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# Service Guide

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see the pages at the end of this book.

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## Agilent 54641A/42A Oscilloscopes and Agilent 54641D/42D Mixed-Signal Oscilloscopes

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## The Oscilloscope At a Glance

### Choose from a variety of oscilloscopes

all with 2 GSa/s sample rate and 2 MBytes of MegaZoom deep memory per channel for capturing long, non-repeating signals.

- **Agilent 54641A** - 2-channel, 350-MHz bandwidth
- **Agilent 54641D** - 2-channel +16 logic channels, 350-MHz bandwidth
- **Agilent 54642A** - 2-channel, 500-MHz bandwidth
- **Agilent 54642D** - 2-channel +16 logic channels, 500-MHz bandwidth

### Display shows current input signals

- All analog and digital (54641D/42D) channels displayed in main and delayed mode
- Indicators for channel, time base, digital (54641D/42D) channel activity, trigger and acquisition status
- Softkey labels
- Measurement results

### Digital channel controls select, position, and label inputs (54641D/42D)

- Turn channels on or off individually or in groups of 8
- Rearrange order of channels to group related signals
- Create and display labels to identify channels

### General controls measure, save and restore results, and configure the oscilloscope

- Waveform math including FFT, subtract, multiply, integrate, and differentiate
- Use Quick Meas to make automatic measurements
- Use cursors to make manual measurements
- Save or recall measurement configurations or previous results
- Autoscale performs simple one-button setup of the oscilloscope

### Horizontal Controls select sweep speed and delay parameters

- Sweep speeds from 1 ns/div to 50 s/div
- Delay control moves waveform display to point of interest
- Delayed mode and delay allow zooming in to show a portion of waveform in detail (split screen)

### Run control keys begin and end data acquisition

- Run/Stop starts and stops continuous acquisitions
- Single performs one acquisition
- Infinite persistence accumulates and displays the results of multiple acquisitions

### Trigger keys define what data the oscilloscope will trigger on

- Source key allows conventional oscilloscope triggering
- Modes include Edge, Pulse Width, Pattern, CAN, Duration, I<sup>2</sup>C, LIN, Sequence, SPI, TV, and USB triggering

### Softkeys extend the functionality of command keys

Select measurement types, operating modes, trigger specifications, label data, and more

### Digital channel inputs through a flexible probing system (54641D/42D)

- Sixteen channels through a dual 8-channel cable with micro-clips
- Set logic levels as TTL, CMOS, ECL, or to a user-definable voltage

### Utilities

- Dedicated parallel printer port, controller operation, floppy disk storage

### Built in Quick Help system

- Press and hold any key front-panel key or softkey to get help in 11 languages.

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## In This Book

This book provides the service information for the Agilent 54641A/42A Oscilloscope and the Agilent 54641D/42D 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 54640-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).

- 54640-Series Oscilloscope (54641A, 41D, 42A, or 42D)
- 10073C 10:1 500 MHz passive probes with ID (qty 2)
- 54620-68701 digital probe kit (for 54641D or 42D)
- Accessory pouch and front-panel cover
- Power cord (see table 1-3)
- IntuiLink for 54600-series Oscilloscopes software and RS-232 cable.

IntuiLink is a Windows application that makes it very easy for you to download images, waveform data, or oscilloscope setups from the oscilloscope to your pc using either Microsoft Word or Microsoft Excel. After installation of IntuiLink, a tool bar in these Microsoft applications will make connection and data transfer from the oscilloscope very simple.

IntuiLink software is available free on the web at:

[www.agilent.com/find/5462xsw](http://www.agilent.com/find/5462xsw)

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.

## General Information

- Agilent IntuiLink Data Capture

IntuiLink Data Capture is a standalone program for downloading waveform data from the oscilloscopes to your PC via GPIB or RS-232 interface. It provides the capability to transfer deep memory data out of the oscilloscope, allowing up to 4MB (scope channels) and 8MB (logic channels). The IntuiLink for 54600-Series limits the size of acquisition data available to a maximum of 2,000 points regardless of actual number of acquisition points on the screen. With the IntuiLink Data Capture, the amount of points transferred will be the actual number of acquisition points currently displayed or you may select the number of points to download. It provides the following functionality:

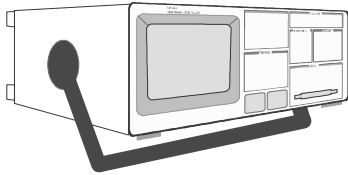
- Download waveform data and display the data as a simple chart
- Save the data as binary or text files
- Copy the chart and a selected portion of the data to the clipboard. The maximum data saved to the clipboard is 50,000 point
- Load saved waveform data back into the application

### □ Inspect the oscilloscope

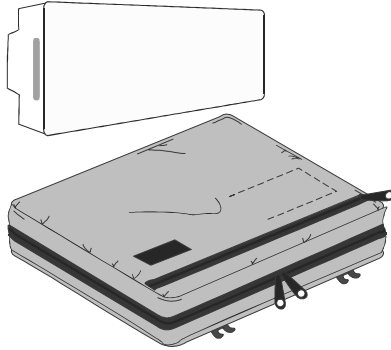
- If there is mechanical damage or a defect, or if the oscilloscope does not operate properly or does not pass the performance tests listed in the Service Guide, notify your Agilent Sales Office.
- If the shipping container is damaged, or the cushioning materials show signs of stress, notify the carrier 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**

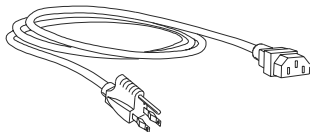
54640-Series Oscilloscope



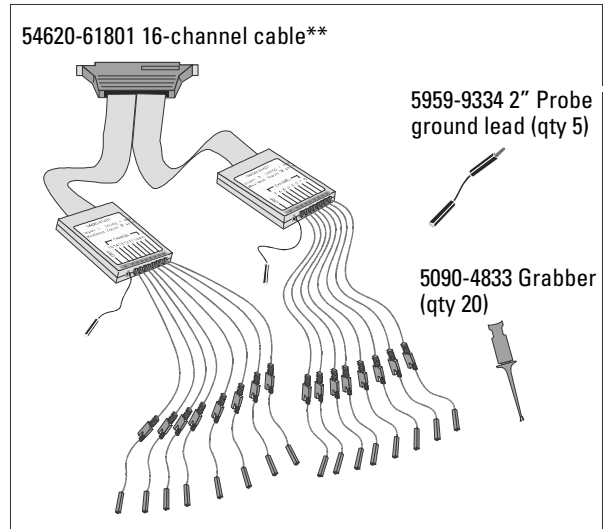
Accessories pouch and front-panel cover



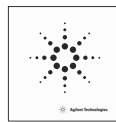
Power cord



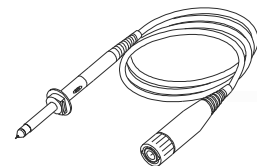
54620-68701 digital probe kit\*



IntuiLink for 54600-series software, Data Capture software and serial cable



10073C Probes (qty 2)



\* 54641D /42D only

\*\* The following additional replacement parts (not included) are available for the digital cable:

- 5959-9333 replacement probe leads (qty 5)
- 5959-9335 replacement pod grounds (qty 5)
- 01650-94309 package of probe labels

**Package contents for 54640-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 54640-Series Oscilloscopes are listed in tables 1-1 am 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.
1CM	Rackmount kit (same as Agilent 1186A)
A6J	ANSII Z540 compliant calibration service See table 1-3 for power cord options

Table 1-2











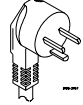

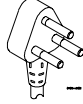
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**Accessories available**


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<b>Model</b>	<b>Description</b>
01650-61607	16:16 digital cable and terminator (for use with 54641D/42D)
54620-68701	16:2 x 8 digital input probe assembly (shipped standard with 54641D/42D)
1146A	100 kHz 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
10073C	10:1 500 MHz probe with ID
10075A	0.5 mm IC clip kit
10076A	100:1, 4 kV 250 MHz probe with ID
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
N2727A	Thermal printer and pouch
N2728A	10 rolls of thermal printer paper
N2757A	GPIB Interface Module
N2758A	CAN Trigger Module
N2771A	1000:1, 15 kV, 50 MHz high voltage probe
N2772A	20 MHz differential probe
N2773A	Differential probe power supply
N2774A	50 MHz current probe, ac/dc
N2775A	Power supply for N2774A

**Table 1-3. Power Cords**

Plug Type	Cable Part Number	Plug Type	Cable Part Number
Opt 900 (U.K.) 	8120-1703	Opt 918 (Japan) 	8120-4754
Opt 901 (Australia) 	8120-0696	Opt 919 (Israel) 	8120-6799
Opt 902 (Europe) 	8120-1692	Opt 920 (Argentina) 	8120-6871
Opt 903 (U.S.A.) 	8120-1521	Opt 921 (Chile) 	8120-6979
Opt 906 (Switzerland) 	8120-2296	Opt 922 (China) 	8120-8377
Opt 912 (Denmark) 	8120-2957	Opt 927 (Thailand) 	8120-8871
Opt 917 (Africa) 	8120-4600		

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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

Max Sample rate	2 GSa/s interleaved, 1 GSa/s each channel
Max Memory Depth	8 MB interleaved, 4 MB each channel
Vertical Resolution	8 bits
Peak Detection	1 ns @ max sample rate
Averages	selectable from 2, 4, 8, 16, 32, 64 ...to 16383
High Resolution Mode	12 bits of resolution when $\geq 100$ us/div, average mode with average = 1
Filter:	Sinx/x interpolation (single shot BW = sample rate/4 or bandwidth of scope, whichever is less) with vectors on.

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### Acquisition: Digital Channels (on 54641D and 54642D only)


Max Sample Rate	1 GSa/s
Max Memory Depth	4 MB
Vertical Resolution	1 bit
Glitch Detection (min pulse width)	5 ns

General Information  
**Vertical System: Analog Channels**

\* 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**

Analog channels	Ch1 and 2 simultaneous acquisition
Bandwidth (-3dB)*	54641A/41D: dc to 350 MHz 54642A/42D: dc to 500 MHz
ac coupled	54641A/41D: 3.5 Hz to 350 MHz 54642A/42D: 3.5 Hz to 500 MHz
Calculated rise time (= 0.35/bandwidth)	54641A/41D: ~1.0 ns 54642A/42D: ~700 ps
Single Shot Bandwidth	54641A/41D: 350 MHz maximum 54642A/42D: 500 MHz maximum
Range <sup>1</sup>	2 mV/div to 5 V/div
Maximum Input	 CAT I 300 Vrms, 400 Vpk CAT II 100 Vrms, 400 Vpk with 10073C 10:1 probe: CAT I 500 Vpk, CAT II 400 Vpk 5 Vrms with 50-ohm input
Offset Range	$\pm 5$ V on ranges <10 mV/div $\pm 20$ V on ranges 10 mV/div to 200 mV/div $\pm 75$ V on ranges >200 mV/div
Dynamic Range	Lesser of $\pm 8$ div or $\pm 32$ V
Input Resistance	1 M $\Omega$ $\pm 1\%$ , 50-ohm selectable
Input Capacitance	~ 13 pF
Coupling	ac, dc
BW Limit	~ 25 MHz selectable
Channel-to-Channel Isolation (with channels at same V/div)	DC to max bandwidth > 40 dB
Probes	10:1 10073C shipped standard for each analog channel
Probe ID (Agilent/HP & Tek Compatible)	Auto probe sense

<sup>1</sup> 2 mV/div is a magnification of 4 mV/div setting. For vertical accuracy calculations, use full scale of 32 mV for 2 mV/div sensitivity setting.



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

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

ESD Tolerance	$\pm 2$ kV
Noise Peak-to-Peak	3% full scale or 3 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	$\leq 200$ mV/div: $\pm 0.1$ div $\pm 2.0$ mV $\pm 0.5\%$ offset $> 200$ mV/div: $\pm 0.1$ div $\pm 2.0$ mV $\pm 1.5\%$ offset value
Single Cursor Accuracy <sup>1</sup>	$\pm\{\text{DC Vertical Gain Accuracy} + \text{DC Vertical Offset Accuracy} + 0.2\%$ full scale ( $\sim 1/2$ 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 mV) + 2.0 mV + 0.5% (5 mV) + 0.2%(80 mV) $\} = \pm 4.78$ mV
Dual Cursor Accuracy* <sup>1</sup>	$\pm\{\text{DC Vertical Gain Accuracy} + 0.4\%$ full scale ( $\sim 1$ LSB) $\}$ <i>Example:</i> For 50 mV signal, scope set to 10 mV/div (80 mV full scale), 5 mV offset, accuracy = $\pm\{2.0\%(80$ mV) + 0.4%(80 mV) $\} = \pm 1.92$ mV

<sup>1</sup> 2 mV/div is a magnification of 4 mV/div setting. For vertical accuracy calculations, use full scale of 32 mV for 2 mV/div sensitivity setting.

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**Vertical System: Digital Channels (54641D and 54642D only)**

Number of Channels	16 Digital – labeled D15 – D0
Threshold Groupings	Pod 1: D7 – D0 Pod 2: D15 – D8
Threshold Selections	TTL, CMOS, ECL, user-definable (selectable by pod)
User-Defined Threshold Range	$\pm 8.0$ V in 10 mV increments
Maximum Input Voltage 	$\pm 40$ V peak CAT I
Threshold Accuracy*	$\pm(100$ mV + 3% 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

## General Information

### Horizontal

\* 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	1 ns/div to 50 s/div
Resolution	2.5 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 1 ms
Post-trigger (positive delay)	500 seconds
Analog Delta-t Accuracy	
Same Channel*	$\pm 0.005\%$ reading $\pm 0.1\%$ screen width $\pm 20$ 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 = $\pm\{.005\%(10\text{ us}) + 0.1\% (50\text{ us}) + 20\text{ ps}\} = 50.52\text{ ns}$
Channel-to-Channel	$\pm 0.005\%$ reading $\pm 0.1\%$ screen width $\pm 40$ ps
Digital Delta-t Accuracy	(non-Vernier settings)
Same Channel	$\pm 0.005\%$ reading $\pm 0.1\%$ screen width $\pm (1\text{ digital sample period}, 1\text{ ns})$ <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 (1 GSa/s), delta-t accuracy = $\pm\{.005\%(10\text{ us}) + 0.1\% (50\text{ us}) + 1\text{ ns}\}$ = 51.5 ns
Channel-to-Channel	$\pm 0.005\%$ reading $\pm 0.1\%$ screen width $\pm (1\text{ digital sample period}) \pm (\text{chan-to-chan skew})$
Delay Jitter	10 ppm
RMS Jitter	0.025% screen width + 30 ps
Modes	Main, Delayed, Roll, XY
XY	
Bandwidth	Max bandwidth
Phase error @ 1 MHz	1.8 degrees

\* 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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## Trigger System

Sources:	54641A/42A: Ch 1, 2, line, ext 54641D/42D: Ch 1, 2, line, ext, D15 - D0
Modes	Auto, Triggered (normal), Single
Holdoff Time	~60 ns to 10 seconds
Selections	Edge, Pattern, Pulse Width, CAN, Duration, I <sup>2</sup> C, Sequence, SPI, TV, USB
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: 2 ns Maximum pulse width setting: 10 s
CAN	Trigger on CAN (Controller Area Network) version 2.0A and 2.0B signals. It can trigger on the Start of Frame bit of a data frame, a remote transfer request frame, or an overload frame.
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
I <sup>2</sup> C	Trigger on I <sup>2</sup> C (Inter-IC bus) serial protocol at a start/stop condition, a restart, a missing acknowledge, or user defined frame with address and/or data values. Also trigger on Missing Acknowledge, Restart, EEPROM read, and 10-bit write.
LIN	Trigger on LIN (Local Interconnect Network) sync break at beginning of message frame.
Sequence	Find event A, trigger on event B, with option to reset on event C or time delay.
SPI	Trigger on SPI (Serial Peripheral Interface) a data pattern during a specific framing period. Support positive and negative Chip Select framing as well as clock Idle framing and user-specified number of bits per frame.
USB	Trigger on USB (Universal Serial Bus) Start of Packet, End of Packet, Reset Complete, Enter Suspend, or Exit Suspend on the differential USB data lines. USB low speed and high speed are supported.
TV	Trigger on any analog 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.
Autoscale	Finds and displays all active analog and digital (for 54641D/54642D) channels, sets edge trigger mode on highest numbered channel, sets vertical sensitivity on analog channels and thresholds on digital channels, time base to display ~1.8 periods. Requires minimum voltage >10 mVpp, 0.5% duty cycle and minimum frequency >50 Hz.

General Information  
**Analog Channel Triggering**

\* 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*	<10 mV/div: Greater of 1 div or 5 mV $\geq 10$ mV/div: 0.6 div
Coupling	ac (~10 Hz), dc, noise reject, HF reject and LF reject (~ 50 kHz)


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**Digital (D15 - D0) Channel Triggering (54641D and 54642D)**

Threshold Range (user-defined)	$\pm 8.0$ V in 10 mV increments
Threshold Accuracy*	$\pm (100$ mV + 3% 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 M $\Omega$ $\pm 3\%$ or 50-0hm
Input Impedance	~ 13 pF
Maximum Input	 CAT I 300 Vrms, 400 Vpk CAT II 100 Vrms, 400 Vpk with 10073C 10:1 probe: CAT I 500 Vpk, CAT II 400 Vpk 5 Vrms with 50-ohm input
Range	DC coupling: trigger level $\pm 8$ V AC coupling/LF reject: AC input minus trigger level not to exceed $\pm 8$ V
Sensitivity	DC to 100 MHz, < 100 mV 100 MHz to max bandwidth, < 200 mV
Coupling	ac (~ 3.5 Hz), dc, noise reject, HF reject and LF reject (~ 50 kHz)
Probe Id (Agilent/HP & Tek compatible)	Auto probe sense for 54641A/42A

\* 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 Analog Channels	25 million gray scale vectors/sec per channel
Resolution	255 vertical by 1000 horizontal points (waveform area) 32 levels of gray scale
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 11 languages displayed by pressing and holding key or softkey of interest
Real Time Clock	Time and date (user setable)

---

### **Measurement Features**

Automatic Measurements	Measurements are continuously updated Cursors track current measurement
Voltage (analog channels only)	Peak-to-Peak, Maximum, Minimum, Average, Amplitude, Top, Base, Overshoot, Preshoot, RMS (dc)
Time	Frequency, Period, + Width, - Width, and Duty Cycle on any channels. Rise time, Fall time, X at Max (Time at max volts), X at Min (Time at min volts), Delay, and Phase on analog channels only.
Counter	Built-in 5-digit frequency counter on any channel. Counts up to 125 MHz.
Threshold Definition	Variable by percent and absolute value; 10%, 50%, 90% default for time measurements
Cursors	Manually or automatically placed readout of Horizontal (X, $\Delta X$ , $1/\Delta X$ ) and Vertical (Y, $\Delta Y$ ). Additionally digital or analog channels can be displayed as binary or hex values
Waveform Math	1-2, 1*2, FFT, differentiate, integrate. Source of FFT: differentiate, integrate, analog channels 1 or 2, 1-2, 1+2, 1*2

## General Information

### FFT

\* 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.

---

#### FFT

Points	Fixed at 2048 points
Source of FFT	Analog 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, dBm @ 50 ohm
Frequency Resolution:	0.097656/(time per div)
Maximum Frequency	102.4/(time per div)

---

#### Storage

Save/Recall (non-volatile)	4 setups and traces can be saved and recalled internally
Floppy Disk	3.5" 1.44 MB double density
Image formats	TIF, BMP
Data formats	X and Y (time/voltage) values in CSV format
Trace/setup formats	Recalled

---

#### I/O

RS-232 (serial) standard port	1 port; XON or DTR; 8 data bits; 1 stop bits; parity=none; 9600, 19200, 38400, 57600 baud rates
Parallel standard port	Printer support
Printer Compatibility	HP DeskJet, HP LaserJet with HP PCL 3 or greater compatibility 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 Typical GPIB throughput of 20 measurements or twenty 2000-point records per second.

\* 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	32.26 cm wide x 17.27 cm high x 31.75 cm deep (without handle)
Weight	6.82 kgs (15 lbs)
Calibrator Output	Frequency ~2 kHz; Amplitude ~5 V
Trigger Out	0 to 5 V with 50 $\Omega$ source impedance; delay ~ 22 ns
Printer Power	7.2 to 9.2 V, 1 A
Kensington lock	Connection on rear panel for security

---

### Power Requirements

Line Voltage Range	100 - 240 VAC, 50/60 Hz, CAT II, automatic selection 100 - 132 VAC, 440 Hz, CAT II, automatic selection
Line Frequency	50/60 Hz, 100 - 240 VAC 440 Hz, 100 - 132 VAC
Power Usage	110 W max

---

### 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 54641D and 54642D)
- connect a printer
- connect a RS-232 cable
- verify basic oscilloscope operation
- get started using the oscilloscope interface
- learn how to use Quick Help

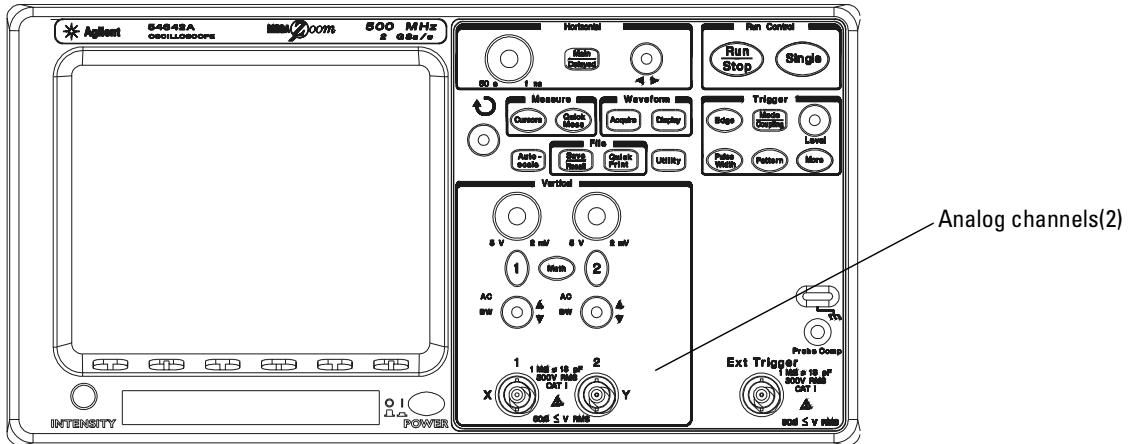
This chapter also tells you how to:

- clean the oscilloscope

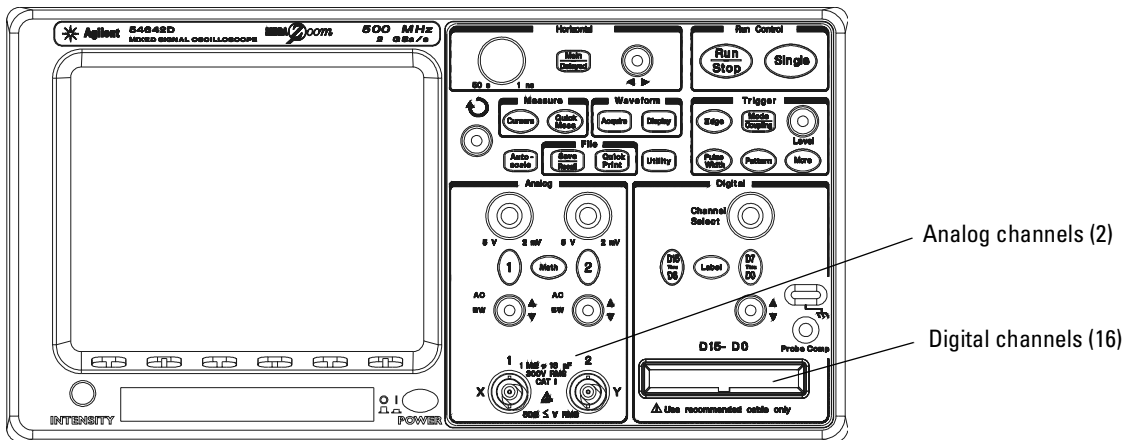
# Setting up the Oscilloscope

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 54641A and 54642A 2-channel Oscilloscopes, you will connect and use analog probes to examine analog signals.

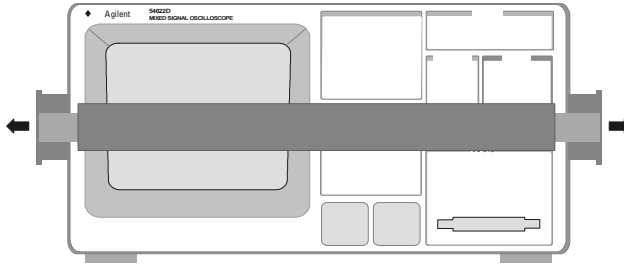


- When using the Agilent 54641D and 54642D Mixed-Signal Oscilloscopes, you will connect and use both analog and digital probes to examine analog and digital signals.

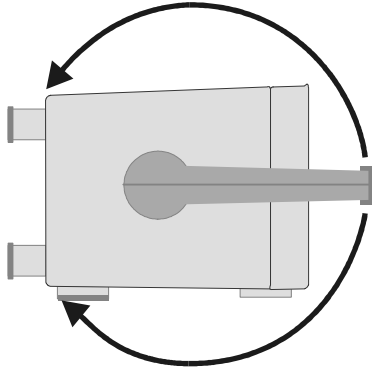


## To adjust the handle

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



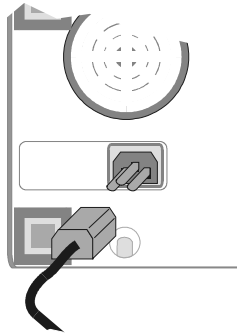
- 2 Without releasing the pivots, swivel the handle to the desired position. Then release the pivots. Continue pivoting the handle until it clicks into a set position.



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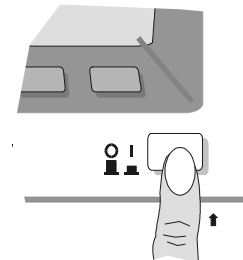
## To power-on the oscilloscope

- 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.

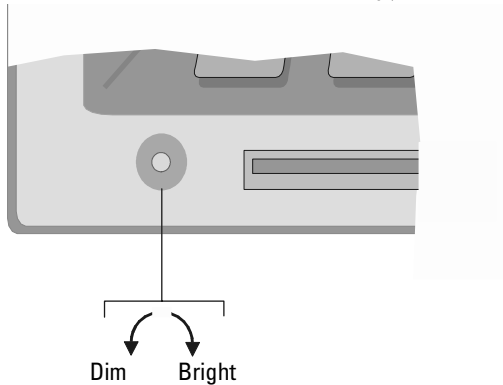


Some front panel key lights will come on and the oscilloscope will be operational in about 5 seconds.


## To adjust the waveform intensity

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

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



### **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 analog probes

The analog input impedance of these oscilloscopes is selectable either  $50\Omega$  or  $1\text{ M}\Omega$ . The  $50\Omega$  mode matches  $50\Omega$  cables commonly used in making high frequency measurements. This impedance matching gives you the most accurate measurements since reflections are minimized along the signal path. The  $1\text{ M}\Omega$  mode is for use with probes and for general purpose measurements. The higher impedance minimizes the loading effect of the oscilloscope on the circuit under test.

---

### CAUTION



Do not exceed 5 Vrms in  $50\Omega$  mode. Input protection is enabled in  $50\Omega$  mode and the  $50\Omega$  load will disconnect if greater than 5 Vrms is detected. However the inputs could still be damaged, depending on the time constant of the signal.

---

### CAUTION

The  $50\Omega$  input protection mode only functions when the oscilloscope is powered on.

- 1 Connect the Agilent 10073C 1.5-meter, 10:1 oscilloscope probe to the analog channel 1 or 2 BNC connector input on the oscilloscope.

Maximum input voltage for analog inputs in  $1\text{ M}\Omega$  impedance mode:



CAT I 300 Vrms, 400 Vpk

CAT II 100 Vrms, 400 Vpk

with 10073C 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.

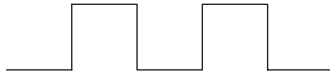
The probe ground lead is connected to the oscilloscope chassis and the ground wire in the power cord. If you need to connect the ground lead to a point in the circuit that cannot be grounded to power ground, consider using a differential probe.

## To compensate your analog probe

You should compensate your analog probes to match their characteristics to the oscilloscope. A poorly compensated probe can introduce measurement errors. To compensate a probe, follow these steps:

- 1 Connect the probe from channel 1 to the **Probe Comp** signal on the lower-right corner of the front panel.
- 2 Press **Autoscale**.
- 3 Use a nonmetallic tool to adjust the trimmer capacitor on the probe for the flattest pulse possible.

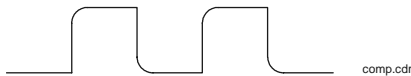
Perfectly compensated



Over compensated



Under compensated

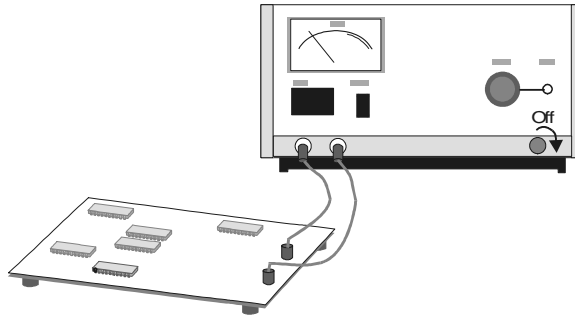




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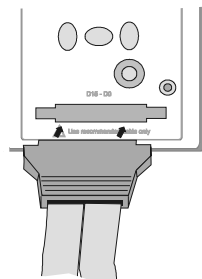
## To use the digital probes (mixed-signal oscilloscope only)

- 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.

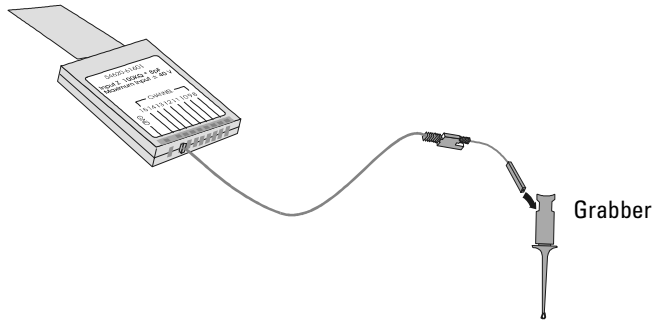


Use only the Agilent part number 54620-68701 digital probe kit supplied with the mixed-signal oscilloscope.

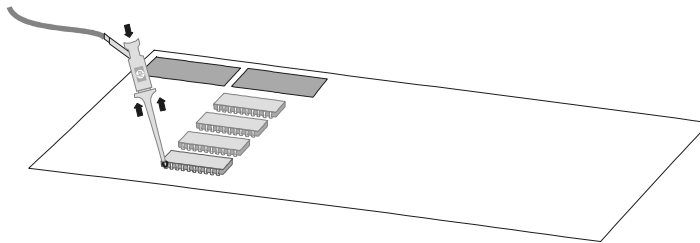
## Preparing the Oscilloscope for Use

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

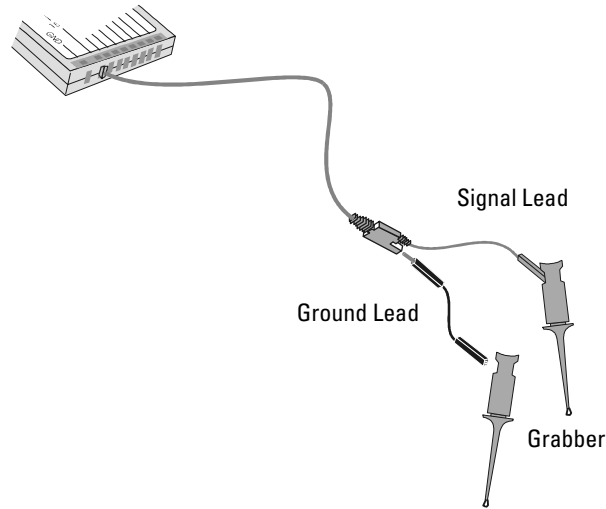
- 3 Connect a grabber to one of the probe leads. Be sure to connect the ground lead. (Other probe leads are omitted from the figure for clarity.)



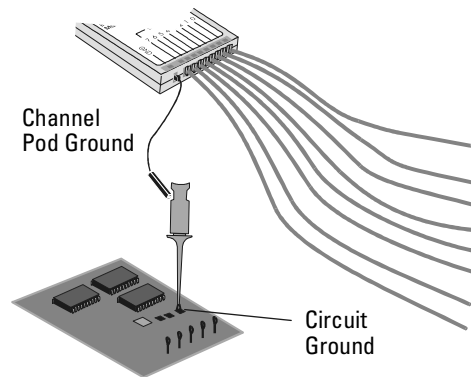
- 4 Connect the grabber to a node in the circuit you want to test.



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

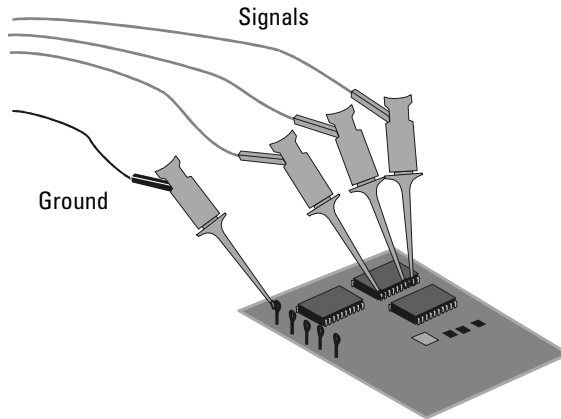


- 6 Connect the ground lead on each set of channels, using a probe grabber. The ground lead improves signal fidelity to the instrument, ensuring accurate measurements.

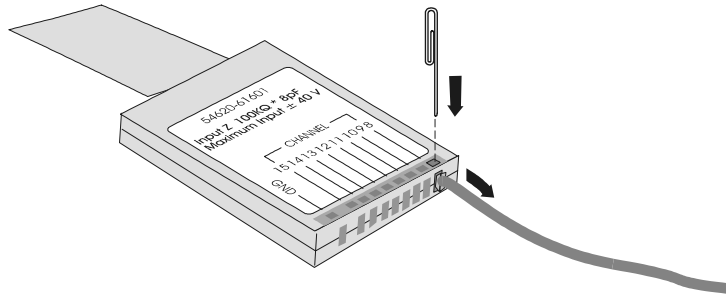


Preparing the Oscilloscope for Use  
**To use the digital probes (mixed-signal oscilloscope only)**

- 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

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 54642A/42D oscilloscope and may be purchased for the 54641A/41D 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.

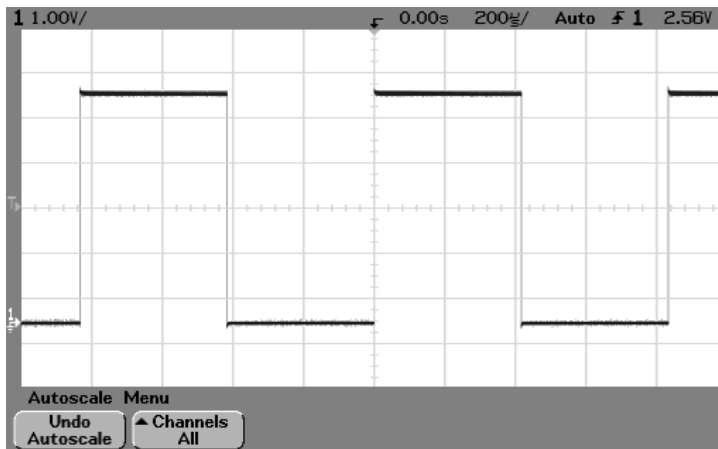
For more information on RS-232 configuration, refer to the “Utilities” chapter in the User’s Guide.

---

## 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.

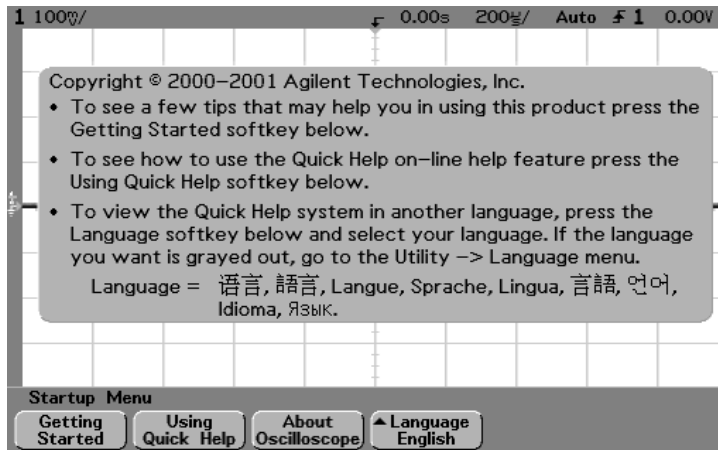


**Verifying Basic Oscilloscope Operation**

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## Getting started using the oscilloscope interface












When the oscilloscope is first turned on, a startup screen is displayed as shown below.



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

Preparing the Oscilloscope for Use  
**To verify basic oscilloscope operation**

- 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.
-  Links you to another menu.
-  Press the softkey to view the menu.
-  Press the softkey to return to the previous menu.



---

## Using Quick Help

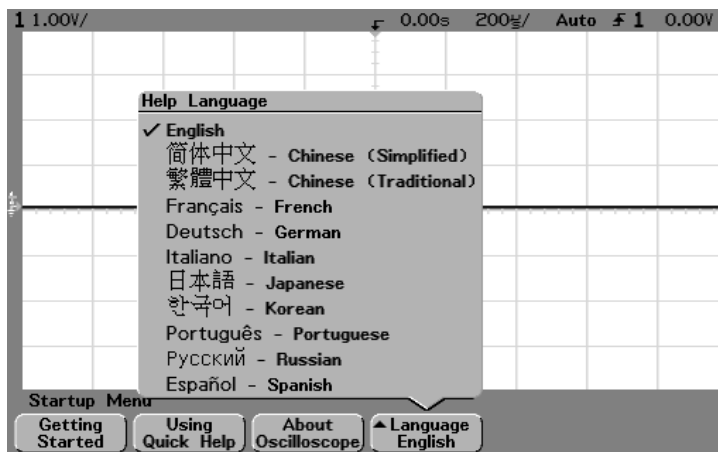
The oscilloscope has a Quick Help system that provides user help for each front-panel key and softkey on the oscilloscope. To view Quick Help information:

- 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. Successively press the **Language** softkey until the desired language in the list is selected.

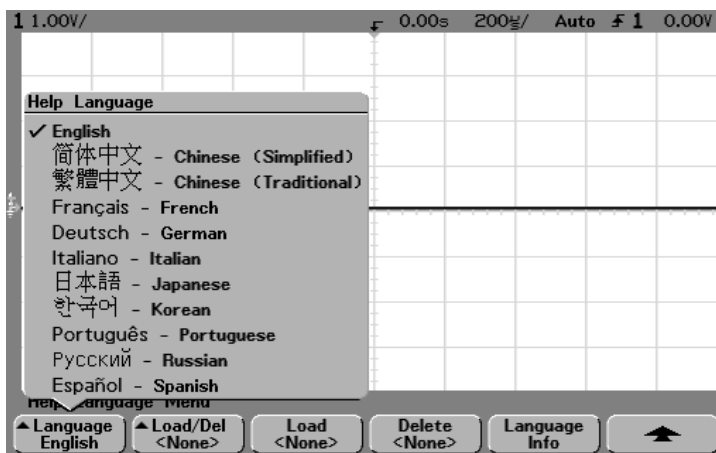


You can also select language later from the **Utility Language** menu.

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

### 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 is selected.



When updates occur, an updated language file can be downloaded from [www.agilent.com/find/5464xsw](http://www.agilent.com/find/5464xsw) or call an Agilent center and request a language disk for your instrument

## Loading an updated language file from floppy disk

When updates occur, an updated language file can be downloaded from [www.agilent.com/find/5464xsw](http://www.agilent.com/find/5464xsw) or call an Agilent center and request a language disk for your instrument.

- 1 Insert the floppy disk with the 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 Languages** softkey to load the updated language file into the oscilloscope.
- 4 Press the **Language** softkey and select the language to be viewed.

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

---

## 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.



---

# 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 mixed-signal oscilloscope, you will create and use a test connector accessory, as described in this chapter.

- The test connector makes it easy for you to connect the oscilloscope probes to function generators and measurement equipment with minimum electrical distortion.
- The connector is used in the digital channel threshold accuracy test.

**Let the Equipment Warm Up Before Testing** For accurate test results, let the test equipment and the oscilloscope warm up 30 minutes before testing.

**Verifying Test Results** During the tests, record the readings in the Performance Test Record at the end of this chapter for your oscilloscope. To verify whether a test passes, verify that the reading is within the limits in the Performance Test Record.

### **If a performance test fails**

If a performance test fails, first perform the User Cal procedure given in Chapter 4. If the User Cal procedure does not correct the problem, refer to Chapter 4, *Calibrating and Adjusting*.

---

## List of Test Equipment

Below is a list of test and equipment and accessories required to perform the performance test verification procedures.

<b>Equipment</b>	<b>Critical Specifications</b>	<b>Recommended Model/ Part Number</b>
Test connector, 8-by-2	<i>Not required if 01660-63801 Test Fixture is available See "To construct the test connector" later in this chapter</i>	n/a
Test fixture	For testing digital channel threshold accuracy	Agilent 01660-63801
Digital Multimeter	0.1 mV resolution, 0.0005% accuracy	Agilent 34401A
Power Splitter	Outputs differ by 0.15 dB	Agilent 11667B
Power Supply	DC offset voltage of -5.5 V to 35.5 V, 0.1 mV resolution	Agilent 3245A
Oscilloscope Calibrator	25 MHz—500 MHz sine wave, 5 ppm	Fluke 5820A
BNC banana cable		Agilent 11001-60001
BNC cable (qty 3)		Agilent 10503A
Probe cable		Agilent 01650-61607
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 10240-60001
Adapter (qty 3)	N(m) to BNC(f)	Agilent 1250-0780

## To construct the test connector

The Agilent 54641D/42D 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 a test connector only if the 01660-63801 Test Fixture is not available.

### Construct Test Connector only if Test Fixture is not available

*The test connector is not required if 01660-63801 Test Fixture is available.*

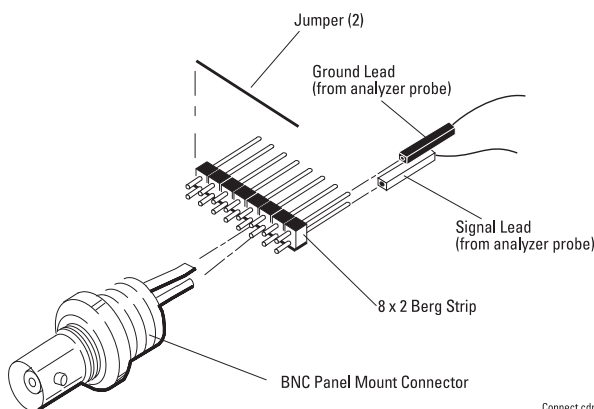
**Table 3-1**

### Materials Required to Construct the Test Connectors

Description	Recommended Part	Qty
BNC (f) Connector	Agilent 1250-1032	1
Berg Strip, 8-by-2		1
Jumper wire		

- 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



---

## To test the 54641D/42D Oscilloscope digital channels

**Only the 54641D/42D Mixed-Signal Oscilloscope has Digital Channels**

You need to perform these instructions only if you will be testing the digital channels on the Agilent 54641D/42D 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 Probe Comp signal on the lower-right corner of the 54641D/42D 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 Probe Comp.
- 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 digital channel threshold accuracy

This test verifies the digital channel threshold accuracy specification of the Agilent 54641D/42D Mixed-Signal Oscilloscope.

<p><b>Test Threshold Accuracy only on the 54641D/42D Mixed-Signal Oscilloscope</b></p>
--

<p>You need to perform these instructions only if you will be testing the Agilent 54641D/42D Mixed-Signal Oscilloscope.</p>
---

Threshold accuracy test limits=  $\pm(100 \text{ mV} + 3\% \text{ of threshold setting})$

**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.

**Table 3-2**

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### Equipment Required to Test Threshold Accuracy

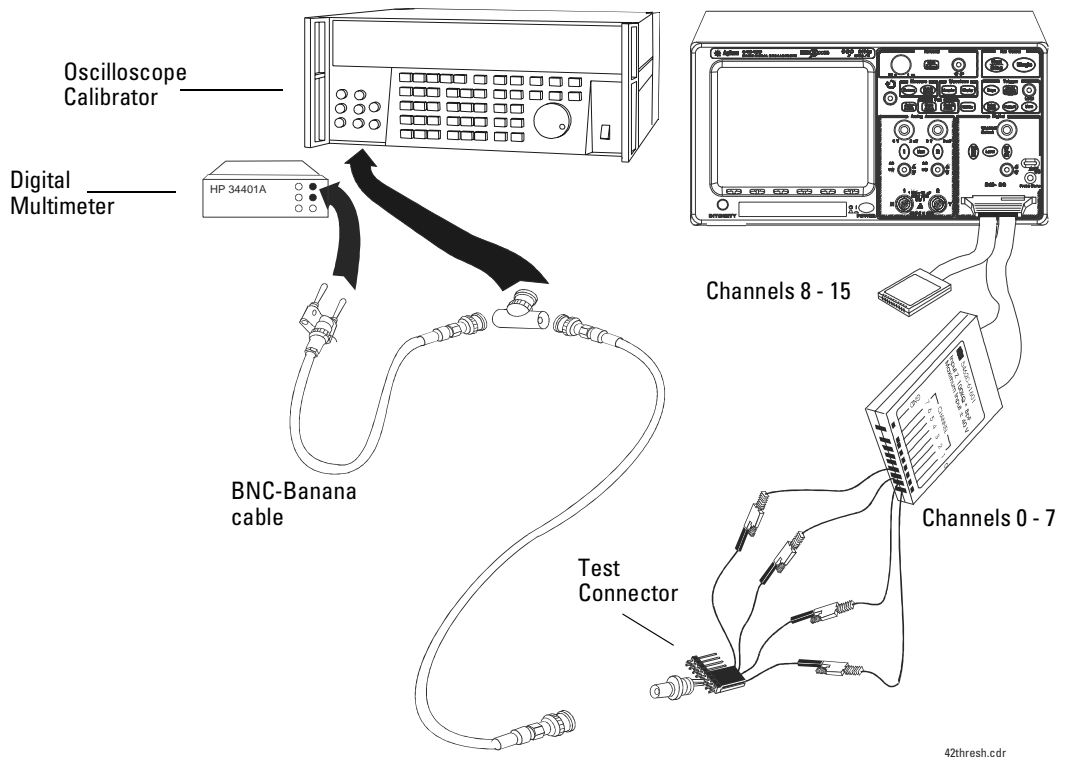
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Equipment	Critical Specifications	Recommended Model/Part
Digital Multimeter	0.1 mV resolution, 0.005% accuracy	Agilent 34401A
Oscilloscope Calibrator	DC offset voltage 6.3 V	Fluke 5820A
BNC-Banana Cable		Agilent 11001-60001
BNC Tee		Agilent 1250-0781
BNC Cable		Fluke 50Ω cable, P/N 686318
BNC Test Connector, 8-by-2	<i>Not required if 01660-63801 Test Fixture is available</i>	User-built (See "Obtain a BNC connector and an 8-by-2 section of Berg strip." on page 3-4.)
Test Fixture	PV test fixture	Agilent 01660-63801
Probe Cable		Agilent 01650-61607

---

- 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 3-2.

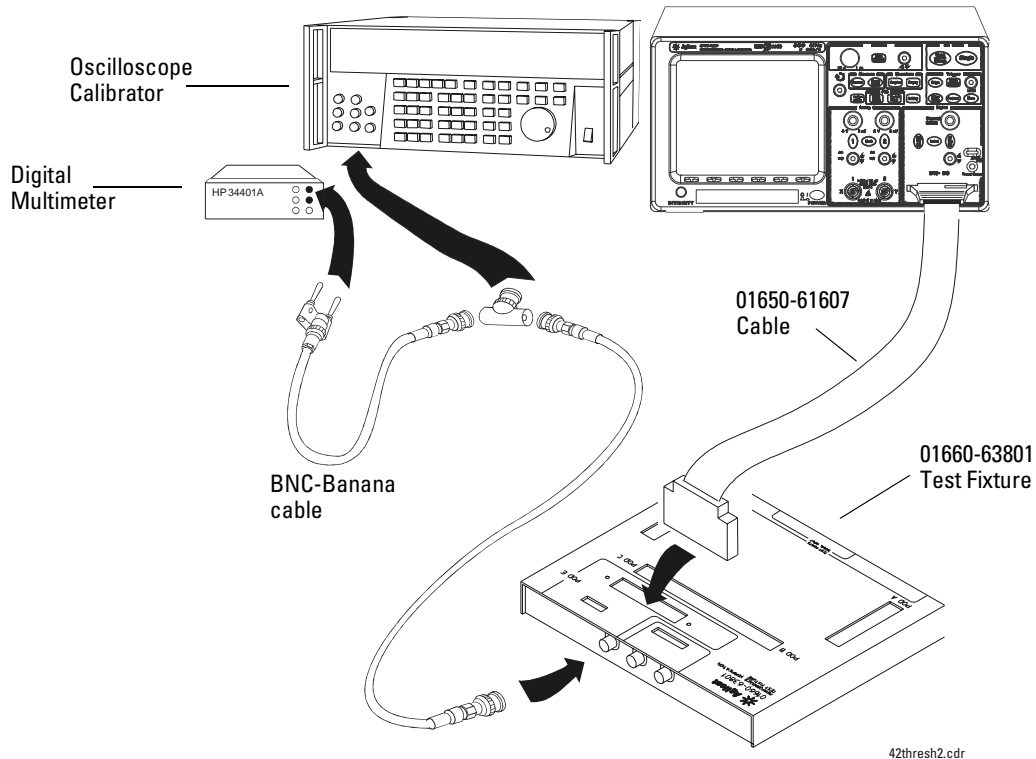
Figure 3-2



Setting Up Equipment and Test Connector for the Threshold Test

**To verify digital channel threshold accuracy****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 3-3.

**Figure 3-3**

42thresh2.cdr

**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 3-2 and figure 3-3.
- 6 On the oscilloscope, press the **D7 Thru D0** key, then press the **Threshold** softkey.

- 7 Press the oscilloscope **User** softkey, then turn the Entry knob (  ) on the front panel on the oscilloscope to set the threshold test settings as shown in Table 3-3.

**Table 3-3**

<b>Threshold Accuracy Voltage Test Settings</b>		
<b>Threshold voltage setting (in oscilloscope User softkey)</b>	<b>DC offset voltage setting (on oscilloscope calibrator)</b>	<b>Limits</b>
+5.00 V	+5.250 V ±1 mV dc	Lower limit = +4.750 V Upper limit = +5.250 V
-5.00 V	-4.750 V ±1 mV dc	Lower limit = -5.250 V Upper limit = -4.750 V
0.00 V	+100m V ±1 mV dc	Upper limit = +100 mV Lower limit = -100 mV

- 8 Do the following steps for each of the threshold voltage levels shown in Table 3-3.

- a Set the threshold voltage shown in the **User** softkey 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.

Digital channel activity indicators are displayed on the status line at the top of the oscilloscope display. The 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 D7-D0 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:  $\pm 2.0\%$  of full scale  $\pm 1$  LSB\*

- Full scale is defined as 32 mV on the 2 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 0.5 division from the bottom of the display.


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**

Volts/Div Setting	Power Supply Setting	Test Limits	
5 V/Div	35 V	34.04 V	to 35.96 V
2 V/Div	14 V	13.616 V	to 14.384 V
1 V/Div	7 V	6.808 V	to 7.192 V
0.5 V/Div	3.5 V	3.404 V	to 3.596 V
0.2 V/Div	1.4 V	1.3616 V	to 1.4384 V
0.1 V/Div	700 mV	680.8 mV	to 719.2 mV
50 mV/Div	350 mV	340.4 mV	to 359.6 mV
20 mV/Div	140 mV	136.16 mV	to 143.84 mV
10 mV/Div	70 mV	68.08 mV	to 71.92 mV
5 mV/Div	35 mV	34.04 mV	to 35.96 mV
2 mV/Div*	14 mV	13.232 mV	to 14.768 mV

\*Full scale is defined as 32 mV on the 2 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.

**To verify voltage measurement accuracy**

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 voltage trace 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.

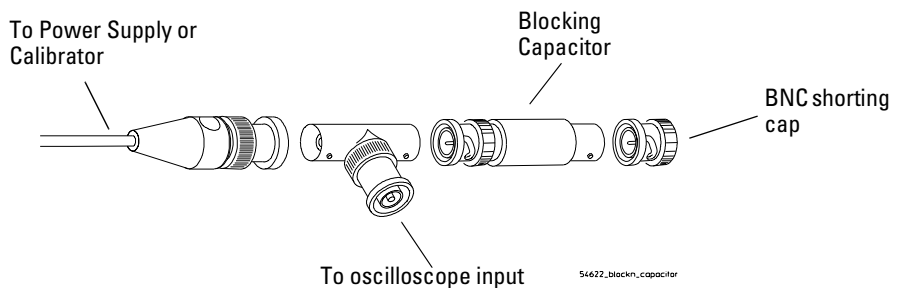
7 When you are finished checking all of the power supply setting values, disconnect the power supply from the oscilloscope.

8 Repeat this procedure for Channels 2.

**Use a Blocking Capacitor to Reduce Noise**

On the more sensitive ranges, such as 2 mV/div and 5 mV/div, noise may be a factor. To eliminate the noise, use a BNC Tee, blocking capacitor, and BNC shorting cap to shunt the noise to ground. See figure 3-4.

**Figure 3-4**



**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 both at 1 MHz and at bandwidth frequency to verify the bandwidth response of the oscilloscope.

### 54642A and 54642D

Test limits at 2 mV/div to 5 V/div:

- All channels ( $\pm 3$  dB)
  - dc to 500 MHz
  - ac coupled 3.5 Hz to 500 MHz

### 54641A and 54641D

Test limits at 2 mV/div to 5 V/div:

- All channels ( $\pm 3$  dB)
  - dc to 350 MHz
  - ac coupled 3.5 Hz to 350 MHz

**Table 3-6**

---

### Equipment Required to Verify Bandwidth

---

Equipment	Critical Specifications	Recommended Model/Part
Oscilloscope Calibrator		Fluke 5820A
Cable *	Type N (m), 24-inch	Agilent 11500B

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

Testing Performance  
**To verify bandwidth**

- 1 Connect the oscilloscope calibrator output to the oscilloscope channel 1 input.
- 2 Set up the oscilloscope.
  - a Set channel 1 **Coupling** to **DC** and **Imped** to **50 Ohm**.
  - b Set the time base to 500 ns/div.
  - c Set the Volts/Div for channel 1 to 200 mV/div.
  - d Press the **Acquire** key, then press the **Averaging** softkey.
  - e Turn the Entry knob to set **# Avgs** to 8 averages.
- 3 Set the calibrator to “Level Sine” and OPR/STBY to “OPR”.
- 4 Set the calibrator for 1 MHz and six divisions of amplitude.
- 5 Press **Autoscale** on the oscilloscope.
- 6 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:  $V_{p-p} = \text{_____ V}$ .
- 7 Change the frequency of the signal generator to the value shown below for your instrument.

**Table 3-7**

<b>Signal Generator Frequency Setting</b>		
<b>Selected Channel</b>	<b>54641A/41D</b>	<b>54642A/42D</b>
<b>Channel 1</b>	350 MHz	500 MHz
<b>Channel 2</b>	350 MHz	500 MHz

- 8 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:  $V_{p-p} = \text{_____ mV}$ .
- 9 Calculate the response using this formula:

$$20 \log 10 \cdot \frac{\text{Step8Result}}{\text{Step6Result}}$$

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

- 10 Repeat this procedure (steps 1 to 9) for channel 2.

---

## 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:  $\pm 0.005\%$  of reading  $\pm 0.1\%$  of full scale  $\pm 20$  ps (same channel)

**Table 3-8**

---

**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

- 1** Connect the oscilloscope calibrator output to the oscilloscope channel 1 input. Then, select **Marker** on the oscilloscope calibrator and set the calibrator for 100  $\mu\text{s}$  markers.
- 2** Set up the oscilloscope.
  - a** Set channel 1 **Coupling** to **DC** and **Imped** to **50 Ohm**.
  - b** Press the **Display key**, then set the **Vectors** softkey to off.
  - c** Press the **Autoscale** key.
  - d** Set the time base to 20  $\mu\text{s}/\text{div}$ .
  - e** Press the **Main/Delayed** key, then set the **Time Ref** softkey to **Left**.
  - f** Adjust the Trigger Level knob to obtain a stable display.
- 3** Press the **Quick Meas** softkey, set the **Source** softkey to **1**, then select and measure **Frequency** and **Period**. Measure the following:
  - Frequency 10 kHz — The test limits are 9.98 kHz to 10.02 kHz.
  - Period 100  $\mu\text{s}$  — The test limits are 99.79  $\mu\text{s}$  to 100.2  $\mu\text{s}$ .

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

**To verify horizontal Dt and 1/Dt accuracy**

**4** Change the calibrator to 100 ns markers. Change the time base to 20 ns/div. Adjust the trigger level to obtain a stable display.

**5** Measure the following:

Frequency 10 MHz — The test limits are 9.98 MHz to 10.02 MHz.

Period 100 ns — The test limits are 99.77 ns to 100.2 ns.

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

**54642A/42D only**

**6** Change the calibrator to 2 ns markers. Change the time base to 1 ns/div. Adjust the trigger level to obtain a stable display.

**7** Measure the following:

Frequency 500 MHz — The test limits are 492.6 MHz to 507.6 MHz.

Period 2 ns — The test limits are 1.970 ns to 2.030 ns.

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

**54641A and 54641D only**

**8** Change the calibrator to 2.857 ns markers. Change the time base to 1 ns/div. Adjust the trigger level to obtain a stable display.

**9** Measure the following:

Frequency 350 MHz — The test limits are 346.4 MHz to 353.7 MHz.

Period 2.857 ns — The test limits are 2.827 ns to 2.887 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:

<10 mV/div (dc to max bandwidth): greater of 1 div or 5 mV<sub>p-p</sub>  
 ≥10 mV/div (dc to max bandwidth): 0.6 div

Test limits for the External trigger:

dc to 100 MHz: <100 mV<sub>p-p</sub>  
 100 MHz to max bandwidth: <200 mV<sub>p-p</sub>

**Table 3-9**

**Equipment Required to Verify Trigger Sensitivity**

<b>Equipment</b>	<b>Critical Specifications</b>	<b>Recommended Model/Part</b>
Oscilloscope Calibrator	25-MHz, 100-MHz, 350-MHz and 500-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

\* 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 oscilloscope calibrator output to the oscilloscope channel 1 input.
- 3 Verify the trigger sensitivity at 25 MHz and <10 mV/div.
  - a Set channel 1 **Coupling** to **DC** and **Imped** to **50 Ohm**.
  - a Set the output of the calibrator to 25 MHz, and set the amplitude to about 10 mV<sub>p-p</sub>.
  - b Press the **Autoscale** key.
  - c Set the time base to 10 ns/div.
  - d Set channel 1 to 5 mV/div.
  - e Decrease the output of the calibrator until 1 vertical division of the signal is displayed.

The trigger is stable when the displayed waveform is 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 maximum bandwidth and ≥10 mV/div division.
  - a Change the output of the calibrator to 500 MHz for the 54642A/42D or 350 MHz or the 54641A/41D, and set the amplitude to about 100 mV<sub>p-p</sub>.
  - b Set the time base to 1 ns/div.
  - c Set channel 1 to 100 mV/div.
  - d Decrease the output of the calibrator until 0.6 vertical division of the signal is displayed.

The trigger is stable when the displayed waveform is 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.
  - e Record the result as Pass or Fail in the Performance Test Record.
- 5 Repeat this procedure for channel 2.

### Test External Trigger Sensitivity

Verify the external trigger sensitivity at these settings:

500 MHz (54642A/42D),  $<200 \text{ mV}_{\text{p-p}}$

350 MHz (54641A/41D),  $<200 \text{ mV}_{\text{p-p}}$

100 MHz (All models),  $<100 \text{ mV}_{\text{p-p}}$

- 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.
- 2 Set up the oscilloscope.
  - a Set channel 1 **Coupling** to **DC** and **Imped** to **50 Ohm**.
  - b Press the **Mode/Coupling** key and set **Coupling** to **DC**
  - c In the **Mode/Coupling** menu, press the **External** softkey, then press the **Imped** softkey and set impedance to **50 Ohm**.
- 3 Change the output of the calibrator to 500 MHz for the 54642A/42D or 350 MHz for the 54641A/41D, and set the amplitude to  $400 \text{ mV}_{\text{p-p}}$ .  
The power splitter divides the  $400 \text{ mV}_{\text{p-p}}$  so that  $200 \text{ mV}_{\text{p-p}}$  is applied to each of the oscilloscope inputs.
- 4 Press the **Autoscale** key.
- 5 Press the **Trigger Edge** key, then press the **Ext** softkey to set the trigger source to external trigger.
- 6 Check for stable triggering, and adjust the trigger level if necessary.
- 7 Record the results as Pass or Fail in the Performance Test Record.  
If the test fails, see the “Troubleshooting” chapter. Then return here.
- 8 Change the output of the calibrator to 100 MHz and set the amplitude to  $100 \text{ mV}_{\text{p-p}}$ .
- 9 Check for stable triggering, and adjust the trigger level if necessary.
- 10 Record the results as Pass or Fail in the Performance Test Record.  
If the test fails, see the “Troubleshooting” chapter. Then return here.

# Agilent 54642A/42D Performance Test Record

<b>Agilent 54642A/54642D</b>				
Serial No. _____		Test by _____		
Test Interval _____		Work Order No. _____		
Recommended Next Testing _____		Temperature _____		
Threshold	Specification	Limits	Ch D7-D0	Ch D15-D8
<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>				
Range	Power Supply Setting	Test Limits	Channel 1	Channel 2
5 V/Div	35 V	34.04 V to 35.96 V	_____	_____
2 V/Div	14 V	13.616 V to 14.384 V	_____	_____
1 V/Div	7 V	6.808 V to 7.192 V	_____	_____
500 mV/Div	3.5 V	3.404 V to 3.596 V	_____	_____
200 mV/Div	1.4 V	1.3616 V to 1.4384 V	_____	_____
100 mV/Div	700 mV	680.8 mV to 719.2 mV	_____	_____
50 mV/Div	350 mV	340.4 mV to 359.6 mV	_____	_____
20 mV/Div	140 mV	136.16 mV to 143.84 mV	_____	_____
10 mV/Div	70 mV	68.08 mV to 71.92 mV	_____	_____
5 mV/Div	35 mV	34.04 mV to 35.96 mV	_____	_____
2 mV/Div	14 mV	13.232 mV to 14.768 mV	_____	_____
<b>Bandwidth</b>		Test Limits	Channel 1	Channel 2
		3 dB at 500 MHz	_____	_____
<b>Horizontal <math>\Delta t</math> and <math>1/\Delta t</math> Accuracy</b>				
	Generator Setting	Test Limits	Results	
Frequency	10 kHz	9.98 kHz to 10.02 kHz	_____	
Period	100 $\mu$ s	99.79 $\mu$ s to 100.2 $\mu$ s	_____	
Frequency	10 MHz	9.98 MHz to 10.02 MHz	_____	
Period	100 ns	99.77 ns to 100.2 ns	_____	
Frequency	500 MHz	492.6 MHz to 507.6 MHz	_____	
Period	2 ns	1.970 ns to 2.030 ns	_____	
Trigger Sensitivity		Test Limits	Channel 1	Channel 2
	Internal trigger	25 MHz at 1 division 500 MHz at 0.6 divisions	_____	_____
	External trigger	500 MHz at <200 mV <sub>p-p</sub> 100 MHz at <100 mV <sub>p-p</sub>	_____	_____
		<b>Ext</b>	_____	_____



# Agilent 54641A/41D Performance Test Record

<b>Agilent 54641A/54641D</b>				
Serial No. _____		Test by _____		
Test Interval _____		Work Order No. _____		
Recommended Next Testing _____		Temperature _____		
Threshold	Specification	Limits	Ch D7-D0	Ch D15-D8
<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>				
Range	Power Supply Setting	Test Limits	Channel 1	Channel 2
5 V/Div	35 V	34.04 V to 35.96 V	_____	_____
2 V/Div	14 V	13.616 V to 14.384 V	_____	_____
1 V/Div	7 V	6.808 V to 7.192 V	_____	_____
500 mV/Div	3.5 V	3.404 V to 3.596 V	_____	_____
200 mV/Div	1.4 V	1.3616 V to 1.4384 V	_____	_____
100 mV/Div	700 mV	680.8 mV to 719.2 mV	_____	_____
50 mV/Div	350 mV	340.4 mV to 359.6 mV	_____	_____
20 mV/Div	140 mV	136.16 mV to 143.84 mV	_____	_____
10 mV/Div	70 mV	68.08 mV to 71.92 mV	_____	_____
5 mV/Div	35 mV	34.04 mV to 35.96 mV	_____	_____
2 mV/Div	14 mV	13.232 mV to 14.768 mV	_____	_____
Bandwidth	Test Limits		Channel 1	Channel 2
	3 dB at 350 MHz		_____	_____
<b>Horizontal <math>\Delta t</math> and <math>1/\Delta t</math> Accuracy</b>				
	Generator Setting	Test Limits	Results	
Frequency	10 kHz	9.98 kHz to 10.02 kHz	_____	
Period	100 $\mu$ s	99.79 $\mu$ s to 100.2 $\mu$ s	_____	
Frequency	10 MHz	9.98 MHz to 10.02 MHz	_____	
Period	100 ns	99.77 ns to 100.2 ns	_____	
Frequency	350 MHz	346.4 MHz to 353.7 MHz	_____	
Period	2.857 ns	2.827 ns to 2.887 ns	_____	
Trigger Sensitivity		Test Limits	Channel 1	Channel 2
	Internal trigger	25 MHz at 1 division 350 MHz at 0.6 divisions	_____	_____
	External trigger	350 MHz at $<200 \text{ mV}_{p-p}$ 100 MHz at $<100 \text{ mV}_{p-p}$	_____	_____
		<b>Ext</b>	_____	_____





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# 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 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.

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**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.

---

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**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.

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**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 +3.4 V adjustment. Other oscilloscope voltages are based on the +3.4 V adjustment.

In this procedure, you will use a digital multimeter to measure the +3.4 V test point, and adjust the power supply to be within tolerance, if necessary.

**Table 4-1**

---

**Equipment Required to Adjust the Power Supply**

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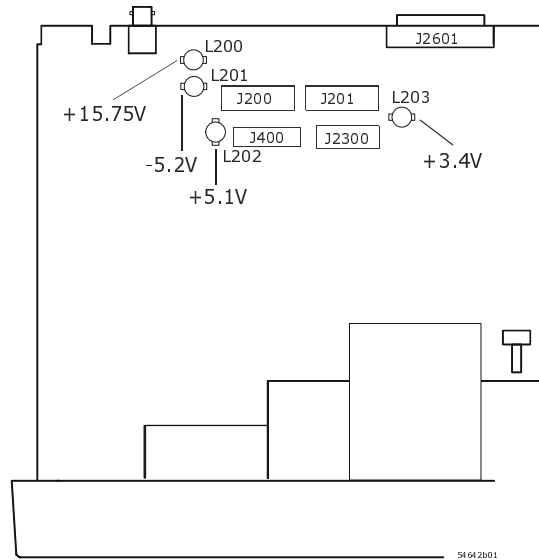
<b>Equipment</b>	<b>Critical Specifications</b>	<b>Recommended Model/Part</b>
Digital multimeter	0.1 mV resolution, accuracy $\pm 0.05\%$	Agilent 34401A

- 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 L200, L201, L202, and L203 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**

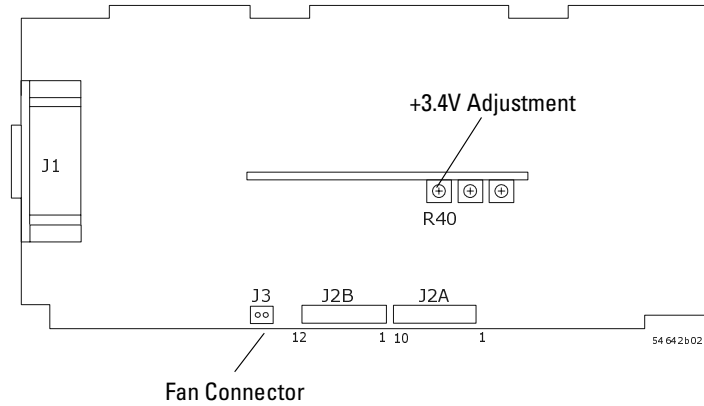
**Power Supply Voltage Tolerances**

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)
+3.4 V	±100 mV (+3.30 V to +3.50 V)
+8.2 V	±82 mV (+8.12 V to +8.28 V) measure at Printer Power connector on rear panel of instrument

Calibrating and Adjusting  
**To adjust the power supply**

- 4 Adjust R40 if necessary to bring the +3.4 V voltage into tolerance. The adjustment location is on the power supply as shown below.

**Figure 4-2**



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

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



## To perform User Cal

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.

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** Connect the Trig Out signal from the rear panel to analog Channel 1 and Channel 2 using 3 BNC cables and a BNC-tee connector.  
The BNC cables from the BNC-tee to the channel inputs must be the same length.
- 4** Press the **Utility** key, then press the **Service** softkey.
- 5** Begin the routine by pressing the **User Cal** softkey.
- 6** 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.HOLD	(vertical hold)
INTENSITY	(intensity control on oscilloscope front panel)
H.HOLD	(horizontal hold)
FOCUS	
V.LIN	(vertical linearity)
V.SIZE	(vertical size)

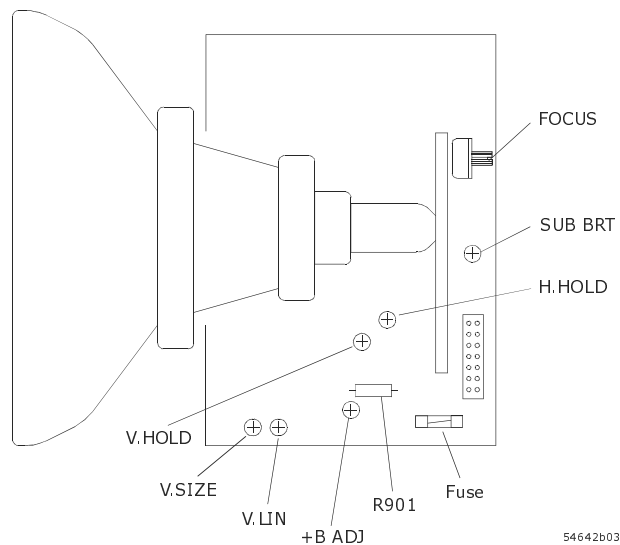
- 3 Adjust **V.HOLD** (vertical hold) for vertical synchronization.
- 4 Set the INTENSITY control (lower-left on the front panel) to approximately 50%.

### Do not adjust Sub Bri control

Do not adjust the **SUB BRT** (sub bright) control. This control is preset at the factory to assure the correct number of display grayscales.

- 5 Adjust **H.HOLD** (horizontal hold) to center the display horizontally.
  - 6 Adjust **FOCUS** to achieve the best focus.
  - 7 Adjust **V.LIN** (vertical linearity) to position all four corners of the half-bright borders equally.
  - 8 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





---

# 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.

<b>Read All Cautions and Warnings</b>
---------------------------------------

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 54641A/42A Oscilloscopes and the 54641D/42D 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 54641A/42A Oscilloscopes and the 54641D/42D 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**

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**Equipment Required to Troubleshoot the Oscilloscope**

---

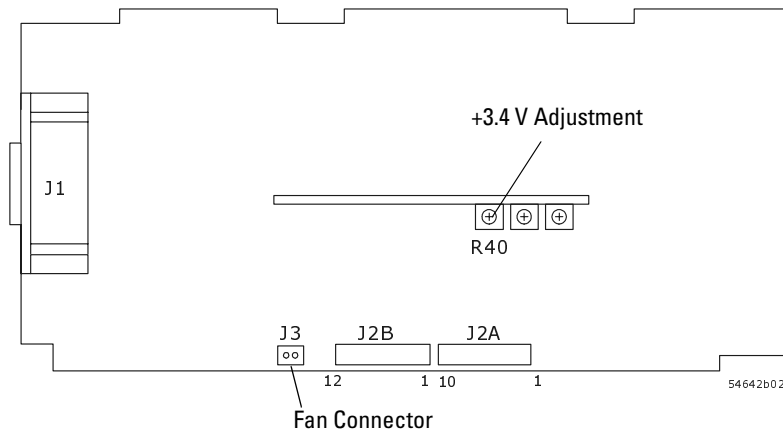
<b>Equipment</b>	<b>Critical Specifications</b>	<b>Recommended Model/Part</b>
Digital multimeter	Accuracy $\pm 0.05\%$ 1 mV resolution	Agilent 34401A
Oscilloscope	100 MHz, 1 M $\Omega$ input R	Agilent 54622A
Dummy load	Compatible with power supply	See "To construct your own dummy load" on page 5-7.

## To construct your own dummy load

- 1 Obtain a connector that is compatible with the connector J2A and J2B 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
+3.4 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**

**Display Signals on the System Board – All Oscilloscopes**

Signal	Name	Frequency	Pulse Width	Voltage
J2300 Pin 14	Hsync	19.72 kHz	3.0 ms	4.5 V <sub>p-p</sub>
J2300 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**

**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)
+3.4 V	±100 mV (+3.30 V to +3.50 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?**

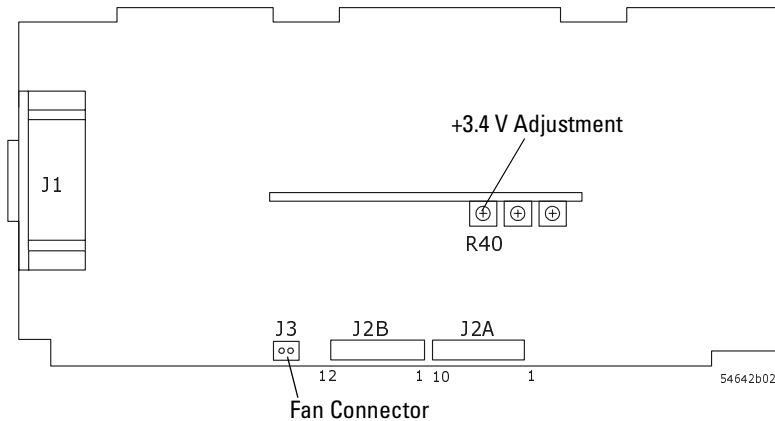
The low voltage power supply has a thermal cut-out circuit. If the fan is defective, the low voltage power supply will shut down when it gets too hot for safe operation.

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**

---

## 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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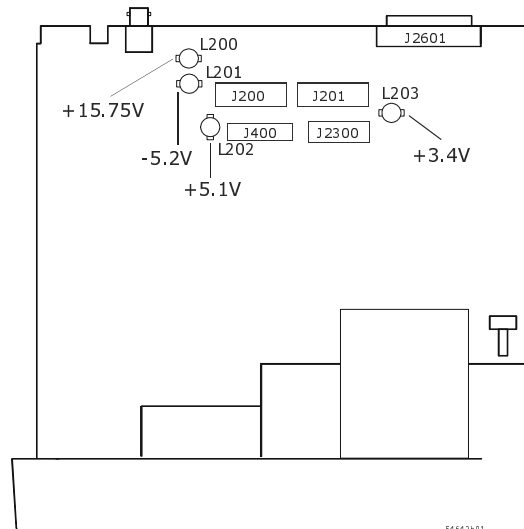
### CAUTION

#### 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 L200 through L203 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)
+3.4 V	±100 mV (+3.30 V to +3.50 V)

- 4 If the +3.4 V measurement is out of tolerance, adjust the +3.4 V adjustment on the power supply (see figure 5-2).

All other supply levels are not adjustable. The power supply should be replaced if those voltages are out of tolerance.

**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:

- T8, T10, T15, and T20 TORX drivers
- 9/16-inch socket driver.

## **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.

---

---

**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.

---

---

**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.

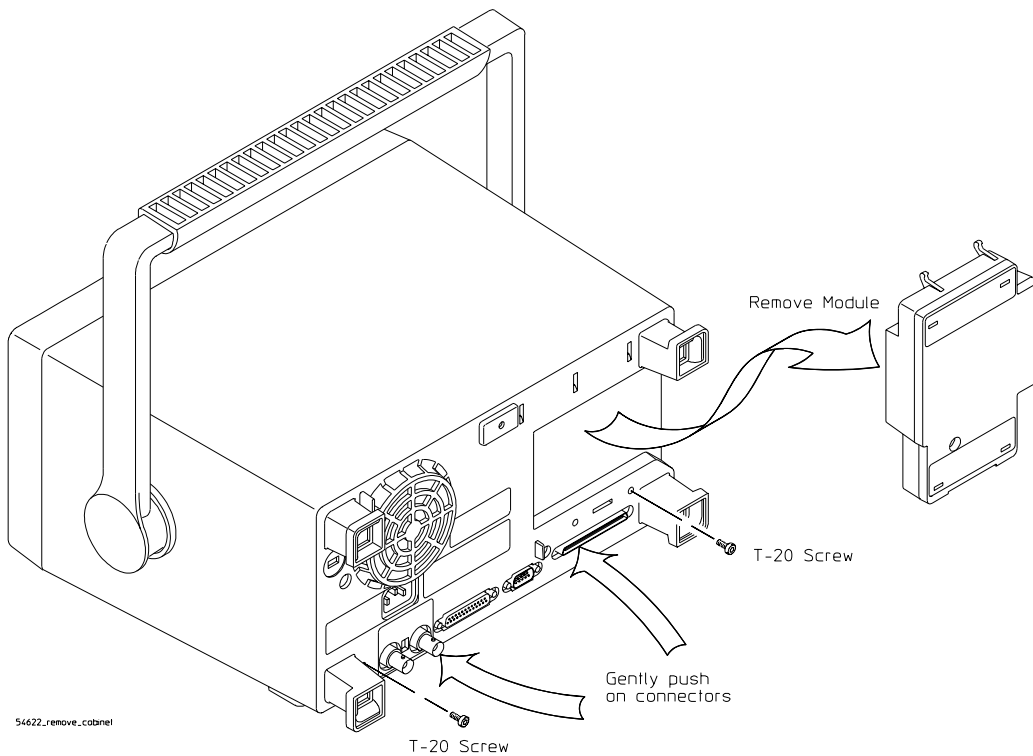
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## To remove the cabinet

- 1 Turn off the oscilloscope and disconnect the power cable.
- 2 Rotate the handle up as shown below.
- 3 If a module is installed, remove it from the oscilloscope.
- 4 Using the T20 TORX driver, remove the two screws from the rear of the cabinet.
- 5 Using your thumbs, gently push on the rear-panel connectors to slide the oscilloscope out of the cabinet.

Figure 6-1



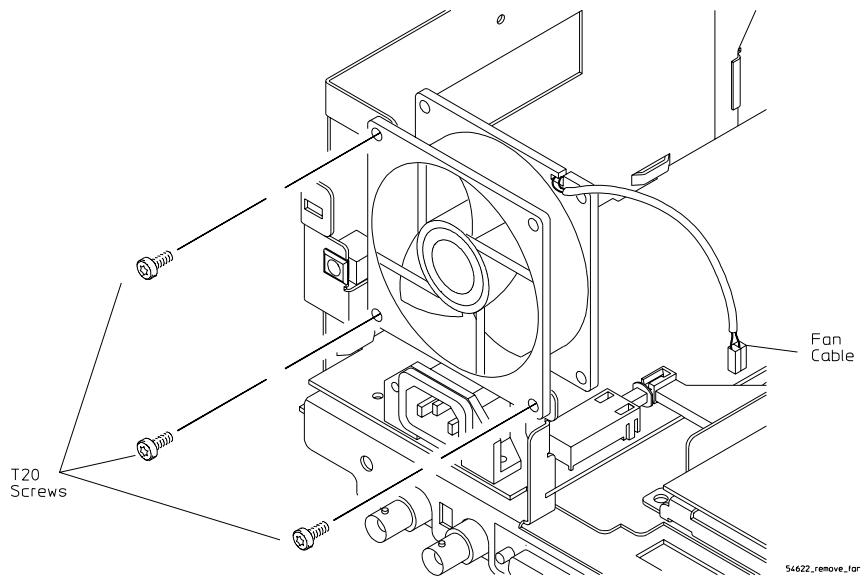
## Removing the cabinet

---

## To remove the fan

- 1 Disconnect the fan cable from the power supply board.
- 2 Using the T20 TORX driver, remove the three screws that hold the fan to the deck.

**Figure 6-2**



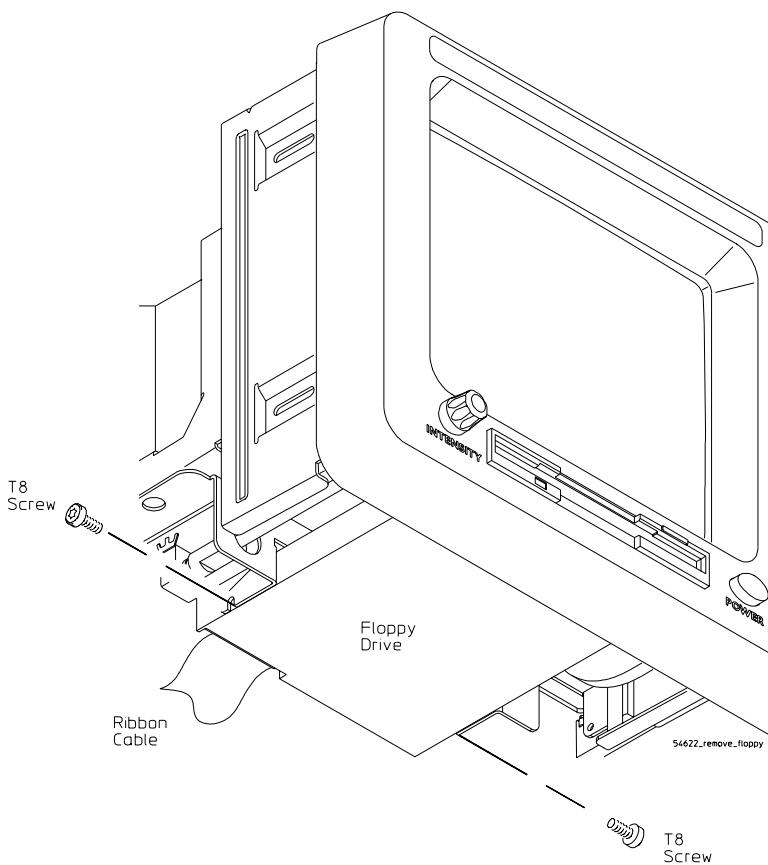
### Removing the fan

---

## 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.

**Figure 6-3**



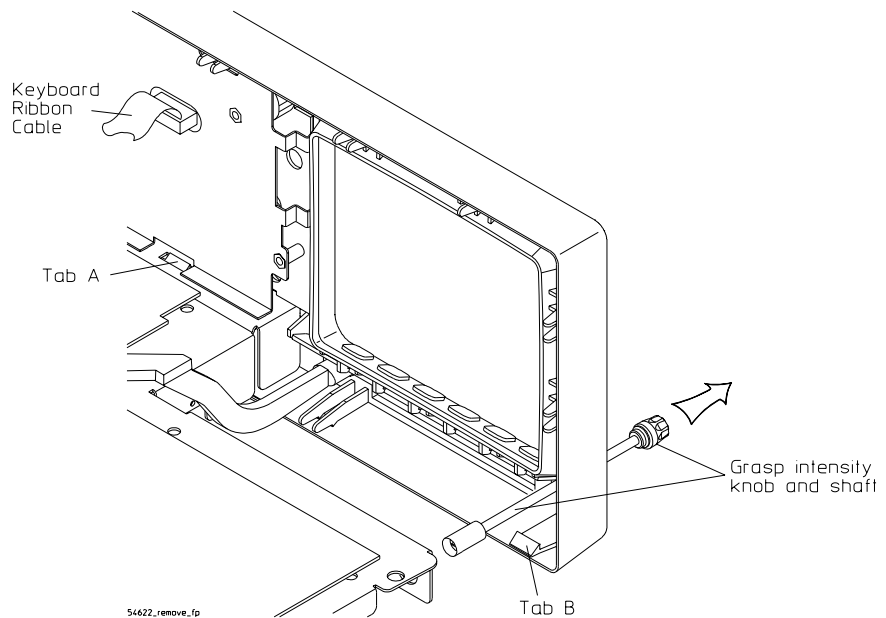
### Removing the floppy drive



## To remove the front panel

- 1 Remove the intensity knob and shaft by grasping the knob with one hand and the grasping the shaft behind the front panel with the other hand and pulling the shaft straight out from the front panel.
- 2 Disconnect the keyboard ribbon cable W2 from the keyboard.
- 3 Use a screwdriver to release retainer tab A, and your finger to release retainer tab B. See the tab locations in Figure 6-4.

Figure 6-4



### Removing the intensity shaft and front panel

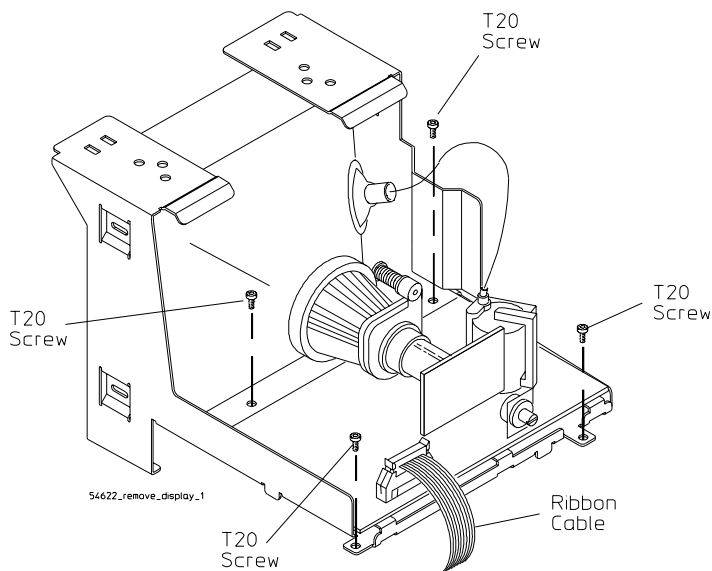
- 4 Swing the front panel out until the bottom clears the deck assembly, then lift it up to free the hooks on top and pull it away from the deck.  
When installing the front panel, make sure that the power switch shaft is aligned with the connection hole in the front panel to make a proper connection.  
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

- 1 Remove the front panel from the oscilloscope.
- 2 Disconnect the ribbon cable from the display board.
- 3 Using the T20 TORX driver, remove the four screws that hold the display to the deck. Set these screws aside.

Figure 6-5



### Removing the display

---

#### CAUTION

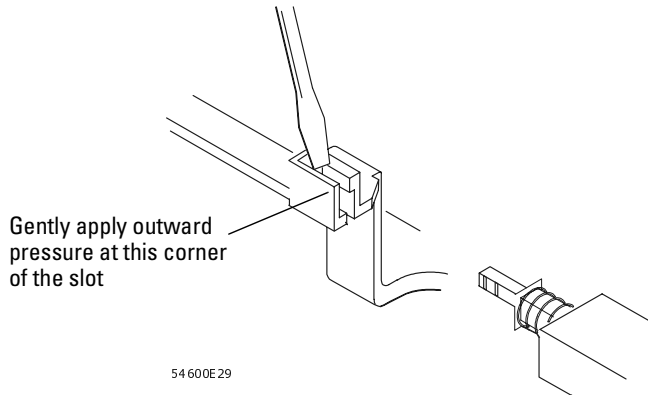
#### USE CORRECT SCREWS TO AVOID SHORTING SYSTEM BOARD !

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 Use a flat-blade screwdriver to gently unhook the latch that holds the white power-actuator shaft to the power switch, then disconnect the shaft from the power switch. After you disconnect the shaft, make sure you position it in the recess along the side of the display bracket.

**Figure 6-6**



**Unhooking the power switch shaft**

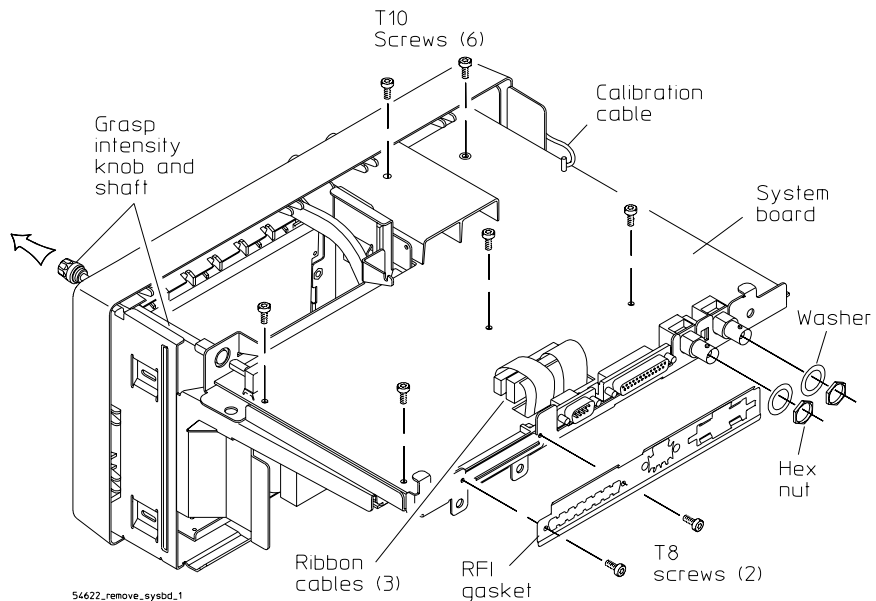
- 5 Lift the display and remove it from the deck.
- 6 When reinserting the power shaft, push the shaft into the power switch until the shaft seats.

---

## To remove the system board

- 1 Remove the floppy drive.
- 2 Using the T10 TORX driver, remove the six screws that hold the system board to the deck.
- 3 Remove the 2 hex nuts and washers from the rear BNCs using the 9/16-inch socket driver.  
The 54641D and 54642D have two rear BNCs, the 54641A and 54642A have one rear BNC.
- 4 Using the T8 TORX driver, remove two screws from module connector and remove the rear RFI gasket.
- 5 Remove the intensity knob and shaft by grasping the knob with one hand and the grasping the shaft behind the front panel with the other hand and pulling the shaft straight out from the front panel.
- 6 Disconnect the three ribbon cables and the calibration cable.

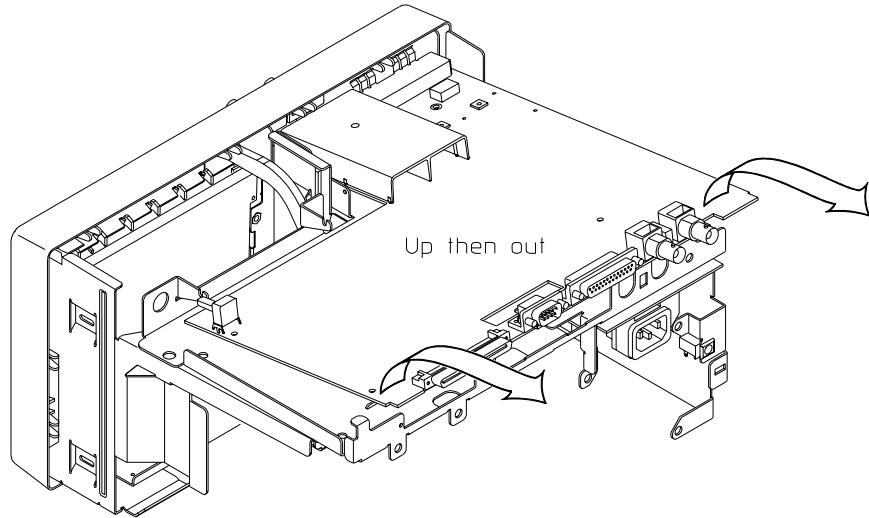
Figure 6-7



### Preparing to remove the system board

- 7 Lift the back of the board to clear the main deck and then pull the board straight out.

Figure 6-8



54622\_remove\_sysbd\_2

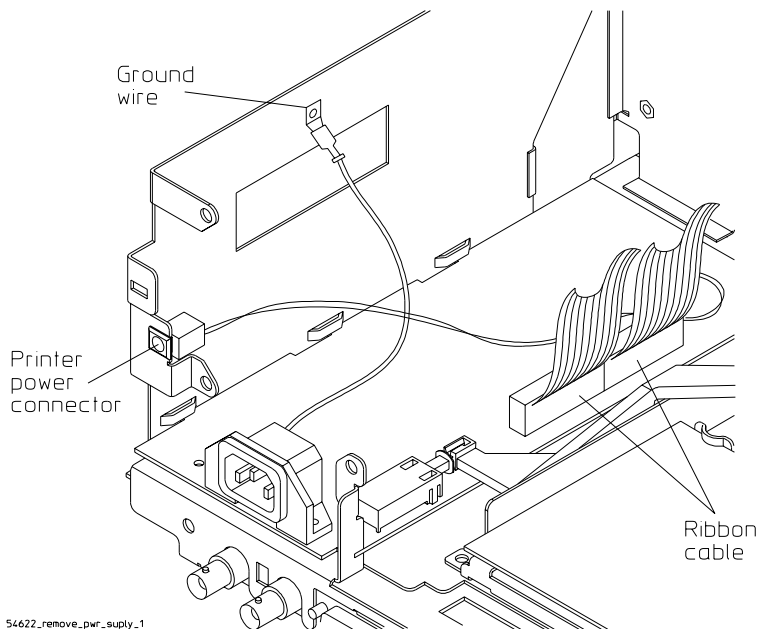
### Removing the system board

---

## 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 Remove the printer power connector by sliding the connector out of the chassis.

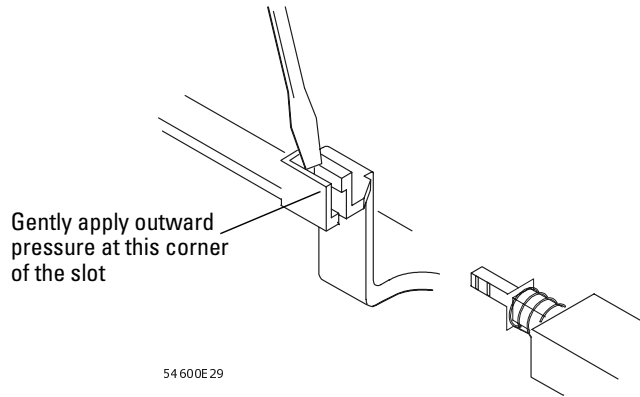
**Figure 6-9**



**Disconnecting ground wire and ribbon cable**

- 5 Use a flat-blade screwdriver to gently unhook the latch that holds the white power-actuator shaft to the power switch, then disconnect the shaft from the power switch. After you disconnect the shaft, make sure you position it in the recess along the side of the display bracket.

**Figure 6-10**

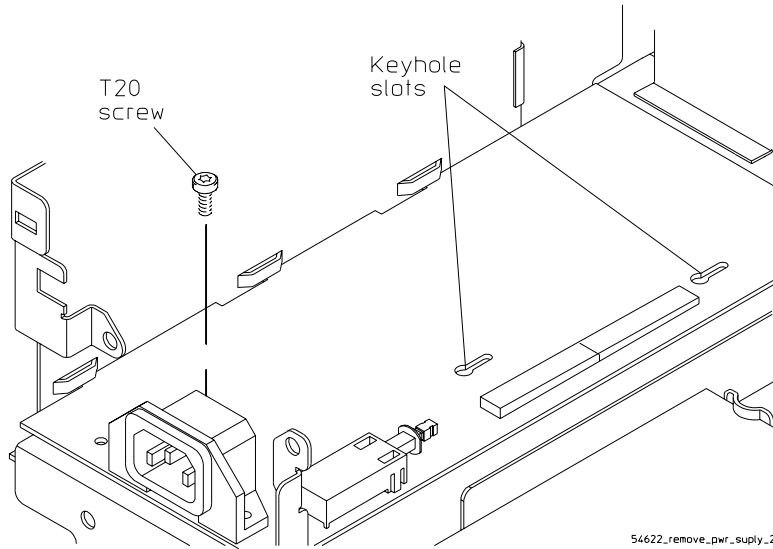


**Unhooking the power switch shaft**

**To remove the power supply**

- 6 Using the T20 TORX driver, remove the screw holding the power supply board to the deck.

**Figure 6-11**



**Removing the power supply**

- 7 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.

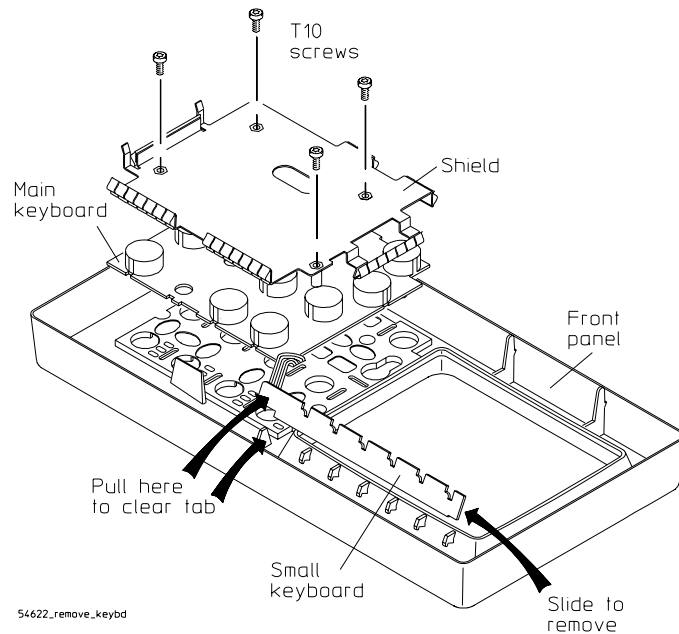


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## To remove the keyboard assembly

- 1 Remove the front panel.
- 2 Remove all of the knobs by pulling them straight out.
- 3 Using the T10 TORX driver, remove the four screws from the keyboard shield.
- 4 Lift the ribbon cable end of the small keyboard and simultaneously slide the small keyboard toward the main keyboard to remove.

Figure 6-12



### Removing the keyboard assembly

---

#### 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 Lift the keyboard assembly straight 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

This chapter describes how to order replaceable assemblies and parts for the Agilent 54641A/42A Oscilloscope and Agilent 54641D/42D 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

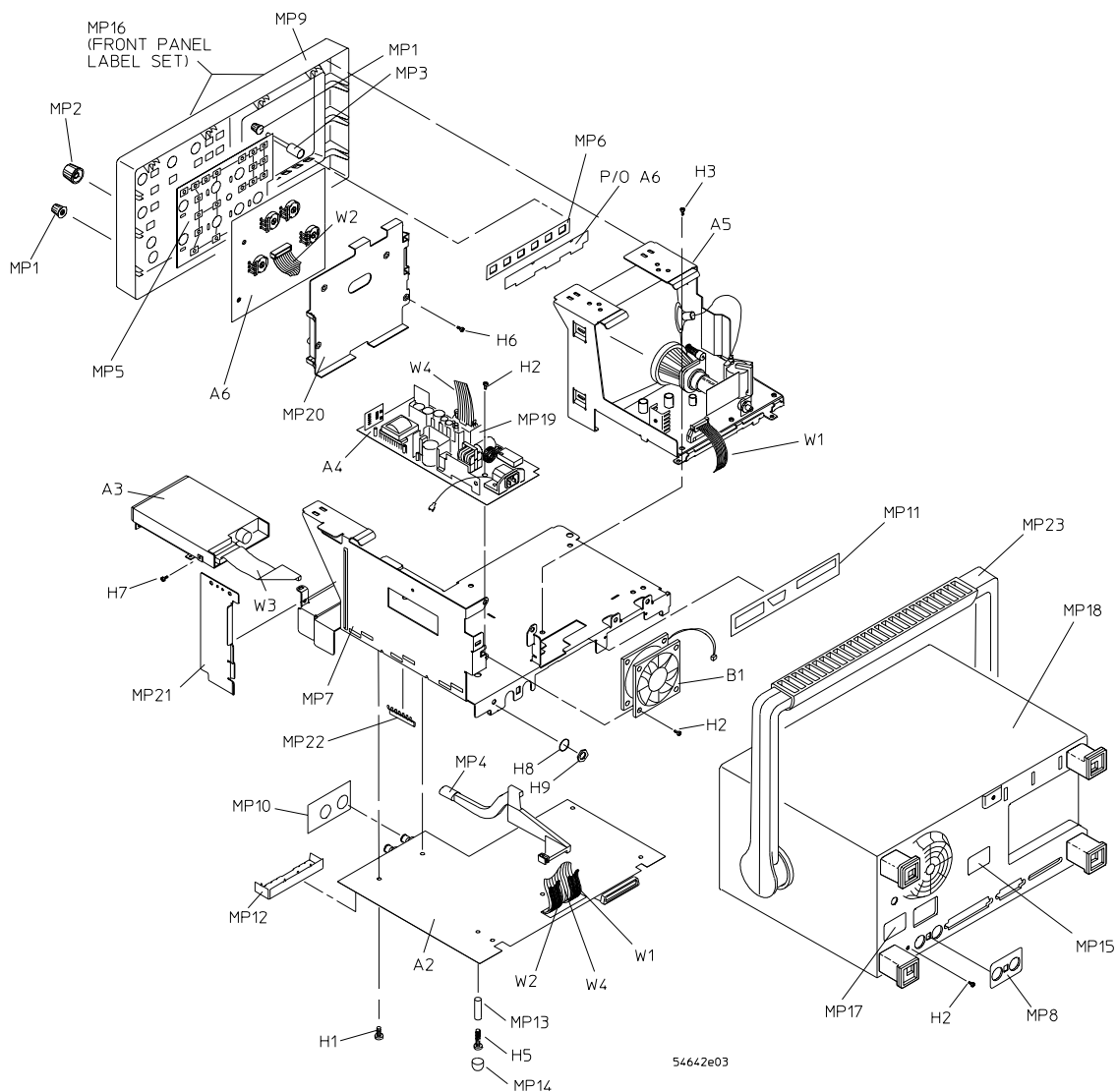
- To order a part in the material list, quote the Agilent Technologies part number, indicate the quantity desired, and address the order to your nearest Agilent Technologies Sales Office.
- To order a part not listed in the material list, include the model number and serial number of the oscilloscope, 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



Exploded view of the 54641A/41D/42A/42D Oscilloscope

**Table 7-1**

**Replaceable Parts**

Reference Designator	Agilent Part Number	Qty	Description
A1	54641-69001	1	Refurbished Product 2 CH 350MHz(54641A-Agilent Express)
A1	54641-69002	1	Refurbished Product 2+16 CH 350MHz (54641D-Agilent Express)
A1	54642-69001	1	Refurbished Product 2 CH 500MHz (54642A-Agilent Express)
A1	54642-69002	1	Refurbished Product 2+16 CH 500MHz (54642D-Agilent Express)
A2	54641-66501	1	System Board (54641A)
A2	54641-66506	1	System Board (54641D)
A2	54642-66501	1	Systemn Board (54642A)
A2	54642-66506	1	Systemn Board (54642D)
A2BT340	1420-0394	1	3V Battery (CR2477)
A3	0950-2782	1	Floppy Disk Drive
A4	0950-4282	1	Power Supply Assembly
A4F1	--	1	Fuse, 6.3 A 250 V SB
A5	2090-0384	1	Display Assembly
A6	54622-66502	1	Keyboard 2 CH (54641A/42A)
A6	54622-66503	1	Keyboard 2 + 16 CH MSO (54641D/42D)
B1	3160-1006	1	Fan
H1	0515-0372	5	T-10 Machine Screw
H2	0515-0380	6	T-20 Machine Screw 4 x 0.7 x 10mm
H3	0515-0390	4	T-20 Machine Screw 4 x 0.7 x 6mm
H4	0515-0658	2	T-6 Pan Head Machine Screw
H5	0515-0667	3	T-10 Machine Screw 3 x 0.5 x 25mm
H6	0515-1410	4	T-10 Machine Screw 3 x 0.5 x 20mm
H7	0515-2691	2	T-8 Machine Screw
H8	2190-0068	See Descr	Washer - Trig Out (54641A/42A - 1 ea) Washer - Ext Trig & Trig Out (54641D/42D - 2 ea)
H9	1250-2075	See Descr	Nut - Trig Out (Qty 1 54641A/42A) Nut - Ext Trig & Trig Out (Qty 2 54641D/42D)
MP1	54801-47401	8	Knob - 12mm Flint Gray (54641A/42A - 6 ea) (54641A/42A - 8 ea)
MP2	54801-47402	3	Knob - 18mm Flint Gray
MP3	54622-43702	1	Intensity Shaft
MP4	54622-43701	1	Power Switch Shaft

## Replaceable Parts

### To order a replacement part

<b>Reference Designator</b>	<b>Agilent Part Number</b>	<b>Qty</b>	<b>Description</b>
MP5	54622-41901	1	Front Panel Keyboard Keypad (54641A/42A)
MP5	54622-41903	1	Front Panel Keyboard Keypad (54641D/42D)
MP6	54622-41902	1	Front Panel Softkey Keypad
MP7	54622-00101	1	Main Deck
MP8	54622-94304	1	Rear Trig Out Label (54641A/42A)
MP8	54624-94302	1	Rear Ext Trig/Trig Out Label (54641D/42D)
MP9	54642-42201	1	Front Panel Casting (54641A/42A)
MP9	54642-42202	1	Front Panel Casting (54641D/42D)
MP10	54622-09104	1	Front RFI Gasket
MP11	54642-09106	1	Rear RFI Gasket
MP12	54642-09103	1	MSO RFI Spring (54641D/42D)
MP13	0380-1900	2	Standoff Spacer
MP14	1401-0202	2	Plastic Cap For Standoff
MP15	54601-94311	1	Non-UL Rear Cabinet Label
MP16	54641-94302	1	Front Panel Label Set (54641A)
MP16	54641-94301	1	Front Panel Label Set (54641D)
MP16	54642-94302	1	Front Panel Label Set (54642A)
MP16	54642-94301	1	Front Panel Label Set (54642D)
MP17	54642-94303	1	Power Specification Rear Cabinet Label
MP18	54642-64401	1	Cabinet Assembly (with handle and feet installed)
MP19	54642-09105	1	Ground Spring from Power Supply to Deck
MP20	54642-60600	1	RFI Shield - Keyboard
MP21	54642-60601	1	RFI Shield - Chassis Side
MP22	8160-0824	1	Ground Spring on Bottom of Deck
MP23	54622-44901	1	Handle (part of MP18)
W1	54630-61601	1	Display Ribbon Cable
W2	54710-61603	1	Front Panel Keyboard Cable
W3	54801-61625	1	Floppy Diskette Drive Ribbon Cable
W4	54642-61601	1	Power Cable (From Power Supply to Acquisition Board)
W5	8120-1703		Power cord option 900, United Kingdom
W5	8120-0696		Power cord option 901, Australia
W5	8120-1692		Power cord option 902, Europe
W5	8120-1521		Power cord option 903, U.S.A.
W5	8120-2296		Power cord option 906, Switzerland
W5	8120-2957		Power cord option 912, Denmark
W5	8120-4600		Power cord option 917, Africa
W5	8120-4754		Power cord option 918, Japan



<b>Reference Designator</b>	<b>Agilent Part Number</b>	<b>Qty</b>	<b>Description</b>
W5	8120-6799		Power cord option 919, Israel
W5	8120-6871		Power cord option 920, Argentina
W5	8120-6979		Power cord option 921, Chile
W5	8120-8377		Power cord option 922, China
W5	8120-8871		Power cord option 927, Thailand
<b>Option 101</b>			<b>Accessory pouch and front-panel cover (also orderable as part number 54600-68722)</b>
	5041-9482		Pouch
	54601-44101		Front-panel cover
<b>Probes</b>			
	10073C	2	10:1 500 MHz passive probe with ID
<b>Input Cable (54641D/42D 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)
	5090-4833		Package replacement grabber (quantity 20)
	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.  
**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:** 54641A  
**Product Options:** This declaration covers all options of the above product(s).

## Conforms with the following product standards:

EMC	Standard	Limit
	IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
	CISPR 11:1990/EN 55011:1991	Group 1 Class A <sup>[1]</sup>
	IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995	4 kV CD, 8 kV AD
	IEC 61000-4-3:1995/EN 61000-4-3:1995	3 V/m, 80-1000 MHz
	IEC 61000-4-4:1995/EN 61000-4-4:1995	0.5 kV signal lines, 1 kV power lines
	IEC 61000-4-5:1995/EN 61000-4-5:1995	0.5 kv line-line, 1 kV line-ground
	IEC 61000-4-6:1996/EN 61000-4-6:1996	3V, 0.15-80 MHz
	IEC 61000-4-11:1994/EN 61000-4-11:1994	1 cycle, 100%
	Canada: ICES-001:1998	
	Australia/New Zealand: AS/NZS 2064.1	
<b>Safety</b>	IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995	
	Canada: CSA C22.2 No. 1010.1:1992	

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).

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

Date: 2002-3-11

  
Name

Ken Wyatt / Product Regulations Manager

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

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## 54641A Product Regulations

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### EMC

Performance Criteria<sup>1</sup>

IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
CISPR 11:1990 / EN 55011:1991	
IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995 (4 kV CD, 8 kV AD)	B
IEC 61000-4-3:1995 / EN 61000-4-3:1995 (3V/m, 80-1000 MHz)	B
IEC 61000-4-4:1995 / EN 61000-4-4:1995 (0.5 kV signal lines, 1 kV power lines)	A
IEC 61000-4-5:1995/EN 61000-4-5:1995 (0.5 kv line-line, 1 kV line-ground)	B
IEC 61000-4-6:1996 / EN 61000-4-6:1996 (3V, 0.15-80 MHz)	B
IEC 61000-4-11:1994/EN 61000-4-11:1994 (1 cycle, 100%)	A
Canada: ICES-001:1998	
Australia/New Zealand: AS/NZS 2064.1	

### Safety

IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995  
Canada: CSA C22.2 No. 1010.1:1992  
USA: UL 3111-1:1994 {optional}

### 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).

#### <sup>1</sup> Performance Criteria:

- A Pass - Normal operation, no effect.
- B Pass - Temporary degradation, self recoverable.
- C Pass - Temporary degradation, operator intervention required.
- D Fail - Not recoverable, component damage.

**Sound Pressure Level**    Less than 60 dBA

### Regulatory Information for Canada

#### ICES/NMB-001

This ISM device complies with Canadian ICES-001.  
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

### Regulatory Information for Australia/New Zealand

This ISM device complies with Australian/New Zealand AS/NZS 2064.1



# DECLARATION OF CONFORMITY

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

**Manufacturer's Name:** Agilent Technologies, Inc.  
**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:** 54641D  
**Product Options:** This declaration covers all options of the above product(s).

## Conforms with the following product standards:

EMC	Standard	Limit
	IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
	CISPR 11:1990/EN 55011:1991	Group 1 Class A <sup>[1]</sup>
	IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995	4 kV CD, 8 kV AD
	IEC 61000-4-3:1995/EN 61000-4-3:1995	3 V/m, 80-1000 MHz
	IEC 61000-4-4:1995/EN 61000-4-4:1995	0.5 kV signal lines, 1 kV power lines
	IEC 61000-4-5:1995/EN 61000-4-5:1995	0.5 kv line-line, 1 kV line-ground
	IEC 61000-4-6:1996/EN 61000-4-6:1996	3V, 0.15-80 MHz
	IEC 61000-4-11:1994/EN 61000-4-11:1994	1 cycle, 100%
	Canada: ICES-001:1998	
	Australia/New Zealand: AS/NZS 2064.1	
<b>Safety</b>	IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995	
	Canada: CSA C22.2 No. 1010.1:1992	

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: 2002-3-11



\_\_\_\_\_  
Name

Ken Wyatt / Product Regulations Manager

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

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## 54641D Product Regulations

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### EMC

Performance Criteria<sup>1</sup>

IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
CISPR 11:1990 / EN 55011:1991	
IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995 (4 kV CD, 8 kV AD)	B
IEC 61000-4-3:1995 / EN 61000-4-3:1995 (3V/m, 80-1000 MHz)	B
IEC 61000-4-4:1995 / EN 61000-4-4:1995 (0.5 kV signal lines, 1 kV power lines)	B
IEC 61000-4-5:1995/EN 61000-4-5:1995 (0.5 kv line-line, 1 kV line-ground)	A
IEC 61000-4-6:1996 / EN 61000-4-6:1996 (3V, 0.15-80 MHz)	B
IEC 61000-4-11:1994/EN 61000-4-11:1994 (1 cycle, 100%)	A
Canada: ICES-001:1998	
Australia/New Zealand: AS/NZS 2064.1	

### Safety

IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995  
Canada: CSA C22.2 No. 1010.1:1992  
USA: UL 3111-1:1994 {optional}

### 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).

#### <sup>1</sup> Performance Criteria:

- A Pass - Normal operation, no effect.
- B Pass - Temporary degradation, self recoverable.
- C Pass - Temporary degradation, operator intervention required.
- D Fail - Not recoverable, component damage.

**Sound Pressure Level**    Less than 60 dBA

### Regulatory Information for Canada

#### ICES/NMB-001

This ISM device complies with Canadian ICES-001.  
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

### Regulatory Information for Australia/New Zealand

This ISM device complies with Australian/New Zealand AS/NZS 2064.1



# DECLARATION OF CONFORMITY

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

**Manufacturer's Name:** Agilent Technologies, Inc.  
**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:** 54642A  
**Product Options:** This declaration covers all options of the above product(s).

## Conforms with the following product standards:

EMC	Standard	Limit
	IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
	CISPR 11:1990/EN 55011:1991	Group 1 Class A <sup>[1]</sup>
	IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995	4 kV CD, 8 kV AD
	IEC 61000-4-3:1995/EN 61000-4-3:1995	3 V/m, 80-1000 MHz
	IEC 61000-4-4:1995/EN 61000-4-4:1995	0.5 kV signal lines, 1 kV power lines
	IEC 61000-4-5:1995/EN 61000-4-5:1995	0.5 kv line-line, 1 kV line-ground
	IEC 61000-4-6:1996/EN 61000-4-6:1996	3V, 0.15-80 MHz
	IEC 61000-4-11:1994/EN 61000-4-11:1994	1 cycle, 100%
	Canada: ICES-001:1998	
	Australia/New Zealand: AS/NZS 2064.1	
<b>Safety</b>	IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995	
	Canada: CSA C22.2 No. 1010.1:1992	

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).

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

Date: 2002-3-11

  
Name

Ken Wyatt / Product Regulations Manager

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

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## 54642A Product Regulations

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### EMC

Performance Criteria<sup>1</sup>

IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
CISPR 11:1990 / EN 55011:1991	
IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995 (4 kV CD, 8 kV AD)	B
IEC 61000-4-3:1995 / EN 61000-4-3:1995 (3V/m, 80-1000 MHz)	B
IEC 61000-4-4:1995 / EN 61000-4-4:1995 (0.5 kV signal lines, 1 kV power lines)	A
IEC 61000-4-5:1995/EN 61000-4-5:1995 (0.5 kv line-line, 1 kV line-ground)	A
IEC 61000-4-6:1996 / EN 61000-4-6:1996 (3V, 0.15-80 MHz)	A
IEC 61000-4-11:1994/EN 61000-4-11:1994 (1 cycle, 100%)	A
Canada: ICES-001:1998	
Australia/New Zealand: AS/NZS 2064.1	

### Safety

IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995  
Canada: CSA C22.2 No. 1010.1:1992  
USA: UL 3111-1:1994 {optional}

### 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).

#### <sup>1</sup> Performance Criteria:

- A Pass - Normal operation, no effect.
- B Pass - Temporary degradation, self recoverable.
- C Pass - Temporary degradation, operator intervention required.
- D Fail - Not recoverable, component damage.

**Sound Pressure Level**    Less than 60 dBA

### Regulatory Information for Canada

#### ICES/NMB-001

This ISM device complies with Canadian ICES-001.  
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

### Regulatory Information for Australia/New Zealand

This ISM device complies with Australian/New Zealand AS/NZS 2064.1





# DECLARATION OF CONFORMITY

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

**Manufacturer's Name:** Agilent Technologies, Inc.  
**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:** 54642D  
**Product Options:** This declaration covers all options of the above product(s).

## Conforms with the following product standards:

EMC	Standard	Limit
	IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
	CCISPR 11:1990/EN 55011:1991	Group 1 Class A <sup>[1][2]</sup>
	IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995	4 kV CD, 8 kV AD
	IEC 61000-4-3:1995/EN 61000-4-3:1995	3 V/m, 80-1000 MHz
	IEC 61000-4-4:1995/EN 61000-4-4:1995	0.5 kV signal lines, 1 kV power lines
	IEC 61000-4-6:1996/EN 61000-4-6:1996	3 V, 0.15-80 MHz
	Canada: ICES-001:1998	
	Australia/New Zealand: AS/NZS 2064.1	
<b>Safety</b>	IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995	
	Canada: CSA C22.2 No. 1010.1:1992	

## 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.

[2] The product meets CISPR requirements using "type test" specified in IEC 61326-1 edition 1.1, section 3.1..

Date: 02/11/2002



\_\_\_\_\_  
Name

Ken Wyatt / Product Regulations Manager

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

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## 54642D Product Regulations

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EMC	Performance Criteria <sup>1</sup>
IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
CISPR 11:1990 / EN 55011:1991	
IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995	B
IEC 61000-4-3:1995 / EN 61000-4-3:1995	B
IEC 61000-4-4:1995 / EN 61000-4-4:1995	B
IEC 61000-4-6:1996 / EN 61000-4-6:1996	B
Canada: ICES-001:1998	
Australia/New Zealand: AS/NZS 2064.1	
<b>Safety</b>	
IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995	
Canada: CSA C22.2 No. 1010.1:1992	

### 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).

#### <sup>1</sup> Performance Criteria:

- A Pass - Normal operation, no effect.
- B Pass - Temporary degradation, self recoverable.
- C Pass - Temporary degradation, operator intervention required.
- D Fail - Not recoverable, component damage.

**Sound Pressure Level**      Less than 60 dBA

### Regulatory Information for Canada

#### **ICES/NMB-001**

This ISM device complies with Canadian ICES-001.  
Cet appareil ISM est conforme à la norme NMB-001 du Canada.

### Regulatory Information for Australia/New Zealand

This ISM device complies with Australian/New Zealand AS/NZS 2064.1

 **N10149**

# Safety Notices

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."

## Warnings

- 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.
- If you energize this instrument by an auto transformer (for voltage reduction or mains isolation), the common terminal must be 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.

- 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.

- 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.

- 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 use the instrument in a manner not specified by the manufacturer.

## To clean the instrument

If the instrument requires cleaning: (1) Remove power from the instrument. (2) Clean the external surfaces of the instrument with a soft cloth dampened with a mixture of mild detergent and water. (3) Make sure that the instrument is completely dry before reconnecting it to a power source.

## 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.

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