3

Service

Service

If the oscilloscope is under warranty, you must return it to Hewlett-Packard for all service work. See "To return the oscilloscope to Hewlett-Packard," on page 64. If the warranty period has expired, you can still return the oscilloscope to Hewlett-Packard for all service work. Contact your nearest Hewlett-Packard Sales Office for additional details on service work.

If you decide to service the oscilloscope yourself, the instructions in this chapter can help you keep the oscilloscope operating at optimum performance.

This chapter is divided into the following four sections:

Service should be performed by trained service personnel only. Some knowledge of the operating controls is helpful, and you may find it helpful to read chapter 1, "The Oscilloscope at a Glance," starting on page 7.

Recommended list of test equipment to service the oscilloscope

Table 2

Equipment	Critical specifications	Recommended Model/Part	Use
Constant amplitude signal generator	100 MHz, Constant amplitude ± 1%	Tek SG503 Tek TM501	P
Digital multimeter	Better than 0.1% accuracy	HP 3458A	P, A, T
Oscilloscope	100 MHz	HP 54501A	T
Power supply	14 mV to 35 Vdc, 0.1 mV resolution	HP 6114A	P
Probe	10:1 division ratio	HP 10432A	T
Pulse generator	Rise time < 875 ps	PSPL 1107B TD and PSPL 1110B Driver	A
Pulse generator	10 kHz, 500 mV p-p, rise time <5 ns	HP 8112A	A
Time marker generator	Stability 5 ppm after 1/2 hour	TG 501A and TM 503A	P
Feedthrough	50 Ω, BNC (m) and (f)	HP 10100C	P, A
Power splitter	Outputs differ <0.15 dB	HP 11667B	P
Shorting cap	BNC	HP 1250-0774	P
Adapter	SMA (f) to BNC (m)	HP 1250-1787	A
Adapter	BNC (f-f)	HP 1250-0080	A
Adapter	BNC tee (m) (f) (f)	HP 1250-0781	A
Adapter	N (m) to BNC (f), Qty 3	HP 1250-0780	P
Adapter	BNC (f) to dual banana (m)	HP 1251-2277	P
Cable	BNC, Qty 3	HP 10503A	P, A
Cable	BNC, 9 inches, Qty 2	HP 10502A	A

Additional equipment needed if you perform the alternate bandwidth test when verifying oscilloscope performance.

Signal generator	1 to 100 MHz at 200 mV	HP 8656B opt 001	P
Power meter and Power Sensor	1 to 100 MHz ± 3% accuracy	HP 436A and HP 8482A	P
Cable	Type N (m) 24 inch	HP 11500B	P
Adapter	Type N (m) to BNC (m)	HP 1251-0082	P

To return the oscilloscope to Hewlett-Packard

Before shipping the oscilloscope to Hewlett-Packard, contact your nearest Hewlett-Packard Sales Office for additional details.

1 Write the following information on a tag and attach it to the oscilloscope.

- Name and address of owner
- Model number
- Serial number
- Description of service required or failure indications

2 Remove all accessories from the oscilloscope.

The accessories include the power cord, probes, cables, and any modules attached to the rear of the oscilloscope. Do not ship accessories back to Hewlett-Packard unless they are associated with the failure symptoms.

3 Protect the control panel with cardboard.

4 Pack the oscilloscope in styrofoam or other shock-absorbing material and place it in a strong shipping container.

You can use either the original shipping containers, or order materials from an HP Sales Office. Otherwise, pack the oscilloscope in 3 to 4 inches of shock-absorbing material to prevent movement inside the shipping container.

5 Seal the shipping container securely.

6 Mark the shipping container as FRAGILE.

Verifying Oscilloscope Performance

This section shows you how to verify the electrical performance of the oscilloscope, using the performance characteristics in chapter 4 as the standard. The characteristics checked are dc calibrator, voltage measurement accuracy, bandwidth, horizontal accuracy, and trigger sensitivity.

You should verify the performance of the oscilloscope when you first receive it, and every 12 months or after 2,000 hours of operation. Also, make sure you allow the oscilloscope to warm up for at least 30 minutes before you begin the following procedures.

Each procedure lists the recommended equipment for the test. You can use any equipment that meets the critical specifications. However, the procedures are based on the recommended model or part number.

On page 82 is a test record for recording the test results of each procedure. Use the test results to gauge the performance of the oscilloscope over time.

To check the output of the DC CALIBRATOR

In this test you measure the output of the DC CALIBRATOR with a multimeter. The DC CALIBRATOR is used for self-calibration of the oscilloscope. The accuracy is not specified, but it must be within the test limits to provide for accurate self-calibration.

Test limits: 5.000 V ±10 mV and 0.000 V ± 500 μV.

Table 1

Equipment	Critical specifications	Recommended Model/Part
Digital Multimeter	0.1 mV resolution, 8 ppm/year, better than 0.0009% of reading ±4 counts, 6 1/2 digit display resolution	HP 3458A
Cable	BNC	HP 10503A

1 Connect a multimeter to the rear panel DC CALIBRATOR connector.

2 Press [Print/Utility].

3 Press the **Self Test** softkey, then press the **DAC** softkey.

The multimeter should measure 0.00 V dc ± 500 μV. If the result is not within the test limits, see "Troubleshooting the oscilloscope," on page 94.

4 Press any key to continue the test.

The multimeter should read 5.000 V ±10 mV. If the result is not within the test limits, see "Troubleshooting the oscilloscope," on page 94.

To verify voltage measurement accuracy

In this test you verify the voltage measurement accuracy by measuring the output of a power supply using dual cursors on the oscilloscope, and comparing the results with a multimeter.

Specification: ±1.5% of reading ±0.4% of full scale.

Table 2

Equipment	Critical specifications	Recommended Model/Part
Power supply	14 mV to 35 Vdc, 0.1 mV resolution	HP 6114A
Digital multimeter	Better than 0.1% accuracy	HP 3458A
Cable	BNC, Qty 2	HP 10503A
Shorting cap	BNC	HP 1250-0774
Adapter	BNC (f) to banana (m)	HP 1251-2277
Adapter	BNC tee (m) (f) (f)	HP 1250-0781

1 Setup the oscilloscope.

   a Press [Setup], then press the **Default Setup** softkey.

   b Press [Voltage], then press the **V avg** softkey.

   c Set the Volts/Div to the first line of table 3.

   d Adjust the channel 1 Position knob to place the baseline near (but not at) the bottom of the display.

2 Press [Cursors], then press the **V1** softkey.

3 Using the cursors knob, set the V1 cursor on the baseline.

   If you are in an electrically noisy environment, it can help to place a shorting cap on the input BNC connector when positioning V1.

4 Connect the power supply to the oscilloscope and to the multimeter, using the BNC tee and cables.

5 Set the power supply output to the first line in table 3.

6 Press the **v2** softkey, then position the V2 cursor to the baseline.

The ΔV value at the bottom of the display should be within the test limits of table 3. If a result is not within the test limits, see "Troubleshooting the oscilloscope," on page 94.

7 Continue checking the voltage measurement accuracy with the remaining lines in table 3.

Table 3

Volts/Div setting	Power supply setting	Test limits		
5 V/Div	35 V	34.315 V	to	35.685 V
2 V/Div	14 V	13.726 V	to	14.274 V
1 V/Div	7 V	6.863 V	to	7.137 V
0.5 V/Div	3.5 V	3.4315 V	to	3.5685 V
0.2 V/Div	1.4 V	1.3726 V	to	1.4274 V
0.1 V/Div	700 mV	686.3 mV	to	713.7 mV
50 mV/Div	350 mV	343.15 mV	to	356.85 mV
20 mV/Div	140 mV	137.26 mV	to	142.74 mV
10 mV/Div	70 mV	68.63 mV	to	71.37 mV
5 mV/Div*	35 mV	34.155 mV	to	35.845 mV
2 mV/Div*	14 mV	13.47 mV	to	14.53 mV

8 Disconnect the power supply from the oscilloscope, then repeat steps 1 to 7 for channel 2 (channels 2 to 4 on the HP 54601A). On the HP 54601A, channels 3 and 4, check the 0.5 V/div and 0.1 V/div range only.

*Full scale is defined as 80 mV on the 5 mV/div and 2 mV/div ranges.

To verify bandwidth

In this test you verify the bandwidth of the oscilloscope by using a constant amplitude signal generator. The frequency of the signal generator is set to 250 kHz to establish a reference level. Then, the frequency is changed to 100 MHz and the level is checked to see if it is 3 dB from the reference level.

The following procedure is a simple method to check bandwidth. However, there is a possibility of measurement uncertainty with a constant amplitude signal generator. If you need a more exact procedure for checking bandwidth see, "To verify the bandwidth (alternate method)" on page 72.

Specification: (−3 dB) dc to 100 MHz, ac coupled 10 Hz to 100 MHz.

Table 4

Equipment	Critical specifications	Recommended Model/Part
Constant amplitude signal generator	100 MHz, Constant amplitude ± 1%	Tek SG503
Cable	BNC	Tek TM501
Feedthrough	50 Ω, BNC (m) and (f)	HP 10503A HP 10100C

1 Using the 50 Ω feedthrough and the BNC cable, connect the signal generator to channel 1 of the oscilloscope.

2 Set the frequency of the signal generator to 250 kHz and the amplitude to about 800 mV.

3 Press [Autoscale].

4 Adjust the output of the signal generator for exactly 8 divisions of vertical deflection.

5 Change the frequency of the signal generator to 100 MHz.

6 Change the sweep speed of the oscilloscope to 5 ns/div and observe the display.

The vertical amplitude of the signal on the display should be equal to or greater than 5.66 divisions (−3 dB point). If the result is not ≤−3 dB, see "Troubleshooting the oscilloscope," on page 94.

7 Repeat steps 1 through 6 for channel 2 (channels 2 to 4 on the HP 54601A).

To verify bandwidth (alternate method)

In this test you verify the bandwidth of the oscilloscope by using a power meter and power sensor to set the output of a signal generator at 1 MHz and 100 MHz. You use the peak-to-peak voltage at 1 MHz and 100 MHz to calculate the bandwidth response of the oscilloscope.

Specification: (−3 dB) dc to 100 MHz, ac coupled 10 Hz to 100 MHz.

Table 5

Equipment	Critical specifications	Recommended Model/Part
Signal generator	1 to 100 MHz at 200 mV	HP 8656B opt 001
Power meter and Power Sensor	1 to 100 MHz ± 3% accuracy	HP 436A and HP 8482A
Power splitter	Outputs differ by <0.15 dB	HP 11667B
Cable	Type N (m), 24 inch	HP 11500B
Adapter	Type N (m) to BNC (m)	HP 1251-0082
Feedthrough	50 Ω, BNC (m) and (f)	HP 10100C

1 Connect the equipment.

a Connect the signal generator to the input of the power splitter.

b Connect the power sensor to one output of the power splitter, and connect channel 1 of the oscilloscope to the other power splitter output (put the 50 Ω feedthrough at the input of the oscilloscope).

2 Setup the oscilloscope.

a Press [Setup], then press the **Default Setup** softkey.

b Set the time base to 500 ns/div.

c Set channel 1 to 100 mV/div.

d Press [Display], then press the **Average** softkey.

e Toggle the **# Average** softkey to select **8** averages.

3 Set the signal generator for 1 MHz at about 5.6 dBm.

Notice that the signal on the display is about 5 cycles and six divisions of amplitude.

4 Press [Voltage], then press the **Vp-p** softkey.

Wait a few seconds for the measurement to settle (averaging is complete), then note the Vp-p reading from the bottom of the display.
Vp-p = _____ mV.

5 Set the calibration factor percent of the power meter to the 1 MHz value from the calibration chart on the probe, then press dB (REF) on the power meter to set a 0 dB reference.

6 Change the signal generator to 100 MHz, then set the calibration factor of the power meter to 100 MHz percent value from the chart on the probe.

Adjust the amplitude of the signal generator for a power reading as close as possible to 0.0 dB (REL). Power meter reading = _____ dB.

7 Change the time base to 2 ns/div.

Wait a few seconds for the measurement to settle (averaging is complete), then note the Vp-p reading from the bottom of the display.
Vp-p = _____ mV.

8 Calculate the response using the following formula.

$$20 \log_{10} \left(\frac{\textit{step 7 result}}{\textit{step 4 result}} \right) .$$

Correct the result from step 8 with any difference in the power meter reading from step 6. Make sure you observe all number signs.

For example:
Result from step 8 = −2.3 dB
Power meter reading from step 6 = −0.2 dB (REL)
True response = (−2.3) − (−0.2) = −2.1 dB
The true response should be ≤−3 dB.

If the result is not ≤−3 dB, see "Troubleshooting the oscilloscope," on page 94.

9 Repeat steps 1 to 8 for channel 2 (channels 2-4 on the HP 54601A).

When you measure the bandwidth on channels 3 and 4, use the 0.1 V/Div range.

To verify horizontal Δt and 1/Δt accuracy

In this test you verify the horizontal Δt and 1/Δt accuracy by measuring the output of a time mark generator with the oscilloscope.

Specification: ±0.01% ±0.2% of full scale ±200 ps.

Table 6

Equipment	Critical specifications	Recommended Model/Part
Time marker generator	Stability 5 ppm after 1/2 hour	TG 501A and TM 503A
Cable	BNC	HP 10503A
Termination	50 Ω, BNC connectors (m) (f)	HP 10100C

1 Connect the time mark generator to channel 1 using the feedthrough at the oscilloscope input. Then, set the time mark generator for 0.1 ms markers.

2 Setup the oscilloscope.

a Press [Setup], then press the **Default Setup** softkey.

b Press [Autoscale].

c Press [Display], then press the **Average** softkey.

d Toggle the **# Average** softkey to select **64** averages.

e Set the time base to 50 µs/div.

f Adjust the trigger level to obtain a stable display.

3 Press [Time], then press the **Freq** and **Period** softkeys.

You should measure the following:
Frequency 10 kHz, test limits are 9.899 kHz to 10.10 kHz.
Period 100 μs, test limits are 98.98 μs to 101.01 μs.

If the measurements are not within the test limits, see "Troubleshooting the oscilloscope," on page 94.

4 Change the time mark generator to 1 μs, and change the time base to 500 ns/div. Adjust the trigger level to obtain a stable display.

5 Press [Time], then press the **Freq** and **Period** softkeys.

You should measure the following:
Frequency 1 MHz, test limits are 989.8 kHz to 1.0104 MHz.
Period 1 μs, test limits are 989.7 ns to 1.010 μs.

If the measurements are not within the test limits, see "Troubleshooting the oscilloscope," on page 94.

6 Change the time mark generator to 10 ns, and change the time base to 5 ns/div. Adjust the trigger level to obtain a stable display.

7 Press [Time], then press the **Freq** and **Period** softkeys.

You should measure the following:
Frequency 100 MHz, test limits are 97.078 MHz to 103.1 MHz.
Period 10 ns, test limits are 9.699 ns to 10.30 ns.

If the measurements are not within the test limits, see "Troubleshooting the oscilloscope," on page 94.

To verify trigger sensitivity

In this test you verify the trigger sensitivity by applying 25 MHz to the oscilloscope. The amplitude of the signal is decreased to the specified levels, then you check to see if the oscilloscope is still triggered. You then repeat the process at 100 MHz.

Specification:
Internal
dc to 25 MHz, 0.35 div or 3.5 mV p-p
dc to 100 MHz 1 div or 10 mV p-p.
External trigger (HP 54600A only)
dc to 25 MHz, 50 mV p-p
dc to 100 MHz, 100 mV p-p.

Table 7

Equipment	Critical specifications	Recommended Model/Part
Signal generator	25 MHz and 100 MHz sine waves	Tek SG 503 Tek TM 501 HP 11667B
Power splitter (HP 54600A only)	Outputs differ <0.15 dB	HP 10503A
Cable	BNC, Qty 3	HP 1250-0780
Adapter	N (m) to BNC (f), Qty 3	HP 10100C
Feedthrough	50 Ω, BNC (m) and (f)	

1 Press [Setup], then press the **Default Setup** softkey.

2 Connect the signal generator to channel 1.

3 Verify the trigger sensitivity at 25 MHz and 0.35 divisions.

a Set the signal generator to 25 MHz and about 50 mV.

b Press [Autoscale].

c Decrease the output of the signal generator until there is 0.35 vertical divisions of the signal displayed.

The trigger should be stable. If the triggering is not stable, try adjusting the trigger level. If adjusting the trigger level makes the triggering stable, the test still passes. If adjusting the trigger does not help, see "Troubleshooting the oscilloscope," on page 94.

4 Verify the trigger sensitivity at 100 MHz and 1 division.

a Change the output of the signal generator to 100 MHz and about 100 mV.

b Press [Autoscale].

c Decrease the output of the signal generator until there is 1 vertical division of the signal displayed.

The trigger should be stable. If the triggering is not stable, try adjusting the trigger level. If adjusting the trigger level makes the triggering stable, the test still passes. If adjusting the trigger does not help, see "Troubleshooting the oscilloscope," on page 94.

5 Repeat steps 1 through 4 for channel 2 on the HP 54600A (channels 2 through 4 on the HP 54601A).

6 Verify the external trigger sensitivity at 100 MHz and 100 mV p-p (HP 54600A only).

a Press [Source], then press the **Ext** softkey.

b Use the power splitter to connect the signal generator to the channel 1 input and to the external trigger input.

c Change the output of the signal generator to 100 MHz and about 200 mV.

The power splitter divides the 200 mV so that 100 mV is applied to each of the oscilloscope inputs.

The oscilloscope triggering should be stable. If the triggering is not stable, try adjusting the trigger level. If adjusting the trigger level makes the triggering stable, the test still passes. If adjusting the trigger does not help, see "Troubleshooting the oscilloscope," on page 94.

7 Verify the external trigger sensitivity at 25 MHz and 50 mV p-p (HP 54600A only).

a Change the output of the signal generator to 25 MHz at about 100 mV.

b Press [Autoscale].

The oscilloscope triggering should be stable. If the triggering is not stable, try adjusting the trigger level. If adjusting the trigger level makes the triggering stable, the test still passes. If adjusting the trigger does not help, see "Troubleshooting the oscilloscope," on page 94.

HEWLETT PACKARD

HP 54600A and HP 54601A
Performance Test Record

Serial No. _____
Test Interval _____
Recommended Next Testing _____

Date _____
Test by _____
Work Order No. _____
Temperature _____

Output of dc calibrator	**Limits**	**Result**
	4.9990 V to 5.0010 V	_____

Voltage measurement accuracy

Range	**Reading**	**Test Limits**		**Channel 1**	**Channel 2**	**Channel 3**	**Channel 4**
5 V/Div	35 V	34.315 V to	35.685 V	_____	_____	_____	_____
2 V/Div	14 V	13.726 V to	14.274 V	_____	_____	_____	_____
1 V/Div	7 V	6.863 V to	7.137 V	_____	_____	_____	_____
500 mV/Div	3.5 V	3.4315 V to	3.5686 V	_____	_____	_____	_____
200 mV/Div	1.4 V	1.3726 V to	1.4274 V	_____	_____	_____	_____
100 mV/Div	700 mV	686.3 mV to	713.7 mV	_____	_____	_____	_____
50 mV/Div	350 mV	343.15 mV to	356.85 mV	_____	_____	_____	_____
20 mV/Div	140 mV	137.26 mV to	142.74 mV	_____	_____	_____	_____
10 mV/Div	70 mV	68.63 mV to	71.37 mV	_____	_____	_____	_____
5 mV/Div	35 mV	34.155 mV to	35.845 mV	_____	_____	_____	_____
2 mV/Div	14 mV	13.47 mV to	14.53 mV	_____	_____	_____	_____

Bandwidth	**Test Limits**	**Channel 1**	**Channel 2**	**Channel 3**	**Channel 4**
	≤ −3 dB	_____	_____	_____	_____

Horizontal Δt and 1/Δt accuracy

	Reading	**Test Limits**	**Results**
Frequency	10 kHz	9.899 kHz to 10.10 kHz	_____
Period	100 μs	98.98 μs to 101.01 μs	_____
Frequency	1 MHz	989.8 kHz to 1.0104 MHz	_____
Period	1 μs	989.7 ns to 1.010 μs	_____
Frequency	100 MHz	97.078 MHz to 103.1 MHz	_____
Period	10 ns	9.699 ns to 10.30 ns	_____

Trigger sensitivity	**Test Limits**	**Channel 1**	**Channel 2**	**Channel 3**	**Channel 4**
Internal trigger	25 MHz at 0.35 divisions	_____	_____	_____	_____
Internal trigger	100 MHz at 1 division	_____	_____	_____	_____
		External			
External trigger	100 MHz at 100 mV p-p	_____			
	25 MHz at 50 mV p-p	_____			

Adjusting the Oscilloscope

This section explains how to adjust the oscilloscope so that it is at optimum operating performance. You should perform the hardware adjustments periodically as indicated below.

- Hardware at 12 months or 2,000 hours of operation
- Firmware at 6 months or 1000 hours of operation, or if ambient temperature is > 10 °C from the calibration temperature, or if the user desires to maximize the measurement accuracy

The amount of use, environmental conditions, and your past experience with other instruments can help you to determine if you need a shorter adjustment interval.

Make sure you allow the oscilloscope to warm up for at least 30 minutes before you start the adjustments.

To adjust the power supply

On the power supply there is only one adjustment and that is for the +5.1 V. The other voltages are based on the +5.1 V adjustment. In this procedure you use a multimeter to measure the +5.1 V, and if necessary, you adjust the supply to within tolerance.

Table 8

Equipment	Critical specifications	Recommended Model/Part
Digital multimeter	0.1 mV resolution, accuracy ± 0.05%	HP 3458A

1 Set up the oscilloscope for the voltage adjustment.

a Turn off the oscilloscope.

b Remove the cover from the oscilloscope.

c Place the oscilloscope on its side.

d Connect the negative lead of the digital multimeter to a ground point on the oscilloscope.

e Turn on the oscilloscope.

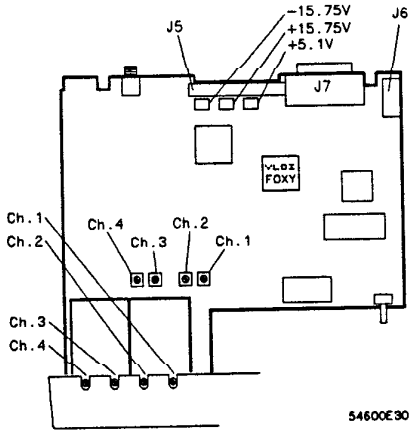
2 Measure the power supply voltages at L3, L4 and L5 on the system board.

Make sure that the voltage measurements are within the following tolerances.

+5.1 V	±150 mV (+4.95 V to +5.25 V)
+15.75 V	±787 mV (+14.96 V to +16.54 V)
– 15.75 V	±787 mV (–14.96 V to –16.54 V)

If the +5.1 V measurement is out of tolerance, adjust the +5.1 V adjustment on the power supply. The ±15.75 V supplies are not adjustable and are dependent upon the +5.1 V supply. If adjusting the power supply does not bring all the voltages within tolerance, see "Troubleshooting the oscilloscope," on page 94.

Figure 34



To calibrate the firmware

In this procedure you load the default calibration factors to give a known starting point for the firmware calibration. *However, once the default calibration factors are loaded, you must perform the remainder of the firmware calibration to maintain the accuracy of the oscilloscope.*

Table 9

Equipment	Critical specifications	Recommended Model/Part
Pulse generator	10 kHz, 500 mV p-p, rise time <5 ns	HP 8112A
Cable	BNC, 3 feet	HP 10503A
Cable	BNC, 9 inches, Qty 2	HP 10502A
Adapter	BNC tee (m) (f) (f)	HP 1250-0781
Adapter	BNC (f-f)	HP 1250-0080
Feedthrough	50 Ω, BNC (m) and (f)	HP 10100C

1 Check the rear panel DC CALIBRATOR output level.

If you are not sure how to check the DC CALIBRATOR, see "To check the output of the DC CALIBRATOR," on page 66.

2 Load the default calibration factors.

a Set the rear-panel CALIBRATION switch to UNPROTECTED (up position).

b Press [Print/Utility], then press the **Self Cal Menu** softkey.

c Press the **Load Defaults** softkey.

3 After the message "**Default calibration factors loaded**" is displayed on the lower left side of the display, press the **Vertical** softkey.

4 Follow the instructions on the display, then press the **Continue** softkey.

The display prompts instruct you to connect the rear panel DC CALIBRATOR output first to channel 3, then to channel 1, then to channel 4, and finally to channel 2. (Channels 1 and 2 only on the HP 54600A.)

5 After the message "**Press Continue to return to calibration menu**" appears on the display, press the **Continue** softkey.

6 Connect a pulse generator set to 10 kHz and 500 mV p-p and with a rise time less than 5 ns to channels 1 and 2. Place the feedthrough at the BNC tee. Make sure you use the HP 10502A cables to ensure equal cable lengths.

7 Press the **Delay** softkey, then follow the instructions on the display.

The display will instruct you to connect the signal simultaneously to channels 1 and 2, 1 and 3, 1 and 4, 2 and 4, 2 and 3, and finally to 3 and 4.

8 Set the rear-panel CALIBRATION switch to PROTECTED.

To adjust the low frequency compensation

In this procedure you adjust the low frequency compensation adjustment for each channel.

Table 12

Equipment	Critical specifications	Recommended Model/Part
Square wave generator	30 kHz at about 3 Vp-p	HP 8112A
Feedthrough	50 Ω, BNC (m) and (f)	HP10100C
Cable	BNC	HP 10503A

1 Using the BNC cable and 50 Ω feedthrough, connect the square wave generator to channel 1.

2 Adjust the generator for about 30 kHz at about 3 Vp-p.

3 Press [Autoscale].

4 Set channel 1 to 500 mV/div.

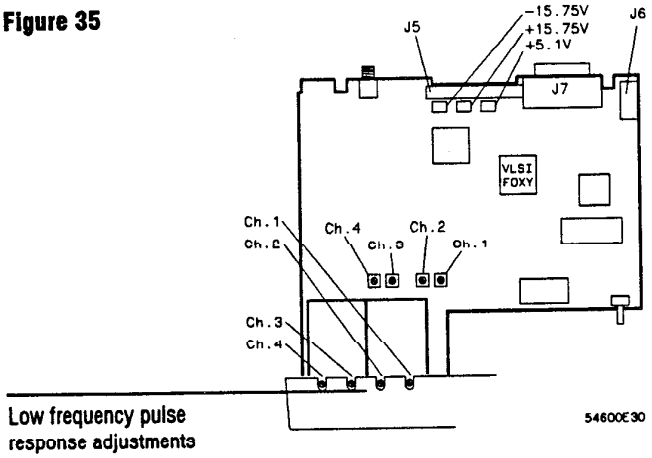
You must perform this adjustment on the 500 mV range.

5 Adjust the output of the generator until you obtain about 5 to 6 divisions of vertical deflection.

6 Adjust the channel 1 low frequency compensation adjustment for as flat a pulse top as possible.

7 Repeat steps 1 through 6 for channel 2 (channels 2 to 4 on the HP 54601A).

Figure 35



To adjust the high frequency pulse response

In this procedure you adjust the high frequency pulse response for each channel.

Table 11

Equipment	Critical specifications	Recommended Model/Part
Pulse generator	Rise time < 875 ps	PSPL 1107B TD and PSPL 1110B Driver
Adapter	SMA (f) to BNC (m)	HP 1250-1787
Feedthrough	50 Ω, BNC (m) and (f)	HP 10100C

1 Connect the pulse generator to channel 1.

2 Press [Autoscale].

3 Change the time base to 10 ns/div.

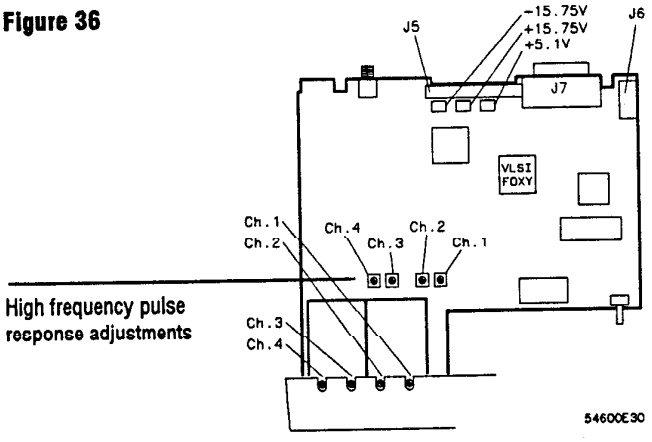
4 Press [1], then toggle the **Vernier** softkey to On.

5 Adjust the Volt/Div until there are about 6 divisions of vertical deflection.

6 Adjust the channel 1 high frequency response for 1.5 minor division of overshoot (6%).

7 Repeat steps 1 through 6 for channel 2 (channels 2 to 4 on the HP 54601A).

Figure 36



To adjust the display

The display adjustments are optional and normally do not require adjustment. You should use this procedure only for the few cases when the display is obviously out of adjustment.

Table 12

Equipment	Critical specifications	Recommended Model/Part
Digital multimeter	Accuracy ±0.05%, 1 mV resolution	HP 3458A

1 Connect the digital multimeter to the end of R901 closest to the fuse. See figure 37.

2 Adjust +B for +14.00 V.

3 Press Print/Utility. Press the **Self Test** Softkey, then press the **Display** softkey.

4 Adjust V.HO (vertical hold) for vertical synchronization.

5 Set the intensity control (on the front panel) to mid-range.

6 Adjust Sub Bri (sub bright) to the lowest setting so that the half bright blocks on the display are visible.

7 Increase the intensity control to a comfortable viewing level.

This is usually about 3/4 of its maximum range.

8 Adjust HB Cont (half bright contrast) for the best contrast between the half bright and full bright blocks.

You can readjust Sub Bri, intensity control, and HB Cont to suit your individual preference.

9 Press any key to continue to the next test pattern. Then, adjust H.Hold (horizontal hold) to center the display horizontally.

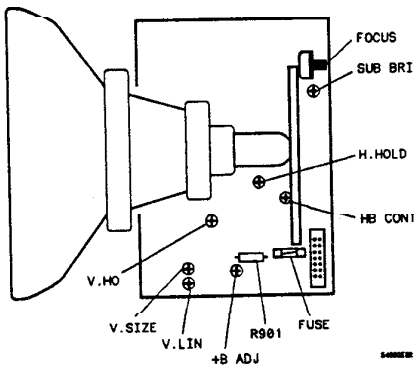
10 Adjust Focus for the best focus.

11 Press any key to continue to the normal display pattern. Then adjust V.Lin (vertical linearity) for equal sizing of all four corner squares.

12 Adjust V.Size (vertical size) to center the display vertically at the maximum allowable size without losing the text.

Adjustments V.Lin and V.Size interact so you may need to readjust sizing and vertical centering of the display.

Figure 37



Troubleshooting the Oscilloscope

The service policy for this instrument is replacement of defective assemblies. The following procedures can help isolate problems to the defective assembly.

Warning

The maintenance described in this section is performed with power supplied to the oscilloscope and with the protective covers removed. Only trained service personnel who are aware of the hazards involved should perform the maintenance. Whenever possible, perform the procedures with the power cord removed from the oscilloscope. Read the safety summary at the front of this book before proceeding.

Caution

Do not disconnect any cables or remove any assemblies with the power applied to the oscilloscope, or damage to the oscilloscope can occur.

The following equipment is needed for troubleshooting the oscilloscope.

Table 13

Equipment	Critical specifications	Recommended model/part
Digital multimeter	Accuracy ±0.05%, 1 mV resolution	HP 3458A
Oscilloscope	100 MHz	HP 54501A
Probe	10:1 division ratio	HP 10432A
Dummy load	Compatible with power supply	HP 54600-66504

To construct your own dummy load

1 Obtain a connector compatible with the connector on the LVPS.

2 Connect the following load resistors to the connector.

+5.1 V requires a 3 A load, 1.7 Ω and 15 W on pin 15, 17, or 19.
+15.75 V requires a 1.3 A load, 12.2 Ω and 20.5 W on pin 11 or 13.
With the fan operating, −15.75 V requires a 0.6 A load, 26.25 Ω and 9.5 W on pin 5 or 7.
Without the fan operating, −15.75 V requires a 0.8 A load, 26.25 Ω and 13 W on pin 5 or 7.

3 Connect the other end of the resistors to ground pins 2, 4, 6, and 8.

To check out the oscilloscope

1 Is there an interface module connected to the oscilloscope?

If yes, do the following steps. If not, go to step 2.

a Turn off the oscilloscope.

b Remove the module.

c Turn on the oscilloscope, then check for the failing symptom.

If the failing symptom disappears, replace the module. If not, go to step 2.

2 Disconnect any external cables from the front panel.

3 Disconnect the power cord, then remove the cover.

4 Connect the power cord, then turn on the oscilloscope.

If the display comes on after a few seconds, (HP logo and copyright text, followed by a graticule with text at top of the display) go to "To check the LVPS," on page 99. If after checking the LVPS, the voltages are within the test limits, go to step 8. If not, go to step 6. If the display did not come on, do the steps below.

a Check the intensity knob to see setting to see if its set too low.

b If there is still no display, disconnect the power cord.

c Check all cable connections.

d Go to "To check the LVPS," on page 99.

If the voltages are within the limits go to step 5. If not, go to step 6.

5 Disconnect the display cable, then check the following signals at U56 on the system board. Refer to figure 38.

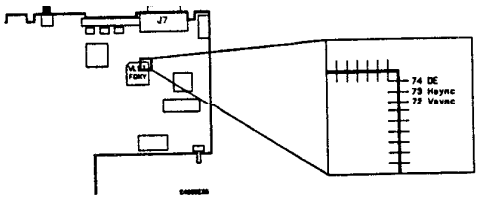
While probing, make sure that you do not short the pins of U56 together. To make the probing easier, use the Emulation Technology 84-pin quad clip (Emulation Technology part number 5402).

Table 14

Pin	Signal	Frequency	Pulse width	Voltage
74	DE	19.72 kHz	38.0 μs	2.6 Vp-p
73	Hsync	19.72 kHz	3.0 μs	5.0 Vp-p
72	Vsync	60.00 Hz	253.5 μs	5.2 Vp-p

If the signals are good, replace the display assembly. If not, replace the system board.

Figure 38



6 Disconnect the LVPS ribbon cable from the display board.

7 Measure the power supply voltages again (steps 1-3).

If the voltages are within the test limits, replace the display assembly. If not, do the steps below.

a Disconnect the power cord.

b Disconnect the ribbon cable from the power supply.

c Connect the dummy load to the power supply connector.

d Connect the power cord, then measure the power supply voltages again (see new tolerances below).

+5.1 V (4.95 V to +5.25 V)
+15.75 V (+15 V to +16.5 V)
−15.75 V (−15 V to −16.5 V)

If the voltages are now within the test limits, replace the system board. If not, replace the power supply.

8 Is the fan running?

If yes, go to "To run the internal self tests," on page 100. If not, do the steps below.

The LVPS has a thermal cut-out circuit. If the fan is defective, the LVPS shuts down when it gets too hot for safe operation.

a Disconnect the fan cable from the power supply.

b Measure the fan voltage at the connector on the power supply.

If the fan voltage is −8.3 Vdc, replace the fan. If not, replace the power supply.

To check the LVPS.

1 Disconnect the power cord, then set the oscilloscope on its side.

2 Connect the negative lead of the multimeter to a ground point on the oscilloscope. Connect the power cord and turn on the oscilloscope.

3 Measure the power supply voltages at L3, L4, and L5 on the system board. See figure 34 on page 85.

+5.1 V ±150 mV (+4.95 V to + 5.25 V)
+15.75 V ±787 mV (+14.96 V to +16.54 V)
−15.75 V ±787 mV (−14.96 V to −16.54 V)

If the +5.1 V measurement is out of the test limits, adjust the +5.1 V adjustment on the power supply. The ±15 V supplies are not adjustable and are dependent upon the +5.1 V supply.

To run the internal self tests

1 Perform the keyboard test.

a Press Print/Utility.

b Press the **Self Tst** softkey, then press the **Keyboard** softkey.

A pictorial diagram of the front panel will appear on the display.

c Press each key, and notice that when you press a key a corresponding block on the display fills in.

d Rotate the knobs (except the intensity) and notice that an arrow appears on the display that points in the direction you rotate the knob.

e Do all the keys and knobs work?

If yes, Press the **Stop** softkey two or three times (the display indicates how many times), then go to step 2. If not, replace the keyboard and keyboard assembly.

2 Check the output level of the DAC.

a Press the **DAC** softkey.

b Connect a multimeter to the rear panel DC CALIBRATOR connector.

The multimeter should read 0 V ±500 μV.

c Press any key to continue.

The multimeter should read 5 V ±10 mV.

d Are the DAC voltages correct?

If yes, press any key to continue. If not, replace the system board.

3 Perform the ROM test

a Press the **ROM** softkey.

b Does the display message say **Test Passed**?

If yes, press any key to continue. If not, (the display message says **Test Failed**) replace the system board.

4 Perform the RAM test.

a Press the **RAM** softkey.

b Does the display message say **Test Passed**?

If yes, press any key to continue. If not, (the display message says **Test Failed**) replace the system board.

5 Perform the display test.

a Press Print/Utility.

b Press the **Self Tst** softkey, then press the **Display** softkey.

c Do the half bright and full bright squares appear?

If yes, continue with the steps below. If not, replace the display.

d Press any key to continue.

e Do squares appear in the four corners?

If yes, the display is good. If not, replace the display.

f Press any key to end the test.

g If you still have the failing symptom, replace the system board.

Replacing Parts in the Oscilloscope

This section contains instructions for removing and ordering replaceable assemblies. Also in this section is a parts list for the assemblies and hardware of the oscilloscope that you can order from Hewlett-Packard.

If you need a component for one of the printed circuit boards, refer to the parts list included with the component information packet for this oscilloscope. For more information on these packets, contact your nearest Hewlett-Packard Sales Office.

Before working on the oscilloscope, read the safety summary at the front of this book.

Warning

Hazardous voltages are on the CRT, power supply, and display sweep board. To avoid electrical shock, disconnect the power cord from the oscilloscope. Wait at least three minutes for the capacitors in the oscilloscope to discharge before you begin disassembling the oscilloscope.

Caution

Do not replace assemblies with the oscilloscope turned on or damage to the components can occur.

To replace an assembly

Refer to the exploded view of the oscilloscope, figure 42, for details on how the oscilloscope fits together. To install an assembly, follow the instructions in reverse order.

You will need the following tools to disassemble the oscilloscope:

- T15 Torx driver to remove the oscilloscope from the cabinet and to remove the fan.
- T10 Torx driver to remove the assemblies from the deck.
- Flat-blade screwdriver to remove the optional modules and the pouch.
- 9/16 inch nut driver or wrench to remove BNC nut.

1 Remove the oscilloscope from the cabinet.

a Turn off the oscilloscope and disconnect the power cable.

b If a module is installed, remove it from the oscilloscope.

c Using the T15 Torx, remove the two screws from the rear of the cabinet.

d Using your thumbs, gently push on the two rear-panel connectors to slide the oscilloscope out of the cabinet.

2 Remove the faulty assembly.

You can remove any of the following six assemblies: fan, front panel, display, system board, power supply, and keyboard.

Fan

a Disconnect the fan cable from the power supply board.

b Using the T15 Torx, remove the three screws that hold the fan to the deck.

Front panel

a Remove the intensity knob by pulling straight out.

b Disconnect the keyboard ribbon cable from the system board.

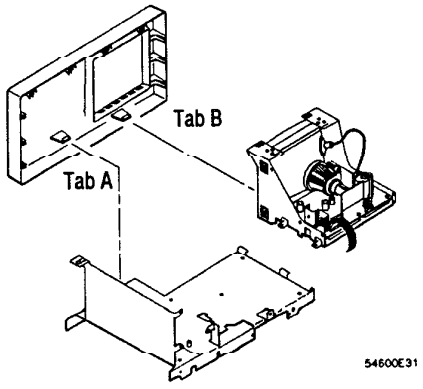
c Use a screwdriver to release retainer tab A, and your finger to release retainer tab B. See figure 39.

d Rotate the front panel out until the bottom clears the rear of the assembly, then lift the front panel to free the hooks on top.

Hint: When installing the front panel, make sure that the power switch shaft is aligned with its mating hole in the front panel.

Hint: The front panel swings in to engage the two retainer tabs. Before attempting to engage the retainer tabs, make sure that the six hooks on top of the front panel are fully engaged with their mating holes in the sheet metal.

Figure 39



Display

a Remove the front panel.

b Disconnect the ribbon cable and the calibration cable from the display.

c Using the T10 Torx, remove the two screws that hold the display to the deck.

Make sure that when you reinstall these screws that you use the correct parts. If longer screws are used, they can short the system board to ground.

d As you lift the display, rotate it off the two tabs on the side of the deck.

System board

a Using the T10 Torx, remove the eight screws that hold the system board to the deck (two of the screws are in the attenuator covers).

b Remove the two screws from the rear-panel interface connector and the nut from the rear-panel BNC.

c Disconnect the three ribbon cables and the calibration cable.

d As you remove the system board, rotate the system board so that the BNCs clear the front panel.

Power supply

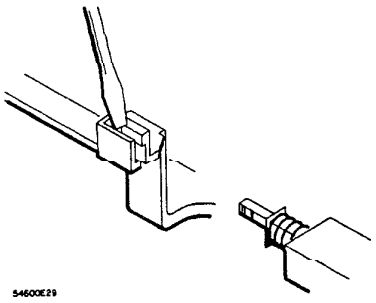
a Remove the fan.

b Disconnect the ground wire (green wire with the yellow stripe) from the deck.

c Disconnect the ribbon cable from the power supply board.

d Use a screw driver to gently unhook the latch that holds the white shaft to the power switch, then disconnect the shaft from the power switch. After you disconnect the shaft, make sure you position it in the recess along the side of the display bracket.

Figure 40



e Using the T10 Torx, remove the screw holding the power supply board to the deck.

f Slide the power supply board towards the front panel about a half an inch. Slip the keyhole slots on the power supply board off of the pins on the deck.

Keyboard

a Remove the front panel.

b Remove all the knobs by pulling straight out.

c Flex the bezel of the front panel to unsnap the small keyboard under the display opening.

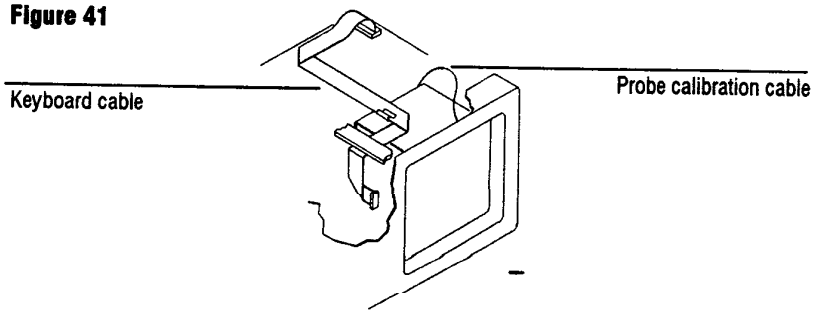
d Using the T10 Torx, remove the three screws from the large keyboard.

Make sure that when you reinstall these screws that you use the correct parts. If longer screws are used, they can damage the front-panel label.

e Press down on the top of the keyboard, and rotate the bottom of the keyboard out.

When installing the keyboard, make sure that the probe calibration cable is kept away from the keyboard cable or noise can occur in the probe adjust signal. See figure 40 for positioning the keyboard cable.

Figure 41



To remove the handle

- Rotate the handle down until it is just past the last detent position (about 1/2 inch before the handle touches the bottom of the oscilloscope), then pull the sides of the handle out of the cabinet.

To order a replacement part

The system board is part of an exchange program with Hewlett-Packard. The exchange program allows you to exchange a faulty assembly with one that has been repaired and performance verified by Hewlett-Packard.

After you receive the exchange assembly, return the defective assembly to Hewlett-Packard. A United States customer has 30 days to return the defective assembly. If you do not return the faulty assembly within the 30 days, Hewlett-Packard will charge you an additional amount. This amount is the difference in price between a new assembly and that of the exchange assembly. For orders not originating in the United States, contact your nearest Hewlett-Packard Sales Office for information.

- To order a part in the material list, quote the Hewlett-Packard part number, indicate the quantity desired, and address the order to your nearest Hewlett-Packard Sales Office.

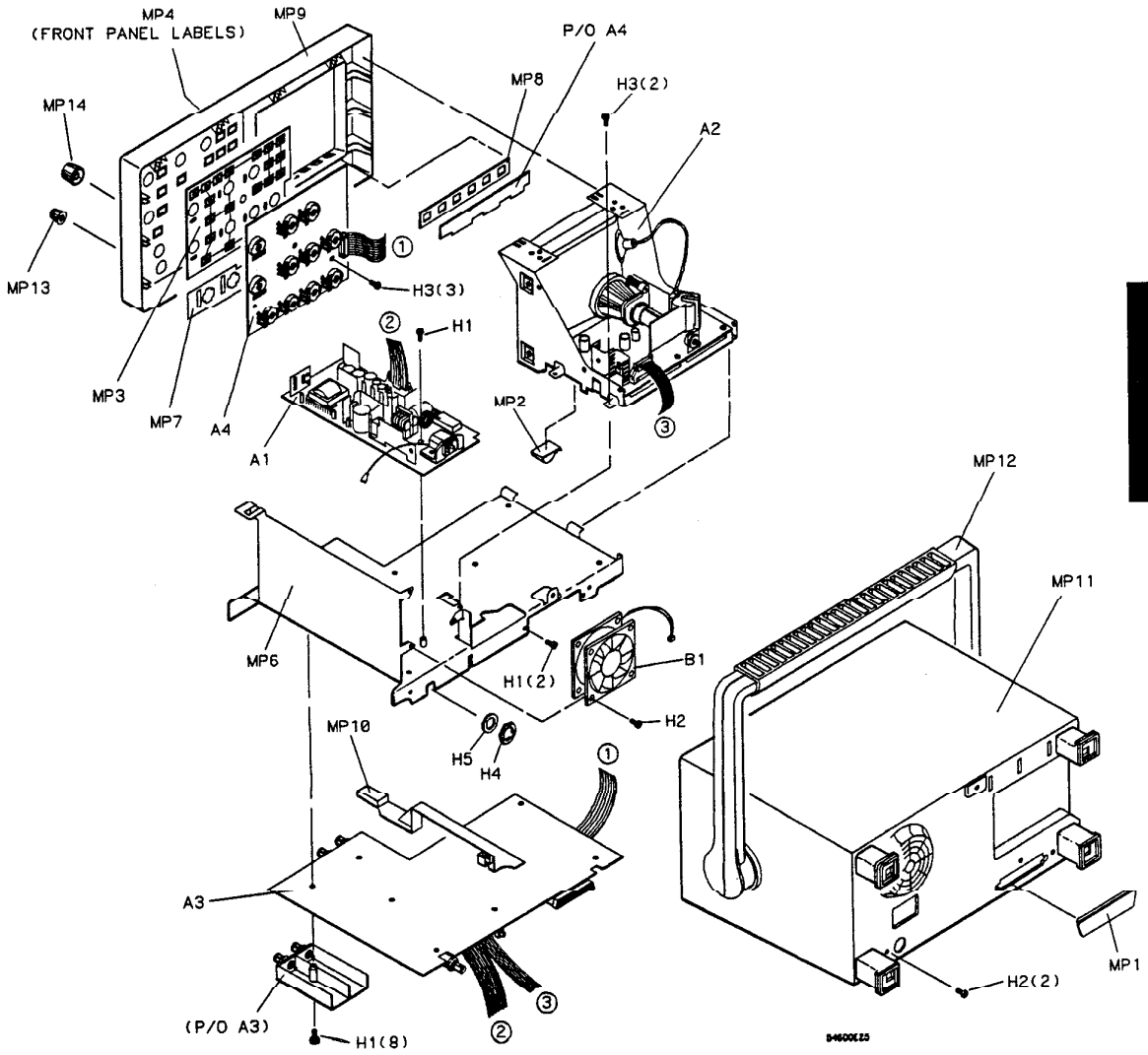
- To order a part not listed in the material list, include the model number and serial number of the oscilloscope, a description of the part (including its function), and the number of parts required. Address the order to your nearest Hewlett-Packard Sales Office.

- To order using the direct mail order system, contact your nearest Hewlett-Packard Sales office.

Within the USA, Hewlett-Packard can supply parts through a direct mail order system. The advantages to the system are, direct ordering and shipment from the HP Parts Center in Mountain View, California. There is no maximum or minimum on any mail order (there is a minimum amount for parts ordered through a local Hewlett Packard Sales Office when the orders require billing and invoicing). Transportation costs are prepaid (there is a small handling charge for each order) and no invoices.

In order for Hewlett-Packard to provide these advantages, a check or money order must accompany each order. Mail order forms and specific ordering information are available through your local Hewlett-Packard Sales Office. Addresses and telephone numbers are located in a separate document shipped with the instrument.

Figure 42



Exploded view of oscilloscope showing reference designators.

Table 15

HP 54600A and HP 54601A Replaceable Parts

Reference Designator	HP Part Number	Qty	Description
A1	0950-2125	1	Power supply assembly
A2	2090-0244	1	Display assembly
A3	54600-66501	1	System board (HP 54600A only)
A3	54600-69501		Exchange system board (HP 54600A only)
A3	54601-66501	1	System board (HP 54601A only)
A3	54601-69501		Exchange system board (HP 54601A only)
A4	54600-66502	1	Keyboard (HP 54600A only)
A4	54601-66502	1	Keyboard (HP 54601A only)
B1	3160-0619	1	Fan
H1	0515-0372	11	Machine screw M3 X 8
H2	0515-0380	5	Machine screw M4 X 10
H3	0515-0430	5	Machine screw M3 X 6
H4	1250-2075	1	RF connector nut, 0.5 inch
H5	2190-0068	1	Lock washer
MP1	1251-2485	1	Connector dust cover
MP2	1400-1581	1	Cable clamp
MP3	54600-41901	1	Large keypad (HP 54600A only)
MP3	54601-41901	1	Large keypad (HP 54601A only)
MP4	54600-94301	1	Front-panel label (HP 54600A only)
MP4	54601-94301	1	Front-panel label (HP 54601A only)
MP5	54600-94303	1	Handle Label (HP 54600A only)
MP5	54601-94303	1	Handle Label (HP 54601A only)
MP6	54601-00101	1	Deck
MP7	54601-07101	1	EMI gasket
MP8	54601-41902	1	Small rubber keypad
MP9	54601-42201	1	Front panel
MP10	54601-43701	1	Power-switch shaft
MP11	54601-64401	1	Cabinet (comes with handle and feet installed)
MP12	54601-44901	1	Handle
MP13	54601-47401	8	Small knob (HP 54600A has 6)
MP14	54601-47402	3	Large knob
MP15	54601-47403	1	Intensity knob

Table 15

HP 54600A and HP 54601A Replaceable Parts

Reference Designator	HP Part Number	Qty	Description
W1	8120-1521	1	Standard power cord
W1	8120-1703		Power cord option 900, United Kingdom
W1	8120-0696		Power cord option 901, Australia
W1	8120-1692		Power cord option 902, Europe
W1	8120-0698		Power cord option 904, 250 V, USA/Canada
W1	8120-2296		Power cord option 906, Switzerland
W1	8120-2957		Power cord option 912, Denmark
W1	8120-4600		Power cord option 917, Africa
W1	8120-4754		Power cord option 918, Japan
	Option 101		**Accessory pouch and front-panel cover.**
	5041-9411		Pouch
	54601-44101		Front-panel cover

4

Performance Characteristics

Performance Characteristics

The performance characteristics describe the typical performance of the oscilloscope. You will notice that some of the characteristics are marked as tested, these are values that you can verify with the performance tests under "Verifying Oscilloscope Performance," on page 65.

Vertical System

All channels

Bandwidth[1]: dc to 100 MHz −3 dB
ac coupled, 10 Hz to 100 MHz −3 dB
Rise time: 3.5 ns (calculated)
Math functions: Channel 1 + or − channel 2
Input resistance: 1 MΩ
Input capacitance: ≈13 pf
⚠ Maximum input voltage: 400 V (dc + peak ac)

1 Tested, see "To verify bandwidth," on page 70.

Channels 1 and 2

Range: 2 mV/div to 5 V/div
Accuracy[1]: ±1.5%
Verniers[1]: Fully calibrated, accuracy: ±3%
Cursor accuracy[1, 2, 3]:
Single cursor accuracy: vertical accuracy ±1.2% of full scale ±0.5% of position value
Dual cursor accuracy: vertical accuracy ±0.4% of full scale
Bandwidth limit: ≈20 MHz
Coupling: Ground, ac, and dc
Inversion: Channel 1 and channel 2
CMRR (common mode rejection ratio): ≈ 20 dB at 50 MHz

Channels 3 and 4 (HP 54601A only)

Range: 0.1 V/div and 0.5 V/div ranges
Accuracy[1]: ±1.5%
Coupling: Ground and dc

1 When the temperature is within ±10 °C from the calibration temperature.
2 Use a full scale of 80 mV for 2 mV/div and 5 mV/div ranges.
3 Tested, see "To verify voltage measurement accuracy," on page 67.

Horizontal System

Sweep speeds: 5 s/div to 2 ns/div main and delayed
Accuracy: ±0.01%
Vernier: Accuracy ±0.05%
Cursor accuracy[1,2]: (Δt and 1/Δt) ±0.01% ±0.2% of full scale ±200 ps
Delay jitter: 10 ppm
Pretrigger delay (negative time): ≥10 divisions
Posttrigger delay (from trigger point to start of sweep): at least 2560 divisions or 50 ms. Not to exceed 100 s.
Delayed sweep operation

Main sweep	Delayed sweep
5 s/div to 10 ms/div	up to 200 times main sweep
5 ms/div and faster	up to 2 ns/div

1 Use full scale of 50 ns on 2 ns/div range.
2 Tested, see "To verify horizontal Δt and 1/Δt accuracy," on page 76.

Trigger System

Internal trigger

Sensitivity[1]:
dc to 25 MHz 0.35 div or 3.5 mV
dc to 100 MHz 1 div or 10 mV
Sources:
Channels 1 to 4 and line on HP 54601A
Channels 1, 2, line, and external on HP 54600A
Coupling: ac, dc, LF reject, HF reject, and noise reject
LF reject and HF reject −3 dB at ≈50 kHz
Modes: Auto, Autolevel, Normal, Single, and TV
TV triggering: Available on channels 1 and 2 only
TV line and field: 0.5 division of composite sync for stable display
Holdoff: Adjustable from 200 ns to ≈13 s

External trigger (available on HP 54600A only)

Range: ±18 V
Sensitivity[1]:
dc to 25 MHz 50 mV
dc to 100 MHz 100 mV
Coupling: dc, HF reject, and noise reject
Input resistance: 1 MΩ
Input capacitance: ≈13 pf
⚠ Maximum input voltage: 400 V (dc + peak ac)

1 Tested, see "To verify trigger sensitivity," on page 79.

XY Operation

Z Blanking: TTL high blanks trace
Bandwidths: X and Y same as vertical system
Phase difference: ±3 degrees at 100 kHz

Display System

Display: 7-inch raster CRT
Resolution: 255 vertical by 500 horizontal points
Controls: Front-panel intensity control
Graticule: 8 × 10 grid or frame
Autostore: Autostore saves previous sweeps in half bright display and the most recent sweep in full bright display.

Acquisition System

Maximum sample rate: 20 MSa/s
Resolution: 8 bits
Simultaneous channels: Channels 1 and 2 or channels 3 and 4
Record length: 4,000 points (2,000 single shot)
Maximum update rate: 1,000,000 points/s
Single-shot bandwidth: 2 MHz single channel, 1 MHz dual channel
Peak detect: 50 ns glitch capture (100 ns dual channel) at all available sweep speeds
Average: Number of averages selectable at 8, 64, and 256

Advanced Functions

Automatic measurements: (measurements are continuously updated)
Voltage: Vavg, Vrms, Vp-p, Vtop, Vbase, Vmin, Vmax
Time: Frequency, period, + width, − width, duty cycle, rise time, and fall time
Cursors: Manually or automatically placed
Setup functions:
Autoscale: Sets vertical and horizontal deflections and trigger level for signals with a frequency ≥50 Hz, duty cycle >1% and voltage level
channels 1 and 2 >20 mVp-p
channels 3 and 4 >100 mVp-p
external trigger (HP 54600A only) >100 mVp-p
Save/Recall: 16 front-panel setups
Trace memory: Two volatile pixel memories

Power Requirements

Line voltage range: 100 Vac to 240 Vac
Line voltage selection: Automatic
Line frequency: 45 Hz to 440 Hz
Maximum power consumption: 220 VA

General

Environmental characteristics

The instrument meets or exceeds the environmental requirements of MIL-T-28800D for Type III, Class 3, Style D equipment as described below.

Ambient temperature: (Tested to MIL-T-28800D paragraphs 4.5.5.13 option 2 and 4.5.5.14)
Operating: −10 °C to +55 °C (+14 °F to +131 °F)
Nonoperating: −51 °C to +71 °C (−60 °F to +160 °F)
Humidity: (tested to Hewlett-Packard environmental specification section 758 paragraphs 4.0, 4.1, and 4.2 for class B-1 products)
Operating: 95% relative humidity at +40 °C (+104 °F) for 24 hours
Nonoperating: 90% relative humidity at +65 °C (+149 °F) for 24 hours
Altitude: (Tested to MIL-T-28800E paragraph 4.5.5.2)
Operating: to 4,500 m (15,000 ft)
Nonoperating: to 15,000 m (50,000 ft)

EMI

EMI (commercial) FTZ 1046 Class B

EMI Meets the requirements in accordance with MIL-T-28800D,
paragraph 3.8.3 table XII, and MIL-STD-461C
CE01: Part 2 narrow band requirements up to 15 kHz
CE03: Part 4
CE07 full limits
CS01: Part 2
CS02: Part 2
CS06: Part 5 limited to 300 V
RE01: Parts 5 and 6 measured at 12 inches, 15 dB relaxation to 20 kHz,
and exceptioned from 20 kHz to 50 kHz.
RE02: Part 2 (limited to 1 GHz) Full limits of class A1c and A1f,
with option 002 installed
without option 002 installed 10 dB relaxation, 14 kHz to 100 kHz
RS02: Part 2, Part I Exceptioned
RS02: Part 2, Part II Exceptioned
RS03: Part 2, limited to 1 V/meter from 14 kHz to 1 GHz
(with option 001 installed) Slight trace shift from 80 MHz to 200 MHz

Vibration

Operating: 15 minutes along each of the 3 major axes; 0.025 inch p-p displacement, 10 Hz to 55 Hz in one-minute cycles. Held for 10 minutes at 55 Hz (4 g at 55 Hz).

Shock

Operating: 30 g, 1/2 sine, 11 ms duration, 3 shocks per axis along major axis. Total of 18 shocks.

Physical characteristics

Size (excluding handle)
Height 172 mm (6.8 in)
Width 322 mm (12.7 in)
Depth 317 mm (12.5 in)
Weight: 6.2 kg (14lbs)

Auto A trigger mode that produces a baseline display if the trigger conditions are not met. If the trigger frequency is less than 40 Hz, even if the level and slope conditions are met, a free running display will result.

Auto Level The oscilloscope sets the trigger point to the 50% amplitude point on the displayed waveform. If there is no signal present, a baseline is displayed.

Autoscale Front-panel key that automatically sets up the oscilloscope to display a signal.

Autostore displays the stored waveforms in half bright, and the most recent trace is displayed in full bright.

Baseline Free running trace on the display when no signal is applied and the trigger mode is set to auto or auto level.

BW Lim (Bandwidth Limit) Limits the displayed bandwidth of the selected channel to 20 MHz, and is available for channels 1 and 2 only. This feature is useful for viewing noisy signals

Couping (Coupling) For the channels, it changes the input coupling. Channels 1 and 2 allow dc, ac, or ground, while channels 3 and 4 allow dc or ground. In the trigger menu, it toggles between dc and ac for trigger coupling.

Cursors Horizontal and vertical markers used for making custom voltage and time measurements.

Delay In main sweep, the delay knob moves the sweep horizontally, and indicates how far the time reference is from the trigger point. In delayed sweep the delay knob moves the starting point of the portion of the main sweep to be expanded by the delayed sweep.

Delayed Gives an expanded view of the main sweep.

Display Allows selection of either normal, peak detect, or averaged display modes.

Erase Clears the display.

External Trigger Is available only on the two channel oscilloscope. Nonviewable input that is usable as a trigger source only.

Field 1 Triggers on the field 1 portion of the video signal.

Field 2 Triggers on the field 2 portion of the video signal.

HF Reject (high frequency reject) Adds a low pass filter with a 3 dB point at 50 KHz to the trigger path.

Holdoff Keeps the trigger from rearming for an amount of time set by the holdoff knob.

Internal Trigger The oscilloscope triggers from a channel input that you choose.

Invert Invert shifts the displayed waveform 180 degree, and is available for channels 1 and 2 only. When the oscilloscope is triggered on the signal to be inverted, the trigger is also inverted.

Level Front-panel knob that changes the trigger level.

LF Reject (low frequency reject) Adds a high pass filter with a 3 dB point at 50 KHz to the trigger path.

Line In TV trigger mode, the oscilloscope triggers on the TV line sync pulses. As a trigger source, the oscilloscope triggers off of the power line frequency.

Main Sets the oscilloscope to a volts vs time display that displays the main time base sweep.

Mode Allows you to select one of five trigger modes, Auto level, Auto, Normal, Single, TV.

Noise Rej (noise reject) Decreases the trigger sensitivity to reduce the triggering on signal noise.

Normal If a trigger signal is present and the trigger conditions are met, a waveform is displayed. If there is no trigger signal, the oscilloscope does not trigger and the display is not updated.

Peak Det (peak detect) Allows detection of signal extremes as the sample rate is decreased in the 5 s to 50 ms/div time base settings.

Polarity Selects either positive or negative TV sync pulses.

Position Knob that moves the signal vertically on the display.

Print/Utility Allows access to the module menus and service menus.

Probe Allows selection of 1, 10, or 100 to match a probe's division ratio so that the vertical scaling and voltage measurements reflect the actual voltage levels at the tip of the probe.

Recall Recalls a selected front-panel setup that you saved to one of 16 memory location. Memory selection is with either a softkey or the knob closest to the Cursors front-panel key.

Recall Setup Recalls the front-panel setup that was saved with a waveform.

Run The oscilloscope acquires data and displays the most recent trace.

Save Saves the current front-panel setup to one of the possible 16 memory locations. Memory selection is with either a softkey or the knob closest to the Cursors front-panel key.

Setup Allows access to front-panel setup keys.

Single (single shot) The oscilloscope triggers once when the trigger conditions are met. The oscilloscope must be rearmed before the oscilloscope retriggers by pressing either the Run or Autostore front-panel keys.

Slope/Coupling Allows access to the trigger slope and input coupling menus.

Slope Selects either the rising or falling edge of the signal to trigger the oscilloscope.

Source Allows you to select a trigger source.

Stop Freezes the display.

Time Allows access to the automatic time measurement keys.

Time/Div Changes the time base in a 1-2-5 step sequence from 2 ns to 5 s.

Time Ref Lft Cntr (time reference left or center) Sets the time reference to either one graticule in from the left edge of the display or to center of the display.

Trace Allows access to the trace storage keys.

Trace Mem (trace memory) One of two pixel memory locations used for storing traces.

TV Allows access to the TV slope and trigger coupling keys.

Vernier Vernier allows a calibrated fine adjustment with the channel 1 and 2 Volts/Div knob, and the time base Time/Div knob.

Voltage Allows access to the automatic voltage measurement keys.

Volts/Div Changes the vertical scaling in a 1-2-5 step sequence from 2 mV to 5 V.

XY Changes the display to a volts versus volts display.

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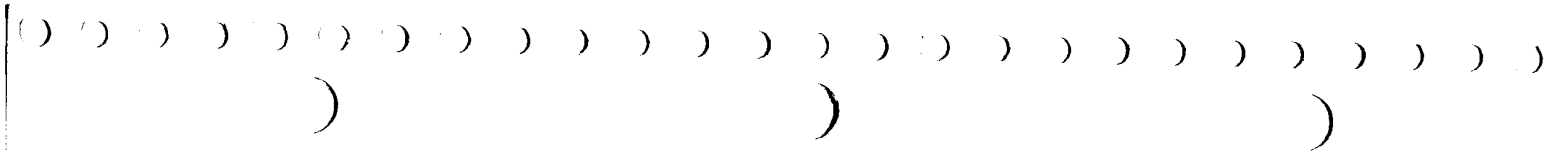

Herstellerbescheinigung

Hiermit wird bescheinigt, daß die Geräte/Systeme HP 54600A and HP 54601A in Übereinstimmung mit den Bestimmungen der Postverfügungen 1046/84 funkentstört sind.

Der Deutschen Bundespost wurde das Inverkehrbringen dieser Geräte/Systeme angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Zusatzinformation für Mess- und Testgeräte

Werden Meß- und Testgeräte mit ungeschirmten Kabeln und/oder in offenen Meßaufbauten verwendet, so ist vom Betreiber sicherzustellen, daß die Funkentstörbestimmungen unter Betriebsbedingungen an seiner Grundstücksgrenze eingehalten werden.

Manufacturer's declaration

This is to certify that these products HP 5454600A and HP 54601A meet the radio frequency interference requirements of directive 1046/84. The German Bundespost has been notified that this equipment was put into circulation and was granted the right to check the product type for compliance with these requirements.

Additional Information for Test and Measurement Equipment

Note: If test and measurement equipment is operated with unshielded cables and/or used for measurements on open set-ups, the user must insure that under these operating conditions, the radio frequency interference limits are met at the border of his premises.

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About this edition

This is the first edition of the *HP 54600A/54601A Oscilloscope User and Service Guide*. Edition dates are as follows:

1st edition, March 1991

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. Within the manual, any page changed since the last edition is indicated by printing the date the changes were made on the bottom of the page. If an update is incorporated when a new edition of the manual is printed, the change dates are removed from the bottom of the pages and the new edition date is listed on the title page.

March 1991: All pages are the original edition.