Agilent 5000 Series Oscilloscopes

Service Guide

Agilent Technologies

Notices

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CAUTION

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WARNING

A WARNING 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 personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

In This Service Guide

This book provides the service information for the Agilent 5000 Series Oscilloscopes. This manual is divided into these chapters:

1 Characteristics and Specifications

This chapter lists characteristics and specifications for the Agilent 5000 Series Oscilloscopes.

2 Testing Performance

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

3 Calibrating and Adjusting

This chapter explains how to adjust the oscilloscope for optimum operating performance.

4 Troubleshooting

This chapter begins with suggestions for solving general problems that you may encounter with the oscilloscope. Procedures for troubleshooting the oscilloscope follow the problem solving suggestions.

5 Replacing Assemblies

This chapter describes how to remove assemblies from the 5000 Series oscilloscope.

7 Replaceable Parts

This chapter describes how to order replaceable assemblies and parts for the Agilent 5000 Series Oscilloscopes. It includes diagrams and parts lists for hardware that you can order.

At the front of the book you will find safety notice descriptions and document warranties.

Abbreviated instructions for pressing a series of keys

Instructions for pressing a series of keys are written in an abbreviated manner. Instructions for pressing Key1, then pressing Key2, then pressing Key3 are abbreviated as follows:

Press **Key1** → **Key2** → **Key3**.

The keys may be front panel keys, or softkeys, which are located directly below the oscilloscope display.

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Tables

1 Characteristics and Specifications

This chapter lists specifications, characteristics, environmental conditions, and measurement category for the Agilent 5000 Series oscilloscopes.

Environmental Conditions

Overvoltage Category

This product is intended to be powered by MAINS that comply to Overvoltage Category II, which is typical of cord-and-plug connected equipment.

Pollution Degree

The 5000A Series Oscilloscope may be operated in environments of Pollution Degree 2 (or Pollution Degree 1).

Pollution Degree Definitions

Pollution Degree 1: No pollution or only dry, non-conductive pollution occurs. The pollution has no influence. Example: A clean room or climate controlled office environment.

Pollution Degree 2. Normally only dry non-conductive pollution occurs. Occasionally a temporary conductivity caused by condensation may occur. Example: General indoor environment.

Pollution Degree 3: Conductive pollution occurs, or dry, non-conductive pollution occurs which becomes conductive due to condensation which is expected. Example: Sheltered outdoor environment.

Measurement Category

Measurement Category

The 5000A Series oscilloscope is intended to be used for measurements in Measurement Category I.

Measurement Category Definitions

Measurement category I is for measurements performed on circuits not directly connected to MAINS. Examples are measurements on circuits not derived from MAINS, and specially protected (internal) MAINS derived circuits. In the latter case, transient stresses are variable; for that reason, the transient withstand capability of the equipment is made known to the user.

Measurement category II is for measurements performed on circuits directly connected to the low voltage installation. Examples are measurements on household appliances, portable tools and similar equipment.

Measurement category III is for measurements performed in the building installation. Examples are measurements on distribution boards, circuit-breakers, wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and equipment for industrial use and some other equipment, for example, stationary motors with permanent connection to the fixed installation.

Measurement category IV is for measurements performed at the source of the low-voltage installation. Examples are electricity meters and measurements on primary overcurrent protection devices and ripple control units.

Transient Withstand Capability

CAUTION

Maximum input voltage for analog inputs:

CAT I 300 Vrms, 400 Vpk; transient overvoltage 1.6 kVpk
CAT II 100 Vrms, 400 Vpk
with N2863A 10:1 probe: CAT I 600 V, CAT II 300 V (DC + peak AC)
with 10073C 10:1 probe: CAT I 500 Vpk, CAT II 400 Vpk

CAUTION

Do not exceed 5 Vrms in 50 Ω mode on the 2-channel models. Input protection is enabled in 50 Ω mode, and the 50 Ω load will disconnect if greater than 5 Vrms is detected. However, the input could still be damaged, depending on the time constant of the signal.

CAUTION

The 50 Ω input protection mode only functions when the oscilloscope is powered on.

Specifications

All specification are warranted. Specifications are valid after a 30-minute warm-up period and within ±10°C of last "User Cal" temperature.

Table 1 Warranted specifications

Vertical system: oscilloscope channels	
Bandwidth (–3dB)	DSO501xA: DC to 100 MHz DSO503xA: DC to 300 MHz DSO505xA: DC to 500 MHz
DC vertical gain accuracy	±2.0% full scale
Dual cursor accuracy[1]	±{DC vertical gain accuracy + 0.4% full scale (~1 LSB)} *Example*: for 50 mV signal, oscilloscope set to 10 mV/div (80 mV full scale), 5 mV offset, accuracy = ±{2.0% (80 mV) + 0.4% (80 mV)} = ±1.92 mV
Scope channel triggering	
Sensitivity	<10 mV/div: greater of 1 div or 5mV; ≥10 mV/div: 0.6 div

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

Characteristics

All characteristics are the typical performance values and are not warranted. Characteristics are valid after a 30-minute warm-up period and within ±10°C of last "User Cal" temperature.

Table 2 Characteristics

Acquisition	
Sample rate	DSO501xA/503xA: 2 GSa/sec each channel DSO505xA: 4 GSa/sec half channel*, 2 GSa/sec each channel
Memory depth	1 Mpts half channel*, 500 kpts each channel
Vertical resolution	8 bits
Peak detection	DSO501xA: 1-ns peak detect DSO503xA: 500-ps peak detect DSO505xA: 250-ps peak detect
Averaging	Selectable from 2, 4, 8, 16, 32, 64 ... to 65536
High resolution mode	Average mode with #avg = 1 12 bits of resolution when ≥10 µs/div, at 4 GSa/s or ≥20 µs/div, at 2 GSa/s
Filter	Sinx/x interpolation (single shot BW = sample rate/4 or bandwidth of oscilloscope, whichever is less) with vectors on and in real-time mode

* Half channel is when only one channel of channel pair 1- 2 is turned on, or only one channel of channel pair 3-4 is turned on.

Vertical system

Scope channels	DSO5xx2A: Ch 1 and 2 simultaneous acquisition DSO5xx4A: Ch 1, 2, 3 and 4 simultaneous acquisition
AC coupled	DSO501xA: 3.5 Hz to 100 MHz DSO503xA: 3.5 Hz to 300 MHz DSO505xA: 3.5 Hz to 500 MHz
Calculated rise time (= 0.35/bandwidth)	DSO501xA: 3.5 nsec DSO503xA: 1.17 nsec DSO505xA: 700 psec
Single-shot bandwidth	DSO501xA: 100 MHz DSO503xA: 300 MHz DSO505xA: 500 MHz (in half-channel mode, i.e., one channel of channel pair is on)
Range[1]	2 mV/div to 5 V/div (1 MΩ or 50 Ω)
Maximum input ⚠	Maximum input voltage for analog inputs: CAT I 300 Vrms, 400 Vpk; transient overvoltage 1.6 kVpk CAT II 100 Vrms, 400 Vpk with N2863A 10:1 probe: CAT I 600 V, CAT II 300 V (DC + peak AC) with 10073C 10:1 probe: CAT I 500 Vpk, CAT II 400 Vpk 5 Vrms with 50-ohm input
Offset range	±5 V on ranges <10 mV/div; ±20 V on ranges 10 mV/div to 200 mV/div; ±75 V on ranges >200 mV/div
Dynamic range	±8 div
Input impedance	1 MΩ ± 1% || 12 pF or 50 Ω ± 1%, selectable
Coupling	AC, DC
BW limit	25 MHz selectable
Channel-to-channel isolation	DC to max bandwidth >40 dB
Standard probes	DSO501xA: 10:1 N2863A shipped standard for each oscilloscope channel DSO503xA: 10:1 N2863A shipped standard for each oscilloscope channel DSO505xA: 10:1 10073C shipped standard for each oscilloscope channel
Probe ID	Auto probe sense and AutoProbe interface Agilent- and Tektronix-compatible passive probe sense
ESD tolerance	±2 kV
Noise peak-to-peak	DSO501xA: 3% full scale or 2.5 mV, whichever is greater DSO503xA: 3% full scale or 3 mV, whichever is greater DSO505xA: 3% full scale or 3.6 mV, whichever is greater
DC vertical offset accuracy	≤ 200 mV/div: ±0.1 div ±2.0 mV ±0.5% offset value; >200 mV/div: ±0.1 div ±2.0 mV ±1.5% offset value

Vertical system (continued)	
Single cursor accuracy[1]	±{DC vertical gain accuracy + DC vertical offset accuracy + 0.2% full scale (~1/2 LSB)} *Example*: for 50 mV signal, oscilloscope set to 10 mV/div (80 mV full scale), 5 mV offset, accuracy = ±{2.0% (80 mV) + 0.1 (10 mV) + 2.0 mV + 0.5% (5 mV) + 0.2%(80 mV)} = ± 4.785 mV

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

Horizontal	
Range	DSO501xA: 5 nsec/div to 50 sec/div DSO503xA: 2 nsec/div to 50 sec/div DSO505xA: 1 nsec/div to 50 sec/div
Resolution	2.5 psec
Timebase accuracy	25 ppm (±0.0025%)
Vernier	1-2-5 increments when off, ~25 minor increments between major settings when on
Delay range	Pre-trigger (negative delay): Greater of 1 screen width or 125 µs Post-trigger (positive delay): 1 s - 500 seconds
Channel delta-t accuracy	Same channel: ±0.0025% reading ±0.1% screen width ±20 ps Channel-to-channel: ±0.0025% reading ±0.1% screen width ±40 ps *Same channel example (DSO505xA)*: For signal with pulse width of 10 µs, oscilloscope set to 5 µs/div (50 µs screen width), delta-t accuracy = ±{0.0025% (10 µs) + 0.1% (50 µs) + 20 ps} = 50.27 ns
Modes	Main, delayed, roll, XY
XY	Bandwidth: Max bandwidth Phase error @ 1 MHz: <0.5 degrees Z Blanking: 1.4 V blanks trace (use external trigger on DSO50x2A, channel 4 on DSO50x4A)
Reference positions	Left, center, right

Trigger system		
Sources		DSO5xx2A: Ch 1, 2, line, ext DSO5xx4A: Ch 1, 2, 3, 4, line, ext
Modes		Auto, Normal (triggered), single
Holdoff time		~60 ns to 10 seconds
Trigger jitter		15 ps rms
Selections		Edge, pulse width, pattern, TV, duration
	Edge	Trigger on a rising, falling, or alternating edge of any source
	Pattern	Trigger at the beginning of a pattern of high, low, and don't care levels and/or a rising or falling edge established across any of the channels, but only after a pattern has been established for a minimum of 2 nsec. The 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 (DSO501xA) 2 ns (DSO503xA, DSO505xA) Maximum pulse width setting: 10 s
	TV	Trigger using any oscilloscope channel on most analog progressive and interlaced video standards including HDTV/EDTV, NTSC, PAL, PAL-M or SECAM broadcast standards. Select either positive or negative sync pulse polarity. Modes supported include Field 1, Field 2, all fields, all lines, or any line within a field. TV trigger sensitivity: 0.5 division of sync signal. Trigger holdoff time can be adjusted in half field increments.
	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, or inside or outside of a set of time values. Minimum duration setting: 2 ns Maximum duration setting: 10 s
AutoScale		Finds and displays all active channels, sets edge trigger mode on highest-numbered channel, sets vertical sensitivity on channels, time base to display ~1.8 periods. Requires minimum voltage >10 mVpp, 0.5% duty cycle and minimum frequency >50 Hz.

Channel triggering	
Range (internal)	±6 div from center screen
Coupling	AC (~10 Hz), DC, noise reject, HF reject and LF reject (~50 kHz)

External (EXT) triggering	DSO5xx2A	DSO5xx4A
Input impedance	1 MΩ ±1% || 12 pF or 50 Ω	Approx. 1.015 kΩ ±5%
Maximum input ⚠	Maximum input voltage for analog inputs: CAT I 300 Vrms, 400 Vpk; transient overvoltage 1.6 kVpk CAT II 100 Vrms, 400 Vpk with N2863A 10:1 probe: CAT I 600 V, CAT II 300 V (DC + peak AC) with 10073C 10:1 probe: CAT I 500 Vpk, CAT II 400 Vpk 5 Vrms with 50-ohm input	±15 V
Range	DC coupling: trigger level ± 1V and ± 8V	±5 V
Sensitivity	For ± 1V range setting: DC to 100 MHz, 100 mV, >100 MHz to bandwidth of the oscilloscope, 200 mV For ±8 V range setting: DC to 100 MHz, 250 mV; >100 MHz to bandwidth of the oscilloscope, 500 mV	DC to 100 MHz, 500 mV
Coupling	AC (~10 Hz), DC, noise reject, HF reject and LF reject (~50 kHz)	n/a
Probe ID	Auto probe sense and AutoProbe interface Agilent- and Tektronix-compatible passive probe sense	

Display system	
Display	6.3-inch (161 mm) diagonal color TFT LCD
Throughput of oscilloscope channels	Up to 100,000 waveforms/sec in real-time mode
Resolution	XGA – 768 vertical by 1024 horizontal points (screen area); 640 vertical by 1000 horizontal points (waveform area) 256 levels of intensity scale
Controls	Waveform intensity on front panel. Vectors on/off; infinite persistence on/off, 8 x 10 grid with intensity control
Built-in help system	Key-specific help displayed by pressing and holding key or softkey of interest
Real-time clock	Time and date (user adjustable)

Measurement features	
Automatic measurements	Measurements are continuously updated. Cursors track last selected measurement.
Voltage (scope channels only)	Peak-to-peak, maximum, minimum, average, amplitude, top, base, overshoot, preshoot, RMS, standard deviation
Time	Frequency, period, + width, – width and duty cycle on any channel. Rise time, fall time, X at max Y (time at max volts), X at min Y (time at min volts), delay, and phase on oscilloscope channels only.
Counter	Built-in 5-digit frequency counter on any channel. Counts up to the oscilloscope's bandwidth.
Threshold definition	Variable by percent and absolute value; 10%, 50%, 90% default for time measurements
Cursors	Manually or automatically placed readout of Horizontal (X, ΔX, 1/ΔX) and Vertical (Y, ΔY). Additionally oscilloscope channels can be displayed as binary or hex values.
Waveform math	One function of 1-2, 1x2, FFT, differentiate, integrate. Source of FFT, differentiate, integrate: oscilloscope channels 1 or 2, 1-2, 1+2, 1x2.

FFT	
Points	Fixed at 1000 points
Source of FFT	Scope channels 1 or 2 (or 3 or 4 on DSO50x4A only), 1+2, 1-2, 1*2
Window	Rectangular, flattop, hanning
Noise floor	–50 to –90 dB depending on averaging
Amplitude	Display in dBV, dBm at 50 Ω
Frequency resolution	0.05/time per div
Maximum frequency	50/time per div

Storage	
Save/recall	10 setups and traces can be saved and recalled using internal non-volatile memory
Storage type and format	USB 1.1 host ports on front and rear panels Image formats: BMP (8-bit), BMP (24-bit), PNG (24-bit) Data formats: X and Y (time/voltage) values in CSV format, ASCII XY format, BIN format Trace/setup formats: Recalled

I/O	
Standard ports	USB 2.0 high speed device, two USB 1.1 host ports, 10/100-BaseT LAN, IEEE488.2 GPIB, XGA video output
Max transfer rate	IEEE488.2 GPIB: 500 kbytes/sec USB (USBTMC-USB488): 3.5 Mbytes/sec 100 Mbps LAN (TCP/IP): 1 Mbytes/sec
Printer compatibility	Selected HP Deskjet printers

General characteristics	
Physical size	35.4 cm wide x 18.8 cm high x 17.4 cm deep (without handle) 38.5 cm wide x 18.8 cm high x 17.4 cm deep (with handle)
Weight	Net: 4.1 kgs (9 lbs) Shipping: approximately 9 kgs (20 lbs)
Probe comp output	Frequency ~1.2 kHz, Amplitude ~2.5 V
Trigger out	0 to 5 V into open circuit (~23 ns delay) 0 to 2.5 V into 50 Ω
Kensington lock	Connection on rear panel for security

Power requirements	
Line Rating	~Line 120 W max, 96-144 V/48-440 Hz, 192-288 V/48-66 Hz, automatic selection

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	Agilent class GP and MIL-PRF-28800F; Class 3 random
Shock	Agilent class GP 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	Rated for indoor use only

Other	
Measurement categories	CAT I: Mains isolated CAT II: Line voltage in appliance and to wall outlet
Regulatory information	Safety IEC 61010-1:2001 / EN 61010-1:2001 Canada: CSA C22.2 No. 61010-1:2004 USA: UL 61010-1:2004
Supplementary information	The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC, and carries the CE-marking accordingly. The product was tested in a typical configuration with HP/Agilent test systems.

Product specifications, characteristics, and descriptions in this document are subject to change without notice.

WARNING **Use this instrument only for measurements within its specified measurement categories.**

See data sheet for more information. You can find the data sheet online at www.agilent.com/find/dso5000.

Acknowledgements

2 Testing Performance

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

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 on page 52. To verify whether a test passes, verify that the reading is within the limits in the Performance Test Record.

If a performance test fails
If a performance test fails, first perform the User Cal procedure

List of Test Equipment

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

Table 3 List of test equipment

Equipment	Critical Specifications	Recommended Model/ Part Number	Qty
Digital Multimeter	0.1 mV resolution, 0.005% accuracy	Agilent 34401A	1
Power Splitter	Outputs differ by ≤ 0.15 dB	Agilent 11667A	1
Oscilloscope Calibrator	14 mV to 35 Vdc, 0.1 V resolution, 25 MHz - 500 MHz sine wave, stability 5 ppm after 1/2 hour	Fluke 5820A	1
Signal Generator	100 kHz - 500 MHz at 200 mVrms	Agilent N5181A, Agilent E4400B, or Agilent 8648A	1
Power Meter/Sensor	1 MHz - 1 GHz ±3% accuracy	Agilent E4418B/8482A	1
BNC banana cable		Agilent 11001-66001	1
BNC cable		Agilent 10503A	2
Cable	Type N (m) 609.6 mm (24 in.)	Agilent 11500B	1
Shorting Cap BNC		Agilent 1250-0774	1
Adapter	BNC(f) to banana(m)	Agilent 1251-2277	1
Adapter	BNC Tee (m) (f) (f)	Agilent 1250-0781	1
Adapter	Type N (m) to BNC (m)	Agilent 1250-0082 or Pomona 3288 with Pomona 3533	1
Blocking capacitor		Agilent 10240-60001	1
Adapter	N(m) to BNC(f)	Agilent 1250-0780	1
Feedthrough	50Ω BNC (f) to BNC (m)	Agilent 0960-0301	1

Some parts and equipment are available at www.agilent.com or www.parts.agilent.com.

The following conventions will be used when referring to oscilloscope models throughout this chapter.

Table 4 Conventions

Models	Referred to as:
DSO5012A, DSO5014A	100 MHz Models
DSO5032A, DSO5034A	300 MHz Models
DSO5052A, DSO5054A	500 MHz Models

To verify voltage measurement accuracy

This test verifies the accuracy of the analog channel voltage measurement for each channel (DC Vertical Gain Accuracy and Dual Cursor Accuracy specifications). In this test, you will measure the dc voltage output of an oscilloscope calibrator 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 32 mV on the 2 mV/div range.
- Full scale on all other ranges is defined as 8 divisions times the V/div setting.

*1 LSB = 0.4% of full scale

Table 5 Equipment Required to Verify Voltage Measurement Accuracy

Equipment	Critical Specifications	Recommended Model/Part	Qty
Oscilloscope Calibrator	14 mV to 35 Vdc, 0.1 V resolution, 25 MHz - 500 MHz sine wave, stability 5 ppm after 1/2 hour	Fluke 5820A	1
Digital multimeter	Better than 0.01% accuracy	Agilent 34401A	1
Cable	BNC	Agilent 10503A	2
Shorting cap	BNC	Agilent 1250-0774	1
Adapter	BNC (f) to banana (m)	Agilent 1251-2277	1
Adapter	BNC Tee (m) (f) (f)	Agilent 1250-0781	1
Blocking capacitor		Agilent 10240-60001	1

1 Set up the oscilloscope.

   a Adjust the channel 1 position knob to place the baseline at 0.5 major division from the bottom of the display.

   b Set the Volts/Div setting to the value in the first line in Table 6.

Table 6 Settings Used to Verify Voltage Measurement Accuracy

Volts/Div Setting	Oscilloscope Calibrator Setting	Test Limits		
5 V/Div	35 V	34.04 V	to	35.96 V
2 V/Div	14 V	13.616 V	to	14.384 V
1 V/Div	7 V	6.808 V	to	7.192 V
500 mV/Div	3.5 V	3.404 V	to	3.596 V
200 mV/Div	1.4 V	1.3616 V	to	1.4384 V
100 mV/Div	700 mV	680.8 mV	to	719.2 mV
50 mV/Div	350 mV	340.4 mV	to	359.6 mV
20 mV/Div	140 mV	136.16 mV	to	143.84 mV
10 mV/Div	70 mV	68.08 mV	to	71.92 mV
5 mV/Div	35 mV	34.04 mV	to	35.96 mV
2 mV/Div[1]	14 mV	13.232 mV	to	14.768 mV

[1] Full scale is defined as 32 mV on the 2 mV/div range. On all other ranges full scale is defined as 8 divisions times the V/div setting.

   c Press the **Acquire** key. Then, press the **Acq Mode** softkey until **Averaging** is selected. Finally, press the **#Avgs** softkey and turn the Entry knob to set the number of averages to 64.

   Wait a few seconds for the measurement to settle.

2 Press the **Cursors** key, set the **Mode** softkey to **Normal**, then press the **X Y** softkey and select **Y**. Press the **Y1** softkey,

then use the Entry knob (labeled ↻ on the front panel) to set the Y1 cursor on the baseline of the signal.

3 Use the BNC tee and cables to connect the oscilloscope calibrator to both the oscilloscope and the multimeter (see Figure 1).

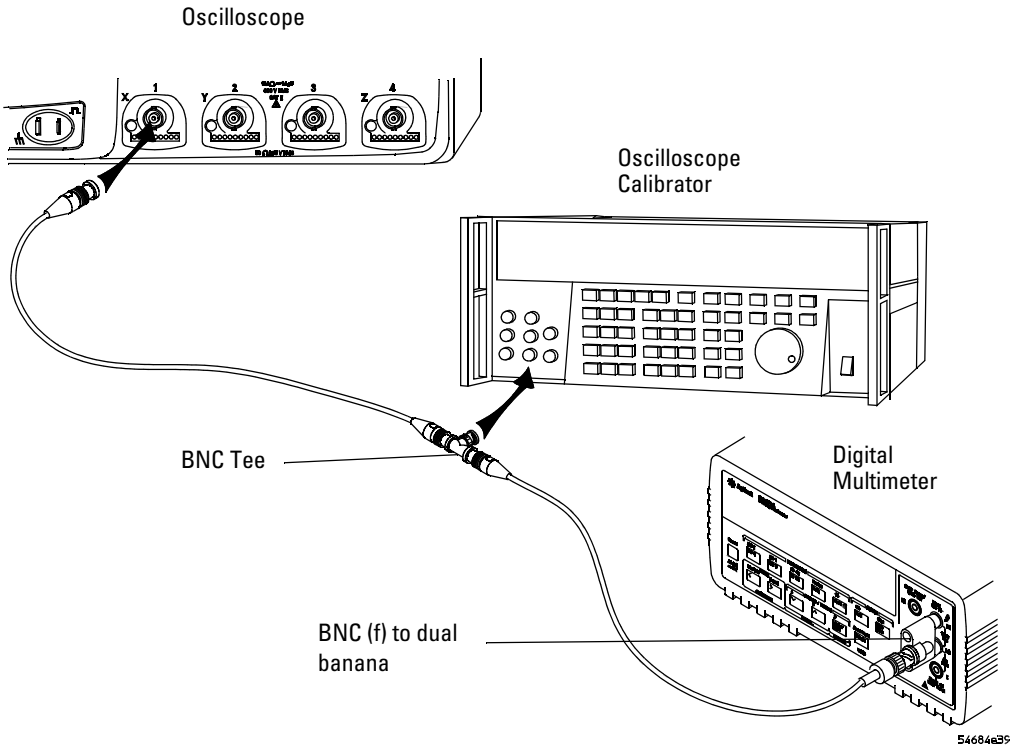


Figure 1 Connect equipment for voltage measurement accuracy test

4 Adjust the output so that the multimeter reading displays the first Volts/div calibrator setting value in Table 6.

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 6. If a result is not within the test limits, go to the "Troubleshooting" chapter. Then return here.

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

7 When you are finished checking all of the voltage values, disconnect the oscilloscope calibrator from the oscilloscope.

8 Record the results as Pass or Fail in the Performance Test Record (see page 52).

9 Repeat this procedure for the remaining channels to be tested.

Use a Blocking Capacitor to Reduce Noise

On the more sensitive ranges, such as 2 mV/div and 5 mV/div, noise may be a factor. To eliminate the noise, add a BNC Tee, blocking capacitor, and BNC shorting cap at the oscilloscope channel input to shunt the noise to ground. See Figure 2.

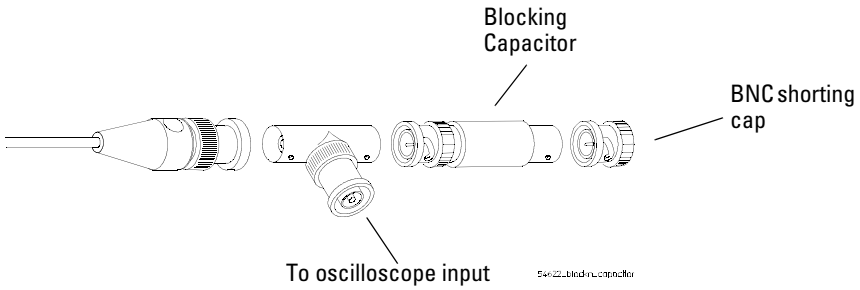


Figure 2 Using a Blocking Capacitor to Reduce Noise

To verify bandwidth

This test checks the bandwidth of the oscilloscope. In this test you will use a signal generator and a power meter.

500 MHz Models

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

- All channels (±3 dB)
  - dc to 500 MHz

300 MHz Models

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

- All channels (±3 dB)
  - dc to 300 MHz

100 MHz Models

Test limits at 1 mV/div to 5 V/div

- All channels (±3 dB)
  - dc to 100 MHz

Table 7 Equipment Required to Verify Bandwidth

Equipment	Critical Specifications	Recommended Model/Part	Qty
Signal Generator	100 kHz - 500 MHz at 200 mVrms	Agilent N5181A, Agilent E4400B, or Agilent 8648A	1
Power Meter/Sensor	1 MHz - 1 GHz ±3% accuracy	Agilent E4418B/8482A	1
Power Splitter	Outputs differ by ≤ 0.15 dB	Agilent 11667A	1
Cable	Type N (m) 24 inch	Agilent 11500B	1
Adapter	Type N (m) to BNC (m)	Agilent 1250-0082	1

1 Connect the equipment (see Figure 3).

   a Use the N cable to connect the signal generator to the input of the power splitter input.

   b Connect the power sensor to one output of the power splitter.

   c Use an N-to-BNC adapter to connect the other splitter output to the channel 1 input.

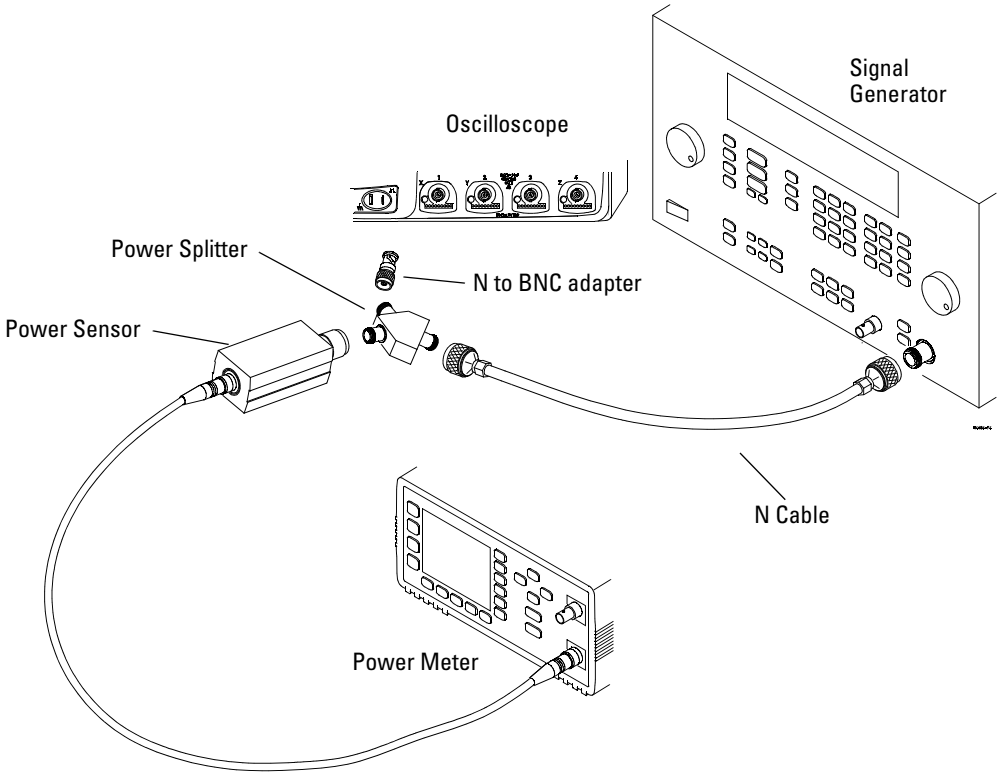


Figure 3 Connect equipment for bandwidth test

2 Set up the power meter.

   Set the power meter to display measurements in units of watts.

3 Set up the oscilloscope.

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

   b Press the **Acquire** key; then, press the **Realtime** softkey to unselect Realtime.

   c Press the **Acq Mode** softkey until **Averaging** is selected. Then, press the **#Avgs** softkey and turn the Entry knob to set the number of averages to 8.

   d Set channel 1 **Imped** to **50 Ohm**.

   e Set the time base to 500 ns/div.

   f Set the Volts/Div for channel 1 to 200 mV/div.

4 Set the signal generator for 1 MHz and six divisions of amplitude.

   The signal on the oscilloscope screen should be about five cycles at six divisions amplitude.

5 Set up the Amplitude measurement

   a Press the **Quick Meas** key.

   b Press the **Clear Meas** softkey.

   c Press the **Select:** softkey and use the Entry knob to select **Std Deviation** within the select menu.

   d Press the **Measure Std Dev** softkey.

6 Note the oscilloscope Std Dev(1) reading at the bottom of the screen. (This is the RMS value with any dc offset removed.)

7 Set the power meter Cal Factor % to the 1 MHz value on the calibration chart on the power sensor.

8 Note the reading on the power meter and covert to Vrms using the expression:

$$\text{Vin}_{1\text{MHz}} = \sqrt{Pmeas_{1MHz} \times 50\Omega}$$

   For example, if the power meter reading is 892 uW, then $\text{Vin}_{1\text{MHz}} = (892*10^{-6} * 50\Omega)^{1/2} = 211.2\ \text{mV}_{\text{rms}}$.

9 Change the signal generator output frequency according to the maximum frequency for the oscilloscope using the following:

- 500 MHz Models: 500 MHz
- 300 MHz Models: 300 MHz
- 100 MHz Models: 100 MHz

10 Referencing the frequency from step 9, set the power meter Cal Factor % to the frequency value on the calibration chart on the power sensor.

11 Set the oscilloscope sweep speed according to the following:

- 500 MHz Models: 1 ns/div
- 300 MHz Models: 2 ns/div
- 100 MHz Models: 5 ns/div

12 Note the oscilloscope Std Dev(1) reading at the bottom of the screen.

13 Note the reading on the power meter and covert to Vrms using the expression:

$$\text{Vin}_{\text{max\_freq}} = \sqrt{Pmeas_{\text{max } freq} \times 50\Omega}$$

14 Calculate the response using the expression:

$$\text{response(dB)} = 20 \log_{10}\left[\frac{\text{Vout}_{\text{max freq}} / \text{Vin}_{\text{max freq}}}{\text{Vout}_{\text{1 MHz}} / \text{Vin}_{\text{1 MHz}}}\right]$$

Example If:

$\text{Pmeas}_{\text{1\_MHz}} = 892$ uW
$\text{Std Dev(n)}_{\text{1MHz}} = 210.4$ mV
$\text{Pmeas}_{\text{max\_freq}} = 687$ uW
$\text{Std Dev(n)}_{\text{max freq}} = 161.6$ mV

Then after converting the values from the power meter to Vrms:

$$\text{response(dB)} = 20 \log_{10}\left[\frac{161.6\,\text{mV} / 185.3\,\text{mV}}{210.4\,\text{mV} / 211.2\,\text{mV}}\right] = \text{-1.16 dB}$$

15 The result from step 14 should be between +3.0 dB and -3.0 dB. Record the result in the Performance Test Record (see page 52).

16 Move the power splitter from the channel 1 to the channel 2 input.

17 Turn off the current channel and turn on the next channel using the channel keys.

18 Record the results as Pass or Fail in the Performance Test Record (see page 52).

19 Repeat steps 3 through 18 for the remaining channels, setting the parameters of the channel being tested where appropriate.

To verify horizontal Δt accuracy

The following test is optional because horizontal Δt accuracy is a characteristic, not a specification.

This test verifies the horizontal Δt accuracy. In this test, you will use the oscilloscope to measure the output of a time mark generator.

Test limits: ±0.0025% of reading ±0.1% of screen width ±20 ps (same channel)

Table 8 Equipment Required to Verify Horizontal Δt Accuracy

Equipment	Critical Specifications	Recommended Model/Part	Qty
Oscilloscope Calibrator	14 mV to 35 Vdc, 0.1 V resolution, 25 MHz - 500 MHz sine wave, stability 5 ppm after 1/2 hour	Fluke 5820A	1
Cable	BNC, 3 feet	Agilent 10503A	1

1 Connect the equipment:
   a Connect the calibrator output to the oscilloscope channel 1 input.
2 Set up the signal source.
   a Select **Marker** on the oscilloscope calibrator.
   b Set the calibrator for 100 µs markers (period = 100 µs).

3 Set up the oscilloscope.

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

   b Set channel 1 **Coupling** to **DC**.

   c Set channel 1 **Imped** to **50 Ohm**.

   d Press the **Display** key, then set the **Vectors** softkey to off.

   e Press the **AutoScale** key.

   f Set the time base to 20 µs/div.

   g Press the **Main/Delayed** key, then set the **Time Ref** softkey to **Left**.

   h Adjust the Trigger Level knob to obtain a stable display.

4 Press the **Quick Meas** softkey, set the **Source** softkey to **1**, then press **Select** and choose **Period**. Press the **Measure** softkey and measure the following:

   Period 100 µs – The test limits are 99.8 µs to 100.2 µs.

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

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

6 Measure the following.

   Period 100 ns– The test limits are 99.8 ns to 100.2 ns.

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

7 Change the time base and calibrator markers as follows:

   a On 300 MHz and 500 MHz models, change time base to 2 ns/div and the calibrator to 5 ns markers

   b On 100 MHz models, change time base to 5 ns/div and the calibrator to 10 ns markers

8 Make the following measurements.

   a For 300 MHz and 500 MHz models, period 5 ns — the test limits are 4.96 ns to 5.04 ns.

   b For 100 MHz models, period 10 ns — the test limits are 9.93 ns to 10.07 ns.

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

9 Record the results as Pass or Fail in the Performance Test Record (see page 52).

To verify trigger sensitivity

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

The internal trigger sensitivity test is mandatory because it is a specification. The external trigger test is optional because it is a characteristic, not a specification.

Test limits for:

- Internal trigger on all models:
  - < 10 mV/div: greater of 1 div or 5 mV_{pp}
    >=10 mV/div: 0.6 div
- External trigger on all 2-channel models (DSO5xx2A):
  - Trigger range: 1.0V

    DC to 100 MHz: < 100 mV_{pp}
    >100 MHz to max bandwidth: < 200 mV_{pp}
  - Trigger range: 8.0V

    DC to 100 MHz: < 250 mV_{pp}
    >100 MHz to max bandwidth: < 500 mV_{pp}
- External trigger on 4-channel models:

  4-channel models:
  DC to 100 MHz: < 500 mV_{pp}

Table 9 Equipment Required to Verify Trigger Sensitivity

Equipment	Critical Specifications	Recommended Model/Part	Qty
Signal Generator	100 kHz - 500 MHz at 200 mVrms	Agilent N5181A, Agilent E4400B, or Agilent 8648A	1
Power Splitter	Outputs differ ≤ 0.15 dB	Agilent 11667A	1
Cable	BNC	Agilent 10503A	1
Adapter	N (m) to BNC (f)	Agilent 1250-0780	1
Feedthrough	50Ω BNC (f) to BNC (m)	Agilent 0960-0301	1

Test Internal Trigger Sensitivity (all models)

1 Connect the equipment (see Figure 4).

a Connect the signal generator output to the oscilloscope channel 1 input.

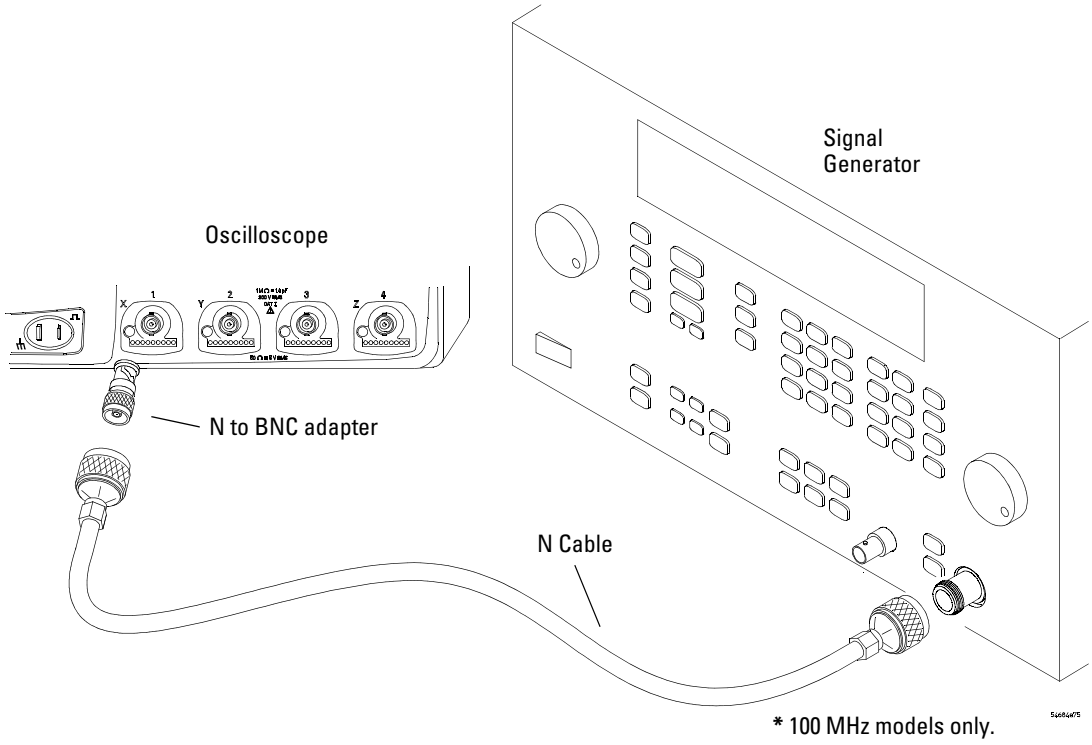


Figure 4 Connect equipment for internal trigger sensitivity test

2 Verify the trigger sensitivity at maximum bandwidth.
500 MHz models: 500 MHz
300 MHz models: 300 MHz
100 MHz models: 100 MHz

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

b Set channel 1 **Imped** to **50 Ohm**.

c Set the output frequency of the signal generator to the maximum bandwidth of the oscilloscope and set the amplitude to about 10 mV_{pp}.

d Press the **AutoScale** key.

e Set the time base to 10 ns/div.

f Set channel 1 to 5 mV/div.

g Decrease the amplitude from the signal generator until 1 vertical division of the signal is displayed.

The trigger is stable when the displayed waveform is stable. If the trigger is not stable, try adjusting the trigger level. If adjusting the trigger level makes the trigger stable, the test still passes. If adjusting the trigger does not help, see the "Troubleshooting" chapter. Then return here.

h Record the result as Pass or Fail in the Performance Test Record (see page 52).

3 Repeat this procedure for the remaining oscilloscope channels.

Test External Trigger Sensitivity (2-channel models)

The following test is optional because External Trigger Sensitivity is a characteristic, not a specification.

This test applies to 2-channel models only.

Verify the external trigger sensitivity at these settings:

Trigger range = +/- 1 V

- 500 MHz (DSO5052A), 200 mV_{pp}
- 300 MHz (DSO5032A), 200 mV_{pp}
- 100 MHz (DSO5012A), 200 mV_{pp}

Trigger range = +/- 8 V

- 500 MHz (DSO5052A), 500 mV_{pp}
- 300 MHz (DSO5032A), 500 mV_{pp}
- 100 MHz (DSO5012A), 500 mV_{pp}

1 Connect the equipment (see Figure 5).

a Use the N cable to connect the signal generator to the power splitter input.

b Connect one output of the power splitter to the Ext Trigger input.

c Connect the power sensor to the other output of the power splitter.

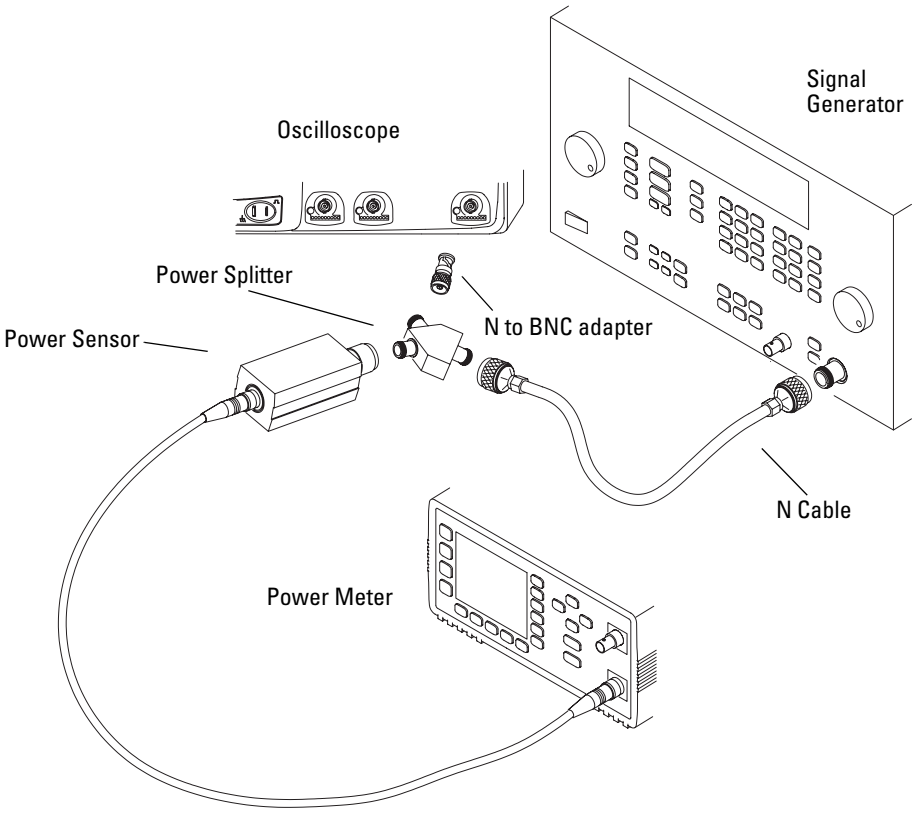


Figure 5 Connect equipment for external trigger sensitivity test (2-channel models)

2 Set up the oscilloscope.

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

b Set the External Trigger impedance to **50 Ohm**.

c Change the trigger **Mode** from Auto to **Normal**.

d Use the **Range** softkey and the Entry knob to set the range to 1.0 V.

3 Verify the trigger sensitivity at maximum frequency.

a Change the signal generator output frequency:
DSO5052A: 500 MHz
DSO5032A: 300 MHz
DSO5012A: 100 MHz

b Set the power meter Cal Factor % to the appropriate value (100, 300, or 500 MHz) on the calibration chart on the power sensor. If necessary, do a linear interpolation if the correct factor is not included in the power meter's calibration chart.

c Adjust the signal generator output for a reading on the power meter of 100µW. (200 mV_{pp} = 70.71mV rms, Power = $Vin^2/50\Omega$ = 70.71 $mV^2/50\Omega$ = 100µW.)

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

e Check for stable triggering and adjust the trigger level if necessary. Triggering is indicated by the **Trig'd** indicator at the top of the display. When it is flashing, the oscilloscope is not triggered. When it is not flashing, the oscilloscope is triggered.

f Record the results as Pass or Fail in the Performance Test Record (see page 52).

If the test fails, see the "Troubleshooting" chapter. Then return here.

4 Verify the trigger sensitivity at maximum frequency for trigger range of 8.0 V.

   a Press the **Mode/Coupling** key, press the **External** softkey, then press the **Range** softkey and use the Entry knob to set the range to 8.0 V.

   b Adjust the signal generator output for reading on the power meter of 625µW. ($500mV_{pp}$ = 176.78mV rms, Power = $Vin^2/50\Omega$ = 176.78 $mV^2/50\Omega$ = 625µW.)

   c Check for stable triggering and adjust the trigger level if necessary. Triggering is indicated by the **Trig'd** indicator at the top of the display. When it is flashing, the oscilloscope is not triggered. When it is not flashing, the oscilloscope is triggered.

   d Record the results as Pass or Fail in the Performance Test Record (see page 52).

Test External Trigger Sensitivity (4-channel models)

The following test is optional because External Trigger Sensitivity is a characteristic, not a specification.

This test applies to 4-channel models only.

Verify the external trigger sensitivity at this setting:

- 100 MHz, 500 mV_{pp}

1 Connect the equipment (see Figure 6).

a Use the N cable to connect the signal generator to the power splitter input.

b Connect one output of the power splitter to the Aux Trig input through a 50Ω feedthrough termination.

c Connect the power sensor to the other output of the power splitter.

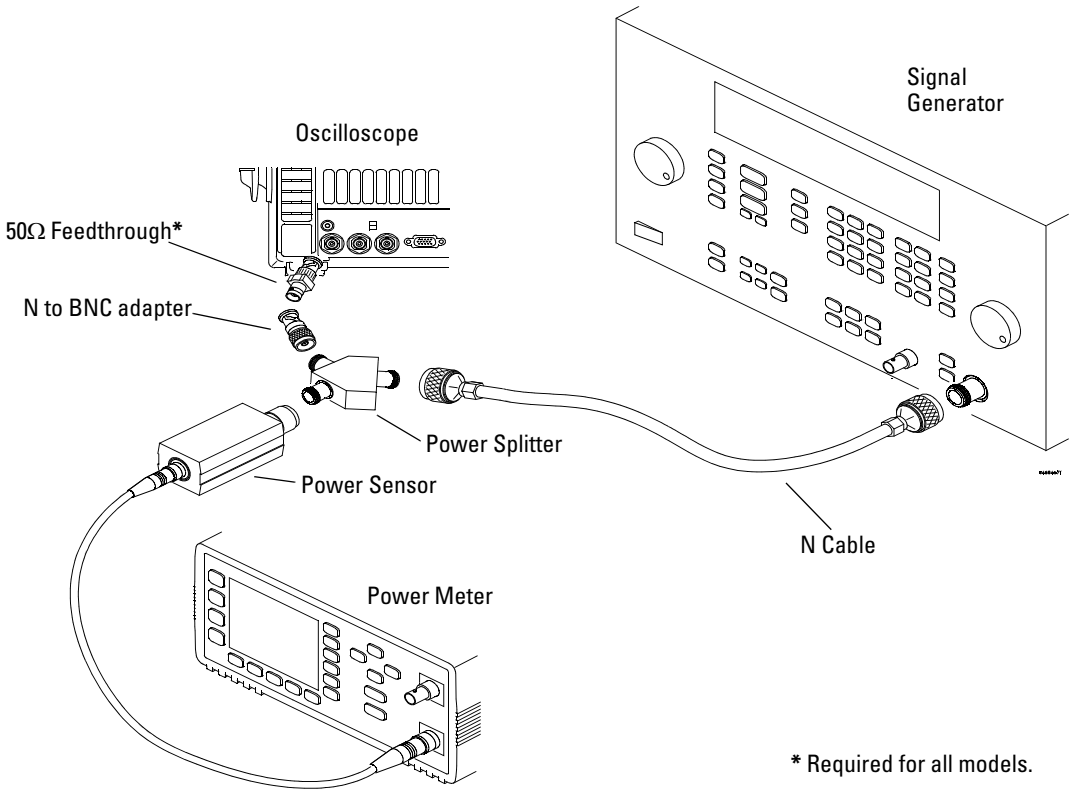


Figure 6 Connect equipment for external trigger sensitivity test (4-channel models)

2 Set up the oscilloscope.

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

3 Set the signal generator output frequency to 100 MHz.

4 Set the power meter Cal Factor % to the 100 MHz value on the calibration chart on the power sensor.

5 Adjust the signal generator output for reading on the power meter of 625µW. ($500mV_{pp}$ = 176.78mV rms, Power = $Vin^2/50\Omega$ = 176.78 $mV^2/50\Omega$ = 625µW.)

6 Press the Trigger **Edge** key, then press the **Source** softkey to set the trigger source to **External**.

7 Check for stable triggering and adjust the trigger level if necessary. Triggering is indicated by the **Trig'd** indicator at the top of the display. When it is flashing, the oscilloscope is not triggered. When it is not flashing, the oscilloscope is triggered.

8 Record the results as Pass or Fail in the Performance Test Record (see page 52).

   If the test fails, see the "Troubleshooting" chapter. Then return here.

Agilent 5000 Series Oscilloscopes Performance Test Record

Table 10 Performance Test Record

Serial No. _____ Test by _____
Test Interval _____ Work Order No. _____
Recommended Next Testing _____ Temperature _____

Voltage Measurement Accuracy

Range	Oscilloscope Calibrator Setting	Test Limits	Channel 1	Channel 2	Channel 3*	Channel 4*
5 V/Div	35 V	34.04 V to 35.96 V				
2 V/Div	14 V	13.616 V to 14.384 V				
1 V/Div	7 V	6.808 V to 7.192 V				
500 mV/Div	3.5 V	3.404 V to 3.596 V				
200 mV/Div	1.4 V	1.3616 V to 1.4384 V				
100 mV/Div	700 mV	680.8 mV to 719.2 mV				
50 mV/Div	350 mV	340.4 mV to 359.6 mV				
20 mV/Div	140 mV	136.16 mV to 143.84 mV				
10 mV/Div	70 mV	68.08 mV to 71.92 mV				
5 mV/Div	35 mV	34.04 mV to 35.96 mV				
2 mV/Div	14 mV	13.232 mV to 14.768 mV				

Bandwidth	Model	Test Limits	Channel 1	Channel 2	Channel 3*	Channel 4*
	505x	3 dB at 500 MHz				
	503x	3 dB at 300 MHz				
	501x	3 dB at 100 MHz				

Horizontal Δt Accuracy

	Generator Setting	Test Limits	Results
Period	100 µs	99.8 µs to 100.2 µs	
Period	100 ns	99.8 ns to 100.2 ns	
Period	10 ns[1]	9.93 ns to 10.07 ns	
Period	5 ns[2]	4.96 ns to 5.04 ns	

[1] 100 MHz models
[2] 300 MHz and 500 MHz models

Table 10 Performance Test Record (continued)

Trigger Sensitivity		Test Limits	Channel 1	Channel 2	Channel 3*	Channel 4*
	Internal trigger					
	500 MHz models	0.6 division at 500 MHz	_____	_____	_____	_____
	300 MHz models	0.6 division at 300 MHz	_____	_____	_____	_____
	100 MHz models	0.6 division at 100 MHz	_____	_____	_____	_____
	External trigger, 2-channel models					
	± 1 V range:					
	5052A	200 mV at 500 MHz	_____	_____	_____	_____
	5032A	200 mV at 300 MHz	_____	_____	_____	_____
	5012A	200 mV at 100 MHz	_____	_____	_____	_____
	± 8 V range:					
	5052A	500 mV at 500 MHz	_____	_____	_____	_____
	5032A	500 mV at 300 MHz	_____	_____	_____	_____
	5012A	500 mV at 100 MHz	_____	_____	_____	_____
	External trigger, 4-channel models					
	5054A, 5034A, 5014A	500 mV at 100 MHz	_____	_____	_____	_____

* Where applicable

3 Calibrating and Adjusting

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

- Every 12 months or after 2000 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.

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 notice at the front 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 and main shield removed, use an external fan to provide continuous air flow over the samplers (the ICs with heat sinks on them). Air flow over the samplers is reduced when the cover and main shield is removed, which leads to higher than normal operating temperatures. Have the fan blow air across the system board where the heat sinks are located. If the cover is removed but the main shield remains installed and the bottom holes are not blocked, the instrument will cool properly.

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.

User Calibration

Perform user-calibration:

- Each year or after 2000 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 User Cal 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.

Performing User Cal will invalidate your Certificate of Calibration. If NIST (National Institute of Standards and Technology) traceability is required perform the procedures in Chapter 2 in this book using traceable sources.

To perform User Cal

1. Set the rear-panel CALIBRATION switch to UNPROTECTED.
2. Connect short (12 inch maximum) equal length cables to each analog channel's BNC connector on the front of the oscilloscope. You will need two equal-length cables for a 2-channel oscilloscope or four equal-length cables for a 4-channel oscilloscope.

Use 50Ω RG58AU or equivalent BNC cables when performing User Cal.

a For a 2-channel oscilloscope, connect a BNC tee to the equal length cables. Then connect a BNC(f)-to-BNC(f) (also called a barrel connector) to the tee as shown below.

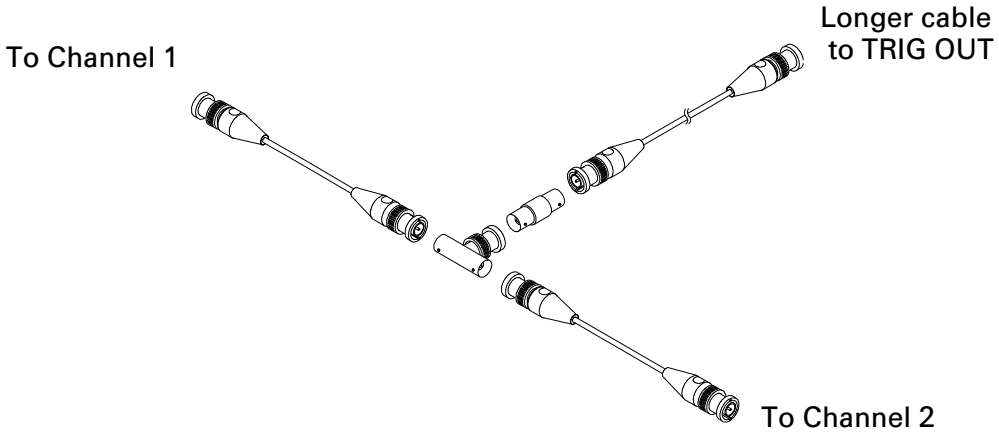


Figure 7 User Calibration cable for 2-channel oscilloscope

b For a 4-channel oscilloscope, connect BNC tees to the equal-length cables as shown below. Then connect a

BNC(f)-to-BNC(f) (barrel connector) to the tee as shown below.

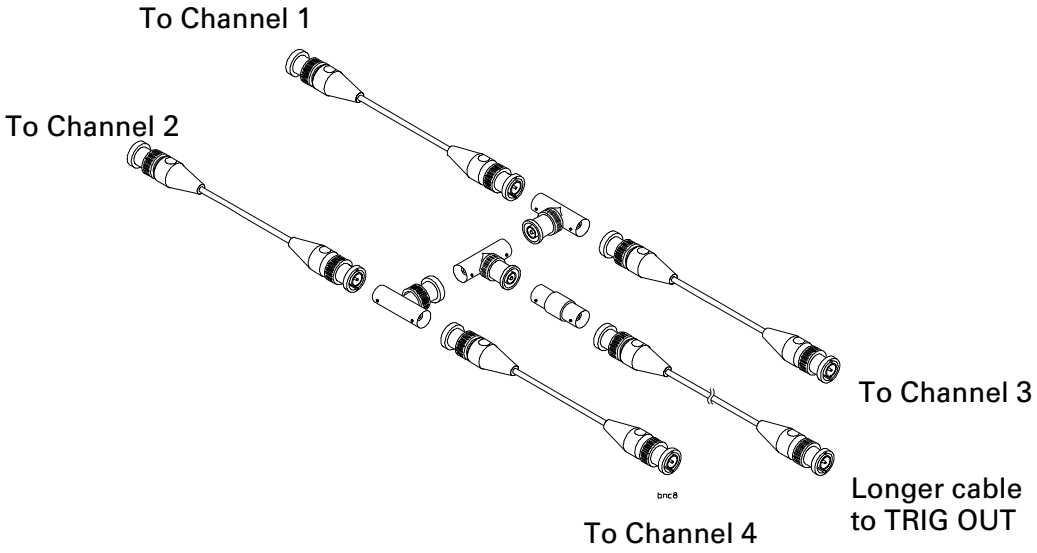


Figure 8 User Calibration cable for 4-channel oscilloscope

3 Connect a BNC cable (40 inches maximum) from the TRIG OUT connector on the rear panel to the BNC barrel connector.

4 Press the **Utility** key, then press the **Service** softkey.

5 Begin the Self Cal by pressing the **Start User Cal** softkey.

6 When the User Cal is completed, set the rear-panel CALIBRATION switch to PROTECTED.

User Cal Status

Pressing the **User Cal Status** softkey displays the following summary results of the previous User Cal, and the status of probe calibrations for probes that can be calibrated. Note that AutoProbes do not need to be calibrated, but InfiniiMax can be calibrated.

```
Results:
User Cal date:
Change in temperature since last User Cal:
Failure:
Comments:
Probe Cal Status:
```

4 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
- Check power supply
- Check the AC input board and the system board
- Check the display
- Check the fan
- Run internal self-tests
- Verify default setup

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

Solving General Problems with the Oscilloscope

This section describes how to solve general problems that you may encounter while using the Agilent 5000 Series Oscilloscopes to make measurements.

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

If there is no display

- ✔ Check that the power cord is firmly seated in the oscilloscope power receptacle.
- ✔ Check that the power source is live.
- ✔ Check that the front-panel power switch is on.
- ✔ If there is still no display, go to the troubleshooting procedures in this chapter.

If there is no trace display

- ✔ Check that the INTENSITY knob on the front panel is adjusted correctly.
- ✔ Recall the default setup by pressing **Save/Recall** then **Default Setup**. This will ensure that the trigger mode is Auto.
- ✔ 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.
- ✔ Obtain service from Agilent Technologies, if necessary.

If the trace display is unusual or unexpected

- ✔ Check that the Horizontal time/division setting is correct for the expected frequency range of the input signals.
- ✔ The sampling speed of the oscilloscope depends on the time/division setting. It may be that when time/division is set to slower speeds, the oscilloscope is sampling too slowly to capture all of the transitions on the waveform. Use peak detect mode.
- ✔ Check that all oscilloscope probes are connected to the correct signals in the circuit under test.
- ✔ Ensure that the probe's ground lead is securely connected to a ground point 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.
- ✔ Check that the trigger setup is correct.
- ✔ A correct trigger setup is the most important factor in helping you capture the data you desire. See the User's Guide for information about triggering.
- ✔ Check that infinite persistence in the Display menu is turned off, then press the **Clear Display** softkey.
- ✔ Press the **AutoScale** key.

If you cannot see a channel

- ✔ Recall the default setup by pressing **Save/Recall** then **Default Setup**. This will ensure that the trigger mode is Auto.
- ✔ Check that the oscilloscope probe's BNC connector is securely attached to the oscilloscope's input connector.
- ✔ 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.

✔ Press the **AutoScale** key to automatically set up all channels.

Troubleshooting the Oscilloscope

The service policy for the Agilent 5000 Series Oscilloscopes is assembly level replacement. If you need parts or assistance from Agilent Technologies to repair your instrument, go to www.agilent.com and locate the service facility for your area.

WARNING

HAZARDOUS VOLTAGES EXIST — REMOVE POWER FIRST !
The procedures described in this section are 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 procedures. Whenever possible, perform the procedures with the power cord removed from the oscilloscope. Read the safety notice 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 this table is required to troubleshoot the oscilloscope.

Table 11 Equipment Required to Troubleshoot the Oscilloscope

Equipment	Critical Specifications	Recommended Model/Part
Digital multimeter	Accuracy ±0.05,% 1 mV resolution	Agilent 34401A
Oscilloscope	Capable of measuring ≥ 500 MHz signal. 1 MΩ input impedance.	Agilent 5000 Series oscilloscope with 500 MHz bandwidth

To check out the oscilloscope

1 Disconnect any external cables from the front panel.

2 Disconnect the power cord, then remove the cabinet following the instructions on page 84.

CAUTION

USE AN EXTERNAL FAN TO AVOID OVERHEATING COMPONENTS !
When you remove the oscilloscope cover and main shield, use an external fan to provide continuous air flow over the heat sinks. Air flow over the heat sinks is reduced when the cover and main shield are removed, which leads to higher than normal operating temperatures. Have the fan blow air across the system board where the heat sinks are located. Otherwise, damage to the components can occur.
If the cover of a 5000 Series oscilloscope is removed but the main shield remains installed and the bottom holes are not blocked, the instrument will cool properly.

3 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 of 100 to 240 VAC. Ensure that you have the correct line cord (see Table 15 on page 126 or Table 4 on page 169). The power cord provided is matched to the country of origin.

WARNING

AVOID INJURY.
Always operate the oscilloscope with an approved three conductor power cable. Do not negate the protective action of the three conductor power cable.

- Press the power switch.
  - When the oscilloscope is turned on, the front panel LEDs will light up in the sequence shown in Figure 9 on page 67.
  - Next the Agilent logo and advisory screen will appear on the LCD before the trace display appears.
  - It will take about 3 to 4 seconds for the instrument to turn on. The instrument will go through the basic self test to make sure all the major hardware is working correctly.

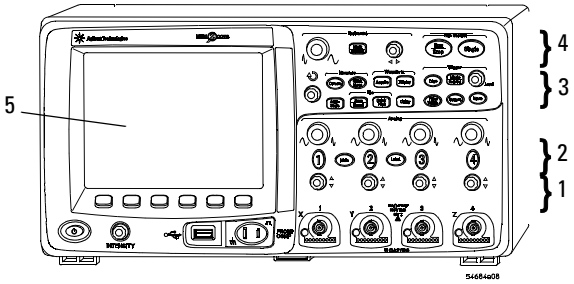


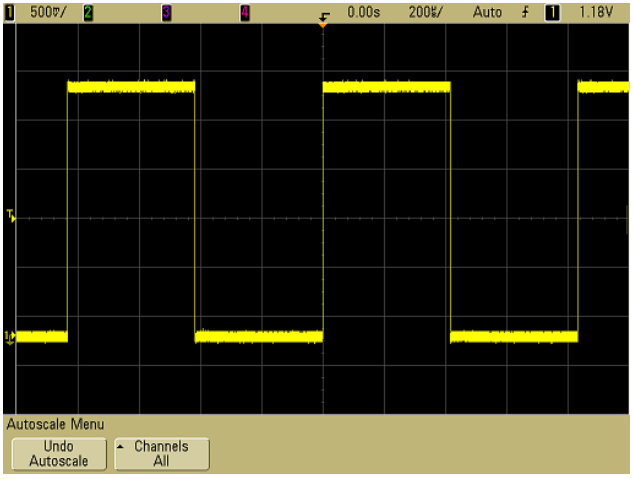
Figure 9 5000 Series start up sequence

4 If the lights illuminate, then the power supply is probably working correctly.

5 Proceed to "To verify basic oscilloscope operation" on page 68.

To verify basic oscilloscope operation

1. 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.
2. Connect an oscilloscope probe from channel 1 to the **Probe Comp** signal terminal on the front panel.
3. Connect the probe's ground lead to the ground terminal that is next to the **Probe Comp** terminal.
4. Press **AutoScale**.
5. You should see a waveform on the oscilloscope's display similar to this:



If you see the waveform, but the square wave is not shaped correctly as shown above, perform the procedure "To compensate the analog probes" on page 69.

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 analog channel input BNC and to the Probe Comp terminal.

6 If you still do not see the waveform, use the troubleshooting flowchart in this chapter to isolate the problem.

To compensate the analog probes

You should compensate your analog probes to match their characteristics to the oscilloscope's channels. A poorly compensated probe can introduce measurement errors.

1 Perform the procedure "To verify basic oscilloscope operation" on page 68

2 Use a nonmetallic tool to adjust the trimmer capacitor on the probe for the flattest pulse possible. The trimmer capacitor is located on the probe BNC connector.

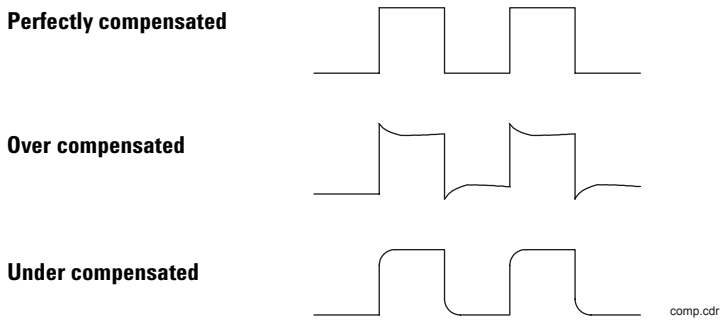


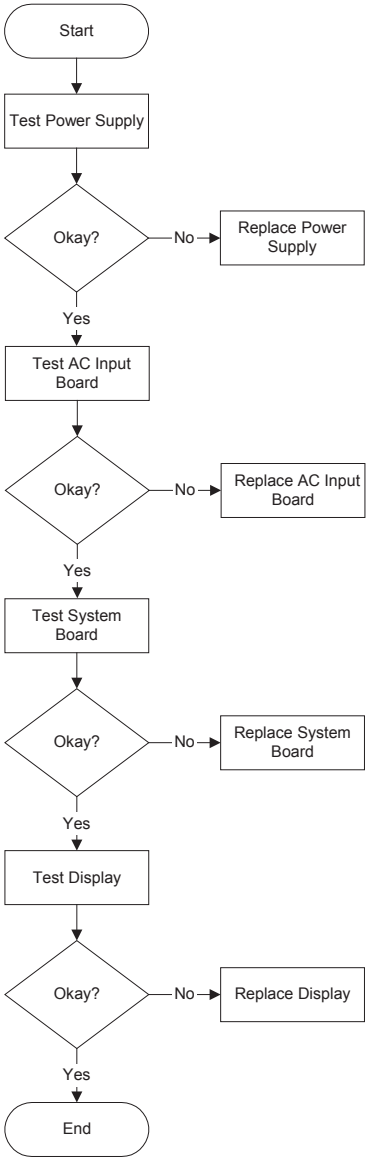
Figure 10 Example pulses

3 Connect probes to all other analog channels (channel 2 of a 2-channel oscilloscope, or channels 2, 3, and 4 of a 4-channel oscilloscope). Repeat the procedure for each channel. This matches each probe to each channel.

The process of compensating the probes serves as a basic test to verify that the oscilloscope is functional.

Troubleshooting Flowchart

The following flowchart describes how to troubleshoot 5000 Series oscilloscope models.



To check the oscilloscope power supply

1 Disconnect the power cord from the oscilloscope. Then remove the oscilloscope cover.

CAUTION

USE AN EXTERNAL FAN TO AVOID OVERHEATING COMPONENTS !
When you remove the oscilloscope cover and main shield, use an external fan to provide continuous air flow over the heat sinks. Air flow over the heat sinks is reduced when the cover and main shield are removed, which leads to higher than normal operating temperatures. Have the fan blow air across the system board where the heat sinks are located. Otherwise, damage to the components can occur.
If the cover of a 5000 Series oscilloscope is removed but the main shield remains installed and the bottom holes are not blocked, the instrument will cool properly.

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

3 Connect the power cord and turn on the oscilloscope.

4 Measure the power supply voltage at J102, pin 7 on the AC input board (comes from the power supply connector's pin 1). See Figure 11. The voltage should be 15 V ±10%.

- If the voltage is not correct, continue to the next step.
- If the voltage is correct, the power supply is good.

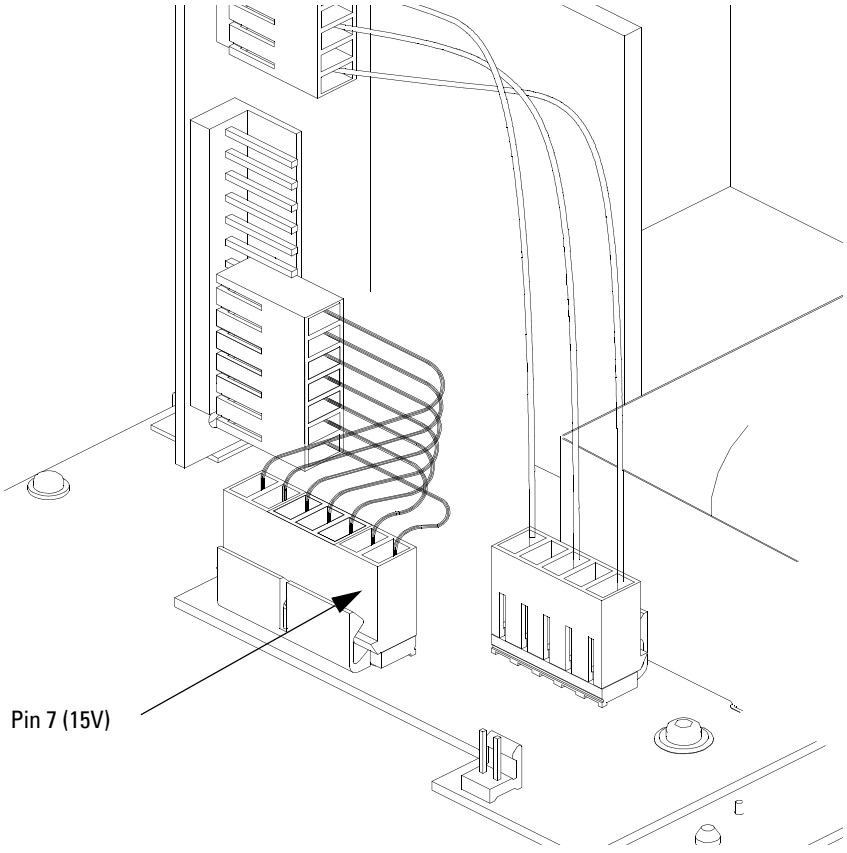


Figure 11 Power supply to AC input board connector

5 Disconnect the power supply cable from the AC input board and check the voltage between pins 1 and 7 of the connector coming from the power supply.

6 If it is less than 14 V, the problem is in the cable or the power supply. Remove the cable and test it for shorts or opens using the DMM. Replace the defective assembly.

7 If the voltage is 15 V ±10% only when the cable is disconnected from the AC input board, then test the AC input board.

To check the AC input board

1. Remove the cabinet.
2. Check that all cable connections are securely connected from the system board to:
   - Power supply
   - Keyboard
   - Display
   - Inverter board
   - Fan
3. Verify the voltages from the AC input board by measuring them at the system board test points, accessible on the bottom of the chassis, and listed in the table below. Refer to Figure 12 on page 74 to locate the test points.

Table 12 System board test points

Test point	Voltage
J3200, pin 1	-5.2 V (+- 0.1)
J3200, pin 9, 10, or 11	+5.0 V (+- 0.1)
J3200, pin 12, 13, or 14	+3.3 V (+- 0.1)
J3200, pin 8, 15, or 16	+1.5 V (+- 0.1)
J3201, pin 1 or 2	+12 V (+- 6%)
J3201, pin 3 or 4	-12 V (+- 6%)
J3201, pin 16, 17, or 18	+15 V (+- 6%)
J3201, pin 19	-15 V (+- 6%)

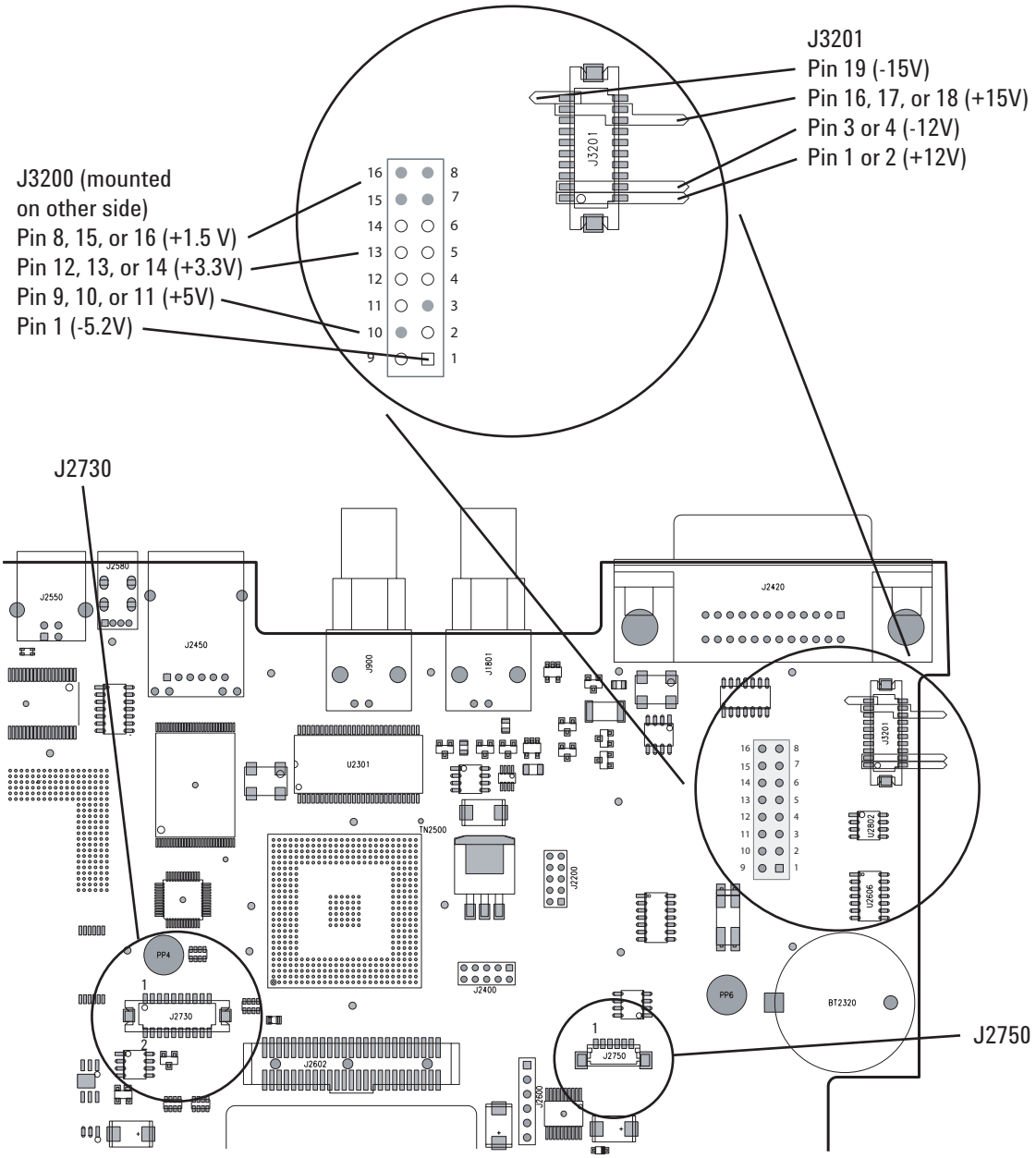


Figure 12 System board test point locations

4 If any of the test point voltages are not within the specified range, replace the AC input board.

To check the system board

1 Disconnect J2730 from the system board and measure pins 19 and 20 on the J2730 connector. This is the voltage to the display, and it should be +3.3 V. If it is not, replace the system board. If the voltage is correct, replace the display.

2 Disconnect J2750 from the system board and measure pins 3 and 4 on the J2750 connector. This is the voltage to the inverter, and it should be +5 V. If it is not, replace the system board. If the voltage is correct, replace the display.

3 If all cables are properly connected and none of the previous tests confirm a failure on another assembly, replace the system board.

To check the display

1 Disconnect the power cord.

2 Check to verify that the backlight inverter cable is connected.

3 Ensure the display LCD cable is connected.

4 Connect the power cord.

5 Use the DMM to check the Inverter Power voltage (see table below).

6 If the voltage is incorrect, replace the system board.

7 If the voltage is correct, use an oscilloscope to check the LCD clock (see table below).

Table 13 Display Signals on the System Board

	Signal	Normal/Typical Result
Inverter Power	J2750 Pin 3 or 4	5 V
Video Signal	J2730 Pin 6 and 7	480 MHz clock

8 If the clock signal is good, replace the LCD.

9 If the clock signal is absent, replace the system board.

To check the fan

The fan speed is controlled by a circuit on the system board.

1 If the fan is running, perform the internal self-tests. Go to "To run the internal self-tests" on page 77.

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

   a Disconnect the fan cable from the AC input board.

   b Measure the fan voltage at the connector on the AC input board.

   See the Figure 13 for the location of the fan connector.

   c If the fan voltage is approximately +8.5 Vdc at room temperature, replace the fan. If the fan voltage is not approximately +8.5 Vdc, replace the system board.

   The proper voltage range depending on temperature is between +6.0 Vdc to +11.5 Vdc.

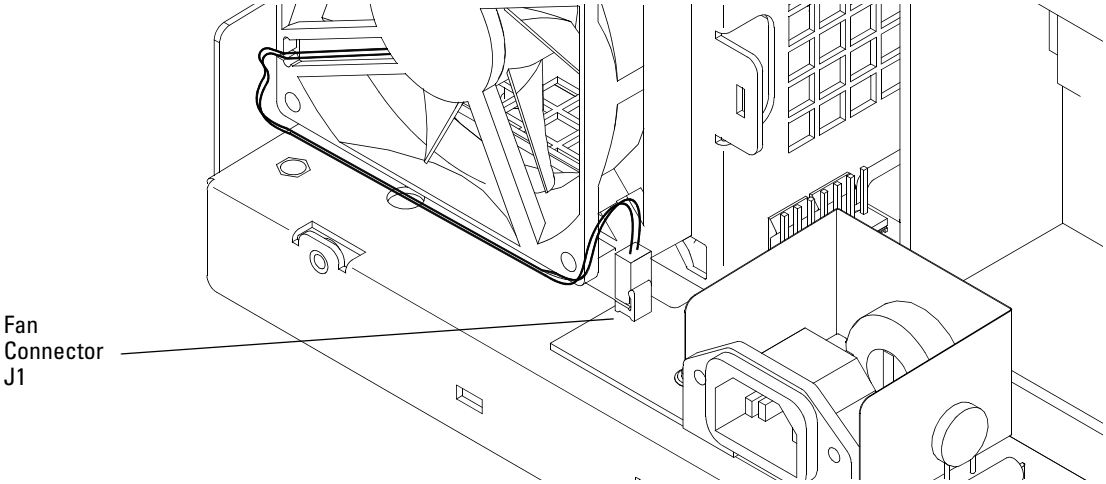


Figure 13 Location of the fan connector

To run the internal self-tests

Self Test performs a series of internal procedures to verify that the oscilloscope is 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 **Start Self Test** softkey.

To verify default setup

The oscilloscope is designed to turn on with the setup from the last turn on or previous setup. However, if the Secure Environment option is installed, the oscilloscope will always execute a Default Setup upon power-up.

To recall the factory default setup:

1 Press the **Save/Recall** key.

2 Press the **Default Setup** softkey.

This returns the oscilloscope to its factory default settings and places the oscilloscope in a known operating condition. The major default settings are:

- **Horizontal** - main mode, 100 us/div scale, 0 s delay, center time reference
- **Vertical** - Channel 1 on, 5 V/div scale, dc coupling, 0 V position, probe factor to 1.0 if an AutoProbe probe is not connected to the channel
- **Trigger** - Edge trigger, Auto sweep mode, 0 V level, channel 1 source, dc coupling, rising edge slope, 60 ns holdoff time
- **Display** - Vectors on, 20% grid intensity, infinite persistence off
- **Other** - Acquire mode normal, Run/Stop to Run, cursor measurements off

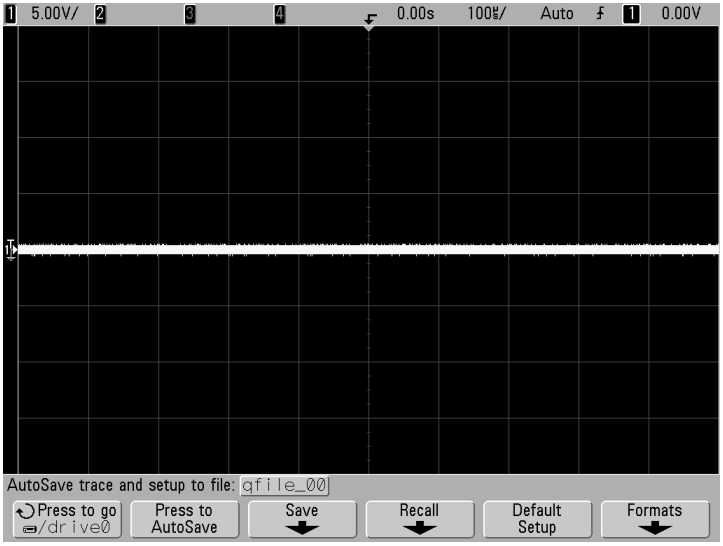


Figure 14 Default setup screen

3 If your screen looks substantially different, replace the system board.

5 Replacing Assemblies

This chapter describes how to remove assemblies from the Agilent 5000 Series oscilloscopes. After you have removed an assembly, to install the replacement assembly, follow the instructions in reverse order.

The parts shown in the following figures are representative and may look different than what you have in your oscilloscope.

Tools Used for Disassembly

Use these tools to remove and replace the oscilloscope assemblies:

- T6, T10, and T20 TORX drivers
- 5/8-inch and 9/32-inch socket drivers

See how the Oscilloscope Parts Fit Together

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

Read All Warnings and Cautions

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

WARNING

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

WARNING

AVOID ELECTRICAL SHOCK !
Hazardous voltages exist on the LCD assembly and power supply. 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.

To remove the cabinet

1 Turn off the oscilloscope and disconnect the power cable.

2 Using the T20 TORX driver, remove the two screws from the rear of the cabinet and the screw inside the tool compartment.

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

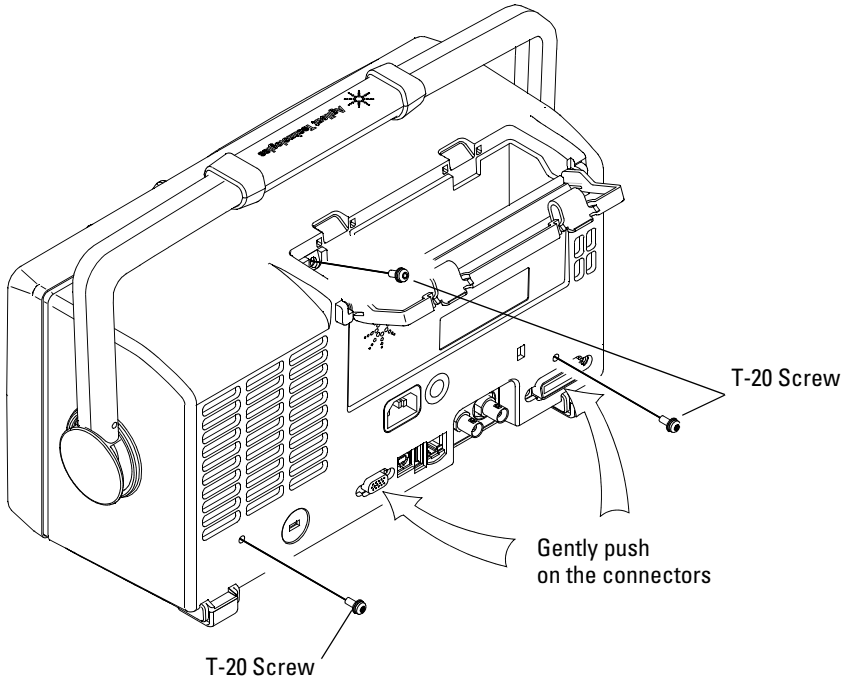


Figure 15 Removing the cabinet

To remove the handle

Handle cannot be removed with cabinet attached to the oscillscope chassis.

1 Perform the following procedures:"To remove the cabinet" on page 84

2 Rotate the handle downward until it just passes the bottom of the cabinet.

3 Place cabinet face down, pull the sides of the handle out of the cabinet and remove.

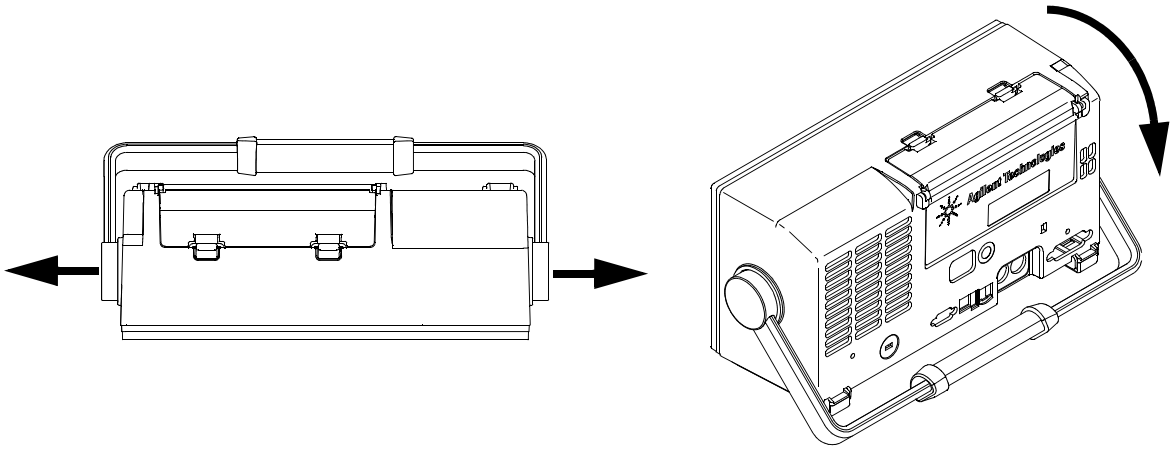


Figure 16 Removing handle

To remove the storage lid

The storage lid is designed to come off without breaking.

1 Push back on the lid until it snaps out of the slots.

2 To reinstall the lid:

   a Insert the left hinge into the slot.

   b Push the lid all the way to the left.

   c Snap the right hinge into the slot.

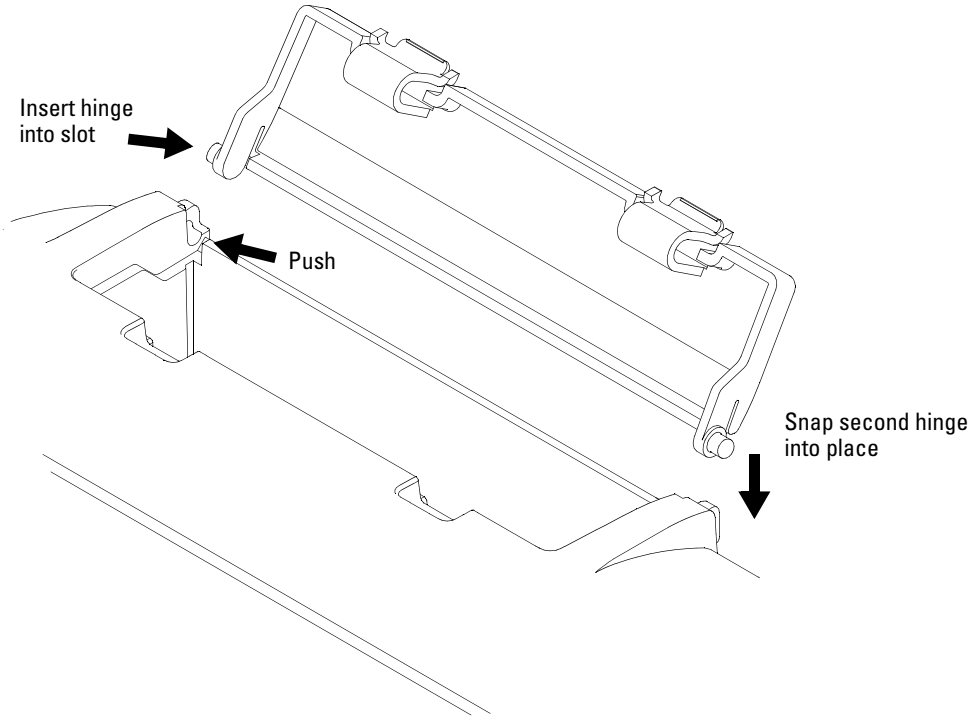


Figure 17 Installing the hinged storage lid

To remove the front panel assembly

1 Perform the following procedures:
   - "To remove the cabinet" on page 84

2 Insert a flat-blade screwdriver under the center of the intensity knob and gently twist the screwdriver as you pull the knob off.

   Using a twisting motion rather than prying prevents marking or damaging the front panel.

3 Remove the T6 screws securing the BNC assembly to the deck.

   This step helps prevent the BNC connectors from binding when removing and reinstalling the front panel.

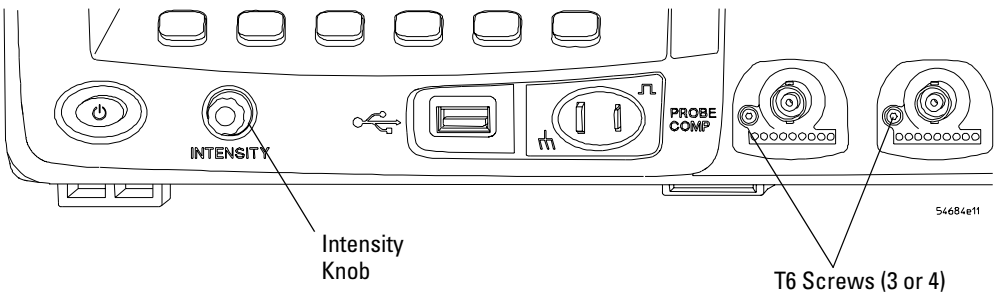


Figure 18 Removing the intensity knob and T6 screws

4 Disconnect the keyboard ribbon cable from the keyboard.

5 Use a flat-blade screwdriver to the release retainer tabs and then push the panel forward.

   Ensure that the retainer tab on the display side moves past the rear edge of the display mount.

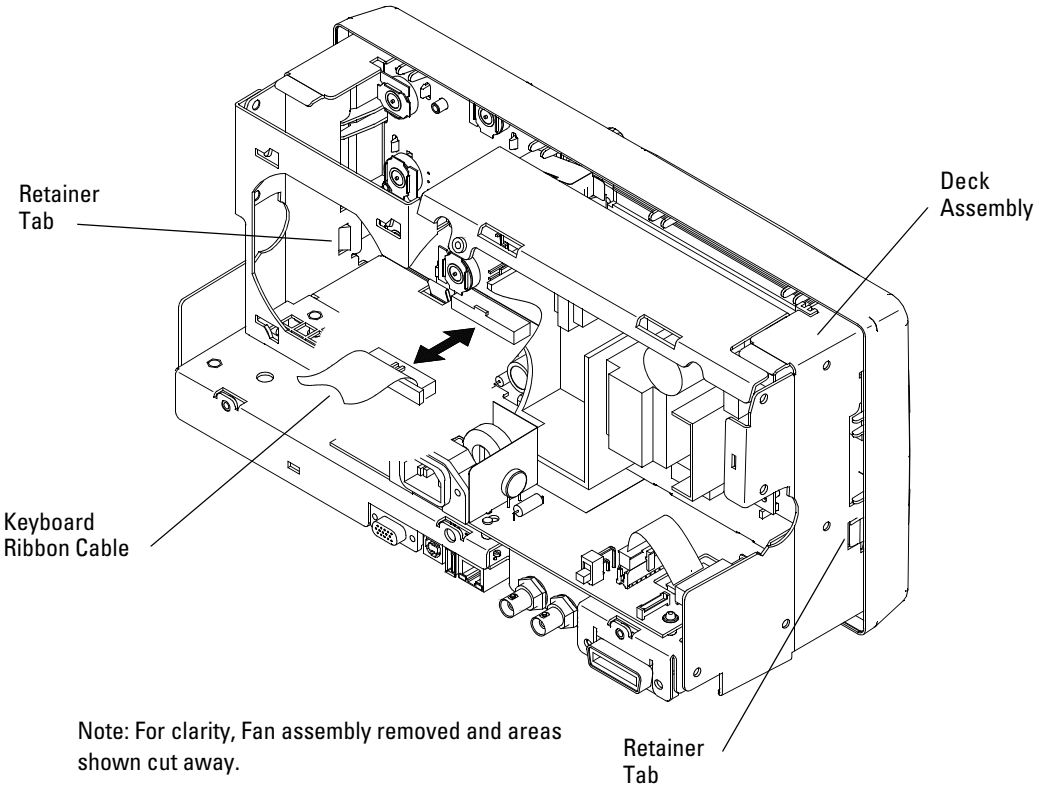


Figure 19 Disconnecting ribbon cable and releasing tab retainers

6 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.

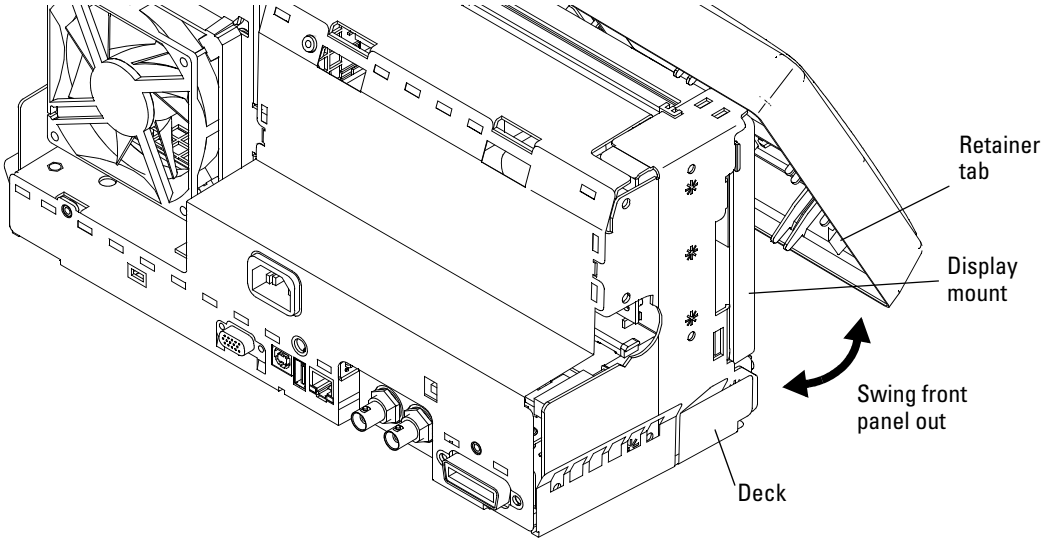


Figure 20 Removing the front panel

7 To reinstall the front panel:

- **a** Align the hooks on top of the front panel with their connection holes in the sheet metal and display mount.
- **b** Swing the front panel down and ensure that the power switch, intensity shaft and BNC connectors are aligned with the holes in the front panel.
- **c** Push the front panel until the two retainer tabs click into place in the deck.
- **d** Reinstall the T6 screws on the BNC connectors.
- **e** Connect the keyboard ribbon cable.
- **f** Install intensity knob.

To remove the keyboard assembly

1 Perform the following procedures:
   - "To remove the cabinet" on page 84
   - "To remove the front panel assembly" on page 87
2 If removing the softkey pad only skip steps 3, 4c, and 4d below.
3 Remove all of the knobs by pulling them straight out. You may need to use a flat-blade screwdriver to gently pry them as you pull.

   Using a twisting motion rather than prying prevents marking or damaging the front panel.
4 Remove the main keyboard and softkey board as follows.
   a Lift the left end of the softkey board enough to clear the tab holding it in place.
   b Slide the softkey board to the left to release it from the retaining tabs.
   c Release the 8 latches holding the main keypad board to the front panel.
   d You will notice the latches do not all face the same direction. This is shown with arrows in the following figure.
   e Lift the board up just enough to clear the latches.
   f Lift both boards out being careful not to damage the ribbon cable between them.
5 Remove and replace keypads as needed.

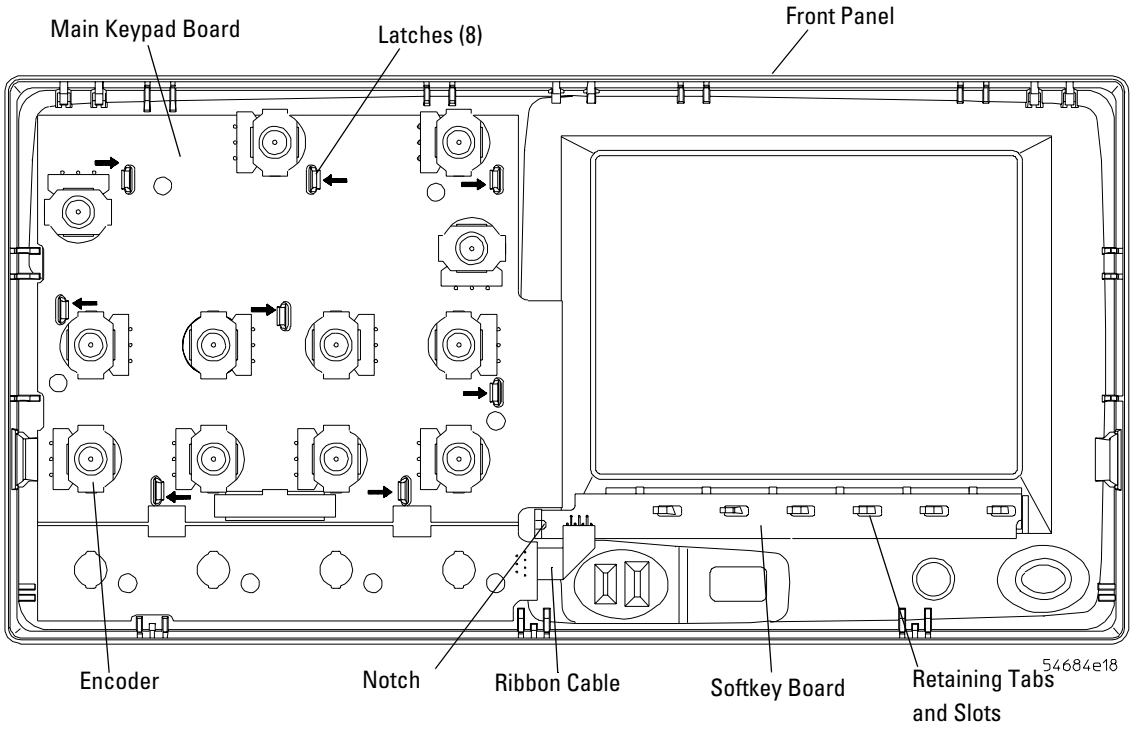


Figure 21 Removing the keyboard assembly

6 When reinstalling the boards:

a If you have a new main board assembly, you will need to separate the softkey board from the main keypad board.

Using a needle nose pliers, carefully remove the two process tabs.

Using a needle nose pliers, carefully remove the two break away tabs connecting the two boards.

b Carefully turn the softkey board so that the gold metal contacts face the keypad. Note the way the ribbon cable is dressed in the previous figure.

c Align the main keypad board over the keypad inserting the knob shafts into their holes.

d Snap the main keypad board in place by pressing on the encoders near each latch. Ensure all 8 catch.

e Align the slots in the softkey board over the retaining tabs.

f Push down on the softkey board. Using a tool (such as a soldering aid) in the notch of the board, slide it to the right until it seats between the tabs.

g Replace the knobs by supporting the back of each encoder and pushing the knob fully onto the shaft.

To remove the main shield

1 Perform the previous procedures:
   - "To remove the cabinet" on page 84
   - "To remove the front panel assembly" on page 87

2 Remove the main shield covering the system board, AC input board and power supply by sliding it toward the back of the instrument

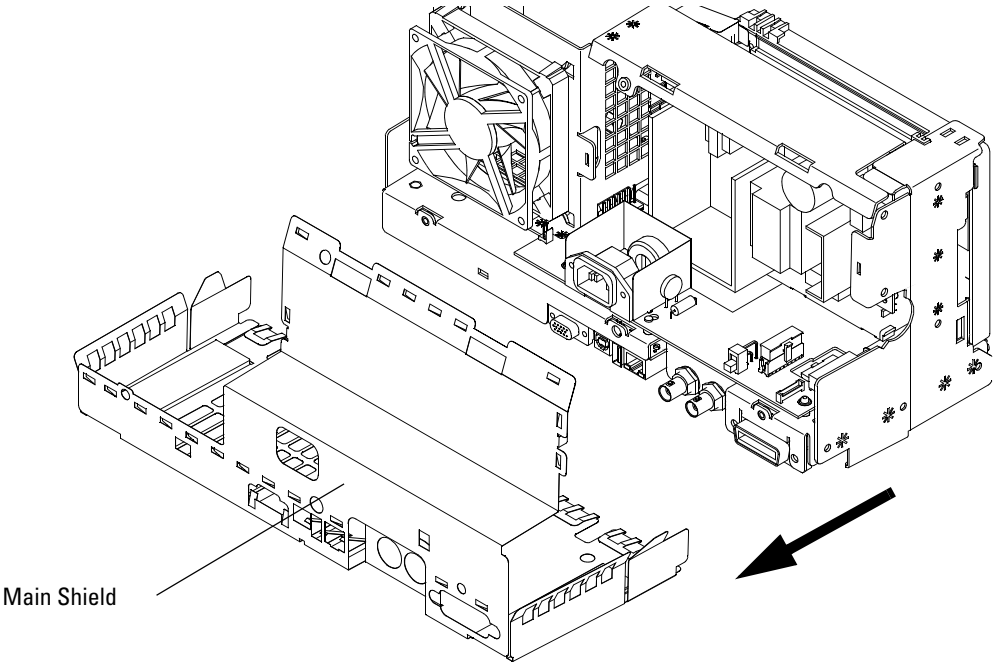


Figure 22 Main shield removal

WARNING Thin sheet metal parts may have sharp edges. Handle with care to avoid injury.

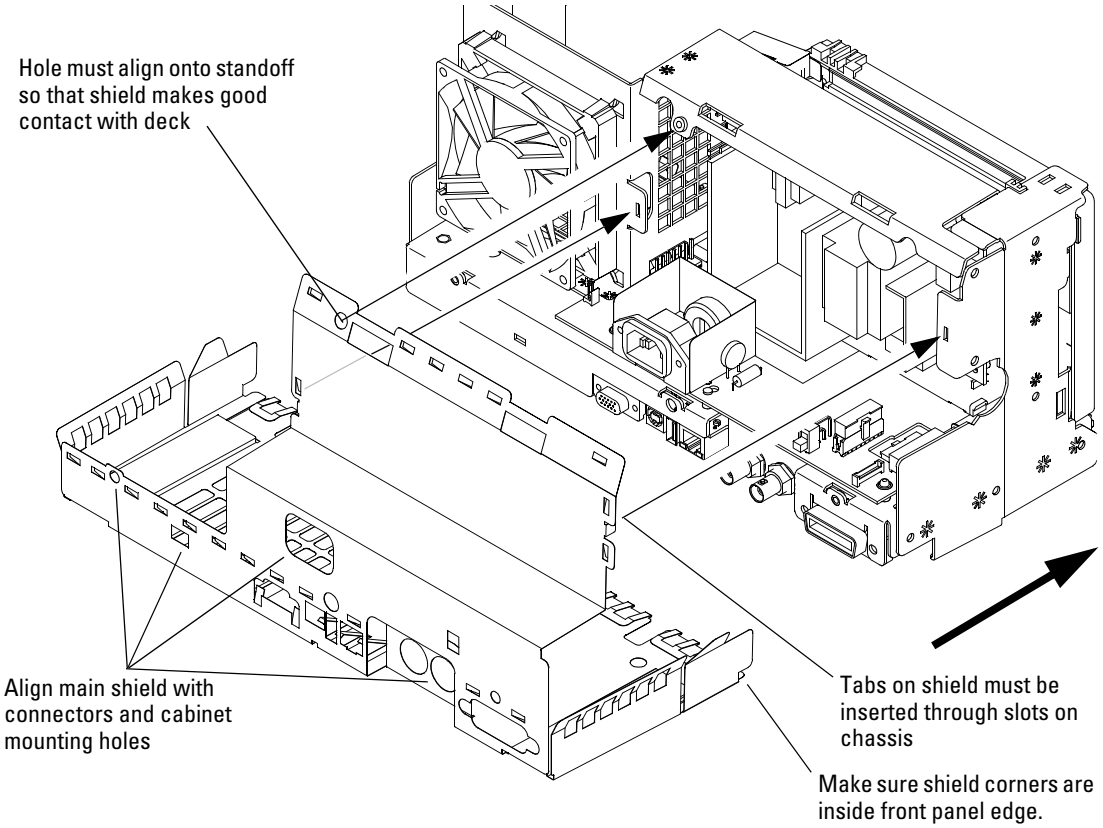


Figure 23 Main shield reinstalll

WARNING Thin sheet metal parts may have sharp edges. Handle with care to avoid injury.

3 To reinstall shield, carefully push it in place around the chassis taking care to align the shield with connectors, cabinet mounting screw locations, and shield tabs to chassis slots locations..

To remove the display assembly

1 Perform the previous procedures:
   - "To remove the cabinet" on page 84
   - "To remove the main shield" on page 93
   - "To remove the front panel assembly" on page 87
2 Using a small flat blade screw driver, gently pry the display and backlight inverter cables to disconnect them from the system board.

   Note the cable routing through the system board for reinstallation.

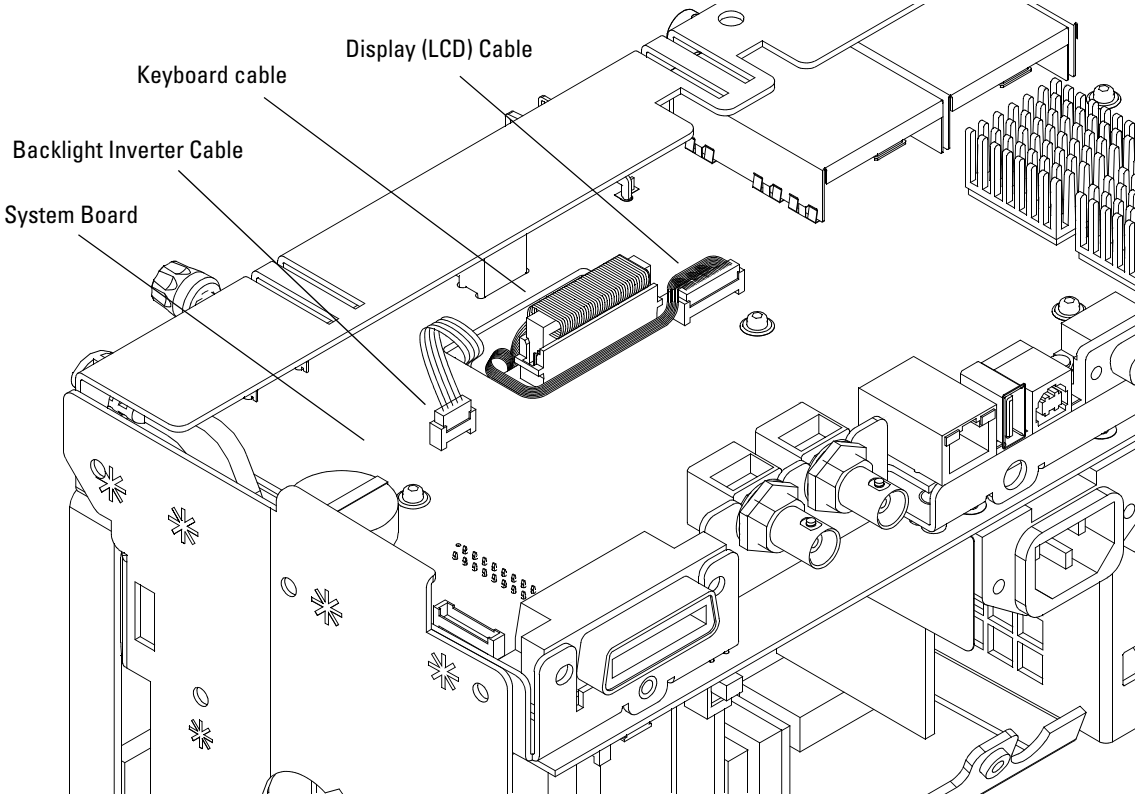


Figure 24 Disconnecting the display cables (bottom view of scope)

3 Using a flat-blade screwdriver, lift the latch tab at the bottom of the display assembly just enough to clear the slot in the deck.

4 Push the entire display assembly to the right to release the retaining hooks from their slots in the deck

5 Lift and remove the display assembly.

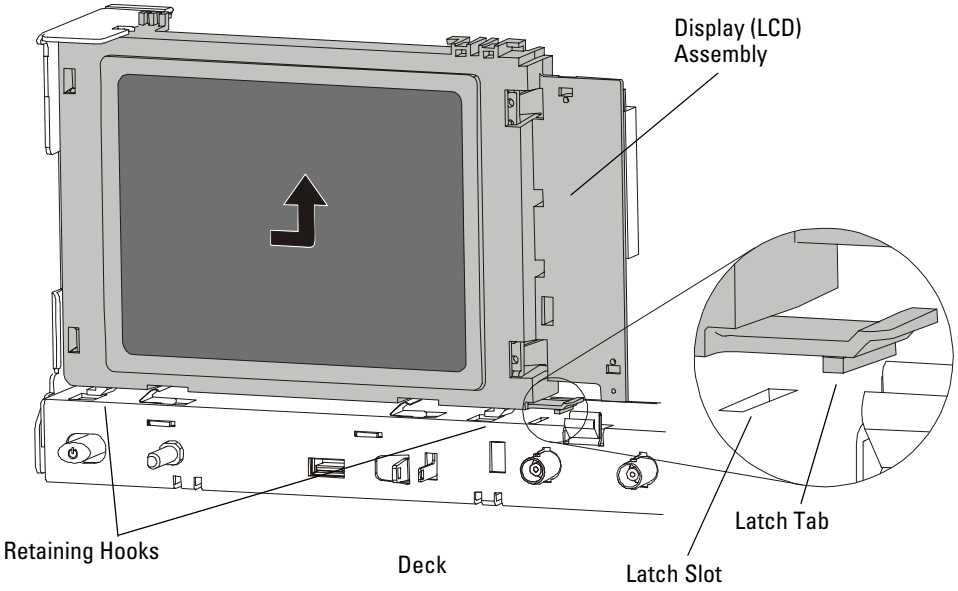


Figure 25 Removing the display assembly

6 To reinstall the display:

a Align the top locating tab with the locating slot in the sheet metal and the retaining hooks with their retaining holes.

b Push down on the LCD until it is flat with the deck and at the same time push the LCD to your left.

c Ensure the latch tab is seated in its hole as shown in Figure 25.

d Route the cables down through the deck hole and reconnect to the system board as shown in Figure 24.

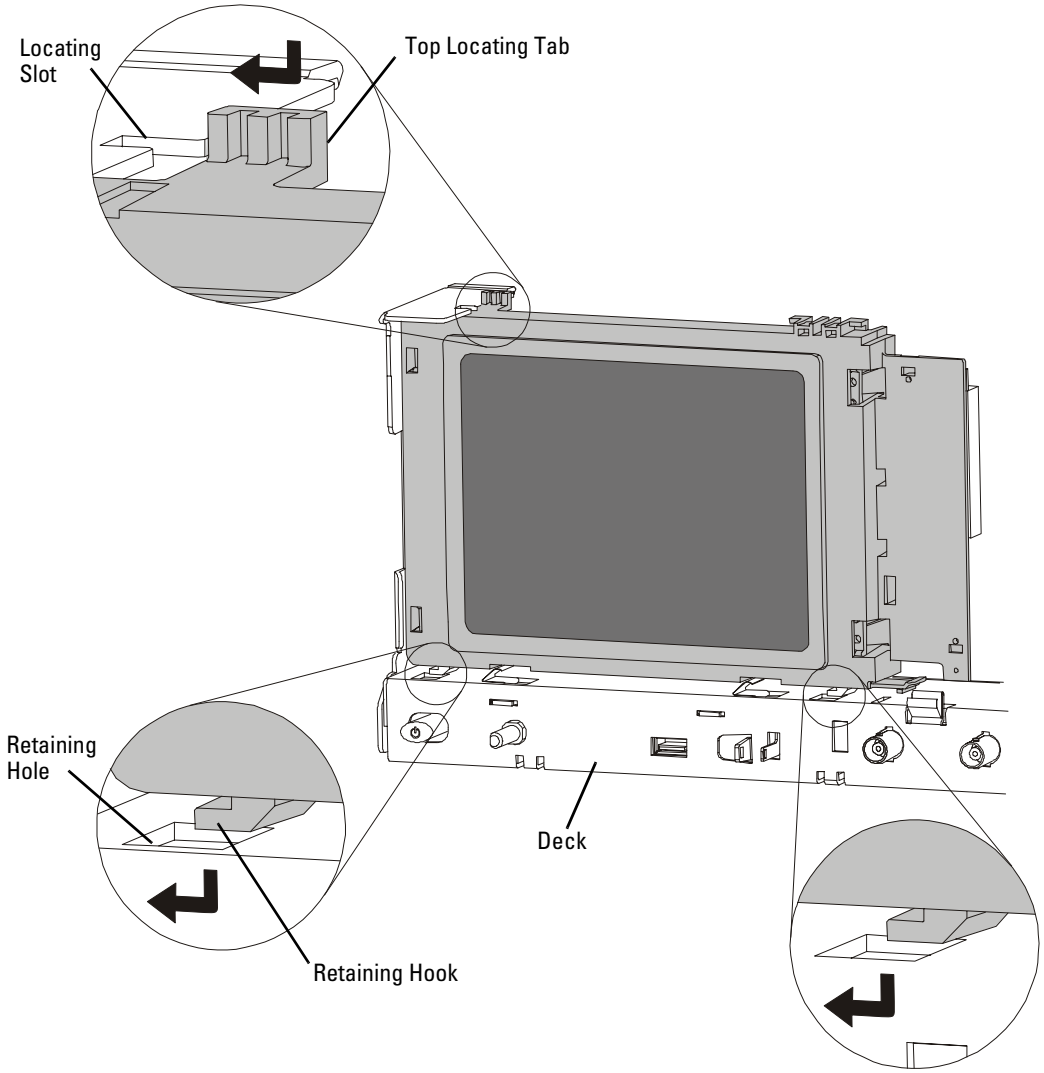


Figure 26 Installing the display

To remove the backlight inverter board and e-field shield

Display assembly must be removed to facilitate the following procedure.

1 Perform the previous procedures:
   - "To remove the cabinet" on page 84
   - "To remove the front panel assembly" on page 87
   - "To remove the display assembly" on page 95

2 Press to release the top tab and use the hole to aid in releasing the side tab. Then open the shield. Do not bend it past the vertical position as shown.

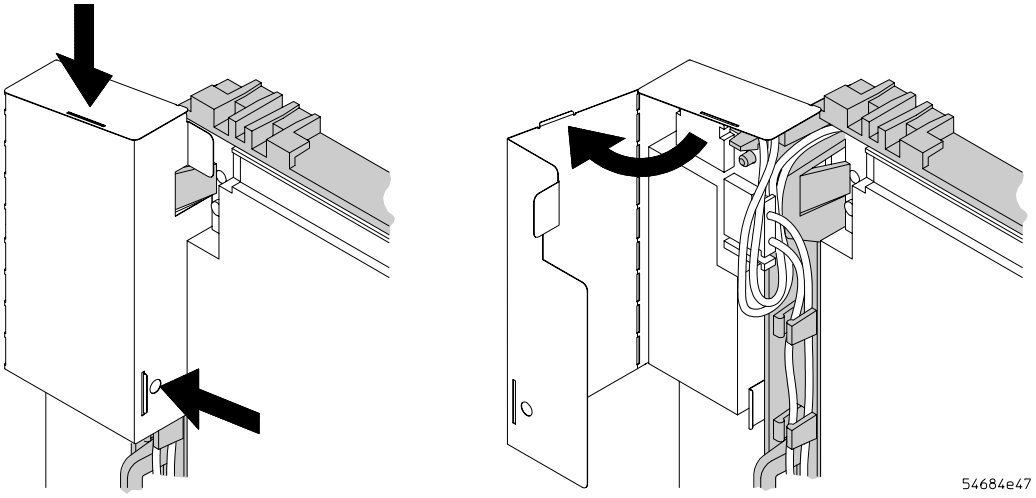


Figure 27 Opening the backlight inverter shield

3 Remove the LCD cables from the cable guides.

4 Release the top latch and lift the top of the board off the top alignment post.

5 Release the bottom latch and lift the board off the bottom alignment post.

6 Disconnect the LCD cables from the backlight inverter board.

7 Unplug the supply cable from the inverter board.

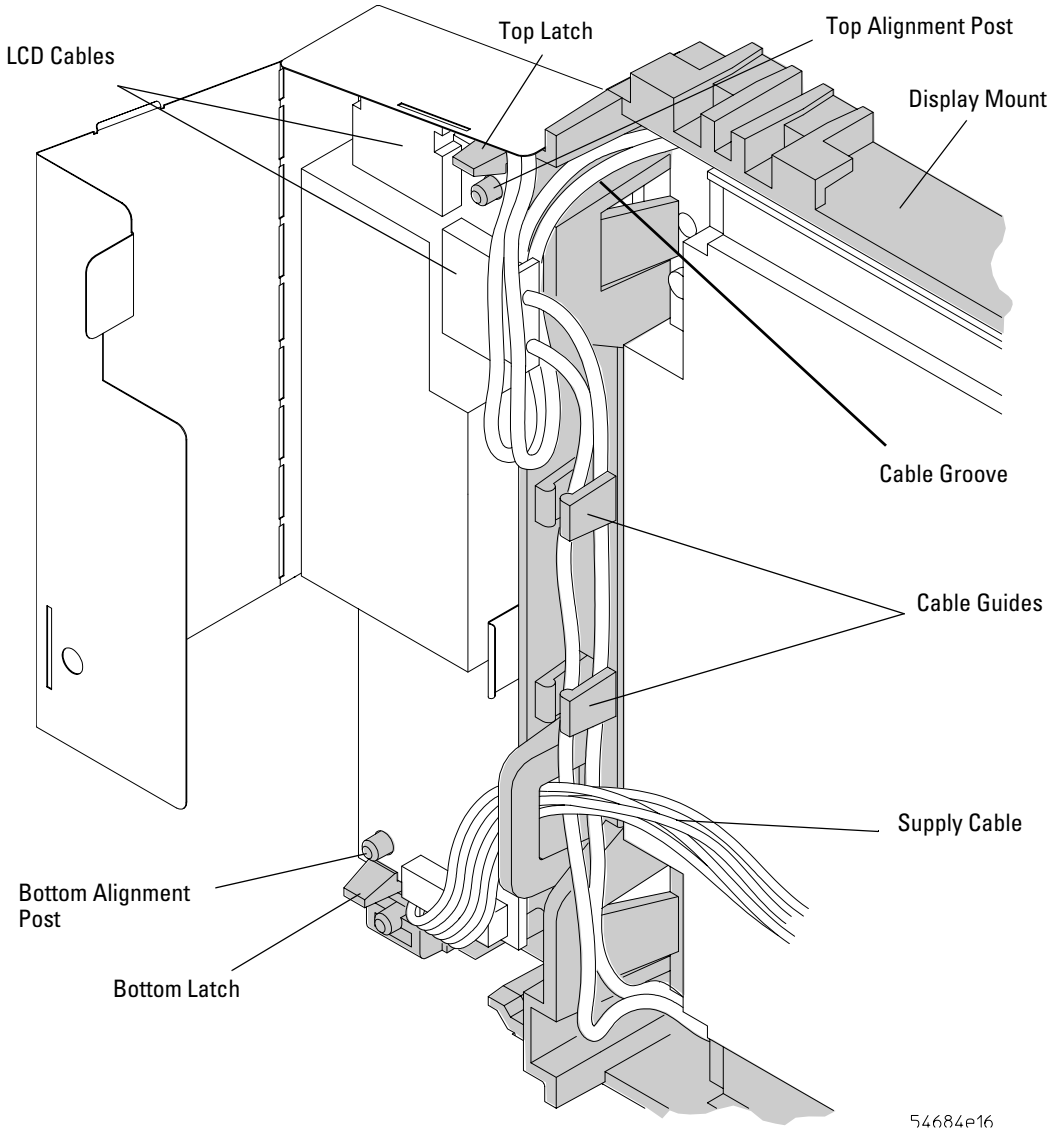


Figure 28 Removing the backlight inverter

8 If the e-field shield requires replacement, use a screwdriver to pry the shield off the studs.

a Align the shield over the studs and push it all the way down on the studs.

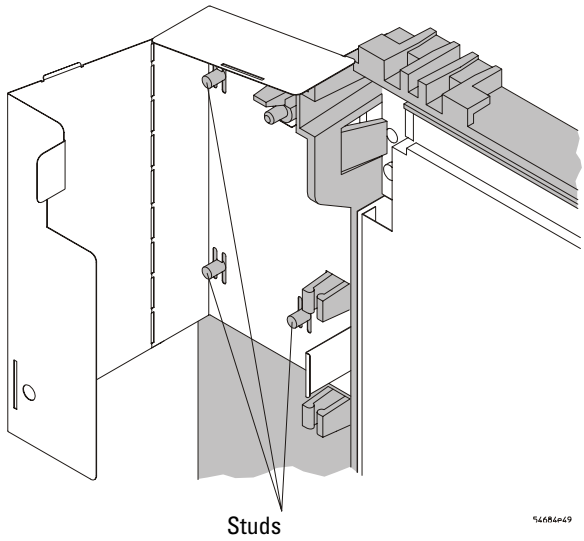


Figure 29 Removing the backlight inverter shield

9 To reinstall the backlight inverter board:

a Reconnect the LCD cables looping them around each other and through the cable guides as shown in Figure 28.

b Reconnect the supply cable.

c Align the holes in the inverter board with the posts on the display mount and push down until the latches snap over the board (refer to Figure 28).

d Route the cables through the cable guides as shown.

e Close the shield.

- Insert the shield between the plastic and sheet metal of the display.
- Ensure the cables do not get pinched.
- After closing, use your fingers to gently pinch along the perforated edge of the shield to square the corner and ensure that the release tabs are in their slots.

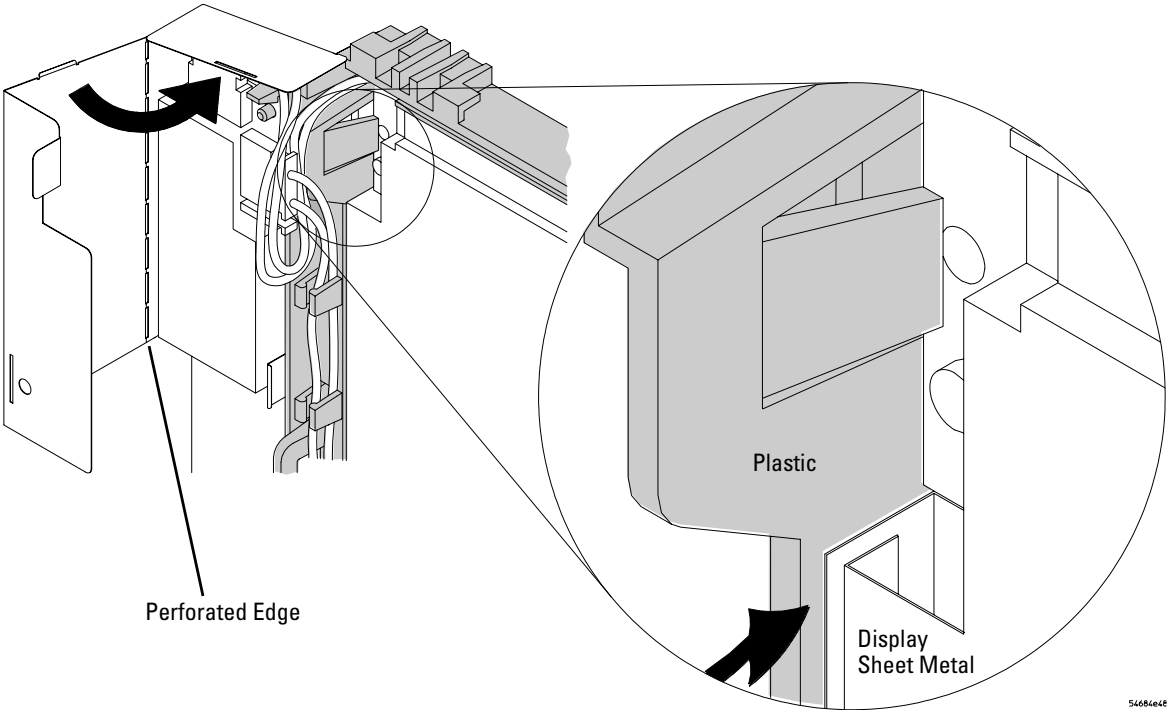


Figure 30 Closing the shield

To remove the LCD, gasket, and protective lens from the display mount

1 Perform the following procedures:
   - "To remove the cabinet" on page 84
   - "To remove the front panel assembly" on page 87
   - "To remove the display assembly" on page 95
   - "To remove the backlight inverter board and e-field shield" on page 99
2 Use a long-nose pliers or flat-blade screwdriver to push and release the two LCD latches on the left side of the display mount.

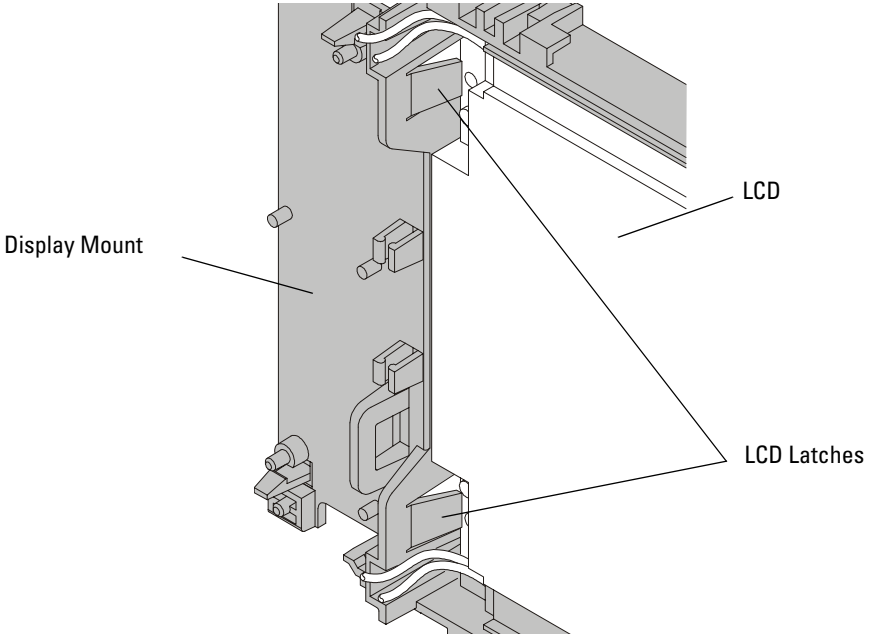


Figure 31 Release display mount latches

3 Lift and remove the LCD from under the guides on the right side of the display mount. Early production units may utilize an RFI spring, note its position- installation so that it may be reinstalled correctly.

4 Remove the gasket and protective lens if necessary.

Note the orientation of the gasket.

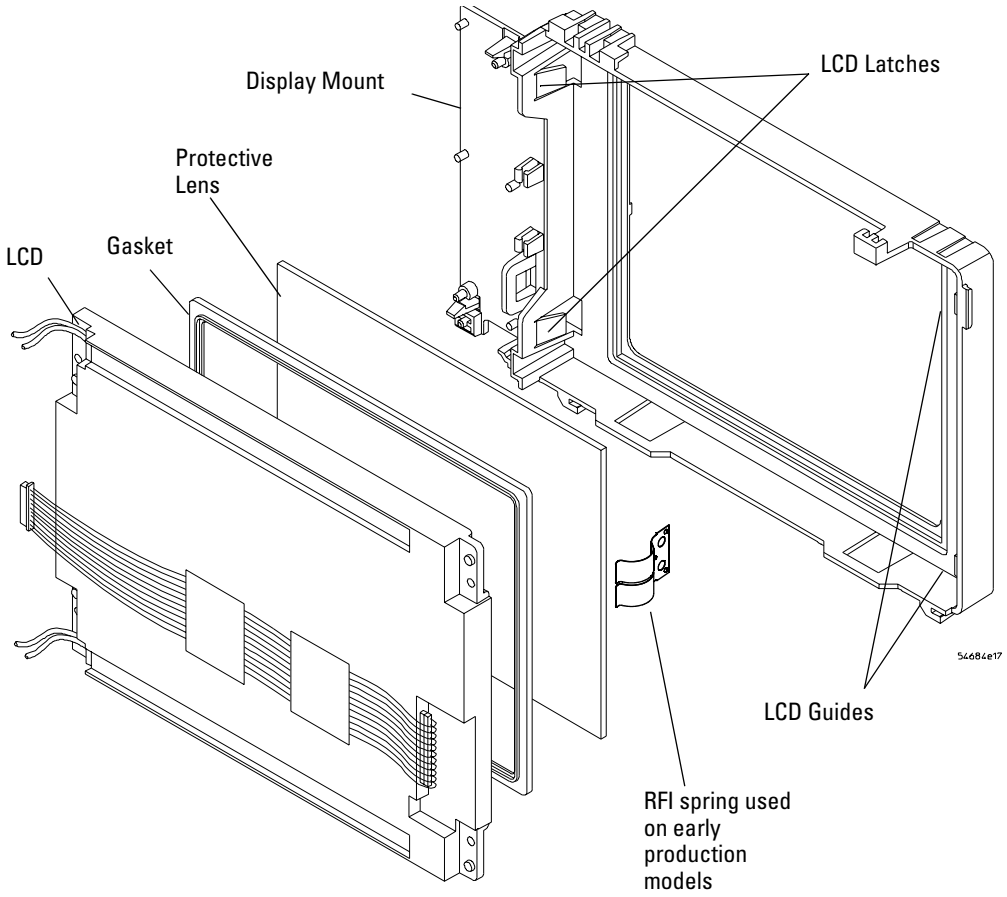


Figure 32 Removing the LCD, gasket, and protective lens

5 To reinstall:

a Place the protective lens into the pocket in the display mount and ensure that the inside of the lens is clean.

b Place the gasket into the slot around the lens making sure it is fully seated in the slot all the way around.

c Clean the LCD window and insert the LCD under the guides on the right side of the display mount.

d Push the left side of the LCD down until it clicks under the latches so that the latches are fully over the face of the sheet metal housing.

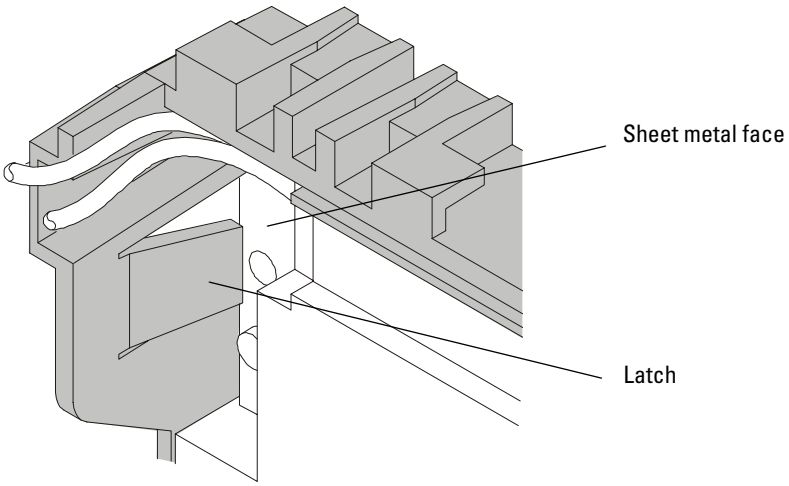


Figure 33 Latch over face of sheet metal housing

e Reinstall the backlight inverter (see step 9 on page 101).

To remove the power shaft

1 Perform the previous procedures:
   - "To remove the cabinet" on page 84
   - "To remove the main shield" on page 93

2 Use a flat-blade screwdriver to gently spread the latch while pushing the power shaft forward. It may be helpful to use a "needle-nose" pliers to grip the shaft or the holding tab during removal.

CAUTION Twisting the latch too much could cause it to break!

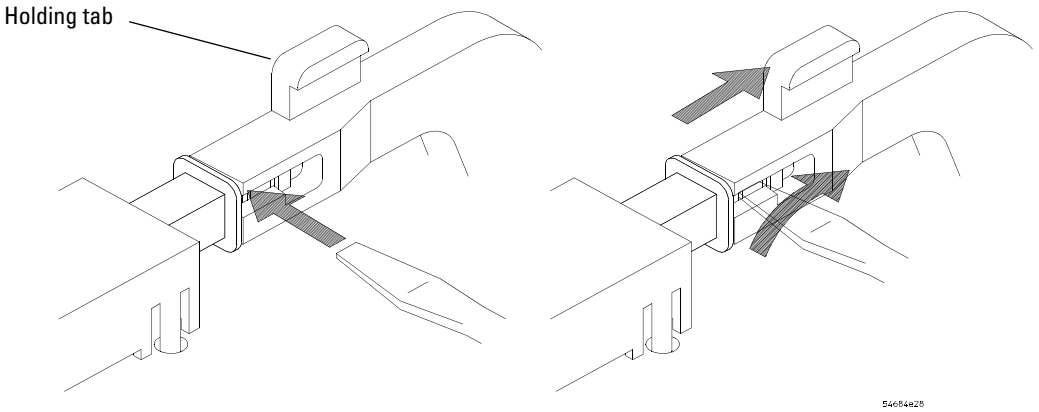


Figure 34 Removing the power shaft latch

3 Lift and remove it from the deck.

4 When reinserting the power shaft, push the shaft into the power switch until the shaft snaps onto the switch.

To remove the AC input board

1 Perform the previous procedures:
   - "To remove the cabinet" on page 84
   - "To remove the main shield" on page 93
   - "To remove the power shaft" on page 106
2 Disconnect power supply cable, AC input cable, fan cable, system power and control cables (these pass through the opening in the board).
3 Remove the two T10 screws securing the input board to the deck.
4 Slide the board to the rear to release it from the single post.
5 Remove the board.

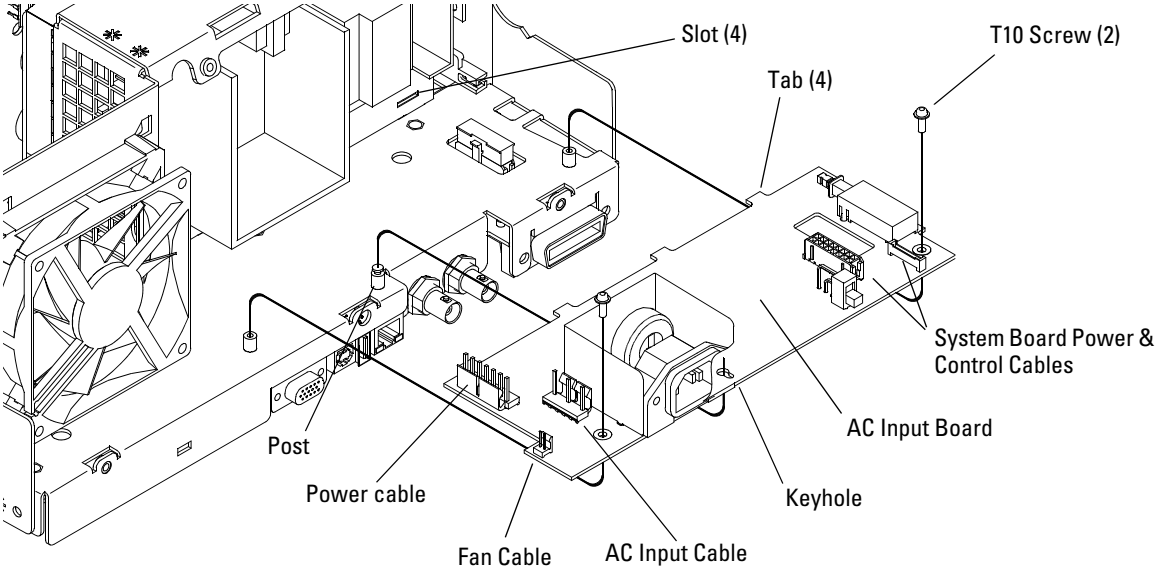


Figure 35 Removing the AC input board

6 Reverse this procedure to reinstall. Note: the four tabs on the front of the AC input board fit into the four slots on the chassis. Insure board keyhole is positioned over post on the chassis and engaged correctly before securing with screws.

To remove the power supply

1 Perform the previous procedures:
   - "To remove the cabinet" on page 84
   - "To remove the main shield" on page 93
   - "To remove the AC input board" on page 107
2 Remove the 4 T10 screws securing the power supply to the deck. then remove the power supply.
3 Disconnect the power supply and AC cables

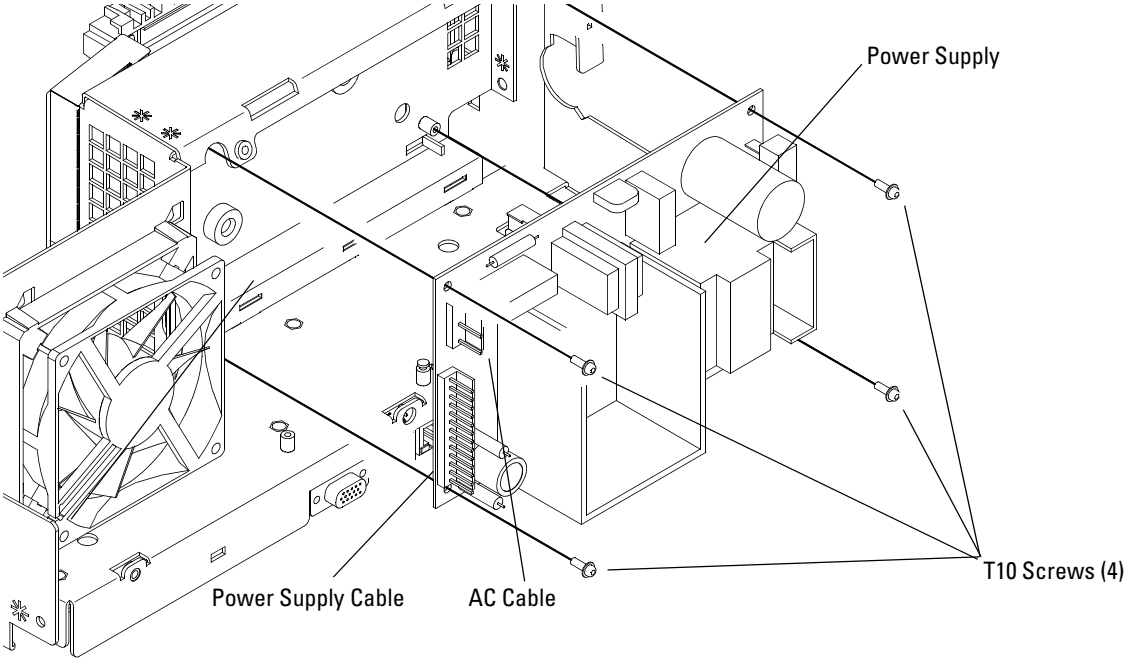


Figure 36 Removing the power supply

4 Reverse this procedure to install the power supply.

To remove the fan

1 Perform the previous procedures:
- "To remove the cabinet" on page 84
- "To remove the main shield" on page 93 (although not required for fan removal, it may be helpful)
- "To remove the AC input board" on page 107
- "To remove the power supply" on page 109

WARNING Thin sheet metal parts may have sharp edges. Handle with care to avoid injury.

2 Disconnect the fan cable from the AC board.

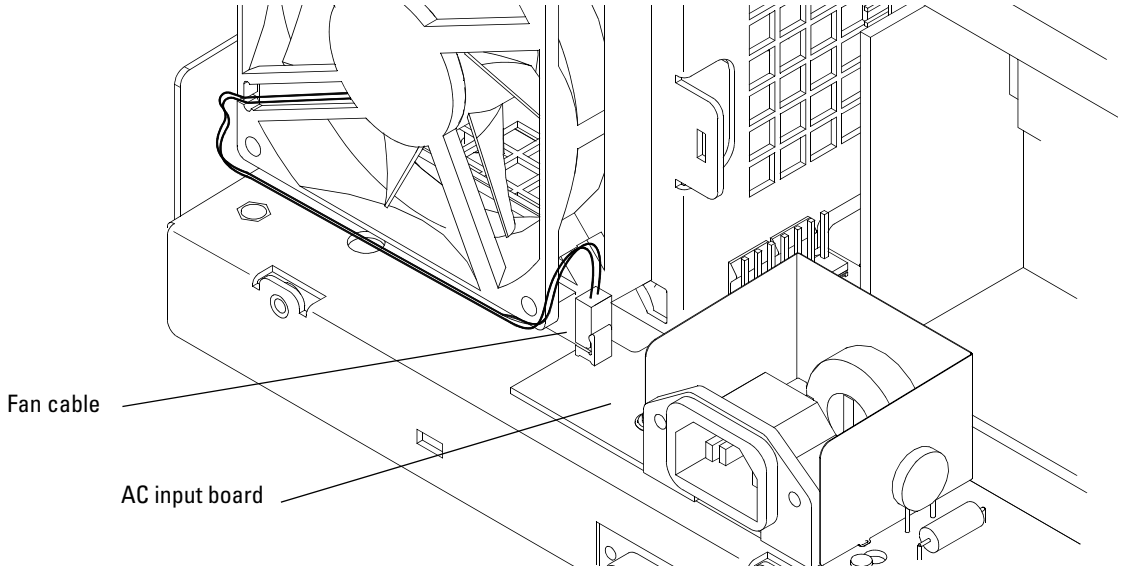


Figure 37 Locating and disconnecting fan cable

3 Slide the fan mount to the side to remove the 4 retainer hooks from their keyholes and lift out.

It may help to push on each of the hooks to keep from tearing them.

4 Peel the rubber fan mount off the corners of the fan.

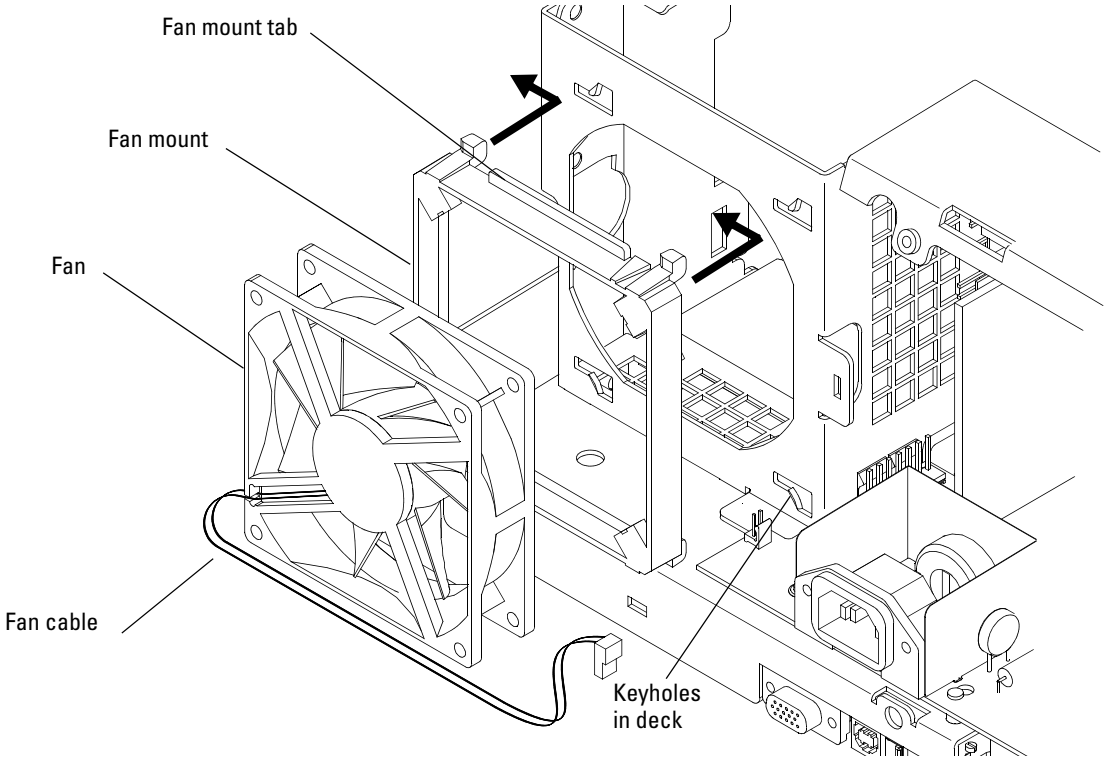


Figure 38 Removing the fan

5 Reverse this procedure to replace the fan assembly.

- When re-installing, note the position of the tab on the fan mount and the direction of the fan cable.
- Ensure that the assembly is locked into the keyholes, fan tab is located at top and fan cables egress as shown.

To remove the system board

1 Perform the previous procedures:
- "To remove the cabinet" on page 84
- "To remove the front panel assembly" on page 87
- "To remove the main shield" on page 93

WARNING Thin sheet metal parts may have sharp edges. Handle with care to avoid injury.

2 Using a small flat blade screw driver, gently pry and remove the display cable and backlight inverter cable, also disconnect the keyboard ribbon cable. Push all cables back through the hole in the system board.

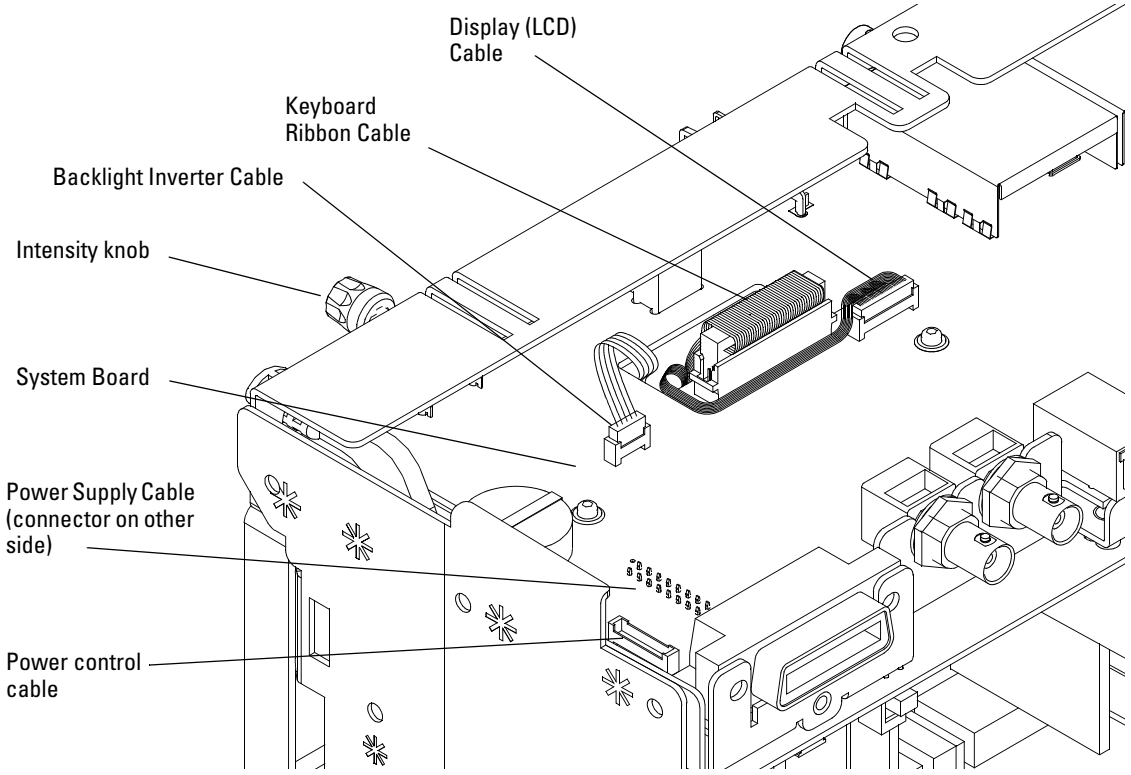


Figure 39 Preparing to remove the system board

3 Disconnect the power control cable. Note: the power supply cable must be disconnected from the other side; locate the power supply cable opening on the AC input board to gain access to the connector.

4 Remove the intensity knob by grasping the knob with one hand and gently prying using a flat-blade screwdriver with the other hand.

   Using a twisting motion with the screwdriver rather than prying prevents marking or damaging the front panel.

5 Remove the 3 or 4 T6 screws located by the BNCs on the front panel (see Figure 18 on page 87).

6 Remove the two hex nuts and washers from the rear BNCs using the 5/8-inch socket driver.

7 Using the 9/32 hex driver, remove two hex standoffs and washers from GPIB connector.

8 Using the T10 TORX driver, remove the six screws that hold the system board to the deck.

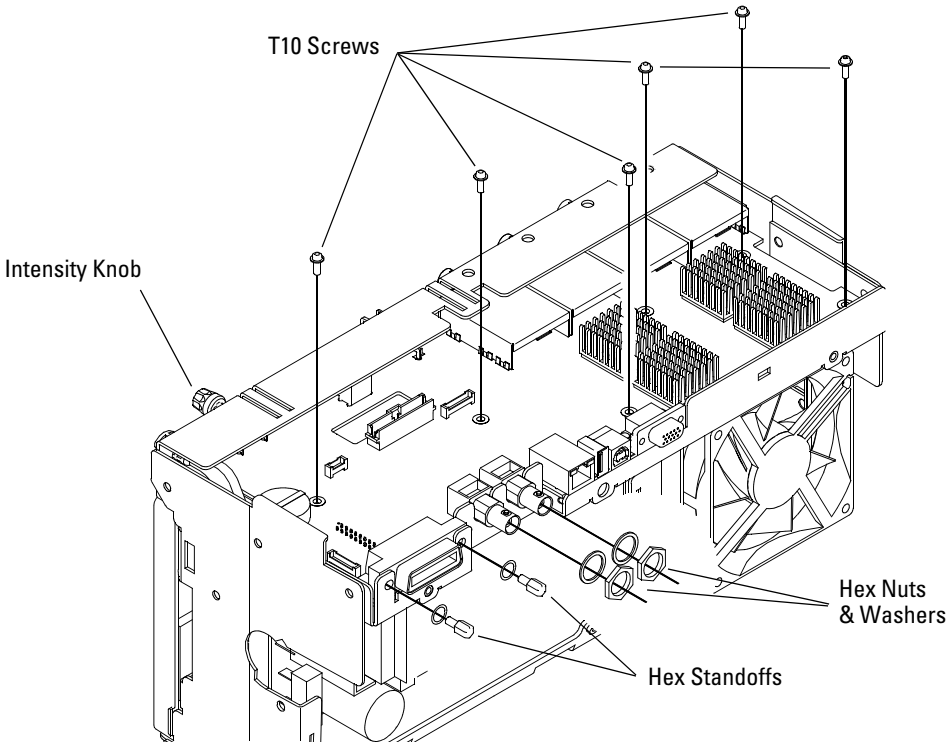


Figure 40 Removing the system board

9 Lift the back of the board to clear the main deck and then gently pull the board straight out.

10 To reinstall the system board:

a Feed the keyboard, display and backlight inverter cables through the hole in the system board. Insure power

control cable/connector feeds through the gap between the chassis and system board.

b Insert the tabs on the board into the slots in the front of the sheet metal; the intensity shaft, BNCs, and CAL lug into their holes.

c Push the back of the board down to seat.

d Reinstall the T6 screws on the front panel (shown in Figure 18 on page 87).

e Reinstall the GP-IB hex standoffs, then the six T10 screws and finally install the BNC hex nuts and washers

f Reconnect the keyboard, display, backlight inverter and power control cables. Reconnect power supply cable from AC input board.

g Ensure that the backlight, fan, and LCD cables are routed to the left of the keyboard ribbon cable as shown in Figure 39 on page 113.

h Replace the intensity knob by supporting the back of the encoder and pushing the knob fully onto the shaft.

6 Replaceable Parts

This chapter describes how to order replaceable assemblies and parts for the Agilent 5000 Series oscilloscopes.

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.

Ordering Replaceable Parts

Listed Parts

To order a part in the parts list, quote the Agilent Technologies part number, indicate the quantity desired, and address the order to the nearest Agilent Technologies Sales Office. To find your nearest sales office go to **www.agilent.com.**

Unlisted Parts

To order a part not listed in the parts list, include the instrument part number, instrument serial number, a description of the part (including its function), and the number of parts required. Address the order to the nearest Agilent Technologies Sales Office.

Direct Mail Order System

Within the USA, Agilent Technologies can supply parts through a direct mail order system. There are several advantages to this system:

- Direct ordering and shipping from the Agilent Technologies parts center in California, USA.
- 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.)
- Prepaid transportation. (There is a small handling charge for each order.)
- No invoices.

In order for Agilent Technologies to provide these advantages, please send a check or money order with 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 manuals.

Exchange Assemblies

Some parts used in this instrument have been set up for an exchange program. This program allows the customer to exchange a faulty assembly with one that has been repaired, calibrated, and performance-verified by the factory. The cost is significantly less than that of a new part. The exchange parts have a part number in the form XXXXX-695XX.

After receiving the repaired exchange part from Agilent Technologies, a United States customer has 30 days to return the faulty assembly. For orders not originating in the United States, contact the local Agilent Technologies service organization. If the faulty assembly is not returned within 30 days, the customer will be charged an additional amount. The additional amount will be the difference in price between a new assembly and that of an exchange assembly.

Exploded Views

The following exploded views provide a graphical representation of the oscilloscope at the time this manual was released. Not all parts are shown. Your parts may be slightly different thank those shown. These views provide reference designator numbers that map to those used in the parts list table in this chapter.

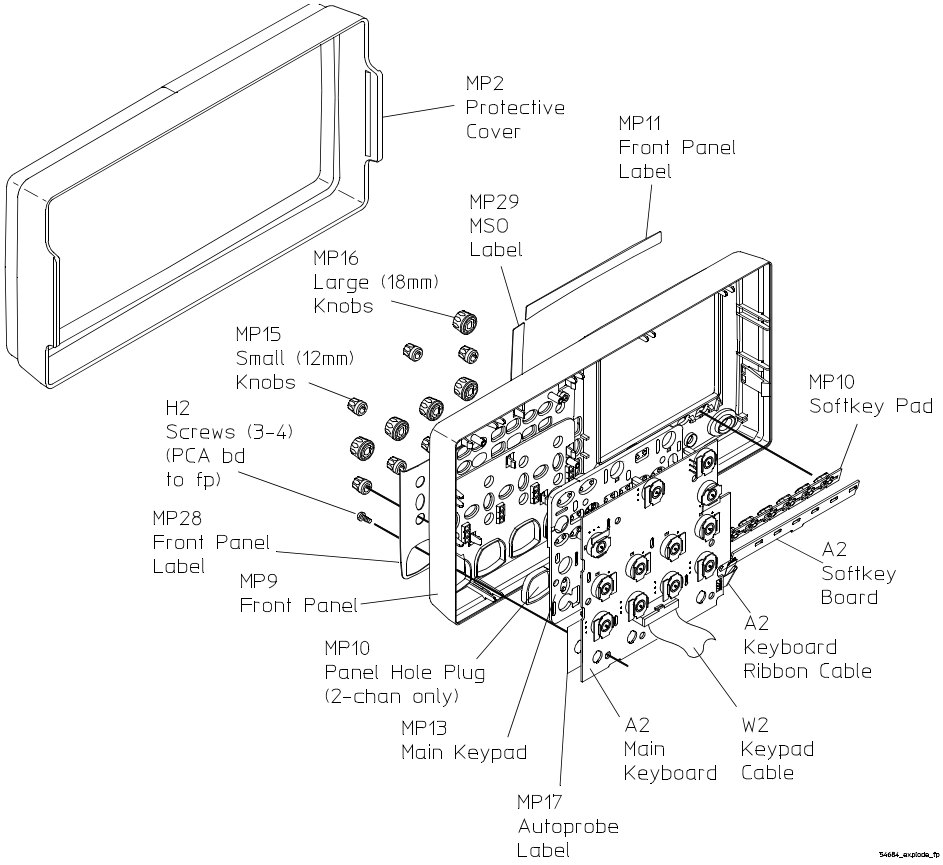


Figure 41 Exploded View 1 of 2

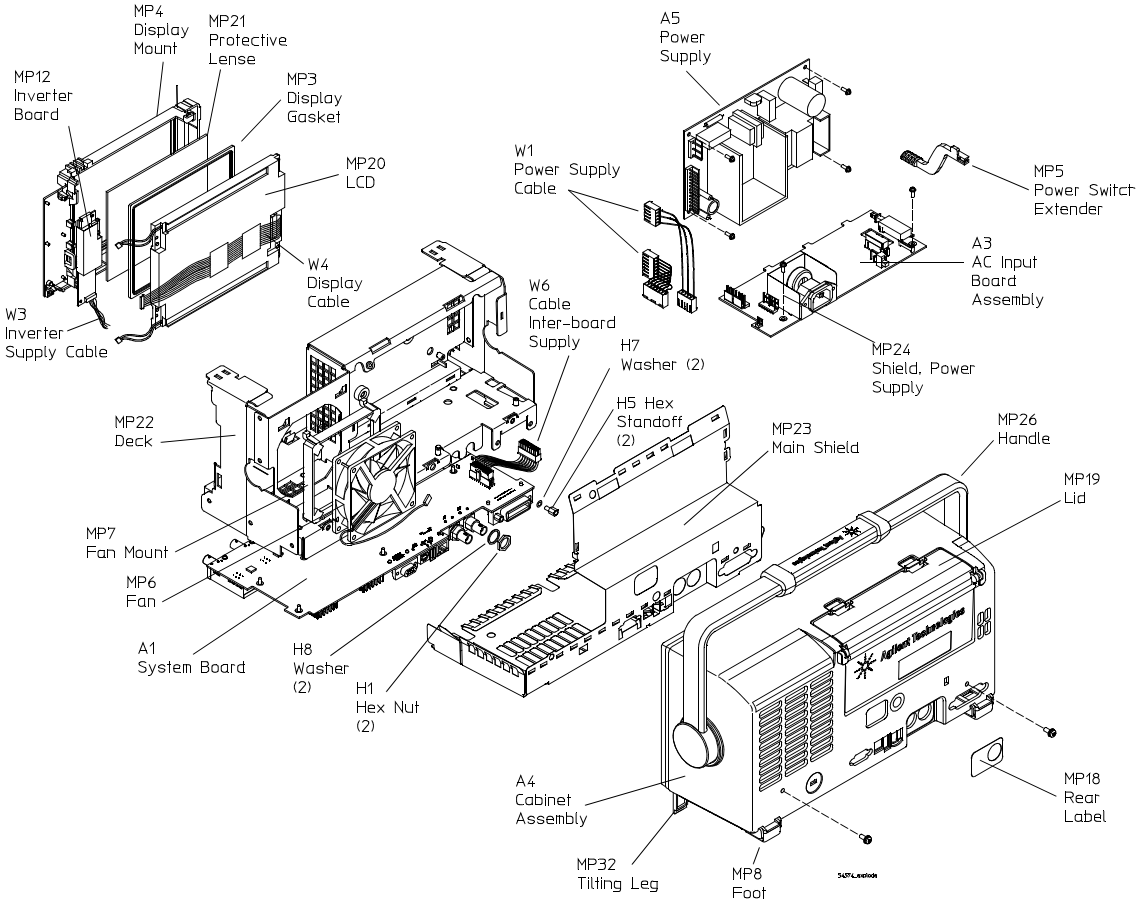


Figure 42 Exploded View 2 of 2

Replaceable Parts List

The information given for each part consists of the following:

- Reference designation.
- Agilent Technologies part number.
- Total quantity (QTY) in the instrument or on assembly.
- Description of the part.

Table 14 Replaceable Parts

Ref Des	Agilent Part Number	Qty	Description
A1	54532-66501	1	2-ch 100 MHz system board
A1	54534-66501	1	4-ch 100 MHz system board
A1	54562-66501	1	2-ch 300 MHz system board
A1	54564-66501	1	4-ch 300 MHz system board
A1	54572-66501	1	2-ch 500 MHz system board
A1	54574-66501	1	4-ch 500 MHz system board
A2	54682-66511	1	2-ch keyboard assembly
A2	54684-66511	1	4-ch keyboard assembly
A3	54574-66502	1	AC line filter/power switch PC board assembly
A4	54574-64401	1	Cabinet assembly
A5	0950-4691	1	Power Supply
H1	2950-0054	3	Hex Nut - 1/2-28 thd
H2	0515-0658	4	Screw - machine m2 x 0.4 - 6 mm lg T6 - w/washer
H3	0515-0372	9	Screw - machine m3 x 0.5 - 8 mm lg T10 - w/washer

Table 14 Replaceable Parts (continued)

Ref Des	Agilent Part Number	Qty	Description
H4	0515-0380	3	Screw - machine m4 x 0.7 - 10 mm lg T15 - w/washer
H5	0380-0643	2	Standoff - hex 0.255 in. lg 6-32 thd
H6	2190-0068	3	Washer - internal tooth lock 0.505 in. id
H7	2190-0009	2	Washer - internal tooth lock 0.168 in. id
MP2	54684-44101	1	Cover, protective front
MP3	54684-47101	1	Display gasket
MP4	54684-44702	1	Display mount
MP5	54574-43901	1	Extender, power switch
MP6	54574-68501	1	Fan
MP7	54684-44701	1	Fan mount
MP8	54684-41001	2	Foot Pad
MP9	54684-60202	1	Front panel
MP10	54684-42202	1	Hole plug front panel - 2 ch only
MP11	54532-94301	1	ID label 2-ch 100 MHz DSO
MP11	54534-94301	1	ID label 4-ch 100 MHz DSO
MP11	54562-94301	1	ID label 2-ch 300 MHz DSO
MP11	54564-94301	1	ID label 4-ch 300 MHz DSO
MP11	54572-94301	1	ID label 2-ch 500 MHz DSO
MP11	54574-94301	1	ID label 4-ch 500 MHz DSO

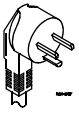
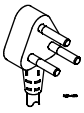
Table 14 Replaceable Parts (continued)

Ref Des	Agilent Part Number	Qty	Description
MP12	0950-4438	1	Inverter, dual backlight
MP13	54684-41901	1	Keypad, main
MP10	54684-41902	1	Keypad, softkey
MP15	54801-47401	4	Knob - 12 mm flint gray
MP15	54801-47404	1	Knob - 12 mm yellow
MP15	54801-47405	1	Knob - 12 mm green
MP15	54801-47406	1	Knob - 12 mm purple
MP15	54801-47407	1	Knob - 12 mm pink
MP16	54801-47402	1	Knob - 18 mm gray
MP16	54801-47408	1	Knob - 18 mm yellow
MP16	54801-47409	1	Knob - 18 mm green
MP16	54801-47410	1	Knob - 18 mm purple
MP16	54801-47411	1	Knob - 18 mm pink
MP17	54684-94314	1	Label, autoprobe
MP18	54572-94302	1	BNC label, 2-channel
MP19	54574-40301	1	Lid, storage compartment
MP20	2090-0881	1	Liquid crystal display
MP21	54684-88001	1	Protective lens
MP22	54574-00101	1	Deck
MP23	54574-00601	1	Shield, main
MP24	54574-00602	1	Shield, power supply
MP25	54574-00604	1	Ground spring display
MP26	54574-44901	1	Handle

Table 14 Replaceable Parts (continued)

Ref Des	Agilent Part Number	Qty	Description
MP27	54684-00604		E-field shield (not shown)
MP28	54572-94303	1	Label, front panel, 2-channel
MP28	54574-94305	1	Label, front panel, 4-channel
MP29	54574-00603	1	Cover - attenuator
MP31	54574-09101	2?	Spring - tilt leg
MP32	54574-41001	2	Tilting leg
MP33	54574-44401	1	Bucket
MP34	54574-85401	1	Protective insulator
MP35	54574-94304	1	Label MSO cover up
W1	54574-61601	1	Cable, DC
W2	54684-61601	1	Cable, keyboard
W3	54684-61602	1	Inverter supply cable
W4	54684-61603	1	LVDS display cable
W6	54574-61603	1	Cable inter-board supply
W7	54574-61604	1	Cable inter-board data
W5	see Table 15	0-1	Power cord option, see Table 15, “Power Cords,” on page 126
	10073C	2-4	Passive Probe 10:1, 500 MHz
	N2863A	2-4	Passive Probe 10:1, 300 MHz

Table 15 Power Cords

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

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Safety Notices

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

Warnings

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

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

If you energize this instrument by an auto transformer (for voltage reduction or mains isolation), the common terminal must be connected to the earth terminal of the power source.

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

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

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

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

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

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

To clean the instrument

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

Safety Symbols

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

Hazardous voltage symbol.

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