

Serial ATA Test Procedure

Revision 1.00

September 8, 2003

Revision History

Rev	Date	Comments
0.10	08/18/2003	Initial Release
0.90	09/03/2003	Beta Release
0.91	09/04/2003	Second Beta Release
1.00	09/08/2003	Final release

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1 Introduction

The Serial ATA Test Procedure is developed to facilitate product validation at the integration level of Serial ATA silicon into final products.

The procedure is streamlined by removing tests that are redundant with known-good Serial ATA silicon solutions. This procedure's main is to ensure proper implementation. This procedure may be used along with other detailed validation tests for new silicon designs.

This Serial ATA Test Procedure documents a series of tests used to evaluate SATA Host Bus Adapter (HBA), SATA systems, motherboards, or SATA drive products using Tektronix Serial ATA Compliance Test Software.

While preparing this document, only 1.5Gbps gen-1 products were available. For test support of gen-2 speed products, some sections in this procedure will require modification.

2 Equipment Required

The following test equipment is required to perform all the tests documented.

- Real Time Digital Storage Oscilloscope – Tektronix Model TDS6604 20GS/s, quantity = 1
- SMA/TekConnect – Tektronix Model TCA-SMA, quantity = 4
- Tektronix Serial ATA Compliance Test Software
- Arbitrary Waveform Generator – Tektronix Model AWG-610 2.6GS/s, quantity = 1 or AWG-710 4.0GS/s, quantity = 1
- 50-ohm Coax Cable With SMA Male Connectors – 24-inch RG316/U (2 sets of matched length pairs); 24-inch or 36-inch RG316/U (one piece for DSO Trigger) Pomona Model 4846-BB-24 and 4846-BB-36
- 2GHz/14dB Attenuator – Inmet Model 2AH-14dB or equivalent
- BNC T-adapter
- 50-ohm terminator – SMA type
- Serial ATA Test Fixtures (near end and far end) – Intel or equivalent
- Known-good 1m SATA cable
- Crossover LAN cables, quantity = 1 (for peer-to-peer connection) or LAN cables, quantity = 2 (for LAN connection) or NI's ENET-GPIB/100 controller and GPIB cable, quantity = 1

2.1 Oscilloscope Operating Systems, Software, Drivers, and Setup Files

2.1.1 Operating Systems

TDS 6604 with Windows 2000 and Firmware version 2.3.2 or above

2.1.2 Application Software

Tektronix Serial ATA Compliance Test Software

2.2 Special Purpose Software

If you install the Tektronix Serial ATA Compliance Test Software on TDS6604, the application copies the following special purpose software to **C:\Program Files\SATA Compliance Toolset\Transfer Test** folder:

- Disk write/read stress test program.
- Vendor specific low-level error reporting program.

2.2.1 AWG Setup Files

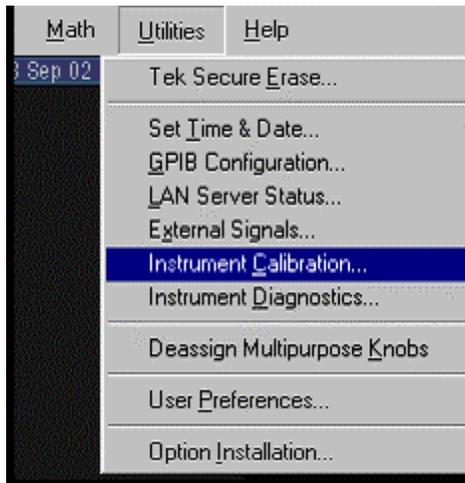
If you install the Tektronix Serial ATA Compliance Test Software on TDS6604, the application copies the AWG 610 and AWG 710 sequence files to **C:\TekApplications\Sata\Awgfiles**. Please transfer the sequence files for the AWG on the main drive (recommended) or floppy drive of the AWG. You can transfer the files using a floppy or through FTP support of the AWG. Please refer to appendix B for details.

3 Test Equipment Setup

3.1 Digital Storage Oscilloscope

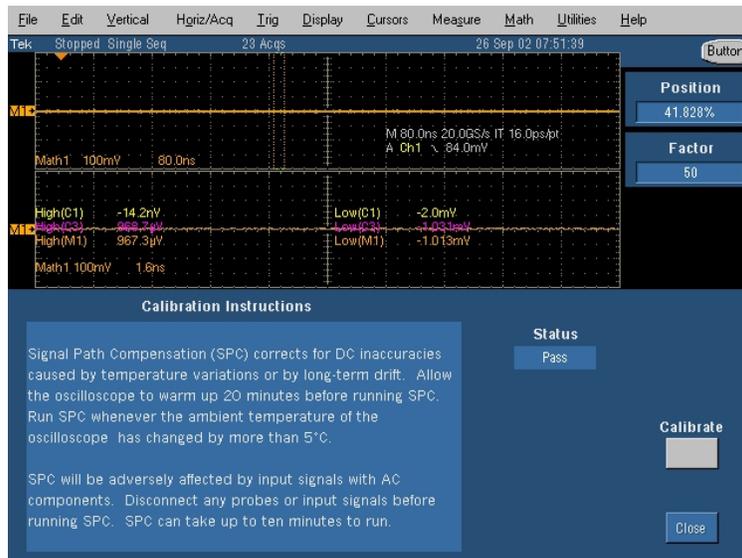
Signal Path Compensation:

Allow the DSO to warm up for at least 20 minutes. Perform the Signal Path Compensation (SPC). Before beginning, ensure the Tektronix TCA-SMA input adapters are installed in all four channels and nothing is connected to the SMA inputs. The SPC can be found in Instrument Calibration under the Utilities drop-down menu:



Instrument Calibration

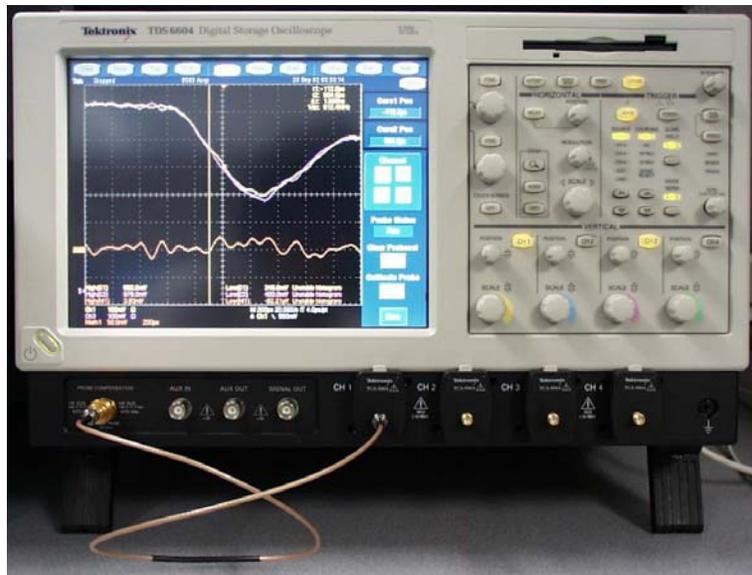
Click the Calibrate button to begin the SPC. Ensure the calibration completes with a PASS status.



Signal Path Compensation

Vertical Input Calibration:

Perform the 50-ohm direct-coupled input calibration for the SMA interface of channel 1 and channel 3. Connect channel 1 to the Probe Compensation BNC jack on the bottom left side of the DSO with one RG316 cable from one of the 24" RG-316 coax matched pairs. Use a BNC to SMA adapter at the Probe Compensation BNC jack:



From the Vertical menu click the Ch1 button and then click the Probe Cal button:



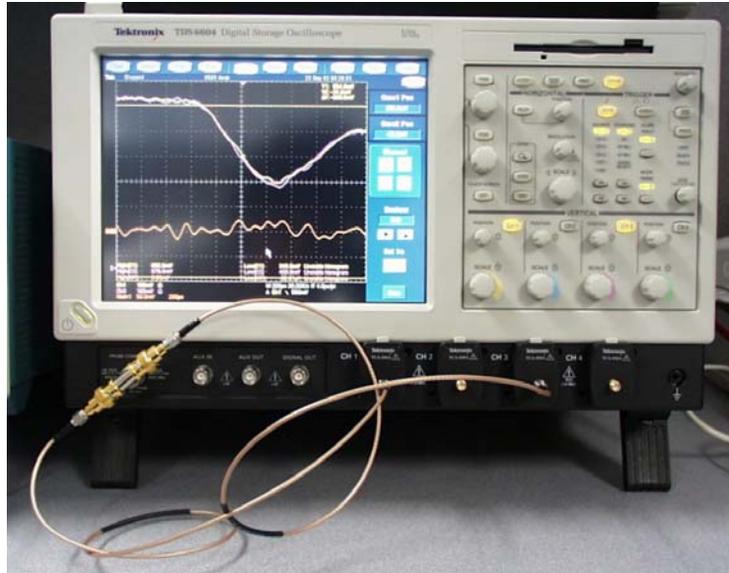
Vertical Input Calibration

The calibration begins with a calibration in progress GUI depiction. Verify the calibration completes successfully and reports PASS.
Repeat for channel 3.

Channel De-skew:

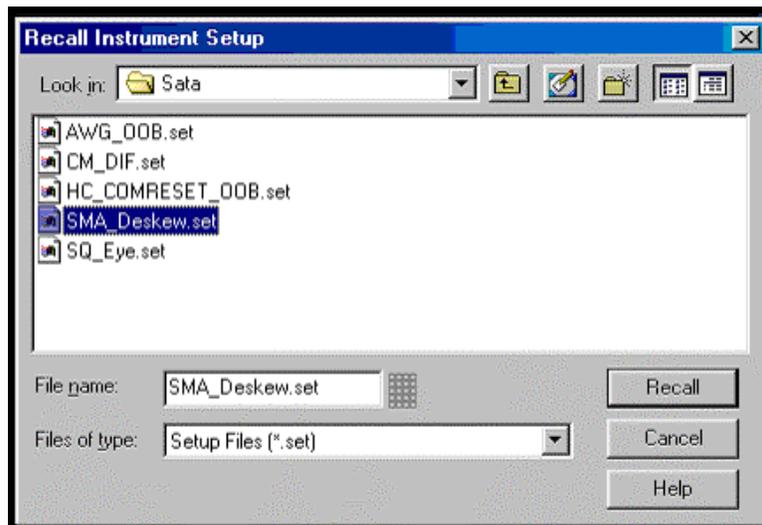
Connect the matched SMA coax cable pair, one to channel 1 and one to channel 3. Perform the following De-skewing on channel 1 with respect to channel 3.

Connect both channel 1 and channel 3 inputs to the Probe Compensation BNC jack on the bottom left side of the DSO using a BNC-T and two SMA-to-BNC adapters. Refer to the following figure for reference.



De-skew Connection

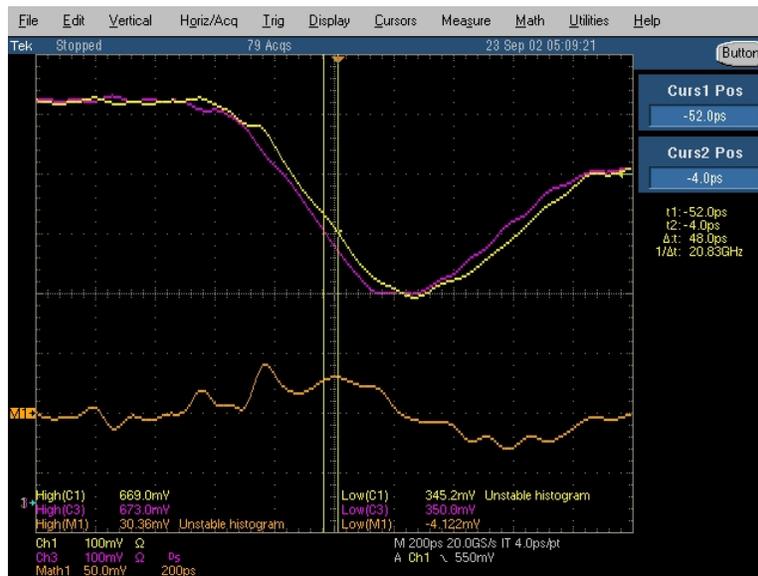
Load the SMA_DESKEW.SET setup file from C:\Program Files\SATA Compliance Toolset\Setup files folder:



Load De-skew Setup

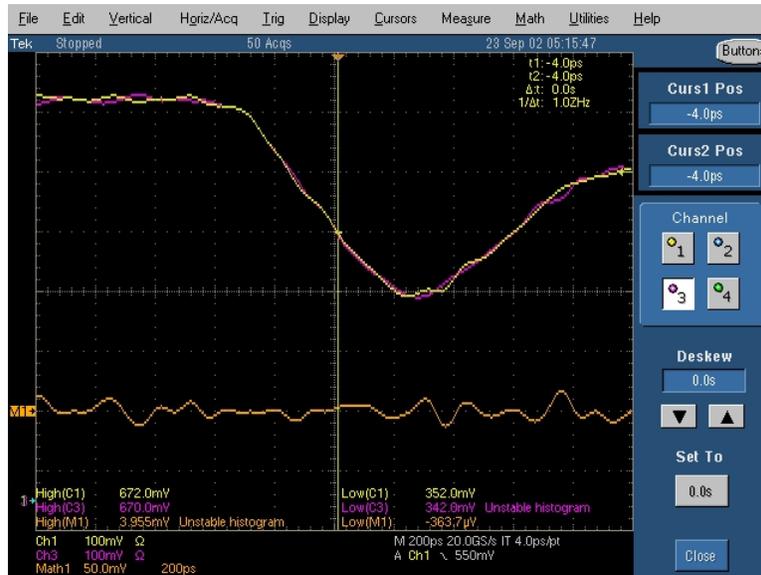
A falling edge of the 1kHz square wave is shown in a 200ps/div horizontal scale. The upper portion of the screen shows channel 1 and channel 3 superimposed on one another. The lower portion of the screen is the differential signal of channel 1 minus channel 3. The top two traces provide for visual inspection of relative time skew between the two channels. The bottom trace provides for visual presentation of unwanted differential mode signal resulted from relative channel skew (and to a much lesser extent from inevitable other channel mismatch parameters like gain and non-linearity).

The following example demonstrates an exaggerated skew exists between channel 1 and channel 3, measured to be about 50ps with the cursor.



Channel Skew

1. Normally with a matched pair of SMA cables and an oscilloscope in good calibration, there should be no measurable skew. Should skew exist between the two channel, use the De-skew function of the vertical menu to adjust one channel with respect to the other until the skew is minimized:



Skew Minimized

The matched pair of RG316 SMA cable should not be swapped during the electrical tests.

3.2 Arbitrary Waveform Generator (AWG)

Do the following to setup the AWG manually or automatically from the Serial ATA Compliance Test Software:

Manual Setup

1. Connect the 14dB attenuators to marker 1 and marker 2.
2. On the arbitrary waveform generator load crst01p.seq (for AWG610) or crst01+.seq (for AWG710) OOB sequence file:
 - Press the HORIZONTAL MENU button
 - Press the Waveform Sequence screen button.
 - Press the Load screen button.
 - Navigate to the directory containing the SATA setup files if necessary.
 - Select crst01p.seq (for AWG610) or crst01+.seq (for AWG710) from the available setup files list and press the OK screen button.
3. Verify the clock is set to 1.5GS/s in AWG610 and 3.0 GS/s in AWG710:
 - Press the HORIZONTAL MENU button.
 - Verify the Clock is set to 1.5GS/s in AWG610 and 3.0 GS/s in AWG710.
 - Verify the Clock Ref is set to Internal.

Note: The clock rate is not saved with the setup files.

4. Verify the Marker output levels are set to a nominal level as follows:
 - Press the VERTICAL MENU button.
 - Press the Marker screen button.
 - Verify the Marker 1 and Marker 2 High Levels are set to 2.50V.
 - Verify the Marker 1 and Marker 2 Low Levels are set to 0.50V.

Note: The marker output levels are not saved with the setup files.

5. Press the HORIZONTAL MENU button.
6. Press the Run Mode screen button and verify it is set to Continuous mode.

Automatic Setup

1. Verify the Clock Ref is set to Internal.
2. Verify the Run Mode is set to Continuous mode.

All other AWG setups will be done when you perform the **Test Connection** from the Serial ATA Compliance Test Software. Refer **AWG Setup Configuration** for details.

4 Test Record

Appendix A contains the test result entry form for this test procedure. Please make copies of Appendix A for use as test record documentation.

4.1 Vendor and Product Information

Collect the following information and enter into a copy of the test record in Appendix A before performing any tests.

5 Test Procedure

5.1 Test Setup

Note that there are 2 pairs of SMA connectors on the SATA Signal Quality Test Fixture. One pair maps to the transmit differential pair (Tx+ / Tx-). The other maps to the receive differential pair (Rx+ / Rx-) of the DUT. The proper connection depends upon whether the DUT is a host controller or a drive. The receive pair from the host controller is adjacent to the SATA connector. This is opposite in the case of a drive device. The positive channel of the transmit and receive pair are the SMA jacks located adjacent to the fixture's outer edges. Please refer to the following figure for reference.

The SMA cables are connected as follows:

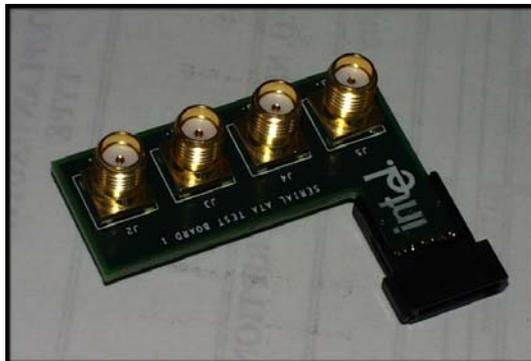
For a host controller as DUT, connect

- AWG Marker 1 to J5 (Rx+)
- AWG Marker 2 to J4 (Rx-)
- DSO Channel 1 to J2 (Tx+)
- DSO Channel 3 to J3 (Tx-)

For a drive as DUT, the connections are reversed.

- AWG Marker 1 to J2 (Rx+)
- AWG Marker 2 to J3 (Rx-)
- DSO Channel 1 to J5 (Tx+)
- DSO Channel 3 to J4 (Tx-)

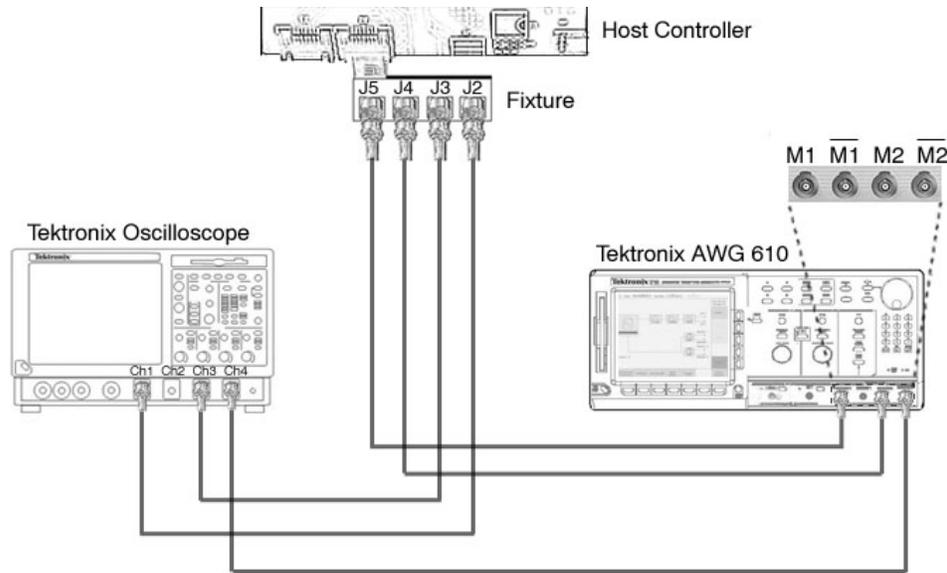
*Note: If you use DSO channel 1 and 3 for Tx+ and Tx- then use DSO Channel 2 or 4 as trigger.
If you use DSO channel 2 and 4 for Tx+ and Tx- then use DSO Channel 1 or 3 as trigger.*



SATA Signal Quality Test Fixture

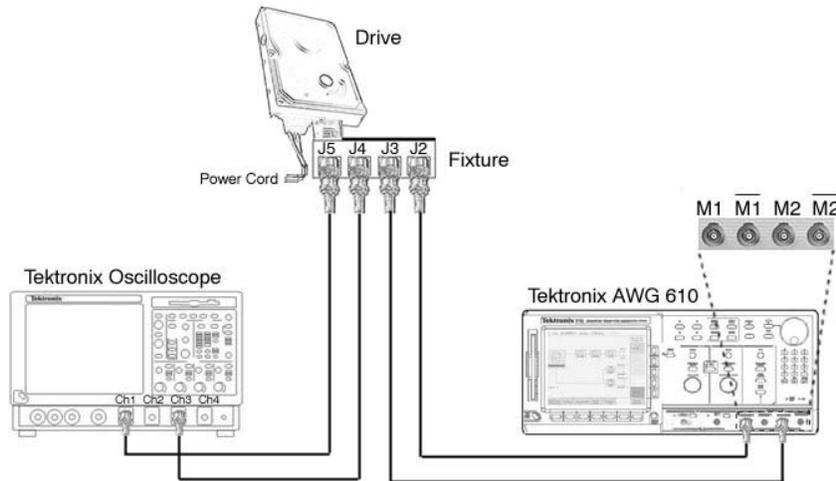
Caution: The SATA connector on this fixture is fragile. When plugging and unplugging the fixture in the port under test apply pressure to the connector body by grasping the black plastic molding at the base (its thickest section). Pushing or pulling on the PCB or SMAs will eventually crack the connector housing or cause the connector to separate from the PCB.

Connect a matched pair of 24" SMA coax cables between the non-inverting marker outputs of the arbitrary waveform generator and the SMA connectors for the DUT receiver on the SATA Signal Quality test fixture. Connect the marker 1 to the Rx+ and marker 2 to the Rx-.



Transmitter Signal Quality Test - Host as DUT (AWG Method)

Connecting SQ Fixture to Drive



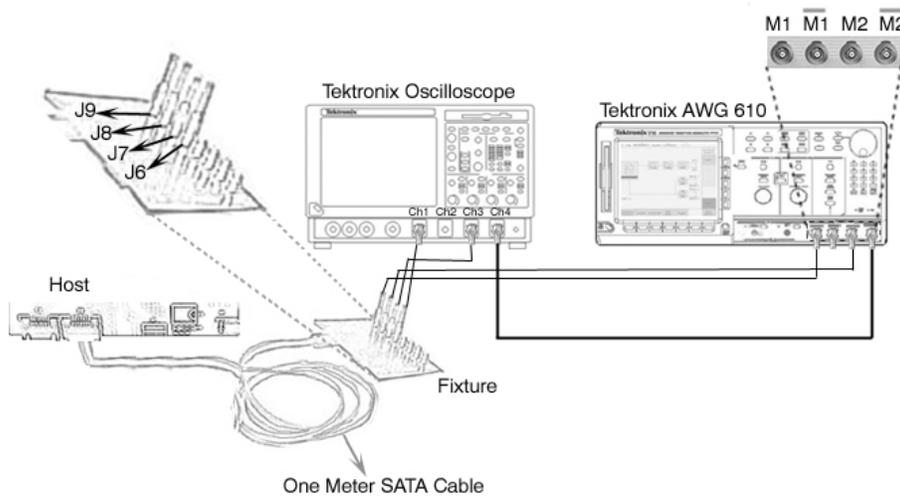
Transmitter Signal Quality Test - Drive as DUT (AWG Method)

Connecting SQ Fixture to Drive

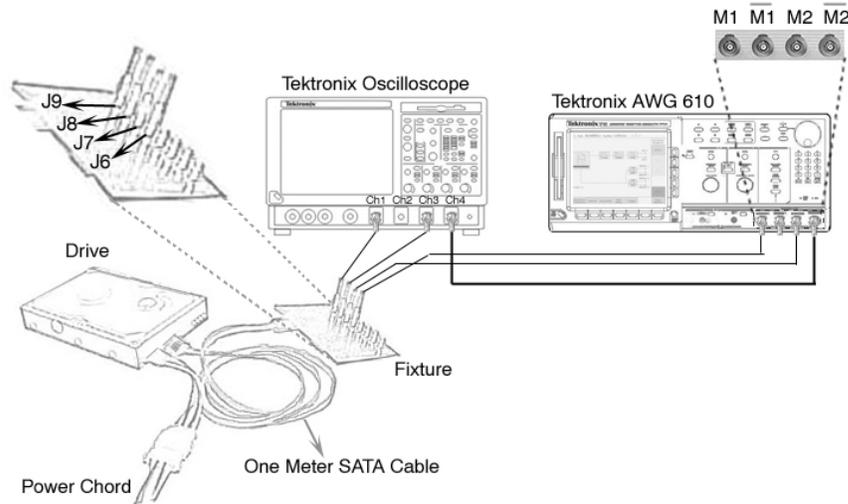
Connect a 48” SMA coax cable between the inverting output of marker 2 (Marker 2-) to channel 4 of DSO. This is the trigger signal for the oscilloscope. Verify a 50-ohm terminator cap is placed on the inverting output of marker 1 (Marker 1-).

Note: It is important to terminate the unused inverting outputs of Marker 1 and Marker 2 with a 50-ohm terminator. Reflections from the unterminated outputs degrade the AWG signal outputs.

Connect the Tx channels (with respect to the DUT) of the SATA test fixture to the DSO using another matched pair of 24” SMA coax cables. Connect Tx+ to channel 1, and Tx- to channel 3 of the DSO.



Transmitter Far-end signal quality test (Receiver end) - Host as DUT (AWG Method)



Transmitter Far-end signal quality test (Receiver end) - Drive as DUT (AWG Method)

Connecting the TDS6604 with AWG610 or AWG710

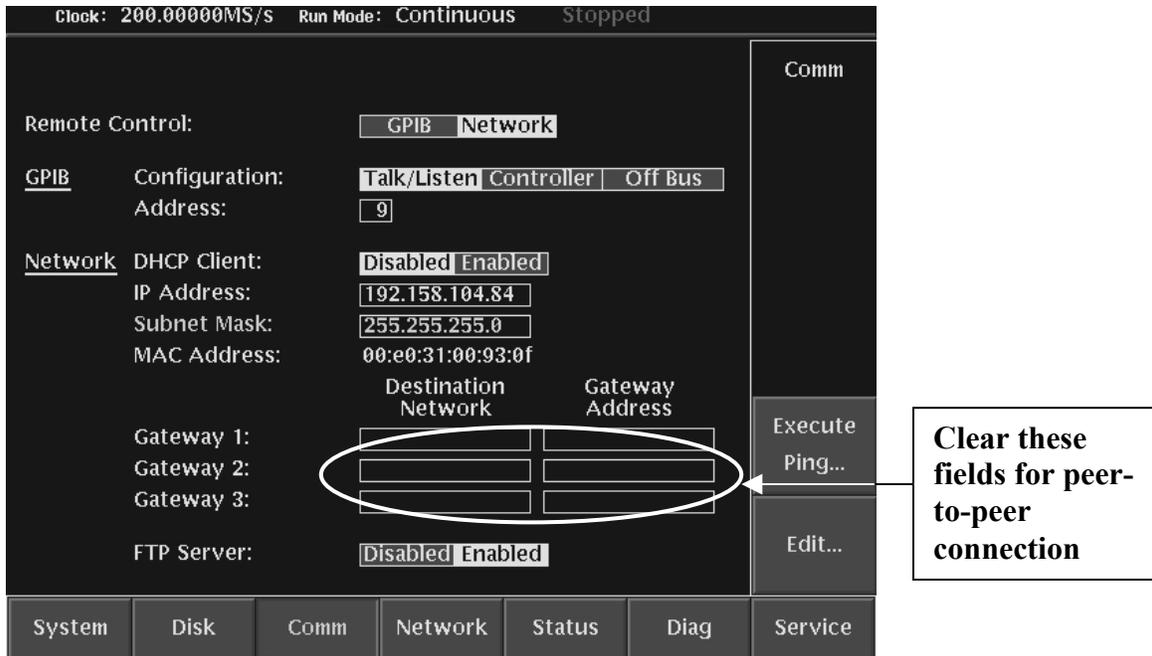
The Serial ATA Compliance Test Software on TDS6604 controls the AWG610 or AWG710. You can connect the two instruments using GPIB or Network:

GPIB Connection

- Connect the oscilloscope to NI's ENET/100 controller via an Ethernet cable.
- Connect the AWG to NI's ENET/100 controller via a GPIB cable.
- To configure the NI's ENET/100 controller, follow the instructions provided with the NI's ENET/100 controller.

Network Connection

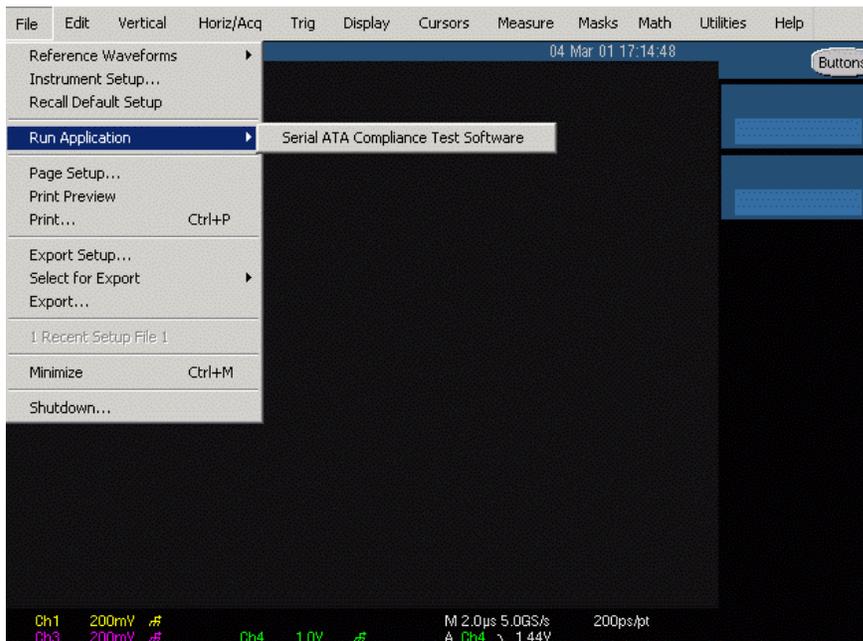
- Connect both instruments to a local LAN
- or
- Use a crossover Network cable directly between the instruments. While configuring the AWG for peer-to-peer connection, clear the Destination Network and Gateway Address fields from the AWG Comm menu as shown below



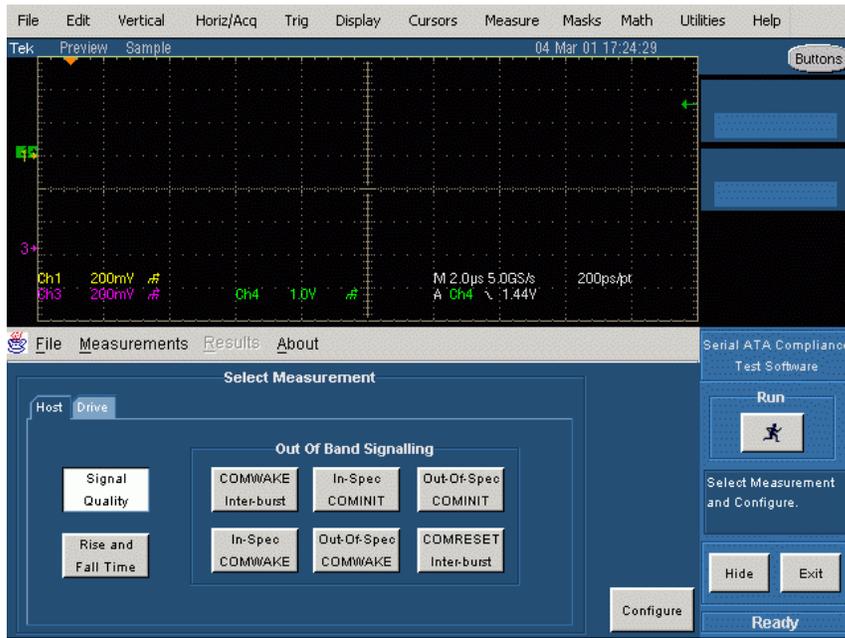
- Refer to the AWG Users' manual to configure the instrument for LAN connectivity

5.1.1 Starting the Serial ATA Compliance Test Software

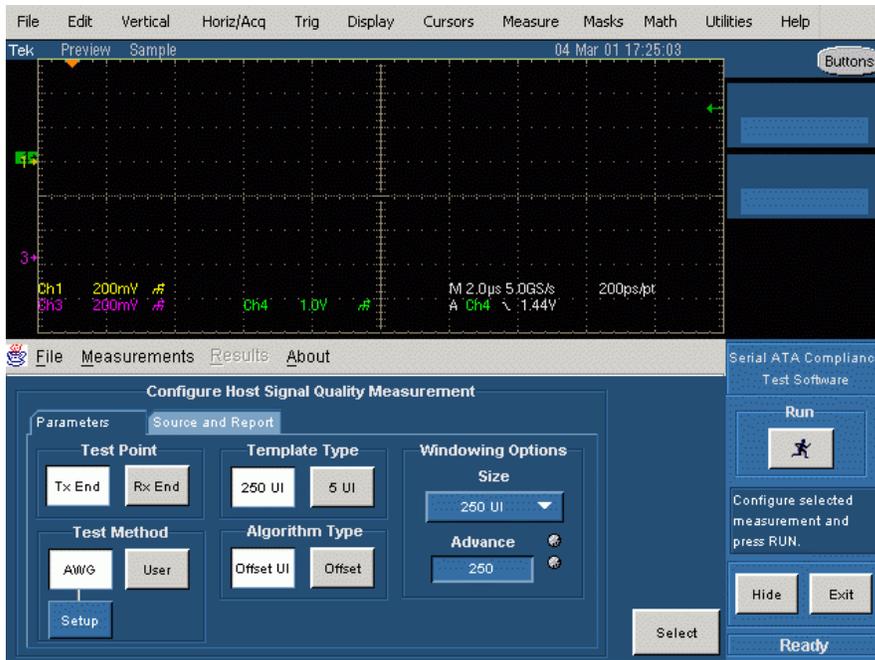
From the oscilloscope menu, select File > Run Application > Serial ATA Compliance Test Software.



5.1.2 Selecting and configuring a measurement 5.1.2



Selecting a measurement



Configuring a measurement

Host Measurements			
#	Measurement	Selecting a Measurement	Configuring a Measurement
1	Signal Quality	Measurements> Select> Host tab > Signal Quality	<p>Measurements> Configure>Parameters tab</p> <ul style="list-style-type: none"> • Select Tx End button for Near End tests or Select Rx End button for Far End tests • Select AWG button for AWG Method Select Setup for AWG Setup (for configuration details go to AWG Setup Configuration) <ul style="list-style-type: none"> ◆ Select GPIB if you have connected the AWG with the oscilloscope through a GPIB cable and ENET/100 controller <ul style="list-style-type: none"> ❖ Enter the GPIB settings ❖ Test Connection ❖ Select Floppy or Main ◆ Select Network if you have connected the AWG with the oscilloscope via LAN or Peer-to-Peer <ul style="list-style-type: none"> ❖ Enter the IP address of the AWG ❖ Test Connection ❖ Select Floppy or Main ◆ Select Manual if you want to control the AWG manually <ul style="list-style-type: none"> ❖ Select the AWG610 or AWG710 button according to the AWG model you are using • Select User button for User (Vendor-Specific Support) Method • Select 250UI or 5UI button if you want to test on the 250UI or 5UI Template • Select Algorithm Type as Offset or Offset UI • Select Window Size and Window Advance from the windowing options <p>Measurements> Configure> Source and Report tab</p> <ul style="list-style-type: none"> • Select the Live button if you are performing a live test <ul style="list-style-type: none"> ➤ Select the oscilloscope channels for Rx+/Tx+, Rx-/Tx- and Trigger • In the Device Id field, enter the device id of the DUT • In the Directory field, enter the location where you want to store the reports • Select the File button if you are performing a test with a .csv or .tsv file • Enter the location of the .csv or .tsv file
2	Rise and Fall Time	Measurements> Select> Host tab > Rise and	<p>Measurements> Configure>Parameters tab</p> <ul style="list-style-type: none"> • Select Tx End button for Near End tests or Select Rx End button for Far End tests

		Fall Time	<ul style="list-style-type: none"> • Select AWG button for AWG Method <ul style="list-style-type: none"> ➤ Select Setup for AWG Setup (for configuration details go to AWG Setup Configuration) • Select User button for User (Vendor-Specific Support) Method <p>Measurements> Configure>Source tab</p> <ul style="list-style-type: none"> • Select the Live button if you are performing a live test <ul style="list-style-type: none"> ➤ Select the oscilloscope channels for Rx+/Tx+, Rx-/Tx- and Trigger • Select the File button if you are performing a test with a .csv or .tsv file <ul style="list-style-type: none"> ➤ Enter the location of the .csv or .tsv file
3	COMWAKE Inter-burst	Measurements> Select> Host tab > COMWAKE Inter-burst	<p>Measurements> Configure>Parameters tab</p> <ul style="list-style-type: none"> • Select AWG button for AWG Method (for configuration details go to AWG Setup Configuration) • Select User button for User (Vendor-Specific Support) Method <p>Measurements> Configure>Source tab</p> <ul style="list-style-type: none"> • Select the oscilloscope channels for Tx+, Tx- and Trigger
4	In-Spec COMINIT	Measurements> Select> Host tab > In-Spec COMINIT	<p>Measurements> Configure>Parameters tab For configuration details go to COMWAKE Inter-burst</p> <p>Measurements> Configure>Source tab For configuration details go to COMWAKE Inter-burst</p>
5	Out-Of-Spec COMINIT	Measurements> Select> Host tab > Out-Of-Spec COMINIT	<p>Measurements> Configure>Parameters tab For configuration details go to COMWAKE Inter-burst</p> <p>Measurements> Configure>Source tab For configuration details go to COMWAKE Inter-burst</p>
6	In-Spec COMWAKE	Measurements> Select> Host tab > In-Spec COMWAKE	<p>Measurements> Configure>Parameters tab For configuration details go to COMWAKE Inter-burst</p> <p>Measurements> Configure>Source tab For configuration details go to COMWAKE Inter-burst</p>
7	Out-Of-Spec COMWAKE	Measurements> Select> Host tab > Out-Of-Spec COMWAKE	<p>Measurements> Configure>Parameters tab For configuration details go to COMWAKE Inter-burst</p> <p>Measurements> Configure>Source tab For configuration details go to COMWAKE Inter-burst</p>
8	COMRESET Inter-burst	Measurements> Select> Host tab > COMRESET Inter-burst	<p>Measurements> Configure>Parameters tab For configuration details go to COMWAKE Inter-burst</p>

Drive Measurements			
#	Measurement	Selecting a Measurement	Configuring a Measurement
1	Signal Quality	Measurements> Select> Host tab > Signal Quality	<p>Measurements> Configure>Parameters tab</p> <ul style="list-style-type: none"> ➤ Select Tx End button for Near End tests or Select Rx End button for Far End tests Select Setup for AWG Setup (for configuration details go to AWG Setup Configuration) ◆ Select GPIB if you have connected the AWG with the oscilloscope through a GPIB cable and ENET/100 controller <ul style="list-style-type: none"> ❖ Enter the GPIB settings ❖ Test Connection ❖ Select Floppy or Main ◆ Select Network if you have connected the AWG with the oscilloscope via LAN or Peer-to-Peer <ul style="list-style-type: none"> ❖ Enter the IP address of the AWG ❖ Test Connection ❖ Select Floppy or Main according to the AWG drive you choose to use ◆ Select Manual if you want to control the AWG manually <ul style="list-style-type: none"> ❖ Select the AWG610 or AWG710 button according to the AWG model you are using • Select User button for User (Vendor-Specific Support) Method • Select 250UI or 5UI button if you want to test on the 250UI or 5UI Template • Select Algorithm Type as Offset or Offset UI • Select Window Size and Window Advance from the windowing options <p>Measurements> Configure> Source and Report tab</p> <ul style="list-style-type: none"> • Select the Live button if you are performing a live test <ul style="list-style-type: none"> ➤ Select the oscilloscope channels for Rx+/Tx+, Rx-/Tx- and Trigger • In the Device Id field, enter the device id of the DUT • In the Directory field, enter the location where you want to store the reports • Select the File button if you are performing a test with a .csv or .tsv file • Enter the location of the .csv or .tsv file
2	Rise and Fall Time	Measurements> Select> Drive tab > Rise and Fall Time	<p>Measurements> Configure>Parameters tab</p> <ul style="list-style-type: none"> • Select Tx End button for Near End tests or Select Rx End button for Far End tests • Select AWG button for AWG Method <ul style="list-style-type: none"> ➤ Select Setup for AWG Setup

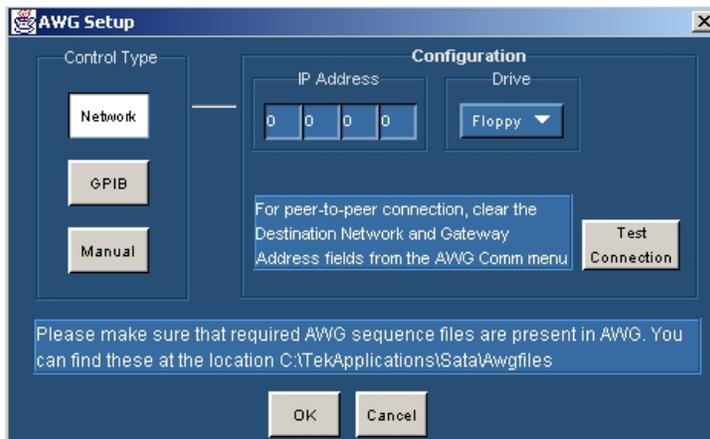
			<p>(for configuration details go to AWG Setup Configuration)</p> <ul style="list-style-type: none"> Select User button for User (Vendor-Specific Support) Method <p>Measurements> Configure>Source tab</p> <ul style="list-style-type: none"> Select the Live button if you are performing a live test <ul style="list-style-type: none"> Select the oscilloscope channels for Rx+/Tx+, Rx-/Tx- and Trigger Select the File button if you are performing a test with a .csv or .tsv file <ul style="list-style-type: none"> Enter the location of the .csv or .tsv file
3	COMINIT Inter-burst	Measurements> Select> Drive tab > COMINIT Inter-burst	<p>Measurements> Configure>Parameters tab</p> <ul style="list-style-type: none"> Select AWG button for AWG Method <ul style="list-style-type: none"> Select Setup for AWG Setup (for configuration details go to AWG Setup Configuration) Select User button for User (Vendor-Specific Support) Method <p>Measurements> Configure>Source tab</p> <ul style="list-style-type: none"> Select the oscilloscope channels for Tx+, Tx- and Trigger
4	COMWAKE Inter-burst	Measurements> Select> Drive tab> COMWAKE Inter-burst	<p>Measurements> Configure>Parameters tab</p> <p>For configuration details go to COMINIT Inter-burst</p> <p>Measurements> Configure>Source tab</p> <p>For configuration details go to COMINIT Inter-burst</p>
5	In-Spec COMRESET	Measurements> Select> Drive tab > In-Spec COMRESET	<p>Measurements> Configure>Parameters tab</p> <p>For configuration details go to COMINIT Inter-burst</p> <p>Measurements> Configure>Source tab</p> <p>For configuration details go to COMINIT Inter-burst</p>
6	Out-Of-Spec COMRESET	Measurements> Select> Drive tab > Out-Of-Spec COMRESET	<p>Measurements> Configure>Parameters tab</p> <p>For configuration details go to COMINIT Inter-burst</p> <p>Measurements> Configure>Source tab</p> <p>For configuration details go to COMINIT Inter-burst</p>
7	In-Spec COMWAKE	Measurements> Select> Drive tab > In-Spec COMWAKE	<p>Measurements> Configure>Parameters tab</p> <p>For configuration details go to COMINIT Inter-burst</p> <p>Measurements> Configure>Source tab</p> <p>For configuration details go to COMINIT Inter-burst</p>
8	Out-of-Spec COMWAKE	Measurements> Select> Drive tab > Out-of-Spec COMWAKE	<p>Measurements> Configure>Parameters tab</p> <p>For configuration details go to COMINIT Inter-burst</p> <p>Measurements> Configure>Source tab</p> <p>For configuration details go to COMINIT Inter-burst</p>

AWG Setup Configuration

You can control the AWG610 or AWG710 from TDS6604 in the following three ways:

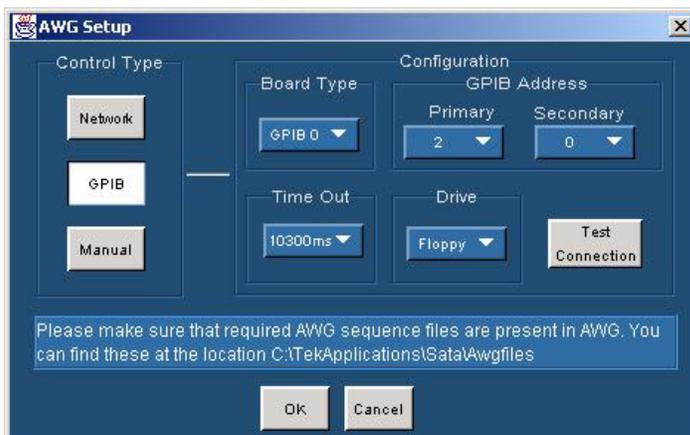
Network

1. Enter the IP Address of the AWG.
2. Choose Floppy or Main.
3. Select the Test Connection button to check whether the oscilloscope is connected properly to the AWG.



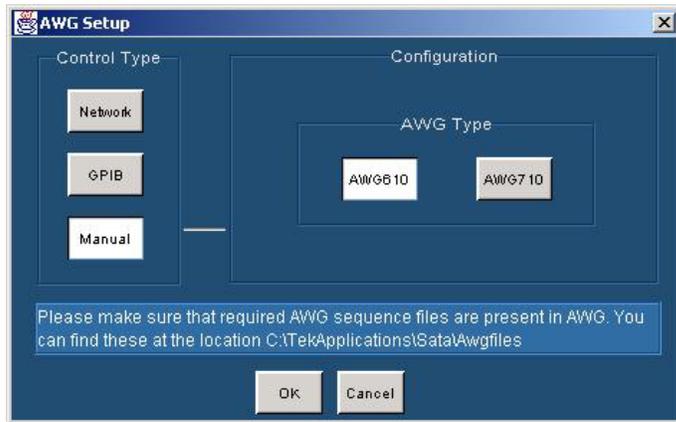
GPIB

1. Select the GPIB Board and GPIB Address
2. Select the Time Out value.
3. Select the Test Connection button to check whether the oscilloscope is connected properly to the AWG.



Manual

Select the AWG610 or AWG710 button depending on the AWG model you are using.



5.2 Out Of Band Signaling Test

5.2.1.1 Host COMWAKE Inter-burst Timing

- Select and configure as mentioned in the section [Host Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

5.2.1.2 Host Adaptive TDR Impedance Cal

Look for the optional adaptive impedance calibration TDR pulse(s). The optional adaptive impedance calibration for SATA Drive, if present, is expected to occur after the COMINIT from the AWG and prior to the Drive's COMWAKE. If found, verify no out of spec behavior is present. Please refer to the 1.0 specification for reference.

Note: Serial ATA Compliance Test Software does not support this test.

5.2.1.3 Host ALIGN Primitives

The Drive should begin sending out ALIGN primitives after seeing the ALIGN primitive from the AWG. The Drive must begin the ALIGN primitive within 2048 ALIGN D-words (~54.613us) from the beginning of the ALIGN from the AWG. One may need to iteratively set up a delay trigger to observe the ALIGN sequence from the Drive should it occur outside of the DSO setting.

Note: Serial ATA Compliance Test Software does not support this test.

5.2.1.4 Host Responds to In-Spec COMINIT

- Select and configure as mentioned in the section [Host Measurements](#).

- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

5.2.1.5 Host Rejects Out-Of-Spec COMINIT

- Select and configure as mentioned in the section [Host Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

5.2.1.6 Host Responds to In-Spec COMWAKE

- Select and configure as mentioned in the section [Host Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

5.2.1.7 Host Rejects Out-Of-Spec COMWAKE

- Select and configure as mentioned in the section [Host Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

5.2.1.8 Host COMRESET Inter-burst Timing

- Select and configure as mentioned in the section [Host Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

5.2.2 Out of Band Signaling Test – Drive as DUT

5.2.2.1 Drive COMINIT Inter-burst Timing

- Select and configure as mentioned in the section [Drive Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

5.2.2.2 Drive COMWAKE Inter-burst Timing

- Select and configure as mentioned in the section [Drive Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

5.2.2.3 Drive Adaptive TDR Impedance Cal

Look for the optional adaptive impedance calibration TDR pulse(s). The optional adaptive impedance calibration for SATA drive, if present, is expected to occur after the COMWAKE from the AWG and prior to the drive's COMWAKE. If found, verify no out of spec behavior is present. Please refer to section 6.6.2 of the 1.0a specification for reference.

The drive should begin sending out ALIGN primitives after seeing the COMWAKE from the AWG. The drive must transmit at least 2048 ALIGN D-words (~54.613us). One may need to iteratively set up a delay trigger to observe the entire ALIGN sequence from the drive.

Note: Serial ATA Compliance Test Software does not support this test.

5.2.2.4 Drive Responds to In-Spec COMRESET

- Select and configure as mentioned in the section [Drive Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

5.2.2.5 Drive Rejects Out-Of-Spec COMRESET

- Select and configure as mentioned in the section [Drive Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

5.2.2.6 Drive Responds to In-Spec COMWAKE

- Select and configure as mentioned in the section [Drive Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

5.2.2.7 Drive Rejects Out-Of-Spec COMWAKE

- Select and configure as mentioned in the section [Drive Measurements](#).

- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

5.3 Transmitter Signal Quality Test – Transmitter Template

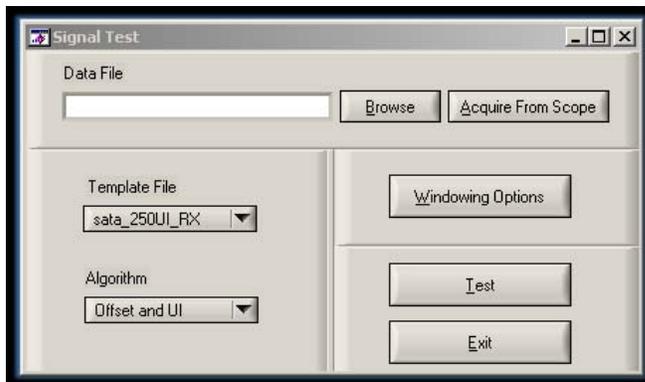
For best qualification of signal quality from the transmitter measurement at the transmitter connector is recommended. However, there are situations that measurement at the receiver connector may be necessary. Transmitter implemented pre-emphasis may employ measurement at the receiver connector. This section describes measurement method made at the transmitter connector against the transmitter eye template. Please refer to section 5.4 for measurement method made at the receiver connector against the receiver template.

5.3.1 Transmitter Signal Quality Test – Host as DUT (AWG Method)

Please skip to section 5.3.3 if the DUT is a drive device.

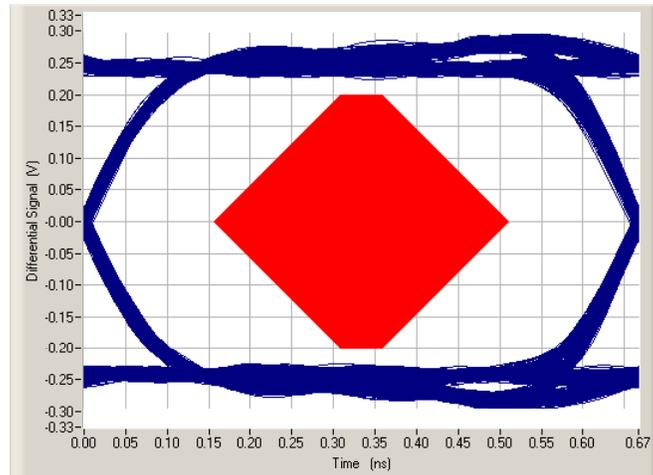
- Select and configure as mentioned in the section [Host Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

Serial ATA Compliance Test Software will invoke and run the SATA Signal Quality Eye Rendering Program. The following window will appear.



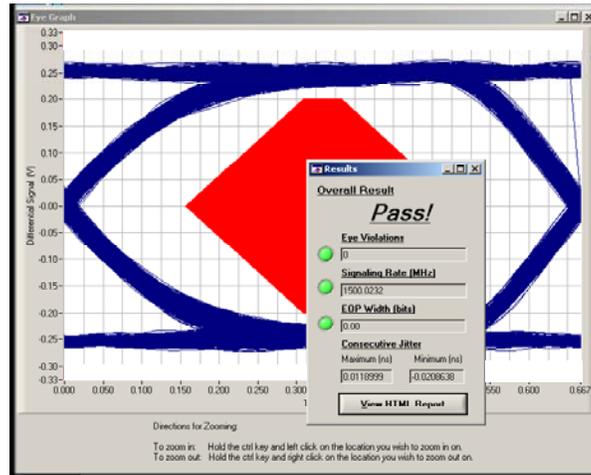
Note: If SATA Signal Quality Eye Rendering Program does not generate the eye diagram, then press the Test button.

The process will take a few seconds and a signal quality eye plot similar to the figure below will be presented:



250 UI Tx Eye

A Pass/Fail dialog box will appear to announce the result:



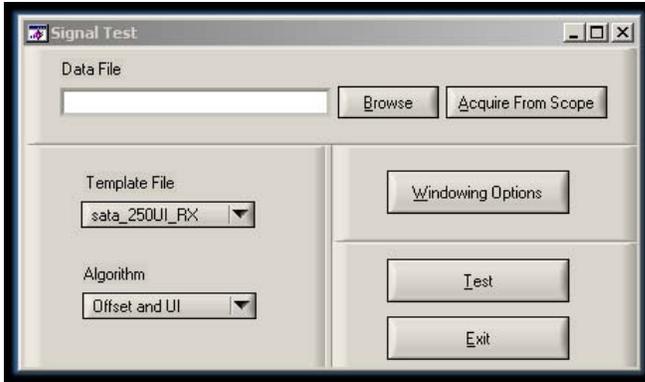
You may click the View HTML Report button to see the HTML report.
Repeat the process for all other ports.

5.3.2 Transmitter Signal Quality Test – Host as DUT (Vendor-Specific Support)

Should the Drive controller provide vendor-specific support for transmitter signal quality test, the AWG610 / AWG710 is not needed. Invoke the vendor-specific test support to place the transmitter in far-end transmit mode. Set the data pattern to include either run-length 1, 2, 3, and 4, or 5.

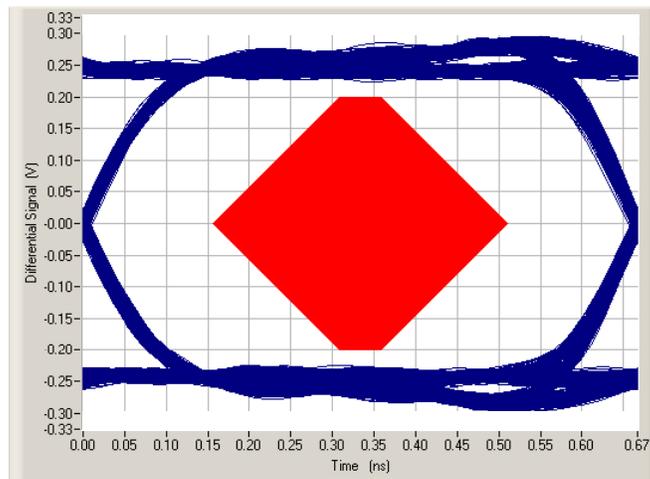
- Select and configure as mentioned in the section [Host Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

Serial ATA Compliance Test Software will invoke and run the SATA Signal Quality Eye Rendering Program. The following window will appear.



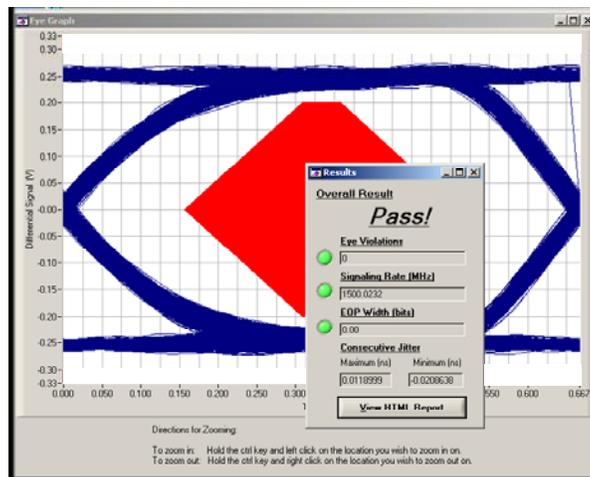
Note: If SATA Signal Quality Eye Rendering Program does not generate the eye diagram, then press the Test button.

The process will take a few seconds and a signal quality eye plot similar to the figure below will be presented:



250 UI Tx Eye

A Pass/Fail dialog box will appear to announce the result:

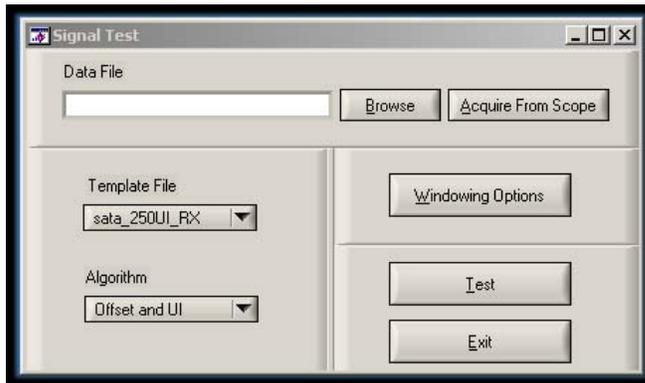


You may click the View HTML Report button to see the HTML report.
Repeat for all other ports.

5.3.3 Transmitter Signal Quality Test – Drive as DUT (AWG Method)

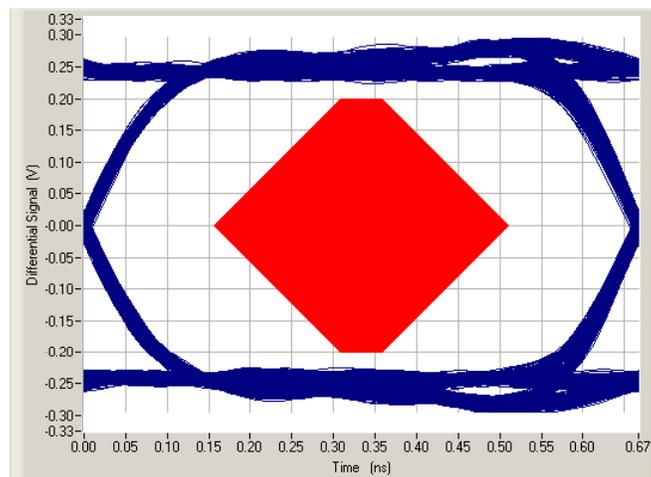
- Select and configure as mentioned in the section [Drive Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

Serial ATA Compliance Test Software will invoke and run the SATA Signal Quality Eye Rendering Program. The following window will appear.



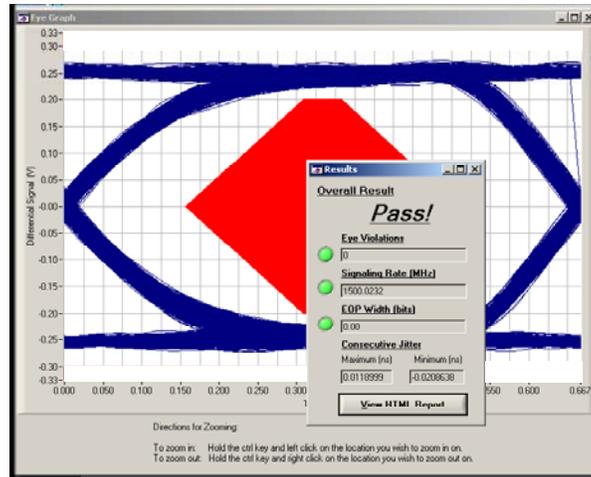
Note: If SATA Signal Quality Eye Rendering Program does not generate the eye diagram, then press the Test button.

The process will take a few seconds and a signal quality eye plot similar to the figure below will be presented:



250 UI Tx Eye

A Pass/Fail dialog box will appear to announce the result:



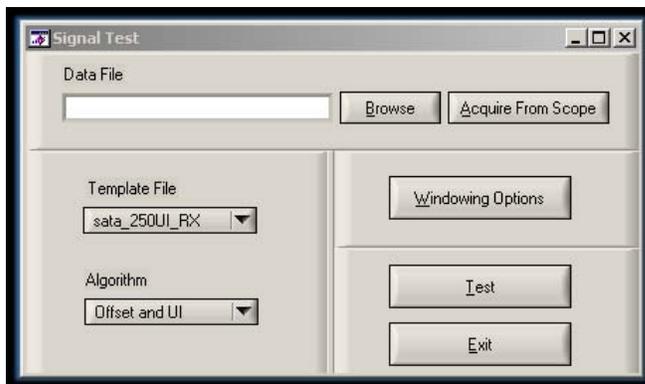
You may click the View HTML Report button to see the HTML report.

5.3.4 Transmitter Signal Quality Test – Drive as DUT (Vendor-Specific Support)

Should the Drive controller provide vendor-specific support for transmitter signal quality test, the AWG610 / AWG710 is not needed. Invoke the vendor-specific test support to place the transmitter in far-end transmit mode. Set the data pattern to include either run-length 1, 2, 3, and 4, or 5.

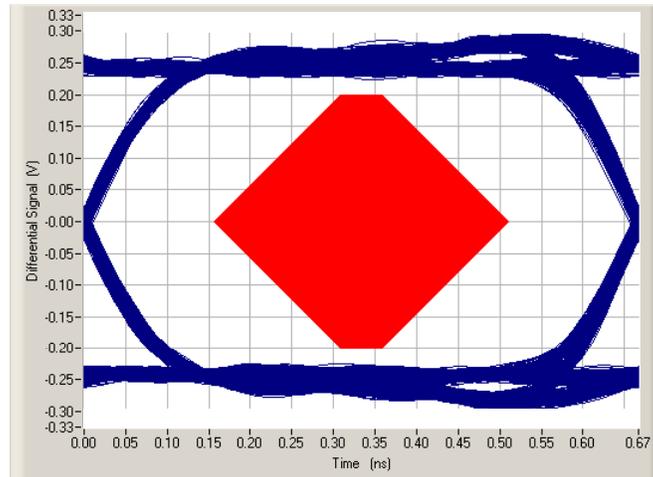
- Select and configure as mentioned in the section [Drive Measurements](#).
- Press Run.
- Follow the on-screen prompts to take the measurement and view the results.

Serial ATA Compliance Test Software will invoke and run the SATA Signal Quality Eye Rendering Program. The following window will appear.



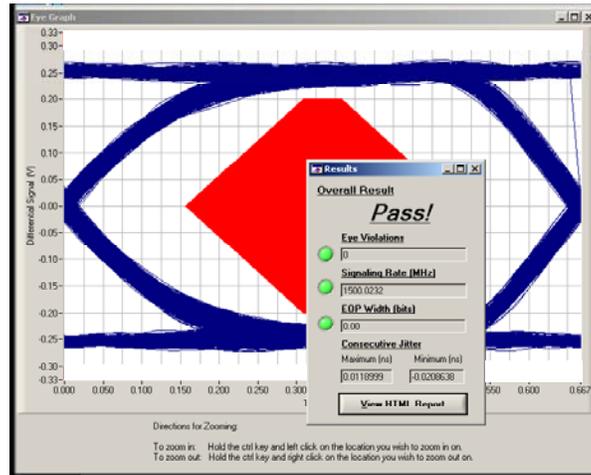
Note: If SATA Signal Quality Eye Rendering Program does not generate the eye diagram, then press the Test button.

The process will take a few seconds and a signal quality eye plot similar to the figure below will be presented:



250 UI Tx Eye

A Pass/Fail dialog box will appear to announce the result:



You may click the View HTML Report button to see the HTML report.

5.3.5 Transmitter Far-End Signal Quality Test – Receiver Template

This test is optional

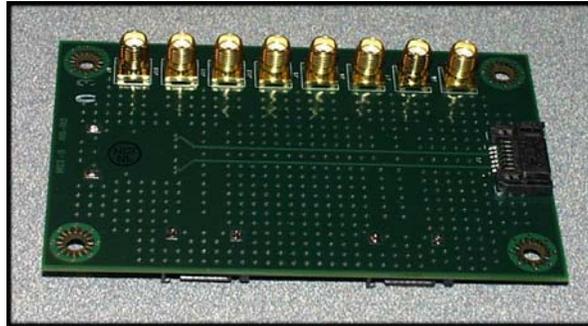
This test looks at the signal quality as measured at the end of a 1 meter cable. This test is not required because the quality of the cable can adversely effect the overall result. However, it can be a useful test for debugging purposes and to check the ability of the device to transmit over a reasonable interconnect length. For qualification of signal quality from the transmitter, measurement at the transmitter connector is strongly recommended.

This section describes measurement method made at the receiver connector against the receiver eye template. Please refer to section [Host Measurements](#) and [Drive Measurements](#) for measurement method made at the transmitter connector against the transmitter template.

The test methodology for transmitter signal quality test using the receiver template is very similar to that using the transmitter template as described in detail in Section 5.3. Only the differences will be described here.

Test Setup

Instead of using the Transmitter SQ Test Fixture, a Far-end Transmitter SQ Test Fixture is used. The fixture shown below is only an example of a far-end fixture and is not available for sale or distribution.



Far End SQ Fixture

Connect the Far-end Transmitter SQ Test Fixture to the DUT using a golden 1m SATA cable. Connect the 2 sets of SMA connectors to the DSO and AWG exactly as in Section 5.1. As follows is a connection for a drive under test:

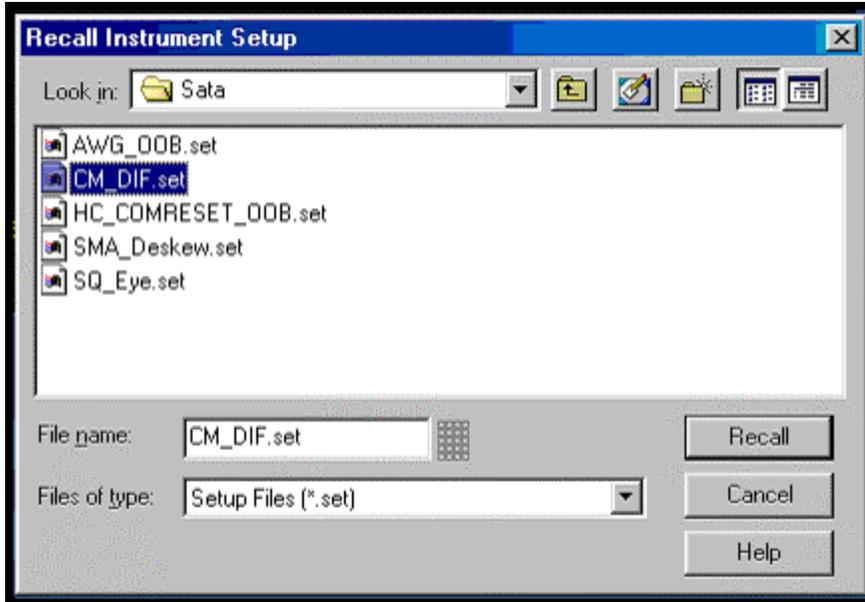


Far End SQ Test Setup

Follow the subsection in Section 5.3 applicable to the DUT characteristic (e.g. Drive or host as DUT, and AWG versus vendor-specific test method).

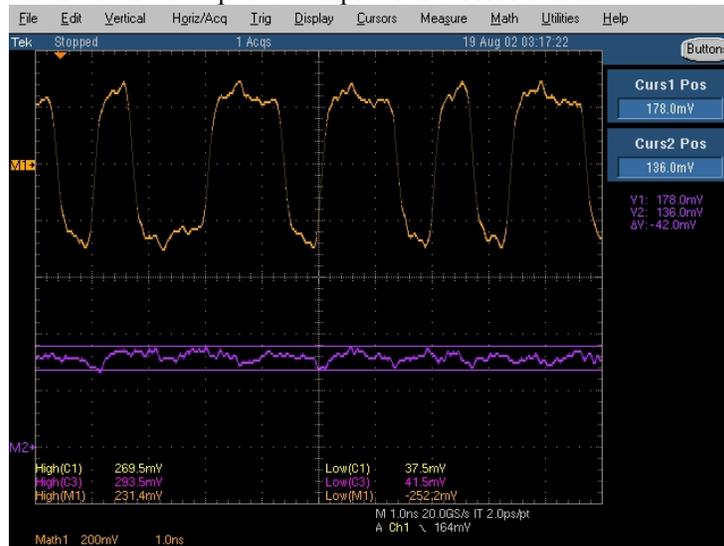
5.4 Common Mode Signal

On TDS6604, load the CM_DIFF.set setup file from C:\Program Files\SATA Compliance Toolset\Setup Files folder using the Recall Setup function:



Load Common Mode Setup

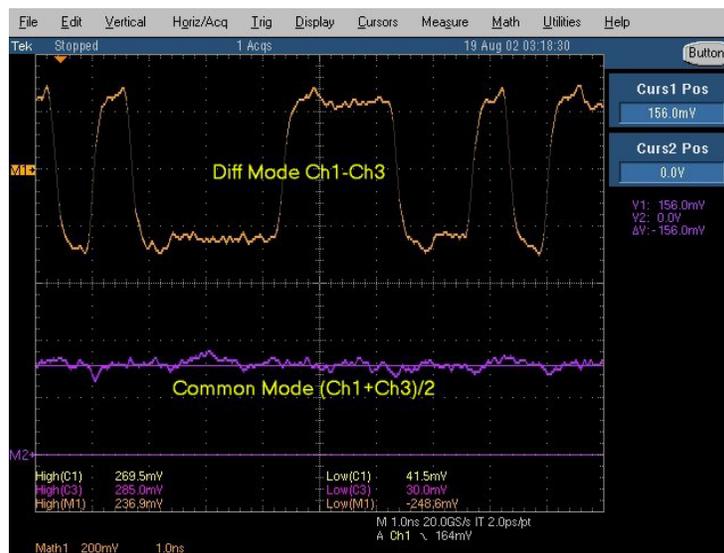
The DSO should capture a sample of the SATA transmitted bus state:



CM AC Voltage in Lower Screen

Use the cursor to measure the peak-to-peak AC amplitude of the common mode voltage. Verify this is between 0 V and 2.0 V. (Please refer to section 6.6.2 of the 1.0a specification for reference).

Use the cursor to measure the DC amplitude of the common mode voltage. Verify this is between 200 mV and 450 mV. (Please refer to section 6.6.2 of the 1.0a specification for reference).



CM DC Voltage in Lower Screen

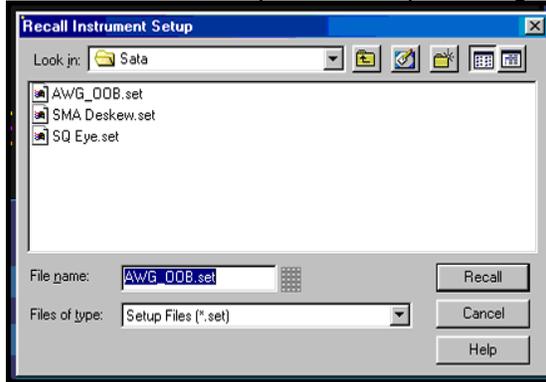
Note: Serial ATA Compliance Test Software does not support this test.

5.5 Receiver Squelch

The squelch level of the receiver can be determined by margining the vertical output levels of the AWG. To accurately measure the squelch, monitor the SATA signal with the Tektronix P7330 differential probe at the pins of the SATA integrated circuit of the DUT. Use an articulating probe holder if necessary.

Move the negative channel of the DUT transmit from channel 3 to channel 2 of the DSO. Replace the SMA-TC module in channel 3 with a Tektronix P7330 differential probe.

On the DSO load the Squelch.set setup file using the Recall Setup function:



Verify the DSO is armed for a single trigger. The SINGLE button should be lit.

On the arbitrary waveform generator load crst01p.seq (for AWG610) or crst01+.seq (for AWG710) OOB sequence file:

1. Press the HORIZONTAL MENU button
2. Press the Waveform Sequence screen button.
3. Press the Load screen button.
4. Navigate to the directory containing the SATA setup files as necessary.
5. Select crst01p.seq (for AWG610) or crst01+.seq (for AWG710) from the available setup file list and press the OK screen button.
6. This is the OOB sequence file with a nominal timing.

Arm the arbitrary waveform generator by pressing the RUN button. The RUN indicator should illuminate. Verify the DSO is armed for SINGLE trigger mode. Press the FORCE TRIGGER button on the arbitrary waveform generator and capture an OOB handshake sequence on the DSO. Please refer to the following two figures for reference:



Host Responds to In-Spec COMINIT Inter-burst Gap

Verify the DUT response with a 6-burst COMINIT sequence. Now use the Marker vertical level of the AWG, iteratively reduce the output amplitude of Marker 1 and Marker 2 and re-initiate the AWG's emulated OOB handshake:

1. Press the VERTICAL MENU button.
2. Press the Marker screen button.
3. Reduce Marker 1 and Marker 2 High Levels by 50mV.
4. Toggle the Run button off and then back on.
5. Re-arm the DSO by pressing the Single button once. The Single indicator should be lit.
6. Press the Force trigger button on the AWG. The DSO should capture an OOB sequence similar to the previous 2 figures. Look for the marker output levels in which the DUT ceases to respond with a COMWAKE. This may take a few iterations of reducing the AWG's markers' output levels in 50mV steps. The differential peak-to-peak voltage measured with the differential probe at the receiver pins when the DUT first ceases to respond with a COMWAKE is the squelch level of the receiver detector

Note: *Serial ATA Compliance Test Software does not support this test.*

5.5 Disk Write/Read Stress Test

The disk write/read stress test is developed to perform transfer of large block of files with worst case data pattern as outlined in Section 6.7.7 of the Revision 1.0 specification. The test is comprised of two files, an executable binary named *TRANSFER.EXE* and a data pattern file named *COMP2K.BIN*. The program

uses the pattern to create a 2Gbyte file on the target. It then reads the file back and compares it against the original pattern, recording any differences that occur as errors. A successful run will have no errors. The test requires a platform with two hard drives, the resident hard drive and the SATA hard drive to serve as the transfer target. The resident hard drive can be any type. This drive is used only to Drive the program files and the resultant log file. The SATA target hard drive must be formatted with a file system that is compatible with the test platform.

To use the transfer test software, copy the two program files to the same directory on the resident hard drive. Open a command prompt (DOS box). Change directories to the directory containing both files. Start the test application by typing “transfer” and pressing the <enter> key. The program will start. The program will prompt, “*Enter name of pattern file to use*”. Enter “*comp2k.bin*” and press the <enter> key. The program will then prompt “*Enter path and name for target file*”. The response to this prompt should be the fully qualified path of the file to create on the target drive. If, for example, the target drive has been assigned drive letter ‘F’, type “*f:\test.bin*” and press the <enter> key. The program will now prompt “*Enter log file comment*”. Enter any meaningful comment about the test to be run or just press the <enter> key if no comment is needed. Any comment entered is restricted to being 80 characters or less. The test will now begin transferring data to and from the target drive.

As the test proceeds, it will update the display with its current activity, either writing the target file or reading the target file. In addition to these messages, it will display a spinner. A moving spinner indicates that the program is moving data. A spinner that stops for an extended period of time indicates a hung drive or controller.

The test will run for at least 15 minutes. It will repeat the write/read sequence several times during this period. At the end of the run, the program will display the total number of Kbytes transferred, the number of compare errors that occurred, and the elapsed time. It will also prompt for a closing log file comment.

Note: *Serial ATA Compliance Test Software does not support this test.*

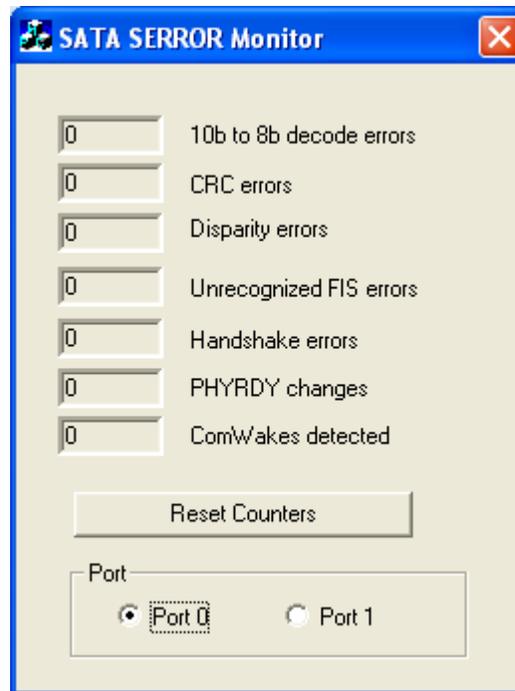
5.5.1 Low-Level Error Reporting

The transfer test described in section 0 can only report uncorrected errors. For accuracy, this program should be run in conjunction with a low-level error monitor program. The low-level error-monitoring program should monitor the SERROR register of the SATA Drive controller to detect and count any low-level recoverable errors that occur during the transfer test.

At this point in time, the Serial ATA specification does not provide a common means of accessing the SERROR register. Hence, any low-level error monitor program is vendor-specific.

This package includes two examples of a low-level error program, one written for the Intel ICH5 chipset and one written for the Silicon Image Sil3112 Drive controller, revision 1.1. To use the Silicon Image monitor, you must have both the Drive controller and drivers installed on the test system.

The monitor software is comprised of a generic application, SERRMON.EXE, and a silicon –specific driver package, either SataSI.SYS and SataSI.REG, or SataICH5.SYS and SataICH5.REG. To install the monitor, first copy the appropriate .SYS file to %WINDIR%\System32\drivers. Next, double click on the appropriate .REG file to install the .SYS file in the list of system services. Reboot the machine. After the machine has rebooted, press Start->Run and type “net start SataICH5” to start the ICH5-specific driver or “net start SataSI” to start the Silicon Image-specific driver. At this point, the SERRMON application can be launched. It will display a dialog box:



SERROR Monitor Dialog Box

Before running the transfer test, insure that the displayed counts all have a value of zero (0). If they do not, press the “Reset Counters” button. Execute the transfer test as described in section 0. When the test has completed, check the SERROR Monitor to see if any low-level errors occurred during the testing and note any that do.

Note: Serial ATA Compliance Test Software does not support this test.

Appendix A – Serial ATA Test Data

A1.1 Vendor and Product Information

	Please fill in all fields. Please contact your silicon supplier if you are unsure of the silicon information.
Test Date	
Company Name	
Company Complete Address	
Company Phone Number	
Company Contact, Title	
Product Name	
Product Model	
Product Revision	
Tested By	

A1.2 Out Of Band Signaling

A1.3 Transmitter Signal Quality Eye

A1.4 Common Mode Signal

Overall Result:

- Pass
- Fail
- N/A

Comments:

A1.5 Disk Write/Read Stress Test

Overall Result:

- Pass
- Fail
- N/A

Comments:

Appendix B

Appendix B – Application Notes

B1 Tektronix AWG610 Arbitrary Waveform Generator

For compatibility, please verify your AWG has version 1.2 operating system.

B1.1 Managing Files and Creating Patterns

To a PC user, the AWG may initially appear to be very cumbersome to use as it lacks the modern GUI we are accustomed to. There are two main areas that deserve discussion – file management and creating pattern files.

Although one can import/export files to/from the AWG using the built-in floppy disk, FTP through the network is by far the preferred method.

Although one may use command line based FTP, the use of a good GUI-based FTP program like WS_FTP LE is recommended because the AWG does not support MGET or MPUT.

As follows are the steps to set up for FTP on the AWG:

1. Press the UTILITY button
2. Press the COMM soft button
3. Use the arrow buttons on the front panel to select FTP for Remote Control
4. Set the IP Address and the Subnet Mask desired for the AWG (Note: the AWG does not support DHCP)
5. Set the Gateway information as necessary
6. Enable FTP server

For a quick test of the FTP setup one may follow the steps below:

1. Open a command line window on the PC test computer by Start -> Run -> enter “cmd” and press <Enter>
2. In the command line window type ping (IP address of AWG) <Enter>. The ping should not result in timeout
3. Now type: ftp ((IP address of AWG) <Enter>. A prompt for user name should appear. Enter a user name. A prompt for password should appear. Enter a password or just press <Enter>. One may list the content of the AWG root director by typing DIR <Enter>. This confirms the FTP support on the AWG is set up correctly. Exit the FTP connection by typing QUIT <Enter>.

The following information should help set up a common GUI based FTP program like WS_FTP LE:

1. Set Drive type to “automatic detect”
2. Set the initial remote folder to root
3. Set the user name to “anonymous”
4. Set a short password
5. Set the initial transfer mode to ASCII
6. Leave the remote port to the default setting of 21h, passive transfer mode

Note: most firewalls impose FTP challenges; it is advisable that the AWG and the PC be on the same side of the firewall.

One cannot perform delete files in the AWG through the FTP program. Delete operations must be made locally at the AWG.

One may, however, perform multiple file copy to or from the AWG.

B1.2 Other AWG Tips

A standard PS2 PC keyboard can be connected to the AWG. This makes editing and managing files tremendously more expedient.

B1.3 SATA Sequence Files

There is a set of OOB sequence files for COMRESET/COMINIT and COMWAKE sequence. Each set of sequence files has varied inter-burst spacing. The sets include a nominal, an in-spec long, an in-spec short, an out-of-spec long, and an out-of-spec short. Please refer to the following table for details.

In addition to the OOB sequence files, there are two sequence files designed to support transmitter signal quality eye test. These two files are similar to the OOB sequence files except the sequence file will handshake the DUT to reach the phy-ready state, so ALIGN or SYNC will be transmitted by the DUT to facilitate the test.

B1.3.1 Understanding Sequence Files

The following figure shows the content of the hc_test.seq sequence file as seen in AWG's pattern editor:

Line	CH1	CH2/Digital	Repeat Count	Wait Trigger	Goto One	Logic Jump
1	idle.pat		1			
2	crst01p.pat		1			
3	idle.pat		15			
4	cwke01p.pat		1			
5	idle.pat		5			
6	D10_2.pat		6			
7	ALIGN.PAT		100			
8	SYNC.PAT		inf.			

The items in the second column under CH1 are pattern files. Pattern files have a minimum size of 512-bit depth for a data width of 10 bits. Of the 10 data bit width, 8 are devoted to the analog channel of the AWG. The remaining two bits are for Marker 1 and Marker 2 – the digital channels we use for SATA application. Another pattern file depth requirement is divisible by 8.

The hc_test.seq sequence is in essence an algorithmic pattern generation. In this example, each pattern file contains the patterns for Marker 1 and Marker 2, created using the AWG's built in pattern editor. These pattern files can be used standalone, or called by the algorithmic sequence file. Once initiated to run, the sequence begins from Line 1 and incrementally to next line number. Depending the number in the Repeat Count, a pattern file may be executed one or more times. The Repeat Count can be set for 'inf.' – denoting repeat infinitely unless stopped by the RUN (toggles between run and stop) button. Please note that the AWG returns to the first state defined in the first pattern file in Line 1 if the last pattern file is set to a finite Repeat Count. The levels of Marker 1 and Marker 2 will take on the static high/low state and this may not be a desired idle condition in your application. In the hc_test.seq the idle.pat pattern file consists of 512 UIs of low state for both Marker 1 and Marker 2, forcing the bus state to simulate uninitiated SATA bus condition.

Pattern files define the state of Marker 1 and Marker 2 as a function of discrete time steps. In the SATA application, the time step is set to 666.67ps – a SATA gen-1 clock speed. The following is the graphical view of the ALIGN.PAT pattern file in the pattern editor.



AWG Pattern Editor

B.1.3.2 Modifying the Sequence Files

The AWG is not an intelligent instrument in the sense that it does not perform true handshake. It is just programmed to transmit specific data events in predetermined order and timing. When testing products with diverse timing characteristics, it would be required to modify the sequence files to cater to the DUT. The likely modification needed for a specific product is to adjust the time delay between the events during the OOB handshake. For example, a drive DUT may need increased delay or bus idle between COMWAKE and transmission of D10.2 so the SATA OOB handshake protocol is simulated. This modification may be accomplished two different ways. One may increase the repeat count in the above example from 6 to 7. Since the D10_2.pat pattern file is 520 UI long, the limitation of this method is that the adjustment granularity is 520UI. Should a finer granularity be needed, a second method can be used. Rather than adjusting the repeat count, one may create a pattern file with a specific number of UIs. For example, we wish to extend the D10.2 sequence by 128 UIs. We can make a new pattern file with 648 UIs. We do this by taking the original D10_2.pat and save it as D10_2_648.pat. We then edit the pattern depth to 648, and then use the copy and paste function in the editor to fill in the additional 128 UIs at the end. Naturally the granularity of the adjustment is still bounded by the divisible-by-8 constraint of the AWG. This should not be a problem in most applications. The modified sequence file in the above example should be as follows:

Line	CH1	CH2/Digital	Repeat Count	Wait Trigger	Goto One	Logic Jump
1	idle.pat		1			
2	crst01p.pat		1			
3	idle.pat		15			
4	cwke01p.pat		1			
5	idle.pat		5			
6	D10_2.pat		5			
7	D10_2_128.pat		1			
8	ALIGN.PAT		100			
9	SYNC.PAT		inf.			

B2 Tektronix TDS6604 Digital Storage Oscilloscope

For compatibility, please verify your TDS6604 has firmware version 2.1 or higher. The latest update may be found at Tektronix's website.

B2.1 Accessing the DSO

There are a number of ways to transfer files to and from the DSO. The recommended method is to set up file sharing on the Tekscope folder:

Right click My Computer on the Desktop. Click the Network Identification tab and enter a desired Computer Name. Click OK to exit.

In the Windows Explorer right click the Tekscope folder with the mouse and select Share

Select "Allow user to read and write content ..." (check this)

On the test PC computer, invoke Windows Explorer. Select Map Network Drive from the Tools drop down menu. Enter the Tekscope path as [\\Computer_Name_of_the_TDS6604](#)\Tekscope. Check the 'Reconnect at logon' box if desired and click Finish. This creates a drive mapping to the Tekscope folder for file transfer. Create a local folder at the test PC Computer for transmitter signal analysis purpose. This folder will be used to hold the captured DSO files for signal quality eye rendering.

B2.1.1 Setup Files for DSO

The setup files for the TDS6604 may be found in the default folder after the installation unless specified otherwise during the installation. Place these files in the Tekscope\Setup folder.

B3 Data File Format for the Signal Quality Eye Rendering Program

The Eye rendering program expects the data files to start with six header lines, followed by a line for each data sample. Below is a sample from an actual data file:

```
"Record Length",50000,"Points",-3.66560005e-008, -0.2638437
"Sample Interval",1.60000002e-011,s,-3.66400005e-008, -0.2625
"Trigger Point",2291,"Samples",-3.66240005e-008, -0.2620312
"Trigger Time",1.31197045e-011,s,-3.66080005e-008, -0.2650625
""",-3.65920005e-008, -0.2715
"Horizontal Offset",-3.66560005e-008,s,-3.65760005e-008, -0.278125
,,,-3.65600005e-008, -0.2798437
,,,-3.65440005e-008, -0.2750625
,,,-3.65280005e-008, -0.2679687
,,,-3.65120005e-008, -0.264
,,,-3.64960005e-008, -0.2660312
,,,-3.64800005e-008, -0.2725625
,,,-3.64640005e-008, -0.279375
,,,-3.64480005e-008, -0.2820312
,,,-3.64320005e-008, -0.2810937
,,,-3.64160005e-008, -0.2799375
,,,-3.64000005e-008, -0.2800938
,,,-3.63840005e-008, -0.282375
,,,-3.63680005e-008, -0.2864062
,,,-3.63520005e-008, -0.2889375
```