Service Guide

Publication Number 54846-97002
December 2001

This manual applies directly to Infiniium oscilloscopes with model number sufixes “B.”

For Safety information, Warranties, and Regulatory information, see the pages at the back of this book.

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Agilent Model 54845B/46B Oscilloscopes

Ease of use with high performance

The Agilent Technologies Infiniium oscilloscopes combine unprecedented ease-of-use with high-performance digitizing oscilloscope functionality to simplify your design and analysis measurement tasks.

- Traditional oscilloscope front-panel interface provides direct access to the controls needed for most troubleshooting tasks
- Graphical user interface with menus, windows, dialogs, and toolbars provides easy access to dozens of configuration and analysis tools, ensuring you can set up and make the most complex measurements
- Agilent 54845B offers 4 channels, 8 GSa/s sampling rate in 2-channel mode, 4 GSa/s sampling rate in 4-channel mode, 1.5 GHz bandwidth
- Agilent 54846B offers 4 channels, 8 GSa/s sampling rate in 2-channel mode, 4 GSa/s sampling rate in 4-channel mode, 2.25 GHz bandwidth

Display shows waveforms and graphical user interface

- Graphical interface allows direct interaction with waveforms, including drag-and-drop positioning and instant waveform zoom
- Waveforms displayed in color, making correlation easy
- Current configuration parameters displayed near the waveform display and are color-coded to make identification easy
- Graphical interface menus and toolbars simplify complex measurement setups

Horizontal controls set sweep speed and position

- Main sweep speeds from 100 ps/div to 5 s/div
- Delayed sweep speeds from 1 ps/div to main time base setting
- Intensified waveforms on main sweep window make it easy to see what will appear in delayed sweep window

Acquisition and general controls start and stop the scope and do basic setup

- Run and stop controls for continuous or single-shot acquisitions
- Clear display before one or more acquisitions
- Default setup and Autoscale set initial configuration

Hard disk drive and floppy disk drive for saving and restoring setups and measurement results

- Store measurement displays for inclusion in reports and test setup guides
- Store oscilloscope setups to repeat tests another time
- Hard disk stores oscilloscope operating system

Trigger setup controls set mode and basic parameters

- Select Edge, Glitch, or Advanced Modes
- Choose input source and slope
- Set coupling for trigger
- Use graphical user interface to simplify configuration of pattern, state, delay, violation, and video triggers
- Use auxiliary trigger to increase triggering flexibility

Vertical controls set input coupling, impedance, attenuation, and position

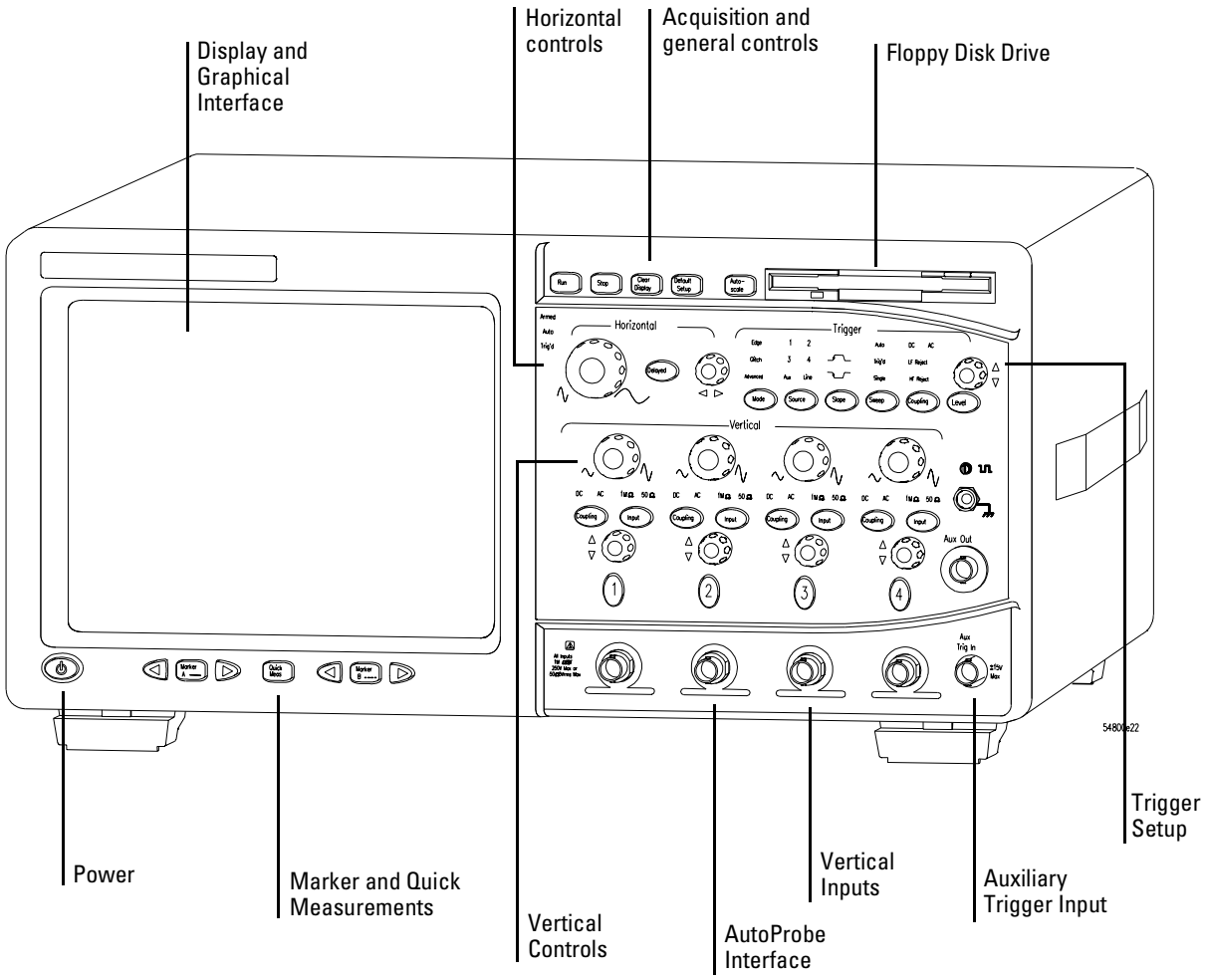
- AC or DC input coupling
- 1 MΩ or 50Ω input impedance
- Input attenuation adjustable from 2 mV/div to 1 V/div (plus 2 V/div in 1 MΩ)
- Color-coded knobs make it easy to find the controls that affect each waveform

Marker and quick measurements help measure waveform parameters

- Waveform markers A and B to check voltage or Δ–time at any point on the displayed waveform
- Quick Meas executes up to four predefined measurements instantly

Service Policy

The service policy of this instrument requires replacing defective assemblies. Some assemblies can be replaced on an exchange basis. Items such as the vertical attenuators, which are subject to wear and tear based on frequency of use, are a maintenance item that may need occasional replacement.


Display and Graphical Interface
Horizontal controls
Acquisition and general controls
Floppy Disk Drive
Trigger Setup
Power
Marker and Quick Measurements
Vertical Controls
AutoProbe Interface
Vertical Inputs
Auxiliary Trigger Input
Run
Stop
Clear Display
Default Setup
Auto-scale
Horizontal
Trigger
Vertical
Aux Out
Aux Trig In

In This Book

This book provides the service documentation for the Agilent Technologies 54845B/46B oscilloscope. It is divided into eight chapters.

Chapter 1 provides general information and specifications.

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

Chapter 3 gives performance tests.

Chapter 4 covers calibration and adjustment procedures, how to do them, and how often they need to be done.

Chapter 5 provides troubleshooting information.

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

Chapter 7 includes a list of exchange assemblies and other replaceable parts, part ordering information, and shipping information.

Chapter 8 briefly covers the internal operation of the oscilloscope.

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

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General Information

General Information

This chapter of the *Agilent Technologies Infiniium Oscilloscope Service Guide* gives you general information about the instrument. The following topics are covered in this chapter.

- Instrument identification
- Options
- Accessories
- Specifications and characteristics
- Test equipment requirements

Instruments covered by this service guide

On the rear panel of the instrument is a serial number label and a VIN # XXX. The serial number is composed of two parts. The first part contains two letters and two numbers that signify the instrument's county of origin and year date code. The second part, or the last six digits from the right, contains a rolling number that is different for each Infiniium. This manual applies to "B" model Infiniinums at release date. This manual may not reflect changes made to the oscilloscope after the release data listed on the title page.

An oscilloscope manufactured after the printing of this manual may have a newer serial number. This newer serial prefix indicates that the oscilloscope may be different from those described in this manual. The manual for this oscilloscope will be revised as needed. If you have an oscilloscope with a newer serial number, please refer to the Agilent Technologies website and download a newer manual edition in Adobe Acrobat (pdf) format. The Agilent Technologies URL is: "www.agilent.com". It will be necessary to search on a key word such as "Infiniium Service Guide", and follow the links.

For additional information on configuration differences see the following sections in this service guide:

- "To configure the motherboard jumpers and setup the BIOS" in the Troubleshooting section 5 for information on determining:

  ¥which computer configuration is contained in your oscilloscope

  ¥setting up the BIOS correctly for that configuration

  ¥setting the motherboard jumpers if the PC motherboard is changed.

- Replaceable Parts section 7.
  This section contains exploded views for the different motherboard configurations, cabling schemes, and outside hardware versions. The Replaceable Parts List also contains the assembly part numbers for the different oscilloscope configurations.

Table 1-1 **Oscilloscopes Covered by this Service Guide**

Model	Description
Agilent 54846B	Four-channel digitizing oscilloscope with 8 GSa/s sample rate in 2-channel mode, 4 GSa/s sample rate in 4-channel mode, 2.25 GHz bandwidth
Agilent 54845B	Four-channel digitizing oscilloscope with 8 GSa/s sample rate in 2-channel mode, 4 GSa/s sample rate in 4-channel mode, 1.5 GHz bandwidth

The oscilloscope can be identified by the product number on the back panel.

Accessories supplied

The following accessories are supplied.

- Agilent Mouse, Agilent P/N C3751-60201
- Agilent Mouse Pad, Agilent P/N 54810-85903
- 1 Keyboard, P/N E2610-68701
- (4) Agilent 1161A 10:1 10 MΩ passive probes
- Accessory Pouch (Agilent P/N 54810-68701)
- Power cord (see chapter 7, “Replaceable Parts,” for available power cords)
- *User's Quick Start Guide*
- *Programmer’s Guide* and *Programmer’s Quick Reference*
- *Agilent Technologies Infiniium Oscilloscope Service Guide* for Agilent Models 54845B/46B (this manual)

Options available

The following options are available for the Agilent Technologies Infiniium oscilloscope.

Table 1-2 **Agilent Technologies Infiniium Oscilloscope Model 54845B/46B Options**

Option Number	Description
001	Add 2 standard probes—Agilent 1161A probes for the Agilent 54845B/46B
002	Add 1 Agilent 1162A 1:1 passive probe
003	Add 1 Agilent 1163A 10:1 500 Ω, low-C passive probe
006	Add 1 Agilent 1152A 2.5 GHz, 0.6 pF active probe
007	Add 1 Agilent E2613A, 0.5 mm wedge kit assembly
008	Add 1 Agilent 1153A 200 MHz differential probe
009	Add 1 Agilent 1154A 500 MHz differential probe
010	Add 1 Agilent 1159A 1 GHz differential probe
011	Add 1 Agilent 1156A probe
012	Add 1 Agilent 1157A probe
013	Add 1 Agilent 1158A probe
100	Communication Mask Test Kit
200	VoiceControl Option
1BP	MIL-STD-45662A and ANSI/NCSL Z540 calibration with test data
1CM	Add 1 Rackmount kit (Agilent E2609A)
B30	USB Option
UL9	Cordless Trackball
UL5	Add 1 touchpad pointing device (Agilent E2612A)
ULA	Cordless Keyboard and Mouse
W32	3 years calibration service
W34	3 years return standards comp cal service
W50	5 years return repair service (additional 2 years)
W52	5 years return calibrations service
W54	5 years return standards comp cal service

Other options are available. See your Agilent Technologies Sales Representative. You can order multiple options, or you can order most of these options separately, using the Agilent model number or part number.

Accessories available

The following accessories are available for use with the Agilent Technologies Infiniium oscilloscope.

Table 1-3 Accessories for the Agilent Technologies Infiniium Oscilloscope Model 54845B/46B

Agilent 1144A	800 MHz Active Probe Requires Agilent 1142A power supply—Agilent 1144-61604 probe power extender also required when using 2 or more Agilent 1144A active probes
Agilent 1144-61604	Power Probe Extender
Agilent 1145A	2-channel 750 MHz SMT active probe Requires Agilent 1142A power supply
Agilent 1146A	Oscilloscope AC/DC Current Probe
Agilent 1152A	2.5 GHz, 10:1, 100 kΩ, 0.6 pF Active Probe
Agilent 1153A	200 MHz Differential Probe
Agilent 1155A	750 MHz 2-Channel, Low-Mass Active Probe
Agilent 1156A	1.5 GHz Active Probe
Agilent 1157A	2.5 GHz Active Probe
Agilent 1158A	4.0 GHz Active Probe
Agilent 1161A	Standard probes for the Agilent 54845B/46B
Agilent 1162A	1:1 Passive Probe
Agilent 1163A	10:1 500-Ω, low-C Passive Probe
Agilent 1170A	500 MHz Low-Mass, miniature 10:1 10 MΩ Passive Probe
Agilent 1171A	500 MHz Low-Mass, miniature 10:1 10 MΩ Passive Probe
Agilent 1172A	500 MHz Low-Mass, miniature 20:1 10 MΩ Passive Probe
Agilent 1173A	500 MHz Low-Mass, miniature 20:1 10 MΩ Passive Probe
Agilent 1182A	Testmobile
Agilent 10020A	Resistive Divider Probe Kit
Agilent 10240B	BNC Blocking Capacitor
Agilent 10833A	GPIB cable, 1 m
Agilent 10833B	GPIB cable, 2 m
Agilent 10833C	GPIB cable, 4 m
Agilent 10833D	GPIB cable, 0.5 m
Agilent 11094B	75Ω Feedthrough Termination
Agilent 34810B	Benchlink Oscilloscope Software
Agilent 34398A + Agilent 34399A	RS-232-C printer cable + adapter kit
Agilent 54006A	6 GHz, 10:1 (500 Ω) or 20:1 (1 kΩ), .25 pF
Agilent 01144-61604	1:2 probe power fan-out (for use with Agilent 1144A and Agilent 1145A)
Agilent C2950A	Parallel printer cable, 2 m
Agilent C2951A	Parallel printer cable, 3 m

Agilent E2610A	Keyboard
Agilent E2609A	Rackmount Kit
Agilent E2647A	Cordless Tackball
Agilent E2648A	Cordless Keyboard and Mouse
Agilent E2612A	Touchpad Pointing Device
Agilent E2625A	Communication Mask Test Kit
Agilent 54832-68803	Service Kit (includes service software and fan safety shield)
Agilent 54810-00601	Fan Safety Shield (clips onto side of chassis with cover removed)
Agilent 54830-68704	Voice Control Kit
Agilent E2636A	Microphone Replacement

Specifications & characteristics

The following tables list the performance specifications and operating characteristics for the Agilent Technologies 54835A/45A/46A oscilloscope. Asterisks (*) denotes warranted specifications, all others are typical. Specifications are valid after a 30 minute warm-up period, and within ± 5 °C from the self-calibration temperature.

Acquisition

Maximum Sample Rate	Real Time	Agilent Models 54845B — 2-channel mode: 8 GSa/s 54845B — 4-channel mode: 4 GSa/s 54846B — 2-channel mode: 8 GSa/s 54846B — 4-channel mode: 4 GSa/s
Maximum Effective Sample Rate	Equivalent Time	500 GSa/s
Memory Depth	2-channel mode: 65,536 points 4-channel mode: 32,768 points	Agilent Agilent 54845B, and Agilent 54846B
Memory Depth Modes	Auto	Optimized for best combination of update rate and display quality.
	Manual	Selectable 2-channel mode: from 16 to 65,536 points 4-channel mode: from 16 to 32,768 points
Sampling Modes	Real Time	Successive single shot acquisitions.
	Equivalent Time	Random repetitive sampling (higher time resolution at fast sweep speeds).
Filters	9-bit Bandwidth Limit filter: BW = (Sample Rate)/20	
	(Sin x)/x Interpolation: On/Off selectable FIR digital filter. Digital signal processing adds points between acquired data points to enhance measurement accuracy and waveform display quality. BW= Sample Rate/4	
Averaging	Selectable from 2 to 4096.	

Vertical

Number of Channels	4 (simultaneous acquisition)	
Bandwidth	Analog Bandwidth (-3dB)*	50Ω: 1.5 GHz — Agilent 54845B 50Ω: 2.25 GHz — Agilent 54846B 1 MΩ: 500 MHz (with Agilent 1161A probe)
	System Bandwidth	Agilent 1161A 10:1 passive probe: 500 MHz Agilent 1162A 1:1 passive probe: 25 MHz Agilent 1163A 10:1, 500 Ω passive probe: 1.5 GHz Agilent 1152A 2.5 GHz, 0.6 pF active probe: 1.3 GHz (Agilent 54845B) Agilent 1153A 200 MHz differential probe: 200 MHz
	Real Time bandwidth*	50Ω: Agilent 54845B — 1.5 GHz (2-channel mode) Agilent 54845B — 1.0 GHz (4-channel mode) Agilent 54846B — 2.25 GHz (2-channel mode) Agilent 54846B — 1.0 GHz (4-channel mode) 1 MΩ: 500 MHz
Rise Time[1]	50Ω: 233 ps (Agilent 54845B) 50Ω: 156 ps (Agilent 54846B) 1 MΩ: 700 ps	
Sensitivity[2]	1 MΩ Coupling: 2 mV/div to 2 V/div 50 Ω Coupling: 2 mV/div to 1 V/div	
Input Impedance*	1 MΩ ± 1% (≅12 pf), or 50 Ω ± 1.5%	
VSWR (50 Ω)	54845B dc to 500 MHz: 1.30 500 MHz to 1 GHz: 1.50 1 GHz to 1.5 GHz: 1.75	54846B dc to 500 MHz: 1.30 500 MHz to 1 GHz: 1.50 1 GHz to 1.5 GHz: 1.75 1.5 GHz to 2.25 GHz: 2.50
Input Coupling	dc, ac (7 Hz, available in 1 MΩ only)	
Maximum Input Voltage	1 MΩ: ± 100 V (dc + ac) [ac<10 kHz], CAT I 50 Ω: 5 V_{rms}, CAT I	
Channel-to-channel Isolation (with channels at equal sensitivity)	54845B dc to 100 MHz: 40 dB 100 MHz to 1 GHz: 30 dB 1 GHz to 1.5 GHz: 25 dB	54846B dc to 100 MHz: 40 dB 100 MHz to 1 GHz: 30 dB 1 GHz to 2.25 GHz: 24 dB
Offset Range	Vertical Sensitivity	Available Offset
	1 MΩ: 2 mV to 104 mV/div > 104 mV to 2 V/div 50Ω: all	 ± 4 V ± 40 V ± 12 div
Full-resolution channel scales	10, 20, 50, 100, 200, 500, 1000 mV/div (plus 2000 mV/div in 1 MΩ)	
Dynamic Range	± 8 div from center screen	
dc Gain Accuracy*[2]	± 1.00% of full scale at full-resolution channel scale.	
Resolution[2]	Real Time	8 bits (0.4% of full scale), 12 bits with sufficient averaging (0.024% of full scale)
	Equivalent Time	8 bits (0.4% of full scale), 12 bits with sufficient averaging (0.024% of full scale)
Offset Accuracy*[2]	± (1.00% of channel offset + 1% of full scale) at full-resolution channel scale.	
dc Voltage Measurement Accuracy*[2]	Dual Cursor	±[(dc gain accuracy)+(resolution)]
	Single Cursor	±[(dc gain accuracy) +(offset accuracy)+(resolution/2)]

AutoProbe Interface	AutoProbe is an intelligent communication and power link between compatible probes and Infiniium scopes. AutoProbe completely configures the scope for the attached probe. For instance, it identifies the probe type and sets up the proper input impedance, attenuation ratio, probe power and offset range, as needed.

Horizontal

Main Time Base Range	100 ps/div to 20 s/div	
Horizontal Position Range	pre-trigger	0 to -1 s or one full screen width, whichever is larger.
	post-trigger	0 to 1 s or one full screen width, whichever is larger.
Delayed Sweep Range	1 ps/div to current main time base setting.	
Delayed Sweep Delay Range	Within main time base acquisition record.	
Resolution	2 ps	
Timebase Accuracy	70 ppm (.007%)	
Δt Accuracy*	Real Time mode[4]	$\pm$[(.007%)(Δt)+(0.2)(sample period)]
	Equivalent Time mode	$\pm$[(.007%)(Δt)+(full scale/ ($2 \times$ memory depth)) + 30 ps] (Example: for $\geq$ 16 avgs, 9 ns signal, 1 ns/div, 1 channel, then accuracy = $\pm$[(.007%)(9 ns)+(10 ns/($2 \times$ 65,536)) + 30 ps] = 31 ps)

Trigger

Sensitivity*[2]	Internal	dc to 100 MHz: 0.5 div 100 MHz to 500 MHz: 1.0 div 500 MHz to 1 GHz: 1.5 div
	Auxiliary	dc to 500 MHz: 300 mV_{pp}
Maximum Input Voltage*	Auxiliary	±15 V, CAT I
Minimum Pulse Width (internal, external)	500 ps at > 1.0 div	
Level Range	Internal	±8 div from center screen
	Auxiliary	±5 V
Sweep Modes	Auto, triggered, single	
Trigger Coupling	dc, ac (7 Hz), low frequency reject (50 kHz), high frequency reject (50 kHz).	
Trigger Holdoff Range	60 ns - 320 ms	
Trigger Modes	Edge, Glitch, Pattern, State, Delay by Time, Delay by Events, Violation (Setup/Hold Time, Pulse Width, Transition), Video, Line.	
Glitch	Select positive or negative polarity, width. Captures glitches as narrow as 500 ps.	
Pattern	Select inputs as High, Low or X (don't care) to create pattern. Trigger when pattern is entered, exited, present > t, present < t, or present over a range of time. Captures patterns as narrow as 500 ps.	
State	Select one channel as clock, specify other inputs as High, Low or X. Logic Type: AND or NAND	
Delay by Time	Time: 30 ns to 160 ms. The trigger is qualified by an edge. After the delay, a rising/falling edge on any one selected input will generate the trigger.	
Delay by Events	Events: 1 to 16,000,000 rising or falling edges. The trigger is qualified by an edge. After the delay, a rising/falling edge on any one selected input will generate the trigger.	
Violation Trigger	Setup/Hold	Modes: Setup, Hold or Setup and Hold. Select Clock, Thresholds, setup and/or hold time.
	Pulse Width	Triggers on pulse width >t, or <t. Captures pulses as narrow as 500 ps.
	Transition	Select Rise Time or Fall Time, present > t or present < t, thresholds.
Accuracy (time) for glitch, pulse width, and time-qualified pattern	1.5 ns - 20 ns: ±(20% setting + 500 ps) 20 ns - 160 ms: ±(3% setting + 2 ns)	
Video Triggering	525 lines/60 Hz (NTSC), 625 lines/50 Hz (PAL), 875 lines/60 Hz. Trigger on Field 1 or Field 2, any line. User defined triggering: User can specify sync pulse level, width and polarity, edge number.	

Display

Display	8.4-inch diagonal color active matrix LCD module incorporating amorphous silicon TFTs.	
Active Display Area	171 mm x 128 mm (21,888 sq. mm)	
Waveform Viewing Area	104 mm x 159 mm (16,536 sq. mm) in Full screen mode (graphical user interface off)	
Display Resolution	640 pixels horizontally x 480 pixels vertically	
Waveform Colors	Select from 100 hues, 0-100% saturation and 0-100% luminosity.	
Dual Intensity Infinite Persistence	Previous sweeps are stored in half bright display and most recent sweep in full bright. This allows easy differentiation of current and historic information.	
Waveform Overlap	When two waveforms overlap, a third color distinguishes the overlap area.	
Full screen mode	On/Off selectable.	
Connect-the-dots	On/Off selectable.	
Persistence	Minimum, Variable (100 ms to 40 s), Infinite. Up to 6 levels of grey scale.	
Graticule	On/Off (Grid or Frame).	
Grid Intensity	0 to 100%	
Display Update Rate (for instruments equipped with AMD-K6-2 400 MHz processor)	Measurement Conditions	Real Time sampling mode, minimum persistence, triggered sweep, no interpolation, markers off, math off, connect the dots off, 1 channel acquisition, 50 ns/div, statistics off.
	512 point record (2 GSa/s)	Waveforms/sec: > 2,100 V_{pp} Measurements/sec: > 130

Measurements

Automatic Parametrics	33 automatic measurements: V_{pp} , V_{min} , V_{max} , V_{avg} , V_{amptd} , V_{base} , V_{top}, V_{rms} , Preshoot, Overshoot, V_{upper} , V_{middle} , V_{lower} , Rise Time, Fall Time, Period, Frequency, Positive Width, Negative Width, Duty Cycle, Delta Time, T_{max} , T_{min} , FFT Frequency, FFT Magnitude, FFT Delta Frequency, FFT Delta Magnitude, Eye Height, Eye Width, Jitter, Crossing %, Q-factor, Duty Cycle Distortion. Over GPIB only: VTime, TVolts.
Threshold Definition	Selectable 10%, 50%, 90% or 20%, 50%, 80% or Custom (% or absolute voltage).
Top-Base Definition	Standard or Custom (in absolute voltage).
Statistics	On/Off selectable. Current measurement, mean, and standard deviation
Measurement Toolbar	16 Drag and Drop automatic measurement icons.
QuickMeas	Activates 4 preselected automatic measurements.
Markers Modes	Manual Markers, Track Waveform Data, Track Measurements.
Waveform Math	4 function waveforms f1-f4. Select from Add, Subtract, Multiply, Divide, Invert, Magnify, Vs, Min, Max, Integral, Differentiate, FFT Magnitude.

FFT

Frequency Range[5]	Agilent 54845B — 2-channel mode: dc to 4 GHz (Sample rate/2) Agilent 54845B — 4-channel mode: dc to 2 GHz (Sample rate/2) Agilent 54846B — 2-channel mode: dc to 4 GHz (Sample rate/2) Agilent 54846B — 4-channel mode: dc to 2 GHz (Sample rate/2)
Freq. Accuracy	(1/2 frequency resolution)+($7x10^{-5}$)(signal frequency)
Amplitude Display	Power in dBm
Signal-to-noise ratio	70 dB at 32K memory depth. Noise floor varies with memory depth and with averaging.
Window Modes	Hanning, Flattop, Rectangular.

Computer System/ Storage

CPU	Intel Celeron Microprocessor 866 MHz	
Disk Drive	10 GByte, or higher internal hard drive depending upon the vintage. Storage capacity is limited only by disk space. LS-120 MS-DOS 120 MByte floppy disk drive.	Store and recall setups, waveforms, and store screen images to the hard drive and the floppy disk drive.
File types	Waveforms	Internal Y values; X and Y values in ASCII or Microsoft Excel formats.
	Images	BMP, EPS, GIF, PCX, PS (Postscript), TIF.
Mouse	Standard mouse supplied—supports any Microsoft® mouse compatible pointing device, serial or PS/2.	
Operating System	Microsoft Windows 98	
Waveform Memories	4 nonvolatile waveform reference memories.	

I/O

LAN	Enables data/setup file transfers and use of network printers; supports popular network operating systems including Novell NetWare, Microsoft, Banyan VINES, SCO UNIX and IBM; 10 Mbps operation that complies with IEEE 802.3 Ethernet and ISO/IEC 8802-3 Ethernet standards; TCP/IP protocol; RJ-45 connector.
GPIB	Fully programmable, complies with IEEE 488.2.
RS-232 (serial)	1 port: COM1. Printer and pointing device support.
Centronics	Printer port.
USB	Two pinheads link with Universal Serial Bus connectors (USB1 and USB2) peripheral devices via either a dual-port USB cable or a single-port USB cable on some configurations with serial prefixes US39480000 and above.
Printers and Plotters	Supports all printers and plotters compatible with Microsoft Windows98®. Includes but is not limited to Hewlett-Packard Deskjet and Laserjet printers. GPIB devices not supported.
PS/2 port	For PS/2 mouse.
Keyboard port	For optional keyboard.
Video Output	15-pin VGA, full color.

Notes	
1	Rise Time figures are calculated from: tr=.35/Bandwidth.
2	Magnification is used below the 10 mV/div range and between the major attenuation settings. Full scale is defined as the major attenuator setting over an intermediate setting. (Major settings for 50Ω: 10, 20, 50, 100, 200, 500, 1000 mV Major settings for 1 MΩ: all as for 50Ω plus 2 V)
3	N/A
4	For bandwidth limited signals, tr >=1.4 x sample interval.
5	FFT amplitude readings are affected by input amplifier roll-off (-3 dB, with amplitude decreasing as frequency increases above 500 MHz in 1 MΩ, 2.25 GHz for Agilent 54846B, 1.5 GHz in 50Ω for Agilent 54845B).

CAT I and CAT II Definitions

Installation category (overvoltage category) I: Signal level, special equipment or parts of equipment, telecommunication, electronic, etc., with smaller transient overvoltages than installation category (overvoltage category) II.

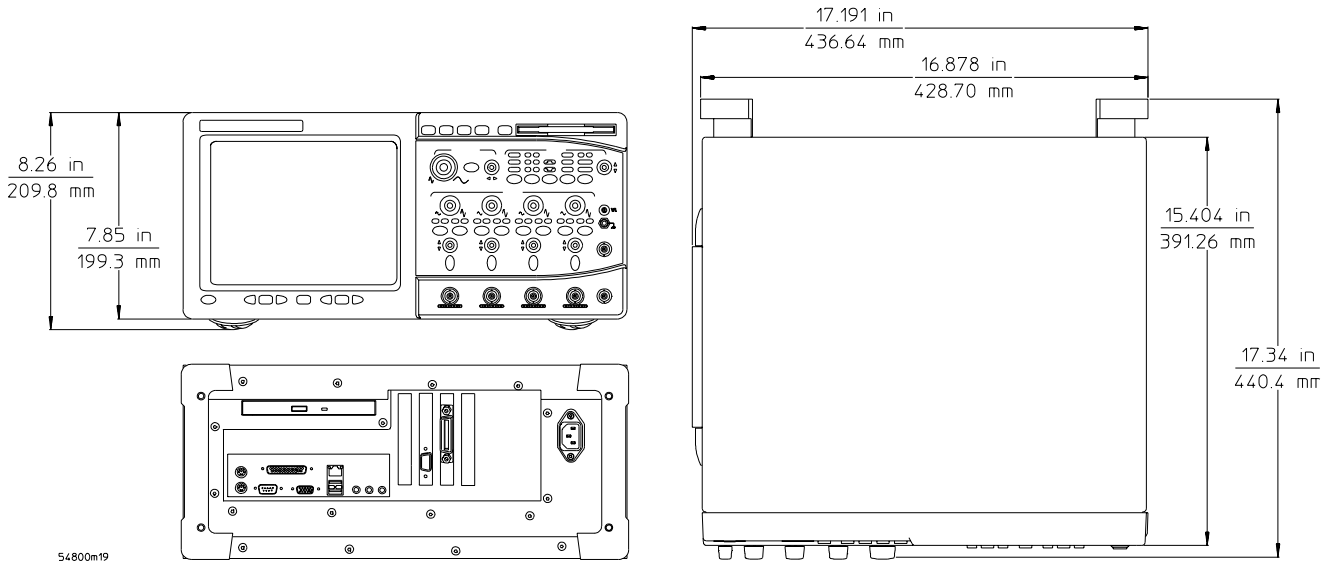
Installation category (overvoltage category) II: Local level, appliances, portable equipment etc., with smaller transient overvoltages than installation category (overvoltage category) III.

Agilent Technologies 54845B/46B general characteristics

The Infiniium oscilloscopes meet the Agilent Technologies Environmental Specification (section 750) for class B-1 products with exceptions as described for temperature.

General Characteristics

Environmental	Temperature	Operating: 10°C to +40°C Nonoperating: –40°C to 70°C Indoor use only
	Humidity	Operating: Up to 95% relative humidity (noncondensing) at +40°C Nonoperating: Up to 90% relative humidity at +65°C
	Altitude	Operating: Up to 4 600 meters Nonoperating: Up to 15 300 meters
	Vibration	Operating: Random vibration 5-500 Hz, 10 minutes per axis, 0.3g (rms) Nonoperating: Random vibration 5-500 Hz, 10 minutes per axis, 2.41g (rms)
		Resonant search 5-500 Hz, swept sine, 1 octave/minute sweep rate, (0.75g), 5-minute resonant dwell at 4 resonances per axis.
Physical	Size (excluding handle)	Height: 216 mm Width: 437 mm Depth: 440 mm
	Weight	Net: approximately 12 kg Shipping: approximately 15 kg
Power	Line voltage selection	None, PFC (Power Factor Correction)
	Line voltage range	100-240VAC, ± 10% CAT II
	Line frequency	47 to 440 Hz
	Maximum power consumption	390 W
Safety	Meets IEC1010-1 +A1, CSA certified to C22.2 No. 1010.1, Self certified to UL 3111.	


8.26 in
209.8 mm
7.85 in
199.3 mm
54800m19
17.191 in
436.64 mm
16.878 in
428.70 mm
15.404 in
391.26 mm
17.34 in
440.4 mm

Recommended test equipment

The following table is a list of the test equipment required to test performance, calibrate and adjust, and troubleshoot this instrument. The table indicates the critical specification of the test equipment and for which procedure the equipment is necessary. Equipment other than the recommended model may be used if it satisfies the critical specification listed in the table.

Recommended Test Equipment

Equipment Required	Critical Specifications	Recommended Model	Use *
Signal Generator	1 - 2.25 GHz, sine wave, amplitude 30 - 200 mV_{rms}, time base accuracy 0.25 ppm	Agilent 8664A	P
RF Amplifier	22 dB gain at 10 MHz, 1.3 GHz bandwidth	Agilent 8447D/F	P
Power Meter/Power Sensor	1 - 500 MHz, -70 dBm to +44 dBm, ±3% accuracy	Agilent EPM-441A/Agilent 8482A	P
DMM	6 1/2 digit (0.1 mV) resolution, dcV accuracy 8 ppm/year, 4-wire resistance acc. ±0.25%	Agilent 34401A	P, A, T
Power Supply	7 mV - 30 V dc, 0.1 mV accuracy and resolution	Agilent 6114A	P
Power Splitter	50 Ω type N, outputs differ by <0.15 dB	Agilent 11667A	P
Probe	No substitute	Agilent 1161A	P
Probe Tip Adapter	1160 series to BNC	Agilent 5063-2143	P
Oscilloscope	General-purpose	Agilent 54622A	P, T
Blocking Capacitor	0.18 µF	Agilent 10240B	P
Cable	Type N (m)(m) - 3 foot	Agilent 11500A or B	P
Cable (2)	BNC - 3 foot	Agilent 10503A	P, A, T
Cable (3)	BNC - 9 inch	Agilent 10502A	P, A, T
Adapter	N (m) to BNC (m)	Agilent 1250-0082	P
Adapter	N (m) to BNC (f)	Agilent 1250-0780	P
Adapter	N (f) to BNC (m)	Agilent 1250-0077	A
Adapter (2)	BNC tee (m)(f)(f)	Agilent 1250-0781	P, T
Adapter	BNC (f)(f)	Agilent 1250-0080	T
Adapter (2)	BNC (f) to dual banana (m)	Agilent 1251-2277	P
Termination	BNC connectors 50 Ω	Agilent 10100C	P
Shorting cap	BNC	Agilent 1250-0774	P
Resistor (2)	5 Ω, 5 W	Agilent 0812-0047	T
Video monitor	Accepts VGA-standard video signals		T
Keyboard	PC-compatible, AT 5-pin connector	Agilent E2610A	T
Mouse	PS/2 compatible	Agilent C3751-60201	P, T
POST Card	Power-on self test card compatible with PC-compatible systems		T
Fan Install Tool	Assists with removal and installation of fan.	Agilent 5061-7354	A, T
Fan Safety Shield	Clips onto side of chassis with cover removed	Agilent 54810-00601	A, T
Service software	No substitution	Agilent 54810-68700	T

Note: the Fan Install Too, Fan Safety Shield, and Service software are part of the Service Kit, Agilent P/N 54832-68803

* P = Performance Tests, A = Adjustments, T = Troubleshooting

2

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- To inspect the instrument 2-3
- To connect power 2-4
- To connect the mouse or other pointing device 2-5
- To attach the optional cordless trackball 2-5
- To attach the optional cordless keyboard and mouse 2-6
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Preparing for Use

Preparing for Use

This chapter shows you how to prepare the Agilent Technologies 54845B/46B oscilloscopes for use. The following areas are covered in this section.

- Inspection
- Setup
- Connecting a signal
- Cleaning

Following instrument setup is a brief section covering oscilloscope operation. If you are unfamiliar with this oscilloscope's operation, refer to the *User's Quick Start Guide*. The topics covered include:

- Using the front panel
- Using the graphical interface
- Starting and stopping acquisition
- Adjusting oscilloscope configuration
- Making measurements

The Infiniium Oscilloscope is designed to make it easy for you to use a high-performance digitizing oscilloscope.

- The familiar front-panel oscilloscope interface with knobs and buttons is optimized for the most common kinds of troubleshooting tasks and basic measurements.
- The graphical interface with menus, windows, dialogs, and toolbars provides easy logical access to dozens of configuration and analysis tools, making it easy for you to set up and make the most complex measurements.

Setting Up the Oscilloscope

This section will help you get the instrument ready to use. Included are procedures for:

- Inspection
- Connecting power
- Connecting probes and accessories
- Connecting peripherals
- Verifying basic operation
- Cleaning

To inspect the instrument

❑ Inspect the shipping container for damage.

Keep a damaged shipping container or cushioning material until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically.

❑ Check the accessories.

Accessories supplied are listed in chapter 1 of this service guide.

- If the contents are incomplete or damaged notify your Agilent Technologies Sales Office.

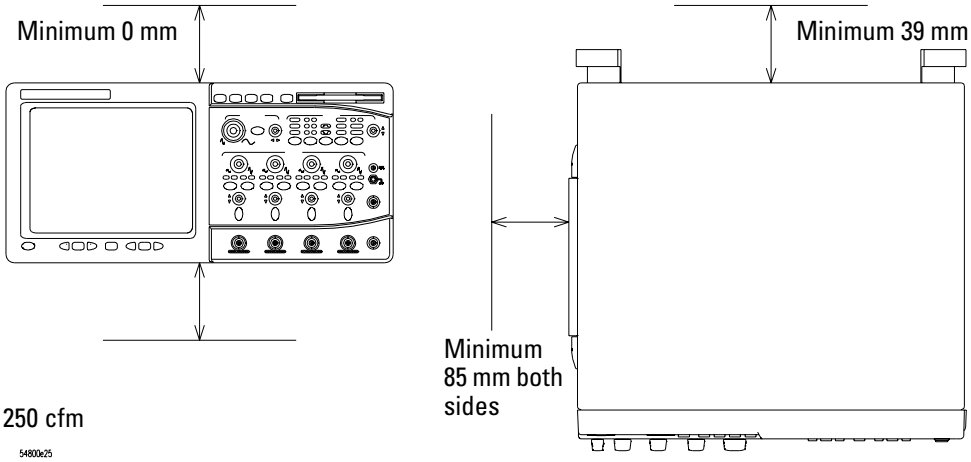
❑ Inspect the instrument.

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

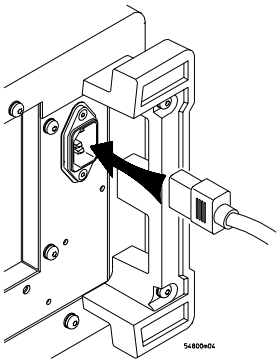
To connect power

The instrument Power Factor Correction (PFC) circuitry in the oscilloscope's power supply operates over a line voltage in the range of 100 to 240 Vac ±10% (the power supply is autoranging to the input voltage and frequency). Line frequency must be in the range 47 to 440 Hz. Power consumption is 390 W maximum.

1 Position the instrument where it will have sufficient clearance for airflow around the top, back, and sides.



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



The line cord provided is matched by Agilent Technologies to the country of origin of order. Ensure that you have the correct line cord. See "Power Cables and Plug Configurations" in chapter 7.

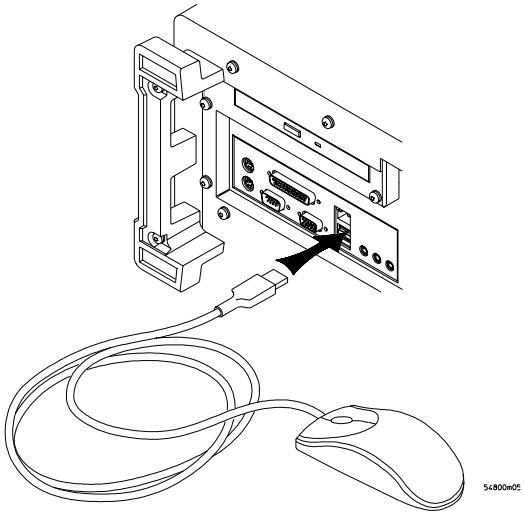
WARNING

SHOCK HAZARD!
BEFORE YOU CONNECT THIS INSTRUMENT TO MAIN POWER OR LIVE MEASURING CIRCUITS, you must provide a protective earth ground. Failure to provide a protective earth ground could result in a shock hazard if there is a failure in this instrument or equipment connected to it.
The mains plug must be inserted in a socket outlet provided with a protective earth contact. Do not use an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet does not provide an instrument ground.

A Three-wire Power Cable is Provided
This instrument is provided with a three-wire power cable. When connected to an appropriate ac power outlet, this cable grounds the instrument cabinet.

To connect the mouse or other pointing device

- Plug the mouse into the matching connector on the back panel of the oscilloscope.



The mouse is included with the oscilloscope, but using it is optional. While you can operate many oscilloscope functions with only the front-panel keys and knobs, you will need the mouse to access advanced oscilloscope functions through the graphical interface, or to find out more about the oscilloscope through the built-in information system.

The optional touchpad pointing device connects to the PS/2 connectors.

The supplied mousepad provides the correct surface for smooth mouse operation. To modify the mouse configuration, see the *User's Quick Start Guide*.

To attach the optional cordless trackball

1 Connect the receiver to the USB or PS/2 port on the back panel of the Infiniium.



2 Press the connect button on the receiver, then press the connect button on the bottom of the trackball.

3 You might be prompted by Windows® to install drivers. Please follow the dialogue boxes.

To attach the optional cordless keyboard and mouse

1 Connect the receivers to the PS/2 ports on the back panel of the Infiniium. Insert the green connector on the top and the purple connector on the bottom.

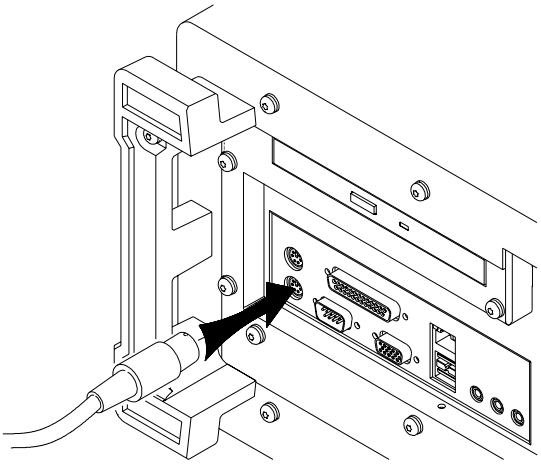


2 Press the connect button on the receiver, then press the connect button on the keyboard, fully press the connect button on the bottom of the mouse.

3 You might be prompted by Windows® to install drivers. Please follow the dialogue boxes.

To connect the keyboard

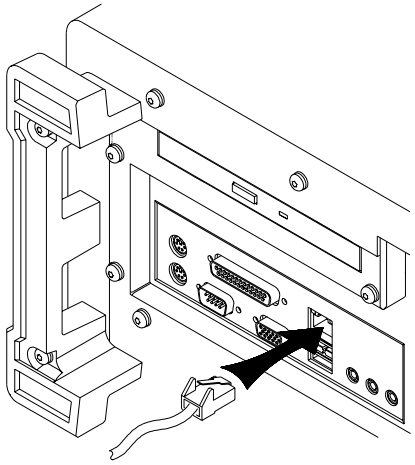
- Plug the keyboard cable into the matching connector on the back panel of the oscilloscope.



The keyboard simplifies access to some oscilloscope functions, such as entering file names when you store waveforms and setups to the disk. If you need to free desk space, place the keyboard on top of the instrument. Do not stack other objects on the keyboard; this will cause self-test failures on power-on.

To connect to the LAN card

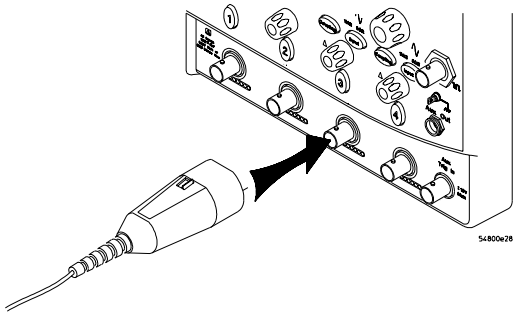
- Connect your LAN cable to the RJ-45 connector. Make sure the connection is secure.



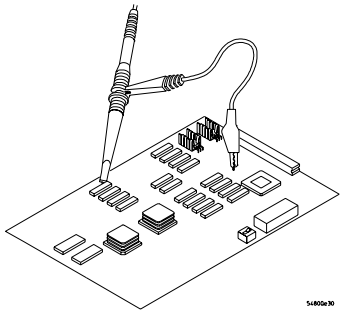
54800m07

To connect oscilloscope probes

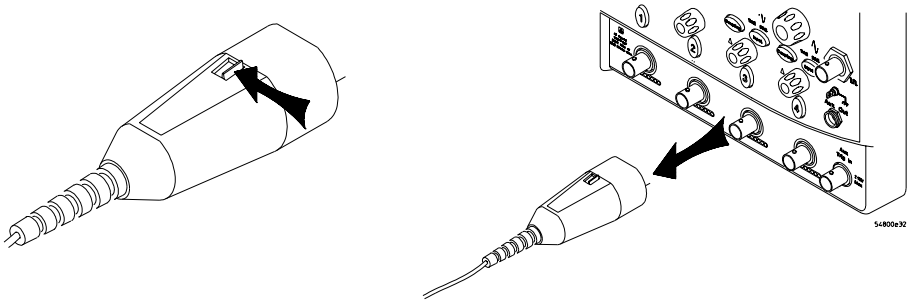
1 Attach the probe BNC connector to the desired oscilloscope channel or trigger input. Push it straight on until it latches into place.



2 Connect the probe to the circuit of interest using grabbers or other probing aids.



3 To disconnect the probe, push the small latch on top of the probe connector to the left, then pull the connector body away from the front panel of the oscilloscope without twisting it.



CAUTION AVOID DAMAGE TO THE PROBE CONNECTOR!
Do not attempt to twist the snap-on probes on or off the oscilloscope's BNC connector. Twisting the probe connector body will damage it.

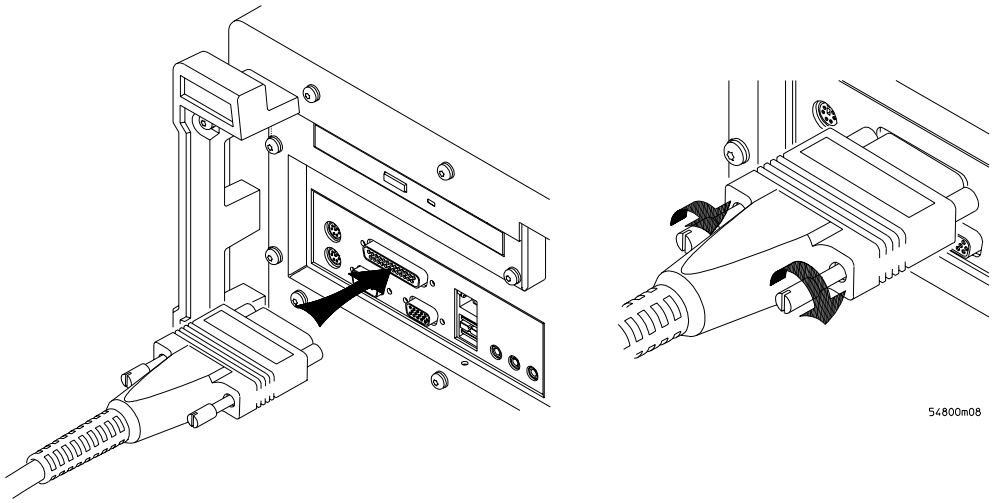
CAUTION DO NOT EXCEED THE MAXIMUM INPUT VOLTAGE!
Do not exceed the maximum input voltage rating of the oscilloscope inputs! The maximum input voltage for 50-Ω inputs is 5 V_{rms}, CAT I. The maximum input voltage for 1 MΩ inputs is ±100V (dc+ac) [ac < 10 kHz], CAT I. (Probes may have different ratings. See the probe documentation.)

To connect a printer

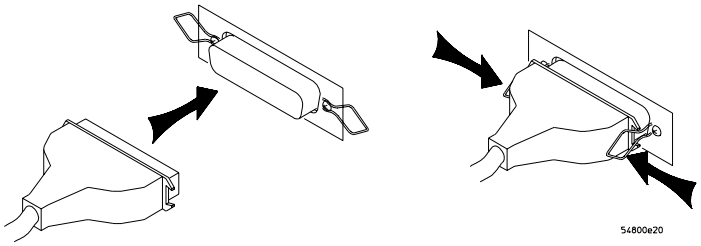
If you have a parallel (Centronics) printer, you will need a parallel printer cable, such as an Agilent C2950A (2 m) or Agilent C2951A (3 m) cable. Go to step 1.

If you have a serial printer, you will need a 9-pin to 25-pin serial printer cable, such as an Agilent 34398A cable, plus the Agilent 34399A adapter kit. Some printers may require other cable configurations, but the oscilloscope has a 9-pin serial connector. Go to step 4.

1 Attach the 25-pin small "D" connector to the printer output connector on the rear of the oscilloscope. Tighten the thumbscrews to secure the cable.



2 Attach the larger 36-pin "D" connector to the printer. Latch the wire bails into the tabs on each side of the connector.

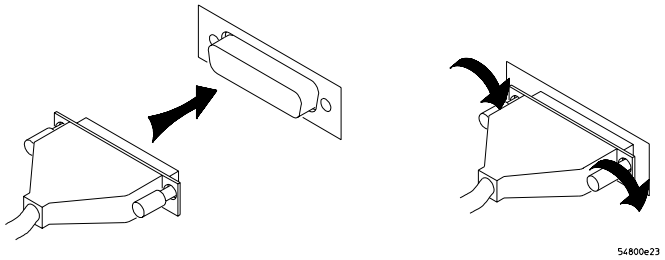


3 Set the printer configuration to use the "Centronics" or "Parallel" interface, if necessary. Refer to the *User's Quick Start Guide* for software installation instructions.

See the documentation for your printer if you have questions about configuring the printer to use the parallel interface.

4 Connect the 9-pin "D" connector of the serial printer cable to the serial output port on the rear panel of the oscilloscope. Tighten the thumbscrews to secure the cable.

5 Attach the 25-pin "D" connector to the serial input port of the printer. Tighten the thumbscrews to secure the cable.



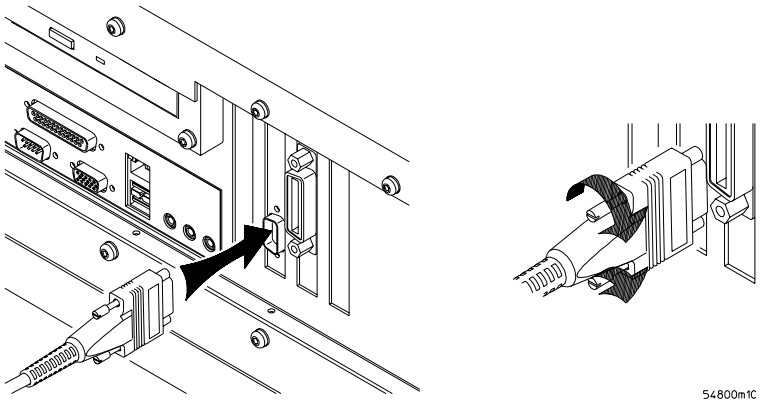
6 Set the printer configuration to use the serial interface. Refer to the *User's Quick Start Guide* for software installation instructions.

See the documentation for your printer if you have questions about configuring the printer to use the serial interface.

To connect an external monitor

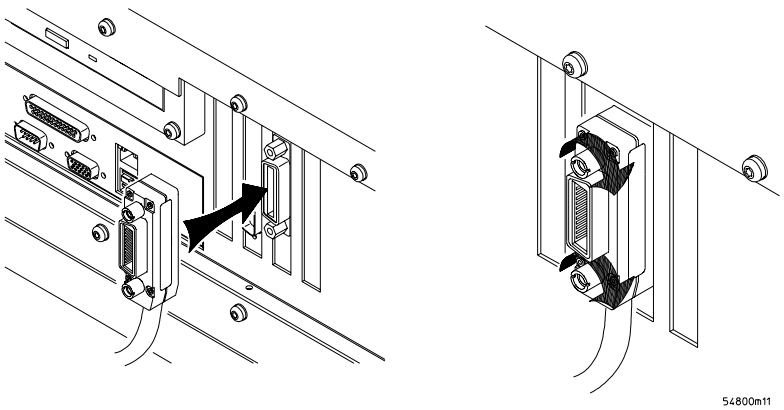
You can connect a VGA-compatible monitor to the Infiniium oscilloscope to provide a larger viewing area.

- Connect the monitor cable to the display board video connector at the rear panel of the oscilloscope. Tighten the retaining screws.



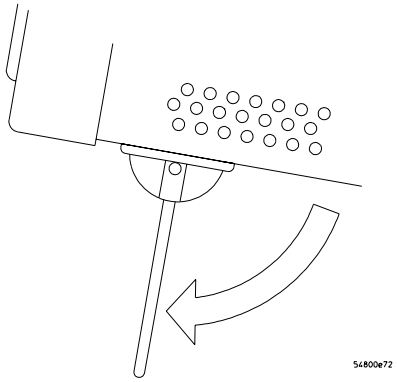
To connect the GPIB cable

- Attach the GPIB connector to the GPIB interface card connector at the rear of the oscilloscope. Tighten the thumbscrews on the connector.



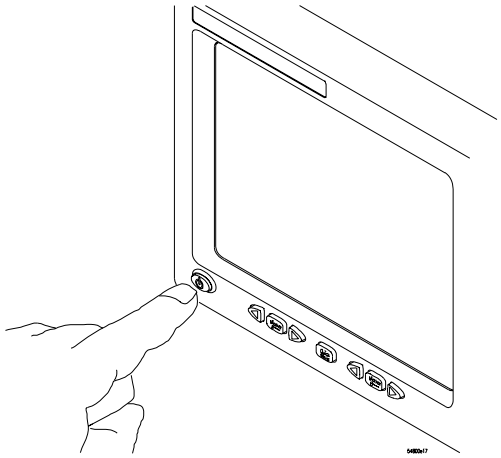
To tilt the oscilloscope upward for easier viewing

- Your oscilloscope has front feet with a wire bail between the two feet, lift up the front of the oscilloscope, grasp the bail near the center, and pull it down and forward until it latches into place.



To power on the oscilloscope

- Depress the power switch at the lower left-hand corner of the oscilloscope front panel.



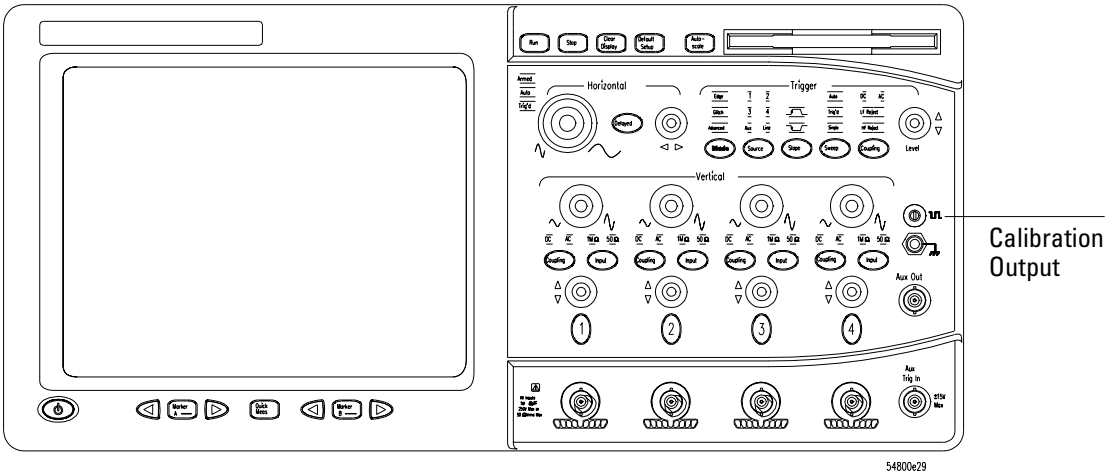
After a short initialization period, the oscilloscope display appears. The oscilloscope is ready to use.

Hook up all cables and accessories before applying power. You can connect and disconnect probes while the oscilloscope is powered-on.

You Can Configure the Backlight Saver
The oscilloscope display has a backlight saver that turns off the backlight when there has been no interface activity for a pre-determined period. The default time is 8 hours and is configurable through the Display Setup dialog in the graphical interface. You can turn the display on by moving the mouse, typing on the optional keyboard, pressing a front-panel key, or turning a front-panel knob.

To verify basic oscilloscope operation

1. Connect an oscilloscope probe to channel 1.
2. Attach the probe to the calibration output on the front panel of the oscilloscope.
   Use a probe grabber tip so you do not need to hold the probe. The calibration output is marked with a square wave symbol.



3. Press the Default Setup key on the front panel.
   The display will pause momentarily while the oscilloscope is configured to its default settings.
4. Press the Autoscale key on the front panel.
   The display will pause momentarily while the oscilloscope adjusts the sweep speed and vertical scale. You should then see a squarewave with peak-to-peak amplitude approximately 5 divisions and a period of almost 3 divisions. If you do not see the waveform, ensure your power source is adequate, the oscilloscope is properly powered-on, and the probe is connected securely to the front-panel channel input BNC and to the probe calibration output.
5. Move the mouse pointer to the graphical interface enable button and click once.
   The graphical interface enable button is in the upper-right corner of the display.
6. Move the mouse around the mouse pad and verify that the pointer follows on the screen.
   If the pointer does not move, ensure that the mouse is properly connected, that you have clicked the correct button to enable the graphical interface, and that the mouse is on a medium-friction surface such as the mouse pad supplied with the oscilloscope.



Graphical Interface Enable Button

To clean the instrument

- Clean the oscilloscope with a soft cloth dampened with a mild soap and water solution.

CAUTION

BE CAREFUL TO AVOID DAMAGING COMPONENTS!
Do not use too much liquid when cleaning the oscilloscope. Water can enter the front panel keyboard, damaging sensitive electronic components.

To clean the display monitor contrast filter

- Clean the display monitor contrast filter using glass cleaner and lens tissue or a soft cloth.

3

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Testing Performance

Testing Performance

The procedures in this section test measurement performance using Performance Specifications given in chapter 1 as performance standards. Specifications applicable to individual tests are noted at the test for reference.

Testing Interval

The performance test procedures may be performed for incoming inspection of the instrument and should be performed periodically thereafter to ensure and maintain peak performance. The recommended test interval is yearly or every 2,000 hours of operation.

Test Interval Dependencies
The test interval depends on frequency and severity of use and the environmental conditions under which the instrument is used. In recording test results, you may find that the test interval could be shortened or lengthened; however, such a decision should be based on substantial quantitative data.

See Also Chapter 4, "Calibrating and Adjusting," for information about the calibration cycle.

Equipment Required

A complete list of equipment required for the performance tests is in the Recommended Test Equipment table in chapter 1. Equipment required for individual tests is listed in the test. Any equipment satisfying the critical specifications listed may be substituted for the recommended model. The procedures are based on the model or part number recommended.

Self-Test Verification

To verify system operation with high confidence, without the test equipment and time required for performance tests, perform the self-tests. These internal tests verify many functions of the oscilloscope.

To run the self-tests, enable the graphical interface, then select Self Test from the Utilities menu. The Self Test drop down list box allows you to select Scope Self Tests, Key and Knob Test, or LED Test. A message is displayed with the instruction to remove all inputs to the instrument. During execution of the self-tests, the oscilloscope displays diagnostic messages indicating the status of each test.

If one of the self-tests fails, FAILED is displayed rather than PASSED, and a 16-bit diagnostic code is displayed. This code is used by factory service personnel when troubleshooting the main assembly. Failure of a self-test indicates an assembly failure. The assembly must be replaced before you attempt performance verification. For more troubleshooting information, refer to chapter 5, "Troubleshooting."

Test Record

You can record the results of the performance tests in the Performance Test Record provided at the end of this chapter. The Performance Test Record lists the performance tests and provides an area to mark test results. You can use the results recorded at incoming inspection for later comparisons during periodic maintenance, troubleshooting, and after repairs or adjustments.

Operating Hints

Some knowledge of operating the oscilloscope is helpful; however, these procedures are written so that little experience is necessary. The following two hints will speed progress of the testing.

Clear Display

When using many averages, it often takes awhile for a waveform display to stabilize after a change. When a control on the oscilloscope is changed, averaging automatically restarts. When just the input signal is changed, the instrument must average new data with the old so it takes longer for the waveform to stabilize.
Press the Clear Display key while changing input signals. The instrument will restart averaging and give a quick indication of the result of the signal change.

Averaging

Averaging is used to assure a stable signal for measurements. It is not necessary to wait for complete stability of the signal (averaging complete), as long as the measurement is well within the limits of the test.

Specifications

The specifications that apply to a particular test are given with the test procedure. The specification as given with the test may be abbreviated for clarity. In case of any questions, refer to the complete specifications and characteristics in chapter 1, “General Information.”

Performance Test Procedures

Performance test procedures start with the next paragraph. Procedures may be done individually and in any order.

Let the Instrument Warm Up Before Testing
Allow the instrument to warm up for at least 30 minutes prior to beginning performance tests. Failure to allow warm-up may cause the instrument to fail tests.

To test the dc calibrator

The Aux Out BNC on the front panel is used for self-calibration and probe calibration. Though calibrator accuracy is not specified in the performance specifications, it must be within limits in order to provide accurate self-calibration.

Test Limits: -2.5 v to +2.5 v, Accuracy ±0.2% of delta voltage output

Equipment Required

Equipment	Critical Specifications	Recommended Model/Part
Digital Multimeter	0.1 mV resolution, better than 0.1 % accuracy	Agilent 34401A
Cable	BNC	Agilent 10503A
Adapter	BNC (f) to banana (m)	Agilent 1251-2277

Procedure

1. Connect the multimeter to the front panel Aux Out BNC.
   Use the BNC cable and the BNC to banana plug adapter.
2. Enable the graphical interface.
   Use the mouse to click on the button in the upper right-hand corner of the display. See figure 3-1.

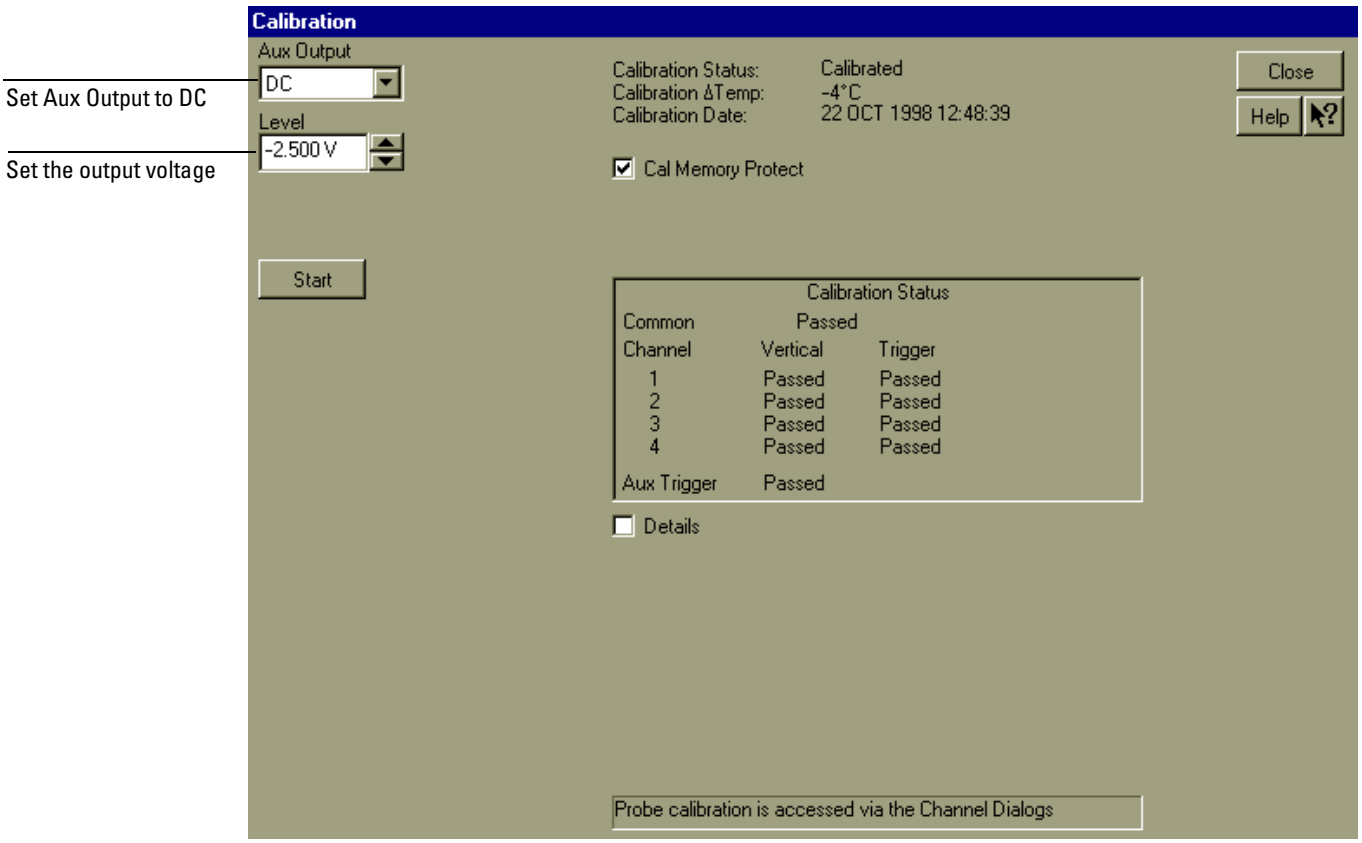
Figure 3-1



Enabling the graphical interface

3. Press Default Setup to set the oscilloscope to default conditions.
4. Select Calibration from the Utilities menu.
5. Select DC from the Aux Output drop-down list box.
   See figure 3-2.

Figure 3-2



Selecting DC in the Calibration Dialog

6 Set the dc output voltage to +2.500 V using the Level spin box or the numeric keypad dialog.

You can access the numeric keypad dialog by clicking on the value in the Level box. Enter the values by clicking on digits, signs, and exponents in the keypad. Click Close when finished.

7 The DVM should read near +2.500 V. Record the reading to four significant digits. V1 = _____.

8 Set the level to -2.500 V using the Level spin box or the numeric keypad dialog.

9 The DVM should read near –2.500 V. Record the reading. V2 = _____.

10 Subtract the second reading from the first reading, then divide the result by 5.

For example, if the first reading is +2.498 V and the second reading is -2.497 V, then

$$\frac{V1 - V2}{5} = \frac{2.489 - (-2.497)}{5} = 0.999$$

11 The final result should be between 0.998 and 1.002. Record the result in the Performance Test Record at the end of the chapter.

12 Click Close to exit the calibration menu.

If the test fails
Repair is necessary. See chapter 5, "Troubleshooting."

To test input resistance

This test checks the input resistance of the vertical inputs. A four-wire measurement is used to accurately measure the 50-Ω and 1-MΩ inputs.

Specification: 1 MΩ ±1% and 50 Ω ±1.5%

Equipment Required

Equipment	Critical Specifications	Recommended Model/Part
Digital Multimeter	Measure resistance (4-wire) at better than 0.25% accuracy	Agilent 34401A
Cables (2)	BNC	Agilent 10503A
Adapter	BNC Tee (m)(f)(f)	Agilent 1250-0781
Adapters (2)	BNC (f) to dual banana (m)	Agilent 1251-2277

Procedure

1 Set up the multimeter to make a four-wire resistance measurement.

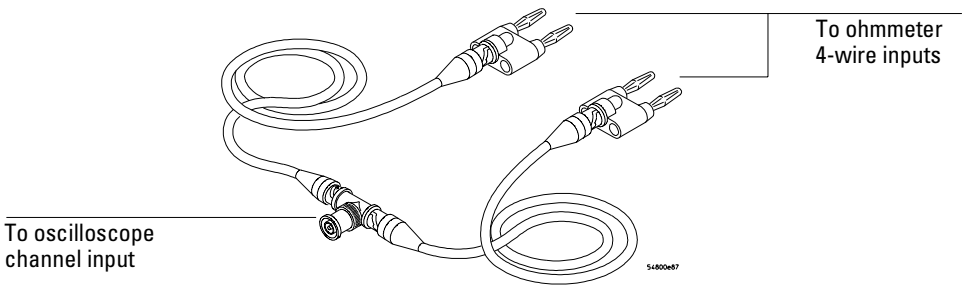
2 Assemble the test cables.

a Use the two BNC-to-banana adapters to connect one end of each BNC cable to the four-wire resistance connections on the multimeter.

b Connect the free ends of the cables to the BNC tee.

See figure 3-3.

Figure 3-3



Input Resistance Equipment Setup

3 Connect the male end of the BNC tee to the channel 1 input of the oscilloscope.

4 Press Default Setup to set the oscilloscope to default conditions.

5 Press the Input key for Channel 1 to select 1 MΩ, then 50Ω, and verify resistance readings of 1 MΩ ±10 kΩ and 50 Ω ±0.75 Ω respectively.

6 Record the readings in the Performance Test Record.

7 Repeat steps 3 through 6 on the remaining channels.

To test voltage measurement accuracy

This test verifies the voltage measurement accuracy of the instrument. The measurement is made using dual-cursor automatic measurement so that offset errors are not a factor.

A power supply provides a reference voltage to check voltage measurement accuracy. The actual supply voltage is monitored for accuracy using a NIST-traceable voltmeter. A dc blocking capacitor and a BNC short are used to filter any noise generated by the power supply (especially at low voltages) so it does not appear at the oscilloscope input.

Specification

Only the dual-cursor specification is tested.

Single Cursor Measurement: ±(gain accuracy + offset accuracy + resolution/2)
Dual Cursor Measurement: ±(gain accuracy + resolution)
Gain Accuracy: ± 1.00% of full scale at full-resolution channel scale
Resolution: 8 bits, (0.4% of full scale without averaging); or
12 bits, (0.024% of full scale with 32 averages) at ful-resolution scale
Offset Accuracy: ±(1.00% of channel offset + 1% of full scale) at full-resolution scale

Equipment Required

Equipment	Critical Specifications	Recommended Model/Part
Power Supply	7 mV to 30 Vdc, 0.1 mV resolution	Agilent 6114A
Digital Multimeter (DVM)	Better than 0.1% accuracy	Agilent 34401A
Cables (2)	BNC	Agilent 10503A
Adapters (2)	BNC (f) to banana (m)	Agilent 1251-2277
Adapters (2)	BNC tee (m)(f)(f)	Agilent 1250-0781
Blocking capacitor	0.18 µF	Agilent 10240B
Shorting cap	BNC	Agilent 1250-0774

Procedure

1 Connect the equipment.

See figure 3-4.

a Use a BNC-to-banana adapter to connect a BNC cable to the power supply.

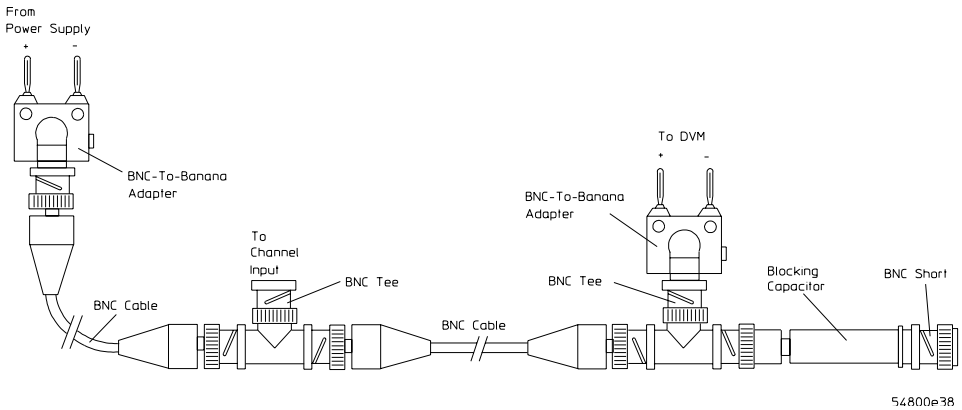
b Connect a BNC tee to the other end of the cable and connect the tee to channel 1 of the oscilloscope.

c Connect another BNC cable to the tee at the oscilloscope and connect a BNC tee to the other end of the cable.

d Connect the blocking capacitor to the BNC tee and connect the BNC short to the blocking capacitor.

e Connect a BNC-to-banana adapter to the same BNC tee and connect the adapter to the DVM input.

Figure 3-4



Voltage Measurement Accuracy Equipment Setup

2 Press Default Setup to set the oscilloscope to default conditions.

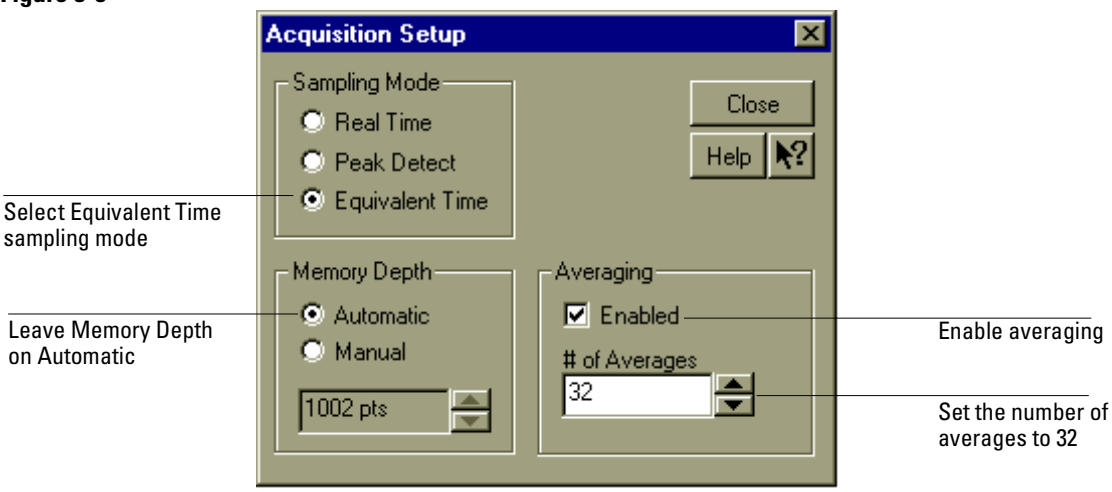
3 Set all channels to dc using the Coupling key and to 1 MΩ input impedance using the Input key.

4 Using the mouse, enable the graphical interface.

5 Select Acquisition from the Setup menu.

6 Select Equivalent Time sampling mode. Enable Averaging. Set the # of Averages to 32, either using the spin box or the numeric keypad dialog. Click Close.
See figure 3-5.

Figure 3-5



Acquisition Setup for Voltage Accuracy Measurement

7 Use the following table for steps 8 through 15.

Scale	Offset	Supply	Tolerance	Limits
2 V/div*	2.5 V	5 V	±163.8 V	4.836 V to 5.164 V
1 V/div	2.5 V	5 V	±82 mV	4.918 to 5.082 V
500 mV	1.75 V	3.5 V	±41 mV	3.459 to 3.541 V
200 mV	700 mV	1.4 V	±16.4 mV	1.384 to 1.416 V
100 mV	350 mV	700 mV	±8.2 mV	691.8 mV to 708.2 mV
50 mV	175 mV	350 mV	±4.1 mV	345.9 mV to 354.1 mV
20 mV	70 mV	140 mV	±1.64 mV	138.36 mV to 141.64 mV
10 mV	35 mV	70 mV	±0.819 mV	69.18 mV to 70.82 mV

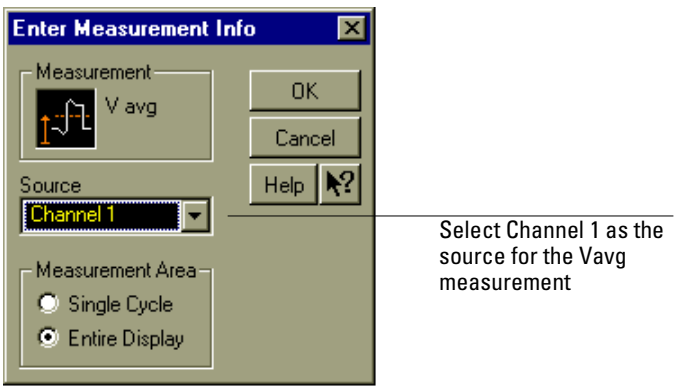
* only in 1 MΩ input

Below 10 mV/div expansion is used and full scale is defined as 80 mV. The ranges from 2 to 9 mV/div are handled in firmware, and will be within specifications when the 10 mV/div range is within specifications.

8 Select Vavg from the Voltage submenu of the Measure menu. Ensure that Channel 1 is selected in the Source dialog and click OK.

See figure 3-6.

Figure 3-6



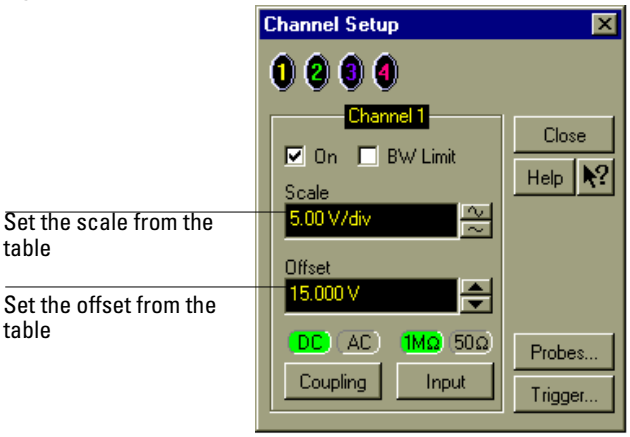
Source Selection for Vavg Measurement

9 Select Channel 1 from the Setup menu.

10 Set the vertical scaling for Channel 1 to the volts/div value from the first row of the table in step 7. Set the Offset value to the Position value from the first row of the same table. Click Close.

See figure 3-7.

Figure 3-7



Vertical Scaling and Offset for Voltage Accuracy Measurement

> **To Set Vertical Scale and Position**
> You can also use the knobs to set the vertical scale and position, but it is usually easier to use the dialog box, particularly for the fine position setting.

11 With the supply disconnected from the channel input, note the V_{avg} mean reading. _____ V

It may take a moment for this value to settle because of averaging.

12 Set the power supply voltage from the first line of the table. Use the voltmeter to adjust the power supply for the most accurate output.

13 Connect the power supply to the channel input and note the V_{avg} reading. _____ V

Press Clear Display and wait a moment to read the value (so that averaging is complete).

14 Subtract the value in step 11 from the value in step 13. Record the difference in the Performance Test Record.

15 On the same channel, repeat steps 10 through 14 for the rest of the rows in the table.

16 With the channel keys, set the active channel OFF and the next ON.

A channel is ON if its key is illuminated and OFF if it is not illuminated.

17 Move the BNC tee to the next channel and repeat steps 8 through 15 for that channel.

18 Repeat steps 8 through 17 for the rest of the channels.

19 Repeat steps 3 through 18 for the 50Ω input.

> **If the test fails**
> Voltage measurement errors can be caused by the need for self-calibration. Before troubleshooting the instrument, perform self-calibration. See "To run the self-calibration" in chapter 4, "Calibrating and Adjusting." If self-calibration fails to correct the problem, the cause may be the attenuator or main assembly.

To test offset accuracy

This test checks the vertical offset accuracy.

Specification: ±(1.00% of channel offset + 1% of full scale) at full-resolution channel scale

Equipment Required

Equipment	Critical Specifications	Recommended Model/Part
Power Supply	0.5 V to 2 Vdc, ±1 mV accuracy	Agilent 6114A
Digital Multimeter (DVM)	Better than 0.1% accuracy	Agilent 34401A
Cables (2)	BNC	Agilent 10503A
Adapters (2)	BNC (f) to banana (m)	Agilent 1251-2277
Adapters (2)	BNC tee (m)(f)(f)	Agilent 1250-0781
Blocking capacitor	0.18 µF	Agilent 10240B
Shorting cap	BNC	Agilent 1250-0774

Procedure

1 Connect the equipment.

The cabling is the same as that used for the voltage measurement accuracy test. See figure 3-4.

- **a** Use a BNC-to-banana adapter to connect a BNC cable to the power supply.
- **b** Connect a BNC tee to the other end of the cable and connect the tee to channel 1 of the oscilloscope.
- **c** Connect another BNC cable to the tee at the oscilloscope and connect a BNC tee to the other end of the cable.
- **d** Connect the blocking capacitor to the BNC tee and connect the BNC short to the blocking capacitor.
- **e** Connect a BNC-to-banana adapter to the same BNC tee and connect the adapter to the DVM input.

2 Press Default Setup to set the oscilloscope to default conditions.

3 Select Acquisition from the Setup menu.

4 Select Equivalent Time under Sampling Mode. Enable Averaging, and set the # Points for averaging to 32. Click Close.

Setup is the same as that for the voltage measurement accuracy test. See figure 3-5.

5 Use the following table for steps 6 through 12.

Volts/div	Position	Supply	Tolerance	Limits	
				minimum	maximum
200 mV	2.00000 V	2.00 V	±36 mV	1.964 V	2.036 V
100 mV	1.00000 V	1.00 V	±18 mV	0.982 V	1.018 V
50 mV	500.000 mV	500 mV	±9 mV	491 mV	509 mV

6 Select Channel 1 from the Setup menu.

7 Set the vertical Scale to the Volts/div value from the first row of the table. Set the Offset to the Position value from the first row of the table. Click Close.

8 Set the supply voltage to 2.00 V as in the first row of the table. Use the DVM to verify the setting.

9 Re-adjust the vertical position, if necessary, so the trace is as close to the horizontal center line of the grid as possible after it has settled (averaging complete).

10 Read the position voltage. It should be equal to the DVM reading, within the limits given in the table. Record the reading in the Performance Test Record.

To find the current position setting, select Channel 1 from the Setup menu and read the Offset field. Click Close when finished.

11 Repeat steps 6 through 10 for the other lines in the table.

12 With the channel keys, set the active channel OFF and the next ON.

13 Move the BNC from one channel to the next.

14 Repeat steps 6 through 13 for each channel, setting the parameters of the channel being tested where appropriate.

If the test fails
Offset errors can be caused by the need for self-calibration. Perform self-calibration (see chapter 4, "Calibrating and Adjusting") before troubleshooting the instrument.

To test bandwidth

This test checks the bandwidth of the oscilloscope. The Agilent 54845B bandwidth at 1.5 GHz and the Agilent 54846B bandwidth at 2.25 GHz oscilloscopes are checked using aliasing since the trigger specification of these oscilloscopes is 1 GHz. The 1.5 GHz or the 2.25 GHz signal is viewed with a time/division setting of approximately 50 µs/div where the on-screen display is an untriggered sinewave that appears to be at a lower frequency, however the vertical response of the amplifiers is correct.

Specification

Equivalent Time:
50Ω: 2.25 GHz (Agilent 54846B), 1.5 GHz (Agilent 54845B), 1 MΩ: 500 MHz (with Agilent 1161A probe)

Real Time:
50Ω: for Agilent 54846B — 2.25 GHz (2-channel mode), 1.0 GHz (4-channel mode)
50Ω: for Agilent 54845B — 1.5 GHz (2-channel mode), 1.0 GHz (4-channel mode)
1 MΩ: 500 MHz (with Agilent 1161A probe)

Equipment Required

Equipment	Critical Specifications	Recommended Model/Part
Signal Generator	10—2250 MHz at ≈200 mVrms	Agilent 8664A
Power Meter/Sensor	1—1.5 GHz ±3% accuracy	Agilent EPM-441A/8482A
Power Splitter	outputs differ by <0.15 dB	Agilent 11667A
Cable	Type N (m) 24 inch	Agilent 11500B
Termination	50Ω, BNC Connectors	Agilent 10100C
Adapter	Type N (m) to BNC (m)	Agilent 1250-0082
Probe	No Substitute	Agilent 1161A
Probe Tip Adapter	1160 Series to BNC	Agilent 5063-2143

Equivalent Time Test

1 Connect the equipment.
   - **a** With the N cable, connect the signal generator to the power splitter input. Connect the power sensor to one output of the power splitter.
   - **b** With an N-to-BNC adapter, connect the other splitter output to the channel 1 input.
2 Press Default Setup to set the oscilloscope to default conditions.
3 Select Acquisition from the Setup menu. Select Equivalent Time sampling mode. Click Close. Select Display from the Setup Menu. Unselect Connect Dots mode. Click Close.
4 Set the vertical scale for Channel 1 to 100 mV/div using the knob. Select 50Ω input impedance.
5 Set the sweep speed to 50 ns/div using the horizontal sweep speed knob.
6 Set the signal generator for 10 MHz at +5.0 dBm.
   The signal on the oscilloscope screen should be about five cycles at six divisions amplitude.

Bandwidth Check Limits
Do not exceed 6 divisions when making the bandwidth check.

7 Select V_{amptd} from the Voltage submenu of the Measure menu.

8 Note the $V_{amptd\ (1)}$ reading at the bottom of the screen. V_{10MHz} =_____mV.

9 Set the power meter Cal Factor % to the 10 MHz value from the calibration chart on the power sensor. Then press dB[REF] on the power meter to set a 0 dB reference.

This establishes the baseline output power at 10 MHz as a reference for the bandwidth measurement.

10 Change the signal generator output frequency to 1500 MHz for Agilent 54845B, or 2250 MHz for Agilent 54846B. Set the power meter chart Cal Factor % to the 2250 MHz value, to the 1500 MHz value, or to the 1000 MHz value depending on the model number.

This step compensates the power meter reading for changes in the power sensor output at 1000 MHz, 1500 MHz, or 2250 MHz with respect to 10 MHz.

11 Adjust the signal generator output amplitude for a power reading as close as possible to 0.0 dB[REL]. Write down the actual reading. Reading = _____ dB [REL].

The reading on the power meter will be used to correct the final bandwidth value.

12 Use one of the following steps depending on the Infiniium oscilloscope model being tested and the bandwidth acquisition mode:

a (Use this step for model 54845B 1500 MHz Equivalent Time bandwidth check.) Set the sweep speed to 50 µs/div using the Horizontal sweep speed knob.

b (Use this step for model 54846B 2250 MHz Equivalent Time bandwidth check.) Set the sweep speed to 50 µs/div using the Horizontal sweep speed knob

c (Use this step for Real Time bandwidth checks: 1500 MHz on 54845B, or 2250 MHz on 54846B)
Set the sweep speed to 500 ps/div using the Horizontal sweep speed knob.

d (Use this step for 1 MΩ, 500 MHz bandwidth check for all three models.)
Set the sweep speed to 1 ns/div using the Horizontal sweep speed knob.

13 Press the Clear Display key followed by the Run key to display a trace. (It there is no trace on the screen slowly adjust the Trigger Level knob through zero until a trace is displayed.) Note the $V_{amptd(1)}$ reading.
$V_{2250MHz}$ = _____ mV (54846B)
$V_{1500MHz}$ = _____ mV (54845B)

14 Calculate the response using the formula:

$$response(dB) = 20\log_{10}\frac{V_{1500\ MHz}}{V_{10\ MHz}} = 20\log_{10}_____ = _____ dB$$

For example:

$$20\log_{10}\frac{487\ mV}{559\ mV} = 20\log_{10}0.871 = Ð1.19 dB$$

15 Correct the result from step 14 with any difference in the power meter from step 11. Observe signs. For example:

Result from step 14 = -1.19 dB

Power meter reading = –0.5 dB(REL)

then true response = (–1.19)–(–0.5) = –0.69 dB

(_____) – (_____) = _____dB

16 The result from step 15 should be between +3.0 dB and –3.0 dB. Record the result in the Test Record.

17 Switch the power splitter from the channel 1 to the channel 2 input.

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

19 Repeat steps 4 through 18 for the remaining channels, setting the parameters of the channel being tested where appropriate.

Real Time Test

20 Select Acquisition from the Setup menu.

21 Select Real Time sampling mode, 8 GSa/s (Agilent 54845B and 54846B) configuration, then click Close.

22 Repeat steps 4 through 19, testing channels 1 and 3 to the 2.25 GHz limit (54846B), 1.5 GHz limit (Agilent 54845B).

23 Select Acquisition from the Setup menu.

24 Select the 4 GSa/s configuration (Agilent 54845B and 54846B) then click Close.

25 Repeat steps 4 through 19, testing channels 1, 2, 3, and 4 to the 1 GHz limit (Agilent 54845B and 54846B).

1 MΩ, 500 MHz Test on 54845B, and 54846B

26 Disconnect the power splitter from the channel input.

27 Select Acquisition from the Setup menu.

28 Select Equivalent time Sampling Mode and click Close.

29 Connect the Agilent 1161A 10:1 probe to channel 1. Verify that the probe compensation is correct.

30 Change channel to 100 mV/div using the knob.

31 Connect the probe tip to the power splitter using the probe-tip-to-BNC adapter and 50Ω termination.

32 Repeat steps 5 through 19, testing the 500 MHz limit on channels 1, 2, 3, and 4.

If the test fails
Failure of the bandwidth test can be caused by a faulty attenuator or main assembly. A self calibration may correct a bandwidth failure.

To test time measurement accuracy

This test uses a precise frequency source to check the accuracy of time measurement functions.

Specification Delta-t accuracy

Equivalent Time: (≥16 averages)
±[(0.007% × delta-t) + (full scale/(2 × memory depth))+ 30 ps]

Real Time: * ±[(0.007% × delta-t) + (0.2 × sample period)]

* The specification applies to bandwidth limited signals (tr ≥ 1.4 × sample period). The sample period is defined as 1/(sample rate). The specification also applies to those automatic measurements computing time intervals on identical slope edges (like pos-pos, neg-neg).

Equipment Required

Equipment	Critical Specifications	Recommended Model/Part
Signal Generator	1-100 MHz, timebase accuracy - 0.25 ppm	Agilent 8664A
RF Amplifier	40 MHz to 1 GHz, 20 dB gain	Agilent 8447D
Cable	Type-N 24 inch	Agilent 11500B
Cable	BNC	Agilent 10503A
Adapter	Type N (f) to BNC (m)	Agilent 1250-0077

The Agilent 8447D RF Amplifier is used as a saturation amplifier to create a very low-jitter squarewave from the sinewave output of the signal generator. You adjust the signal generator output level to change the risetime of the squarewave.

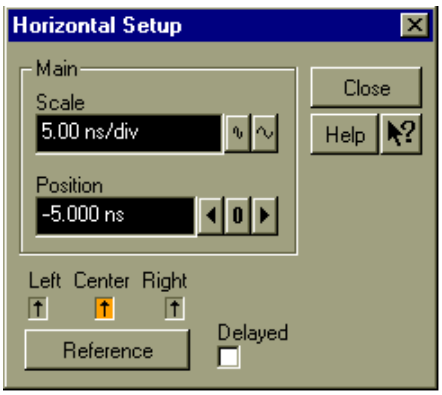
Equivalent Time Mode Procedure

This test checks time measurement in equivalent time mode with averaging.

1. Set the Agilent 8664A signal generator for a 40-MHz sine wave (25.0 ns period) at 250 mV_{rms}.
2. Connect the output of the signal generator to the INPUT of the Agilent 8447D RF amplifier.
3. Connect the OUTPUT of the RF amplifier to the channel 1 input of the oscilloscope.
4. Press Default Setup to set the oscilloscope to default conditions.
5. Press Input to select 50 Ω. Press Coupling to select dc.
6. Press Autoscale.
7. Set the vertical scale to 500 mV per division.

8 Select horizontal from the setup mean. Set the scale to 5 ns/div, position at –5 ns, and reference to the left.

Figure 3-8

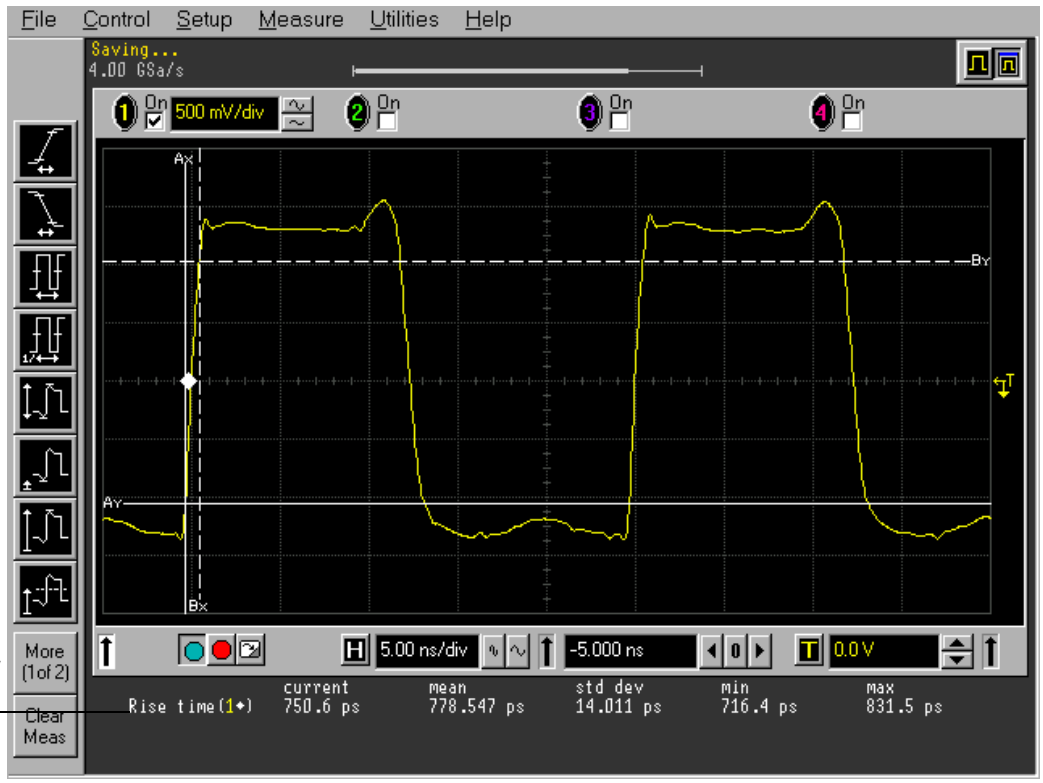


Horizontal Setup for Equivalent Time Procedure

9 Adjust the signal generator output voltage to obtain a waveform with a risetime of approximately 700 ps to 1.4 ns.

You can measure the risetime by selecting the Risetime command from the Time submenu of the Measure menu. See figure 3-9.

Figure 3-9



Use the risetime measurement to verify correct waveform shape for the time measurement accuracy check

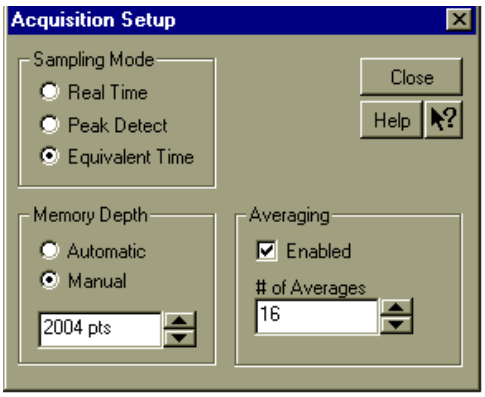
Waveform for Time Measurement Accuracy Check

10 Select Acquisition from the Setup menu.

11 Select Equivalent Time sampling mode. Enable Averaging and set the # Points to be averaged to 16. Select Manual Memory Depth. Set the memory depth to 2004 points. Click Close.

See figure 3-10.

Figure 3-10

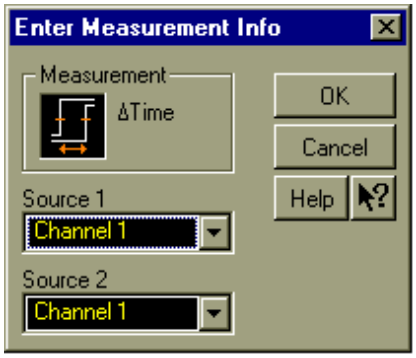


Acquisition Setup for Equivalent Time Procedure

12 Select Delta Time from the Time submenu of the Measure menu. Select Channel 1 as the source in the dialog that appears and click Close.

See figure 3-11.

Figure 3-11



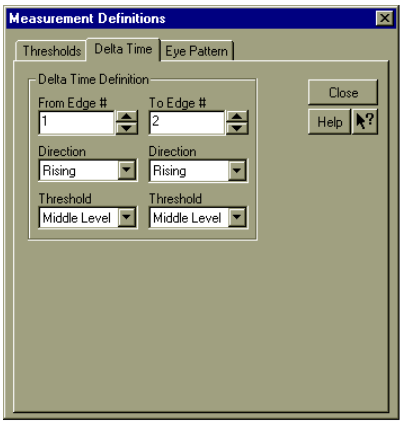
Source Selection for Delta Time Measurement

13 Select Measurement Definitions from the Customize submenu of the Measure menu. (If you have code Revision A.03.00 or higher, select Delta Time from the Measurements Definitions submenu of the Measure menu.)

14 Set From Edge # to 1 with Direction Rising and Threshold Middle. Set To Edge # to 2 with Direction Rising and Threshold Middle. Click Close.

See figure 3-12.

Figure 3-12



Measurement Settings for Time Interval Measurement

For valid statistical data
In equivalent time mode, measurement specifications are valid with sixteen or more acquisitions averaged. Statistics accumulated before the required number of averaged acquisitions may show the instrument to fail the specification. This is particularly true for minimum and maximum in this case since they are set by measurements taken with the fewest averages.

If the procedure above is followed exactly, the required number of acquisitions are averaged before statistics are turned on. Therefore, if you clear and restart measurements, averaging and statistics are restarted simultaneously and the result is erroneous data collected from the early averages.

If in doubt about the statistical data, after #Avg is complete select Clear Measurements or Clear All from the Measure menu tool bar, then repeat the custom measurement again. This restarts the statistics without restarting averaging and the result is valid statistical data.

15 Verify the period is 25 ns ± 44 ps, minimum 24.956 ns and maximum 25.044 ns. Record the minimum and maximum readings in the Performance Test Record.

16 Change the signal generator frequency to 100 MHz (10 ns period).

17 Select horizontal from the setup menu. Set the position to –11 ns.

18 Clear measurement statistics.

Do this by clicking Clear Meas (Clear All) on the measurement toolbar, then selecting Delta time from the Time submenu of the measure menu.

19 The delta time reading should be 10 ns ± 43 ps, minimum 9.957 ns and maximum 10.043 ns. Record the minimum and maximum readings in the Performance Test Record.

20 Change the signal generator frequency to 20 MHz (50 ns period).

21 Select horizontal from the setup menu. Set the scale to 100 ns/div, position to –11 ns.

22 Clear measurement statistics as in step 18 and restart the measurement.

23 The delta time reading should be 50 ns ± 283 ps; minimum 49.72 ns and maximum 50.28 ns. Record the minimum and maximum readings in the Performance Test Record.

24 Change the signal generator frequency to 1 MHz (1 µs period).

25 Select horizontal from the setup menu. Set the scale to 1 µs/div, position to –11 ns.

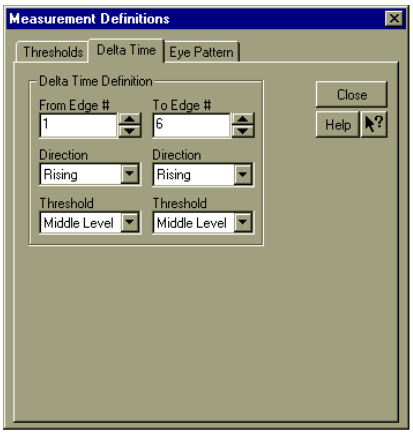
26 Clear measurement statistics as in step 18 and restart the measurement.

27 The delta time reading should be 1 µs ± 2.595 ns, minimum 997.4 ns and maximum 1.0026 µs. Record the minimum and maximum readings in the Performance Test Record.

28 Select Measurement Definitions from the Customize submenu of the Measure menu. (If you have code Revision A.03.00 or higher, select Delta Time from the Measurements Definitions submenu of the Measure menu.)

29 Set the To Edge # to 6 with Direction Rising and Threshold Middle. Click Close.
See figure 3-13.

Figure 3-13



New Measurement Settings for Delta Time Measurement

30 Clear measurement statistics as in step 18 and restart the measurement.

31 The delta time readings should be 5 µs ± 2.875 ns, minimum 4.9971 µs and maximum 5.0029 µs. Record the minimum and maximum readings in the Performance Test Record.

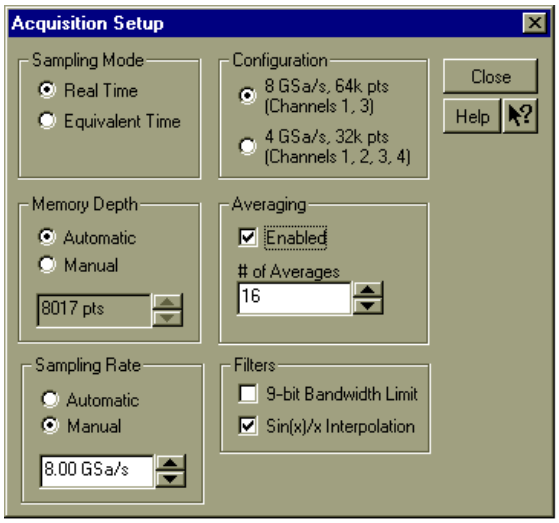
Real-Time Mode Procedure

This procedure continues from the previous one.

1. Change the signal generator frequency to 25.31646 MHz (39.49999 ns period).
2. Select Acquisition from the Setup menu.
3. Select Real Time sampling mode. Set Configuration to 8 GSa/s (Agilent 54846B and 54845B). Set Sampling Rate to Manual, 8 GSa/s (Agilent 54845B and 54846B). Enable Averaging with the number of points set to 16. Set Memory Depth to Automatic. Click Close.

   See figure 3-14.

Figure 3-14

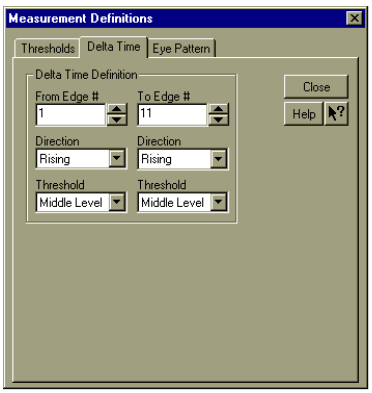


Acquisition Setup for Real Mode Procedure (showing Agilent 54845B)

4. Set sweep speed to 50 ns/div with horizontal position at 0.0 s.
5. Select Measurement Definitions from the Customize submenu of the Measure menu. (If you have code Revision A.03.00 or higher, select Delta Time from the Measurements Definitions submenu of the Measure menu.)
6. Set To Edge # to 11 with Direction Rising and Threshold Middle. Click Close.

   See figure 3-15.

Figure 3-15



Measurement Definitions for Real Mode Procedure

7 Clear measurements.

8 Select Period from the Time submenu of the Measure menu.

9 Period should be the following.

For Agilent 54845B and 54846B: 39.50 ns ± 28 ps, minimum 39.47 ns, maximum 39.53 ns. Record the minimum and maximum readings in the Performance Test Record.

10 Select Delta Time from the Time submenu of the Measure menu.

11 Delta time should read the following:

For Agilent 54845B and 54846B: 395 ns ± 53 ps, minimum 394.947 ns, maximum 395.053 ns. Record the minimum and maximum readings in the Performance Test Record.

12 Press the Stop key on the front panel.

13 Press the Sweep key (in the Trigger section of the front panel) to highlight the LED labeled "Single."

14 Press the Clear Display key.

15 Set the timebase to 1 µs/div.

16 Press the Run key once.

17 Select Measurement Definitions from the Customize submenu of the Measure menu. (If you have code Revision A.03.00 or higher, select Delta Time from the Measurements Definitions submenu of the Measure menu.)

18 Set the To Edge # to 101 with Direction Rising and Threshold Middle. Click Close.

19 Delta time mean should read the following:

For Agilent 54845B and 54846B: 3.94999 µs ± 301 ps, minimum 3.949688 µs, maximum 3.950291 µs. Record the reading in the Performance Test Record.

20 Select Measurement Definitions from the Customize submenu of the Measure menu. (If you have code Revision A.03.00 or higher, select Delta Time from the Measurements Definitions submenu of the Measure menu.)

21 Set the To Edge # to 201. Click Close.

22 The Delta Time mean should read the following:

For Agilent 54845B and 54846B: 7.89999 µs ± 578 ps, minimum 7.89942 µs and maximum 7.90058 µs. Record the reading in the Performance Test Record.

23 Click Close.

If the test fails

Before troubleshooting the oscilloscope, be sure to verify your test setup and the waveform shape, then repeat the procedure. Try the measurement on different channels. If you still encounter problems, there may be a problem with the acquisition board. You may need to adjust the pulse overshoot response. See chapter 4 for adjustment information on the pulse response. See chapter 5 for troubleshooting information.

To test trigger sensitivity

This test checks channel and external triggers for sensitivity at rated bandwidth.

Specification

Internal: dc to 500 MHz: 0.5 div

100 MHz to 500 MHz: 1.0 div

500 MHz to 1 GHz: 1.5 div

Auxiliary: dc to 500 MHz: 300 mV_{pp}

Equipment Required

Equipment	Critical Specifications	Recommended Model/Part
Signal Generator	100 and 500 MHz, 1.0 GHz, 30-80 mVrms output	Agilent 8664A
Power Splitter	outputs differ by <0.15 dB	Agilent 11667A
Termination	BNC feedthrough, 50 Ω	Agilent 10100C
Cable	Type N (m) 24 inch	Agilent 11500B
Cable	50 Ω BNC 36 inch	Agilent 10503A
Adapter	Type N (f) to BNC (m)	Agilent 1250-0077
Adapter	Type N (m) to BNC (m)	Agilent 1250-0082
Adapter	Type N (m) to BNC (f)	Agilent 1250-0780
Adapter	BNC tee (m)(f)(f)	Agilent 1250-0781

Internal Trigger Test

Perform this test on all vertical channels.

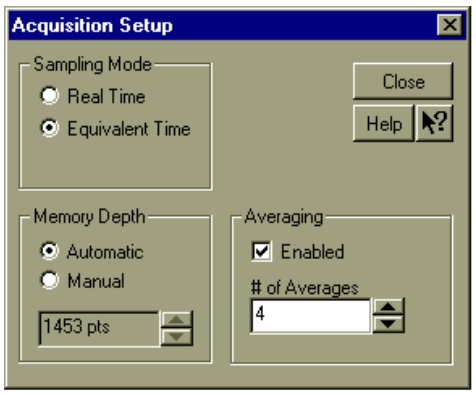
1 Press Default Setup.

2 Select Acquisition from the Setup menu.

3 Select Equivalent time sampling mode. Enable Averaging and set the number of points to 4. Click Close.

See figure 3-16.

Figure 3-16



Acquisition Setup for Trigger Sensitivity Test

4 Set horizontal time/div to 5 ns/div.

5 Turn on Channel 1 and turn off all other channels.

You can do this by using the channel keys above each input BNC or by using the check boxes at the top of the waveform display area.

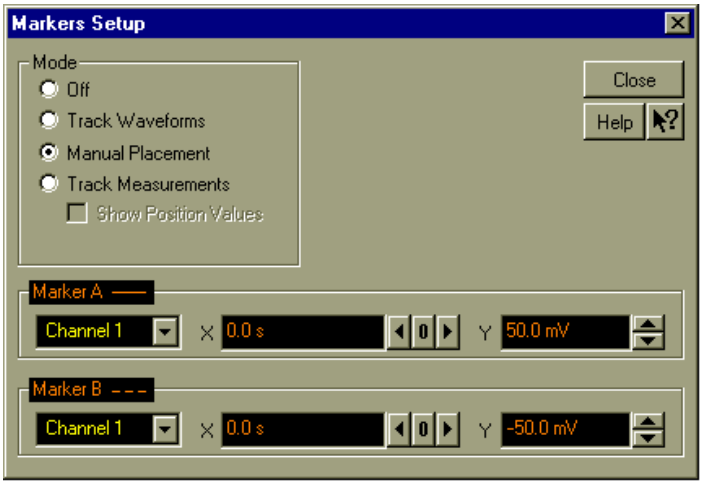
6 Set vertical scale for channel 1 to 200 mV/div. Select dc coupling and 50Ω input impedance.

7 With an N cable and N-to-BNC adapter, connect the signal generator to the channel 1 input.

8 Set the signal frequency to 100 MHz and output level for 0.5 divisions of vertical deflection.

You can use the markers to set a 0.5 division reference. Select Markers from the Measure menu and select Manual Placement in the dialog that appears. Both Markers should be set to the same channel. Set the Y value for Marker A to +50.0 mV and the Y value for Marker B to –50.0 mV, then click Close. (If the markers do not appear on the screen, press the Marker A and Marker B keys on the front panel.) See figure 3-17.

Figure 3-17



Setting the Markers for a 0.5 Division Reference

9 Press the Sweep key (Trigger section of the front panel controls) to select Trig'd.

The scope's Armed and Trig'd LEDs (in the Horizontal section of the front panel) should flash. However, the waveform display may not be stable.

10 Adjust the trigger level control for a stable display.

11 The test passes if triggering is stable. Record the result in the Performance Test Record.

12 Set the signal frequency to 500 MHz and the output level for 1 division of vertical deflection.

Again, you can use the markers to check the deflection, with one set to +100 mV and the other to –100 mV.

13 Adjust the horizontal sweep speed to 1 ns/div.

14 Adjust the trigger level for a stable display.

15 The test passes if triggering is stable. Record the result in the Performance Test Record.

16 Set the signal frequency to 1.0 GHz and the output level for 1.5 division of vertical deflection.

Again, you can use the markers to check the deflection, with one set to +150 mV and the other to –150 mV.

17 Adjust the horizontal sweep speed to 1 ns/div.
18 Adjust the trigger level for a stable display.
19 The test passes if triggering is stable. Record the result in the Performance Test Record.
20 Connect the signal generator to the channel 2 input.
21 Repeat steps 4 through 20 for the remaining channels.

Procedure—Auxiliary Trigger Test

The auxiliary trigger input is on the front panel of the oscilloscope near the vertical inputs. The dc input resistance of the aux trigger is 2.58kΩ, so to avoid reflections, the trigger source is back-terminated with 50 Ω.

1 With an N-to-BNC adapter and BNC cable, connect the signal generator to the input of the power splitter. Connect one output of the power splitter to the Aux Trig input through a 50 Ω feedthrough termination. Connect the other output of the power splitter to channel 1.
2 Set the signal generator for 500 MHz, approximately 0 dBm.
3 Set the channel 1 input to 50-Ω input impedance and press Autoscale.
4 Set the channel 1 scaling to 50 mV/div. Then set the signal generator for 6 divisions of signal (300 mV_{pp}).
5 Press the Source key (Trigger section of front panel) to highlight Aux.
6 Set the trigger level to 0.000 V.
7 Slowly adjust the Trigger Level knob slightly around the 0 V setting to obtain a stable trigger. Otherwise, the test fails. Record the result in the Performance Test Record.

If a test fails
Failure of the internal trigger or external trigger sensitivity tests can be caused by a defective main assembly or attenuator. Failure of the auxiliary trigger sensitivity is caused by a problem on the main assembly or a bad input cable. If you need further troubleshooting information, go to chapter 5, "Troubleshooting."

Agilent Technologies	**Agilent Technologies 54845B/46B Oscilloscope**
Model Number _____	Tested by_____
Serial Number _____	Work Order No._____
Recommended Test Interval - 1 Year/2000 hours	Date_____
Recommended next testing_____	Ambient temperature _____

Test	Limits				Results			
	(Vmax - Vmin)/5 =		**Limits**					
dc Calibrator Amplitude	1.000		0.998 to 1.002		_____			
Input Resistance					**Channel 1**	**Channel 2**	**Channel 3**	**Chan 4/Ext**
	50Ω		49.25 Ω to 50.75 Ω		_____	_____	_____	_____
	1 MΩ		990 kΩ to 1.010 MΩ		_____	_____	_____	_____
Voltage Measurement Accuracy	**Scale**	**Coupling**	**Supply**	**Limits**	**Channel 1**	**Channel 2**	**Channel 3**	**Channel 4**
	2 V/div	1 MΩ	5 V	4.836 V to 5.164 V	_____	_____	_____	_____
	1 V/div	1 MΩ	5 V	4.918 V to 5.082 V	_____	_____	_____	_____
	1 V/div	50Ω	5 V	4.918 V to 5.082 V	_____	_____	_____	_____
	500 mV/div	1 MΩ	3.5 V	3.459 V to 3.541 V	_____	_____	_____	_____
	500 mV/div	50Ω	3.5 V	3.459 V to 3.541 V	_____	_____	_____	_____
	200 mV/div	1 MΩ	1.4 V	1.384 V to 1.416 V	_____	_____	_____	_____
	200 mV/div	50Ω	1.4 V	1.384 V to 1.416 V	_____	_____	_____	_____
	100 mV/div	1 MΩ	700 mV	691.8 mV to 708.2 mV	_____	_____	_____	_____
	100 mV/div	50Ω	700 mV	691.8 mV to 708.2 mV	_____	_____	_____	_____
	50 mV/div	1 MΩ	350 mV	345.9 mV to 354.1 mV	_____	_____	_____	_____
	50 mV/div	50Ω	350 mV	345.9 mV to 354.1 mV	_____	_____	_____	_____
	20 mV/div	1 MΩ	140 mV	138.36 mV to 141.64 mV	_____	_____	_____	_____
	20 mV/div	50Ω	140 mV	138.36 mV to 141.64 mV	_____	_____	_____	_____
	10 mV/div	1 MΩ	70 mV	69.18 mV to 70.82 mV	_____	_____	_____	_____
	10 mV/div	50Ω	70 mV	69.18 mV to 70.82 mV	_____	_____	_____	_____
Offset Accuracy	**Range**	**Offset**	**Limits**		**Channel 1**	**Channel 2**	**Channel 3**	**Channel 4**
	200 mV/div	2.0 V	1.964 to 2.036 V		_____	_____	_____	_____
	100 mV/div	1.0 V	0.982 to 1.018 V		_____	_____	_____	_____
	50 mV/div	500 mV	491 to 509 mV		_____	_____	_____	_____

Test	Limits		Results			
Bandwidth (50Ω Input)		**Down from reference:**	**Channel 1**	**Channel 2**	**Channel 3**	**Channel 4**
	Equivalent Time	Agilent 54845B <3.0 dB at 1500 MHz Agilent 54846B <3.0 dB at 2250 MHz	_____	_____	_____	_____
	Realtime					
	2 channel (8 GSa/s) 2 channel (8 GSa/s)	Agilent 54845B <3.0 dB at 1500 MHz Agilent 54846B <3.0 dB at 2250 MHz	_____		_____	
	4 channel (4 GSa/s) 4 channel (4 GSa/s)	Agilent 54845B <3.0 dB at 1000 MHz Agilent 54846B <3.0 dB at 1000 MHz	_____	_____	_____	_____
Bandwidth (1 MΩ Input)		**Down from reference:**	**Channel 1**	**Channel 2**	**Channel 3**	**Channel 4**
	With 1161A Probe	<3.0 dB at 500 MHz	_____	_____	_____	_____
Time measurement accuracy—equivalent time mode	**ΔTime**	**Limits**	**Minimum**		**Maximum**	
	25 ns	24.946 to 25.044 ns	_____		_____	
	10 ns	9.957 to 10.043 ns	_____		_____	
	50 ns	49.72 to 50.28 ns	_____		_____	
	1 μs	997.4 to 1.0026 μs	_____		_____	
	5 μs	4.9971 to 5.0029 μs	_____		_____	
Time measurement accuracy—real time mode	**Period**	**Limits**	**Minimum**		**Maximum**	
	Agilent 54845B/46B: 39.50 ns ± 28 ps	39.47 to 39.53 ns	_____		_____	
	ΔTime (edge#11)	**Limits**				
	Agilent 54845B/46B: 395 ns ± 53 ps	394.947 to 395.053 ns	_____		_____	
	ΔTime (edge#101)	**Limits**				
	Agilent 54845B: 3.949999 μs ± 301 ps Agilent 54846B: 3.949999 μs ± 301 ps	3.949688 to 3.950291 μs 3.949688 to 3.950291 μs	_____		_____	
	ΔTime (edge#201)	**Limits**				
	Agilent 54845B: 7.89999 μs ± 578 ps Agilent 54846B: 7.89999 μs ± 578 ps	7.89942 to 7.90058 μs 7.89942 to 7.90058 μs	_____		_____	
Trigger Sensitivity	**Mode**	**Stable Trigger On:**	**Pass/Fail**			
			Channel 1	**Channel 2**	**Channel 3**	**Channel 4**
	Internal Trigger	0.5 div at 100 MHz	_____	_____	_____	_____
		1.0 div at 500 MHz	_____	_____	_____	_____
		1.5 div at 1.0 GHz	_____	_____	_____	_____
	Auxiliary Trigger	300 mV_{pp} at 500 MHz	_____	_____	_____	_____

4

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Loading New Software 4-3
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To check the 715 Hz auxiliary output (probe compensation squarewave) 4-6
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Calibrating and Adjusting

Calibrating and Adjusting

This chapter provides firmware (self calibration) and hardware adjustment procedures for the Agilent Technologies 54845B/46B oscilloscope.

- Power Supply Check
- Oscillator Check
- Flat-Panel Display Check
- self calibration

Equipment Required

Equipment required for adjustments is listed in the Recommended Test Equipment table in chapter 1 of this manual. Any equipment that satisfies the critical specification listed in the table may be substituted for the recommended model. Equipment for individual procedures is listed at the procedure.

Self Calibration Interval and Hardware Adjustments

The firmware calibration is the self cal (self calibration). Self calibration should be done every year, or every 2,000 hours of operation, whichever comes first. The hardware adjustment consists of checking the power supply, 715 Hz calibration output (probe compensation squarewave), and flat-panel display. These adjustments only need to be done under circumstances set by certain needs, which are explained in other areas of this guide.

The self calibration uses signals generated in the oscilloscope to calibrate channel sensitivity, offsets, and trigger parameters. You should run the self calibration

- yearly, or according to your periodic needs,
- when you adjust or replace the acquisition assembly or acquisition hybrids,
- when you replace the hard drive or any other assembly,
- when the delta temperature is more than ±5 °C different than the last calibration, or
- after performing incoming performance verification and before performing outgoing performance verification.

The need for self calibration will also depend on your experience and on the environment in which you use the oscilloscope.

Mainframe Cal Factor Memory Error

If power is applied to the oscilloscope and the message “Mainframe cal factor memory error: Please perform calibration” is displayed, you must calibrate the oscilloscope. See “To run the self calibration” in this chapter.

If the oscilloscope does not pass the self calibration, repair is necessary.

Operating Hints

Some knowledge of operating the Agilent Technologies 54845B/46B oscilloscope is helpful. However, procedures are written so that little experience is necessary. The following hints will speed progress of the procedures.

When using many averages, it often takes awhile for a waveform display to stabilize after a change. When a front panel control on the oscilloscope is changed, averaging automatically restarts. When the input signal or an adjustment is changed, the oscilloscope averages new data with the old, so it takes longer for the waveform to stabilize to the new value. Press the Clear Display key while changing input signals or adjustments. Clearing the display restarts averaging, which gives a quicker indication of the result of the change.

Loading Default Oscilloscope Settings

To reset the oscilloscope to default conditions, press the Default Setup key.

Loading New Software

This oscilloscope stores its operating system code on a hard disk drive. New code is loaded into the oscilloscope by using the CD-ROM. It is rarely necessary to reload the code. You should load the code only if prompted by a troubleshooting procedure, or if you want to load a later version of code.

To load new code, enable the graphical interface, then select Upgrade Software from the Utilities menu. You can then follow the instructions on the screen, inserting CD-ROMs as necessary.

Calibration Procedures

The procedures start with the next paragraphs. Unless specified elsewhere, procedures must be followed in the order given. Display checks are optional and independent of other procedures.

Let the Oscilloscope Warm Up Before Adjusting
Warm up the oscilloscope for 30 minutes before starting adjustment procedures. Failure to allow warm-up may result in inaccurate calibration.

WARNING SHOCK HAZARD!
Read the Safety information at the back of this guide before performing adjustment procedures. Failure to observe safety precautions may result in electrical shock.

WARNING INJURY CAN RESULT!
Install the fan safety shield (included in the Service Kit) if you remove the oscilloscope cover. Without this shield, the oscilloscope fan blades are exposed and can cause injury.

To check the power supply

There are no adjustments for the supply. Perform this procedure only if you suspect a power supply problem.

Equipment Required

Equipment	Critical Specifications	Recommended Model/Part
Digital Voltmeter	Accuracy ±0.05%	Agilent 34401A

Procedure

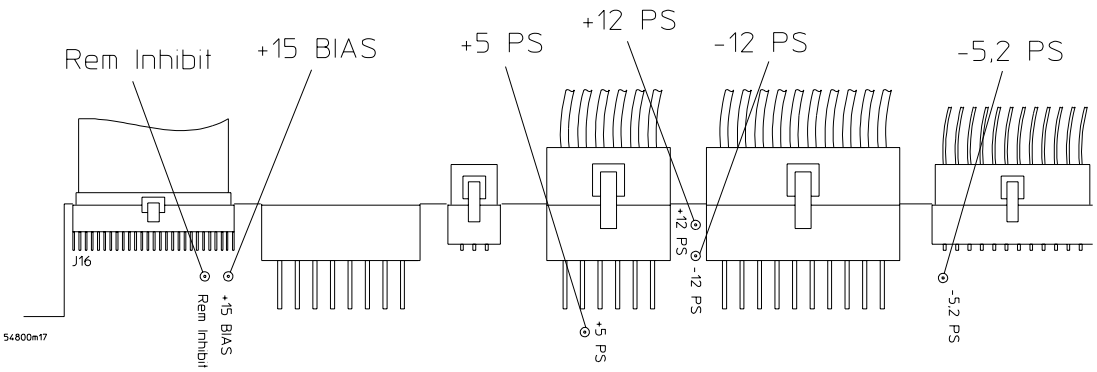
1 Disconnect the oscilloscope power cord and remove the cover.
If necessary, refer to the procedures in chapter 6, "Replacing Assemblies."

WARNING

INJURY CAN RESULT!
Use care when working around the oscilloscope with the cover off and power applied. The fan blades are exposed and could cause injury; also, there is approximately 900 V generated by the backlight inverter for the flat-panel display.

2 Connect the oscilloscope power cord and set power switch to ON.
3 Refer to the following figure for testpoint locations.

Figure 4-1



Power Supply Test Points

4 Connect the common lead of the voltmeter to the GND test point.
5 Connect the positive lead of the voltmeter to the +5.1 V test point.
6 Verify that the +5.1 supply voltage is within limits as shown in the following table:

Table 4-1 Power Supply Voltage Limits

Supply Voltage Specification	Limits
+5.1 V ± 0.1 V	+5.0 V to +5.2 V
-5.2 V ± 0.1 V	-5.1 V to -5.3 V
+12.2 V ± 0.3 V	+11.9 V to +12.5 V
-12.2 V ± 0.3 V	-11.9 V to -12.5 V
+15 V bias	+14 V to +16 V

7 Repeat steps 4 through 6 for each of the other supply voltages.
If any supply voltage is not within specifications, see chapter 5, "Troubleshooting."

To check the 715 Hz auxiliary output (probe compensation squarewave)

This test is optional. The 715 Hz auxiliary output is not specified in the oscilloscope performance specifications. The values given are typical. Results are not recorded in the Performance Test Record.

Equipment Required

You can check the 715 Hz auxiliary output using the scope itself.

Procedure

1. Press Default Setup.
2. Use a BNC cable to connect the front panel Aux Out to the Channel 1 input.
3. Set Coupling to DC and Input to 50Ω for Channel 1.
4. Press Autoscale.
5. Select Vamptd from the Voltage submenu of the Measure menu.
6. Select Frequency from the Time submenu of the Measure menu.
7. The signal should be a squarewave at approximately 715 Hz with amplitude of approximately 300 mV_{pp}.

To check the flat panel display (FPD)

No equipment is required for this procedure. Specifications for flat-panel displays used in the Infiniium oscilloscope are shown in the following table.

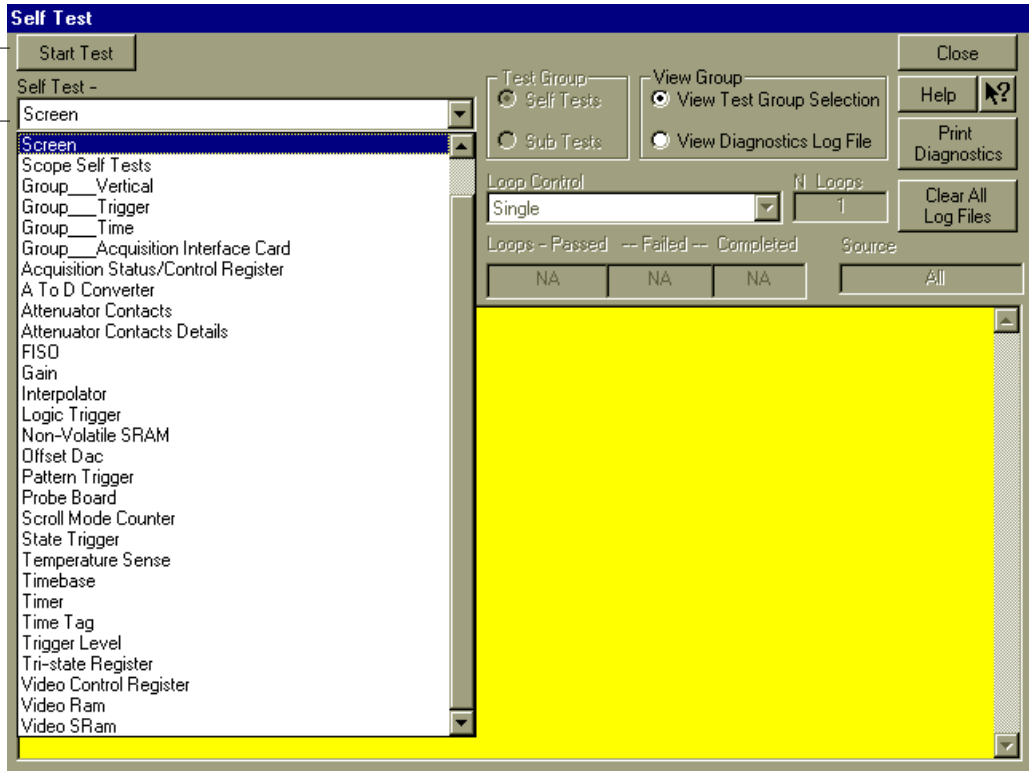
Flat-Panel Display Specifications

Defect Type		Limit
Polarizer	Scratch	Width ≤ 0.05 mm Length ≤ 10 mm
	Dent	$\phi \leq 0.4$mm
Dot Defect (A dot is defined as 1, 2, or 3 stuck subpixels touching horizontally. Subpixels are horizontal red, green, blue triads, so these may show up as one of 8 colors or black.)	Bright dot	N ≤ 5
	Dark dot	N ≤ 7
	Total dot	N ≤ 12
	Two adjacent dots Bright dot Dark dot	 ≤ 2 pairs ≤ 2 pairs
	Three or more adjacent dots	Not allowed
	Distance between defects Bright dot Dark dot	 ≥ 10 mm ≥ 10 mm
Line Defect		Not allowed
Non-uniformity		Check other specifications
Luminance (The measurement is perpendicular to the screen surface in both axes.)	Minimum Typical	160 cd/m^2 200 cd/m^2

When to Use this Procedure
This procedure should not be performed as a part of routine maintenance. Perform the procedure only when there appears to be a problem with the display.

1. Enable the graphical interface.
2. Select Self Test from the Utilities menu.
3. Click the Service Extensions box in the Self Test dialog.
4. Select Screen from the Test drop-down list box.
   See figure 4-2.

Figure 4-2

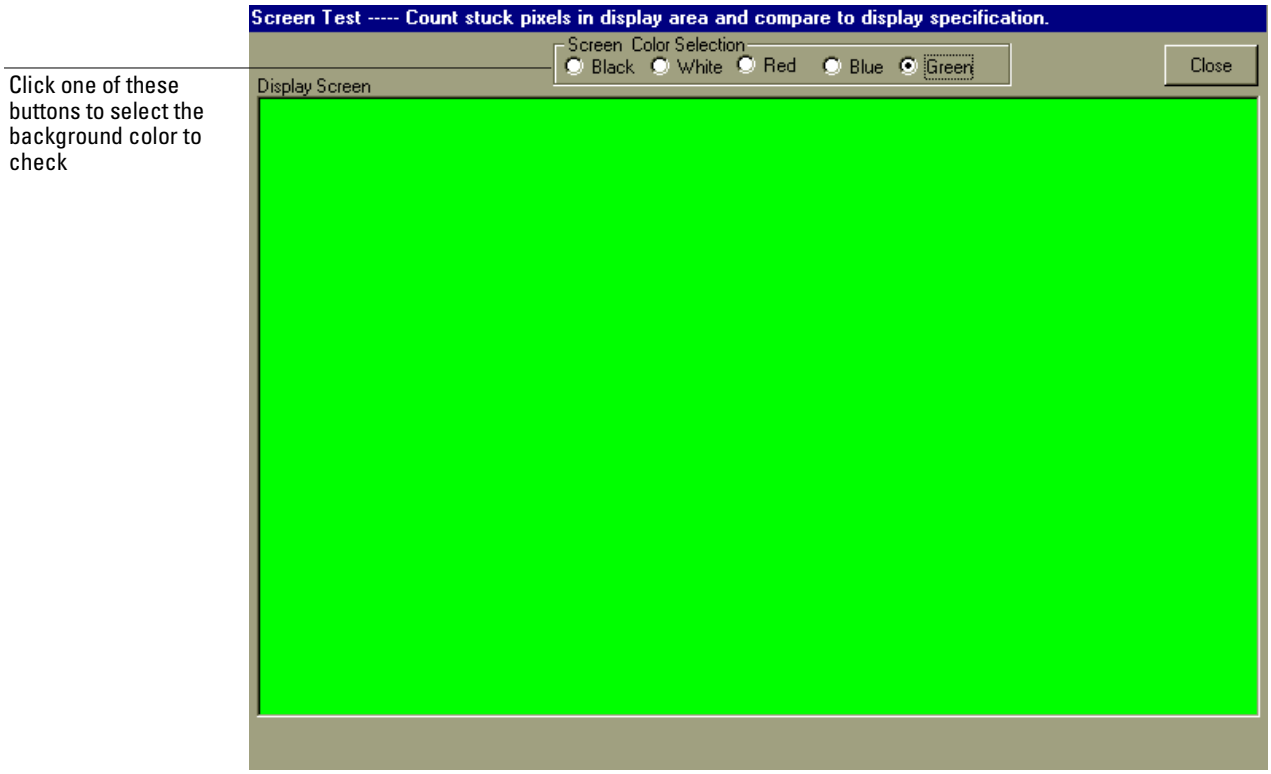


Starting the Screen Test

5 Click Start.

A new dialog appears with a series of radio buttons that allow selection of different background colors. See figure 4-3.

Figure 4-3



Screen Test

6 Select a color by clicking the radio button for that color.

7 Carefully check the colored region for pixels colored differently than the current selection.

These pixels are either inactive or stuck. If black (when a color or white is selected), they are inactive; if another color than the current selection, but not black, then they are stuck. If the display does not meet the specification given on the previous page, replace it. See chapter 6 for removal and replacement procedures.

8 Repeat steps 6 and 7 for all colors.

To run the self calibration

The self calibration uses signals generated in the oscilloscope to calibrate channel sensitivity, offsets, and trigger parameters. You should run the self calibration

- yearly, or according to your periodic needs,
- when you adjust or replace the acquisition assembly or acquisition hybrids,
- when you replace the hard drive or any other assembly,
- when the delta temperature is more than ±5 °C different than the last calibration, or
- after performing incoming performance verification and before performing outgoing performance verification.

Equipment Required

Equipment	Critical Specifications	Recommended Model/Part
Cable	BNC 50 Ω 9 inch	Agilent 10502A

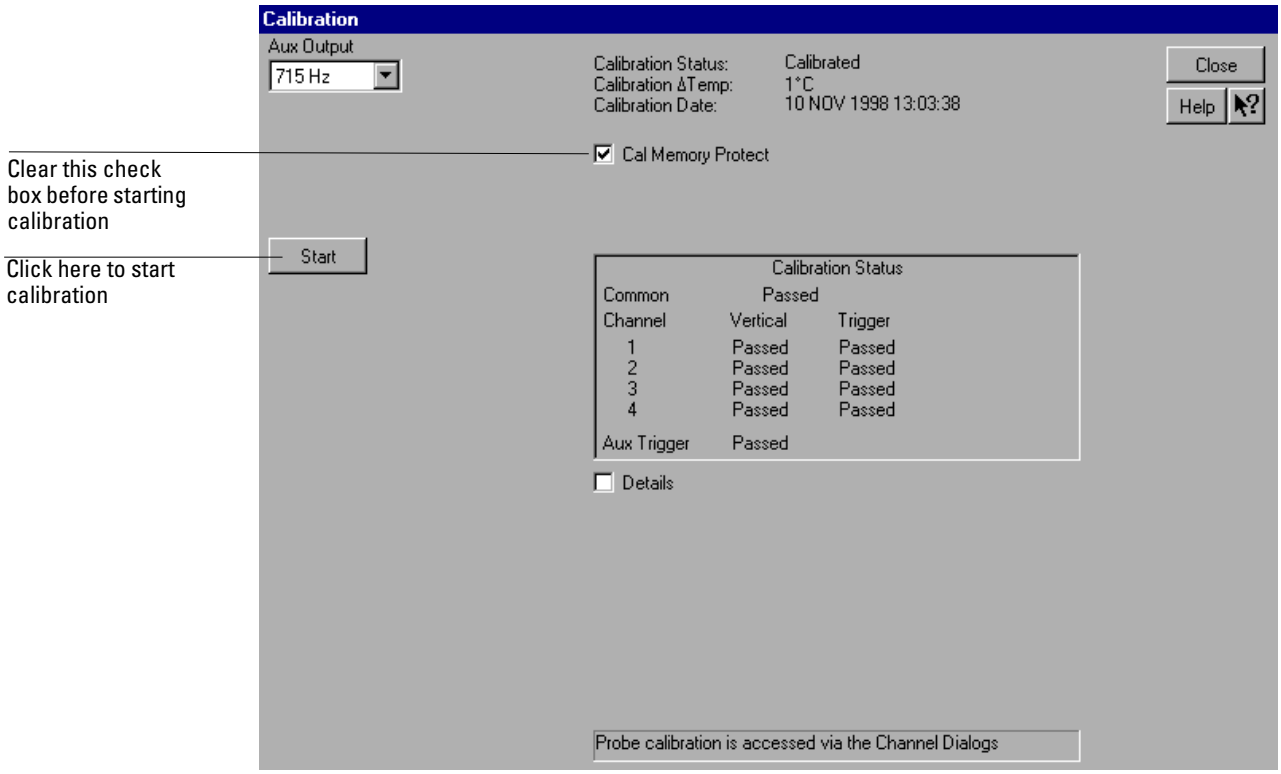
Let the Oscilloscope Warm Up Before Running the Self Calibration
The self calibration should only be done after the oscilloscope has run for one half hour at ambient temperature with the cover installed. Calibration of an oscilloscope that has not warmed up may result in performance test failure.

self calibration

Calibration time
It will take approximately 45 minutes to run the self calibration on the oscilloscope, including the time required to change cables from channel to channel.

1 Enable the graphical interface.
2 Select Calibration from the Utilities menu.
3 If the Cal Memory Protect box in the Calibration dialog is checked, click the check box to clear the check mark.
See figure 4-4.

Figure 4-4



Calibration Dialog

Clear Cal Memory Protect to Run self calibration
You cannot run self calibration if this box is checked.

4 Click Start, then follow the instructions on the screen.

You will be asked first to disconnect all channels and the Aux Output, then to connect Aux Out to each channel and the auxiliary trigger in turn. After you complete each cable change, click OK in the dialog box to continue the calibration.

The oscilloscope displays a Passed/Failed message as each calibration routine is completed.

5 After calibration has been completed, click to check the Cal Memory Protect box to protect the calibration memory. Then click Close.

If calibration fails
Go to chapter 5 "Troubleshooting."

5

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"Tools Required" on page 5-2
"ESD Precautions" on page 5-2
"Keystroke Conventions" on page 5-2
"Default Setup" on page 5-3
"To install the fan safety shield" on page 5-3
"To troubleshoot the instrument" on page 5-4
"Primary Trouble Isolation" on page 5-6
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"To check probe power outputs" on page 5-15
"To Check the keyboard; Troubleshooting Procedure" on page 5-16
"To check the LEDs" on page 5-17
"To check the motherboard, CPU, and RAM" on page 5-18
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    "Determining the Acquisition Contact Closure Count" on page 5-26
    "Isolating Acquisition Problems" on page 5-26
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    "Attenuator Click Test" on page 5-33
    "Swapping Attenuators" on page 5-34
    "Attenuator Connectivity Test" on page 5-34
"Software Revisions" on page 5-36

Troubleshooting

Troubleshooting

This section provides troubleshooting information for the Agilent Technologies 54845B/46B oscilloscope. The service strategy of this instrument is replacement of defective assemblies.

Safety

Read the Safety Summary at the front of this manual before servicing the instrument. Before performing any procedure, review it for cautions and warnings.

WARNING SHOCK HAZARD!
Maintenance should be performed by trained service personnel aware of the hazards involved (for example, fire and electric shock). Lack of training and awareness of the hazards could result in electrical shock. When maintenance can be performed without power applied, the power cord should be removed from the instrument.

WARNING INJURY CAN RESULT!
Use caution when working around the cooling fan with the cover removed from the instrument. The cooling fan blades are exposed on one side and can be hazardous. Install the optional fan safety shield (Agilent Technologies P/N 54801-00601) to protect your fingers from the fan blades.

Tools Required

You will need basic electronic troubleshooting tools, including a digital multimeter and a 100-MHz oscilloscope. Performance verification tests have more stringent requirements. See chapter 1 for the list of recommended test equipment.

If you need to remove and replace assemblies, you will need some of the hand tools listed in chapter 6, “Replacing Assemblies.”

ESD Precautions

When using any of the procedures in this chapter, you should use proper ESD precautions. As a minimum, you should place the instrument on a properly grounded ESD mat and wear a properly grounded ESD wrist strap.

Keystroke Conventions

To guide you while setting up the oscilloscope, the following conventions are used to represent keystrokes and other interactions with the instrument:

- When you need to issue a command through the graphical interface, the command will be phrased like this: “Select <command> from the <menu name> menu.”
- When you need to click on an object on the graphical interface, the instructions will be phrased something like this: “Click the OK button.”
- When you need to press a key, the instructions will be phrased something like this: “Press the Run key.”

Default Setup

A Default Setup is provided to assure the instrument setup is in a known default state. The default setup prevents previous setups from interfering with the next test. It also simplifies the instrument setup procedure. Use the default setup when a procedure requires it.

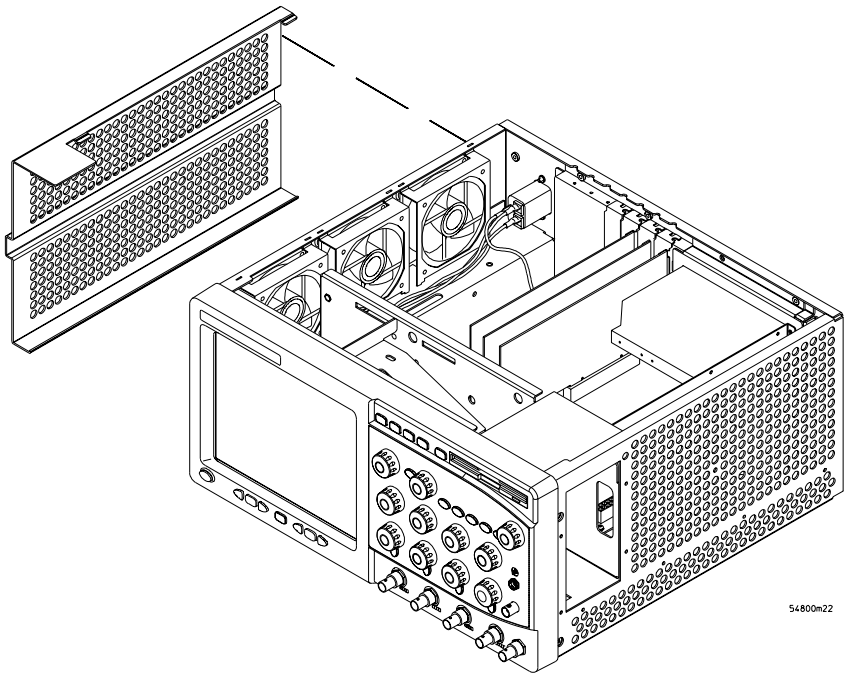
- Press the Default Setup key to set the instrument to the default state.

To install the fan safety shield

1 Disconnect the instrument power cord and remove the cover.
If necessary, refer to the procedures in chapter 6 "Replacing Assemblies".

2 Clip the fan safety shield over the outside of the instrument chassis next to the fans.
See figure 5-1.

Figure 5-1



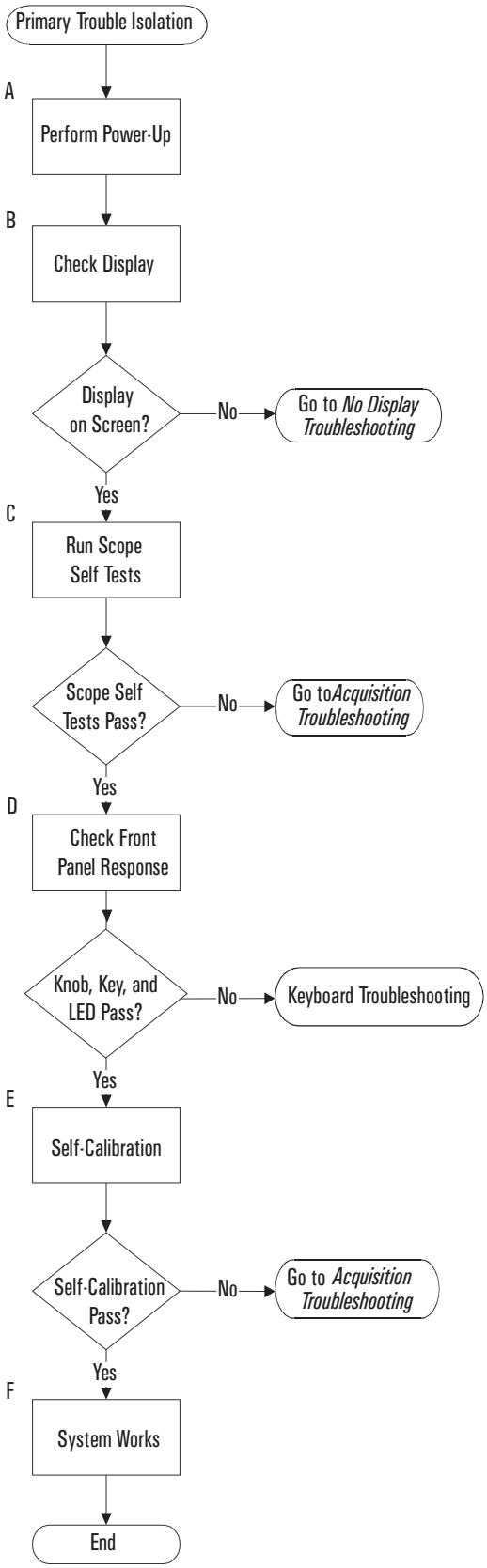
Installing the Fan Safety Shield

To troubleshoot the instrument

The troubleshooting procedure is used to isolate problems to a faulty assembly. When you find the faulty assembly, use the disassembly and assembly procedures in chapter 6 to replace the assembly.

The primary procedural tool in this section is the flowchart. The flowchart contains the entire troubleshooting path from a failed instrument to a working one, and will direct you in an orderly manner through the possible failure symptoms. Reference letters on the flowcharts point to procedural steps that explain the brief instructions in the chart. Do not try to troubleshoot by following only the reference text because the text is not in the correct order for troubleshooting. Instead, simply follow the flowchart.

If you are unfamiliar with this instrument, start with the Primary Trouble Isolation Flowchart on the next page.



Primary Trouble Isolation Flowchart

Primary Trouble Isolation

The actions in the Primary Trouble Isolation are done without disassembling the instrument. Interaction of the front panel with the rest of the instrument and other indicators are used to help identify the problem area.

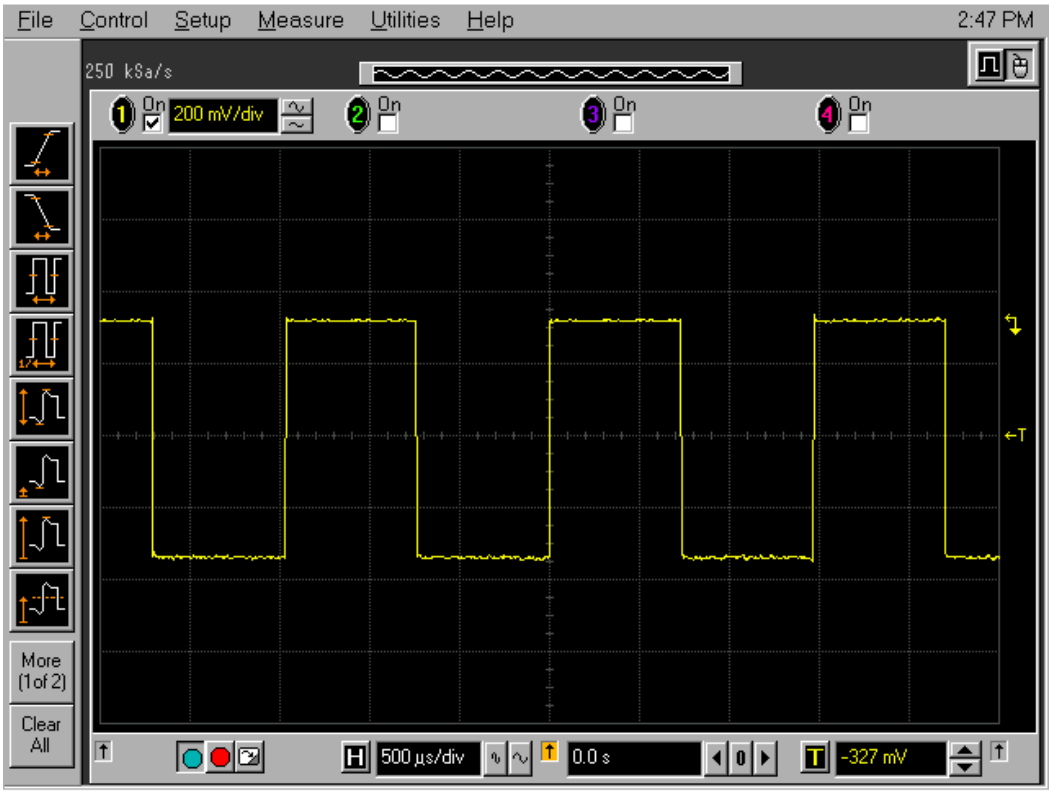
A letter is assigned to boxes in the flowchart. The letter corresponds to a specific section in the reference text. Be sure to use the flowchart itself for your troubleshooting path.

A Perform power-up.

1 Power-on the instrument.

A short time after the instrument is turned on, the scope graticule is displayed on the screen. The screen should look similar to the next figure. The exact appearance may vary depending on the setup selected before the instrument was turned off.

Figure 5-2



Power-on Display Default (Graphical Interface Disabled)

2 Press the Default Setup key.

B Check the display.

The display on the screen should be similar to the figure above. If there is no display on the oscilloscope flat-panel display after power-up, go to the No Display Trouble Isolation Flowchart otherwise go to step C.

C Run oscilloscope self-tests.

1 Enable the graphical interface. Refer to section 2 “Preparing for use” for instructions.

2 Select Self Test from the Utilities menu.

3 Select Scope Self Tests from the Self Test drop down list box.

4 Click the Start Test button and follow the instructions on the screen.

If any of the selftests fail, go to the Acquisition Trouble Isolation troubleshooting flowchart later in this chapter for further troubleshooting. Otherwise, go to step D.

D Check the front panel response by running the knob, key, and LED self tests.

Use this procedure to verify correct keyboard operation.

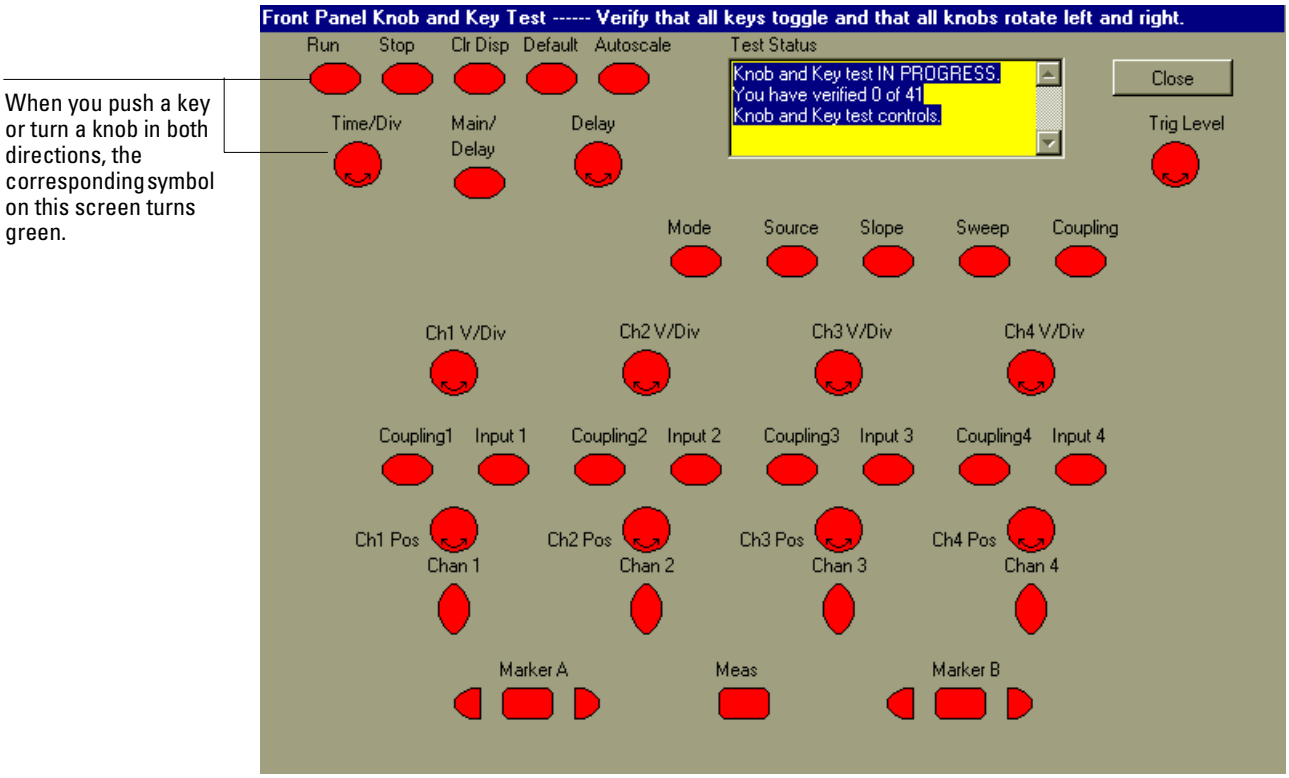
1 Enable the graphical interface.

2 Select Self Test from the Utilities menu.

3 Select Knob and Key from the Self Test drop down list box, then click Start.

A new window appears with a symbolic representation of the keyboard. See figure 5-6.

Figure 5-3



Knob and Key Self Test Screen

4 Push each key on the keyboard until you have pushed all keys.

When you push a key, the corresponding key symbol on the display should change from red to green.

5 Turn each knob in both directions until you have turned all knobs.

When you turn a knob in one direction, the corresponding knob symbol on the display should change from red to yellow. When you then turn the knob in the other direction, the knob symbol should change from yellow to green.

6 When you are finished, click Close.

If any of the knobs or keys do not work, go to "To Check the keyboard; Troubleshooting Procedure" on page 5-16.

Use the following procedure to test the front-panel LED (light-emitting diode) indicators.

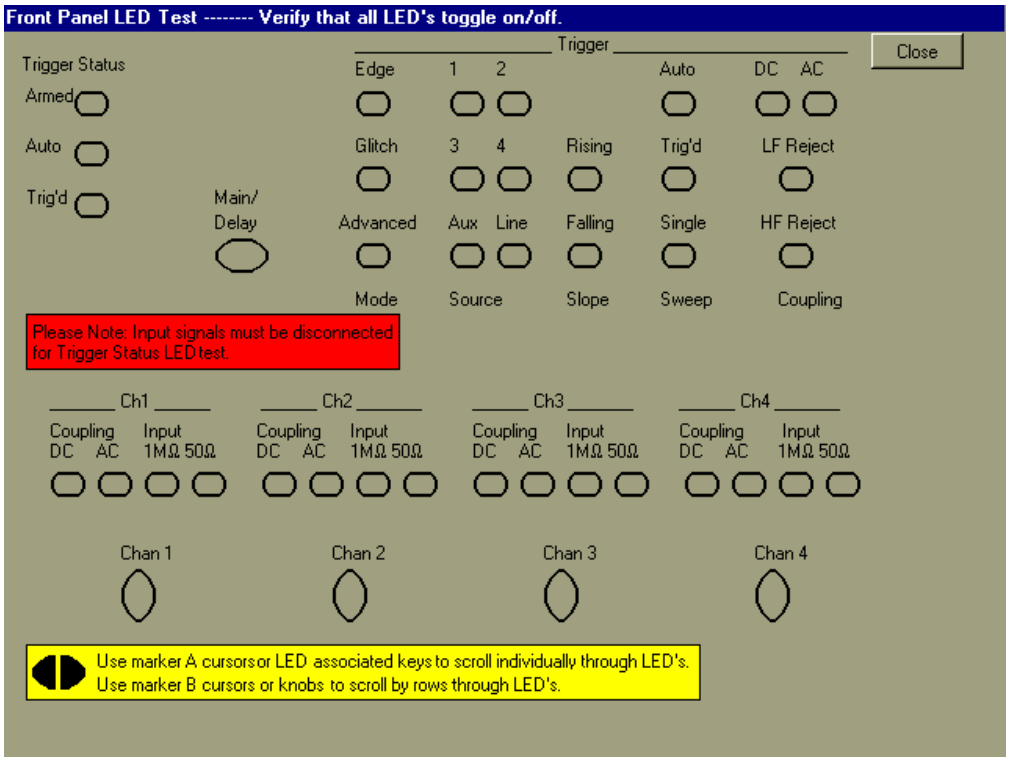
1 Enable the graphical interface.

2 Select Self Test from the Utilities menu.

3 Select LED from the Self Test drop-down list box, then click Start Test.

The LED test screen appears, which shows a symbolic representation of all front panel LED indicators. See figure 5-7.

Figure 5-4



LED Test Screen

4 Push the Marker A left and right arrow keys to highlight each LED symbol in the test screen. Verify that the corresponding LEDs on the front panel are the only ones illuminated.

Test by Rows
You can use the Marker B arrow keys to test LEDs by row; however, in the event that two LED indicators are shorted together, there is a small chance that the test will not reveal the failure.

5 When you are finished, click Close.

If any of the LEDS do not work, go to "To check the LEDs" later in this chapter.

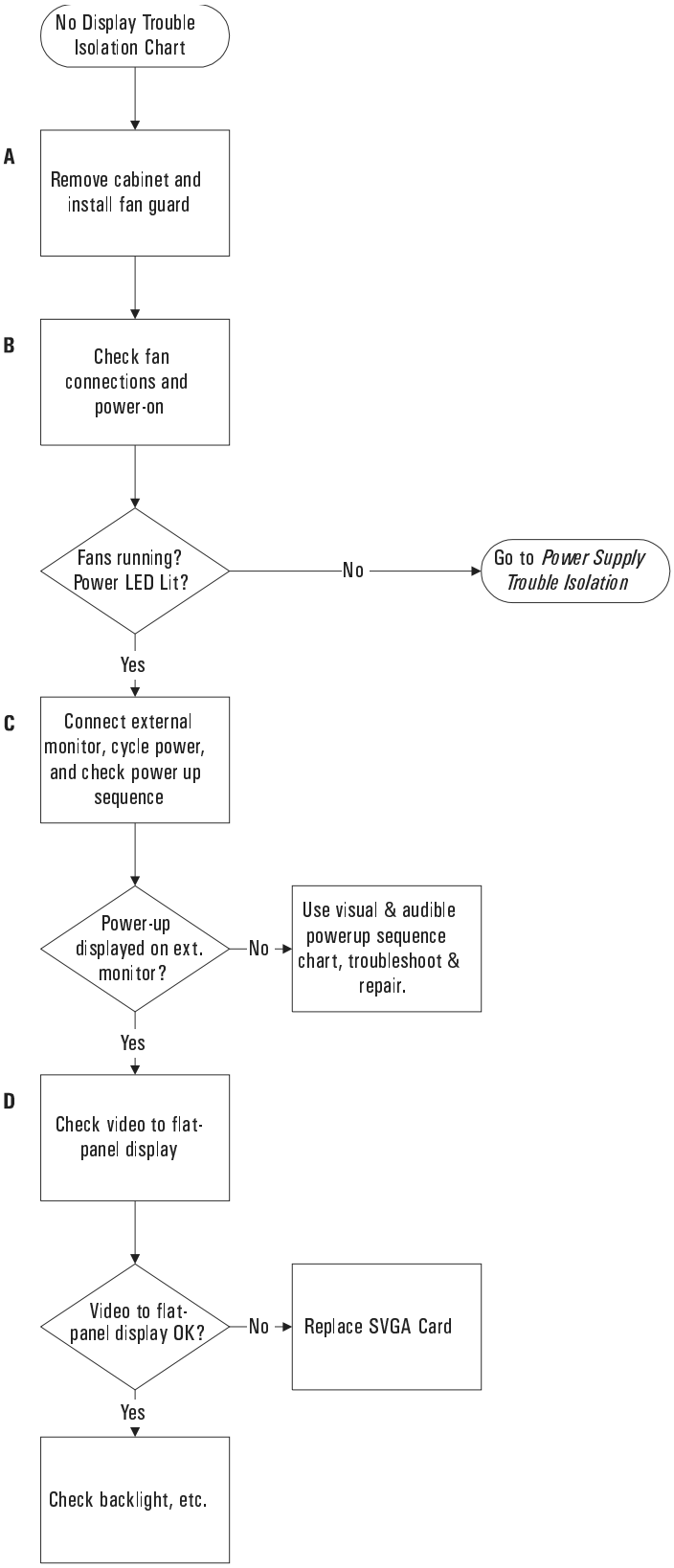
6 If both tests pass, go to step E.

E Self Calibration

1 Complete a self Calibration by following the procedures in chapter 3, "Testing Performance."

2 If the calibration test fails, replace the acquisition assembly. If the calibration test passes, go to step F.

F The system is operational. Performance test the oscilloscope using the procedures in chapter 3 of this service manual.



No Display Trouble Isolation Flowchart

No Display Trouble Isolation

This trouble isolation procedure helps isolate a problem to the assembly level when there is no display on the flat-panel liquid crystal display screen.

A Remove the cabinet and install the fan safety shield.

1 Disconnect the power cord from the oscilloscope. Refer to chapter 6, "Replacing Assemblies," for instructions on removing the cabinet. Use care in handling the instrument.

2 Install the optional fan safety shield, Agilent Technologies P/N 54810-00601, over the fans on the left side of the instrument.

WARNING SHOCK HAZARD!
The backlight inverter assembly, which is mounted at the front corner of the instrument near the flat-panel display, operates at 900 V at turn on. DO NOT handle this assembly while it is in operation.

WARNING INJURY CAN RESULT!
Once the cover is removed, the fan blades are exposed both inside and outside the chassis. Disconnect the power cable before working around the fan. Use extreme caution in working with the instrument when the cover is removed. Install the fan safety shield (Agilent Technologies P/N 54810-00601) on the side of the chassis over the fan. Failure to observe these precautions may result in injury.

B Check the fan connections.

Verify that the fan mounted in the left side of the instrument and the CPU fan (on the motherboard) are connected.

1 The instrument fans connect to the side of the Acquisition assembly at J3 and J5.

2 The CPU fan connects to the top side of the motherboard noted "CPU Fan."

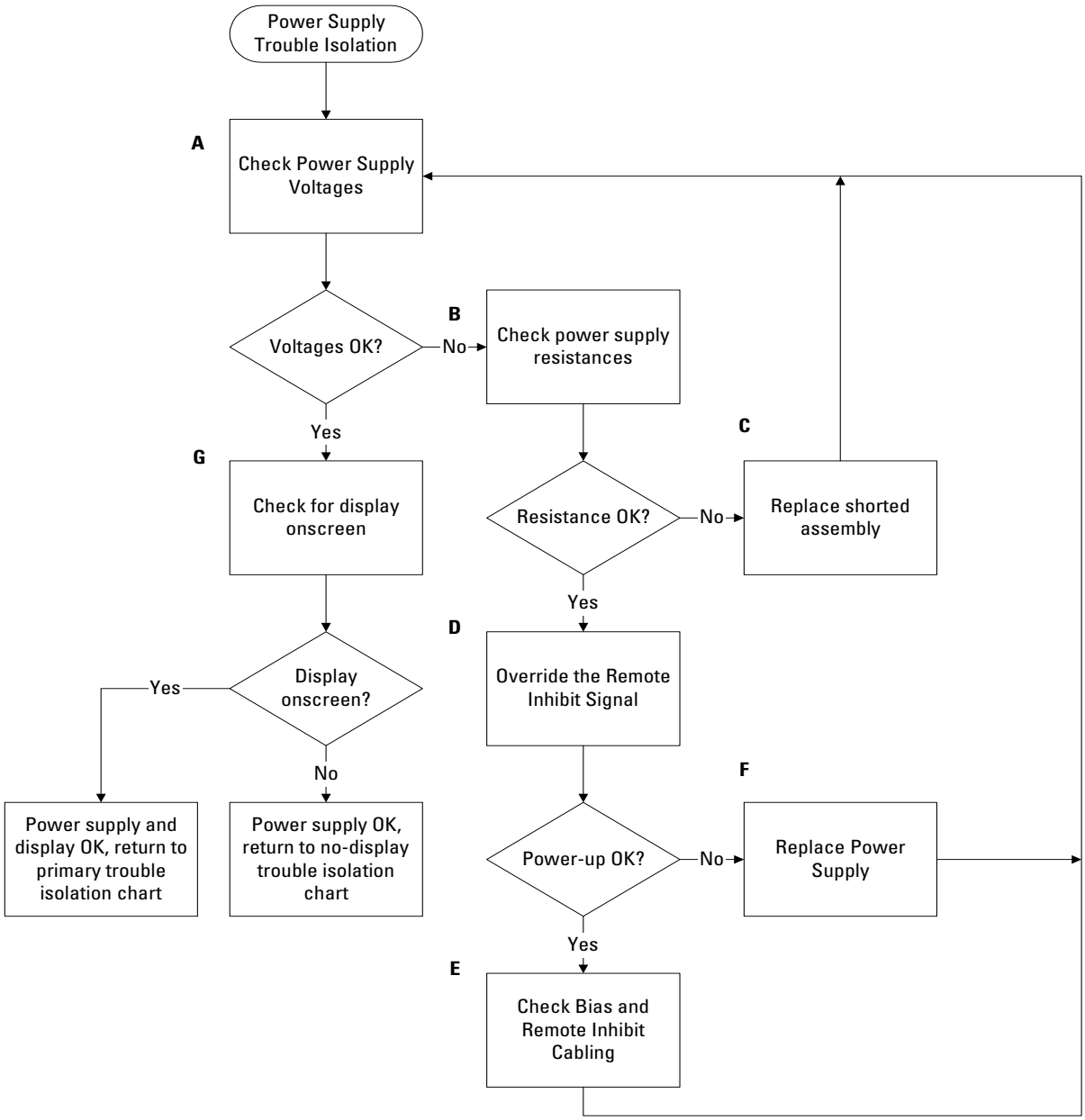
3 Connect the power cord and press the power switch on the front panel. Verify that all fans are running and that the front panel power switch LED is illuminated. These are indications that the power supply is functioning. If the fans and LED are off, go to the Power Supply Trouble Isolation flowchart. Otherwise go to step C.

C Connect an external monitor, cycle power, and observe the following instrument power-on sequence. If the power-up on external monitor test passes go to step D.

D Check the video flat panel display.

1 Ensure the proper seating of the Display Cable (Agilent Technologies P/N54810-61610).

2 If the cable is seated properly, but the display is still not active replace the SVGA card, check the backlight, or other display components.



Power Supply Trouble Isolation Flowchart

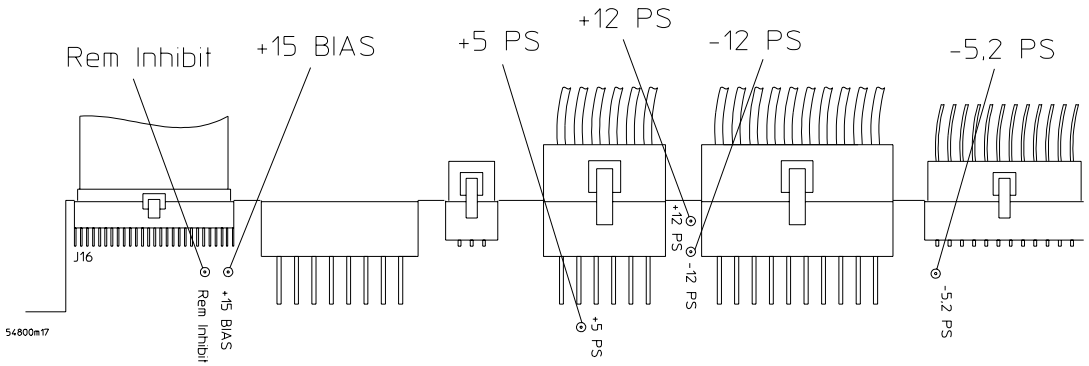
Power Supply Trouble Isolation

These trouble isolation instructions help isolate the problem to the assembly level when the power supply is not operating. Because of advanced power supply protection features, the problem may not be with the supply itself, and therefore you will need to work through the procedure systematically to determine the source of the fault.

A Check the power supply voltages.

You check the power supply voltages on the acquisition board, A13. See figure 5-3 for the location of these test points. Table 5-2 shows the allowable range of power supply voltages.

Figure 5-5



Power Supply Voltage Test Locations (A13)

Table 5-1 **Power Supply Voltage Limits**

Supply Voltage Specification	Limits
+5.1 V ± 0.1 V	+5.0 V to +5.2 V
-5.2 V ± 0.1 V	-5.1 V to -5.3 V
+12.2 V ± 0.3 V	+11.9 V to +12.5 V
-12.2 V ± 0.3 V	-11.9 V to -12.5 V

B Turn off the power and measure the power supply resistances to ground to check for shorted supply lines.

You can probe the test points on A13, shown in figure 5-3, for this resistance check. Table 5-3 shows the characteristic resistance values for the Agilent Technologies 54845B/46B oscilloscope.

Table 5-2 **Approximate Resistance Values, Each Power Supply to Ground**

Supply	Approximate Resistance to Ground
+12 V	300Ω
–12 V	180Ω
–5.2 V	10Ω
+5.1 V	50Ω

C Replace any shorted assembly.

You can locate the shorted assembly by disconnecting assemblies from the power supply, one at a time. Use the power supply distribution chart in table 5-4 as a guide to locating the shorted assembly.

Reconnect Assemblies and Cables
Reconnect all assemblies after testing. The oscilloscope must have all cables connected for correct power up.

If you want to test the power supply without any assemblies connected, the +5 V supply must be loaded to 2 A. Use two 5Ω, 10W resistors between the +5 V output and ground.

Table 5-3 **Power Supply Distribution**

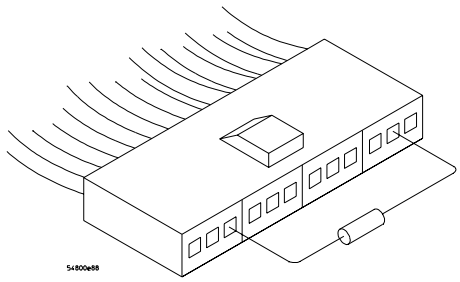
Assembly	+5.1 V	-5.2 V	Ground	+12.2 V	-12.2 V	3.3 V (generated on Motherboard)
Acquisition	X	X	X	X	X	
Motherboard	X	X	X	X	X	X
Probe Power & Control	X		X	X	X	
Front-Panel Keyboard	X		X			
Scope Interface Board	X		X			X
Display Board	X		X	X	X	X
Backlight Inverter			X	X		
Flat Panel Display	X		X			X
Floppy Disk Drive	X		X			
Hard Disk Drive	X		X			

D Override the Remote Inhibit signal.

Power up the unit by connecting a resistor between pin 3 and pin 11 of power supply control cable W2. Use a resistor in the range of 196-220Ω, 1/8 W, such as Agilent Technologies P/N 0698-3440 or 0757-0407.

See figure 5-4.

Figure 5-6



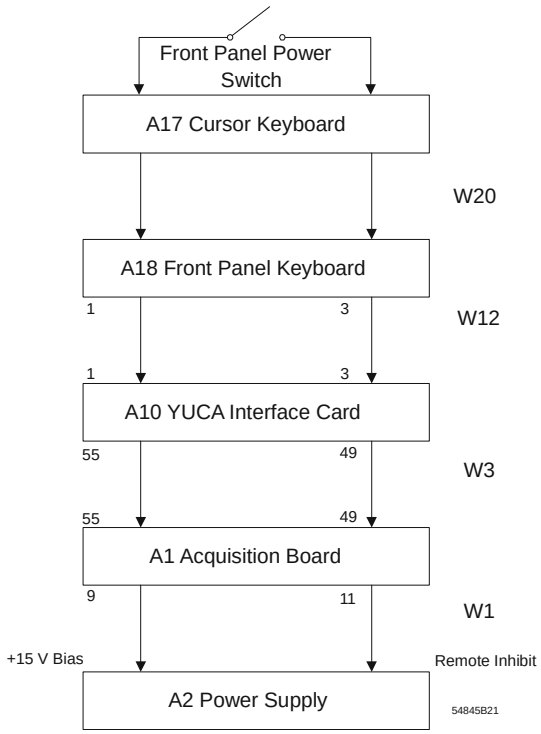
Power-up Sense Resistor Connection

E Check +15 V Bias and Remote Inhibit cabling.

If the oscilloscope will not power up, check all cabling to troubleshoot and correct the problem.

Figure 5-4 shows the routing of the +15 V Bias and Remote Inhibit signals from the front panel to the power supply. The power supply is on only when the remote inhibit signal is between +1 V and +5 V. A problem could be caused by a faulty cable or bad connector anywhere in this path. Check all the cables and connections and replace any at fault.

Figure 5-7



Routing of +15 V Bias and Remote Inhibit Signals

F Replace the power supply.

1 If the +15 V bias is correct, but the instrument will not power up with a 196-220Ω resistor, replace the power supply. Chapter 6 explains how to remove and replace the power supply.

2 Re-assemble the instrument and apply power.

G Check for the oscilloscope display onscreen.

1 You should see the oscilloscope display (see figure 5-2). If not, see the No Display Trouble Isolation Flowchart.

2 If you see the display, return to the Primary Trouble Isolation Flowchart.

To check probe power outputs

Probe power outputs are on the front panel, surrounding each BNC input.

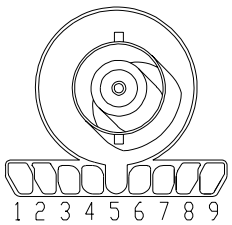
Use the table and figure to the right to check the power output at the connectors.

The +12 V and –12 V supplies come directly from the power supply, and the +3 V and –3 V supplies are developed in three-terminal regulators on the probe power & control assembly.

Measure the voltages with respect to the ground terminal on the front panel, located near the Aux Out BNC.

Do not attempt to measure voltages at pins 3 through 7.

Pin	Supply
1	+3V
2	–3V
3	Offset
4	Data
5 & ring	Probe ID
6	Clk
7	R_p
8	–12 V
9	+12 V



Any failure may be a problem with the probe power and control assembly, the AutoProbe flex cable W13, or the probe power and control cable W12.

To Check the keyboard; Troubleshooting Procedure

Use this procedure only if you encounter key failures in the keyboard test procedure. If any knobs fail, replace the keyboard assembly.

1. Disconnect the power cord and remove the cover.
2. Remove the front panel assembly.
   See chapter 6 for instructions.
3. Remove the keyboard assembly and the cursor keyboard assembly from the front panel assembly. Partially re-assemble the front panel assembly, including the flat-panel display and lens, but omitting the keyboard and cursor keyboard. Re-attach the partial assembly to the chassis.
   Be sure to reconnect the display video cable and the backlight inverter cables. See chapter 6 for instructions on removing and disassembling the front panel.
4. Separate the elastomeric keypads from the cursor keyboard and keyboard assemblies.

CAUTION CONTAMINATION CAN CAUSE INTERMITTENT OPERATION!
Be careful not to contaminate the key side of the PC board or the keypads. Dust and fingerprints on these parts may cause intermittent key operation.

5. Set the cursor keyboard and keyboard assembly on an antistatic electrical insulated surface.
6. Connect the cursor keyboard cable to the keyboard assembly. Connect the keyboard cable to the scope interface board in the chassis.
   You may need to set the chassis on its side to allow proper routing of the cables without straining them.
7. Reconnect the power cable and apply power.
8. Enable the graphical interface, then start the keyboard test as described in the previous procedure.
9. Carefully short the PC board trace, with a paper clip or screwdriver, at each nonoperating key (as determined by keyboard test), and look for an appropriate response on the display.
   - If the display responds as though a key were pressed, replace the elastomeric keypad.
   - If the display does not respond as though a key were pressed, replace the keyboard.
10. Re-assemble the instrument.

To check the LEDs

If you see a failure with the Auto or Trig'd LEDs, check the voltage at pin 6 of W16, with W16 disconnected from the keyboard. The voltage should be as follows:

- 0 V ±0.5 V when both LEDs are supposed to be off.
- 2.5 V ±0.5 V when Trig'd is supposed to be on and Auto is supposed to be off.
- 5.0 V ±0.5 V when both LEDs are supposed to be on.

If the voltages are not correct, the problem may be with keyboard cable W16, scope interface board A6, acquisition cable W11, or acquisition board W13. Try troubleshooting the acquisition system first to verify correct behavior before replacing any assemblies. If the voltages are correct but the LEDs do not light correctly, replace the keyboard assembly.

If you find a problem with the Armed LED, check pin 5 of W16 with the cable disconnected from the keyboard. The voltage should be as follows:

- 5.0 V ±0.5 V when Armed is supposed to be on.
- < 3.6 V ±0.5 V when Armed is supposed to be on.

Isolation is the same as for the Trig'd and Auto LEDs.

If you find any other failures, replace the keyboard assembly. If the front panel power indicator LED does not light, replace the cursor keyboard assembly.

To check the motherboard, CPU, and RAM

This procedure verifies that the PC system board and the associated CPU and RAM are functioning. It assumes that the power supply, SVGA display board, and an external VGA monitor are functioning correctly.

1. Connect an external keyboard to the keyboard port.
2. Connect an external VGA monitor to the VGA output connector on the rear panel.
3. Hold down the Insert key on the external keyboard, then apply power to the oscilloscope.
4. Verify that a message, such as the following, appears on the external monitor:

```
Award Modular Bios v6.00PG
Copyright...
VP22...

Main Processor: Intel Pentium III 866 MHz
Memory Testing: 262144 K Ok
:
Primary Master: IBM DJSA-205...
Primary Slave: LS120 SLIM4 00
Secondary Master: MATSHITA CR-122 7508
```

Messages Vary Slightly
These messages may vary slightly depending on the motherboard version.

If the above message is displayed, you can assume that the PC system board, CPU, and RAM are functioning correctly.

If you need to run setup, press F1. Otherwise, turn off power and proceed with troubleshooting. See “To configure the motherboard jumpers and set up the BIOS” for information.

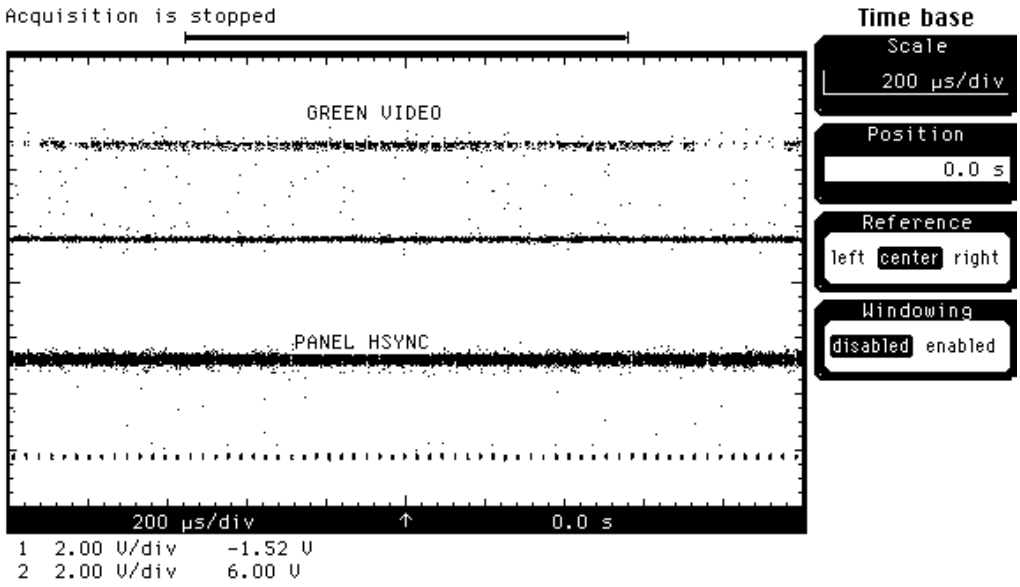
To check the SVGA display board video signals

The video signals are checked on the 40-pin connector J103 on the SVGA display board A5. Use a 100-MHz, general-purpose oscilloscope, such as the Agilent Technologies 54600B, to verify the signals. Even-numbered pins are on the top side of the connector. The video signals are present during the system boot process before the backlights come on. If the signals are not present, suspect the display card. If the signals are present and the backlights are on, suspect the flat-panel display as the problem.

Table 5-4 **Video Signals**

Pin Number	Signal
1-2	+3.3 V
3, 5-6	NC
4, 7-9, 11, 15, 19, 23, 27, 31, 35, 38, 40	Ground
12-14, 16-18	Blue video
20-22, 24-26	Green video
28-30, 32-34	Red video
10	Panel enable
36	Panel HSync
37	Panel VSync
39	Panel Clk

Figure 5-8



Video Signals

To check the backlight inverter voltages

The backlight inverter board A3 is located in the front-left corner of the oscilloscope (as you face the front panel).

- There is one input connector on the side of the board.
- There are two output connectors, one at each end of the board (top and bottom), which power the two backlights inserted into the flat panel display.

The output voltage is approximately 300-450 V_{rms}, 40 kHz (measured differentially between the two wires) when the backlight is illuminated. The voltage is approximately 1 kV before the backlight tube is illuminated.

The outputs are controlled by the input. Notice that input pin 5 goes low to enable the output voltage. These pins can be reached at J1 on the SVGA display board A5.

Table 5-5 **Backlight Inverter Board Input Voltages**

Input Pin #	7	6	5	4	3	2	1
Backlight OFF	0 V	0 V	12 V	0 V	0 V	12 V	12 V
Backlight ON	0 V	0 V	0 V	0 V	0 V	12 V	12 V

POST Code Listing

Use the following listing to troubleshoot the motherboard. You will need a POST (Power-On Self Test) card installed in an PCI slot to use this listing.

POST Code Listing

Checkpoint Code	Description
CF	Test CMOS read/write functionality
C0	Early Chipset Initialization. Disable Shadow RAM; Program basic chipset registers.
C1	Memory Detect.
C3	Expand the compressed BIOS code to DRAM.
C5	Use chipset hook to copy BIOS back to shadow RAM in E000 & F000.
01	Expand the Xgroup codes located in physical address 1000:0.
03	Initialize Superio_Early_Init switch
05	Blank out the screen and clear CMOs error flag.
07	Clear 8042 interface and Initialize 8042 self-test.
08	Test keyboard controller for Winbond 977 series Super I/O chips and enable keyboard interface.
0A	Disable PS/2 mouse interface (optional). Auto detect mouse and keyboard ports. Reset Keyboard for Winbond 977 series Super I/O chips.
0E	Test F000 segment shadow to see if it is R/W-able or not. If test fails the speaker will keep beeping.
10	Auto detect flash type to load appropriate flash R/W codes into the runtime area in F000 for ESCD & DMI support.
12	Use walking 1's algorithm to check out the interface in CMOS circuitry. Set real time clock power status, and then check for override.
14	Program chipset default values into chipset. Chipset default values are MODBINable by OEM customers.
16	Initialize Early_Init_onboard_generator switch.
18	Detect CPU information.
1B	Initialize interrupts vector table.
1D	Initialize Early_PM_Init switch.
1F	Load keyboard matrix (notebook only).
21	Initialize HPM (notebooks only).
23	Check validity of RTC value. Load CMOS setting into BIOS stack. If CMOS checksum fails use default values. Prepare BIOS resource map for PCI and PnP use. Onboard clock generator initialized. Early PCI initialization.
27	Initialize Int 09 buffer.
29	Program CPU internal MTRR for 0-640K memory address. Initialize the APIC for pentium class CPU. Measure CPU speed. Invoke video BIOS.
2D	Initialize multi language. Put information on screen display, including Award title, CPU type and speed.
33	Reset keyboard except Winbond 977 series Super I/O chips.
3C	Test 8254.

3E	Test 8259 interrupt mask bits for channel 1.
40	Test 8259 interrupt mask bits for channel 2.
43	Test 8259 functionality.
47	Initialize EISA slot.
49	Calculate total memory by testing the last double word of each 64K page.
4E	Program MTRR of M1 CPU. Initialize APIC for P6 class CPU.
50	Initialize USB.
52	Test all memory and clear all extended memory to 0.
55	Display number of processors for multi processor platforms.
57	Display PnP logo. Early ISA PnP initialization.
59	Initialize the combined Trend Anti-Virus code.
5B	Show message for entering awardflash.exe.
5D	Initialize Init_Onboard_Super_IO switch. Init_Onboard_AUDIO switch
60	Okay to enter setup utility.
65	Initialize PS/2 mouse.
67	Prepare memory size information for function call: INT 15hex ax=E820hex.
69	Turn on L2 Cache.
6B	Program Chipset registers according to items described in setup & Auto configuration table.
6D	Assign resources to all ISA PnP devices. Auto assign ports to COM ports if setup is on Auto.
6F	Initialize floppy controller. Set up floppy related fields in 40:hardware.
73	Enter AWARDFLASH.EXE if found if floppy drive.
75	Detect and install all IDE devices. Example: hard drive, LS120, CDROM.
77	Detect serial ports and parallel ports.
7A	Detect and install co-processor.
7F	Switch back to text mode if full screen is supported.
82	Call chipset power management hook. Recover the text found used by EPA logo. If password is set, ask for password.
83	Save all data in stack back to CMOS.
84	Initialize ISA PnP boot devices.
85	USB final initialization. Net PC. Switch screen back to text mode. Set up APCI table at of memory. Invoke ISA adapter ROMs. Assign IRQs to PCI devices. Initialize APM. Clear noise of IRQs.
93	Read HDD book sector information for trend Anti-Virus code.
94	Enable L2 Cache. Program boot up speed. Chipset final initialization. Power management final initialization. Clear screen & display summary table. Program K write allocation. Program P6 class write combining.
95	Program Daylight Savings. Update Keyboard LED an typematic rate.
96	Build MP table. build and updated ESCD. Set CMOS century to 20 Hex or 19Hex. Load CMOS time into DOS timer tick. Build MSIRQ routing table.
FF	Boot Attempt (INT 19 Hex).

To Configure the motherboard jumpers and setup BIOS

If the BIOS settings become corrupted, the Infiniium oscilloscope PC motherboard will not recognize the hard drive and the unit will not boot. To determine the correct BIOS setup procedure for your configuration, determine the following information:

- BIOS release number
- RAM size shown on screen at power-up

The 120 MB floppy has the release button below the disk opening. From this information, determine the correct WINBIOS setup procedure in order to enter the correct BIOS setting.

When the motherboard is replaced, set the motherboard jumpers to support the CPU clock speed and CPU power.

Configure the MOT series VP-22 866 MHz CPU, 120 MByte floppy drive, and CDROM.

This configuration is labeled "VIN #40" on the instrument rear panel. Infiniium oscilloscopes of this configuration are equipped wit the MOT Series VP-22 motherboard and the Intel 866 MHz processor. The motherboard's voltage select is automatic for the correct processor voltage.

This motherboard configuration lists the following message or similar at turn-on:

Award Modular BIOS v.6.0PG
Copyright
VP22
Main Processor: Intel Pentium III 866 MHz
Memory Test: 262144K OK

See "Configure the MOT series VP-22 Motherboard BIOS parameters" for the appropriate BIOS setup procedure.

This configuration/vintage incorporates mechanical changes to the instrument chassis and cabling to match the change in form factor of this motherboard. See Replaceable Parts chapter for new part numbers.

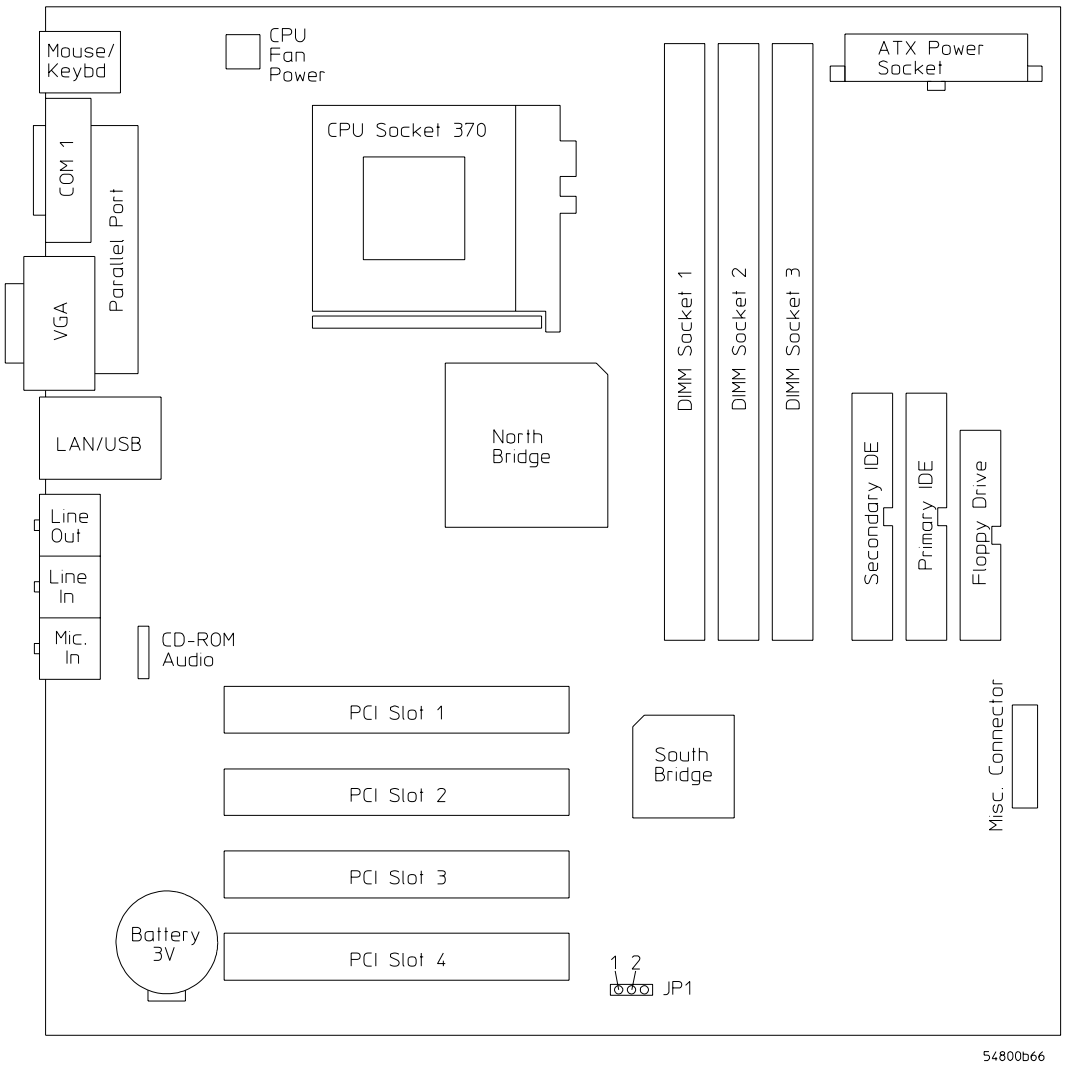
The motherboard jumper information and BIOS setups procedures are presented in the following pages.

Agilent Technologies Service Note Describes Upgrade Details

For improved performance and hard disk drive reliability, refer to Agilent Service Note 54810-06. This service note gives detailed information for upgrading to 64 MB RAM, upgrading to revision 2.51 or newer code, and enabling power managementin the BIOS. This combination of upgrades and power management settings enable the instrument to load the application into memory at power-up and allows the hard drive to power down. This provides for a quick response from the oscilloscope controls during use, while maximizing the hard drive life.

Configure the MOT VP-22 motherboard for the 866 MHz CPU, CDROM, and 120 Mbyte floppy drive.

There is only one jumper to configure on the MOT VP-22 motherboard. It is JP1 and is located at the bottom of the board by the fourth PCI slot. JP1 must be jumpered between 1 and 2. The test of the configuration settings are automatically handled by the motherboard, except for the BIOS settings.



Configure the MOT series VP-22 Motherboard BIOS parameters.

Use this procedure to set the MOT VP-22 motherboard BIOS.

1. Connect the power cable to the Infiniium oscilloscope.
2. Connect the external keyboard to the rear panel.
3. Press the delete key when you see the following prompt on the bottom of the screen

```
Press TAB to Show POST screen, DEL to enter SETUP, F12 to select boot device.
```

Note: If you are not seeing the prompt, or the oscilloscope does not appear to be functioning, check the motherboard jumper setting, and the ribbon cable connectors. Otherwise, continue with the next step.

4 Go to the standard CMOS features and verify or change these settings:

a	Set Data and Time	
b	Primary Master Type	Auto
c	Primary Master Mode	Auto
d	Primary Slave	Auto
e	Secondary Master	Auto
f	Secondary Slave	None
g	Drive A	None
h	Drive B	None
i	Video	EGA/VGA
j	Halt On	All, But Keyboard

When you are finished, press Esc to exit the menu.

Note: When a field is highlighted you might have to press enter to see the settings.

5 Go to the Bios Features Setup and verify or change these settings:

a	Anit-Virus	Disabled
b	Quick Power On Self Test	Enabled
c	Boot Up Numlock Status	Off
d	IDE HDD Block Mode	Enabled
e	Gate A20 option	Fast
f	Typematic Rate Setting	Disabled
g	Security option	SETUP
h	OS Select for DRAM >64MB	Non-OS2
i	Summary Screen Show	Enabled
j	Cache Setup	All three fields Enabled
k	Boot Seq. and Floppy Setup	1st LS120 2nd CDROM 3rd HDD BOD Enabled Last two fields Disabled
l	Console Redirection	Disabled

When you are finished, press Esc to exit the menu.

6 Go to the Chipset Features menu and change this settings:

a	Onchip Video Window Site	Disabled

7 Under Integrated Peripherals, changes these settings:

a	Onchip IDE Primary PCI	Enabled
b	Onchip IDE secondary PCI	Enabled
c	USB CONTROLLERS	Enabled
d	AC97 Audio	Enabled

8 Under the Power Management Setup, change these settings:

a	HDD power down	15 min

9 Under the PnP/PCI Configuration, change these settings:

a	Reset Configuration Data	Disabled
b	Resources Controlled By	Auto ESCD

10 Under Frequency Voltage Control, change or verify these settings:

a	Auto Detect DIMM PCI Clock	Enabled

11 Press F10 to save and exit the setup. Type “Y” to save changes.

To troubleshoot the acquisition system

This procedure will help you isolate problems to the assembly or firmware level when the built-in Self Test routine shows acquisition system failures. Using this procedure, you can determine whether one or more of the attenuator assemblies, one or more of the A/D hybrids, the Probe board, the acquisition interface assembly, or the entire acquisition assembly is at fault. If you cannot isolate the fault to attenuator(s) or A/D hybrid(s), you must replace the entire acquisition assembly, including the attenuators and hybrids.

A built-in counter keeps track of the number of times the attenuator contacts have been opened and closed. This is a direct indicator of the usage level of the attenuator and is useful for scheduling preventative maintenance. When you replace the acquisition assembly with a factory rebuilt exchange assembly, you must record the contact closure information for each channel, using the labels attached to each attenuator. If you later exchange the acquisition assembly, Agilent Technologies uses this information to determine when to replace the attenuators to insure quality of future exchange assemblies.

Determining the Acquisition Contact Closure Count

1. Select Self Test from the Utilities menu.
2. Check the "Service Extensions" check box.
3. Select Attenuator Contacts from the Self Test drop down list box.
4. Click Start Test to run the test.

   The accumulated contact closure information will be displayed on screen for each channel. Write this information on the label attached to each attenuator before returning the failed acquisition assembly.

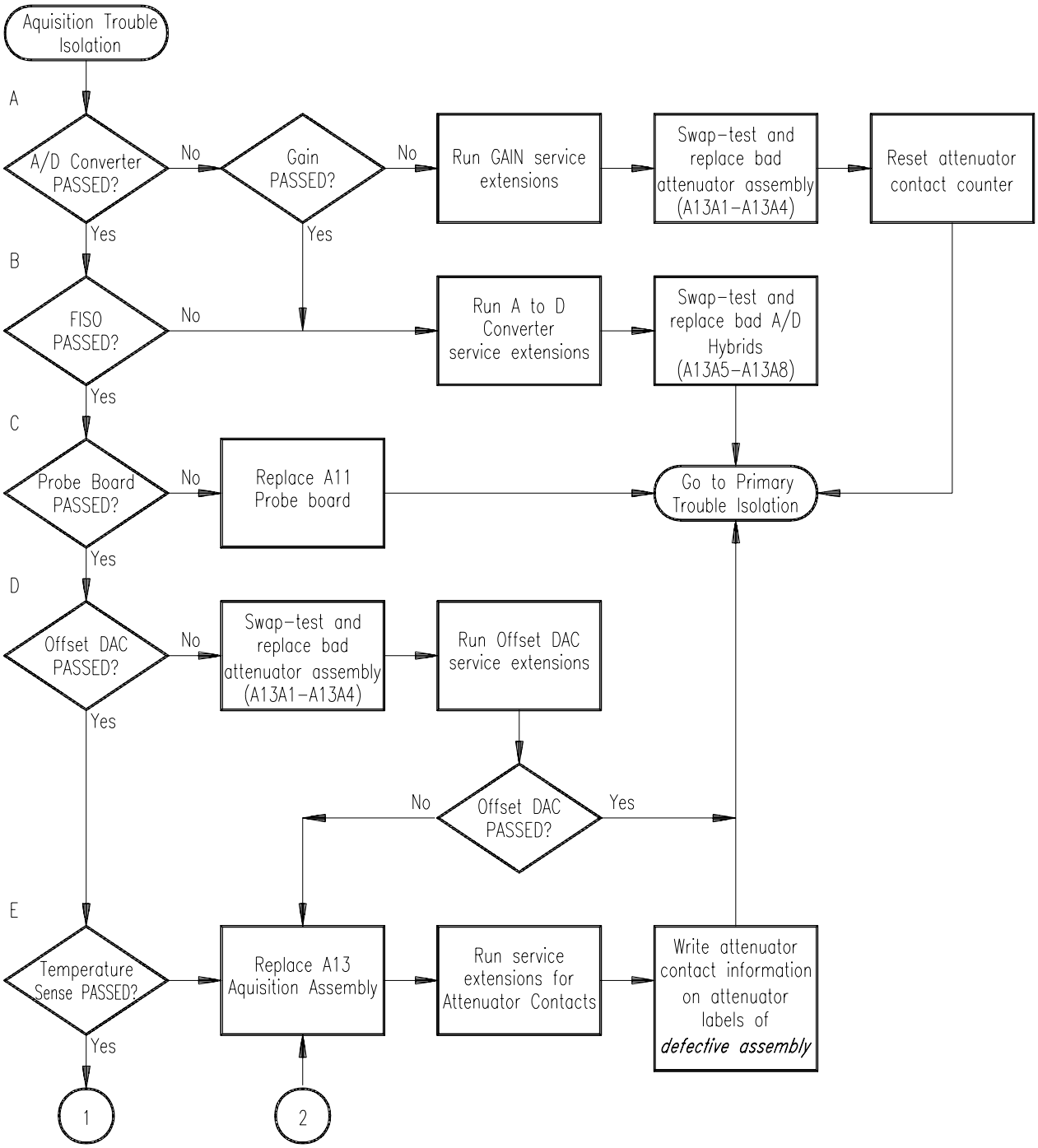
Isolating Acquisition Problems

The Infiniium acquisition system has been designed to work with firmware selftest routines, which provide pass/fail indications for each subsystem. Use the Passed/FAILED information and the trouble isolation chart to determine the appropriate assemblies to replace.

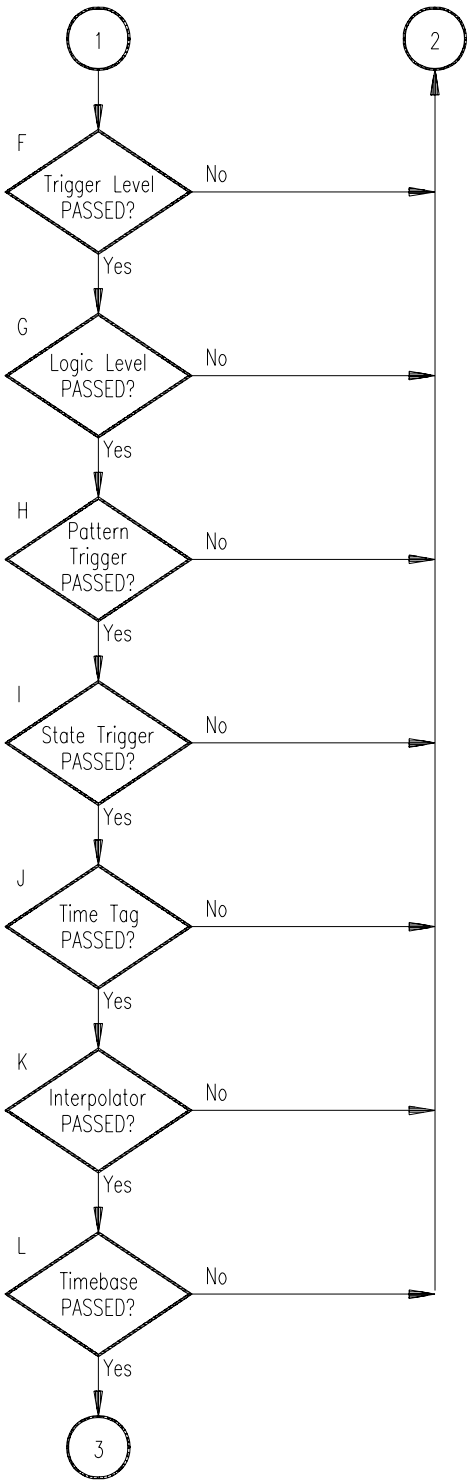
To run a particular test for troubleshooting, do the following:

1. Select Self Test from the Utilities menu.
2. Check the "Service Extensions" check box.
3. Select the desired test from the Self Test drop-down list box.
4. Click Start Test to run the test.

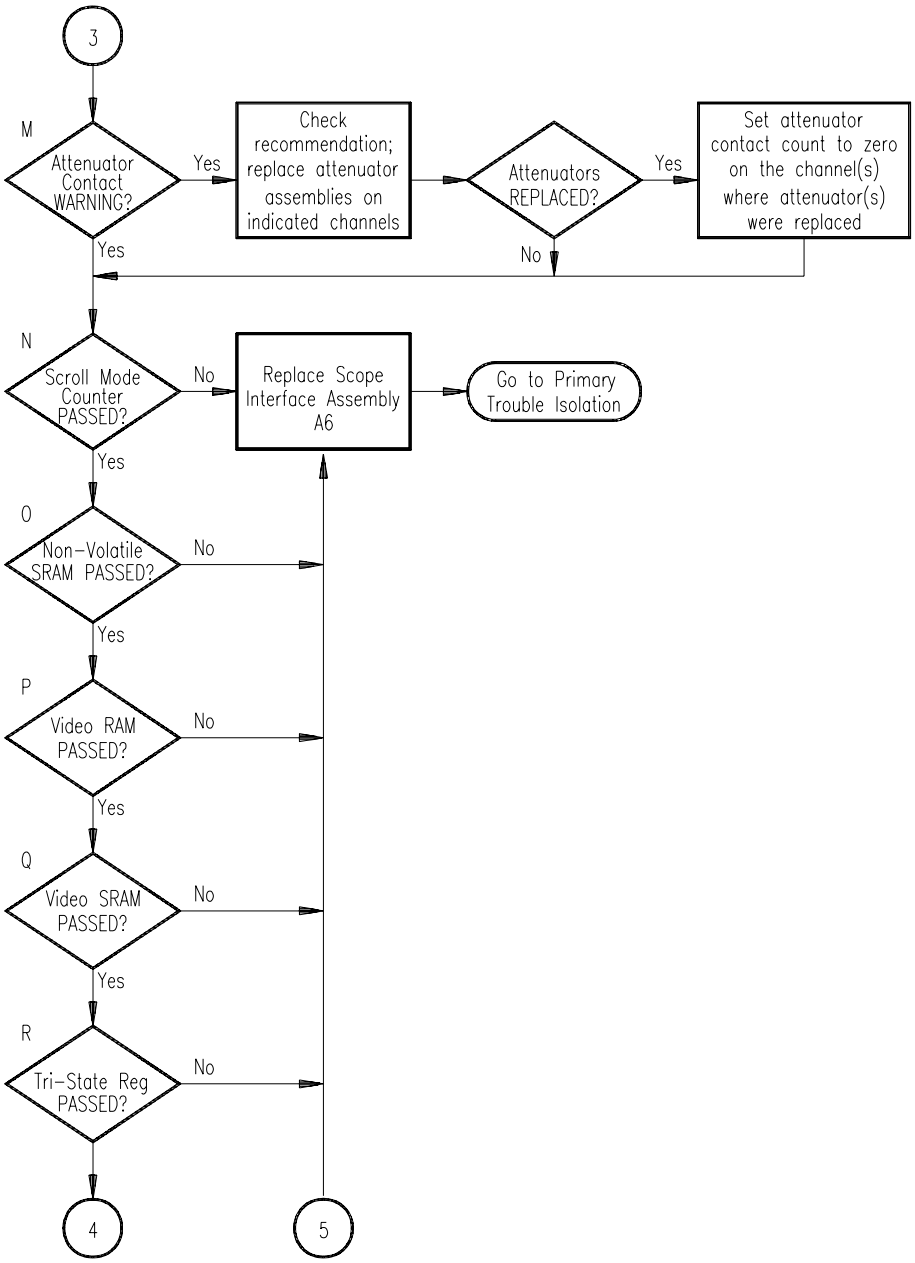
   Run the tests in the following order, as shown by the flowchart.



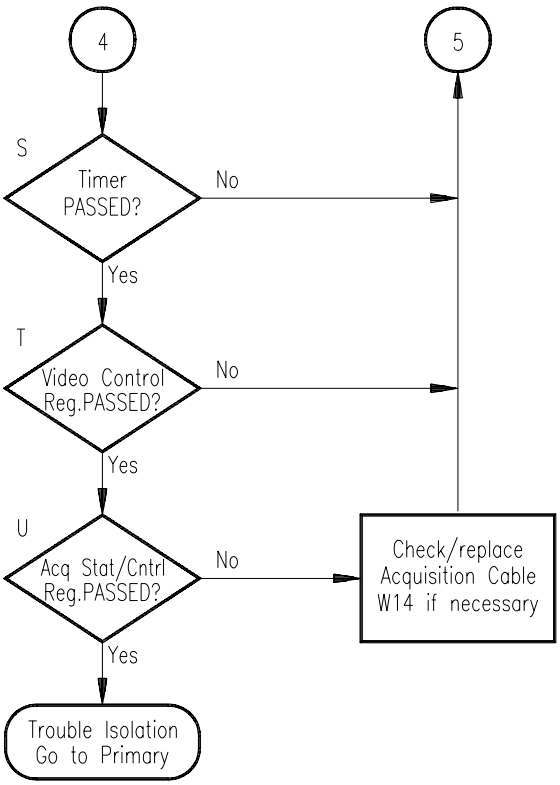
Acquisition Trouble Isolation (1 of 4)



Acquisition Trouble Isolation (2 of 4)



Acquisition Trouble Isolation (3 of 4)



Acquisition Trouble Isolation (4 of 4)

A A to D Converter Failed

Failure of this test may involve failure in the Gain test. If the Gain test also fails, first attempt to correct the cause of the Gain test failure by running the Extended Service test for Gain. If any of the channels pass the extended service gain test, you can either use an attenuator from a known good channel to verify the problem in a failing channel, or simply replace the attenuator in a failing channel with a new one.

Return the Known Good Attenuator to Original Channel
If you swap attenuators to verify that the failure follows the attenuator assembly, return the known good attenuator to its original channel so that the attenuator contact counter is consistent with the specific attenuator.

When you replace one or more attenuators, you must reset the attenuator contact counter for the affected channel(s) to zero. This enables continued monitoring of the repaired channel.

If the Gain test passes, run the Extended Service test for the A to D Converter. If any of the channels pass the extended service A to D Converter test, you can swap an A to D hybrid from a known good channel to a suspected failing channel to verify the problem, or simply replace the failing A to D hybrid with a new hybrid.

B FISO failed

When this test fails, run the Extended Service test for the A to D Converter. If any of the channels pass the extended service A to D Converter test, you can swap an A to D hybrid from a known good channel to a suspected failing channel to verify the problem, or simply replace the failing A to D hybrid with a new hybrid.

C Probe Board failed

Replace the Probe Power and Control assembly.

D Offset DAC failed

Either an Attentuator Assembly failure or Acquisition Assembly failure can cause this test to fail. If the Offset DAC test fails, first attempt to correct the failure by swapping in known good attenuator assemblies and then running the Offset DAC Service Extension. If the Offset DAC test continues to fail, exchange the acquisition assembly, which includes attenuator assemblies. Before you replace the acquisition assembly with a factory rebuilt exchange assembly, record the contact closure information for each channel onto the labels attached to each attenuator. Agilent Technologies uses this to determine when to replace the attenuators to insure quality of future exchange assemblies.

E Temperature Sense failed

Replace the acquisition assembly when this test fails. Before you replace the acquisition assembly with a factory rebuilt exchange assembly, record the contact closure information for each channel onto the labels attached to each attenuator. Agilent Technologies uses this to determine when to replace the attenuators to insure quality of future exchange assemblies.

F Trigger level failed

Replace the acquisition assembly when this test fails. Before you replace the acquisition assembly with a factory rebuilt exchange assembly, record the contact closure information for each channel onto the labels attached to each attenuator. Agilent Technologies uses this to determine when to replace the attenuators to insure quality of future exchange assemblies.

G Logic Level failed

Replace the acquisition assembly when this test fails. Before you replace the acquisition assembly with a factory rebuilt exchange assembly, record the contact closure information for each channel onto the labels attached to each attenuator. Agilent Technologies uses this to determine when to replace the attenuators to insure quality of future exchange assemblies.

H Pattern Trigger failed

Replace the acquisition assembly when this test fails. Before you replace the acquisition assembly with a factory rebuilt exchange assembly, record the contact closure information for each channel onto the labels attached to each attenuator. Agilent Technologies uses this to determine when to replace the attenuators to insure quality of future exchange assemblies.

I State Trigger failed

Replace the acquisition assembly when this test fails. Before you replace the acquisition assembly with a factory rebuilt exchange assembly, record the contact closure information for each channel onto the labels attached to each attenuator. Agilent Technologies uses this to determine when to replace the attenuators to insure quality of future exchange assemblies.

J Time Tag failed

Replace the acquisition assembly when this test fails. Before you replace the acquisition assembly with a factory rebuilt exchange assembly, record the contact closure information for each channel onto the labels attached to each attenuator. Agilent Technologies uses this to determine when to replace the attenuators to insure quality of future exchange assemblies.

K Interpolator failed

Replace the acquisition assembly when this test fails. Before you replace the acquisition assembly with a factory rebuilt exchange assembly, record the contact closure information for each channel onto the labels attached to each attenuator. Agilent Technologies uses this to determine when to replace the attenuators to insure quality of future exchange assemblies.

L Timebase failed

Replace the acquisition assembly when this test fails. Before you replace the acquisition assembly with a factory rebuilt exchange assembly, record the contact closure information for each channel onto the labels attached to each attenuator. Agilent Technologies uses this to determine when to replace the attenuators to insure quality of future exchange assemblies.

M Attenuator contact warning

The oscilloscope software monitors closures for each set of attenuator contacts and accumulates the closure count. The set of contacts with the highest number of closures is the one reported for the channel. When the accumulation for any set of contacts for a channel reaches two million closures, this test displays a warning message. This warning is not an indication of attenuator failure. This warning does advise you that the attenuator is near the mean of its range of reliable usage. You should plan your maintenance strategy based on this contact closure information and your application. For example, in an automated test application, you might want to replace attenuators as soon as the warning appears; this will help prevent costly production line stops. In a bench test application, you might choose to take the warning as an advisory only, and continue to monitor the oscilloscope's measurement accuracy. You can then replace attenuators when measurement accuracy changes dramatically or when a failure occurs.

N Scroll Mode Counter failed

Replace the scope interface board.

O Nonvolatile SRAM failed

Replace the scope interface board.

P Video RAM failed

Replace the scope interface board.

Q Video SRAM failed

Replace the scope interface board.

R Tri-State Register failed

Replace the scope interface board.

S Timer failed

Replace the scope interface board.

T Video Control Register failed

Replace the scope interface board.

U Test Acquisition State/Control Register failed

Replace the scope interface board.

To troubleshoot attenuator failures

The best method for troubleshooting attenuator assembly failures is to swap the suspected one with a known good one. This discussion will help you determine whether the attenuator or acquisition board is causing a problem.

The attenuator assembly consists of attenuators and a preamplifier for two channels. The attenuator assembly contains the following:

- A relay for selecting input resistance (50 Ω or 1 MΩ)
- Two switchable attenuators (1:1/5:1 and 1:1/10:1) which can be cascaded to provide attenuation ranges of 1:1, 5:1, 10:1, and 50:1 in the 50 Ω path
- An impedance conversion circuit in the 1 MΩ path
- A programmable preamplifier and multiplexer for 1x and 2x gain

Defective attenuators can cause a variety of symptoms.

- Wrong input resistance
- Low bandwidth/slow rise time
- Signal distortion
- Calibration failures
- Self-test failures

Firmware Calibration should also be done after attenuator replacement (see chapter 4, “Calibrating and Adjusting”).

Attenuator Click Test

The solenoids for the passive attenuators can be heard switching when the vertical sensitivity is changed. However, the gain calibration will give different switching points to different attenuator assemblies. Individual attenuator assemblies will not necessarily switch at the same sensitivities. Check for switching sounds between the following range changes:

- 20 to 50 mV/div
- 100 to 200 mV/div
- 200 to 500 mV/div
- 1.0 to 2.0 V/div

You can hear relays switching when going either direction through the transitions.

You can hear the input path relay when the input resistance is changed. Toggle the input resistance button for each channel.

If either of the click tests fail, the attenuator assembly may be defective.

Swapping Attenuators

Attenuator swapping is the best method of finding a faulty attenuator. All input channels of the Infiniium oscilloscope use identical attenuator assemblies. The attenuators for channels 1/2 and 3/4 have been manufactured into assemblies to enhance sampling performance. This troubleshooting method provides fast trouble isolation because it is unlikely that multiple channels will experience the same attenuator failure.

Swap suspected and good attenuators, and rerun the tests. The good attenuator can be a separate, known good part, or the attenuator assembly for the other channels of the oscilloscope. If the swap test reveals a faulty attenuator assembly, then install a new attenuator assembly to replace the faulty one, and return the swapped attenuator assembly to its original channels. Following this procedure will maintain the integrity of the attenuator actuation counters.

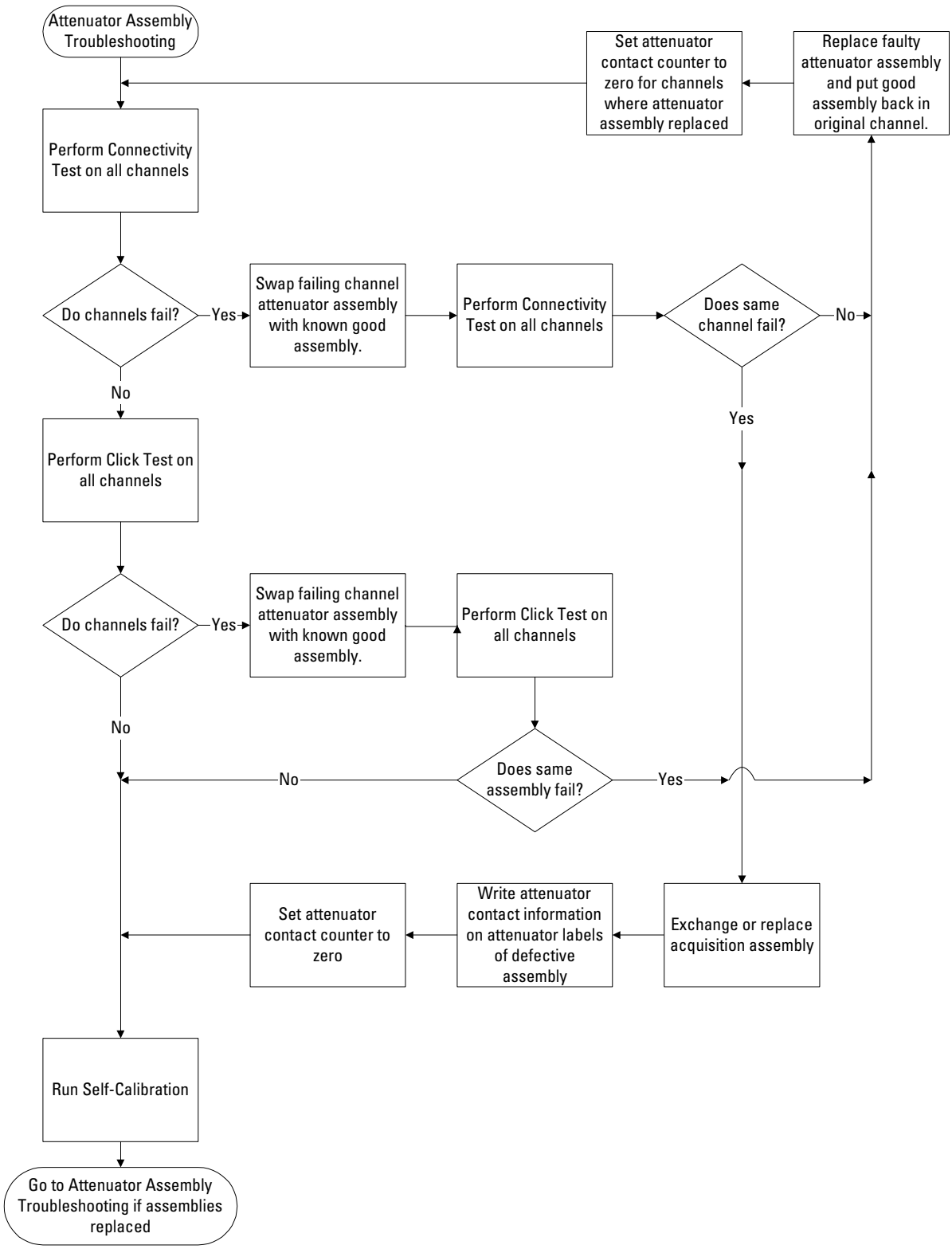
The attenuator actuation counter is maintained by the oscilloscope software to keep track of the number of times an individual attenuator has switched. Each attenuator is capable of 2 million or more actuations (switches of contacts) before the reliability of the contacts begins to degrade. This provides useful preventative maintenance information for keeping the Infiniium oscilloscope in peak measurement condition. If you replace or permanently swap an attenuator, you may need to reset the attenuator counter. See "To reset the attenuator contact counter" on page 6-33.

Attenuator Connectivity Test

The attenuator assembly scales incoming signals so that the acquisition system can accurately digitize the signal. The Click Test verifies that the relays for switching input resistance and the passive attenuators are working. This connectivity test provides a qualitative assessment of attenuator operation.

1. Connect the Aux Out signal from the front panel to the Channel 1 input using a 50 Ω BNC cable.
2. Press the Default Setup key, then the Autoscale key.
3. The connected channel should display the 715 Hz square wave of the Aux Out signal in both the 50 Ω and 1 MΩ path. If the waveform is not found, or is not stable horizontally and vertically, the attenuator's internal connectivity is suspect. Swap the attenuator assembly with a new or known good assembly (see "Swapping Attenuators").
4. Repeat steps 1 through 3 for the remaining input channels.

   If swapping attenuators into malfunctioning channels does not correct the problem, perform the procedure in "To run the self-calibration" in chapter 4. Then repeat the above procedure for the malfunctioning channels.


Attenuator Assembly Troubleshooting
Set attenuator contact counter to zero for channels where attenuator assembly replaced
Replace faulty attenuator assembly and put good assembly back in original channel.
Perform Connectivity Test on all channels
Do channels fail?
Yes
Swap failing channel attenuator assembly with known good assembly.
Perform Connectivity Test on all channels
Does same channel fail?
No
Yes
No
Perform Click Test on all channels
Do channels fail?
Yes
Swap failing channel attenuator assembly with known good assembly.
Perform Click Test on all channels
No
Does same assembly fail?
No
Yes
Exchange or replace acquisition assembly
Write attenuator contact information on attenuator labels of defective assembly
Set attenuator contact counter to zero
Run Self-Calibration
Go to Attenuator Assembly Troubleshooting if assemblies replaced

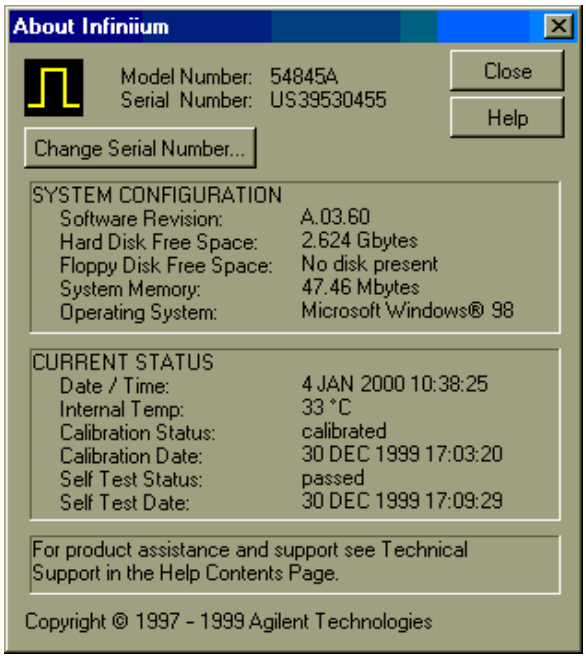
Software Revisions

- Select About Infiniium... from the Help Menu.

Enable the Graphical Interface
The graphical interface must be enabled to select this command.

A dialog box appears showing the current version number for the scope software and on-line information system software. This information may be useful when contacting Agilent Technologies for further service information. See figure 5-13.

Figure 5-9



About Infiniium... Information

6

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Replacing Assemblies

Replacing Assemblies

Use the procedures in this chapter when removing and replacing assemblies and parts in the Agilent Technologies 54835B/45B oscilloscope.

In general, the procedures that follow are placed in the order to be used to remove a particular assembly. The procedures listed first are for assemblies that must be removed first.

ESD Precautions

When using any of the procedures in this chapter you must use proper ESD precautions. As a minimum you must place the instrument on a properly grounded ESD mat and wear a properly grounded ESD wrist strap.

CAUTION

AVOID DAMAGE TO THE INSTRUMENT!
Failure to implement proper antistatic measures may result in damage to the instrument.

Tools Required

The following tools are required for these procedures.

- Torx drivers: T6, T8, T10, T15, T20
- Socket wrench: 5/8 inch
- Medium size (3/16-in) flat-blade screwdriver
- Nut Drivers: 3/16-in, 9/32-in, 5/16-in, 5/8-in
- Torque driver, 0.34 Nm (3 in-lbs), 5 mm or 3/16-in hex drive
- Torque driver, 0.34 Nm (3 in-lbs), Torx T6 drive

CAUTION

REMOVE POWER BEFORE REMOVING OR REPLACING ASSEMBLIES!
Do not remove or replace any circuit board assemblies in this instrument while power is applied. The assemblies contain components which may be damaged if the assembly is removed or replaced while power is connected to the instrument.

WARNING

SHOCK HAZARD!
To avoid electrical shock, adhere closely to the following procedures. Also, after disconnecting the power cable, wait at least three minutes for the capacitors on the power supply and sweep boards to discharge before servicing this instrument. Hazardous voltages exist on the inverter for the display monitor.

To return the instrument to Agilent Technologies for service

Before shipping the instrument to Agilent Technologies, contact your nearest Agilent Technologies Instrument Support Center (or Agilent Technologies Service Center if outside the United States) for additional details.

1. **Write the following information on a tag and attach it to the instrument.**
   - Name and address of owner
   - Instrument model numbers
   - Instrument serial numbers
   - Description of the service required or failure indications
2. **Remove all accessories from the instrument.**

   Accessories include all cables. Do not include accessories unless they are associated with the failure symptoms.
3. **Protect the instrument by wrapping it in plastic or heavy paper.**
4. **Pack the instrument in foam or other shock absorbing material and place it in a strong shipping container.**

   You can use the original shipping materials or order materials from an Agilent Technologies Sales Office. If neither are available, place 8 to 10 cm (3 to 4 inches) of shock-absorbing material around the instrument and place it in a box that does not allow movement during shipping.
5. **Seal the shipping container securely.**
6. **Mark the shipping container as FRAGILE.**

   In any correspondence, refer to instrument by model number and full serial number.

To remove and replace the cover

Use these steps to remove and replace the cover. When necessary, refer to other removal procedures.

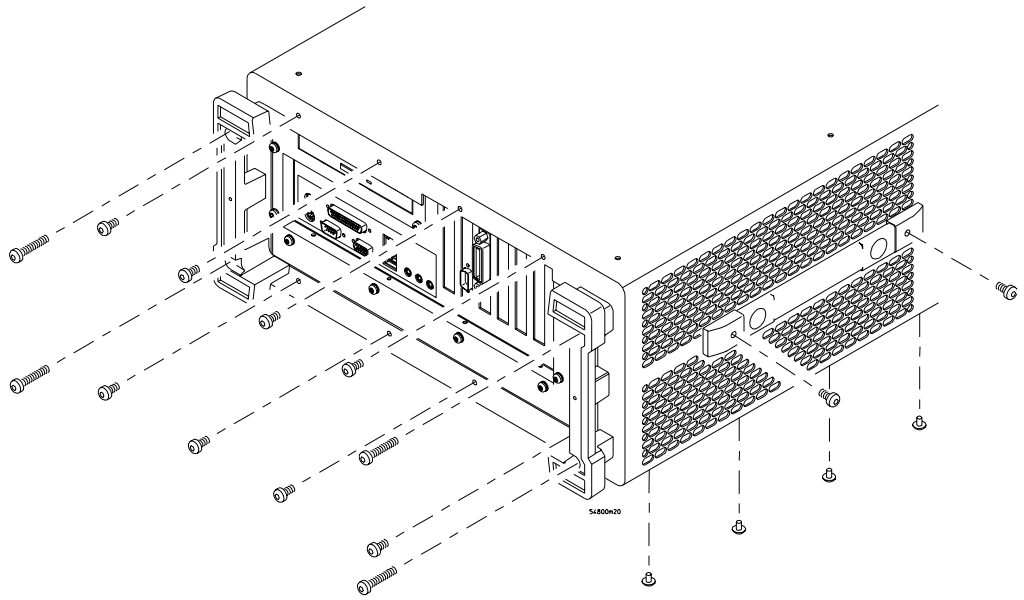
1. Disconnect the power cable.
2. Disconnect all scope probes and BNC input cables from the front panel.
3. Disconnect any other cables, such as mouse, keyboard, printer, or GPIB cables.
4. Remove the two Torx T15 screws securing the side handle.
5. Remove the four Torx T20 screws that secure the rear feet (two in each foot).
6. Remove the eight Torx T20 screws that secure the cover and the bottom to the chassis.
7. Place the unit so the bottom is facing up.
8. Remove the eight Torx T8 screws that secure the bottom to the chassis.
9. Set the unit on its bottom. Cafefully slide the sleeve off of the frame by pulling the front panel and the cover away from each other.
10. Set the unit on its top. Carefully slide the bottom cover off of the frame.
11. To replace the sleeve, reverse the above procedure.

    Be sure to keep ribbon cables out of the way when replacing the cover, particularly the flex cable and connector for the AutoProbe assembly at the bottom front of the oscilloscope.

CAUTION

PROPERLY TIGHTEN HANDLE AND SCREWS!
Tighten the side handle screws to 2.4 Nm (21 in-lbs) and rear feet screws to 2 Nm (18 in-lbs).

Figure 6-1



Cover Fasteners

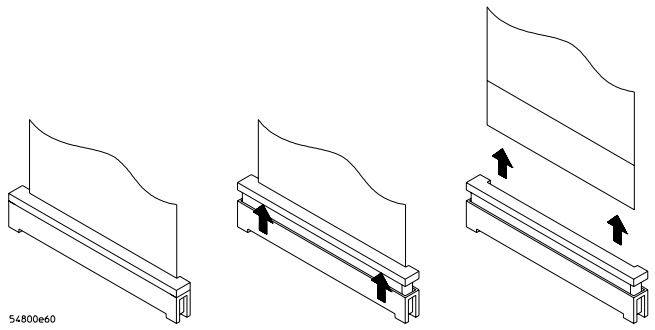
To disconnect and connect Mylar flex cables

Use this procedure when you are instructed to disconnect or connect a Mylar flex cable. Such cables and their connectors are fragile; mishandling may damage the cable or connector.

To disconnect the cable

1. Pry up the retainer slightly at either end of the connector using a small flat-blade screwdriver. Do not force the retainer; it should remain attached to the body of the socket.
2. Gently pull the flex cable out of the connector.

Figure 6-2

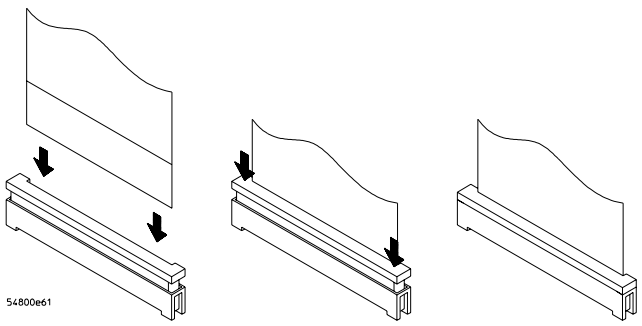


Disconnecting a Mylar Ribbon Cable

To reconnect the cable

1. Ensure that the cable retainer is up, then insert the ribbon cable into the socket, making sure to observe polarity of the cable with respect to the connector.
2. Push the ends of the retainer down onto the connector body, using a small flat-bladed screwdriver. The retainer should be flush with the connector body when you are finished.

Figure 6-3

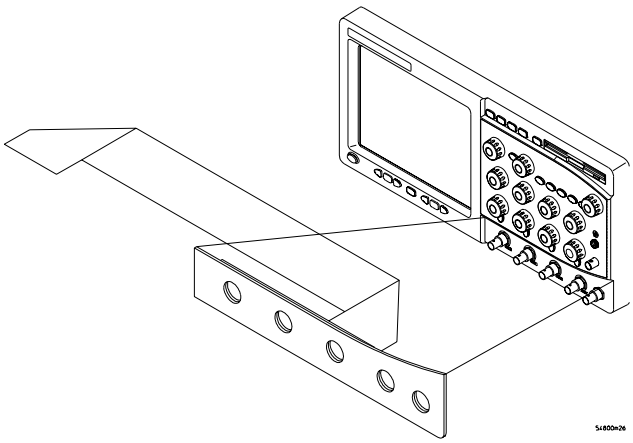


Connecting Mylar Ribbon Cables

To remove and replace the AutoProbe assembly

Use this procedure to remove and replace the AutoProbe assembly. When necessary, refer to other removal procedures.

Figure 6-4



AutoProbe Assembly

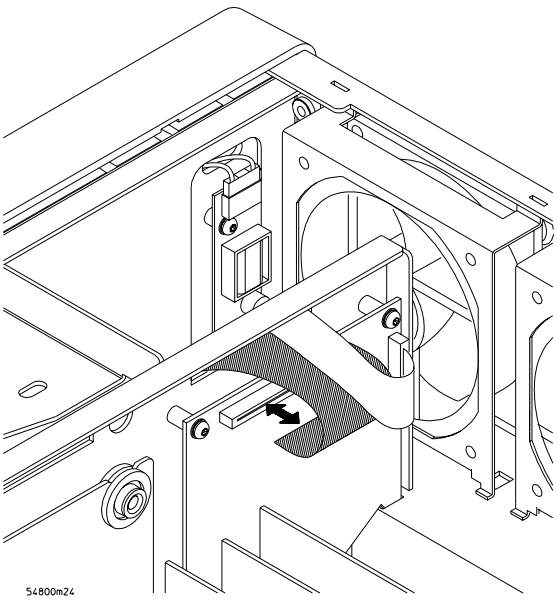
1 Disconnect the power cable and remove the cover.

2 Remove the AutoProbe connector assembly, the subpanel, and the probe connector assembly that fits around the front-panel BNC connectors, by doing the following:

a Disconnect the mylar ribbon cable W8 from the Probe Power and Control Board, A15.

See "To disconnect and connect Mylar flex cables" in this chapter.

Figure 6-5

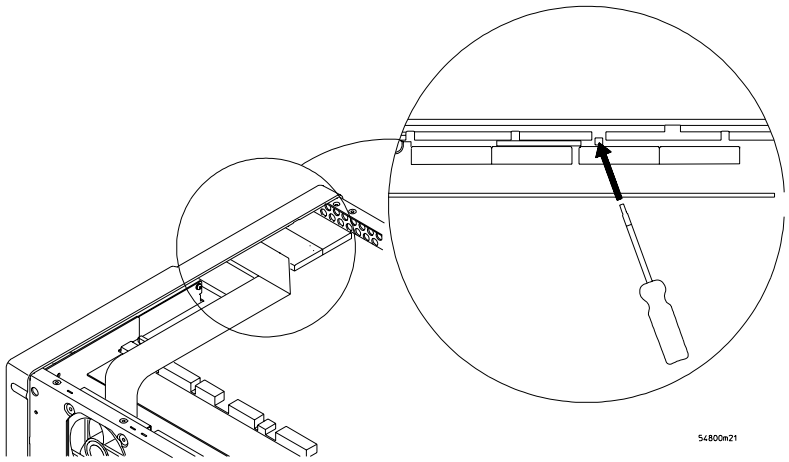


Disconnecting W13

b Locate the access hole in the front-panel assembly below and almost between channel two and channel three attenuators.

c From the back of the front panel, use a small screw driver or other slender pointed object through the access hole to push the AutoProbe assembly faceplate away from the front panel assembly.

Figure 6-6



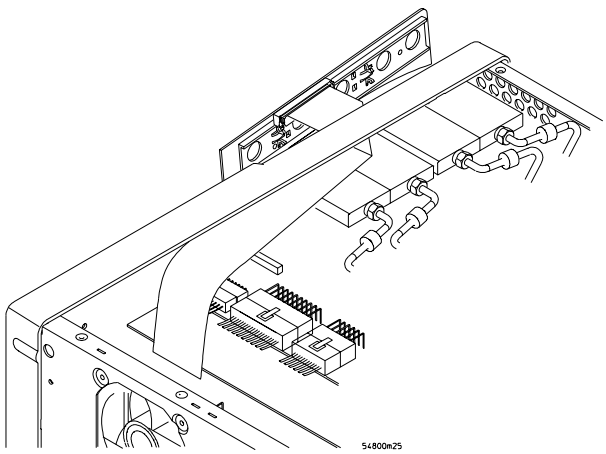
Access Hole

CAUTION

AVOID DAMAGE TO THE RIBBON CABLE AND FACEPLATE!
Do not pry around the edge of the assembly. Doing so may damage the ribbon cable or faceplate.

d Finish removing the AutoProbe assembly by feeding the mylar ribbon cable through the front panel slot.

Figure 6-7



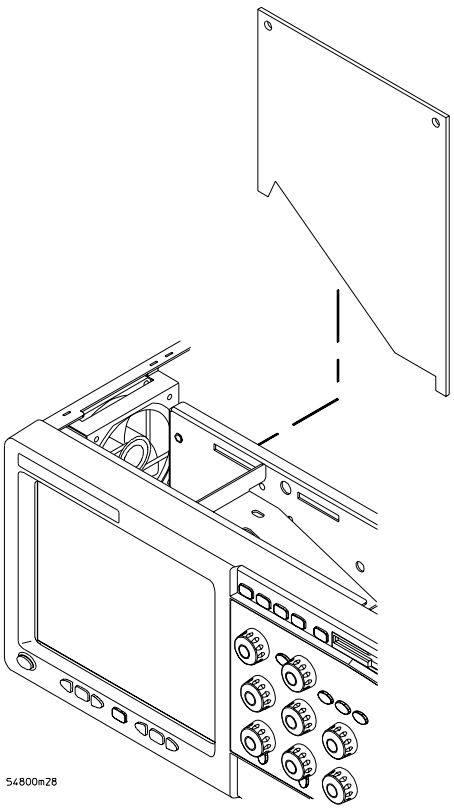
Pushing Out the AutoProbe Faceplate

3 To replace the AutoProbe assembly, reverse the above procedure.

To remove and replace the probe power and control assembly

Use this procedure to remove the probe power and control assembly. When necessary, refer to other removal procedures.

Figure 6-8



Probe Power and Control Assembly

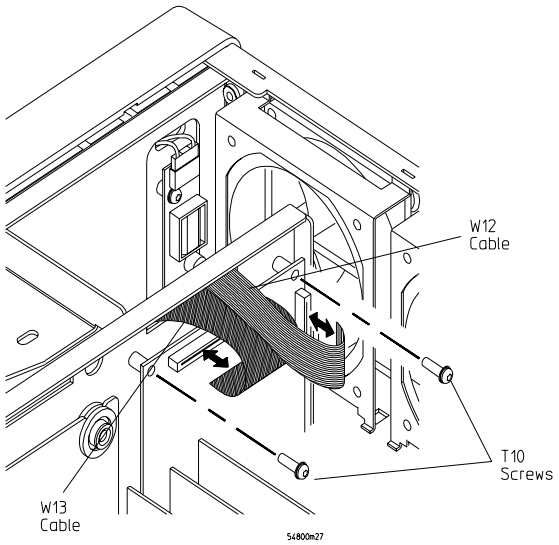
1. Disconnect the power cable and remove the cover.
2. Disconnect the mylar flex cable W8 that connects the probe power and control assembly to the AutoProbe assembly.

   The connector must be unlocked before you can remove the flex cable. See "To disconnect and connect Mylar flex cables" in this chapter.
3. Disconnect the mylar flex cable W17 from the probe power and control assembly.
4. Remove the two Torx T10 screws securing the probe power and control assembly to the chassis.

Avoid Interference with the Fan
You may need to use a Torx key or stubby Torx driver to avoid interference with the fan.

5 Lift the probe power and control assembly out and away from the chassis.

Figure 6-9



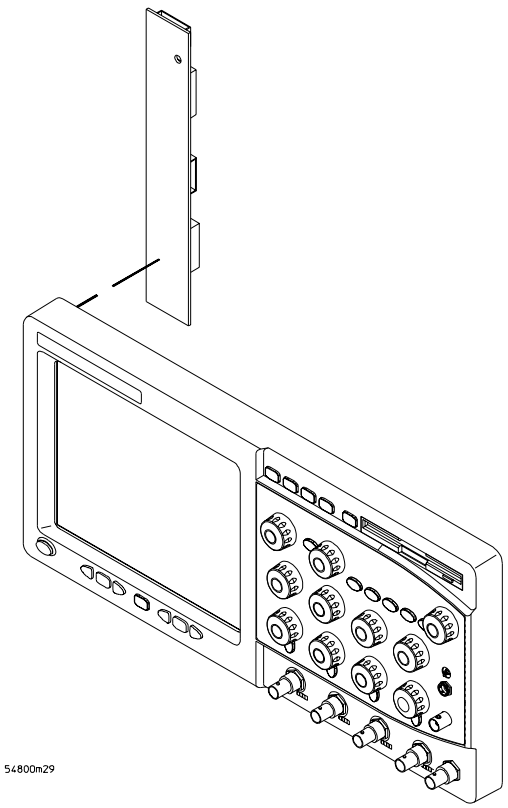
Remove the Probe Power and Control Assembly

6 To replace the probe power and control assembly, reverse the above procedure.
When inserting the assembly, be sure the two tabs on the circuit board engage the two slots in the sheet metal. Also, be sure to carefully lock in the connector for the mylar flex cable when reattaching the cable. See “To disconnect and reconnect mylar flex cables” in this chapter.

To remove and replace the backlight inverter board

Use this procedure to remove and replace the backlight inverter board. When necessary, refer to other removal procedures.

Figure 6-10



Backlight Inverter Board

WARNING

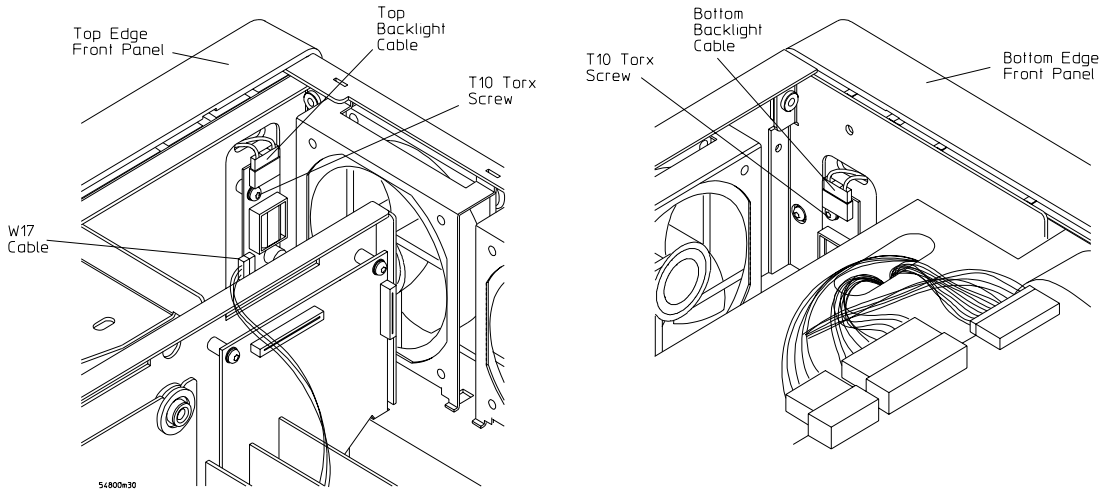
SHOCK HAZARD!
The backlight inverter assembly, which is mounted at the front corner of the instrument near the flat-panel display, operates at high voltages from 300-1 kV ac_{rms}. DO NOT handle this assembly while it is in operation.

1. Disconnect the power cable and remove the cover.
2. Disconnect the two backlight cables from the top and bottom of the backlight inverter board.

   You can either stand the chassis on end or turn it over to gain access to both cables.
3. Disconnect the backlight primary cable W21 from the side of the backlight inverter board.
4. Using a long T10 driver, remove the two Torx T10 screws that secure the backlight inverter board to the chassis.

5 Lift the backlight inverter board out through the top of the chassis.
6 To replace the backlight inverter board, reverse the assembly procedure.

Figure 6-11



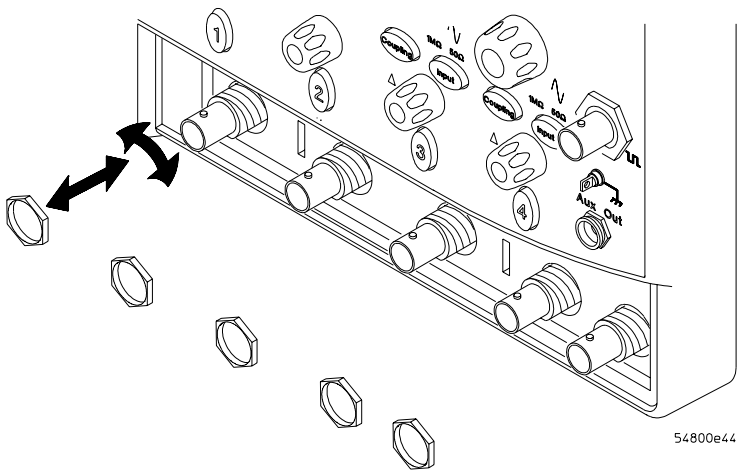
Removing the Backlight Inverter Board

To remove and replace the front panel assembly

Use these steps to remove and replace the front panel assembly. When necessary, refer to other removal procedures.

1 Disconnect the power cable and remove the cover.
2 Remove the Auto-Probe assembly A16 and Mylar flex cable W8.
3 Remove the hex nuts that secure the BNC connectors to the front panel.
Use a 9/16" nut-driver to remove the hex nuts.

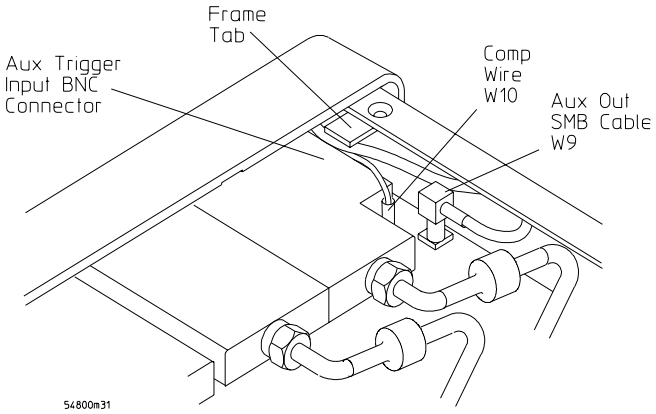
Figure 6-12



Removing the BNC Nuts

4 Disconnect the Aux Out SMB cable W9 from J10 and the black Comp wire W10 from J4. Push them to the side. If necessary, use pliars to remove the Comp wire.
These cables are located behind the Aux Trigger Input BNC connector on the Acquisition board.

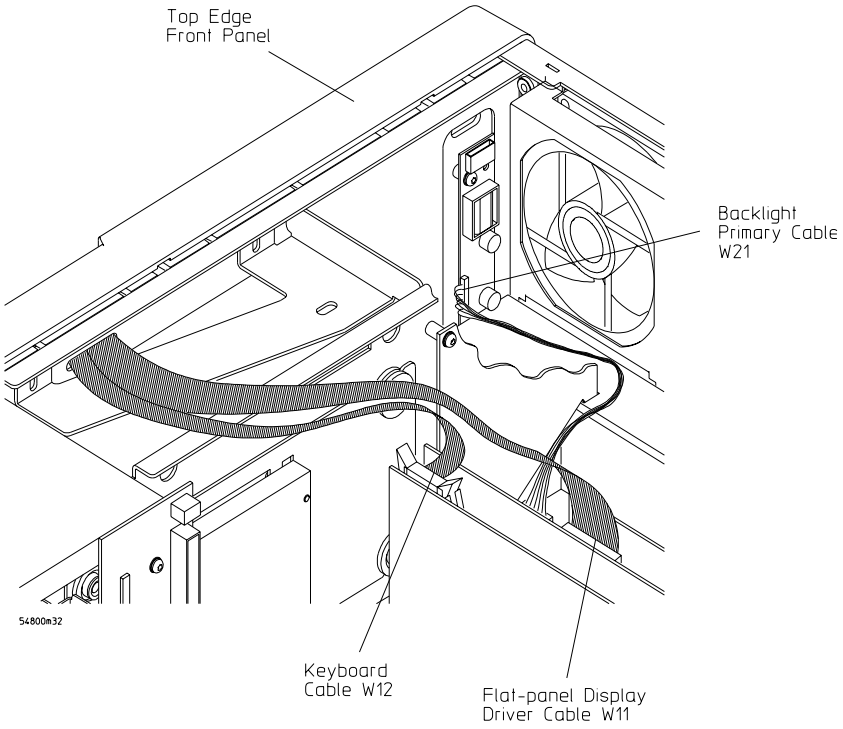
Figure 6-13



SMB Cable W9 and Comp Wire W10

5 Disconnect the backlight primary cable W21, flat-panel display driver cable W11, and keyboard cable W12.

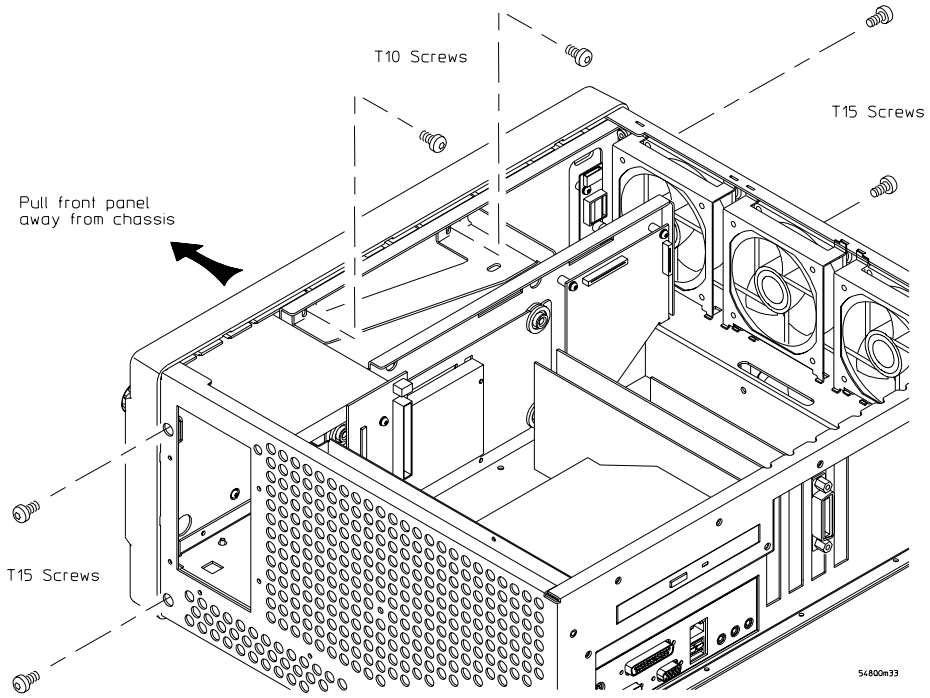
Figure 6-14



Disconnecting W21 Backlight Primary Cable, W11 Display Driver Cable, and W12 Keyboard Cable

6 Remove the four Torx T15 screws that secure the chassis sides to the front panel assembly.

Figure 6-15



Front Panel Side Screws

7 Remove the two Torx T10 screws that secure the chassis front to the front panel assembly.

8 Pull the front panel assembly away from the chassis, being careful to feed the ribbon cables W16 and W20 out through the slot in the front of the chassis and not to damage the backlight invertor board.

9 To replace the front panel assembly, reverse the above procedure.

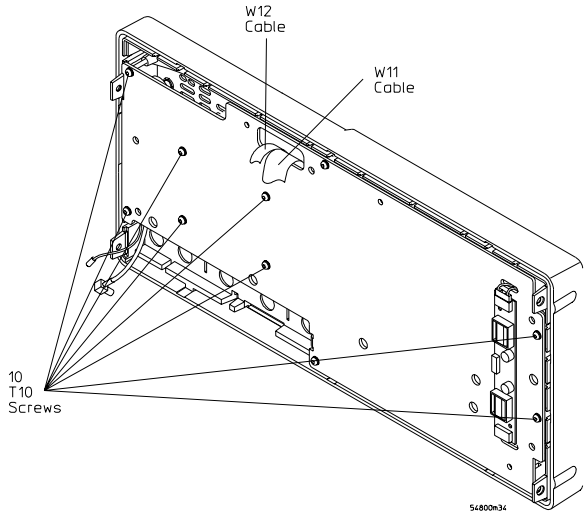
Ensure that you observe polarity designations when reconnecting the ribbon cables.

To remove and replace the keyboard and flat-panel display assemblies

Use these steps to disassemble and re-assemble the front panel assembly, including the keyboard and flat-panel display. Where necessary, refer to other removal procedures.

1 Disconnect the power cable and remove the cover.
2 Remove the front panel assembly from the chassis.
3 Remove the ten Torx T10 screws that secure the front panel cover plate to the front casting.

Figure 6-16



Front Panel Cover Plate Screws

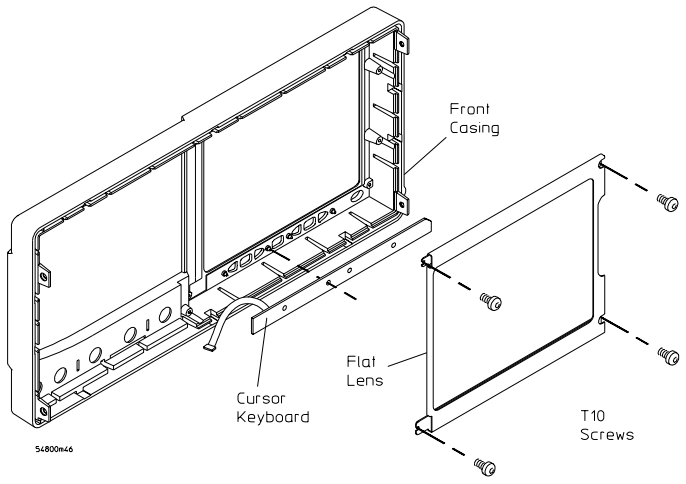
4 Carefully feed the front-panel keyboard cable W12 and the flat-panel display driver cable W11 through the cable access hole while separating the front panel cover plate from the front casting.

Keep Long Screws Separate for Re-assembly
The four screws that fasten the keyboard to the front panel plate are longer than those around the perimeter of the plate. Keep them separate for re-assembly.

5 To remove the main keyboard, disconnect the cursor keyboard cable W15, pull off the knobs, and lift out the keyboard.
6 To remove the flat-panel display from the front-panel cover plate, remove the four Torx fasteners.

7 To remove the cursor keyboard and flat lens, remove the four Torx T10 screws that secure the lens corners, then carefully remove the lens. You can lift the cursor keyboard directly out of the front casting.

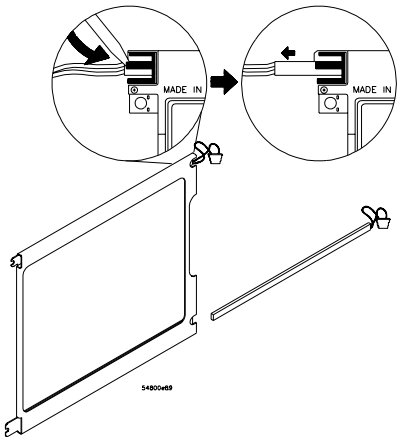
Figure 6-17



Removing the Cursor Keyboard

8 To remove the backlights, lift the tab and slide each backlight out of the flat-panel display.

Figure 6-18



Removing the backlights

9 To re-assemble the front panel assembly, reverse the above procedure.
The cursor keyboard has holes that fit over locating pins in the front panel casting.

CAUTION

PREVENT GLASS BREAKAGE!
Use care when handling the Lens Glass and the FPD monitor to prevent glass breakage.

Inspect the inside surfaces of the Lens Glass and the Display Monitor closely for dust, smudges, and finger prints. Viewing these with line-of-sight 45 degrees to the surface is the best method for seeing subtle faults. Clean the inside surfaces with glass cleaner and lint-free lens paper before re-assembly. Clean the front of the FPD monitor by applying the glass cleaner to the lint-free lens paper or soft lens cloth. Do not apply glass cleaner directly to the FPD monitor. This will prevent cleaner from corroding FPD connections.

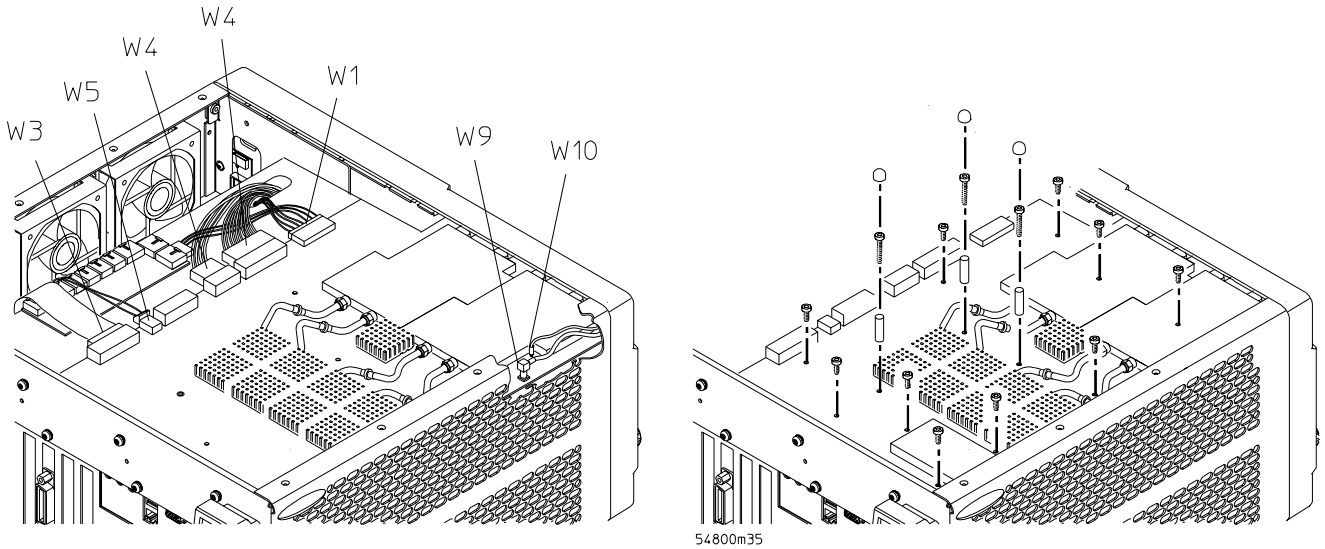
To remove and replace the acquisition board assembly

Use this procedure to remove and replace the acquisition assembly. When necessary, refer to other removal procedures.

1. Disconnect the power cable and remove the cover.
2. Remove the Probe Assembly subpanel assembly.
3. Remove the hex nuts that secure the BNC connectors to the front panel.
   Use a 9/16" nut-driver to remove the hex nuts. See figure 6–11.
4. Disconnect the Aux Out SMB cable W9 from J10 and the black Comp wire W10 from J4 on the Acquisition assembly.
   These cables are located behind the Aux Trigger Input BNC connector. See figure 6–12.
5. Disconnect the following cables from the inside edge of the Acquisition assembly:
   - Power supply sense cable W1
   - Probe control cable W17
   - Power harness cable W4
   - Line sync cable W5
   - Acquisition cable W3

   These cables are attached to J11, J12, J13, J16, J2 and J10.
6. Remove the thirteen Torx T10 screws that secure the acquisition board to the chassis, then lift the board back from the front panel until the BNC connectors clear the panel. Lift the board away from the chassis.
7. To re-install the acquisition board assembly, reverse the above procedure. Be sure to observe correct polarity for all cables.

Figure 6-19



Removing the Acquisition Assembly

To remove and replace the GPIB interface board

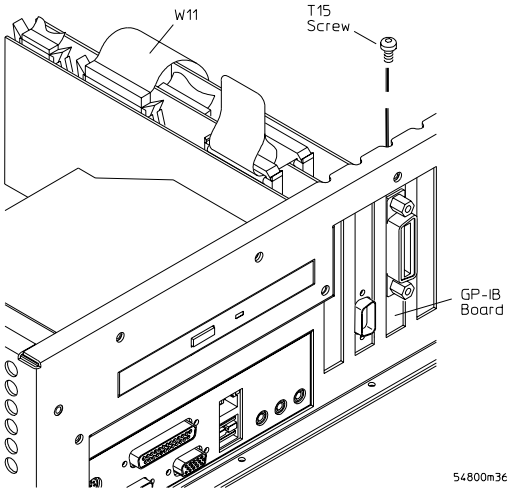
Use this procedure to remove and replace the GPIB interface board. When necessary, refer to other removal procedures.

1 Disconnect the power cable and remove the cover.
2 Remove the Torx T15 screw that secures the GPIB board to the rear of the chassis.
3 Pull the board up to disengage it from the motherboard, then lift up and out of the chassis.

CAUTION BE CAREFUL NOT TO SNAG THE ACQUISITION CABLE W11.

4 To replace the board, reverse the removal procedure.

Figure 6-20



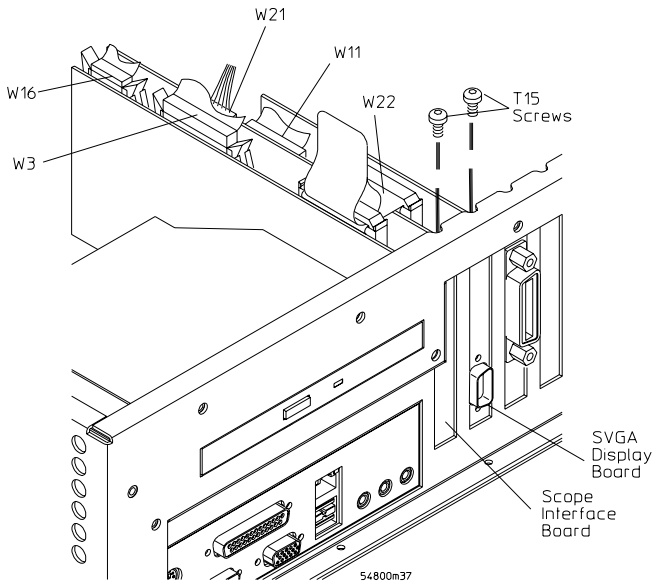
Removing the GPIB Interface Board

To remove and replace the scope interface board and SVGA display board

Use these steps to remove and replace the scope interface board and SVGA display boards. These boards must be removed and replaced as a unit. When necessary, refer to other removal procedures.

1. Disconnect the power cable and remove the cover.
2. Disconnect these cables from the scope interface board:
   - Acquisition cable W3
   - Keyboard cable W12
3. Disconnect these cables from the SVGA display board:
   - Bridge cable W22
   - Backlight primary cable W21
   - Display video cable W11
4. Remove the two Torx T15 screws that secure the scope interface and SVGA display boards to the chassis.
   These screws are at the rear of the chassis.

Figure 6-21



Removing the Scope Interface and SVGA Display Boards

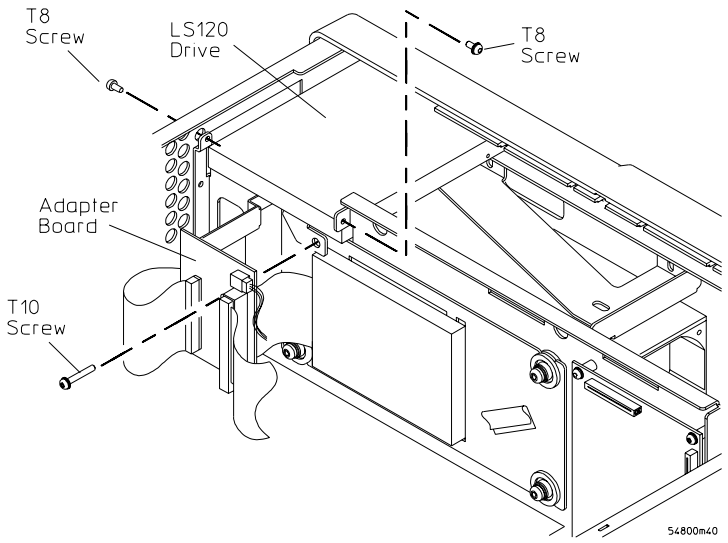
5. Grasp the scope interface and SVGA display boards at the top corners and pull them straight up until they are free of the card cage.
6. To replace the scope interface and SVGA display boards, reverse the above procedure.
   Be sure to observe correct polarity on all cables when replacing the boards.

To remove and replace the LS120 floppy disk drive

Use this procedure to remove and replace the floppy disk drive. When necessary, refer to other removal procedures.

1 Disconnect the power cable and remove the top sleeve.
2 Using a T10 driver remove the adapter board from the LS120 disk drive.
3 Using a T8 driver remove the two side screws holding the LS120 disk drive in place.
4 Slide the LS120 disk drive through the front frame and remove.

Figure 6-22



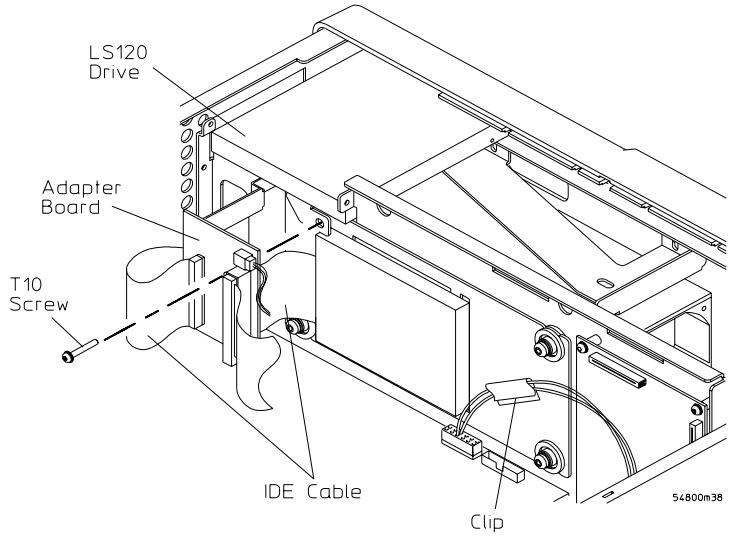
Removing the Floppy Disk Drive Screws

5 To replace the LS120 disk drive, reverse the above procedure with a new disk drive.

To remove and replace the hard disk drive

1 Disconnect the power cable and remove the top sleeve.
2 Using a T10 driver remove the adapter board from the LS120 drive.
3 Remove the hard drive IDE cable.
4 Remove the black and white cables from the clip on the shock mount plate.

Figure 6-23



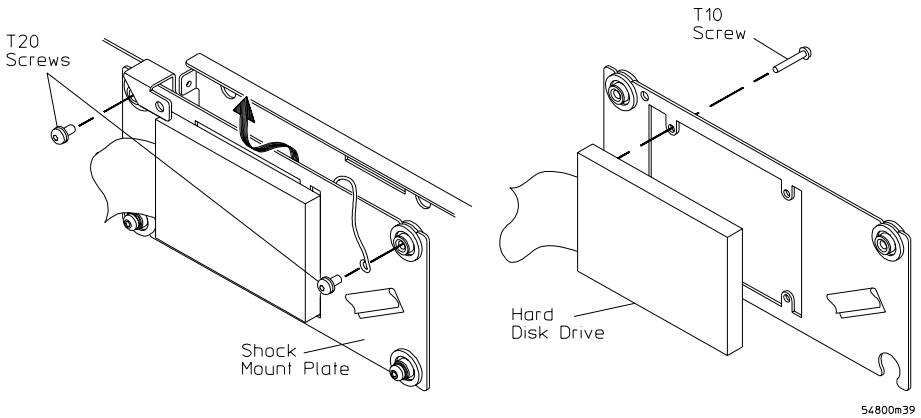
Removing the Cables

CAUTION

DO NOT LET THE DISK DRIVE FALL!
Support the drive while removing the screws so that the drive does not fall.

5 Using a T20 driver remove the two screws holding the shock mount in place.
6 Tilt the disk drive assembly forward and lift up to remove.
7 Using a T10 remove the four screws holding the disk drive onto the shock mount.

Figure 6-24



Removing the Hard Disk Drive

8 To replace the hard disk reverse, the above procedure with a new hard drive.

CAUTION

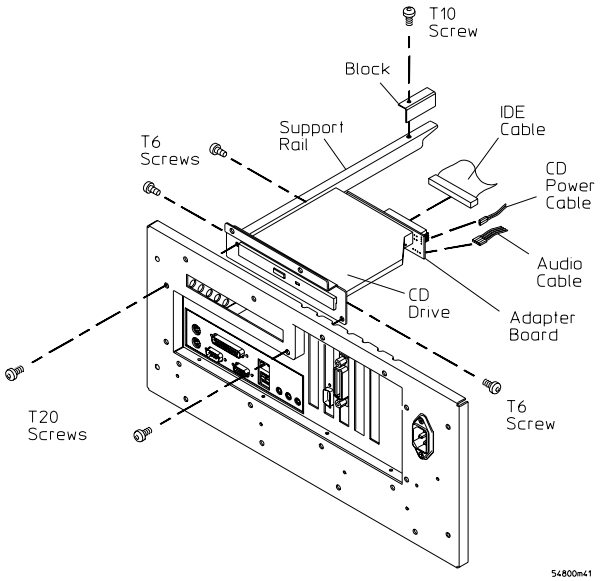
DO NOT OVER TIGHTEN THESCREWS!
Do not overtighten the T10 screws that secure the Hard Disk Drive to the bracket. Torque to 3 in-lbs.

To remove and replace the CD-ROM drive

Use this procedure to remove and replace the CD-ROM drive. When necessary, refer to other removal procedures.

1. Disconnect the power cable and remove the top sleeve.
2. Remove the following cables:
   - IDE cable (W15)
   - CD-ROM Power cable (W4)
   - Audio cable (W16)
3. Using a T10 driver remove the block from the CD-ROM support rail.
4. Using a T20 driver remove the two back panel screws holding the CD-ROM drive in place.
5. Slide the CD-ROM drive back towards the front frame, then lift and pull to remove.
6. Using a T6 driver remove the three screws securing the CD-ROM to the support brackets.

Figure 6-25



Removing the CD-ROM Drive

7. Remove the A4 CD-ROM Adapter Board from the rear of the CD-ROM.
8. To replace the CD-ROM drive, reverse the above procedure with a new drive.

To remove and replace the motherboard

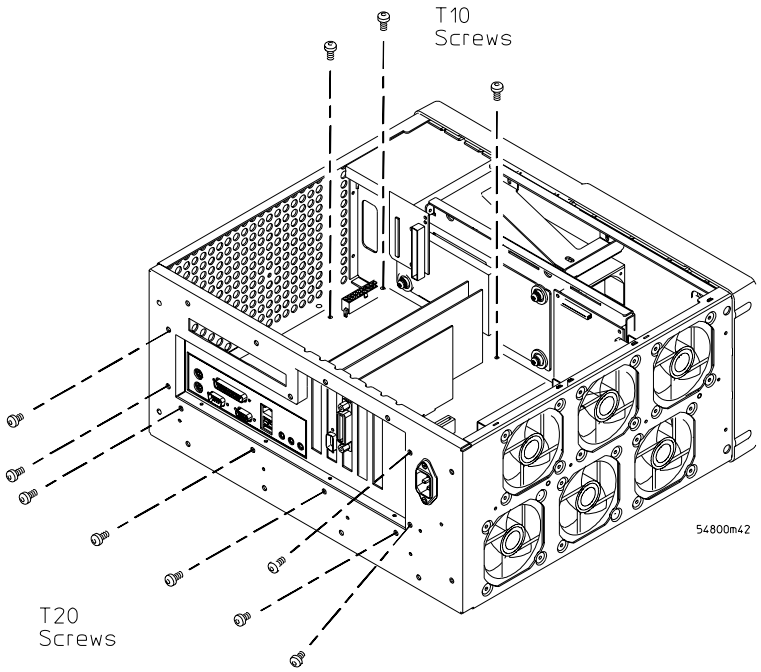
Use the following procedure to remove and replace the motherboard assembly. When necessary, refer to other removal procedures.

CAUTION

REPLACE MOTHERBOARD WITH THE SAME TYPE!
Be sure to order the correct motherboard, and replace the motherboard with the same type.

1. Disconnect the power cable and remove the cover.
2. Remove the CD-ROM drive.
3. Remove the eight T20 screws holding the computer tray in on the rear of the chassis.
4. Remove the three T10 screws holding the tray down to the chassis in the upper right corner by the LS120 disk drive.

Figure 6-26

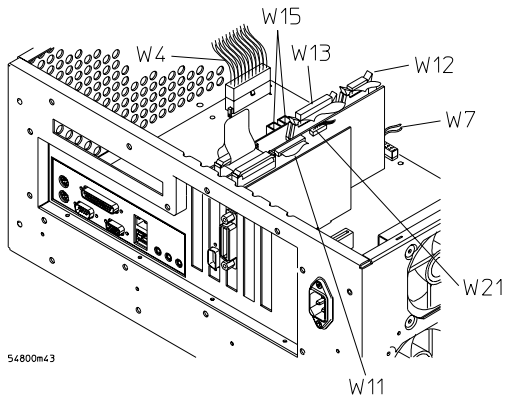


Removing the Torx Screws

5 Disconnect the following cables.

- IDE cables (2) from Motherboard to LS120 disk drive and CD-ROM drive adapter board W15
- Motherboard power supply cable W4
- Display ribbon cable W11
- Keyboard cable W12
- Motherboard switch cable W7
- Acquisition cable W3
- Backlight primary cable W21

Figure 6-27

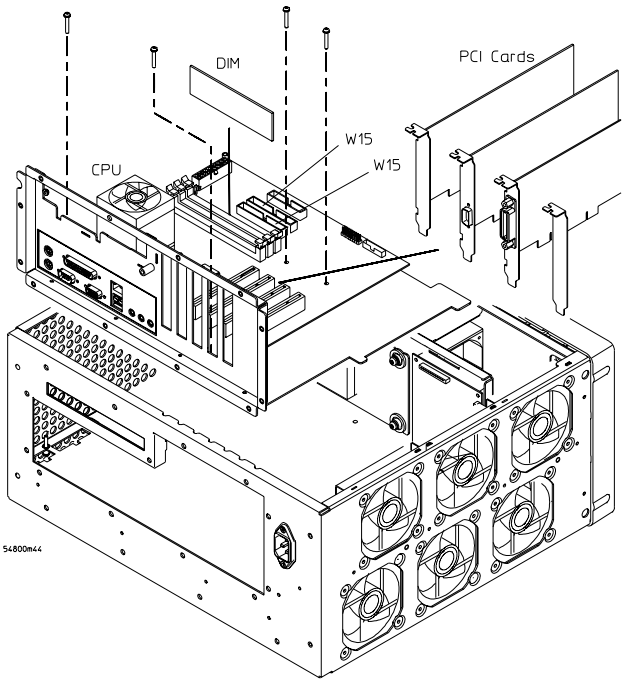


Removing the Cables

6 Remove the computer tray by lifting up from the rear panel.

7 Remove all PCI cards, CPU, RAM DIMM, and cables.

Figure 6-28



Removing the Motherboard

8 Remove the remaining T10 screws from the motherboard.

9 Lift the motherboard out of the tray.

10 To replace the motherboard assembly, reverse the above procedure. Note the following:

- Replacement motherboards come with a CPU and RAM DIMMs. Be sure to observe polarity when reconnecting all the cables.
- Ensure that all jumpers are set correctly on the new motherboard before installation. See “To configure the motherboard jumpers and set up the BIOS” in chapter 5.

11 Once an upgraded motherboard has been installed, turn on the instrument and run the WINBIOS setup procedure. See “To configure the motherboard jumpers and set up the BIOS” in chapter 5.

12 Once the WINBIOS has been configured, cycle power to start the Windows operating system and begin harddrive recovery.

13 Run the self-test to verify the instrument is operating properly.
See "Self-Test Verification" in chapter 3.

To remove and replace the power supply

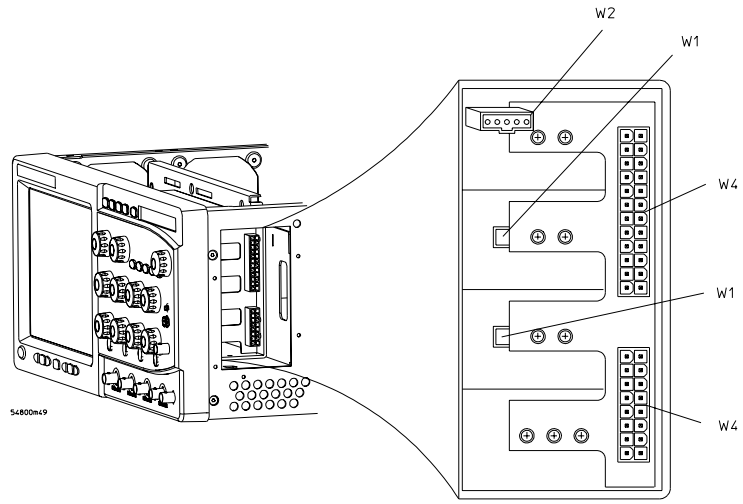
Use these steps to remove the power supply assembly. When necessary, refer to other removal procedures.

WARNING

SHOCK HAZARD!
If the power supply is defective is could have a dangerous charge on some capacitors. This charge could remain for many days after removing power from the supply.

1 Disconnect the power cable and remove the cover.
2 Disconnect the cables from the front of the supply.
3 Remove the motherboard subassembly.

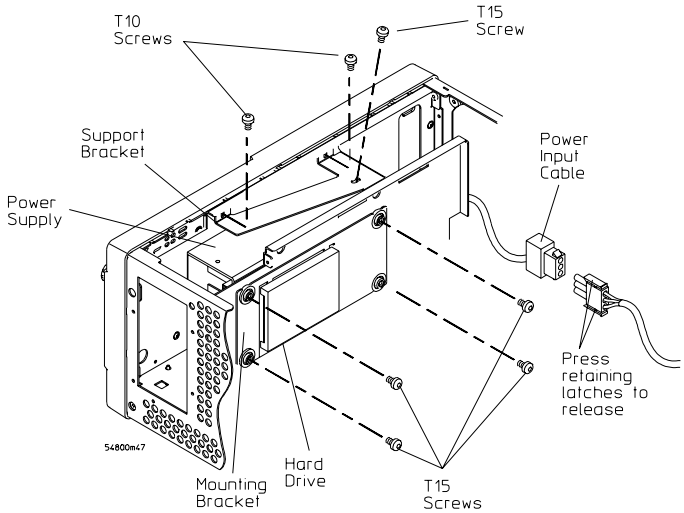
Figure 6-29



Removing Motherboard Subassembly

4 Remove the Torx T15 screw that secures the power supply support bracket to the power supply.

Figure 6-30



Removing Motherboard Subassembly Torx Screws and Power Supply Cables

5 Remove the two Torx T10 screws that secure the support bracket to the chassis.

6 Remove the four Torx T15 screws that secure the hard drive to the mounting bracket.

7 Seperate the power input cable, 54810-61614, from the cable assembly, 54810-61613, to the power supply.

8 Lift the supply up and out of the chassis.

9 To replace the supply, reverse the installation procedure. Ensure that the AC power connector is aligned with the cutout in the rear panel, that the supply chassis rests on the two tabs in the instrument chassis, and that the ground wire is routed through the notch at the rear of the power supply chassis.

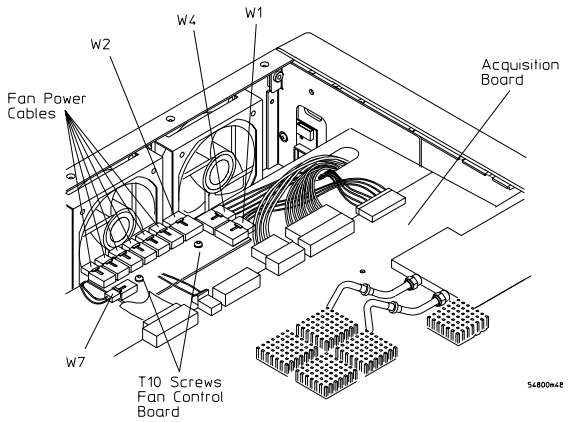
Cable W2, which is the middle connector in front, connects to the pins toward the top of the supply.

To ensure electrical safety, you must reconnect the ground wire to the chassis.

To remove and replace the fan controller board

1 Disconnect the power cable and remove the cover.
2 Disconnect the following cables from the fan control board.
- All six fan power cables from the fan control board
- Motherboard sense line 1 at P8
- Power supply control cable at P10
- Controller board power at P1
- Motherboard sense line 2 at P9

3 Remove the two T10 screws from the fan controller board.
4 Lift board out of chassis.
5 To re-install reverse this procedure paying attention to polarity of power cables.



To remove and replace the fan

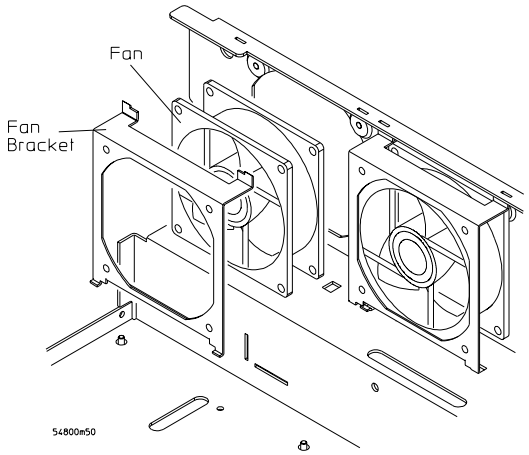
WARNING

AVOID INJURY!
The fan blades are exposed both inside and outside the chassis. Disconnect the power cable before working around the fan. Use extreme caution in working with the instrument. Failure to observe these precautions may result in injury.

Use this procedure to remove and replace the fans. When necessary, refer to other removal procedures.

1. Disconnect the power cable and remove the cover.
2. Disconnect the fan cable from the fan control board.
3. Remove the fan bracket securing the fan to the chassis.
4. The ATX Service Kit (Agilent Technologies P/N 54845-68803) has instructions and a tool to assist with fan bracket removal.

Figure 6-31



Removing Fan Fasteners

CAUTION

AVOID OVERHEATING THE INSTRUMENT!
When replacing the fan, be sure the direction of the fan air flow is coming from the inside to the outside of the instrument. Check the flow arrows on the fan and check for proper flow once power is applied to the instrument. Improper air flow can overheat the instrument.

5. To install the fan, reverse this procedure.

To remove and replace an attenuator

Use this procedure to remove and replace an attenuator assembly. When necessary, refer to other removal procedures.

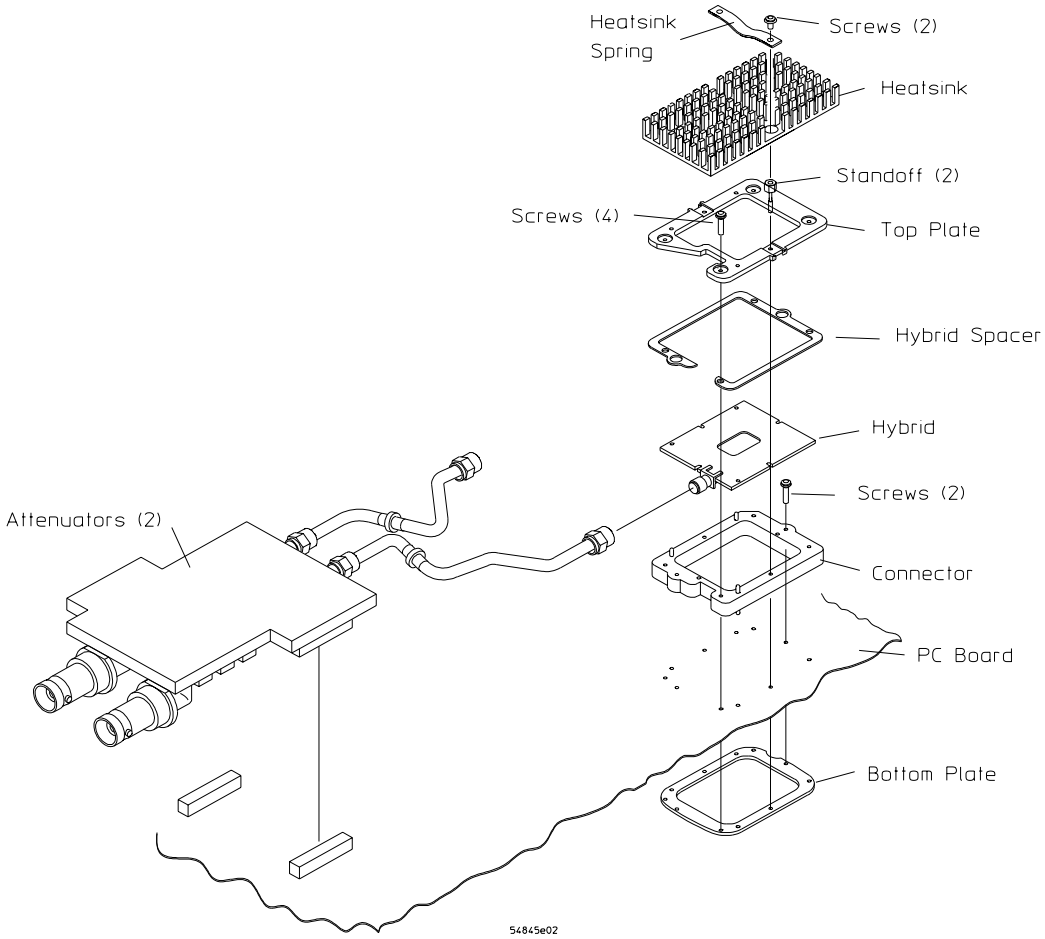
CAUTION

ELECTROSTATIC DISCHARGE!
Use grounded wrist straps and mats when servicing the acquisition board. Electrostatic discharge can damage electronic components.

Do Not Remove the Attenuators from the Acquisition Board
Attenuators are part of the acquisition board. When replacing the acquisition assembly, do not remove the attenuators.

1. Using ESD procedures, remove the acquisition board assembly from the unit.
2. Using a Torx T6 driver, remove the heatsinks from the associated A/D-FISO hybrids.
   The heatsinks must be removed first to allow you to disconnect the semi-rigid cables from the hybrid end before disconnecting the cables from the attenuator end.
3. Carefully disconnect the semi-rigid cables from the A/D-FISO hybrids, then disconnect from the attenuator ends.
4. Carefully lift up on the rear of the attenuator boards near the two mating connectors to remove from the acquisition board.
5. Replace the attenuator by reversing this procedure. Torque the semi-rigid cables to no more than 5 in-lbs and the heatsink screws A13H3 to 3 in-lbs.

Figure 6-32



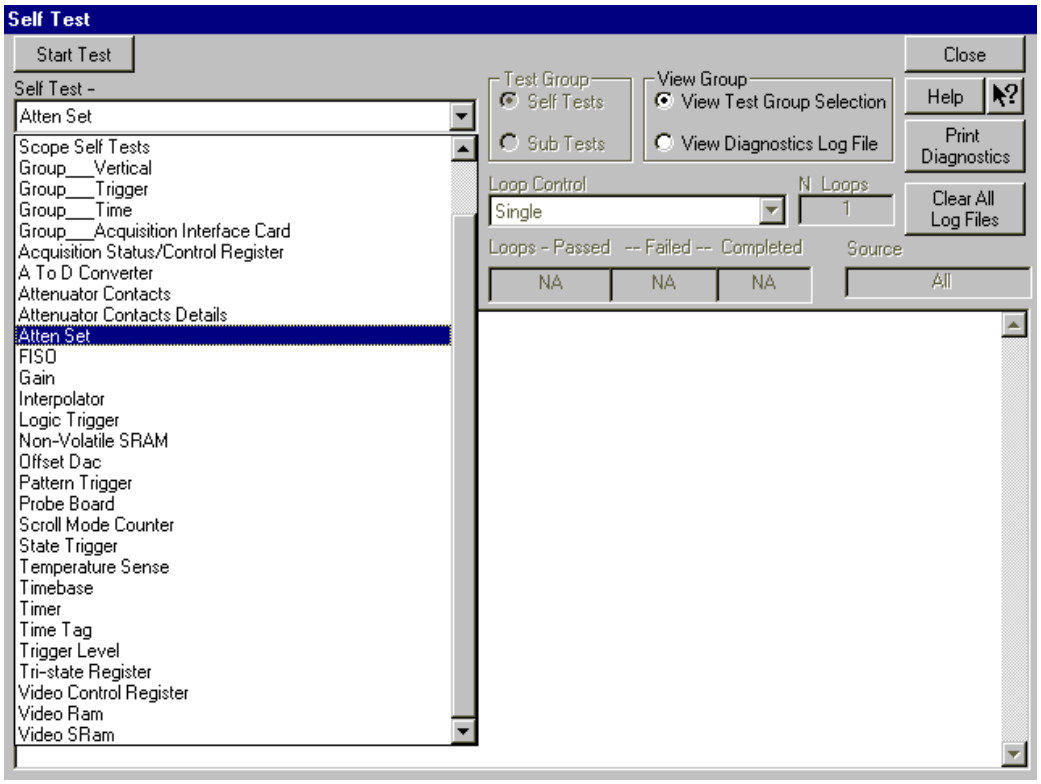
Removing an Attenuator

If You Permanently Replace Parts
When you replace acquisition system components, you should rerun the self calibration routines prior to performance verification or use of the instrument.

To reset the attenuator contact counter

1 Turn off the Infiniium oscilloscope.
2 Connect a mouse and a keyboard to the oscilloscope.
3 Turn on the oscilloscope. Insert the service disk when the message “Starting Windows 9x...” appears.
appears on the screen.
4 The oscilloscope will boot into the Windows® operating system.
5 Press Control-Esc on the keyboard to access the Windows® Start menu.
6 Open the Programs group and click the Infiniium Scope icon.
7 When the oscilloscope application comes up, click the mouse icon in the upper right corner of the screen.
8 Click the Utility pull down menu, then click Self Test. In the Self Test screen click Select Service Extensions.
9 Click the Self Test pull down menu, scroll down and select Atten Set.

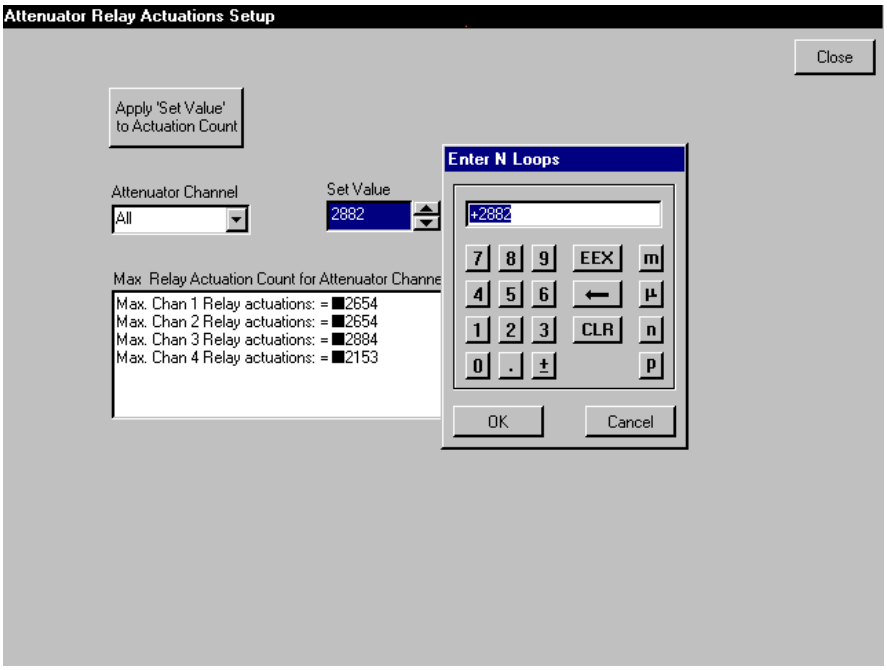
Figure 6-33



Self Test

10 Click the Start Test button. A screen like the following will be displayed.

Figure 6-34



Attenuator Relay Actuations Setup

11 In the Attenuator Channel box, select the channel you are changing.

12 Under Set Value, enter the corrected attenuator value using the keyboard or the drop down keypad, then press the button labeled Apply 'Set Value' to Actuation Count.

13 Repeat for each channel you need to change.

To remove and replace an acquisition hybrid

Use the following procedure to remove and replace an acquisition hybrid. When necessary, refer to other removal procedures.

CAUTION

ELECTROSTATIC DISCHARGE!
Use grounded wrist straps and mats when servicing the acquisition board. Electrostatic discharge can damage electronic components.

You do not have to remove the acquisition board before replacing an acquisition hybrid.
To understand the sequence of parts, use the accompanying illustration.

To remove the acquisition hybrid

1. Disconnect the power cable and remove the cover.
2. Use a T-6 Torx driver to remove two screws that secure the heatsink spring, then remove the heatsink.
3. Disconnect the semi-rigid cables from the A/D-FISO hybrids, then disconnect from the attenuator ends.
4. First, use a T-6 Torx driver to remove the four screws that secure the top plate.
5. Use a 3/16 hex driver to remove two standoffs that secure the top plate.
6. Remove the top plate.
7. Grasp the hybrid across the diagonal corners (or sides) using your thumb and index finger. Then lift the hybrid off of the connector assembly.

To replace the acquisition hybrid

The location of pins and other locator features will guide the alignment of parts. This assembly cannot be assembled incorrectly without forcing.

1 Install the hybrid with the three corner holes over the three large locator pins.

2 Install the top plate with the three cut-out corners over the three locator pins.

CAUTION DO NOT USE EXCESSIVE FORCE!
Tighten the hybrid carefully. Excess force or improper procedure may break the hybrid, which is very expensive to replace.

3 Loosely install the two hex standoffs along the long dimensions of the top plate.

4 Loosely install the two M2 pan-head screws.

5 Use a 5 mm (3/16 in) torque driver set to 0.34 Nm (3 in-lbs) to tighten the standoffs in the following sequence.

- **a** Tighten any standoff to specifications.
- **b** Tighten the standoff directly opposite the first one to specifications.
- **c** Tighten the remaining two screws to specifications, using the Torx T6 torque driver set to 0.34 Nm (3 in-lbs).

6 Connect the semi-rigid cables to the attenuator ends, then connect to the A/D-FISO hybrids.

7 Check for the graphite pad on the underside of the heatsink, then install it with the hole that is near one corner toward the front of the instrument.

8 Install the heatsink spring with the curve down.

9 Install the two heatsink screws. Use a T6 torque driver set to 0.34 Nm (3 in-lbs) to tighten them.

If You Permanently Replace Parts
When you replace acquisition system components, you should rerun the self calibration routines prior to performance verification or use of the instrument.

The Hybrid Connector

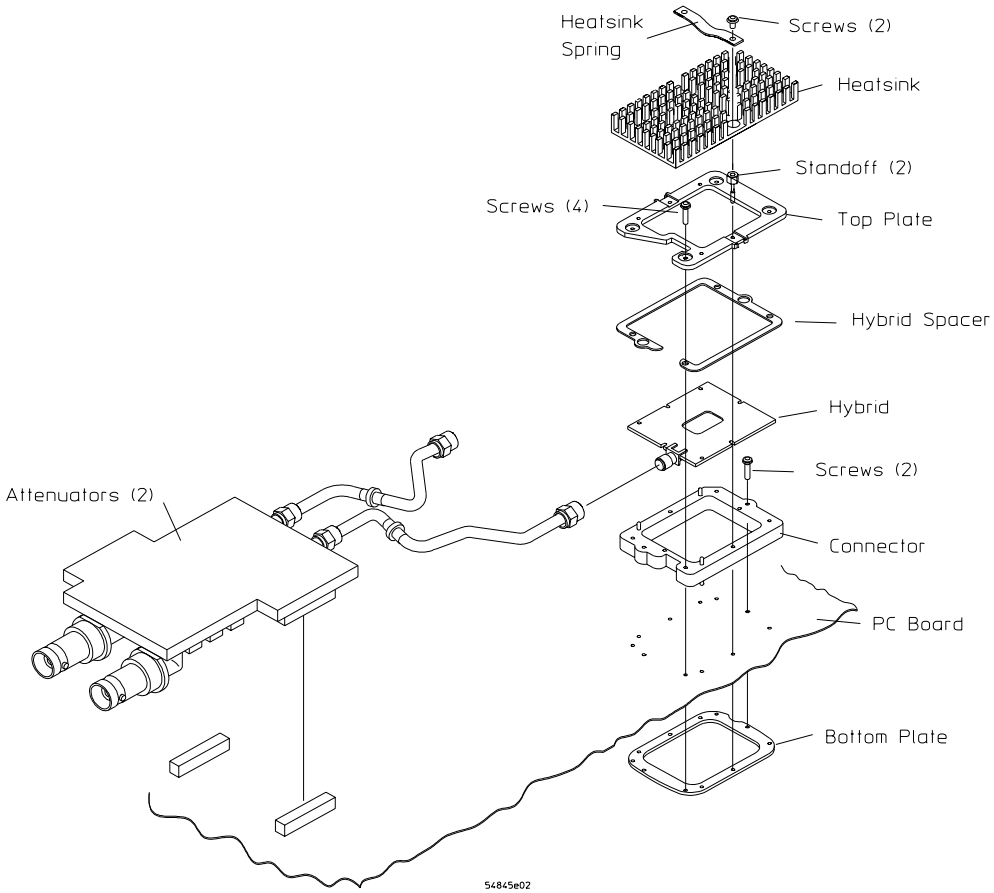
As shown in the illustration, two screws through the hybrid connector hold the bottom plate to the underside of the PC board. If you remove the connector, the bottom plate can fall away from the board.

Sometimes the plate will stick to the bottom of the board by itself because of adhesives that fasten an insulator to the plate. If the connector is very gently removed and replaced, you might be able to replace the connector without removing the acquisition board. The key is to apply very little pressure while removing the connector screws. Too much pressure will push the plate away from the bottom of the board. If the plate falls from the board, you will have to remove the acquisition board to re-install the connector. If the plate does not fall from the board, you will have saved some time and work.

To replace a connector:

1 Remove the acquisition board from the instrument.
2 Follow the procedure for removing the hybrid.

Figure 6-35



Removing the Hybrid Connector

3 Remove the two screws to remove the connector.
4 Re-assemble by following all procedures, taking note of the following:
- Use a T6 torque driver set to 0.34 Nm (3 in-lbs) to tighten the hybrid connector screws.

7

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Replaceable Parts

Replaceable Parts

This chapter of the *Agilent Technologies Infiniium Oscilloscope Service Guide* includes information for ordering parts. Service support for this instrument is replacement of parts to the assembly level. The replaceable parts include assemblies and chassis parts.

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.

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

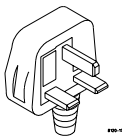
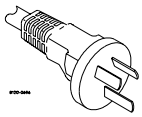
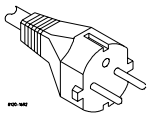
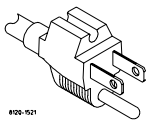
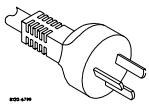
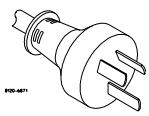
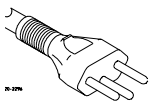
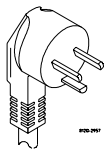
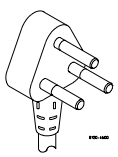
Some parts used in this instrument have been set up for an exchange program. This program allows the customer to exchange a faulty assembly with one that has been repaired, calibrated, and performance-verified by the factory. The cost is significantly less than that of a new part. The exchange parts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

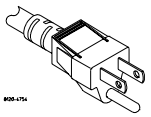
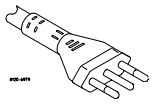
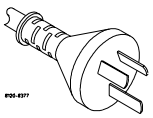
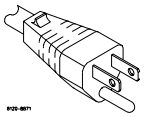
After receiving the repaired exchange part from Agilent Technologies, a United States customer has 30 days to return the faulty assembly. For orders not originating in the United States, contact the local Agilent Technologies service organization. If the faulty assembly is not returned within the warranty time limit, 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.

Power Cables and Plug Configurations

This instrument is equipped with a three-wire power cable. The type of power cable plug shipped with the instrument depends on the country of destination. The following figure shows option numbers of available power cables and plug configurations.

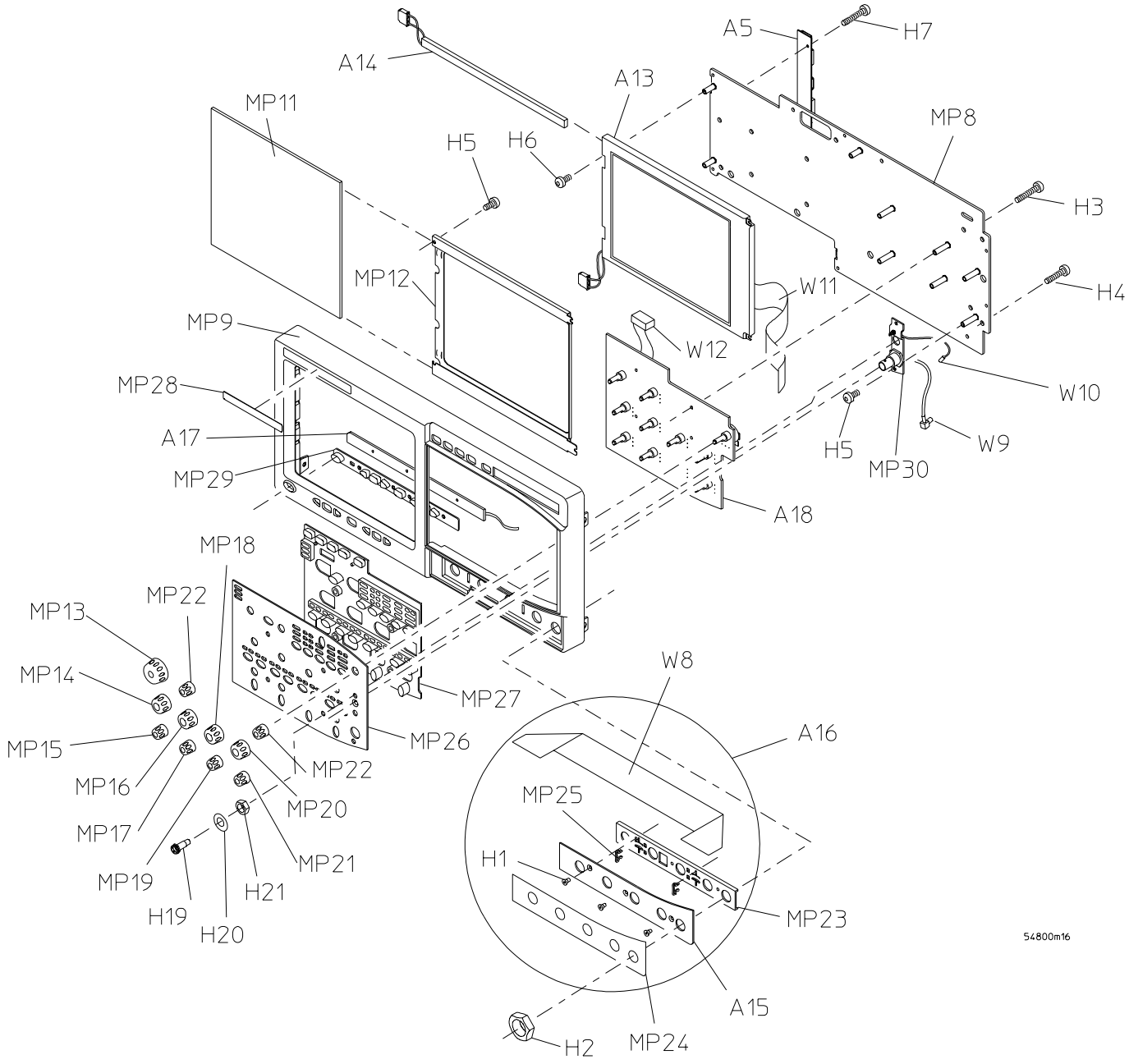
Power Cables and Plug Configurations

Plug Type	Cable Part No.	Plug Description	Length (in/cm)	Color	Country
Opt 900 250V 	8120-1703	90°	90/228	Mint Gray	United Kingdom, Cyprus, Nigeria, Zimbabwe, Singapore
Opt 901 250V 	8120-0696	90°	87/221	Mint Gray	Australia, New Zealand
Opt 902 250V 	8120-1692	90°	79/200	Mint Gray	East and West Europe, Saudi Arabia, So. Africa, India (unpolarized in many nations)
Opt 903** 125V 	8120-1521	90°	90/228	Jade Gray	United States, Canada, Mexico, Philippines, Taiwan
Opt 919 250V 	8120-6799	90°	90/228		Israel
Opt 920 250 V 	8120-6871	90°			Argentina
Opt 906 250V 	8120-2296	1959-24507 Type 12 90°	79/200	Mint Gray	Switzerland
Opt 912 220V 	8120-2957	90°	79/200	Mint Gray	Denmark
Opt 917 250V 	8120-4600	90°	79/200		Republic of South Africa India

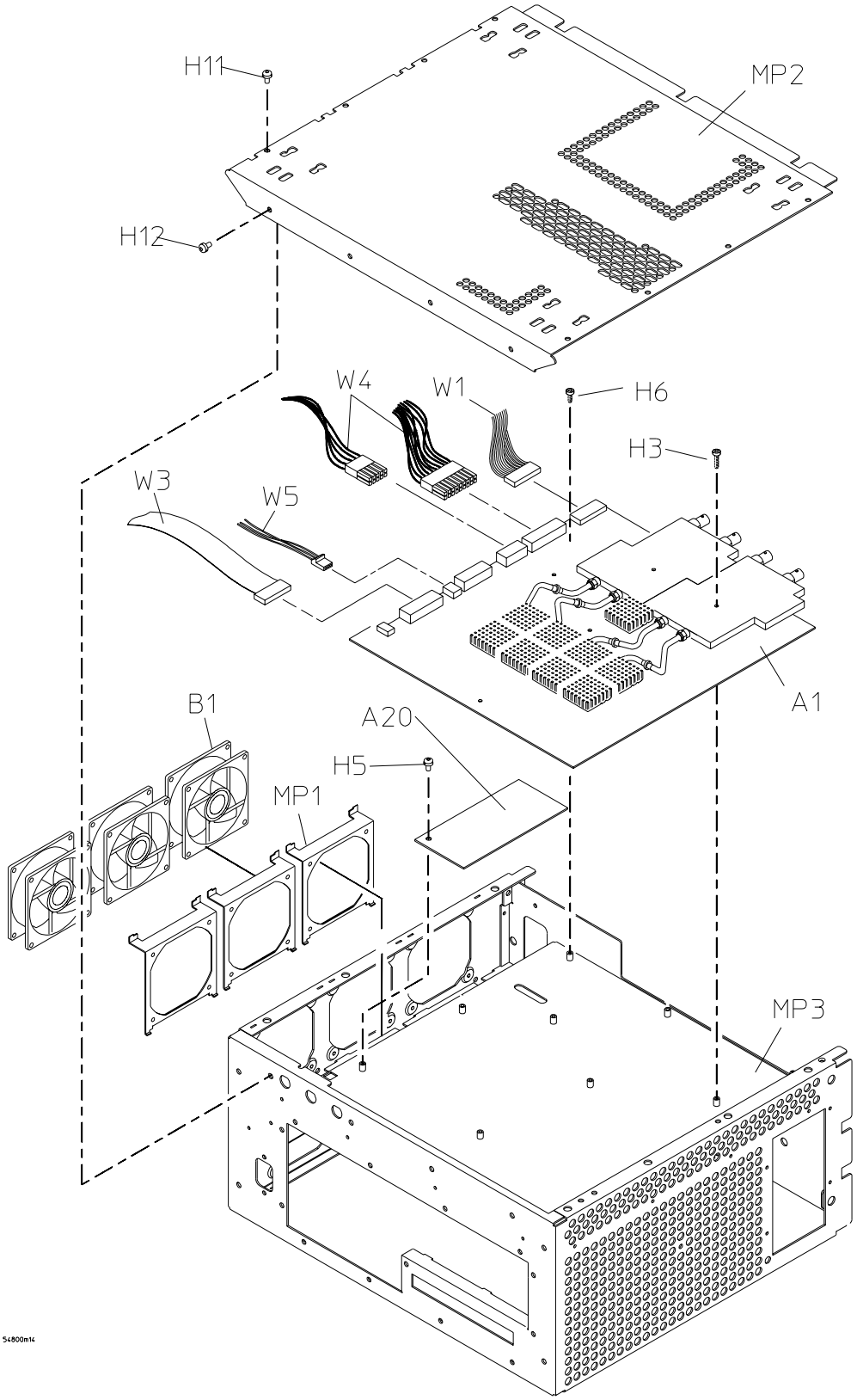
Plug Type		Cable Part No.	Plug Description	Length (in/cm)	Color	Country
Opt 918 100V		8120-4754	90°	90/230		Japan
Opt 921		8120-6979	90°			Chile
Opt 922		8120-8377	90°			
Opt 927		8120-8871	90°			Thailand

* Part number shown for plug is industry identifier for plug only. Number shown for cable is Agilent Technologies part number for complete cable including plug.
** These cords are included in the CSA certification approval of the equipment.
E = Earth Ground
L = Line
N = Neutral

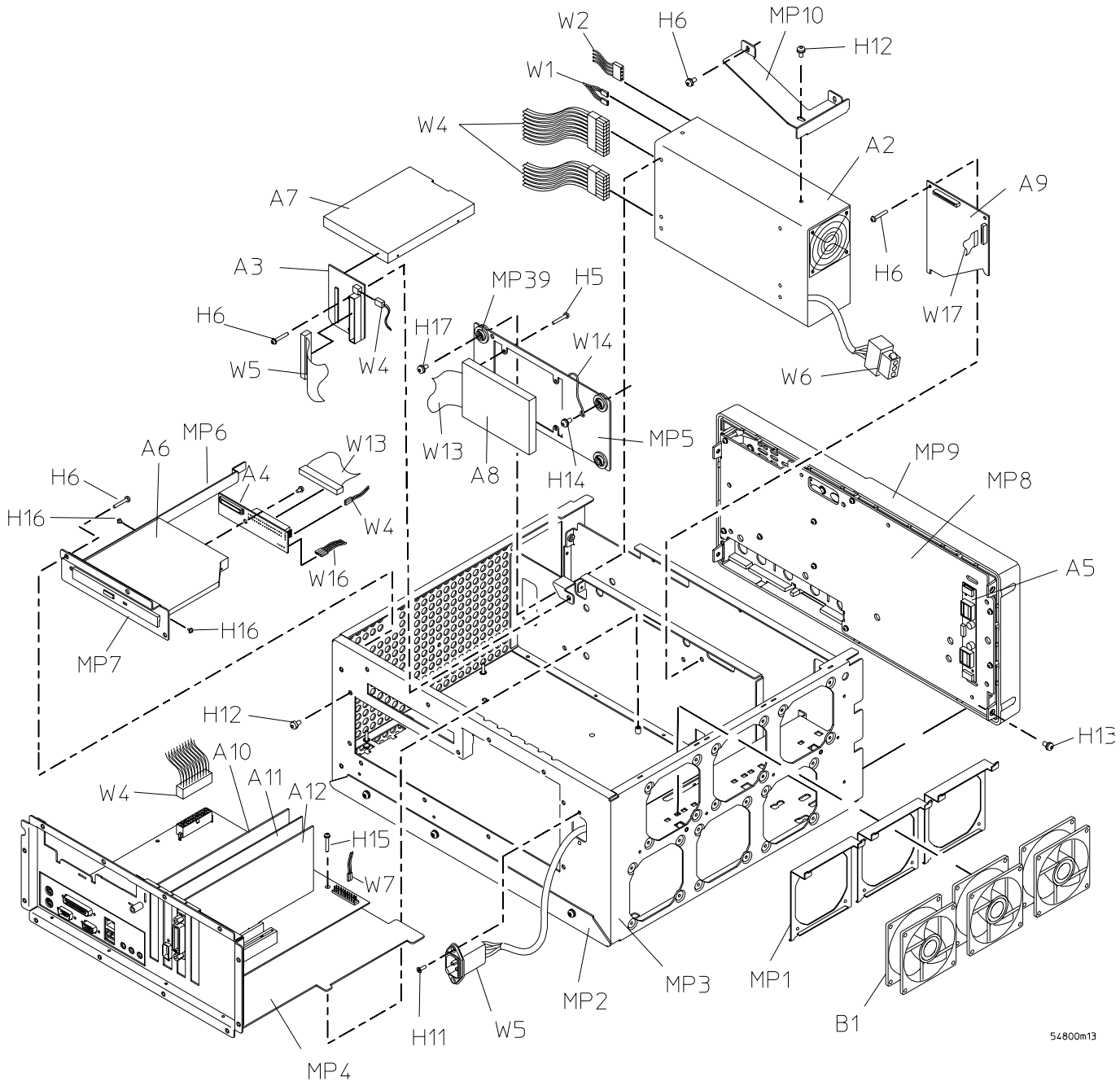
Exploded Views



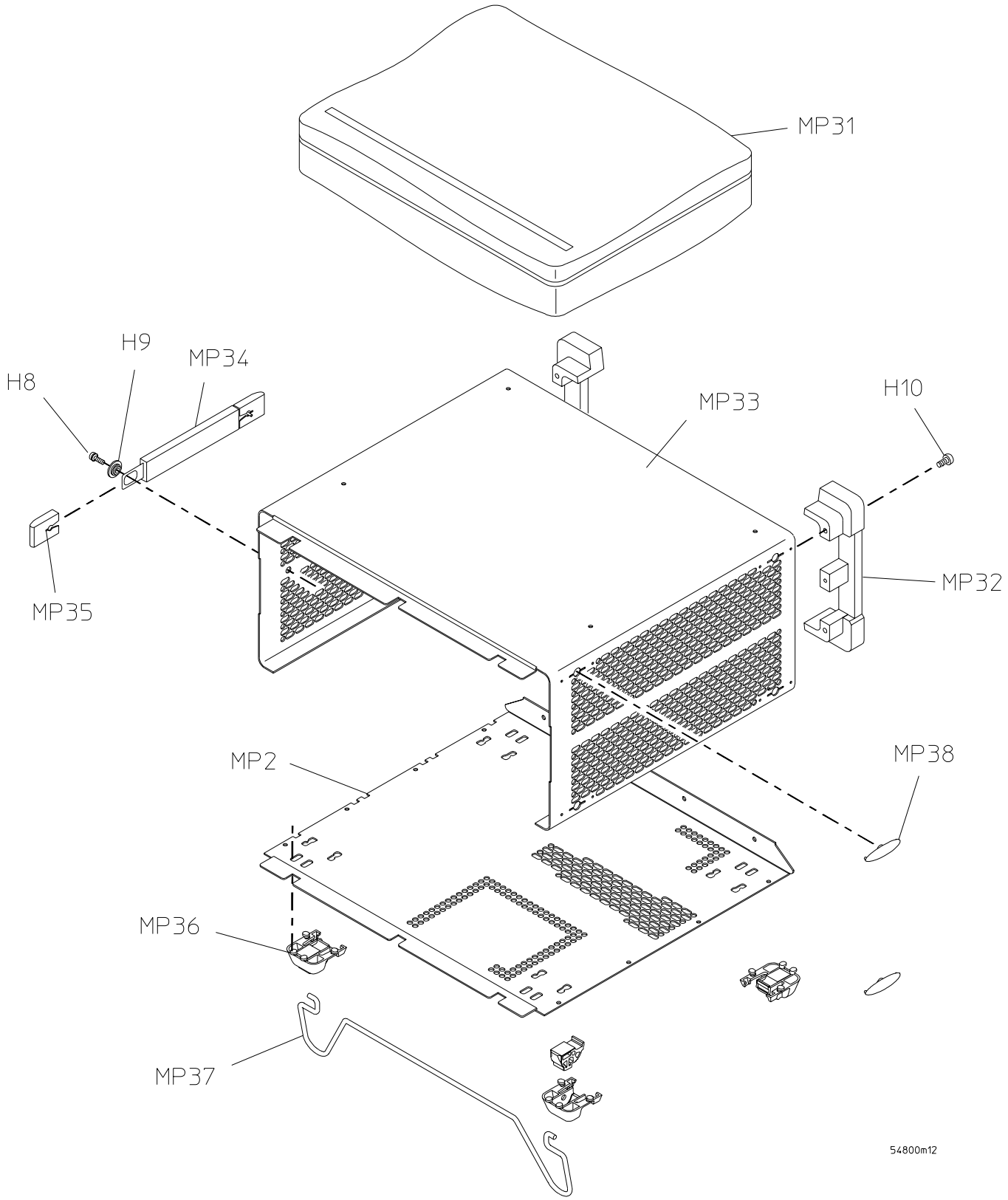
Front Frame and Front Panel



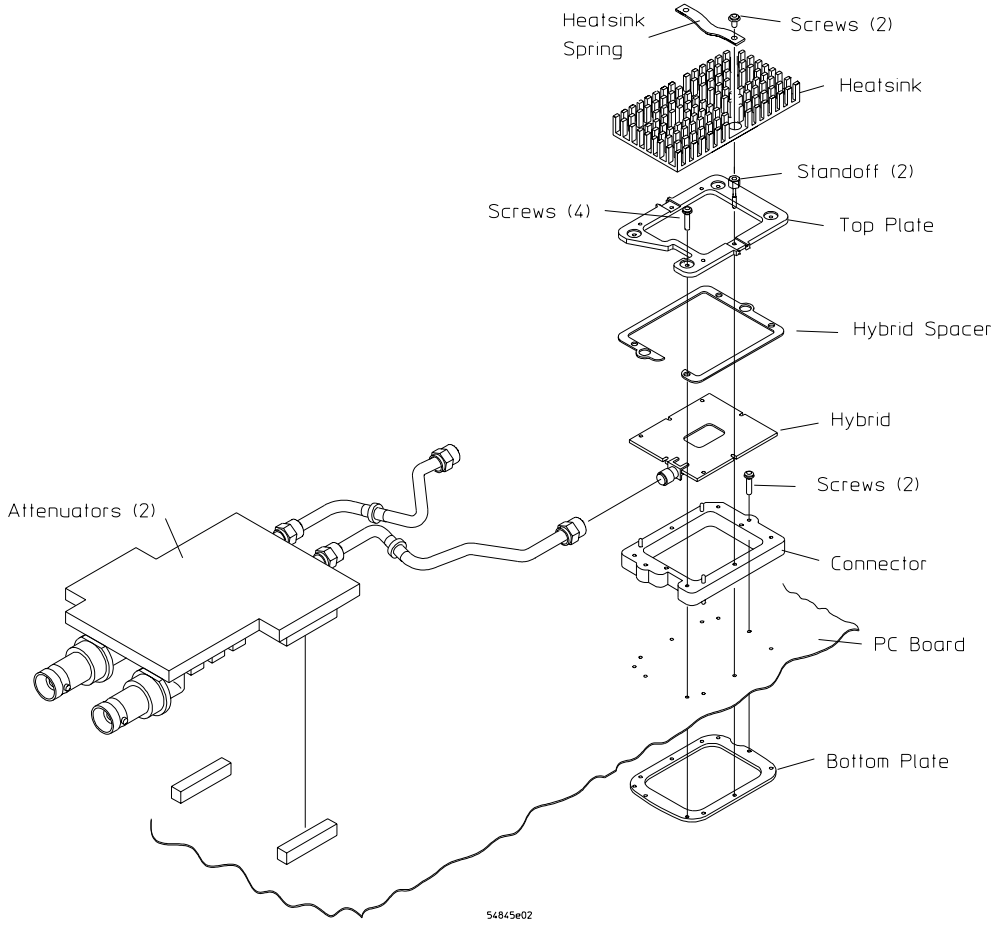
Fan and Acquisition Assembly



Power Supply and PC Motherboard



Sleeve and Accessory Pouch



Attenuator Assembly

Replaceable Parts List

The following table is a list of replaceable parts and is organized as follows:

- Exchange assemblies in alphanumeric order by reference designation.
- External chassis parts in alphanumeric order by reference designation. These parts are generally those that take the physical wear and tear of use.
- Internal parts in several categories. Each category is in alphanumeric order by reference designation. Replacing these parts generally requires opening the cabinet.

The information given for each part consists of the following:

- Reference designation.
- Agilent Technologies part number.
- Total quantity (QTY) in instrument or on assembly. The total quantity is given once and at the first appearance of the part number in the list.
- Description of the part.

Replaceable Parts

Ref. Des.	Agilent Part Number	QTY	Description
Exchange Assemblies			
A1	54845-69527	1	4-CH ACQUISITION ASSEMBLY W/ATTENUATORS (Agilent Model 54845B)
A1	54846-69527	1	4-CH ACQUISITION ASSEMBLY W/ATTENUATORS (Agilent Model 54846B)
External Chassis Parts			
MP13	54801-47403	1	KNOB 24 MM GRAY
MP14	54801-47408	1	KNOB 18 MM YELLOW
MP15	54801-47404	1	KNOB 12 MM YELLOW
MP16	54801-47409	1	KNOB 18 MM GREEN
MP17	54801-47405	1	KNOB 12 MM GREEN
MP18	54801-47410	1	KNOB 18 MM PURPLE
MP19	54801-47406	1	KNOB 12 MM PURPLE
MP 20	54801-47411	1	KNOB 18 MM PINK
MP21	54801-47407	1	KNOB 12 MM PINK
MP22	54801-47401	2	KNOB 12 MM GRAY
MP24	54845-94304	1	AUTO PROBE LABEL
MP26	54845-94330	1	FRONT PANEL 4CH LABEL
MP28	54845-94305	1	LOGO LABEL/54845B(Infiniium 1 GHz 8GSa/s)
MP28	54846-94305	1	LOGO LABEL/54846B(Infiniium 2.25 GHz 8GSa/s)
MP31	54810-68701	1	ACCESSORY POUCH
MP32	5042-1753	2	REAR FEET
MP34	54810-44901	1	MOLD OVER HANDLE
MP35	54810-45001	2	END CAP HANDLE
MP36	54810-61001	4	BOTTOM FEET w/INSERT
MP37	54810-03702	1	TILT STAND
MP38	01680-41002	4	SIDE FOOT
W18	8120-1521	1	CABLE-POWER (standard 125V USA)
W18	8120-1703	1	CABLE-POWER (Option 900-UK)
W18	8120-0696	1	CABLE-POWER (Option 901-AUSTL)
W18	8120-1692	1	CABLE-POWER (Option 902-EUR)
W18	8120-2296	1	CABLE-POWER (Option 906-SWIT)
W18	8120-2957	1	CABLE-POWER (Option 912-DEN)
W18	8120-4600	1	CABLE-POWER (Option 917-AFRICA)
W18	8120-4754	1	CABLE-POWER (Option 918-JAPAN)
W18	8120-6799	1	CABLE-POWER (Option 919-ISRAEL)
W18	8120-6871	1	CABLE-POWER (Option 920-ARGENTINA)
W18	8120-6979	1	CABLE-POWER (Option 921-CHILE)
W18	8120-8377	1	CABLE-POWER (Option 922)
W18	8120-8871	1	CABLE-POWER (Option 927-THAILAND)
Electrical Assemblies			
A2	0950-4191	1	POWER SUPPLY
A5	0950-3235	1	INVERTER BOARD
A13	2090-0396	1	LCD DISPLAY
A14	2090-0365	2	BACKLIGHT FLUORESCENT LAMP

To identify the motherboard configuration, see "To configure the motherboard jumpers and set up the BIOS in chapter 5.
Depending on the motherboard configuration, determine which hard drive, motherboard, CPU, RAM, floppy drive, chassis, and cables are used in your unit.

PC Motherboard (Motorola Motherboard w/120 MByte Floppy Drive and CD ROM Drive)

Replaceable Parts

Ref. Des.	Agilent Part Number	QTY	Description
A3	54810-66531	1	LS120 ADAPTER BOARD
A4	86100-66517	1	CDROM ADAPTER BOARD
A6	0950-4192	1	CD ROM Drive
A7	0950-3931	1	LS120 SUPERDISK
A8	0950-3933	1	HARD DRIVE
A8	54810-83523	1	HARD DRIVE w/SOFTWARE
A19	0960-2176	1	MOTHERBOARD SUBASSEMBLY
H22	0624-0847	3	SELF TAPING SCREWS
W13	54801-61643	1	HARD DRIVE MINI IDE CABLE
W14	54810-61615	1	HARD DRIVE GROUND CABLE
W15	54810-61611	2	IDE HARD DRIVE CABLE
W16	54810-61616	1	CDROM AUDIO CABLE
All Configurations			
A9	54810-66506	1	CAREFREE BOARD
A10	54810-66529	1	TOMBSTONE INTERFACE BOARD
A11	54810-66525	1	DISPLAY BOARD
A12	82350A #002	1	PCI GPIB BOARD
A15	54810-66511	1	AUTO PROBE I/F
A16	54845-68703	0	KIT I/O REPLACEMENT
A17	54810-66507	1	KEYBOARD - CURSOR
A18	54815-66536	1	KEYBOARD - 4CH
A20	54810-66537	1	FAN CONTROLLER BOARD
Attenuator Assemblies And A/D Hybrids (P/O Acquisition Board)			
A13A1-A13A4	54512-63402	2/4	ATTENUATOR ASSY
A13A5-A13A8	1NB7-8353	2/4	A/D CONVERTER HYBIRD
A13E1	54542-67601	2/4	CONNECTOR ASSEMBLY
A13H1	0515-0365	4/8	MS M2X0.4 4MM-LG PANHD T6
A13H2	0515-1908	4/8	MS M2X0.4 16MM-LG PANHD T6
A13H3	0515-2363	4/8	MS M2X0.4 8MM-LG FLATHD T6
A13MP1	54542-09101	2/4	HEAT SINK SPRING
A13MP2	54542-21101	2/4	HEAT SINK
A13MP3	54542-22401	2/4	HEATSINK STANDOFF
A13MP4	54542-04102	2/4	TOP PLATE
A13MP5	54542-04101	2/4	BOTTOM PLATE
Fans			
B1	3160-0644	6	12 V FAN
Internal Chassis Parts			
H1	0515-2219	3	MACHINE SCREW 5 MM
H2	54503-25701	5	HEX NUT BNC
H3	0515-1025	6	PAN HEAD SCREW 26 MM
H4	0515-1410	4	PAN HEAD SCREW 20 MM
H5	0515-0430	11	PAN HEAD SCREW 6 MM
H6	0515-0372	19	PAN HEAD SCREW 8 MM
H7	0515-1246	2	PATCH LOCK SCREW 6 MM
H8	5021-4302	4	M4x0.7 20MM-LG PANHD PATCHLOCK BLACK

Replaceable Parts

Ref. Des.	Agilent Part Number	QTY	Description
H9	54801-24702	1	RETAINER STRAP HANDLE
H10	0515-2195	4	PAN HANDLE SCREW 40 MM
H11	0515-1103	10	FLAT HEAD SCREW
H12	0515-0380	17	PAN HEAD SCREW
H13	0515-1403	4	M4X0.7 6 MM 90DEG FLATHD T15
H14	0515-0456	1	MS M4X0.7 20 MM LG SCREW
H15	0515-0375	3	MS MSX0.5 16 MM LG
H16	0515-0365	3	SCR MACHINE
H17	0515-0383	3	SCR MACHINE
H18	0515-2691	2	MS M2.6X0.45 6 MM PAN HEAD
H19	54542-26101	1	GROUND LUG
H20	2190-0027	1	WIL.256 .478 .02
H21	2950-0072	1	NUTH 1/4-32 .062
H23	0403-1052	3	STAND OFF
H24	1401-0202	3	PROTECTOR CAP
MP1	54810-01212	6	FAN CLIP
MP2	54810-04105	1	SLEEVE BOTTOM
MP3	54810-60101	1	CHASSIS ASSEMBLY
MP4	54810-60102	1	ATX TRAY
MP5	54810-01211	1	HARD DRIVE BRACKET
MP6	54810-03701	1	CDROM SUPPORT RAIL
MP7	54810-01214	1	CDROM MOUNT BRACKET
MP8	54810-04103	1	FRONT FRAME BACK PLATE
MP9	54801-40502	1	FRONT FRAME
MP10	54810-01213	1	POWER SUPPLY SUPPORT BRACKET
MP11	54801-88001	1	LENS GLASS
MP12	54801-01205	2	LENS BRACKET
MP23	54801-24701	1	BRACKET STIFFENER
MP25	54801-09101	1	SPRING STEEL
MP27	54815-41901	1	KEYPAD 4CH
MP29	54810-41902	1	CURSOR KEYPAD
MP30	54801-01206	1	CAL BNC BRACKET
MP33	54810-04104	1	SLEEVE TOP
MP39	1520-0238	4	GROMET
MP40	54810-68825	1	HANDLE SUBASSEMBLY
MP41	54810-03703	1	CD-SUPPORT RAIL STOP
Cables			
W1	54810-61608	1	SENSE CABLE
W2	54810-61607	1	CONTROL CABLE
W3	54801-61640	1	ACQUISITION SIGNAL CABLE
W4	54810-61601	1	POWER HARNESS CABLE
W5	54810-61614	1	POWER INPUT/LINE SINC
W6	54810-61613	1	CABLE ASSEMBLY POWER SUPPLY
W7	54810-61609	1	MOTHERBOARD SWITCH CABLE
W8	54810-61606	1	AUTO PROBE INTERFACE CABLE
W9	54801-61638	1	CAL BNC CABLE
W10	54801-61634	1	PROBE COMP CABLE
W11	54810-61610	1	DISPLAY CABLE

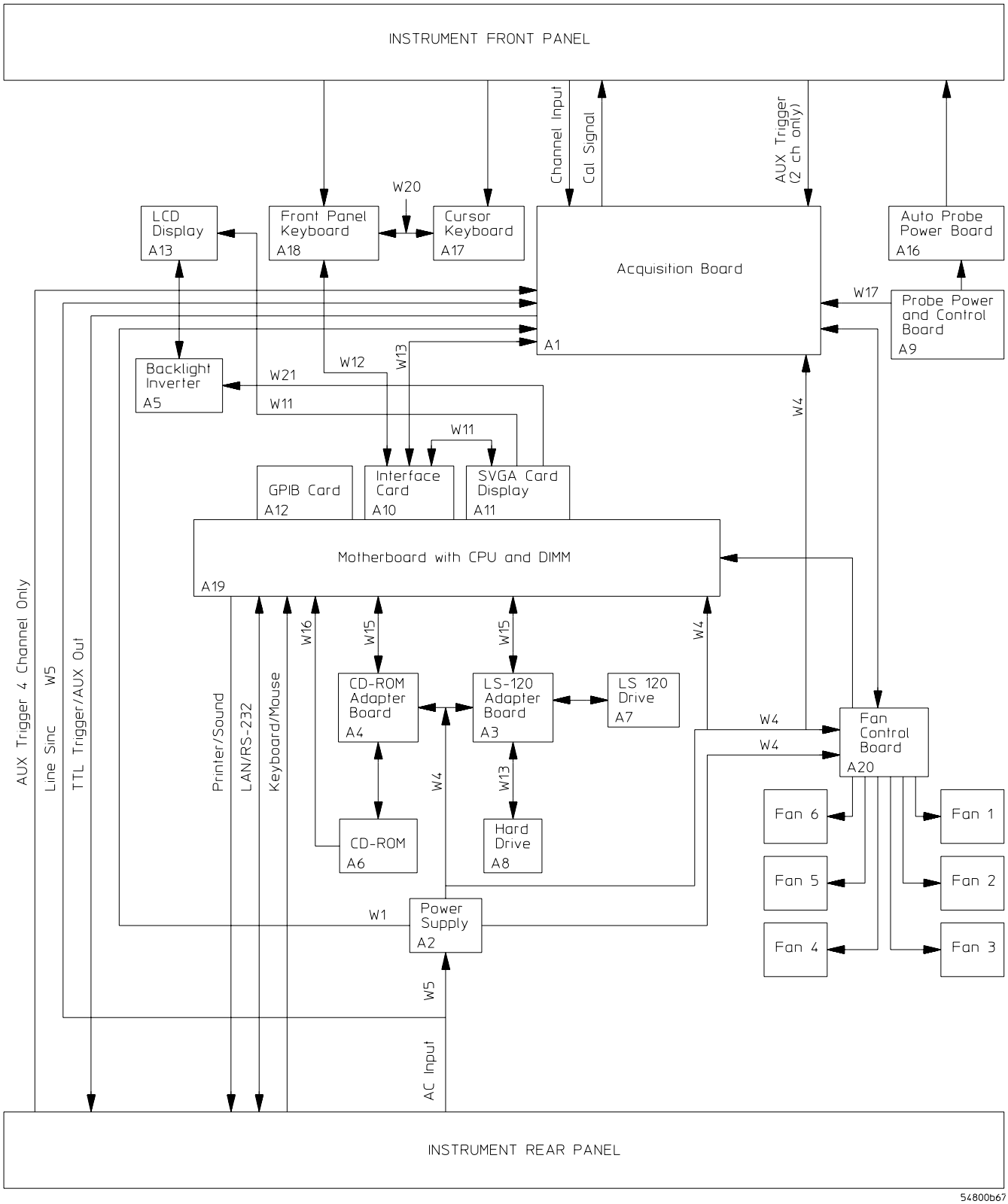
Replaceable Parts

Ref. Des.	Agilent Part Number	QTY	Description
W12	54810-61612	1	KEYBOARD CABLE
W17	54810-61604	1	PROBE POWER CABLE
W19	54810-61603	6	FAN CABLE
W20	54801-61626	1	KEYBOARD INTERCONNECT
W21	54810-61605	1	BACKLIGHT POWER CABLE
W22	54801-61624	1	DISPLAY JUMPER CABLE

8

Block-Level Theory 8-3
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Scope Interface Board 8-9

Theory of Operation



Instrument Block Diagram Shown for Original Configuration w/1.44 MByte Floppy Drive

Theory of Operation

This *Service Guide* supports troubleshooting the Agilent Technologies 54845B/46B to assembly level. Theory of operation is included only as supplemental information. It is not comprehensive enough for component-level troubleshooting.

Block-Level Theory

The Agilent Technologies 54845B Oscilloscope has four channels which are individually sampled at 4 GSa/s. Each channel is stored into 32 Kbytes of memory. Pairs of channels can be combined to sample at 8 GSa/s and extend memory to 64 Kbytes.

The Agilent Technologies 54846B Oscilloscope has the same features as the 54845B with a higher bandwidth of 2.25 GHz.

The front panel provides:

- Dedicated knobs and pushbuttons for major oscilloscope functions.
- An 8.4-inch (diagonal) color flat panel display for waveform, measurement, and graphical interface display.
- A 3 1/2-inch flexible disk drive.
- BNC connectors for channel input signals, auxiliary trigger input, and auxiliary output.
- AutoProbe interface for probe power and probe control.
- A connection for probe compensation.

The rear panel provides several connections:

- The line power input.
- An GPIB connector, for connection to an instrument controller.
- An RS-232 connection.
- A parallel printer connection.
- VGA monitor connection.
- Mouse and keyboard connections.

The instrument has several assemblies and four attenuators. Use the instrument block diagram on the previous page for the following discussion.

Power Supply Assembly

The switching power supply provides 300 W maximum for the instrument. The ac input to the power supply is 100–240 Vac, +/-10%. Maximum input power is 390W. The ac input frequency is 47 to 440 Hz.

Filtered voltages of +5.1 V, –5.2 V, +12.2 V, and –12.2 V are supplied to the acquisition board, where they are distributed throughout the board and to other assemblies.

FPD Monitor Assembly

The monitor is a thin film liquid-crystal display (TFT-LCD). This FPD is an 8.4-inch diagonal, 640 by 480 pixel VGA Color Monitor. The assembly requires +3.3 V and +12 V from the power supply.

A twin fluorescent back light provides illumination for the LCD. The Backlight Inverter assembly converts the +12 V to +300-1000 volts (acrms) and drives the back light.

Acquisition System

The acquisition system includes two attenuator assemblies, acquisition board, and scope interface board. The attenuators condition the signal, which is then digitized and stored by the acquisition board. The scope interface board provides the system control interface from the motherboard, and also interfaces the acquisition board to the SVGA display board for display of the acquired data. More detailed theory on the acquisition system follows this top-level block theory.

Front Panel

The front panel is read and controlled by a microcontroller IC. This device contains a microprocessor, RAM, ROM, and a DUART for communication with the microprocessor on the main assembly. The microcontroller is located on the keyboard and communicates with the system control circuitry through a cable and RS-232 interface. It reads the keys and knobs and controls the LED indicators.

The elastomeric keypad has 30 keys, all dedicated to a single function to improve ease of use. A conductive element on the inside of each key closes a gap on the underlying keyboard circuit. The keyboard controller detects this short and sends the proper keypress information to the system controller on the motherboard.

There are eleven dedicated knobs. Each knob controls a mechanical switch. The output of the switch is a 2-bit gray code that is read by the microcontroller for direction and distance turned.

A pushbutton controls the power through a Remote Inhibit sense line that is routed to the power supply. When closed, there is an impedance of approximately 196 Ω to ground from the Remote Inhibit sense line; the power supply detects this and turns on or off as required.

Disk Drives

The LS-120 flexible disk drive is 120 Mbyte, MS-DOS compatible. It is located on the front panel. The disk drive can be used to load a new oscilloscope operating system or to load application-specific software. This disk drive is available on newer Infiniium oscilloscopes or those Infiniium oscilloscopes that have been upgraded.

The hard disk drive is a 2.5" high-capacity, shock-resistant unit. It is used to store the oscilloscope operating system and certain system configuration data.

Either drive can also be used to store and recall instrument setups and waveforms.

Attenuators

The attenuators provide the appropriate impedance matching and all the attenuation and gain selection for each input channel. They connect directly to the acquisition board and are fastened to the acquisition board with screws.

Motherboard

The motherboard provides all system control and interface functions for the instrument. It contains a CPU, ROM, RAM, keyboard and mouse interfaces, serial and parallel interfaces, CDROM, hard and floppy disk drive interfaces, and PCI (Peripheral Component Interconnect) buses.

SVGA Display Card

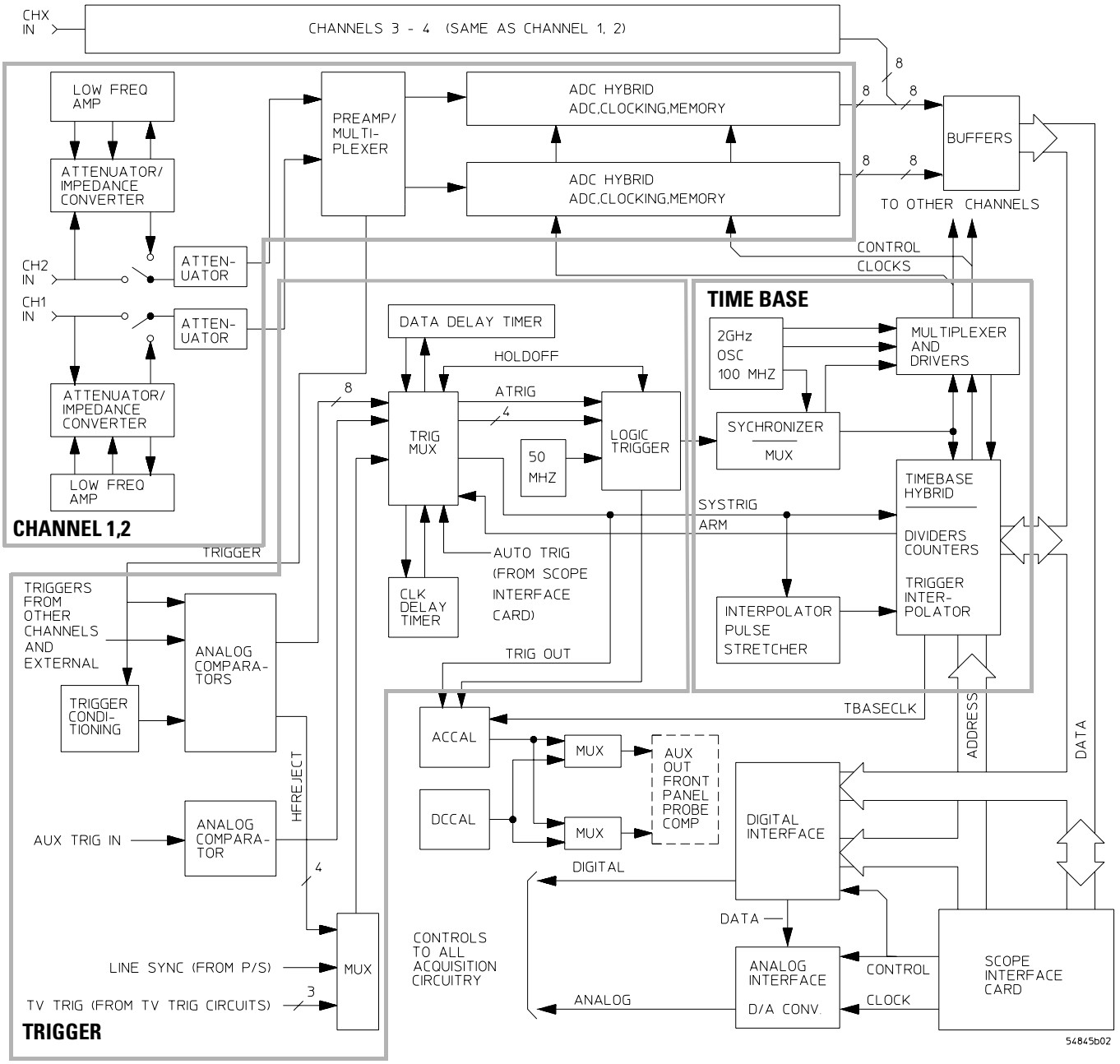
The SVGA Display Card controls the flat-panel display monitor. There are two major video paths on this board. The first is used by the system controller on the motherboard to draw all general display elements, including the grid, status indicators, and toolbars and menus for the graphical interface. This is handled through a standard VGA chip, BIOS, and DRAM, similar to a standard PC VGA interface. The other path is the video input from the scope interface board, which is multiplexed with the main video to produce the video signals for the flat-panel display. The video from the scope interface board is the waveform display data. The second path is used to provide the fastest possible display update rate, which would not be possible through the standard bus interface to the display controller.

GPIB Interface Card

The GPIB Interface card provides IEEE-488.2 standard bus services for the oscilloscope. The card interfaces the bus to the motherboard system controller, allowing the system controller to receive and process GPIB commands and return data to the bus. The circuit consists of three main components. The GPIB controller provides an interface between the microprocessor system and the GPIB in accordance with IEEE 488 standards. An 8-bit data buffer and 8-bit control line buffer connect the GPIB controller to the GPIB bus. The GPIB is a 24-conductor shielded cable carrying 8 data lines, 8 control lines, 7 system grounds, and 1 chassis ground.

Probe Power and Control

The Probe Power and Control board provides filtered, regulated power to the front-panel AutoProbe interface. It also provides serial communications capability , offset and probe detection and identification circuitry. All of these are interfaced to the probe through the conductive pads surrounding the BNCs. Using the facilities of this board, the Autoprobe interface can supply power for active probes, notify the oscilloscope operating system when a probe is connected or disconnected, identify the probe type to the oscilloscope operating system for automatic configuration, and communicate with the probe to support advanced probe functionality.



Acquisition Block Diagram

Attenuator Theory

The channel input signals are conditioned by the dual channel attenuator assemblies. There are two completely independent attenuators on each assembly, but one channel can be routed in the preamp/multiplexer hybrid to drive both channel outputs for sample rate doubling purposes. Each channel contains passive attenuators, an impedance converter, and a programmable gain amplifier. There are two identical outputs for each channel: one to drive the ADC hybrids and one to drive the trigger circuitry.

The channel input impedance is selectable between 1 MΩ and 50 Ω. The 50 Ω path consists of high-frequency 5:1 and 10:1 attenuators and the preamp/multiplexer hybrid, which allows gain-switching between 1:1 and 2:1. This combination of attenuators and gain allows channel sensitivities in the standard 1-2-5 sequence from 10 mV/div to 1 V/div. For sensitivities other than these, full resolution ranges software expansion is performed. The preamp/multiplexer hybrid also provides offset adjustment for the 50 Ω path.

The 1 MΩ path consists of a 10:1 attenuator and a 1 MΩ to 50 Ω impedance converter. Once converted to 50 Ω, the signal is routed back to the 50 Ω path (described above) for further attenuation and amplification. Compensation for the 1 MΩ 10:1 attenuator is adjusted at the factory and does not require readjustment.

After the passive attenuators, the signal is split into high-frequency and low-frequency components. Low-frequency components are amplified on the main assembly where they are combined with the offset voltage. The ac coupling is implemented in the low-frequency amplifier.

The high- and low-frequency components of the signal are recombined and applied to the input FET of the impedance converter. The FET provides a high impedance load for the input attenuators and a low impedance drive for a buffer, which drives 50 Ω.

Acquisition Theory

The acquisition system includes two major sections. One is the acquisition board, which conditions, stores, and processes the input signals. The other is the scope interface board, which provides the interface from the acquisition to the motherboard and display, and also interfaces the motherboard to the front-panel keyboard.

Acquisition Board

The acquisition circuitry samples, digitizes, and stores the signals from the channel attenuators. The four channels are identical. The trigger signals synchronize acquisition through the trigger and time base circuitry. A reference oscillator and the time base provide the base sample rates.

ADC Hybrid The Agilent Technologies 54845B ADC hybrid provides all of the sampling, digitizing, and high-speed waveform storage. Each ADC hybrid contains two 2 GSa/s ADCs. They can be run in phase to increase resolution, or out-of-phase to sample at 4 GSa/s. The ADC includes a delay-locked loop to synchronize the 2 GHz sample clock to the 100 MHz timebase reference clock. For sample rates < 2 GSa/s, data is decimated.

Trigger There are four main trigger circuits: Trigger Conditioning, Analog Comparators, a Trigger Multiplexer, and Logic Trigger. Trigger signals from the channel are fed to the analog trigger comparators and the trigger conditioning circuit. The trigger conditioning circuitry selects dc, ac, low-frequency reject, high-frequency reject, and noise reject (hysteresis) modes and sets the trigger levels. The trigger multiplexer selects the trigger modes, such as edge, glitch, and pattern trigger.

The channel triggers are sent to the Logic Trigger. The logic trigger provides the advanced triggering functions, such as holdoff, delay, and pattern duration and range. The data delay and clock delay timers are used to implement trigger functions that require timing between 1.5 and 20 ns.

The auxiliary trigger, which cannot be displayed on screen, is compared to the trigger level setting in a separate circuit. The line sync trigger line from the power supply is combined in a multiplexer with the TV trigger and the high frequency reject comparators before being sent to the analog trigger.

Time Base The time base provides the sample clocks and timing necessary for data acquisition. It primarily consists of a reference oscillator, time base IC, and trigger interpolator pulse stretcher.

- The 100-MHz oscillator provides the timebase reference.
- The time base has programmable dividers to provide the rest of the sample frequencies appropriate for the time range selected. The time base uses the time-stretched output of the interpolator pulse stretcher to time-reference the sampling to the trigger point. The time base has counters to control how much data is taken after the trigger event (post-trigger data). After enough pre-trigger samples have occurred, the time base IC sends a signal to the trigger multiplexer (ARM) indicating it is ready for the trigger event. When the trigger condition is satisfied, the trigger multiplexer sends a signal back to the time base (SYSTRIG). The time base IC then starts the post-trigger delay counter. When the countdown reaches zero, the sample clocks are stopped and the CPU is signaled that the acquisition is complete.
- The Interpolator Pulse Stretcher is a dual-slope integrator that acts as a time-interval stretcher. When the trigger system receives a signal that meets the programmed triggering requirements (SYSTRIG), it signals the time base. The time base then sends a pulse to the pulse stretcher. The pulse is equal in width to the time between the trigger (SYSTRIG) and the next sample clock. The pulse stretcher stretches this time by a factor of approximately 1000. Meanwhile, the time base hybrid runs a counter with a clock derived from the sample rate oscillator. When the interpolator indicates the stretch is complete, the counter is stopped. The count represents, with high accuracy, the time between the trigger and the first sample clock. The count is stored and used to place the recently acquired data in relationship to the trigger point.

Calibration The Calibration circuit provides several signals to the Probe Compensation and Aux Out outputs. Which signal is driven to the front panel depends on the current selection from the drop-down menu in the Calibration dialog box. Available signals for Aux Out include a 715 Hz probe compensation signal, a pulse representing the trigger event, the timebase clock, or a dc voltage in the range –2.5 to +2.5 V. The dc voltage is used for self-calibration, and is an output from a 16-channel DAC. The calibration signals are sent to an analog multiplexer, which selects the signal that will be sent to the front panel.

Microprocessor Interface The Microprocessor Interface provides control and interface between the system control and digital functions in the acquisition circuitry.

Analog Interface The Analog Interface provides analog control of functions in the acquisition circuitry. It is primarily DACs with accurate references and filtered outputs. The analog interface controls:

- Channel offsets
- Trigger levels
- Two logic trigger functions

Acquisition Modes

The Agilent Technologies 54845B and 54846B provides two acquisition modes:

- 4 GSa/s on each of the four channel inputs
- 8 GSa/s on channel 1 and channel 3 inputs

4 GSa/s In this mode, the scope uses all four channel inputs. Each channel can sample up to 4 GSa/s (for Agilent Technologies 54845B/46B).

8 GSa/s In this mode, the scope only uses the channel 1 and channel 3 inputs. The ADC hybrids for the channel 1 inputs are routed to both the channel 1 and channel 2 ADC hybrids. The hybrids are time-aligned to sample 90° out-of-phase to yield a sample rate of 8 GSa/s. Channel 3 and channel 4 are combined in the same way (for Agilent Technologies 54845B/46B).

Scope Interface Board

The Scope Interface Board has three primary functions:

- Interface the acquisition board to the motherboard system controller.
- Manage the waveform display, through an interface to the SVGA display board.
- Implement miscellaneous oscilloscope functions, including an RS-232 interface to the front-panel keyboard, a 32-bit timer, and non-volatile RAM.

Acquisition Board Interface The interface to the acquisition board consists of 16 data lines, 10 address lines, a R/W line, and read and write strobes. A second read strobe is used for reading acquisition data; the address latches are not used when this strobe is active. Three lines are used to indicate run, trigger, and interpolator status; two control lines are used for trigger control and clocking.

There are two address ranges on the acquisition board; the first is used for reading acquisition data, while the second is used to access status and control elements of the board.

Waveform Display Management A PC video connector connects the scope interface board to the SVGA display board. The scope interface board accepts video clock and synchronization signals from the SVGA display board, and drives 16 bits of RGB data in 5,6,5 format to the display controller on the SVGA display board. The display driver will only substitute the PC video RGB data from the scope interface card for the other video data when the screen data matches the value specified in the display driver. In this way, the scope interface card can supply the waveform data from the acquisition system and have it properly multiplexed with regular video data for output on the flat-panel display.

Miscellaneous System Functions An RS-232 interface is used to communicate with the front panel keyboard. The connector routes transmit and receive, power supply bias and inhibit signals, and keyboard power to the keyboard. The interface functionality is contained in the FPGA. The data rate is 19.2 KBaud, with 1 start bit, 8 data bits (LSB first), and one stop bit, no parity. The keyboard itself has a controller that transmits and receives data through this interface.

Non-Volatile RAM (NVRAM) on the scope interface board provides high-speed access to instrument configuration settings.

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About this edition

This is the *Agilent Technologies Infiniium Oscilloscopes Service Guide for Agilent Model 54845B/46B* Oscilloscopes.

Publication number
54846-97002, December 2001

Print history is as follows:
54846-97002, December 2001

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