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Keysight Infiniium 90000A Series Oscilloscopes

KEYSIGHT TECHNOLOGIES

Service Guide

Notices

Manual Part Number

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CAUTION

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WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Contents

1 General Information

For technical assistance, contact your local Keysight Technologies representative at http://www.keysight.com/find/contactus.

Instruments Covered by this Service Guide

Oscilloscopes manufactured after the date this manual was released may be different from those described in this manual. The release date of this manual is shown on the back of the title page. This manual will be revised when necessary.

If you have an oscilloscope that was manufactured after the release of this manual, please check the Keysight Technologies website at www.keysight.com to see whether a newer version of this manual is available.

The following 90000A Series oscilloscopes are covered in this guide.

Model	Bandwidth
DSO/DSA 91304A	13 GHz bandwidth, 40 GSa/s
DSO/DSA 91204A	12 GHz bandwidth, 40 GSa/s
DSO/DSA 90804A	8 GHz bandwidth, 40 GSa/s
DSO/DSA 90604A	6 GHz bandwidth, 20 GSa/s
DSO/DSA 90404A	4 GHz bandwidth, 20 GSa/s
DSO/DSA 90254A	2.5 GHz bandwidth, 20 GSa/s

The oscilloscope model can be identified by the product number on the front or rear panel.

Performance-Enhanced Versus Standard Models

In the fall of 2000, Keysight started shipping performance-enhanced models of the 90000A Series oscilloscope. This service guide covers both the standard and performance-enhanced versions. Any differences between the two versions are noted.

To tell whether the oscilloscope you have is a standard one or a performance-enhanced version, check whether it has one handle or two handles. Standard models have one handle; performance-enhanced models have two handles.

Accessories Supplied

The following accessories are supplied with the oscilloscope:

- mouse
- stylus
- keyboard
- accessory pouch
- front panel cover
- calibration cable (not available or required for the DSO90254A)
- precision 3.5 mm adapters (qty 2) (not available or required for the DSO90254A)
- Probe De-skew and Performance Verification Kit, Keysight E2655B
- power cord
- *Finding Product Manuals* sheet

Specifications and Characteristics

The following table contains a partial list of specifications and characteristics for the Keysight Infiniium 90000A Series oscilloscopes. For a complete list, see the data sheet at www.keysight.com/find/90000.

Environment	Indoor use only
Ambient temperature	Operating: 5 °C to +40 °C Non-operating: –40 °C to +65 °C
Humidity	Operating: up to 95% relative humidity (non-condensing) at +40 °C Non-operating: up to 90% relative humidity at +65 °C
Altitude	Operating: up to 4,000 meters (12,000 feet) Non-operating: up to 15,300 meters (50,000 feet)
Weight	18.95 kg (41.8 lbs)
Dimensions (excluding handle)	Height: 282 mm (11.13 in), Width 432 mm (17.02 in), Depth 506 mm (19.91 in)
Installation Category	II
Power Requirements	100-240 VAC at 50-60 Hz; maximum input power 800 W
Voltage Fluctuations	The mains supply voltage fluctuations are not to exceed ± 10% of the nominal supply voltage
Pollution Degree	The Infiniium 90000A Series oscilloscopes may be operated in environments of Pollution Degree 2
Pollution Degree Definitions	Pollution Degree 1: No pollution or only dry, non-conductive pollution occurs. The pollution has no influence. Example: A clean room or climate-controlled office environment. Pollution Degree 2: Normally only dry non-conductive pollution occurs. Occasionally a temporary conductivity caused by condensation may occur. Example: General indoor environment. Pollution Degree 3: Conductive pollution occurs, or dry, non-conductive pollution occurs which becomes conductive due to condensation which is expected. Example: Sheltered outdoor environment.

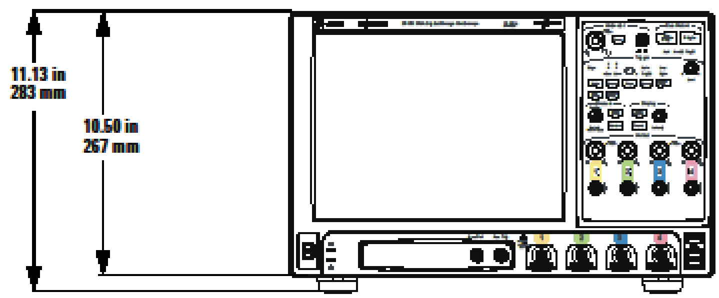
WARNING

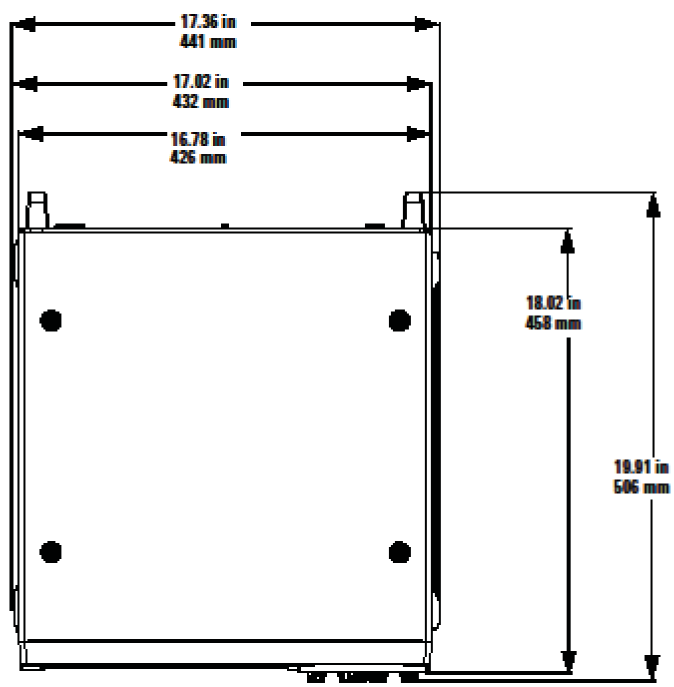
Safety Class I Product

This is a Safety Class 1 Product (provided with a protective earth ground incorporated in the power cord). The mains plug shall be inserted only in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

Oscilloscope Dimensions

The following pictures show the dimensions of the 90000A Series oscilloscope.





2 Calibration

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What Is a Calibration?

A calibration is simply an oscilloscope self-adjustment. The purpose of a calibration is performance optimization.

There are two ways to calibrate an Infiniium A-Series oscilloscope:

- A *user calibration*, also known as a *self calibration*. A user calibration includes the minimum set of calibrations and is intended to be run by oscilloscope users. It can include a time scale calibration.
- A service calibration is performed only by Keysight Service Center technicians.

The following section describes how to run a user calibration.

Running a User Calibration

NOTE **The oscilloscope must be warmed up (with the oscilloscope application running) for at least 30 minutes at ambient temperature before starting the calibration procedure. Failure to allow warm up may result in inaccurate calibration.**

The user calibration uses signals generated in the oscilloscope to calibrate channel scale, offsets, and trigger parameters.

When to perform a user calibration:

- at least once a year
- when you replace an acquisition board or the hard drive
- when the oscilloscope's operating temperature (after the 30-minute warm-up period) is more than ±5 °C different from that of the last calibration

Equipment required

Equipment	Critical Specifications	Keysight Part Number
Adapters (2 supplied with oscilloscope except for the DSO90254A)	3.5 mm (f) to precision BNC No substitute	Keysight 54855-67604
Cable assembly	50 Ω characteristic impedance BNC (m) connectors, 36 inches (91 cm) to 48 inches (122 cm) long	Keysight 8120-1840
Cable (supplied with oscilloscope except for the DSO90254A, which can use a good-quality BNC cable)	No substitute	Keysight 54855-61620
10 MHz signal source (required for time scale calibration)	Frequency accuracy better than 0.4 ppm	Keysight 53131A with opt. 010

Calibration time

It takes approximately 1 hour to run the user calibration on the oscilloscope, including the time required to change cables from channel to channel.

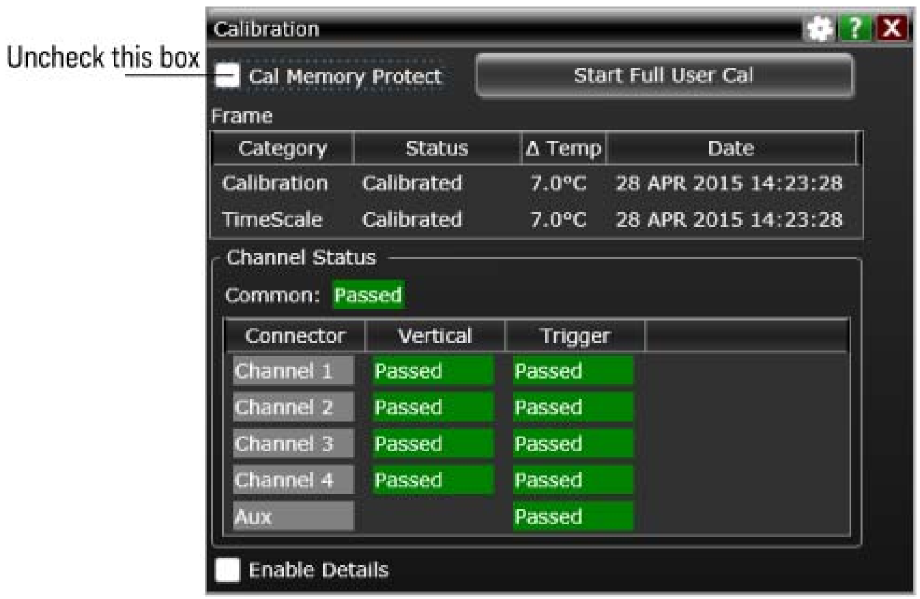
Procedure

1 Let the oscilloscope warm up before running the self calibration.

The self calibration should be done only after the oscilloscope has run for 30 minutes at ambient temperature. Calibration of an oscilloscope that has not warmed up may result in inaccurate calibration.

2 Click **Utilities > Calibration...**.

3 Uncheck the **Cal Memory Protect** box. You cannot run a self calibration if this box is checked.



4 Click **Start Full User Cal**, then follow the instructions on the screen. The routine will prompt you to follow these steps:

a Disconnect everything from all inputs and Aux Out.

b Select the level of calibration you want to perform.

- Standard Calibration—Time scale calibration will not be performed. Time scale calibration factors from the previous time scale calibration will be used and the 10 MHz reference signal will not be required. The remaining calibration procedure will continue.
- Standard Calibration and Time Scale Calibration—Time scale calibration will be performed. This option requires you to connect a 10 MHz reference signal to channel 1 that meets the following specifications. Failure to use a reference signal that meets these specifications will result in an inaccurate calibration.

Frequency: 10 MHz ±0.4 ppm = 10 MHz ±4 Hz
Amplitude: 0.2 Vpeak-to-peak to 5.0 Vpeak-to-peak
Wave shape: Sine or Square

- Standard calibration and Default Time Scale—Factory time scale calibration factors will be used. The 10 MHz reference signal will not be required. The remaining calibration procedure will continue.

c Connect the calibration cable from Aux Out to channel 1.

You must use the 54855-61620 cable assembly with two connector saver adapters for all oscilloscopes except the DSO90254A, which can use a good-quality BNC cable. Failure to use the appropriate calibration cable will result in an inaccurate calibration.

d Connect the calibration cable from Aux Out to each channel input as requested.

e Connect the 50 Ω BNC cable from the Aux Out to the Aux Trig on the front panel of the oscilloscope.

f A Passed/Failed indication appears for each calibration section. If any section fails, click the Enable Details box for information on the failures. Also check the calibration cables and run the oscilloscope self tests.

3 Testing Performance

Full performance verification for 90000A Series oscilloscopes consists of three main procedures:

1 Performing the internal oscilloscope self tests to ensure the measurement system is functioning properly. To perform the self tests, click **Utilities > Self Test...**. Then select **Scope SelfTest** from the **Available Self Test** drop-down list box, click **Start**, and follow the instructions on the screen. If any of the self tests fail, ensure that the failure is diagnosed and repaired before calibrating and testing performance.
2 Calibrating the oscilloscope, as described in Chapter 2, “Calibration”.
3 Testing the oscilloscope to ensure that it is performing to specification. This chapter describes the performance test procedures.

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Verifying System Performance

This chapter describes performance test procedures.

Performance Test Interval

The procedures in this section may be performed for incoming inspection and should be performed periodically to verify that the oscilloscope is operating within specification. The recommended test interval is once per year or after 2000 hours of operation. Performance should also be tested after repairs or major upgrades.

Performance Test Record

A test record form is provided at the end of this section. This record lists performance tests and test limits, and provides space to record test results.

Test Order

The tests in this section may be performed in any order. However, it is recommended to conduct the tests in the order presented as it represents an incremental approach to performance verification. This approach may be useful if you are trying to troubleshoot a suspected problem.

Test Equipment

Lists of equipment needed to conduct each test are provided for each test procedure. The procedures are written to minimize the number and types of equipment and accessories required. The test equipment in these lists are currently available for sale by Keysight at the time this document was written. In some cases, the test procedures use features specific to the test equipment in the recommended equipment list. However, other equipment, cables, and accessories that satisfy the critical specifications in these lists may be substituted for the recommended models with some modification to the test procedures.

Contact Keysight Technologies for more information about the Keysight products in these lists.

Vertical Performance Verification

This section describes the following vertical performance verification tests:

- Offset Accuracy Test
- DC Gain Accuracy Test
- Analog Bandwidth Test
- Time Scale Accuracy Test

Offset Accuracy Test

CAUTION Ensure that the input voltage to the oscilloscope never exceeds ±5 V.

NOTE The oscilloscope under test must be warmed up (with the oscilloscope application running) for at least 30 minutes prior to the start of any performance test.

Specifications

Offset Accuracy	≤ 3.5 V: ±(2% of channel offset + 1% of full scale + 1 mV) >3.5 V: ±(2% of channel offset + 1% of full scale)
Full scale is defined as 8 vertical divisions. Magnification is used below 5 mV/div. Below 5 mV/div, full scale is defined as 40 mV. The major scale settings are 5 mV/div, 10 mV/div, 20 mV/div, 50 mV/div, 100 mV/div, 200 mV/div, 500 mV/div, and 1 V/div.	

Equipment Required

Equipment	Critical Specifications	Recommended Model/Part #
Digital Multimeter	DC voltage measurement accuracy better than ±0.1% of reading	Keysight 34401A or Keysight 3458A
Cable Assembly (2 required)	50 Ω characteristic impedance, BNC (m) connectors	Keysight 8120-1840
Adapter	BNC Tee (m)(f)(f)	Keysight 1250-0781
Adapter	BNC (f) to dual banana	Keysight 1251-2277

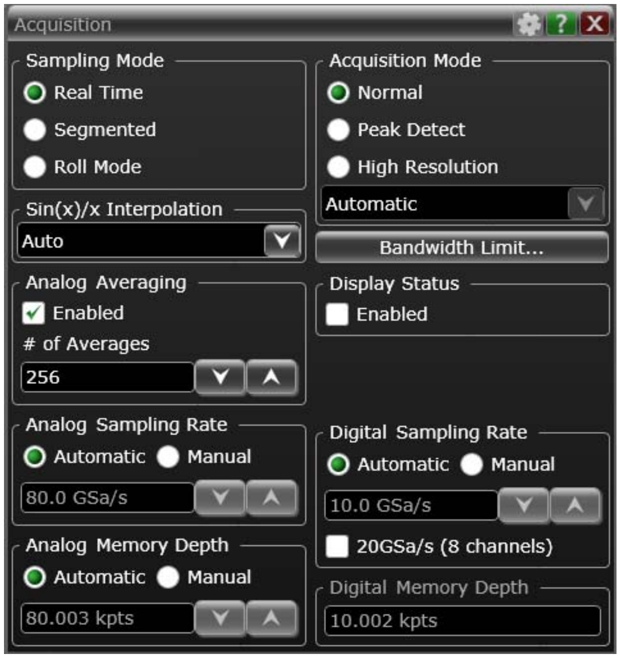
NOTE The offset accuracy specification has two terms: ± (offset gain + zero error). The offset gain specification is ±2% of channel offset, and the zero error specification is ±(1% of full scale + 1mV) for ≤ 3.5 V, and 1% of full scale for > 3.5 V. The offset accuracy test procedure tests each of these terms individually.

Zero Error Test Procedure

1 Disconnect all cables from the oscilloscope channel inputs.

2 Click **Control > Factory Default**.

3 Click **Setup > Acquisition...**. In the Acquisition dialog box, enable averaging and set # of Averages to 256.



4 Configure the oscilloscope to measure the average voltage (V avg) on channel 1 as follows:

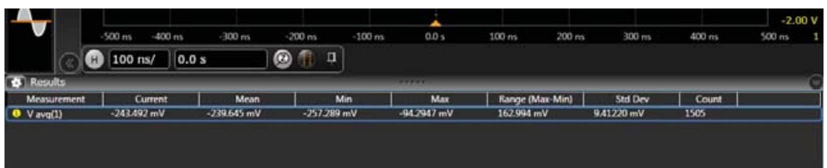
   a Change the vertical scale of channel 1 to 5 mV/div.

   b Click the Vertical Meas tab on the left side of the waveform window, then drag and drop the Average measurement icon onto the channel 1 waveform.

5 Press **[Clear Display]** on the oscilloscope and wait for the number of averages display (top right area of the screen) to return to 256. Record the oscilloscope's mean V avg reading in the Offset Accuracy—Zero Error Test section of the Performance Test Record.

NOTE

- For all oscilloscope readings in this procedure, use the mean value in the Measurement Results area at the bottom of the screen.
- If a question mark appears in front of any values in the Results area, press **[Clear Display]** on the oscilloscope, wait for the number of averages to return to 256, and then record the oscilloscope reading. The question mark indicates that the oscilloscope could not make a reliable measurement.



Record the
Mean reading

6 Change the vertical scale of channel 1 to 10 mV/div, press **[Clear Display]** on the oscilloscope, wait for the number of averages to return to 256, and then record the V avg reading in the Offset Accuracy—Zero Error Test section of the Performance Test Record.

7 Repeat step 6 for the remaining vertical scale settings for channel 1 in the Zero Error Test section of the Performance Test Record.

8 Click **Control > Factory Default**, then turn off channel 1 and turn the channel 2 display on.

9 Configure the oscilloscope to measure the average voltage on channel 2 as follows:

  a Click **Setup > Acquisition....** In the Acquisition dialog box, enable averaging and set # of Averages to 256.

  b Change the vertical scale of channel 2 to 5 mV/div.

  c Drag and drop the Average voltage measurement icon from the left side of the screen onto the channel 2 waveform.

10 Press **[Clear Display]** on the oscilloscope, wait for the number of averages to return to 256, and then record the oscilloscope's mean V avg reading in the Offset Accuracy—Zero Error Test section of the Performance Test Record.

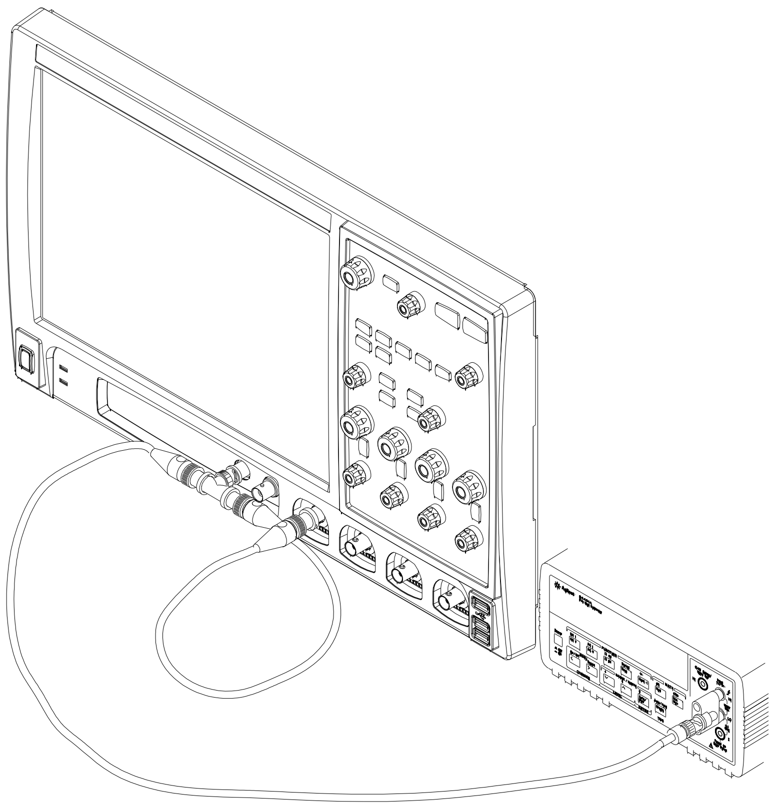
11 Repeat steps 9b and 10 for the remaining vertical scale settings for channel 2.

12 Repeat steps 8 through 11 for channels 3 and 4.

Offset Gain Test Procedure

1 Click **Control > Factory Default**.

1 Make the connections to oscilloscope channel 1 as shown below.



NOTE

- Where the BNC Tee adapter is used, it is important to connect it directly to the oscilloscope channel input to minimize ground potential differences and to ensure that the DMM measures the input voltage to the oscilloscope channel as accurately as possible. Differences in ground potential can be a significant source of measurement error, particularly at high oscilloscope sensitivities.
- It also helps to reduce ground potential differences if the oscilloscope and DMM are connected to the same AC supply circuit.
- 256 averages are used in the oscilloscope measurements of this section to reduce measurement noise and to reduce the measurement error due to resolution.

2 Set up the DMM to perform DC voltage measurements.

3 Configure the oscilloscope to measure the average voltage on the channel under test as follows:

   a Make sure the channel under test is enabled.

   b Click **Setup > Acquisition...**. In the Acquisition dialog box, enable averaging and set # of Averages to 256.

   c Change the vertical scale to 5 mV/div.

   d Set the offset value of the channel under test to 400 mV.

   e Drag and drop the Average voltage measurement icon onto the waveform.

4 Set the Aux Out voltage ($V_{Aux\ Out}$) to +400.0 mV as follows:

   a Click **Utilities > Calibration Output...**.

   b Change the Signal Output function to DC.

5 Set the Level to 400.0 mV.

6 Press **[Clear Display]** on the oscilloscope, wait for the number of averages to return to 256, and then record the DMM voltage reading as V_{DMM+} and the scope V avg reading as V_{Scope+} in the Offset Accuracy—Offset Gain Test section of the Performance Test Record.

7 Change the offset value of the channel under test to -400.0 mV.

8 Set the Aux Out voltage to -400.0 mV.

9 Change the vertical scale to 10 mV/div.

10 Press **[Clear Display]** on the oscilloscope, wait for the number of averages to return to 256, and then record the DMM voltage reading as V_{DMM-} and the scope V avg reading as V_{Scope-} in the Offset Accuracy—Offset Gain Test section of the Performance Test Record.

11 Change the offset value of the channel under test to 0 mV.

12 Set the Cal Out voltage to 0 mV.

13 Press **[Clear Display]** on the oscilloscope, wait for the number of averages to return to 256, and then record the DMM voltage reading as V_{DMM0} and the scope V avg reading as V_{Scope0} in the Offset Accuracy—Offset Gain Test section of the Performance Test Record.

14 Calculate the offset gain error using the following expressions and record the value in the Offset Accuracy—Offset Gain Test section of the Performance Test Record. The offset gain error is the greater (maximum magnitude) of either:

$$\left(\frac{V_{scope+} - V_{scope0}}{V_{DMM+} - V_{DMM0}} - 1\right)100$$

or

$$\left(\frac{V_{scope-} - V_{scope0}}{V_{DMM-} - V_{DMM0}} - 1\right)100$$

15 Repeat steps 3 through 14 for the remaining vertical scale settings for the channel under test. Record the results in the Offset Accuracy—Offset Gain Test section of the Performance Test Record. For each measurement, set both the Aux Out voltage ($V_{Aux\ Out}$) and the Channel offset voltage to the positive $V_{Cal\ Out}$ value and then to the negative $V_{Cal\ Out}$ value in the "$V_{Cal\ Out}$ Setting" column of the Offset Accuracy—Offset Gain Test table in the Performance Test Record for each of the vertical scale settings.

16 Move the Tee connector to the next channel input and repeat steps 4 to 14 for channels 2 to 4.

DC Gain Accuracy Test

CAUTION Ensure that the input voltage to the oscilloscope never exceeds ±5 V.

NOTE The oscilloscope under test must be warmed up (with the oscilloscope application running) for at least 30 minutes prior to the start of any performance test.

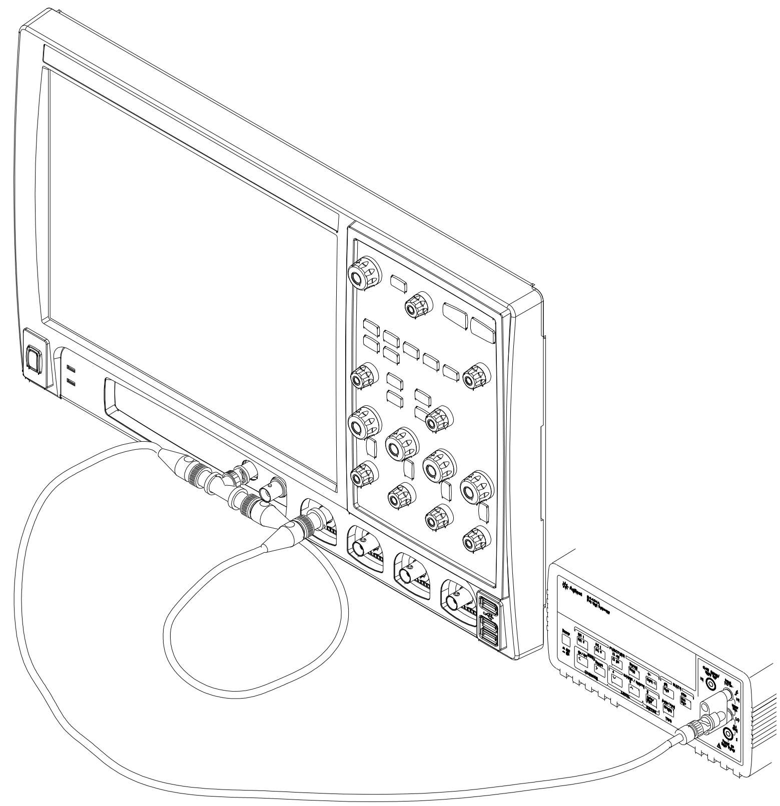
Specifications

DC Gain Accuracy	±2% of full scale at full resolution channel scale. ±2.5% of full scale at 5 mV/div.
Full scale is defined as 8 vertical divisions. Magnification is used below 5 mV/div. Below 5 mV/div, full scale is defined as 40 mV. The major scale settings are 5 mV/div, 10 mV/div, 20 mV/div, 50 mV/div, 100 mV/div, 200 mV/div, 500 mV/div, and 1 V/div.	

Description	Critical Specifications	Recommended Model/ Part #
Digital Multimeter	DC voltage measurement accuracy better than ±0.1% of reading	Keysight 34401A
Cable Assembly (2 required)	50 Ω characteristic impedance, BNC (m) connectors	Keysight 8120-1840
Adapter	BNC Tee (m)(f)(f)	Keysight 1250-0781
Adapter	BNC (f) to dual banana	Keysight 1251-2277

Procedure

1 Make the connections to oscilloscope channel 1 as shown below.



NOTE

- Where the BNC Tee adapter is used, it is important to connect it directly to the oscilloscope channel input using the BNC (f) to SMA (m) adapter and the connector saver to minimize ground potential differences and to ensure that the DMM measures the input voltage to the oscilloscope channel as accurately as possible. Differences in ground potential can be a significant source of measurement error, particularly at high scope sensitivities.
- It also helps to reduce ground potential differences if the oscilloscope and DMM are connected to the same AC supply circuit.
- 256 averages are used in the oscilloscope measurements of this section to reduce measurement noise and to reduce the measurement error due to resolution.

2 Click **Control > Factory Default**, then configure the oscilloscope as follows:

   a Click **Setup > Acquisition...**.

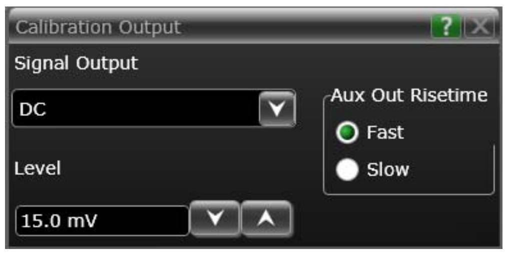
   a In the Acquisition dialog box, enable averaging and set # of Averages to 256.

3 Set the Aux Out voltage ($V_{Aux\ Out}$) to +15 mV as follows:

   a Click **Utilities > Calibration Output...**.

   b Change the Signal Output function to DC.

   c Set the Level to 15 mV.



4 Set the vertical scale of the channel under test to 5 mV/div.

5 Drag and drop the Average voltage measurement icon onto the channel 1 waveform.

6 Press **[Clear Display]** on the oscilloscope, wait for the number of averages to return to 256, and then record the DMM voltage reading as V_{DMM+} and the scope V avg reading as V_{Scope+} in the DC Gain Accuracy Test section of the Performance Test Record.

NOTE

- For all oscilloscope readings in this procedure, use the mean value in the Results area at the bottom of the screen.
- If a question mark appears in front of any of the values in the Results area, press **[Clear Display]** on the oscilloscope, wait for the number of averages to return to 256, and then record the oscilloscope reading. The question mark indicates that the oscilloscope could not make a reliable measurement.

Record the Mean reading

7 Change the Aux Out voltage to -15 mV.

8 Press **[Clear Display]** on the oscilloscope, wait for the number of averages to return to 256, and then record the DMM voltage reading as V_{DMM-} and the scope V avg reading as V_{Scope-} in the DC Gain Accuracy Test section of the Performance Test Record.

9 Calculate the DC gain using the following expression and record this value in the Calculated DC Gain Error column of the DC Gain Accuracy Test section of the Performance Test Record.

For vertical scale values < 1 V use the following equation:

$$DCGainError = \frac{\Delta V_{out}}{\Delta V_{in}} = \left(\frac{V_{scope+} - V_{scope-}}{V_{DMM+} - V_{DMM-}} - 1\right)75$$

For vertical scale values = 1 V use the following equation:

$$DCGainError = \frac{\Delta V_{out}}{\Delta V_{in}} = \left(\frac{V_{scope+} - V_{scope-}}{V_{DMM+} - V_{DMM-}} - 1\right)60$$

10 Repeat steps 3 to 9 for the remaining channel 1 vertical scale settings in the DC Gain Test section of the Performance Test Record. For each measurement, set the Aux Out voltage (V_{AuxOut}) to the positive V_{AuxOut} value and then to the negative V_{AuxOut} value in the “V_{AuxOut} Setting” column of the DC Gain Accuracy Test table in the Performance Test Record for each of the vertical scale settings.

11 Move the Tee connector to the next channel input and repeat steps 2 to 10 for channels 2 to 4.

Analog Bandwidth—Maximum Frequency Test

CAUTION Ensure that the input voltage to the oscilloscope never exceeds ±5 V.

NOTE The oscilloscope under test must be warmed up (with the oscilloscope application running) for at least 30 minutes prior to the start of any performance test.

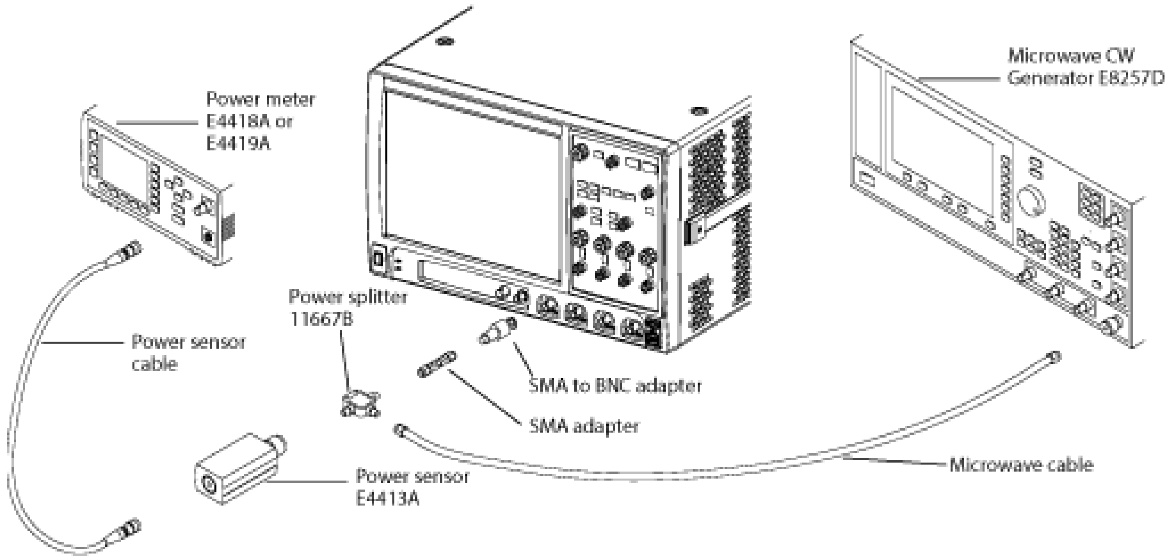
Specifications

Analog Bandwidth (-3 dB)	
DSO/DSA91304A	12.0 GHz, 11.8 GHz at 5 mV/div
DSO/DSA91204A	12.0 GHz, 11.8 GHz at 5 mV/div
DSO/DSA90804A	8.0 GHz
DSO/DSA90604A	6.0 GHz
DSO/DSA90404A	4.0 GHz
DSO/DSA90254A	2.5 GHz

Equipment Required

Description	Critical Specifications	Recommended Keysight Model/Part #
Microwave CW Generator	Maximum Frequency ≥ 14 GHz Power range: -20 dBm to +16 dBm into 50 Ω Output resistance = 50 Ω	E8257D with Opt 520
Power Splitter	2 Resistor Power Splitter Max Frequency ≥ 18 GHz	11667B
Power Meter	Keysight E-series with power sensor compatibility	E4418B or E4419B
Power Sensor	Maximum Frequency ≥ 14 GHz Power range: -24 dBm to +16 dBm	8487A, or E4413B with 8485A-033
Microwave Cable	50 Ω Characteristic Impedance 3.5 mm (m) to 3.5 mm (m) connectors Max Frequency ≥ 18 GHz	8120-4948
SMA Adapters	3.5 mm (m) to 3.5 mm (m) SMA)	E2655-83202
SMA to BNC Adapter	3.5 mm (f) SMA to Precision BNC (no substitute)	54855-67604

Connections



NOTE

- Connect output 1 of the 11667B splitter to the scope channel N input directly using the 54855-67604 adapter, without any additional cabling or adapters.
- Connect the power sensor directly to output 2 of the power splitter without any additional cabling or adapters.
- Minimize the use of other adapters.
- Ensure the SMA and 3.5 mm connectors are tightened properly:
  - 8 in-lbs (90 N-cm) for 3.5 mm
  - 5 in-lbs (56 N-cm) for SMA

Procedure

1 Preset the power meter.
2 Ensure that the power sensor is disconnected from any source and zero the meter.
3 Connect the power sensor to the power meter's Power Ref connector and calibrate the meter.
4 Make the connections to oscilloscope channel 1 as shown in the preceding connection diagram.
5 Set up the power meter to display measurements in units of Watts.

6 Press **[Default Setup]**, then configure the oscilloscope as follows:

a Ensure the channel under test is displayed and all other channels are turned off.

b Set the vertical scale of the channel under test to 5 mV/div.

c Set the horizontal scale to 16 ns/div (to display 8 cycles of a 50 MHz waveform).

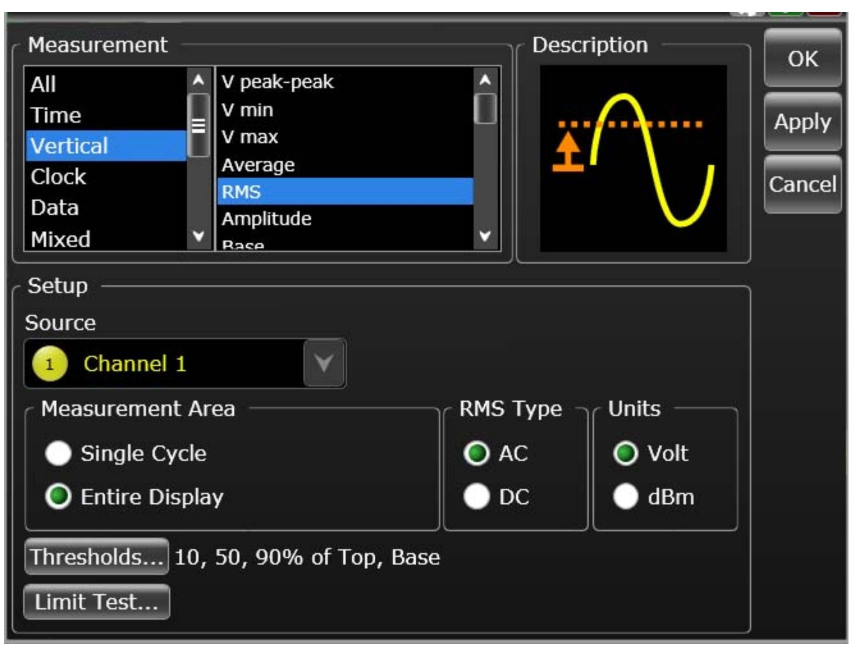
d Click **Setup** > **Acquisition...** and make sure the acquisition parameters are set up as follows:

- Sin(x)/x Interpolation = Auto
- Averaging = Disabled
- Sampling rate = 40 GSa/s (maximum)
- Memory Depth = Automatic

e Click **Measure** > **Add Measurement...**.

f In the Add Measurement dialog box, select the Vertical RMS measurement and configure it as follows:

- Source = Channel 1
- Measurement Area = Entire Display
- RMS Type = AC



7 Set the generator to apply a 50 MHz sine wave with a peak-to-peak amplitude of about four divisions.

Use the following table to determine the approximate required signal amplitude.

The amplitude values in the table is not absolutely required. If your generator is unable to produce the recommended amplitude, then set the generator to the highest value that does not produce a vertically clipped signal on the oscilloscope.

Nominal Generator Amplitude Settings

Oscilloscope Vertical Scale	Generator Signal Amplitude (Vp-p)	Generator Signal Amplitude (dBm)
5 mV/div	0.02	-30
10 mV/div	0.04	-24
20 mV/div	0.08	-18
50 mV/div	0.20	-10
100 mV/div	0.40	-4
200 mV/div	0.80	+2
500 mV/div	2.0	+10
1 V/div	4.0	+16

8 Measure the input power to the oscilloscope channel and convert this measurement to Volts RMS using the expression:

$$V_{in} = \sqrt{P_{meas} \times 50\Omega}$$

For example, if the power meter reading is 4.0 μW, then Vin = $(4.0*10^{-6} * 50\ \Omega)^{1/2}$ = 14.1 mVrms.

Record the RMS voltage in the Analog Bandwidth—Maximum Frequency Check section of the Performance Test Record (Vin @ 50 MHz).

9 Press **[Clear Display]** on the oscilloscope and record the scope V rms reading in the Analog Bandwidth—Maximum Frequency Check section of the Performance Test Record (Vout @ 50 MHz).

NOTE For all oscilloscope readings in this procedure, use the mean value in the Results area at the bottom of the screen.

10 Calculate the reference gain as follows:

$$Gain_{50\ MHz} = \frac{V_{out\ @50\ \mathrm{MHz}}}{V_{in\ @50\ \mathrm{MHz}}}$$

Record this value in the Calculated Gain @50 MHz column in the Analog Bandwidth—Maximum Frequency Check section of the Performance Test Record.

11 Change the generator frequency to the maximum value for the model being tested as shown in the table below. It is not necessary to adjust the signal amplitude at this point in the procedure.

Setting	Model					
	DSO90254A DSA90254A	DSO90404A DSA90404A	DSO90604A DSA90604A	DSO90804A DSA90804A	DSO91204A DSA91204A	DSO91304A DSA91304A
Maximum Frequency	2.5 GHz	4.0 GHz	6.0 GHz	8 GHz	12 GHz 11.8 GHz at 5 mV/div	12 GHz 11.8 GHz at 5 mV/div
Scope Horizontal Scale	100 ps/div	100 ps/div	100 ps/div	100 ps/div	100 ps/div	100 ps/div

12 Change the oscilloscope horizontal scale to the value for the model under test in the preceding table.

13 Measure the input power to the oscilloscope channel at the maximum frequency and convert this measurement to Volts RMS using the expression:

$$V_{in} = \sqrt{P_{meas} \times 50\Omega}$$

For example, if the power meter reading is 4.0 μW, then Vin = $(4.0*10^{-6} * 50\Omega)^{1/2}$ = 14.1 mVrms.

Record the RMS voltage in the Analog Bandwidth—Maximum Frequency Check section of the Performance Test Record (Vin @ Max Freq).

14 Press **[Clear Display]** on the oscilloscope and record the scope V rms reading in the Analog Bandwidth—Maximum Frequency Check section of the Performance Test Record (Vout @ Max Freq).

15 Calculate the gain at the maximum frequency using the expression:

$$Gain_{Max\ \mathrm{Freq}} = 20\ \log_{10}\left[\frac{(V_{out\ Max\ Freq})/(V_{in\ Max\ Freq})}{Gain_{50\ MHz}}\right]$$

For example, if (Vout @ Max Frequency) = 13.825 mV, (Vin @ Max Frequency) = 13.461 mV and Gain @ 50MHz = 1.0023, then:

$$Gain_{Max\ \mathrm{Freq}} = 20\ \log_{10}\left[\frac{13.825\ mV/13.461\ mV}{1.0023}\right] = 0.212\ \mathrm{dB}$$

Record this value in the Calculated Gain @Max Freq column in the Analog Bandwidth—Maximum Frequency Check section of the Performance Test Record. To pass this test, this value must be greater than -3.0 dB.

16 Change the oscilloscope setup as follows:

- **a** Change the channel vertical scale to 10 mV/div.
- **b** Reset the horizontal scale to 16 ns/div (to display 8 cycles of a 50 MHz waveform).

17 Change the generator output as follows:

- **a** Reset the generator frequency to 50 MHz.
- **b** Change the amplitude to the value suggested for this scale setting in the Nominal Generator Amplitude Settings table.

18 Repeat steps 8, 9, and 10 to measure the reference gain at 50 MHz for this scale setting.

19 Repeat steps 11 through 14 to measure the gain at maximum frequency for this scale setting.

20 Repeat steps 15 through 19 to complete measuring gains for the remaining scale settings for channel 1 in the Analog Bandwidth—Maximum Frequency Check section of the Performance Test Record.

21 Move the splitter to channel 2 and change the oscilloscope configuration as follows:

- **a** Press **[Default Setup].**
- **b** Ensure Channel 2 is displayed and all other channels are turned off.
- **c** Set the vertical scale of channel 2 to 5 mV/div.
- **d** Set the horizontal scale to 16 ns/div (to display 8 cycles of a 50 MHz waveform).
- **e** Click **Trigger > Setup Trigger...** and change the source to channel 2.
- **f** Click **Measure > Add Measurement...**. Select the RMS voltage measurement, Channel 2 as the source, Entire Display as the Measurement Area, and AC for the RMS Type.

22 Repeat steps 7 to 20 to complete measuring gains for channel 2.

23 Move the splitter to channel 3 and change the oscilloscope configuration as follows:

   a Press **[Default Setup].**
   b Ensure channel 3 is displayed and all other channels are turned off.
   c Set the vertical scale of channel 3 to 5 mV/div.
   d Set the horizontal scale to 16 ns/div (to display 8 cycles of a 50 MHz waveform).
   e Click Trigger > Setup Trigger... and change the source to channel 3.
   f Click Measure > Add Measurement.... Select the RMS voltage measurement, Channel 3 as the source, the Entire Display as the Measurement Area, and AC for the RMS Type.

24 Repeat steps 7 to 20 to complete measuring gains for channel 3.

25 Move the splitter to channel 4 and change the oscilloscope configuration as follows.

   a Press **[Default Setup].**
   b Ensure Channel 4 is displayed and all other channels are turned off.
   c Set the vertical scale of channel 4 to 5 mV/div.
   d Set the horizontal scale to 16 ns/div (to display 8 cycles of a 50 MHz waveform).
   e Click Trigger > Setup Trigger... and change the source to Channel 4.
   f Click Measure > Add Measurement.... Select the RMS voltage measurement, Channel 4 as the source, the Entire Display as the Measurement Area, and AC for the RMS Type.

26 Repeat steps 7 to 20 to complete measuring gains for channel 4.

Time Scale Accuracy (TSA) Test

This procedure verifies the maximum TSA specification for the oscilloscope.

Description

TSA refers to the absolute accuracy of an oscilloscope's time scale. Because TSA depends directly on frequency of a crystal oscillator, it is comprised of two components: an initial accuracy component and an aging component.

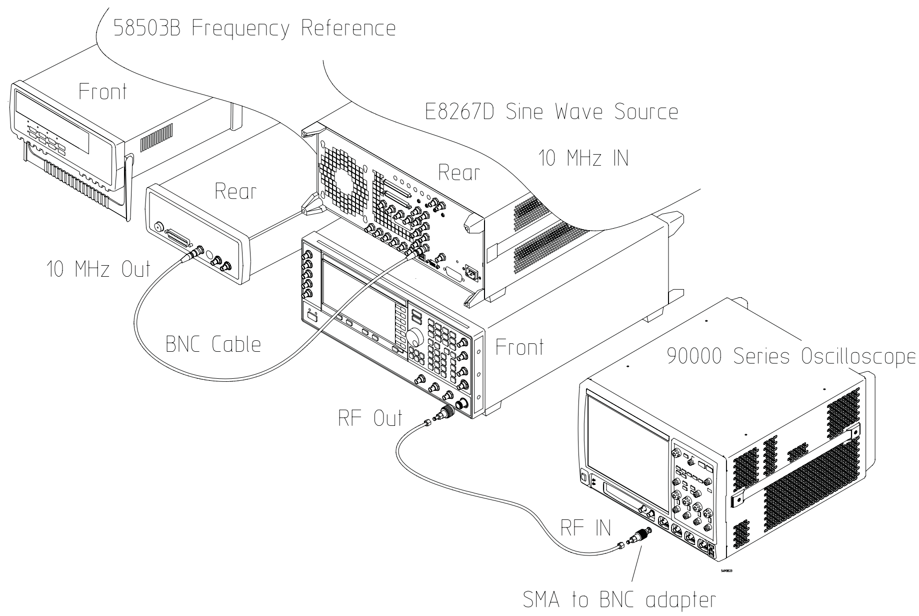
The initial accuracy component applies to the oscilloscope's accuracy immediately after a time base calibration, whether performed at the factory, by a customer, or by a Keysight service center. The aging component scales linearly from the time since the last time base calibration, and adds to the initial accuracy component.

Equipment Required

Description	Critical Specifications	Recommended Model/Part #
Synthesized sine wave source	Output Frequency: ≥ 10 MHz Output Amplitude: 0 dBm Frequency Resolution: 0.1 Hz	Keysight E8257D PSG
10 MHz frequency reference	Output Frequency: 10 MHz Output amplitude: 0 dBm Absolute Freq. Error: < ±0.01 ppm	Keysight 53132A opt. 012 frequency counter
SMA cable	50 Ω characteristic impedance SMA connectors Max frequency: ≥ 50 MHz	Keysight 8120-4948
RF cable	50 Ω characteristic impedance BNC (m) connectors Max Frequency: ≥ 50 MHz	Keysight 8120-1840
Adapters, assorted	3.5 mm (f) to Precision BNC (m)	Keysight 54855-67604

Connections

Connect the equipment as shown here.



Procedure

1 Configure the sine wave source to output a 0 dBm (600 mVpp) sine wave into 50 ohms with a frequency of 10.00002000 MHz.
2 Adjust the source amplitude such that the displayed sine wave is 600 mVpp.
3 Press **[Default Setup]** on the oscilloscope.
4 Set the vertical scale of channel 1 to 100 mV/div.
5 Set the oscilloscope’s sampling rate to 100 kSa/s.
6 Set the oscilloscope's horizontal scale to 20 ms/div.
7 Set the measurement thresholds for all waveforms to a fixed voltage level of 0 V and ±20 mV hysteresis:
   a Click **Measure > Thresholds...**.
   b Select **Custom: level +/- hysteresis** from the Thresholds drop-down list box.
   c Enter 20 mV in the **Hysteresis** field and 0 V in the **Threshold Level** field.
8 Enable a frequency measurement on channel 1.
9 On the oscilloscope, press **[Stop]**.
10 Press **[Clear Display]**.
11 Press **[Run]**, wait until 10 acquisitions have accumulated, and then press **[Stop]**.

12 Convert the average frequency value to time scale error by subtracting 20 Hz and dividing by 10 Hz/ppm. Record the result in the Measured Time Scale Error (ppm) column of the Time Scale Accuracy table.

13 Record the time since calibration (in years) in the table. The calibration date can be found in the Calibration window (**Utilities > Calibration...**).

14 Calculate the test limits using the following formula and record them in the table.

Test Limits = ±(0.4 + 0.5 x Years Since Calibration)

15 Record the results in the Performance Test Record.

Performance Test Record

Keysight Technologies	Keysight Infiniium 90000A Series Oscilloscopes
Model Number ___________________	Tested by______________________
Serial Number _________________________	Work Order No._________________
Recommended Test Interval—1 Year/2000 hours	Date___________________________
Recommended next test date _________________	Ambient temperature _____________

Offset Accuracy—Zero Error Test

Vertical Scale	Test Limits	Channel 1	Channel 2	Channel 3	Channel 4
5 mV/div	-1.4 mV to +1.4 mV				
10 mV/div	-1.8 mV to +1.8 mV				
20 mV/div	-2.6 mV to +2.6 mV				
50 mV/div	-5.0 mV to +5.0 mV				
100 mV/div	-9.0 mV to +9.0 mV				
200 mV/div	-17.0 mV to +17.0 mV				
500 mV/div	-41.0 mV to +41.0 mV				
1 V/div	-81.0 mV to +81.0 mV				

Offset Accuracy—Offset Gain Test

Vertical Scale	$V_{Aux\ Out}$ Setting	V_{DMM+}	V_{Scope+}	V_{DMM-}	V_{Scope-}	V_{DMM0}	V_{Scope0}	**Calc. Offset** Gain Error	**Offset Gain Error** Test Limits
Channel 1									
5 mV/div	±400 mV								
10 mV/div	±400 mV								±2%
20 mV/div	±400 mV								±2%
50 mV/div	±900 mV								±2%
100 mV/div	±1.6 V								±2%
200 mV/div	±2.4 V								±2%
500 mV/div	±2.4 V								±2%
1 V/div	±2.4 V								±2%
Channel 2									
5 mV/div	±400 mV								
10 mV/div	±400 mV								±2%
20 mV/div	±400 mV								±2%
50 mV/div	±900 mV								±2%
100 mV/div	±1.6 V								±2%
200 mV/div	±2.4 V								±2%
500 mV/div	±2.4 V								±2%
1 V/div	±2.4 V								±2%
Channel 3									
5 mV/div	±400 mV								
10 mV/div	±400 mV								±2%
20 mV/div	±400 mV								±2%
50 mV/div	±900 mV								±2%
100 mV/div	±1.6 V								±2%
200 mV/div	±2.4 V								±2%
500 mV/div	±2.4 V								±2%
Channel 4									
5 mV/div	±400 mV								
10 mV/div	±400 mV								±2%
20 mV/div	±400 mV								±2%
50 mV/div	±900 mV								±2%
100 mV/div	±1.6 V								±2%
200 mV/div	±2.4 V								±2%
500 mV/div	±2.4 V								±2%

DC Gain Accuracy Test

Vertical Scale	$V_{Aux\ Out}$ Setting	V_{DMM+}	V_{Scope+}	V_{DMM-}	V_{Scope-}	Calc. DC Gain Error	DC Gain Error Test Limits
Channel 1							
5 mV/div	±15 mV						±2.5%
10 mV/div	±30 mV						±2%
20 mV/div	±60 mV						±2%
50 mV/div	±150 mV						±2%
100 mV/div	±300 mV						±2%
200 mV/div	±600 mV						±2%
500 mV/div	±1.5 V						±2%
1 V/div	±2.4 V						±2%
Channel 2							
5 mV/div	±15 mV						±2.5%
10 mV/div	±30 mV						±2%
20 mV/div	±60 mV						±2%
50 mV/div	±150 mV						±2%
100 mV/div	±300 mV						±2%
200 mV/div	±600 mV						±2%
500 mV/div	±1.5 V						±2%
1 V/div	±2.4 V						±2%
Channel 3							
5 mV/div	±15 mV						±2.5%
10 mV/div	±30 mV						±2%
20 mV/div	±60 mV						±2%
50 mV/div	±150 mV						±2%
100 mV/div	±300 mV						±2%
200 mV/div	±600 mV						±2%
500 mV/div	±1.5 V						±2%
1 V/div	±2.4 V						±2%
Channel 4							
5 mV/div	±15 mV						±2.5%
10 mV/div	±30 mV						±2%
20 mV/div	±60 mV						±2%
50 mV/div	±150 mV						±2%
100 mV/div	±300 mV						±2%
200 mV/div	±600 mV						±2%
500 mV/div	±1.5 V						±2%
1 V/div	±2.4 V						±2%

Max frequency:
DSO/DSA90254A = 2.5 GHz, DSO/DSA90404A = 4.0 GHz, DSO/DSA90604A = 6.0 GHz, DSO/DSA90804A = 8.0 GHz, DSO/DSA91204A = 12 GHz (11.8 GHz at 5 mV/div), DSO/DSA91304A = 12 GHz (11.8 GHz at 5 mV/div),

Analog Bandwidth—Maximum Frequency Check

Vertical Scale	**Measurement**					
	Vin @ 50 MHz	**Vout @ 50 MHz**	**Calculated Gain @ 50 MHz**	**Vin @ Max Freq**	**Vout @ Max Freq**	**Calculated Gain @ Max Freq; Test Limit = > -3 dB**
Channel 1						
5 mV/div						
10 mV/div						
20 mV/div						
50 mV/div						
100 mV/div						
200 mV/div						
500 mV/div						
1 V/div						
Channel 2						
5 mV/div						
10 mV/div						
20 mV/div						
50 mV/div						
100 mV/div						
200 mV/div						
500 mV/div						
1 V/div						
Channel 3						
5 mV/div						
10 mV/div						
20 mV/div						
50 mV/div						
100 mV/div						
200 mV/div						
500 mV/div						
1 V/div						
Channel 4						
5 mV/div						
10 mV/div						
20 mV/div						
50 mV/div						
100 mV/div						
200 mV/div						
500 mV/div						
1 V/div						

Time Scale Accuracy

Measured Time Scale Error (ppm)	**Years Since Calibration (years)**	**Low Test Limit (ppm)**	**High Test Limit (ppm)**	**Pass/Fail**
___________	___________	___________	___________	___________

4 Troubleshooting

KEYSIGHT TECHNOLOGIES

Troubleshooting Overview

The service strategy for troubleshooting Infiniium 90000A Series oscilloscopes is to isolate problems to a faulty assembly, then use the disassembly and assembly procedures in Chapter 5, “Replacing Assemblies”, to replace the defective assembly.

Read the *For Your Safety* booklet before servicing the oscilloscope. Before performing any procedure, review it for any cautions and warnings.

The only equipment you need for troubleshooting to the assembly level is basic electronic troubleshooting tools such as a digital multimeter. If you need to remove and replace any assemblies, refer to Chapter 5, “Replacing Assemblies”.

A default setup is provided to return the oscilloscope to a known state. You can use the default setup to undo previous setups so they do not interfere with the current measurement. Use the default setup when a procedure requires it by pressing **[Default Setup]** on the front panel.

WARNING **INJURY CAN RESULT! Use caution when the oscilloscope fan blades are exposed as they can cause injury. If the procedure allows, replace the cover over the chassis (without screwing it back in place) before turning the oscilloscope on.**

CAUTION AVOID ESD DAMAGE TO COMPONENTS! Electrostatic discharge (ESD) can damage electronic components. Use proper ESD precautions when doing any of the procedures in this chapter. Failure to follow proper ESD procedures may cause immediate failure or latent damage. Latent damage may result in equipment failure after a period of time. As a minimum, place the oscilloscope on a properly grounded ESD mat and wear a properly grounded ESD strap.

WARNING **SHOCK HAZARD! Maintenance should be performed by trained service personnel. Lack of training and awareness could result in electrical shock or other injury. When maintenance can be performed without power applied, the power cord should be removed from the oscilloscope.**

Verifying Basic Operation

Follow the procedures in this section to verify the basic operation of the oscilloscope. Where problems occur, you are directed to the section that provides detailed troubleshooting help.

Power Up the oscilloscope

1 Connect the power cord to the oscilloscope, then to a suitable AC voltage source.

   Ensure that you have the correct power cord. The power cord provided is matched to the country of origin.

2 Press the power button in the lower left corner of the front panel. If the oscilloscope is working properly, it will take several minutes to start up, and the grid will appear on the screen. The exact appearance may look slightly different than shown below, depending on the setup selected before the oscilloscope was turned off.

If the oscilloscope turns off without you pressing the front panel power button, go to the “Power Supply Troubleshooting” section of this chapter.

Run the oscilloscope self tests

Running the oscilloscope self tests performs a series of internal procedures to verify that the oscilloscope is working properly.

1 Click **Utilities > Self Test...**.
2 Select **Scope SelfTest** from the Available Self Tests drop-down list box.
3 Click **Start** and follow the instructions on the screen.

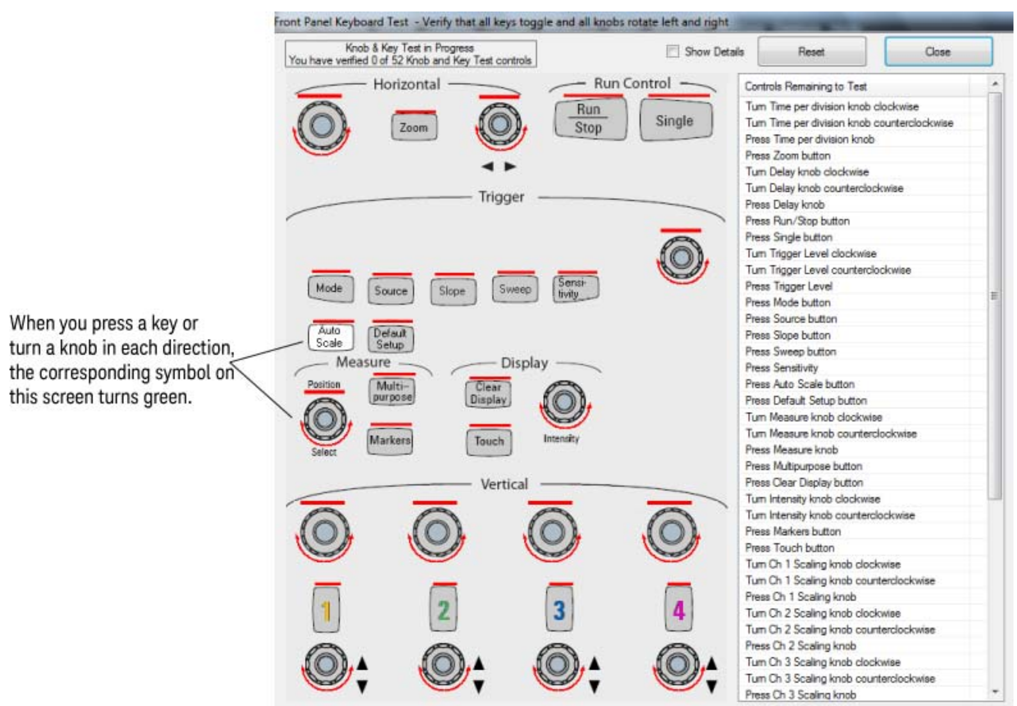
If any of the self tests fail, go to the “Acquisition/Backplane assembly troubleshooting” section.

Run the keyboard, LED, and touch screen self tests

To verify correct keyboard operation:

1 Click **Utilities > Self Test...**.
2 Select **Keyboard Test** from the drop-down list box, then click **Start**.

   The Front Panel Keyboard Test window appears, showing a symbolic representation of the keyboard.



3 Press each key on the keyboard until you have pressed all keys. When you press a key or push a knob, the bar above the corresponding key/knob symbol on the display should change from red to green.

4 Turn each knob in both directions until you have turned all knobs. When you turn a knob in one direction, half the rotation arrow under the corresponding knob symbol should turn green. When you then turn the knob in the other direction, the entire rotation arrow under the knob symbol should turn green.

5 When you are finished, click **Close**.

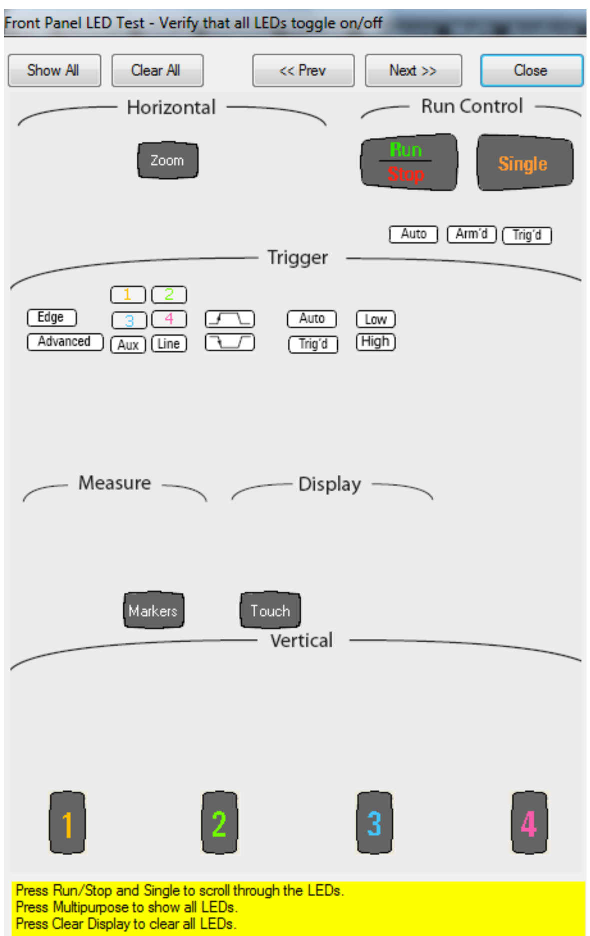
6 If any of the knobs or keys do not work, go to “Keyboard Troubleshooting” later in this chapter.

To test the front panel LED indicators:

1 Click **Utilities > Self Test...**.

2 Select **LED Test** from the drop-down list box, then click **Start**.

The Front Panel LED Test window appears, showing a symbolic representation of all front panel LED indicators.



3 Repeatedly press the **[Single]** button on the front panel to step through and highlight each LED symbol in the test screen. You can also step through the LEDs by pressing the **<<Prev** or **Next>>** buttons on the display screen. Verify that the corresponding LEDs on the front panel are the only ones illuminated.

Pressing **[Multi Purpose]** on the front panel illuminates all the LEDs, and pressing **[Clear Display]** turns off all the LEDs.

4 When you are finished, click **Close**.

If any of the LEDS do not work, go to “LED Troubleshooting” later in this chapter.

To verify correct touch screen operation:

1 Click **Utilities > Self Test...**.

2 Select Touch Screen Test from the Available Self Tests drop-down list box, then click **Start** and follow the on-screen instructions.

If the touch screen is not working properly, go to “Touch Screen Troubleshooting” in this chapter.

Run a user calibration

1 Complete a user calibration by following the procedures in Chapter 2.

2 If the calibration test fails, look at the details to find the channel associated with the failure.

   - If the failure is not associated with channel 1, replace the acquisition board associated with that channel (where channels 1 and 2 = bottom acquisition board, channels 3 and 4 = top acquisition board).
   - If the failure is associated with channel 1, look at the specific calibration that failed. If it was a trigger cal, a timebase cal, or an interpolator gain cal, replace the backplane board because it is likely the problem. If the cal still fails, replace the bottom acquisition board.
   - If the failure is associated with channel 1 but is not a trigger cal, a timebase cal, or an interpolator gain cal, replace the bottom acquisition board. If the cal still fails, replace the backplane board.
   - If all four channels have cal failures, the problem may be with the calibrator located on the backplane board, so replace the backplane board first.

Verify system performance

After you have verified the basic operation of the oscilloscope, you need to verify that it meets all warranted specifications by following the procedures in the “Testing Performance” chapter.

Power Supply Troubleshooting

WARNING **SHOCK HAZARD! Maintenance should be performed by trained service personnel. Lack of training and awareness could result in electrical shock or other injury. When maintenance can be performed without power applied, the power cord should be removed from the oscilloscope.**

WARNING **SHOCK HAZARD! Once the bulk +12 V power supply is removed from the oscilloscope, two AC leads located on the supply are exposed and severe shock can result if touched. Extreme care should be taken to avoid contact with these leads when removing or testing the bulk +12 V power supply.**

This section provides information to help you isolate the problem to the assembly level when the power system is not operating properly.

There are three main types of faults:

- Under-voltage faults
- Over-temperature faults
- Over-voltage faults

To determine what type of fault is occurring and what assembly needs to be replaced, follow these steps:

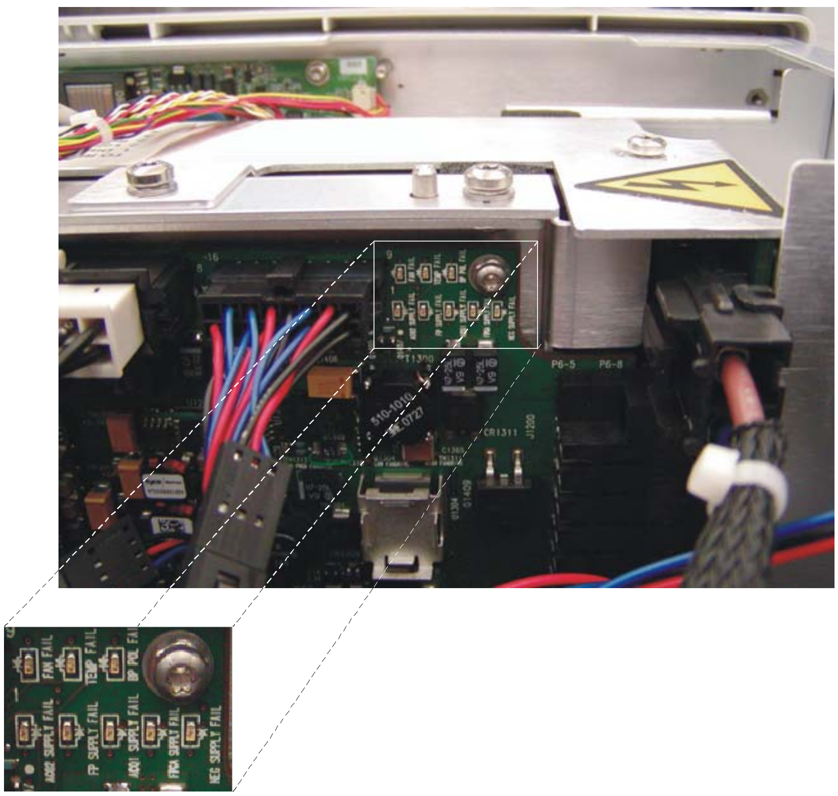
1. Unplug the AC power cord from the rear of the instrument so the +5 V standby power supply can fully discharge.
2. Wait 30 seconds.
3. Plug the AC power cord back into the oscilloscope.
4. Wait 5 seconds.
5. Press the front panel power button, and count how many seconds it takes for the oscilloscope to lose power again.
   a. If it takes about 2 seconds for the scope to lose power, go to the “Under-voltage fault” section in this chapter.
   b. If it takes 4 seconds or more for the scope to lose power, go to the “Over-temperature fault” section in this chapter.
   c. If the scope never powers up, or shuts off almost immediately, go to the “Over-voltage fault” section in this chapter.
   d. If all the steps within these sections have been followed and the oscilloscope still does not turn on, go to the “Motherboard verification” section of this chapter.

Under-Voltage Fault

If the oscilloscope takes about 2 seconds to lose power as just described, the problem is either an under-voltage fault on the backplane assembly or one of the two acquisition assemblies, or a defective bulk 12 V power supply.

To determine which problem it is, first remove the handle, the outer oscilloscope cover, and the inner top cover to expose the motherboard cavity and the top edges of the backplane assembly. A series of six under-voltage indicator LEDs are located in the upper-right corner of the backplane assembly. The other LEDs in this section of the backplane assembly indicate over-temperature or fan problems and are described in the “Over-temperature fault” section.

Location of under-voltage fault LEDs



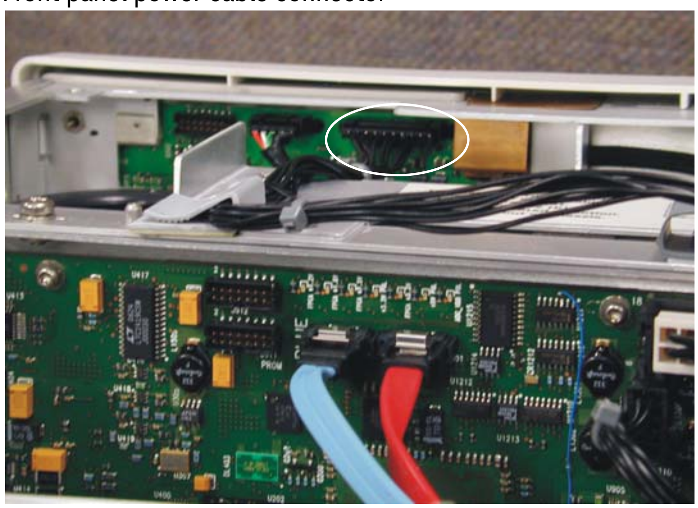
Each of the six under-voltage fault LEDs is labeled.

- If only the ACQ1 SUPPLY FAIL LED is lit, replace the channels 3 and 4 acquisition assembly (upper acquisition).
- If only the ACQ2 SUPPLY FAIL LED is lit, replace the channels 1 and 2 acquisition assembly (lower acquisition).
- If BP POL FAIL, NEG SUPPLY FAIL, or FPGA SUPPLY FAIL is lit, replace the backplane assembly.
- If only the FP SUPPLY FAIL LED is lit, go to the next section, “If the FP SUPPLY FAIL LED is lit”.

If the FP SUPPLY FAIL LED is lit

If the FP SUPPLY FAIL LED is the only one lit, there might be a problem with one of the supplies that goes to the front panel assembly, or a problem on the front panel assembly. Unplug the front panel power connector (see cable circled below) and turn the oscilloscope on again. If no other under-voltage indicator LEDs on the backplane assembly turn on, the fault is on the front panel assembly and it should be replaced. If either the BP POL FAIL or NEG SUPPLOES FAIL LEDs turn on, then replace the backplane assembly and confirm that the fault goes away with the front panel power reconnected to the backplane assembly.

Front panel power cable connector



If the oscilloscope turns off again after two seconds and no under-voltage LEDs are lit, the bulk +12 V supply may be defective and may need to be replaced.

Before replacing the supply, be sure to verify that the +5 V standby potential from the bulk supply is good by confirming the green LED on the motherboard is lit. If this LED is not lit when AC power is applied to the instrument, the bulk +12 V supply might need to be replaced.

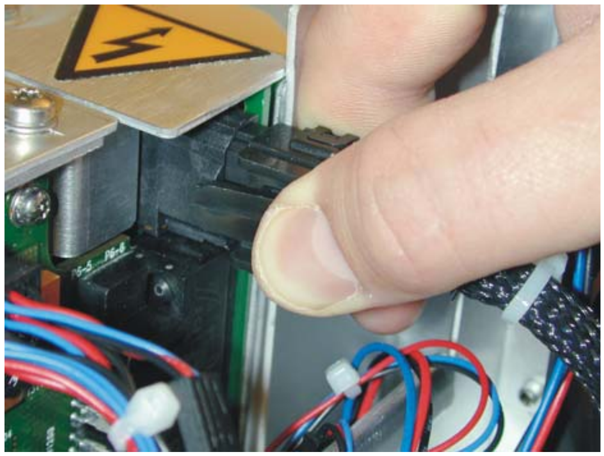
Also be sure to verify the operation of the AC OK and DC OK signals before replacing the supply. The AC OK signal indicates that the applied AC signal is within the specified input range (TTL high logic level indicates AC input is good). It is possible for this signal to indicate the AC input is not within the requested range even though it is correct. The DC OK signal indicates whether the main output from the supply (+12.6 V) is good (TTL high logic level indicates the DC output is good). It is possible for this output to be false even though the supply output is correct.

Both of these outputs are open collectors and would require a pull-up resistor to some external potential to confirm that the output logic level is high, or a simple resistance measurement to ground would indicate whether the open collector output transistors are turned off, meaning both outputs would be in the logic high state.

It is also possible that there is a short circuit on the bulk +12 V supply trace somewhere in the system, which would also cause the oscilloscope to not power on. If so, you need to isolate the assembly that is shorted. You do not need to remove the acquisition or backplane assemblies to perform the following steps.

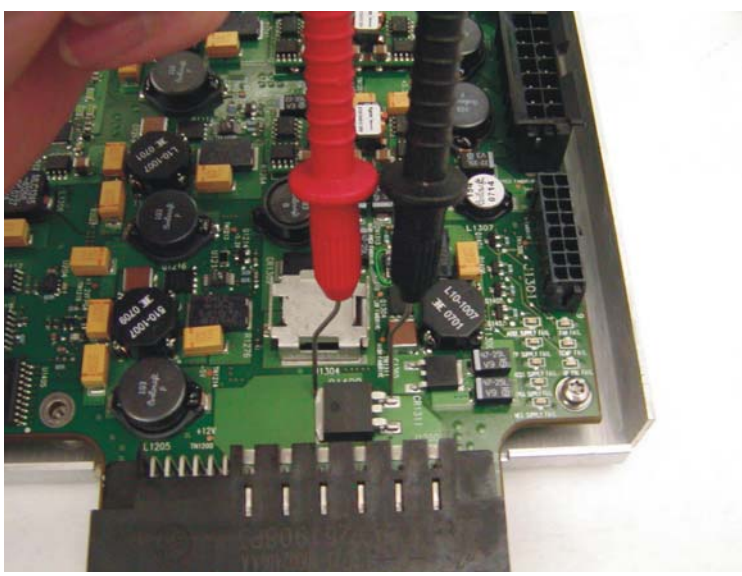
1 With the power turned off, disconnect the bulk +12 V supply, but do not remove the supply from the oscilloscope.

Power supply disconnect



2 On the backplane assembly, measure the resistance across the FET (Q1409, located in the upper right corner of the backplane) between +12 V and ground as shown below, or measure the resistance across the bulk supply input pins on the backplane assembly. Make sure the red lead is plugged into the HI input and the black lead is plugged into the LO or COMMON input of the DVM. On a good backplane assembly, you should measure about 700 ohms. If there is a short on this board, you would measure something very near zero ohms.

Measuring the backplane resistance between +12 V and ground across Q1409



3 If there is a short, disconnect the power cable to the front panel and redo the resistance measurement.

4 If the short is gone, replace the front panel assembly and verify that the oscilloscope now powers on.

5 If there is still a short circuit, disconnect the two large connectors that provide power to the motherboard (J1201 and J1202) from the backplane assembly as shown below and redo the resistance measurements across the FET (Q1409) or the bulk supply input pins on the backplane assembly.

Cable connection into backplane

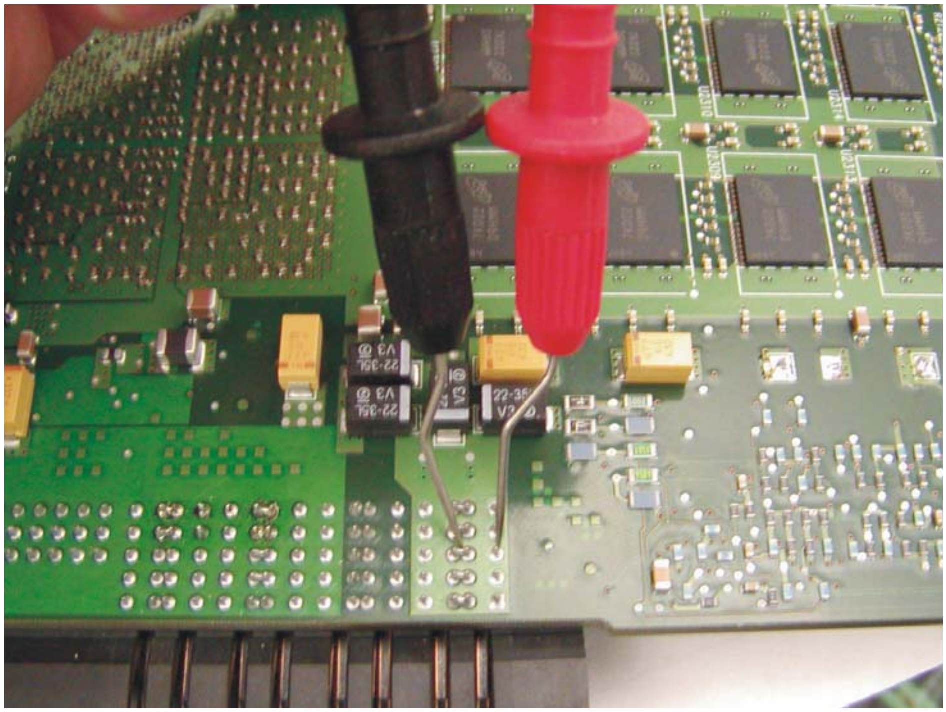
6 If the short is gone, replace the motherboard assembly and confirm the unit will power on.

7 If there is still a short circuit, remove both acquisition boards and unplug them from the backplane assembly.

8 Measure each assembly individually to see if there is a short between the +12V trace and ground (see following figure). You should see a resistance of about 2000 ohms between the +12 V trace and ground on a good acquisition assembly. Make sure you make the measurement using a DVM with the red lead plugged into the HI input and the black lead plugged into the LO or COMMON input of the DVM. If there is a short between these two traces, the

reading you will get will be very low (near 0 ohms). Replace either assembly if needed.

Measuring the acquisition assembly resistance between +12 V and ground



If no shorts are found on the bulk +12 V supply trace or if you have fixed all the shorts and the oscilloscope still will not turn on, follow these steps, which include replacing parts with known good parts until you discover the problem.

1 Replace the bulk +12 V power supply with a known good supply.
2 If the oscilloscope still does not power on, replace the motherboard with a known good one.
3 If the oscilloscope still does not power on, replace the front panel ON/OFF switch with a known good one.
4 If the oscilloscope still does not power on, then the backplane assembly is causing the problem and must be replaced.
5 Once the faulty board or switch is discovered, be sure to reinstall all other parts that were removed, as they were not the cause of the problem.

Over-Temperature Fault

If the oscilloscope takes 4 seconds or more to lose power as described earlier, then the problem is a cooling system failure.

Four case fans are located on the left side of the oscilloscope to cool it. In addition, a single fan is attached to the backplane assembly to cool the trigger ICs. For the oscilloscope to shut down because of a cooling system fault, one of the following conditions must exist:

- The circuitry that generates the reference potential for all five fans may have failed. This circuitry failure would cause the fans to stop turning and the oscilloscope to shut down.
- The fan that cools the trigger ICs failed or the high side drive circuitry for the trigger ICs fan failed. It could also be that the rotation sensor for the trigger ICs fan failed. This sensor lets the oscilloscope know that the fan is turning.
- All four case fans do not turn. It is unlikely that all four case fans would become faulty simultaneously and stop turning. It is more likely that the high side drive circuitry for the case fans failed.

Follow these steps to diagnose a case fan failure.

1 Reset the sensing and shutdown logic by removing the AC power until the green LED on the motherboard goes out (or just wait 30 seconds).
2 Move to the left side of the oscilloscope so you can see the case fans.

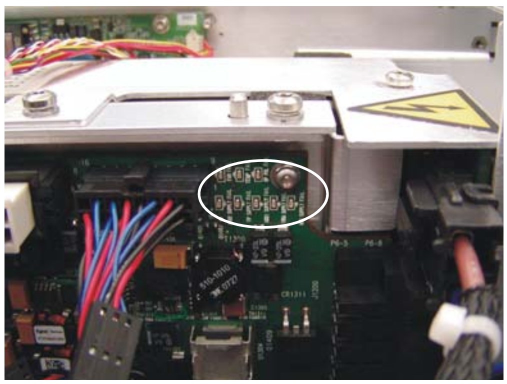
Case fans

3 Apply AC power to the oscilloscope and turn it on if it does not start up automatically. Visually check to see if any of the fans are not turning. If none of the fans are turning, it is likely a problem with the high side drive circuitry for the case fans. In that case, replace the backplane assembly.

If any of the fans are turning then they are probably not the cause of your shutdown problem. (You should still replace any fans that are not turning, however.)

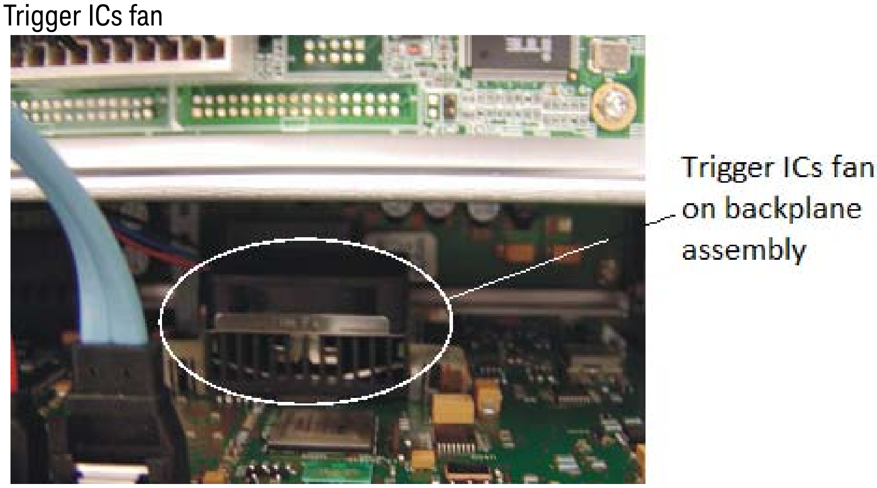
If this is the case, the next step is to see if the FAN FAIL indicator LED on the upper right corner of the backplane assembly is lit.

FAN FAIL indicator LED



To check, reset the sensing and shutdown logic by removing the AC power until the green LED on the motherboard goes out (or just wait 30 seconds). Then position yourself so you can see the trigger ICs fan on the backplane assembly. Because this fan is on the bottom of the backplane it is somewhat hidden by the acquisition assemblies. Look down the backplane board to see it from above.

Trigger ICs fan



Apply AC power and turn the instrument on if it does not start up on its own. Notice whether the trigger ICs fan is turning. If it is not, replace it and redo this part of the diagnostic test. If it is turning and the instrument still turns off after 4 seconds or more, then consider these possibilities:

- If any of the case fans were turning and the trigger ICs fan was turning, the problem is most likely that the rotation sensor on the ICs fan is defective. Replace the trigger ICs fan and redo this part of the diagnostic test.

- If the oscilloscope stays on after you reset the shutdown logic (by removing AC power for 30 seconds) and powered it back on, then you have fixed the shutdown problem.
- If the oscilloscope shuts down again after you have replaced the trigger ICs fan, then the problem could be that the rotation sensor for all the fans located on the backplane assembly failed, so replace the backplane assembly and redo this part of the diagnostic test.

If the oscilloscope does not shut down after you replace the trigger ICs fan and the backplane assembly, you have fixed the problem. Replace any case fans that were not working.

WARNING **INJURY CAN RESULT! The following procedure requires you to touch fan hubs with objects or to use objects to stop the fan blades from moving. Use caution when working near the fan blades with the cover removed from the oscilloscope. The cooling fan blades are exposed on one side and can be hazardous. Be careful not to let the moving fan blades come in contact with any part of your body.**

If the oscilloscope still shuts down, follow these steps:

1. Replace all the case fans and verify that they work properly.
2. Reset the logic by removing AC power for 30 seconds and make all of the case fans so they cannot rotate. For example, have two people hold the four fan hubs or insert an object between the blades of each of the fans.
3. Power the oscilloscope back on. If it shuts down again, the fan sensing and shutdown function is operating properly.

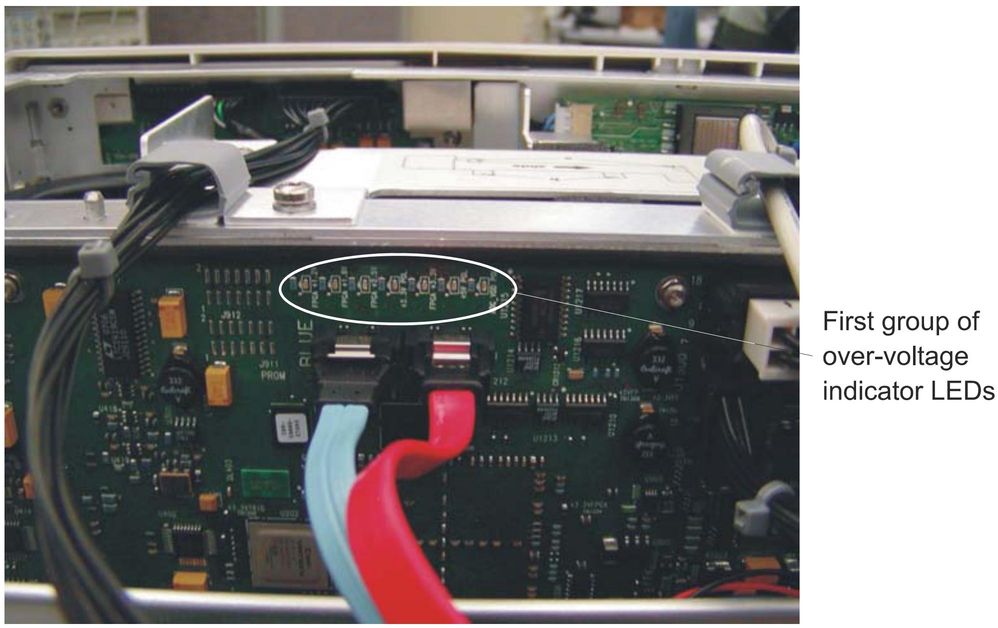
If the oscilloscope shuts down and the TEMP FAIL indicator LED is on, then one of the scope channels is getting too hot or the temperature sensing circuitry has failed. Normally, you would have to turn the instrument on and leave it on for a while before you would see a shutdown due to temperature. If all the fans are turning, it is unlikely that the unit would shut down due to temperature unless the airflow is being restricted or the input air is already too hot to cool the insides of the oscilloscope. If one or more of the case fans has failed, the unit would overheat and shut down, but the oscilloscope would alert the user that one or more case fans has failed and the unit needs to be repaired.

It is possible that all the case fans and the trigger ICs fan are working, but the unit still shuts down because of temperature due to one or more of the channels malfunctioning and drawing too much current. In this case, you would need to replace the acquisition assemblies one at a time until you find which assembly is defective. It is also possible for one of the heat sinks on one of the acquisition assemblies' critical parts to become detached and cause that part to overheat and shut down the instrument.

Over-Voltage Fault

If the oscilloscope loses power almost immediately as described earlier, it is probably an over-voltage fault.

Three groups of LEDs indicate over-voltage faults. One group is located near the center of the top edge of the backplane assembly just above the blue and red SATA cables.

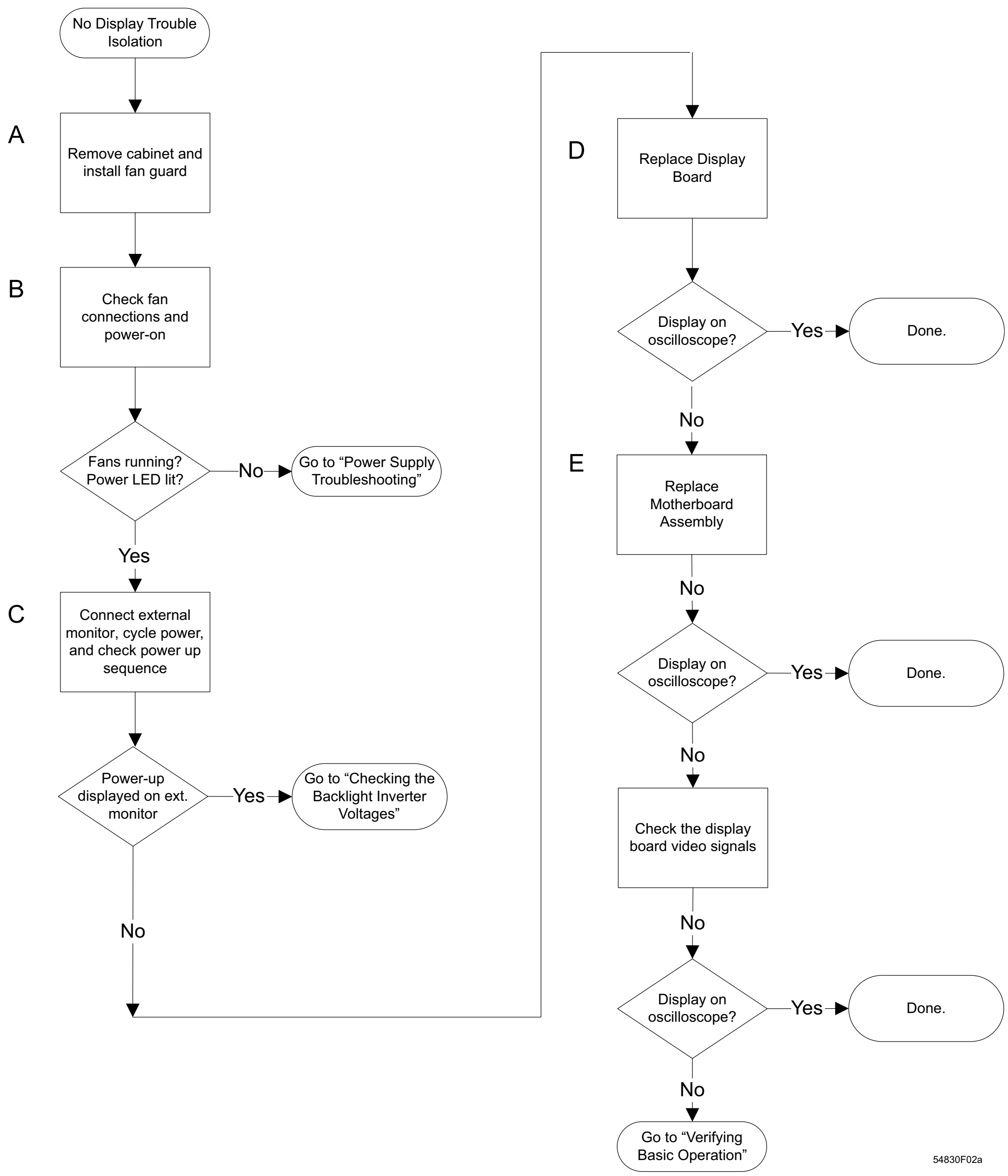


If any of these LEDs are lit, the backplane assembly must be replaced.

The other two groups of LEDs that indicate over-voltage faults are located along the edges of the two acquisition assemblies and are visible through the bottom fan opening located on the left side of the oscilloscope, nearest the rear panel.

The acquisition assembly nearest the bottom of the instrument is the channels 1 and 2 acquisition assembly and the one above it is the channels 3 and 4 acquisition assembly. If you look through the fan and see any of these over-voltage LEDs illuminated, that acquisition assembly needs to be replaced.

Display Troubleshooting



Checking the Backlight Inverter Voltages

The backlight inverter board MP13 is located in the front-left corner of the oscilloscope.

- There is an input connector at one side of the board.
- Two output connectors are on the other end of the board to power the two backlights, which are 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. A red LED on the backlight inverter board illuminates when the output voltage is present.

When the backlight goes off (when the oscilloscope's operating system switches to screen saver mode) the voltage on pins 1 and 2 (with respect to ground) slowly decays to 0 V.

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 display board MP12.

Backlight inverter board input voltage

Input pin #	7	6	5	4	3	2	1
Backlight OFF	0 V	0 V	0 V	0 V	0 V	0 V	0 V
Backlight ON	5 V	0 V	2.5 V	0 V	0 V	12 V	12 V

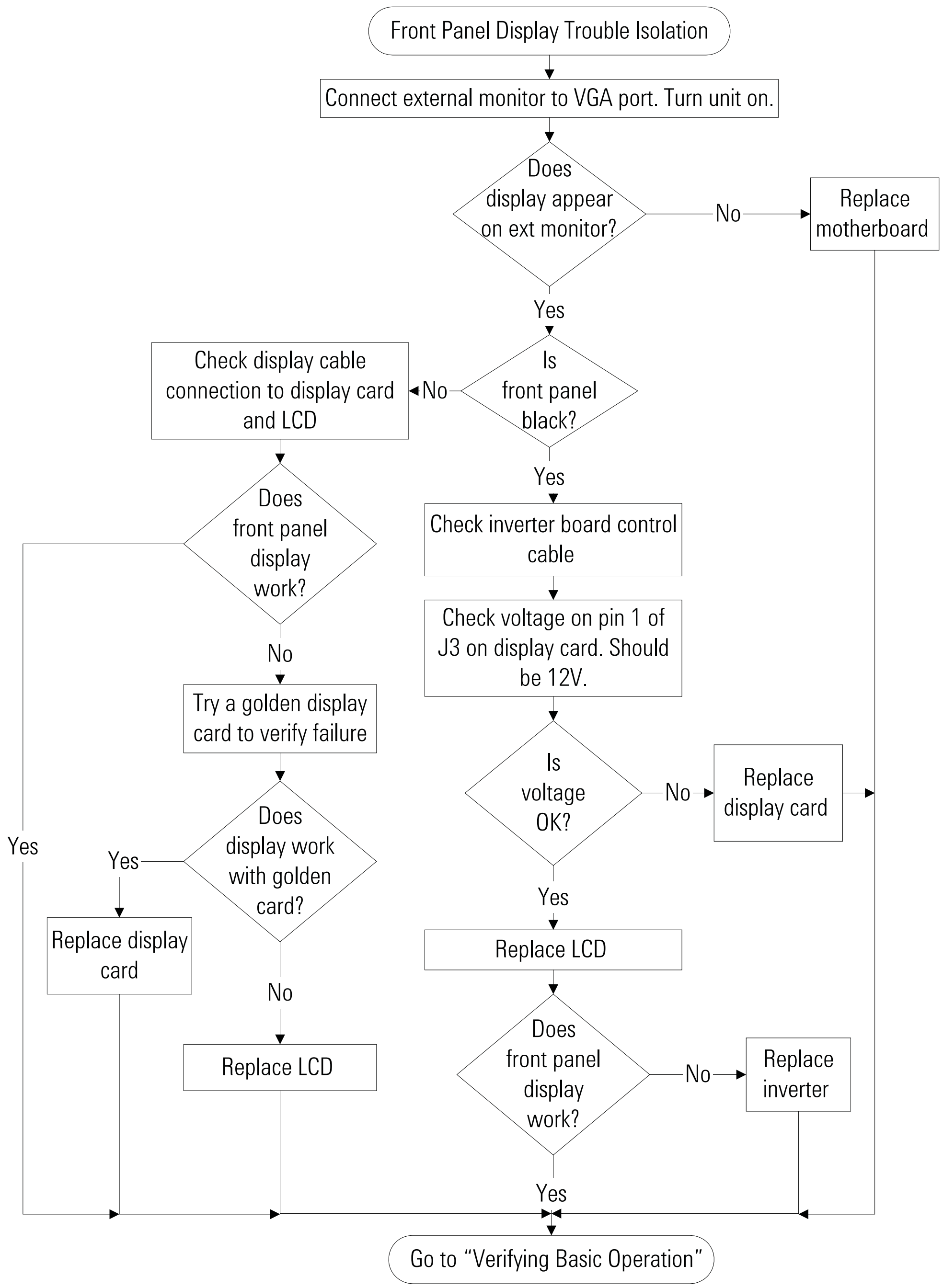
Checking the Display Board Video Signals

The video signals are checked on the 32-pin connector J2 on the display board MP12. You can use an oscilloscope with a bandwidth of at least 100 MHz to verify the signals. Even-numbered pins are closest to the PC board. 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. Note that CLK, A0, A1, A2, and A3 are Low Voltage Differential Signals (LVDS).

Video Signals

Pin Number	Signal		Pin Number	Signal
1	NC		26	NC
2	CLK-	(LVDS pair)	27	NC
3	CLK+		28	NC
4	GROUND		29	NC
5	A3-	(LVDS pair)	30	NC
6	A3+		31	NC
7	GROUND		32	NC
8	A2-	(LVDS pair)		
9	A2+			
10	GROUND			
11	A1-	(LVDS pair)		
12	A1+			
13	GROUND			
14	A0-	(LVDS pair)		
15	A0+			
16	NC			
17	NC			
18	NC			
19	NC			
20	NC			
21	GROUND			
22	GROUND			
23	+3.3 V			
24	+3.3 V			
25	+3.3 V			

Front Panel Display Troubleshooting



WARNING **SHOCK HAZARD! The backlight inverter assembly, which is mounted at the front corner of the oscilloscope near the flat-panel display, operates at 1.65 kV at turn on. DO NOT handle this assembly while it is in operation. An LED on the inverter board illuminates to indicate the presence of high voltage.**

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 fans. Use extreme caution in working with the oscilloscope when the cover is removed. If the procedure allows, replace the cover over the chassis (without screwing it back in place) before turning the oscilloscope on. If the procedure requires you to have the cover off, be careful not to contact these fan blades with any part of your body.**

Motherboard Verification

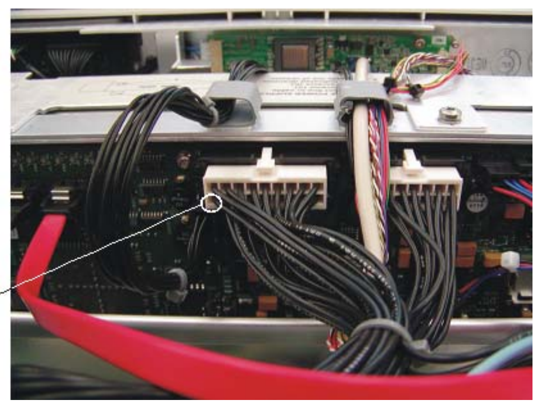
If you have been through the Power Supply Troubleshooting section of this chapter and the oscilloscope still does not stay powered up, the problem may be with the motherboard. To diagnose this problem, follow these steps.

1 Remove the handle, outer case, and top shield.
2 Turn the oscilloscope on.

   If the unit beeps once after about 5 to 10 seconds but fails to boot up, the motherboard is defective and needs to be replaced.

   If the unit fails to beep after it is powered on, then measure the potential relative to the chassis at pin 9 of J1201 (see following figure). You should measure about 3.3 V. If the potential you measure is correct, but the unit still has not beeped and started up, the motherboard is defective and needs to be replaced.

Pin 9 is under this connection (bottom left pin)



3 If the potential you measure is not correct, shut the oscilloscope down and unplug the AC cord from the rear of the instrument.
4 Unplug the front panel power cable, the two large power cables that go to the motherboard (J1201 and J1202), and the red and blue SATA cables (J900 and J901) from the backplane assembly. Do not allow the two SATA cables to touch the backplane assembly and cause a short circuit.
5 Plug the AC power back into the oscilloscope and turn the unit on if it does not come on automatically.
6 Measure the potential relative to the chassis at pin 9 of J1201 again.

   If you measure the required 3.3 V, the motherboard is defective and needs to be replaced.

   If you did not measure the correct voltage, the backplane assembly is defective and must be replaced.

7 Be aware that there could be a fault on the motherboard that caused the backplane assembly to fail so before you plug the motherboard cables back into the new backplane assembly, measure the resistance to the chassis from the pin 9 contact in the connector that plugs into J1201. If you measure a very low resistance or a short circuit to the chassis, replace the motherboard and then assemble the instrument and confirm the unit beeps and boots up properly.

Setting Up the BIOS

If the BIOS settings become corrupt, the Infiniium oscilloscope PC motherboard will not recognize the hard drive and the oscilloscope may not start. To configure the motherboard BIOS parameters to the default settings, follow these steps:

1. Connect the power cable to the oscilloscope.
2. Connect the external keyboard to the rear panel.
3. Press **[Delete]** as soon as the following prompt appears on the bottom of the screen:

Press DEL to enter SETUP, F12 to select boot device.

If the prompt does not appear, or the oscilloscope does not appear to be functioning, check the J1201 and J1202 motherboard power cable connectors. Otherwise, continue with the next step.

4. Go to F3 Optimized Defaults and press **[Enter]**. Select Yes to load the defaults, then press **[Enter]**.
5. Go to the Save and Exit Setup option and press **[Enter]**, to save and exit the setup. Select Yes, then press **[Enter]**.

Acquisition/Backplane Assembly Troubleshooting

This section describes which board assembly to replace if any of the scope self tests fail. A self-test error message file is generated and is sent to this location:

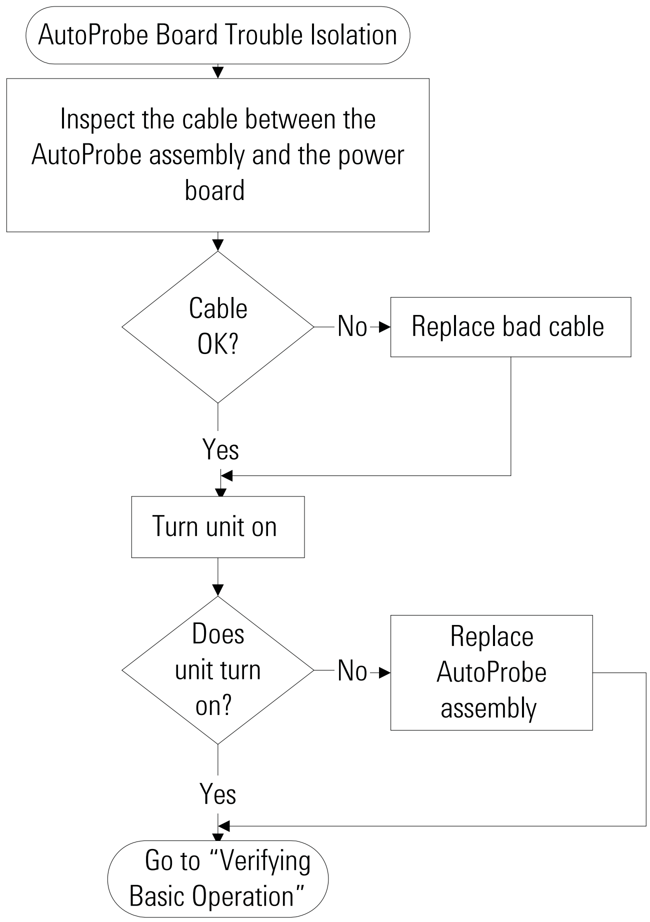
C:\ProgramData\Infiniium\selftest\SelfTestLog.txt

The error message usually indicates the channel with the error. When identifying which acquisition assembly to replace, remember that the acquisition assembly nearest the bottom of the oscilloscope is for channels 1 and 2. Channels 3 and 4 are on the upper acquisition assembly. Replace the acquisition assembly that has the error.

If the error message does not indicate a channel, refer to the following table to determine which assembly to replace.

Test Group	Test Name	Error Type	Assembly to Replace
Timebase	Timebase Interpolator Test		Backplane
ADC	ADC Register Tests	ADC1, ADC2, ADC3, ADC4	Lower acquisition
		ADC5, ADC6, ADC7, ADC8	Upper acquisition
	ADC Voltage Test Points	ADC1, ADC2, ADC3, ADC4	Lower acquisition
		ADC5, ADC6, ADC7, ADC8	Upper acquisition
Acquisition Memory	Hedwig MBIST		
	Hedwig Register		
	Hedwig-DDR2 ADDR & Data	MEMCON_1, MEMCON_2, MEMCON_3, MEMCON_4,	Lower acquisition
		MEMCON_5, MEMCON_6, MEMCON_7, MEMCON_8,	Upper acquisition
	Hedwig DDR2 Stress	Memory Controller 1-4	Lower acquisition
		Memory Controller 1-8	Upper acquisition
	Hedwig DDR2 Interface	Hedwig1, Hedwig2, Hedwig3, Hedwig4	Lower acquisition
		Hedwig5, Hedwig6, Hedwig7, Hedwig8	Upper acquisition
Misc. Scope	Temp Sensor	Hedwig0, Hedwig1, Hedwig2, Hedwig3, Oak0	Lower acquisition
		Hedwig4, Hedwig5, Hedwig6, Hedwig7, Oak2	Upper acquisition
		Pred1, Pred2, MainFPGA	Backplane
	Acq Flash RAM	Test is not currently being run.	

AutoProbe Board Troubleshooting



Keyboard Troubleshooting

Use this procedure only if you encounter key failures in the keyboard self 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.
3 Remove the 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. Re-attach the partial assembly to the chassis.
4 Be sure to reconnect the display video cable and the backlight inverter cables. See chapter 5 for instructions on removing and disassembling the front panel.
5 Separate the elastomeric keypads from the keyboard assembly.

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.

6 Set the keyboard assembly on an antistatic electrical insulated surface.
7 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.

8 Reconnect the power cable and apply power.
9 Enable the user interface, then start the keyboard test as described earlier in this chapter.
10 Carefully short the PC board trace with a paper clip or screwdriver, at each non-operating 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.

11 Re-assemble the oscilloscope.

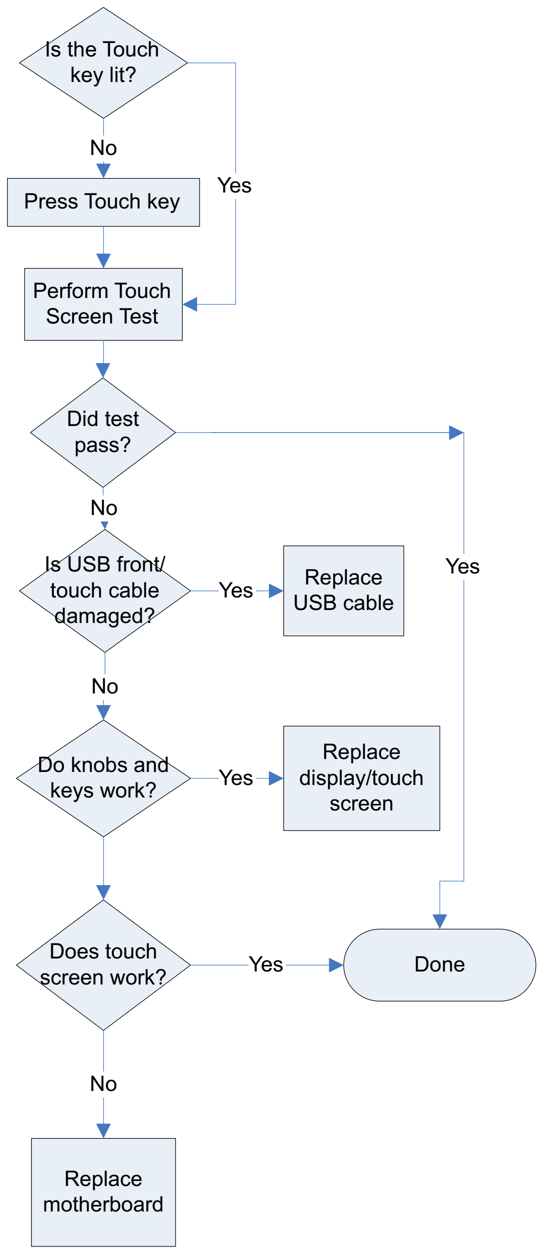
LED Troubleshooting

If you see a failure with the on/off switch backlight LED, replace the On/Off board. If the LED will still not illuminate, replace the motherboard and see if this fixes the problem. If the LED still does not work, check the on/off cable connecting the On/Off board to the motherboard.

If any of the other LEDs are not working on the front panel, the first step is to trouble shoot the acquisition assemblies to make sure they are working. If they are working, replace the keyboard assembly and see if the LEDs will illuminate. If the LEDs do not illuminate, the last step is to reload the oscilloscope software.

When reassembling the oscilloscope, be sure to reinstall all boards that were replaced, but that were not causing the problem.

Touch Screen Troubleshooting



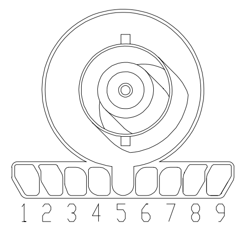
Checking Probe Power Outputs

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

Refer to the following figure to check the power output at the connectors. Measure the +3 V, -3 V, +12 V, and -12 V voltages with respect to the ground terminal on the front panel, located near the Aux Out BNC.

Do not try 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 is likely caused by a problem with the probe power and control assembly, the AutoProbe flex cable, the probe power and control cable, or the power board.

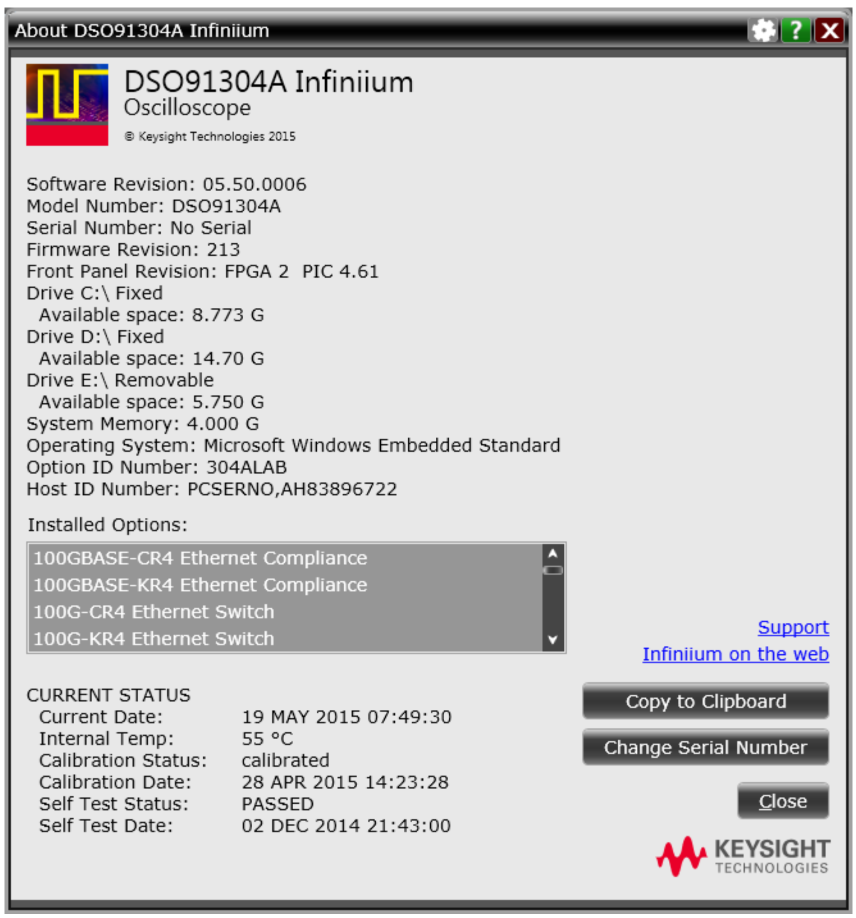
Before You Contact Keysight

If you have read this troubleshooting chapter and have unresolved questions about troubleshooting the oscilloscope, be ready to provide system information such as the current software version and installed options. This information will be useful when you contact Keysight Technologies.

To find and save system information, follow these steps:

1 Click **Help > About Infiniium...**.

A dialog box similar to this one appears.



2 Click **Copy to Clipboard**.

3 Bring up a text editor, such as Notepad, and paste the copied information into the editor.

4 Save the text editor file.

5 Replacing Assemblies

Replacing Assemblies

Use the procedures in this chapter when removing and replacing assemblies and parts in the Infiniium 90000A Series oscilloscopes.

The pictures in this chapter are representative of the oscilloscope at the time of this printing. Your unit may look different.

Tools required

The following tools are required for these procedures.

- Torx drivers: T10, T20
- Socket wrench: 9/16 inch
- Torque wrench: 3.5 mm (8 in-lbs)
- Flat-blade screwdriver: medium size (3/16 inch)

Safety precautions

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

CAUTION Failure to implement proper antistatic measures may result in damage to the oscilloscope.

CAUTION Remove power before removing or replacing assemblies.

Do not remove or replace any circuit board assemblies in this oscilloscope while power is applied. The assemblies contain components that may be damaged if the assembly is removed or replaced while power is connected to the oscilloscope.

WARNING **The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the product from all voltage sources while it is being opened.**

WARNING **The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. The front panel switch is only a standby switch and is not a LINE switch (disconnecting device).**

WARNING **The power cord is connected to internal capacitors that may remain live for 5 seconds after the plug is disconnected from its power supply.**

WARNING **These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.**

WARNING **To avoid electric shock, adhere closely to the following procedures. Also, after disconnecting the power cable, wait at least 3 minutes for the capacitors on the power supply to discharge before servicing this oscilloscope.**

WARNING **Use caution when the oscilloscope fan blades are exposed as they can cause injury.**

WARNING **Use alcohol to clean connectors. The power cord must be removed, and the oscilloscope must be in a well-ventilated area. Allow all residual alcohol moisture to evaporate, and the fumes to dissipate prior to powering up the oscilloscope. Dispose of the cleaning materials in a responsible manner.**

Returning the oscilloscope to Keysight Technologies for service

Before shipping the oscilloscope, contact Keysight Technologies for more details.

1 Write the following information on a tag and attach it to the oscilloscope.

- Name and address of owner
- Oscilloscope model number
- Oscilloscope serial number
- Description of the service required or failure indications

2 Remove all accessories from the oscilloscope.

Accessories include all cables. Do not include accessories unless they are associated with the failure symptoms.

3 Protect the oscilloscope by wrapping it in plastic or heavy paper.

4 Pack the oscilloscope in foam or other shock-absorbing material and place it in a strong shipping container.

Place 8 to 10 cm (3 to 4 inches) of shock-absorbing material around the oscilloscope and place it in a box that does not allow movement during shipping.

5 Seal the shipping container securely.

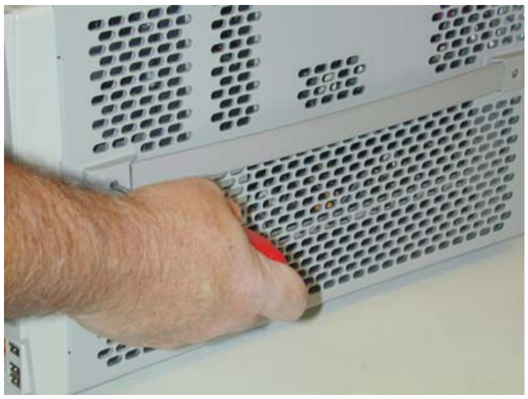
6 Mark the shipping container as FRAGILE.

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

Removing and replacing the cover, top plate, and bottom plate

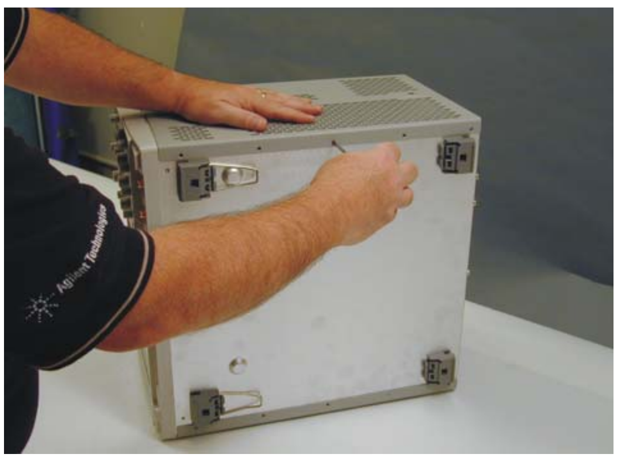
1 Disconnect the power cable, all probes and BNC input cables, the accessory pouch if it is attached, and any other cables including those for a mouse, keyboard, printer, USB, and LAN.

2 Remove the two Torx T20 screws securing each side handle. Standard models have one handle; performance-enhanced models have two handles.



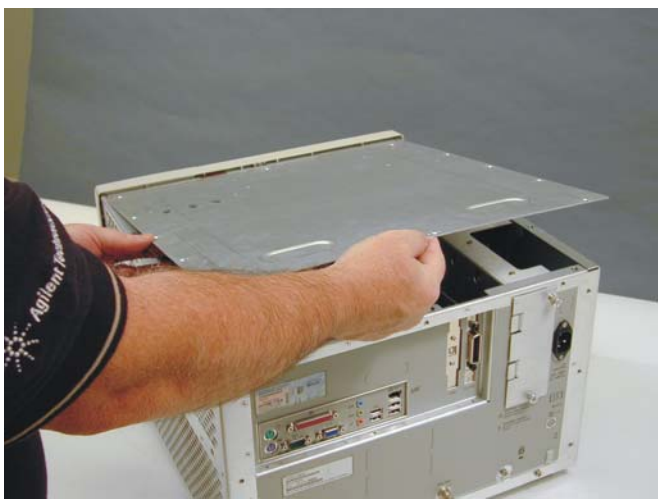
3 Remove the 6 Torx T20 screws that secure the rear feet (three in each foot).

4 Remove the three Torx T20 screws from the rear panel of the oscilloscope, then turn the instrument on its side and remove the ten Torx T10 screws from the underside of the oscilloscope that attach the cover to the chassis.

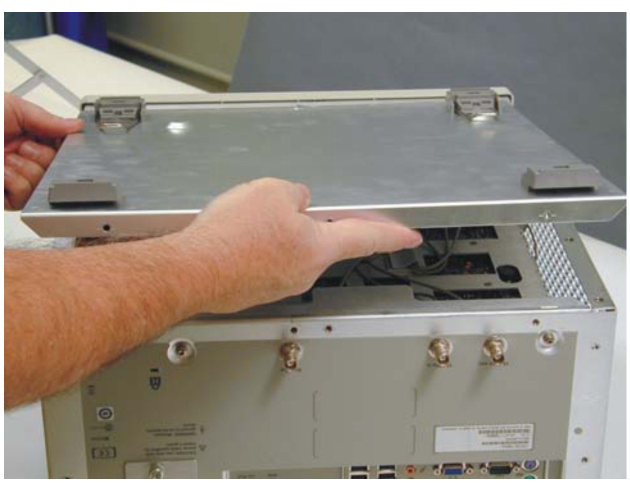


5 Carefully slide the cover toward the rear of the instrument and off the chassis.

6 Once the cover is removed, you can remove the top plate by removing the 12 Torx T10 screws from its edges. Then pull back on the top plate and lift it off.



7 To remove the bottom plate, flip the oscilloscope upside down and remove the three Torx T20 screws from the bottom panel. Then remove the 3 Torx T20 screws from the bottom edge of the rear panel. Slide the bottom panel up and out.



8 To replace the cover, top plate, and bottom plate, reverse this procedure. Note that all sheet metal holes that are supposed to have screws placed in them are marked by lines on four sides of the hole.

CAUTION PROPERLY TIGHTEN HANDLE AND SCREWS! Tighten the side handle screws to 2.4 Nm (21 in-lbs).

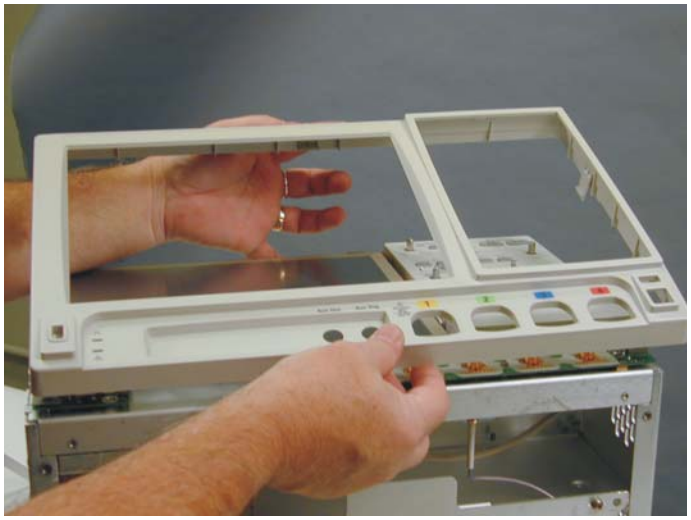
Removing and replacing the front panel bezel and front panel circuit assembly

1 Disconnect the power cable and remove the cover, top plate, and bottom plate as described in the previous section.

2 Disconnect front panel cables.

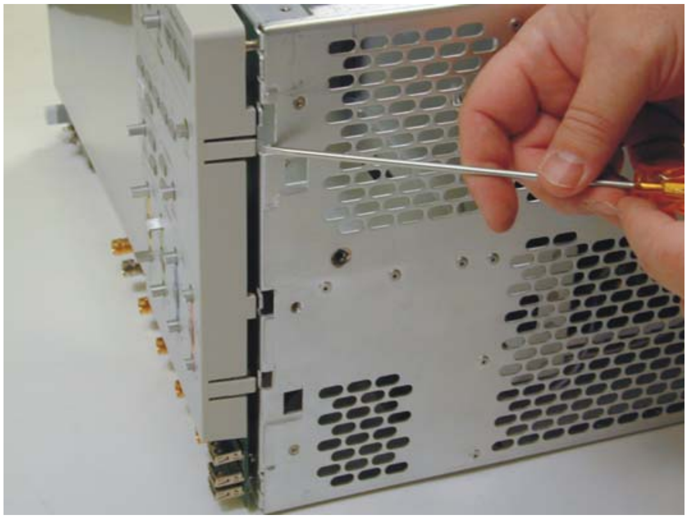
3 Grasp and pull on all 13 knobs located on the front panel to remove them.

4 Use a screwdriver to disengage the locking tabs located along the edges of the front panel bezel. For best results, disengage the four side tabs first, then the top tab, and then pull the bezel off at an angle and flex it until the bottom tab disengages.



5 Remove two Torx T10 screws from the front panel assembly.

6 Disengage the tabs located along the edges of the control panel faceplate. Three tabs are located along the right side (first photo below) and two more tabs are on the top and bottom of the left edge (following two photos). You need to look inside the instrument to see the left side tabs. You can see the top left side tab by looking through the top cavity, and the bottom left tab by turning the oscilloscope on its side and looking through the bottom cavity.



7 Pull off both the control panel faceplate and front panel circuit assembly together after all the tabs are disengaged. The faceplate and the circuit assembly will not come all the way off the instrument until you disconnect all the cables connected to the front panel circuit assembly. Once the faceplate and assembly have been removed, remove the faceplate from the assembly.

8 To replace the front panel assembly, reverse this procedure. Suggestion: When you snap the tabs located on the control panel faceplate back into the chassis, it is best to snap the faceplate and the assembly together first before trying to attach them back to the chassis using these tabs. Once they are attached together, snap down the right side tabs first and then the left tabs.

Removing and replacing the on/off board

1 Remove the front panel bezel as described earlier.
2 Remove the Torx T10 screw from the on/off board.

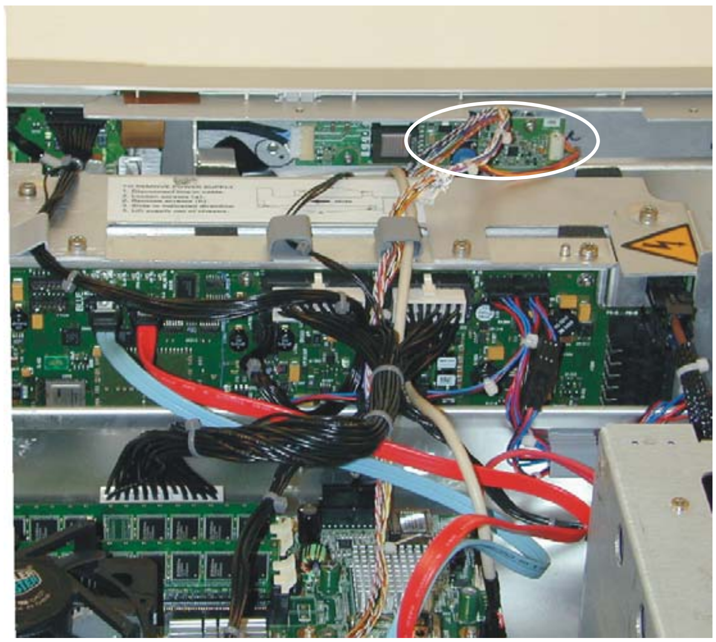
3 Pull the board out a little so you can see the cables connected behind it. Disconnect these cables and then take the board off.

4 To replace the on/off board, reverse this procedure.

Removing and replacing the backlight inverter board

WARNING **SHOCK HAZARD! The backlight inverter assembly, which is mounted at the front corner of the oscilloscope near the flat-panel display, operates at high voltages from 300-1 kVACrms. DO NOT handle this assembly while it is in operation.**

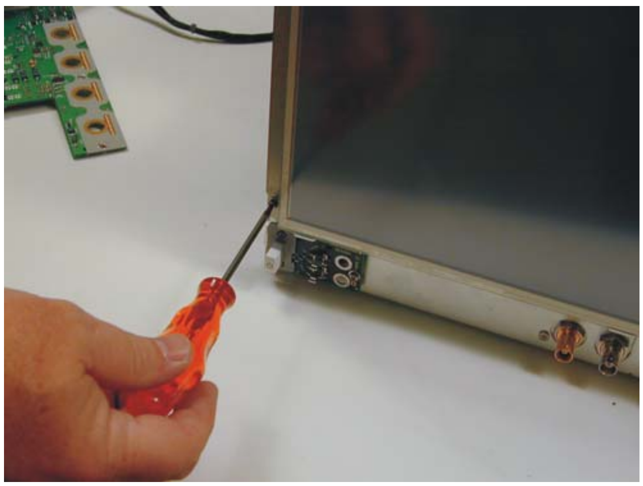
1 Disconnect the power cable and remove the cover and top plate.
2 Disconnect the cables from the backlight inverter board.



3 Remove two Torx T20 screws that connect the board to the chassis.
4 Lift the backlight inverter board out through the top of the chassis.
5 To replace the backlight inverter board, reverse this procedure.

Removing and replacing the touch screen, front deck, and controller assembly

1 Disconnect the power cable and remove the cover, top plate, and bottom plate.
2 Remove the front panel bezel and front panel circuit assembly from the chassis.
3 Remove the two Torx T20 screws attaching the touch screen to the front deck of the chassis, located along the left side of the screen.

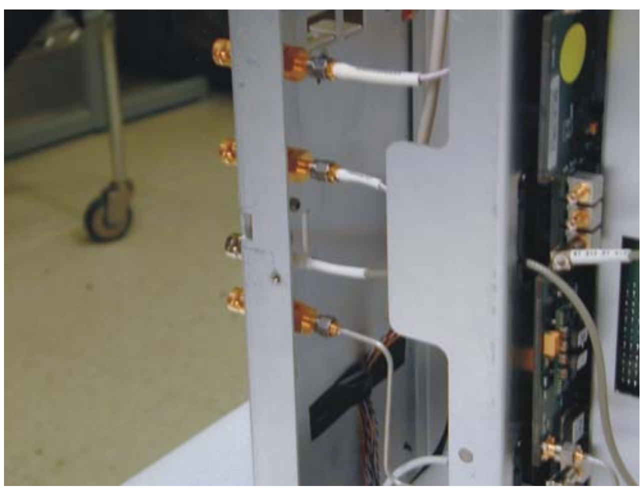


4 Disconnect the three cables that are attached to the screen (one is connected to the back of the lower left corner of the screen, one is connected to the back of the upper right corner of the screen, and one is connected to the right edge of the screen) and the copper shielding located in the upper right corner of the screen.

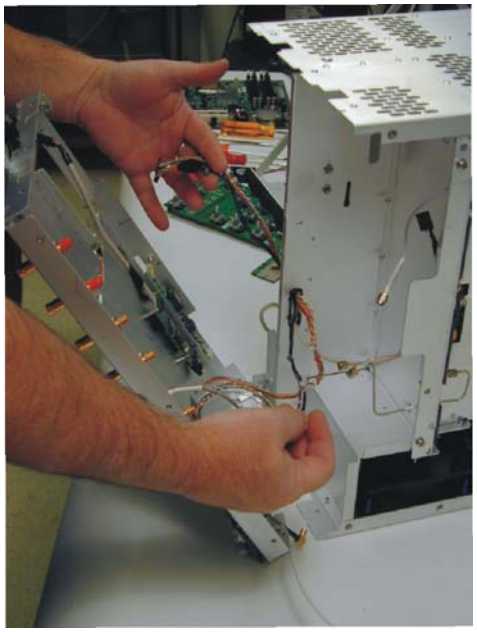
5 Pull the touch screen off.

6 To remove the front deck off the chassis, remove four Torx T10 screws from the front deck (two on the right side and two on the left side).

7 Turn the oscilloscope upside down or on its side and look through the bottom cavity to see the SMA connectors attached to the front deck. Remove these SMA connectors with a wrench.



8 Feed the cables through any openings that are required and remove the front deck from the frame.



9 Remove the controller board and backlight inverter board from the back of the front deck if these need to be replaced, by removing the Torx T20 screws attached to them.

To reassemble the front deck and touch screen, reverse the above procedure.

NOTE Before reattaching the front deck to the frame, attach the touch screen to the front deck. This gives you some room to feed cables through the correct holes and attach them to the correct boards. When reattaching the SMA cables, use an 8-lb. torque wrench as shown below.

CAUTION

PREVENT GLASS BREAKAGE! Use care when handling the touch screen and the flat-panel display to prevent glass breakage.

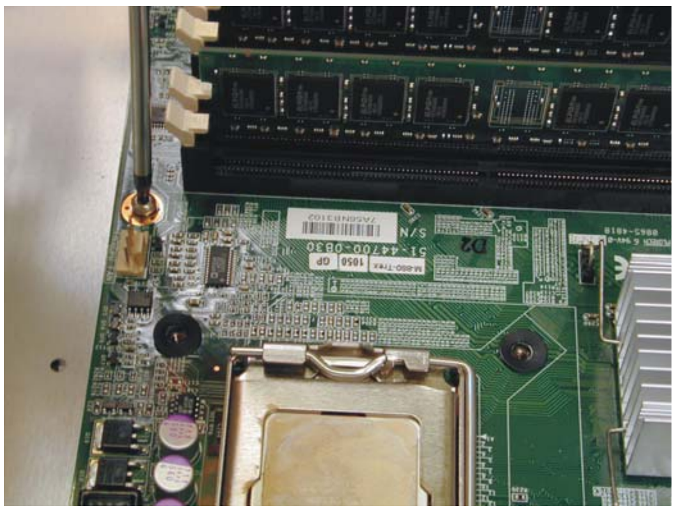
Inspect the inside surfaces of the touch screen and the flat-panel display closely for dust, smudges, and fingerprints. Viewing these with line-of-sight 45 degrees to the surface is the best method for seeing subtle flaws. Clean the surfaces of the touch screen with glass cleaner and lint-free lens paper before re-assembly.

Removing and replacing the motherboard

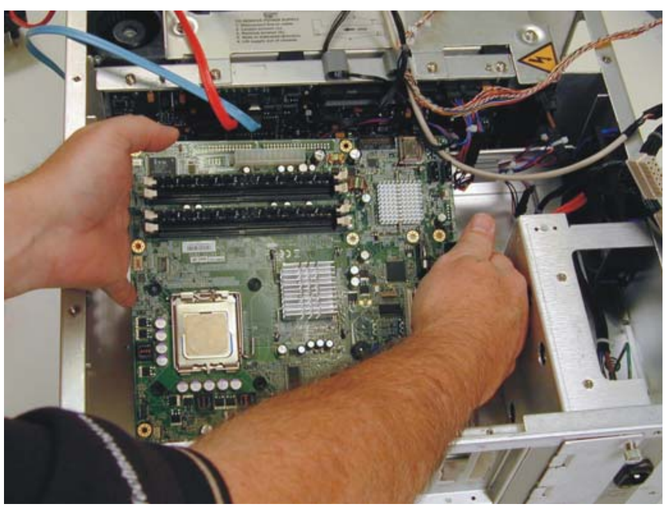
1 Disconnect the power cable and remove the cover and top plate.

2 Disconnect all the cables from the motherboard.

3 Remove the Torx T10 screws attaching the motherboard to the frame. The motherboard shown below is the one in the standard 90000A Series models. If you have a performance-enhanced model it will look different, but you still remove the screws from it to lift it out.



4 Pull the motherboard toward the front panel and then lift out.



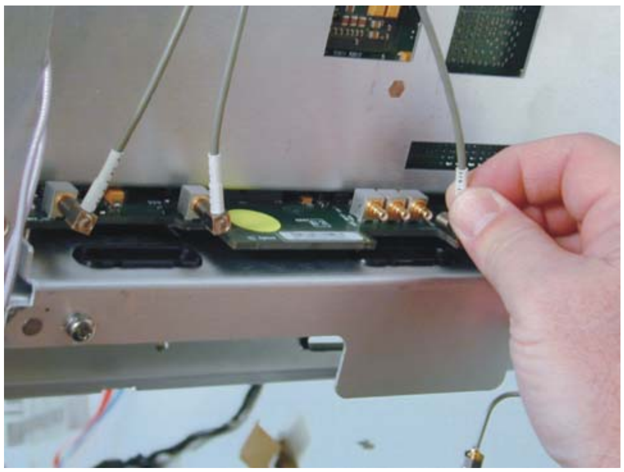
5 To reassemble the motherboard, reverse this procedure.

WARNING

The motherboard has a Rayovac BR2032 lithium battery, shown below. Danger of explosion if battery is incorrectly replaced. Replace only with the same or alternate type recommended. Discard used batteries according to manufacturer's instructions.

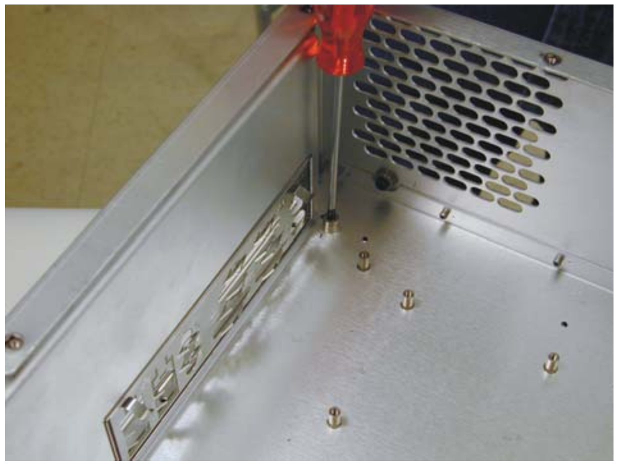
Removing and replacing the acquisition boards/backplane assembly

1 Disconnect the power cable and remove the cover, top plate, and bottom plate.
2 Remove the motherboard and bulk +12 V power supply.
3 Turn the oscilloscope on its side and remove the SMAs connected to the bottom of the backplane board.

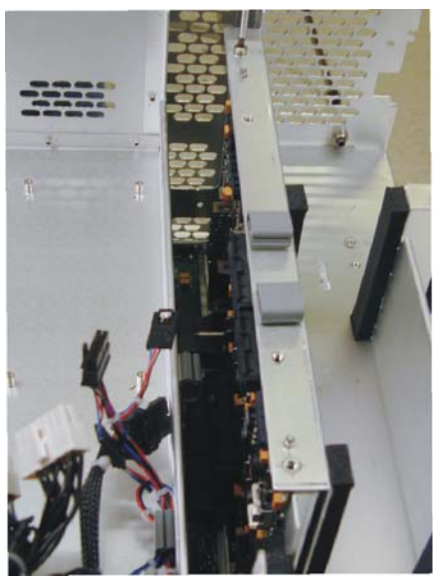


4 Disconnect the BNCs from the rear of the instrument using a 9/16-inch open-ended or socket wrench.

5 Turn the oscilloscope over so it is positioned upright. Remove the Torx T20 locking screws from the top (underneath where the motherboard used to be).



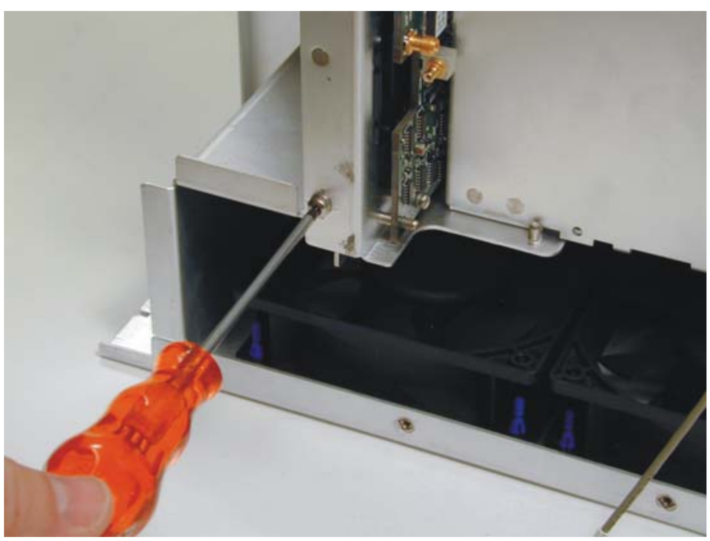
6 Remove the Torx T20 screws from the top of the backplane assembly.



7 Flip the instrument so it is upside down or on its side.

8 Remove the Torx T20 screws from lower side of the rear of the instrument.

9 Remove the two Torx T20 screws from the underside of the backplane assembly.

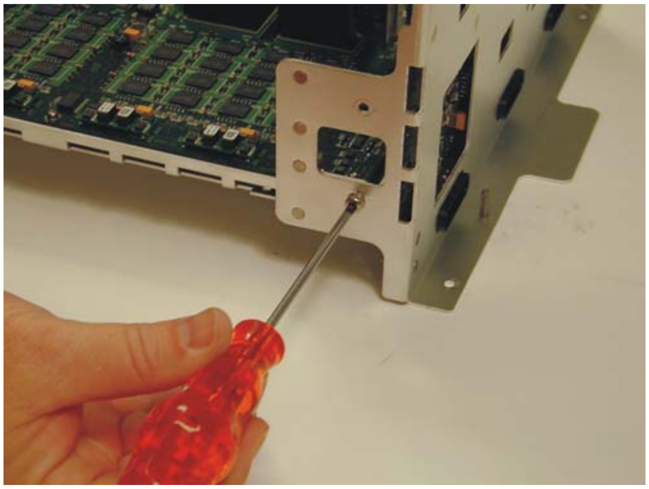


10 If unit is not already upside down, flip it upside down now. Then lift the entire acquisition boards/backplane assembly out of the instrument using the handles on the bottom.

Removing the backplane assembly from the acquisition assemblies

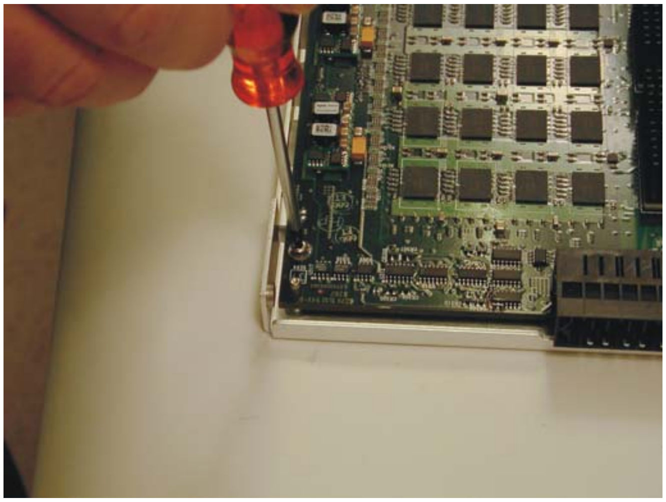
1 Remove the entire acquisition/backplane assembly as described in the previous section.

2 Remove the four Torx T20 screws (two per acquisition assembly) on the side of the backplane assembly.



3 Gently pry on the sheet metal portions to separate the backplane assembly from each of the acquisition assemblies.

4 Remove the Torx T10 screws to remove each of the boards from their respective subassembly chassis.



5 To reassemble the backplane/acquisition assembly, reverse this procedure.

Setting the calibration factors after replacing the acquisition board

The following procedure must be performed after replacing an acquisition board. Only trained Keysight service personnel should perform this level of calibration.

NOTE

Let the oscilloscope warm up before running the calibration.

The service calibration should be done only after the oscilloscope has run for 30 minutes at ambient temperature. Calibration of an oscilloscope that has not warmed up may result in inaccurate calibration.

Equipment required

Equipment	Critical Specifications	Keysight Part Number
Digital Multimeter	No substitute	Keysight 34401A
Adapters (2 supplied with oscilloscope except for the DSO90254A)	No substitute	Keysight 54855-67604
Adapter	BNC barrel (f)-(f)	Keysight 1250-0080
Adapter	BNC shorting cap	Keysight 1250-0929
Adapter	BNC (f) to dual banana	Keysight 1251-2277
Cable assembly	50 Ω characteristic impedance BNC (m) connectors, 36 inches (91 cm) to 48 inches (122 cm) long	Keysight 8120-1840
Cable assembly	No substitute	Keysight 54855-61620
Cable assembly	RS-232 (f)-(f)	Keysight 34398A
10 MHz signal source (required for time scale calibration)	Frequency accuracy better than 0.4 ppm	Keysight 53131A with opt. 010

Procedure

1 Perform self tests:

   a Right-click the Infiniium Default Setup desktop icon, click Properties, and add -service to the end of the Target location. For example: C:\Program Files\Infiniium\Infiniium.exe -default setup -service

   b Click **Utilities > Self Test...**.

   c Select **Scope SelfTest** from the Available Self Tests drop-down list box.

   d Click Start and follow the instructions on the screen.

   e If any of the self-tests fail, ensure that the failure is diagnosed and repaired before calibrating and testing performance.

2 Perform a service calibration after the warm-up period:

a Connect the RS-232 cable to the Digital Multimeter RS-232 port and to the RS-232 port on the oscilloscope.

b Set the Digital Multimeter as follows:

Interface: RS-232
Baud Rate: 9600 Baud
Parity: None: 8 bits
Language: SCPI

c Click **Utilities > Calibration**.

d Clear the Cal Memory Protect box to allow calibration.

e Click **Start** to start the calibration procedure.

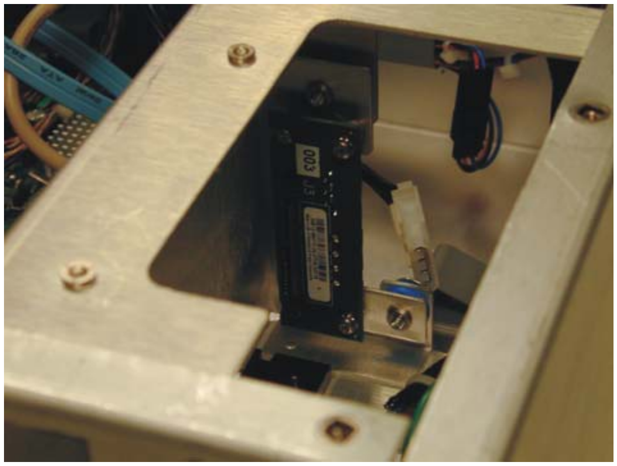
f Follow the on-screen instructions as calibration proceeds.

Removing and replacing the hard disk and hard disk control board

1 Disconnect the power cable and remove the cover and top plate.
2 Disconnect the two cables connected to the hard disk.
3 Remove the two latch screws located on the rear panel of the oscilloscope.

4 Pull the hard disk out.

5 To remove the hard disk control board, first locate it by looking in the cavity where the hard disk used to be. Remove the two Torx T10 screws holding the board to the frame.



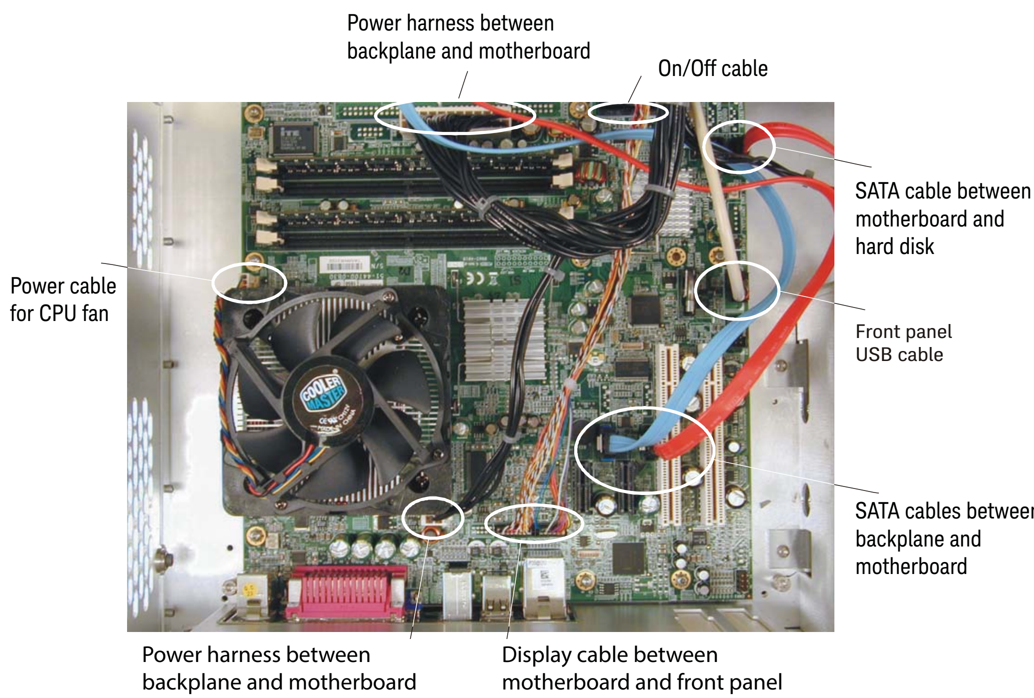
6 To replace the hard disk and hard disk control board, reverse this procedure.

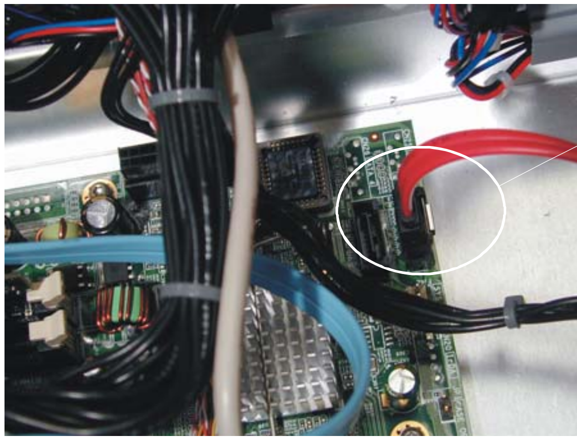
Removing cables (for replacing the motherboard)

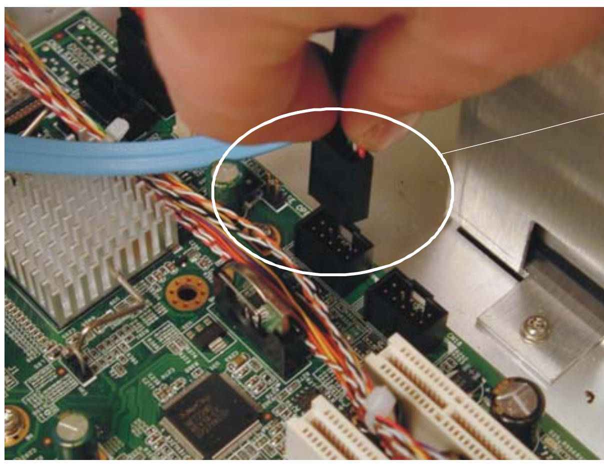
1 Disconnect the power cable and remove the top cover.

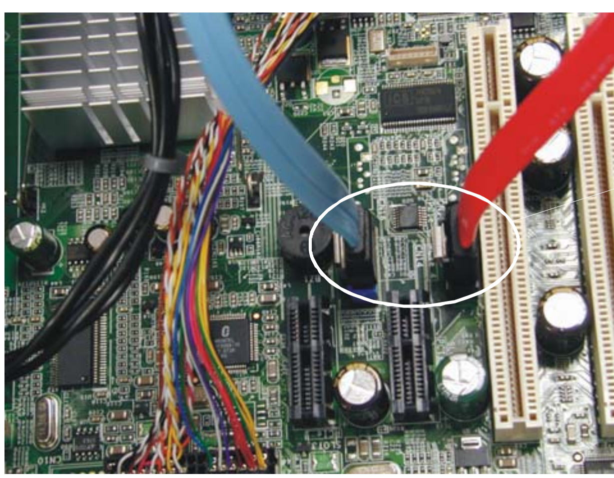
2 Disconnect all cables from the motherboard.

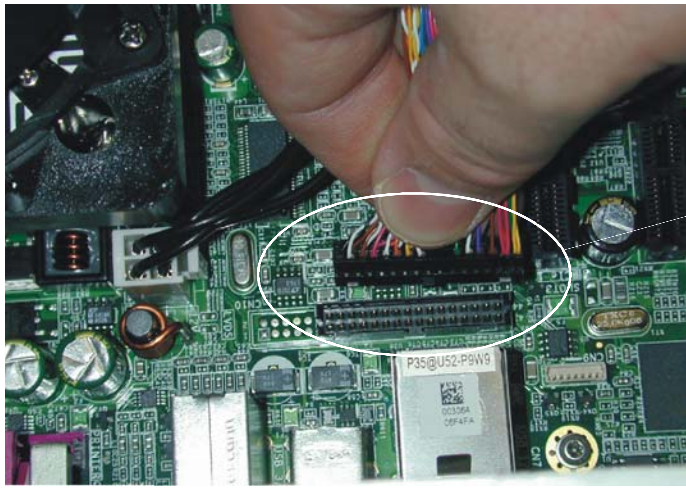
The following figure shows an overview of the cables that need to be removed from the standard 90000A Series motherboard. The subsequent figures show close-ups of each cable. The last figure in this section shows the performance-enhanced 90000A Series motherboard so you know where to reconnect the cables. The cables are the same on the performance-enhanced models, but they may connect to the motherboard in different locations.

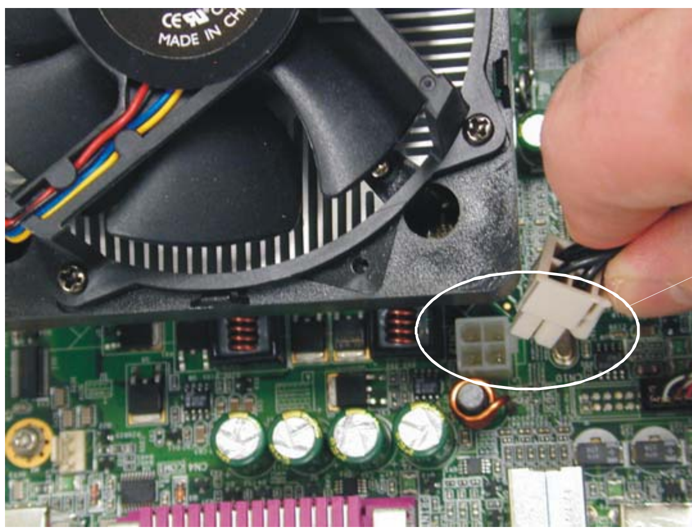


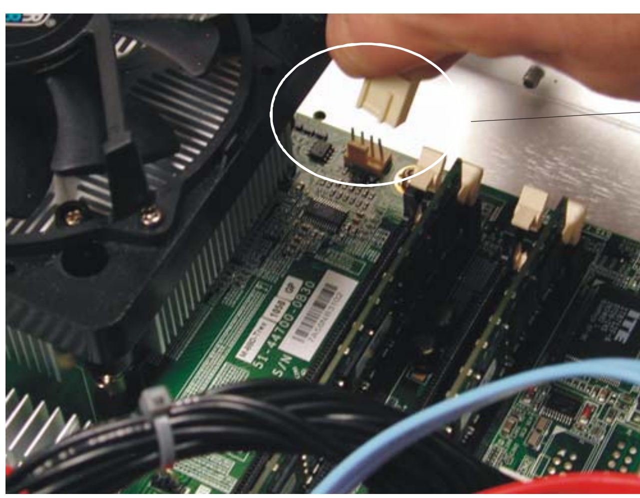

SATA cable between motherboard and hard drive

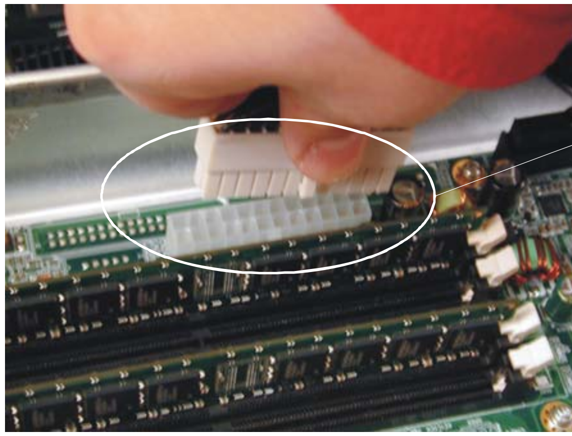

Front panel USB cable

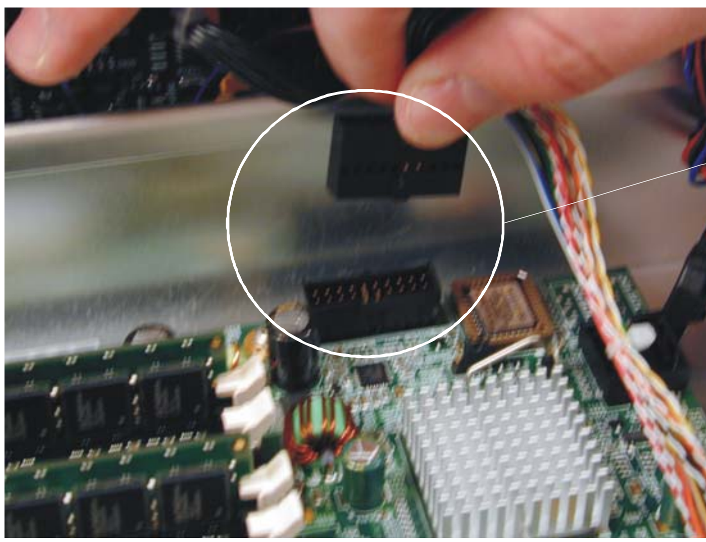

SATA cables between backplane and motherboard


Display cable
between
motherboard and
front panel


Power harness
between
backplane and
motherboard


Power cable for
CPU fan


Power harness between backplane and motherboard


On/Off cable

Motherboard and cables in performance-enhanced 90000A Series models

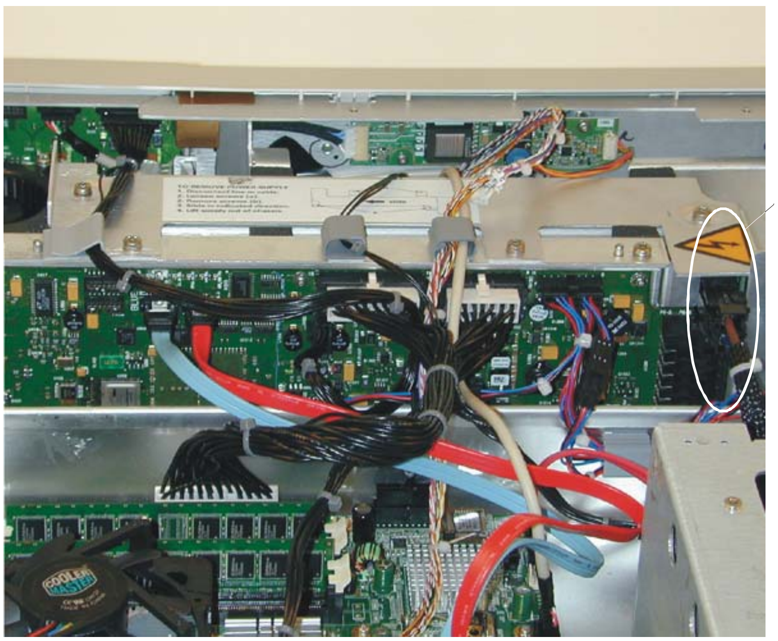
Removing and replacing the power supply

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

WARNING **SHOCK HAZARD! When the power supply is removed, two AC leads are exposed. Be careful not to come into contact with these leads.**

1. Disconnect the power cable and remove the top cover.
2. Disconnect the AC power cable from the bulk +12 V power supply.

   The picture below shows where the AC power cable connects to the bulk 12V power supply.

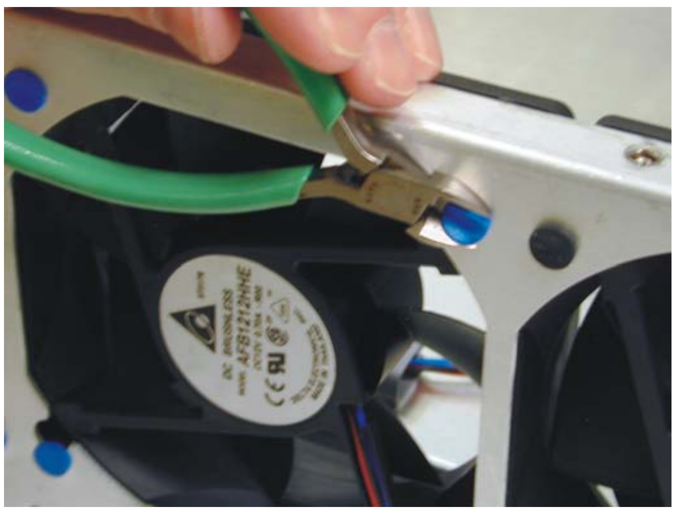


3. Follow the instructions on the label attached to the top of the power supply to remove it.

Removing and replacing the fans

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 when working with the oscilloscope.**

1 Disconnect the power cable and remove the cover and top plate.
2 Disconnect the fan harness cables.
3 Clip off the end of each locking button and remove the fan. Repeat for each fan that needs to be replaced.



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

4 To install a fan, reverse this procedure.

Removing and replacing the power cord

1 Disconnect the power cable and remove the cover and top plate.
2 Unplug the power cable from the +12 V power supply.
3 Unscrew the power cord connector from the rear panel (Torx T10 screws).

4 Remove the ground screw (Torx T10) on right side of hard drive.

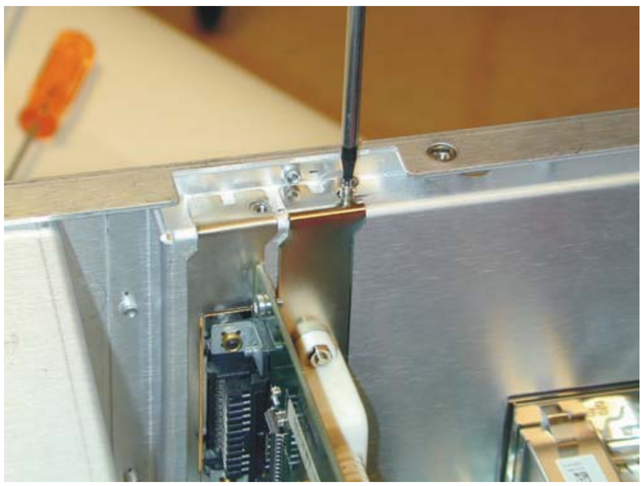
5 Pull the power cord out of the instrument.
6 To replace the power cord, reverse this procedure.

Removing and replacing the USB or GPIB port

Use this procedure to remove and replace the USB or GPIB port. The GPIB is an option and may not be on your oscilloscope. The procedure is exactly the same for both of these ports so only one is shown here.

1 Disconnect the power cable and remove the cover and top plate.

2 Remove the screw from top edge of the chassis.



3 Undo the connection to the motherboard by disconnecting the cable.

4 Pull the port out of the instrument.

5 To replace one of these ports, reverse this procedure.

6 Replaceable Parts

This chapter describes how to order replaceable assemblies and parts for the Infiniium 90000A Series oscilloscopes. Service support for this oscilloscope is replacement of parts to the assembly level.

Ordering Replaceable Parts

Listed Parts

To order a part in the parts list, quote the Keysight Technologies part number, indicate the quantity desired, and address the order to the nearest Keysight Technologies Sales Office.

Unlisted Parts

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

Direct Mail Order System

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

- Direct ordering and shipping from the Keysight 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 Keysight Technologies Sales Office when the orders require billing and invoicing.)
- Prepaid transportation. (There is a small handling charge for each order.)
- No invoices.

For Keysight Technologies to provide these advantages, please send a check or money order with each order.

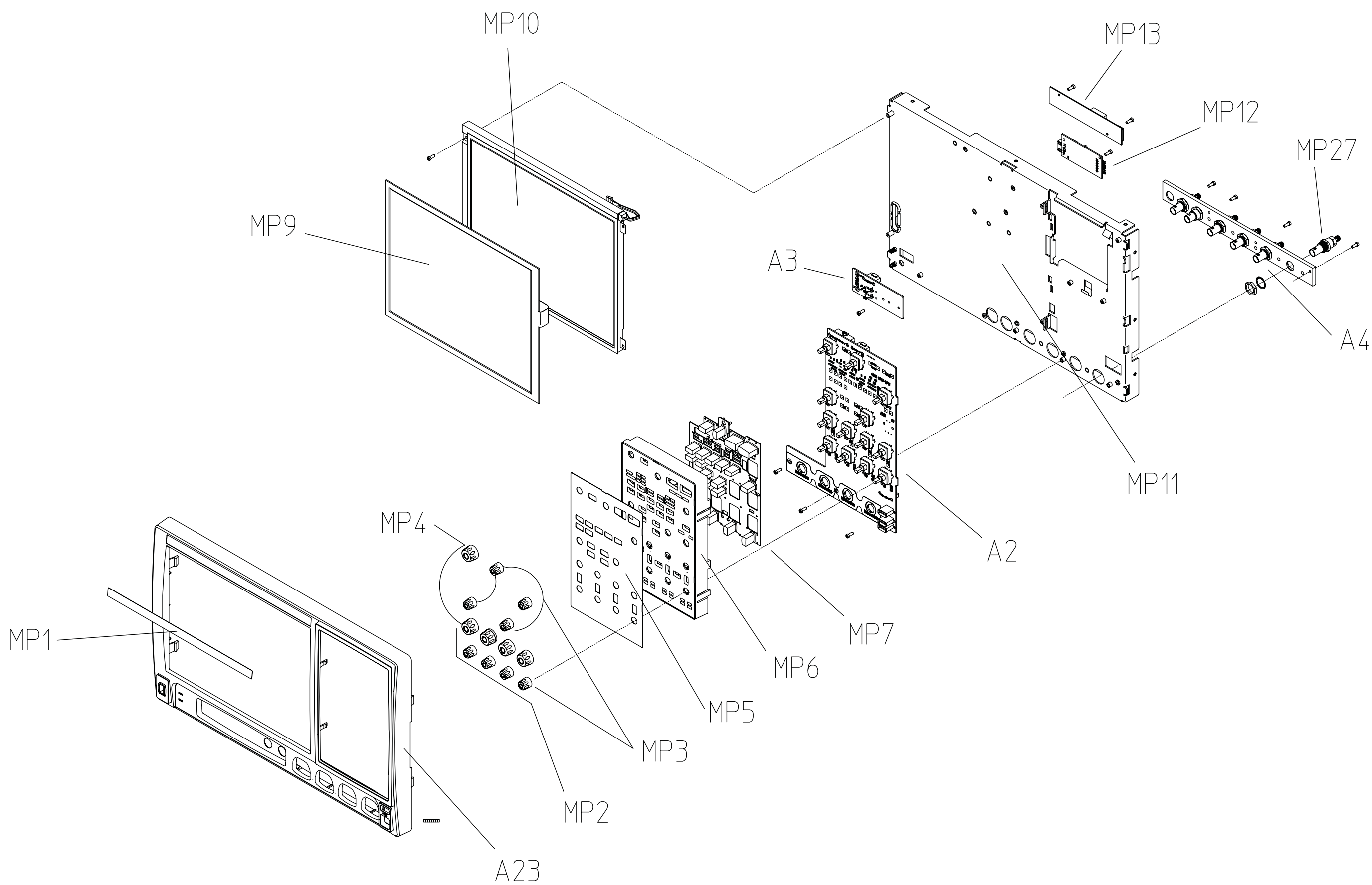
Mail order forms and specific ordering information are available through your local Keysight Technologies Sales Office. Addresses and telephone numbers are located in a separate document shipped with the manuals.

Exchange Assemblies

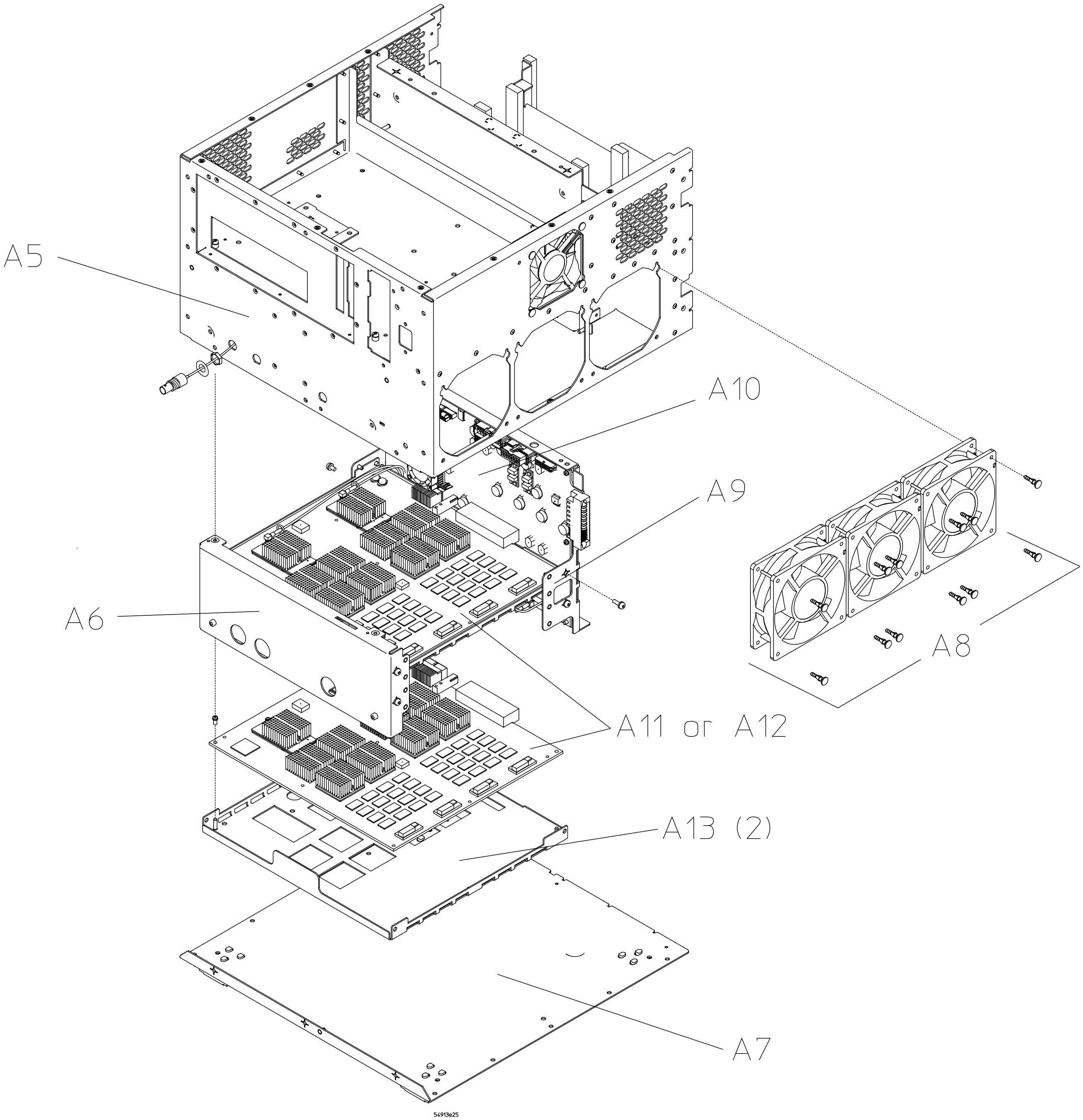
Exchange assemblies have been set up for Keysight Service Center use only.

Exploded Views

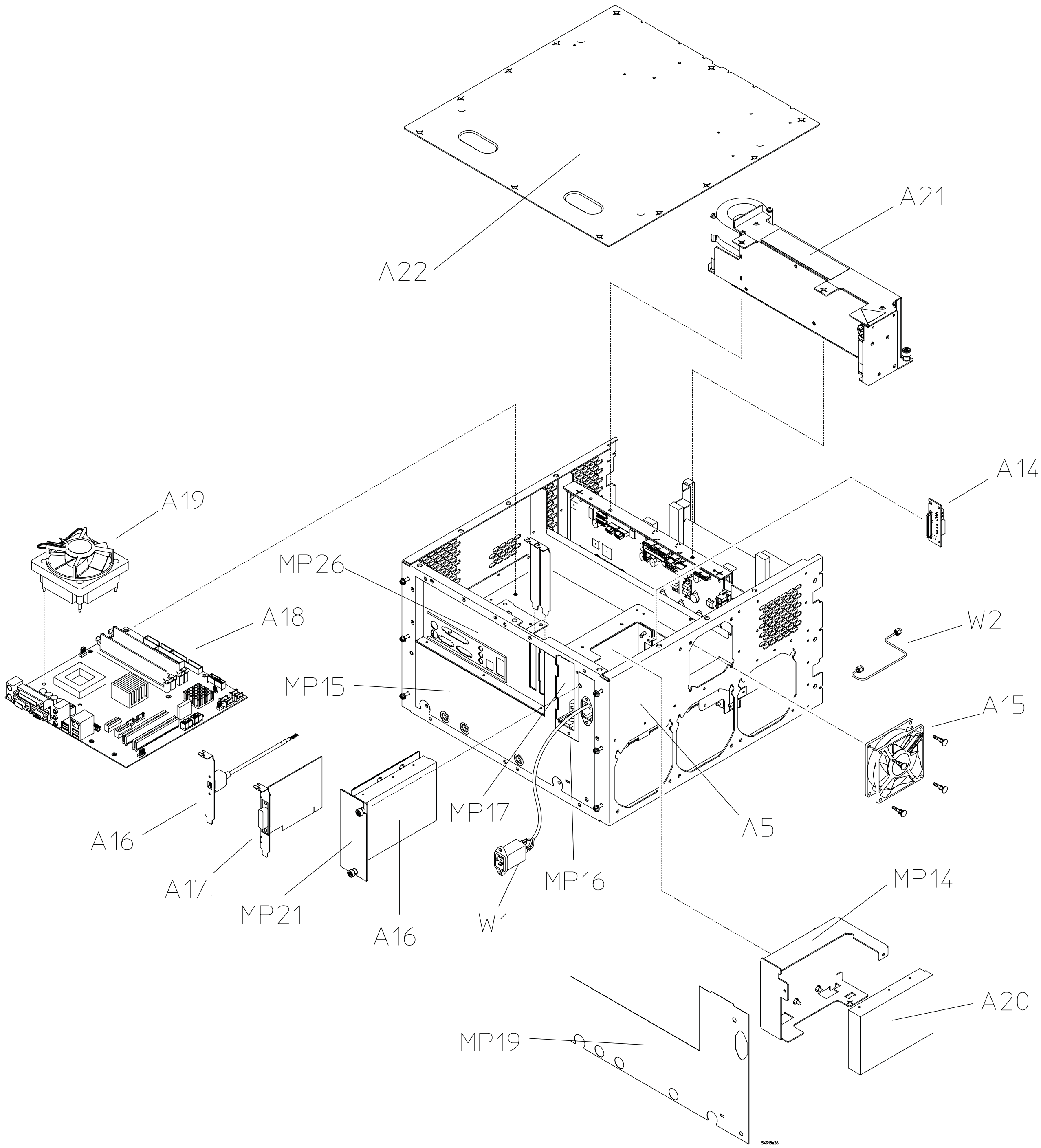
Front Frame and Front Panel



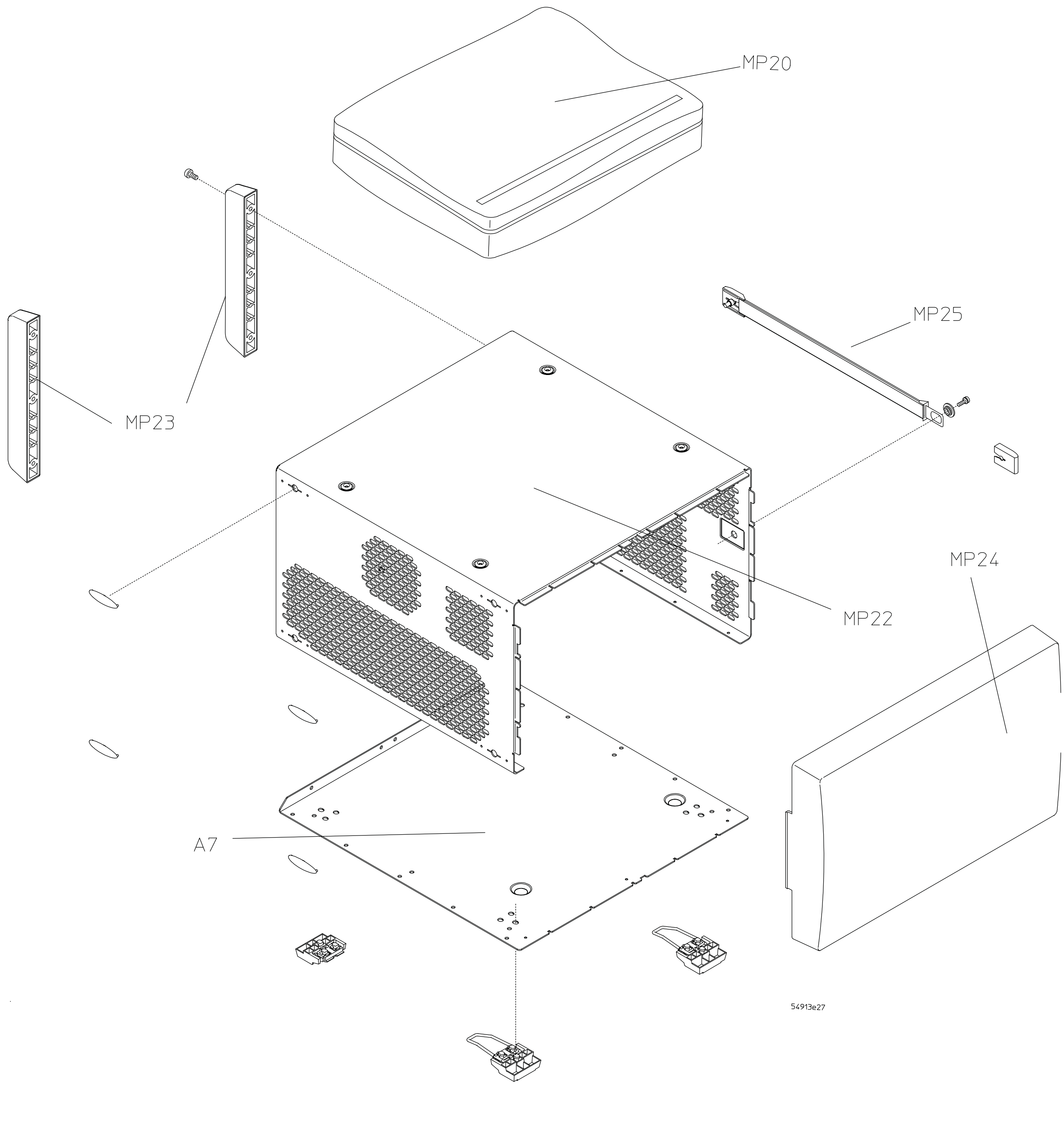
Fan and Acquisition Assembly



Power Supply and PC Motherboard



Sleeve and Accessory Pouch



Replaceable Parts List

The following table is a list of replaceable parts. Information given for each part includes:

- reference designation in exploded views
- Keysight Technologies part number
- total quantity (QTY) in the oscilloscope or an assembly
- description of the part

Ref des	Part number	QTY	Description
A2	54913-66505	1	Tested Front Panel Printed Circuit Assembly
A3	54913-66406	1	On/Off Printed Circuit Assembly
A4	54913-68707	1	Front Panel BNC Assembly
A5	54913-00102	1	Chassis
A6	54913-00201	1	Rear Panel
A7	54913-00203	1	Bottom Panel
A8	54913-68710	1	Fan Replacement Kit 120 MM
A9	54913-00501	1	Backplane Frame
A10	54913-66502	1	Backplane Printed Circuit Assembly - replaced by 54913-66512
A10	54913-69502	1	Backplane Printed Circuit Assembly - Exchange, replaced by 54913-69512
A10	54913-66512	1	Backplane Printed Circuit Assembly - replaces 54913-66502
A10	54913-69512	1	Backplane Printed Circuit Assembly - replaces 54913-69502
A11	54913-66501	2	Acquisition Printed Circuit Assembly 8 GHz and above - replaced by 54913-66511
A11	54913-69501	2	Acquisition Printed Circuit Assembly 8 GHz and above - Exchange, replaced by 54913-69511
A11	54913-66511	2	Acquisition Printed Circuit Assembly 8 GHz and above - replaces 54913-66501
A11	54913-69511	2	Acquisition Printed Circuit Assembly 8 GHz and above - Exchange, replaces 54913-69501
A12	54906-66501	2	Acquisition Printed Circuit Assembly 6 GHz and below - replaced by 54906-66511
A12	54906-69501	2	Acquisition Printed Circuit Assembly 6 GHz and below - Exchange, replaced by 54906-69511
A12	54906-66511	2	Acquisition Printed Circuit Assembly 6 GHz and below - replaces 54906-66501
A12	54906-69511	2	Acquisition Printed Circuit Assembly 6 GHz and below - Exchange, replaces 54906-69501
A13	54913-00502	2	Acquisition Frame
A14	54913-66410	1	RHDD Board Printed Circuit Assembly
A15	54913-68711	1	Fan Replacement Kit 90 MM
A17	82350-66512	1	GPIB Interface Card

Ref des	Part number	QTY	Description
A18*	0960-2653*	1	Motherboard Printed Circuit Assembly for M880 (standard models)
A18**	0960-2869**	1	Motherboard Printed Circuit Assembly for M890 (performance-enhanced models)
A19	3160-4243	1	Motherboard Fan w/heat sink
	54916-04112**	1	CPU Adapter Plate (Required if upgrading to new performance-enhanced motherboard from a standard model. This part is located underneath the heat sink on the motherboard. It is a part of the chassis on standard models.)
A20	54913-68701	1	Replacement HDD for M880/XP-based 90000 Series scopes
A20	54913-83503	1	Infiniium 90000A Series imaged hard-drive, version M880-9XB (Service Centers only)
A20	54913-83505	1	Infiniium series Imaged HDD for M890/WinXP (Service Centers only)
A20	54913-68717	1	Replacement Infiniium series Imaged HDD for M890/WinXP
A20	54913-83506	1	Infiniium series Imaged HD for M890/Win7, 500 GB 7200RPM Serial-ATA (Service Centers only)
A20	54913-68718	1	Replacement HDD for M890/Win7-based DSO90000 series scopes
A20	54932-83501	1	Removable hard drive only: Imaged Solid State HDD for M890/Win7-based 90000 Series scopes (Service Centers only)
A20	54932-68717	1	Replacement Removable hard drive only: Imaged Solid State HDD for M890/Win7-based 90000 Series scopes
A21	0950-5196	1	Power Supply
A21	54916-00504	1	Power Supply Frame
A21	54916-66403	1	Power Supply Bridge PCA
A22	54913-00202	1	Top Panel
A23	54913-68702	1	Front Panel Bezel
MP1*	54913-94310*	1	Label - DSO 91304A (standard models)
MP1*	54913-94311*	1	Label - DSO 91204A (standard models)
MP1*	54913-94313*	1	Label - DSO 90804A (standard models)
MP1*	54913-94314*	1	Label - DSO 90604A (standard models)
MP1*	54913-94315*	1	Label - DSO 90404A (standard models)
MP1*	54913-94316*	1	Label - DSO 90254A (standard models)
MP1*	54913-94326*	1	Label - DSA 90254A (standard models)
MP1*	54913-94325*	1	Label - DSA 90404A (standard models)
MP1*	54913-94324*	1	Label - DSA 90604A (standard models)
MP1*	54913-94323*	1	Label - DSA 90804A (standard models)
MP1*	54913-94321*	1	Label - DSA 91204A (standard models)
MP1*	54913-94320*	1	Label - DSA 91304A (standard models)

Ref des	Part number	QTY	Description
MP1**	54913-94330**	1	Label - DSO 91304A (performance-enhanced models)
MP1**	54913-94331**	1	Label - DSO 91204A (performance-enhanced models)
MP1**	54913-94333**	1	Label - DSO 90804A (performance-enhanced models)
MP1**	54913-94334**	1	Label - DSO 90604A (performance-enhanced models)
MP1**	54913-94335**	1	Label - DSO 90404A (performance-enhanced models)
MP1**	54913-94336**	1	Label - DSO 90254A (performance-enhanced models)
MP1**	54913-94346**	1	Label - DSA 90254A (performance-enhanced models)
MP1**	54913-94345**	1	Label - DSA 90404A (performance-enhanced models)
MP1**	54913-94344**	1	Label - DSA 90604A (performance-enhanced models)
MP1**	54913-94343**	1	Label - DSA 90804A (performance-enhanced models)
MP1**	54913-94341**	1	Label - DSA 91204A (performance-enhanced models)
MP1**	54913-94340**	1	Label - DSA 91304A (performance-enhanced models)
MP2	54913-94300	1	Set of Colored Knob Labels
MP3	54913-47401	8	12 MM Knob (also order 54913-94300 if colored label is required for knob)
MP4	54913-47402	5	18 MM Knob (also order 54913-94300 if colored label is required for knob)
MP5	54913-94301	1	Control Panel Label
MP6	54913-40201	1	Control Panel
MP7	54913-41901	1	Control Panel Switch
MP9*	2090-0960*	1	Touch Screen 12.1 in. (standard models)
MP9**	54916-89801**	1	Touch Screen (performance-enhanced models)
MP10	2090-0947	1	LCD Display 12.1 in.
MP11*	54913-00101*	1	Front Deck (standard models)
MP11**	54913-00104**	1	Front Deck (performance-enhanced models)
MP12*	0960-2742*	1	Touch Screen Controller (standard models)
MP12**	0960-2796**	1	Touch Screen Controller (performance-enhanced models)
MP13	0950-4068	1	Inverter Dual Backlight 8-Watt 1-Output
MP14	54913-01202	1	Hard Drive Bracket
MP15	54913-94318	1	Label - Rear Panel w/RHDD
MP16	16902-41201	1	RHDD Guide
MP17	54913-04501	1	RHDD Case
MP18	54913-00103	1	RHDD Deck
MP19	54913-94306	1	Label - Rear Panel without RHDD
MP20	54913-62301	1	Accessory Pouch
MP21	54913-94307	1	RHDD Label
MP22*	54913-04101*	1	Cover (standard models; 1 handle)
MP22**	54916-04101**	1	Cover (performance-enhanced models; 2 handles)
MP23	54913-41001	2	Rear Foot
MP24	54913-44101	1	Front Cover

Ref des	Part number	QTY	Description
MP25*	E4400-60026*	1	Handle Assembly (standard models)
MP25**	54916-64901**	1	Handle - Strap Assembly (performance-enhanced models -- order twice if you want to replace both handles)
MP26*	54913-94309*	1	Label - PC i/o (standard models)
MP26**	54916-94309**	1	Label - PC i/e (performance-enhanced models)
MP27	54855-67601	5	Female Connector Assembly coaxial adapter
	54916-22401**	2	Screws for Side Handles (performance-enhanced models)
	54913-94308*	1	Label - PC Rear Panel (standard models)
	54916-94308**	1	Label - PC Rear Panel (performance-enhanced models)
W1	54913-61610	1	Cable - AC Input
W2	54913-61602	1	Cable - semi-rigid auxiliary output
W3	54913-61613	1	Cable - USB Host
W4	54913-61603	1	Cable - PC Power (not shown)
W5	54913-61611	1	Cable - Fan (not shown)
W6	54913-61604	1	Cable - ON/OFF (not shown)
W7	54913-61608	1	Cable - Display (not shown)
W8	54913-61601	4	Cable - Input (not shown)
	54913-61607*	1	Cable - USB Touch (standard models)
	54913-61617**	1	Cable - USB Touch (performance-enhanced models)
	8120-5392	1	Power cord - United Kingdom
	8120-5393	1	Power cord - Australia and New Zealand
	8120-5336	1	Power cord - Continental Europe
	8120-5395	1	Power cord - United States and Canada
	8120-5397	1	Power cord - Switzerland
	8120-5398	1	Power cord - Denmark
	8120-5399	1	Power cord - India
	8120-5400	1	Power cord - Japan
	8121-0955	1	Power cord - Israel
	8120-8390	1	Power cord - Argentina
	8120-8389	1	Power cord - Chile
	8121-1632	1	Power cord - China
	8120-5399	1	Power cord - South Africa
	8121-1660	1	Power cord - Thailand
	8121-1858	1	Power cord - Brazil
	8121-1636	1	Power cord - Taiwan
	8121-1640	1	Power cord - Cambodia

Ref des	Part number	QTY	Description

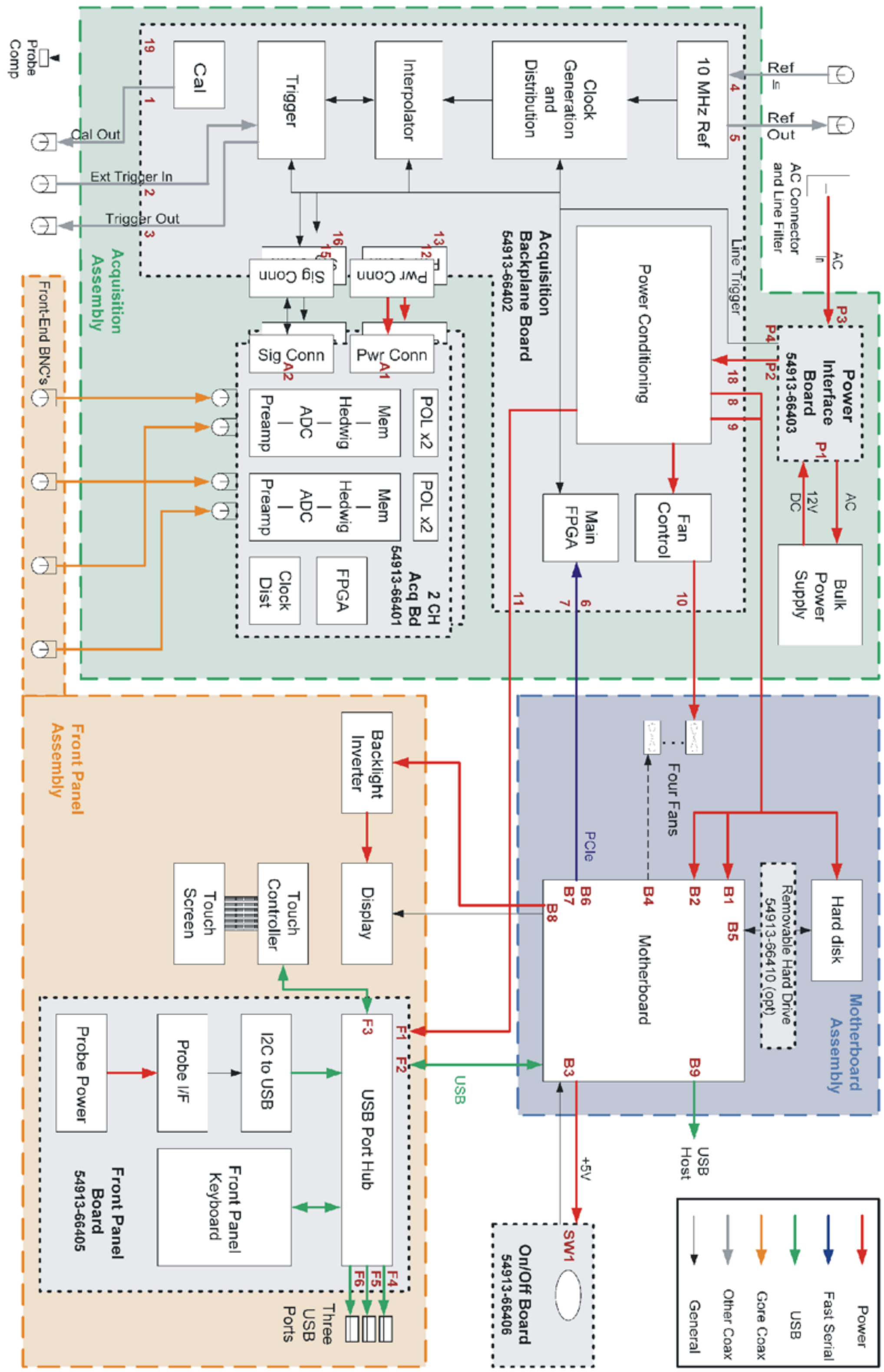
* Parts marked with a single asterisk are to be used only with the standard models (not performance-enhanced models). For information on how to tell which model you have, refer to page 9.

** Parts marked with a double asterisk are to be used only with the performance-enhanced models (not standard models). For information on how to tell which model you have, refer to page 9.

7 Theory of Operation

This chapter describes the basic structure of the Infiniium 90000A Series oscilloscope and how the parts interact.

Oscilloscope block diagram



Block-Level Theory

The main components of the Infiniium 90000A Series oscilloscopes are described here.

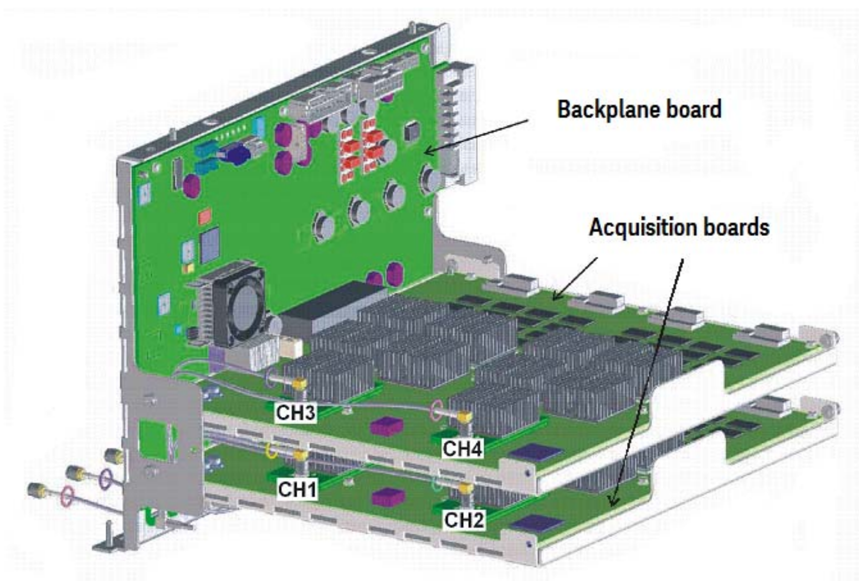
Motherboard

The motherboard provides all system control and interface functions for the oscilloscope. It contains a CPU, ROM, and RAM; keyboard and mouse interfaces, serial and parallel interfaces, CDROM, hard disk drive interface, PCI buses, etc.

Acquisition Assembly

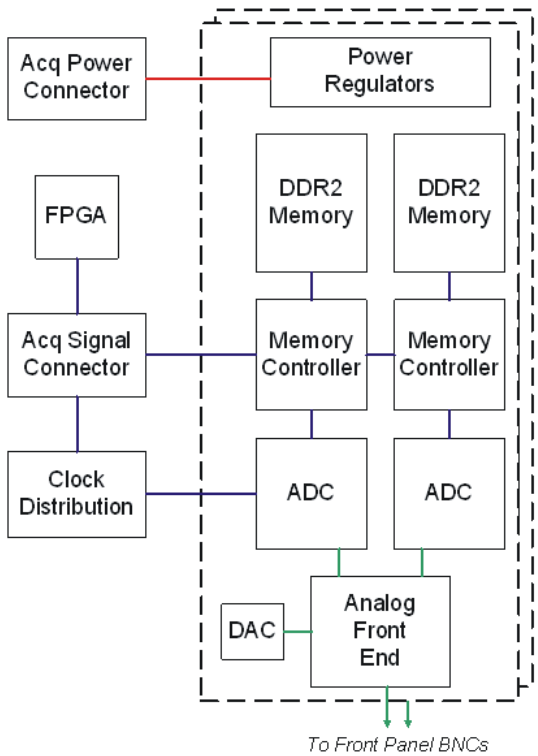
The acquisition assembly consists of two identical acquisition boards. These two boards connect to the backplane board.

Backplane and acquisition boards



The upper acquisition assembly circuitry samples, digitizes, and stores the signals for channels 3 and 4 while the lower acquisition assembly does the same for channels 1 and 2. The acquisition boards contain the TUT modules, Onboard ADC, clock distribution, data management ASICs, external acquisition memory, ADCs, communication and programming FPGA, and supporting power supply circuitry.

Acquisition board block diagram

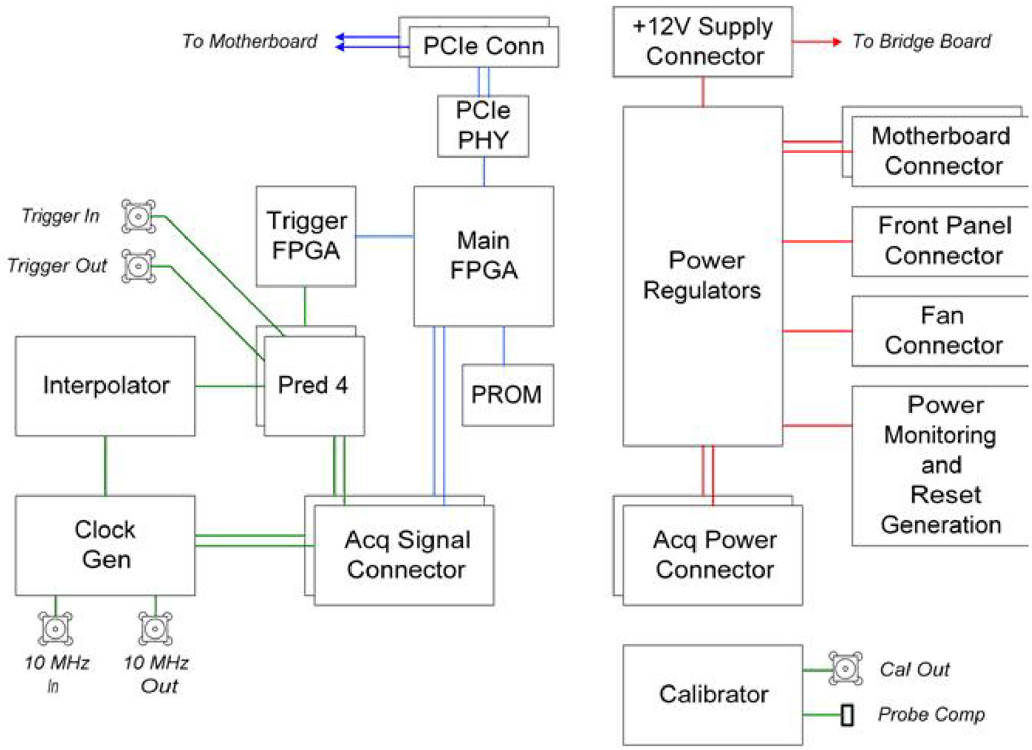


Backplane Assembly

The backplane board is essentially a device on the PCI-Express bus connected by two SATA cables to the motherboard. The backplane board receives +12V power through a distribution board from the supply and all voltage are derived from switches and other circuitry. Most of these are on the backplane board, with some further distribution and generation done on the acquisition boards.

The backplane board uses three identical buses to communicate with three different downstream FPGAs. One is used to control the trigger functions on the backplane board and one is on each of the two acquisition boards. The acquisition board FPGAs are used to program the parts on the acquisition boards. On power-up, after the software recognizes the acquisition boards, the driver loads the trigger FPGA and the acquisition FPGAs using an 8-bit parallel bus with miscellaneous control signals. There is a separate bus for each FPGA so timing problems and reflections could be minimized. After programming is complete, the downstream FPGAs each communicate with the BFPGA using their 8-bit data bus along with a 62.5 MHz communication clock, a 2-bit command bus, a ready signal to the BFPGA, a Data_valid signal from the BFPGA, and an Interrupt line,

Backplane assembly block diagram



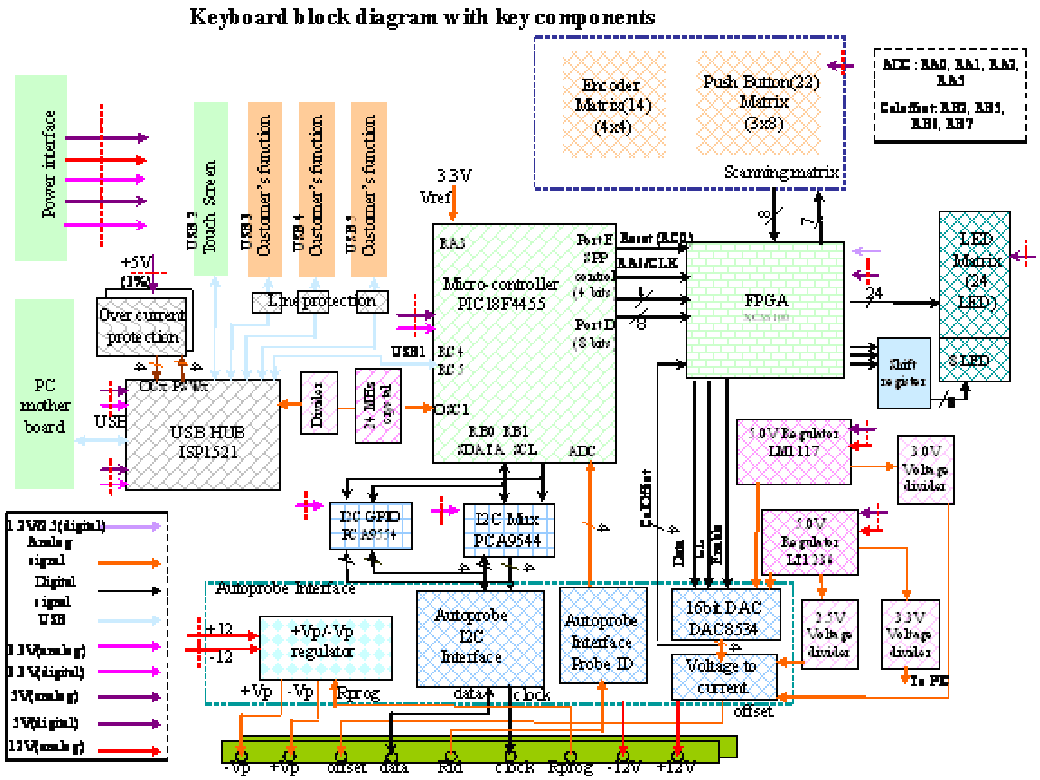
Front panel

The front panel board combines functions from the main keyboard and the Autoprobe interface board in a single PCA.

The keyboard links to the scope PC motherboard through a high-speed USB 2.0 interface. The on-board USB hub serves the PIC microcontroller, the touch screen controller board, and up to three front panel USB connectors for customer peripherals.

A conductive element on the inside of each key shorts a gap on the underlying keyboard circuit board. The keyboard controller detects this short and sends the proper keypress information to the system controller on the motherboard.

Keyboard block diagram



The front panel provides:

- Dedicated knobs and pushbuttons for major oscilloscope functions
- A 12.1 inch (diagonal) color flat panel display for waveform, measurement, and graphical interface display
- Three front panel USB 2.0 ports
- Precision BNC connectors for channel input signals
- BNC connector for auxiliary output signal
- AutoProbe interface for probe power and probe control
- A connection for probe compensation

Rear panel

The rear panel provides several connections:

- The line power input

- A GPIB connector, for connection to an oscilloscope controller (optional)
- An RS-232 connection
- A parallel printer connection
- XGA monitor connection
- Mouse and keyboard connections
- LAN 10/1000 connection
- Auxiliary Trigger Input BNC
- 10 MHz Reference Output BNC
- 10 MHz Reference Input BNC
- TTL trigger output BNC
- Four rear panel USB 2.0 ports

Display Board

The display board controls the flat-panel display monitor. It translates the video signals from the motherboard's on-board video system to the Low Voltage Differential Signal (LVDS) signals that drive the monitor.

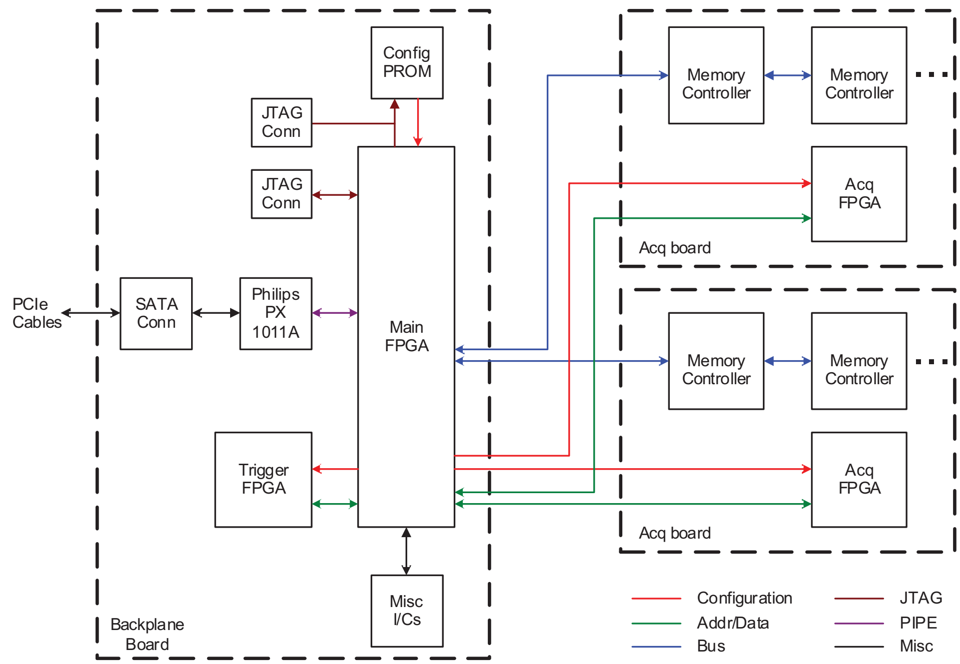
On/Off Board

The On/Off board interfaces with the motherboard to provide the on-off switch function and the backplane to provide the probe compensation output. Power indicator LEDs backlight the on-off pushbutton and are driven by the motherboard. The probe compensation lugs connect to the calibrator output on the backplane through an SMB connector coax cable. An ESD protection diode sits on the On-Off board, connecting the signal and ground probe compensation lugs.

Main FPGA

The main FPGA is the only communication link from the oscilloscope hardware to the PC system. All system controls and data must pass through the main FPGA. It contains a number of registers that can be used to control peripherals, configure, and communicate with other FPGAs, and pass sampled data to the PC. shows the main connections to the FPGA. In addition, the FPGA generates PCI interrupts for special events such as front-end overload, the timer done, and a stopped cooling fan.

Main FPGA connections block diagram



Power Supply Assembly

The AC input to the power supply is 100–240 VAC ±10%. Maximum input power is 800 W. The AC input frequency is 47 to 63 Hz.

Filtered voltages of +3.3 V, +2.5 V, +1.8 V, +1.2 V, -6 V, -5.2 V, -5 V, and –2.3 V are supplied and distributed throughout the oscilloscope.

Monitor Assembly

The Flat Panel Display (FPD) monitor is a thin film liquid-crystal display (TFT-LCD). This FPD is a 12.1–inch diagonal, 1024 x 768 pixel XGA color monitor.

Disk Drive

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

The drive can also be used to store and recall oscilloscope setups and waveforms.

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