The Oscilloscope At a Glance

Choose from a variety of oscilloscopes for capturing long, non-repeating signals with 200 MSa/s sample rate and 2 MBytes of MegaZoom deep memory per channel.

- Agilent 54621A - 2-channel, 60-MHz bandwidth
- Agilent 54621D - 2-channel +16 logic channels, 60-MHz bandwidth
- Agilent 54622A - 2-channel, 100-MHz bandwidth
- Agilent 54622D - 2-channel +16 logic channels, 100-MHz bandwidth
- Agilent 54624A - 4-channel, 100-MHz bandwidth

Display shows current input signals
- All analog and digital (54621D/22D) channels displayed in main and delayed mode
- Indicators for channel, time base, digital (54621D/22D) channel activity, trigger and acquisition status
- Softkey labels
- Measurement results

Digital channel controls select, position, and label inputs (54621D/22D)
- 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

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

Horizontal Controls select sweep speed and delay parameters
- Sweep speeds from 5 ns/div to 50 ns/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)

Trigger keys define what data the oscilloscope will trigger on
- Source key allows conventional oscilloscope triggering
- Modes include Edge, Pulse Width, Pattern, CAN, Duration, I2C, LIN, Sequence, SPI, TV, and USB triggering

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

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 (54621D/22D)
- 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.
In This Book

This book provides the service information for the Agilent 54621A/22A/24A Oscilloscope and the Agilent 54621D/22D Mixed-Signal Oscilloscope. This manual is divided into these chapters:

Chapter 1 provides general information and specifications.
Chapter 2 shows you how to prepare the oscilloscope for use.
Chapter 3 gives performance tests.
Chapter 4 covers calibration and adjustment procedures.
Chapter 5 provides troubleshooting information.
Chapter 6 gives the procedures and techniques for replacing assemblies and other parts.
Chapter 7 includes a list of replaceable parts, part ordering information, and shipping information.

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

This chapter lists general information for the Agilent 54620-series Oscilloscopes. It also includes performance characteristics and specifications for the oscilloscopes.
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).
  - 54620-Series Oscilloscope (54621A, 21D, 22A, 22D, or 24A)
  - 10074C 10:1 150 MHz passive probes with ID:
    - (2) for 54621A, 21D, 22A, or 22D oscilloscopes
    - (4) for 54624A oscilloscope
  - 54620-68701 digital probe kit (for 54621D or 22D)
  - Accessory pouch and front-panel cover (standard for 54622A, 22D, and 24A)
    - (optional on 54621A and 21D; order N2726A)
  - Power cord (see table 1-3)
  - IntuiLink for 54600-series Oscilloscopes software and RS-232 cable (for 54622A, 22D, or 24A).
    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
    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 (for 54622A, 22D, or 24A)

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

IntuiLink Data Capture software is available free on the web at: www.agilent.com/find/5462xsw
RS-232 cable may be ordered separately, part number 34398A

- 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

54620-Series Oscilloscope

Accessories pouch and front-panel cover**

Power cord

54620-68701 digital probe kit*

54620-61801 16-channel cable***

5959-9334 2” Probe ground lead (qty 5)

5090-4833 Grabber (qty 20)

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

10074C Probes

* 54621D /22D only
** 54622A/22D/24A 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 54620-Series Oscilloscopes
General Information

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 54620-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

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>003</td>
<td>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.</td>
</tr>
<tr>
<td>1CM</td>
<td>Rackmount kit (same as Agilent 1186A)</td>
</tr>
<tr>
<td>A6J</td>
<td>ANSI Z540 compliant calibration service</td>
</tr>
</tbody>
</table>

See table 1-3 for power cord options
### Table 1-2

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01650-61607</td>
<td>16:16 logic cable and terminator (for use with 54621D/22D)</td>
</tr>
<tr>
<td>54620-68701</td>
<td>16:2 x 8 logic input probe assembly (shipped standard with 54621D/22D)</td>
</tr>
<tr>
<td>1146A</td>
<td>100 kHz current probe, ac/dc</td>
</tr>
<tr>
<td>1183A</td>
<td>Testmobile scope cart</td>
</tr>
<tr>
<td>1185A</td>
<td>Carrying case</td>
</tr>
<tr>
<td>1186A</td>
<td>Rackmount kit</td>
</tr>
<tr>
<td>10070C</td>
<td>1:1 passive probe with ID</td>
</tr>
<tr>
<td>10072A</td>
<td>Fine-pitch probe kit</td>
</tr>
<tr>
<td>10073C</td>
<td>10:1 500 MHz probe with ID</td>
</tr>
<tr>
<td>10075A</td>
<td>0.5 mm IC clip kit</td>
</tr>
<tr>
<td>10076A</td>
<td>100:1, 4 kV 250 MHz probe with ID</td>
</tr>
<tr>
<td>10100C</td>
<td>50Ω termination</td>
</tr>
<tr>
<td>10833A</td>
<td>GPIB cable, 1 m long</td>
</tr>
<tr>
<td>34398A</td>
<td>RS-232 cable (standard with 100 MHz models)</td>
</tr>
<tr>
<td>E2613B</td>
<td>0.5 mm Wedge probe adapter, 3-signal, qty 2</td>
</tr>
<tr>
<td>E2614A</td>
<td>0.5 mm Wedge probe adapter, 8-signal, qty 1</td>
</tr>
<tr>
<td>E2615B</td>
<td>0.65 mm Wedge probe adapter, 3-signal, qty 2</td>
</tr>
<tr>
<td>E2616A</td>
<td>0.65 mm Wedge probe adapter, 8-signal, qty 1</td>
</tr>
<tr>
<td>E2643A</td>
<td>0.5 mm Wedge probe adapter, 16-signal, qty 1</td>
</tr>
<tr>
<td>E2644A</td>
<td>0.65 mm Wedge probe adapter, 16-signal, qty 1</td>
</tr>
<tr>
<td>N2726A</td>
<td>Accessory pouch and front-panel cover (standard with 100 MHz models)</td>
</tr>
<tr>
<td>N2727A</td>
<td>Thermal printer and pouch</td>
</tr>
<tr>
<td>N2728A</td>
<td>10 rolls of thermal printer paper</td>
</tr>
<tr>
<td>N2757A</td>
<td>GPIB Interface Module</td>
</tr>
<tr>
<td>N2758A</td>
<td>CAN Trigger Module</td>
</tr>
<tr>
<td>N2771A</td>
<td>1000:1, 15 kV, 50 MHz high voltage probe</td>
</tr>
<tr>
<td>N2772A</td>
<td>20 MHz differential probe</td>
</tr>
<tr>
<td>N2773A</td>
<td>Differential probe power supply</td>
</tr>
<tr>
<td>N2774A</td>
<td>50 MHz current probe, ac/dc</td>
</tr>
<tr>
<td>N2775A</td>
<td>Power supply for N2774A</td>
</tr>
</tbody>
</table>
### Table 1-3. Power Cords

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

Acquisition: Analog Channels

Performance Characteristics

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

**Acquisition: Analog Channels**

- **Max Sample rate**: 200 MSa/s
- **Max Memory Depth**: 4 MB interleaved, 2 MB each channel
- **Vertical Resolution**: 8 bits
- **Peak Detection**: 5 ns
- **Averages**: selectable from 2, 4, 8, 16, 32, 64 ... to 16383
- **High Resolution Mode**: 12 bits of resolution when ≥500 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.

**Acquisition: Digital Channels (on 54621D and 54622D only)**

- **Max Sample Rate**: 400 MSa/s
- **Max Memory Depth**: 8 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 ±10 °C from firmware calibration temperature.

### Vertical System: Analog Channels

- **Analog channels**: 54621A/21D, 54622A/22D: Ch1 and 2 simultaneous acquisition; 54624A: Ch 1, 2, 3, and 4 simultaneous acquisition
- **Bandwidth (-3dB)**
  - 54621A/22D: dc to 60 MHz
  - 54622A/22D/24A: dc to 100 MHz
- **ac coupled**
  - 54621A/21D: 3.5 Hz to 60 MHz
  - 54622A/22D/24A: 3.5 Hz to 100 MHz
- **Calculated rise time**
  - 54621A/22D: ~5.8 ns
  - 54622A/22D/24A: ~3.5 ns
- **Single Shot Bandwidth**: 50 MHz
- **Range**: 1 mV/div to 5 V/div

### Maximum Input

- **CAT I**: 300 Vrms, 400 Vpk
- **CAT II**: 100 Vrms, 400 Vpk

### Offset Range

- ±5 V on ranges <10 mV/div
- ±25 V on ranges 10 mV/div to 199 mV/div
- ±100 V on ranges ≥200 mV/div

### Dynamic Range

Lesser of ±8 div or ±32 V

### Input Resistance

1 MΩ ±1%

### Input Capacitance

~ 14 pF

### Coupling

ac, dc, ground

### BW Limit

~ 20 MHz selectable

### Channel-to-Channel Isolation

- dc to 20 MHz > 40 dB
- 20 MHz to max bandwidth > 30 dB

### Probes

- 10:1 10074C shipped standard for each analog channel
- Probe ID (Agilent/HP & Tek Compatible): Auto probe sense

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

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

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

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD Tolerance</td>
<td>±2 kV</td>
</tr>
<tr>
<td>Noise Peak-to-Peak</td>
<td>2% full scale or 1 mV, whichever is greater</td>
</tr>
<tr>
<td>Common Mode Rejection Ratio</td>
<td>20 dB @ 50 MHz</td>
</tr>
<tr>
<td>DC Vertical Gain Accuracy*1</td>
<td>±2.0% full scale</td>
</tr>
<tr>
<td>DC Vertical Offset Accuracy</td>
<td>&lt; 200 mV/div: ±0.1 div ±1.0 mV ±0.5% offset ≥200 mV/div: ±0.1 div ±1.0 mV ±1.5% offset value</td>
</tr>
<tr>
<td>Single Cursor Accuracy1</td>
<td>±(DC Vertical Gain Accuracy + DC Vertical Offset Accuracy + 0.2% full scale (~1/2 LSB))</td>
</tr>
<tr>
<td>Example:</td>
<td>For 50 mV signal, scope set to 10 mV/div (80 mV full scale), 5 mV offset, accuracy = ±(2.0%(80 mV) + 0.1 (10 mV) + 1.0 mV + 0.5% (5 mV) + 0.2%(80 mV)) = ±3.78 mV</td>
</tr>
<tr>
<td>Dual Cursor Accuracy*1</td>
<td>±(DC Vertical Gain Accuracy + 0.4% full scale (~1 LSB))</td>
</tr>
<tr>
<td>Example:</td>
<td>For 50 mV signal, scope set to 10 mV/div (80 mV full scale), 5 mV offset, accuracy = ±(2.0%(80 mV) + 0.4%(80 mV)) = ±1.92 mV</td>
</tr>
</tbody>
</table>

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

**Vertical System: Digital Channels (54621D and 54622D only)**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Channels</td>
<td>16 Digital – labeled D15 – D0</td>
</tr>
<tr>
<td>Threshold Groupings</td>
<td>Pod 1: D7 - D0 Pod 2: D15 - D8</td>
</tr>
<tr>
<td>Threshold Selections</td>
<td>TTL, CMOS, ECL, user-definable (selectable by pod)</td>
</tr>
<tr>
<td>User-Defined Threshold Range</td>
<td>±8.0 V in 10 mV increments</td>
</tr>
<tr>
<td>Maximum Input Voltage</td>
<td>±40 V peak CAT I</td>
</tr>
<tr>
<td>Threshold Accuracy*</td>
<td>±(100 mV + 3% of threshold setting)</td>
</tr>
<tr>
<td>Input Dynamic Range</td>
<td>±10 V about threshold</td>
</tr>
<tr>
<td>Minimum Input Voltage Swing</td>
<td>500 mV peak-to-peak</td>
</tr>
<tr>
<td>Input Capacitance</td>
<td>~ 8 pF</td>
</tr>
<tr>
<td>Input Resistance</td>
<td>100 kΩ ±2% at probe tip</td>
</tr>
<tr>
<td>Channel-to-Channel Skew</td>
<td>2 ns typical, 3 ns maximum</td>
</tr>
</tbody>
</table>
### General Information

#### Horizontal

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

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td>5 ns/div to 50 s/div</td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td>25 ps</td>
</tr>
<tr>
<td><strong>Vernier</strong></td>
<td>1-2-5 increments when off, 25 minor increments between major settings when on</td>
</tr>
<tr>
<td><strong>Reference Positions</strong></td>
<td>Left, Center, Right</td>
</tr>
<tr>
<td><strong>Delay Range</strong></td>
<td></td>
</tr>
<tr>
<td>Pre-trigger (negative delay)</td>
<td>Greater of 1 screen width or 10 ms</td>
</tr>
<tr>
<td>Post-trigger (positive delay)</td>
<td>500 seconds</td>
</tr>
<tr>
<td><strong>Analog Delta-t Accuracy</strong></td>
<td>±0.01% reading ±0.1% screen width ±40 ps</td>
</tr>
<tr>
<td>Same Channel</td>
<td>Example: for signal with pulse width of 10 us, scope set to 5 us/div (50 us screen width), delta-t accuracy = ±0.01% (10 us) + 0.1% (50 us) + 40 ps = 51.04 ns</td>
</tr>
<tr>
<td>Channel-to-Channel</td>
<td>±0.01% reading ±0.1% screen width ±80 ps</td>
</tr>
<tr>
<td>Digital Delta-t Accuracy</td>
<td>(non-Vernier settings)</td>
</tr>
<tr>
<td>Same Channel</td>
<td>±0.01% reading ±0.1% screen width ±(1 digital sample period, 2.5 or 5 ns based on sample rate of 200/400 MSa/s)</td>
</tr>
<tr>
<td>Example: for signal with pulse width of 10 us, scope set to 5 us/div (50 us screen width), and single pod active (400 MSa/s), delta-t accuracy = ±0.01% (10 us) + 0.1% (50 us) + 2.5 ns = 53.5 ns</td>
<td></td>
</tr>
<tr>
<td>Channel-to-Channel</td>
<td>±0.01% reading ±0.1% screen width ±(1 digital sample period, 2.5 or 5 ns)</td>
</tr>
<tr>
<td>Delay Jitter</td>
<td>10 ppm</td>
</tr>
<tr>
<td>RMS Jitter</td>
<td>0.025% screen width + 30 ps</td>
</tr>
<tr>
<td>Modes</td>
<td>Main, Delayed, Roll, XY</td>
</tr>
<tr>
<td>XY</td>
<td></td>
</tr>
<tr>
<td>Z blanking</td>
<td>1.4 V blanks trace (use External trigger)</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>Max bandwidth</td>
</tr>
<tr>
<td>Phase error @ 1 MHz</td>
<td>1.8 degrees</td>
</tr>
</tbody>
</table>

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

Trigger System

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

<table>
<thead>
<tr>
<th>Trigger System</th>
</tr>
</thead>
</table>
| **Sources:** | 54621A/22A: Ch 1, 2, line, ext  
54621D/22D: Ch 1, 2, line, ext, D15 - D0  
54624A: Ch 1, 2, 3, 4, line, ext |
| **Modes** | Auto, Auto level, Triggered (normal), Single |
| **Holdoff Time** | ~60 ns to 10 seconds |
| **Selections** | Edge, Pattern, Pulse Width, CAN, Duration, I²C, 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: 5 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, an overload 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 |
| **I²C** | Trigger on I²C (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 ad 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 (54621D/54622D) 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 ±10 °C from firmware calibration temperature.

<table>
<thead>
<tr>
<th>Analog Channel Triggering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range (Internal)</td>
</tr>
<tr>
<td>Sensitivity*</td>
</tr>
<tr>
<td>Coupling</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Digital (D15 - D0) Channel Triggering (54621D and 54622D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold Range (user-defined)</td>
</tr>
<tr>
<td>Threshold Accuracy*</td>
</tr>
<tr>
<td>Predefined Thresholds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External (EXT) Triggering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Resistance</td>
</tr>
<tr>
<td>Input Impedance</td>
</tr>
<tr>
<td>Maximum Input</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Range</td>
</tr>
<tr>
<td>Sensitivity</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Coupling</td>
</tr>
<tr>
<td>Probe ID (Agilent/HP &amp; Tek Compatible)</td>
</tr>
</tbody>
</table>
General Information

Display System

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

**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, ∆X, 1/∆X) and Vertical (Y, ∆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 (or 3 or 4 for 54624A), 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 ±10 °C from firmware calibration temperature.

FFT

Points Fixed at 2048 points
Source of FFT Analog channels 1 or 2 (or 3 or 4 for 54624A), 1+2, 1-2, 1*2
Window Rectangular, Flattop, Hanning
Noise Floor -70 to -100 dB depending on averaging
Amplitude Display In dBV
Frequency Resolution: 0.097656/(time per div)
Maximum Frequency 102.4/(time per div)

Storage

Save/Recall (non-volatile) 3 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
Compatibilities: 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.
General Information

General Characteristics

Physical:
- Size: 32.26 cm wide x 17.27 cm high x 31.75 cm deep (without handle)
- Weight: 6.35 kgs (14 lbs)

Calibrator Output: Frequency ~1.2 kHz; Amplitude ~5 V

Trigger Out: 0 to 5 V with 50 Ω source impedance; delay ~ 55 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 ±10%, CAT II, automatic selection
- Line Frequency: 47 to 440 Hz
- Power Usage: 100 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

* Denotes Warranted Specifications, all others are typical. Specifications are valid after a 30-minute warm-up period and ±10 °C from firmware calibration temperature.
Preparing the Oscilloscope for Use
Preparing the Oscilloscope for Use

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

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

This chapter also tells you how to:
- clean the oscilloscope
Setting up the Oscilloscope

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

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

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

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.
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.
Preparing the Oscilloscope for Use

To adjust the display intensity

To adjust the display intensity

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

- To decrease display intensity, rotate the Intensity control counterclockwise.
- To increase display 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.
Preparing the Oscilloscope for Use

To connect the oscilloscope probes

1. Connect the Agilent 10074C 1.5-meter, 10:1 oscilloscope probe to the analog channel 1 or 2 BNC connector input on the oscilloscope, or channel 1 through channel 4 on the 54624A.
   Maximum input voltage for analog inputs:
   - CAT I 300 Vrms, 400 Vpk
   - CAT II 100 Vrms, 400 Vpk
   with 10074C 10:1 probe: CAT I 500 Vpk, CAT II 400 Vpk

2. Connect the retractable hook tip on the probe tip to the circuit point of interest. Be sure to connect the probe ground lead to a ground point on the circuit.
   The probe ground lead is connected to the oscilloscope chassis and the ground wire in the power cord. If you need to connect the ground lead to a point in the circuit that cannot be grounded to power ground, consider using a differential probe.

To compensate your probe

You should compensate your 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
Preparing the Oscilloscope for Use

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

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.
Preparing the Oscilloscope for Use

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

5. For high-speed signals, connect a ground lead to the probe lead, connect a 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.

![Diagram of signals and ground connections]

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.

![Diagram showing removal of probe lead]

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

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 Config softkey.
   b. Press the Print to: softkey and set the interface to Parallel.
   c. Press the Format softkey and select your printer format from the list.

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

To connect an RS-232 cable

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

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

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

![Waveform Image](image.png)

**Verifying Basic Oscilloscope Operation**
Getting started using the oscilloscope interface

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

This menu is only accessible when the oscilloscope first starts up.
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.
  - Press the softkey to view the menu.
  - Press the softkey to return to the previous menu.
  - Links you to another 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. Successive press the Language softkey until the desired language in the list selected.

You can also select and load a language later from the Utility Language menu.
Preparing the Oscilloscope for Use

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

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

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

Loading a language from floppy disk

Loading a language from floppy disk

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

1. Insert the floppy disk with a language file into the floppy disk drive on the oscilloscope.
2. Press the Utility key, then press the Language softkey to display the Language menu.
3. Press the Load 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 and deleting 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
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.

<table>
<thead>
<tr>
<th>If a performance test fails</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>
List of Test Equipment

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

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Critical Specifications</th>
<th>Recommended Model/Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test connector, 8-by-2</td>
<td>Not required if 01660-63801 Test Fixture is available See “To construct the test connector” later in this chapter</td>
<td>n/a</td>
</tr>
<tr>
<td>Test fixture</td>
<td>For testing digital channel threshold accuracy</td>
<td>Agilent 01660-63801</td>
</tr>
<tr>
<td>Digital Multimeter</td>
<td>0.1 mV resolution, 0.005% accuracy</td>
<td>Agilent 34401A</td>
</tr>
<tr>
<td>Power Splitter</td>
<td>Outputs differ by 0.15 dB</td>
<td>Agilent 11667B</td>
</tr>
<tr>
<td>Power Supply</td>
<td>DC offset voltage of -5.5 V to 35.5 V, 0.1 mV resolution</td>
<td>Agilent 3245A</td>
</tr>
<tr>
<td>Oscilloscope Calibrator</td>
<td>25 MHz—100 MHz sine wave, 5 ppm</td>
<td>Fluke 5820A</td>
</tr>
<tr>
<td>BNC banana cable</td>
<td></td>
<td>Agilent 11001-60001</td>
</tr>
<tr>
<td>BNC cable (qty 3)</td>
<td></td>
<td>Agilent 10503A</td>
</tr>
<tr>
<td>Probe cable</td>
<td></td>
<td>Agilent 01650-61607</td>
</tr>
<tr>
<td>Shorting Cap BNC</td>
<td></td>
<td>Agilent 1250-0774</td>
</tr>
<tr>
<td>Adapter</td>
<td>BNC(f) to banana(m)</td>
<td>Agilent 1251-2277</td>
</tr>
<tr>
<td>Feedthrough</td>
<td>50Ω, BNC (m) and (f)</td>
<td>Agilent 11048C</td>
</tr>
<tr>
<td>Adapter</td>
<td>BNC Tee (m) (f) (f)</td>
<td>Agilent 1250-0781</td>
</tr>
<tr>
<td>Blocking capacitor</td>
<td></td>
<td>Agilent 10240-60001</td>
</tr>
<tr>
<td>Adapter (qty 3)</td>
<td>N(m) to BNC(f)</td>
<td>Agilent 1250-0780</td>
</tr>
</tbody>
</table>
To construct the test connector

The Agilent 54621D/22D Mixed-Signal Oscilloscope has digital channels that you will need to connect to test equipment during testing. To easily connect the digital channels, you will construct a test connector only if the 01660-63801 Test Fixture is not available.

**Table 3-1**

<table>
<thead>
<tr>
<th>Description</th>
<th>Recommended Part</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNC (f) Connector</td>
<td>Agilent 1250-1032</td>
<td>1</td>
</tr>
<tr>
<td>Berg Strip, 8-by-2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Jumper wire</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 54621D/22D Oscilloscope digital channels

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

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

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

1 Disconnect all probes from the circuit under test and from any other input source.

2 Using probe leads and grabbers, connect digital channels D0, D1, D2, and D3 to the calibration point on the 54621D/22D front panel.

3 Press the Autoscale key.
   If four square waves appear, the acquisition system is functioning correctly.
   If the square waves do not appear, go to the “Troubleshooting” chapter. Then return here to finish testing the digital channels.

4 Disconnect the digital channels from the calibration point.

5 Use steps 2 and 3 to test the following sets of digital channels. After you test one set of digital channels, remove them before connecting the next set.
   - D4, D5, D6, D7
   - D8, D9, D10, D11
   - D12, D13, D14, D15
Testing Performance
To verify digital channel threshold accuracy

To verify digital channel threshold accuracy

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

<table>
<thead>
<tr>
<th>Test Threshold Accuracy only on the 54621D/22D Mixed-Signal Oscilloscope</th>
</tr>
</thead>
<tbody>
<tr>
<td>You need to perform these instructions only if you will be testing the Agilent 54621D/22D Mixed-Signal Oscilloscope.</td>
</tr>
</tbody>
</table>

Threshold accuracy test limits = ±(100 mV + 3% 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

**Equipment Required to Test Threshold Accuracy**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Critical Specifications</th>
<th>Recommended Model/Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Multimeter</td>
<td>0.1 mV resolution, 0.005% accuracy</td>
<td>Agilent 34401A</td>
</tr>
<tr>
<td>Oscilloscope Calibrator</td>
<td>DC offset voltage 6.3 V</td>
<td>Fluke 5820A</td>
</tr>
<tr>
<td>BNC-Banana Cable</td>
<td></td>
<td>Agilent 11001-60001</td>
</tr>
<tr>
<td>BNC Tee</td>
<td></td>
<td>Agilent 1250-0781</td>
</tr>
<tr>
<td>BNC Cable</td>
<td></td>
<td>Fluke 50Ω cable, P/N 686318</td>
</tr>
<tr>
<td>BNC Test Connector, 8-by-2</td>
<td></td>
<td>User-built (See “Obtain a BNC connector and an 8-by-2 section of Berg strip.” on page 3-4.)</td>
</tr>
<tr>
<td>Test Fixture</td>
<td>PV test fixture</td>
<td>Agilent 01660-63801</td>
</tr>
<tr>
<td>Probe Cable</td>
<td></td>
<td>Agilent 01650-61607</td>
</tr>
</tbody>
</table>

3-6
Testing Performance

To verify digital channel threshold accuracy

1. Turn on the test equipment and the oscilloscope. Let them warm up for 30 minutes before starting the test.

2. Set up the oscilloscope calibrator.
   a. Set the oscilloscope calibrator to provide a DC offset voltage at the Channel 1 output.
   b. Use the multimeter to monitor the oscilloscope calibrator DC output voltage.

3. Use either method 1 or method 2, described in the following, to connect the digital channels for testing.
   a. **Method 1 — Using the Test Connector**
      Use the 8-by-2 test connector and the BNC cable assembly to connect digital channels D0-D7 to one side of the BNC Tee. Then connect the D0-D7 ground lead to the ground side of the 8-by-2 connector. See figure 3-2.

Figure 3-2

![Setting Up Equipment and Test Connector for the Threshold Test](image)
Testing Performance

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

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>
<thead>
<tr>
<th>Threshold voltage setting (in oscilloscope User softkey)</th>
<th>DC offset voltage setting (on oscilloscope calibrator)</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>+5.00 V</td>
<td>+5.250 V ±1 mV dc</td>
<td>Lower limit = +4.750 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upper limit = +5.250 V</td>
</tr>
<tr>
<td>-5.00 V</td>
<td>-4.750 V ±1 mV dc</td>
<td>Lower limit = -5.250 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upper limit = -4.750 V</td>
</tr>
<tr>
<td>0.00 V</td>
<td>+100 mV ±1 mV dc</td>
<td>Upper limit = +100 mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower limit = -100 mV</td>
</tr>
</tbody>
</table>

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.
Testing Performance

To verify voltage measurement accuracy

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: ±2.0% of full scale ±1 LSB*

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

*1 LSB = 0.4% of full scale

Table 3-4

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

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

1 Set up the oscilloscope.
   a Adjust the channel 1 position knob to place the baseline at approximately 0.5 division from the bottom of the display.
b Set the Volts/Div setting to the value in the first line in Table 3-5.

<table>
<thead>
<tr>
<th>Table 3-5</th>
</tr>
</thead>
</table>

**Settings Used to Verify Voltage Measurement Accuracy**

<table>
<thead>
<tr>
<th>Volts/Div Setting</th>
<th>Power Supply Setting</th>
<th>Test Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 V/Div</td>
<td>35 V</td>
<td>34.04 V to 35.96 V</td>
</tr>
<tr>
<td>2 V/Div</td>
<td>14 V</td>
<td>13.616 V to 14.384 V</td>
</tr>
<tr>
<td>1 V/Div</td>
<td>7 V</td>
<td>6.808 V to 7.192 V</td>
</tr>
<tr>
<td>0.5 V/Div</td>
<td>3.5 V</td>
<td>3.404 V to 3.596 V</td>
</tr>
<tr>
<td>0.2 V/Div</td>
<td>1.4 V</td>
<td>1.3616 V to 1.4384 V</td>
</tr>
<tr>
<td>0.1 V/Div</td>
<td>700 mV</td>
<td>680.8 mV to 719.2 mV</td>
</tr>
<tr>
<td>50 mV/Div</td>
<td>350 mV</td>
<td>340.4 mV to 359.6 mV</td>
</tr>
<tr>
<td>20 mV/Div</td>
<td>140 mV</td>
<td>136.16 mV to 143.84 mV</td>
</tr>
<tr>
<td>10 mV/Div</td>
<td>70 mV</td>
<td>68.08 mV to 71.92 mV</td>
</tr>
<tr>
<td>5 mV/Div</td>
<td>35 mV</td>
<td>34.04 mV to 35.96 mV</td>
</tr>
<tr>
<td>2 mV/Div</td>
<td>14 mV</td>
<td>13.616 mV to 14.384 mV</td>
</tr>
<tr>
<td>1 mV/Div*</td>
<td>7 mV</td>
<td>6.616 mV to 7.384 mV</td>
</tr>
</tbody>
</table>

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

- 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 **XY** 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.
Testing Performance

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 ΔY value on the lower line of the display should be within the test limits of Table 3-5. If a result is not within the test limits, see the “Troubleshooting” chapter. Then return here.

6. Continue to check the voltage measurement accuracy with the remaining Volts/div setting values in Table 3-5.

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

8. Repeat this procedure for Channels 2, 3, and 4, if applicable on your oscilloscope model.

Use a Blocking Capacitor to Reduce Noise

On the more sensitive ranges, such as 1 mV/div, 2 mV/div, and 5 mV/div, noise may be a factor. To eliminate the noise, use a BNC Tee, blocking capacitor, and BNC 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.

**54622A, 54622D, and 54624A**

Test limits at 1 mV/div to 5 V/div:
- All channels (±3 dB)
  - dc to 100 MHz
  - ac coupled 10 Hz to 100 MHz

**54621A and 54621D**

Test limits at 1 mV/div to 5 V/div:
- All channels (±3 dB)
  - dc to 60 MHz
  - ac coupled 10 Hz to 60 MHz

### Table 3-6: Equipment Required to Verify Bandwidth

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Critical Specifications</th>
<th>Recommended Model/Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscilloscope Calibrator</td>
<td></td>
<td>Fluke 5820A</td>
</tr>
<tr>
<td>Cable *</td>
<td>Type N (m), 24-inch</td>
<td>Agilent 11500B</td>
</tr>
<tr>
<td>Feedthrough</td>
<td>50Ω, BNC (m) and (f)</td>
<td>Agilent 11048C</td>
</tr>
</tbody>
</table>

* 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 through a 50Ω feedthrough to the oscilloscope channel 1 input.

2. Set up the oscilloscope.
   a. Set the time base to 500 ns/div.
   b. Set the Volts/Div for channel 1 to 200 mV/div.
   c. Press the Acquire key, then press the Averaging softkey.
   d. Turn the Entry knob to set #Avgs to 8 averages.

3. Set the calibrator 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} = _______ V.

7. Change the frequency of the signal generator to the value shown below for your instrument.

<table>
<thead>
<tr>
<th>Selected Channel</th>
<th>54621A/21D</th>
<th>54622A/22D</th>
<th>54624A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel 1</td>
<td>60 MHz</td>
<td>100 MHz</td>
<td>100 MHz</td>
</tr>
<tr>
<td>Channel 2</td>
<td>60 MHz</td>
<td>100 MHz</td>
<td>100 MHz</td>
</tr>
<tr>
<td>Channel 3</td>
<td>—</td>
<td>—</td>
<td>100 MHz</td>
</tr>
<tr>
<td>Channel 4</td>
<td>—</td>
<td>—</td>
<td>100 MHz</td>
</tr>
</tbody>
</table>

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} = ______ mV.

9. Calculate the response using this formula:
   \[ 20 \log_{10} \frac{\text{Step8Result}}{\text{Step6Result}} \]
   If the result is not ±3 dB, see the “Troubleshooting” chapter. Then return here.

10. Repeat this procedure (steps 1 to 9) for channel 2, 3, and 4, as applicable to your oscilloscope model.
    Proceed to the next step after you have completed the procedure for channels 2, 3, and 4, as applicable.
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: ±0.01% of reading ±0.1% of full scale ±40 ps (same channel)

<table>
<thead>
<tr>
<th>Table 3-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Required to Verify Horizontal $\Delta t$ and $1/\Delta t$ Accuracy</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
</tr>
<tr>
<td>Oscilloscope Calibrator</td>
</tr>
<tr>
<td>Cable</td>
</tr>
<tr>
<td>Feedthrough</td>
</tr>
</tbody>
</table>

1. Connect the oscilloscope calibrator to channel 1 using the 50 Ω feedthrough at the oscilloscope input. Then, select **Marker** and set the calibrator for 100 μs markers.

2. Set up the oscilloscope.
   a. Press the **Display key**, then set the **Vectors** softkey to off.
   b. Press the **Autoscale** key.
   c. Set the time base to 20 μs/div.
   d. Press the **Main/Delayed** key, then set the **Time Ref** softkey to **Left**.
   e. Adjust the Trigger Level knob to obtain a stable display.

3. Press the **Quick Meas** softkey, set the **Source** softkey to 1, then 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 μs — The test limits are 99.79 μs to 100.2 μs.

If the measurements are not within the test limits, see the “Troubleshooting” chapter. Then return here.
Testing Performance
To verify horizontal Dt and 1/Dt accuracy

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

5 Measure the following:
   Frequency 1 MHz — The test limits are 997.9 kHz to 1.002 MHz.
   Period 1 µs — The test limits are 997.9 ns to 1.002 µs.
If the measurements are not within the test limits, see the “Troubleshooting” chapter. Then return here.

54622A/22D/24A only

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

7 Measure the following:
   Frequency 100 MHz — The test limits are 99.10 MHz to 100.9 MHz.
   Period 10 ns — The test limits are 9.91 ns to 10.09 ns.
If the measurements are not within the test limits, see the “Troubleshooting” chapter. Then return here.

54621A and 54621D only

8 Change the calibrator to 20-ns markers. Change the time base to 5 ns/div.
   Adjust the trigger level to obtain a stable display.

9 Measure the following:
   Frequency 50 MHz — The test limits are 49.77 MHz to 50.23 MHz.
   Period 20 ns — The test limits are 19.91 ns to 20.09 ns.
If the measurements are not within the test limits, see the “Troubleshooting” chapter. Then return here.
To verify trigger sensitivity

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

Test limits for the Internal trigger:
1 mV to 5 V/div (dc to max bandwidth): greater of 0.35 div or 2.5 mV<sub>p-p</sub>

Test limits for the External trigger:
dc to 25 MHz: <75 mV<sub>p-p</sub>
25 MHz to max bandwidth: <150 mV<sub>p-p</sub>

<table>
<thead>
<tr>
<th>Table 3-9</th>
<th>Equipment Required to Verify Trigger Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>Critical Specifications</td>
</tr>
<tr>
<td>Oscilloscope Calibrator</td>
<td>25-MHz, 60-MHz and 100-MHz sine waves</td>
</tr>
<tr>
<td>Power splitter</td>
<td>Outputs differ &lt; 0.15 dB</td>
</tr>
<tr>
<td>Cable *</td>
<td>BNC, Qty 3</td>
</tr>
<tr>
<td>Adapter</td>
<td>N (m) to BNC (f), Qty 3</td>
</tr>
<tr>
<td>Feedthrough</td>
<td>50Ω, BNC connectors (m) and (f)</td>
</tr>
</tbody>
</table>

* 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 trigger sensitivity

Test Internal Trigger Sensitivity

1 Press the Save/Recall key, then press the Default Setup softkey.

2 Connect the calibrator to channel 1 using a 50Ω feedthrough at the oscilloscope input.

3 Verify the trigger sensitivity at 25 MHz and 0.35 divisions.
   a Set the output of the calibrator to 25 MHz, and set the amplitude to about 100 mV_{p-p}.
   b Press the Autoscale key.
   c Set the time base to 50 ns/div.
   d Set channel 1 to 100 mV/div.
   e Decrease the output of the calibrator until 0.35 vertical divisions of the signal are displayed.
      The trigger should be stable. If the trigger is not stable, try adjusting the trigger level. If adjusting the trigger level makes the trigger stable, the test still passes. If adjusting the trigger does not help, see the “Troubleshooting” chapter. Then return here.
   f Record the result as Pass or Fail in the Performance Test Record.

4 Verify the trigger sensitivity at maximum bandwidth and 0.35 division.
   a Change the output of the calibrator to 100 MHz for the 54622A/22D/24A or 60 MHz or the 54621A/21D, and set the amplitude to about 100 mV_{p-p}.
   b Set the time base to 10 ns/div.
   c Decrease the output of the calibrator until 0.35 vertical divisions of the signal is displayed.
      The trigger should be stable. If the trigger is not stable, try adjusting the trigger level. If adjusting the trigger level makes the trigger stable, the test still passes. If adjusting the trigger does not help, see the “Troubleshooting” chapter. Then return here.
   d Record the result as Pass or Fail in the Performance Test Record.

5 Repeat this procedure for channels 2, 3, and 4, as applicable to your oscilloscope model.
Testing Performance
To verify trigger sensitivity

**Test External Trigger Sensitivity**

Verify the external trigger sensitivity at these settings:
- 100 MHz (54622A/22D/24A), <150 mV<sub>p-p</sub>
- 60 MHz (54621A/21D), <150 mV<sub>p-p</sub>
- 25 MHz (All models), <75 mV<sub>p-p</sub>

1. Use the power splitter to connect the calibrator to both the channel 1 input and the external trigger input. The Ext Trigger input is on the rear panel of the mixed-signal oscilloscope and the 4-channel oscilloscope. Connect 50Ω feedthroughs to the oscilloscope inputs.

2. Change the output of the calibrator to 100 MHz for the 54622A/22D/24A or 60 MHz for the 54621A/21D, and set the amplitude to 106 mV<sub>rms</sub> (300 mV<sub>p-p</sub>). The power splitter divides the 300 mV<sub>p-p</sub> so that 150 mV<sub>p-p</sub> is applied to each of the oscilloscope inputs.

3. Press the *Autoscale* key.

4. Press the Trigger *Edge* key, then press the *Ext* softkey to set the trigger source to external trigger.

5. Check for stable triggering, and adjust the trigger level if necessary.

6. Record the results as Pass or Fail in the Performance Test Record. If the test fails, see the “Troubleshooting” chapter. Then return here.

7. Change the output of the calibrator to 25 MHz and set the amplitude to 25.74 mV<sub>rms</sub> (75 mV<sub>p-p</sub>).

8. Check for stable triggering, and adjust the trigger level if necessary.

9. Record the results as Pass or Fail in the Performance Test Record. If the test fails, see the “Troubleshooting” chapter. Then return here.
# Agilent 54622A/22D/24A Performance Test Record

## Serial No. ________________

## Test by ______________________

## Test Interval ______________________

## Work Order No. ______________________

## Recommended Next Testing ________________

## Temperature ____________

### Threshold Specification Limits

<table>
<thead>
<tr>
<th>Ch D7-D0</th>
<th>Channel 1</th>
<th>Channel 2</th>
<th>Channel 3</th>
<th>Channel 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch D15-D8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Accuracy Test

- **5 V - 250 mV**: 4.750 V
- **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

### Voltage Measurement Accuracy

<table>
<thead>
<tr>
<th>Range</th>
<th>Power Supply Setting</th>
<th>Test Limits</th>
<th>Channel 1</th>
<th>Channel 2</th>
<th>Channel 3</th>
<th>Channel 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 V/Div</td>
<td>35 V</td>
<td>34.04 V to 35.96 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 V/Div</td>
<td>14 V</td>
<td>13.616 V to 14.384 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 V/Div</td>
<td>7 V</td>
<td>6.808 V to 7.192 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500 mV/Div</td>
<td>3.5 V</td>
<td>3.404 V to 3.596 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 mV/Div</td>
<td>1.4 V</td>
<td>1.3616 V to 1.4384 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 mV/Div</td>
<td>0.7 V</td>
<td>0.6808 V to 0.7192 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 mV/Div</td>
<td>0.35 V</td>
<td>0.3404 V to 0.3596 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 mV/Div</td>
<td>0.14 V</td>
<td>0.13616 V to 0.14384 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 mV/Div</td>
<td>0.07 V</td>
<td>0.06808 V to 0.07192 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 mV/Div</td>
<td>0.035 V</td>
<td>0.03404 V to 0.03596 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 mV/Div</td>
<td>0.014 V</td>
<td>0.013616 V to 0.014384 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 mV/Div</td>
<td>0.007 V</td>
<td>0.006808 V to 0.007192 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Bandwidth

- **3 dB at 100 MHz**: [Test Limits]

### Horizontal ∆t and 1/∆t Accuracy

<table>
<thead>
<tr>
<th>Generator Setting</th>
<th>Test Limits</th>
<th>Results</th>
</tr>
</thead>
</table>

#### Frequency

- **10 kHz**: 9.98 kHz to 10.02 kHz
- **1 MHz**: 997.9 kHz to 1.002 MHz
- **100 MHz**: 99.10 MHz to 100.9 MHz

#### Period

- **100 µs**: 99.79 µs to 100.2 µs
- **1 µs**: 997.9 ns to 1002 µs
- **10 ns**: 9.91 ns to 10.09 ns

### Trigger Sensitivity

#### Internal trigger

- **25 MHz at 0.35 division**: [Test Limits]
- **100 MHz at 0.35 division**: [Test Limits]

#### External trigger

- **25 MHz at <75 mV_{p-p}**: [Test Limits]
- **100 MHz at <150 mV_{p-p}**: [Test Limits]
## Agilent 54621A/54621D Performance Test Record

### Serial No. __________________________ Test by __________________________

### Test Interval ______________ Work Order No. ______________________

### Recommended Next Testing ______________ Temperature ________

### Threshold Specification Limits Ch D7-D0 Ch D15-D8

<table>
<thead>
<tr>
<th>Voltage Test</th>
<th>Specification</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 V - 250 mV</td>
<td>4.750 V</td>
<td></td>
</tr>
<tr>
<td>-5 V - 250 mV</td>
<td>-5.250 V</td>
<td></td>
</tr>
<tr>
<td>0 V - 100 mV</td>
<td>-100 mV</td>
<td></td>
</tr>
<tr>
<td>0 V + 100 mV</td>
<td>100 mV</td>
<td></td>
</tr>
<tr>
<td>5 V + 250 mV</td>
<td>5.250 V</td>
<td></td>
</tr>
<tr>
<td>-5 V + 250 mV</td>
<td>-4.750 V</td>
<td></td>
</tr>
<tr>
<td>0 V - 100 mV</td>
<td>-100 mV</td>
<td></td>
</tr>
<tr>
<td>0 V + 100 mV</td>
<td>100 mV</td>
<td></td>
</tr>
</tbody>
</table>

### Voltage Measurement Accuracy

<table>
<thead>
<tr>
<th>Range</th>
<th>Power Supply Setting</th>
<th>Test Limits</th>
<th>Channel 1</th>
<th>Channel 2</th>
<th>Channel 3</th>
<th>Channel 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 V/Div</td>
<td>35 V</td>
<td>34.04 V to 35.96 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 V/Div</td>
<td>14 V</td>
<td>13.616 V to 14.384V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 V/Div</td>
<td>7 V</td>
<td>6.808 V to 7.192  V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500 mV/Div</td>
<td>3.5 V</td>
<td>3.404 V to 3.596  V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 mV/Div</td>
<td>1.4 V</td>
<td>1.3616 V to 1.4384 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 mV/Div</td>
<td>700 mV</td>
<td>680.8 mV to 719.2 mV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 mV/Div</td>
<td>350 mV</td>
<td>340.4 mV to 359.6 mV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 mV/Div</td>
<td>140 mV</td>
<td>136.16 mV to 143.84 mV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 mV/Div</td>
<td>70 mV</td>
<td>68.08 mV to 71.92 mV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 mV/Div</td>
<td>35 mV</td>
<td>34.04 mV to 35.96 mV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 mV/Div</td>
<td>14 mV</td>
<td>13.616 mV to 14.384 mV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 mV/Div</td>
<td>7 mV</td>
<td>6.616 mV to 7.384 mV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Bandwidth

<table>
<thead>
<tr>
<th>Test Limits</th>
<th>Channel 1</th>
<th>Channel 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 dB at 60 MHz</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Horizontal Δt and 1/Δt Accuracy

<table>
<thead>
<tr>
<th>Generator Setting</th>
<th>Test Limits</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency 10 kHz</td>
<td>9.96 kHz to 10.02 kHz</td>
<td></td>
</tr>
<tr>
<td>Period 100 μs</td>
<td>99.79 μs to 100.2 μs</td>
<td></td>
</tr>
<tr>
<td>Frequency 1 MHz</td>
<td>997.9 kHz to 1.002 MHz</td>
<td></td>
</tr>
<tr>
<td>Period 1 μs</td>
<td>997.9 ns to 1.002 μs</td>
<td></td>
</tr>
<tr>
<td>Frequency 50 MHz</td>
<td>49.77 MHz to 50.23 MHz</td>
<td></td>
</tr>
<tr>
<td>Period 20 ns</td>
<td>19.91 ns to 20.09 ns</td>
<td></td>
</tr>
</tbody>
</table>

### Trigger Sensitivity

<table>
<thead>
<tr>
<th>Test Limits</th>
<th>Channel 1</th>
<th>Channel 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal trigger</td>
<td>25 MHz at 0.35 division</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60 MHz at 0.35 division</td>
<td></td>
</tr>
<tr>
<td>External trigger</td>
<td>25 MHz at &lt;75 mV_{pp}</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60 MHz at &lt;150 mV_{pp}</td>
<td></td>
</tr>
</tbody>
</table>
Calibrating and Adjusting
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.

CAUTION

REMOVE POWER TO AVOID DAMAGE!

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

CAUTION

USE EXTERNAL FAN TO REDUCE TEMPERATURE!

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

CAUTION

AVOID DAMAGE TO ELECTRONIC COMPONENTS!

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

To adjust the power supply

To adjust the power supply

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

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

Table 4-1

<table>
<thead>
<tr>
<th>Equipment Required to Adjust the Power Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
</tr>
<tr>
<td>Digital multimeter</td>
</tr>
</tbody>
</table>

1 Prepare the oscilloscope for the voltage adjustment.
   a Turn off the oscilloscope and disconnect the power cable.
   b Remove the oscilloscope cover. For a list of parts, see the “Replaceable Parts” chapter, then return here.
   c Place the oscilloscope on its side.
   d Connect the negative lead of the digital multimeter to a ground point on the oscilloscope chassis.
   e Reconnect the power cable.
   f Turn on the oscilloscope.
2 Locate the power supply voltages at E204, E205, E207, and E208 on the system board.
The power supply voltages are not labeled on the system board. See Figure 4-1 for the locations.

Figure 4-1

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

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

Table 4-2  

<table>
<thead>
<tr>
<th>Supply Voltage</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>+5.1 V</td>
<td>±250 mV (4.85 V to 5.35 V)</td>
</tr>
<tr>
<td>-5.2 V</td>
<td>±156 mV (-5.04 V to -5.36 V)</td>
</tr>
<tr>
<td>+15.75 V</td>
<td>+1.260 V, -787 mV (+14.963 V to +17.010 V)</td>
</tr>
<tr>
<td>+3.3 V</td>
<td>±100 mV (+3.20 V to +3.40 V)</td>
</tr>
<tr>
<td>+8.2 V</td>
<td>±82 mV (+8.12 V to +8.28 V)</td>
</tr>
</tbody>
</table>

Measure at J4 on the power supply board
Calibrating and Adjusting

To adjust the power supply

4 If the +5.1 V measurement is out of tolerance, adjust the +5.1 V / -5.2 V balance adjustment on the power supply. See Figure 4-2.

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

Figure 4-2

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

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

To perform User Cal

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 Press the Utility key, then press the Service softkey.
4 Begin the Self Cal by pressing the User Cal softkey.
5 When the User Cal is completed, set the rear-panel CALIBRATION switch to PROTECTED.
Calibrating and Adjusting

To adjust the oscilloscope display

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 ±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 or Cont controls

Do not adjust the **SUB BRT** (sub bright) or **CONTRAST** Controls. These controls are preset at the factory to assure the correct number of display grayscales.
Calibrating and Adjusting

To adjust the oscilloscope display

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
Troubleshooting

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

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

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

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

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

Read All Cautions and Warnings
Before you begin any troubleshooting, read all Warning and Cautions in the “Troubleshooting” section.
Solving General Problems with the Oscilloscopes

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

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

If there is no trace display

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

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.
Troubleshooting
If you cannot see a channel

If you cannot see a channel

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

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

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

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

**WARNING**

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

**CAUTION**

**REMOVE POWER TO AVOID DAMAGE !**
Do not disconnect any cables or remove any assemblies while power is applied to the oscilloscope, or damage to the oscilloscope can occur.

**CAUTION**

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

**Equipment required for troubleshooting**
The equipment listed in Table 5-1 is required to troubleshoot the oscilloscope.

**Table 5-1**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Critical Specifications</th>
<th>Recommended Model/Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital multimeter</td>
<td>Accuracy ±0.05%, 1 mV resolution</td>
<td>Agilent 34401A</td>
</tr>
<tr>
<td>Oscilloscope</td>
<td>100 MHz, 1 MΩ input R</td>
<td>Agilent 54622A</td>
</tr>
<tr>
<td>Dummy load</td>
<td>Compatible with power supply</td>
<td>See “To construct your own dummy load” on page 5-7.</td>
</tr>
</tbody>
</table>

5-6
To construct your own dummy load

1. Obtain a connector that is compatible with the connector J3 on the Low Voltage Power Supply.

2. Connect load resistors to the connector as follows:

<table>
<thead>
<tr>
<th>Connector</th>
<th>Load (Amps)</th>
<th>Resistor</th>
<th>Watts</th>
<th>Connect to Pin</th>
<th>Ground to Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>+5.1 V</td>
<td>4.4 A</td>
<td>1.2 Ω</td>
<td>22 W</td>
<td>10, 11, 12</td>
<td>13, 14</td>
</tr>
<tr>
<td>-5.2 V</td>
<td>1.6 A</td>
<td>3.25 Ω</td>
<td>8 W</td>
<td>4, 5</td>
<td>6</td>
</tr>
<tr>
<td>+15.75 V</td>
<td>1.2 A</td>
<td>13.1 Ω</td>
<td>20 W</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>+3.3 V</td>
<td>4 A</td>
<td>0.825 Ω</td>
<td>13 W</td>
<td>15, 16, 17, 18</td>
<td>19, 20</td>
</tr>
</tbody>
</table>

Figure 5-1

Location of the Low Voltage Power Supply Connectors
Troubleshooting

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

<table>
<thead>
<tr>
<th>Signal</th>
<th>Name</th>
<th>Frequency</th>
<th>Pulse Width</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>J900 Pin 14</td>
<td>Hsync</td>
<td>19.72 kHz</td>
<td>3.0 ms</td>
<td>4.5 V&lt;sub&gt;p-p&lt;/sub&gt;</td>
</tr>
<tr>
<td>J900 Pin 13</td>
<td>Vsync</td>
<td>60.00 Hz</td>
<td>253.5 ms</td>
<td>4.5 V&lt;sub&gt;p-p&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Supply Voltage</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>+5.1 V</td>
<td>±153 mV (+4.947 V to +5.253 V)</td>
</tr>
<tr>
<td>-5.2 V</td>
<td>±156 mV (-5.04 V to -5.36 V)</td>
</tr>
<tr>
<td>+15.75 V</td>
<td>±1.280 V, -787 mV (+14.963 V to +17.010 V)</td>
</tr>
<tr>
<td>+3.3 V</td>
<td>±100 mV (+3.20 V to +3.40 V)</td>
</tr>
</tbody>
</table>

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.
Troubleshooting

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.

**CAUTION**

USE AN EXTERNAL FAN TO AVOID OVERHEATING COMPONENTS!

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

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

3 Measure the power supply voltages at E1 through E6 on the system board. See Figure 5-3 and Table 5-4.

**Figure 5-3**

![Low Voltage Power Supply Test Points](image-url)

Low Voltage Power Supply Test Points
Troubleshooting

To check the Low Voltage Power Supply

<table>
<thead>
<tr>
<th>Table 5-4</th>
<th>Low Voltage Power Supply Tolerances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>Tolerance</td>
</tr>
<tr>
<td>+5.1 V</td>
<td>±153 mV (+4.947 V to +5.253 V)</td>
</tr>
<tr>
<td>-5.2 V</td>
<td>±156 mV (-5.04 V to -5.36 V)</td>
</tr>
<tr>
<td>+15.75 V</td>
<td>+1.260 V, -787 mV (+14.963 V to +17.010 V)</td>
</tr>
<tr>
<td>+3.3 V</td>
<td>±100 mV (+3.20 V to +3.40 V)</td>
</tr>
</tbody>
</table>

4 If the +5.1 V measurement is out of tolerance, adjust the +5.1 V adjustment on the power supply.

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

If the Fuse is Blown

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

CAUTION

BEWARE OF HAZARDOUS VOLTAGES!

Be careful when performing component-level repair. Voltages greater than 300 Vdc exist, and can cause injury.
To run the internal self-tests

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

It is recommended that you run the Self Test:
• after experiencing abnormal operation
• for additional information to better describe an oscilloscope failure
• to verify proper operation after the oscilloscope has been repaired

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

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

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

The removable assemblies include:

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

Tools Used for Disassembly

Use these tools to remove and replace the oscilloscope assemblies:

- 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.
Replacing Assemblies

**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.
Replacing Assemblies
To remove the cabinet

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
Replacing Assemblies

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
Replacing Assemblies
To remove the floppy drive

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

6-6
Replacing Assemblies

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.
Replacing Assemblies

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**

**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

Gently apply outward pressure at this corner of the slot

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.
Replacing Assemblies
To remove the system board

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 two hex nuts and washers from the rear BNCs using the 9/16-inch socket driver.
   The 54621D, 54622D, and 54624A have two rear BNCs, the 54621A and 54622A 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
Replacing Assemblies

To remove the power supply

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
To remove the power supply

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
Replacing Assemblies

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.
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**

**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.
Replacing Assemblies
To remove the handle

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.
Replaceable Parts
Replaceable Parts

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

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

Before working on the oscilloscope, read the safety summary at the back of this book.
To order a replacement part

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

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

For Agilent Technologies to provide these advantages, a check or money order must accompany each order. Mail-order forms and specific ordering information are available through your local Agilent Technologies Sales Office. Addresses and telephone numbers are located in a separate document shipped with the instrument.
Replaceable Parts
To order a replacement part

Figure 7-1

Exploded View of the 54621A/22A/24A/21D/22D Oscilloscope
Table 7-1

Replaceable Parts

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<thead>
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<th>Reference Designator</th>
<th>Agilent Part Number</th>
<th>Qty</th>
<th>Description</th>
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</thead>
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<td>A1</td>
<td>54621-69001</td>
<td>1</td>
<td>Refurbished Product 2 CH 60MHz (54621A-Agilent Express)</td>
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<tr>
<td>A1</td>
<td>54621-69002</td>
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<td>Refurbished Product 2+16 CH 60MHz (54621D-Agilent Express)</td>
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<td>54622-69001</td>
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<td>Refurbished Product 2 CH 100MHz (54622A-Agilent Express)</td>
</tr>
<tr>
<td>A1</td>
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<td>54624-69001</td>
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<td>Refurbished Product 4 CH 100MHz (54624A-Agilent Express)</td>
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<td>A2</td>
<td>54621-66501</td>
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<td>System board (54621A)</td>
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<td>A2</td>
<td>54621-66506</td>
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<td>A2BT340</td>
<td>1420-0573</td>
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<td>3V Battery (CR2354)</td>
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<td>0950-2782</td>
<td>1</td>
<td>Floppy disk drive</td>
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<td>A4</td>
<td>0950-4095</td>
<td>1</td>
<td>Power supply assembly</td>
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<td>A4F1</td>
<td>--</td>
<td>1</td>
<td>Fuse 5A, 250V SB</td>
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<td>A5</td>
<td>2090-0384</td>
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<td>Display assembly</td>
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<td>54622-66502</td>
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<td>Keyboard (54621A, 54622A)</td>
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<td>54622-66503</td>
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<td>Keyboard (54621D, 54622D)</td>
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<td>Keyboard (54624A)</td>
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<td>B1</td>
<td>3160-1006</td>
<td>1</td>
<td>Fan</td>
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<td>T10 Machine screw</td>
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<td>0515-0380</td>
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<td>T-20 Machine screw 4 X 0.7 X 10mm</td>
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<td>0515-0390</td>
<td>5</td>
<td>T20 Machine screw 4 X 0.7 X 6mm</td>
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<td>H4</td>
<td>0515-0658</td>
<td>2</td>
<td>T-6 Pan Head Machine screw</td>
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<td>H5</td>
<td>0515-0667</td>
<td>See Descr</td>
<td>T10 Machine screw 3 X 0.5 X 25mm (54621A/22A/21D/22D – 1 ea) (54624A – 2 ea)</td>
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<td>H7</td>
<td>0515-2691</td>
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<td>T8 Machine screw</td>
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<td>H8</td>
<td>2190-0068</td>
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<td>Washer - Trig Out (Qty 1 54621A/22A/24A) Washer - Ext Trig &amp; Trig Out (Qty 2 54621D/22D)</td>
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<td>H9</td>
<td>1250-2075</td>
<td>See Descr</td>
<td>Nut - Trig Out (Qty 1 54621A/22A/24A) Nut - Ext Trig &amp; Trig Out (Qty 2 54621D/22D</td>
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Replaceable Parts

To order a replacement part

<table>
<thead>
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<th>Reference Designator</th>
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<th>Description</th>
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<td>54801-47401</td>
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<td>See Descr Knob - 12mm Flint Gray</td>
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<td>(54621A/22A – 6 ea)</td>
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<td>(54624A – 5 ea)</td>
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<td>MP3</td>
<td>54622-43702</td>
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<td>Intensity shaft</td>
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<td>MP4</td>
<td>54622-43701</td>
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<td>Power switch shaft</td>
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<td>MP5</td>
<td>54622-41901</td>
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<td>Front-panel keyboard keypad</td>
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<td>(54621A/22A)</td>
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## Replaceable Parts

To order a replacement part

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<td>Attenuator lid</td>
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<td>(54624A - 2 each)</td>
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<tr>
<td>W1</td>
<td>54630-61601</td>
<td>1</td>
<td>Display ribbon cable</td>
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<td>W2</td>
<td>54710-61603</td>
<td>1</td>
<td>Front-panel keyboard cable</td>
</tr>
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<td>W3</td>
<td>54801-61625</td>
<td>1</td>
<td>Floppy diskette driver ribbon cable</td>
</tr>
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<td>W4</td>
<td>54630-61602</td>
<td>1</td>
<td>Power cable (from power supply to Acquisition board</td>
</tr>
<tr>
<td>W5</td>
<td>8120-1703</td>
<td></td>
<td>Power cord option 900, United Kingdom</td>
</tr>
<tr>
<td>W5</td>
<td>8120-0696</td>
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<td>Power cord option 901, Australia</td>
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<td>W5</td>
<td>8120-1692</td>
<td></td>
<td>Power cord option 902, Europe</td>
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<td>W5</td>
<td>8120-1521</td>
<td></td>
<td>Power cord option 903, U.S.A.</td>
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<td>W5</td>
<td>8120-2296</td>
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<td>Power cord option 906, Switzerland</td>
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<td>8120-2957</td>
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<td>Power cord option 912, Denmark</td>
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<td>8120-4600</td>
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<td>Power cord option 917, Africa</td>
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<td>8120-4754</td>
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<td>Power cord option 918, Japan</td>
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<td>8120-6799</td>
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<td>Power cord option 919, Israel</td>
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<td>W5</td>
<td>8120-8871</td>
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<td>Power cord option 920, Argentina</td>
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<td>8120-6979</td>
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<td>Power cord option 921, Chile</td>
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<td>W5</td>
<td>8120-8377</td>
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<td>Power cord option 922, China</td>
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<td>W5</td>
<td>8120-8871</td>
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<td>Power cord option 927, Thailand</td>
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<td><strong>Option 101</strong></td>
<td><strong>Accessory pouch and front-panel cover</strong></td>
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<td>(also orderable as part number 54600-68722)</td>
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<td>5041-9482</td>
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<td>Pouch</td>
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<td>54601-44101</td>
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<td>Front-panel cover</td>
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<td><strong>Probes</strong></td>
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<td>10:1 150 MHz passive probe with ID</td>
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<td>10074C</td>
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<td>(54624A - 4 each)</td>
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<td><strong>Input Cable (54621D/22D only)</strong></td>
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<td>Cable, Woven (includes probe leads)</td>
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<td>54620-61801</td>
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<td>Package replacement probe leads (quantity 5)</td>
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<td>5959-9333</td>
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<td>Package replacement probe grounds (quantity 5)</td>
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<td>5959-9334</td>
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<td>Package replacement pod grounds (quantity 5)</td>
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<td>5959-9335</td>
<td></td>
<td>Package replacement grabber (quantity 20)</td>
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<td>5090-4833</td>
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<td>Package of probe labels</td>
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DECLARATION OF CONFORMITY

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

Manufacturer's Name: Agilent Technologies, Inc.
Manufacturer's Address: Garden of the Gods Road
Colorado Springs, Colorado
80907 U.S.A.

Declares, that the product

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

Is in conformity with:

IEC 61000-4-3:1995/EN 61000-4-3:1995 (3V/m 80% AM)
IEC 61000-4-4:1995/EN 61000-4-4:1995 (0.5kV line-line, 1kV line-earth)
IEC 61000-4-6:1996/EN 61000-4-6:1996 (3V 80% AM, power line)
Australia/New Zealand: AS/NZS 2064.1

Canada: CSA C22.2 No. 1010.1:1992
USA: UL 3111-1:1994

Additional Information:


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

Date: 01/27/2000

Name

Ken Wyatt / Product Regulations Manager

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

<table>
<thead>
<tr>
<th>EMC</th>
<th>Performance Criteria</th>
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<tr>
<td>IEC 61000-4-3:1995 / EN 61000-4-3:1995</td>
<td>B</td>
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<tr>
<td>IEC 61000-4-4:1995 / EN 61000-4-4:1995</td>
<td>B</td>
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<td>IEC 61000-4-6:1996 / EN 61000-4-6:1996</td>
<td>A, B (1)</td>
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<td>Canada: ICES-001:1998</td>
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<table>
<thead>
<tr>
<th>Safety</th>
<th>Performance Criteria</th>
</tr>
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<tbody>
<tr>
<td>Canada: CSA C22.2 No. 1010.1:1992</td>
<td></td>
</tr>
</tbody>
</table>

**Additional Information**

**Performance Criteria:**

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

**Notes:**

1. 54621D/54622D = A, 54621A/54622A/54624A = B

**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.

接地符号: 用于表示与接地机箱共同连接的电路。

Agilent Technologies Inc.
P.O. Box 2197
1900 Garden of the Gods Road
Colorado Springs, CO 80901-2197, U.S.A.
Notices

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54622-97037, December 2002

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54622-97028, November 2001
54622-97025, February 2001
54622-97000, March 2000

Agilent Technologies, Inc.
1601 California Street
Palo Alto, CA 94304 USA

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CAUTION
A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

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