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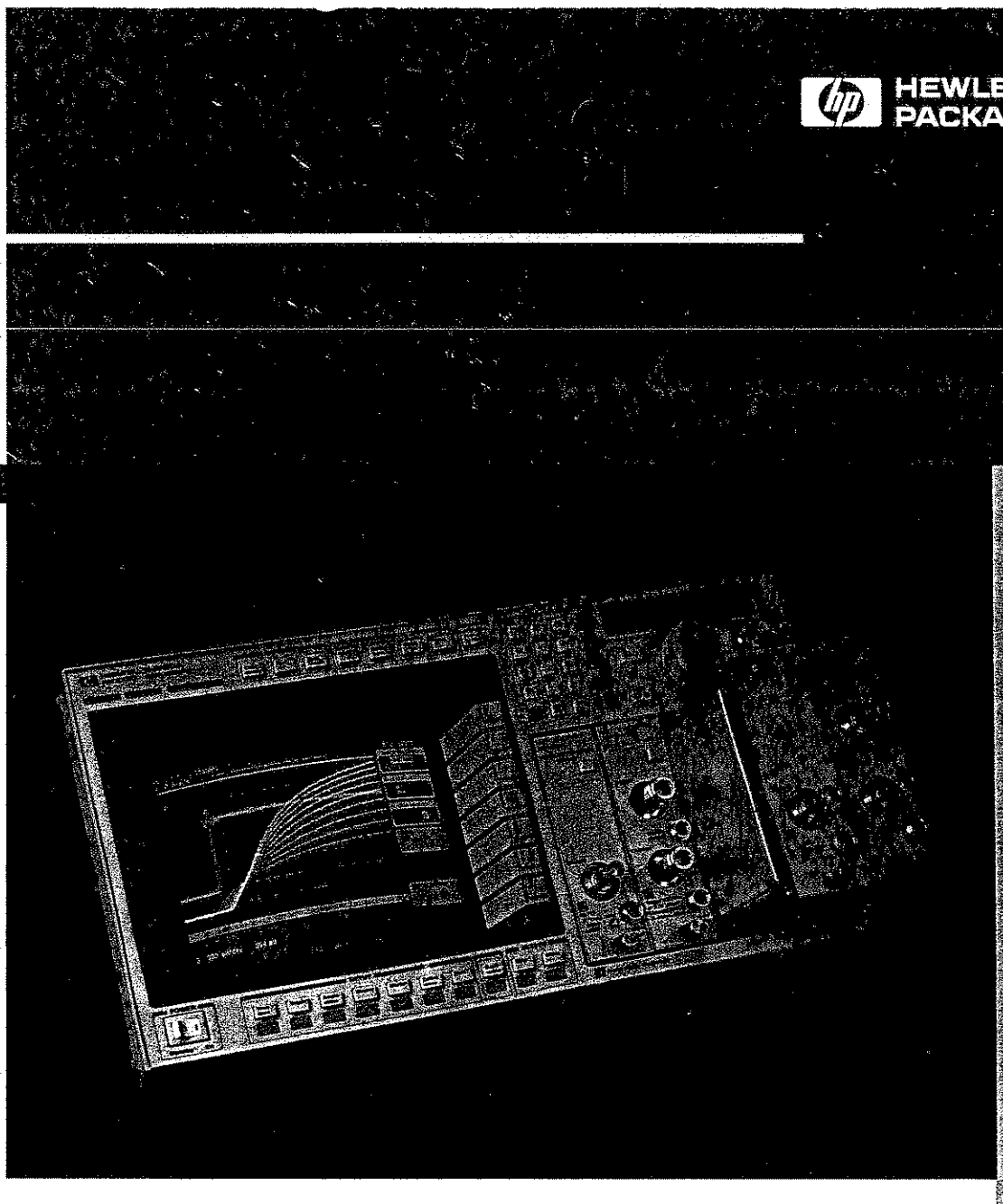

User's Referen

HP 54713A
Amplifier Plug-In

User's Reference

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

HP 54713A
Amplifier Plug-In

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

The HP 54713A Amplifier is one of several plug-ins for the HP 54720 or HP 54710 mainframes. Use this plug-in for general-purpose troubleshooting and characterization. Typically, this plug-in is used on signals that occur either once or infrequently. Its main features are:

- 500-MHz bandwidth
- 500-MHz internal trigger
- BNC (f) channel connector
- One probe-power connector an active probe
- 7-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.

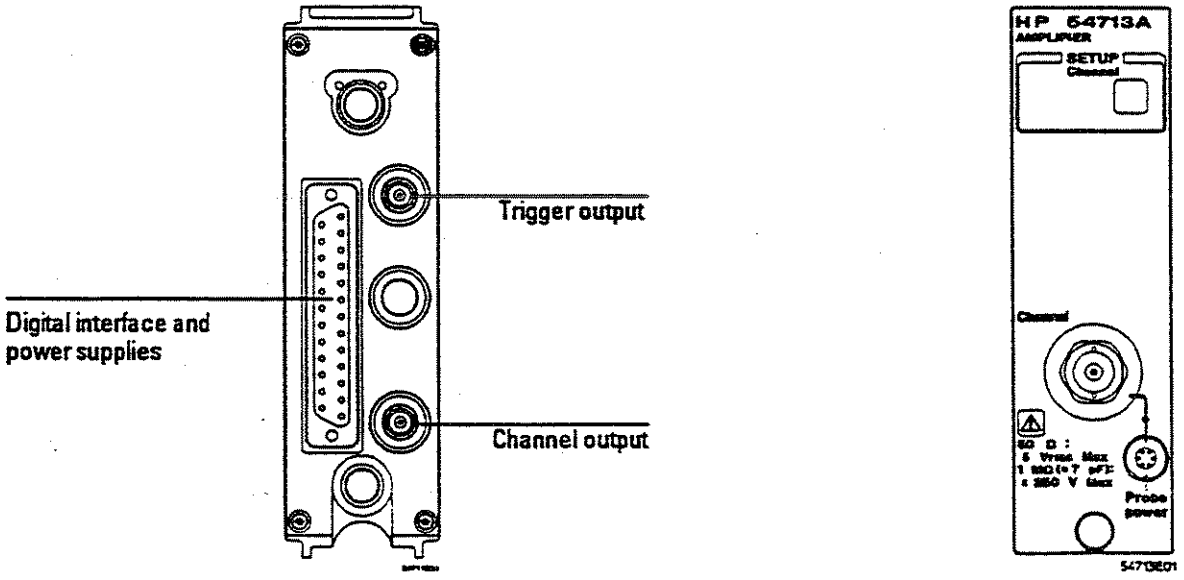
Getting the best performance from the plug-in

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 15.

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.

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.



In this book

This book is a User's Reference book for the HP 54713A 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 as a user in case the plug-in does not appear to be operating properly.

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

Contents

1

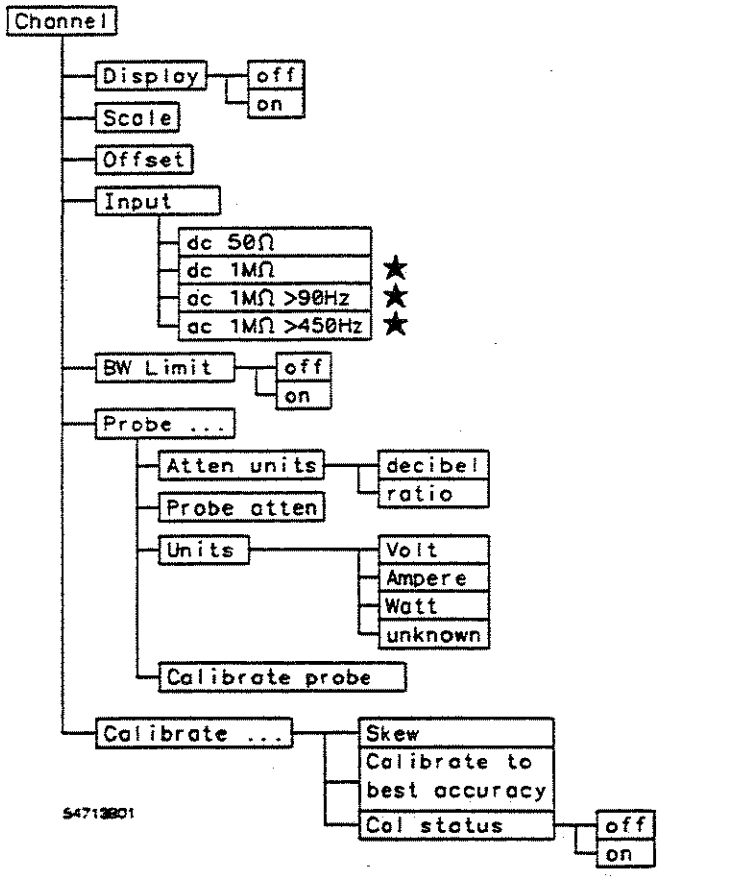
Channel Setup Menu

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



★ (These modes not available with the HP 54701A active probe.)

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.

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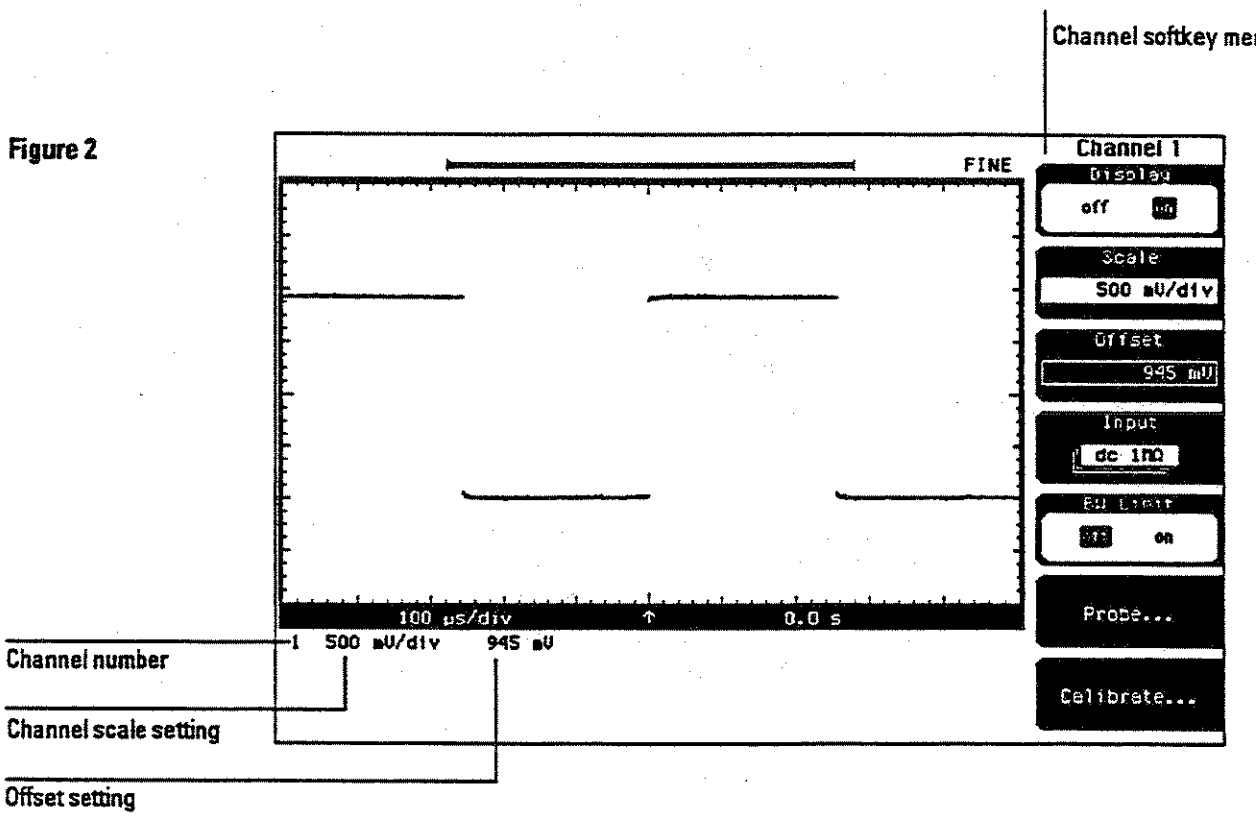


Figure 2

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 up to 1 V/div, and in 10 mV increments above 1 mV/div. 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 below 7 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. The range of offset is listed in chapter 2, "Specifications and Characteristics." 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 of the active probe.

Input

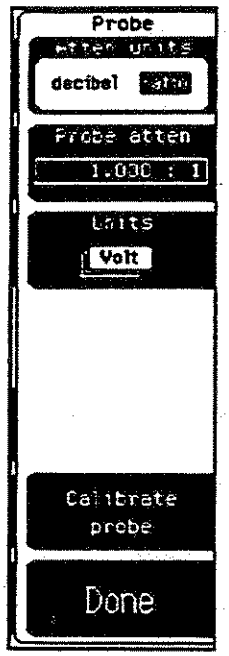
You can use the Input softkey to change the input coupling of the plug-in. Use dc 50 Ω for connecting to devices use a standard 50 Ω transmission line, and use dc 1 MΩ for connecting to high impedance probes. The ac 1 MΩ mode removes the dc component from signals, which allows you to use more sensitive scale settings to view an ac signal that is riding on a dc voltage.

On this plug-in, the dc input impedance in the ac 1 MΩ mode is always 1 MΩ.

BW Limit

Bandwidth limit reduces the vertical bandwidth of the oscilloscope to 30 MHz. Use bandwidth limit to view noisy signals.

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

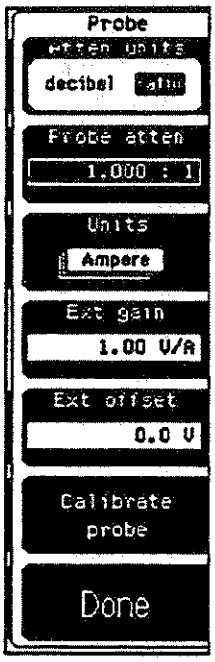
Probe attenuation lets you select a probe attenuation that matches the probe or device connected to the oscilloscope. When the probe attenuation is set correctly, the oscilloscope maintains the current scale factors if possible. All marker values and voltage measurement will reflect the actual voltage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



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 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 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 **Atten units** to **ratio**.

2 Set **Units** to **Voltage**.

3 Connect the probe to the front-panel CAL signal

4 Press **Calibrate Probe**.

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

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

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

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 Skew range is about ±100 μs.

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 last mainframe calibration is within ±5 °C of the temperature at which it was calibrated, the temperature of the last best accuracy calibration is within ±5 °C of the temperature at which it was calibrated, and the best accuracy calibration was performed within the last 24 hours.

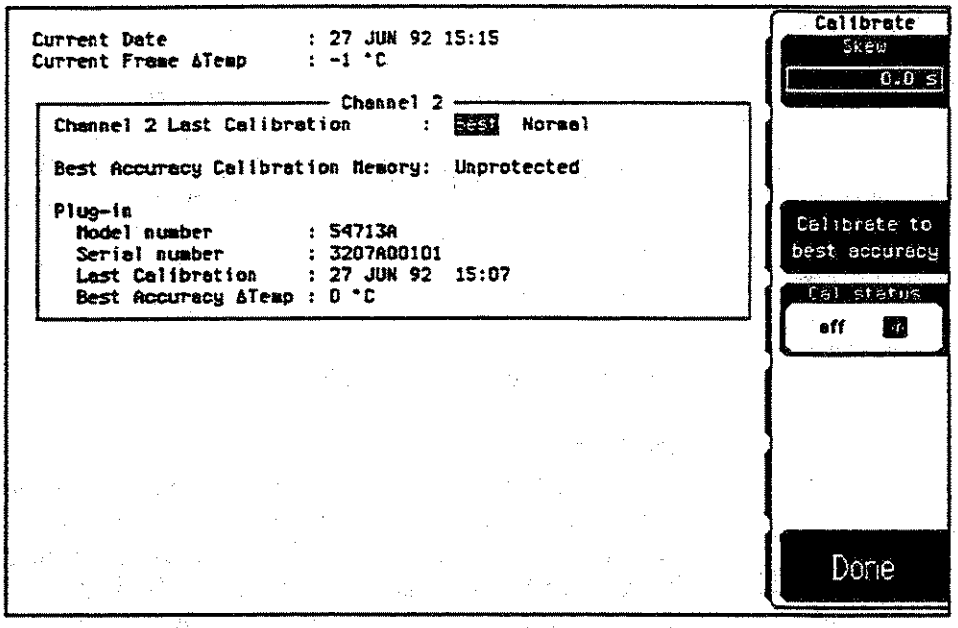
The calibration factors for a best accuracy calibration are stored in the mainframe's memory. The calibration factors are retained until another best accuracy calibration is performed in this slot.

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.

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.

Current Frame ΔTemp This is the temperature change, of the inside of the instrument, from when 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 temperatureΔ is within ±5 °C. If the temperatureΔ is more than ±5 °C, 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 ±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 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.

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 temperatureΔ from the mainframe's temperature when the last best accuracy calibration was performed. If this temperatureΔ is more than ± 5 °C, then you must perform a 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 54713A 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 54713A 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 >500 MHz

Bandwidth (−3 dB) with HP 54701A Active probe dc to >500 MHz

dc Voltage Measurement Accuracy (Best Accuracy calibration only)[1]

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

Input Resistance 50 Ω ±1%, 1 MΩ (at ≈7 pF) ±1%

Trigger (internal)

Trigger Sensitivity[2]

High Sensitivity 0.1 div at 100 MHz; 0.3 div at 500 MHz
Normal Sensitivity 0.5 div at 100 MHz; 1 div at 500 MHz
Noise Reject 1 div at 100 MHz; 3.0 div at 500 MHz

Minimum Pulse Width at Normal Sensitivity[2] ≤700 ps at ≥1 div

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 54713A plug-in. See the *HP 54701A Active Probe Service Guide* for complete probe characteristics.

Channel

Number of Channels 1

Number of Mainframe Slots 1

Max Sample Rate to Analog Bandwidth 4:1

Hardware Bandwidth Limit (channel and trigger paths) 30 MHz

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

Rise Time 700 ps

Channel Scale (8 divisions full screen) [3] 1 mV/div to 5 V/div

Channel Scale with HP 54701A Active Probe [4] 10 mV/div to 10 V/div

Full Resolution Channel Scales All channel scale ≥7 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.

dc Gain Accuracy [2]

Normal Accuracy ±3% of full screen
Best Accuracy Cal [5] ±1% of full screen
With HP 54701A Active Probe [5] ±2% of full screen

Offset Accuracy [2]

Normal Accuracy ±(3% of offset setting + 3% of fullscreen)
Best Accuracy Cal ±(0.5% of offset setting + 2% of fullscreen)
With HP 54701A Active Probe[5] ±(0.5% of offset setting +3% of full screen)

dc Offset Range

1mV/div to 49 mV/div ±2 V
50 mV/div to 249 mV/div ±10V
250 mV/div to 1.24 V/div ±50V
1.25 V/div to 5.00 V/div ±250 V

RMS Noise (Max Sensitivity) 300 μV

Input Connector BNC (f)

Input Coupling (cutoff Frequency) dc, ac (90 or 450 Hz)

Maximum Safe Input Voltage

dc 5 Vrms (+27 dBm)
ac ±250 Vdc
1 MΩ ±250 V[dc + peak ac (<10 kHz)]

Probe Power Yes

Time Base

Maximum Sampling Rate

Real Time 2 GSa/s
Equivalent Time[7] 500 MSa/s

Record Length Per Plug-in[8] 16 to 16,384 points

Max Record Duration at Max Sample Rate 8.192 μs

Trigger (internal)

RMS Jitter <6 ps ±0.005% of delay setting

Trigger Level Range ±1.5 full resolution screen diameters from center screen

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

3) Adjustable in 1 mV/div steps up to 1 V/div and 10 mV/div steps above 1 V/div

4) 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 Ω.

5) When using the HP 54713A plug-in at channel scales ≥1.25 V/div, the Best Accuracy Cal dc gain specification changes to 3%.

6) These characteristics are valid after a Best Accuracy Cal and Probe Cal.

7) 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.

8) All data points that fall within the waveform display area's time window are plotted to the screen.

General Characteristics

Environmental Conditions

These general characteristics apply to the HP 54713A oscilloscope 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)
Non-operating −40°C to +70°C (−40°F to +158°F)

Humidity

Operating up to 95% relative humidity (non-condensing) at +40°C (+104°F)
Non-operating up to 90% relative humidity at +65°C (+149°F)

Altitude

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

Vibration

Operating Random vibration 5-500 Hz, 10 minutes per axis, 0.3 g_{rms}
Non-operating Random vibration 5-500 Hz, 10 minute per axis, 2.41 g_{rms}; 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 0.8 kg (1.7 lb)

Shipping approximately 1.7 kg (3.7 lb)

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.

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 [Trigger].
  2 Set **Sweep** to **auto**.
- ☐ Make sure that the channel display softkey is set to On.

  1 Press [Channel] on the plug-in.
  2 Set 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 [Utility...]
  2 Press **System config...**

  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.

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.**

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.

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 [ ] (blue shift key on the keypad), then press [Setup print] (printed in blue above the Print key).

3 Press **Print format**. Use the knob, arrow keys, or softkeys to select the correct printer, then press **Enter**.

4 Press **Destination** to 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 [Utility].

6 Press **Firmware support...**

7 Press **Firmware update request**.

Glossary

The definitions in this glossary reflect how the terms apply to the HP 54713A plug-in.

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

BW Limit (bandwidth limit) Places a 30-MHz, low-pass filter in the trigger path.

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.

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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.

Complete product warranty information is given at the end of this manual.

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 of 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 a CRT. Handling or replacing a CRT shall be done only by qualified maintenance personnel.

Safety Symbols

Instruction manual symb
the product is marked w
this symbol when it is
necessary for you to refe
the instruction manual ir
order to protect against
damage to the product.

Hazardous voltage symb

Earth terminal symbol: U
to indicate a circuit com
connected to grounded
chassis.

WARNING

The Warning sign denote
hazard. It calls attention
procedure, practice, or t
like, which, if not correct
performed or adhered to
could result in personal
injury. Do not proceed
beyond a Warning sign u
the indicated conditions
fully understood and me

CAUTION

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

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Colorado Springs, CO 80901

Product Warranty

This Hewlett-Packard product has a warranty against defects in material and workmanship for a period of three years 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.

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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.

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About this edition

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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.

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