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# Service Guide

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## Agilent 54621A/22A/24A Oscilloscope and Agilent 54621D/22D Mixed-Signal Oscilloscope

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# Agilent Technologies 54621A/22A 2-channel, 54624A 4-channel, and 54621D/22D Mixed-Signal Oscilloscopes

## At a Glance

### Ease of Use with High Performance

The Agilent 54621A/22A/24A, and 54621D/22D oscilloscopes combine ease-of-use and high-performance to simplify design and analysis measurement tasks.

- 2 MBytes of MegaZoom deep memory per channel for capturing long, non-repeating signals
- Graphical user interface with menus, windows, dialogs, and toolbars on a high-definition display — provides easy access to configuration and analysis tools to ensure setup and execution of complex measurements and a view of signal details
- Flexible triggering helps isolate and analyze complex signals and fault conditions

### Choose From a Variety of Oscilloscopes

- **Agilent 54621A** — 2-channel, 60 MHz Bandwidth, 200 MSa/s Sample Rate, 2 MByte Memory per channel
- **Agilent 54622A** — 2-channel, 100 MHz Bandwidth, 200 MSa/s Sample Rate, 2 MByte Memory per channel
- **Agilent 54624A** — 4-channel, 100 MHz Bandwidth, 200 MSa/s Sample Rate, 2 MByte Memory per channel
- **Agilent 54621D** — 2-channel + 16 logic channels, 60 MHz Bandwidth, 200 MSa/s Sample Rate, 2 MByte Memory per channel
- **Agilent 54622D** — 2-channel + 16 logic channels, 100 MHz Bandwidth, 200 MSa/s Sample Rate, 2 MByte Memory per channel

### Combinations of Features

Analog channels, logic timing channels and MegaZoom deep memory with triggering across all 18 channels provide a new and flexible way to debug mixed analog and digital systems.

### MegaZoom Deep Memory

The MegaZoom deep memory oscilloscopes respond instantly to control inputs, have fast, responsive displays, and easy-to-use pan and zoom. With deep memory, you can keep the sample rate high, even when capturing long time periods. And, deep memory helps you locate details hidden in complex signals.

### High-definition Display

- The MegaZoom deep memory is mapped into 32 levels of gray scale on a display that has > 2x the horizontal resolution of other digital scopes.
- The screen update rate is > 25x faster than typical digital scopes.

### Reduced Chances of Missing Events

The deep memory and high-definition display reduce the chances of missing events:

- a narrow occasional transient
- a glitch or distorted edge that impacts circuit operation
- subtle details that take a long time to find
- display artifacts typically created by digital scopes

### Flexible Triggering

The flexible triggering capabilities of these scopes include edge, pulse width, pattern, glitch, TV, and sequence and duration triggering. The I<sup>2</sup>C trigger mode helps verify inter-IC communication handshaking.

### Connectivity and Use Made Easy

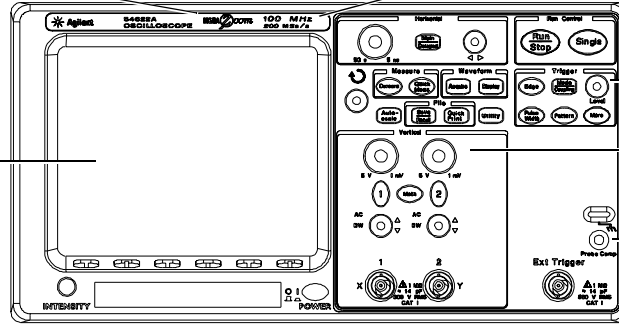
These oscilloscopes also include:

- Parallel and RS-232 interfaces
- BenchLink waveform transfers to PC
- Built-in 1.4 MByte floppy drive
- Online help in multiple languages

MegaZoom  
Deep Memory  
Oscilloscopes

Bandwidth, Sample Rate

High-definition  
Display

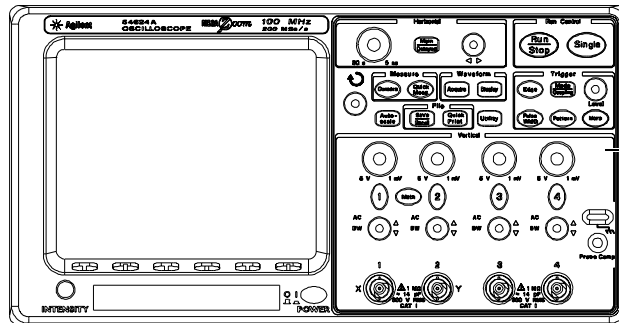


Triggering

Analog Channels (2)

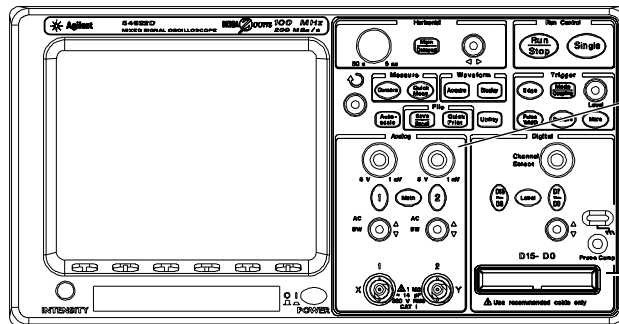
Probe  
Compensator

**Agilent Technologies 54621A/22A 2-channel Oscilloscope**



Analog Channels (4)

**Agilent Technologies 54624A 4-channel Oscilloscope**



Analog Channels (2)

Digital Channels (16)

**Agilent Technologies 54621D/22D Mixed-Signal Oscilloscope**

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## In This Book

This book provides the service information for the Agilent 54621A/22A/24A Oscilloscope and the Agilent 54621D/22D Mixed-Signal Oscilloscope.

This manual is divided into these chapters:

**Chapter 1** provides general information and specifications.

**Chapter 2** shows you how to prepare the oscilloscope for use.

**Chapter 3** gives performance tests.

**Chapter 4** covers calibration and adjustment procedures.

**Chapter 5** provides troubleshooting information.

**Chapter 6** gives the procedures and techniques for replacing assemblies and other parts.

**Chapter 7** includes a list of replaceable parts, part ordering information, and shipping information.

At the back of the book you will find Safety information, Warranties, and Regulatory information.

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# General Information

This chapter lists general information for the Agilent 54600-series Oscilloscopes. It also includes performance characteristics and specifications for the oscilloscopes.



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## To inspect package contents

### ❑ Inspect the shipping container for damage.

If your shipping container appears to be damaged, keep the shipping container or cushioning material until you have inspected the contents of the shipment for completeness and have checked the oscilloscope mechanically and electrically.

### ❑ Verify that you received the following items and any optional accessories in the oscilloscope packaging (see figure following).

- 54600-Series Oscilloscope (54621A, 21D, 22A, 22D, or 24A)
- 10074C 10:1 passive probes:
  - (2) for 54621A, 21D, 22A, or 22D oscilloscopes
  - (4) for 54624A oscilloscope
- 54620-68701 digital probe kit (for 54621D or 22D)
- Accessory pouch and front-panel cover (standard for 54622A, 22D, and 24A) (optional on 54621A and 21D; order N2726A)
- Power cord (see table 1-3)
- BenchLink XL 54600 software and RS-232 cable (for 54622A, 22D, or 24A)  
BenchLink XL 54600 software is available free on the web at:  
[www.agilent.com/go/megazoom](http://www.agilent.com/go/megazoom)  
RS-232 cable may be ordered separately, part number 34398A

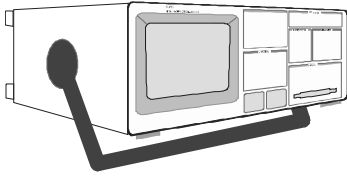
If anything is missing, contact your nearest Agilent Sales Office. If the shipment was damaged, contact the carrier, then contact the nearest Agilent Sales Office.

### ❑ Inspect the oscilloscope

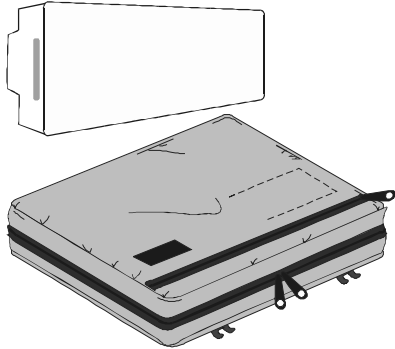
- If there is mechanical damage or a defect, or if the oscilloscope does not operate properly or does not pass the performance tests listed in the Service Guide, notify your Agilent Sales Office.
- If the shipping container is damaged, or the cushioning materials show signs of stress, notify the carrier and your Agilent Sales Office. Keep the shipping materials for the carrier's inspection. The Agilent Sales Office will arrange for repair or replacement at Agilent's option, without waiting for claim settlement.

**Figure 1-1**

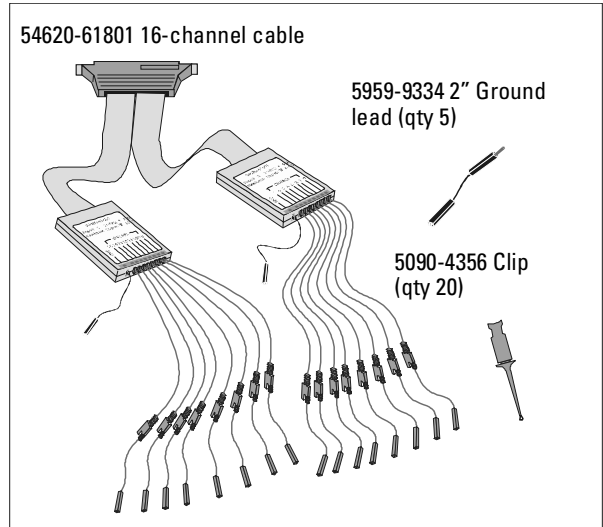
54600-Series Oscilloscope



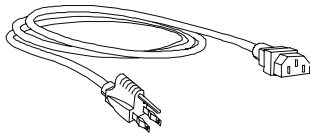
Accessories pouch and front-panel cover\*\*



54620-68701 digital probe kit\*



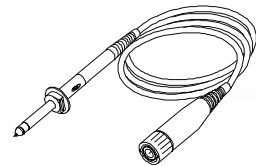
Power cord



BenchlinkXL 54600 software and serial cable\*\*



10074C Probes



\* 54621D /22D only

\*\* 54622A/22D/24A only

**Package contents for 54600-Series Oscilloscopes**

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## To inspect options and accessories

- ❑ Verify that you received the options and accessories you ordered and that none were damaged.

If anything is missing, contact your nearest Agilent Sales Office. If the shipment was damaged, or the cushioning materials show signs of stress, notify the carrier and your Agilent Sales Office.

Some of the options and accessories available for the 54600-Series Oscilloscopes are listed in tables 1-1 and 1-2. Contact your Agilent Sales Office for a complete list of options and accessories.

**Table 1-1**


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### Options available

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Option	Description
003	Shielding Option for use in severe environments or with sensitive devices under test—shields both ways (in and out): RS-03 magnetic interface shielding added to CRT, and RE-02 display shield added to CRT to reduce radiated interference.
0B0	Delete manuals
A6J	ANSI Z540 compliant calibration with test data
W32	3-year, customer-return calibration service
W34	3-year, customer-return standard comp calibration service
W50	Additional 2-year warranty (5 years total)
W52	5-year, customer-return calibration service
W54	5-year customer-return standard comp calibration service
	See table 1-3 for power cord options

Table 1-2

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**Accessories available**


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<b>Model</b>	<b>Description</b>
1146A	Current probe, ac/dc
1183A	Testmobile scope cart
1185A	Carrying Case
1186A	Rackmount Kit
10070C	1:1 Passive Probe with ID
10072A	Fine-pitch probe kit
10073B	10:1 500 MHz probe with ID
10075A	0.5 mm IC clip kit
10076A	100:1, 4 kV 250 MHz probe with ID
10085A	16:16 logic cable and terminator (for use with 54621D/22D)
10089A	16:2 x 8 logic input probe assembly (shipped standard with 54621D/22D)
10100C	50 $\Omega$ Termination
10833A	GPIB cable, 1 m long
34398A	RS-232 cable (standard with 100 MHz models)
E2613B	0.5 mm Wedge probe adapter, 3-signal, qty 2
E2614A	0.5 mm Wedge probe adapter, 8-signal, qty 1
E2615B	0.65 mm Wedge probe adapter, 3-signal, qty 2
E2616A	0.65 mm Wedge probe adapter, 8-signal, qty 1
E2643A	0.5 mm Wedge probe adapter, 16-signal, qty 1
E2644A	0.65 mm Wedge probe adapter, 16-signal, qty 1
N2726A	Accessory pouch and front-panel cover (standard with 100 MHz models)
N2727A	Thermal printer and pouch
N2728A	10 rolls of thermal printer paper
N2757A	GPIB Interface Module
N2772A	20 MHz differential probe
N2773A	Differential probe power supply

Table 1-3

## Power Cords

Plug Type		Cable Part No.	Plug Description	Length in/cm	Color
Opt 903 (U.S.A.) 124V **		8120-1378	Straight (NEMA5-15P*)	90/228	Jade Gray
Opt 900 (U.K.) 250V		8120-1351	Straight (BS136A*)	90/228	Gray
Opt 901 (Australia) 250V		8120-1369	Straight (NZSS198/ASC*)	79/200	Gray
Opt 902 (Europe) 250V		8120-1689 8120-2857	Straight (CEE7-Y11*) Straight (Shielded)	79/200/79/200	Mint Gray Coco Brown
Opt 906 (Switzerland) 250V		8120-2104	Straight (SEV1011*)	79/200	Mint Gray
Opt 912 (Denmark) 220V		8120-2957	Straight (DHCK107*)	79/200	Mint Gray
Opt 917 (Africa) 250V		8120-4600	Straight (SABS164)	79/200	Jade Gray
Opt 918 (Japan) 100V		8120-4753	Straight Miti	90/230	Dark Gray

\* Part number shown for plug is industry identifier for plug only.

Cable part number shown is Agilent part number for complete cable including plug.

\*\* These cords are included in the CSA certification approval for the equipment.

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## Performance Characteristics

\* Denotes Warranted Specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and  $\pm 10$  °C from firmware calibration temperature.

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### Acquisition: Analog Channels

Sample rate	200 MSa/s maximum per scope channel
Memory Depth	2 M/channel 4 M max with single scope channel on (Single)
Vertical Resolution	8 bits
Peak Detection	5 ns
Averages	selectable from 2, 4, 8, 16, 32, 64 ...to 16k
High Resolution Mode	12 bits of resolution when > 200 us/div, average mode with average = 1
Filter:	Sinx/x interpolation (single shot BW = sample rate/4) with vectors on.

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### Acquisition: Logic Channels (on 54621D and 54622D only)

Sample Rate	400 MSa/s maximum
Memory Depth Per Channel	
8 channels same pod	8 MB/channel maximum
2 pods in use	4 MB/channel maximum
Vertical Resolution	1 bit
Glitch Detection (min pulse width)	5 ns

\* Denotes Warranted Specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and  $\pm 10$  °C from firmware calibration temperature.

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**Vertical System: Analog Channels**

54621A/D, 54622A/D		Ch1 and 2 simultaneous acquisition
54624A		Ch 1, 2, 3 and 4 simultaneous acquisition
54621A/D		
Bandwidth (-3dB)*		dc to 60 MHz
ac coupled		3.5 Hz to 60 MHz
Calculated rise time		~5.8 ns (= 0.35/bandwidth)
54622A/D, 54624A		
Bandwidth (-3dB)*		dc to 100 MHz
ac coupled		3.5 Hz to 100 MHz
Calculated rise time		~3.5 ns (= 0.35/bandwidth)
Single Shot Bandwidth		50 MHz
Range <sup>1</sup>		1 mV/div to 5 V/div
Maximum Input		CAT I 300 Vrms, 400 Vpk CAT II 100 Vrms, 400 Vpk with 10074C 10:1 probe: CAT I 500 Vpk, CAT II 400 Vpk
Offset Range		$\pm 5$ V on ranges <10 mV/div $\pm 25$ V on ranges 10 mV/div to 199 mV/div $\pm 100$ V on ranges $\geq 200$ mV/div
Dynamic Range		Lesser of $\pm 8$ div or $\pm 32$ V
Input Resistance		1 M $\Omega$ $\pm 1\%$
Input Capacitance		~ 14 pF
Coupling		ac, dc, ground
BW Limit		~ 20 MHz selectable
Channel-to-Channel Isolation		dc to 20 MHz > 40 dB (with channels at same V/div) 20 MHz to max bandwidth > 30 dB
Probes		10:1 10074C shipped standard for each scope channel
Probe ID (Agilent/HP & Tek Compatible)		Auto probe sense

<sup>1</sup> 1 mV/div is a magnification of 2 mV/div setting. For vertical accuracy calculations, use full scale of 16 mV for 1 mV/div sensitivity setting.

## General Information

### Vertical System: Analog Channels (continued)

\* Denotes Warranted Specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and  $\pm 10$  °C from firmware calibration temperature.

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#### Vertical System: Analog Channels (continued)

ESD Tolerance	$\pm 2$ kV
Noise Peak-to-Peak	<2% full scale or 1 mV, whichever is greater
Common Mode Rejection Ratio	20 dB @ 50 MHz
DC Vertical Gain Accuracy* <sup>1</sup>	$\pm 2.0\%$ full scale
DC Vertical Offset Accuracy Value	< 200 mV/div: $\pm 0.1$ div $\pm 1.0$ mV $\pm 0.5\%$ offset $\geq 200$ mV/div: $\pm 0.1$ div $\pm 1.0$ mV $\pm 1.5\%$ offset value
Single Cursor Accuracy <sup>1</sup>	$\pm\{\text{DC Vertical Gain Accuracy} + \text{DC Vertical Offset Accuracy} + 0.2\% \text{ full scale } (\sim 1/2 \text{ LSB})\}$ <i>Example:</i> For 50 mV signal, scope set to 10 mV/div (80 mV full scale), 5 mV offset, accuracy = $\pm\{2.0\%(80\text{mV}) + 0.1 (10 \text{ mV}) + 1.0 \text{ mV} + 0.5\% (5 \text{ mV}) + 0.2\%(80 \text{ mV})\} = \pm 3.78 \text{ mV}$
Dual Cursor Accuracy* <sup>1</sup>	$\pm\{\text{DC Vertical Gain Accuracy} + 0.4\% \text{ full scale } (\sim 1 \text{ LSB})\}$ <i>Example:</i> For 50 mV signal, scope set to 10 mV/div (80 mV full scale), 5 mV offset, accuracy = $\pm\{2.0\%(80 \text{ mV}) + 0.4\%(80 \text{ mV})\} = \pm 1.92 \text{ mV}$

<sup>1</sup> 1 mV/div is a magnification of 2 mV/div setting. For vertical accuracy calculations, use full scale of 16 mV for 1 mV/div sensitivity setting.

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#### Vertical System: Logic Channels (54621D and 54622D only)

Number of Channels	16 Digital – labeled D15 – D0
Threshold Selections	Pod 1: D7 – D0, pod 2: D15 – D8
Maximum Input Voltage 	$\pm 40$ V peak CAT I
Threshold Range	$\pm 8.0$ V in 10 mV increments
Threshold Accuracy*	$\pm(100 \text{ mV} + 3\% \text{ of threshold setting})$
Input Dynamic Range	$\pm 10$ V about threshold
Minimum Input Voltage Swing	500 mV peak-to-peak
Input Capacitance	$\sim 8$ pF
Input Resistance	100 k $\Omega$ , $\pm 2\%$ at probe tip
Channel-to-Channel Skew	2 ns typical, 3 ns maximum



\* Denotes Warranted Specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and  $\pm 10$  °C from firmware calibration temperature.

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**Horizontal**

Range	5 ns/div to 50 s/div
Resolution	40 ps
Vernier	1-2-5 increments when off, 25 minor increments between major settings when on
Reference Positions	Left, Center, Right
Delay Range	
Pre-trigger (negative delay)	Greater of 1 screen width or 10 ms
Post-trigger (positive delay)	500 seconds
Scope Delta-t Accuracy	
Same Channel*	$\pm 0.01\%$ reading $\pm 0.1\%$ screen width $\pm 40$ ps <i>Example:</i> for signal with pulse width of 10 us, scope set to 5 us/div (50 us screen width), delta-t accuracy = $\pm\{0.01\%(10\text{ us}) + 0.1\%(50\text{ us}) + 40\text{ ps}\} = 51.04\text{ ns}$
Channel-to-Channel	$\pm 0.01\%$ reading $\pm 0.1\%$ screen width $\pm 80$ ps
Logic Delta-t Accuracy	(non-Vernier settings)
Same Channel	$\pm 0.01\%$ reading $\pm 0.1\%$ screen width $\pm (1$ logic sample period, 2.5 or 5 ns based on sample rate of 200/400 MSa/s) <i>Example:</i> for signal with pulse width of 10 us, scope set to 5 us/div (50 us screen width), and single pod active (400 MSa/s), delta-t accuracy = $\pm\{0.01\%(10\text{ us}) + 0.1\%(50\text{ us}) + 2.5\text{ ns}\} = 53.5\text{ ns}$
Channel-to-Channel	$\pm 0.01\%$ reading $\pm 0.2\%$ screen width $\pm (1$ logic sample period, 2.5 or 5 ns) $\pm$ chan-to-chan skew (2 ns typical, 3 ns maximum)
Delay Jitter	10 ppm
RMS Jitter	0.025% screen width + 100 ps
Modes	Main, Delayed, Roll, XY
XY	
Bandwidth	Max bandwidth
Phase error @ 1 MHz	1.8 degrees

**Trigger System**

\* Denotes Warranted Specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and  $\pm 10$  °C from firmware calibration temperature.

**Trigger System**

## Sources:

54621A/622A	Ch 1, 2, line, ext
54621D/622D	Ch 1, 2, line, ext, D15 - D0
54624A	Ch 1, 2, 3, 4, line, ext

## Modes

Auto, Auto level, Triggered (normal), Single

## Holdoff Time

~60 ns to 10 seconds

## Selections

Edge, Pattern, Pulse Width, TV, Sequence, I<sup>2</sup>C, Duration

## Edge

Trigger on a rising or falling edge of any source.

## Pattern

Trigger on a pattern of high, low, and don't care levels and a rising or falling edge established across any of the sources. The analog channel's high or low level is defined by that channel's trigger level.

## Pulse Width

Trigger when a positive- or negative-going pulse is less than, greater than, or within a specified range on any of the source channels.

Minimum pulse width setting: 5 ns

Maximum pulse width setting: 10 s

## TV

Trigger on any scope channel for NTSC, PAL, PAL-M, or SECAM broadcast standards on either positive or negative composite video signals. Modes supported include Field 1, Field 2, or both, all lines, or any line within a field. Also supports triggering on non-interlaced fields. TV trigger sensitivity: 0.5 division of synch signal.

## Sequence

Find event A, trigger on event B, with option to reset on event C or time delay.

I<sup>2</sup>C

Trigger on I<sup>2</sup>C (Inter-IC bus) serial protocol at a start/stop condition or user defined frame with address and/or data values.

## Duration

Trigger on a multi-channel pattern whose time duration is less than a value, greater than a value, greater than a time value with a timeout value, or inside or outside of a set of time values.

Minimum duration setting: 5 ns

Maximum duration setting: 10 s

## Autoscale

Finds and displays all active scope and logic channels (for 54621D/54622D), sets edge trigger mode on highest numbered channel, sets vertical sensitivity on scopes channels and thresholds on logic channels, time base to display ~1.8 periods. Requires minimum voltage >10 mVpp, 0.5% duty cycle and minimum frequency >50 Hz.

\* Denotes Warranted Specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and  $\pm 10$  °C from firmware calibration temperature.

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**Analog Channel Triggering**

Range (Internal)	$\pm 6$ div
Sensitivity*	Greater of 0.35 div or 2.5 mV
Coupling	ac (~3.5 Hz), dc, noise reject, HF reject and LF reject (~ 50 kHz)


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**Logic (D15 - D0) Channel Triggering (54621D and 54622D)**

Threshold Range (used defined)	$\pm 8.0$ V in 10 mV increments
Threshold Accuracy*	$\pm (100 \text{ mV} + 3\% \text{ of threshold setting})$
Predefined Thresholds	TTL = 1.4 V, CMOS = 2.5 V, ECL = -1.3 V

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**External (EXT) Triggering**

Input Resistance	$1 \text{ M}\Omega, \pm 3\%$
Input Impedance	$\sim 14 \text{ pF}$
Maximum Input	 CAT I 300 Vrms, 400 Vpk CAT II 100 Vrms, 400 Vpk with 10074C 10:1 probe: CAT I 500 Vpk, CAT II 400 Vpk
Range	$\pm 10 \text{ V}$
Sensitivity	dc to 25 MHz, < 50 mV 25 MHz to max bandwidth, < 150 mV
Coupling	ac (~ 3.5 Hz), dc, noise reject, HF reject and LF reject (~ 50 kHz)

## General Information

### Display System

\* Denotes Warranted Specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and  $\pm 10$  °C from firmware calibration temperature.

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#### Display System

Display	7-inch raster monochrome CRT
Throughput of Scope Channels	25 million gray scale vectors/sec per channel
Resolution	255 vertical by 1000 horizontal points (waveform area) 32 levels of gray scale
High-performance custom graphics display processor	400 MB/sec graphics BW / channel 2 MB SGRAM (Agilent 54621A/D and 54622A/D) 4 MB SGRAM (Agilent 54624A)
Controls	Waveform intensity on front panel Vectors on/off; infinite persistence on/off 8 x 10 grid with continuous intensity control
Built-in Help System	Key-specific help in 9 languages displayed by pressing and holding key or softkey of interest
Real Time Clock	Time and date (user settable)

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#### Measurement Features

Automatic Measurements	Measurements are continuously updated Cursors track current measurement
Voltage (scope channels only)	Peak-to-Peak, Maximum, Minimum, Average, Amplitude, Top, Base, Overshoot, Undershoot, RMS (front panel: dc; GPIB: ac and dc)
Time	Frequency, Period, + Width, - Width, Duty Cycle, X at Max (Time at max volts) on any channels. Rise time and Fall time on scope channels only
Threshold Definition	10%, 50%, 90% for time measurements
Cursors	Manually or automatically placed readout of Horizontal (X, $\Delta X$ , $1/\Delta X$ ) and Vertical (Y, $\Delta Y$ ). Additionally logic or scope channels can be displayed as binary or hex values
Waveform Math	One function of 1-2, $1^*2$ , FFT, $dV/dt$ , $\int Vdt$ . Source of FFT, $dV/dt$ , $\int Vdt$ : scope channels 1 or 2, 1-2, 1+2, $1^*2$

\* Denotes Warranted Specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and  $\pm 10$  °C from firmware calibration temperature.

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### FFT

Points	Fixed at 2048 points
Source of FFT	Scope channels 1 or 2, 1+2, 1-2, 1*2
Window	Rectangular, Flattop, Hanning
Noise Floor	-70 to -100 dB depending on averaging
Amplitude Display	In dBV
Frequency Resolution:	0.097656/(time per div)
Maximum Frequency	102.4/(time per div)

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### Storage

Save/Recall (non-volatile)	3 setups and traces can be saved and recalled internally
Floppy Disk	3.5" 1.44 Mbytes double density
Image formats	TIF, BMP
Data formats	X and Y (time/voltage) values in CSV format
Trace/setup formats	Recalled

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### I/O

RS-232 (serial) standard port	1 port; XON or DTR; 8 data bits; 1 stop bits; No parity; 9600, 19200, 38400, 57600 baud rates
Parallel standard port	Printer support
Printer Compatibility	DeskJet, LaserJet with HP PCL 3 or greater Compatibility– black and white @150x150 dpi gray scale @ 600x600 dpi Epson–black and white @180x180 dpi Seiko–DPU-414 black and white
Optional GPIB Interface Module	Fully programmable with IEEE488.2 compliance

## General Information

### General Characteristics

\* Denotes Warranted Specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and  $\pm 10$  °C from firmware calibration temperature.

---

#### General Characteristics

Physical:	
Size	35.25 cm wide x 17.27 cm high x 31.75 cm deep (without handle)
Weight	~ 6.35 kgs (14 lbs)
Calibrator Output	Frequency ~1.2 kHz; Amplitude 5 V
Trigger Out	0 to 5 V with 50 $\Omega$ source impedance; delay ~ 55 ns
Printer Power	7.2 to 9.2 V, 1 A

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#### Power Requirements

Line Voltage Range	100 - 240 VAC $\pm 10\%$ , CAT II, automatic selection
Line Frequency	47 to 440 Hz
Power Usage	100 W max

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#### Environmental Characteristics

Ambient Temperature	Operating -10 °C to +55 °C Non-operating -51 °C to +71 °C
Humidity	Operating 95% RH at 40 °C for 24 hr Non-operating 90% RH at 65 °C for 24 hr
Altitude	Operating to 4,570 m (15,000 ft) Non-operating to 15,244 m (50,000 ft)
Vibration	HP/Agilent class B1 and MIL-PRF-28800F Class 3 random
Shock	HP/Agilent class B1 and MIL-PRF-28800F (operating 30 g, 1/2 sine, 11-ms duration, 3 shocks/axis along major axis. Total of 18 shocks)
Pollution degree2	Normally only dry non-conductive pollution occurs. Occasionally a temporary conductivity caused by condensation must be expected.
Indoor use only	This instrument is rated for indoor use only

<b>Installation categories</b>	CAT I: Mains isolated CAT II: Line voltage in appliance and to wall outlet
--------------------------------	---



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# Preparing the Oscilloscope for Use

To prepare your oscilloscope for use, you need to do the following tasks. After you have completed them, you will be ready to use the oscilloscope.

In the following topics you will:

- adjust the handle
- power-on the oscilloscope
- adjust the display intensity
- connect the oscilloscope probes
- connect the digital probes (with 54621D and 54622D)
- connect a printer
- connect a RS-232 cable
- verify basic oscilloscope operation
- get started using the oscilloscope interface
- learn how to use Quick Help

This chapter also tells you how to:

- clean the oscilloscope

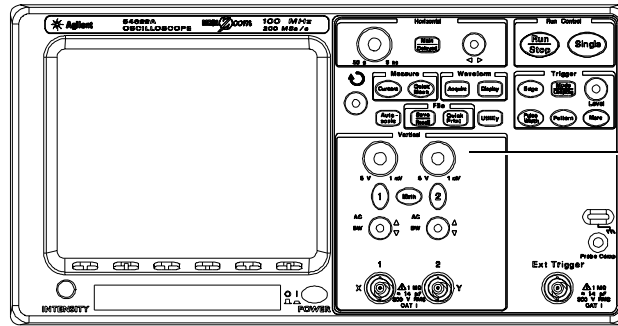


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# Setting up the Oscilloscope

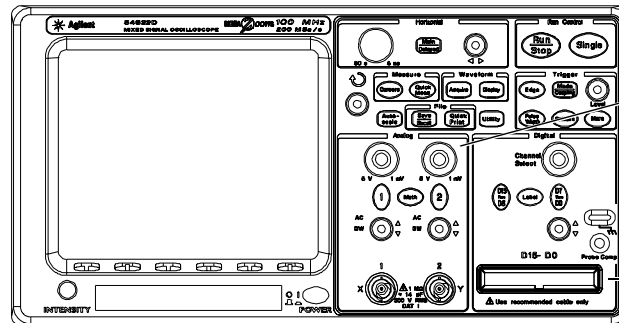
After you have done a few basic tasks, you will connect probes to the oscilloscope. The number of probes, and the type of probes that you will use depends on the oscilloscope model that you have.

- When using the Agilent 54621A and 54622A 2-channel Oscilloscopes, and the Agilent 54624A 4-channel Oscilloscope, you will connect and use analog probes to examine analog signals.



Analog channels  
(2 or 4, depending  
on the oscilloscope  
model)

- When using the Agilent 54621D and 54622D Mixed-Signal Oscilloscopes, you will connect and use both analog and digital probes to examine analog and digital signals.

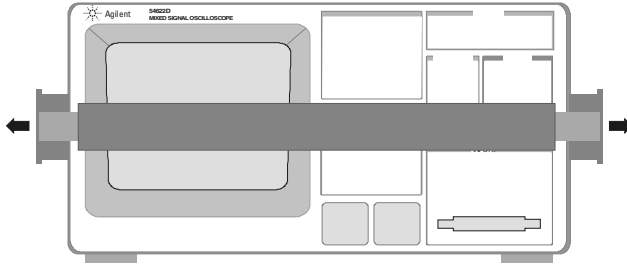


Analog channels (2)

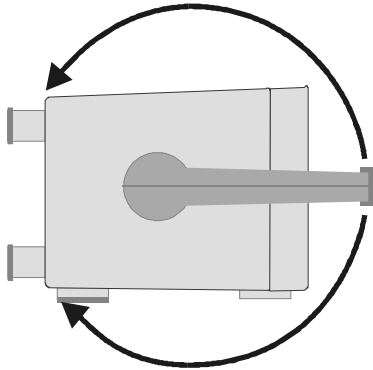
Digital channels (16)

## To adjust the handle

- 1 Grasp the handle pivot points on each side of the instrument and pull the pivot out until it stops.



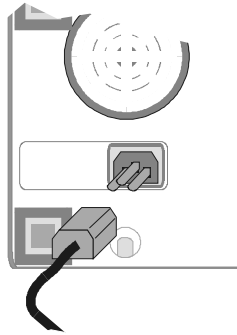
- 2 Without releasing the pivots, swivel the handle to the desired position. Then release the pivots. Continue pivoting the handle until it clicks into a set position.



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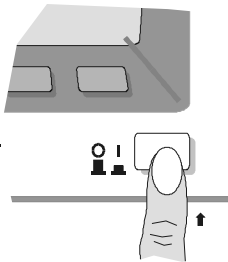
## To power-on the oscilloscope

- 1 Connect the power cord to the rear of the oscilloscope, then to a suitable ac voltage source.



The oscilloscope power supply automatically adjusts for input line voltages in the range 100 to 240 VAC. Therefore, you do not need to adjust the input line voltage setting. The line cord provided is matched to the country of origin. Ensure that you have the correct line cord. See table 1-3

- 2 Press the power switch.



Some front panel key light will come on and the oscilloscope will be operational in about 5 seconds.

**To adjust the display intensity**

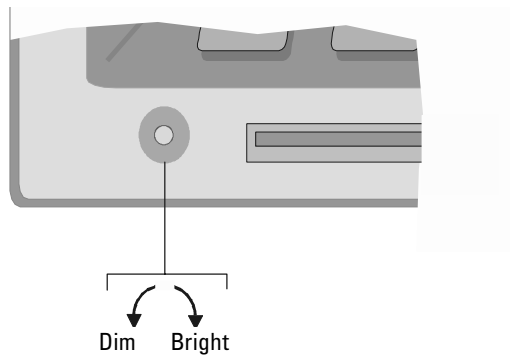
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## To adjust the display intensity


The Intensity control is at the lower left corner of the front panel.

- To decrease display intensity, rotate the Intensity control counter-clockwise.
- To increase display intensity, rotate the Intensity control clockwise.

**Figure 2-1**



### **Intensity control**

The grid or graticule intensity on the display can be adjusted by pressing the **Display** key, then turn the Entry knob (labeled  on the front panel) to adjust the **Grid** control.

## To connect the oscilloscope probes

- 1 Connect the Agilent 10074C 1.5-meter, 10:1 oscilloscope probe to the analog channel 1 or 2 BNC connector input on the oscilloscope, or channel 1 through channel 4 on the 54624A.

Maximum input voltage for analog inputs:



CAT I 300 Vrms, 400 Vpk

CAT II 100 Vrms, 400 Vpk

with 10074C 10:1 probe: CAT I 500 Vpk, CAT II 400 Vpk

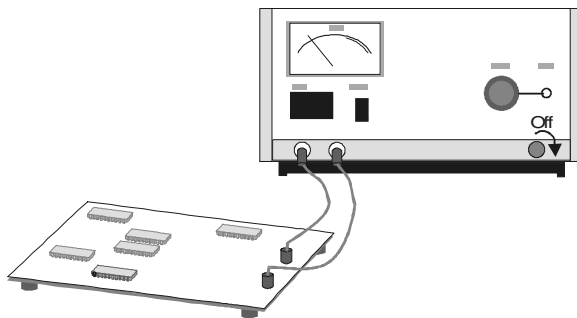
- 2 Connect the retractable hook tip on the probe tip to the circuit point of interest. Be sure to connect the probe ground lead to a ground point on the circuit.

The probe ground lead is connected to the oscilloscope chassis and the ground wire in the power cord. If you need to connect the ground lead to a point in the circuit that cannot be grounded to power ground, consider using a differential probe.

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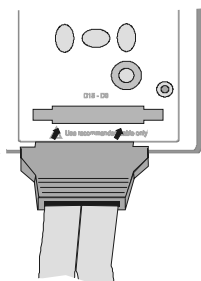
## To use the digital probes (mixed-signal oscilloscope only)

- 1 If you feel it's necessary, turn off the power supply to the circuit under test.



Turning off power to the circuit under test would only prevent damage that might occur if you accidentally short two lines together while connecting probes. You can leave the oscilloscope powered on because no voltage appears at the probes.

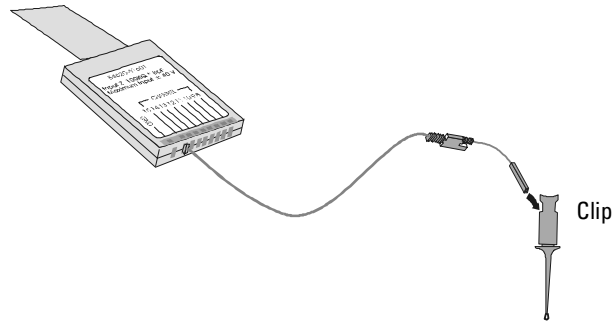
- 2 Connect the digital probe cable to D15 - D0 connector on the front panel of the mixed-signal oscilloscope. The digital probe cable is indexed so you can connect it only one way. You do not need to power-off the oscilloscope.



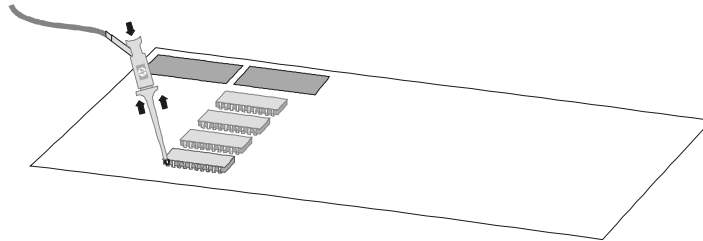
Use only the Agilent part number 54620-68701 digital probe kit supplied with the mixed-signal oscilloscope. Additional probe kits may be ordered by specifying Agilent part number 10089A.

Preparing the Oscilloscope for Use  
To use the digital probes (mixed-signal oscilloscope only)

- 3 Connect a clip to one of the probe leads. Be sure to connect the ground lead. (Other probe leads are omitted from the figure for clarity.)



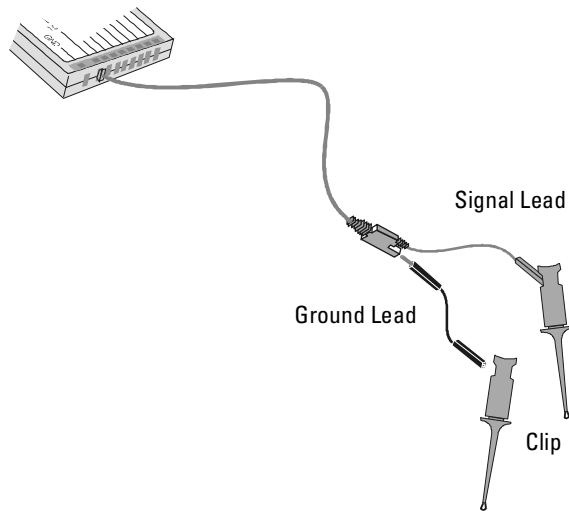
- 4 Connect the clip to a node in the circuit you want to test.



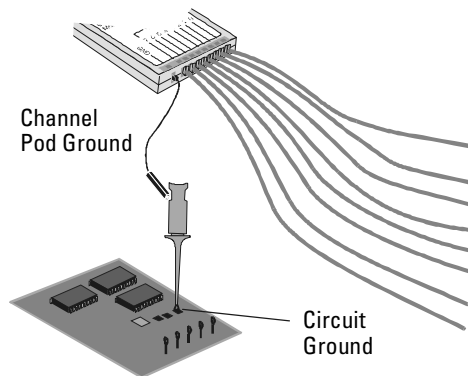
## Preparing the Oscilloscope for Use

### To use the digital probes (mixed-signal oscilloscope only)

- 5 For high-speed signals, connect a ground lead to the probe lead, connect a clip to the ground lead, and attach the clip to ground in the circuit under test.

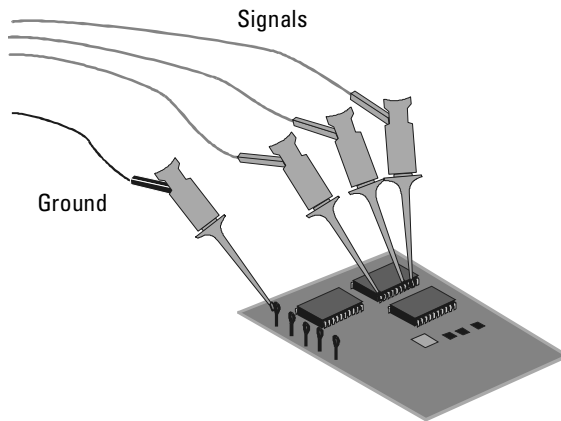


- 6 Connect the ground lead on each set of channels, using a probe clip. The ground lead improves signal fidelity to the instrument, ensuring accurate measurements.

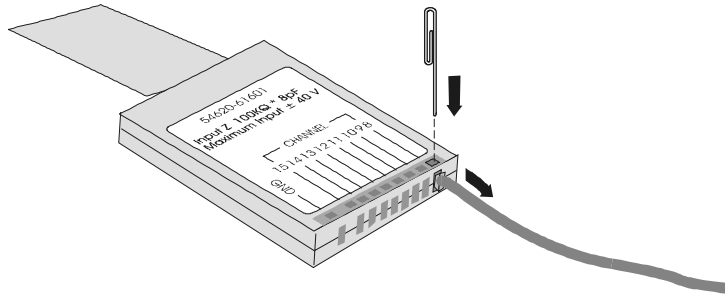




- 7 Repeat steps 3 through 6 until you have connected all points of interest.



- 8 If you need to remove a probe lead from the cable, insert a paper clip or other small pointed object into the side of the cable assembly, and push to release the latch while pulling out the probe lead.



Replacement parts are available. See the “Replaceable Parts” chapter for details.

**To connect a printer**

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## To connect a printer

The oscilloscope connects to a parallel printer through the Parallel output connector on the rear of the oscilloscope. You will need a parallel printer cable to connect to the printer.

- 1 Attach the 25-pin small “D” connector to the Parallel output connector on the rear of the oscilloscope. Tighten the thumbscrews on the cable connector to secure the cable.
- 2 Attach the larger 36-pin “D” connector to the printer.
- 3 Set up the printer configuration on the oscilloscope.
  - a Press the **Utility** key, then press the **Print Confg** softkey.
  - b Press the **Print to:** softkey and set the interface to **Parallel**.
  - c Press the **Format** softkey and select your printer format from the list.

For more information on printer configuration, refer to the “Utilities” chapter in the User’s Guide.

---

## To connect an RS-232 cable

The oscilloscope can be connected to a controller or a PC through the RS-232 connector on the rear of the oscilloscope. An RS-232 cable is shipped with each 54622A/22D/24A oscilloscope and may be purchased for the 54621A/21D oscilloscopes.

- 1 Attach the 9-pin “D” connector on the RS-232 cable to the RS-232 connector on the rear of the oscilloscope. Tighten the thumbscrews on the cable connector to secure the cable
- 2 Attach the other end of the cable to your controller or pc.
- 3 Set up the RS-232 configuration on the oscilloscope.
  - a Press the **Utility** key, then press the **I/O** softkey.
  - b Press the **Controller** softkey and select **RS-232**.
  - c Press the **Baud** softkey and set the baud rate to match your controller or pc.
  - d Press the **XON DTR** softkey and set the handshake to match your controller or pc.

For more information on RS-232 configuration, refer to the “Utilities” chapter in the User’s Guide.

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## To verify basic oscilloscope operation

- 1 Connect an oscilloscope probe to channel 1.
- 2 Attach the probe to the Probe Comp output on the lower-right side of the front panel of the oscilloscope.

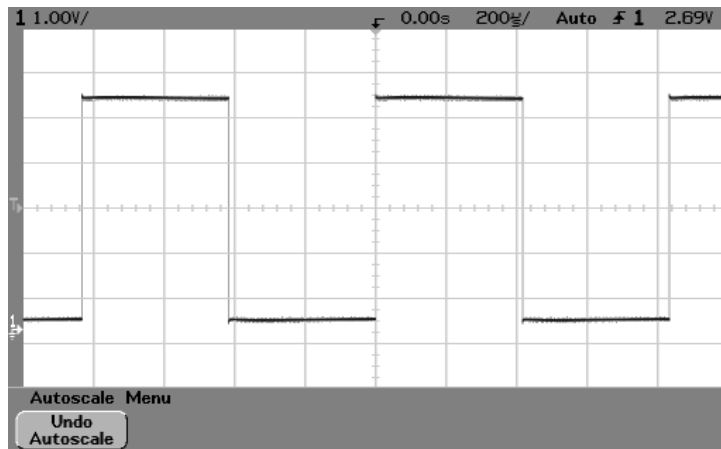
Use a probe retractable hook tip so you do not need to hold the probe.

- 3 Press the **Save/Recall** key on the front panel, then press the **Default Setup** softkey under the display.

The oscilloscope is now configured to its default settings.

- 4 Press the **Autoscale** key on the front panel.

You should then see a square wave with peak-to-peak amplitude of about 5 divisions and a period of about 4 divisions as shown below. If you do not see the waveform, ensure your power source is adequate, the oscilloscope is properly powered-on, and the probe is connected securely to the front-panel channel input BNC and to the Probe Comp calibration output.



**Verifying Basic Oscilloscope Operation**

---

## Getting started using the oscilloscope interface


When the oscilloscope is first turned on, it performs a self-test, then momentarily shows a startup screen as shown below.



This menu is only accessible when the oscilloscope first starts up.

- Press the **Getting Started** softkey to view the symbols used in the oscilloscope softkey menus.

 Use the Entry knob labeled  to adjust the parameter.

 Press the softkey to display a pop up with a list of choices. Repeatedly press the softkey until your choice is selected.


 Use the Entry knob labeled  or press the softkey to adjust the parameter.


 Option is selected and operational.


 Feature is on. Press the softkey again to turn the feature off.

 Feature is off. Press the softkey again to turn the feature on.

 Press the softkey to view the menu.

 Press the softkey to return to the previous menu.

 Press the softkey to view additional selections.

 Links you to another menu.

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## Using Quick Help

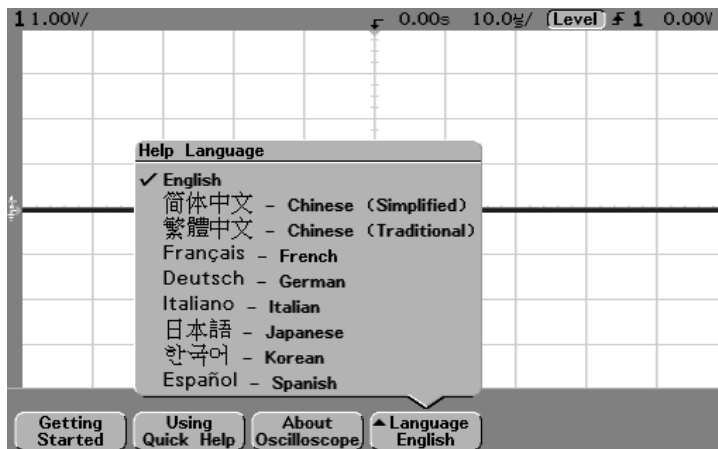
The oscilloscope has a Quick Help system that provides user help for each front-panel key and softkey on the oscilloscope. To view Quick Help information:

- 1 Press and hold down the key for which you would like to view help.
- 2 Release the key after reading the message. Releasing the key returns the oscilloscope to the previous state.

---

## Selecting a language for Quick Help when the oscilloscope starts up

When the oscilloscope first powers up, you can press the **Language** softkey to select a language for viewing Quick Help. Successive press the **Language** softkey until the desired language in the list selected.

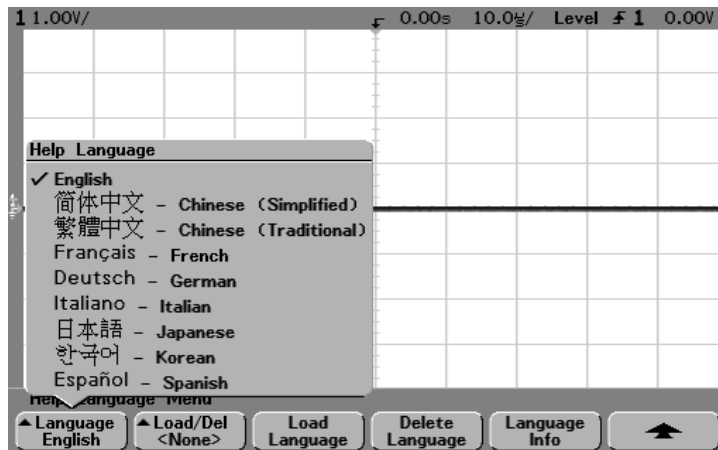


You can also select and load a language later from the **Utility Language** menu.

---

## Selecting a language for Quick Help after you have been operating the oscilloscope

- 1 Press the **Utility** key, then press the **Language** softkey to display the Language menu.
- 2 Press the **Language** softkey until the desired language in the list selected.



If the language you want to load is grayed-out in the list, you will need to load the language from floppy disk. The language file can be downloaded from [www.agilent.com/find/5462xsw](http://www.agilent.com/find/5462xsw) or call an Agilent center and request a language disk for your instrument

## Loading a language from floppy disk

Language files can be downloaded from [www.agilent.com/find/5462xsw](http://www.agilent.com/find/5462xsw) or call an Agilent center and request a language disk for your instrument.

- 1 Insert the floppy disk with a language file into the floppy disk drive on the oscilloscope.
- 2 Press the **Utility** key, then press the **Language** softkey to display the Language menu.
- 3 Press the **Load/Del** softkey to select the language to be loaded.
- 4 Press the **Load Language** softkey to load the selected language into the oscilloscope.

For more information about loading and deleting languages, refer to the “Utilities” chapter in the User’s Guide.



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## Cleaning the oscilloscope

- 1 Disconnect power from the instrument.

---

### **CAUTION**

#### **Avoid Damage to Sensitive Electronic Components!**

Do not use too much liquid in cleaning the oscilloscope. Water can enter the front-panel keyboard, control knobs, or floppy disk damaging sensitive electronic components.

- 
- 2 Clean the oscilloscope with a soft cloth dampened with a mild soap and water solution.
  - 3 Make sure that the instrument is completely dry before reconnecting to a power source.





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# Testing Performance

This chapter explains how to verify correct oscilloscope operation and perform tests to ensure that the oscilloscope meets the performance specifications.

To completely test and troubleshoot the oscilloscope, you will create and use two test connector accessories, as described in this chapter.

- The test connectors make it easy for you to connect the oscilloscope probes to function generators and measurement equipment with minimum electrical distortion.
- The connectors are used in the threshold and time interval tests.

---

## To construct the test connectors

The Agilent 54621D/22D Mixed-Signal Oscilloscope has digital channels that you will need to connect to test equipment during testing. To easily connect the digital channels, you will construct two test connectors.

**Construct Test Connectors Only for the 54621D/22D Mixed-Signal Oscilloscope**

You need to construct the test connectors only if you will be connecting the Agilent 54621D/22D Oscilloscope models to the test equipment.

**Table 3-1**

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### Materials Required to Construct the Test Connectors

---

Description	Recommended Part	Qty
BNC (f) Connector	Agilent 1250-1032	2
Berg Strip, 8-by-2		1
Berg Strip, 1-by-2		1
100 $\Omega$ 1% resistor	Agilent 0698-7212	2
Jumper wire		

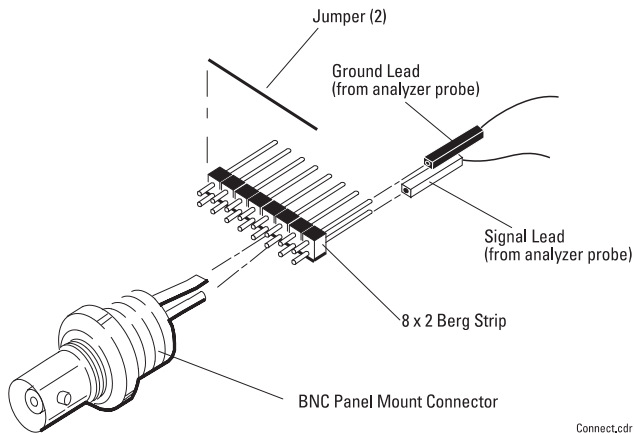
**To construct the test connectors**

**Build the 8-by-2 Test Connector**

You will build the 8-by-2 test connector as shown in the following diagram.

- 1 Obtain a BNC connector and an 8-by-2 section of Berg strip.
- 2 On one side of the Berg strip, solder a jumper wire to all of the pins.
- 3 On the other side of the Berg strip, solder another jumper wire to all of the pins.
- 4 Solder the center of the BNC connector to a center pin on one of the rows on the Berg strip.
- 5 Solder the ground tab of the BNC connector to a center pin on the other row on the Berg strip.

**Figure 3-1**



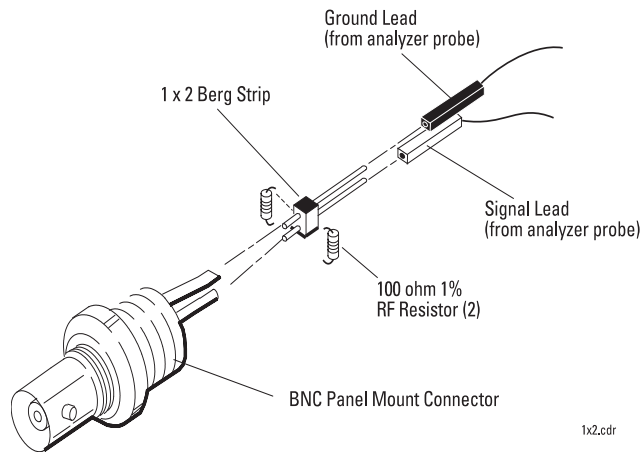
**Constructing the 8-by-2 Connector**

### Build the 1-by-2 Test Connector

You will build the 1-by-2 test connector as shown in the following diagram.

- 1 Obtain a BNC connector and a 1-by-2 section of Berg strip.
- 2 Solder two 100  $\Omega$ , 1% RF resistors to the Berg strip, one on each side in parallel across the two pins.
- 3 Solder the center of the BNC connector to one pin on the Berg strip.
- 4 Solder the ground tab of the BNC connector to the other pin on the Berg strip.

Figure 3-2



### Constructing the 1-by-2 Test Connector

## To test the 54621D/22D Oscilloscope digital channels

**Only the 54621D/22D Mixed-Signal Oscilloscope has Digital Channels**

You need to perform these instructions only if you will be testing the digital channels on the Agilent 54621D/22D Mixed-Signal Oscilloscope.

The acquisition system testing provides confidence that the acquisition system is functioning correctly. It does not, however, check a particular specification.

- 1** Disconnect all probes from the circuit under test and from any other input source.
- 2** Using probe leads and grabbers, connect digital channels D0, D1, D2, and D3 to the calibration point on the 54621D/22D front panel.
- 3** Press the **Autoscale** key.  
If four square waves appear, the acquisition system is functioning correctly.  
If the square waves do not appear, go to the “Troubleshooting” chapter. Then return here to finish testing the digital channels.
- 4** Disconnect the digital channels from the calibration point.
- 5** Use steps 2 and 3 to test the following sets of digital channels. After you test one set of digital channels, remove them before connecting the next set.
  - D4, D5, D6, D7
  - D8, D9, D10, D11
  - D12, D13, D14, D15



## To verify threshold accuracy

This test verifies the data channel threshold accuracy specification of the Agilent 54621D/22D Mixed-Signal Oscilloscope.

### Test Threshold Accuracy only on the 54621D/22D Mixed-Signal Oscilloscope

You need to perform these instructions only if you will be testing the Agilent 54621D/22D Mixed-Signal Oscilloscope.

### When to Test

You should perform this test every 24 months or after 4000 hours of operation, whichever comes first.

### What to Test

Use these instructions to test the threshold settings of digital channels D7-D0. Then, use the same instructions to test digital channels D15-D8.

### Verifying Test Results

After each threshold test, record the voltage reading in the Performance Test Record at the end of this chapter. To verify whether a test passes, verify that the voltage reading is within the limits in the Performance Test Record.

### Let the Equipment Warm Up Before Testing

For accurate test results, let the test equipment and the oscilloscope warm up 30 minutes before testing.

Table 3-2

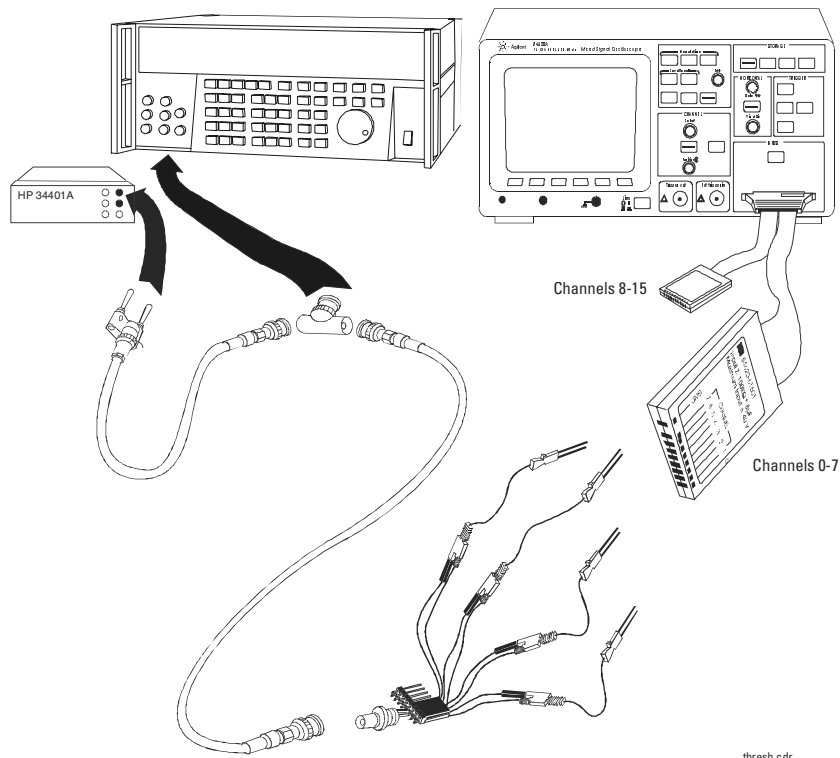
### Equipment Required to Test Threshold Accuracy

Equipment	Critical Specifications	Recommended Model/Part
Digital Multimeter	0.1 mV resolution, 0.005% accuracy	Agilent 34401A
Oscilloscope Calibrator	DC offset voltage 6.3 V	Fluke 5820A
BNC-Banana Cable		Agilent 11001-60001
BNC Tee		Agilent 1250-0781
BNC Cable		Fluke 50- $\Omega$ cable, P/N 686318
BNC Test Connector, 8-by-2		User-built (See "Build the 8-by-2 Test Connector" on page 3-4.)
Test Fixture	PV test fixture	Agilent 01660-63801
Probe Cable		Agilent 01650-61607

Testing Performance  
To verify threshold accuracy

- 1 Turn on the test equipment and the oscilloscope. Let them warm up for 30 minutes before starting the test.
- 2 Set up the oscilloscope calibrator.
  - a Set the oscilloscope calibrator to provide a DC offset voltage at the Channel 1 output.
  - b Use the multimeter to monitor the oscilloscope calibrator DC output voltage.
- 3 Use either method 1 or method 2, described in the following, to connect the digital channels for testing.
  - a **Method 1 — Using the Test Connector**  
Use the 8-by-2 test connector and the BNC cable assembly to connect digital channels D0-D7 to one side of the BNC Tee. Then connect the D0-D7 ground lead to the ground side of the 8-by-2 connector. See figure 3-3.

Figure 3-3

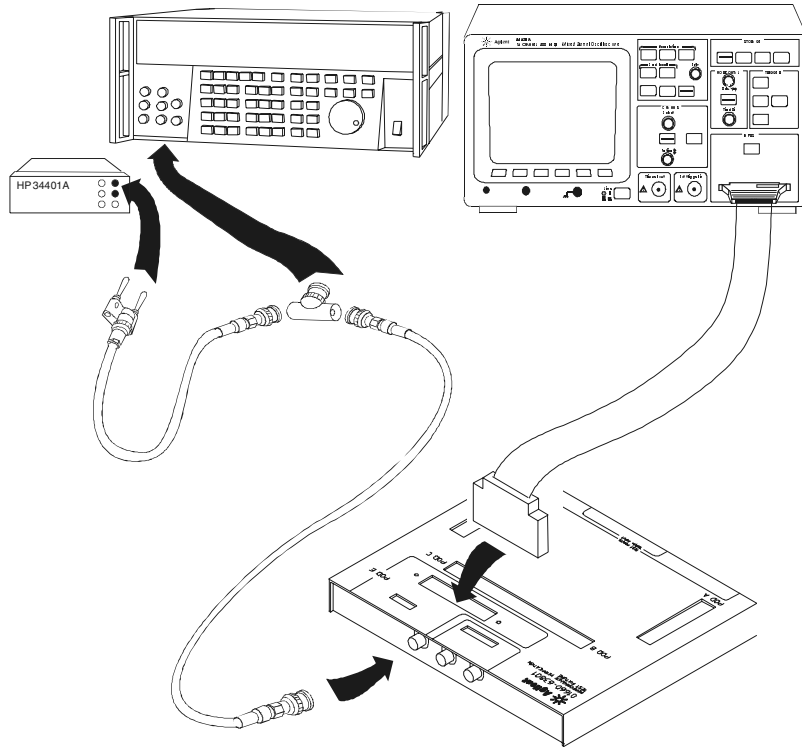


Setting Up Equipment and Test Connector for the Threshold Test

**b Method 2 — Using the Test Fixture**

Use the Agilent 01660-63801 Performance Verification Test Fixture and the Agilent 01650-61607 cable, BNC Tee, and BNC cable to connect the digital channels D0 - D15 to the oscilloscope calibrator. See figure 3-4.


**Figure 3-4**



**Setting Up Equipment and Test Fixture for the Threshold Test**

- 4 Use a BNC-banana cable to connect the multimeter to the other side of the BNC Tee.
- 5 Connect the BNC Tee to the Channel 1 output of the calibrator as shown in figure 3-3 and figure 3-4.

**To verify threshold accuracy**

- 6 On the oscilloscope, press the **D7 Thru D0** softkey, then press the **Threshold** softkey and select **User**.
- 7 Press the **User** softkey, then turn the Entry knob (labeled  on the front panel) on the oscilloscope to set the threshold test settings as shown in Table 3-3.

**Table 3-3****Threshold Accuracy Voltage Test Settings**

<b>Threshold Voltage</b>	<b>DC Offset Voltage</b>
+5.0	+5.252 V $\pm$ 1 mV DC
-5.0	-4.748 V $\pm$ 1 mV DC
0.0	+0.102 V $\pm$ 1 mV DC

- 8 Do the following steps for each of the threshold voltage levels shown in Table 3-3.
  - a Select the threshold voltage using the Entry knob on the oscilloscope.
  - b Enter the corresponding DC offset voltage on the oscilloscope calibrator front panel. Then use the multimeter to verify the voltage.
 

The activity indicators appear for several seconds after you press the variable threshold softkey, and are displayed on the status line at the top of the display. The oscilloscope activity indicators for D7-D0 should show all of the channels at digital high levels.
  - c Use the knob on the oscilloscope calibrator to decrease the offset voltage, in increments of 10 mV, until the activity indicators for digital channels D0-D7 are all at digital low levels. Record the oscilloscope calibrator voltage in the performance test record.
  - d Use the knob on the oscilloscope calibrator to increase the offset voltage, in increments of 10 mV, until the activity indicators for digital channels D7-D0 are all at digital high levels. Record the oscilloscope calibrator voltage in the performance test record.

Before proceeding to the next step, make sure that you have recorded the oscilloscope calibrator voltage levels for each of the threshold settings shown in Table 3-3.
- 9 Use the 8-by-2 test connector or the Agilent 01660-63801 Test Fixture to connect digital channels D15-D8 to the output of the oscilloscope calibrator. Then connect the D15-D8 ground lead to the ground side of the 8-by-2 connector.
- 10 Repeat this procedure for digital channels D15-D8 to verify threshold accuracy and record the threshold levels in the Performance Test Record.

---

## To verify voltage measurement accuracy

This test verifies the voltage measurement accuracy. In this test, you will measure the output of a power supply using dual cursors on the oscilloscope, and compare the results with the multimeter reading.

Test limits:  $\pm 1.5\%$  of full scale  $\pm 1$  LSB\*

- Full scale is defined as 16 mV on the 1 mV/div range.
- Full scale on all other ranges is defined as 8 divisions times the V/div setting.

\*1 LSB = 0.4% of full scale

**Table 3-4**

---

### Equipment Required to Verify Voltage Measurement Accuracy

---

Equipment	Critical Specifications	Recommended Model/Part
Power supply	14 mV to 35 Vdc, 0.1 mV resolution	Fluke 5820A or Agilent 3245A
Digital multimeter	Better than 0.01% accuracy	Agilent 34401A
Cable	BNC, Qty 2	Agilent 10503A
Shorting cap	BNC	Agilent 1250-0774
Adapter	BNC (f) to banana (m)	Agilent 1251-2277
Adapter	BNC tee (m) (f) (f)	Agilent 1250-0781
Blocking capacitor		Agilent 10240B

Do this procedure first for Channel 1. Then repeat the procedure for Channel 2.

- 1 Set up the oscilloscope.
  - a Adjust the channel 1 position knob to place the baseline at approximately 0.5 division from the bottom of the display.

**To verify voltage measurement accuracy**


- b Set the Volts/Div setting to the value in the first line in Table 3-5.

**Table 3-5****Settings Used to Verify Voltage Measurement Accuracy**

<b>Volts/Div Setting</b>	<b>Power Supply Setting</b>	<b>Test Limits</b>	
5 V/Div	35 V	34.24 V	to 35.76 V
2 V/Div	14 V	13.696 V	to 14.304 V
1 V/Div	7 V	6.848 V	to 7.152 V
0.5 V/Div	3.5 V	3.424 V	to 3.576 V
0.2 V/Div	1.4 V	1.3696 V	to 1.4304 V
0.1 V/Div	700 mV	684.8 mV	to 715.2 mV
50 mV/Div	350 mV	342.4 mV	to 357.6 mV
20 mV/Div	140 mV	136.96 mV	to 143.04 mV
10 mV/Div	70 mV	68.48 mV	to 71.52 mV
5 mV/Div	35 mV	34.24 mV	to 35.76 mV
2 mV/Div	14 mV	13.696 mV	to 14.304 mV
1 mV/Div*	7 mV	6.696 mV	to 7.304 mV

\*Full scale is defined as 16 mV on the 1 mV/div range.

Full scale on all other ranges is defined as 8 divisions times the V/div setting.

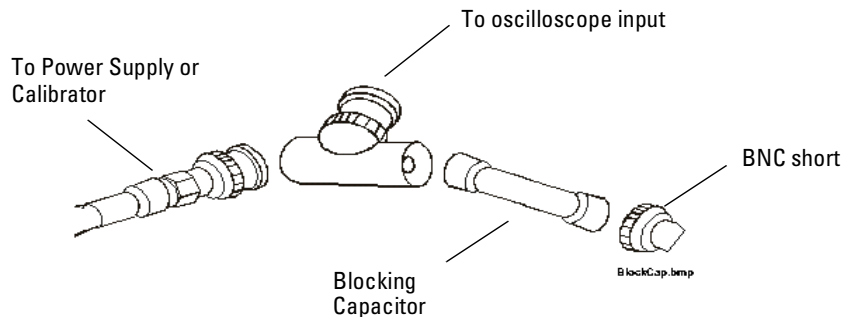
- c Press the **Acquire** key. Then press the **Averaging** softkey and set **#Avgs** to 64.  
Wait a few seconds for the measurement to settle.
- 2 Press the **Cursors** key, set the **Mode** softkey to **Normal**, then press the **X Y** softkey and select **Y**. Press the **Y1** softkey, then use the Entry knob (labeled  on the front panel) to set the Y1 cursor on the baseline of the signal.

- 3 Use the BNC tee and cables to connect the oscilloscope calibrator / power supply to both the oscilloscope and the multimeter.
- 4 Adjust the output so that the multimeter reading displays the first Volts/div supply setting value in Table 3-5.  
Wait a few seconds for the measurement to settle.
- 5 Press the **Y2** softkey, then position the Y2 cursor to the center of the waveform using the Entry knob.  
The  $\Delta Y$  value on the lower line of the display should be within the test limits of Table 3-5. If a result is not within the test limits, see the “Troubleshooting” chapter. Then return here.
- 6 Continue to check the voltage measurement accuracy with the remaining Volts/div setting values in Table 3-5.
- 7 When you are finished checking all of the power supply setting values, disconnect the power supply from the oscilloscope.
- 8 Repeat this procedure for Channels 2, 3, and 4, if applicable on your oscilloscope model.

#### Use a Blocking Capacitor to Reduce Noise

On the more sensitive ranges, such as 1 mV/div, 2 mV/div, and 5 mV/div, noise may be a factor. To eliminate the noise, use a BNC Tee, blocking capacitor, and BNC short to shunt the noise to ground. See figure 3-5.

Figure 3-5



Using a Blocking Capacitor to Reduce Noise

---

## To verify bandwidth

This test verifies bandwidth. In this test you will use an oscilloscope calibrator with a level sinewave output.

You will use the peak-to-peak voltage at both 1 MHz and 100 MHz to verify the bandwidth response of the oscilloscope. You will then repeat the test at 5 mV/div (75-MHz bandwidth).

Test limits at 10 mV/div to 5 V/div:

- All channels ( $\pm 3$  dB)
  - dc to 100 MHz
  - ac coupled 10 Hz to 100 MHz

Test limits at <10 mV/div:

- All channels ( $\pm 3$  dB)
  - dc to 75 MHz
  - ac coupled 10 Hz to 75 MHz

**Table 3-6**

---

**Equipment Required to Verify Bandwidth**

---

<b>Equipment</b>	<b>Critical Specifications</b>	<b>Recommended Model/Part</b>
Oscilloscope Calibrator		Fluke 5820A
Cable *	Type N (m), 24-inch	Agilent 11500B
Feedthrough	50 $\Omega$ , BNC (m) and (f)	Agilent 11048C

\* The oscilloscope calibrator is supplied with 2 or more coaxial cables N (m), BNC (m), 1 meter long, Fluke P/N 686318.



- 1 Connect the oscilloscope calibrator output through a 50  $\Omega$  feedthrough to the oscilloscope channel 1 input.
- 2 Set up the oscilloscope.
  - a Set the time base to 500 ns/div.
  - b Set the Volts/Div for channel 1 to 200 mV/div.
  - c Press the **Acquire** key, then press the **Averaging** softkey.
  - d Turn the Entry knob to set **# Avgs** to 8 averages.
- 3 Set the calibrator for 1 MHz and six divisions of amplitude.
- 4 Press the **Quick Meas** key, then press the **Peak-Peak** softkey.

Wait a few seconds for the measurement to settle (averaging is then complete).  
View the Pk-Pk reading at the bottom of the display.

Record the reading:  $V_{p-p} = \text{_____ V}$ .

- 5 Change the frequency of the signal generator to 100 MHz.
- 6 Change the time base to 5 ns/div.
  - a Wait a few seconds for the measurement to settle.
  - b View the Pk-Pk reading at the bottom of the display.
  - c Record the reading:  $V_{p-p} = \text{_____ mV}$ .
- 7 Calculate the response using this formula:

$$20 \log 10 \cdot \frac{\text{Step6Result}}{\text{Step4Result}}$$

If the result is not  $\pm 3$  dB, see the “Troubleshooting” chapter. Then return here.

- 8 Repeat this procedure (steps 1 to 7) for channel 2, 3, and 4, as applicable to your oscilloscope model.

Proceed to the next step after you have completed the procedure for channels 2, 3, and 4, as applicable.
- 9 Repeat this procedure (steps 1 to 8) using a 5 mV/div (75 MHz) setting.

---

## To verify horizontal $\Delta t$ and $1/\Delta t$ accuracy

This test verifies the horizontal  $\Delta t$  and  $1/\Delta t$  accuracy. In this test, you will use the oscilloscope to measure the output of a time mark generator.

Test limits:  $\pm 0.01\%$   $\pm 0.2\%$  of full scale  $\pm 40$  ps (same channel)

**Table 3-7**

**Equipment Required to Verify Horizontal  $\Delta t$  and  $1/\Delta t$  Accuracy**

Equipment	Critical Specifications	Recommended Model/Part
Oscilloscope Calibrator	Stability 5 ppm after 1/2 hour	Fluke 5820A
Cable	BNC, 3 feet	Agilent 10503A
Termination	50 $\Omega$ , BNC connectors (m) and (f)	Agilent 11048C

- 1 Connect the oscilloscope calibrator to channel 1 using the 50  $\Omega$  feedthrough at the oscilloscope input. Then, select **Marker** and set the calibrator for 0.1 ms markers.
- 2 Set up the oscilloscope.
  - a Press the **Display key**, then set the **Vectors** softkey to off.
  - b Press the **Autoscale** key.
  - c Set the time base to 20 ms/div.
  - d Press the **Main/Delayed** key, then set the **Time Ref** softkey to **Left**.
  - e Adjust the Trigger Level knob to obtain a stable display.
- 3 Press the **Quick Meas** softkey, set the **Source** softkey to **1**, then press the **Frequency** softkey and the **Period** softkey. Measure the following:

Frequency 10 kHz — The test limits are 9.96 kHz to 10.04 kHz.

Period 100 ms — The test limits are 99.59 ms to 100.41 ms.

If the measurements are not within the test limits, see the “Troubleshooting” chapter. Then return here.

**4** Change the calibrator to 1-ms markers. Change the time base to 200 microseconds/div. Adjust the trigger level to obtain a stable display.

**5** Measure the following:

Frequency 1 MHz — The test limits are 995.9 kHz to 1.0042 MHz.

Period 1 ms — The test limits are 995.9 ns to 1.0041 ms.

If the measurements are not within the test limits, see the “Troubleshooting” chapter. Then return here.

**6** Change the calibrator to 10-ns markers. Change the time base to 5 ns/div. Adjust the trigger level to obtain a stable display.

**7** Measure the following:

Frequency 100 MHz — The test limits are 98.61 MHz to 101.43 MHz.

Period 10 ns — The test limits are 9.86 ns to 10.14 ns.

If the measurements are not within the test limits, see the “Troubleshooting” chapter. Then return here.

## To verify trigger sensitivity

This test verifies the trigger sensitivity. In this test, you will apply 25 MHz to the oscilloscope. You will then decrease the amplitude of the signal to the specified levels, and check to see if the oscilloscope is still triggered. You will then repeat the process at the upper bandwidth limit.

Test limits for the Internal trigger:

1 mV/div to < 10 mV/div

dc to 25 MHz: 1.0 div or 2.0 mV<sub>p-p</sub>

25 MHz to 100 MHz: 1.5 div or 3.0 mV<sub>p-p</sub>

10 mV/div to 5 V/div

dc to 25 MHz: 0.35 div or 3.5 mV<sub>p-p</sub>

25 MHz to 100 MHz: 1.0 div or 10.0 mV<sub>p-p</sub>

Test limits for the External trigger:

dc to 25 MHz: 50 mV<sub>p-p</sub>

25 MHz to 100 MHz: 100 mV<sub>p-p</sub>

**Table 3-8**

**Equipment Required to Verify Trigger Sensitivity**

<b>Equipment</b>	<b>Critical Specifications</b>	<b>Recommended Model/Part</b>
Oscilloscope Calibrator	25-MHz and 100-MHz sine waves	Fluke 5820A
Power splitter	Outputs differ < 0.15 dB	Agilent 11667B
Cable *	BNC, Qty 3	Agilent 10503A
Adapter	N (m) to BNC (f), Qty 3	Agilent 1250-0780
Feedthrough	50Ω, BNC connectors (m) and (f)	Agilent 11048C (2 required)

\* The oscilloscope calibrator is supplied with 2 or more coaxial cables N (m), BNC (m), 1 meter long, Fluke P/N 686318.

### Test Internal Trigger Sensitivity

- 1 Press the **Save/Recall** key, then press the **Default Setup** softkey.
- 2 Connect the calibrator to channel 1 using a 50  $\Omega$  feedthrough at the oscilloscope input.
- 3 Verify the trigger sensitivity at 25 MHz and 0.35 divisions.
  - a Set the output of the calibrator to 25 MHz, and set the amplitude to about 100 mV.
  - b Press the **Autoscale** key.
  - c Set the time base to 50 ns/div.
  - d Set channel 1 to 100 mV/div.
  - e Decrease the output of the calibrator until 0.35 vertical divisions of the signal are displayed.

The trigger should be stable. If the trigger is not stable, try adjusting the trigger level. If adjusting the trigger level makes the trigger stable, the test still passes. If adjusting the trigger does not help, see the “Troubleshooting” chapter. Then return here.
  - f Record the result as Pass or Fail in the Performance Test Record.
- 4 Verify the trigger sensitivity at 100 MHz and 1 division.
  - a Change the output of the calibrator to 100 MHz, and set the amplitude to about 100 mV.
  - b Set the time base to 10 ns/div.
  - c Decrease the output of the calibrator until 1 vertical division of the signal is displayed.

The trigger should be stable. If the trigger is not stable, try adjusting the trigger level. If adjusting the trigger level makes the trigger stable, the test still passes. If adjusting the trigger does not help, see the “Troubleshooting” chapter. Then return here.
  - d Record the result as Pass or Fail in the Performance Test Record.
- 5 Repeat this procedure for channels 2, 3, and 4, as applicable to your oscilloscope model.

Testing Performance  
**To verify trigger sensitivity**

**Test External Trigger Sensitivity**

Verify the external trigger sensitivity at these settings:

100 MHz, 100 mV<sub>p-p</sub>

25 MHz, 50 mV<sub>p-p</sub>.

- 1** Use the power splitter to connect the calibrator to both the channel 1 input and the external trigger input. The Ext Trigger input is on the rear panel of the mixed-signal oscilloscope and the 4-channel oscilloscope. Connect 50Ω feedthroughs to the oscilloscope inputs.
- 2** Change the output of the calibrator to 100 MHz, and set the amplitude to 70.7 mV<sub>rms</sub> (200 mV<sub>p-p</sub>).  
The power splitter divides the 200 mV<sub>p-p</sub> so that 100 mV<sub>p-p</sub> is applied to each of the oscilloscope inputs.
- 3** Press the **Autoscale** key.
- 4** Press the Trigger **Edge** key, then press the **Ext** softkey to set the trigger source to external trigger.
- 5** Check for stable triggering, and adjust the trigger level if necessary.
- 6** Record the results as Pass or Fail in the Performance Test Record.  
If the test fails, see the “Troubleshooting” chapter. Then return here.
- 7** Change the output of the calibrator to 25 MHz and set the amplitude to 35.4 mV<sub>rms</sub> (100 mV<sub>p-p</sub>).
- 8** Check for stable triggering, and adjust the trigger level if necessary.
- 9** Record the results as Pass or Fail in the Performance Test Record.  
If the test fails, see the “Troubleshooting” chapter. Then return here.

# Performance Test Record

Enter values from testing in this Performance Test Record.

Performance Test Record for the 54621A/22A/24A Oscilloscope and 54621D/22D Mixed-Signal Oscilloscope						
Serial No. _____			Test by _____			
Test Interval _____			Work Order No. _____			
Recommended Next Testing _____			Temperature _____			
<b>Threshold</b>	<b>Specification</b>	<b>Limits</b>	<b>Ch D7-D0</b>	<b>Ch D15-D8</b>		
<b>Accuracy Test</b>	5 V - 250 mV	4.750 V	_____	_____		
<b>(100 mV + 3% of threshold setting)</b>	5 V + 250 mV	5.250 V	_____	_____		
	-5 V - 250 mV	-5.250 V	_____	_____		
	-5 V + 250 mV	-4.750 V	_____	_____		
	0 V - 100 mV	-100 mV	_____	_____		
	0 V + 100 mV	100 mV	_____	_____		
<b>Voltage Measurement Accuracy</b>						
<b>Range</b>	<b>Power Supply Setting</b>	<b>Test Limits</b>	<b>Channel 1</b>	<b>Channel 2</b>	<b>Channel 3</b>	<b>Channel 4</b>
5 V/Div	35 V	34.24 V to 35.76 V	_____	_____	_____	_____
2 V/Div	14 V	13.696 V to 14.304 V	_____	_____	_____	_____
1 V/Div	7 V	6.848 V to 7.152 V	_____	_____	_____	_____
500 mV/Div	3.5 V	3.424 V to 3.576 V	_____	_____	_____	_____
200 mV/Div	1.4 V	1.3696 V to 1.4304 V	_____	_____	_____	_____
100 mV/Div	700 mV	684.8 mV to 715.2 mV	_____	_____	_____	_____
50 mV/Div	350 mV	342.4 mV to 357.6 mV	_____	_____	_____	_____
20 mV/Div	140 mV	136.96 mV to 143.04 mV	_____	_____	_____	_____
10 mV/Div	70 mV	68.48 mV to 71.52 mV	_____	_____	_____	_____
5 mV/Div	35 mV	34.24 mV to 35.76 mV	_____	_____	_____	_____
2 mV/Div	14 mV	13.696 mV to 14.304 mV	_____	_____	_____	_____
1 mV/Div	7 mV	6.696 mV to 7.304 mV	_____	_____	_____	_____
<b>Bandwidth</b>		<b>Test Limits</b>	<b>Channel 1</b>	<b>Channel 2</b>	<b>Channel 3</b>	<b>Channel 4</b>
		3 dB at 100 MHz	_____	_____	_____	_____
		3 dB at 75 MHz	_____	_____	_____	_____
<b>Horizontal <math>\Delta t</math> and <math>1/\Delta t</math> Accuracy</b>						
	<b>Generator Setting</b>	<b>Test Limits</b>	<b>Results</b>			
Frequency	10 kHz	9.96 kHz to 10.04 kHz	_____			
Period	100 ms	99.59 ms to 100.41 ms	_____			
Frequency	1 MHz	995.9 kHz to 1.0042 MHz	_____			
Period	1 ms	995.9 ns to 1.0041 ms	_____			
Frequency	100 MHz	98.61 MHz to 101.43 MHz	_____			
Period	10 ns	9.86 ns to 10.14 ns	_____			
<b>Trigger Sensitivity</b>		<b>Test Limits</b>	<b>Channel 1</b>	<b>Channel 2</b>	<b>Channel 3</b>	<b>Channel 4</b>
Internal trigger		25 MHz at 0.35 divisions	_____	_____	_____	_____
		100 MHz at 1 division	_____	_____	_____	_____
External trigger		100 MHz at 100 mV <sub>p-p</sub>	_____	_____	_____	_____
		25 MHz at 50 mV <sub>p-p</sub>	_____	_____	_____	_____







---

# Calibrating and Adjusting

This chapter explains how to adjust the oscilloscope for optimum operating performance. You should perform the hardware adjustments and self-calibration according to the following recommendations.

- Perform hardware adjustments every 12 months or after 2,000 hours of operation.
- Perform self-calibration:
  - every 6 months or after 1000 hours of operation
  - if the ambient temperature is  $>10$  °C from the calibration temperature
  - if you want to maximize the measurement accuracy

The amount of use, environmental conditions, and experience with other instruments help determine if you need shorter adjustment intervals.

In this chapter, you will:

- Adjust the power supply
- Perform self-calibration
- Adjust the low-frequency compensation
- Adjust the high-frequency pulse response
- Adjust the display

## **Let the Equipment Warm Up Before Adjusting**

Before you start the adjustments, let the oscilloscope and test equipment warm up for at least 30 minutes.

## **Read All Cautions and Warnings**

Read the following cautions and warning before making adjustments or performing self-calibration.

---

**WARNING****HAZARDOUS VOLTAGES !**

Read the safety summary at the back of this book before proceeding.

Maintenance 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.

---

---

**CAUTION****REMOVE POWER TO AVOID DAMAGE !**

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

---

---

**CAUTION****USE EXTERNAL FAN TO REDUCE TEMPERATURE !**

When you must operate the oscilloscope with its cover removed, use an external fan to provide continuous air flow over the samplers. Air flow over the samplers is reduced when the cover is removed, which leads to higher than normal operating temperatures. Have the fan blow air across the system PC board where the heat sinks are located.

---

---

**CAUTION****AVOID DAMAGE TO ELECTRONIC COMPONENTS !**

Electrostatic discharge (ESD) can damage electronic components. When you use any of the procedures in this chapter, use proper ESD precautions. As a minimum, place the oscilloscope on a properly grounded ESD mat and wear a properly grounded ESD strap.

---

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## To adjust the power supply

The oscilloscope power supply has both a +3.3 V adjustment, and a +5.1 V / -5.2 V balance adjustment. Other oscilloscope voltages are based on the +3.3 V adjustment.

In this procedure, you will use a digital multimeter to measure the +3.3 V and +5.1 V / -5.2 V test points, and adjust the power supplies to be within tolerance, if necessary.

**Table 4-1**

---

**Equipment Required to Adjust the Power Supply**

---

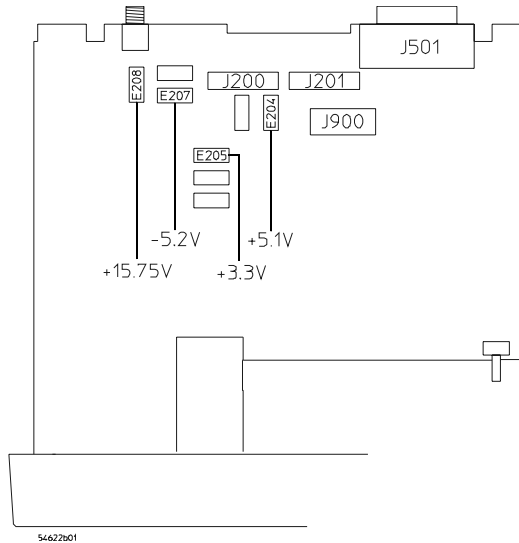
<b>Equipment</b>	<b>Critical Specifications</b>	<b>Recommended Model/Part</b>
Digital multimeter	0.1 mV resolution, accuracy $\pm 0.05\%$	Agilent 34401A

- 1** Prepare the oscilloscope for the voltage adjustment.
  - a** Turn off the oscilloscope and disconnect the power cable.
  - b** Remove the oscilloscope cover. For a list of parts, see the “Replaceable Parts” chapter, then return here.
  - c** Place the oscilloscope on its side.
  - d** Connect the negative lead of the digital multimeter to a ground point on the oscilloscope chassis.
  - e** Reconnect the power cable.
  - f** Turn on the oscilloscope.

- 2 Locate the power supply voltages at E204, E205, E207, and E208 on the system board.

The power supply voltages are not labeled on the system board. See Figure 4-1 for the locations.

**Figure 4-1**



**Low Voltage Power Supply Voltages (on the bottom of the oscilloscope)**

- 3 Make sure that the voltage measurements are within the tolerances listed in Table 4-2.

**Table 4-2**

**Power Supply Voltage Tolerances**

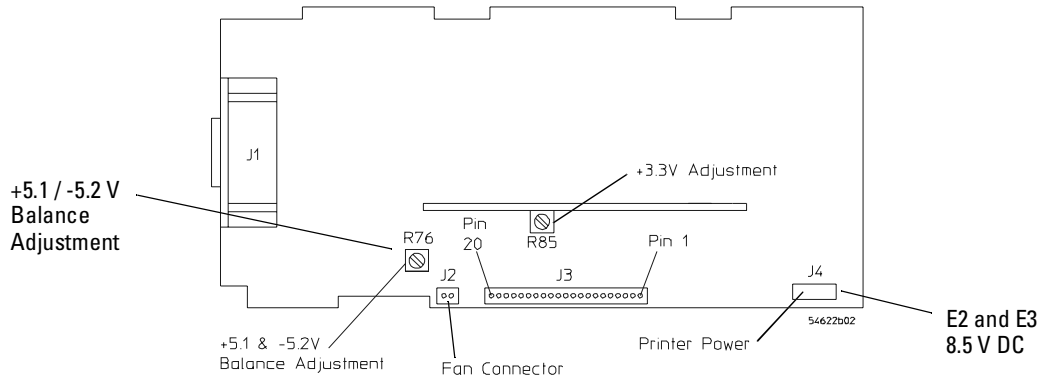
Supply Voltage	Tolerance
+5.1 V	±250 mV (4.85 V to 5.35 V)
-5.2 V	±156 mV (-5.04 V to -5.36 V)
+15.75 V	+1.260 V, -787 mV (+14.963 V to +17.010 V)
+3.3 V	±100 mV (+3.20 V to +3.40 V)
+8.2 V	±82 mV (+8.12 V to +8.28 V) measure at J4 on the power supply board

## Calibrating and Adjusting

### To adjust the power supply

- 4 If the +5.1 V measurement is out of tolerance, adjust the +5.1 V / -5.2 V balance adjustment on the power supply. See Figure 4-2.
- 5 If the -5.2 V measurement is out of tolerance, adjust the +5.1 V / -5.2 V balance adjustment on the power supply. See Figure 4-2.  
The +15.75 V supply is not adjustable, and is dependent upon the +5.1 V supply.

**Figure 4-2**



#### **Low Voltage Power Supply Adjustments (on the top of the oscilloscope)**

- 6 If adjusting the power supply does not bring all the voltages within tolerance, go to the “Troubleshooting” chapter.

## To perform User Cal

User Cal performs an internal self-alignment routine to optimize the signal path in the oscilloscope. The routine uses internally generated signals to optimize circuits that affect channel sensitivity, offset, and trigger parameters. Disconnect all inputs and allow the oscilloscope to warm up before performing this procedure.

User Cal should be performed at least once a year, any time the ambient temperature of the oscilloscope has changed more than 10 °C since the last User Cal, or after any repair.

Performing User Cal will not invalidate your Certificate of Calibration. Successful completion of User Cal does not certify this oscilloscope with a National Institute of Standards and Technology (NIST) calibration.

- 1** Disconnect all inputs signals from the oscilloscope
- 2** Set the rear-panel CALIBRATION switch to UNPROTECTED.
- 3** Press the **Utility** key, then press the **Service** softkey.
- 4** Begin the Self Cal by pressing the **User Cal** softkey.
- 5** When the User Cal is completed, set the rear-panel CALIBRATION switch to PROTECTED.

---

## To adjust the oscilloscope display

### When to Adjust the Oscilloscope Display

The oscilloscope display normally does not require adjustment. However, when it is obvious that the display is out of adjustment, use this optional procedure.

In this procedure, you will make adjustments using two display patterns.

**Table 4-3**

---

### Equipment Required to Adjust the Oscilloscope Display

---

Equipment	Critical Specifications	Recommended Model/Part
Digital multimeter	Accuracy $\pm 0.05\%$ , 1 mV resolution	Agilent 34401A

- 1 Connect the digital multimeter to the end of R901, located closest to the fuse, as shown in Figure 4-3.
- 2 Adjust **+B ADJ** for +14.00 V.

In the remainder of this procedure, you will make adjustments to:

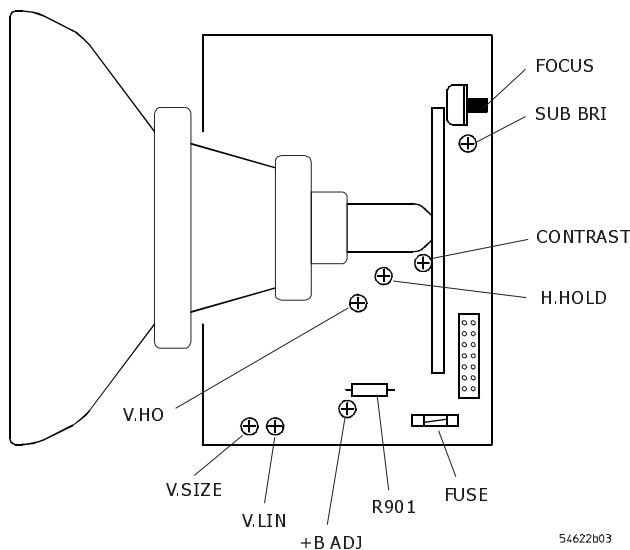
V.HO	(vertical hold)
Intensity	(intensity control on oscilloscope front panel)
Sub Bri	(sub bright)
Cont	(contrast)
H.Hold	(horizontal hold)
Focus	
V.Lin	(vertical linearity)
V.Size	(vertical size)

- 3 Adjust **V.HO** (vertical hold) for vertical synchronization.
- 4 Set the INTENSITY control (on the front panel) to approximately 50%.
- 5 Adjust **Sub Bri** (sub bright) to the lowest setting so that the half-bright borders around the display are visible.



- 6 Adjust **Cont** (contrast) to achieve the best contrast between the half-bright borders and the full-bright softkeys.  
Re-adjust **Sub Bri**, the INTENSITY control, and **Cont** to suit your preference, if necessary.
- 7 Adjust **H.Hold** (horizontal hold) to center the display horizontally.
- 8 Adjust **Focus** to achieve the best focus.
- 9 Adjust **V.Lin** (vertical linearity) to position all four corners of the half-bright borders equally.
- 10 Adjust **V.Size** (vertical size) to center the display vertically at the maximum allowable size without losing the half-bright borders.  
Because V.Lin and V.Size interact with each other, you may need to re-adjust the sizing and vertical centering of the pattern on the display.

Figure 4-3



Oscilloscope Display Board Adjustments





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# Troubleshooting

This chapter begins with suggestions for solving general problems that you may encounter with the oscilloscope. It tells you what to do in these cases:

- If there is no trace display
- If the trace display is unusual or unexpected
- If you cannot see a channel
- If you cannot get any response from the oscilloscope

Procedures for troubleshooting the oscilloscope follow the problem solving suggestions. The troubleshooting section shows you how to:

- Check out the oscilloscope
- Clear error messages from the display
- Check the low voltage power supply
- Run internal self-tests

## **Using the Dummy Load**

Before you begin troubleshooting, you must either already have the dummy load that is mentioned, or you must construct one, as described in this chapter. You will use this dummy load while troubleshooting.

### **Read All Cautions and Warnings**

Before you begin any troubleshooting, read all Warning and Cautions in the "Troubleshooting" section.

---

# Solving General Problems with the Oscilloscopes

This section describes how to solve general problems that you may encounter while using the 54621A/22A/24A Oscilloscopes and the 54621D/22D Mixed-Signal Oscilloscopes to make measurements.

After troubleshooting the oscilloscope, if you need to replace parts, refer to the “Replaceable Parts” chapter.

---

## If there is no trace display

- ❑ Check that the power cord is connected to the oscilloscope and to a live power source.
- ❑ Check that the front-panel power switch is set to 1 (on).
- ❑ Check that the display is illuminated and that the INTENSITY knob is adjusted correctly.
- ❑ If there is no display, go to the troubleshooting procedures in this chapter.
- ❑ Check that the oscilloscope probe lead wires are securely inserted into the connector assembly and that the probe clips make good contact with the probe lead wires.
- ❑ Check that the probe clips are securely connected to points in the circuit under test, and that the ground is connected.
- ❑ Check that the circuit under test is powered on.
- ❑ Press the **Autoscale** key.
- ❑ Reset the oscilloscope.
  - To reset the entire oscilloscope, press and hold any softkey and switch the oscilloscope power on. Release the softkey when the display appears.
- ❑ Obtain service from Agilent Technologies, if necessary.

## If the trace display is unusual or unexpected

- ❑ Check that the Horizontal time/division setting is correct for the expected frequency range of the input signals.
- ❑ The sampling speed of the oscilloscope depends on the time/division setting. It may be that when the time/division setting is slower than 1 ms/div, the oscilloscope is sampling too slowly to capture all of the transitions on the waveform.
- ❑ Check that all oscilloscope probes are connected to the correct signals in the circuit under test.
- ❑ Check to see that the ground lead on the cable is securely connected to ground in the circuit under test. For high-speed measurements, each probe's individual ground lead should also be connected to a ground point closest to the signal point in the circuit under test.
- ❑ Use chapter 2 for information on probing considerations.
- ❑ Check that the trigger setup is correct.
- ❑ A correct trigger setup is the most important factor in helping you capture the data you desire. See the User's Guide for information about triggering.
- ❑ Check that infinite persistence in the Display menu is turned off, then press the **Clear Display** softkey.
- ❑ Press the **Autoscale** key.

## If you cannot see a channel

- ❑ Check that the oscilloscope probe cable is securely connected to the input connector.
- ❑ Check that the oscilloscope probe lead wires are securely inserted into the connector assembly and that the probe clips make good contact with the probe lead wires.
- ❑ Check that the probe clips are securely connected to points in the circuit under test.
- ❑ Check that the circuit under test is powered on.

You may have pressed the **Autoscale** key before an input signal was available. Performing the checks listed here ensures that the signals from the circuit under test will be seen by the oscilloscope. Perform the remaining checks in this topic to make sure the oscilloscope channels are on, and to obtain an automatic setup.

- ❑ Check that the desired oscilloscope channels are turned on.
  - a Press the analog channel key until it is illuminated.
  - b Press the digital channel group key (**D15 Thru D8** or **D7 Thru D0** keys) until it is illuminated. Use the Entry knob or Channel Select knob to scroll through the digital channels to make sure that the desired channels are turned on.
- ❑ Press the **Autoscale** key to automatically set up all channels.

---

# Troubleshooting the Oscilloscope

The service policy for the 54621A/22A/24A Oscilloscopes and the 54621D/22D Mixed-Signal Oscilloscopes is instrument replacement. Please call (877) 447-7278 to return the defective instrument, and Agilent Technologies will expedite a refurbished instrument to you under the Agilent Express Exchange program.

---

## WARNING

### **HAZARDOUS VOLTAGES EXIST — REMOVE POWER FIRST !**

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 back of this book before proceeding.

---

## CAUTION

### **REMOVE POWER TO AVOID DAMAGE !**

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

---

## CAUTION

### **AVOID ESD DAMAGE TO COMPONENTS !**

ELECTROSTATIC DISCHARGE (ESD) can damage electronic components. Use proper ESD precautions when doing any of the procedures in this chapter. As a minimum, place the oscilloscope on a properly grounded ESD mat and wear a properly grounded ESD strap.

---

## **Equipment required for troubleshooting**

The equipment listed in Table 5-1 is required to troubleshoot the oscilloscope.

**Table 5-1**

---

**Equipment Required to Troubleshoot the Oscilloscope**

---

<b>Equipment</b>	<b>Critical Specifications</b>	<b>Recommended Model/Part</b>
Digital multimeter	Accuracy $\pm 0.05\%$ , 1 mV resolution	Agilent 34401A
Oscilloscope	100 MHz, 1 M $\Omega$ input R	Agilent 54600B
Dummy load	Compatible with power supply	See "To construct your own dummy load" on page 5-7.

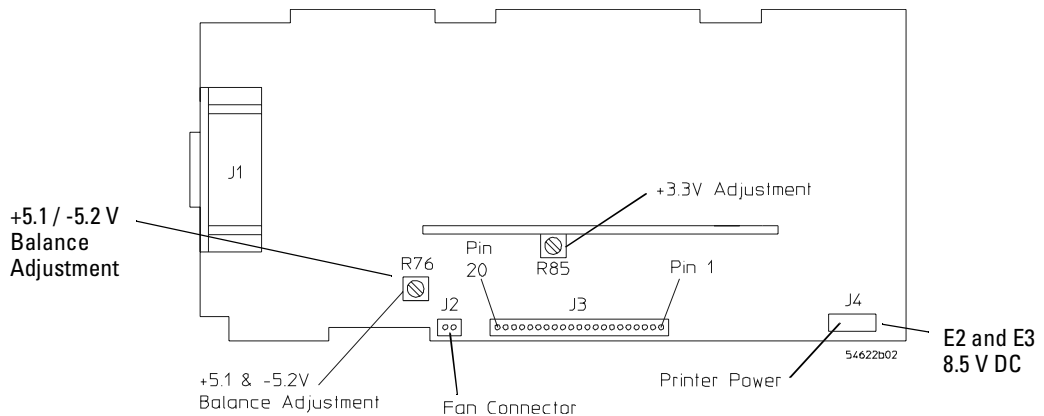


## To construct your own dummy load

- 1 Obtain a connector that is compatible with the connector J3 on the Low Voltage Power Supply.
- 2 Connect load resistors to the connector as follows:

Connector	Load (Amps)	Resistor	Watts	Connect to Pin	Ground to Pin
+5.1 V	4.4 A	1.2 $\Omega$	22 W	10, 11, 12	13, 14
-5.2 V	1.6 A	3.25 $\Omega$	8 W	4, 5	6
+15.75 V	1.2 A	13.1 $\Omega$	20 W	1	2
+3.3 V	4 A	0.825 $\Omega$	13 W	15, 16, 17, 18	19, 20

**Figure 5-1**



**Location of the Low Voltage Power Supply Connectors**

## To check out the oscilloscope

- 1 Is an interface module connected to the rear panel of the oscilloscope?  
If the answer is yes, follow these steps. Otherwise, go to step 2.
  - a Turn off the oscilloscope.
  - b Remove the interface module.
  - c Turn on the oscilloscope, then check for the failing symptom.
  - d If the failing symptom is not present, replace the interface module.
  - e If the failing symptom is still present, go to step 2.
- 2 Disconnect any external cables from the front panel.
- 3 Disconnect the power cord, then remove the cabinet.

---

### CAUTION

#### USE AN EXTERNAL FAN TO AVOID OVERHEATING COMPONENTS !

If you operate the oscilloscope with the cabinet removed, you must use an external fan to blow air across the system board. This external air flow is necessary to cool the heat sinks on the system board. Otherwise, damage to the components can occur.

---

- 4 Connect the power cord, then turn on the oscilloscope.
  - If the oscilloscope display comes on after a few seconds, you will need to check the low voltage power supply. Go to “To check the Low Voltage Power Supply” on page 5-11. Then return here.
  - If, after checking the low voltage power supply, the voltages are within the test limits, go to step 8. If they are not within the test limits, go to step 6.If the display did not come on, follow these steps:
  - a Disconnect the power cord.
  - b Check to verify that all of the cable connections are secure.
  - c Check the low voltage power supply. Go to “To check the Low Voltage Power Supply” on page 5-11.  
If the voltages are within the limits go to step 5. If the voltages are not within the limits, go to step 6.

- 5 Disconnect the display ribbon cable from the system board. Then check the signals on the system board listed in Table 5-2.

**Table 5-2**

<b>Display Signals on the System Board – All Oscilloscopes</b>				
<b>Signal</b>	<b>Name</b>	<b>Frequency</b>	<b>Pulse Width</b>	<b>Voltage</b>
J900 Pin 14	Hsync	19.72 kHz	3.0 ms	4.5 V <sub>p-p</sub>
J900 Pin 13	Vsync	60.00 Hz	253.5 ms	4.5 V <sub>p-p</sub>

If the signals are good, replace the display assembly.

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

- 6 Disconnect the ribbon cable from the display board.
- 7 Check the low voltage power supply. Go to “To check the Low Voltage Power Supply” on page 5-11.

If the voltages are within the test limits, replace the display assembly.

If the voltages are not within the test limits, follow these steps:

- 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 the new tolerances in Table 5-3.

**Table 5-3**

<b>Low Voltage Power Supply Tolerances</b>	
<b>Supply Voltage</b>	<b>Tolerance</b>
+5.1 V	±153 mV (+4.947 V to +5.253 V)
-5.2 V	±156 mV (-5.04 V to -5.36 V)
+15.75 V	+1.260 V, -787 mV (+14.963 V to +17.010 V)
+3.3 V	±100 mV (+3.20 V to +3.40 V)

If the voltages are within the test limits now, replace the system board.

If the voltages are still not within the test limits, replace the power supply.

**To check out the oscilloscope**

**8 Is the fan running?**

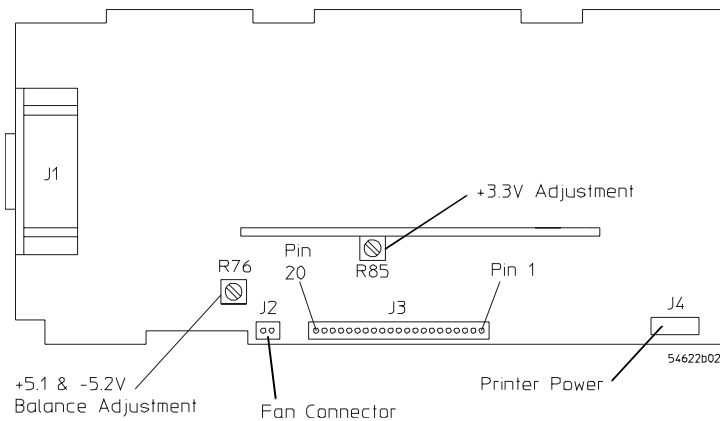
The low voltage power supply has a thermal cut-out circuit. If the fan is defective, the low voltage power supply will shut down when it gets too hot for safe operation.

If the fan is running, perform the internal self-tests. Go to “To run the internal self-tests” on page 5-13.

If the fan is not running, it may be defective. Follow these steps:

- a** Disconnect the fan cable from the power supply.
- b** Measure the fan voltage at the connector on the power supply.  
See Figure 5-2 for the location of the fan connector.
- c** If the fan voltage is approximately +8 Vdc, replace the fan. If the fan voltage is not approximately +8 Vdc, replace the power supply.

**Figure 5-2**



**Location of the Fan Connector**

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## To check the Low Voltage Power Supply

- 1 Disconnect the power cord from the oscilloscope. Then remove the oscilloscope cover and set the oscilloscope on its side.

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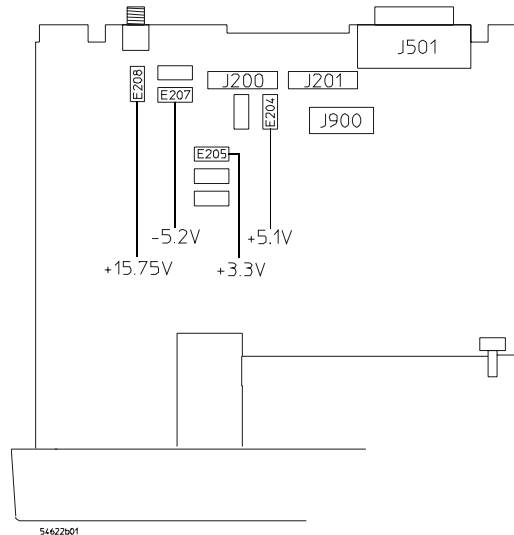
### CAUTION

#### USE AN EXTERNAL FAN TO AVOID OVERHEATING COMPONENTS !

If you operate the oscilloscope with the cabinet removed, you must use an external fan to blow air across the system board. This external air flow is necessary to cool the heat sinks on the system board. Otherwise, damage to the components can occur.

- 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 E1 through E6 on the system board. See Figure 5-3 and Table 5-4.

Figure 5-3



Low Voltage Power Supply Test Points

**To check the Low Voltage Power Supply**

**Table 5-4**

**Low Voltage Power Supply Tolerances**

Supply Voltage	Tolerance
+5.1 V	±153 mV (+4.947 V to +5.253 V)
-5.2 V	±156 mV (-5.04 V to -5.36 V)
+15.75 V	+1.260 V, -787 mV (+14.963 V to +17.010 V)
+3.3 V	±100 mV (+3.20 V to +3.40 V)

- 4 If the +5.1 V measurement is out of tolerance, adjust the +5.1 V adjustment on the power supply.
  - 5 If the -5.2 V measurement is out of tolerance, adjust the -5.2 V adjustment on the power supply.
- The +15.75 V supply is not adjustable, and is dependent upon the +5.1 V supply.

**If the Fuse is Blown**

If the power supply fuse is blown, the power supply is defective, and you must replace it. See the "Replaceable Parts" chapter for information about removing the power supply.

**CAUTION**

**BEWARE OF HAZARDOUS VOLTAGES !**

Be careful when performing component-level repair. Voltages greater than 300 Vdc exist, and can cause injury.

## To run the internal self-tests

Self Test performs a series of internal procedures to verify that the oscilloscope and any attached module are operating properly.

It is recommended that you run the Self Test:

- after experiencing abnormal operation
- for additional information to better describe an oscilloscope failure
- to verify proper operation after the oscilloscope has been repaired

Successfully passing Self Test does not guarantee 100% of the oscilloscope's functionality. Self Test is designed to provide an 80% confidence level that the oscilloscope is operating properly.

- 1** Press the **Utility** key, then press the **Service** softkey.
- 2** Begin the internal self tests by pressing the **Self Test** softkey.
  - a** The oscilloscope will display the message "Running self tests" on the screen.
  - b** The oscilloscope will then display one of the following messages on the screen indicating the status of the self-tests:
    - Self Tests Passed.
    - Self Tests Failed.







---

# Replacing Assemblies

This chapter describes how to remove assemblies from the oscilloscope. After you have removed an assembly, to install the replacement assembly, follow the instructions in reverse order.

The removable assemblies include:

- Cabinet
- Fan
- Floppy Drive
- Front panel
- Display
- System board
- Power supply
- Keyboard
- Handle

## **Tools Used for Disassembly**

Use these tools to remove and replace the oscilloscope assemblies:

- 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 front panel and power shaft, and the optional interface modules and pouch.

## **See how the Oscilloscope Parts Fit Together**

An exploded view of the oscilloscope is included in the “Replaceable Parts” chapter. It shows the individual part numbers used in the assemblies, and shows you how the parts fit together.

## **Read All Warnings and Cautions**

Read the following warnings and cautions before removing and replacing any assemblies in the oscilloscope.

---

**WARNING****HAZARDOUS VOLTAGES !**

Read the safety summary at the back of this book before proceeding.

Maintenance 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.

---

---

**WARNING****AVOID ELECTRICAL SHOCK !**

Hazardous voltages exist on the CRT, power supply, and display sweep board. To avoid electrical shock:

- 1 Disconnect the power cord from the oscilloscope.
- 2 Wait at least three minutes for the capacitors in the oscilloscope to discharge before you begin disassembly.

Read the Safety Summary at the back of this manual before you begin.

---

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**CAUTION****REMOVE POWER TO AVOID DAMAGE !**

Remove power before you begin to remove and replace assemblies. Do not remove or replace assemblies while the oscilloscope is turned on, or damage to the components can occur.

---

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**CAUTION****AVOID DAMAGE TO ELECTRONIC COMPONENTS !**

ELECTROSTATIC DISCHARGE (ESD) can damage electronic components. When doing any of the procedures in this chapter, use proper ESD precautions. As a minimum, you should place the instrument on a properly grounded ESD mat and wear a properly grounded ESD strap.

---

## To remove the cabinet

- 1** Turn off the oscilloscope and disconnect the power cable.
  - 2** If a module is installed, remove it from the oscilloscope.
  - 3** Using the T15 TORX driver, remove the two screws from the rear of the cabinet.
  - 4** Using your thumbs, gently push on the rear-panel connector to slide the oscilloscope out of the cabinet.
- 

## To remove the fan

- 1** Disconnect the fan cable from the power supply board.
  - 2** Using the T15 TORX driver, remove the three screws that hold the fan to the deck.
- 

## To remove the floppy drive

- 1** Using the T8 TORX driver, loosen the two screws that hold the drive to the deck.
- 2** Lift the drive away from the system board.
- 3** Disconnect the ribbon cable from the connector on the rear of the drive.

## To remove the front panel

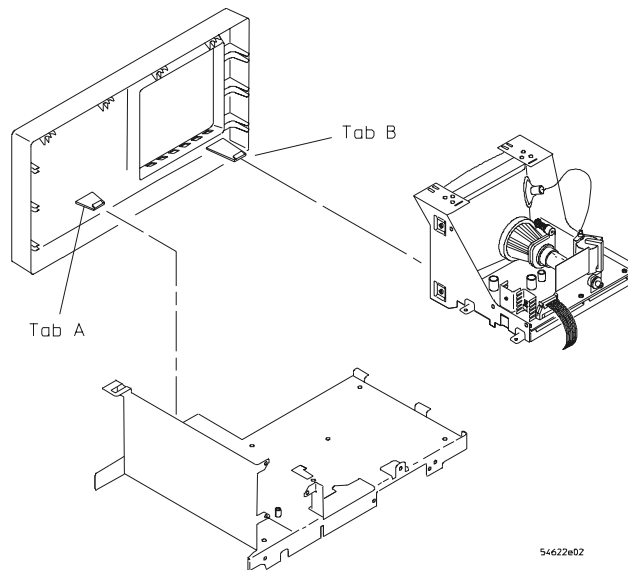
- 1 Remove the intensity knob and shaft by pulling it straight out.
- 2 Disconnect the keyboard ribbon cable from the system board.

### Releasing Tabs to Remove the Front Panel from the Oscilloscope Deck

In the next step, when you release tab B, take care that the sheet metal tab for the front-panel ground input clears the softkey circuit board. You can use a screwdriver to slightly depress the circuit board to avoid damage to the circuit board.

- 3 Use a screwdriver to release retainer tab A, and your finger to release retainer tab B. See the tab locations in Figure 6-1.

Figure 6-1



### Removing the Front Panel

- 4 Swing the front panel out until the bottom clears the deck assembly, then lift it up to free the hooks on top and pull it away from the deck. When installing the front panel, make sure that the power switch shaft is aligned with the connection hole in the front panel to make a proper connection. Before engaging the retainer tabs, make sure that all of the hooks on top of the front panel are fully engaged with their connection holes in the sheet metal. Then swing the front panel in to engage the two retainer tabs.

**To remove the display**

---

## To remove the display

- 1 Remove the front panel from the oscilloscope.
- 2 Disconnect the ribbon cable and the calibration cable from the display.
- 3 Using the T10 TORX driver, remove the four screws that hold the display to the deck. Set these screws aside.

---

**CAUTION**

**USE CORRECT SCREWS TO AVOID SHORTING SYSTEM BOARD !**

When you re-install the display, you must re-insert the screws you removed in this step. If you re-insert screws that are longer, they can short the system board to ground.

- 
- 4 Lift the display and remove it from the deck.

---

## To remove the system board

- 1 Using the T10 TORX driver, remove the six screws that hold the system board to the deck.
- 2 Remove the two hex nuts and washers from the rear BNCs.
- 3 Disconnect the three ribbon cables and the calibration cable.
- 4 As you remove the system board, rotate it so that the BNCs clear the front panel.

---

## To remove the front-panel BNC connectors

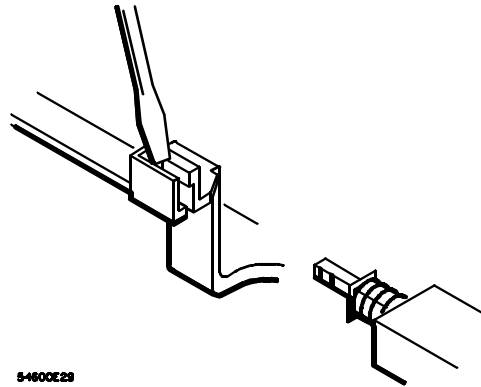
- 1 Remove the system board.
- 2 De-solder the center conductor wire and the probe readout wire from the board.
- 3 Using the T10 Torx driver, remove the screw holding the BNC to the housing.

---

## To remove the power supply

- 1 Remove the fan.
- 2 Disconnect the ground wire (green wire with the yellow stripe) from the deck.
- 3 Disconnect the ribbon cable from the power supply board.
- 4 Use a screwdriver to gently unhook the latch that holds the white shaft to the power switch, then disconnect the shaft from the power switch. See Figure 6-2. After you disconnect the shaft, make sure you position it in the recess along the side of the display bracket.

**Figure 6-2**



54600E28

### Unhooking the Power Switch Shaft

- 5 Using the T10 TORX driver, remove the screw holding the power supply board to the deck.
- 6 Slide the power supply board toward the front panel about 1/2 inch. Slip the power supply board keyhole slots off of the pins on the deck.

## To remove the keyboard

- 1 Remove the front panel.
- 2 Remove all of the knobs by pulling them straight out.
- 3 Flex the bezel of the front panel to unsnap the small keyboard under the display opening.
- 4 Using the T10 TORX driver, remove the four screws from the large keyboard.

---

### **CAUTION**

#### **USE CORRECT SCREWS TO AVOID DAMAGING FRONT PANEL LABEL!**

When you re-install the keyboard, you must re-insert the screws you removed in this step. If you re-insert screws that are longer, they can damage the front panel label.

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

---

## To remove the handle

- Rotate the handle downward until it just passes the last detente position; this is about 1/2 inch before the handle touches the bottom of the oscilloscope.
- Pull the sides of the handle out of the cabinet.



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## Replaceable Parts

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## Replaceable Parts

This chapter describes how to order replaceable assemblies and parts for the Agilent 54621A/22A/24A Oscilloscope and Agilent 54621D/22D Mixed-Signal Oscilloscope.

Diagrams and parts lists are included for assemblies and hardware that you can order.

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

## To order a replacement part

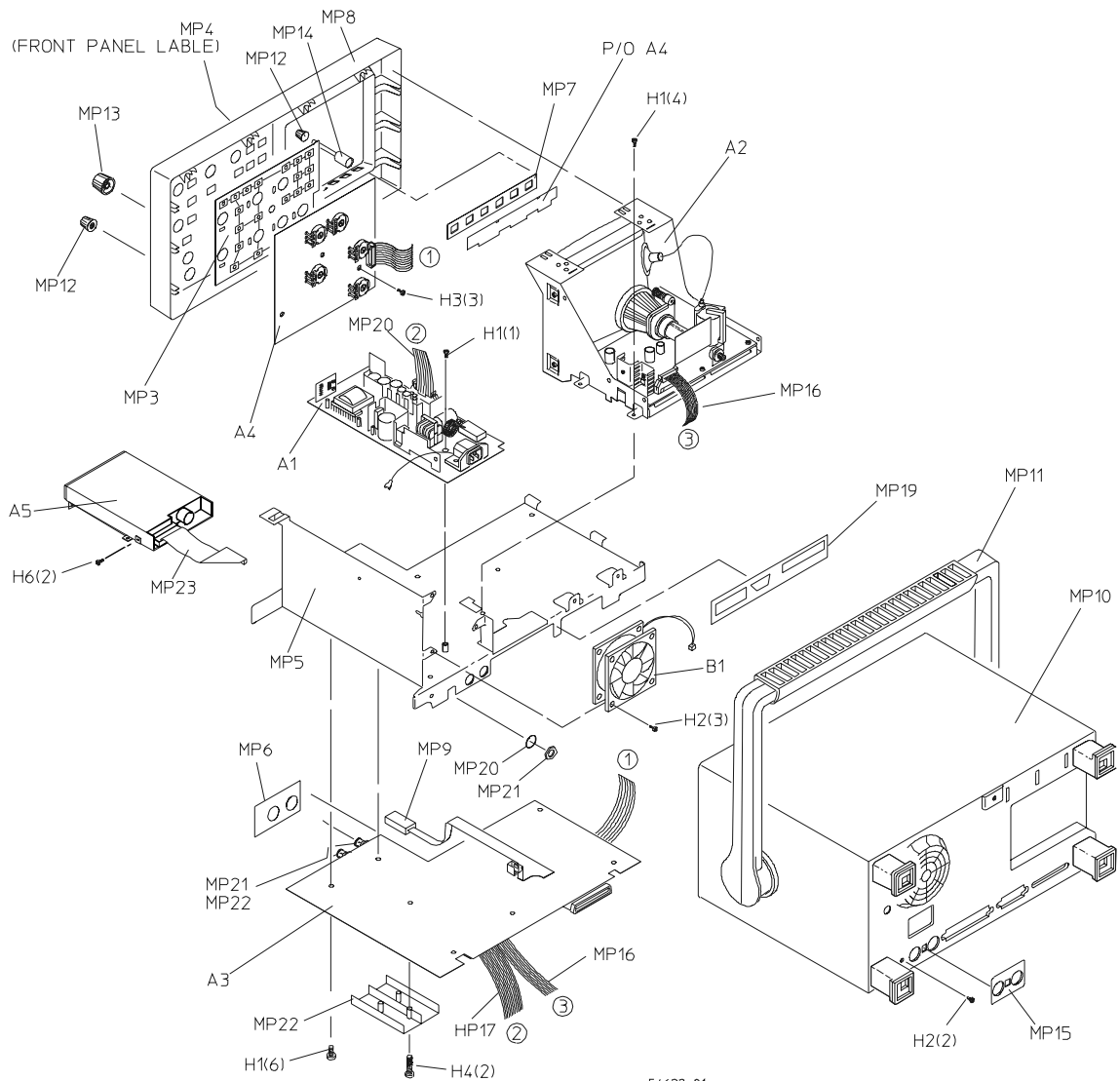
- To order a part in the material list, quote the Agilent Technologies part number, indicate the quantity desired, and address the order to your nearest Agilent Technologies Sales Office.
- To order a part not listed in the material list, include the model number and serial number of the oscilloscope, a description of the part (including its function), and the number of parts required. Address the order to your nearest Agilent Technologies Sales Office.
- To order using the direct mail order system, contact your nearest Agilent Technologies Sales Office.

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

For Agilent Technologies 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 Agilent Technologies Sales Office. Addresses and telephone numbers are located in a separate document shipped with the instrument.

**Replaceable Parts**  
**To order a replacement part**

**Figure 7-1**



54622e01

**Exploded View of the 54621A/22A/24A/21D/22D Oscilloscope**

**Table 7-1**

**Agilent 54621A/22A/24A/21D/22D Oscilloscope Replaceable Parts**

Reference Designator	Agilent Part Number	Qty	Description
A1	0950-3698	1	Power supply assembly
A2	2090-0384	1	Display assembly
A3	54621-66501	1	System board (Agilent 54621A)
A3	54622-66501	1	System board (Agilent 54622A)
A3	54624-66501	1	System board (Agilent 54624A)
A3	54621-66506	1	System board (Agilent 54621D)
A3	54622-66506	1	System board (Agilent 54622D)
A4	54622-66502	1	Keyboard (Agilent 54621A, 54622A)
A4	54622-66503	1	Keyboard (Agilent 54621D, 54622D)
A4	54624-66504	1	Keyboard (Agilent 54624A)
A5	0950-2782	1	Floppy disk drive
B1	3160-1006	1	Fan
H1	0515-0390	5	SCR – Machine screw, M4 X 0.7, 6mm
H2	0515-0372	9	SCR – Machine screw
H3	0515-0380	5	Machine screw M4 X 0.7 X 10
H4	0515-0667	See Descr	SCR, Machine screw M3 X 0.5, 25mm LG (Agilent 54621A/22A/21D/22D – 1 ea) (Agilent 54624A – 2 ea)
H5	0515-0658	2	MSPH – Machine screw, M2 6 SMS6
H6	0515-2691	2	Screw
MP3	54622-41901	1	Large keypad (Agilent 54621A/22A)
MP3	54622-41903	1	Large keypad (Agilent 54621D/22D)
MP3	54624-41901	1	Large keypad (Agilent 54624A)
MP4	54621-94301	1	Front-panel label (Agilent 54621A)
MP4	54622-94301	1	Front-panel label (Agilent 54622A)
MP4	54621-94302	1	Front-panel label (Agilent 54621D)
MP4	54622-94302	1	Front-panel label (Agilent 54622D)
MP4	54624-94301	1	Front-panel label (Agilent 54624A)
MP5	54622-00101	1	Deck

Replaceable Parts  
**To order a replacement part**

<b>Reference Designator</b>	<b>Agilent Part Number</b>	<b>Qty</b>	<b>Description</b>
MP6	54622-09104	See Descr	RFI Gasket (Front) (Agilent 54621D/22D – 1 ea) (Agilent 54621A/22A/24A – 2 ea)
MP7	54622-41902	1	Small rubber keypad
MP8	54622-42201	1	Front panel (Agilent 54621A/22A/24A)
MP8	54622-42202	1	Front panel (Agilent 54621D/22D)
MP9	54622-43701	1	Power switch shaft
MP10	54622-64401	1	Cabinet (comes with handle and feet installed)
MP11	54622-44901	1	Handle
MP12	54801-47401	See Descr	Small knob (Agilent 54621A/22A – 5 ea) (Agilent 54621D – 6 ea) (Agilent 54622D – 7 ea) (Agilent 54624A – 7 ea)
MP13	54801-47402	See Descr	Large knob (Agilent 54621A/22A – 3 ea) (Agilent 54621D – 4 ea) (Agilent 54622D – 3 ea) (Agilent 54624A – 5 ea)
MP14	54622-43702	1	Intensity knob
MP15	54622-94304	1	Rear-panel Ext Trig label (Agilent 54621A/22A)
MP15	54624-94302	1	Rear-panel Ext Trig label (Agilent 54621D/22D/24A)
	54622-94303		Label - Power spec
	54622-94311		Label - CE
MP16	54630-61601	1	Ribbon cable – display
MP17	54630-61602	1	Ribbon cable – power supply
MP18	54624-27601	See Descr	BNC (Agilent 54621D/22D – 1 ea) (Agilent 54621A/22A/24A – 2 ea)
MP19	54622-09105	1	RFI Gasket (Rear) – All oscilloscopes –1 each
MP20	2190-0068	1	Washer – Aux Trig & Trig Out (Agilent 54621A/22A – 1 ea) (Agilent 54621D/22D/24A – 2 ea)
MP21	1250-2075	1	Nut – Aux Trig & Trig Out (Agilent 54621A/22A – 1 ea) (Agilent 54621D/22D/24A – 2 ea)
MP22	54622-63403	1	Attenuator lid
MP23	54801-61625	1	Cable – Flex, Floppy

Reference Designator	Agilent 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 Power cord option 919, Israel Power cord option 920, Argentina
	<b>Option 101</b>		<b>Accessory pouch and front-panel cover (also orderable as Agilent P/N 54600-68722)</b>
	5041-9482		Pouch
	54601-44101		Front-panel cover
	<b>Probes</b>		
	10074C	2	X1 passive probe
	<b>Input Cable (Agilent 54621D/22D only)</b>		
	54620-61801	1	Cable, Woven (includes probe leads)
	5959-9333		Package replacement probe leads (quantity 5)
	5959-9334		Package replacement probe grounds (quantity 5)
	5959-9335		Package replacement pod grounds (quantity 5)
	5090-4356		Package replacement grabbers (quantity 20, includes 1 5959-9334)
	01650-94309		Package of probe labels





# DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014

**Manufacturer's Name:** Agilent Technologies, Inc. / Digital Design PGU  
**Manufacturer's Address:** 1900 Garden of the Gods Road  
Colorado Springs, Colorado  
80907 U.S.A.

## Declares, that the product

**Product Name:** Digitizing Oscilloscope  
**Model Number(s):** 54621A/D, 54622A/D, and 54624A  
**Product Option(s):** All options based on the above

## Is in conformity with:

**EMC:** IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998  
CCISPR 11:1990/EN 55011:1991– Group 1 Class A<sup>[1]</sup>  
IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995 (ESD 4kV CD, 8kV AD)  
IEC 61000-4-3:1995/EN 61000-4-3:1995 (3V/m 80% AM)  
IEC 61000-4-4:1995/EN 61000-4-4:1995 (0.5kV line-line, 1kV line-earth)  
IEC 61000-4-6:1996/EN 61000-4-6:1996 (3V 80% AM, power line)  
Australia/New Zealand: AS/NZS 2064.1

**Safety** IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1994+A2:1995  
Canada: CSA C22.2 No. 1010.1:1992  
USA: UL 3111-1:1994

## Additional Information:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC (including 93/68/EEC) and carries the CE-marking accordingly (European Union).

[1] The product was tested in a typical configuration with Agilent Technologies test systems.

Date: 01/27/2000

  
Name

Ken Wyatt / Product Regulations Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.



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#### **Safety**

This apparatus has been designed and tested in accordance with IEC Publication 1010, Safety Requirements for Measuring Apparatus, and has been supplied in a safe condition. This is a Safety Class I instrument (provided with terminal for protective earthing). Before applying power, verify that the correct safety precautions are taken (see the following warnings). In addition, note the external markings on the instrument that are described under "Safety Symbols."

#### **Warning**

Before turning on the instrument, you must connect the protective earth terminal of the instrument to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. You must not negate the protective action by using an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.

- Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuseholders. To do so could cause a shock or fire hazard.

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

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

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

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

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

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

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

#### **Safety Symbols**



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



Hazardous voltage symbol.



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

#### **WARNING**

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

#### **CAUTION**

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

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## About this edition

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