
Service Guide

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Infiniium 90000 Q-Series Oscilloscopes



The Agilent Technologies Infiniium 90000 Oscilloscope at a Glance

Ease of use with high performance

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

- Traditional oscilloscope front-panel interface provides direct access to the controls needed for most troubleshooting tasks.
- Graphical user interface with menus, windows, dialogs boxes, and toolbars provides easy access to dozens of configuration and analysis tools, ensuring you can set up and make the most complex measurements.
- All models offer 80 GSa/s sampling rate on all four channels.
- Models with bandwidths from 20 GHz to 63 GHz.

Display shows waveforms and graphical user interface

- Graphical interface allows direct interaction with waveforms, including drag-and-drop positioning and instant waveform zoom.
- Touchscreen display allows oscilloscope operation without an external pointing device.
- Waveforms displayed in color, making correlation easy.
- Current configuration parameters displayed near the waveform display and are color-coded to make identification easy.
- Graphical interface menus and toolbars simplify complex measurement setups.

Horizontal controls set sweep speed and position

- Intensified waveforms on main sweep window make it easy to see what will appear in the zoom window.

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

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

Hard disk drive and USB 2.0 port for saving and restoring setups and measurement results

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

Trigger setup controls set mode and basic parameters

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

Vertical controls set attenuation and position

- Color-coded knobs make it easy to find the controls that affect each waveform.

Marker and quick measurements help measure waveform parameters

- Waveform markers A and B to check voltage or Δ -time at any point on the displayed waveform.

Service Policy

The service policy of this instrument requires replacing defective assemblies. Some assemblies can be replaced on an exchange basis.

In This Service Guide

This guide provides the service information for the Agilent Technologies 90000 Q-Series oscilloscopes. It is divided into seven chapters.

Chapter 1, "General Information," describes which oscilloscope models are covered by this guide, supplied accessories, and where to find the specifications for the 90000 Q-Series oscilloscopes.

Chapter 2, "Calibration," describes the types of calibrations, and how and when to run the user calibration procedure.

Chapter 3, "Testing Performance," provides instructions for testing the oscilloscope to verify that it performs according to specifications.

Chapter 4, "Troubleshooting," provides flowcharts and procedures for diagnosing problems for assembly-level repair.

Chapter 5, "Replacing Assemblies," provides instructions for removing and replacing assemblies in the oscilloscope.

Chapter 6, "Replaceable Parts," provides exploded parts diagrams and a list for ordering replaceable parts.

Chapter 7, "Theory of Operation," describes the basic structure of the oscilloscope and how its parts interact.

At the back of the book you will find safety notices.

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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 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 Agilent Technologies website at www.agilent.com to see whether a newer version of this manual is available.

The following 90000 Q-Series oscilloscopes are covered in this guide.

Oscilloscopes Covered by this Service Guide

Model	Bandwidth
DSOX/DSAX92004Q	20 GHz bandwidth
DSOX/DSAX92504Q	25 GHz bandwidth
DSOX/DSAX93304Q	33 GHz bandwidth
DSOX/DSAX95004Q	50 GHz bandwidth on 2 channels; 33 GHz bandwidth on 4 channels
DSOX/DSAX96204Q	62 GHz bandwidth on 2 channels; 33 GHz bandwidth on 4 channels

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

Accessories supplied

The following accessories are supplied.

- Mouse
- Stylus
- Keyboard
- Front panel cover
- Calibration cable (the 50 GHz and 62 GHz bandwidth models include a second calibration cable for the RealEdge inputs)
- Connector Savers (qty. 5 for 20 GHz, 25 GHz, and 33 GHz; additional 2 for 50 GHz and 62 GHz)
- Power cord (see parts list in chapter 6 for country-dependent part number)

Specifications and Characteristics

The following table contains a partial list of specifications and characteristics for the Agilent Infiniium 90000 Q-Series oscilloscopes. For a full list of specifications and characteristics, see the data sheets at www.agilent.com/find/90000q-series.

Specifications that are pertinent to each test are in the "Testing Performance" chapter. Specifications are valid after a 30-minute warm-up period, and within $\pm 5^{\circ}\text{C}$ from the temperature at which the last self-calibration was performed.

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 m (12,000 feet) Non-operating: up to 15,300 meters (50,000 feet)
Installation/ Measurement Category	Installation category: 2. Measurement category: 1
Power Requirements	100-240 V, 47-63 Hz; 800 W Max for 4-channel models. 100-240 V, 50 Hz; 100-208 V, 50/60 Hz; 800 W Max for 8-channel models.
Voltage Fluctuations	Note that the mains supply voltage fluctuations are not to exceed +/-10% of the nominal supply voltage.
Pollution Degree	The Infiniium 90000 X-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.

**Chapter 1: General Information
Specifications and Characteristics**

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Calibration

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

There are three ways to calibrate an Infiniium oscilloscope:

- User mode, also known as a normal calibration, user calibration, or self calibration. User mode includes the minimum set of calibrations and is intended to be run by oscilloscope users. The user must be logged in as an administrator to run a self calibration. In user mode you may choose to run time scale calibrations and interleave correction calibrations, though those selections default to not run and they require additional equipment. A self calibration for channels 1-4 takes at least 4 hours to complete, and an additional 4 hours for RealEdge channels 1R and 3R on 50 GHz and 62 GHz models.
- Service mode, also known as a service calibration. A service calibration is performed only by Agilent Service Center technicians. In service mode the 50 Ohm input resistance calibration is performed, in addition to everything calibrated in the normal mode. The time scale and interleave correction calibrations are run by default, though they can be turned off. Additional equipment is required to run a service calibration. A service calibration takes at least 4-1/2 hours for channels 1-4, and an additional 4-1/2 hours for RealEdge channels 1R and 3R on 50 GHz and 62 GHz models.
- Factory mode, also known as a factory calibration. A factory calibration includes the full set of calibrations, including time scale and interleave correction, and other calibrations. A factory calibration is normally performed once during production of the oscilloscope. All of the calibration factors are stored into flash RAM on the acquisition board so that the calibration factors determined by the factory calibration are preserved even if the hard drive is replaced or reformatted. Additional equipment is required to perform a factory calibration on RealEdge channels.

The following section describes how to run a self calibration.

Running a self calibration

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

The self calibration uses signals generated in the oscilloscope to calibrate channel sensitivity, offsets, and trigger parameters. There are three times we recommend performing a self calibration:

- At least once a year
- When you replace 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. Be sure to perform a self calibration -- even if one was recently performed -- when environmental temperature conditions cause the oscilloscope's operating temperature to change, such as when the oscilloscope is moved to a test rack or chamber.

Equipment Required

Equipment	Critical Specifications	Agilent Part Number
Connector Savers (5 supplied with oscilloscope)	3.5 mm (f) to 3.5 mm (f)	Agilent 54916-68717 (for all oscilloscope models, channels 1-4)
Connector Savers (2 supplied with 50 GHz and 62 GHz models)	1.85 mm (f) to 1.85 mm (f)	Agilent 54932-68712 (for 50 GHz and 62 GHz models, channels 1R and 3R)
Cable assembly	50 Ohm characteristic impedance BNC (m) connectors, 36 inches (91 cm) to 48 inches (122 cm) long	Agilent 8120-1840
Adapter	SMA(m) to BNC(f)	Agilent 1250-1200
Cable (supplied with oscilloscope)	No substitute	Agilent 54916-61626 (for all oscilloscope models, channels 1-4) Agilent 54932-61630 (for 50 GHz and 62 GHz models, channels 1R and 3R)

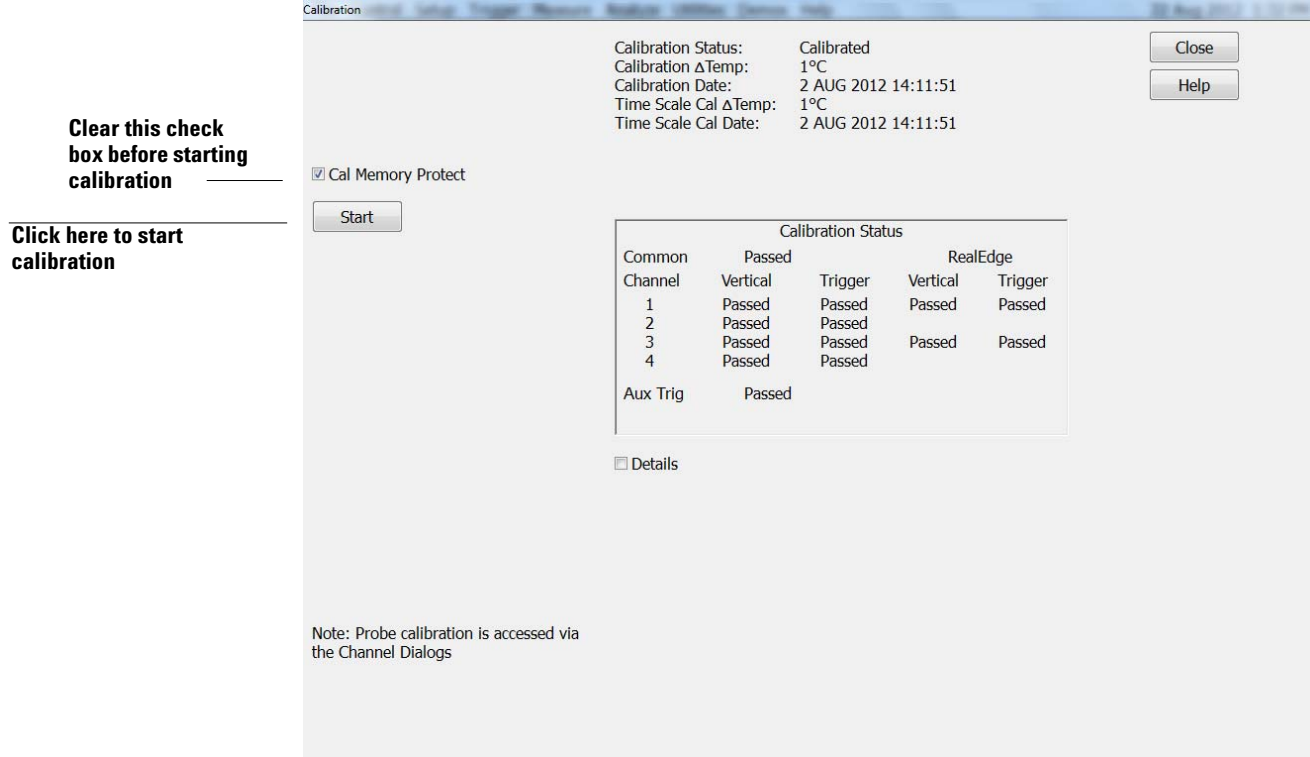
Calibration time
It will take approximately 4-1/2 hours to run the self calibration on channels 1-4 on the oscilloscope, plus 4-1/2 more hours to calibrate RealEdge channels 1R and 3R, including the time required to change cables from channel to channel.

- 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 with the cover installed. Calibration of an oscilloscope that has not warmed up may result in an inaccurate calibration.
- 2 Select **Utilities > Calibration**.
- 3 Uncheck the **Cal Memory Protect** box.
 You cannot run a self calibration if this box is checked. See Figure 2-1 for an example screen showing RealEdge channels.

Chapter 2: Calibration

Running a self calibration

Figure 2-1 Calibration Dialog Box



Clear this check box before starting calibration

Click here to start calibration

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

The routine will ask you to do the following steps:

 - a Disconnect everything from all inputs and Cal Out.
 - b Indicate whether you want to run time scale and interleave correction calibrations. For a list of equipment required to perform the time scale calibration, refer to the “Time Scale Accuracy (TSA) Test” section in the next chapter. The interleave correction calibration requires a sine wave generator and a ≥ 67 GHz cable with 1.85 mm male connectors on each end. You will also need to use the two supplied 1.85 mm (f)-(f) connector savers. To learn more about both calibration options, click **Help**.
 - c Connect the calibration cable from Cal Out to channel 1.

You must use the 54916-61626 cable (channels 1-4) or 54932-61630 cable (channels 1R and 3R) with two connector saver adapters for all oscilloscopes. Failure to use the appropriate calibration cable will result in an inaccurate calibration.
 - d Connect the calibration cable from Cal Out to each of the channel inputs as requested.
 - e When instructed, connect the calibration cable from the Cal Out on the front panel of the oscilloscope to the 1250-1200 SMA(m) to BNC(f) adapter and then connect the other end of the 1250-1200 adapter to the 8120-1840 BNC cable. Connect the other end of the BNC cable to the Trig In on the rear of the oscilloscope.
 - f A Passed/Failed indication appears for each calibration section. If any section fails, click the **Details** box for information on the failures. Also check the calibration cables.
- 5 After the calibration procedure is completed, click **Close**.

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This section 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 in this manual as this represents an incremental approach to performance verification. This may be useful if you are attempting 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 oscilloscopes and accessories required. The oscilloscopes in these lists are ones that are currently available for sale by Agilent at the time of writing this document. In some cases, the test procedures use features specific to the oscilloscopes in the recommended equipment list. However, the oscilloscopes, 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 Agilent Technologies for more information about the Agilent products in these lists.

Vertical Performance Verification

This section contains the following vertical performance verification tests:

- Offset Accuracy Test
- DC Gain Accuracy Test
- Analog Bandwidth -- Maximum Frequency Test
- Time Scale Accuracy (TSA) Test

Offset Accuracy Test

CAUTION

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

Let the oscilloscope warm up before testing.

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: $\pm(2\%$ of channel offset + 1% of full scale + 1 mV) > 3.5 V: $\pm(2\%$ of channel offset + 1% of full scale)
Full scale is defined as 8 vertical divisions. Magnification is used below 10 mV/div. Below 10 mV/div, full scale is defined as 80 mV. The major scale settings are 10 mV, 20 mV, 50 mV, 100 mV, 200 mV, 500 mV and 1 V.	

Equipment Required

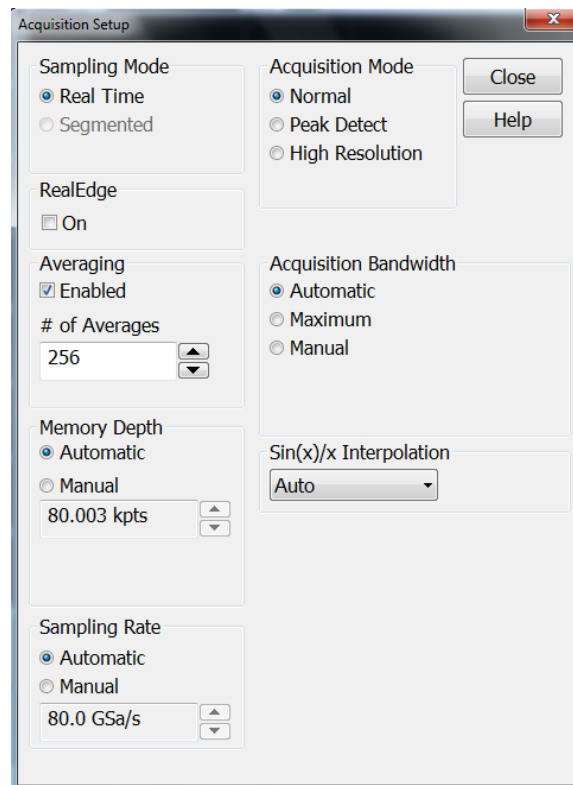
Description	Critical Specifications	Recommended Model/ Part Numbers
Digital Multimeter	DC voltage measurement accuracy better than $\pm 0.1\%$ of reading	Agilent 34411A
Cable Assembly (2 required)	50 ohm characteristic impedance, BNC (m) connectors	Agilent 8120-1840
Adapter	BNC Tee (m)(f)(f)	Agilent 1250-0781
Adapter	BNC (f) to dual banana	Agilent 1251-2277
Connector Saver	3.5 mm (f)-(f), shipped with each 90000 Q-Series oscilloscope 2.4 mm (f) to 3.5 mm (f) adapter	Agilent 5061-5311 (used with 20, 25, and 32 GHz oscilloscope models) Agilent 11901B (used with 50 GHz and 62 GHz oscilloscope models)
Adapter (2 required)	BNC (f) to SMA (m) Adapter	Agilent 1250-1200

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

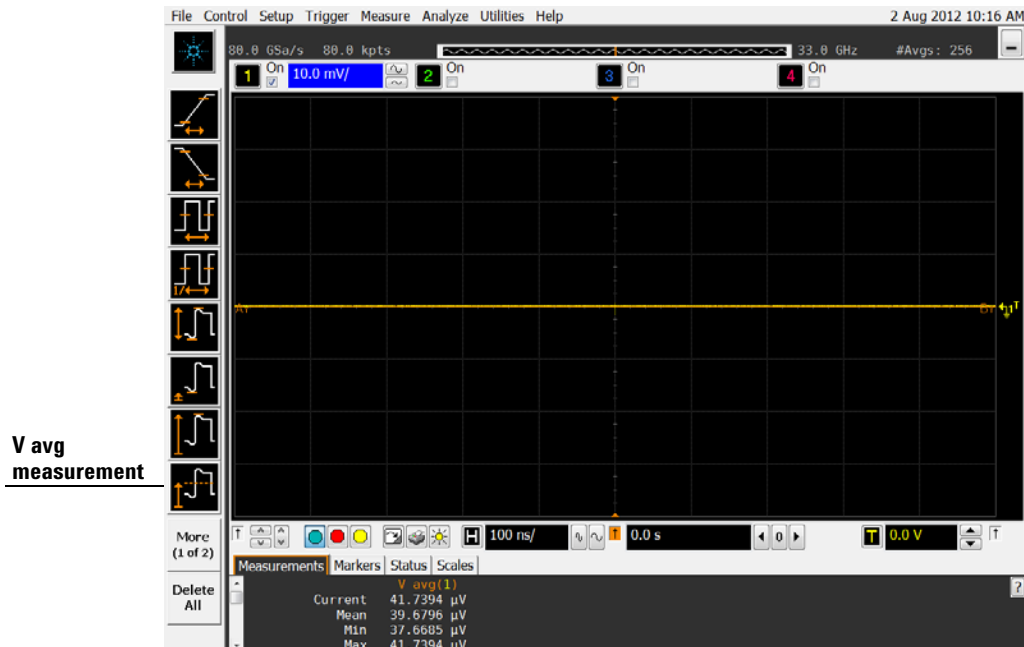
Zero Error Test Procedure

- 1 Disconnect all cables from the scope channel inputs.
- 2 Press [**Default Setup**], then configure the scope as follows:
 - a Select **Setup > Acquisition**.

- b When the Acquisition Setup window appears, enable averaging and set the # of averages to 256 as shown below.



- 3 Configure the scope to measure Average voltage on channel 1 as follows:
a Change the vertical scale of channel 1 to 10 mV/div.
b Click the V avg measurement on the left side of the screen.

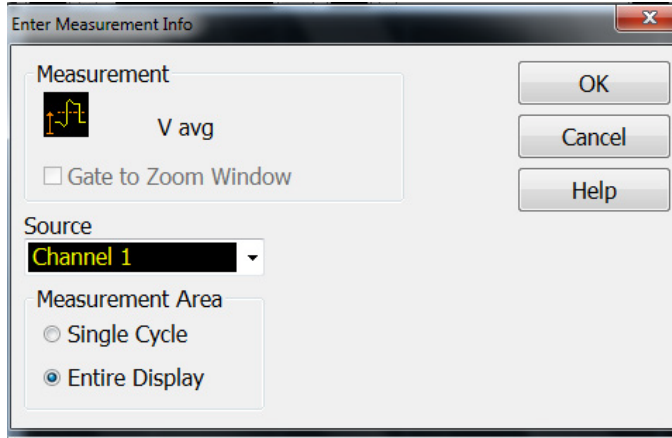


Chapter 3: Testing Performance Offset Accuracy Test

- c When the Enter Measurement Info window appears, ensure that the V avg function is set up as follows and then click **OK**:

Source = Channel 1

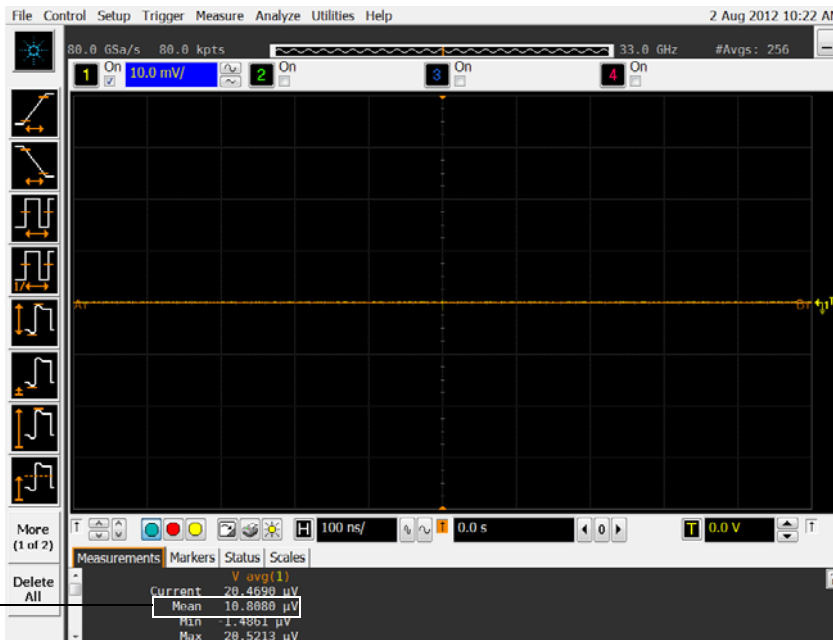
Measurement Area = Entire Display



- 4 Press [**Clear Display**] on the scope and wait for the #Aves value (top right corner of screen) to return to 256. Record the scope's mean V avg reading in the Zero Error Test section of the Performance Test Record.

Notes

- For all scope readings in this procedure, use the mean value in the Measurements display area at the bottom of the screen.
- If a question mark appears in front of any of the values at the bottom of the screen, press [**Clear Display**] on the scope, wait for the #Aves value to return to 256, and then record the scope reading.



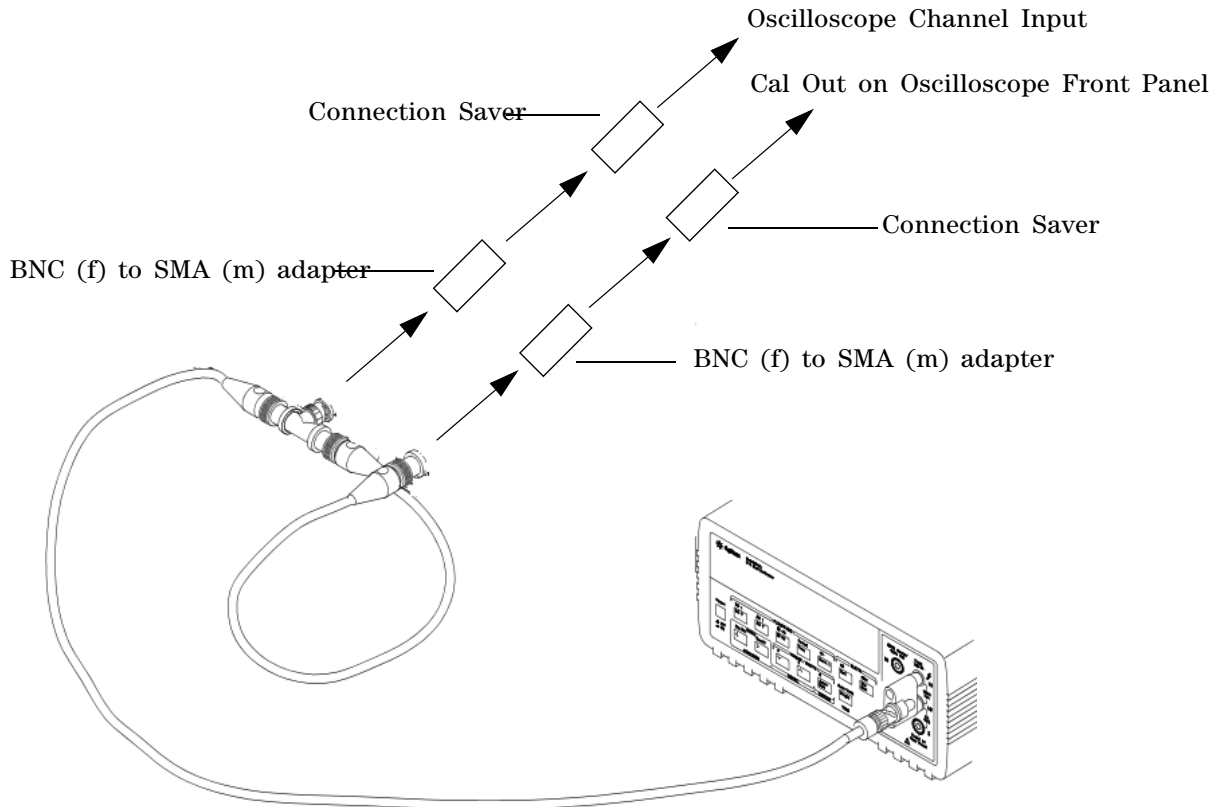
- 5 Change the vertical scale of channel 1 to 20 mV/div, press [**Clear Display**], wait for the #Aves value (top right corner of screen) to return to 256, and then record the scope V avg reading in the Zero Error Test section of the Performance Test Record.

- 6 Repeat step 5 for the remaining vertical sensitivities for channel 1 in the Zero Error Test section of the Performance Test Record.
- 7 Press [**Default Setup**], then turn off channel 1 and turn the channel 2 display on.
- 8 Configure the scope to measure V avg on Channel 2 as follows:
 - a Select **Setup > Acquisition**. When the Acquisition Setup window appears, enable averaging and set the # of averages to 256.
 - b Change the vertical sensitivity of channel 2 to 10 mV/div.
 - c Click the V avg measurement icon on the left side of the screen.
 - d When the Enter Measurement Info window appears, ensure that the Vavg function is set up as follows and then click **OK**:
Source = Channel 2
Measurement area = Entire Display
- 9 Press [**Clear Display**] on the scope, wait for the #Avgs value to return to 256, and then record the scope's mean V avg reading in the Zero Error Test section of the Performance Test Record.
- 10 Repeat step 9 for the remaining vertical sensitivities for channel 2 in the Zero Error section of the Performance Test Record.
- 11 Repeat steps 7 through 10 for channels 3 and 4, and for channels 1R (RealEdge) and 3R for 50 GHz and 62 GHz models. Press the RealEdge button to enable channels 1R and 3R.

Offset Gain Test Procedure

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

Connections



Notes:

- Where the BNC Tee adapter is used, it is important to connect it directly to the scope channel input using the BNC (f) to SMA (m) adapter and the connection savers to minimize ground potential differences and to ensure that the DMM measures the input voltage to the scope 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 scope and DMM are connected to the same AC supply circuit.
- 256 averages are used in the scope 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 scope to measure V avg on Channel 1 as follows:

a Press [**Default Setup**].

b Select **Setup > Acquisition**. When the Acquisition Setup window appears, enable averaging and set the # of averages to 256.

c Click the V avg measurement icon on the left side of the screen.

d When the Enter Measurement Info window appears, ensure that the V avg function

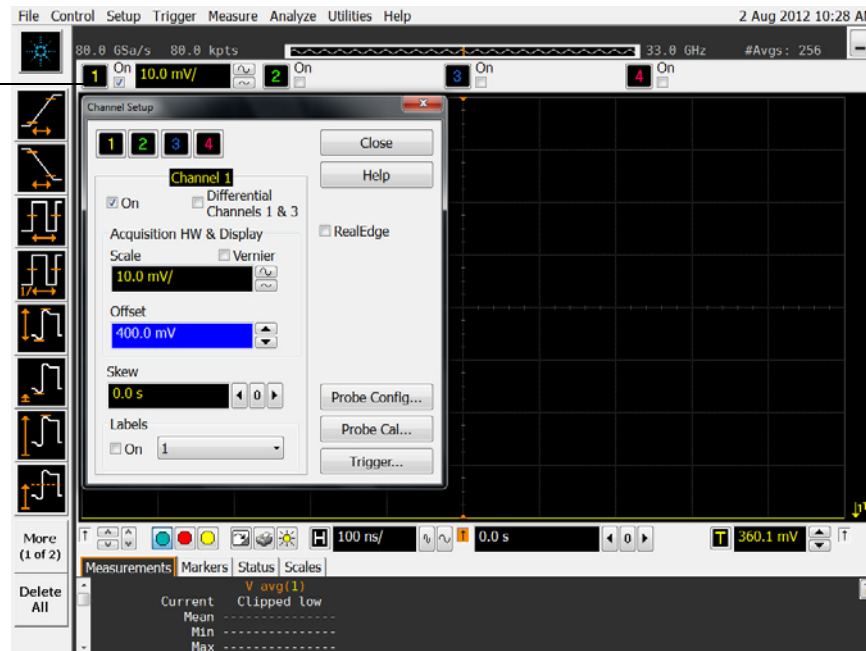
is set up as follows and then click **OK**:

Source = Channel 1

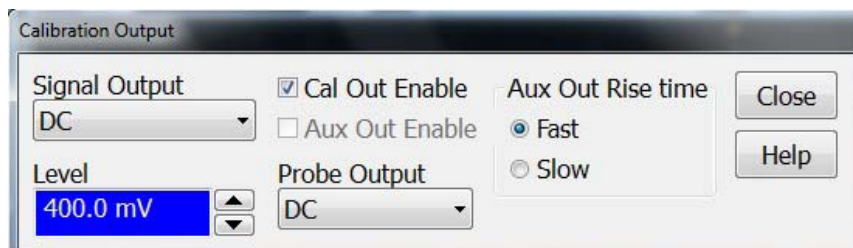
Measurement area = Entire Display

- 4 Set the channel 1 offset value to 400.0 mV. This can be done using the front panel control or:
 - a Pull down the Setup menu and select Channel 1 or click the Channel 1 setup icon.
 - b Change the vertical sensitivity (Scale) of channel 1 to 10 mV/div.
 - c Click the Offset control arrows to change the offset value or click on the offset value and enter 400.0 mV in the dialog box.

Channel 1
setup icon



- 5 Set the Cal Out voltage ($V_{\text{Cal Out}}$) to +400.0 mV as follows:
 - a Select **Utilities > Calibration Output**.
 - b Change the Signal Output function to DC (top left corner).
 - c Set the Level to 400.0 mV.
 - d Click **Close**.



- 6 Press [**Clear Display**] on the scope, wait for the #Avs value (top right corner of screen) to return to 256, and then record the DMM voltage reading as $V_{\text{DMM+}}$ and the scope Vavg reading as $V_{\text{Scope+}}$ in the Offset Gain Test section of the Performance Test Record.

Chapter 3: Testing Performance

Offset Accuracy Test

- 7 Change the channel 1 offset value to -400.0 mV.
- 8 Set the Cal Out voltage to -400.0 mV.
- 9 Press [**Clear Display**] on the scope, wait for the #Avgs value (top left corner of screen) to return to 256, and then record the DMM voltage reading as V_{DMM-} and the scope Vavg reading as V_{Scope-} in the Offset Gain Test section of the Performance Test Record.
- 10 Change the channel 1 offset value to 0 mV.
- 11 Set the Cal Out voltage to 0 mV.
- 12 Press [**Clear Display**] on the scope, wait for the #Avgs value (top left corner of screen) to return to 256, and then record the DMM voltage reading as V_{DMM0} and the scope Vavg reading as V_{Scope0} in the Offset Gain Test section of the Performance Test Record.
- 13 Calculate the offset gain error using the following expressions and record the value in the 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

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

- 14 Repeat steps 4 to 13 for the remaining channel 1 vertical sensitivities in the Offset Gain Test section of the Performance Test Record. For each measurement, set both the Cal Out voltage ($V_{Cal Out}$) 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 Gain Test table in the Performance Test Record for each of the vertical sensitivities.
- 15 Move the Tee connector to the next channel input and repeat steps 4 to 13 for channels 2 to 4 and for channels 1R and 3R. Press the RealEdge button to enable channels 1R and 3R.

DC Gain Accuracy Test

CAUTION

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

Let the oscilloscope warm up before testing.

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	$\pm 2\%$ of full scale at full resolution channel scale ($\pm 2.5\%$ for 5 mV/div)
Full scale is defined as 8 vertical divisions. Magnification is used below 10 mV/div. Below 10 mV/div full scale is defined as 80 mV. The major scale settings are 10 mV, 20 mV, 50 mV, 100 mV, 200 mV, 500 mV and 1 V.	

Equipment Required

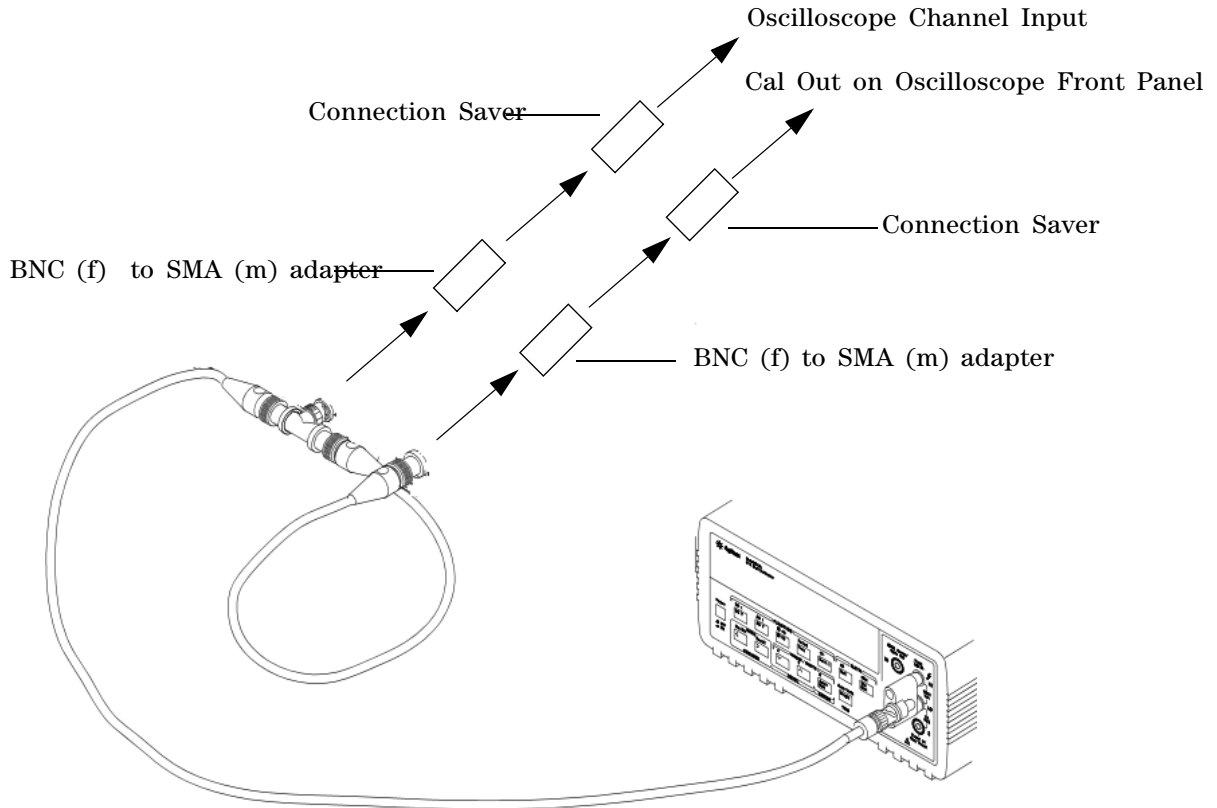
Description	Critical Specifications	Recommended Model/ Part Numbers
Digital Multimeter	DC voltage measurement accuracy better than $\pm 0.1\%$ of reading	Agilent 34411A
Cable Assembly (2 required)	50 Ω characteristic impedance, BNC (m) connectors	Agilent 8120-1840
Adapter	BNC Tee (m)(f)(f)	Agilent 1250-0781
Adapter	BNC (f) to dual banana	Agilent 1251-2277
Connector Saver	3.5 mm (f)-(f), shipped with each 90000 Q-Series oscilloscope 2.4 mm (f) to 3.5 mm (f) adapter	Agilent 5061-5311 (used with 20, 25, and 32 GHz oscilloscope models) Agilent 11901B (used with 50 GHz and 62 GHz oscilloscope models)
Adapter (2 required)	BNC (f) to SMA (m) Adapter	Agilent 1250-1200

Chapter 3: Testing Performance DC Gain Accuracy Test

Procedure

- 1 Make the connections to scope channel 1 as shown below.

Connections

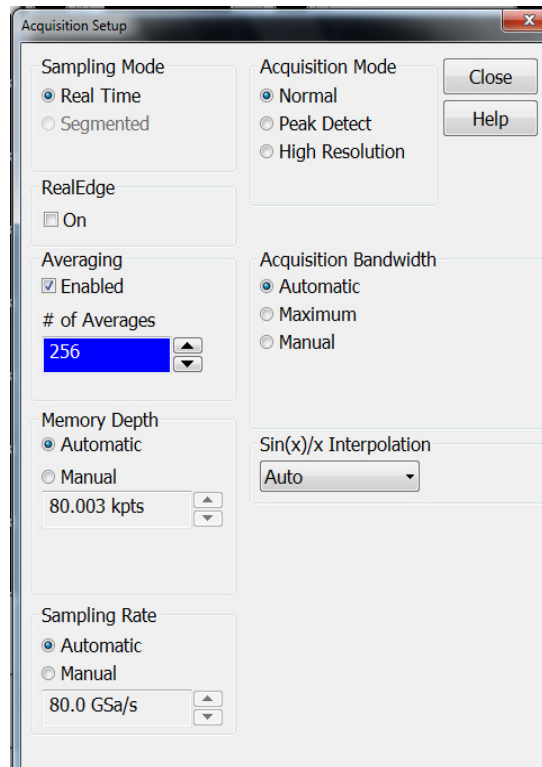


Notes:

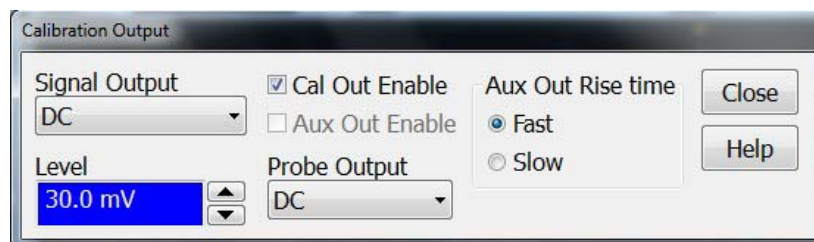
- Where the BNC Tee adapter is used, it is important to connect it directly to the scope channel input using the BNC (f) to SMA (m) adapter and the connection saver to minimize ground potential differences and to ensure that the DMM measures the input voltage to the scope channel as accurately as possible. 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 scope and DMM are connected to the same AC supply circuit.
- 256 averages are used in the scope measurements of this section to reduce measurement noise and to reduce the measurement error due to resolution.

- 2 Press [**Default Setup**], then configure the scope as follows:
 - a Select **Setup > Acquisition**.

- b When the Acquisition Setup window appears, enable averaging and set the # of averages to 256 as shown below.



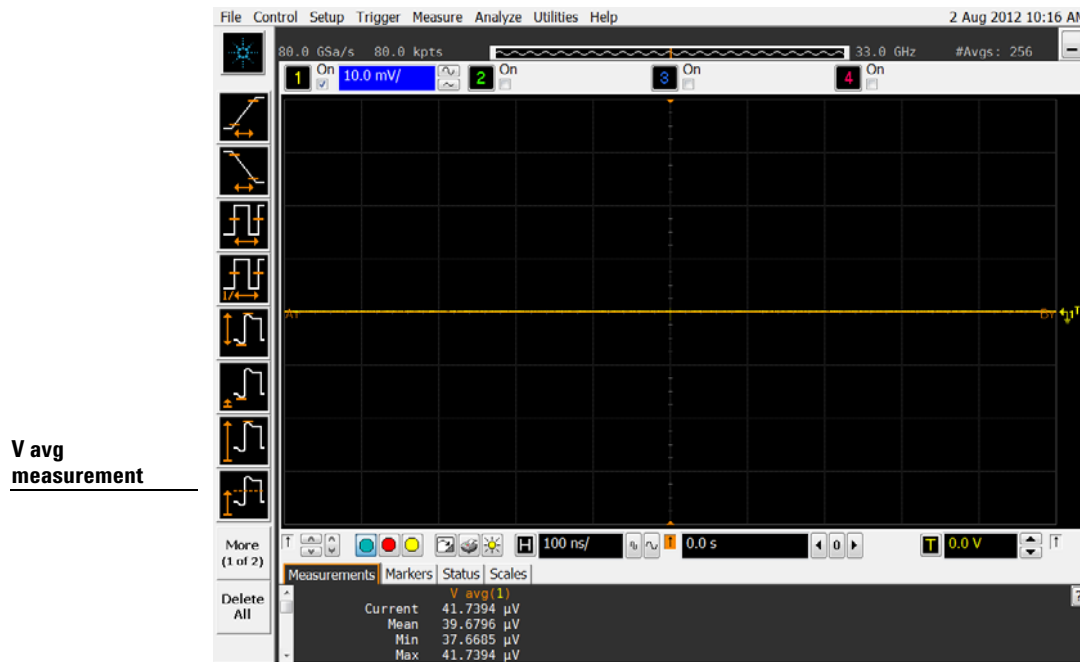
- 3 Set the Cal Out voltage ($V_{\text{Cal Out}}$) to +30 mV as follows:
- Select **Utilities > Calibration Output**.
 - Change the Signal Output function to DC (top left corner).
 - Set the Level to 30 mV.
 - Click **Close**.



- 4 Set the channel 1 vertical sensitivity value to 10 mV/div. This can be done either using the front panel control or:
- Pull down the Setup menu and select Channel 1 or click the Channel 1 setup icon.
 - Change the vertical sensitivity of channel 1 to 10 mV/div.

Chapter 3: Testing Performance DC Gain Accuracy Test

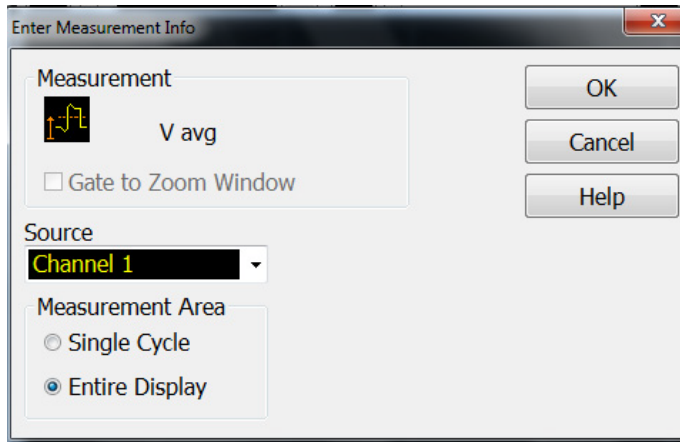
c Select the Vavg measurement as shown below.



d When the Enter Measurement Info window appears, ensure that the V avg function is set up as follows and then click **OK**:

Source = Channel 1

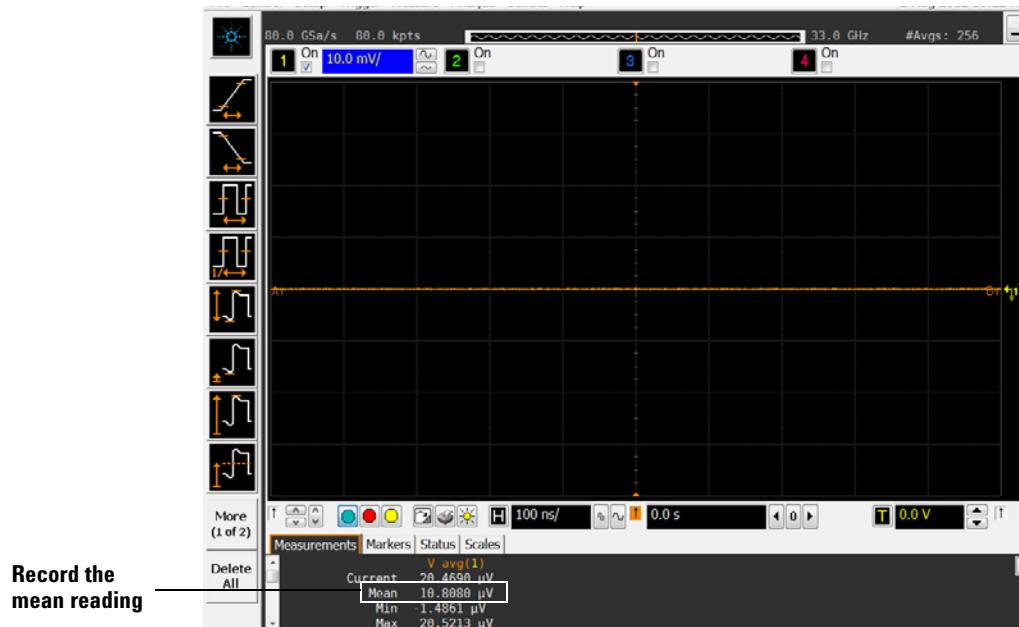
Measurement Area = Entire Display



5 Press **[Clear Display]** on the scope, wait for the #Avs value (top right corner of screen) to return to 256, and then record the scope's mean V avg reading in the DC Gain Accuracy Test section of the Performance Test Record.

Notes

- For all scope readings in this procedure, use the mean value in the Measurements display area at the bottom of the screen.
- If a question mark appears in front of any of the values at the bottom of the screen, press **[Clear Display]** on the scope, wait for the #Avs value to return to 256, and then record the scope reading.



- 6 Change the Cal Out voltage to -30 mV.
- 7 Press [**Clear Display**] on the scope, wait for the #Aves value to return to 256 and then record the DMM voltage reading and the scope V avg reading in the DC Gain Test section of the Performance Test Record.
- 8 Calculate the DC gain using the following expression and record this value in the DC Gain Test section of the Performance Test Record.

For vertical sensitivities of less than 1 volt use the following equation:

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

For vertical sensitivity = 1 V use the following equation:

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

- 9 Repeat steps 3 to 8 for the remaining channel 1 vertical sensitivities in the DC Gain Test section of the Performance Test Record. For each measurement, set both the Cal Out voltage (V_{CalOut}) and the Channel offset voltage to the positive V_{CalOut} value and then to the negative V_{CalOut} value in the “ V_{CalOut} Setting” column of the DC Gain Test table in the Performance Test Record for each of the vertical sensitivities.
- 10 Move the Tee connector to the next channel input and repeat steps 3 to 9 for channels 2 to 4 and for channels 1R and 3R.

Analog Bandwidth -- Maximum Frequency Test

CAUTION

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

Let the oscilloscope warm up before testing.

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.

Specification

Analog Bandwidth (-3 dB)	
DSO/DSAX92004Q	20.0 GHz
DSO/DSAX92504Q	25.0 GHz
DSO/DSAX93304Q	32.0 GHz
DSO/DSAX95004Q	50.0 GHz
DSO/DSAX96204Q	62.0 GHz

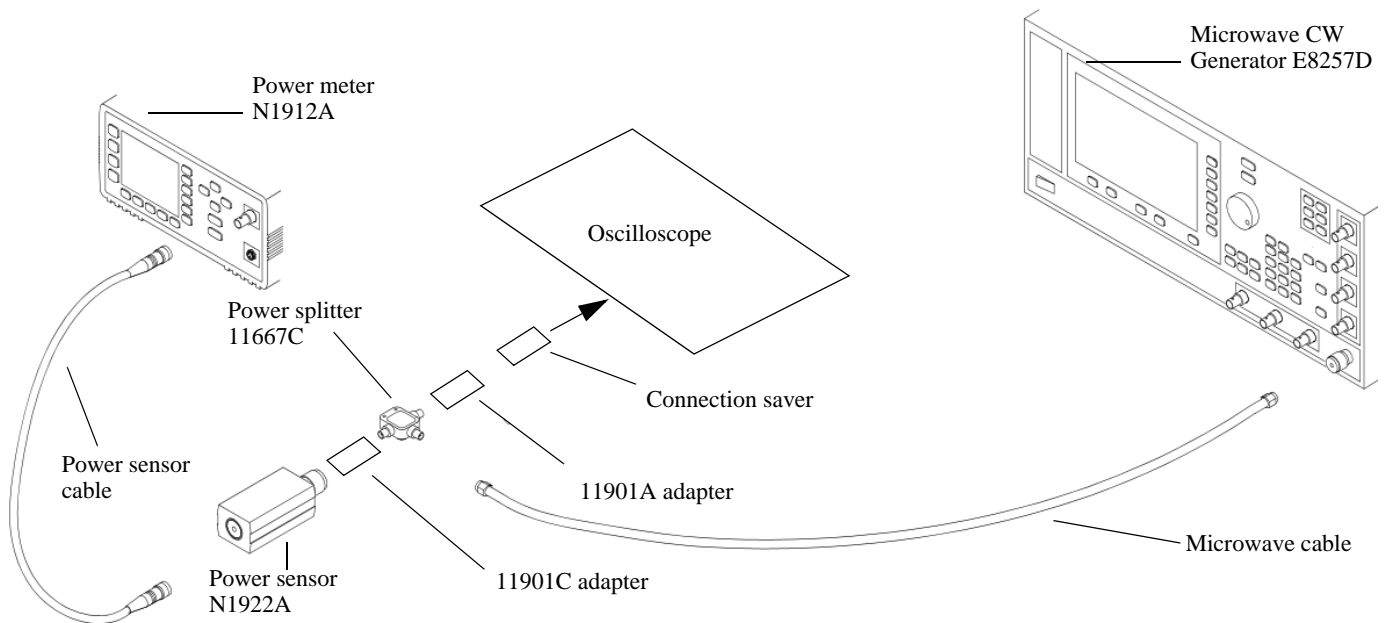
Equipment Required

Description	Critical Specifications	Recommended Model/ Part Numbers
Microwave CW Generator	Maximum Frequency ≥ 32 GHz Power range: -20 dBm to +16 dBm into 50 ohm Output resistance = 50 ohm	Agilent E8257D with Opt 540 (used with 20, 25, and 32 GHz oscilloscope models) or Opt 567 (used with all models)
	Maximum Frequency ≥ 67 GHz Power range: -20 dBm to +25 dBm into 50 ohm Output resistance = 50 ohm	Agilent E8257D with Opt 567 (used with 50 GHz and 62 GHz oscilloscope models)
Power Splitter	2 Resistor Power Splitter Max Frequency ≥ 32 GHz	Agilent 11667C (used with 20, 25, and 32 GHz oscilloscope models)
	2 Resistor Power Splitter Max Frequency ≥ 65 GHz	Anritsu V241C (used with 50 GHz and 62 GHz oscilloscope models)
Power Meter	Agilent P-series with power sensor compatibility	Agilent N1912A
Power Sensor	Maximum Frequency ≥ 32 GHz Power range: -24 dBm to +23 dBm	Agilent N1922A (used with 20, 25, and 32 GHz oscilloscope models)
	Maximum Frequency ≥ 67 GHz Power range: -35 dBm to +20 dBm	Agilent N8488A (used with 50 GHz and 62 GHz oscilloscope models)
Microwave Cable	50 ohm Characteristic Impedance 2.4 mm (m) to 2.4 mm (m) connectors Max Frequency ≥ 32 GHz	Agilent N5180-60204 (used with 20, 25, and 32 GHz oscilloscope models)
	1.85 mm (m) to 1.85 mm (m) 50 ohm Max Frequency ≥ 67 GHz	Gore 0F0CB0CB036.0 (67 GHz) (used with 50 GHz and 62 GHz oscilloscope models)
Adapter	2.4 mm (m) to 3.5 mm (m) (qty. 1)	Agilent 11901A (used with 20, 25, and 32 GHz oscilloscope models)
Adapter	2.4 mm (m) to 3.5 mm (f) (qty. 2)	Agilent 11901C (used with 20, 25, and 32 GHz oscilloscope models)

Description	Critical Specifications	Recommended Model/ Part Numbers
Connector Saver	3.5 mm (f)-(f), shipped with 20, 25, and 32 GHz oscilloscope models	Agilent 5061-5311 (used with 20, 25, and 32 GHz oscilloscope models)

Chapter 3: Testing Performance
Analog Bandwidth -- Maximum Frequency Test

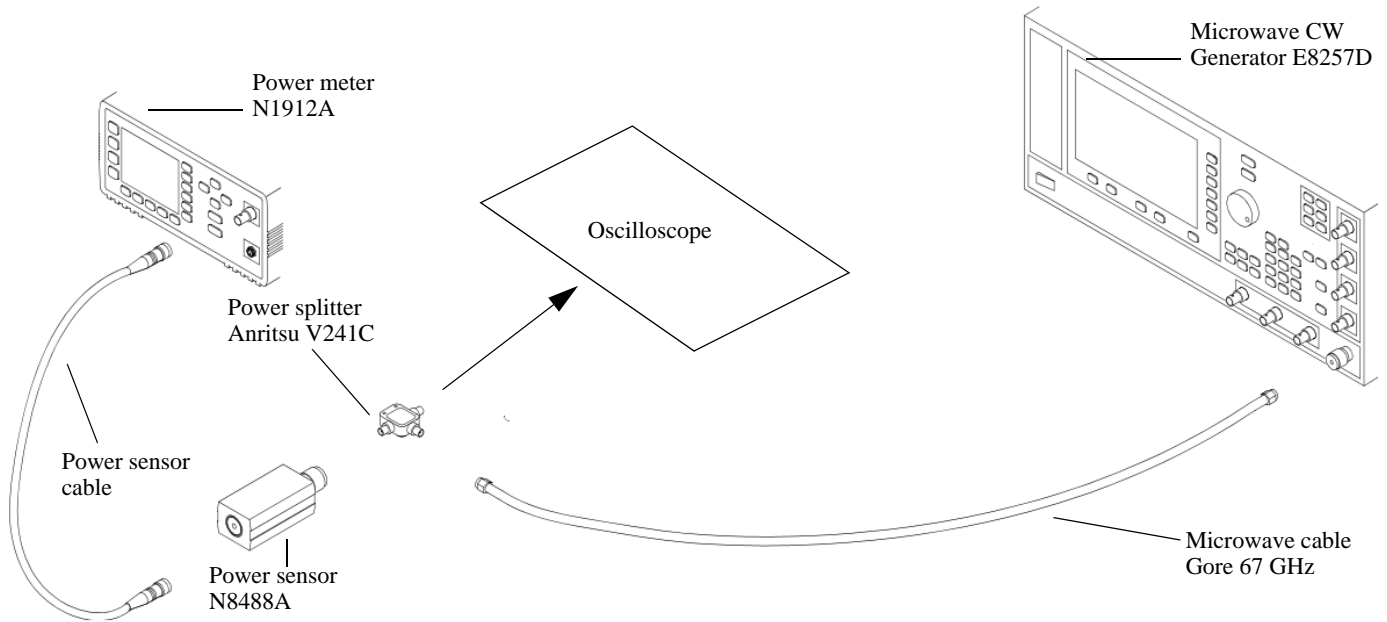
Connections for all oscilloscope models, channels 1-4



Notes

- Connect output 1 of the 11667C splitter to the scope Channel n input directly using the 11901A adapter and a connector saver, without any additional cabling or adapters.
- Connect the power sensor directly to output 2 of the power splitter using the 11901C adapter without any additional cabling or adapters.
- Connect the microwave cable directly to output 3 of the power splitter using the 11901C adapter without any additional cabling or adapters.
- Minimize the use of other adapters.
- Ensure that 2.4 mm and 3.5 mm connectors are tightened properly:
8 in-lbs (90 N-cm) for 3.5 mm
8 in-lbs (90 N-cm) for 2.4 mm

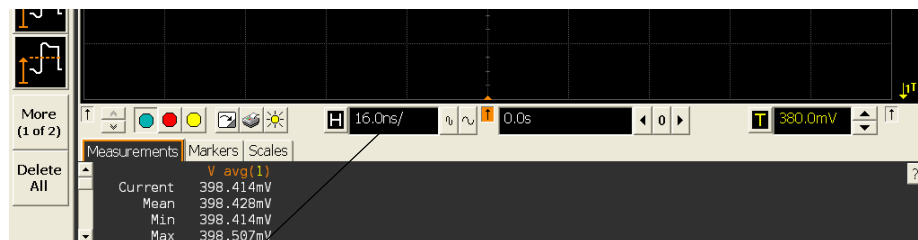
Connections for 50 and 62 GHz oscilloscope models, channels 1R-3R



- Notes**
- Connect output 1 of the V241C splitter to the scope Channel n input directly without any additional cabling or adapters.
 - Minimize the use of any adapters.
 - Ensure that 1.85 mm connectors are tightened properly:
8 in-lbs (90 N-cm) for 1.85 mm

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 connection diagram above.
- 5 Set up the Power Meter to display measurements in units of Watts.
- 6 Press [**Default Setup**], then configure the scope as follows:
 - a Ensure Channel 1 is displayed and all other channels are turned off.
 - b Set the vertical scale of channel 1 to 10 mV/div.
 - c Set the horizontal scale to 16 ns/div (to display 8 cycles of a 50 MHz waveform).



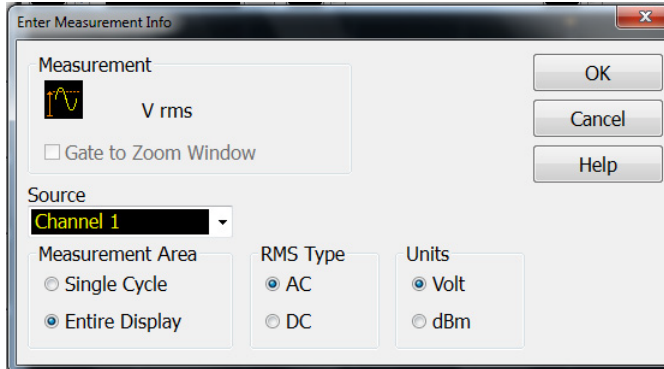
Click here and enter 16 ns

Chapter 3: Testing Performance Analog Bandwidth -- Maximum Frequency Test

- d Select **Setup > Acquisition** and then set up the acquisition parameters as follows:
 - Memory Depth = Automatic
 - Sampling rate = 160 GSa/s (maximum)
 - Sin(x)/x Interpolation = Auto
 - Averaging = Disabled
- e Select **Measure > Voltage > V rms**.



- f When the Enter Measurement Info window appears, configure this measurement 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 4 divisions.
- Use the following tables to determine the approximate required signal amplitude. The amplitude values in the tables are 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 scope.

Table 3-1. Nominal Generator Amplitude Settings for all Oscilloscope Models, channels 1-4

Scope Vertical Sensitivity	Generator Signal Amplitude (Vp-p)	Generator Signal Amplitude (dBm)
10 mV/div	0.08	-18
20 mV/div	0.16	-12
50 mV/div	0.4	-4
100 mV/div	0.8	+2
200 mV/div	1.6	+8
500 mV/div	4.0	+16
1 V/div	6.3	+20

Table 3-2. Nominal Generator Amplitude Settings for 50 and 62 GHz Oscilloscope Models, channels 1R-3R

Scope Vertical Sensitivity	Generator Signal Amplitude (Vp-p)	Generator Signal Amplitude (dBm)
10 mV/div	0.08	-12.5
20 mV/div	0.16	-9.5
50 mV/div	0.4	-5.5
100 mV/div	0.8	-2.5

Chapter 3: Testing Performance
Analog Bandwidth -- Maximum Frequency Test

- 8 Measure the input power to the scope 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 μ W, then $V_{in} = (4.0 \times 10^{-6} \times 50\Omega)^{1/2} = 14.1$ mVrms.

Record the RMS voltage in the Analog Bandwidth - Maximum Frequency Check section of the Performance Test Record (V_{in} @ 50 MHz).

- 9 Press [**Clear Display**] on the scope and record the scope V_{rms} reading in the Analog Bandwidth - Maximum Frequency Check section of the Performance Test Record (V_{out} @ 50 MHz).

Notes

- For all scope readings in this procedure, use the mean value in the Measurements display area at the bottom of the screen.



Record the mean reading

- 10 Calculate the reference gain as follows:

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

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		
	DSOX/DSAX92004Q (channels 1-4)	DSOX/DSAX 92504Q (channels 1-4)	DSOX/DSAX 93304Q, 95004Q, and 96204Q (channels 1-4)
Maximum Frequency	20 GHz	25 GHz	32 GHz
Scope Time Base Setting	50 ps/div	50 ps/div	50 ps/div
	Model		
	DSOX/DSAX95004Q (channels 1R, 3R)	DSOX/DSAX 96204Q (channels 1R, 3R)	
Maximum Frequency	50 GHz	62 GHz	
Scope Time Base Setting	16 ps/div	16 ps/div	

- 12 Change the scope time base to the value for the model under test in the table above.



Click here and enter time
base value from table

- 13 Measure the input power to the scope 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 μ W, then $V_{in} = (4.0 \times 10^{-6} \times 50\Omega)^{1/2} = 14.1$ mVrms.

Record the RMS voltage in the Analog Bandwidth - Maximum Frequency Check section of the Performance Test Record (V_{in} @ Max Freq).

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

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

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

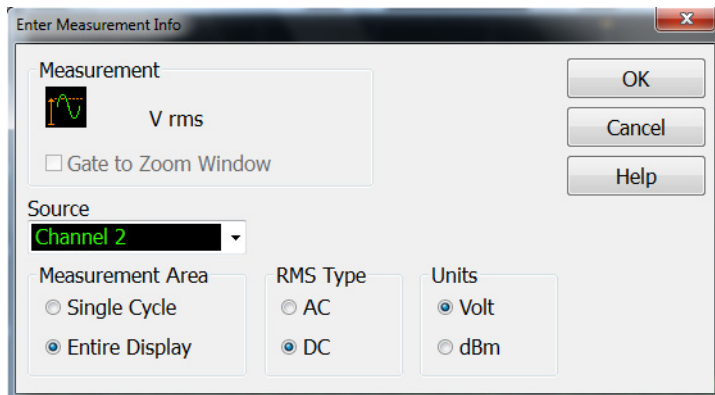
For example, if (V_{out} @ Max Frequency) = 13.825 mV, (V_{in} @ Max Frequency) = 13.461 mV and Gain @ 50MHz = 1.0023, then:

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

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.

Chapter 3: Testing Performance
Analog Bandwidth -- Maximum Frequency Test

- 16 Change the scope setup as follows:
 - a Change the channel vertical sensitivity to 20 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 sensitivity in Table 3-1.
- 18 Repeat steps 8, 9, and 10 to measure the reference gain at 50 MHz for this sensitivity.
- 19 Repeat steps 11, 12, 13, and 14 to measure the gain at maximum frequency for this sensitivity.
- 20 Repeat steps 15 to 19 to complete measuring gains for remaining sensitivities 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 scope configuration as follows:
 - Ensure Channel 2 is displayed and all other channels are turned off.
 - Set the vertical sensitivity of channel 2 to 10 mV/div.
 - Set the horizontal scale to 16 ns/div (to display 8 cycles of a 50 MHz waveform).
 - Right click on the V rms measurement at the bottom of the screen. When the RMS voltage measurement setup window appears, change the source from Channel 1 to Channel 2.



- 22 Repeat steps 7 to 20 to complete measuring gains for channel 2.
- 23 Move the splitter to channel 3 and change the scope configuration as follows:
 - a Ensure Channel 3 is displayed and all other channels are turned off.
 - b Set the vertical sensitivity of channel 3 to 10 mV/div.
 - c Set the horizontal scale to 16 ns/div (to display 8 cycles of a 50 MHz waveform).
 - d Click on the V rms measurement at the bottom of the screen and select Customize. When the V rms setup window appears, change the source from Channel 2 to Channel 3.
- 24 Repeat steps 7 to 20 to complete measuring gains for channel 3.
- 25 Move the splitter to channel 4 and change the scope configuration as follows:
 - a Ensure Channel 4 is displayed and all other channels are turned off.
 - b Set the vertical sensitivity of channel 4 to 10 mV/div.
 - c Set the horizontal scale to 16 ns/div (to display 8 cycles of a 50 MHz waveform).
 - d Click on the V rms measurement at the bottom of the screen. When the V rms setup window appears, change the source from Channel 3 to Channel 4.
- 26 Repeat steps 7 to 20 to complete measuring gains for channel 4.
- 27 Press the RealEdge button to enable channels 1R and 3R.
- 28 Repeat steps 7 to 22 for channels 1R and 3R, using Table 3-2 in step 17.

Time Scale Accuracy (TSA) Test

This procedure verifies the maximum TSA specification for the oscilloscope.

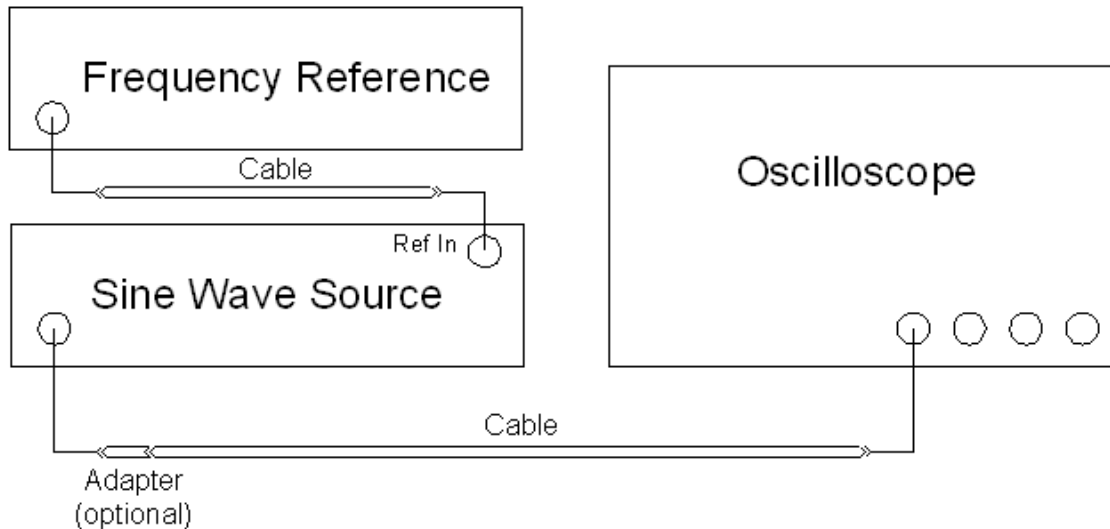
Equipment Required

Equipment	Critical Specifications	Recommended Model/Part
Synthesized sine wave source	Output Frequency: ≥ 10 MHz Output Amplitude: 0 dBm Frequency Resolution: 0.1 Hz	Agilent E8257D PSG
10 MHz frequency reference	Output Frequency: 10 MHz Absolute Freq. Error: $< \pm 0.0275$ ppm	Agilent 53132A opt. 012 frequency counter
RF cable	50 ohm characteristic impedance (no substitute) BNC (m) connectors Max Frequency: ≥ 50 MHz	Agilent 8120-1840
Adapters, assorted	3.5 mm (f) to Precision BNC (m) 3.5 mm (f) to 3.5 mm (f) 2.4 mm (f) to 2.92 mm (f)	Agilent 54855-67604 Agilent 83059B Rosenberger 02K109-K00S3

Chapter 3: Testing Performance Time Scale Accuracy (TSA) Test

Connections

Connect the equipment as shown in the following figure.



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 source amplitude such that displayed sine wave is 600 mVpp.
- 3 Press [**Default Setup**] on the oscilloscope.
- 4 Set channel 1's vertical scale to 100 mV/div.
- 5 Set the oscilloscope sample rate to 100 kSa/s.
- 6 Set the scope'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. To do this, go under **Measure > Thresholds** in the top menu. Then select **Custom: level +/- Hysteresis** and enter 20 mV into the **Hysteresis** field and 0 V into 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.
- 13 Record the time since calibration (in years) in the table. The calibration date can be found in the Calibration menu window.
- 14 Calculate the test limits using the following formula and record them in the table.
Test Limits = $\pm(0.100 + 0.100 \times \text{Years Since Calibration})$
- 15 Record the results in the Performance Test Record.

Performance Test Record

Agilent Technologies

Agilent 90000 Q-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 Test

Zero Error Test

Vertical Sensitivity	Test Limits	Channel 1	Channel 2	Channel 3	Channel 4	Channel 1R	Channel 3R
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						

**Chapter 3: Testing Performance
Performance Test Record**

Offset Gain Test

Vertical Sensitivity	V_{Cal Out} Setting	V_{DMM+}	V_{DMM-}	V_{DMM0}	V_{Scope+}	V_{Scope-}	V_{Scope0}	Calc. Offset Gain Error	Offset Gain Error Test Limits
Channel 1									
10 mV/div	±400 mV								±2 %
20 mV/div	±400 mV								±2 %
50 mV/div	±700 mV								±2 %
100 mV/div	±1.2 V								±2 %
200 mV/div	±2.2 V								±2 %
500 mV/div	±2.4 V								±2 %
1 V/div	±2.4 V								±2 %
Channel 2									
10 mV/div	±400 mV								±2 %
20 mV/div	±400 mV								±2 %
50 mV/div	±700 mV								±2 %
100 mV/div	±1.2 V								±2 %
200 mV/div	±2.2 V								±2 %
500 mV/div	±2.4 V								±2 %
1 V/div	±2.4 V								±2 %
Channel 3									
10 mV/div	±400 mV								±2 %
20 mV/div	±400 mV								±2 %
50 mV/div	±700 mV								±2 %
100 mV/div	±1.2 V								±2 %
200 mV/div	±2.2 V								±2 %
500 mV/div	±2.4 V								±2 %
1 V/div	±2.4 V								±2 %
Channel 4									
10 mV/div	±400 mV								±2 %
20 mV/div	±400 mV								±2 %
50 mV/div	±700 mV								±2 %
100 mV/div	±1.2 V								±2 %
200 mV/div	±2.2 V								±2 %
500 mV/div	±2.4 V								±2 %
1 V/div	±2.4 V								±2 %
Channel 1R									
10 mV/div	±400 mV								±2 %
20 mV/div	±400 mV								±2 %
50 mV/div	±700 mV								±2 %
100 mV/div	±1.2 V								±2 %
200 mV/div	±2.2 V								±2 %
500 mV/div	±2.4 V								±2 %
1 V/div	±2.4 V								±2 %
Channel 3R									
10 mV/div	±400 mV								±2 %
20 mV/div	±400 mV								±2 %
50 mV/div	±700 mV								±2 %
100 mV/div	±1.2 V								±2 %
200 mV/div	±2.2 V								±2 %
500 mV/div	±2.4 V								±2 %
1 V/div	±2.4 V								±2 %

DC Gain Accuracy Test

Vertical Sensitivity	V _{Cal Out} Setting	V _{DMM+}	V _{DMM-}	V _{Scope+}	V _{Scope-}	Calc. DC Gain Error	DC Gain Error Test Limits
Channel 1							
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							
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							
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							
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 1R							
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 3R							
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 %

**Chapter 3: Testing Performance
Performance Test Record**

Analog Bandwidth - Maximum Frequency Check

Max frequency: DSOX/DSAX92004Q = 20 GHz, DSOX/DSAX92504Q = 25 GHz, DSOX/DSAX93304Q = 32 GHz, DSOX/DSAX95004Q = 50 GHz, DSOX/DSAX96204Q = 62 GHz .

Vertical Sensitivity	Measurement					
	Vin @ 50 MHz	Vout @ 50 MHz	Calculated Gain @ 50 MHz (Test Limit = greater than -3 dB)	Vin @ Max Freq	Vout @ Max Freq	Calculated Gain @ Max Freq (Test Limit = greater than -3 dB)
Channel 1						
10 mV/div						
20 mV/div						
50 mV/div						
100 mV/div						
200 mV/div						
500 mV/div						
1 V/div						
Channel 2						
10 mV/div						
20 mV/div						
50 mV/div						
100 mV/div						
200 mV/div						
500 mV/div						
1 V/div						
Channel 3						
10 mV/div						
20 mV/div						
50 mV/div						
100 mV/div						
200 mV/div						
500 mV/div						
1 V/div						
Channel 4						
10 mV/div						
20 mV/div						
50 mV/div						
100 mV/div						
200 mV/div						
500 mV/div						
1 V/div						
Channel 1R						
10 mV/div						
20 mV/div						
50 mV/div						
100 mV/div						
Channel 3R						
10 mV/div						
20 mV/div						
50 mV/div						
100 mV/div						

Time Scale Accuracy

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

**Chapter 3: Testing Performance
Performance Test Record**

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Troubleshooting

The service strategy for troubleshooting oscilloscopes is to isolate problems to a faulty assembly, then use the disassembly and assembly procedures in the "Replacing Assemblies" chapter to replace the defective assembly.

Read the Safety Notices at the back of this guide before servicing the oscilloscope. Before performing any procedure, review any cautions and warnings included in the procedures.

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 assembly, refer to the "Replacing Assemblies" chapter.

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. Press **[Default Setup]** on the front panel to set the oscilloscope to the default state.

WARNING

INJURY CAN RESULT! Use caution when the oscilloscope fan blades are exposed as they can cause injury.

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.

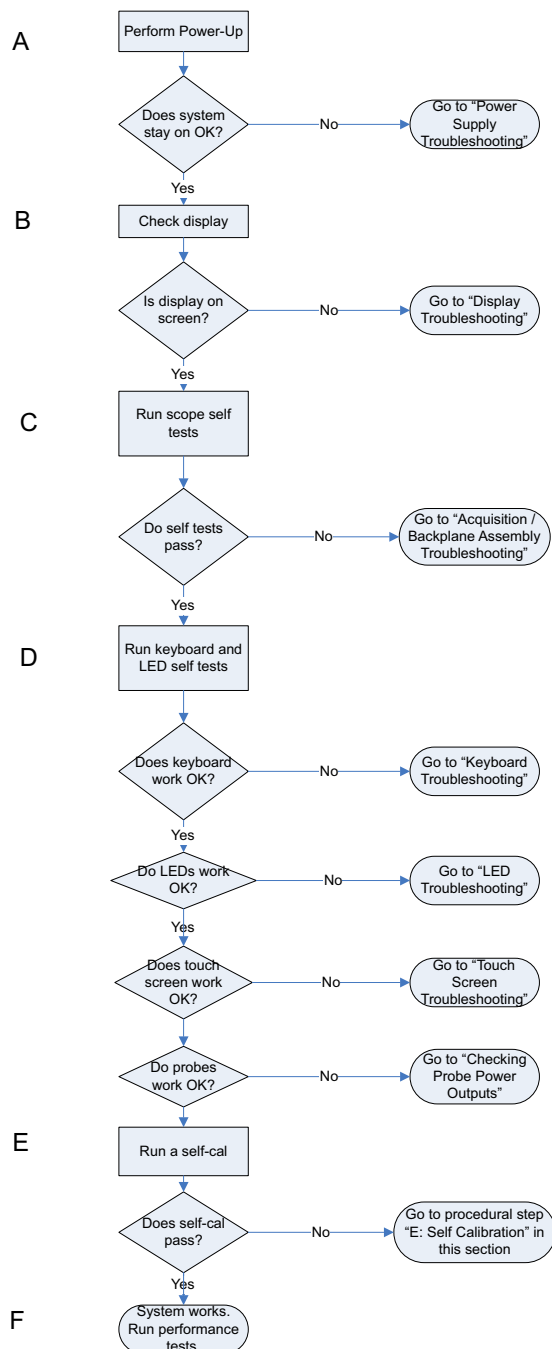
WARNING

SHOCK HAZARD! Maintenance should be performed by trained service personnel aware of the hazards involved (for example, moving parts, fire, and electric shock). Lack of training and awareness of the hazards 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.

Primary Trouble Isolation

The main procedural tool in this chapter is the flowchart. The Primary Trouble Isolation flowchart in Figure 4-1 shows the entire troubleshooting path from a failed oscilloscope to a working one, and directs you to other sections in this chapter where the procedures are described in detail. Reference letters on the flowcharts point to procedural steps that explain the brief instructions in the chart.

Figure 4-1 Primary Trouble Isolation Flowchart



Chapter 4: Troubleshooting

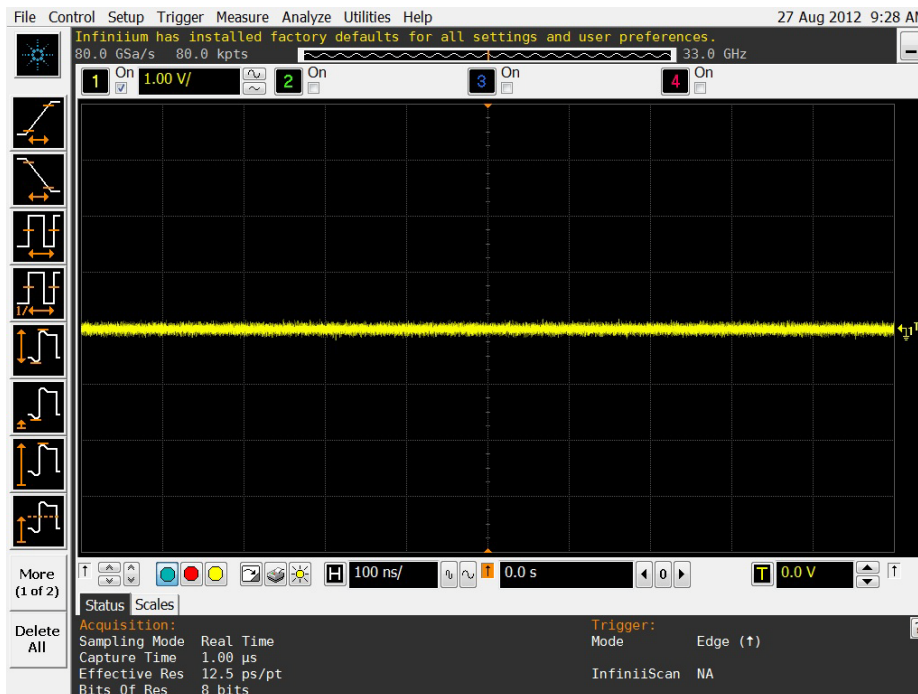
Primary Trouble Isolation

A Perform power-up.

Connect the oscilloscope power cord and 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. The LEDs on the front panel should all illuminate brightly for several seconds, then dim. If the LEDs do not light up, refer to “LED Troubleshooting” later in this chapter.

When the system is done starting up, the graticule will appear on the screen. The exact appearance may look slightly different than shown in [Figure 4-2](#), depending on the setup selected before the oscilloscope was turned off.

Figure 4-2 Power-on Display



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

If the oscilloscope does not start up at all, unplug the oscilloscope, wait 30 seconds, plug the oscilloscope back in, and turn the power on. If it still does not start up, go to the “Setting Up the BIOS” and “Motherboard Verification” sections of this chapter.

B Check the display.

If the screen is black or has a scrambled display, go to the “Display Troubleshooting” section of this chapter.

If the display shows MEMCON1, MEMCON2, MEMCON3, or MEMCON4 errors during boot-up of the oscilloscope software, the bottom (channel 1) acquisition board is faulty and requires replacement. MEMCON5, MEMCON6, MEMCON7, and MEMCON8 errors refer to the next higher acquisition board (channel 2). MEMCOM9 through MEMCON12 errors refer to the next higher (channel 3) acquisition board, and MEMCON13 through MEMCON16 errors refer to the top acquisition board.

C Run the oscilloscope self-tests.

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

If any of the self tests fail, go to the “Acquisition/Backplane Assembly Troubleshooting” section of this chapter for further troubleshooting.

D Check the front panel response by running the Keyboard and LED self tests.

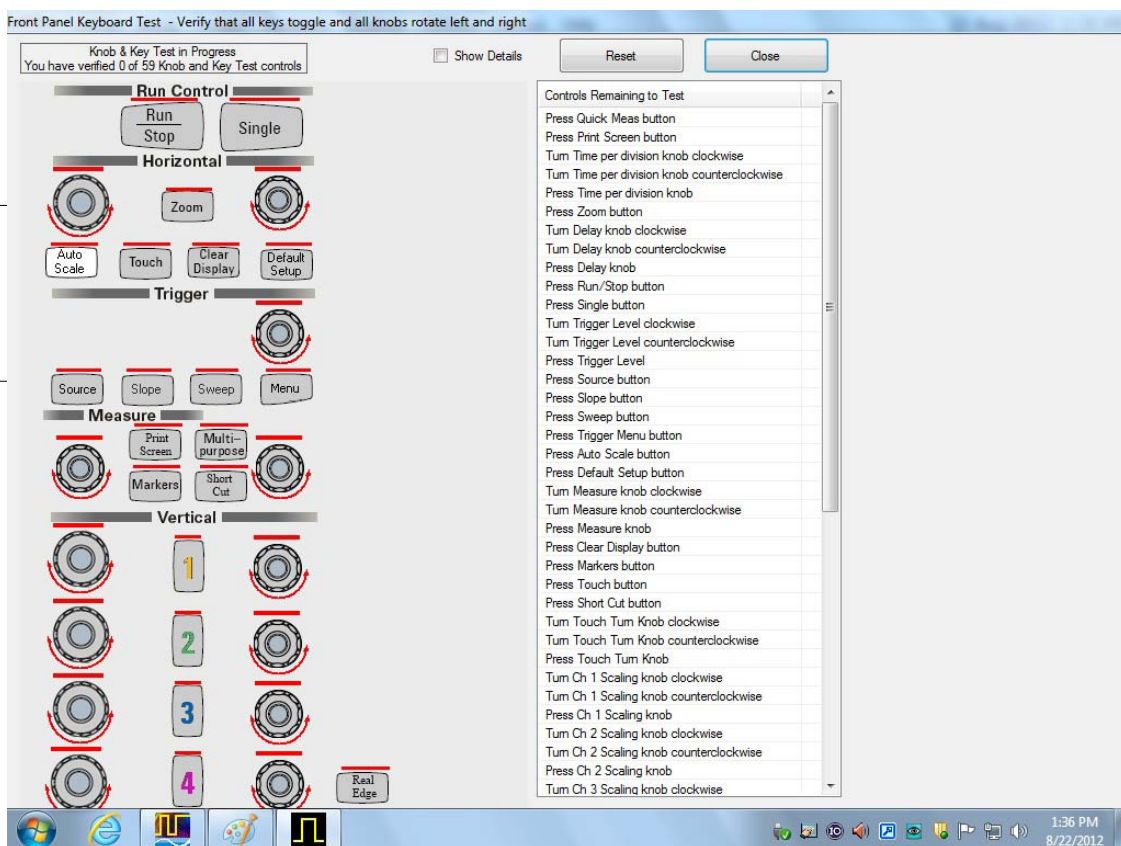
Follow these steps to verify correct keyboard operation.

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

The Front Panel Keyboard Test window appears with a symbolic representation of the keyboard. See [Figure 4-3](#).

Figure 4-3 Knob and key self test screen

When you press a key or turn a knob in both directions, the corresponding symbol on this screen turns green.



- 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.

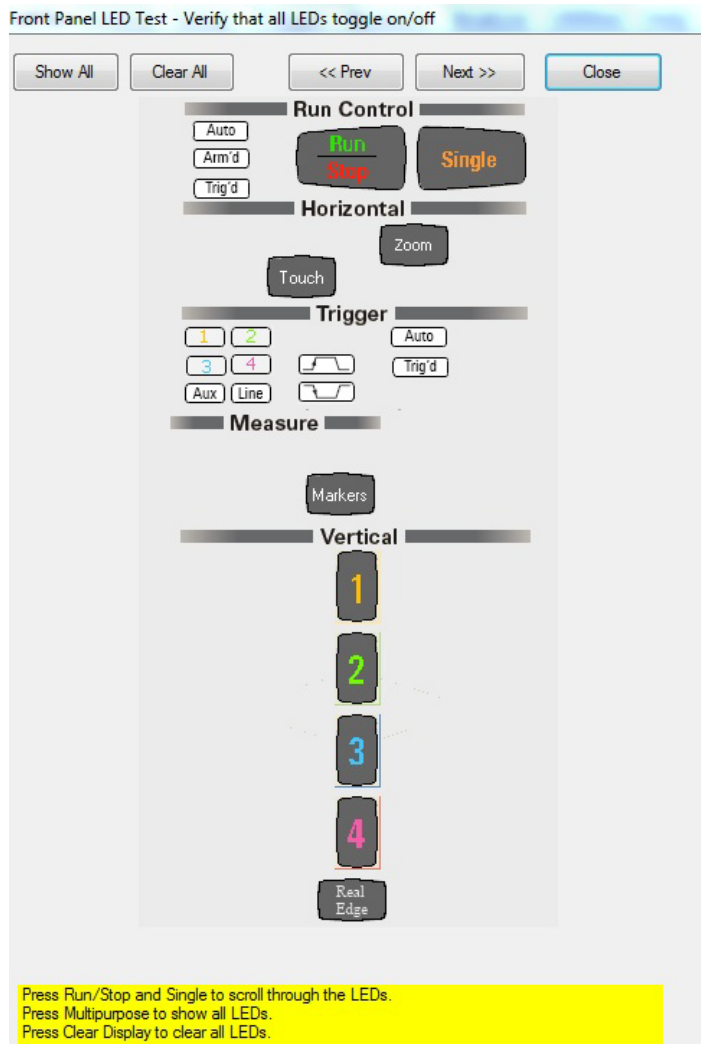
Follow these steps to test the front panel LED (light-emitting diode) indicators.

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

Chapter 4: Troubleshooting Primary Trouble Isolation

The Front Panel LED Test screen appears, showing a symbolic representation of all front panel LED indicators. See [Figure 4-4](#).

Figure 4-4 LED test screen



- 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 screen. Verify that the corresponding LEDs on the front panel are the only ones illuminated. Additionally, pressing the [**Multi Purpose**] button on the front panel will illuminate all the LEDs, and pressing the [**Clear Display**] button on the front panel will turn off all the LEDs.
- 4 When you are finished, click **Close**.
- 5 If any of the LEDs do not work, go to “LED Troubleshooting” later in this chapter.
- 6 If the touch screen is not working properly, go to the “Touch Screen Troubleshooting” section of this chapter.
- 7 If the oscillator board is not working properly, go to “Oscillator Board Troubleshooting” in this chapter.
- 8 To check power outputs of the probes, go to “Checking Probe Power Outputs” in this chapter.

E Run a self calibration.

- 1 Complete a self 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 associated with a RealEdge Technology channel, replace the two acquisition boards associated with the RealEdge Technology.
 - If replacing the two acquisition boards does not fix the problem with the RealEdge Technology channels, replace the RealEdge Technology attenuators and modules.
 - If the failure is associated with channel 1, look at the specific calibration that failed. If it was a trigger cal, a time scale 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 time scale cal, or an interpolator gain cal, replace the bottom acquisition board. If the cal still fails, replace the backplane board.
 - If the failure is not associated with channel 1, replace the acquisition board associated with that channel (channel 1 - bottom acquisition board, channel 2 - next higher acquisition board, channel 3 - next higher acquisition board, channel 4 - top acquisition board).
 - If all four channels have cal failures, the problem may be with the calibrator located on the backplane board, so replace that board first. If the calibration test passes, go to step F.

F The system is operational. Verify that the oscilloscope meets all warranted specifications by following the procedures in the “Testing Performance” chapter.

Power Supply Troubleshooting

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

There are two sets of LEDs on the backplane assembly. Seeing which of these LEDs are illuminated will help you identify the reason and the remedy for the power failure.

WARNING

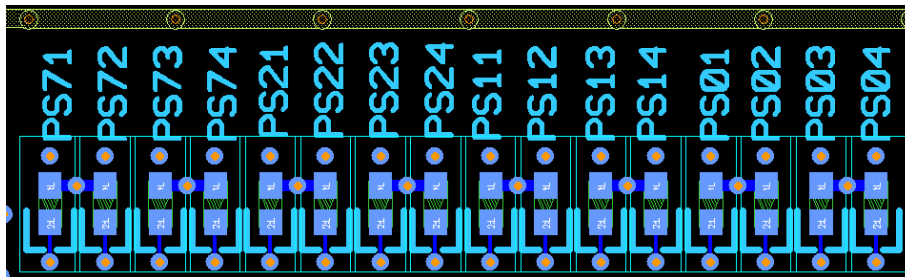
SHOCK HAZARD!

The maintenance described in this section is performed with power supplied to the oscilloscope and with the protective covers removed. Only trained service personnel who are aware of the hazards involved should perform the maintenance. Read the safety notices at the back of this guide before proceeding. Failure to observe safety precautions may result in electric shock.

To locate both sets of LEDs, remove the oscilloscope top panel to expose the top edges of the backplane assembly. The first set of LEDs is located in the upper right corner of the backplane assembly, to the right of the J13001 connector (see [Figure 4-5](#)).

Note: If you cannot see either set of LEDs, you may have a slightly modified backplane board. Contact your Agilent Service Center for assistance.

Figure 4-5 First set of LEDs



This set of LEDs works in groups. To use them to determine the problem and remedy, refer to the following table and follow these steps:

- 1 Connect the power cord. All 16 LEDs should illuminate. If none of them are illuminated, replace the bulk supply.
- 2 Turn power on. If all 16 LEDs turn off, the power supplies are working.

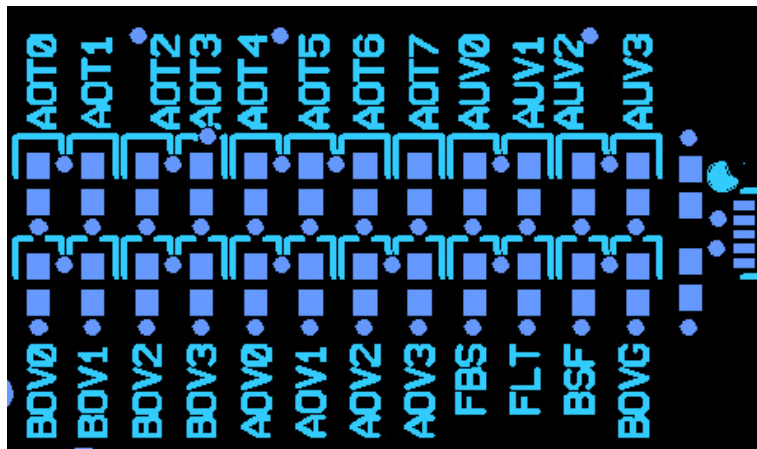
LED				Type of Fault	What To Do	
PS01	PS02	PS03	PS04			
ON	ON	ON	ON	Supply late	Replace Backplane Assembly	
ON	ON	ON	OFF	Supply late		
ON	ON	OFF	ON	Supply late		
ON	ON	OFF	OFF	Supply late		
ON	OFF	ON	ON	Under-voltage		
ON	OFF	ON	OFF	Under-voltage		
ON	OFF	OFF	ON	Under-voltage		
ON	OFF	OFF	OFF	Under-voltage		
OFF	OFF	ON	ON	Over-voltage		
OFF	OFF	ON	OFF	Over-voltage		
OFF	OFF	OFF	ON	Over-voltage		
OFF	OFF	OFF	OFF	Over-voltage		
OFF	ON	X	X	Power button pushed at wrong time		Unplug scope, wait 30 seconds, plug in, power up
PS11	PS12	PS13	PS14			
ON	ON	ON	ON	Supply late	Replace Backplane Assembly	
ON	ON	ON	OFF	Supply late		
ON	ON	OFF	ON	Supply late		
ON	ON	OFF	OFF	Supply late		
ON	OFF	ON	ON	Under-voltage		
ON	OFF	ON	OFF	Under-voltage		
ON	OFF	OFF	ON	Under-voltage		
ON	OFF	OFF	OFF	Under-voltage		
OFF	OFF	ON	ON	Over-voltage		
OFF	OFF	ON	OFF	Over-voltage		
OFF	OFF	OFF	ON	Over-voltage		
OFF	OFF	OFF	OFF	Over-voltage		
OFF	ON	X	X	Power button pushed at wrong time		Unplug scope, wait 30 seconds, plug in, power up
PS21	PS22	PS23	PS24			
ON	ON	ON	ON	Supply late	Replace Backplane Assembly	
ON	ON	ON	OFF	Supply late		
ON	ON	OFF	OFF			
ON	OFF	ON	ON	Under-voltage		
ON	OFF	ON	OFF			
ON	OFF	OFF	OFF			
OFF	OFF	ON	ON	Over-voltage		
OFF	OFF	ON	OFF	Over-voltage		
OFF	OFF	OFF	ON			
OFF	OFF	OFF	OFF			
ON	ON	OFF	ON	Acquisition power good is late		Swap out each acquisition board until problem is resolved
ON	OFF	OFF	ON	Acquisition power good went low		See AUV0, AUV1, AUV2, or AUV3

Chapter 4: Troubleshooting
Power Supply Troubleshooting

LED				Type of Fault	What To Do	
PS71	PS72	PS73	PS74			
ON	ON	ON	ON	Supply late	Replace Backplane Assembly	
ON	ON	ON	OFF	Supply late		
ON	ON	OFF	ON	Supply late		
ON	ON	OFF	OFF	Supply late		
ON	OFF	ON	ON	Under-voltage		
ON	OFF	ON	OFF	Under-voltage		
ON	OFF	OFF	ON	Under-voltage		
ON	OFF	OFF	OFF	Under-voltage		
OFF	OFF	ON	ON	Over-voltage		
OFF	OFF	ON	OFF	Over-voltage		
OFF	OFF	OFF	ON	Over-voltage		
OFF	OFF	OFF	OFF	Over-voltage		
OFF	ON	X	X	Power button pushed at wrong time		Unplug scope, wait 30 seconds, plug in, power up

The second set of LEDs is located to the left of the first set and slightly lower, below the J12002 connector (see [Figure 4-6](#)).

Figure 4-6 Second set of LEDs



The following table shows each LED in this second set, the type of fault it indicates, and what to do if that LED indicator is illuminated. When identifying which acquisition assembly to replace, remember that the acquisition assembly nearest the bottom of the oscilloscope is for channel 1. The one above it is for channel 2. The next higher is for channel 3, and the top acquisition assembly is for channel 4.

NOTE There is no correlation between the short name of each LED and the type of fault. Use the table to determine the fault and how to address the problem.

LED	Type of Fault	What To Do
AOT0*	Over-temperature	Replace acquisition assembly 4
AOT1*	Over-temperature	Replace acquisition assembly 4
AOT2*	Over-temperature	Replace acquisition assembly 3
AOT3*	Over-temperature	Replace acquisition assembly 3
AOT4*	Over-temperature	Replace acquisition assembly 2
AOT5*	Over-temperature	Replace backplane assembly 2
AOT6*	Over-temperature	Replace backplane assembly 1
AOT7*	Over-temperature	Replace acquisition assembly 1
AOV0	Under-voltage	Replace acquisition assembly 4
AOV1	Under-voltage	Replace acquisition assembly 3
AOV2	Under-voltage	Replace acquisition assembly 2
AOV3	Under-voltage	Replace acquisition assembly 1
AUV0	Over-voltage	Replace acquisition assembly 4
AUV1	Over-voltage	Replace acquisition assembly 3
AUV2	Over-voltage	Replace acquisition assembly 2
AUV3	Over-voltage	Replace acquisition assembly 1
BOV0	Over-voltage	Replace assembly indicated by illuminated AUV0 or FBS LED
BOV1	Used for internal testing purposes only	N/A
BOV2	Any	Any problem that causes a shutdown also turns on this LED
BOV3	Used for internal testing purposes only	N/A
BOVG	Over-voltage	Replace backplane assembly
BSF	Over-voltage	Replace backplane assembly
FBS	Over-voltage	Replace backplane assembly
FLT	Over-voltage	Replace backplane assembly
<p>*If an AOT LED is Lit</p> <p>If the oscilloscope shuts down and the AOT0, AOT1, AOT2, AOT3, AOT4, AOT5, AOT6, or AOT7 indicator LED is lit, then one of the scope channels is getting too hot or the temperature sensing circuitry has failed. Normally, you would have to turn the oscilloscope on and leave it on for awhile before you would see a shutdown caused by temperature problems. If all the fans are turning, it is unlikely that the oscilloscope 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.</p> <p>It is possible that all the fans are working, but the oscilloscope still shuts down because of temperature due to one or more of the channels malfunctioning and drawing too much current. If so, you would need to replace the indicated acquisition assembly. 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 oscilloscope.</p>		

Setting Up the BIOS

If the BIOS settings become corrupt, the Infinium 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** when the following prompt appears on the bottom of the screen:

Press TAB to show POST screen, DEL to Enter SETUP, F12 to Boot Menu.

If the prompt does not appear, or the oscilloscope does not appear to be functioning, check the J12001 and J12002 motherboard power cable connectors. Otherwise, continue with the next step.

- 4 Go to **Load Optimal Defaults** and press **Enter** for optimized values, or go to **Load Failsafe Defaults** and press **Enter** for fail-safe values. Select **OK** 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 **Y** to save and exit, then press **Enter**.

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 top panel.
- 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 J12001 (Figure 4-7). Pin 9 is the reset line for the motherboard. It is controlled by the backplane. You should measure about 3.3V. 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.

Figure 4-7 Measure potential relative to chassis at pin 9 of J12001

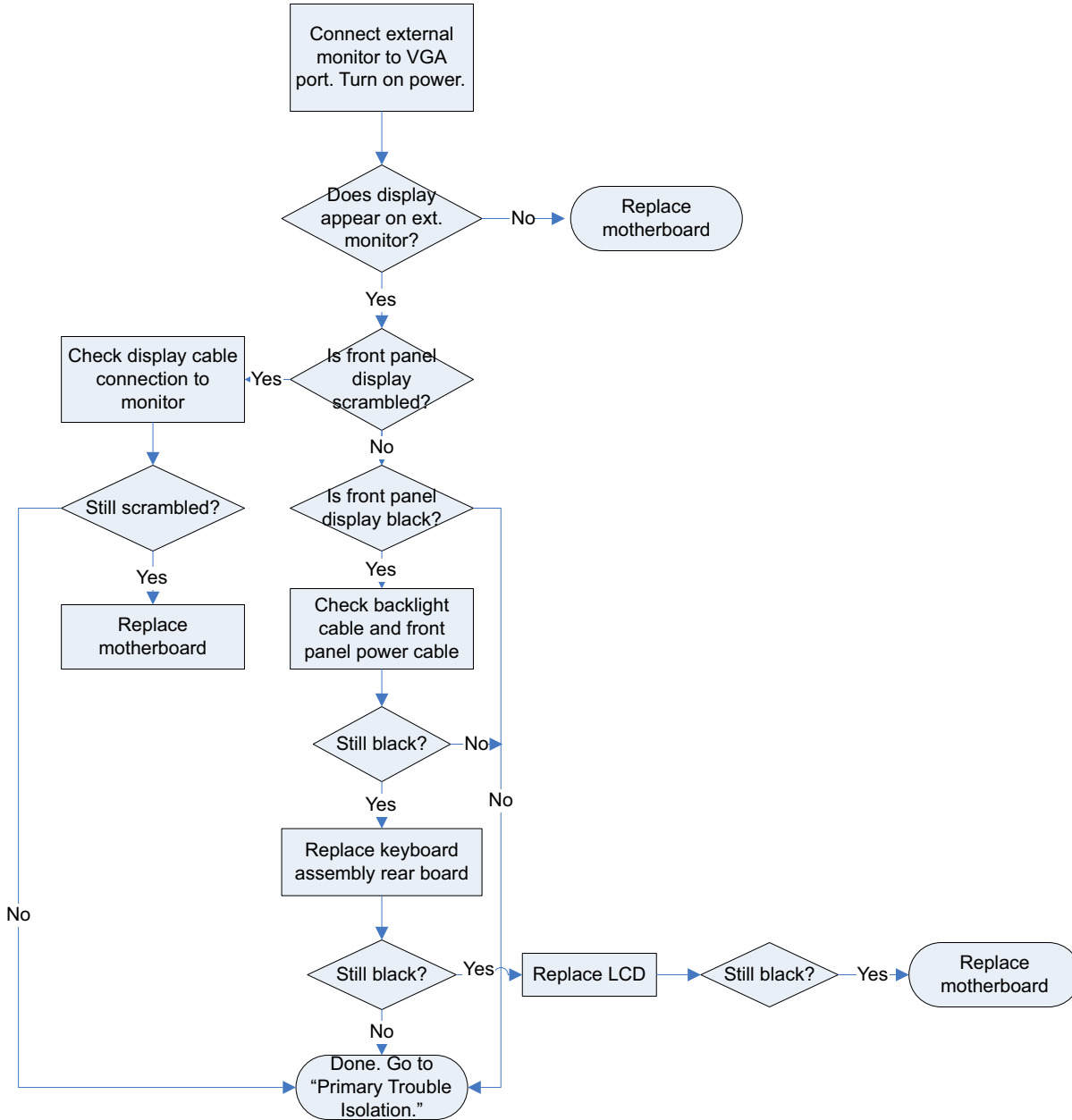
Pin 9 is located in the bottom left corner of J12001.



- 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 (J12001 and J12002), and the PCI Express cable (J10000) from the backplane assembly. Do not allow the PCI Express cable 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 J12001 again.
If you measure the required 3.3V, 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 J12001. 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.

Display Troubleshooting

Figure 4-8 Display Troubleshooting Flowchart



WARNING

INJURY CAN RESULT!

Use caution when the oscilloscope fan blades are exposed as they can cause injury. 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 requires you to have the cover off, be careful not to let these fan blades come in contact with any part of your body.

For information on how to replace the display parts, see the "Replacing Assemblies" chapter.

Acquisition/Backplane Assembly Troubleshooting

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

C:\ProgramData\Agilent\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 channel 1. The one above it is for channel 2. The next higher is for channel 3, and the top acquisition assembly is for channel 4. 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 and Test Name	Error Type	Assembly to Replace
Timebase Test Group		
Timebase Interpolator Test		Backplane assembly
ADC Test Group		
ADC Register Tests	ADC1, ADC2, ADC3, ADC4	Acquisition assembly 1
	ADC5, ADC6, ADC7, ADC8	Acquisition assembly 2
	ADC9, ADC10, ADC11, ADC12	Acquisition assembly 3
	ADC13, ADC14, ADC15, ADC16	Acquisition assembly 4
ADC Voltage Test Points	ADC1, ADC2, ADC3, ADC4	Acquisition assembly 1
	ADC5, ADC6, ADC7, ADC8	Acquisition assembly 2
	ADC9, ADC10, ADC11, ADC12	Acquisition assembly 3
	ADC13, ADC14, ADC15, ADC16	Acquisition assembly 4
Misc. Scope Test Group		
Temp Sensor Tests	Hedwig0, Hedwig1, Hedwig2, Hedwig3, Oak0	Acquisition assembly 1
	Hedwig4, Hedwig5, Hedwig6, Hedwig7, Oak2	Acquisition assembly 2
	Pred1, Pred2, MainFPGA, Wahoo, Ambient	Backplane assembly
	Merwig0, Merwig1	Replace acquisition assembly 1. If error still occurs, put original acquisition assembly back into scope and replace backplane assembly.
	Merwig2, Merwig3	Replace acquisition assembly 2. If error still occurs, put original acquisition assembly back into scope and replace backplane assembly.
	Merwig4, Merwig5, Hedwig8, Hedwig9, Hedwig10, Hedwig11, Oak4	Replace acquisition assembly 3. If error still occurs, put original acquisition assembly back into scope and replace backplane assembly.

Test Group and Test Name	Error Type	Assembly to Replace
	Merwig6, Merwig7, Hedwig12, Hedwig13, Hedwig14, Hedwig15, Oak6	Replace acquisition assembly 4. If error still occurs, put original acquisition assembly back into scope and replace backplane assembly.
Acq Flash RAM Tests	Test is currently not being run.	

Keyboard Troubleshooting

If some of the knobs fail the keyboard self test but some work properly, replace the rear board of the keyboard assembly.

If none of the knobs work properly, replace the front board of the keyboard assembly.

If any of the keys do not work properly but the LEDs light up, replace the front board of the keyboard assembly.

If the keys still do not work properly, check the incoming cables.

LED Troubleshooting

LED Failure During System Start-Up

When power is turned on to the scope, the front panel LEDs should all illuminate brightly for several seconds, then dim. The RealEdge LED (on 50 and 62 GHz models) should pulse off and on. When the Infiniium software starts up, the LEDs should turn off. If the LEDs do not light up this way during system start-up, then follow these steps:

- 1 Make sure connectors J2 and J3 on the front and rear boards of the keyboard assembly are securely connected to their mates on the other board.
- 2 Ensure the power cable is properly connected.
- 3 Make sure J17 is connected on the rear board of the keyboard assembly.

On/Off Switch Backlight LED Failure During Self Test

If the on/off switch backlight LED is not working, check the on/off cable connecting the On/Off board to the motherboard. If the LED still does not work, replace the On/Off board. If the LED still does not illuminate, replace the motherboard.

Front Panel LED Failures During Self Test

If any of the other LEDs on the front panel are not working, check these cables:

- The power cable to the front panel
- The USB cable to the front panel
- The backlight connector (J1) to the motherboard

If the cables are connected and working properly but the LEDs are still not working, then troubleshoot the acquisition assemblies to make sure they are working. If they are, replace the front board of the keyboard assembly. If the LEDs still do not illuminate, reload the oscilloscope software.

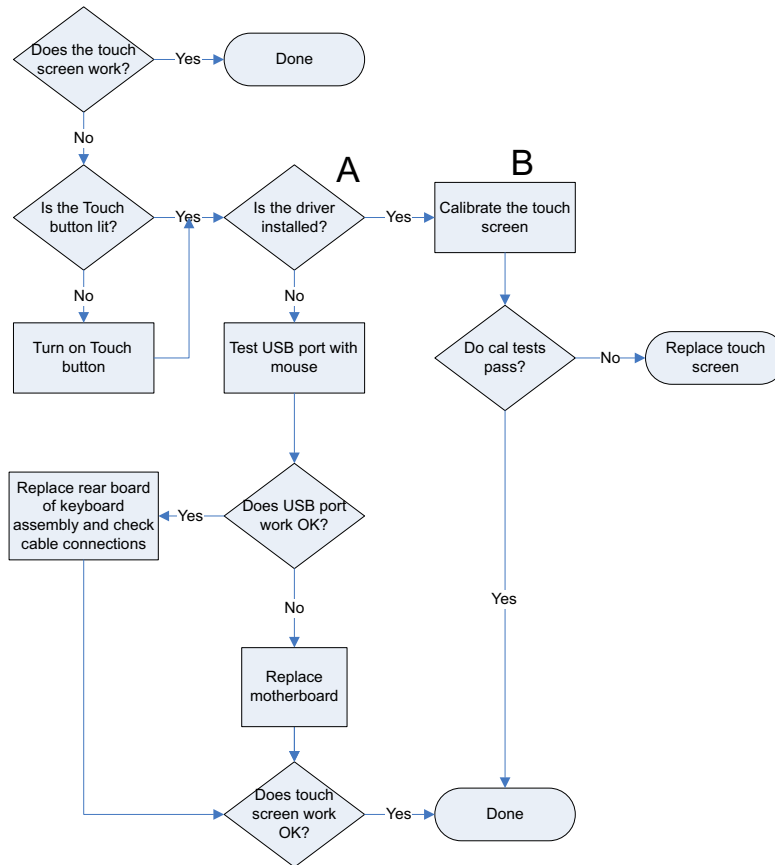
Replace the front board of the keyboard assembly in these cases:

- Only some of the LEDs illuminate
- No LEDs and no knobs work
- The knobs work but the LEDs don't illuminate.

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

Touch Screen Troubleshooting

Figure 4-9 Touch screen flowchart



A To find the driver, bring up the Start menu, right click **Computer**, then go to **Manage > Device Manager > Human Interface devices** and look for **USB HID Touch Screen Controller**. To ensure that it is enabled and working properly, right click the file name and select **Properties**. The General tab in the Properties menu should display a message stating that the device is working properly.

B To calibrate the touch screen, go to **All Programs > Microchip TSHARC Control Panel**. Select the Calibration tab, then press **Begin Calibration** and follow the instructions.

Oscillator Board Troubleshooting

If you encounter any problems with the oscillator board, first check all cabling and connections to ensure they are secure and tight:

- Check the connection between the oscillator board and the backplane board.
- Check the 10 GHz DRO output cable.
- Check the reference to the oscillator board cable.
- Check the 32 GHz DRO power cable (50 and 62 GHz models).
- Check the 32 GHz DRO cable connected to the RealEdge modules and the RealEdge auxiliary module (50 and 62 GHz models).
- Check the coax cables between the RealEdge auxiliary module and the RealEdge modules (50 and 62 GHz models).

If you cannot calibrate the time scale, or if all channels have excessive sample clock jitter, then replace the oscillator board.

If you get an error message similar to the following example, tighten the cable connections from the oscillator board to the RealEdge inputs. If the error appears again, replace the oscillator board:

Self calibration failure on Channel 1R, pilot tone amplitude too small

If replacing the oscillator board does not fix the problem, then replace the backplane board.

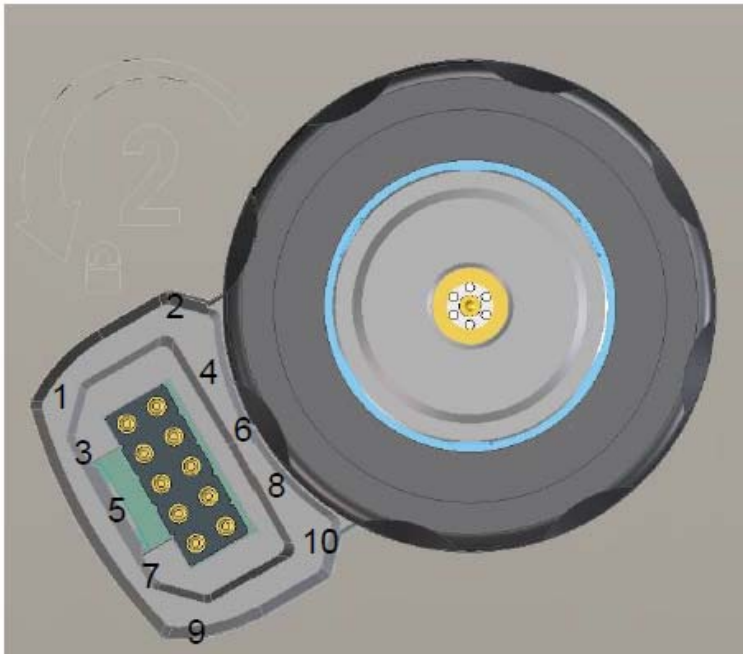
You must run a user calibration after replacing an oscillator board.

Checking Probe Power Outputs

Probe power outputs are on the front panel, in the lower left corner of the 3.5mm inputs.

Refer to [Figure](#) to check the power output at the connectors. Measure the voltages with respect to the ground terminal on the front panel, located near Aux Out. Measure the voltages at pins 2 and 5 only (+12V and -12V). These supplies, and all others, come from the front panel.

Figure 4-10 AutoProbe II pins



Pin	Desc.
1	+Vprog
2	+12V
3	Rprog
4	Offset
5	-12V
6	-Vprog
7	DATA1
8	Rid
9	CLK
10	DATA0

Before You Contact Agilent

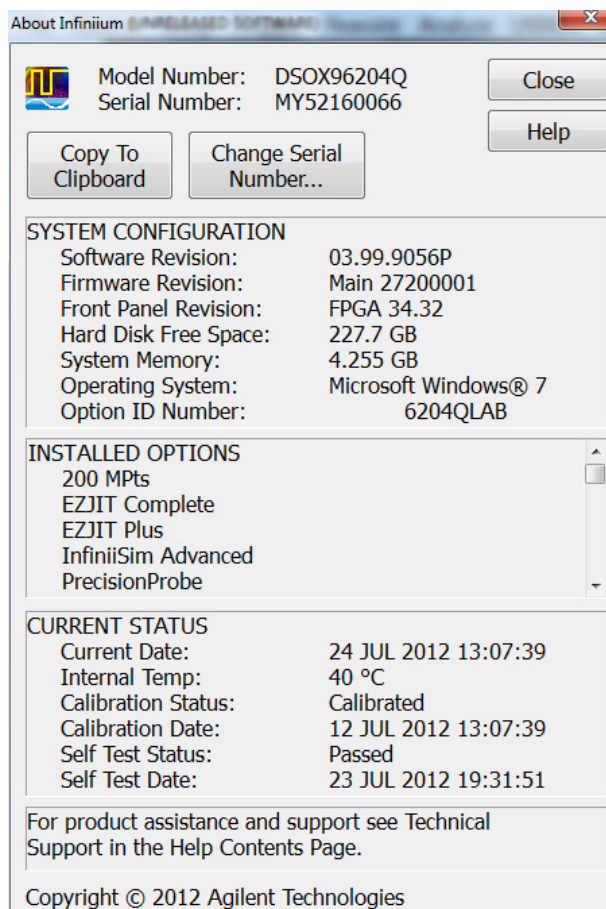
If you have read this Troubleshooting chapter and have unresolved questions about troubleshooting the oscilloscope, be ready to provide system information such as the current software version and installed options. This information will be useful when you contact Agilent Technologies.

To find and save system information, follow these steps:

- 1 Select **Help > About Infiniium**.

A dialog box similar to the one in Figure 4-11 appears.

Figure 4-11 About Infiniium Information



- 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.

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Replacing Assemblies

Replacing Assemblies

Use the procedures in this chapter when removing and replacing assemblies and parts in the Agilent Technologies oscilloscopes.

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

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

ESD 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

AVOID DAMAGE TO THE OSCILLOSCOPE!

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

Tools Required

The following tools are required for these procedures.

- Torx drivers: T10, T20
- Socket wrench: 5/8 inch
- Torque wrench: 5/16 inch (8 in-lbs)
- Flat-blade screwdriver: medium size (3/16 inch)
- Power driver vertical with T-20 bit (18 in-lbs)
- Power driver vertical with T-10 bit (5 in-lbs)
- Hex socket bit: 5/16 inch
- Open-end wrench: size 6 metric
- Needle-nose pliers (optional)

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 which may be damaged if the assembly is removed or replaced while power is connected to the oscilloscope.

WARNING

SHOCK HAZARD!

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

WARNING

SHOCK HAZARD!

Read the Safety information at the back of this guide before performing the following procedures. Failure to observe safety precautions may result in electrical shock.

WARNING

INJURY CAN RESULT!

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

Returning the Oscilloscope to Agilent Technologies for Service

Before shipping the oscilloscope, contact Agilent Technologies, Inc. for more details.

- 1 Write the following information on a tag and attach it to the oscilloscope.
 - Name and address of owner
 - Oscilloscope model numbers
 - Oscilloscope serial numbers
 - 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.

You can use the original shipping materials or order materials from an Agilent Technologies Sales Office. If neither is available, place 16 to 20 cm (6 to 8 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 Top Panel and Motherboard

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.

- 1 Remove the four M3 screws that connect the top panel to the rear. When replacing, use a Torx T10 to torque to 5 in-lbs.

Figure 5-1



- 2 Slide the top panel back 1 to 2 inches and then lift it off. If necessary, gently pry it using a flat-blade screwdriver at the rear lip.

Figure 5-2

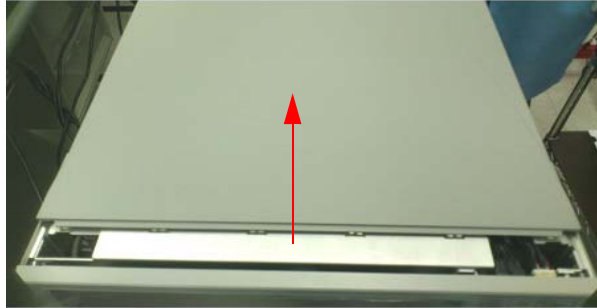
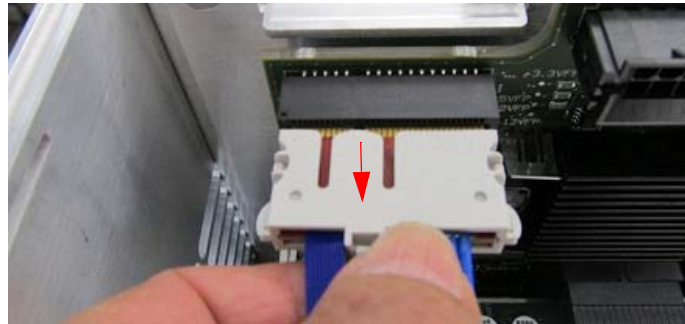


Figure 5-3



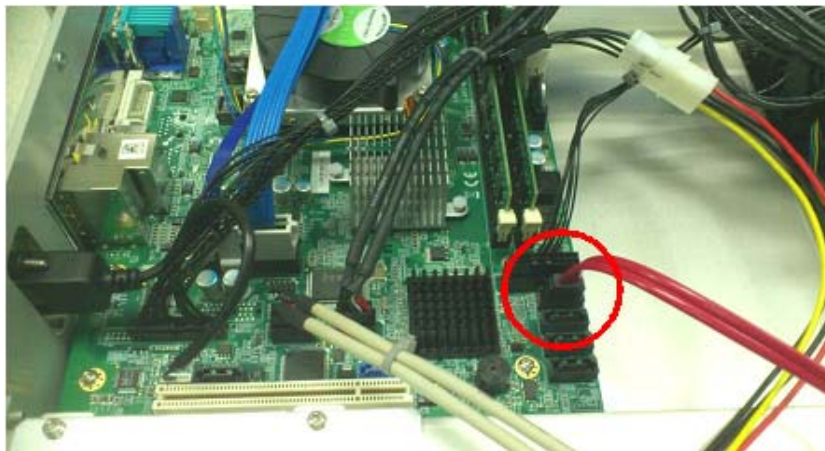
- 3 Disconnect the PCIe cable by pressing down on the locking tab and pulling the cable.

Figure 5-4



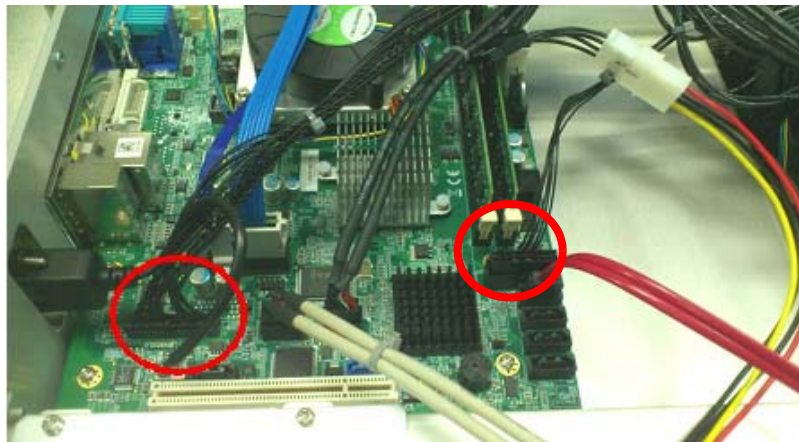
- 4 Disconnect the red SATA cable.

Figure 5-5



- 5 Disconnect the display cable (left circle in photo) and the standby switch cable (right circle, next to the SATA cable).

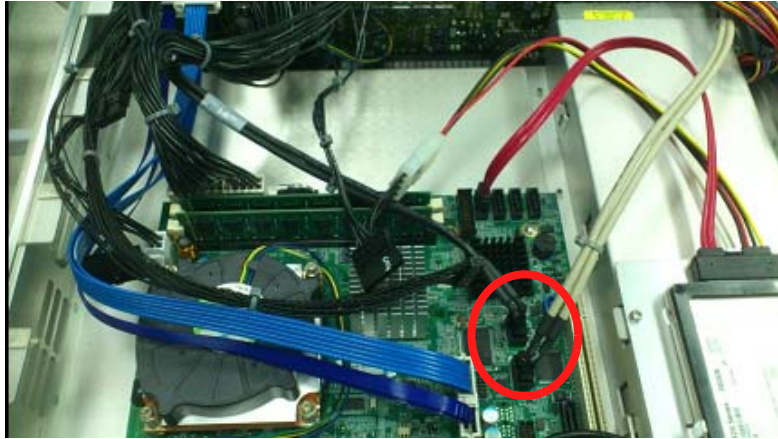
Figure 5-6



Chapter 5: Replacing Assemblies
Removing and Replacing the Top Panel and Motherboard

6 Disconnect the two USB cables.

Figure 5-7



7 Disconnect the power cable from the four locations shown in the next three figures.

Figure 5-8



Figure 5-9

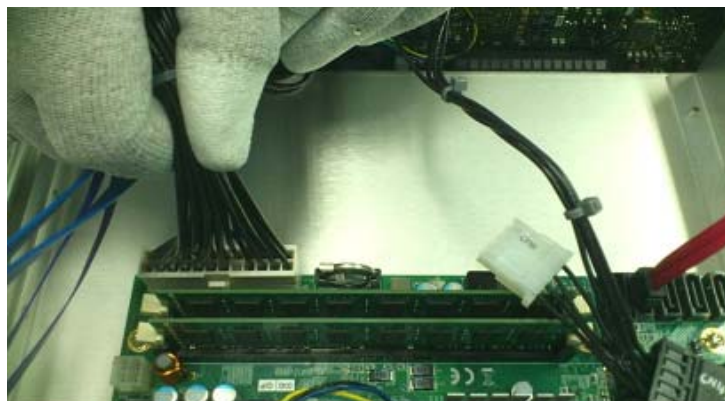
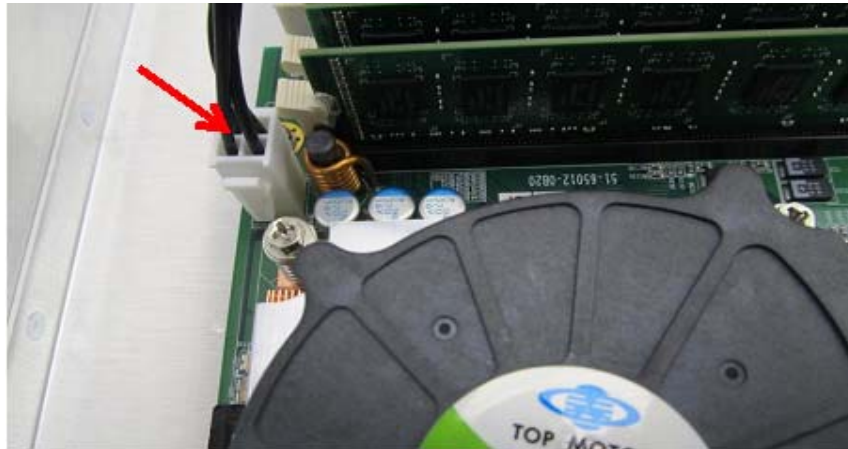


Figure 5-10



- 8 If you need to replace the motherboard fan, disconnect the cable from the fan to the motherboard now. Otherwise, you do not need to disconnect it.

Figure 5-11



- 9 Disconnect the USB controller cable.

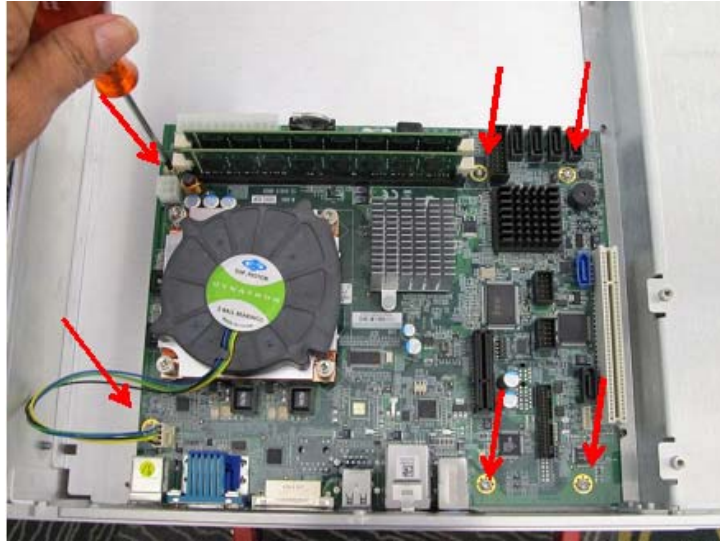
Figure 5-12



Chapter 5: Replacing Assemblies
Removing and Replacing the Top Panel and Motherboard

- 10 Remove the PCIe cable from the motherboard and set it aside to put on the new motherboard.
- 11 Remove the six M3 screws from the motherboard. When replacing, torque the screws to 5 in-lbs.

Figure 5-13



- 12 Pull the motherboard away from the back panel and then lift it out. Place the motherboard in an anti-static bag.
- 13 To reassemble the motherboard, reverse the above procedure. You will need a new heat sink and bracket and a support assembly board (54904-41203) when putting in a new motherboard.

Figure 5-14



Removing and Replacing the Hard Disk Drive

- 1 Loosen the two screws on back of the hard disk drive.

Figure 5-15



- 2 Pull the hard drive out.

Figure 5-16



- 3 Remove the four screws connecting the disk drive to the bottom of the plate.
- 4 To replace the hard disk drive, reverse this procedure.

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.

- 1 Loosen the rear panel screw and lower the handle.

Figure 5-17



- 2 Remove the power supply.
- 3 Reverse the procedure to replace the power supply.

Removing and Replacing the Front Panel Assembly and Bottom Panel

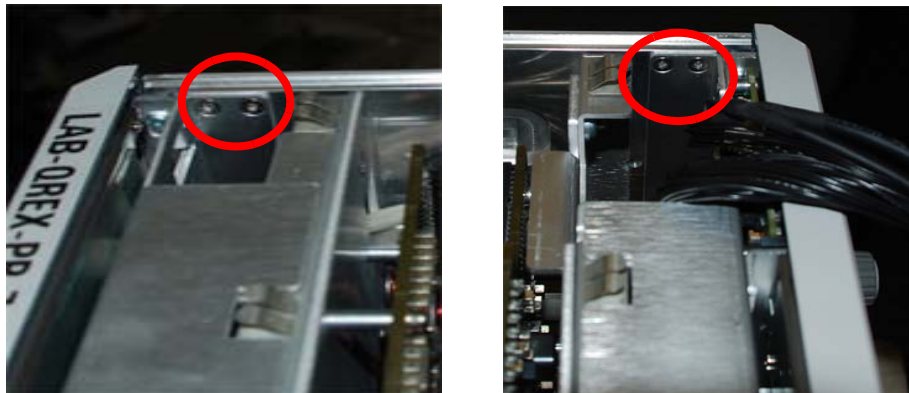
- 1 Remove the top panel as described previously. Disconnect the two USB cables and the display and standby switch cables as described previously. Unsnap the locking clip to remove the USB cable. Also disconnect the front panel power cable from the backplane board.

Figure 5-18



- 2 Remove the four screws (two on each side) connecting the front panel assembly to the top of the chassis.

Figure 5-19



Chapter 5: Replacing Assemblies
Removing and Replacing the Front Panel Assembly and Bottom Panel

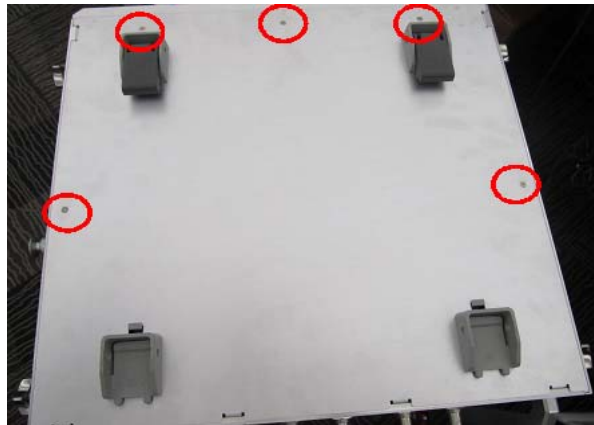
- 3 Turn the oscilloscope upside-down and remove the four M3 screws connecting the bottom panel to the back panel. When replacing, torque the screws to 5 in-lbs.

Figure 5-20



- 4 Remove the five M3 screws from the bottom panel.

Figure 5-21



- 5 Remove the bottom panel.

- 6 Disconnect each input cable from each of the four attenuator connectors using a 5/16-inch Hex torque wrench. When reconnecting, torque to 8 in-lbs. The length of the cable will guide the installation (longest cable on left, shortest cable on right).

Figure 5-22



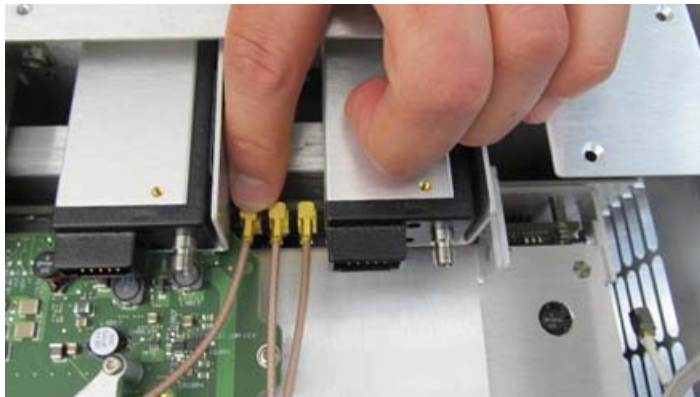
- 7 Disconnect the attenuator power cable from each input channel attenuator.

Figure 5-23



- 8 Disconnect the Probe Comp cable from the connector on the backplane board.

Figure 5-24



Chapter 5: Replacing Assemblies
Removing and Replacing the Front Panel Assembly and Bottom Panel

- 9 Disconnect the Aux Out and Cal Out cables from both the front panel and the backplane board. Pull straight back to remove the cables from the backplane board. **CAUTION:** Be sure to pull straight back to avoid bending or breaking the connection to the backplane board. When reconnecting, gently reinsert each cable. You will hear a snap when it is fully seated.

Figure 5-25



Figure 5-26



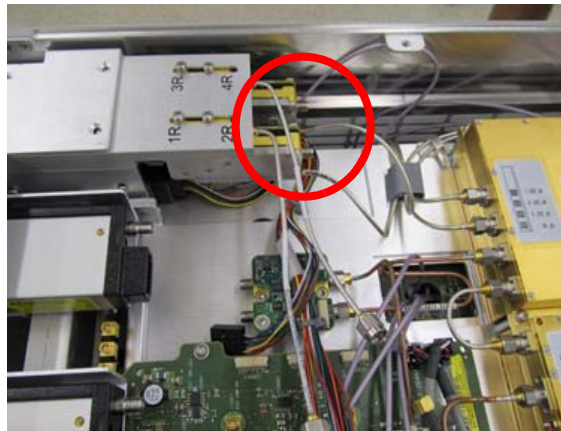
The front panel is now disconnected.

Removing a RealEdge Assembly

If you are working on a 50 or 62 GHz model, it will have a RealEdge assembly. The following steps show how to remove it. Be sure to remove the RealEdge assembly before removing the front panel to avoid damaging the assembly.

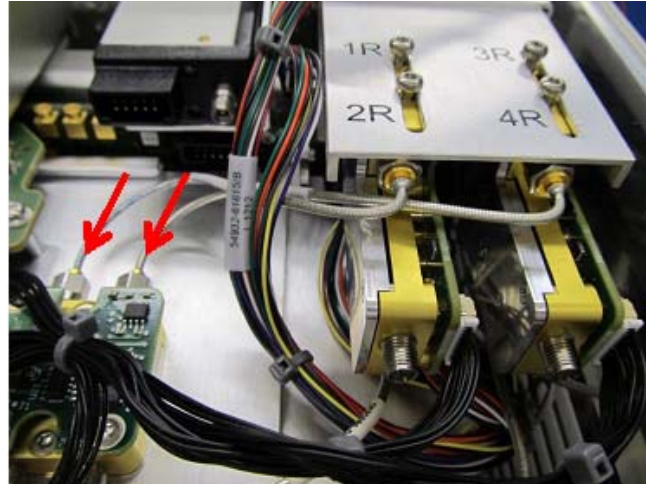
- 1 Disconnect the two input cables from the RealEdge modules and from the RealEdge modules to the RealEdge auxiliary module.

Figure 5-27



- 2 Disconnect the cable connecting the pilot cables to the RealEdge auxiliary module. When reconnecting, torque the connectors to 8 in-lbs. using a 5/8-in. hex torque wrench.

Figure 5-28



- 3 Disconnect the RealEdge assembly power cables.

Figure 5-29



- 4 Remove the four M3 screws.

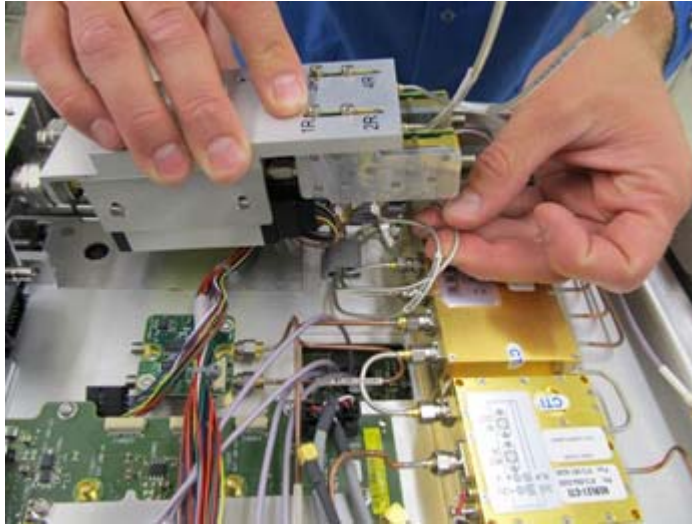
Figure 5-30



Chapter 5: Replacing Assemblies
Removing and Replacing the Front Panel Assembly and Bottom Panel

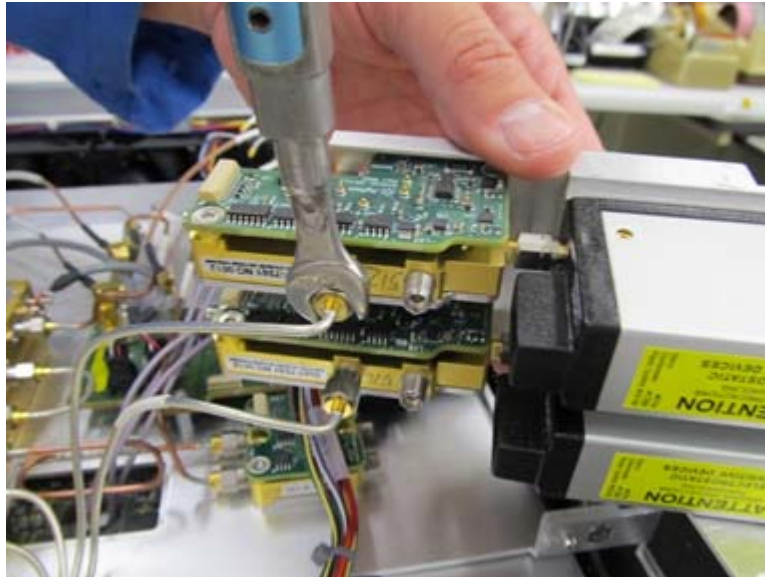
- 5 Gently remove the RealEdge assembly, keeping the cables from getting caught. Gently slide it toward the back, careful to avoid catching any parts on the sheet metal flange on the chassis.

Figure 5-31



- 6 Flip the RealEdge assembly over and disconnect the remaining cables: two input cables, two attenuator cables, and the two cables coming from the 32 GHz DRO. You do not need to disconnect the cables from the DRO itself.

Figure 5-32



- 7 Place the RealEdge assembly into an anti-static bag.

Finishing Removal of the Front Panel

- 1 To finish removing the front panel, remove the four M3 screws (two on each side) connecting the front panel to the bottom of the chassis. When replacing, torque the screws to 5 in-lbs.

Figure 5-33



- 2 Pull off the front panel, carefully feeding the USB cable through the opening.
- 3 To replace the front panel assembly, reverse this procedure.

Removing and Replacing Front Panel Assembly Parts

Remove the front panel assembly as described in the previous section.

Front Panel Clutches, Connectors, and Knobs

WARNING

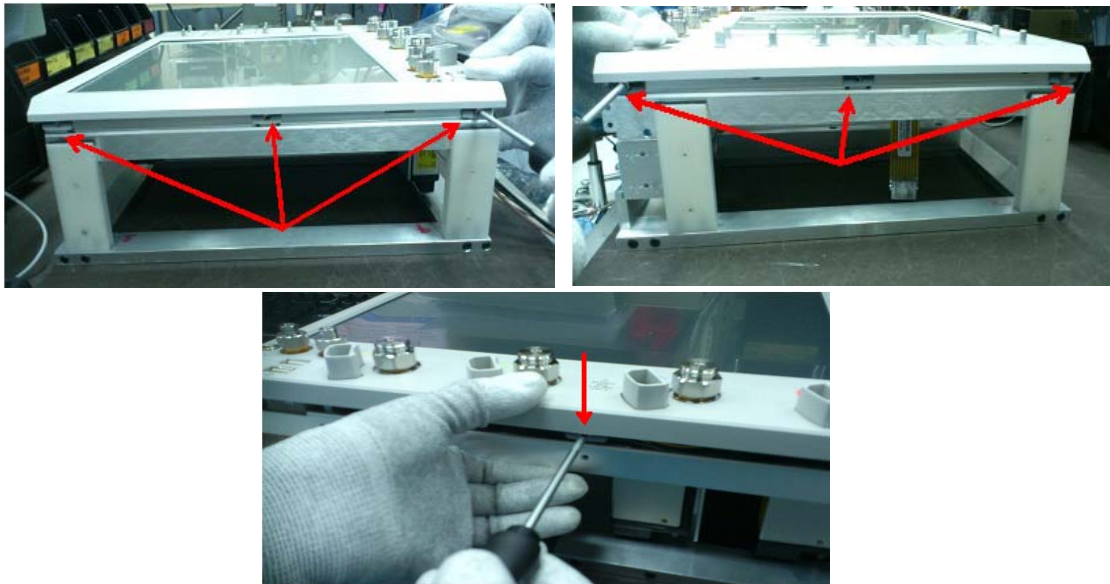
This step will ruin the clutch. You will have to replace the clutch with a new one.

- 1 Use a thin item such as a ribbon to protect the oscilloscope from scratches, and pull on the dark gray plastic clutches to pop them off of the oscilloscope.
- 2 Use your fingers to pull off the knobs.

Front Panel Bezel and Front Panel Assembly

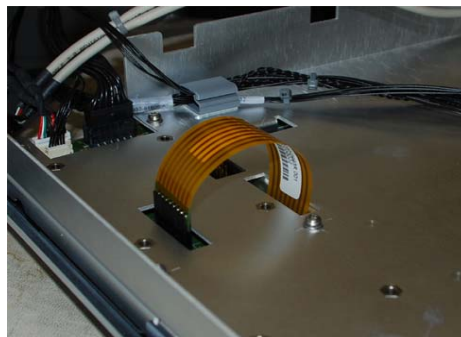
- 1 Remove the seven M3 screws (three from each side and one from the bottom). When replacing the screws, torque to 5 in-lbs.

Figure 5-34



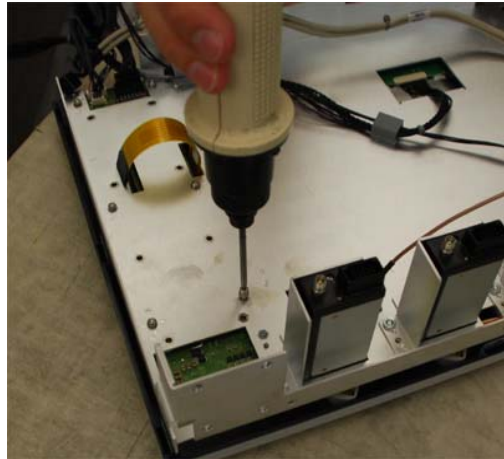
- 2 Disconnect the orange touch screen cable.

Figure 5-35



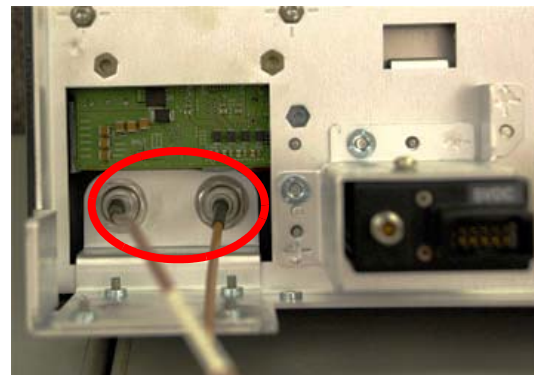
- 3 Remove the six screws from the back of the front panel.

Figure 5-36



- 4 If the oscilloscope is a 20, 25, or 32 GHz model, it will have a filler plate covering Trig Out and Aux Trig. Remove this plate from the back of the front panel by removing the nuts and washers from the cables.

Figure 5-37



Remove nuts
and washers

- 5 Lift off the front panel bezel.

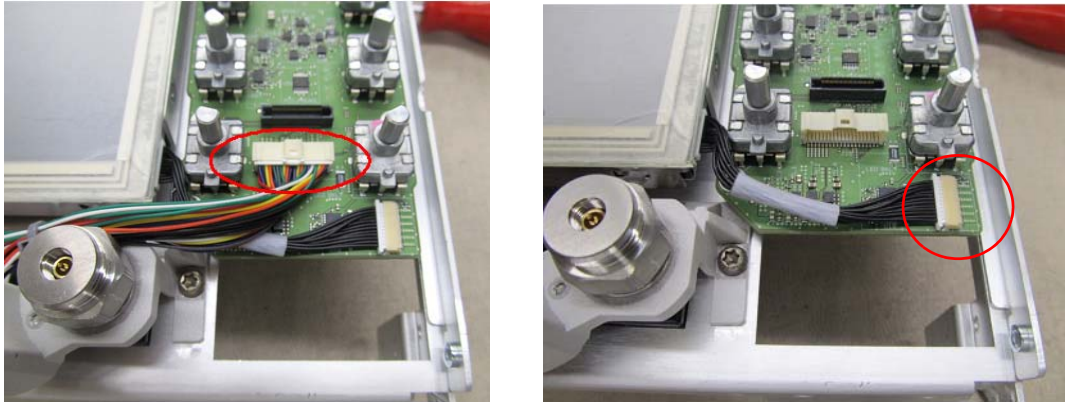
Figure 5-38



Chapter 5: Replacing Assemblies
Removing and Replacing Front Panel Assembly Parts

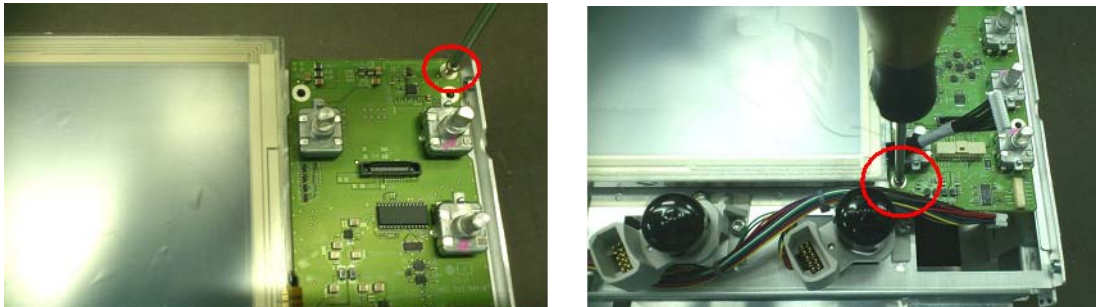
- 6 The front circuit board of the keyboard assembly is connected to the front bezel. If you need to remove and replace only this front board, push the snap tabs out of way with a screwdriver and pull out the board.
- 7 Disconnect the autoprobe cable and backlight cable.

Figure 5-39



- 8 Remove the two M3 screws, top right and bottom left, connecting the rear board of the keyboard assembly to the deck, and remove the board. When reinstalling, torque to 5 in-lbs.

Figure 5-40



- 9 To reassemble the front panel assembly, reverse these steps.

Cal Connector (Power Button) Assembly

- 1 Remove the two screws connecting the cal bracket to the front deck. When replacing, use a power driver and T-10 bit to torque the screws to 8 in-lbs.

Figure 5-41



- 2 Remove the cal connector assembly from the front panel deck. Carefully pull the cables through the front deck. Replace individual parts as needed.

Figure 5-42



Display Assembly

- 1 Remove the front panel bezel and front panel assembly as described previously.
- 2 Disconnect the display cable from the back of the display.

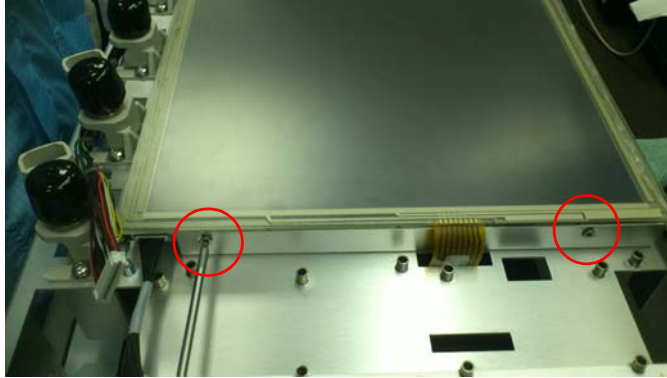
Figure 5-43



Chapter 5: Replacing Assemblies
Removing and Replacing Front Panel Assembly Parts

- 3 Remove the four M3 screws (two on each side) connecting the display to the deck. When reinstalling, torque to 5 in-lbs.

Figure 5-44



Attenuators (20, 25, and 33 GHz Models)

- 1 Remove the four screws connecting each attenuator to its bracket. When reconnecting, torque the screws to 8 in-lbs.



- 2 Remove the four attenuators by removing the nut of the attenuator from the threads of the 3.5 mm connector. Remove the attenuator from the bracket. When replacing, use a hand torque wrench to torque the nuts to 8 in-lbs.

Figure 5-45

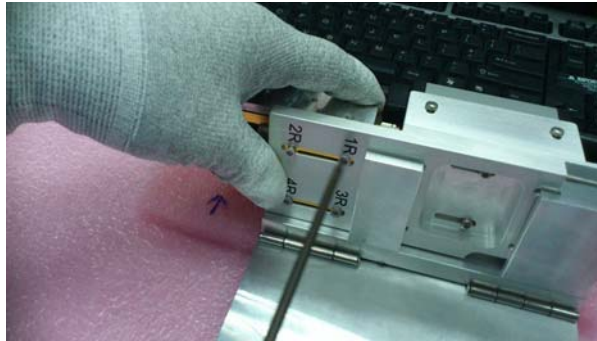


Removing and Replacing RealEdge Components

This section describes how to remove and replace the RealEdge modules and the attenuator components of the RealEdge assembly.

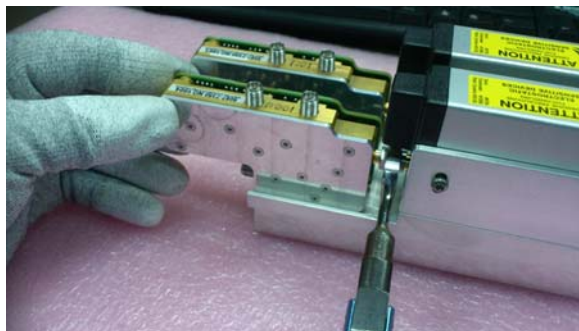
- 1 Remove the RealEdge assembly as described previously.
- 2 Remove the two screws from the back of the top RealEdge module as shown below. When replacing, torque to 5 in-lbs.

Figure 5-46



- 3 Loosen the connection between the RealEdge SMA connector and the attenuator connector. Be careful to handle the RealEdge module by the casing and not the connector. When tightening, torque the connector to 8 in-lbs.

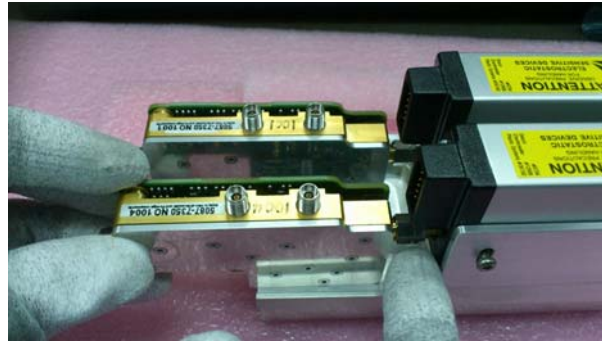
Figure 5-47



Chapter 5: Replacing Assemblies
Removing and Replacing RealEdge Components

- Carefully remove the RealEdge module.

Figure 5-48



- Remove the two screws on the side of the attenuator. When replacing, torque to 5 in-lbs.

Figure 5-49



- Loosen the SMA connector from the male SMA connector on the 1.85 connector. When replacing, torque the connector to 8 in-lbs.

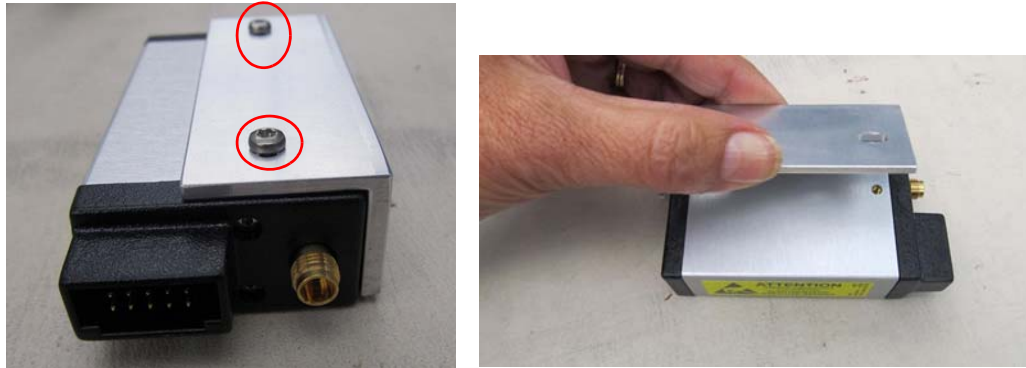
Figure 5-50



- Remove the attenuator assembly.

- 8 Remove the two screws connecting the attenuator to the bracket. When replacing, hand tighten the screws and then back off the screw one full turn to allow the frame to move. Tighten the screws after the connector is tightened.

Figure 5-51



- 9 Repeat these steps to remove and replace the bottom RealEdge module and attenuator.

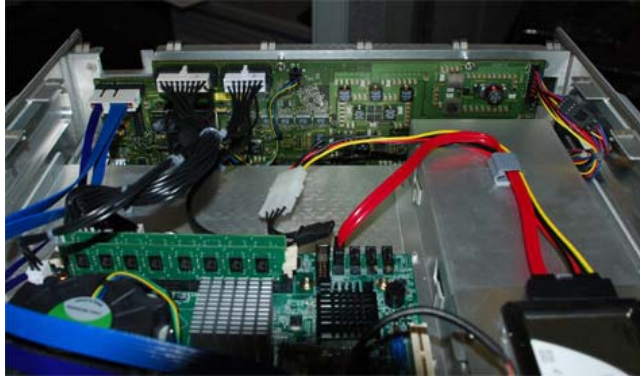
Removing and Replacing the Acquisition Boards/Backplane Assembly

Use these procedures to remove and replace the acquisition and backplane assemblies and individual acquisition boards. When necessary, refer to other removal procedures. The graphics in this chapter are representative of the oscilloscope at the time of this printing. Your unit may look different.

Removing the acquisition and backplane assemblies

- 1 Remove the top panel, power supply, front panel assembly, and bottom panel as described previously.
- 2 Remove all cables connected to the backplane board.

Figure 5-52



- 3 Remove the two M4 screws from the backplane tray (one in each corner).

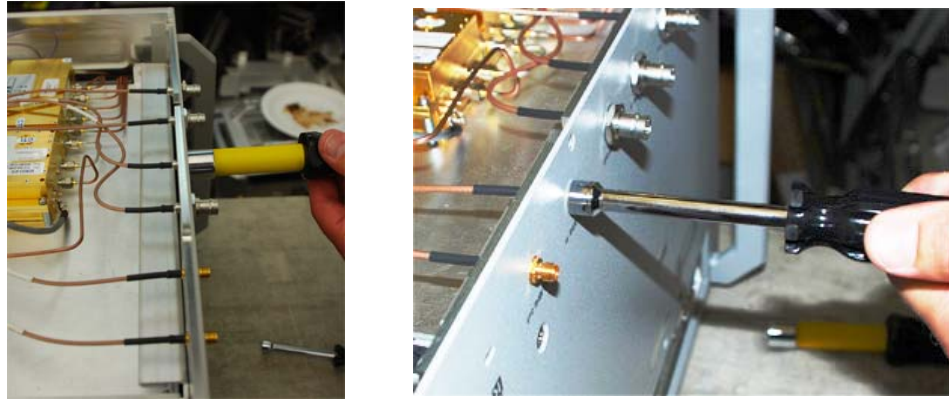
Figure 5-53



- 4 Turn the oscilloscope over.

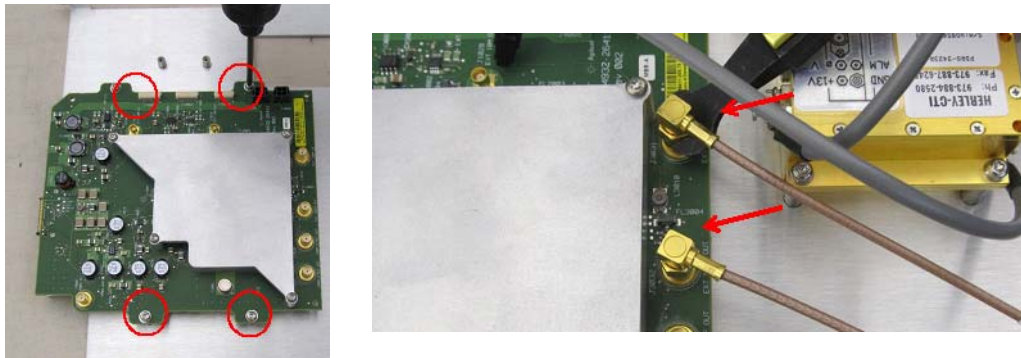
- 5 Disconnect the cables from the rear panel (four cables for 33 GHz and lower models; six cables for 50 GHz and 62 GHz models), using 5/8 (left photo) and 5/16 (right photo) drivers. When reconnecting, torque the nut and washers to 18 in-lbs.

Figure 5-54



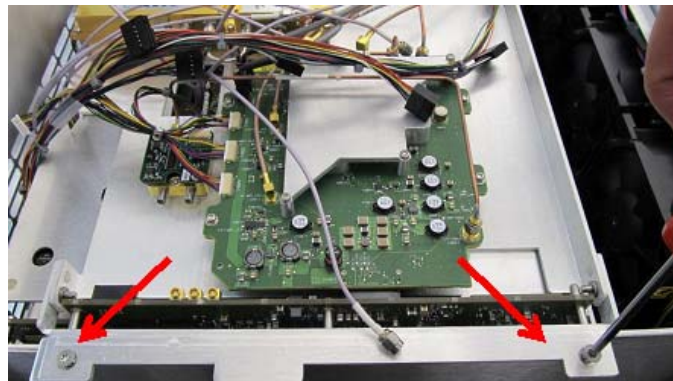
- 6 If you need to replace the oscillator board, remove the four M3 screws connecting the board to its tray and disconnect all attached cables. When replacing, torque the screws to 5 in-lbs and torque SMA connectors to 8 in-lbs using a 5/16-inch hand torque wrench.

Figure 5-55



- 7 Remove the two screws connecting the backplane deck to the chassis.

Figure 5-56



Chapter 5: Replacing Assemblies
Removing and Replacing the Acquisition Boards/Backplane Assembly

- 8 Remove the four M4 screws from the rear panel of the chassis. When replacing, torque the screws to 18 in-lbs.

Figure 5-57



- 9 Dress all cables into the center to keep them from getting caught.
- 10 Lift the entire backplane board/acquisition assembly out of the chassis and place it on another table. Use the handles, as the assembly is heavy.

Figure 5-58

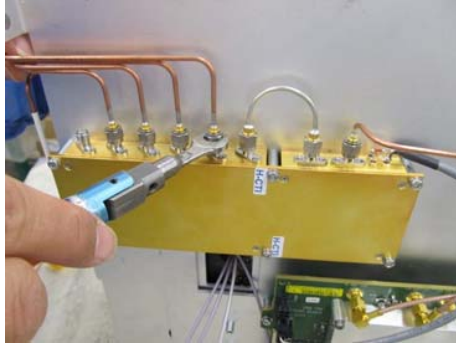


Removing an Acquisition Board

When removing an individual acquisition board, keep in mind that acquisition board 1 is next to the oscillator board and it has the longest cable. Acquisition board 4 has the shortest cable. You may want to label the acquisition boards 1 through 4 for easy reference.

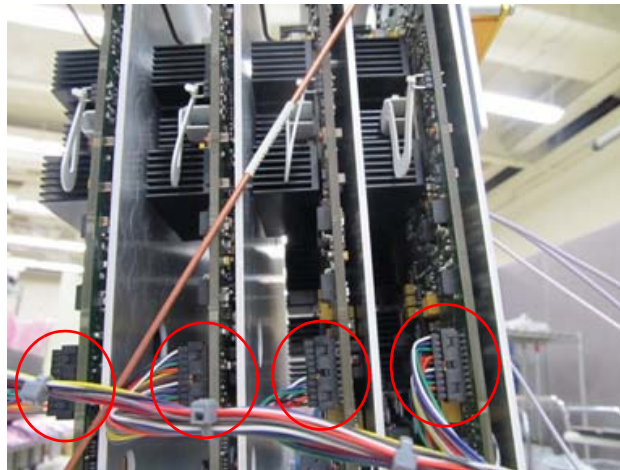
- 1 Carefully remove the five clock cables from the DRO to the acquisition boards using a 5/16 Torx wrench. Be sure to avoid catching the cables on any acquisition board components.

Figure 5-59



- 2 Remove the attenuator control cables.

Figure 5-60



Chapter 5: Replacing Assemblies
Removing and Replacing the Acquisition Boards/Backplane Assembly

- 3 Remove the 10 M4 screws (five from each side) connecting the acquisition boards to the rear panel. Keep the oscillator board tray connected to acquisition board 1 unless you have already removed it. When reassembling, torque the screws to 18 in-lbs using a T20 driver.

Figure 5-61



- 4 Lift off the rear panel.
- 5 Remove the two screws (one on each side) connecting the oscillator board tray to the backplane deck, unless you are replacing only acquisition board 4.

Figure 5-62



To remove only board 4, disconnect the 54932-61624 cable and the attenuator cable connection from board 4 only. Then remove the cable from the backplane board to the DRO.

- 6 Lift the oscillator board tray straight up and slide it forward, carefully threading the input cables through the opening. Place the oscillator board into an anti-static bag.

- 7 Remove the eight remaining screws securing the acquisition trays to the backplane tray. Remove each acquisition board starting with the lowest slot (next to the oscillator board).

Figure 5-63



- 8 Gently rock the acquisition board and guide the input cables through. Remove the acquisition board and place it upside-down in an anti-static bag to avoid crimping the cables.
- 9 Repeat steps 7-8 for any additional acquisition boards to be removed, if applicable. When removing the last acquisition board, grip it firmly and then gently rock it up and out.

Removing Acquisition Board Cables and Trays

- 1 Disconnect the input cables (one cable for 20, 25, and 32 GHz models; two cables for 50 and 62 GHz models) and feed them through the hole.

Figure 5-64

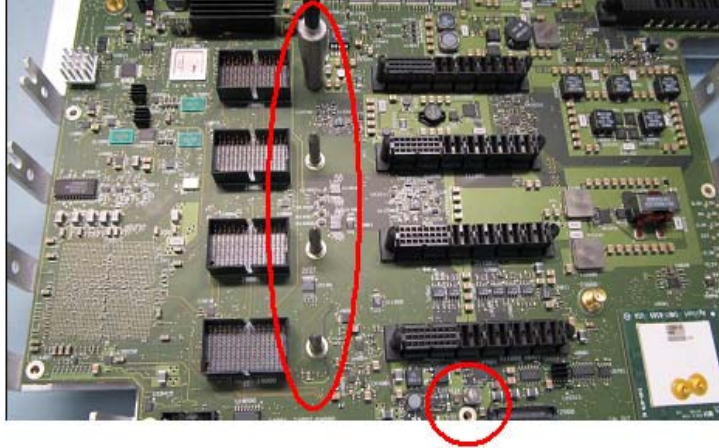


- 2 Remove the 10 screws connecting the acquisition board to the tray. Keep the cables to attach to the new acquisition board.

Removing the Backplane Board from the Deck

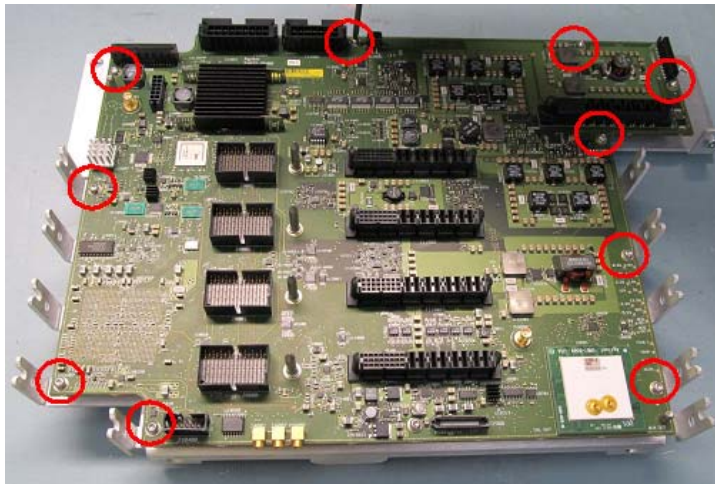
- 1 Loosen the five guide pins. When replacing, torque the guide pins to 5 in-lbs using a size 6 metric open-end wrench.

Figure 5-65



- 2 Using a T10 Torx, remove the 10 tie-down screws from the edges. When replacing, torque the screws to 5 in-lbs.

Figure 5-66



- 3 Lift the backplane assembly off the deck.

Setting the Calibration Factors after Replacing an Acquisition Board

You must perform a user calibration and self test procedure after replacing an acquisition board. Refer to the calibration chapter in this Service Guide for details.

Let the oscilloscope warm up before testing.

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.

Removing and Replacing the Fans

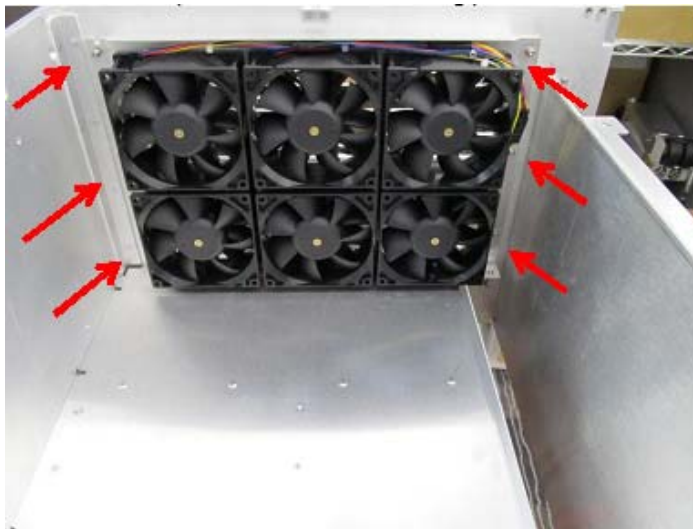
WARNING

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 in working with the oscilloscope. Failure to observe these precautions may result in injury.

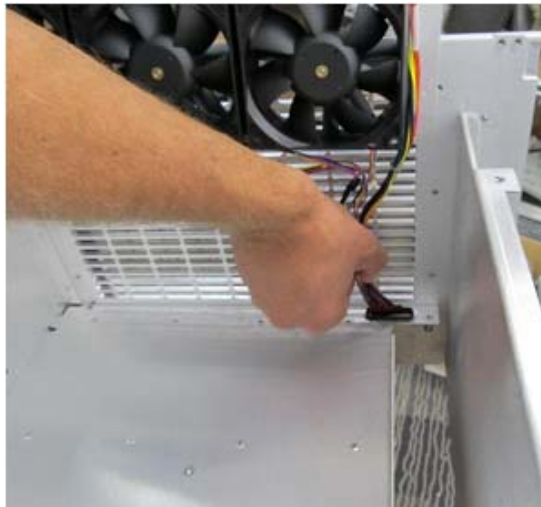
- 1 Disconnect the power cable and remove the top panel, power supply, front panel, bottom panel, and acquisition assembly as described earlier.
- 2 Remove the six M3 screws connecting the fan bracket to the chassis. When replacing, torque the screws to 5 in-lbs.

Figure 5-67



- 3 Remove the fan assembly, carefully feeding the fan assembly cable through the bottom of the chassis.

Figure 5-68



- 4 Clip off the end of each of the fan mounts (see Figure 5-69) and take the fan out. Repeat for each fan that needs to be replaced.

Figure 5-69



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.

- 5 To install the fan, reverse this procedure.

Removing and Replacing the USB Controller Cable

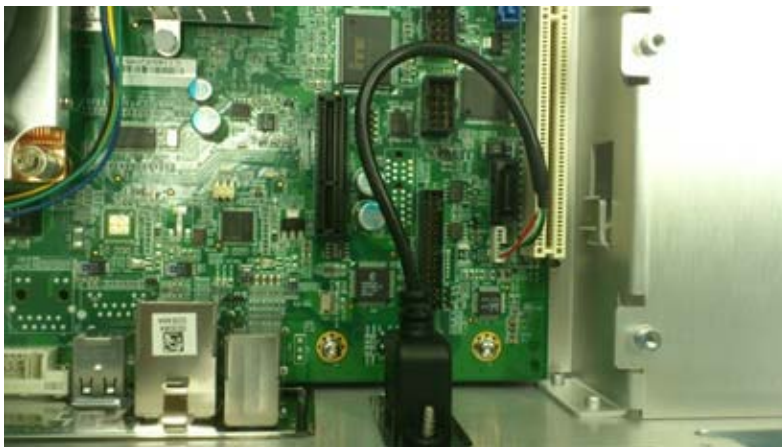
- 1 Remove the top panel.
- 2 Remove the two self-tapping screws from the top edge of chassis. When replacing, torque the screws to 3 in-lbs.

Figure 5-70



- 3 Disconnect both ends of the cable.

Figure 5-71



- 4 Pull the connector cable out of the oscilloscope.

Figure 5-72



- 5 To replace the USB controller cable, reverse the procedure. Be careful not to overtighten the screws.

Chapter 5: Replacing Assemblies
Removing and Replacing the USB Controller Cable

Ordering Replaceable Parts	108
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Unlisted Parts	108
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Replaceable Parts List	114

Replaceable Parts

This chapter describes how to order replaceable assemblies and parts for the Agilent 90000 Q-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 Agilent Technologies part number, indicate the quantity desired, and address the order to the nearest Agilent Technologies Sales Office.

Unlisted Parts

To order a part not listed in the parts list, include the 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 Agilent Technologies Sales Office.

Direct Mail Order System

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

- Direct ordering and shipping from the Agilent Technologies parts center in California, USA.
- No maximum or minimum on any mail order. (There is a minimum amount for parts ordered through a local Agilent Technologies Sales Office when the orders require billing and invoicing.)
- Prepaid transportation. (There is a small handling charge for each order.)
- No invoices.

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

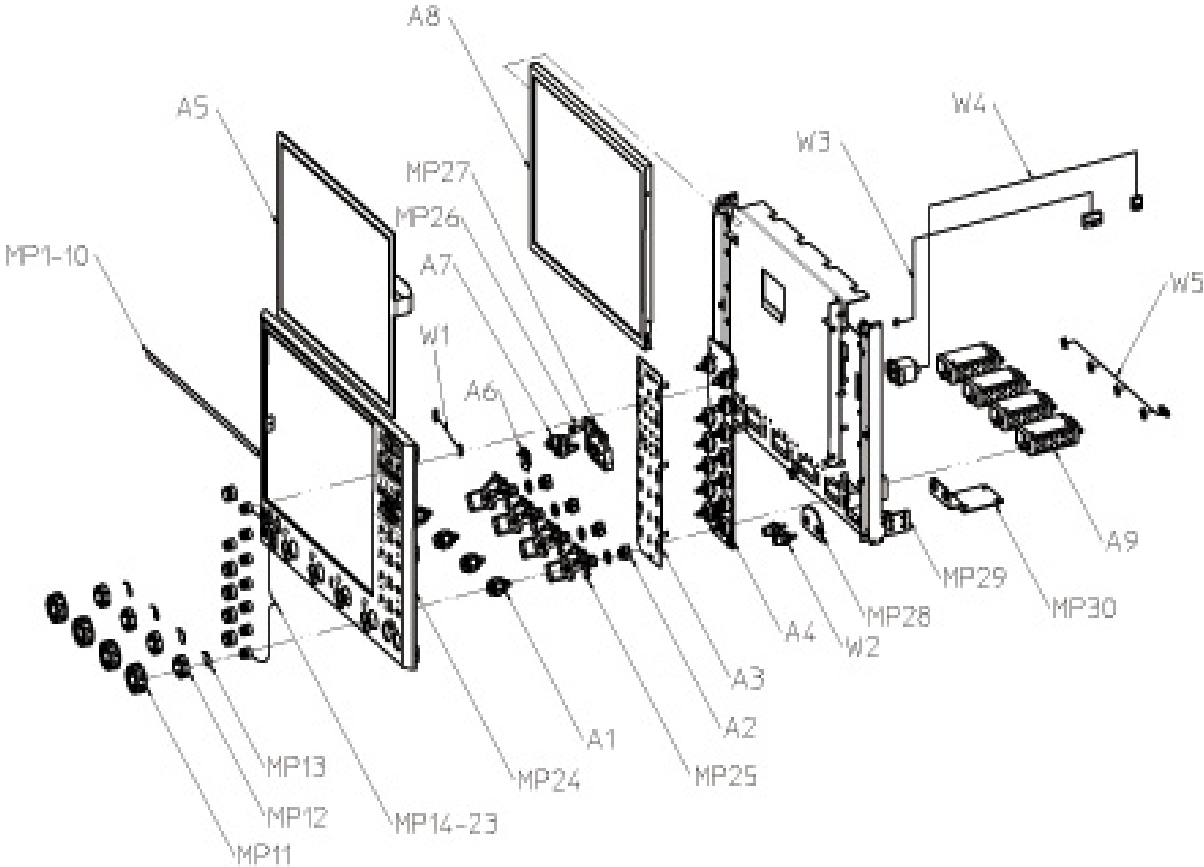
Mail order forms and specific ordering information are available through your local Agilent Technologies Sales Office. Addresses and telephone numbers are located in a separate document shipped with the manuals.

Exchange Assemblies

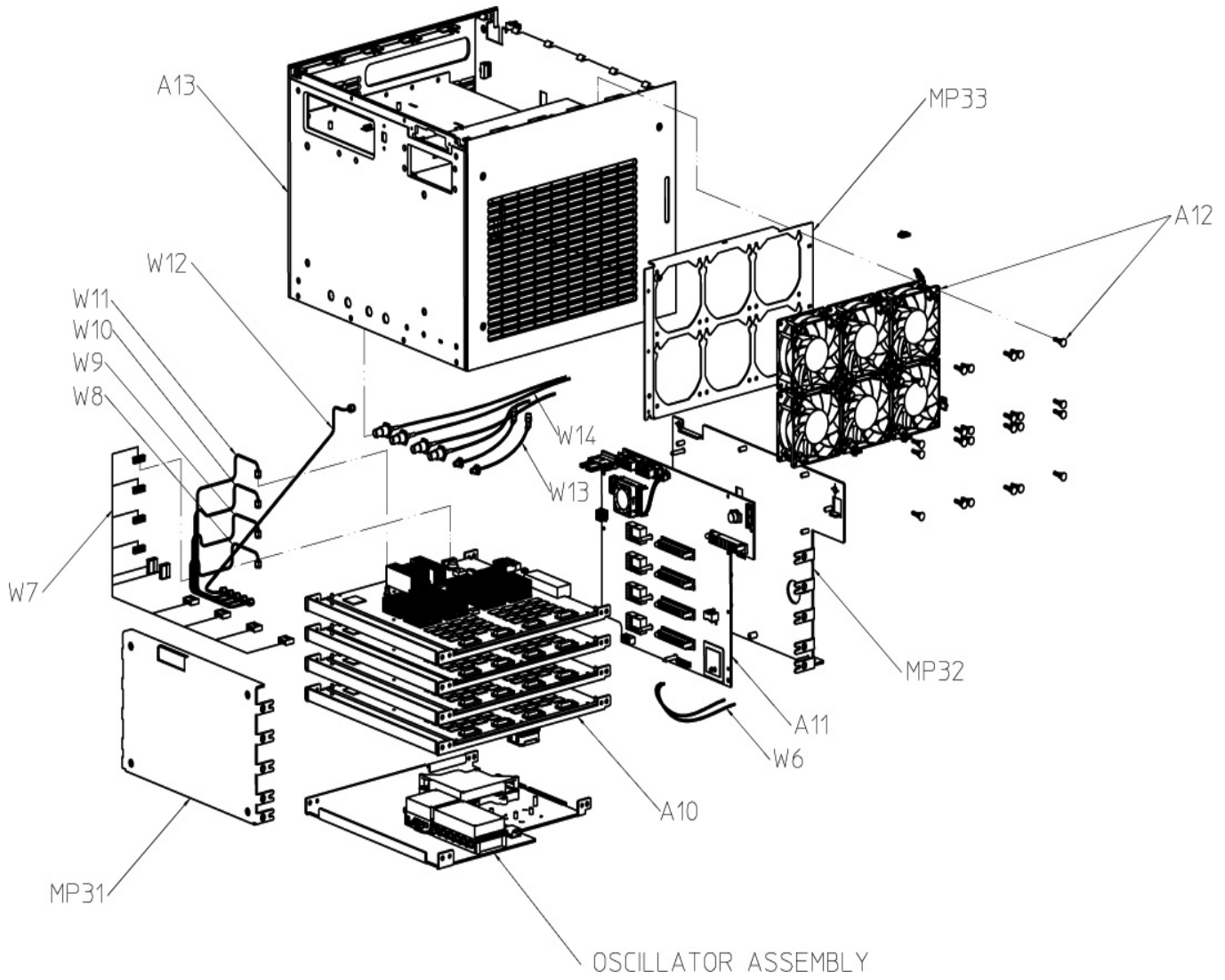
Exchange assemblies have been set up for Agilent Service Center use only.

Exploded Views

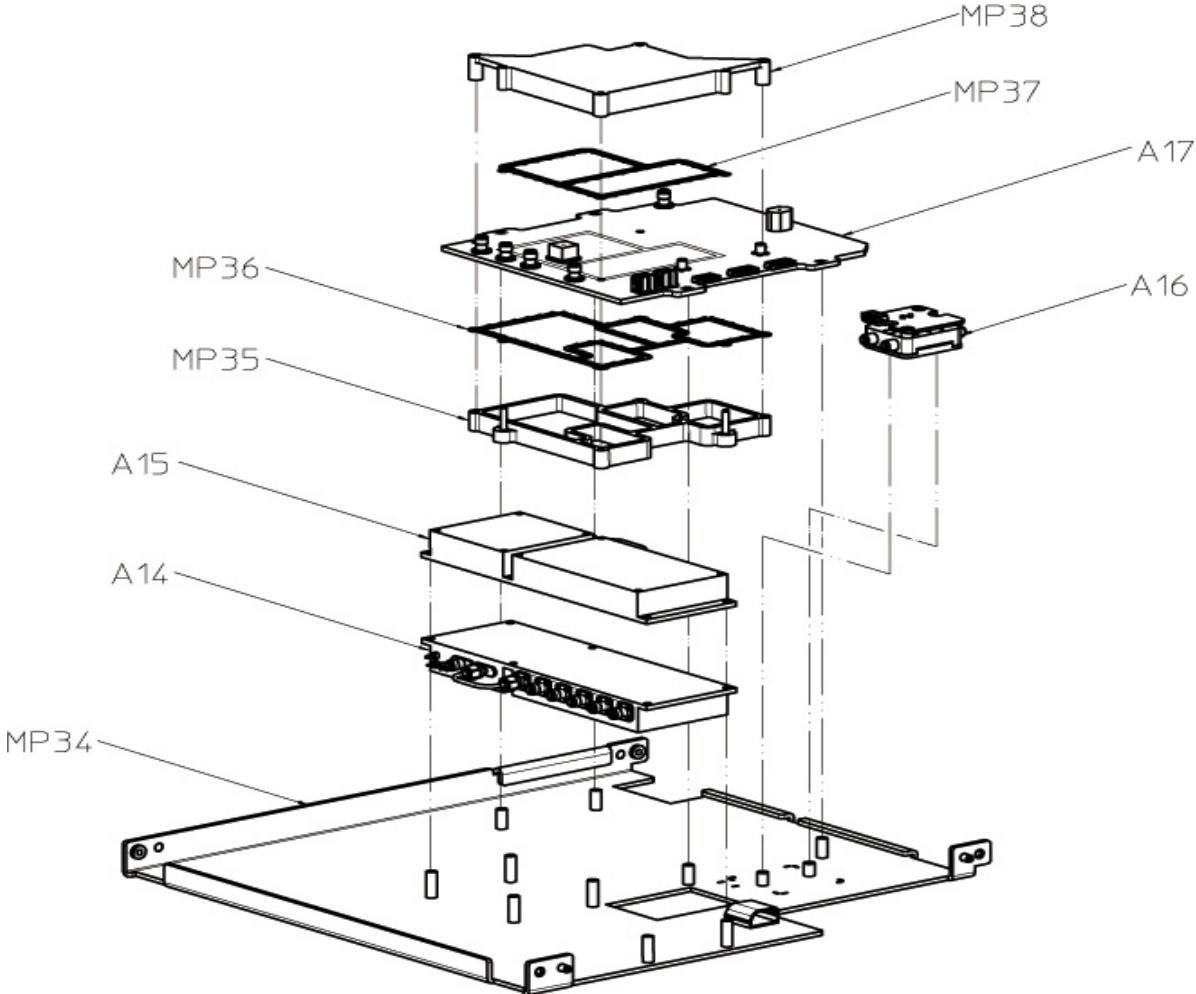
Front Panel



Fan and Acquisition Assembly

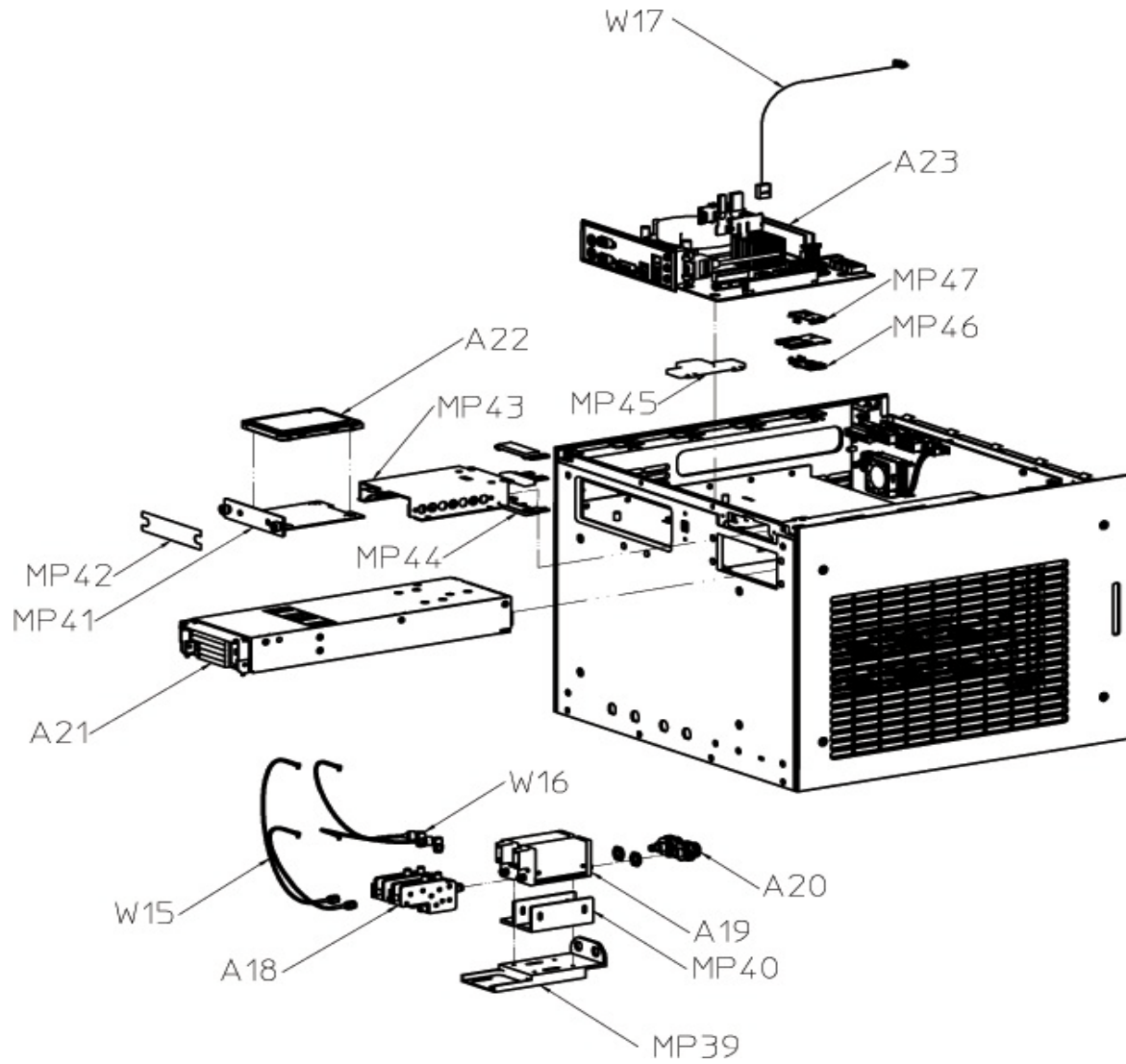


Oscillator Assembly

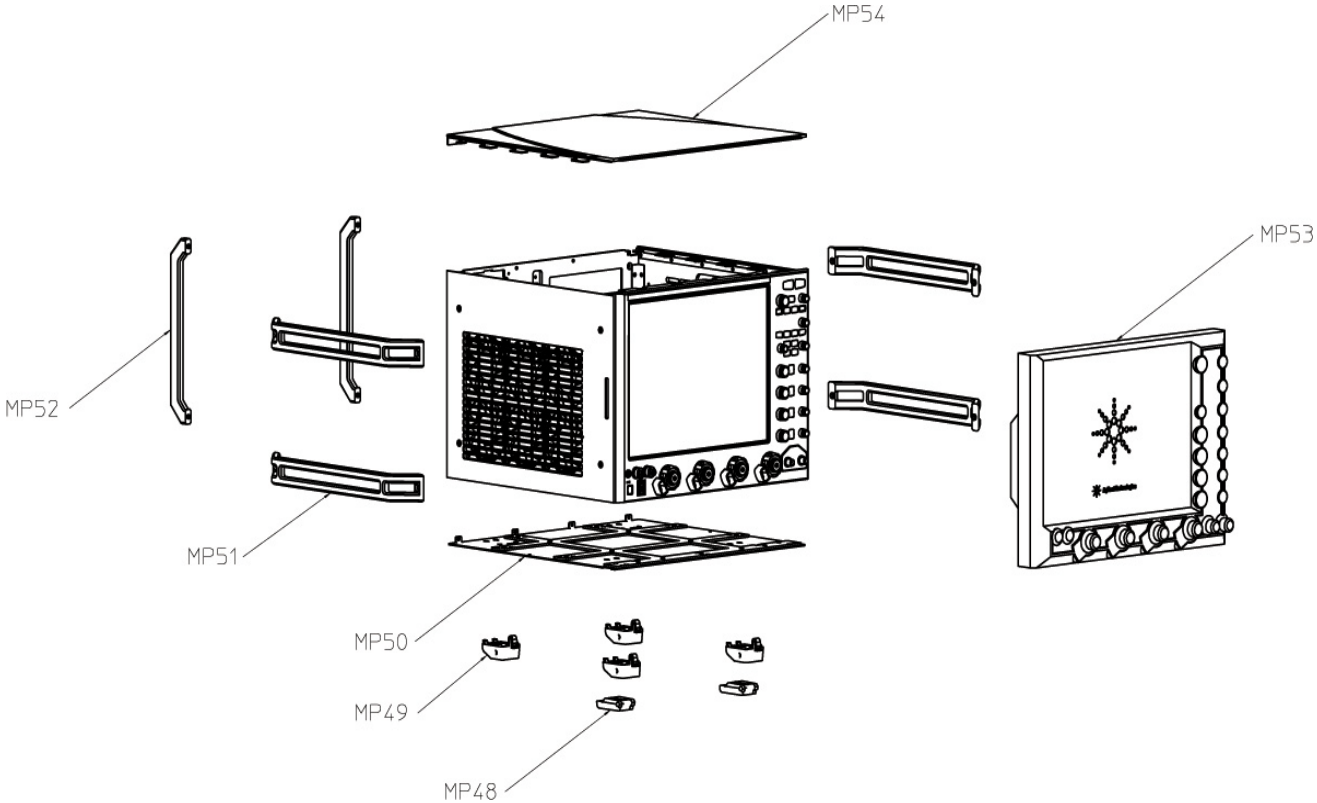


**Chapter 6: Replaceable Parts
Exploded Views**

Power Supply and PC Motherboard



External



Replaceable Parts List

The following table is a list of replaceable parts. The information given for each part consists of the following:

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

Replaceable Parts

Ref. Des.	Agilent Part Number	QTY	Description
A1	5062-1247	1	Assembly - 3.5 mm Connector
A2	54916-66414	1	PCA Autoprobe Board
A3	54932-66404	1	PCA Keyboard - Front
A4	54932-66405	1	PCA Keyboard
A5	2090-0993	1	Display-Touch Screen 15-in 330.08X254.9X2.25mm 8-wire resistive
A6	54932-66406	1	PCA On/Off Board
A7	08673-67601	1	Connector Assembly - Output
A8	2090-1012	1	Display LCD 15-in TFT 1024X768-Pixels 253.5-LG X 326.5-WD X11.5-D-mm
A9	33325-60019	1	Step attenuator, 35dB, 5V, Female-Male, Pb free
A10	54916-66701	1	Acquisition board tested
A11	54932-66502	1	Backplane Board Tested
A12	54932-68716	1	Fan with Fan Mounts - replacement
A13	54932-00102	1	Chassis
A14	54932-63401	1	Oscillator Assembly 10 GHz
A15	54932-63402	1	Oscillator Assembly 32 GHz
A16	5087-7351	1	Top Assembly, Hwin
A17	54932-66411	1	Oscillator Board
A18	5087-7361	1	Top Assembly, Pearl
A19	84905-60003	1	Attenuator 35DB,5 Volt, Female-Male, 67Ghz, Pb Free
A20	5064-7891	1	Conn 1.85 blkhd
A21	0950-5393	1	Power Supply 1600W single output 12V
A22	54932-83501	1	Infinium 90000 Q-Series Imaged Hard Drive (Service Centers Only)
A22	54932-68717	1	Replacement HDD for m890/Win7-based DS090000 Q-series scopes
A23	0960-2869	1	Mother Board Printed Circuit Assembly
MP1	54932-94301	1	Label - ID DS0X92004Q
MP2	54932-94302	1	Label - ID DS0X92504Q
MP3	54932-94303	1	Label - ID DS0X93304Q
MP4	54932-94304	1	Label - ID DS0X95004Q
MP5	54932-94305	1	Label - ID DS0X96204Q
MP6	54932-94311	1	Label - ID DSAX92004Q
MP7	54932-94312	1	Label - ID DSAX92504Q
MP8	54932-94313	1	Label - ID DSAX93304Q
MP9	54932-94314	1	Label - ID DSAX95004Q
MP10	54932-94315	1	Label - ID DSAX96204Q
MP11	54916-47401	1	Outer clutch
MP12	54916-45001	1	Inner clutch
MP13	54916-07101	1	Input Connector Ground Spring
MP14	54932-47403	1	Knob 12 mm slate blue
MP15	54932-47404	1	Knob 12 mm slate red

Replaceable Parts

Ref. Des.	Agilent Part Number	QTY	Description
MP16	54932-47405	1	Knob 12 mm slate plain
MP17	54932-47410	1	Knob 18 mm slate yellow
MP18	54932-47411	1	Knob 12 mm slate yellow
MP19	54932-47420	1	Knob 18 mm slate green
MP20	54932-47422	1	Knob 12 mm slate green
MP21	54932-47430	1	Knob 18 mm slate blue
MP22	54932-47440	1	Knob 18 mm slate red
MP23	54932-47450	1	Knob 18 mm slate plain
MP24	54932-62201	1	Bezel Assembly
MP25	54916-42001	1	Casting - Probe Mate
MP26	54542-26101	1	Ground lug
MP27	54932-21201	1	Bracket Power Button
MP28	54932-24105	1	Cover - Front Cal
MP29	54932-00101	1	Deck Front Panel
MP30	54932-01201	1	Bracket - Front Cal
MP31	54932-00201	1	Panel Rear
MP32	54932-00502	1	Frame - Backplane
MP33	54932-21202	1	Fan Bracket
MP34	54932-00503	1	Frame Oscillator
MP35	54932-24102	1	Cover Oscillator Bottom
MP36	54932-07102	1	Gasket Oscillator Bottom
MP37	54932-07101	1	Gasket Oscillator Top
MP38	54932-24101	1	Cover Oscillator Top
MP39	54932-20511	1	Frame - base
MP40	54932-20502	1	Frame Attenuator
MP41	54904-04101	1	Plate RHDD
MP42	54913-94317	1	Label - RHDD
MP43	54904-01201	1	Bracket RHDD
MP44	54904-41202	1	Clamp SATA
MP45	54904-41203	1	Support assembly board
MP46	54904-45202	1	Housing PCIe cable snap
MP47	54904-45203	1	Housing PCIe cable receptacle
MP48	54916-41002	1	Foot - Tilt Lever
MP49	54916-41001	1	Foot - Tilt Base
MP50	54932-00203	1	Panel Bottom
MP51	54932-24901	1	Handle
MP52	54932-41001	1	Foot Rear
MP53	54932-44101	1	Cover Front
MP54	54932-20202	1	Panel Top
W1	54932-61607	1	Cable - Backlight
W2	54932-61631	1	Cable - MCX to BNC Decorative
W3	54932-61604	1	Cable - On/Off
W4	54932-61610	1	Cable - USB Ports
W5	54932-61637	1	Cable - Autoprobe
W6	54932-61625	1	Cable - Step Aux
W7	54932-61615	1	Cable - Attenuator Dual
W8	54932-61621	1	Cable - SR 10 GHz CH1 (shortest)
W9	54932-61622	1	Cable - SR 10 GHz CH2
W10	54932-61623	1	Cable - SR 10 GHz CH3
W11	54932-61624	1	Cable - SR 10 GHz CH4 (longest)

Chapter 6: Replaceable Parts
Replaceable Parts List

Replaceable Parts

Ref. Des.	Agilent Part Number	QTY	Description
W12	54932-61618	1	Cable - SR 10 GHz backplane
W13	54932-61629	1	Cable - SMA to SMA
W14	54932-61628	1	Cable - MCX to BNC
W15	54916-61601	1	Cable - Input
W16	54932-61601	1	Cable - Input
W17	54932-61606	1	Cable - USB Front/Touch
	54916-60003	10	Connector Saver Collars
	54916-61603	1	Cable - PC Power
	54916-61626	1	Cable - Calibration
	0403-1116	1	Guide PC BD Black POLYC .05 .1 in BD THKNS
	0960-2929	1	OEM Mini Keyboard 319X157X20-mm
	1150-7913	1	Optical Wheel Mouse Mouton 2D Combo with Ferrite-Core inside
	1150-7997	1	STYLUS-PEN Cushion Grip 5.54-in-LG 0.44-in-DIA
	3160-4331	1	CPU-Fan Assembly
	5185-4719	1	ESD wrist strap metal 12' cord light blue
	54904-61606	1	Cable - USB device
	54904-61614	1	Cable - Hard disk power
	54904-94317	1	Label, RHDD tray
	54916-68717	1	Connector Assembly - 3.5mm female to female - kit of 5
	54932-61602	1	Cable - Jewel LO
	54932-61603	1	Cable - Jewel Pilot
	54932-61605	1	Cable - Power Front
	54932-61608	1	Cable - Display
	54932-61609	1	Cable - Hwin Jewel Harness
	54932-61611	1	Cable - Fan Harness
	54932-61617	1	Cable - SR 32 GHz Hwin
	54932-61619	1	Cable - SR 100 MHz Reference 1
	54932-61620	1	Cable - SR 100 MHz Reference 2
	54932-61626	1	Cable - SR PRBS
	54932-61627	1	Cable - MCX to MCX
	54932-61630	1	Cable - Calibration
	8121-2121	1	Cable-Assembly 30AWG 64-COND 400mm-LG
	54932-69502	1	Backplane Board Tested - exch
	8120-8620	1	Power cord - United Kingdom
	8120-8619	1	Power cord - Australia and New Zealand
	8121-2221	1	Power cord - Continental Europe
	8121-1713	1	Power cord - United States and Canada (120V) - EM-controlled environment required
	8120-8623	1	Power cord - United States and Canada (240V)
	8121-1765	1	Power cord - Switzerland
	8121-1882	1	Power cord - Denmark
	8121-2159	1	Power cord - India
	8121-1763	1	Power cord - Japan - EM-controlled environment required
	8121-0161	1	Power cord - Israel
	8121-1857	1	Power cord - Argentina
	8121-1084	1	Power cord - Chile
	8121-1766	1	Power cord - China
	8121-0710	1	Power cord - South Africa
	8121-1764	1	Power cord - Thailand
	8121-1800	1	Power cord - Japan - 250V
	8121-1787	1	Power cord - Brazil

Replaceable Parts

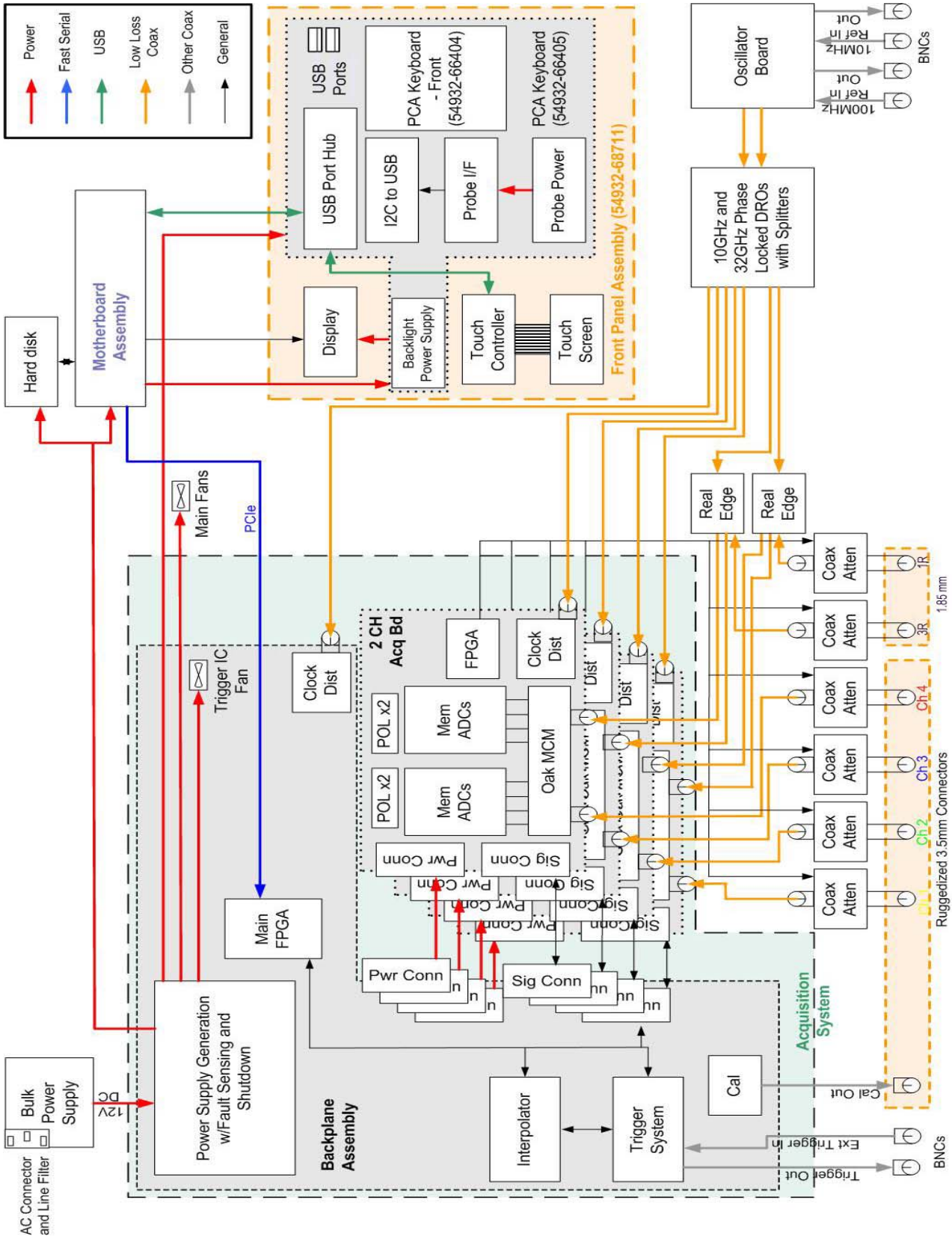
Ref. Des.	Agilent Part Number	QTY	Description
	8121-1853	1	Power cord - Taiwan - EM-controlled environment required
	8121-2158	1	Power cord - Cambodia
	8121-2176	1	Power cord - Taiwan (250V)

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Theory of Operation

Figure 7-1 Oscilloscope block diagram



Theory of Operation

This chapter describes the basic structure of the oscilloscope and how the parts interact. The 90000 Q-Series oscilloscopes are comprised of five or six main assemblies, depending on the model of the oscilloscope: a motherboard assembly, an acquisition assembly, a backplane assembly, an oscillator assembly, and a front panel assembly for all models, plus a RealEdge Technology Assembly for 50 GHz and 62 GHz bandwidth models. Each oscilloscope also has a bulk power supply.

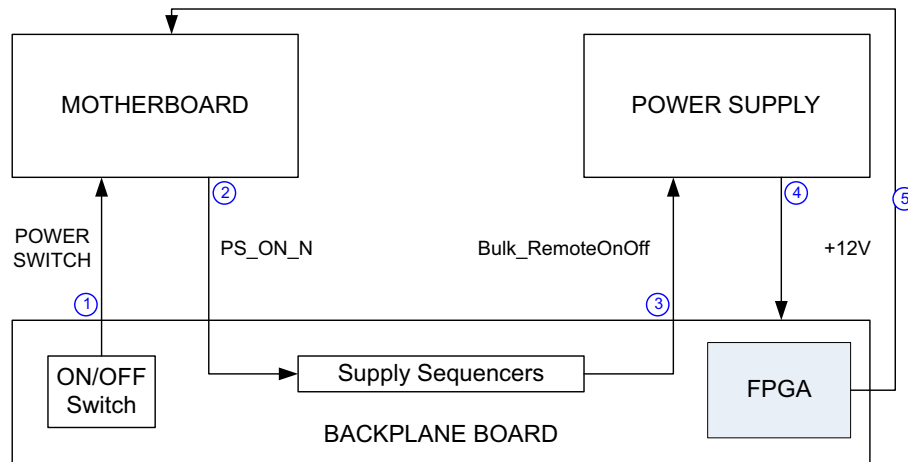
Figure 7-1 shows a block diagram of the Q-Series Infiniium oscilloscope.

Motherboard Assembly

The motherboard assembly provides all system control and interface functions for the oscilloscope. The motherboard contains a microprocessor, a hard disk drive interface, ROM, RAM, keyboard and mouse interfaces, connections to the front panel assembly, and serial and parallel interfaces.

Pressing the on/off button sends a signal to the motherboard. The motherboard then signals the backplane assembly, which in turn sends a signal to tell the bulk 12V power supply to turn on. When the power supply turns on, the remaining power supplies are enabled and powered on. Then the main FPGA on the backplane assembly gets self-configured from its PROM. Once it's configured, the main FPGA asserts a signal to tell the motherboard to power up and become fully functional. Figure 7-2 illustrates this system start-up process.

Figure 7-2 Power-Up Sequence



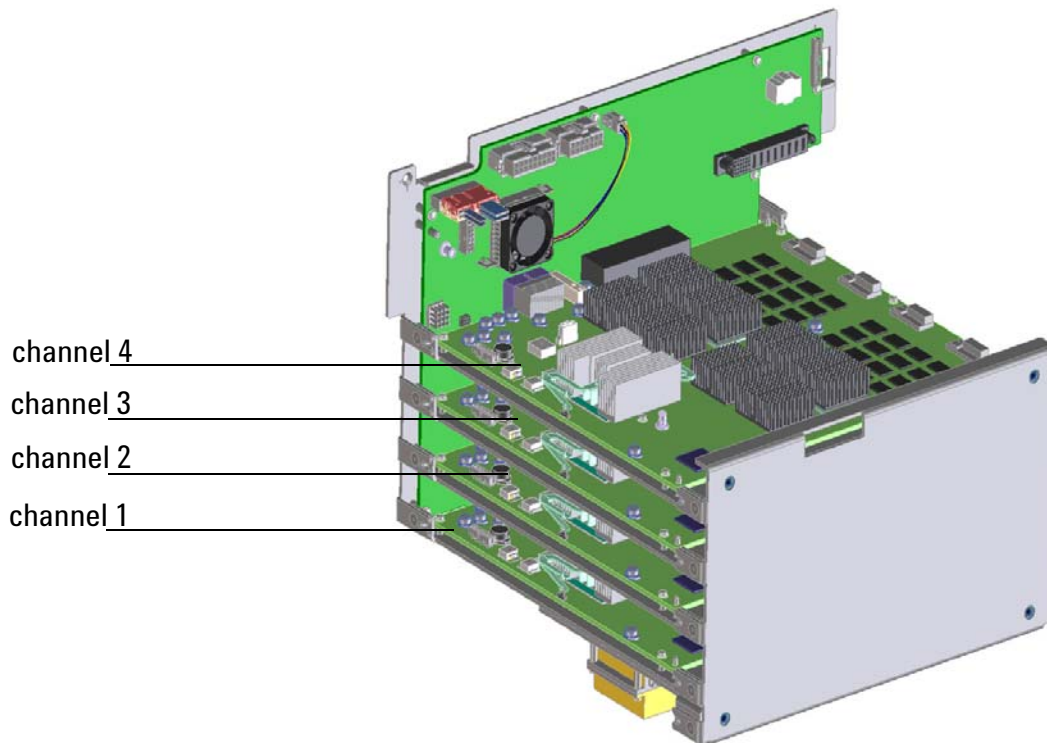
The hard disk drive is a high-capacity (> 250 GB), shock-resistant unit that stores the oscilloscope operating system, the oscilloscope application, compliance application information, calibration data, other data files, drivers for the boards and oscilloscope, and user data files. The hard disk drive can also be used to store and recall oscilloscope setups and waveforms.

It is common for the motherboard to be revised during the life of the oscilloscope, so if a motherboard is replaced during a repair procedure, check to make sure it matches the image on the hard drive. It is important for the hard disk drive image to match the motherboard. If they do not match, the oscilloscope may not have the correct Windows software drivers.

Acquisition Assembly

The acquisition assembly consists of four identical acquisition boards. These four boards connect to the backplane board as shown in Figure 7-3.

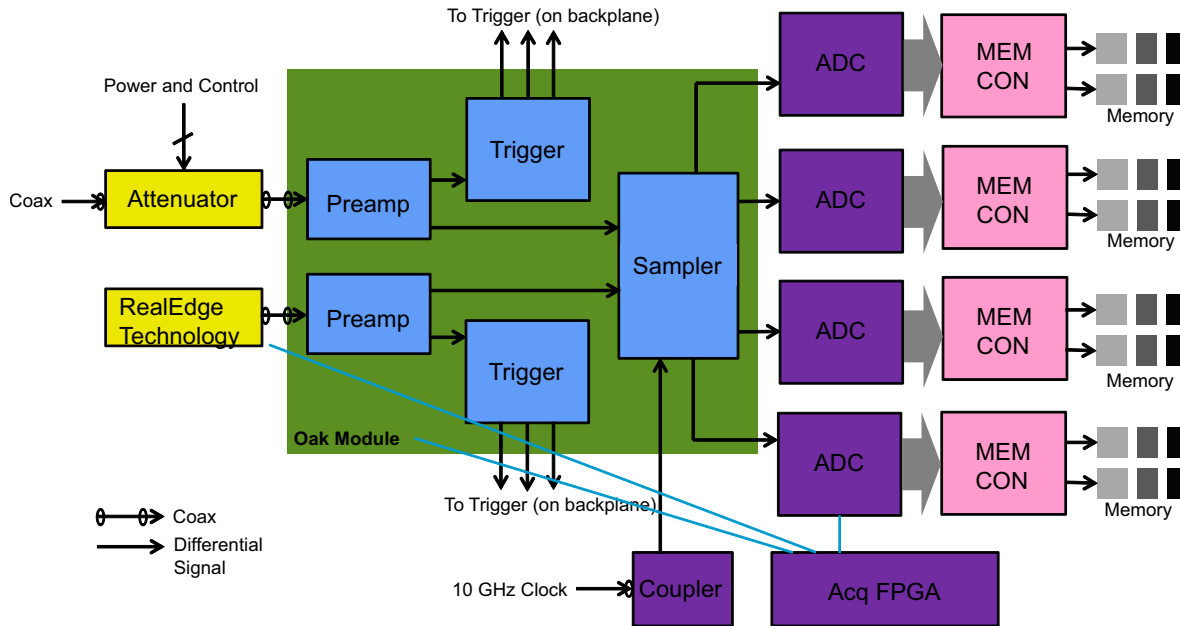
Figure 7-3 Acquisition Assembly



The bottom acquisition board circuitry samples, digitizes, and stores the signals for channel 1. The next higher acquisition board does the same for channel 2. The next higher board is for channel 3, and the top board is for channel 4.

All four acquisition boards contain the Oak module (a full-custom ball grid array multi-chip module), the Onboard ADC, clock distribution, data management ASICs, external acquisition memory, ADCs, communication and programming FPGAs, and supporting power supply circuitry. Figure 7-4 shows a block diagram of the acquisition boards including the Oak module.

Figure 7-4 Oak Module and Acquisition Components

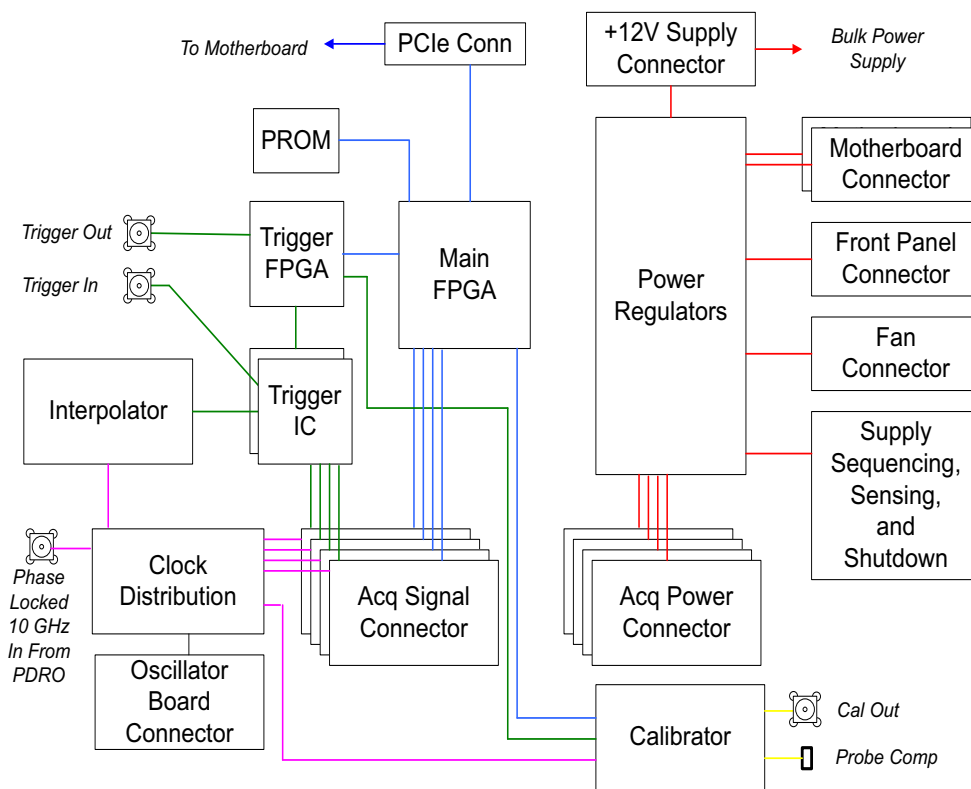


The acquisition front end (analog path) starts at the front panel input connectors, then goes through the attenuators, cabling, and Oak module. The differential outputs from Oak then go into one differential input pair of the ADC. Each ADC has two sets of differential inputs.

Backplane Assembly

The backplane assembly is a device on the PCI Express (PCIe) bus connected by a PCI Express cable to the motherboard. The backplane assembly receives +12 V DC power through a power interface board from the bulk supply, and all voltages are derived from switching power regulators and other circuitry. Most of the switching and circuitry are on the backplane board, with some distribution and generation done on the acquisition boards. Figure 7-5 shows a block diagram of the functions contained on the backplane assembly.

Figure 7-5 Backplane Block Diagram

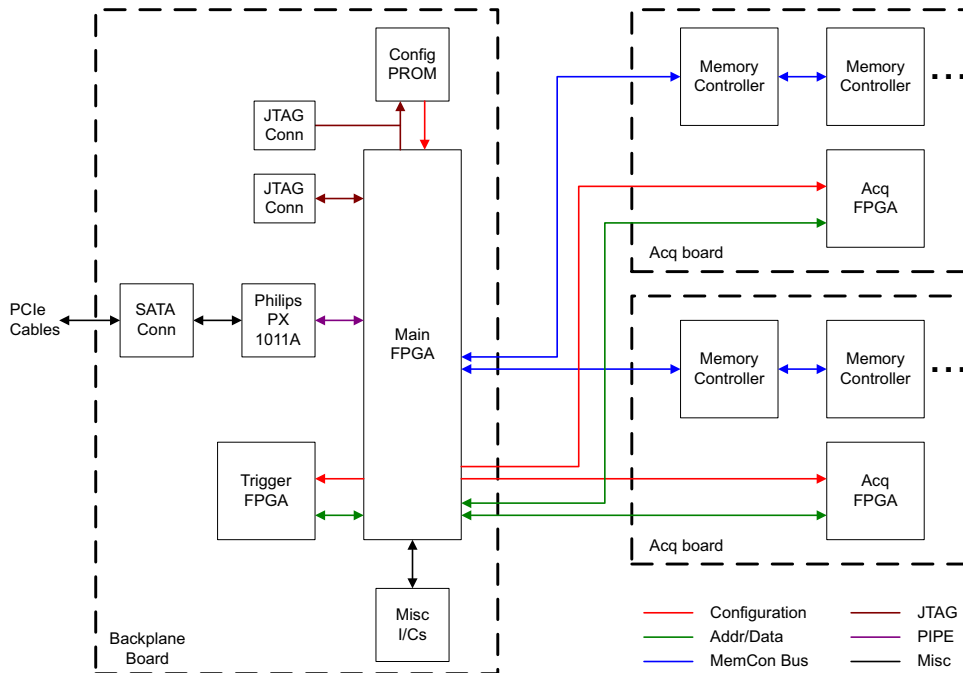


The colors in the diagram represent different signal groups. The backplane provides power (red), clock generation (pink), trigger (green), and calibrator (yellow) functions to the oscilloscope, as well as communications and control for the PC software (blue). The PC connects to the measurement system through PCIe to the main FPGA. Connections to all other circuits go through the main FPGA.

Main FPGA

The main FPGA (field-programmable gate array) is the only communication link from the oscilloscope hardware to the PC system. All system controls and data pass through the main FPGA. Figure 7-6 shows the connections to the main FPGA.

Figure 7-6 Main Communication FPGA Connections.



During a successful power-up, an EPROM configures the FPGA over a serial bus. The PROM comes pre-loaded with the required bits, but can be re-programmed through the FPGA by software, or through the FPGA JTAG port with a programming cable.

The FPGA is a device on the PCIe bus. A custom cable connects a PCIe slot on the PC motherboard to the backplane board. When Windows is booted up, the main communication FPGA must show up in the device listing (as Infiniium Acquisition) for the oscilloscope application to run and control the oscilloscope hardware.

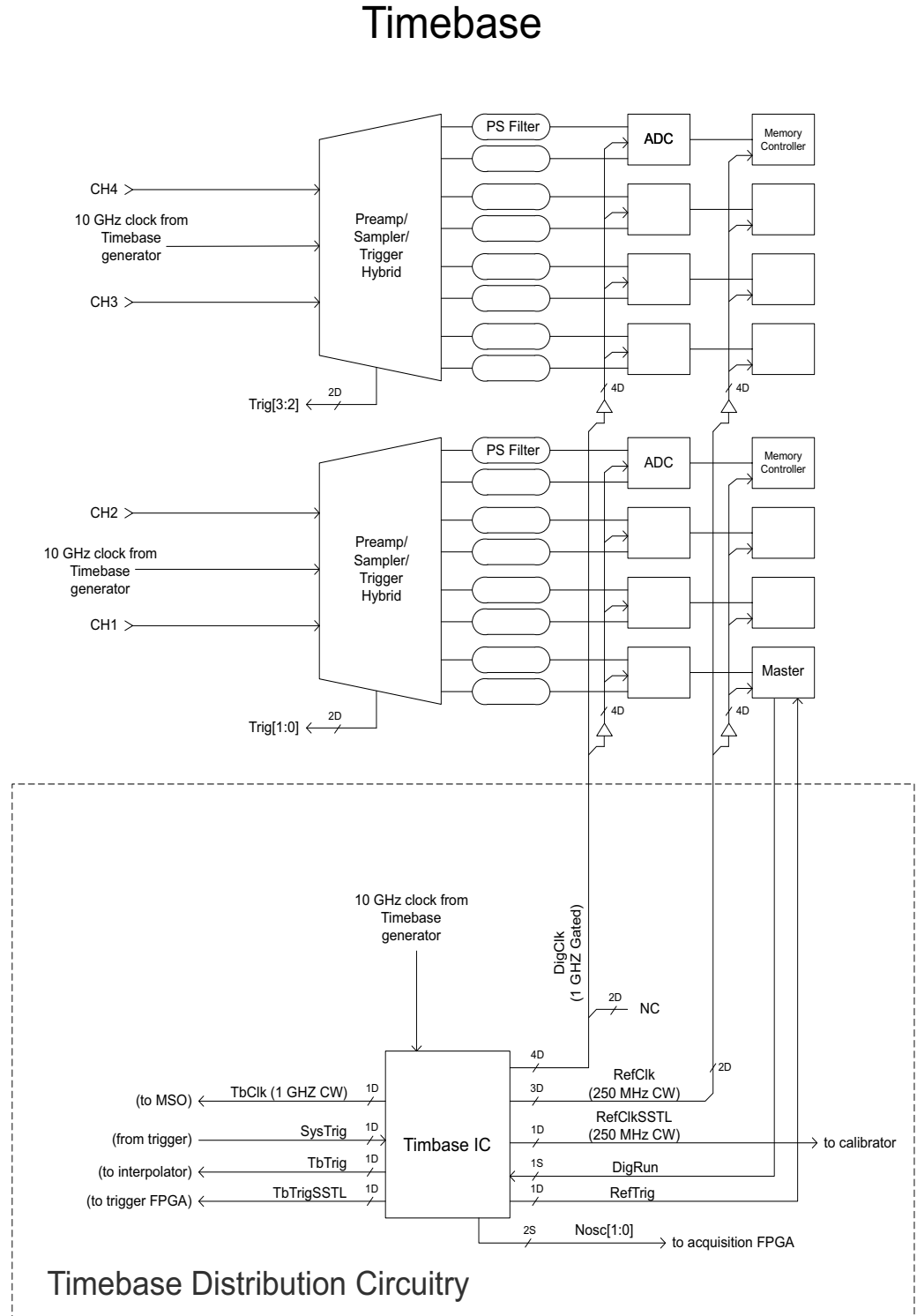
The main FPGA can be used to control peripherals and fan speed, configure and communicate with other FPGAs, and pass sampled data to the PC for reconstruction of the measured waveform on the oscilloscope display. In addition, the FPGA generates PCI interrupts for all oscilloscope-related special events such as a front-end overload or a stopped cooling fan.

The main FPGA uses five identical buses to communicate with five different downstream FPGAs. The buses are 8-bit parallel buses with miscellaneous control signals. One bus is used to control the trigger FPGA in the backplane board, and the other buses connect to each of the four acquisition assemblies. A separate bus for each FPGA minimizes timing problems and reflections. The FPGAs on the acquisition boards are used to control the oscilloscope functions on each of those boards. On power-up, after the PC software recognizes the acquisition assembly, it loads the trigger FPGA and the acquisition FPGAs using these buses. When programming is complete, the PC communicates with these FPGAs over the same buses. The main FPGA provides access to the memory controllers over a separate bus to each acquisition board. The acquired data is retrieved from the acquisition boards over these buses.

Clock Distribution System

Figure 7-7 shows the timebase system including its circuitry.

Figure 7-7 Timebase



The fundamental sample clock is a single-ended 10 GHz signal created by the timebase generation system. Multiple copies of this clock are created there and distributed to each Oak module and the timebase IC through semi-rigid coax cables. In each case, the single-ended signal is converted to a differential signal using a bandpass filtered 180° phase splitter implemented using microwave structures on shielded inner layers of the PCB. The clock distribution system divides this clock and distributes phase-aligned lower speed clocks to the acquisition boards.

The timebase IC divides the 10 GHz CW clock down into multiple 1 GHz and 250 MHz clocks. The 1 GHz DigClk clocks are gated by DigRun so that the ADCs can be synchronized with each other. The timebase IC also performs some of the time interpolator functionality by synchronizing the system trigger to the 1 GHz DigClk and generating the first two MSBs of the trigger interpolation value.

The 10 GHz SampClk 10G signal is divided down to 1 GHz for use as TbClk and DigClk. TbClk is divided by four to generate RefClk, which drives the memory controllers and the calibrator chip. These four 250 MHz outputs are phased in quadrature to minimize the coupling of sub-harmonics into the DigClk signals. The RefClk signal that goes to the calibrator chip must be disabled when not in use by the calibrator system.

SysTrig is the primary output from the trigger system. It is synchronous to the trigger event and asynchronous to the time base clock, TbClk. The timebase IC synchronizes SysTrig to the time base clock with low probability of metastability, producing the TbTrig signal. TbTrig pulses high once immediately after every rising edge of SysTrig.

The timebase IC also produces a trigger signal that is synchronous to RefClk. This signal, RefTrig, pulses high once immediately after every rising edge of SysTrig. RefTrig tells the memory controller when a trigger event has occurred. It is important to note that although DigRun and RefTrig are both synchronous to RefClk, their phase relationship to RefClk is not important. As long as their phase relationship is consistent, the memory controller can adjust for it. Finally, the timebase IC records the phase relationship between RefTrig and TbTrig, and provides it as the 2-bit digital value, Nosc. Nosc[0] is driven by the 500 MHz clock and Nosc[1] is driven by the 250 MHz clock.

The clock distribution system also creates and distributes clocks for other purposes. A 212.5 MHz oscillator creates a clock that is intentionally not an integer division of the sample clock. This approach prevents beat frequency effects from showing up in the captured data. The clock is sent to the trigger FPGA and to the main FPGA.

The trigger FPGA uses the clock for capturing and processing trigger signals. The FPGA propagates a copy of this clock to each trigger ASIC.

The main FPGA uses the clock to generate the bus clocks for communications with the other FPGAs and the memory controller ICs. It sends a 62.5 MHz clock as part of the FPGA bus to each FPGA. It generates another clock for the memory controller buses. This clock is buffered and fanned out in the clock distribution system, then driven to the memory controller ICs and back to the main FPGA.

Trigger System

The trigger system contains an FPGA that is used to coordinate the trigger system operation and two trigger ICs. The FPGA uses a 212.5 MHz clock that is synchronous to the main communication FPGA clock. On power-up it is blank and is loaded from the Infiniium oscilloscope driver.

The trigger ICs are the main trigger-handling chips, programmed with a serial interface from the main FPGA. Each trigger IC also receives two DAC signals that set the internal clock and data timers. The trigger IC is used for setting the timing for the logic trigger from 0.3 ns to 20 ns. The trigger FPGA is used for times greater than 20 ns.

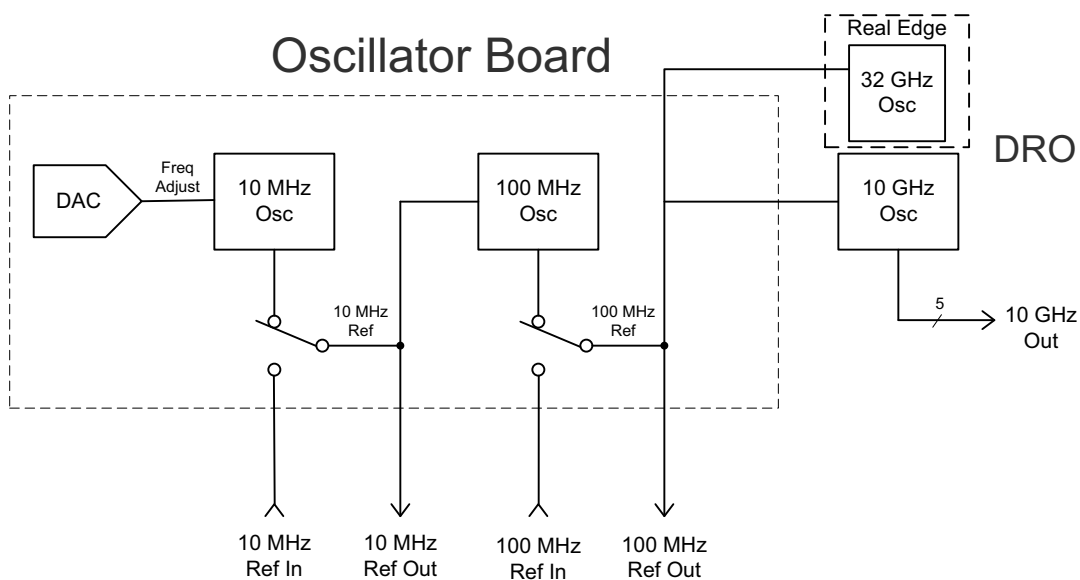
Oscillator Assembly

The oscillator assembly consists of an oscillator board; one or two DROs (dielectric resonator oscillators), depending on the oscilloscope's model; two SMA connectors for the 100 MHz clock; two BNC connectors for the 10 MHz clock; and a connector to the backplane board.

The timebase distribution system described in the previous section is driven by a precision low-jitter 10 GHz clock generation system. The 90000 Q-Series clock generation system is comprised of the oscillator board and the 10 GHz DRO.

The 10 GHz sample clock is generated with a DRO that is phase-locked to a 100 MHz reference signal. This signal can be selected from either an internal oscillator or an external 100 MHz reference signal input. The internal oscillator's 10 MHz reference input can be selected from either an internal oven-controlled crystal oscillator located on the oscillator board or from an external 10 MHz signal input. See Figure 7-8.

Figure 7-8 Oscillator Assembly



The external 10 MHz reference is applied through a rear-panel BNC connector and runs to the backplane assembly. Users can select between an internal and external reference through a dialog box in the oscilloscope application.

Front Panel Assembly

The front panel assembly consists of an LCD display board with backlight; a touch screen and touch controller; an on/off board; and a keyboard assembly, which is two boards that sit with one behind the other, connected with a pair of 60-pin board-to-board connectors.

On/Off Board

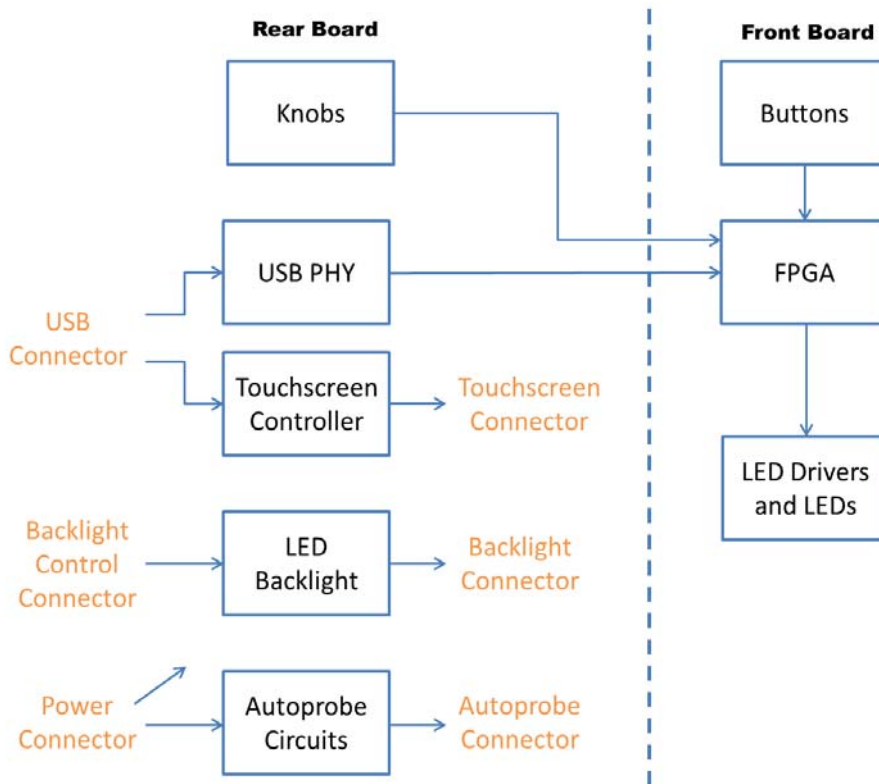
The on/off board interfaces with the motherboard to provide the on/off switch function, and with the backplane to provide the probe compensation output. Power indicator LEDs backlight the on/off button and are driven by the motherboard. The probe compensation lugs connect to the calibrator output on 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.

Keyboard Assembly

The two boards that comprise the keyboard assembly work together to provide the main user interface to the instrument, and power and communication to the probe interface. The rear board has all the external connectors, AutoProbe II circuits for probe power and probe control, LED backlight power supply, touchscreen controller, and knobs. The front board has the buttons, FPGA, and LEDs.

Figure 7-9 shows a block diagram of the oscilloscope keyboard assembly.

Figure 7-9 Keyboard Assembly Block Diagram



RealEdge Technology Assembly

The RealEdge Technology assembly is included with Q-Series oscilloscope models of 50 GHz and 62 GHz (DSOX/DSAX95004Q and DSOX/DSAX96204Q). The RealEdge Technology assembly consists of a connector, a 67 GHz attenuator, three RealEdge Technology microcircuits, and a 32 GHz DRO.

This Service Guide does not describe the RealEdge Technology assembly in any detail, as the technology is Agilent proprietary.

Power Supply

The power supply is a +12 V bulk supply that is removable, exchangeable, and safety-approved. It transforms AC power to the main +12 V 100A supply and a small +5 V supply. The +5 V supply is standby power and is always on whenever AC power is applied. The +5 V supply is used only by supervisory circuits that monitor and control all other supplies. In the event of a safety shutdown from the supervisory circuits, LEDs turn on to indicate the cause of the shutdown. They remain lit until AC power is removed from the bulk supply.

The +12 V bulk supply is used to create all other supplies in the instrument. +12 V is turned on by the power switch on the front panel. It is turned off under software control when a shutdown is requested, or by the supervisory circuits when a fault occurs.

The +12 V bulk supply performs some internal fault sensing and drives LEDs on the backplane board to indicate its status. It also provides an I²C bus, which is connected to the main FPGA.

Safety Notices

This apparatus has been designed and tested in accordance with IEC Publication EN 61010-1:2001, Safety Requirements for Measuring Apparatus, and has been supplied in a safe condition. This is a Safety Class I instrument (provided with terminal for protective earthing). Before applying power, verify that the correct safety precautions are taken (see the following warnings). In addition, note the external markings on the instrument that are described under "Safety Symbols."

Warnings

- Before turning on the instrument, you must connect the protective earth terminal of the instrument to the protective conductor of the (mains) power cord. The mains plug shall be inserted only in a socket outlet provided with a protective earth contact. You must not negate the protective action by using an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two-conductor outlet is not sufficient protection.
- Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuseholders. To do so could cause a shock or fire hazard.
- If you energize this instrument by an auto transformer (for voltage reduction or mains isolation), the common terminal must be connected to the earth terminal of the power source.
- Whenever it is likely that the ground protection is impaired, you must make the instrument inoperative and secure it against any unintended operation.
- Service instructions are for trained service personnel. To avoid dangerous electric shock, do not perform any service unless qualified to do so. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.
- Do not install substitute parts or perform any unauthorized modification to the instrument.
- Capacitors inside the instrument may retain a charge even if the instrument is disconnected from its source of supply.

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

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

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

Safety Symbols



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



Hazardous voltage symbol.



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

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