12  
front panel,3
- H**  
hardkey  
  Channel-setup,10  
  Run,29  
humidity for operation,26
- I**  
input coupling,13  
input resistance,22  
Input softkey,13  
installing the plug-in,5  
Interleave cal (calibration) output  
  specifications,23
- internal trigger  
  characteristics,25  
  specifications,5, 22
- K**  
known (~known),29
- L**  
last calibration status,20
- M**  
main features,2  
messages, error,30–32  
model number,20  
moving the plug-in,5
- N**  
noise  
  channel,13  
  reject,22  
  RMS,24  
noisy signals,13
- O**  
offset,24  
Offset softkey,13  
operation difficulties,29  
Output softkey,13
- P**  
performance maximizing,5  
plug-in  
  best performance,5  
  difficulties,29  
  mainframe identification,29  
  moving,5  
  purpose,2  
  screen message,20  
Plug-in (screen message),20  
power  
  difficulties,28  
  requirements,26  
Probe atten (attenuation) softkey,14  
probe calibrating,16  
probe menu,14  
pulse width,23  
purpose of plug-in,2
-

## Index

- 
- R**  
real time,23, 25  
rear panel,4  
records,25  
repetitive sample mode  
  See real time  
resolution,23  
RF connectors,5  
rise time,23  
Run hardkey,29
- S**  
sample mode  
  See real time  
sample rate,25  
scale,14, 23  
Scale softkey,12  
serial number,20  
signal, calibration,13  
Skew softkey,17  
softkey  
  Atten (attenuation) units softkey,14  
  Cal (calibrated) status,18  
  Calibrate,17  
  Calibrate probe,16  
  Calibrate to best accuracy,17  
  Display,12  
  Ext (external) gain softkey,15  
  Ext (external) offset,15  
  Input,13  
  menu,3  
  Offset,13  
  Output,13  
  Probe atten (attenuation),14  
  Scale,12  
  Skew,17  
  Units,15  
specifications  
  channel,22-23  
  external trigger,22  
  Interleave cal (calibration) output,23  
  internal trigger,22
- T**  
temperature  
  current,19  
  operation,26  
time  
  current,18  
  of last calibration,20  
time base characteristics,25  
trigger  
  characteristics,25  
  failure,12  
  menu,5  
triggering edge placement,17  
troubles with operation,28
- U**  
Unit softkey,15  
unknown (~known),29
- V**  
vertical  
  moving waveform,13  
  scaling,12  
  waveform movement,13  
vibration effects,26
- W**  
waveform  
  comparing,17  
  moving horizontally,17  
  moving vertically,13  
weight,26

© Copyright Hewlett-Packard Company 1993  
All Rights Reserved.

Reproduction, adaptation, or translation without prior written permission is prohibited, except as allowed under the copyright laws.

#### Document Warranty

The information contained in this document is subject to change without notice.

**Hewlett-Packard makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability or fitness for a particular purpose.**

Hewlett-Packard shall not be liable for errors contained herein or for damages in connection with the furnishing, performance, or use of this material.

#### Safety

This apparatus has been designed and tested in accordance with IEC Publication 348, Safety Requirements for Measuring Apparatus, and has been supplied in a safe condition. This is a Safety Class I instrument (provided with terminal for protective earthing). Before applying power, verify that the correct safety precautions are taken (see the following warnings). In addition, note the external markings on the instrument that are described under "Safety Symbols."

#### Warning

- Before turning on the instrument, you must connect the protective earth terminal of the instrument to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. You must not negate the protective action by using an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.
- Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuseholders. To do so could cause a shock or fire hazard.

- Service instructions are for trained service personnel. To avoid dangerous electric shock, do not perform any service unless qualified to do so. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

- If you energize this instrument by an auto transformer (for voltage reduction), make sure the common terminal is connected to the earth terminal of the power source.

- Whenever it is likely that the ground protection is impaired, you must make the instrument inoperative and secure it against any unintended operation.

- Do not operate the instrument in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

- Do not install substitute parts or perform any unauthorized modification to the instrument.

- Capacitors inside the instrument may retain a charge even if the instrument is disconnected from its source of supply.

- Use caution when exposing or handling the CRT. Handling or replacing the CRT shall be done only by qualified maintenance personnel.

#### Safety Symbols



Instruction manual symbol: the product is marked with this symbol when it is necessary for you to refer to the instruction manual in order to protect against damage to the product.



Hazardous voltage symbol.



Earth terminal symbol: Used to indicate a circuit common connected to grounded chassis.

#### WARNING

The Warning sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a Warning sign until the indicated conditions are fully understood and met.

#### CAUTION

The Caution sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a Caution symbol until the indicated conditions are fully understood or met.

**Product Warranty**

This Hewlett-Packard product has a warranty 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 that prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by Hewlett-Packard.

For products returned to Hewlett-Packard for warranty service, the Buyer shall prepay shipping charges to Hewlett-Packard and Hewlett-Packard shall pay shipping charges to return the product to the Buyer. However, the 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 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 the 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.

**No other warranty is expressed or implied. Hewlett-Packard specifically disclaims the implied warranties of merchantability or fitness for a particular purpose.**

**Exclusive Remedies**

The remedies provided herein are the buyer's sole and exclusive remedies.

Hewlett-Packard shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

**Assistance**

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

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

**Certification**

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

**About this edition**

This is the first edition of the *HP 54721A Amplifier Plug-in User's Reference*.

Publication number  
54721-97001

Printed in USA.

Edition dates are as follows:

First edition, December 1993

New editions are complete revisions of the manual. Update packages, which are issued between editions, contain additional and replacement pages to be merged into the manual by you. The dates on the title page change only when a new edition is published.

A software or firmware code may be printed before the date. This code indicates the version level of the software or firmware of this product at the time the manual or update was issued. Many product updates do not require manual changes; and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual updates.

The following list of pages gives the date of the current edition and of any changed pages to that edition.

All pages original edition