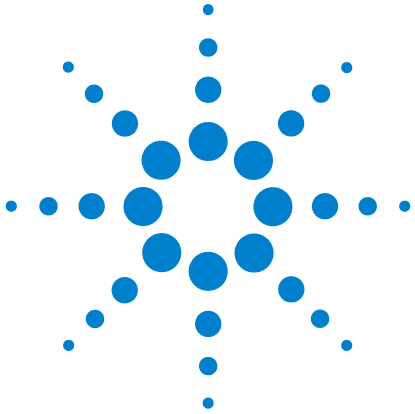

Agilent N5416A USB 2.0 Compliance Test Option

Notes on Electrical Testing

Agilent Technologies

Notices

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USB Automated Testing—At A Glance

The Agilent N5416A USB 2.0 compliance test option helps you verify USB compliance to specifications using the Agilent 5485xA, 80000 or 90000A Series Infiniium digital storage oscilloscope.

The USB 2.0 compliance test option runs under an automated test engine that.

- Lets you select individual or multiple tests to run.
- Lets you identify the device being tested and its configuration.
- Shows you how to make oscilloscope connections to the device under test.
- Automatically checks for proper oscilloscope configuration.
- Automatically sets up the oscilloscope for each test.
- Provides detailed information for each test that has been run and lets you specify the thresholds at which marginal or critical warnings appear.
- Creates a printable HTML report of the tests that have been run.

In This Book

This manual contains notes on the electrical tests that are performed by the USB 2.0 compliance test option; it describes the equipment used, and it describes how the tests are performed.

- Chapter 1, “Installing the USB 2.0 Compliance Test Option” shows how to install and license the automated test application software (if it was purchased separately).
- Chapter 2, “Preparing to Take Measurements” describes the equipment required, how to set up the equipment, how to start the USB 2.0 Compliance Test Option, and how to run tests.
- Chapter 3, “Device Hi-Speed Tests” describes the equipment used for each test setup.
- Chapter 4, “Hub Hi-Speed Tests” describes the equipment used for each test setup.
- Chapter 5, “Host Hi-Speed Electrical Tests” describes the equipment used for each test setup.
- Chapter 6, “Troubleshooting Hi-Speed Test Failures” describes the Debug Mode options that can be used when troubleshooting hi-speed test failures.
- Chapter 7, “Low and Full Speed Tests” describes the equipment used for each test setup.
- Chapter 8, “On-The-Go Electrical Tests” describes the equipment used for the test setup.

See Also

- The USB 2.0 Compliance Test Option’s online help, which describes:
  - Creating or opening a test project.
  - Selecting tests.
  - Configuring selected tests.
  - Connecting the oscilloscope to the DUT.
  - Running tests.
  - Viewing test results.
  - Viewing/printing the HTML test report.
  - Saving test projects.
- The USB 2.0 developers documents are available at the USB Implementers Forum web site, http://www.usb.org/developers/docs. This web page has test procedure documents for the E2683A USB 2.0 Compliance Test Option, which contain test records used for compliance test submission.

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1 Installing the USB 2.0 Compliance Test Option

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If you purchased the N5416A USB 2.0 Compliance Test Option separately, you need to install the software and license key.

Installing the Software

1. Make sure you have version 05.20 or higher of the Infiniium oscilloscope software by choosing **Help>About Infiniium...** from the main menu.
2. Download the latest version of the N5416A USB 2.0 Compliance Test Option software to your oscilloscope:
   a. Go to: http://www.agilent.com/find/scope-apps-sw
   b. Click the N5416A USB 2.0 Compliance Test Option links.
3. Run the setup program, and follow the instructions.

   Be sure to accept the installation of the .NET Framework software; it is required in order to run the USB 2.0 Compliance Test Option.

Installing the License Key

1. Request a license code from Agilent by following the instructions on the Entitlement Certificate.

   You will need the oscilloscope's "Option ID Number", which you can find in the **Help>About Infiniium...** dialog.

2. After you receive your license code from Agilent, choose **Utilities>Install Option License...**.
3. In the Install Option License dialog, enter your license code and click **Install License**.
4. Click **OK** in the dialog that tells you to restart the Infiniium oscilloscope application software to complete the license installation.
5. Click **Close** to close the Install Option License dialog.
6. Choose **File>Exit**.
7. Restart the Infiniium oscilloscope application software to complete the license installation.

2 Preparing to Take Measurements

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After you gather and set up the required equipment and software, you can start the USB 2.0 Compliance Test Option and begin performing the electrical compliance tests.

Required Equipment and Software

Table 1 Digital Storage Oscilloscope, Software, and Accessories

Equipment Required	Host Hi-Speed	Hub Hi-Speed	Device Hi-Speed	Low/Full Speed
Agilent 5485xA, 80000 or 90000A Series Infiniium oscilloscope.	1*,**	1*,**	1*,**	1***
Agilent N5416A USB Compliance Test Option.	1	1	1	1
Computer monitor (optional).	optional	optional	optional	optional
Agilent 1131A, 1133A, or 1134A InfiniiMax differential probe.	1	2	1	n/a
Agilent E2669A differential connectivity kit, OR E2678A socketed head.	1	2	1	n/a
Agilent header adapter (P/N 01131-68703), included with E2669A and E2678A purchased after October, 2003.	1	2	1	n/a
Agilent E2697A 1 Mohm adapter with passive probe, OR 1156A, 1157A, or 1158A active probe.	2	2	2	3***
Agilent E2697A high impedance converter, N2774A current probe, and N2775A power supply.	n/a	n/a	n/a	1***

*The oscilloscope's memory upgrade option is recommended (Option 001 when ordered with the oscilloscope, or after purchase: E2680A for the 5485xA Series oscilloscopes, or N5404A for the 80000 and 90000A Series oscilloscopes). This gives the automated test software more flexibility in making corner case measurements (and improves test performance).

**The enhanced bandwidth software option is recommended for the Agilent 54855A oscilloscope (Option 008), and the noise reduction software option is recommended for the 80000 and 90000A Series oscilloscopes (Option 005 when ordered with the oscilloscope or N5403A after purchase). This reduces the bandwidth of the oscilloscope to just what is required by the USB-IF (2 GHz for USB 2.0), which can greatly reduce system measurement noise, allowing the maximum measurement margin.

***For low/full speed testing, the Agilent 54831B/D or 54832B/D Infiniium oscilloscope with 1165A passive probes and 1147A current probe can be used instead.

Table 2 Digital Multimeter

Equipment Required	Host Hi-Speed	Hub Hi-Speed	Device Hi-Speed	Low/Full Speed
Agilent 33401A digital multimeter or equivalent.	1	1	1	1
Mini-clip DMM leads - one each of black and red color.	1	1	1	1

Table 3 Digital Signal Generator

Equipment Required	Host Hi-Speed	Hub Hi-Speed	Device Hi-Speed	Low/Full Speed
Agilent 81130A Pulse/Pattern Generator with 2 channels of Agilent 81132A (660 MHz) option.	n/a	1	1	n/a
1 MB Memory card option for 81130A (option UFJ).	n/a	1	1	n/a
6dB attenuator (Agilent 8493C Option 006) – for scaling the DSG output voltages needed for receiver sensitivity test.	n/a	2	2	n/a
50-ohm coaxial cable with male SMA connectors at both ends (Agilent 8120-4948 or equivalent).	n/a	2	2	n/a
Agilent 82357A USB/GPIB interface	n/a	1	1	n/a

Table 4 USB Electrical Test Fixtures

Equipment Required	Host Hi-Speed	Hub Hi-Speed	Device Hi-Speed	Low/Full Speed
Device Hi-Speed Signal Quality test fixture, Agilent P/N E2645-66507.	1	1	1	n/a
Host Hi-Speed Signal Quality test fixture, Agilent P/N E2645-66508.	1	1	n/a	n/a
Receiver Sensitivity test fixture, Agilent P/N E2645-66503.	n/a	1	1	n/a
Host Disconnect test fixture, Agilent P/N E2645-66506.	1	n/a	n/a	n/a
5V test fixture power supply, Agilent P/N 0950-2546.	1	1	1	n/a
SQiDD board, included in the USB test option.	n/a	n/a	n/a	1*
100 mA load board (see the schematic in Figure 4 on page 165)				1
500 mA load board (see the schematic in Figure 5 on page 165)				1

*A second SQiDD board is recommended for droop/drop testing; additional SQiDD boards can be ordered as Agilent E2646A.

Table 5 Miscellaneous Cables and Devices

Equipment Required	Host Hi-Speed	Hub Hi-Speed	Device Hi-Speed	Low/Full Speed
5 m USB cable (any listed on USB-IF web site).	1	1	1	as needed
1.5 m USB cable (any listed on USB-IF web site).	1	1	n/a	n/a
1 m USB cable (any listed on USB-IF web site).				as needed
Modular AC power cord.	2	2	2	
Hi-Speed USB Hub (any listed on USB-IF web site).	1	n/a	n/a	
Hi-Speed USB Device (any listed on USB-IF web site).	1	n/a	n/a	
USB self-powered hub (and power supply). These are the hubs used for compliance testing and are available from the USB-IF. For development testing, in most cases, a hub that has passed USB compliance testing can be used.	n/a	n/a	n/a	5

Table 6 High-Speed Electrical Test Bed Computer

Equipment Required	Host Hi-Speed	Hub Hi-Speed	Device Hi-Speed	Low/Full Speed
High-Speed Electrical Test Bed Computer. This computer hosts a USB 2.0 compliance host controller for hi-speed hub or device electrical test, or serves as a test bed host for a USB 2.0 host controller under test. For instructions on configuring this computer, refer to the *High-Speed Electrical Test Toolkit Setup Instruction* document which comes with the High-Speed Electrical Test Tool Kit software.	1	1	1	1
High-Speed Electrical Test Tool Kit software (USBHSET)*,**.	1	1	1	1

*You can get this software from the developers tools page at the USB Implementers Forum web site, http://www.usb.org/developers/tools.

**Contains a proprietary EHCI driver stack. The Hi-speed Electrical Test Tool software requires the use of a proprietary EHCI driver stack. The use of this proprietary EHCI driver stack facilitates the electrical testing that requires direct control of the command registers of the USB EHCI host controllers. The end result much more robust test bed environment. Since the proprietary EHCI driver stack is designed for debug and test validation purposes, this driver stack does not support the normal functionality as found in the EHCI drivers from Microsoft (or the device vendor). An automatic driver stack switching function has been implemented into the Hi-speed Electrical Test Tool for easy switching between the proprietary EHCI driver stack and that from Microsoft. Upon invocation of the HS Electrical Test Tool software, the driver stack will automatically switch to the Intel proprietary EHCI driver stack. Upon exit of the HS Electrical Test Tool software, the driver stack will automatically switch to the Microsoft EHCI driver stack.

Setting Up the Equipment

Infiniium 5485xA, 80000 and 90000A Series Digital Sampling Oscilloscope

1 Connect keyboard and mouse to oscilloscope.

2 Connect optional computer monitor to the VGA connector on the rear nearest the right side of the instrument.

3 Attach the Agilent 113xA differential probe to Channel 1 of the oscilloscope.

   a Attach the socketed probe head to the differential probe amp.

   b Attach the header adapter to the socketed probe head (Figure 1).

   c Handle the socketed probe head and header adapter carefully.

   d For durability, epoxy can be used to strengthen the assembly. Only apply epoxy to back (noncomponent) side of probe head.

Figure 1 Differential Probe Setup

4 Attach the E2697A adapters or 1156A probes to Channels 2 and 3.

   a When using the E2697A adapter, connect the 10073C miniature passive probes to the E2697A adapter.

NOTE These probe assignments will be used through out the entire test procedure.

5 Turn on the oscilloscope to allow 30 minutes of warm up time prior to use.

6 Configure the second monitor, if being used, while the oscilloscope is warming up.

7 If the ambient temperature has changed more than 5 degrees from the previous calibration, perform the calibration procedure built into the oscilloscope (in the [Calibration...] section of [Utilities] pull down menu).

8 If the E2697A adapter is being used, compensate the passive probes (see probe instructions).

9 Calibrate all the probes.

   a If you will be performing hub hi-speed tests, calibrate out the skew between the differential probes on channel 1 and channel 4 (refer to oscilloscope instructions).

NOTE In certain test situations, there may not be a ground connection between the DSO and the device under test. This may lead to the signal seen by the differential probe to be modulated up and down due to the mid-frequency switching power supply. Connecting the DSO ground to the DUT ground will be required to establish a common ground reference.

81130A Digital Signal Generator

The digital signal generator is needed to perform hi-speed hub and device receiver sensitivity tests. For energy conservation, you may choose to turn on the digital signal generator about 15 minutes prior to performing these measurements.

Starting the USB 2.0 Compliance Test Option

1 From the Infiniium oscilloscope's main menu, choose **Analyze>Automated Test Apps>USB Test**.

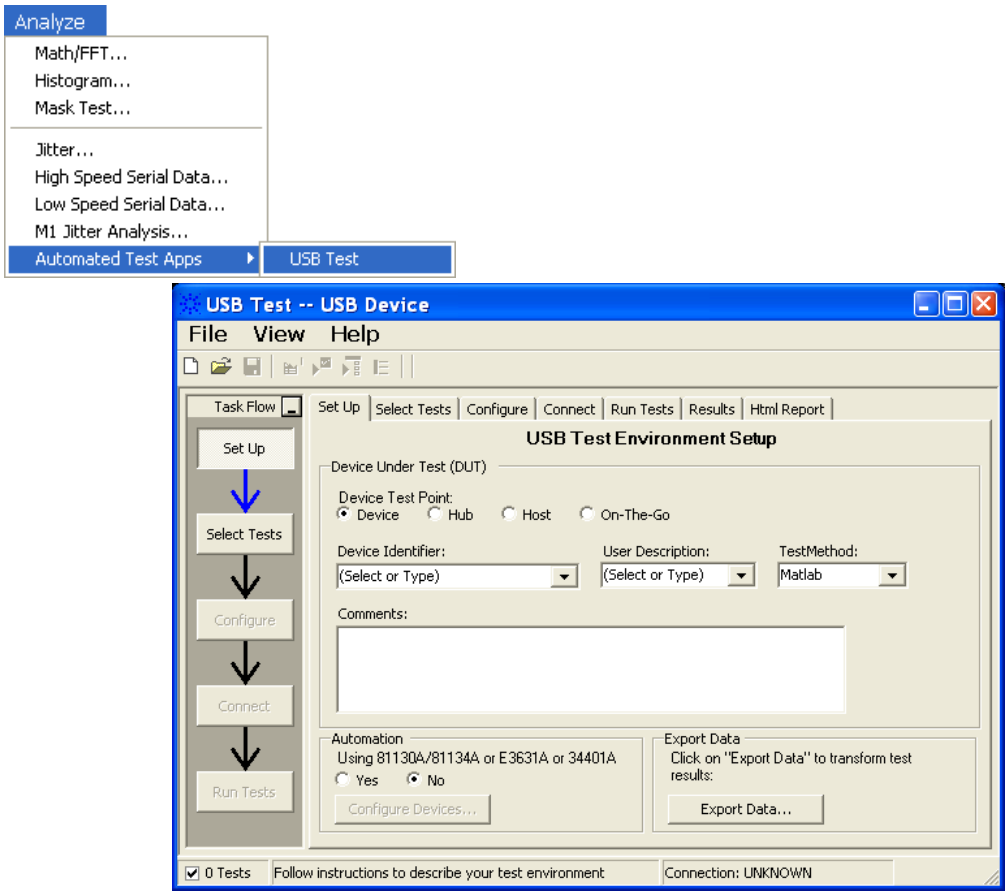

Figure 2 The USB 2.0 Compliance Test Option

NOTE If "USB Test" does not appear in the Automated Test Apps menu, the USB 2.0 Compliance Test Option has not been installed (see Chapter 1, "Installing the USB 2.0 Compliance Test Option").

Figure 2 shows the USB 2.0 Compliance Test Option main window. The task flow pane, and the tabs in the main pane, show the steps you take in running the automated tests:

Set Up — Lets you identify the test environment, including information about the device being tested and other test instruments that can be automatically configured.

Select Tests	Lets you select the tests you want to run. The tests are organized hierarchically so you can select all tests in a group. After tests are run, status indicators show which tests have passed, failed, or not been run, and there are indicators for the test groups.
Configure	Lets you configure test parameters (like test type).
Connect	Shows you how to connect the oscilloscope to the device under test for the tests to be run.
Run Tests	Starts the automated tests. If the connections to the device under test need to be changed while multiple tests are running, the tests pause, show you how to change the connection, and wait for you to confirm that the connections have been changed before continuing.
Results	Contains more detailed information about the tests that have been run. You can change the thresholds at which marginal or critical warnings appear.
HTML Report	Shows a compliance test report that can be printed. You can choose between a verbose and compact report.

Online Help Topics

For information on using the USB 2.0 Compliance Test Option, see its online help (which you can access by choosing Help>Contents... from the application's main menu).

The USB 2.0 Compliance Test Option's online help describes:

- Creating or opening a test project.
- Selecting tests.
- Configuring selected tests.
- Connecting the oscilloscope to the DUT.
- Running tests.
- Viewing test results.
  - To show reference images and flash mask hits.
  - To change margin thresholds.
- Viewing/printing the HTML test report.
- Saving test projects.

Running Tests

To run USB electrical compliance tests:

1. Select the tests you want to run.
2. Change test configuration options if necessary.
3. Connect the oscilloscope to the device under test.
4. Run the tests.
5. View the detailed test results.
6. View/print the HTML test report.

3 Device Hi-Speed Tests

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Device Packet Parameters 32
Device CHIRP Timing 39
Device Suspend/Resume/Reset Timing 42
Device Test J/K, SE0_NAK 50
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NOTE

To give the automated test software more flexibility in making corner case measurements (and improve test performance), the oscilloscope's memory upgrade option is recommended (Option 001 when ordered with the oscilloscope, or after purchase: E2680A for the 5485xA Series oscilloscopes, or N5404A for the 80000 and 90000A Series oscilloscopes).

Also, to reduce the bandwidth of the oscilloscope to just what is required by the USB-IF (2 GHz for USB 2.0)—this can greatly reduce system measurement noise, allowing the maximum measurement margin—the enhanced bandwidth software option is recommended for the Agilent 54855A oscilloscope (Option 008), and the noise reduction software option is recommended for the 80000 and 90000A Series oscilloscopes (Option 005 when ordered with the oscilloscope or N5403A after purchase).

In addition to the hi-speed electrical tests described in this chapter, the device under test must also pass the following compliance tests applicable to hi-speed capable devices:

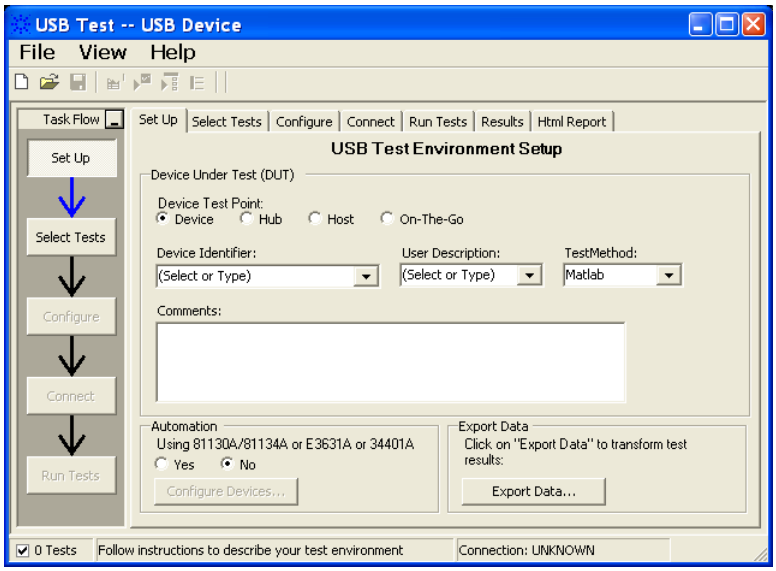
- Upstream full speed signal quality.
- Upstream low speed signal quality.
- Inrush current.
- Back-voltage.

Before Running These Tests

If you haven't already performed the initial equipment set up, see "Setting Up the Equipment" on page 19.

Selecting the Device Test Environment Setup

1 In the USB automated test application, select the **Device** test environment.



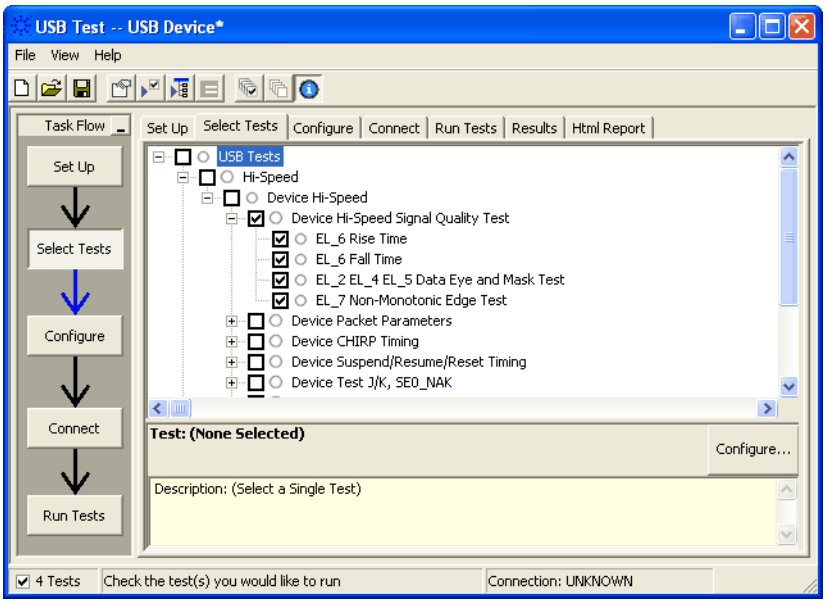
Device Hi-Speed Signal Quality Test

Equipment Used

Table 7 Equipment Used in Device Hi-Speed Signal Quality Tests

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
1	Differential probe	Agilent 113xA with E2699A or E2678A
1	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Device Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66507
1	5V power supply	Agilent 0950-2546 or equivalent
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests

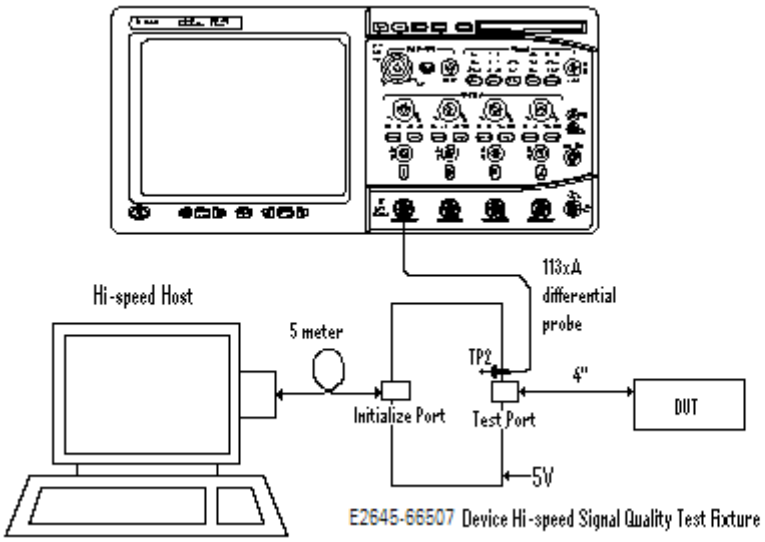


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. Attach the 5V power supply to J5 of the E2645-66507 Device Hi-Speed signal quality test fixture. Leave the TEST switch at the OFF position. Verify the green Power LED (D1) is lit and the yellow Test LED (D2) is not lit.
2. Connect the [TEST PORT] of the Device Hi-speed Signal Quality test fixture into the upstream facing port of the device under test, using the 4" USB cable.
3. Connect the [INIT PORT] of the test fixture to a Hi-speed capable port of the Test Bed Computer, using the 5 meter USB cable.
4. Apply power to the device.
5. Attach the differential probe to D+/D- of TP2 on the test fixture, using the damped header adapter. Ensure the + polarity on the probe lines up with D+.



6. Check **I have completed these instructions**.

Running the Tests

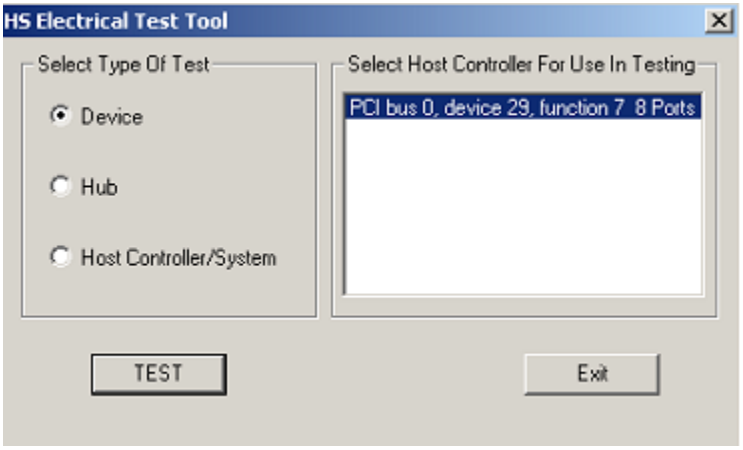
1 Click **Run Tests**.

Test Instructions, Part 1

The USB automated test application will prompt you to perform these steps:

1 Invoke the HS Electrical Test Tool software on the Hi-Speed Electrical Test Bed computer.

2 Select Device and click the [TEST] button to enter the Device Test menu.



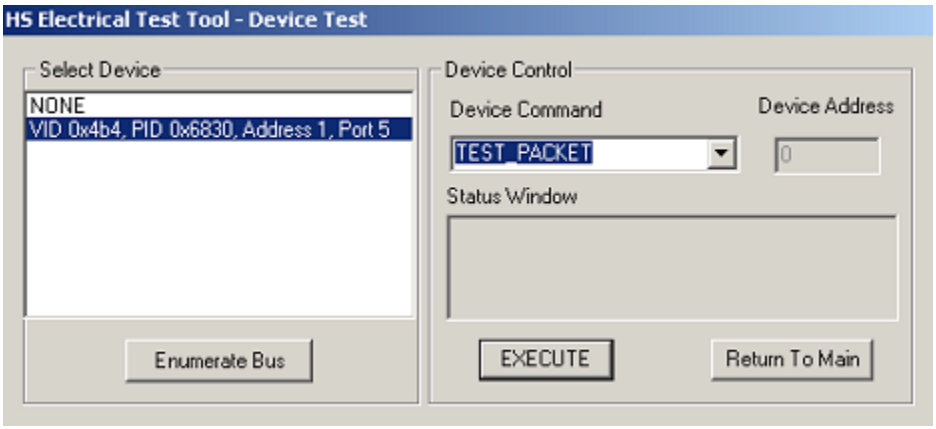
3 Click **OK** to close the Test Instructions dialog.

Test Instructions, Part 2

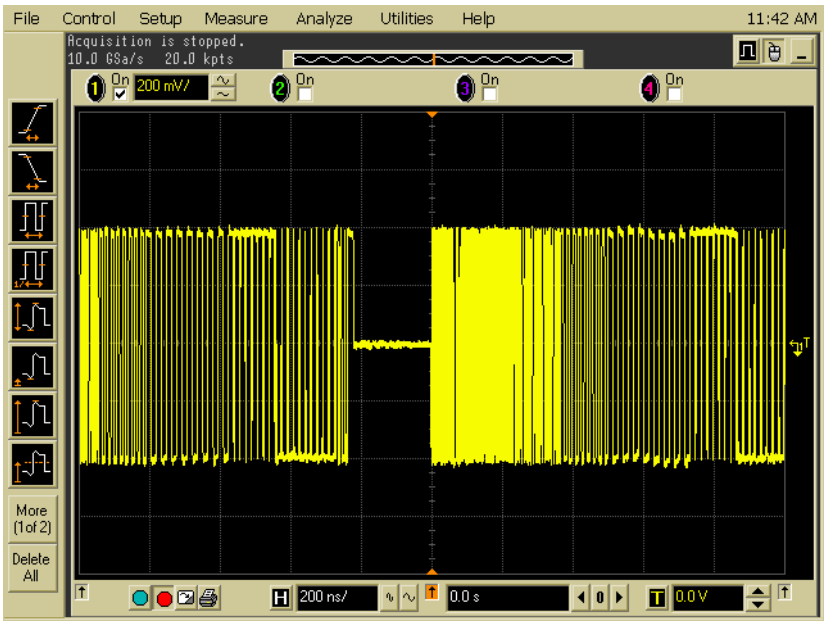
The USB automated test application will prompt you to perform these steps:

1 The device under test should be enumerated with the device's VID shown together with the root port in which it is connected.

2 Select **TEST_PACKET** from the Device Command drop down menu and click **[EXECUTE]**. This forces the device under test to continuously transmit test packets.



3 Place the Test Switch (S1) in the **TEST** position. Verify the yellow TEST LED is lit. You should see the transmitted test packet on the oscilloscope as below.



4 Click **OK** to close the Test Instructions dialog.

EL_6 Rise Time

EL_6 Fall Time

EL_2 EL_4 EL_5 Data Eye and Mask Test

After viewing the test results, click **OK** to close the Test Instructions dialog.

EL_7 Non-Monotonic Edge Test

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

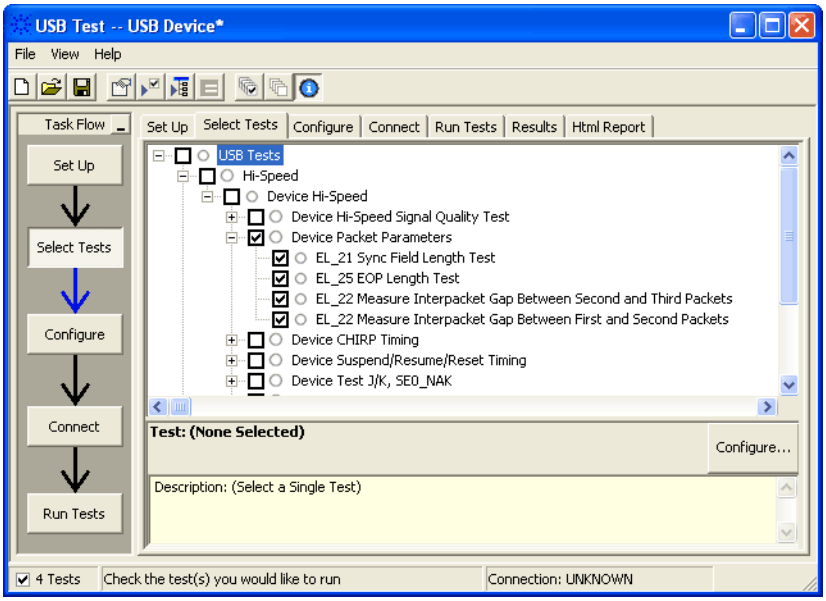
Device Packet Parameters

Equipment Used

Table 8 Equipment Used in Device Packet Parameters Tests

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
1	Differential probe	Agilent 113xA with E2699A or E2678A
1	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Device Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66507
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests



Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

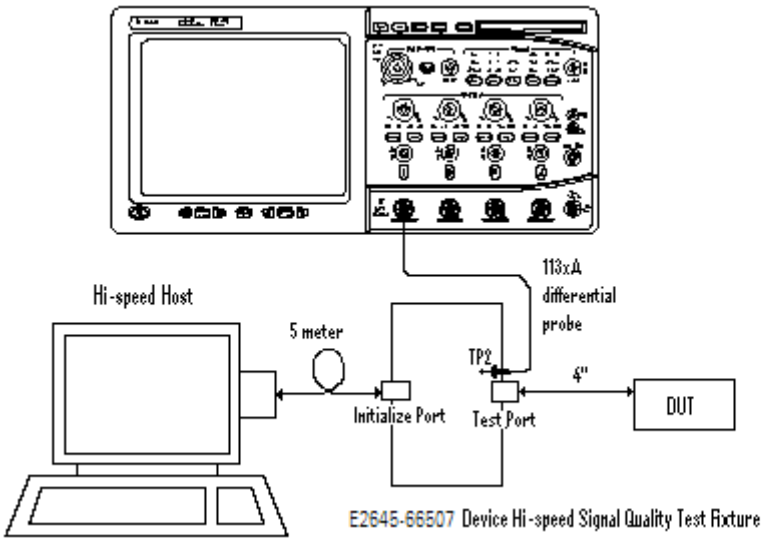
1 Remove the 5V supply. Connect the E2645-66507 Device Hi-Speed Signal Quality test fixture ([INIT PORT]) into a high-speed capable port of the test bed, using the 5 meter USB cable.

2 Connect the test fixture [TEST PORT] into B receptacle of the upstream facing port under test of the device, using the 4" USB cable. Apply power to the device.

3 Ensure that the test switch on the test fixture is in the OFF position, and the test LED is not lit.

4 Attach the Agilent 113xA differential probe to D+/D- of TP2 on the test fixture, using a damped header adapter.

NOTE Ensure the + polarity on the probe lines up with D+.



5 Check **I have completed these instructions**.

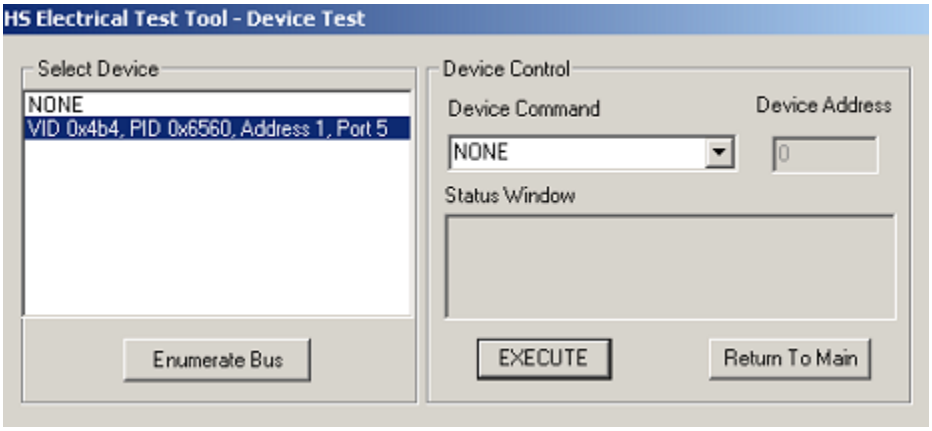
Running the Tests

1 Click **Run Tests**.

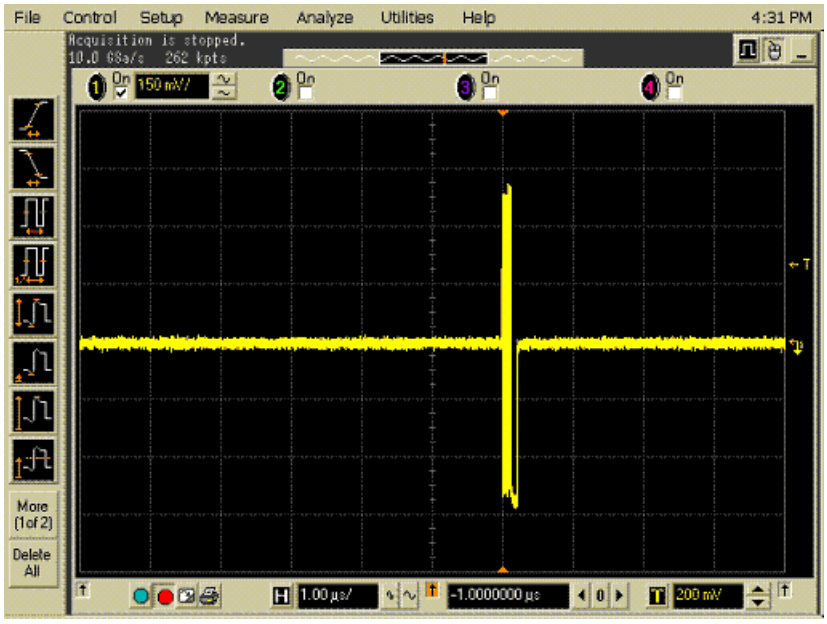
Test Instructions, Part 1

The USB automated test application will prompt you to perform these steps:

1 Cycle the device power to restore the device to normal operation. On the Device Test Menu of the HS Electrical Tool, click **Enumerate Bus** once.



2 Using the oscilloscope, verify the SOFs (Start Of Frame) packets are being transmitted on the port under test. You may need to lower the trigger level to somewhat below 400 mV.



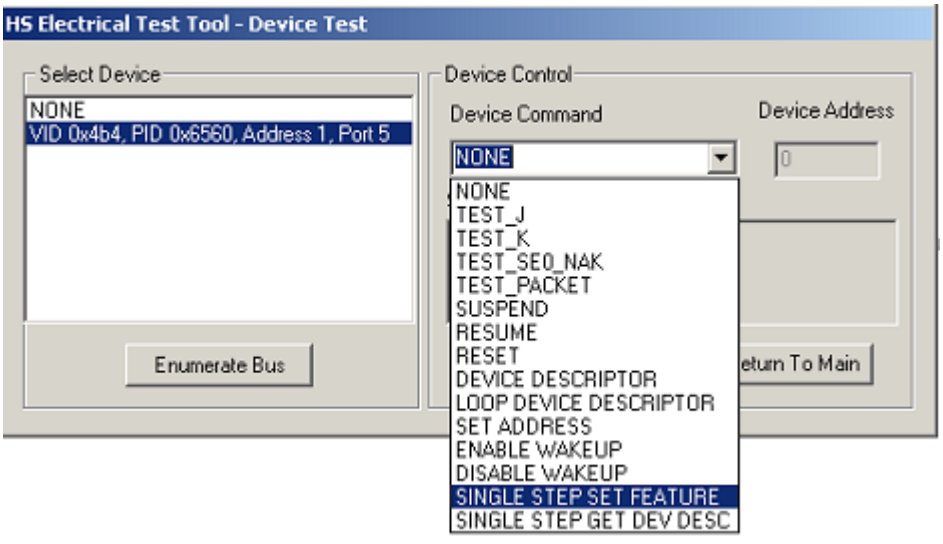
3 Click **OK** to close the Test Instructions dialog.

Test Instructions, Part 2

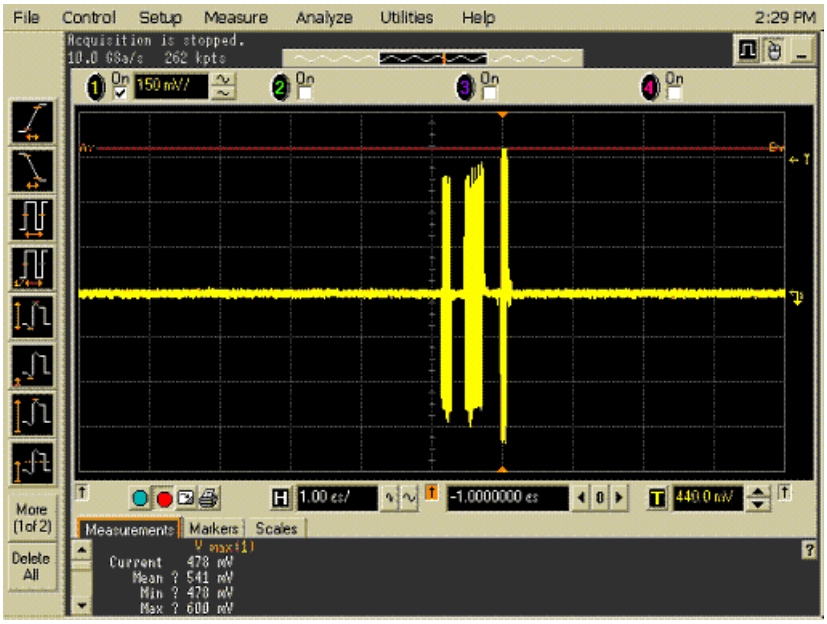
The USB automated test application will prompt you to perform these steps:

1 In the Device Test menu of the HS Electrical Test Tool, ensure that the hub under test is selected.

2 Select **SINGLE STEP SET FEATURE** from the Device Command window. Click **[EXECUTE]** once.



3 You should see the transmitted test packet on the oscilloscope as below.



4 Click **OK** to close the Test Instructions dialog.

EL_21 Sync Field Length Test

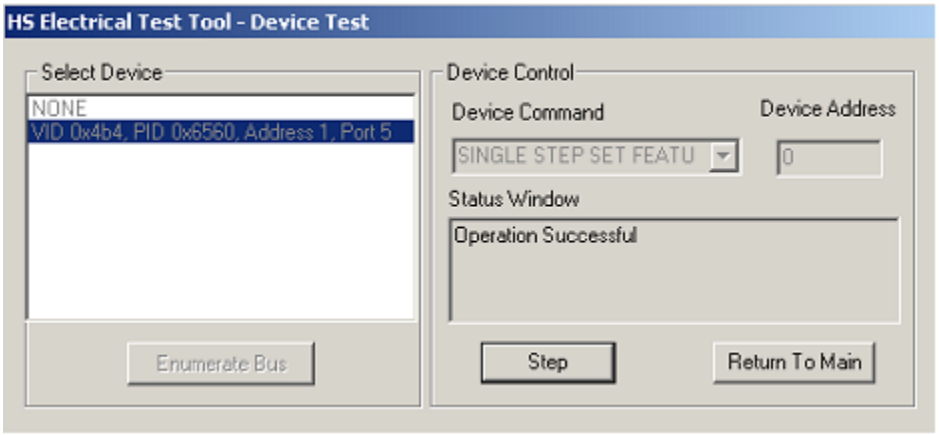
EL_25 EOP Length Test

EL_22 Measure Interpacket Gap Between Second and Third Packets

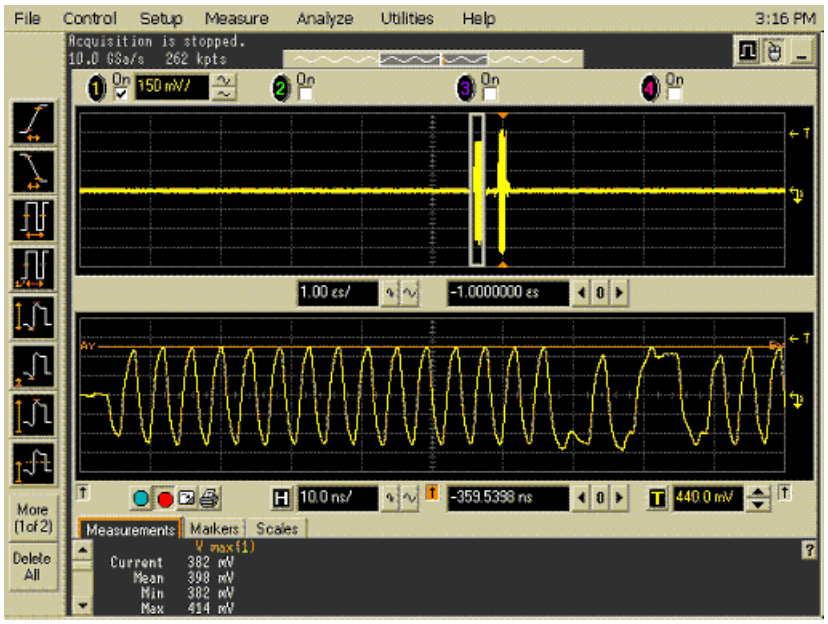
EL_22 Measure Interpacket Gap Between First and Second Packets

The USB automated test application will prompt you to perform these steps:

1 In the Device Test menu of the HS Electrical Test Tool, click **[STEP]** once again. This is the second step of the two-step Single Step Set Feature command.



2 You should see the transmitted test packet on the oscilloscope as below.



3 Click **OK** to close the Test Instructions dialog.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

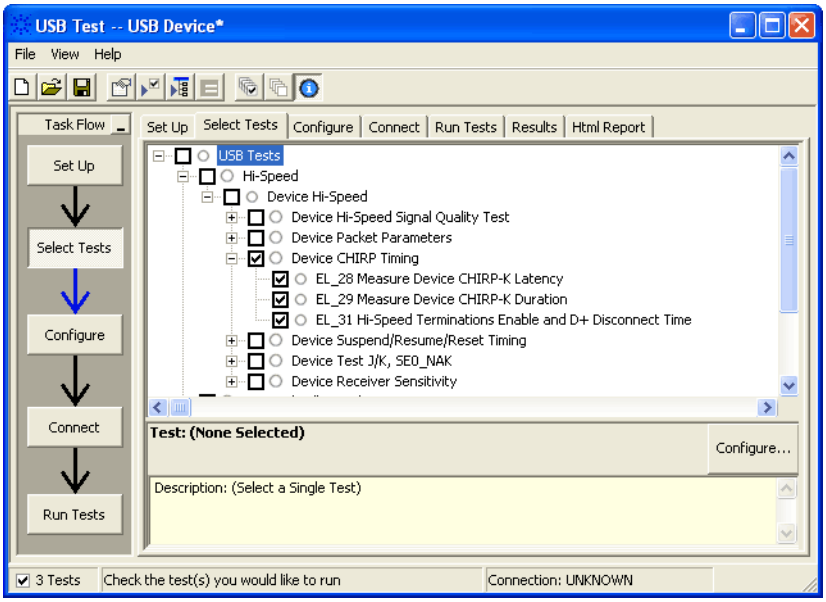
Device CHIRP Timing

Equipment Used

Table 9 Equipment Used in Device CHIRP Timing Tests

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
2	Passive or active probes	Agilent E2697A with 10073C, or 1156A
1	Host test bed computer	Any computer with hi-speed USB ports
1	Device Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66507
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests

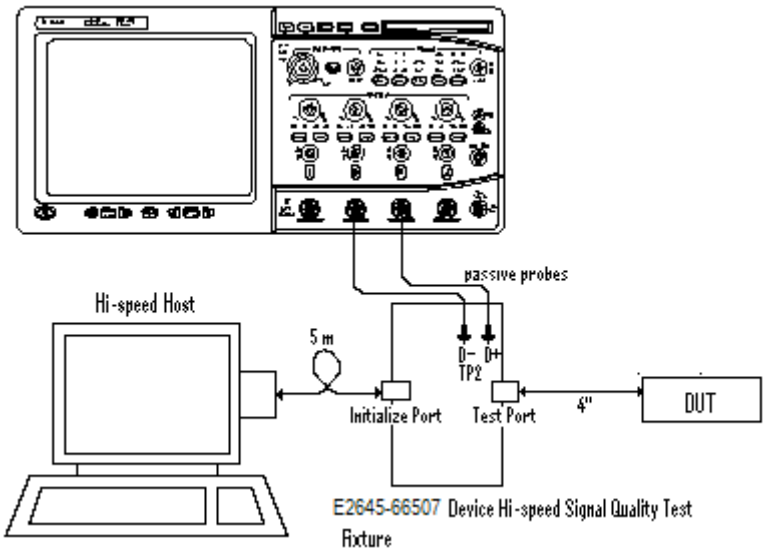


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. Connect the E2697A with 10073C passive probe or the 1156A active probe on Channel 2 to the D- pin at TP2 of the E2645-66507 Device Hi-Speed Signal Quality test fixture.
2. Connect the E2697A with 10073C passive probe or the 1156A active probe on Channel 3 to the D+ pin at TP2.
3. Connect both probe grounds to GND leads.
4. Connect the [INIT PORT] of the test fixture into the HS host controller port, using the 5-meter USB cable.
5. Connect the [TEST PORT] on the fixture to the upstream port of the device under test. Do not apply 5V to the test fixture.



6. Check **I have completed these instructions**.

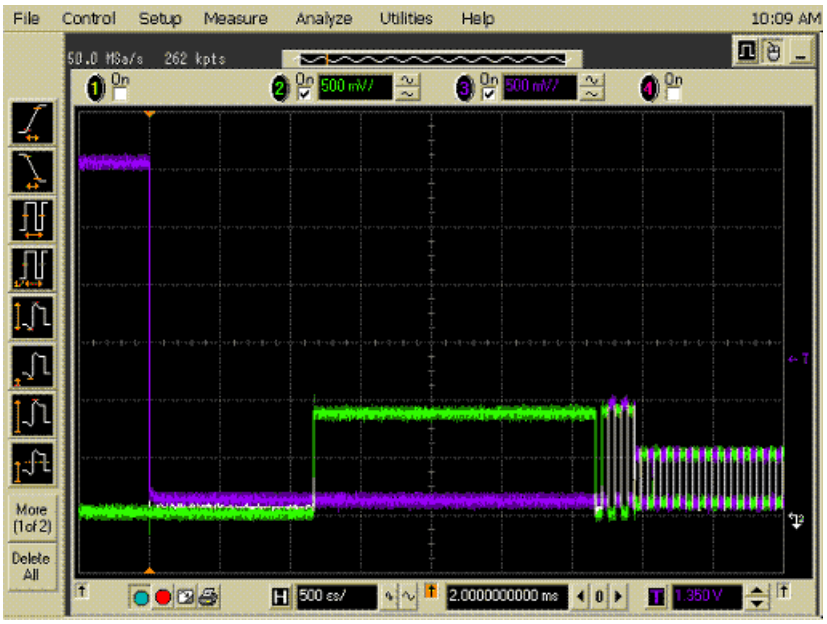
Running the Tests

1 Click **Run Tests**.

Test Instructions

The USB automated test application will prompt you to perform these steps:

1 On the HS Electrical Test Tool software, click **[Enumerate Bus]** once. You should capture the CHIRP handshake as in the below figure.



2 Click **OK** to close the Test Instructions dialog.

EL_28 Measure Device CHIRP-K Latency

EL_29 Measure Device CHIRP-K Duration

EL_31 Hi-Speed Terminations Enable and D+ Disconnect Time

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

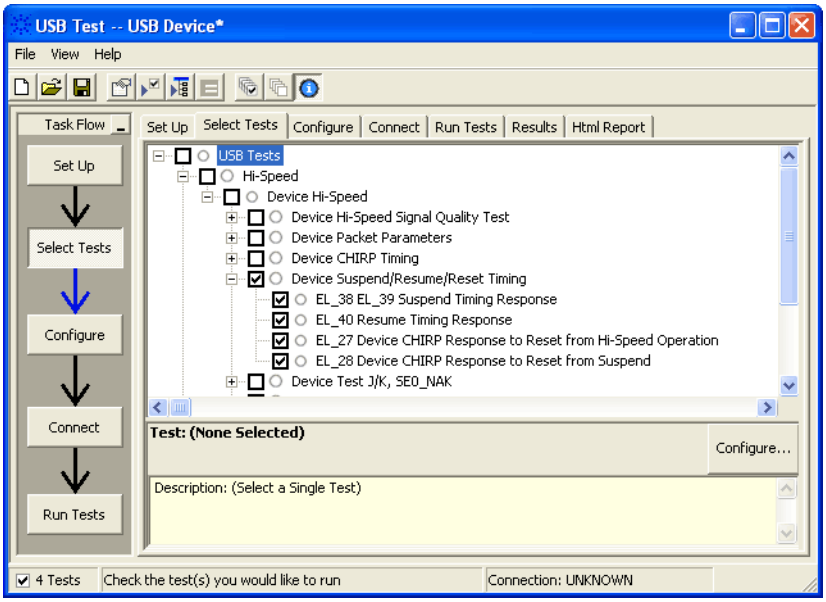
Device Suspend/Resume/Reset Timing

Equipment Used

Table 10 Equipment Used in Device Suspend/Resume/Reset Timing Tests

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
2	Passive or active probes	Agilent E2697A with 10073C, or 1156A
1	Host test bed computer	Any computer with hi-speed USB ports
1	Device Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66507
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests



Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

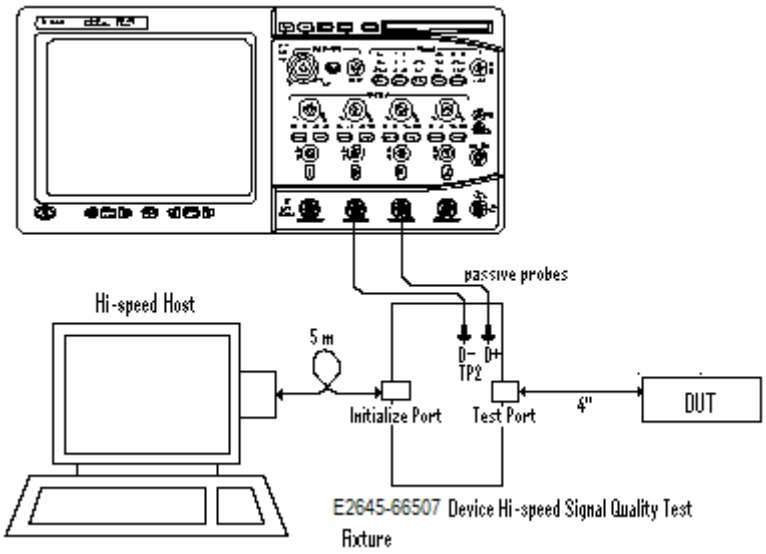
1 Connect the E2697A with 10073C passive probe or the 1156A active probe on Channel 2 to the D- pin at TP2 of the E2645-66507 Device Hi-Speed Signal Quality test fixture.

2 Connect the E2697A with 10073C passive probe or the 1156A active probe on Channel 3 to the D+ pin at TP2. D+ on TP2 is the pin closest to the USB connector.

3 Connect both probe grounds to leads TP5.

4 Connect the [INIT PORT] of the test fixture into the HS host controller port, using the 5-meter USB cable.

5 Connect the [TEST PORT] on the fixture to the upstream port of the device under test. Do not apply 5V to the test fixture.



6 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

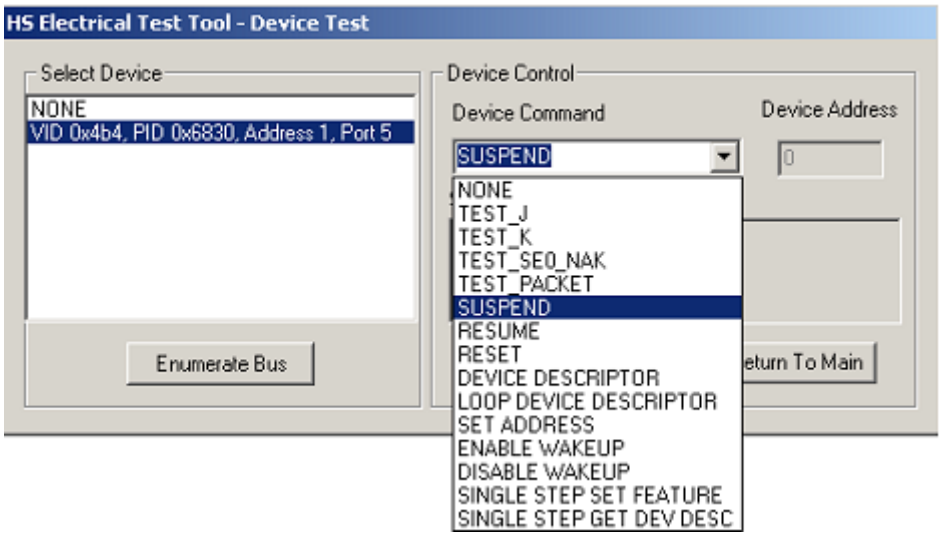
Test Instructions

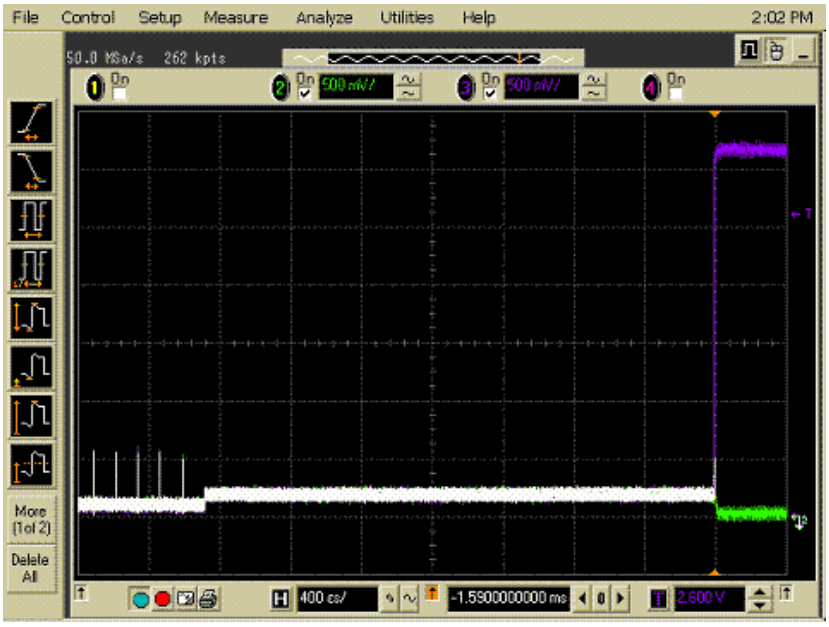
EL_38 EL_39 Suspend Timing Response

The USB automated test application will prompt you to perform these steps:

1 On the Device Test Menu of the HS Electrical Test Tool software, click **[Enumerate Bus]** once.

2 Select **SUSPEND** from the Device Command drop down menu. Click **[EXECUTE]** once to place the device into suspend. The captured transition should be as in the figure below.



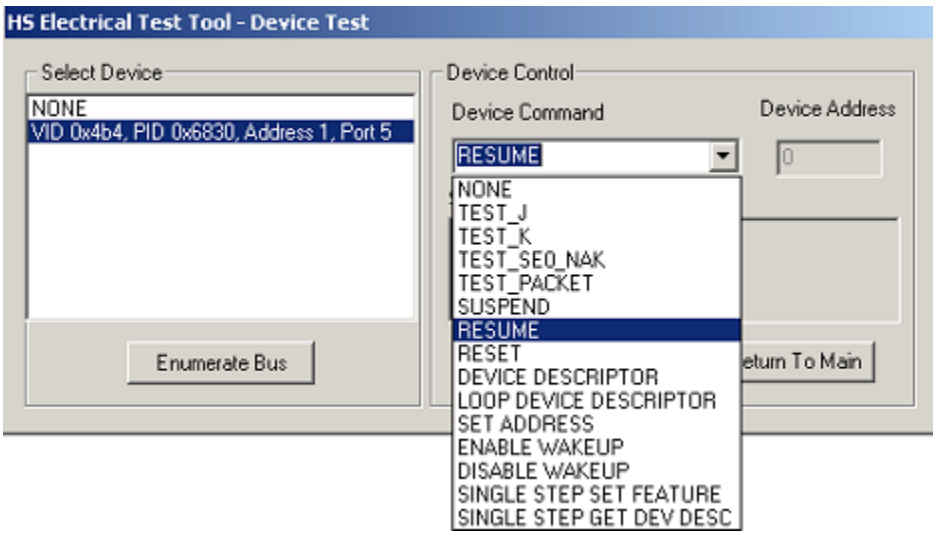


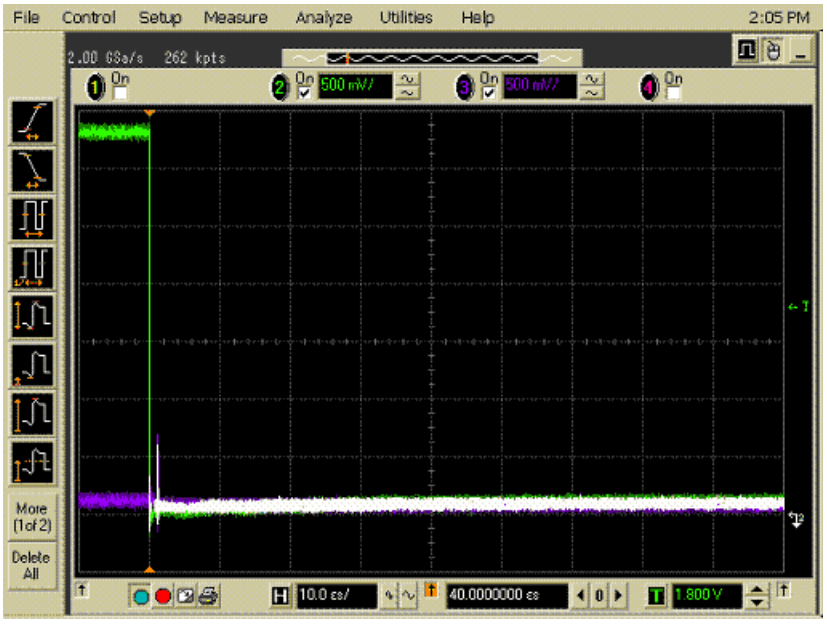
3 Click **OK** to close the Test Instructions dialog.

EL_40 Resume Timing Response

The USB automated test application will prompt you to perform these steps:

1 On the Device Test Menu of the HS Electrical Test Tool, select **RESUME** from the Device Command drop down menu. Click **[EXECUTE]** once to resume the hub from suspend. The captured transition should be as in the figure below.



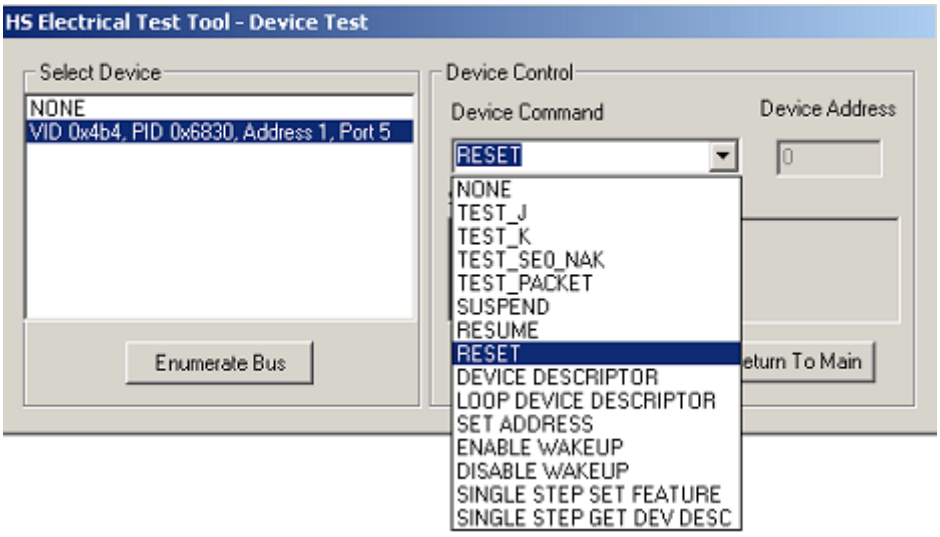


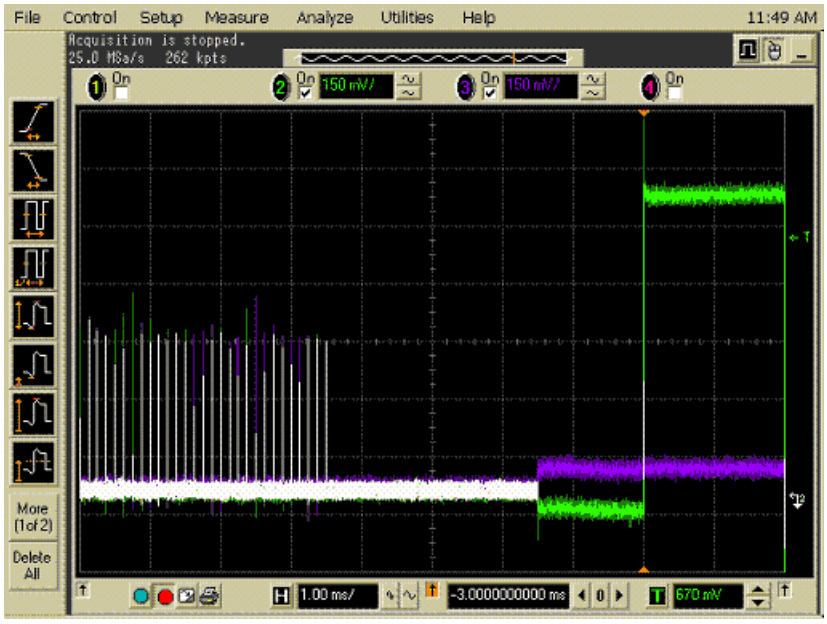
2 Click **OK** to close the Test Instructions dialog.

EL_27 Device CHIRP Response to Reset from Hi-Speed Operation

The USB automated test application will prompt you to perform these steps:

1 On the Device Test Menu of the HS Electrical Test Tool, select **RESET** from the Device Command drop down menu. Click **[EXECUTE]** once to reset the device operating in high speed. The captured transition should be as in the figure below.



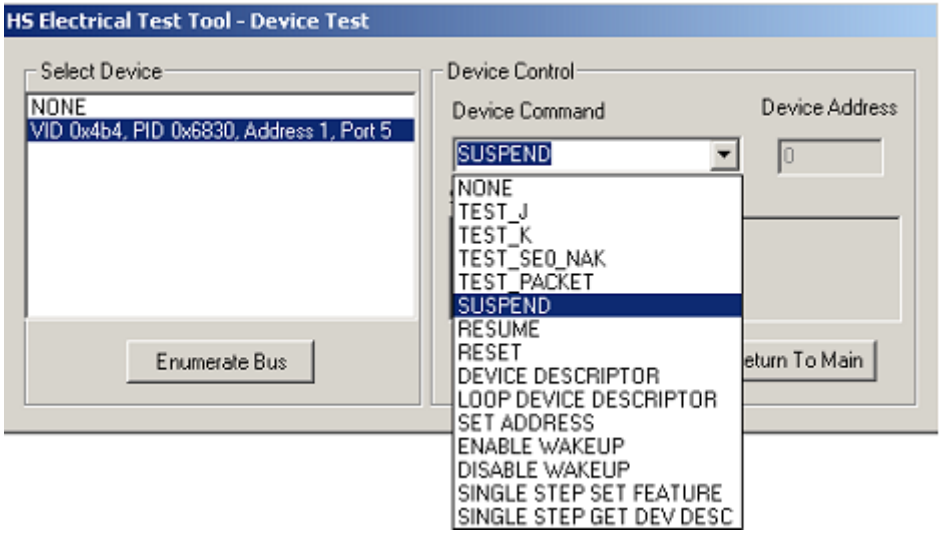


2 Click **OK** to close the Test Instructions dialog.

EL_28 Device CHIRP Response to Reset from Suspend

The USB automated test application will prompt you to perform these steps:

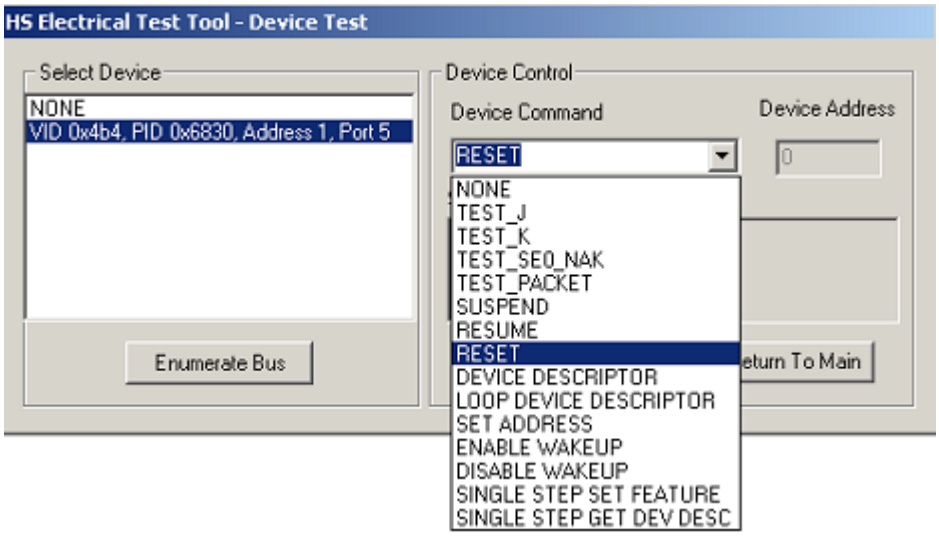
1 On the Device Test Menu of the HS Electrical Test Tool software, select **SUSPEND** from the Device Command drop down menu. Click **[EXECUTE]** once to place the device into suspend.

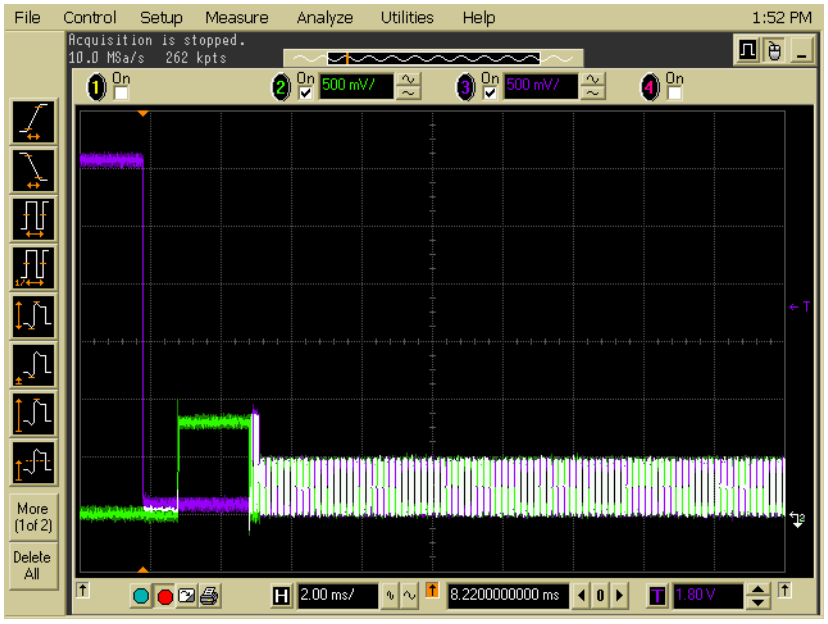


2 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you to perform these steps:

1 On the Device Test Menu of the HS Electrical Test Tool, select **RESET** from the Device Command drop down menu. Click **[EXECUTE]** once to reset the device operating in high speed. The captured transition should be as in the figure below.





2 Click **OK** to close the Test Instructions dialog.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

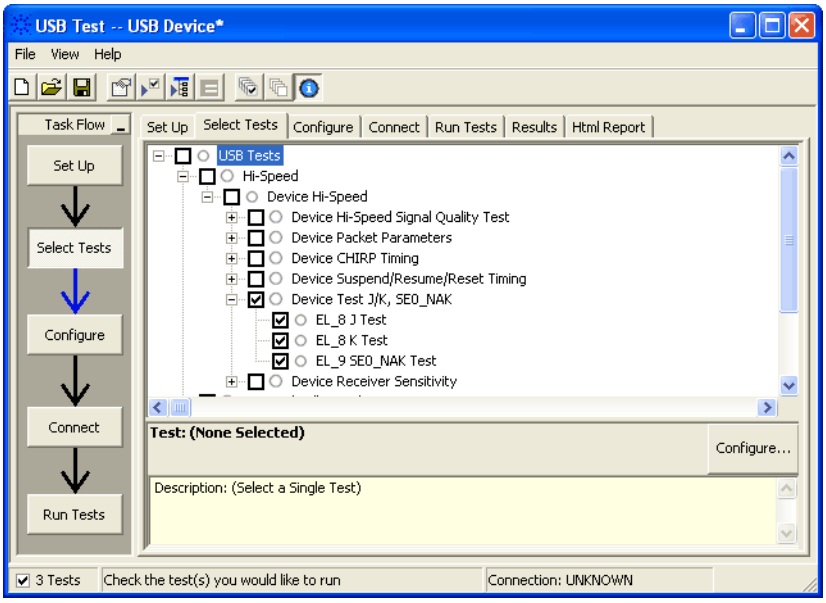
Device Test J/K, SE0_NAK

Equipment Used

Table 11 Equipment Used in Device Test J/K, SE0_NAK Tests

Quantity	Item	Description/Model
1	Digital Multimeter (DMM)	Agilent 34401A or equivalent
1	Host test bed computer	Any computer with hi-speed USB ports
1	Device Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66507
1	5V power supply	Agilent 0950-2546 or equivalent
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests



Configuring the Tests

Connecting the Equipment

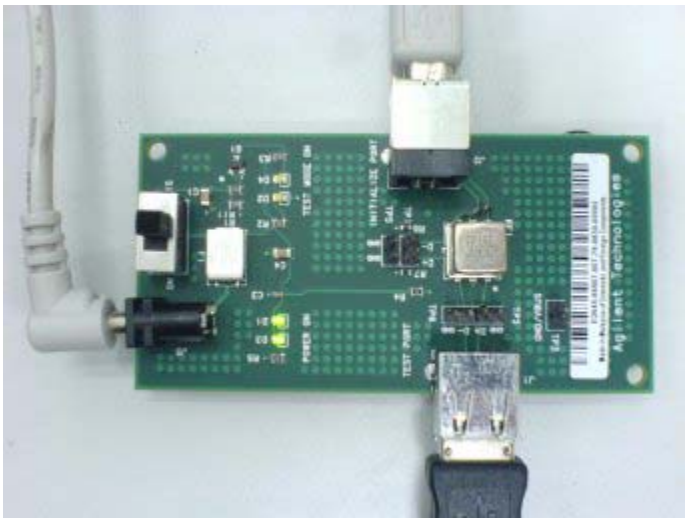
The USB automated test application will prompt you to perform these connection steps:

1 Attach the 5V power supply to J5 of the E2645-66507 Device High-Speed Signal Quality test fixture.

2 Place the switch in the test switch to **OFF** position. Verify the green Power LED(D1) is lit, and the yellow Test LED(D2) is off.

3 Connect the [TEST PORT] of the test fixture into the upstream facing port of the device under test, using the 4" USB cable.

4 Connect the [INIT PORT] of the test fixture to a port of the Test Bed Computer, using the 5 meter cable.



5 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Test Instructions

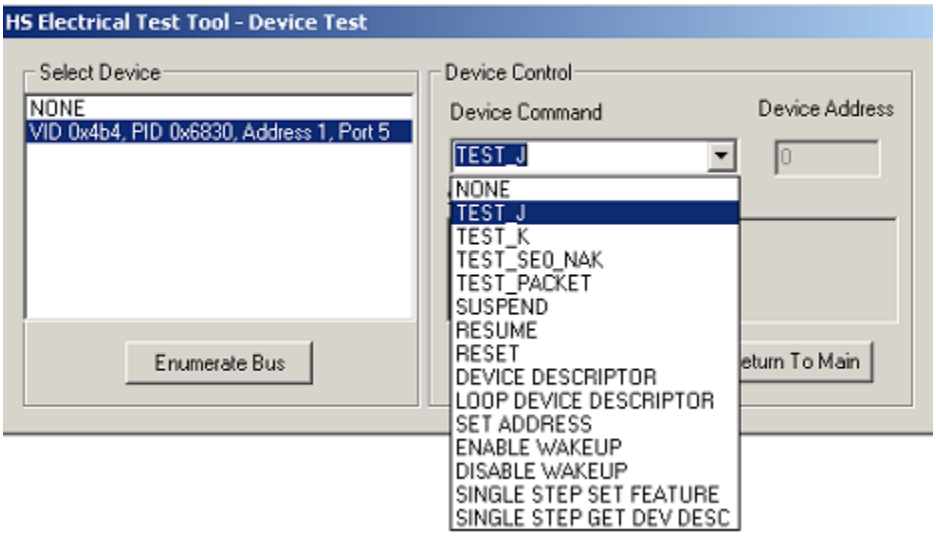
EL_8 J Test

The USB automated test application will prompt you to perform these steps:

1 On the Device Test Menu of the HS Electrical Test Tool, click **[Enumerate Bus]** once.

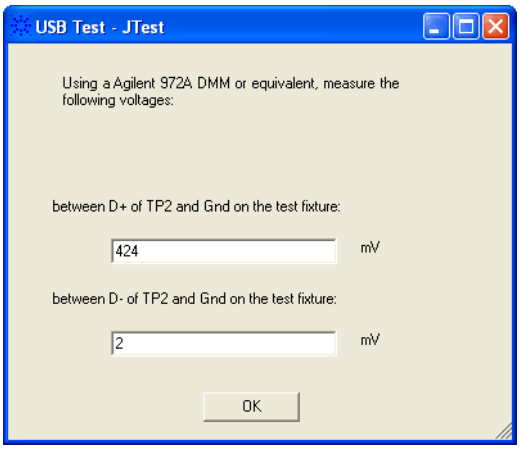
2 Select **TEST_J** from the Device Command drop down menu. Click **[EXECUTE]** once to place the device into TEST_J test mode.

3 Switch the test fixture into the **TEST** position.



4 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you for the following voltage measurements:



EL_8 K Test

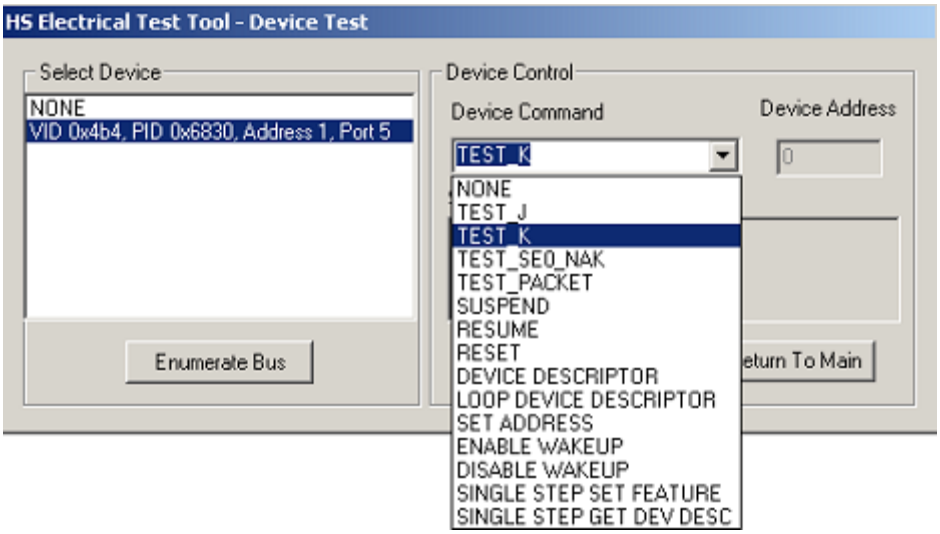
The USB automated test application will prompt you to perform these steps:

1 Return the Test switch of the test fixture to the **NORMAL** position.

2 Cycle the device power to restore the device to normal operation. On the Device Test Menu of the HS Electrical Test Tool, click **[Enumerate Bus]** once.

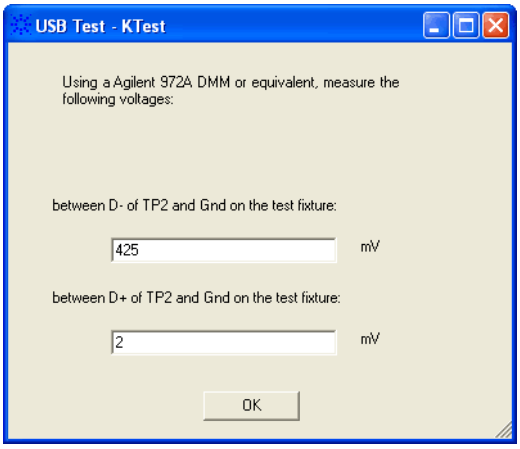
3 Select **TEST_K** from the Device Command drop down menu. Click **[EXECUTE]** once to place the device into TEST_K test mode.

4 Switch the test fixture into the **TEST** position.



5 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you for the following voltage measurements:



EL_9 SE0_NAK Test

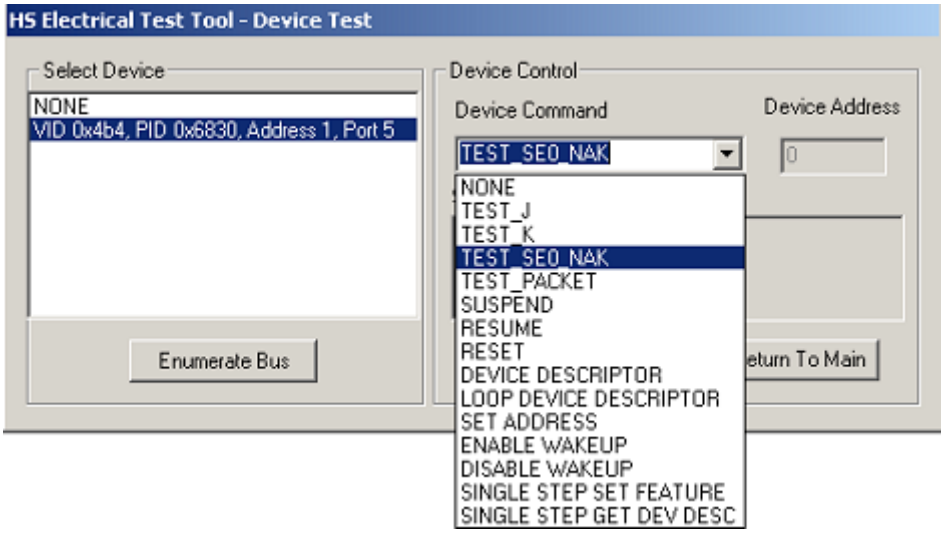
The USB automated test application will prompt you to perform these steps:

1 Return the Test switch of the test fixture to the **NORMAL** position.

2 Cycle the device power to restore the device to normal operation. On the Device Test Menu of the HS Electrical Test Tool, click **[Enumerate Bus]** once.

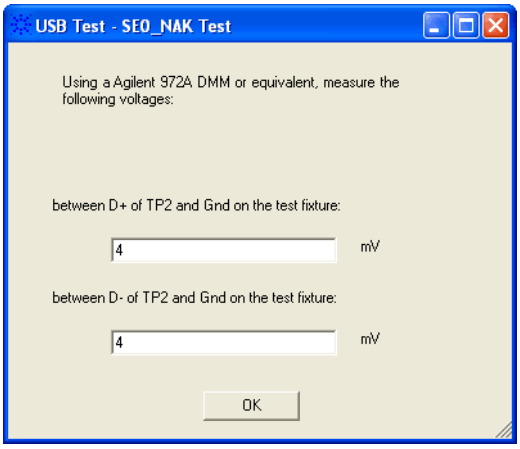
3 Select **TEST_SE0_NAK** from the Device Command drop down menu. Click **[EXECUTE]** once to place the device into TEST_SE0_NAK test mode.

4 Switch the test fixture into the **TEST** position.



5 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you for the following voltage measurements:



Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

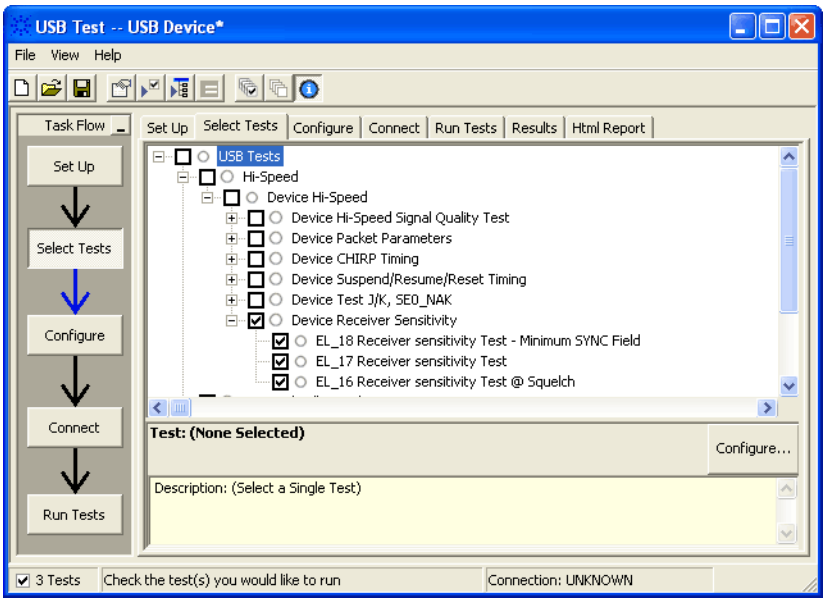
Device Receiver Sensitivity

Equipment Used

Table 12 Equipment Used in Device Receiver Sensitivity Tests

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
1	Differential probe	Agilent 113xA with E2699A or E2678A
1	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Receiver Sensitivity test fixture and 4" USB cable	Agilent E2645-66503
1	5V power supply	Agilent 0950-2546 or equivalent
1	Digital signal generator	Agilent 81130A (or 81134A with two 15432B transition time converters connected to the pulse generator outputs)
1	USB/GPIB interface	Agilent 82357A
2	6 dB attenuators	Agilent 8493C
2	50 ohm coaxial cable with male SMA connectors at both ends	Agilent 8120-4948 or equivalent
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests



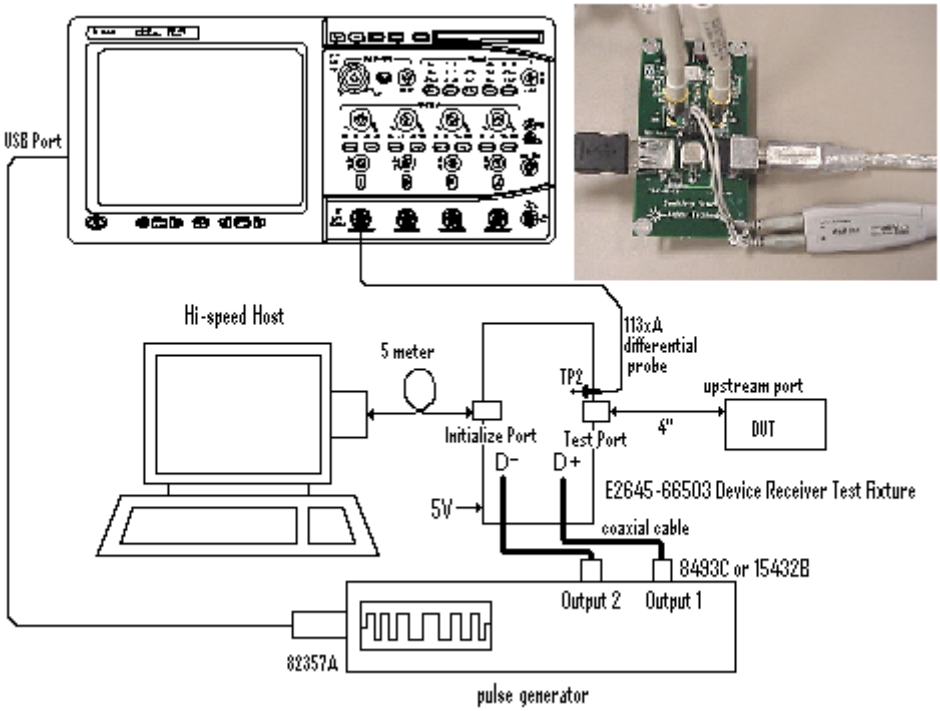
Configuring the Tests

If the pulse generator's SICL address is different from the default, make sure you set the 81134A/81130A Instrument Address configuration option to the pulse generator's SICL address.

See also "Configuring the 81134A pulse generator using the 82357A GPIB-USB converter" on page 89.

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:



1 Attach the 5V power supply to the E2645-66503 Device Receiver test fixture (J5).

   a Verify the green Power LED (D1) is lit.

   b Leave the TEST switch at the OFF position (S1).

   c The yellow LED (D2) should be off.

2 Connect the [INIT PORT] of the fixture to a Hi-Speed port on the Test Bed Computer, using the 5 meter USB cable.

3 Connect the [TEST PORT] of the fixture to the device under test, using the 4" USB cable.

4 Connect the Agilent 113xA differential probe to the test fixture at TP2, using the 01131-68703 header adapter.

NOTE Ensure the + polarity on the probe lines up with D+, which is the pin nearest the USB connector.

5 Connect the 81130A or 81134A pulse generator to the oscilloscope using the 82357A USB/GPIB Interface.

   a If you choose to use the Agilent 81130A Pulse/Pattern Generator, connect the 8493C 6dB attenuators to OUTPUT1 and OUTPUT2 of Agilent 81130A Pulse/Pattern Generator.

   b If you choose to use the Agilent 81134A Pulse/Pattern Generator, connect the 15432B Transition Time Converters to OUTPUT1 and OUTPUT2 of Agilent 81134A Pulse/Pattern Generator. Agilent 15432B Transition Time Converters are recommended, to reduce the output edge speed of the 81134A to speed close to what the 81130A provides.

6 Connect OUTPUT1 to SMA1 (D+) of the E2645-66503 Device Receiver Sensitivity test fixture using the 8120-4948 SMA cables.

7 Connect OUTPUT2 to SMA2 (D-) of the E2645-66503 Device Receiver Sensitivity test fixture using the 8120-4948 SMA cables.

8 Check **I have completed these instructions**.

Running the Tests

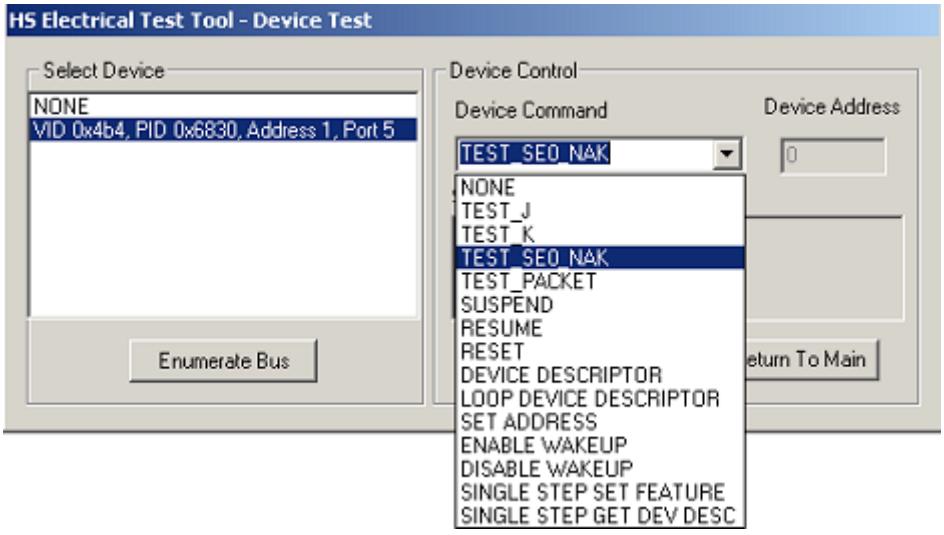
1 Click **Run Tests**.

Test Instructions

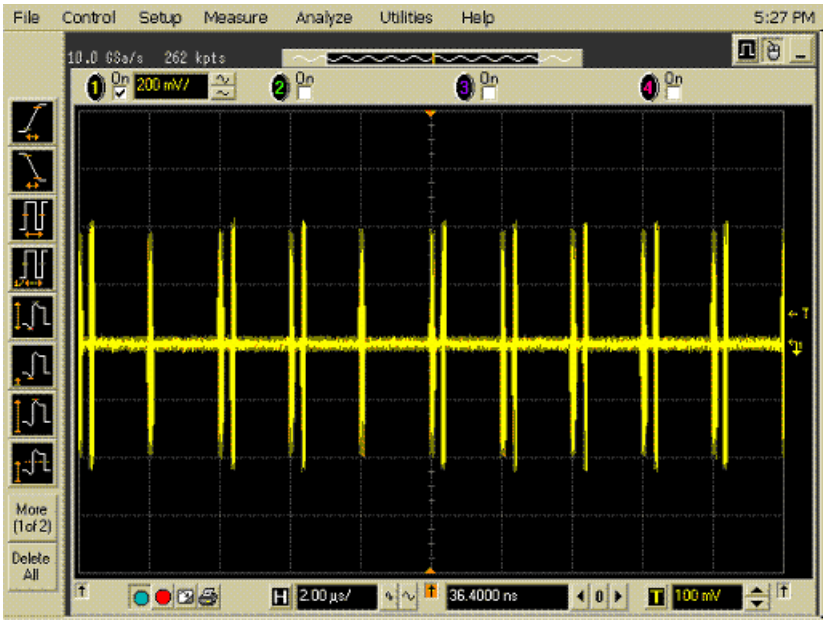
The USB automated test application will prompt you to perform these steps:

1 Cycle the device power to restore the device to normal operation. On the Device Test Menu of the HS Electrical Test Tool, click **[Enumerate Bus]** button once to force enumeration of the newly connected device.

2 Select **TEST_SE0_NAK** from the Device Command drop down menu. Click **[EXECUTE]** once to place the device into TEST_SE0_NAK test mode.



3 Place the test fixture Test Switch (S1) into the **TEST** position. This switches in the data generator in place of the host controller. The data generator emulates the "IN" packets from the host controller.



4 Click **OK** to close the Test Instructions dialog.

EL_18 Receiver sensitivity Test - Minimum SYNC Field

EL_17 Receiver sensitivity Test

EL_16 Receiver sensitivity Test @ Squelch

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

4 Hub Hi-Speed Tests

Hub Hi-Speed Signal Quality Test - Upstream Facing Ports 65
Hub Hi-Speed Signal Quality Test - Downstream Facing Ports 69
Hub Jitter Test - Downstream Facing Ports 73
Hub Disconnect Detect 77
Hub Packet Parameters - Upstream Facing Port 81
Hub Receiver Sensitivity - Upstream Facing Port 88
Hub Repeater Test - Downstream Facing Port 97
Hub Repeater Test - Upstream Facing Port 102
Hub CHIRP Timing - Upstream Facing Port 108
Hub Suspend/Resume/Reset Timing - Upstream Facing Port 111
Hub Test J/K, SE0_NAK - Upstream Facing Port 119
Hub Test J/K, SE0_NAK - Downstream Facing Port 125

NOTE

To give the automated test software more flexibility in making corner case measurements (and improve test performance), the oscilloscope's memory upgrade option is recommended (Option 001 when ordered with the oscilloscope, or after purchase: E2680A for the 5485xA Series oscilloscopes, or N5404A for the 80000 and 90000A Series oscilloscopes).

Also, to reduce the bandwidth of the oscilloscope to just what is required by the USB-IF (2 GHz for USB 2.0)—this can greatly reduce system measurement noise, allowing the maximum measurement margin—the enhanced bandwidth software option is recommended for the Agilent 54855A oscilloscope (Option 008), and the noise reduction software option is recommended for the 80000 and 90000A Series oscilloscopes (Option 005 when ordered with the oscilloscope or N5403A after purchase).

In addition to the high-speed electrical tests prescribed in this chapter, the hub under test must also pass the following legacy electrical compliance tests applicable to the high-speed hub:

- Full speed signal quality – Upstream and downstream facing ports.
- Low speed signal quality – Downstream facing ports only.
- Inrush current – Upstream facing port only.

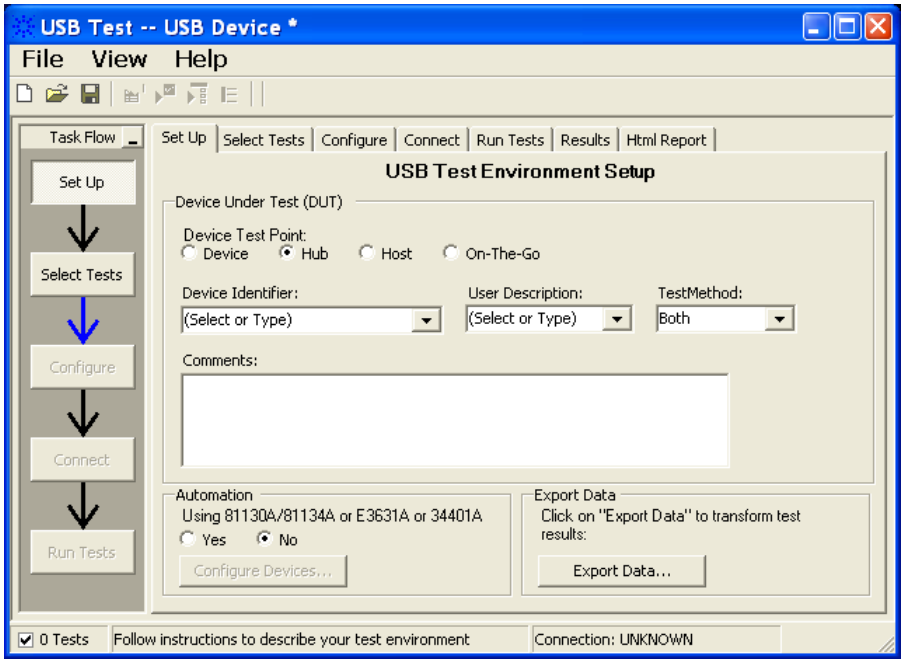
- Drop/Droop – Downstream facing ports.
- Back-voltage.

Before Running These Tests

If you haven't already performed the initial equipment set up, see "Setting Up the Equipment" on page 19.

Selecting the Hub Test Environment Setup

1 In the USB automated test application, select the **Hub** test environment.



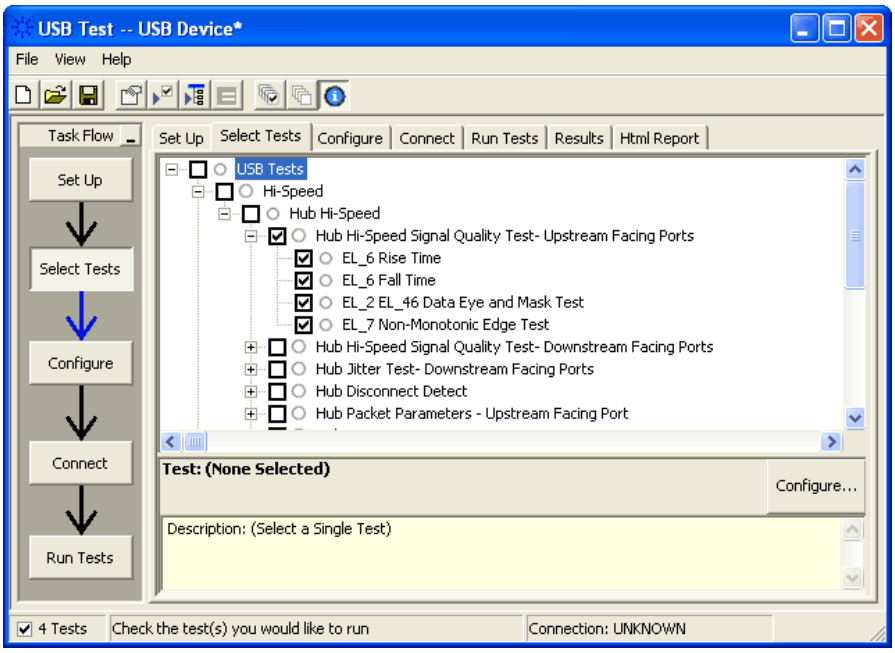
Hub Hi-Speed Signal Quality Test - Upstream Facing Ports

Equipment Used

Table 13 Equipment Used in Hub Hi-Speed Signal Quality Test - Upstream Facing Ports

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
1	Differential probe	Agilent 113xA with E2699A or E2678A
1	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Device Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66507
1	5V power supply	Agilent 0950-2546 or equivalent
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests

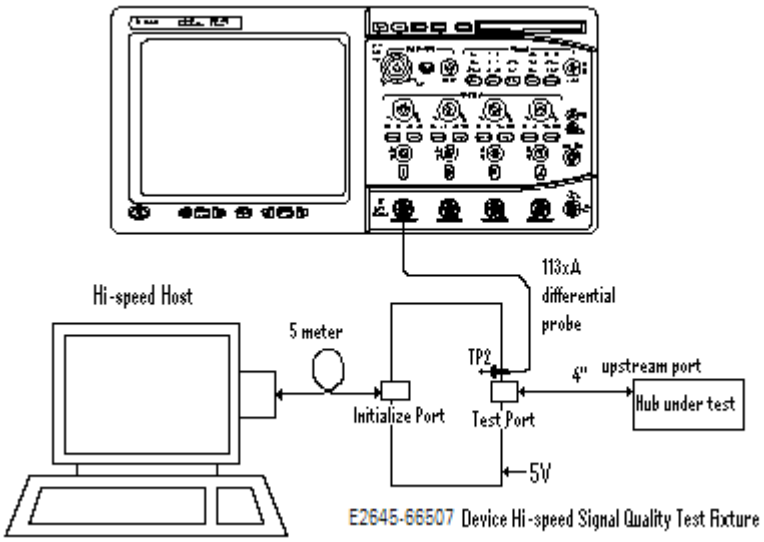


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. Attach the 5V power supply to J5 of the E2645-66507 Device Hi-Speed Signal Quality test fixture. Leave the TEST switch at the **OFF** position. Verify green Power LED (D1) is lit, and yellow test LED (D2) is off.
2. Connect the [TEST PORT] of the test fixture into the upstream facing port of the hub under test, using the 4" USB cable.
3. Connect the [INIT PORT] of the test fixture to a hi-speed port of the Test Bed Computer, using a 5 meter cable. Apply power to the hub.
4. Attach the Agilent 113xA differential probe to D+/D- of TP2 on the test fixture, using the header adapter. Ensure the + polarity on the probe lines up with D+ on the fixture.



5. Check **I have completed these instructions**.

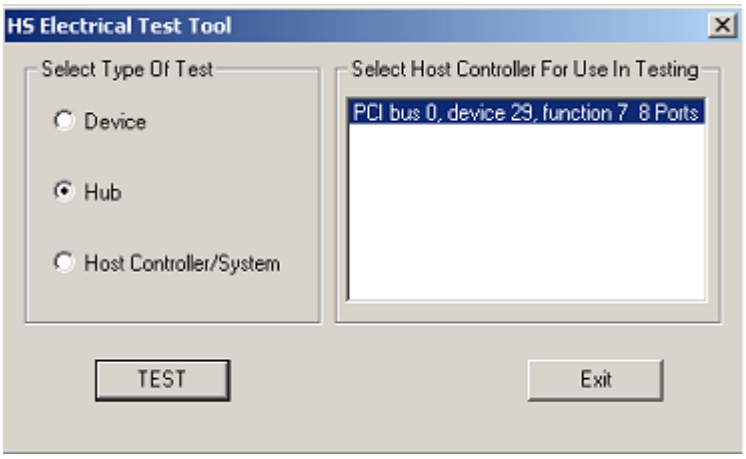
Running the Tests

1 Click **Run Tests**.

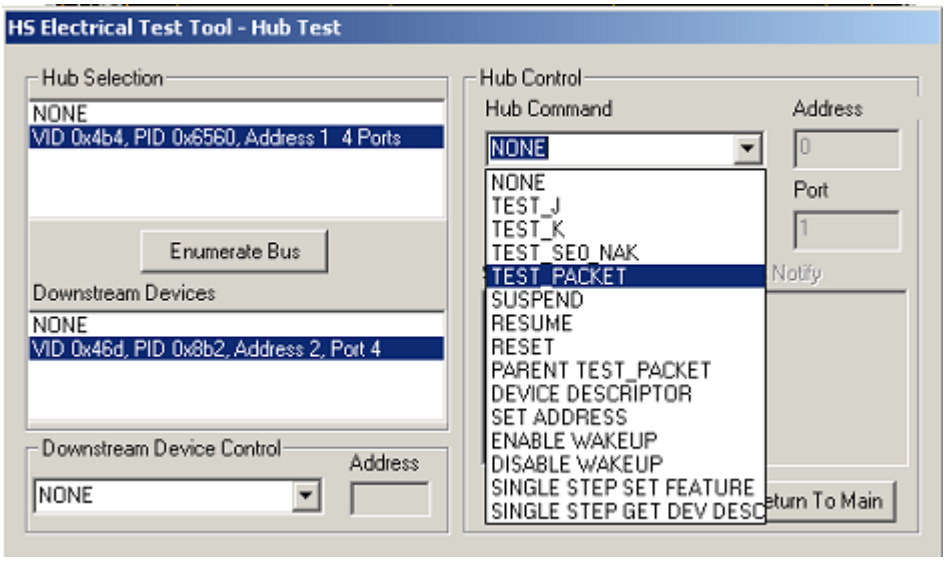
Test Instructions, Part 1

The USB automated test application will prompt you to perform these steps:

1 Invoke the HS Electrical Test Tool software on the Hi-Speed Electrical Test Bed computer. Select **Hub** and click the **[TEST]** button to enter the Hub Test menu.



2 The hub under test should be enumerated with the hub's VID shown together with the USB address. Select **[TEST_PACKET]** from the Hub Command drop down menu and click **[EXECUTE]**.

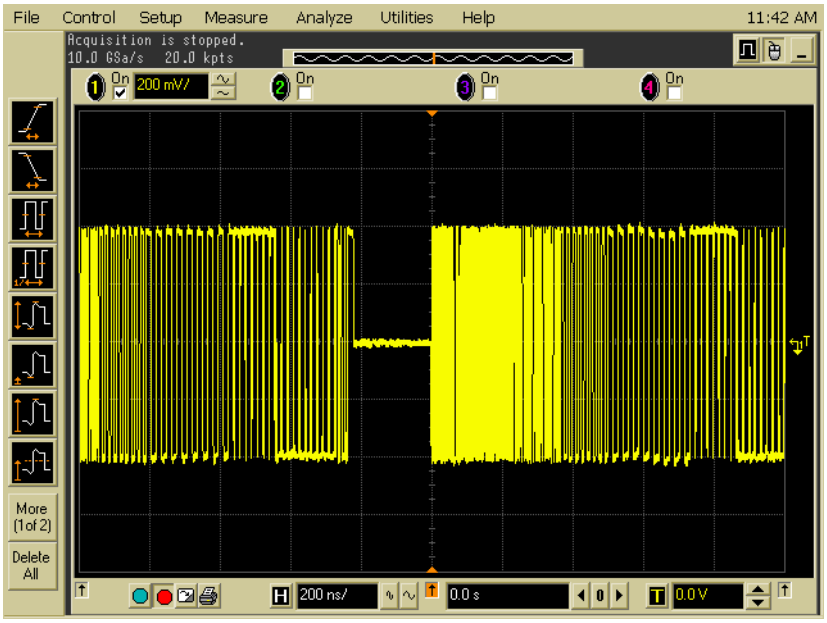


3 Click **OK** to close the Test Instructions dialog.

Test Instructions, Part 2

The USB automated test application will prompt you to perform these steps:

1 Place the Test Switch (S1) of the test fixture in the **TEST** position. Verify the yellow TEST LED is lit. You should see the transmitted test packet on the oscilloscope as below.



2 Click **OK** to close the Test Instructions dialog.

EL_6 Rise Time

EL_6 Fall Time

EL_2 EL_46 Data Eye and Mask Test

After viewing the test results, click **OK** to close the Test Instructions dialog.

EL_7 Non-Monotonic Edge Test

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

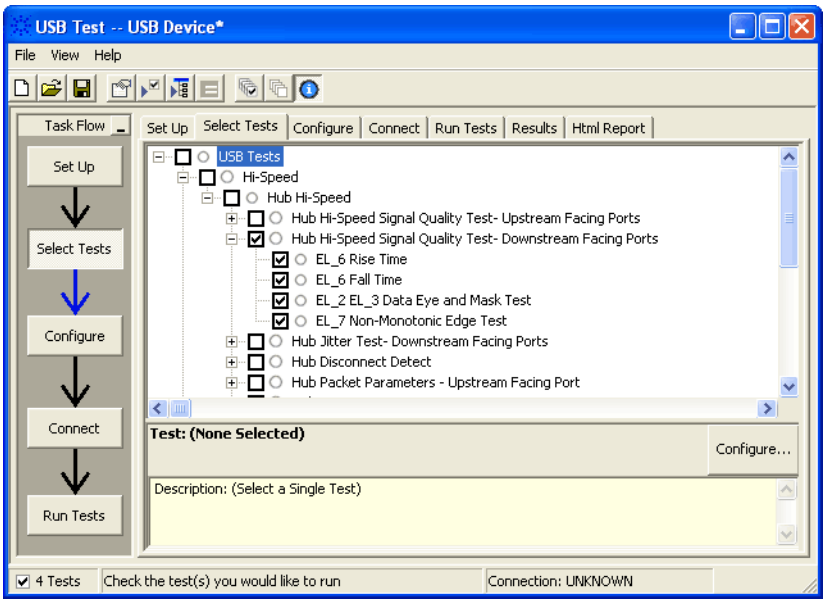
Hub Hi-Speed Signal Quality Test - Downstream Facing Ports

Equipment Used

Table 14 Equipment Used in Hub Hi-Speed Signal Quality Test - Downstream Facing Ports

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
1	Differential probe	Agilent 113xA with E2699A or E2678A
1	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Host Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66508
1	5V power supply	Agilent 0950-2546 or equivalent
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests

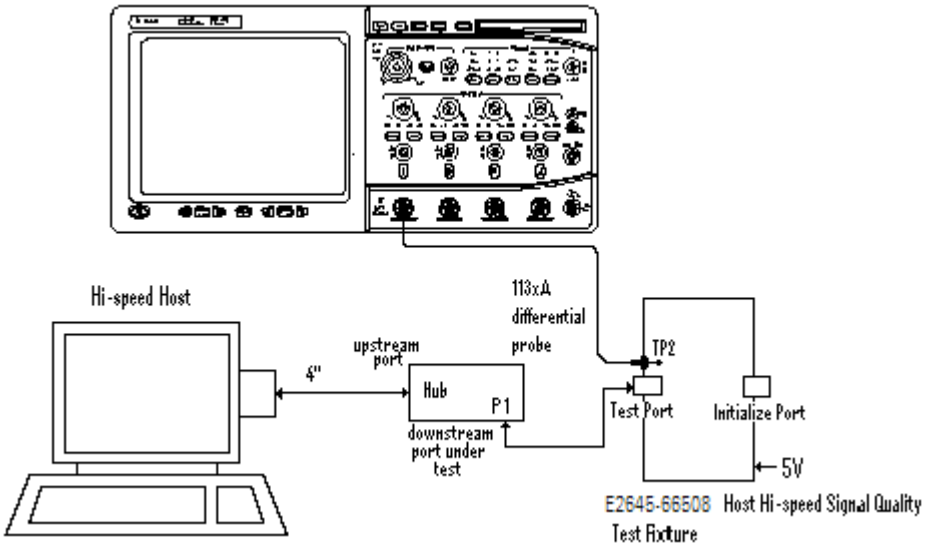


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. Attach the 5V power supply to J5 of the E2645-66508 Host Hi-Speed Signal Quality test fixture. Set the Test switch to the TEST position. Verify green Power LED (D1) and yellow test LED (D2) are both lit.
2. Attach the Agilent 113xA differential probe to TP2 of the test fixture, using the header adapter. Ensure the + polarity on the probe lines up with D+ on the fixture, located nearest to the USB connector.
3. Connect the upstream port of the hub to a high-speed root port of the test bed computer.
4. Connect the [TEST PORT] of the test fixture into the down stream facing port under the test of the hub. Apply power to the hub.



5. Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

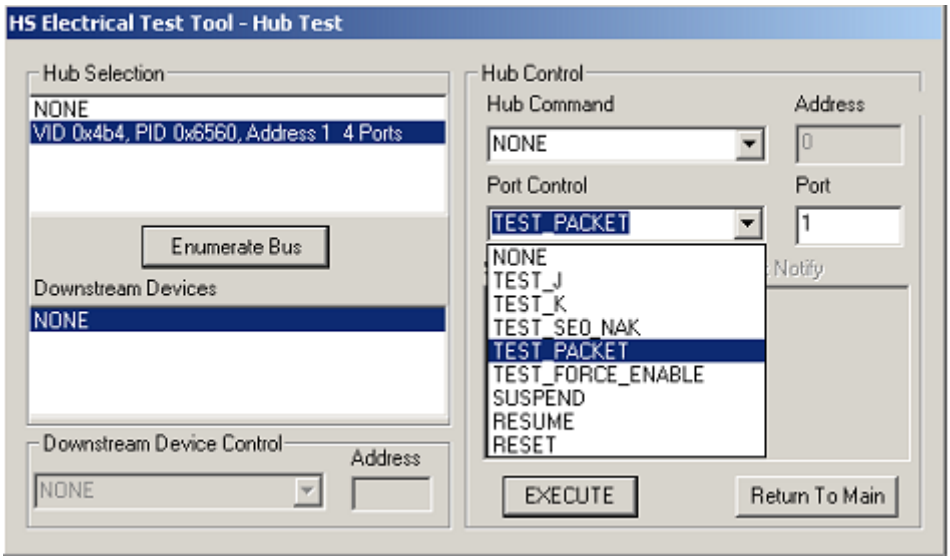
Test Instructions

The USB automated test application will prompt you to perform these steps:

1 On the Hub Test menu of the HS Electrical Test Tool, click the **[Enumerate Bus]** button once. The hub under test should be enumerated with the hub's VID shown together with the USB address.

2 Select **TEST_PACKET** from the Port Control drop down menu.

3 Enter the port number of the hub port being tested and click **[EXECUTE]**.



4 Click **OK** to close the Test Instructions dialog.

EL_6 Rise Time

EL_6 Fall Time

EL_2 EL_3 Data Eye and Mask Test

After viewing the test results, click **OK** to close the Test Instructions dialog.

EL_7 Non-Monotonic Edge Test

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

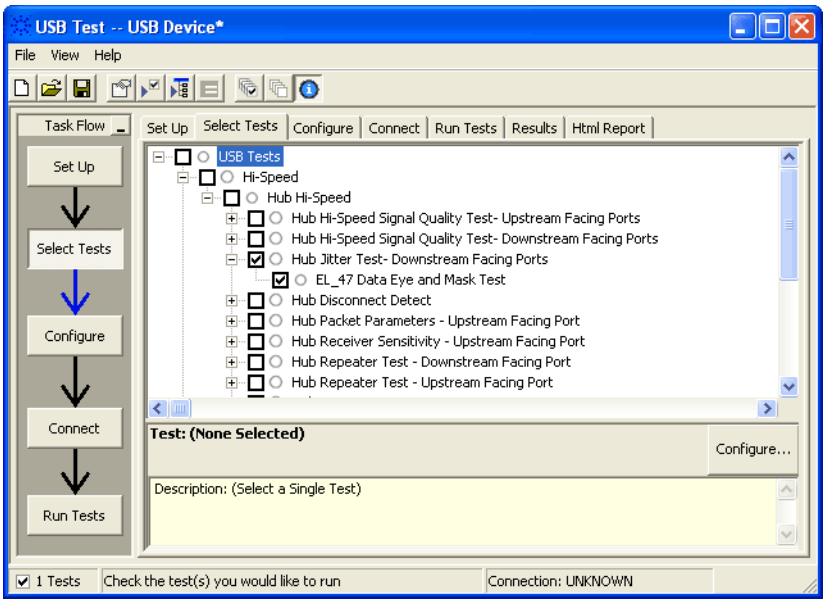
Hub Jitter Test - Downstream Facing Ports

Equipment Used

Table 15 Equipment Used in Hub Jitter Test - Downstream Facing Ports

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
1	Differential probe	Agilent 113xA with E2699A or E2678A
1	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Host Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66508
1	5V power supply	Agilent 0950-2546 or equivalent
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests

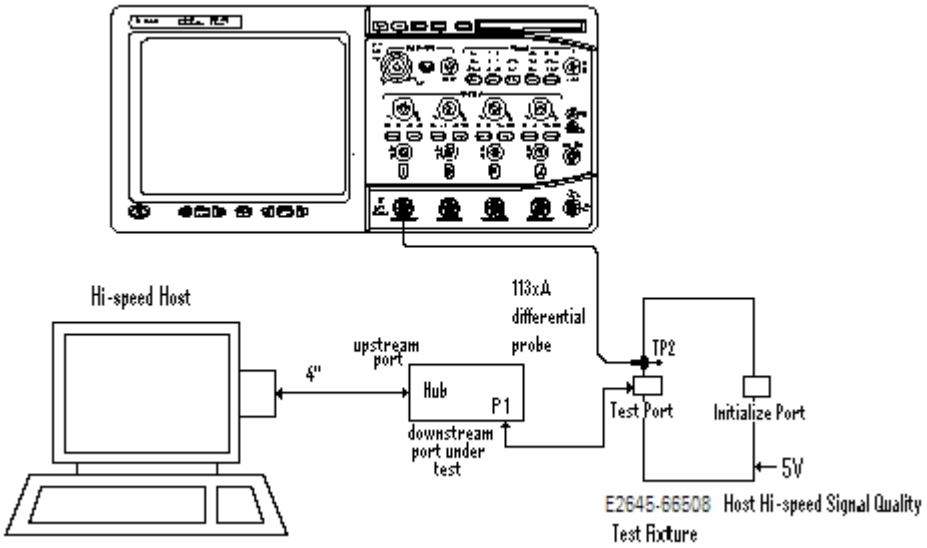


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. Attach the 5V power supply to J5 of the E2645-66508 Host Hi-Speed Signal Quality test fixture. Set the Test switch to the TEST position. Verify green Power LED (D1) and yellow test LED (D2) are both lit.
2. Attach the differential probe to TP2 of the test fixture, using the header adapter. Ensure the + polarity on the probe lines up with D+ on the fixture, located nearest to the USB connector.
3. Connect the upstream port of the hub to a high-speed root port of the test bed computer.
4. Connect the [TEST PORT] of the test fixture into the down stream facing port under the test of the hub. Apply power to the hub.



5. Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Test Instructions

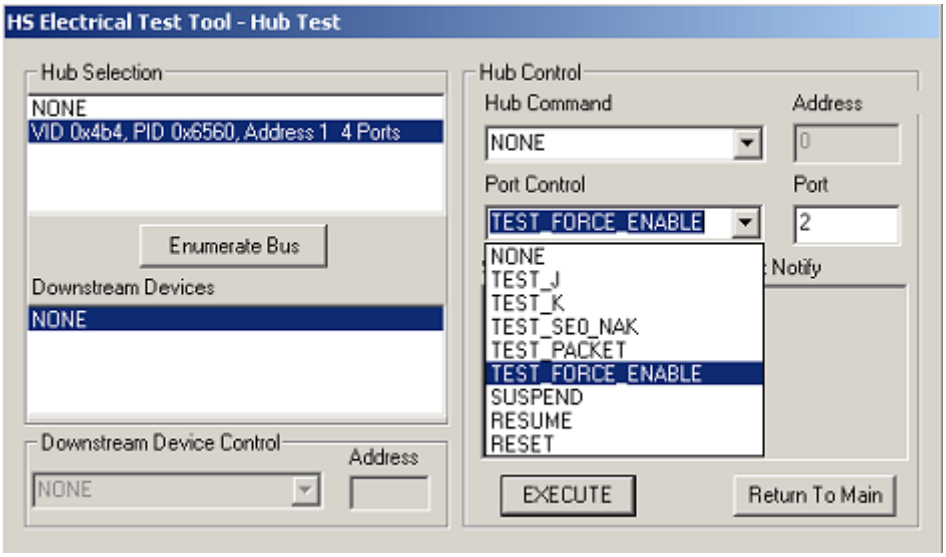
EL_47 Data Eye and Mask Test

The USB automated test application will prompt you to perform these steps:

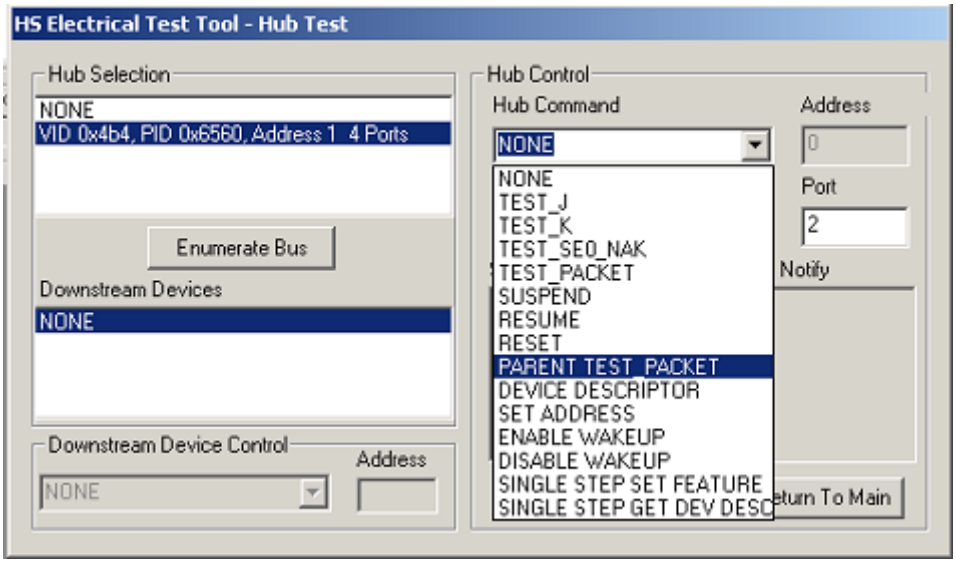
1 On the Hub Test menu of the HS Electrical Test Tool, click **[Enumerate Bus]** once.

2 Select **TEST_FORCE_ENABLE** from the Port Control drop down menu.

3 Enter the port number of the hub port being tested and click **[EXECUTE]** once to force-enable the hub port under test.



4 Select **PARENT TEST_PACKET** from the Hub Command drop down menu and click **[EXECUTE]**.



5 Click **OK** to close the Test Instructions dialog.

After viewing the test results, click **OK** to close the Test Instructions dialog.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

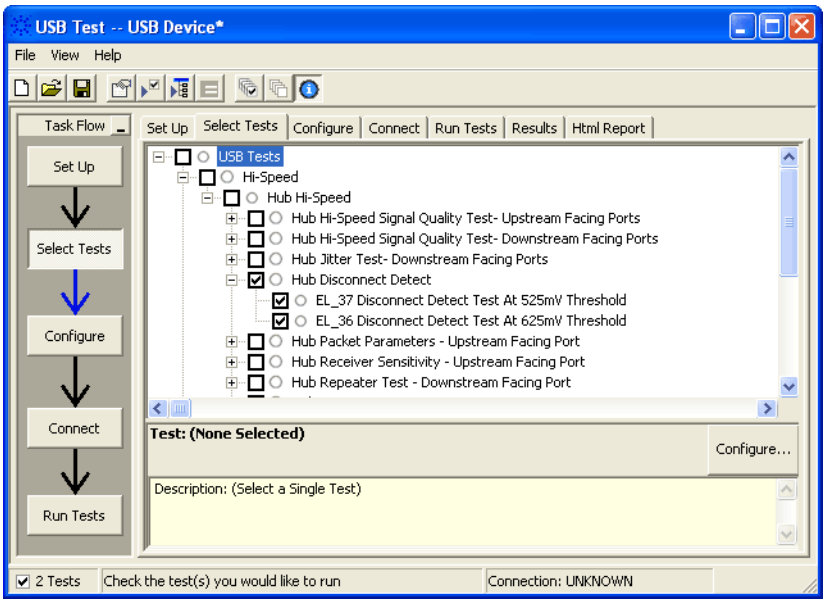
Hub Disconnect Detect

Equipment Used

Table 16 Equipment Used in Hub Disconnect Detect

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
1	Differential probe	Agilent 113xA with E2699A or E2678A
1	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Host Disconnect test fixture and 4" USB cable	Agilent E2645-66506
1	5V power supply	Agilent 0950-2546 or equivalent
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests

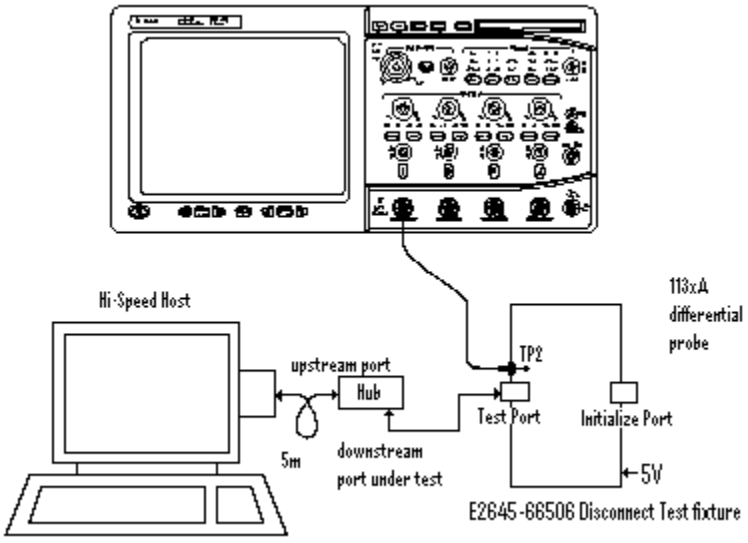


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. Attach the 5V power supply to E2645-66506 Disconnect test fixture (J5).
2. Attach the Agilent 113xA differential probe to TP2 of the test fixture, using a damped header adapter. Ensure the + polarity on the probe lines up with D+, which is the pin nearest the USB connector.
3. Set the Test switch to the TEST position. This sets the test fixture to emulate a must-not-disconnect threshold.
   a. Verify both the green Power LED (D1) and yellow Test LED (D2) are lit
4. Cycle power on the hub under test. Connect the upstream port of the hub to the host computer, using the 5 meter USB cable.



5. Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Test Instructions

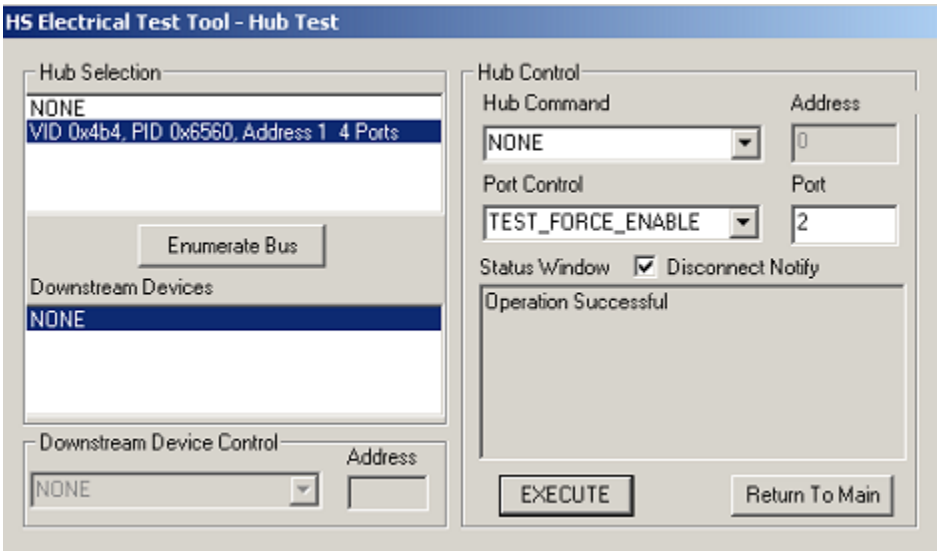
1 In the Hub Test menu of the HS Electrical Test Tool, click **[Enumerate Bus]** once and verify the hub successfully enumerates.

2 Attach the [TEST PORT] of the test fixture to the port under test.

3 From the Port Control window of the Hub Test menu, select **TEST_FORCE_ENABLE**.

4 Enter the port number and click **[EXECUTE]** once and ensure operation is successful in the Status Window.

5 Click the **Disconnect Notify** check box to monitor the disconnect status in the Status Window.



6 Click **OK** to close the Test Instructions dialog.

EL_37 Disconnect Detect Test At 525mV Threshold

The USB automated test application will prompt you to answer the question “Does the Status Window display Disconnect Event Detected?”

EL_36 Disconnect Detect Test At 625mV Threshold

The USB automated test application will prompt you to: Set the Test switch of the E2645-66506 Disconnect test fixture to the Normal position and verify the yellow TEST LED (D2) is not lit.

The USB automated test application will prompt you to answer the question “Does the Status Window now display Disconnect Event Detected?”

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

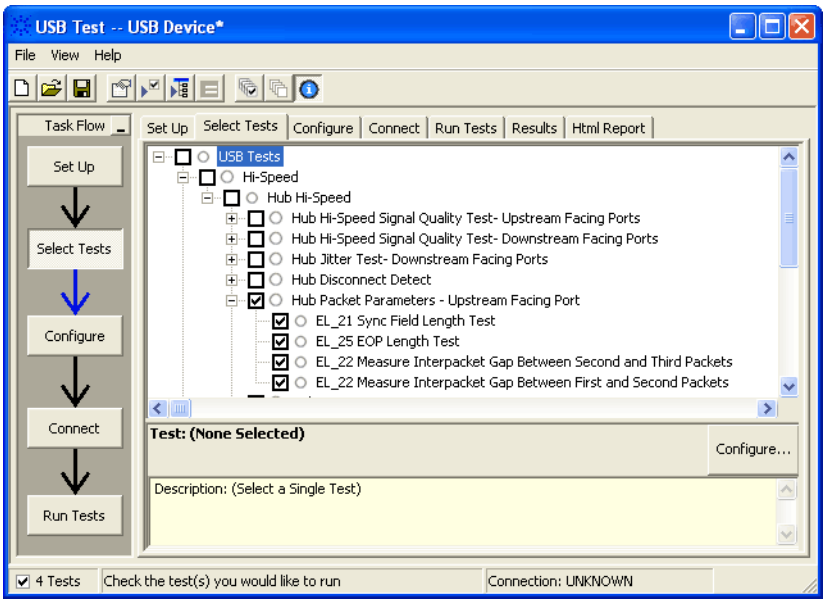
Hub Packet Parameters - Upstream Facing Port

Equipment Used

Table 17 Equipment Used in Hub Packet Parameters - Upstream Facing Port

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
1	Differential probe	Agilent 113xA with E2699A or E2678A
1	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Device Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66507
1	5V power supply	Agilent 0950-2546 or equivalent
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests



Configuring the Tests

Connecting the Equipment

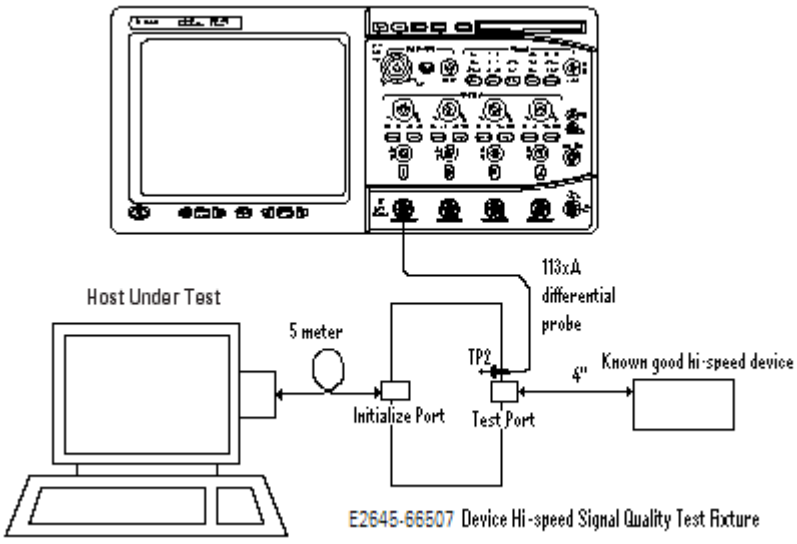
The USB automated test application will prompt you to perform these connection steps:

1 Connect the E2645-66507 Device Hi-Speed Signal Quality test fixture [INIT PORT] into a high-speed capable port of the test bed, using the 5 meter USB cable. Do not apply 5V to the test fixture.

2 Connect the test fixture [TEST PORT] into B receptacle of the upstream facing port under test of the hub, using the 4" USB cable. Apply power to the hub.

3 Attach the Agilent 113xA differential probe to D+/D- of TP2 on the test fixture, using a damped header adapter.

NOTE Ensure the + polarity on the probe lines up with D+.



4 Check **I have completed these instructions**.

Running the Tests

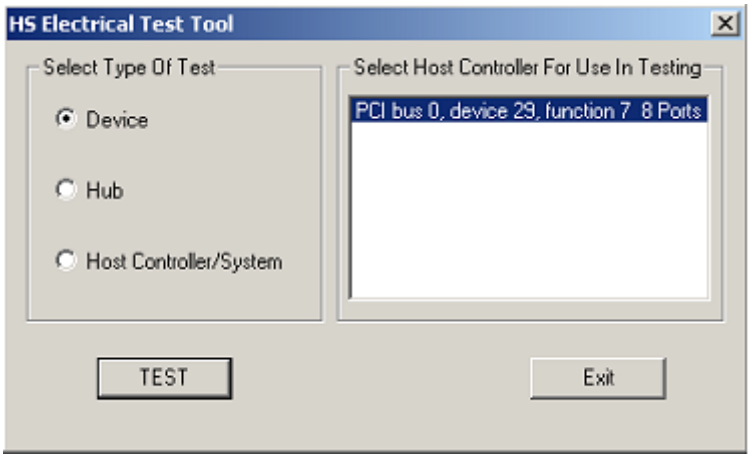
1 Click **Run Tests**.

Test Instructions, Part 1

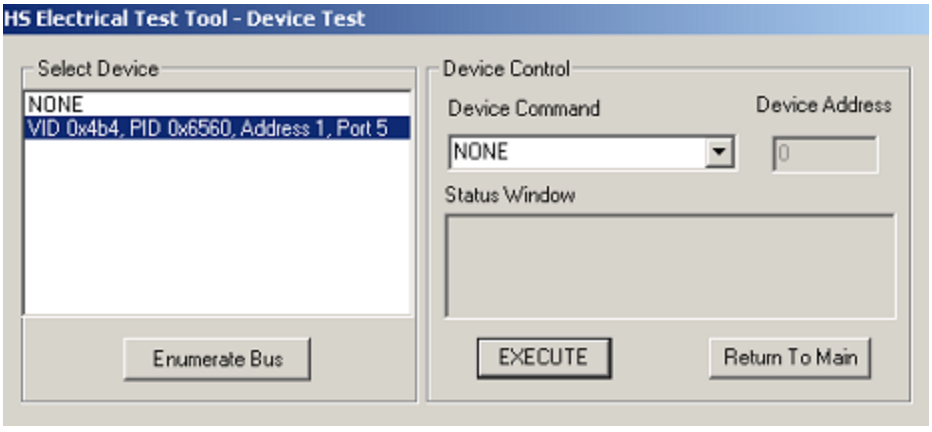
The USB automated test application will prompt you to perform these steps:

1 Exit the Hub Test menu of the HS Electrical Test Tool by clicking the **[Return to Main button]**.

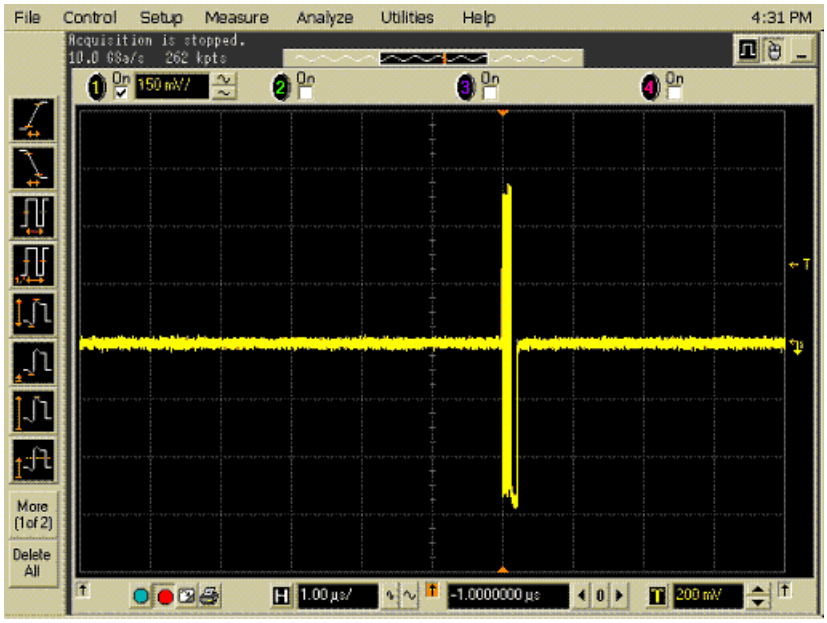
2 From the HS Electrical Test Tool main menu select **Device** and click **[TEST]** to enter the Device Test menu.



3 The Device Test menu of the HS Electrical Test Tool should appear as below.



4 Using the oscilloscope, verify the SOFs (Start Of Frame) packets are being transmitted on the port under test. You may need to lower the trigger level to somewhat below 400 mV.



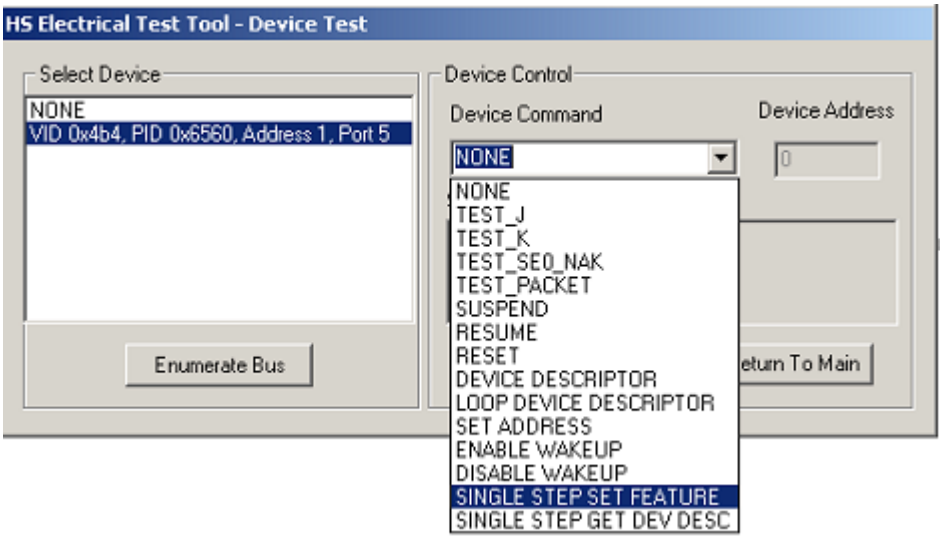
5 Click **OK** to close the Test Instructions dialog.

Test Instructions, Part 2

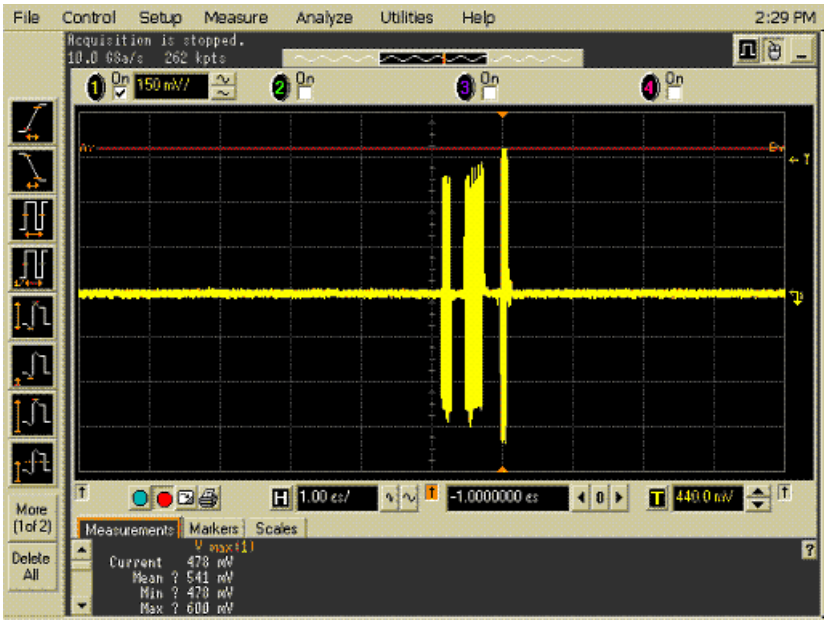
The USB automated test application will prompt you to perform these steps:

1 In the Device Test menu of the HS Electrical Test Tool, ensure that the hub under test is selected.

2 Select **SINGLE STEP SET FEATURE** from the Device Command window. Click **[EXECUTE]** once.



3 You should see the transmitted test packet on the oscilloscope as below.



4 Click **OK** to close the Test Instructions dialog.

EL_21 Sync Field Length Test

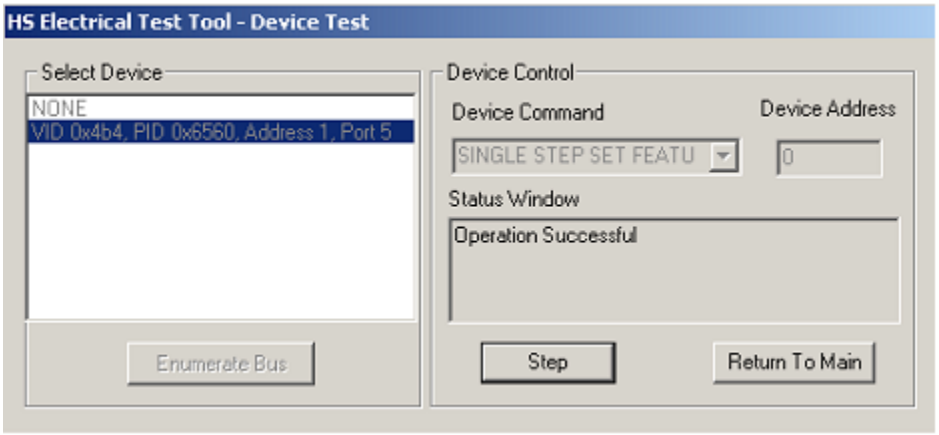
EL_25 EOP Length Test

EL_22 Measure Interpacket Gap Between Second and Third Packets

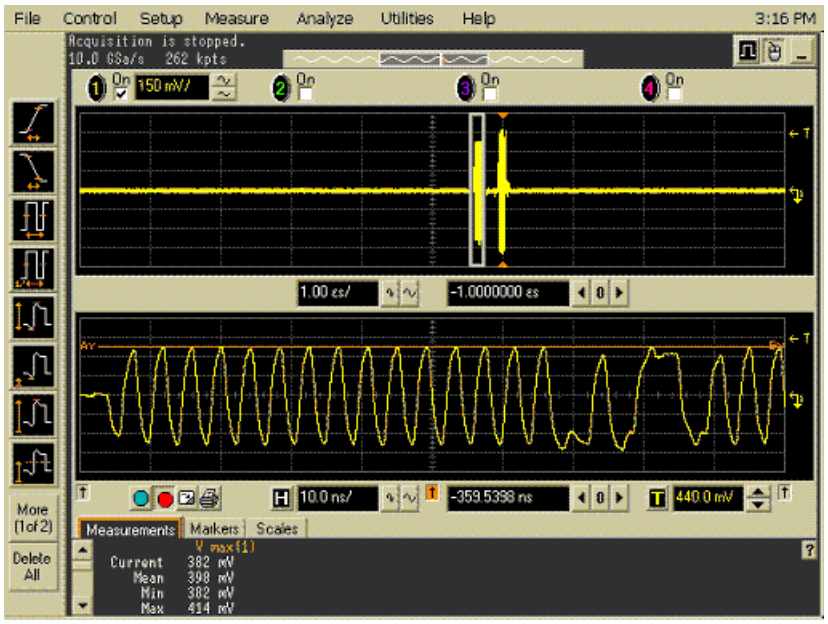
EL_22 Measure Interpacket Gap Between First and Second Packets

The USB automated test application will prompt you to perform these steps:

1 In the Device Test menu of the HS Electrical Test Tool, click **[STEP]** once again. This is the second step of the two-step Single Step Set Feature command.



2 You should see the transmitted test packet on the oscilloscope as below.



3 Click **OK** to close the Test Instructions dialog.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

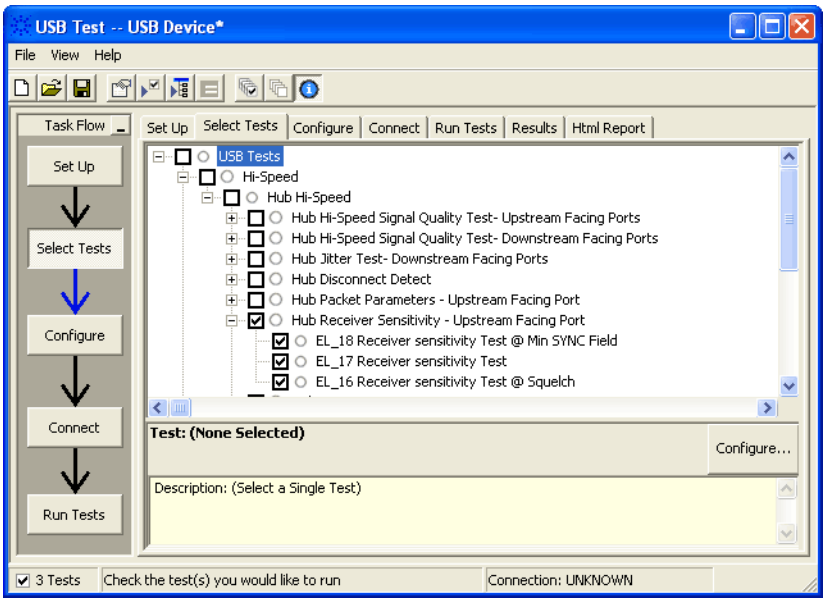
Hub Receiver Sensitivity - Upstream Facing Port

Equipment Used

Table 18 Equipment Used in Hub Receiver Sensitivity - Upstream Facing Port

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
1	Differential probe	Agilent 113xA with E2699A or E2678A
1	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Receiver Sensitivity test fixture and 4" USB cable	Agilent E2645-66503
1	5V power supply	Agilent 0950-2546 or equivalent
1	Digital signal generator	Agilent 81130A (or 81134A with two 15432B transition time converters connected to the pulse generator outputs)
1	USB/GPIB interface	Agilent 82357A
2	6 dB attenuators	Agilent 8493C
2	50 ohm coaxial cable with male SMA connectors at both ends	Agilent 8120-4948 or equivalent
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests



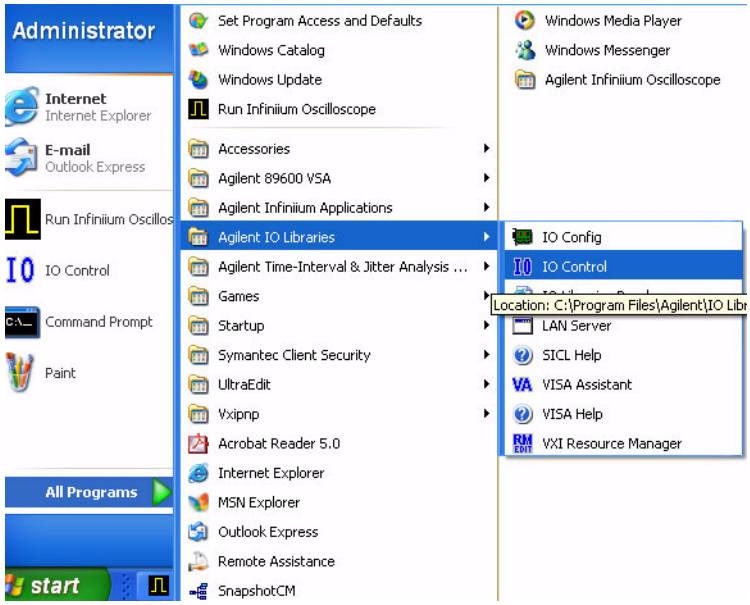
Configuring the Tests

If the pulse generator's SICL address is different from the default, make sure you set the 81134A/81130A Instrument Address configuration option to the pulse generator's SICL address.

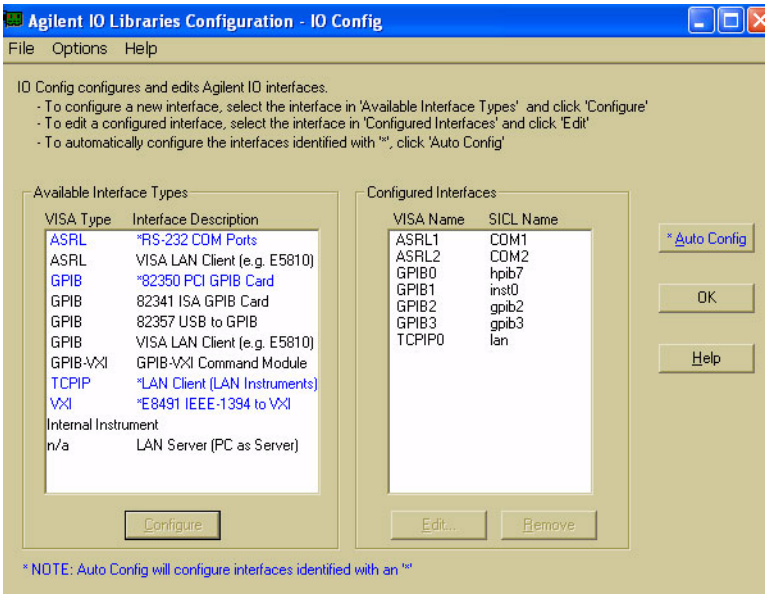
Configuring the 81134A pulse generator using the 82357A GPIB-USB converter

1 Ensure that IO Controls is already running by checking the task bar at the bottom right of the screen.

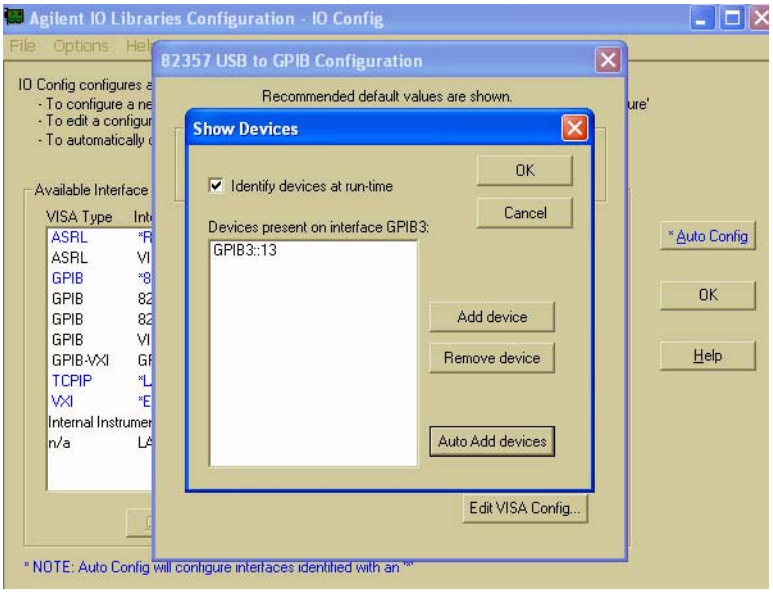
2 If the IO Control has not been launched, go to **Start>Programs>Agilent IO Libraries>IO Control**.



3 Run **IO Config>Auto Config**. This should automatically detect the 82357 device.



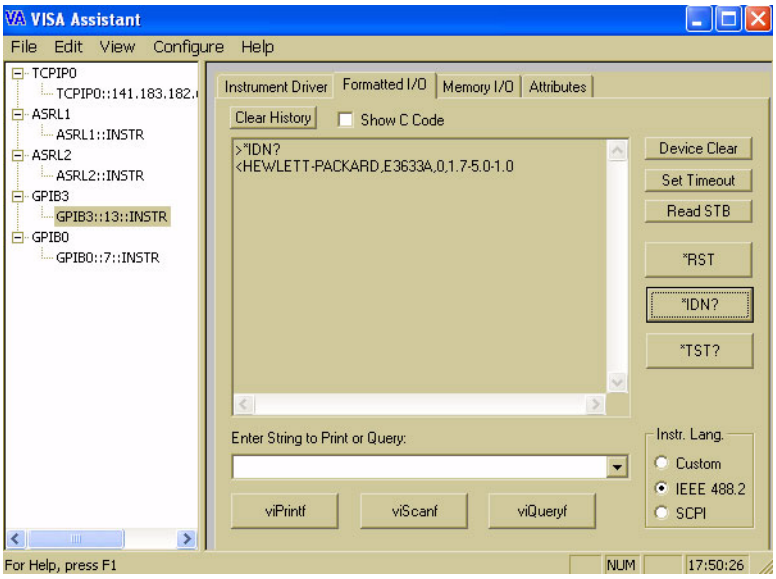
4 Select **GPIB# (last digit is the USB device)>Edit VISA Config...>Auto Add devices**.



5 Click **OK**, and close the IO Config window.

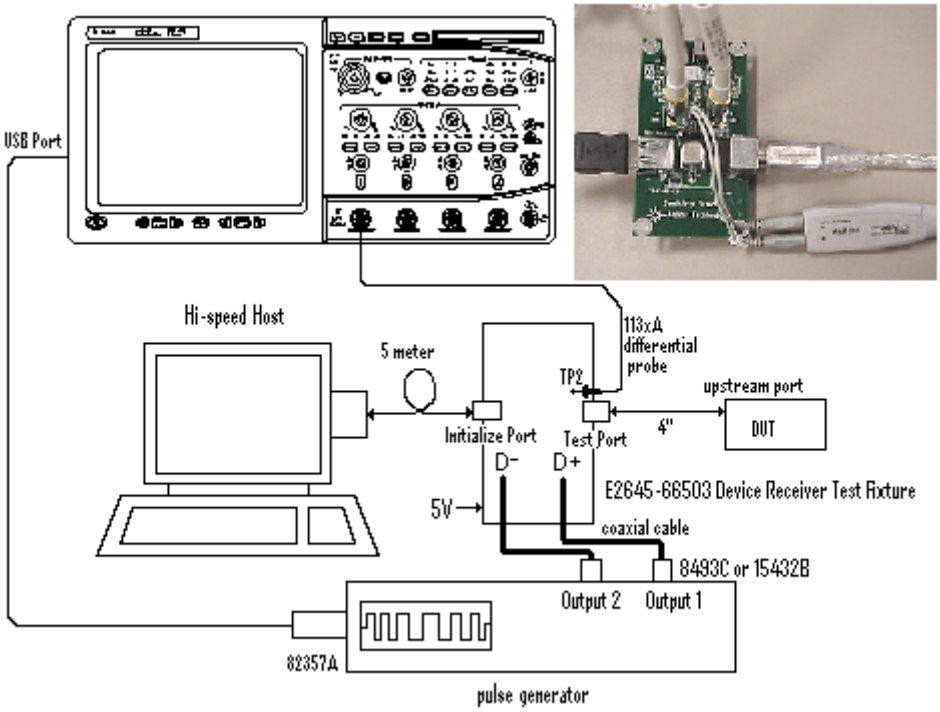
6 Launch VISA Assistant.

7 You can now verify the device connection.



Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:



1 Attach the 5V power supply to the E2645-66503 Device Receiver test fixture (J5).

   a Verify the green Power LED (D1) is lit.

   b Leave the TEST switch at the OFF position (S1).

   c The yellow LED (D2) should be off.

2 Connect the [INIT PORT] of the fixture to a Hi-Speed port on the Test Bed Computer, using the 5 meter USB cable.

3 Connect the [TEST PORT] of the fixture to the device under test, using the 4" USB cable.

4 Connect the Agilent 113xA differential probe to the test fixture at TP2, using the 01131-68703 header adapter.

NOTE Ensure the + polarity on the probe lines up with D+, which is the pin nearest the USB connector.

5 Connect the 81130A or 81134A pulse generator to the oscilloscope using the 82357A USB/GPIB Interface.

   a If you choose to use the Agilent 81130A Pulse/Pattern Generator, connect the 8493C 6dB attenuators to OUTPUT1 and OUTPUT2 of Agilent 81130A Pulse/Pattern Generator.

   b If you choose to use the Agilent 81134A Pulse/Pattern Generator, connect the 15432B Transition Time Converters to OUTPUT1 and OUTPUT2 of Agilent 81134A Pulse/Pattern Generator. Agilent 15432B Transition Time Converters are recommended, to reduce the output edge speed of the 81134A to speed close to what the 81130A provides.

6 Connect OUTPUT1 to SMA1 (D+) of the E2645-66503 Device Receiver Sensitivity test fixture using the 8120-4948 SMA cables.

7 Connect OUTPUT2 to SMA2 (D-) of the E2645-66503 Device Receiver Sensitivity test fixture using the 8120-4948 SMA cables.

8 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

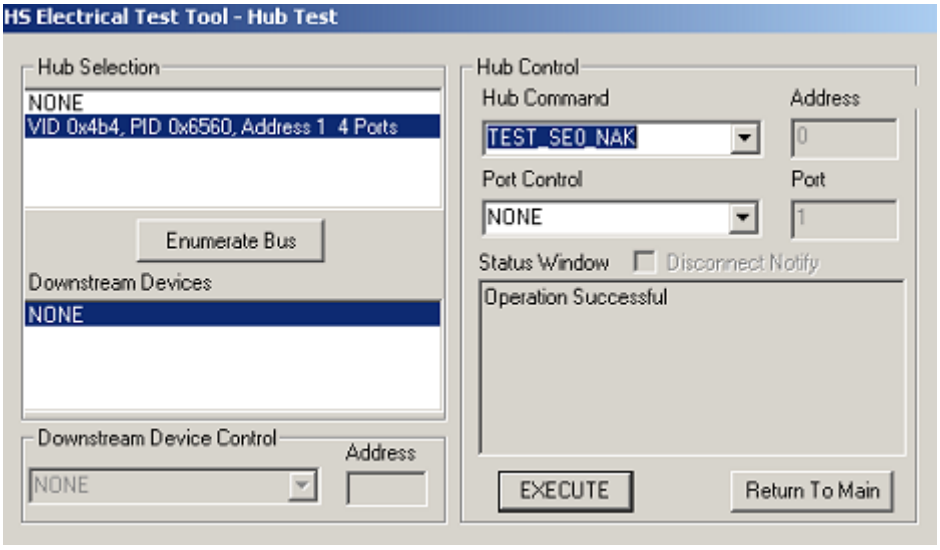
Test Instructions

The USB automated test application will prompt you to perform these steps:

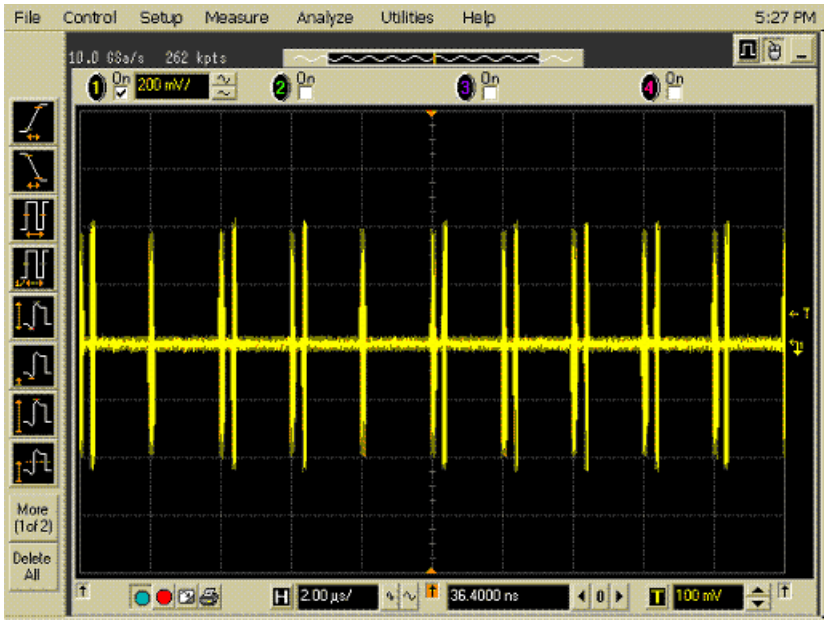
1 Exit the HS Electrical Test Tool - Device Test menu by clicking the **[Return to Main]** button. From the HS Electrical Test Tool main menu select **Hub** and click **[TEST]** to enter the Hub Test menu.

2 On the Hub Test Menu, click **[Enumerate Bus]** button once and verify that the hub enumerates properly.

3 Select **TEST_SE0_NAK** from the Hub Command drop down menu. Click **[EXECUTE]** once to place the hub into TEST_SE0_NAK test mode.



4 Place the test fixture Test Switch (S1) into the **TEST** position. This switches in the data generator in place of the host controller. The data generator emulates the "IN" packets from the host controller.



5 Click **OK** to close the Test Instructions dialog.

EL_18 Receiver sensitivity Test @ Min SYNC Field

EL_17 Receiver sensitivity Test

EL_16 Receiver sensitivity Test @ Squelch

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

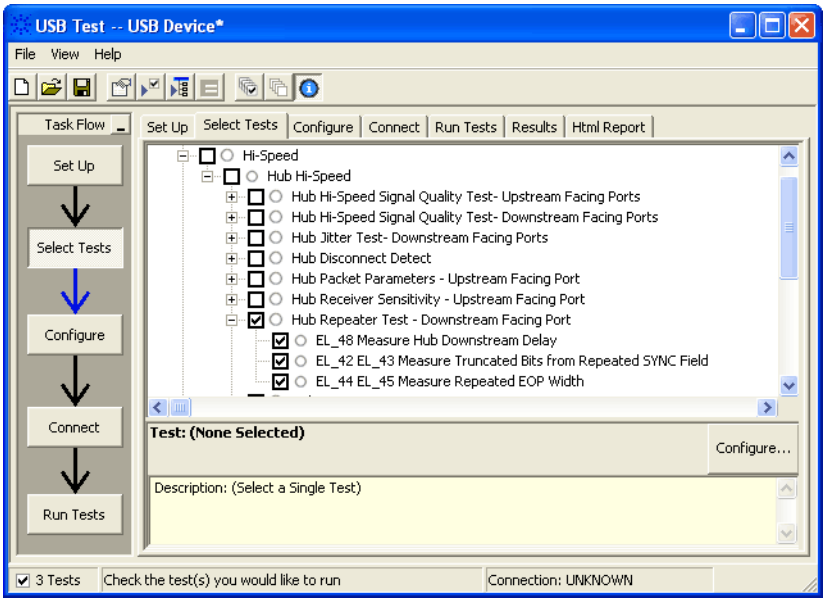
Hub Repeater Test - Downstream Facing Port

Equipment Used

Table 19 Equipment Used in Hub Repeater Test - Downstream Facing Port

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
2	Differential probe	Agilent 113xA with E2699A or E2678A
2	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Device Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66507
1	Host Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66508
2	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site
2	1 meter USB cable	Any listed on USB-IF web site

Selecting the Tests

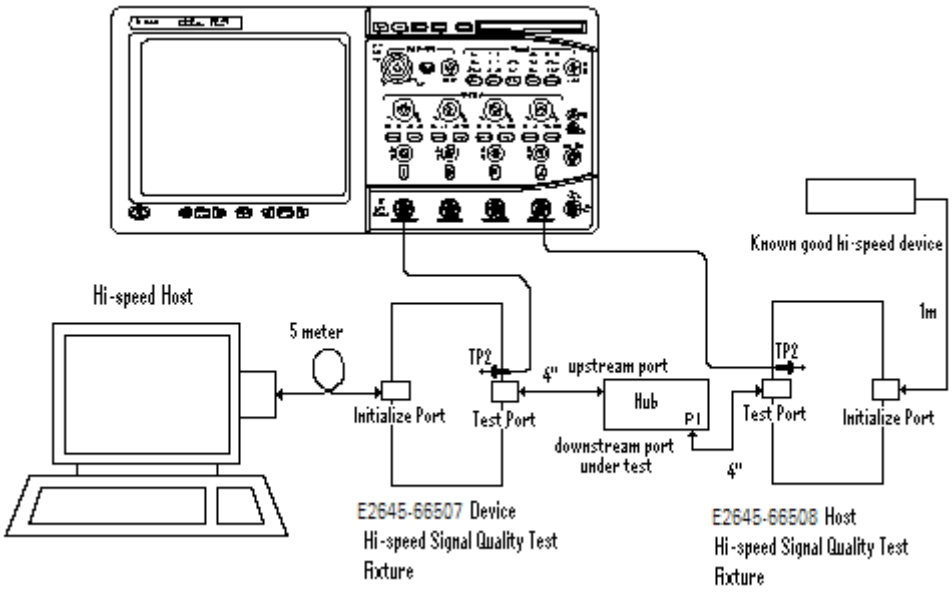


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. Connect the E2645-66507 Device Hi-Speed Signal Quality test fixture between the upstream facing port of the hub and the host controller port.
   a. Attach the Channel 1 differential probe to TP2 of the fixture. Ensure the + polarity on the probe lines up with D+ on the fixture. The D+ pin is the pin closest to the USB connector.
   b. Connect the fixture's [TEST PORT] to the hub's upstream port with the 4" USB cable.
   c. Connect the fixture's [INIT PORT] to the controller port with the 5 meter USB cable.
2. Connect the E2645-66508 Host Hi-Speed Signal Quality test fixture between the downstream port under test of the hub and a known-good hi-speed device.
   a. Attach the Channel 4 differential probe to D+/D- of TP2 on the fixture. Ensure the + polarity on the probe lines up with the D+ on the fixture.
   b. Connect the test fixture's [TEST PORT] to the hub downstream port under test, using the 4" USB cable.
   c. Connect the test fixture's [INIT PORT] to the known good device using the 1 meter USB cable.
   d. Apply power to the hub and the known good device.



3 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

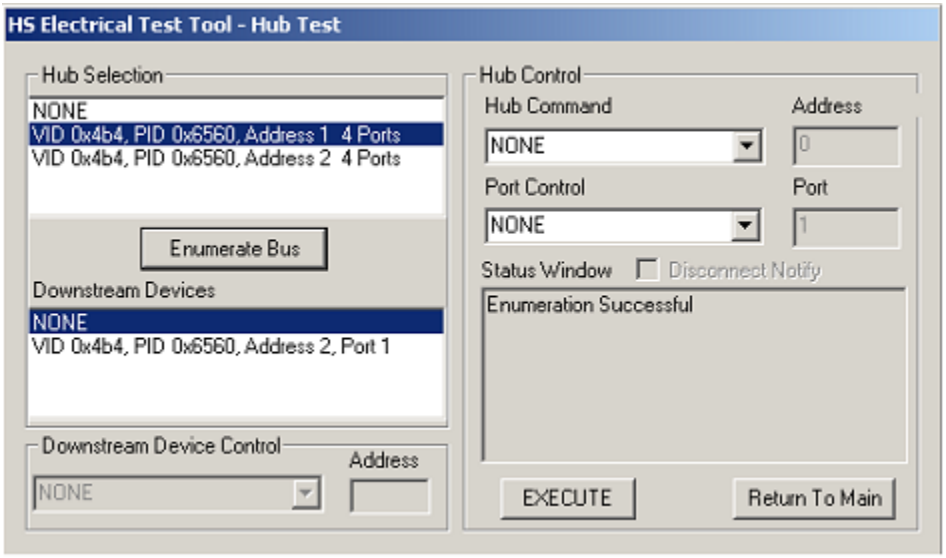
Test Instructions

The USB automated test application will prompt you to perform these steps:

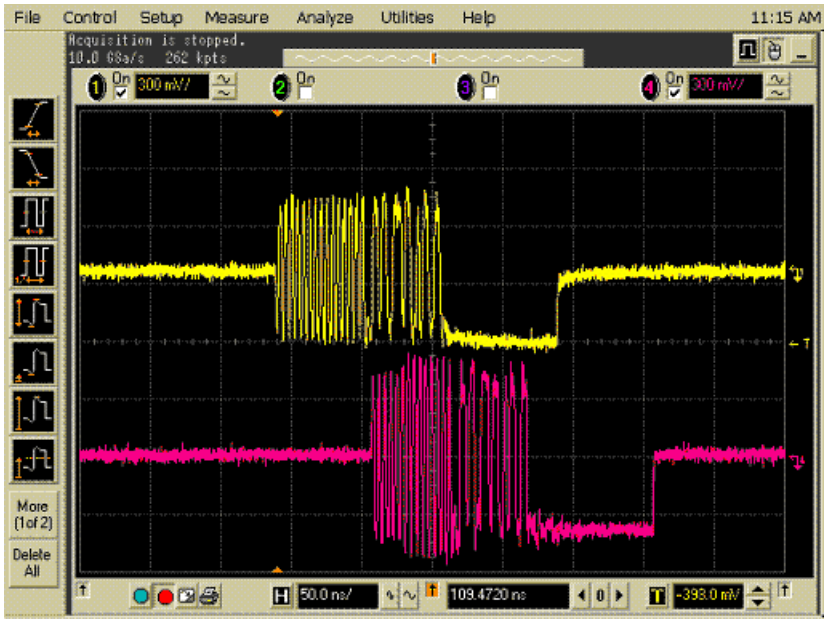
1 On the Hub Test menu of the HS Electrical Test Tool, click **[Enumerate Bus]** once.

   a The hub under test should be enumerated with the hub's VID shown together with the USB address.

   b Likewise the known good device should be enumerated with its VID shown together with the hub port in which it is connected.



2 The captured transition should be as in the figure below.



3 Check **I have completed these instructions**.

EL_48 Measure Hub Downstream Delay

EL_42 EL_43 Measure Truncated Bits from Repeated SYNC Field

EL_44 EL_45 Measure Repeated EOP Width

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

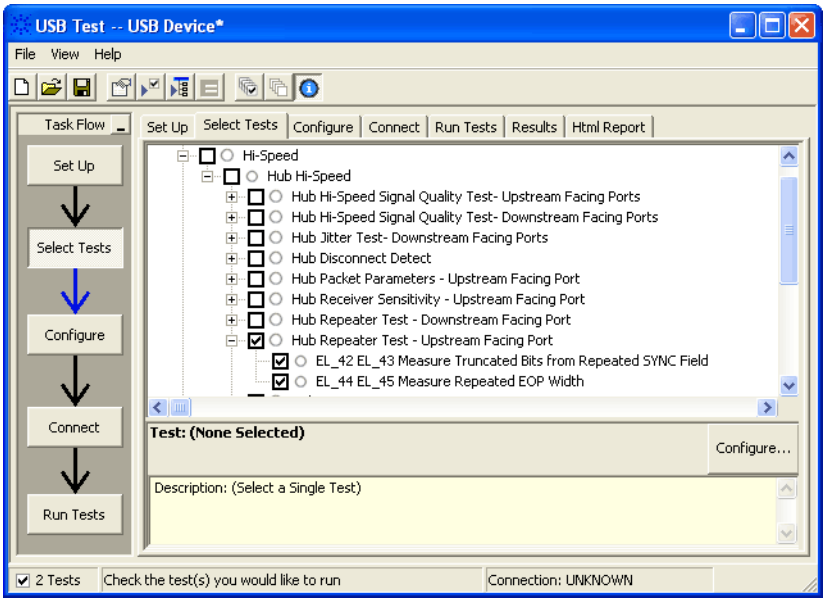
Hub Repeater Test - Upstream Facing Port

Equipment Used

Table 20 Equipment Used in Hub Repeater Test - Upstream Facing Port

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
2	Differential probe	Agilent 113xA with E2699A or E2678A
2	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Device Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66507
1	Host Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66508
2	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site
2	1 meter USB cable	Any listed on USB-IF web site

Selecting the Tests

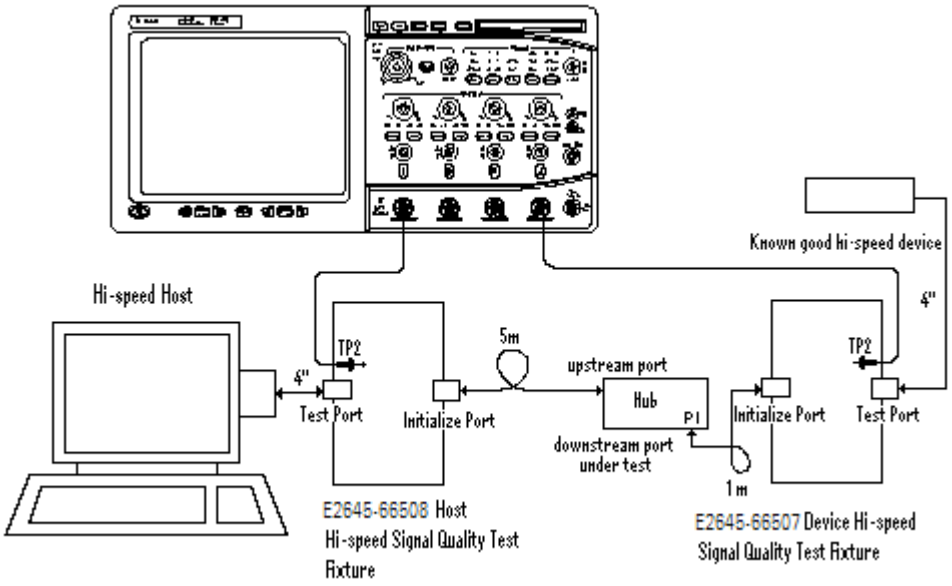


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. Connect the E2645-66508 Host Hi-Speed Signal Quality test fixture between the upstream facing port of the hub and the host controller port.
   a. Attach the Channel 1 differential probe to TP2 of the fixture. Ensure the + polarity on the probe lines up with D+ on the fixture. The D+ pin is the pin closest to the USB connector.
   b. Connect the fixture's [INIT PORT] to the hub's upstream port, with the 5 meter USB cable.
   c. Connect the fixture's [TEST PORT] to the host controller port, using the 4" USB cable.
2. Connect the E2645-66507 Device Hi-Speed Signal Quality test fixture between the downstream port under test of the hub and a known good hi-speed device, nearest to the device.
   a. Attach the Channel 4 differential probe to D+/D- of TP2 on the fixture. Ensure the + polarity on the probe lines up with the D+ on the fixture.
   b. Connect the test fixture's [TEST PORT] to a known good device using the 4" USB cable.
   c. Connect the test fixture's [INIT PORT] to the hub's downstream port under test using the 1 meter USB cable.
   d. Apply power to the hub and the known good device.



3 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

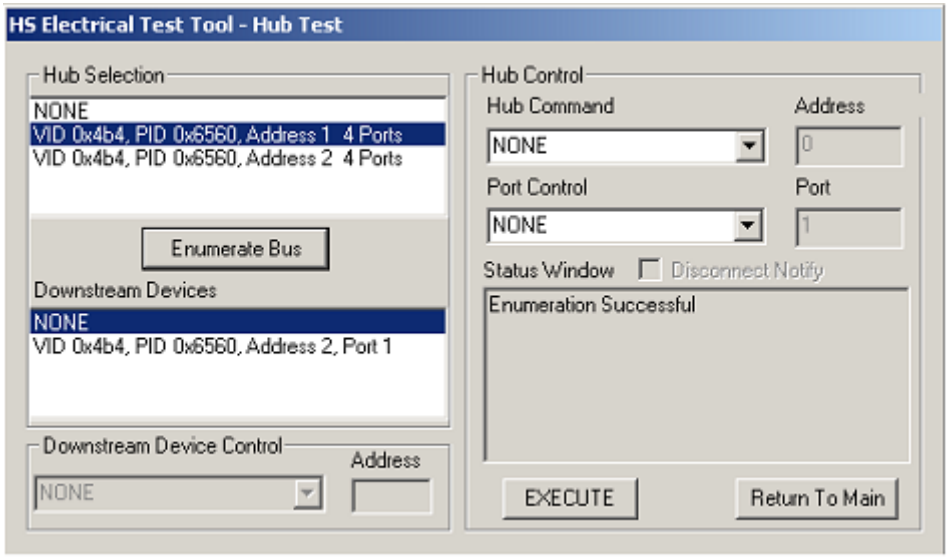
Test Instructions, Part 1

The USB automated test application will prompt you to perform these steps:

1 On the Hub Test menu of the HS Electrical Test Tool, click **[Enumerate Bus]** once.

   a The hub under test should be enumerated with the hub's VID shown together with the USB address.

   b Likewise the known good device should be enumerated with its VID shown together with the hub port in which it is connected.

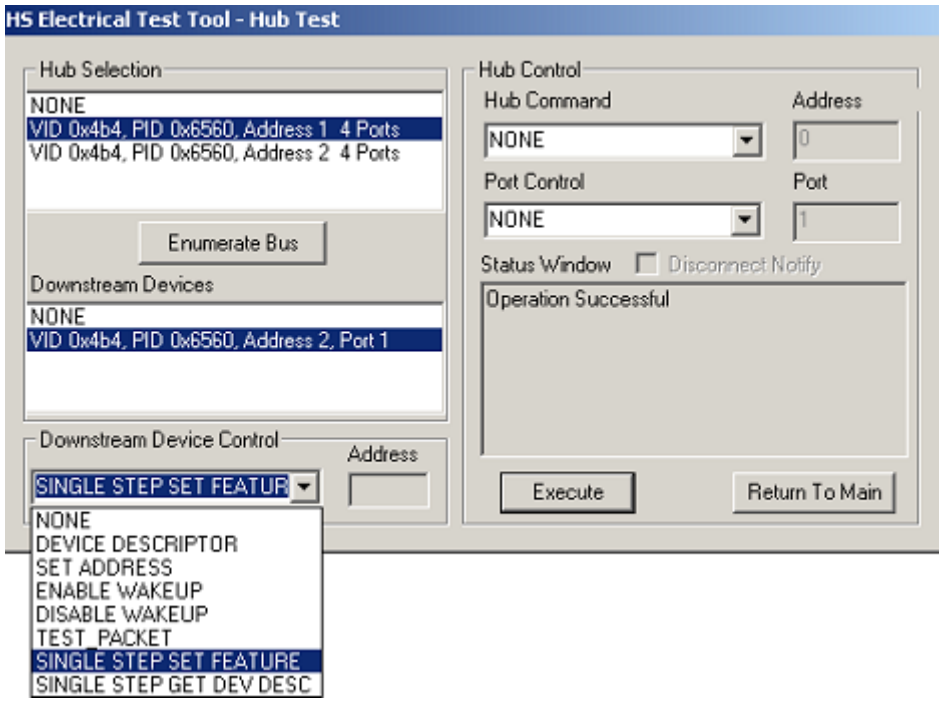


2 Check **I have completed these instructions**.

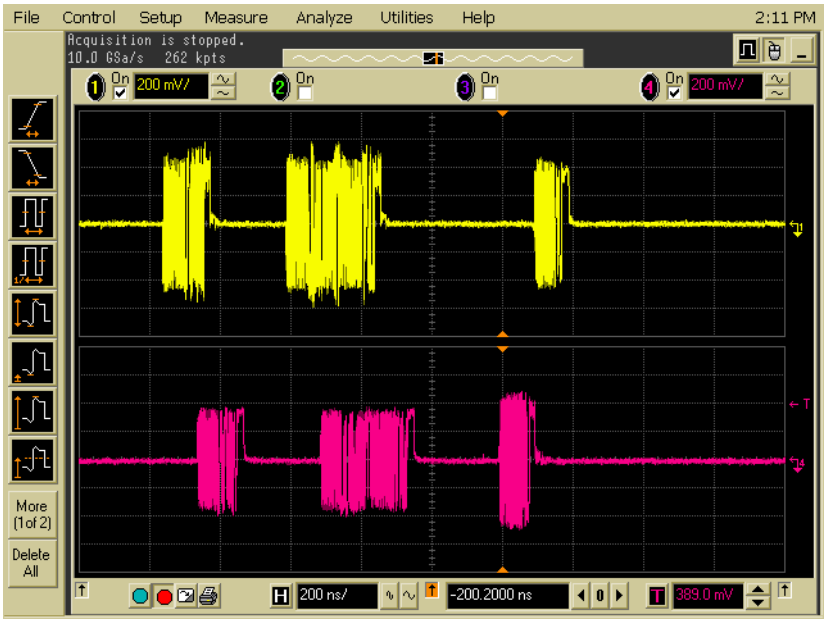
Test Instructions, Part 2

The USB automated test application will prompt you to perform these steps:

1 On the Hub Test menu of the HS Electrical Test Tool, select **SINGLE STEP SET FEATURE** from the Downstream Device Control drop down menu and click **[EXECUTE]** once.



2 The captured transition should be as in the figure below.



3 Check **I have completed these instructions**.

EL_42 EL_43 Measure Truncated Bits from Repeated SYNC Field

EL_44 EL_45 Measure Repeated EOP Width

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

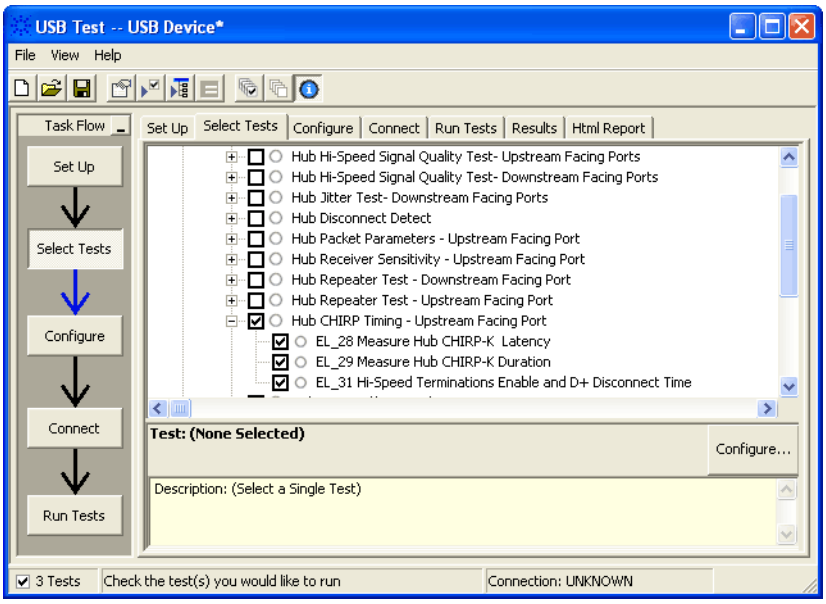
Hub CHIRP Timing - Upstream Facing Port

Equipment Used

Table 21 Equipment Used in Hub CHIRP Timing - Upstream Facing Port

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
2	Passive or active probes	Agilent E2697A with 10073C, or 1156A
1	Host test bed computer	Any computer with hi-speed USB ports
1	Device Hi-Speed Signal Quality test fixture	Agilent E2645-66507
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests



Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1 Connect the E2697A with 10073C passive probe or the 1156A active probe on Channel 2 to the D- pin at TP2 of the E2645-66507 Device Hi-Speed Signal Quality test fixture.

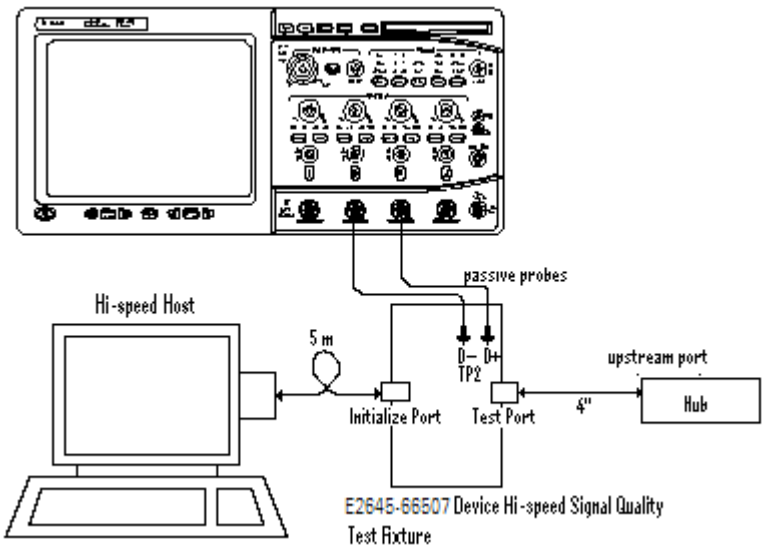
2 Connect the E2697A with 10073C passive probe or the 1156A active probe on Channel 3 to the D+ pin at TP2.

3 Connect both probe grounds to GND leads.

4 Connect the [INIT PORT] of the test fixture into the host controller port, using the 5-meter USB cable.

5 Connect the [TEST PORT] on the fixture to the upstream port of the hub.

6 Apply power to the hub. Do not apply 5V to the test fixture.



7 Check **I have completed these instructions**.

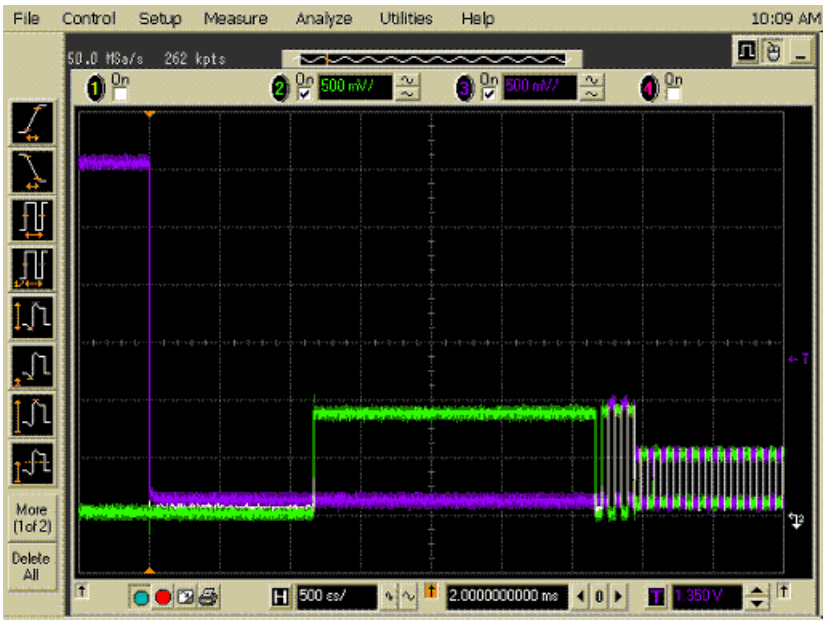
Running the Tests

1 Click **Run Tests**.

Test Instructions

The USB automated test application will prompt you to perform these steps:

1 On the HS Electrical Test Tool software, click **[Enumerate Bus]** once. You should capture the CHIRP handshake as in the below figure.



2 Click **OK** to close the Test Instructions dialog.

EL_28 Measure Hub CHIRP-K Latency

EL_29 Measure Hub CHIRP-K Duration

EL_31 Hi-Speed Terminations Enable and D+ Disconnect Time

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

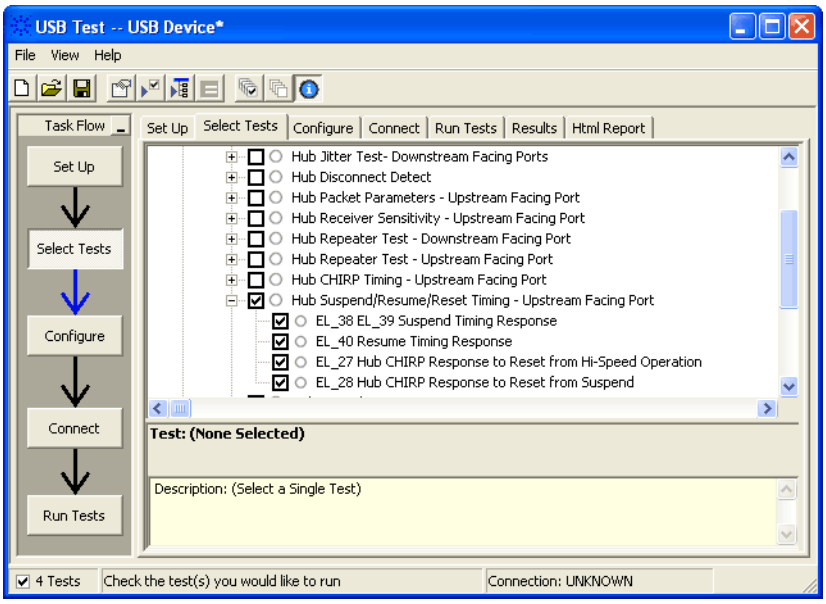
Hub Suspend/Resume/Reset Timing - Upstream Facing Port

Equipment Used

Table 22 Equipment Used in Hub Suspend/Resume/Reset - Upstream Facing Port

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
2	Passive or active probes	Agilent E2697A with 10073C, or 1156A
1	Host test bed computer	Any computer with hi-speed USB ports
1	Device Hi-Speed Signal Quality test fixture	Agilent E2645-66507
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests

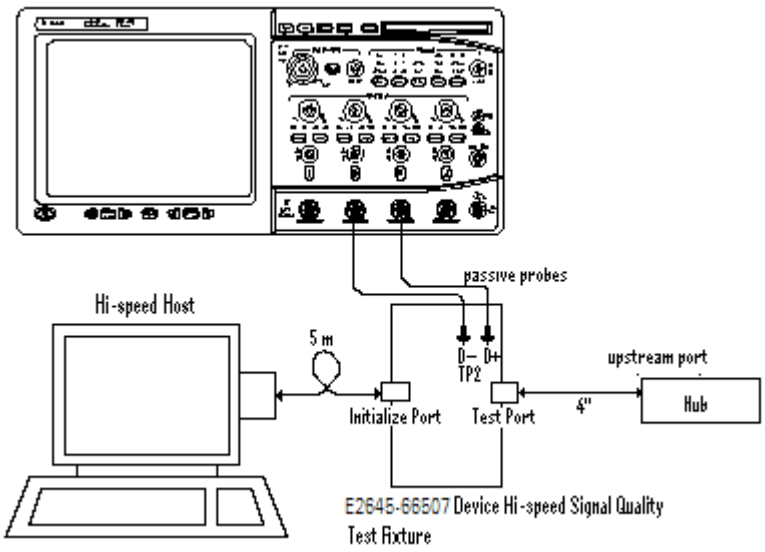


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. Connect the E2697A with 10073C passive probe or the 1156A active probe on Channel 2 to the D- pin at TP2 of the E2645-66507 Device Hi-Speed Signal Quality test fixture.
2. Connect the E2697A with 10073C passive probe or the 1156A active probe on Channel 3 to the D+ pin at TP2. D+ on TP2 is the pin closest to the USB connector.
3. Connect both probe grounds to leads TP5.
4. Connect the [INIT PORT] of the test fixture into the host controller port, using the 5-meter USB cable.
5. Connect the [TEST PORT] on the fixture to the upstream port of the hub.
6. Apply power to the hub. Do not apply 5V to the test fixture.



7. Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

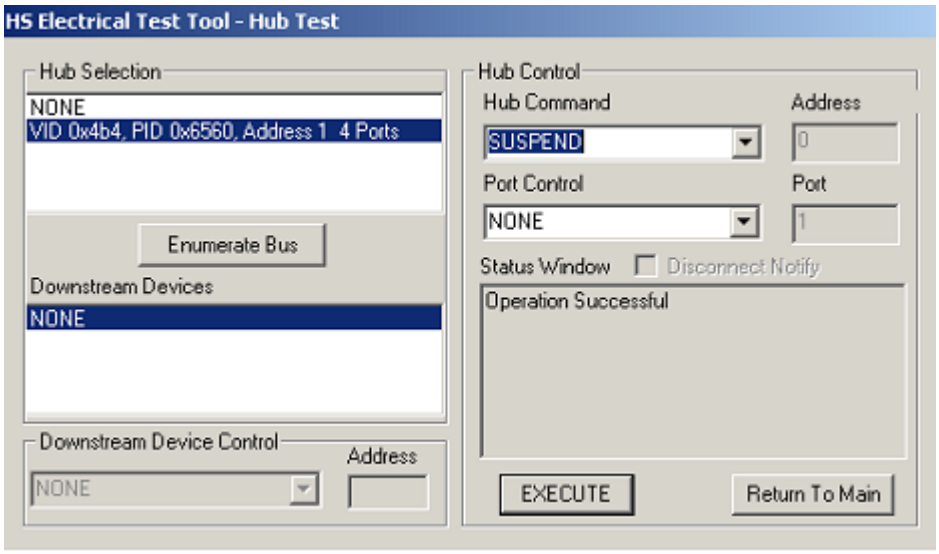
Test Instructions

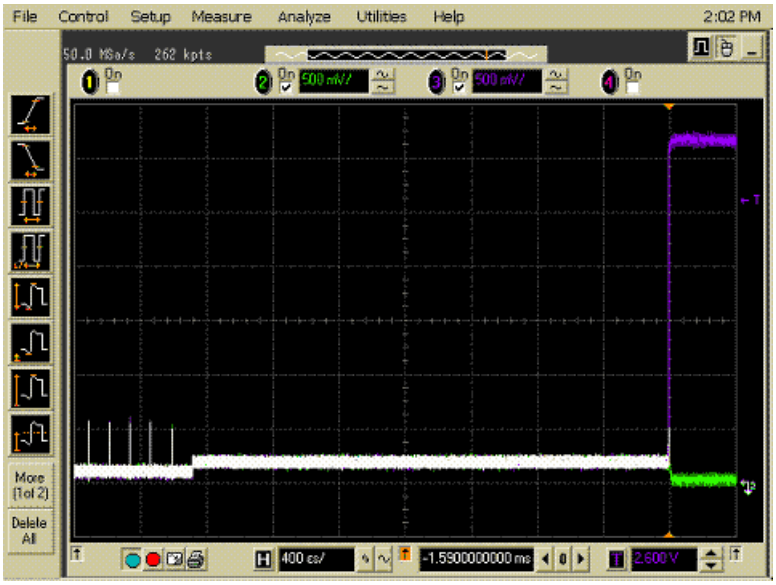
EL_38 EL_39 Suspend Timing Response

The USB automated test application will prompt you to perform these steps:

1 On the Hub Test menu of the HS Electrical Test Tool software, click **[Enumerate Bus]** once.

2 Select **SUSPEND** from the Hub Command drop down menu. Click **[EXECUTE]** once to place the device into suspend. The captured transition should be as in the figure below.



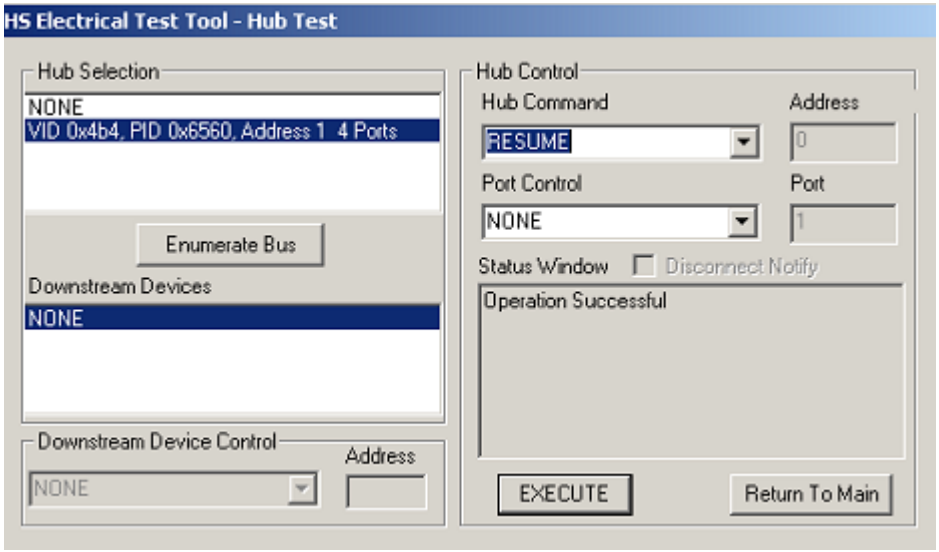


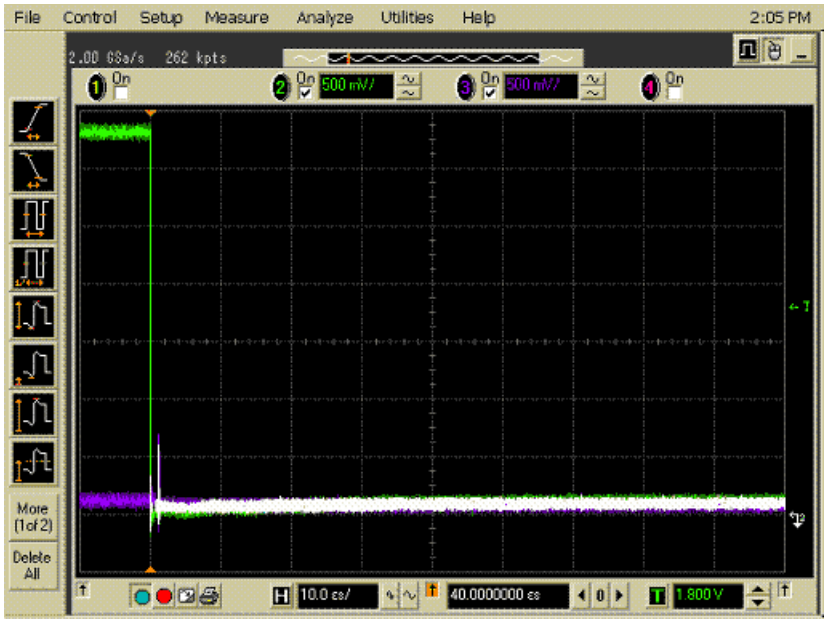
3 Click **OK** to close the Test Instructions dialog.

EL_40 Resume Timing Response

The USB automated test application will prompt you to perform these steps:

1 On the Hub Test menu of the HS Electrical Test Tool, select **RESUME** from the Hub Command drop down menu. Click **[EXECUTE]** once to resume the hub from suspend. The captured transition should be as in the figure below.



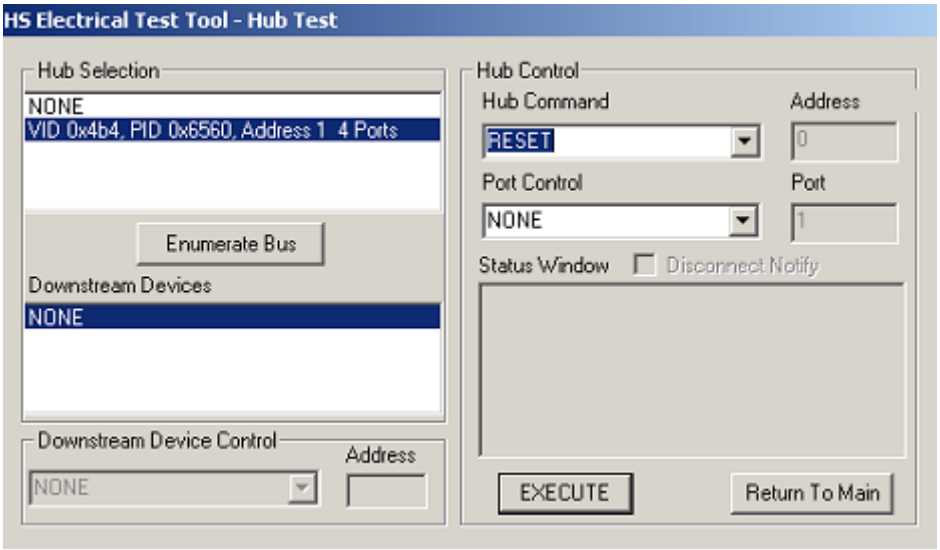


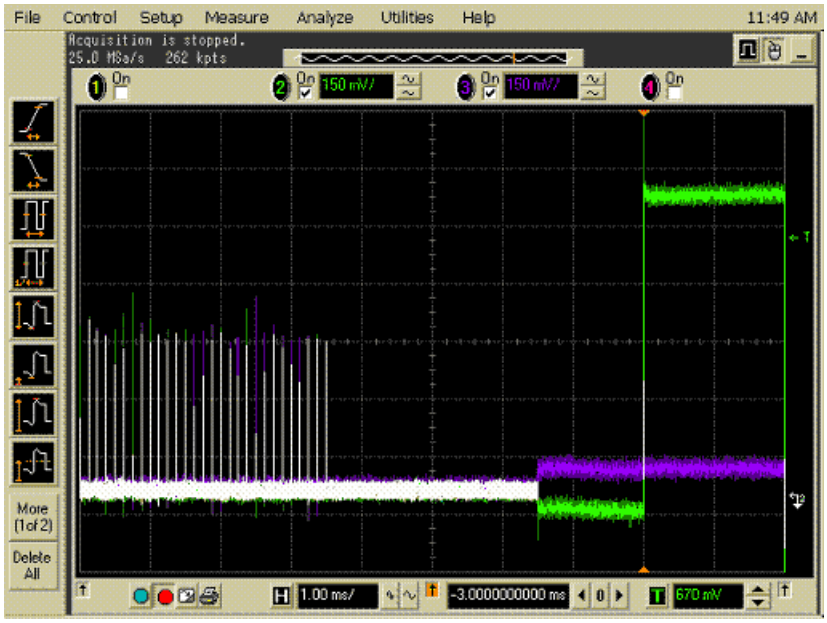
2 Click **OK** to close the Test Instructions dialog.

EL_27 Hub CHIRP Response to Reset from Hi-Speed Operation

The USB automated test application will prompt you to perform these steps:

1 On the Hub Test menu of the HS Electrical Test Tool, select **RESET** from the Hub Command drop down menu. Click **[EXECUTE]** once to reset the hub operating in high speed. The captured transition should be as in the figure below.



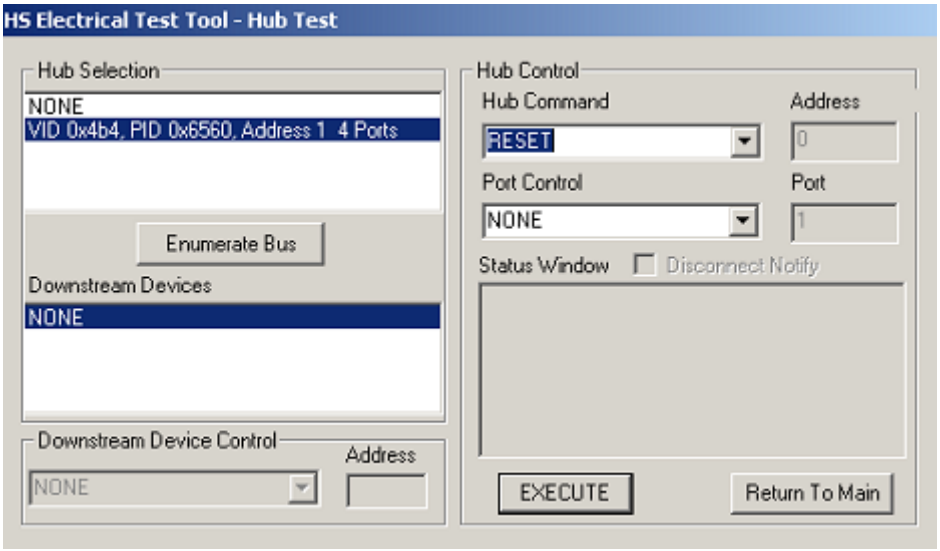


2 Click **OK** to close the Test Instructions dialog.

EL_28 Hub CHIRP Response to Reset from Suspend

The USB automated test application will prompt you to perform these steps:

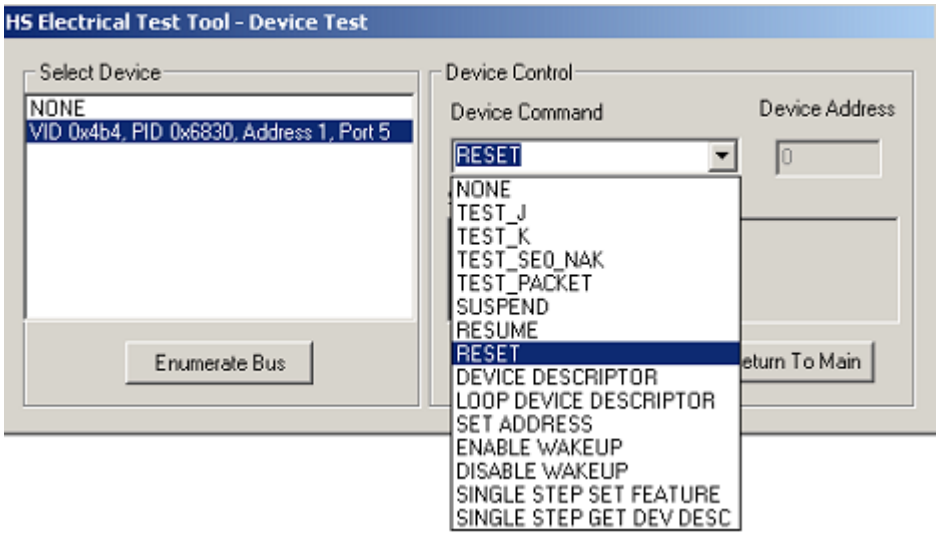
1 On the Hub Test menu of the HS Electrical Test Tool software, select **SUSPEND** from the Hub Command drop down menu. Click **[EXECUTE]** once to place the device into suspend.

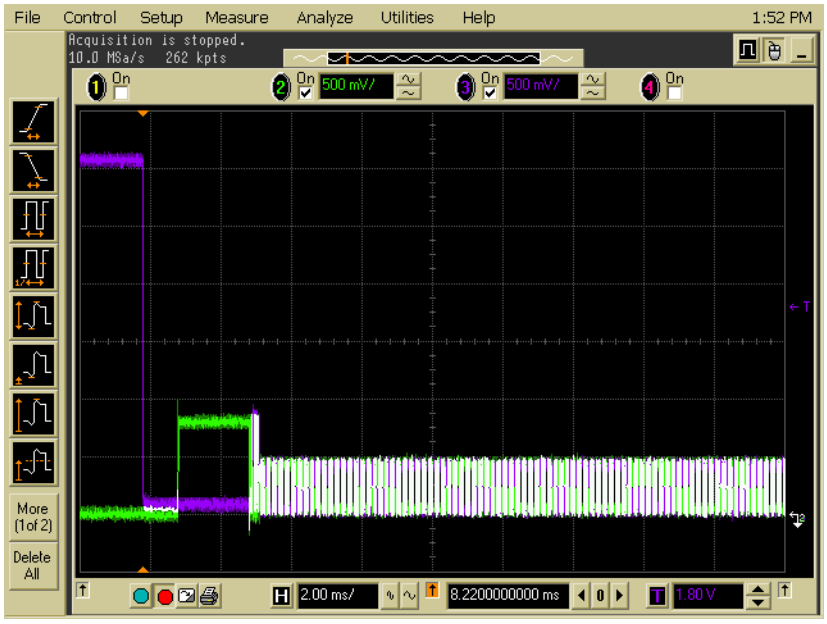


2 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you to perform these steps:

1 On the Device Test Menu of the HS Electrical Test Tool, select **RESET** from the Device Command drop down menu. Click **[EXECUTE]** once to reset the device operating in high speed. The captured transition should be as in the figure below.





2 Click **OK** to close the Test Instructions dialog.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

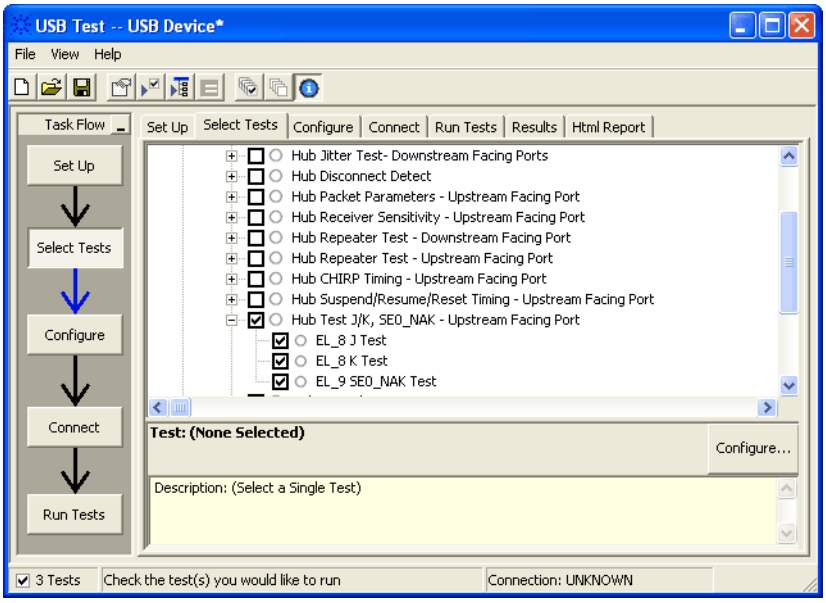
Hub Test J/K, SE0_NAK - Upstream Facing Port

Equipment Used

Table 23 Equipment Used in Hub Test J/K, SE0_NAK - Upstream Facing Port

Quantity	Item	Description/Model
1	Digital Multimeter (DMM)	Agilent 34401A or equivalent
1	Host test bed computer	Any computer with hi-speed USB ports
1	Device Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66507
1	5V power supply	Agilent 0950-2546 or equivalent
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests

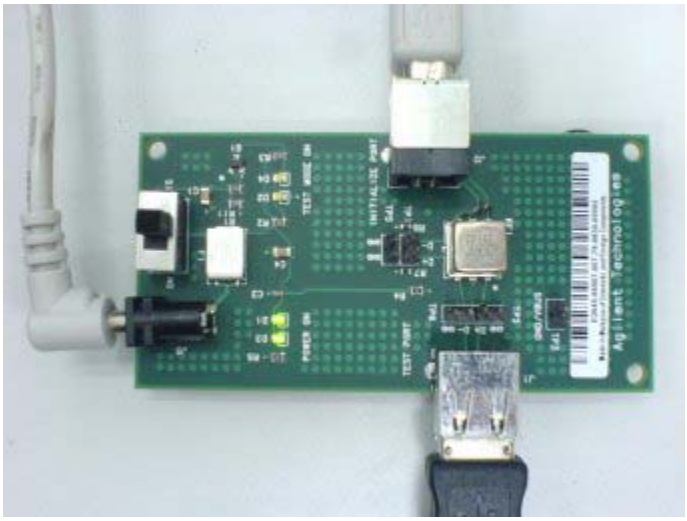


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. Attach the 5V power supply to J5 of the E2645-66507 Device High-Speed Signal Quality test fixture. Leave the TEST switch at the **OFF** position. Verify the green Power LED(D1) is lit, and the yellow Test LED(D2) is off.
2. Connect the [TEST PORT] of the test fixture into the upstream facing port of the hub under test, using the 4" USB cable.
3. Connect the [INIT PORT] of the test fixture to a port of the Test Bed Computer, using the 5 meter cable.
4. Apply power to the hub.



5. Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Test Instructions

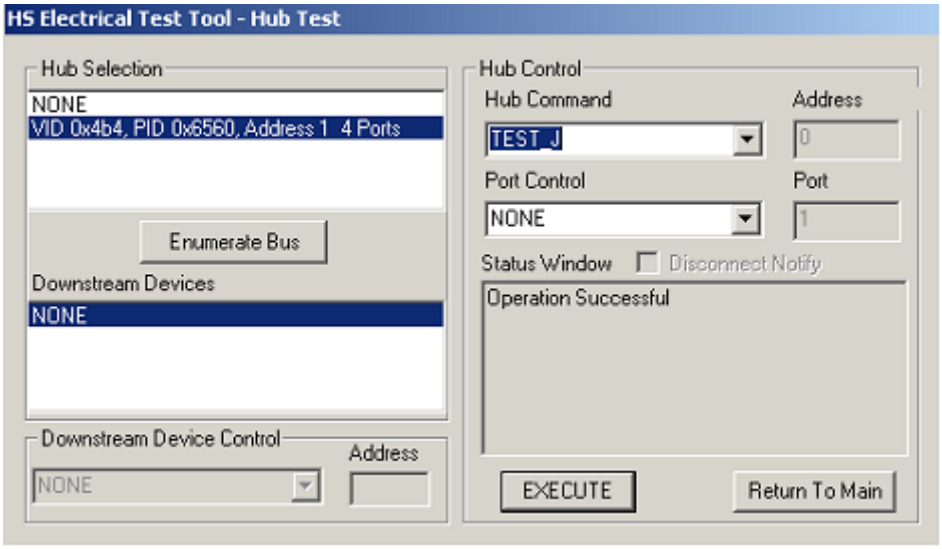
EL_8 J Test

The USB automated test application will prompt you to perform these steps:

1 On the Hub Test menu of the HS Electrical Test Tool, click **[Enumerate Bus]** once.

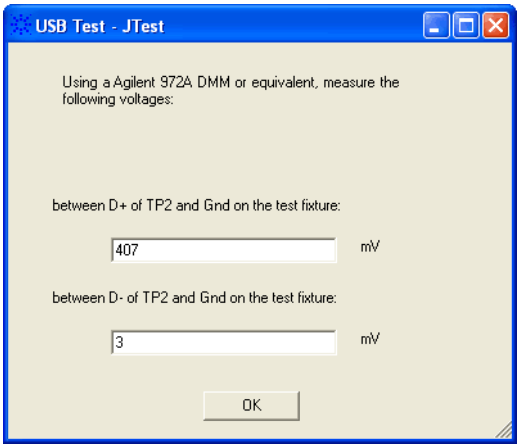
2 Select **TEST_J** from the Hub Command drop down menu. Click **[EXECUTE]** once to place the hub into TEST_J test mode.

3 Switch the test fixture into the **TEST** position.



4 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you for the following voltage measurements:



EL_8 K Test

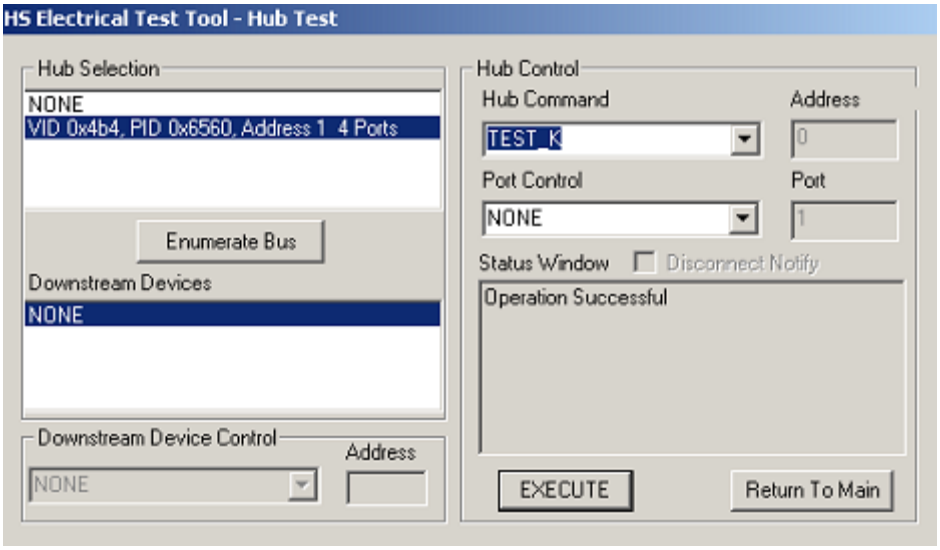
The USB automated test application will prompt you to perform these steps:

1 Return the Test switch of the test fixture to the **NORMAL** position.

2 Cycle the hub power to restore the hub to normal operation. On the Hub Test menu of the HS Electrical Test Tool, click **[Enumerate Bus]** once.

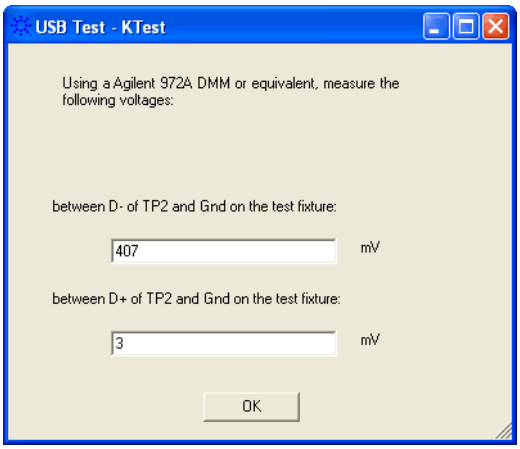
3 Select **TEST_K** from the Hub Command drop down menu. Click **[EXECUTE]** once to place the hub into TEST_K test mode.

4 Switch the test fixture into the **TEST** position.



5 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you for the following voltage measurements:



EL_9 SE0_NAK Test

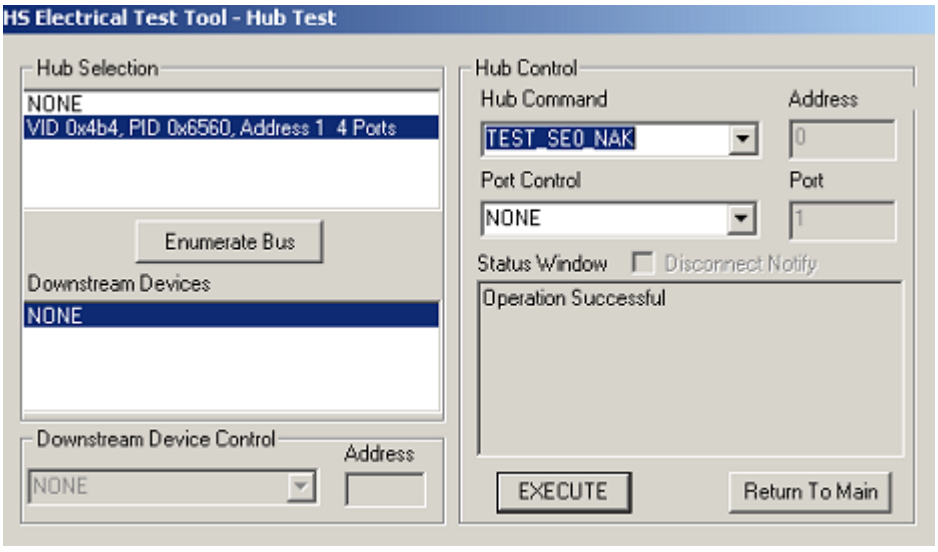
The USB automated test application will prompt you to perform these steps:

1 Return the Test switch of the test fixture to the **NORMAL** position.

2 Cycle the hub power to restore the hub to normal operation. On the Hub Test menu of the HS Electrical Test Tool, click **[Enumerate Bus]** once.

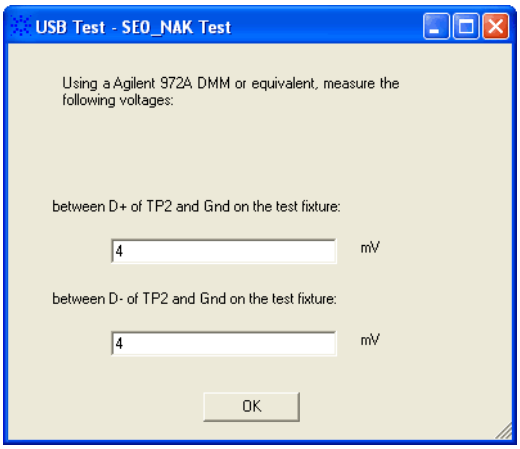
3 Select **TEST_SE0_NAK** from the Hub Command drop down menu. Click **[EXECUTE]** once to place the hub into TEST_SE0_NAK test mode.

4 Switch the test fixture into the **TEST** position.



5 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you for the following voltage measurements:



Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

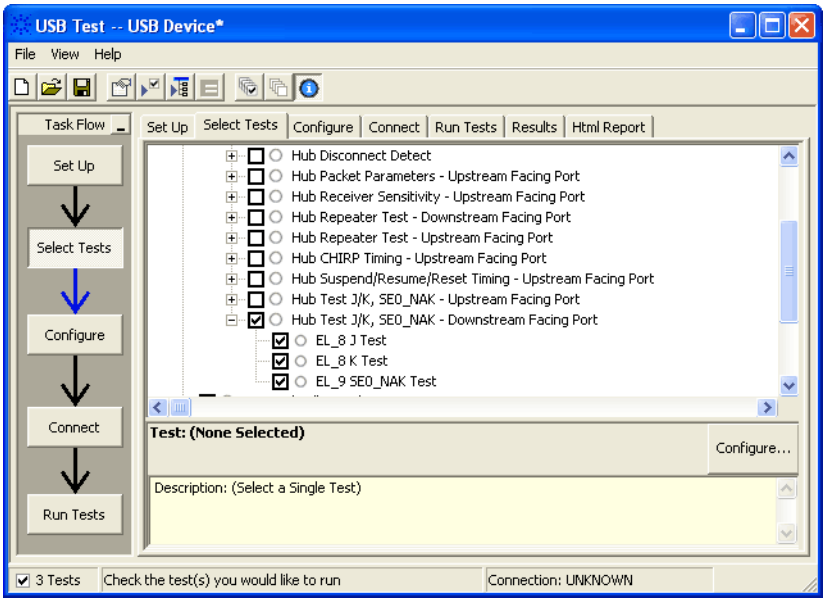
Hub Test J/K, SE0_NAK - Downstream Facing Port

Equipment Used

Table 24 Equipment Used in Hub Test J/K, SE0_NAK - Downstream Facing Port

Quantity	Item	Description/Model
1	Digital Multimeter (DMM)	Agilent 34401A or equivalent
1	Host test bed computer	Any computer with hi-speed USB ports
1	Host Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66508
1	5V power supply	Agilent 0950-2546 or equivalent
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests

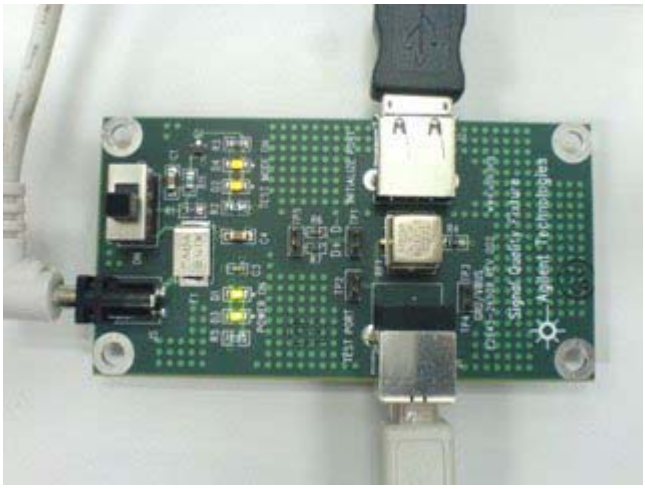


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. Attach the 5V power supply to J5 of the E2645-66508 Host High-Speed Signal Quality test fixture. Verify the green Power LED(D1) is lit. Place the TEST switch (S1) in the Test position and the yellow Test LED(D2) is lit.
2. Connect the [TEST PORT] of the test fixture into the downstream facing port of the hub under test, using the 4" USB cable.
3. Attach the hub upstream port to the host controller port, using the 5 meter cable.
4. Apply power to the hub.



5. Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

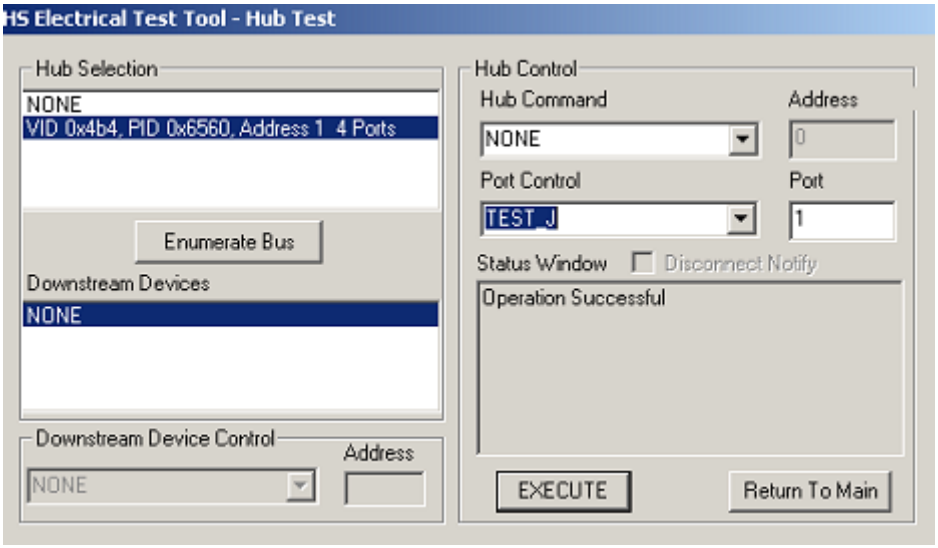
Test Instructions

EL_8 J Test

The USB automated test application will prompt you to perform these steps:

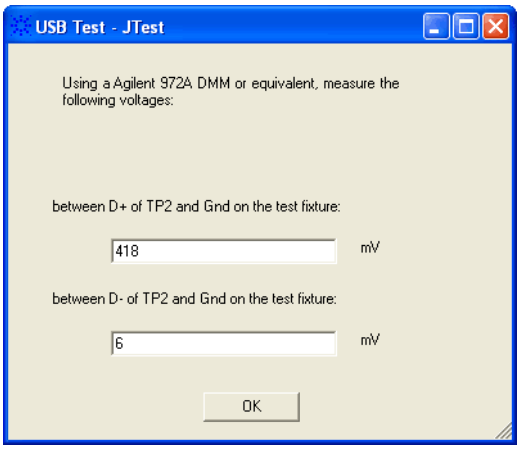
1 On the Hub Test menu of the HS Electrical Test Tool, click **[Enumerate Bus]** once.

2 Select **TEST_J** from the Port Control drop down menu. Enter port number and click **[EXECUTE]** once to place the port under test into TEST_J test mode.



3 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you for the following voltage measurements:

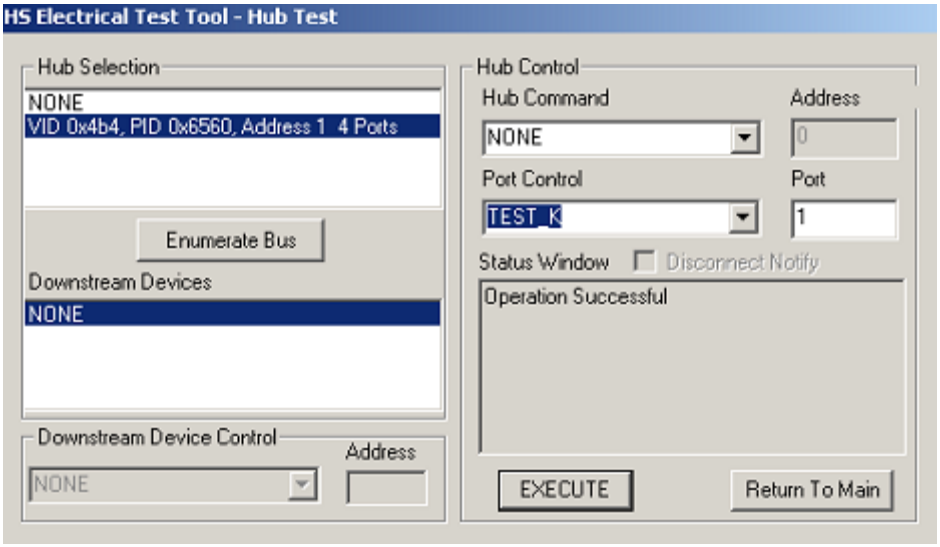


EL_8 K Test

The USB automated test application will prompt you to perform these steps:

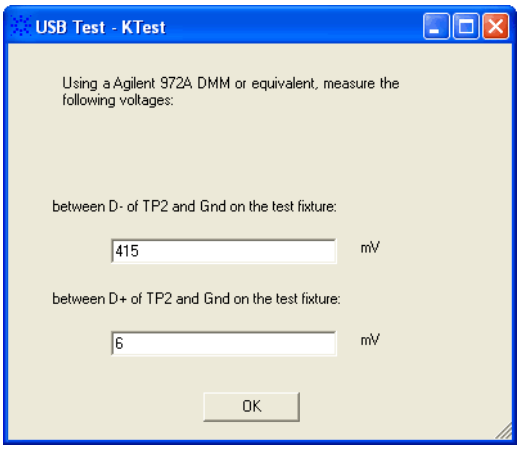
1 On the Hub Test menu of the HS Electrical Test Tool, click **[Enumerate Bus]** once.

2 Select **TEST_K** from the Port Control drop down menu. Enter port number and click **[EXECUTE]** once to place the port under test into TEST_K test mode.



3 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you for the following voltage measurements:

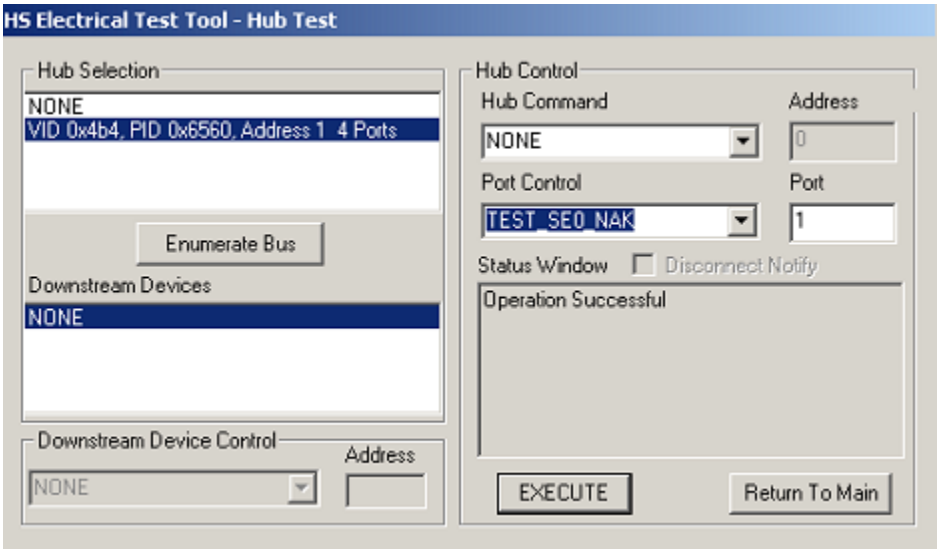


EL_9 SE0_NAK Test

The USB automated test application will prompt you to perform these steps:

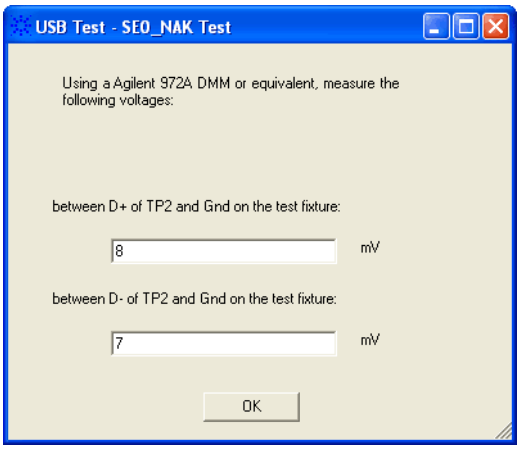
1 On the Hub Test menu of the HS Electrical Test Tool, click **[Enumerate Bus]** once.

2 Select **TEST_SE0_NAK** from the Port Control drop down menu. Enter port number and click **[EXECUTE]** once to place the port under test into TEST_SE0_NAK test mode.



3 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you for the following voltage measurements:



Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

5 Host Hi-Speed Electrical Tests

Host Hi-Speed Signal Quality 133
Host Controller Packet Parameters 137
Host Disconnect Detect 144
Host CHIRP Timing 148
Host Suspend/Resume Timing 152
Host Test J/K, SE0_NAK 157

NOTE

To give the automated test software more flexibility in making corner case measurements (and improve test performance), the oscilloscope's memory upgrade option is recommended (Option 001 when ordered with the oscilloscope, or after purchase: E2680A for the 5485xA Series oscilloscopes, or N5404A for the 80000 and 90000A Series oscilloscopes).

Also, to reduce the bandwidth of the oscilloscope to just what is required by the USB-IF (2 GHz for USB 2.0)—this can greatly reduce system measurement noise, allowing the maximum measurement margin—the enhanced bandwidth software option is recommended for the Agilent 54855A oscilloscope (Option 008), and the noise reduction software option is recommended for the 80000 and 90000A Series oscilloscopes (Option 005 when ordered with the oscilloscope or N5403A after purchase).

In addition to the hi-speed electrical tests prescribed in this chapter, the host controller under test must also pass the following electrical compliance tests applicable to the EHCI Host Controller:

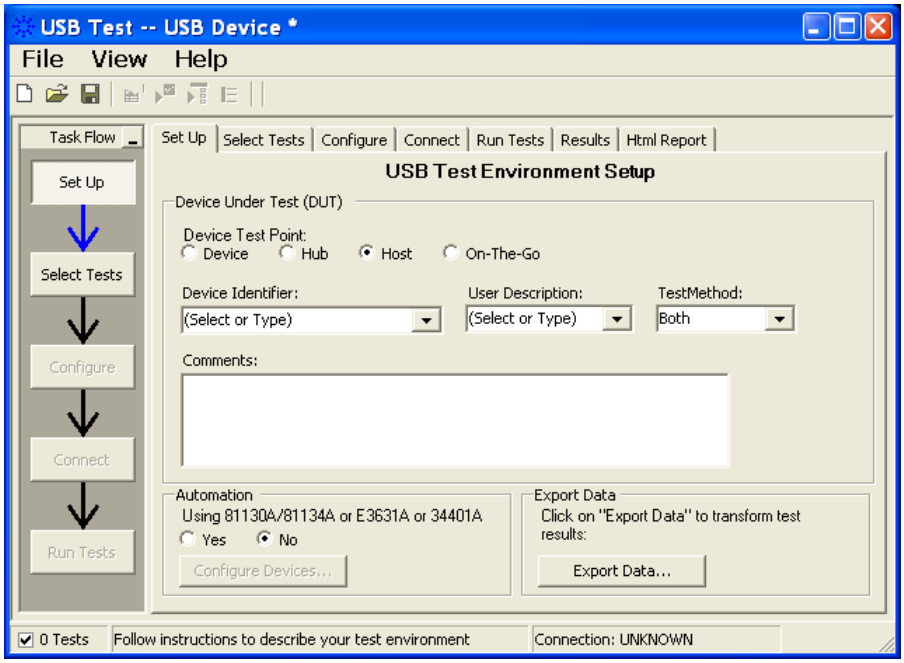
- Full speed signal quality.
- Low speed signal quality.
- Drop/Droop.

Before Running These Tests

If you haven't already performed the initial equipment set up, see "Setting Up the Equipment" on page 19.

Selecting the Host Test Environment Setup

1 In the USB automated test application, select the **Host** test environment.



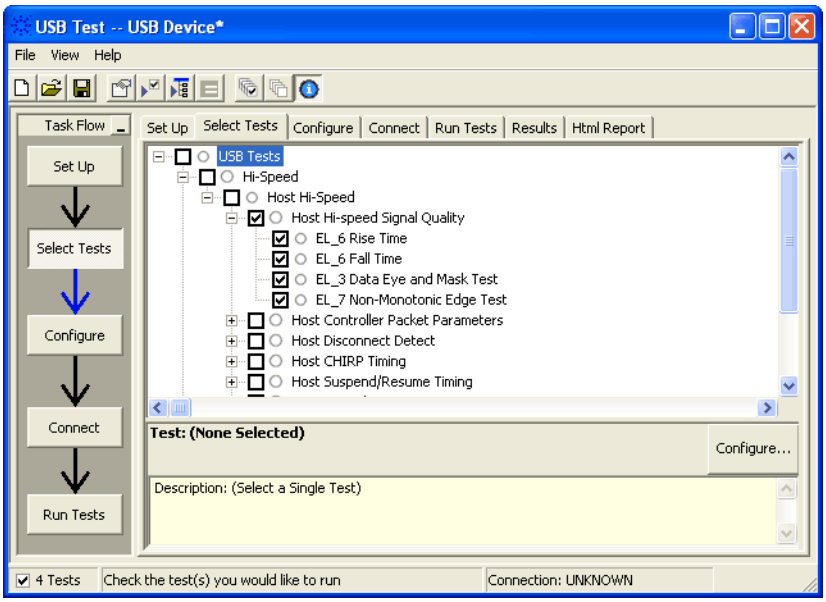
Host Hi-Speed Signal Quality

Equipment Used

Table 25 Equipment Used in Host Hi-Speed Signal Quality Tests

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
1	Differential probe	Agilent 113xA with E2699A or E2678A
1	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Host Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66508
1	5V power supply	Agilent 0950-2546 or equivalent

Selecting the Tests



Configuring the Tests

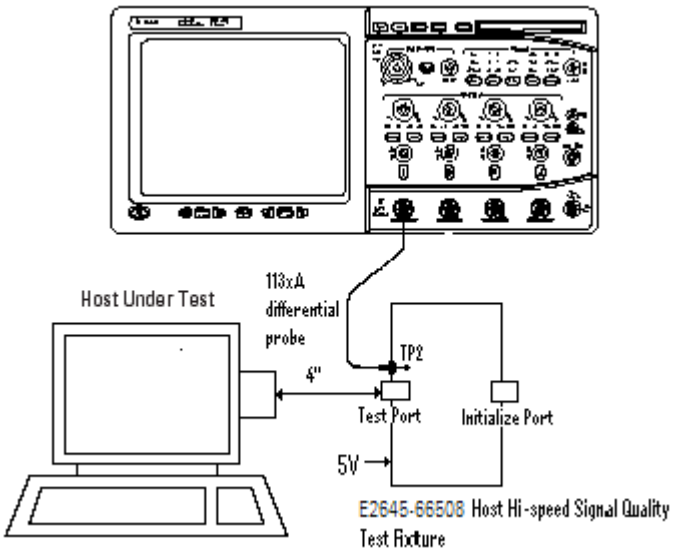
Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1 Attach the 5V power supply to J5 of the E2645-66508 Host Hi-Speed Signal Quality test fixture and verify the green Power LED (D1) is lit.

   a Set the Test switch (S1) of the test fixture to **TEST** and verify the yellow TEST LED is lit.

2 Attach the Agilent 113xA differential probe to TP2 of the test fixture, using the damped header adapter. Ensure the + polarity on the probe lines up with D+, which is the pin nearest the USB connector.



3 Check **I have completed these instructions**.

Running the Tests

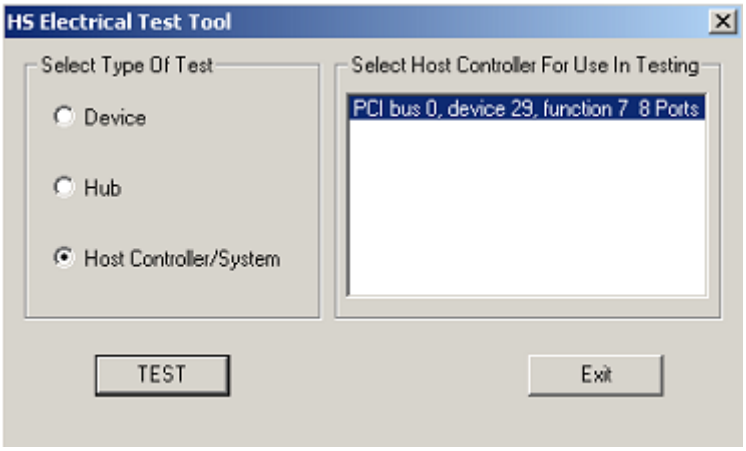
1 Click **Run Tests**.

Test Instructions, Part 1

The USB automated test application will prompt you to perform these steps:

1 Invoke the HS Electrical Test Tool software on the Hi-Speed Electrical Test Bed computer.

2 Select **Host Controller/System** and click the **[TEST]** button to enter the Host Test menu.



3 Click **OK** to close the Test Instructions dialog.

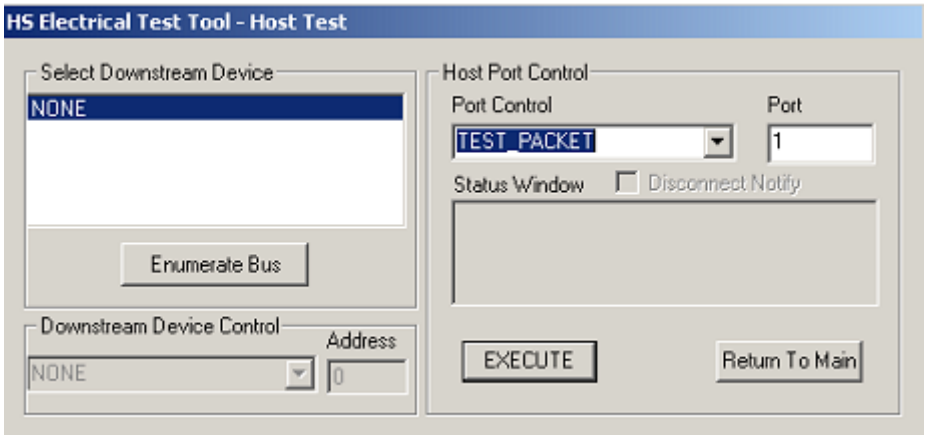
Test Instructions, Part 2

The USB automated test application will prompt you to perform these steps:

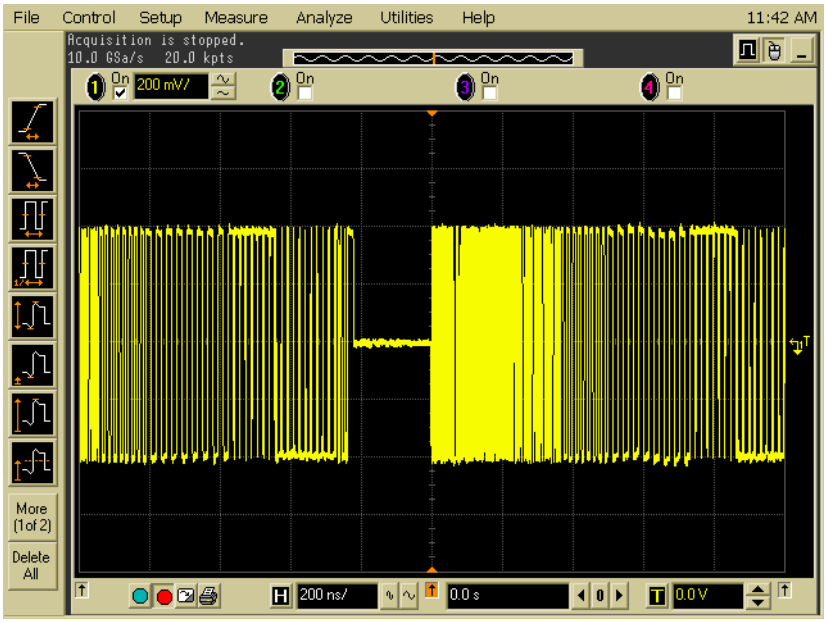
1 Connect the [TEST PORT] of the E2645-66508 Host Hi-Speed Signal Quality test fixture into the port under test of the host controller, using the 4" USB cable. The host controller here refers to the Hi-speed Electrical Test Bed Computer that has the HS Electrical Test Tool on it.

2 Select **TEST_PACKET** from the Port Control drop down menu.

3 Enter the port number of the port under test and click **[EXECUTE]**. This forces the port under test to continuously transmit test packets.



You should see the transmitted test packet on the oscilloscope as below.



4 Click **OK** to close the Test Instructions dialog.

EL_6 Rise Time

EL_6 Fall Time

EL_3 Data Eye and Mask Test

After viewing the test results, click **OK** to close the Test Instructions dialog.

EL_7 Non-Monotonic Edge Test

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

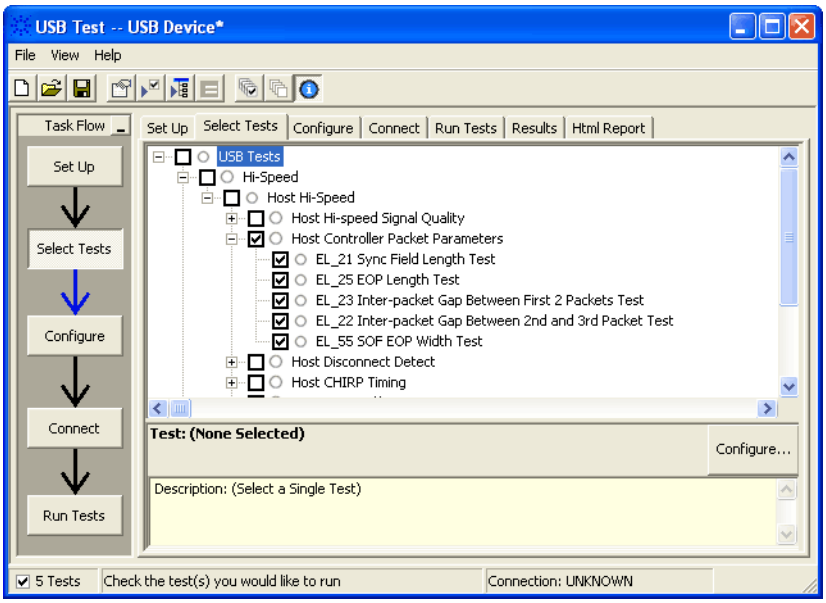
Host Controller Packet Parameters

Equipment Used

Table 26 Equipment Used in Host Controller Packet Parameters Tests

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
1	Differential probe	Agilent 113xA with E2699A or E2678A
1	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Device Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66507
1	Hi-Speed USB hub	Any listed on USB-IF web site
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests



Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

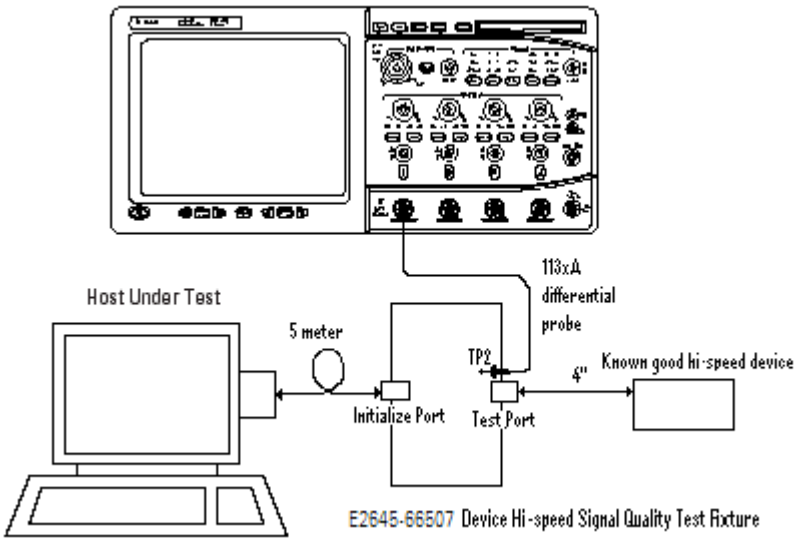
1 Connect the E2645-66507 Device Hi-Speed Signal Quality test fixture ([TEST PORT]) into B receptable of a known good hi-speed hub, using the 4" USB cable.

   a Apply power to the known good hub. Do not apply 5V to the test fixture.

2 Attach the Agilent 113xA differential probe to D+/D- of TP2 on the test fixture, using a damped header adapter.

NOTE Ensure the + polarity on the probe lines up with D+.

3 Connect the test fixture ([INIT PORT]) into the host controller under test, using the 5 meter USB cable.



4 Check **I have completed these instructions**.

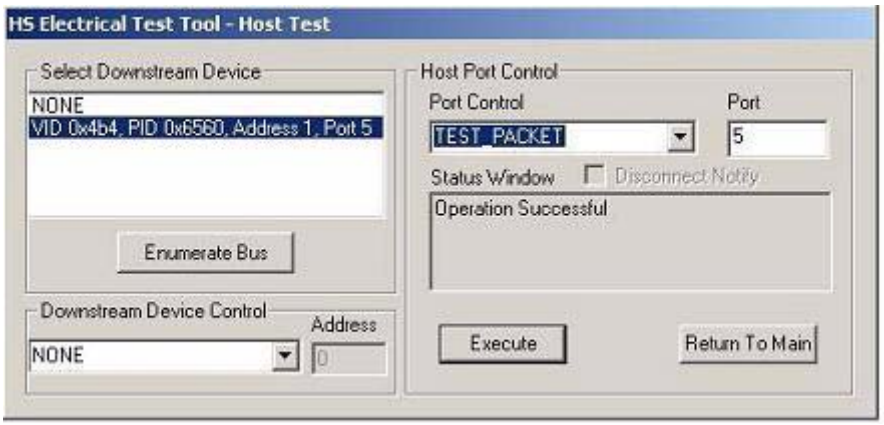
Running the Tests

1 Click **Run Tests**.

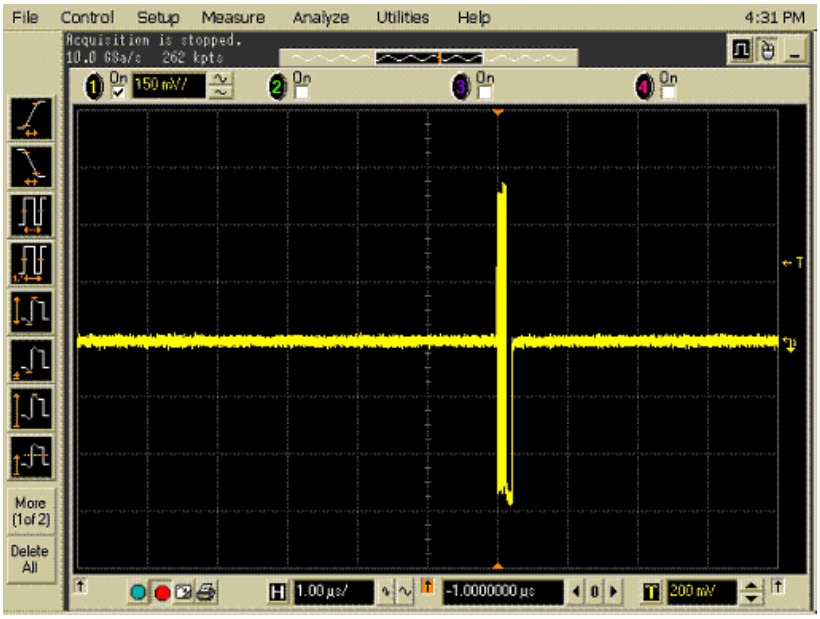
Test Instructions, Part 1

The USB automated test application will prompt you to perform these steps:

1 Click **[Enumerate Bus]** and verify that the device enumerates properly.



2 Using the oscillopscope, verify SOFs (Start of Frame packets) are being transmitted by the port under test. You may need to lower the trigger level to somewhat below 400 mV to obtain a trigger.



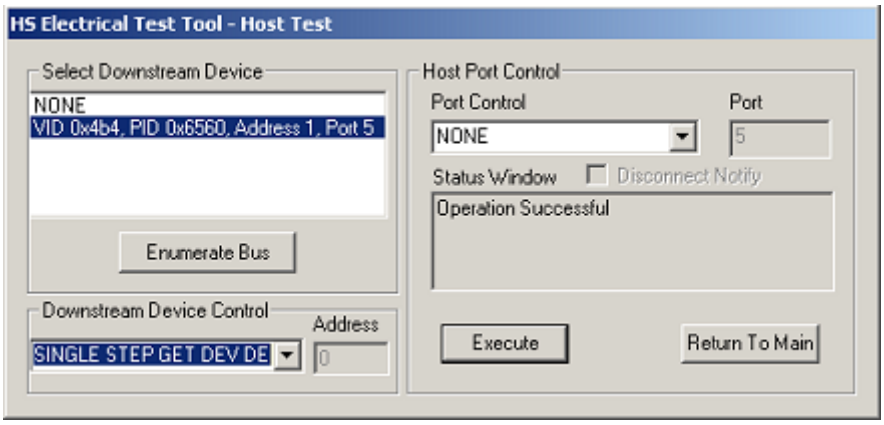
3 Click **OK** to close the Test Instructions dialog.

Test Instructions, Part 2

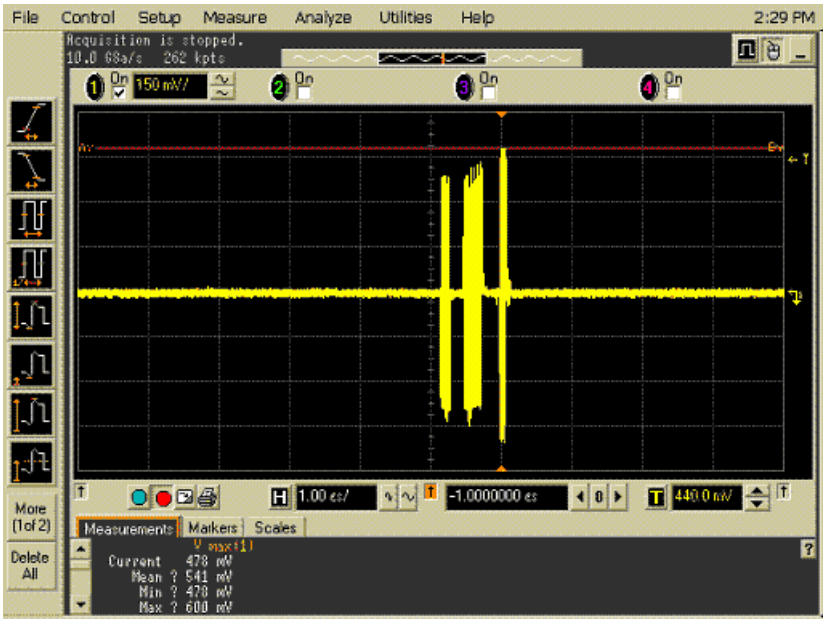
The USB automated test application will prompt you to perform these steps:

1 In the Host Test menu of the HS Electrical Test Tool software, ensure that the device is selected.

2 Select **SINGLE STEP GET DEV DESC** from the Downstream Device Control menu and click **[EXECUTE]**.



You should see the transmitted test packet on the oscilloscope as below.



3 Click **OK** to close the Test Instructions dialog.

EL_21 Sync Field Length Test

EL_25 EOP Length Test

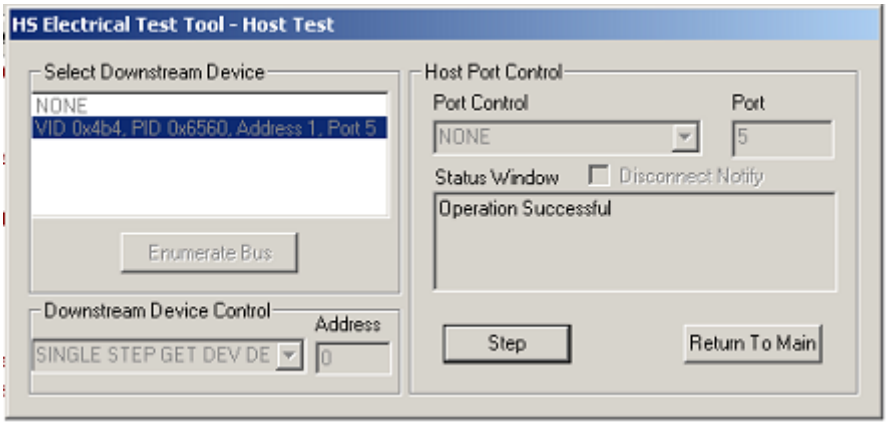
EL_23 Inter-packet Gap Between First 2 Packets Test

EL_22 Inter-packet Gap Between 2nd and 3rd Packet Test

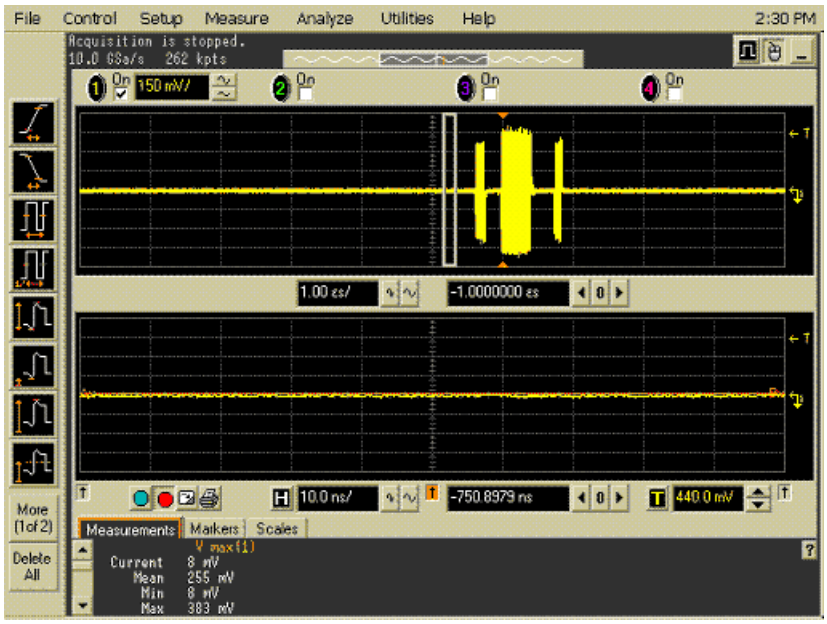
Test Instructions, Part 3

The USB automated test application will prompt you to perform these steps:

1 In the Host Test menu of the HS Electrical Test Tool software, click **[STEP]** once again.



You should see the transmitted test packet on the oscilloscope as below.



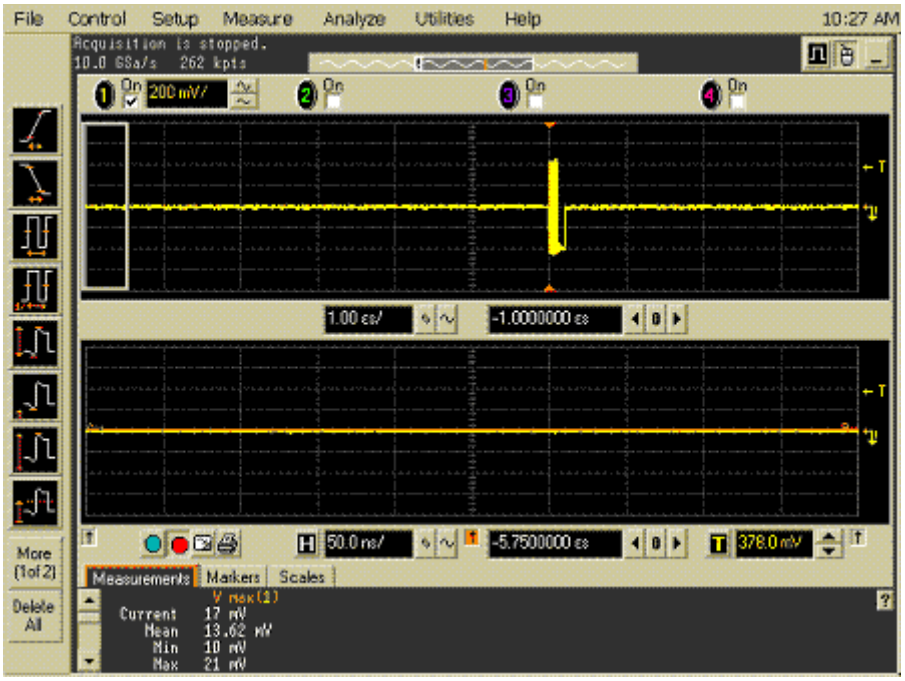
2 Click **OK** to close the Test Instructions dialog.

EL_55 SOF EOP Width Test

Test Instructions

The USB automated test application will prompt you to perform these steps:

1 Using the oscillopscope, verify SOFs(Start of Frame packets) are being transmitted by the port under test. You may need to lower the trigger level to somewhat below 400mV to obtain a trigger.



2 Click **OK** to close the Test Instructions dialog.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

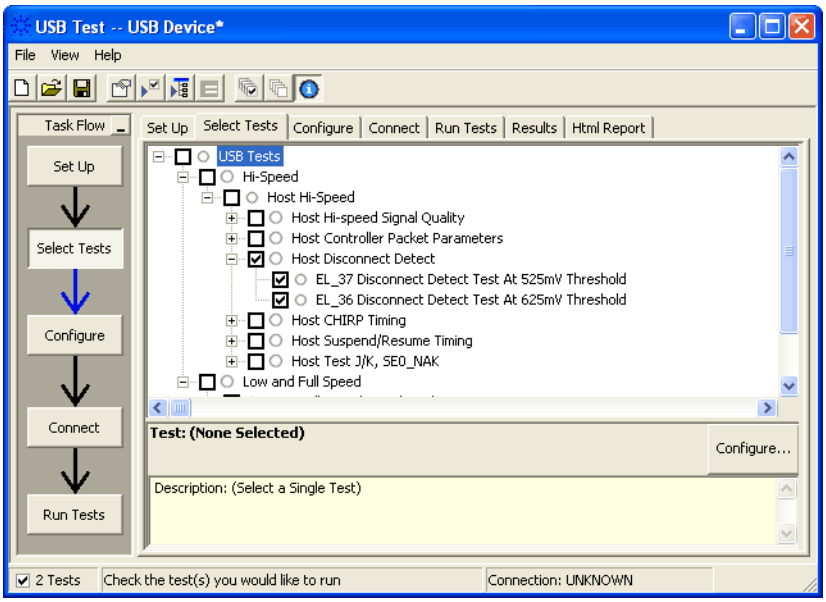
Host Disconnect Detect

Equipment Used

Table 27 Equipment Used in Host Disconnect Detect Tests

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
1	Differential probe	Agilent 113xA with E2699A or E2678A
1	Header adapter	Agilent 01131-68703
1	Host test bed computer	Any computer with hi-speed USB ports
1	Host Disconnect test fixture and 4" USB cable	Agilent E2645-66506
1	5V power supply	Agilent 0950-2546 or equivalent

Selecting the Tests



Configuring the Tests

Connecting the Equipment

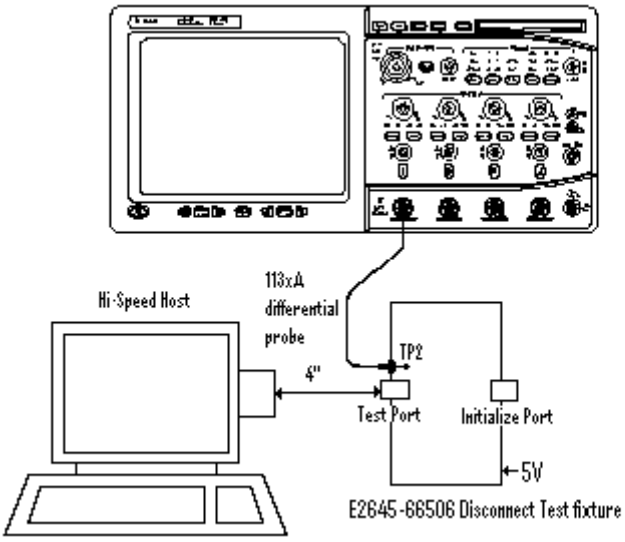
The USB automated test application will prompt you to perform these connection steps:

1 Attach the 5V power supply to E2645-66506 Disconnect test fixture (J5).

2 Attach the Agilent 113xA differential probe to TP2 of the test fixture, using a damped header adapter. Ensure the + polarity on the probe lines up with D+, which is the pin nearest the USB connector.

3 Set the TEST switch to the Test position. This sets the test fixture to emulate a must-not-disconnect threshold.

   a Verify both the green Power LED (D1) and yellow Test LED (D2) are lit.



4 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Test Instructions

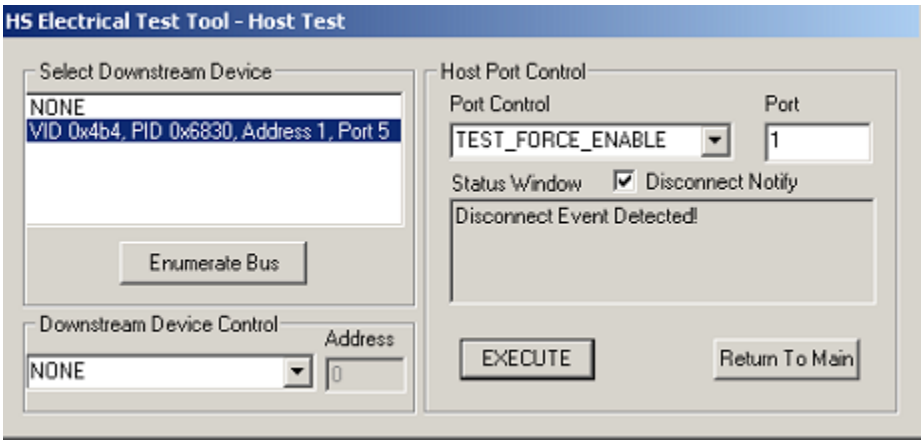
The USB automated test application will prompt you to perform these steps:

1 Attach the [TEST PORT] of the test fixture to the port under test, using the 4" USB cable.

2 In the Host Test Menu of the HS Electrical Test Tool, select **TEST_FORCE_ENABLE** from the Port Control drop down menu.

3 Enter the port number and click **[EXECUTE]** once and ensure operation is successful in the Status Window.

4 Click the **Disconnect Notify** check box to monitor the disconnect status in the Status Window.



5 Click **OK** to close the Test Instructions dialog.

EL_37 Disconnect Detect Test At 525mV Threshold

The USB automated test application will prompt you to answer the question “Does the Status Window display Disconnect Event Detected?”

EL_36 Disconnect Detect Test At 625mV Threshold

The USB automated test application will prompt you to: Set the Test switch of the E2645-66506 Disconnect test fixture to the Normal position and verify the yellow TEST LED (D2) is not lit.

The USB automated test application will prompt you to answer the question “Does the Status Window now display Disconnect Event Detected?”

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

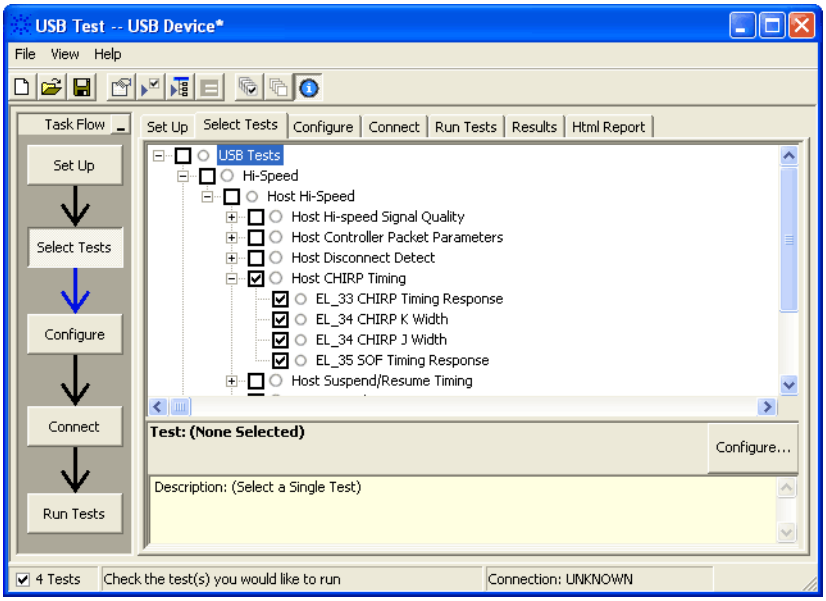
Host CHIRP Timing

Equipment Used

Table 28 Equipment Used in Host CHIRP Timing Tests

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
2	Passive or active probes	Agilent E2697A with 10073C, or 1156A
1	Host test bed computer	Any computer with hi-speed USB ports
1	Host Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66508
1	Hi-Speed USB device	Any listed on USB-IF web site
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests

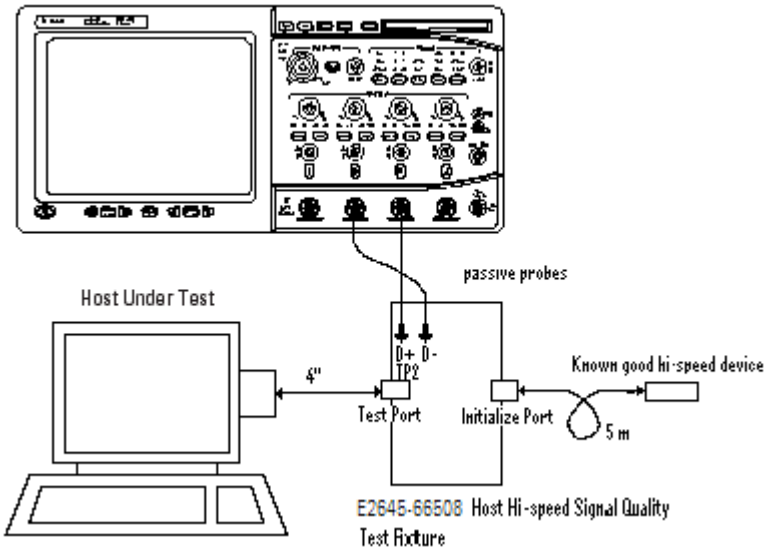


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. Replace the E2645-66506 Disconnect test fixture with the E2645-66508 Host Hi-Speed Signal Quality test fixture. Do not apply 5V to the test fixture.
2. Connect the E2697A with 10073C passive probe or the 1156A active probe on Channel 2 to the D- pin at TP2 of the E2645-66508 Host Hi-Speed Signal Quality test fixture.
3. Connect the E2697A with 10073C passive probe or the 1156A active probe on Channel 3 to the D+ pin at TP2. D+ on TP2 is the pin closest to the USB connector.
4. Connect both probe grounds to leads TP5.
5. Connect a known good Hi-Speed device into the [INIT PORT] of the test fixture, using the 5-meter USB cable.
6. Connect the [TEST PORT] on the fixture to the port under test, using the 4" USB cable.
7. Apply power to the known good Hi-Speed device.



8. Check **I have completed these instructions**.

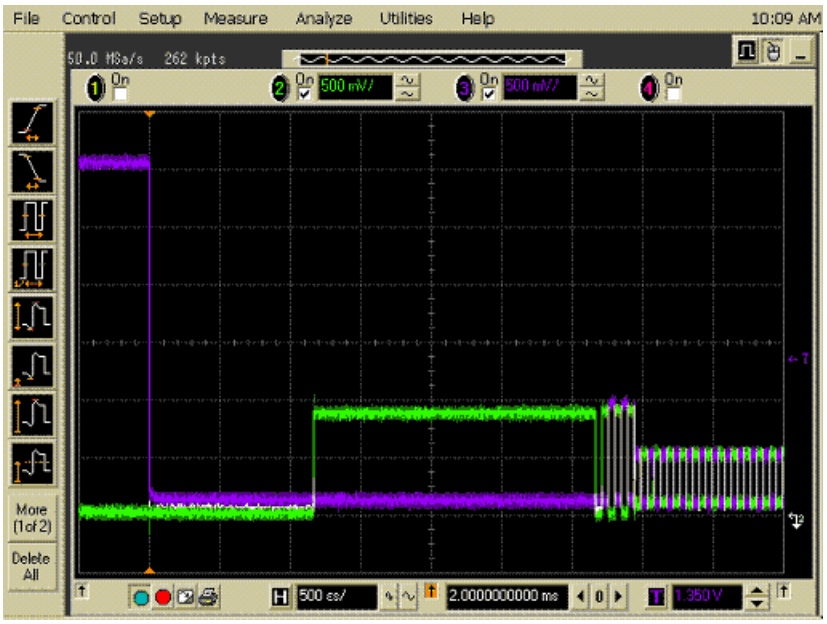
Running the Tests

1 Click **Run Tests**.

Test Instructions

The USB automated test application will prompt you to perform these steps:

1 On the HS Electrical Test Tool software, click **[Enumerate Bus]** once. You should capture the CHIRP handshake as in the below figure.



2 Click **OK** to close the Test Instructions dialog.

EL_33 CHIRP Timing Response

EL_34 CHIRP K Width

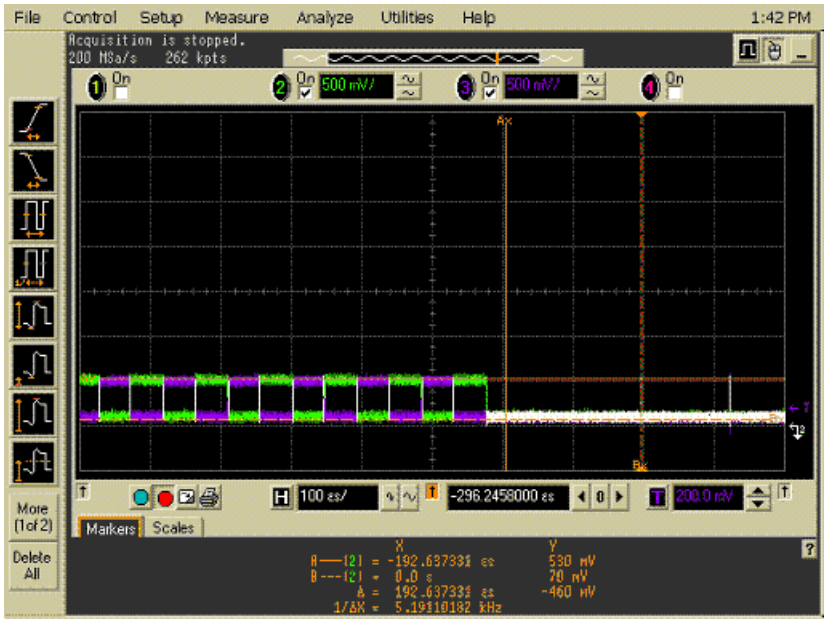
EL_34 CHIRP J Width

EL_35 SOF Timing Response

The USB automated test application will prompt you to: Unplug the known good device and reattach it.

The USB automated test application will prompt you to perform these steps:

1 On the Host Test menu of the HS Electrical Test Tool software, click **[Enumerate Bus]** once. The oscilloscope should capture as in the below figure.



2 Click **OK** to close the Test Instructions dialog.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

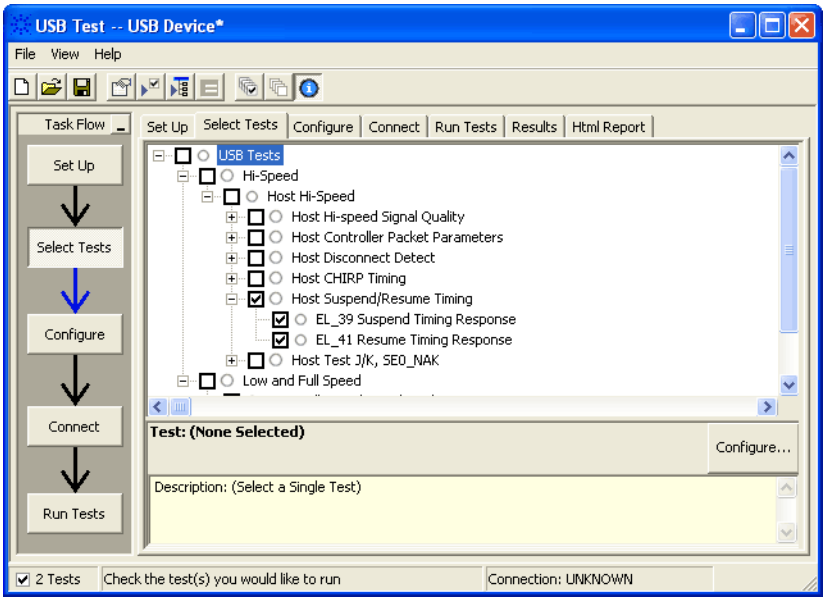
Host Suspend/Resume Timing

Equipment Used

Table 29 Equipment Used in Host Suspend/Resume Timing Tests

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series
2	Passive or active probes	Agilent E2697A with 10073C, or 1156A
1	Host test bed computer	Any computer with hi-speed USB ports
1	Host Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66508
1	Hi-Speed USB device	Any listed on USB-IF web site
1	5 meter USB 2.0 hi-speed cable	Any listed on USB-IF web site

Selecting the Tests

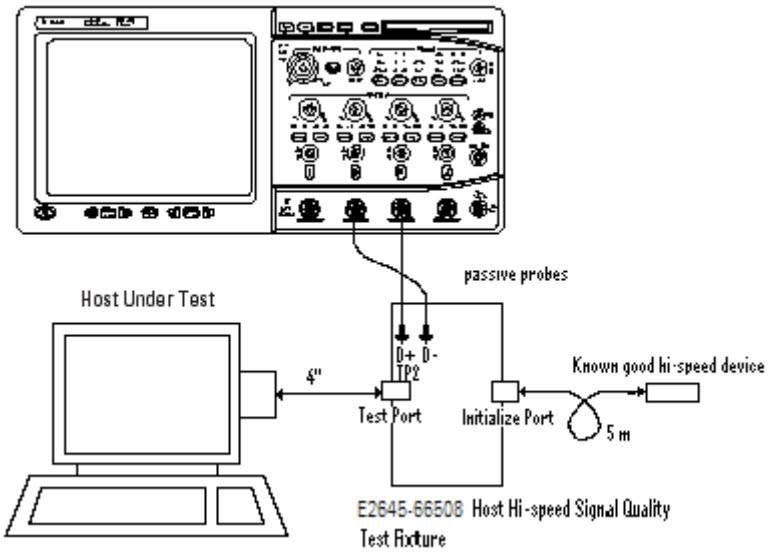


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. Replace the E2645-66506 Disconnect test fixture with the E2645-66508 Host Hi-Speed Signal Quality test fixture. Do not apply 5V to the test fixture.
2. Connect the E2697A with 10073C passive probe or the 1156A active probe on Channel 2 to the D- pin at TP2 of the E2645-66508 Host Hi-Speed Signal Quality test fixture.
3. Connect the E2697A with 10073C passive probe or the 1156A active probe on Channel 3 to the D+ pin at TP2. D+ on TP2 is the pin closest to the USB connector.
4. Connect both probe grounds to leads TP5.
5. Connect a known good Hi-Speed device into the [INIT PORT] of the test fixture, using the 5-meter USB cable.
6. Connect the [TEST PORT] on the fixture to the port under test, using the 4" USB cable.
7. Apply power to the known good Hi-Speed device.



8. Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Test Instructions

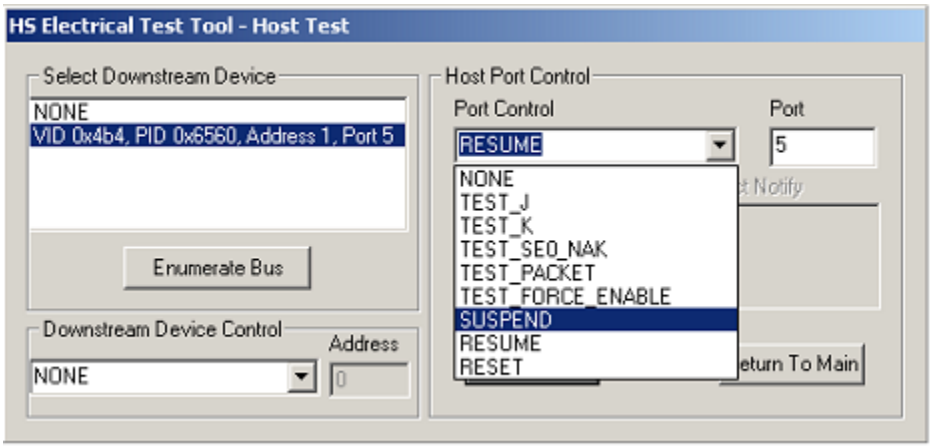
EL_39 Suspend Timing Response

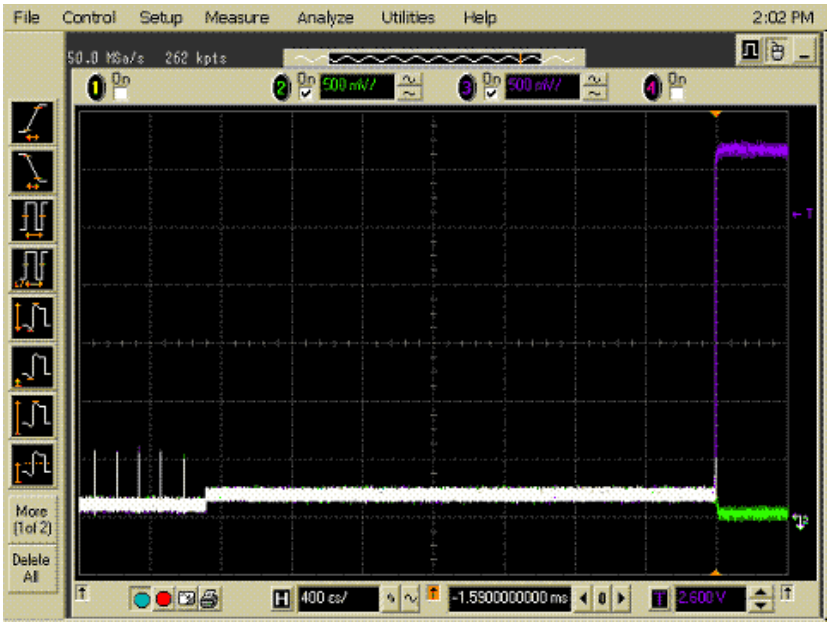
The USB automated test application will prompt you to perform these steps:

1 On the Host Test menu of the HS Electrical Test Tool software, click **[Enumerate Bus]** once.

2 Select **SUSPEND** from the Port Control drop down menu.

3 Enter the port number. Click **[EXECUTE]** once to place the port into suspend. The captured transition should be as in the figure below.





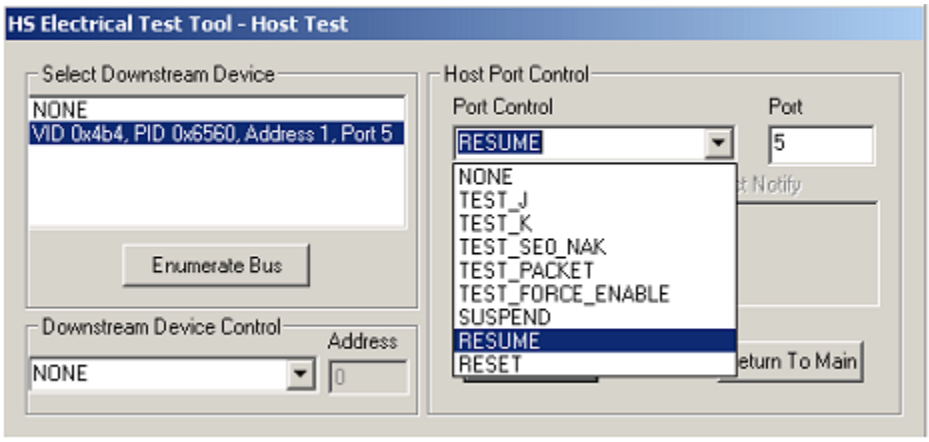
4 Click **OK** to close the Test Instructions dialog.

EL_41 Resume Timing Response

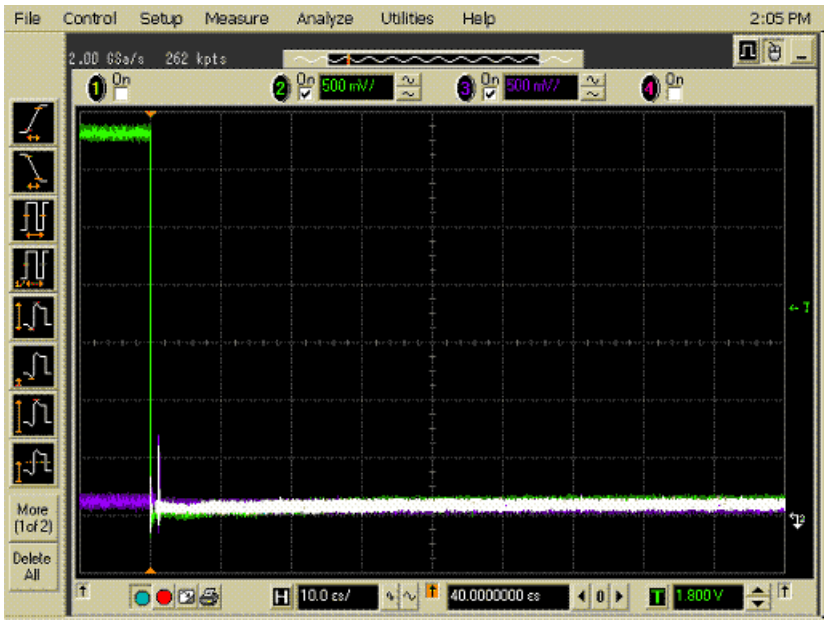
The USB automated test application will prompt you to perform these steps:

1 On the Host Test menu of the HS Electrical Test Tool software, select **RESUME** from the Port Control drop down menu.

2 Enter the port number. Click **[EXECUTE]** once to resume the port.



The captured transition should be as in the figure below.



3 Click **OK** to close the Test Instructions dialog.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

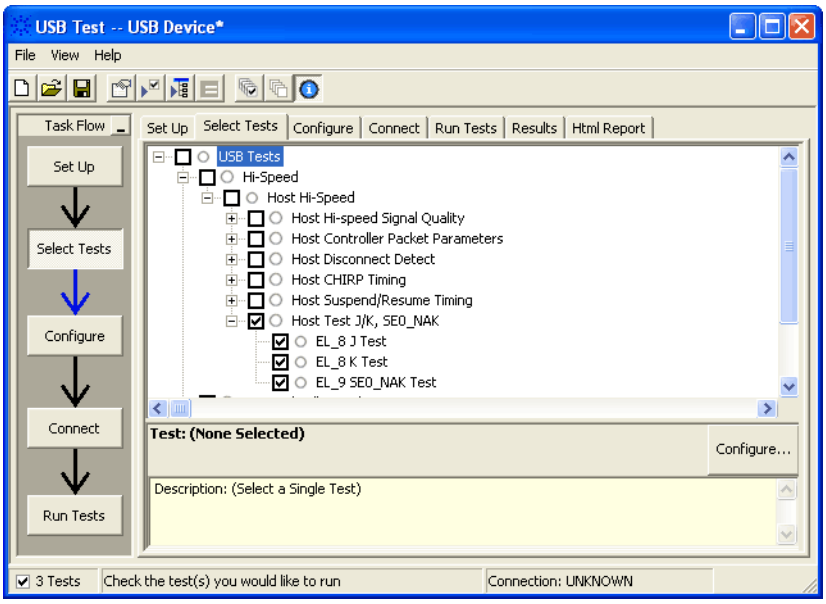
Host Test J/K, SE0_NAK

Equipment Used

Table 30 Equipment Used in Host Test J/K, SE0_NAK Tests

Quantity	Item	Description/Model
1	Digital Multimeter (DMM)	Agilent 34401A or equivalent
1	Host test bed computer	Any computer with hi-speed USB ports
1	Host Hi-Speed Signal Quality test fixture and 4" USB cable	Agilent E2645-66508
1	5V power supply	Agilent 0950-2546 or equivalent

Selecting the Tests



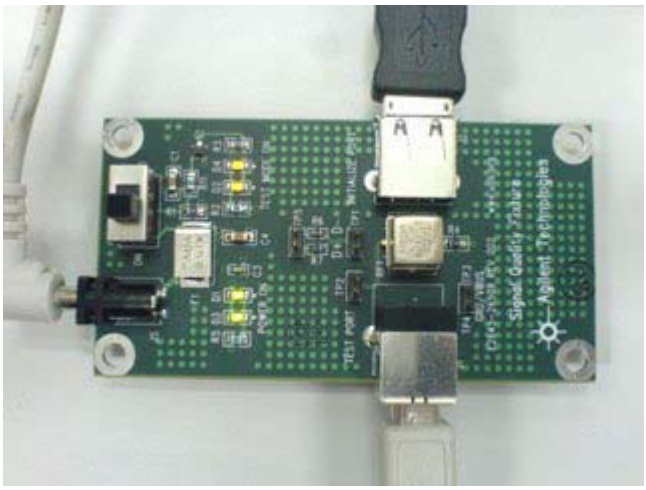
Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1 Attach the 5V power supply to J5 of the E2645-66508 Host High-Speed Signal Quality test fixture. Verify the green Power LED(D1) is lit. Place the TEST switch (S1) in the Test position and the yellow Test LED(D2) is lit.

2 Connect the [TEST PORT] of the test fixture into the port of under test, using the 4" USB cable.



3 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

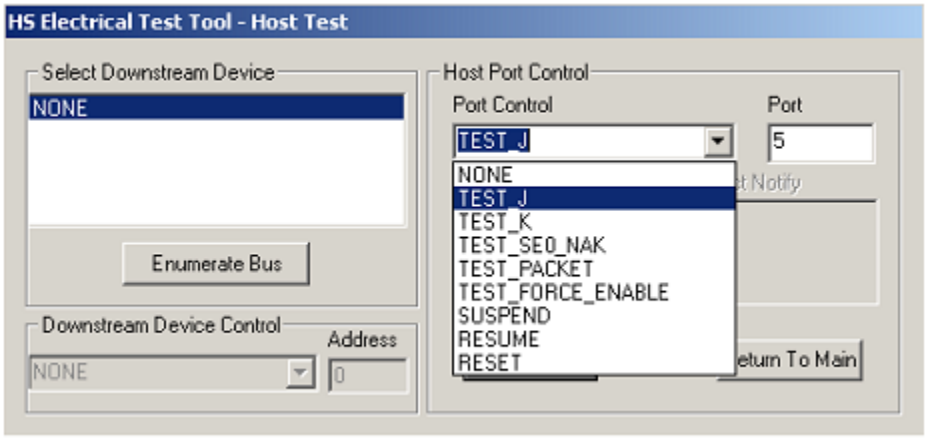
Test Instructions

EL_8 J Test

The USB automated test application will prompt you to perform these steps:

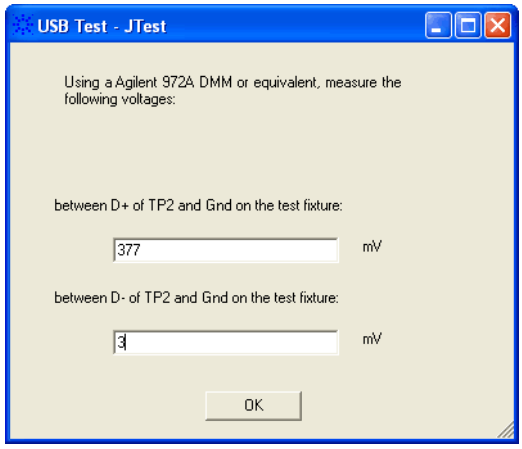
1 On the Host Test menu of the HS Electrical Test Tool software, select **TEST_J** from the Port Control drop down menu.

2 Enter the port number. Click **[EXECUTE]** once to place the port under test into the TEST_J test mode.



3 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you for the following voltage measurements:

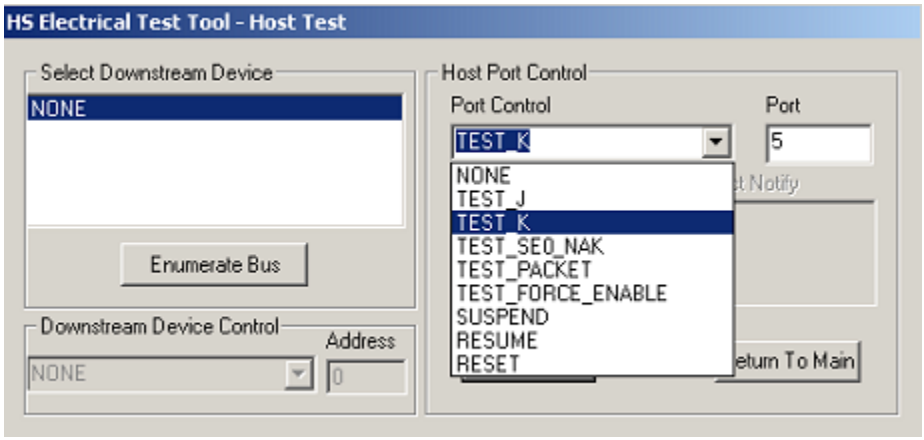


EL_8 K Test

The USB automated test application will prompt you to perform these steps:

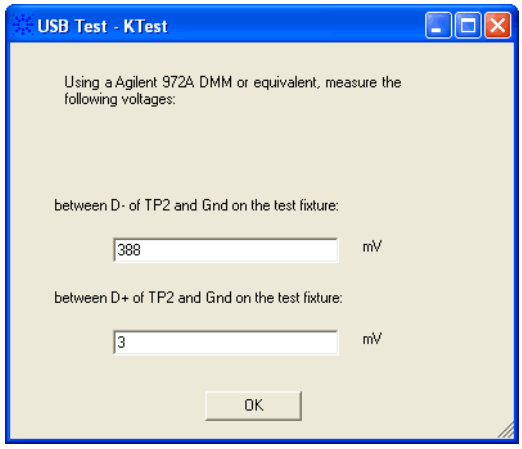
1 On the Host Test menu of the HS Electrical Test Tool software, select **TEST_K** from the Port Control drop down menu.

2 Enter the port number. Click **[EXECUTE]** once to place the port under test into the TEST_K test mode.



3 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you for the following voltage measurements:

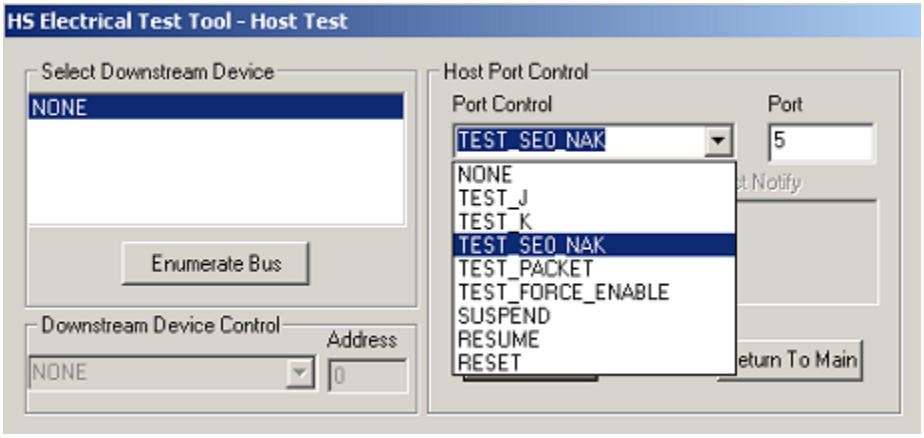


EL_9 SE0_NAK Test

The USB automated test application will prompt you to perform these steps:

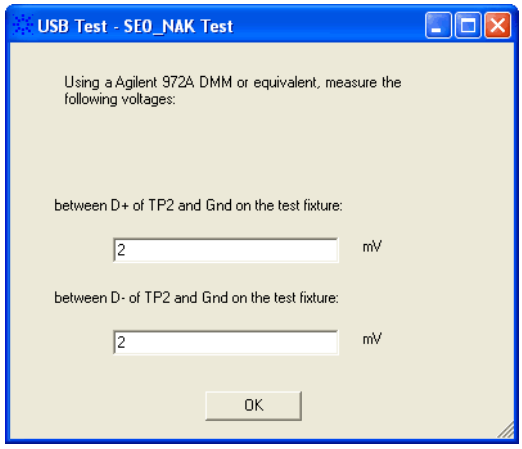
1 On the Host Test menu of the HS Electrical Test Tool software, select **TEST_SE0_NAK** from the Port Control drop down menu.

2 Enter the port number. Click **[EXECUTE]** once to place the port under test into the TEST_SE0_NAK test mode.



3 Click **OK** to close the Test Instructions dialog.

The USB automated test application will prompt you for the following voltage measurements:



Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

6 Troubleshooting Hi-Speed Test Failures

In the Configure tab's Debug Mode, there are several options that can help you troubleshoot hi-speed test failures:

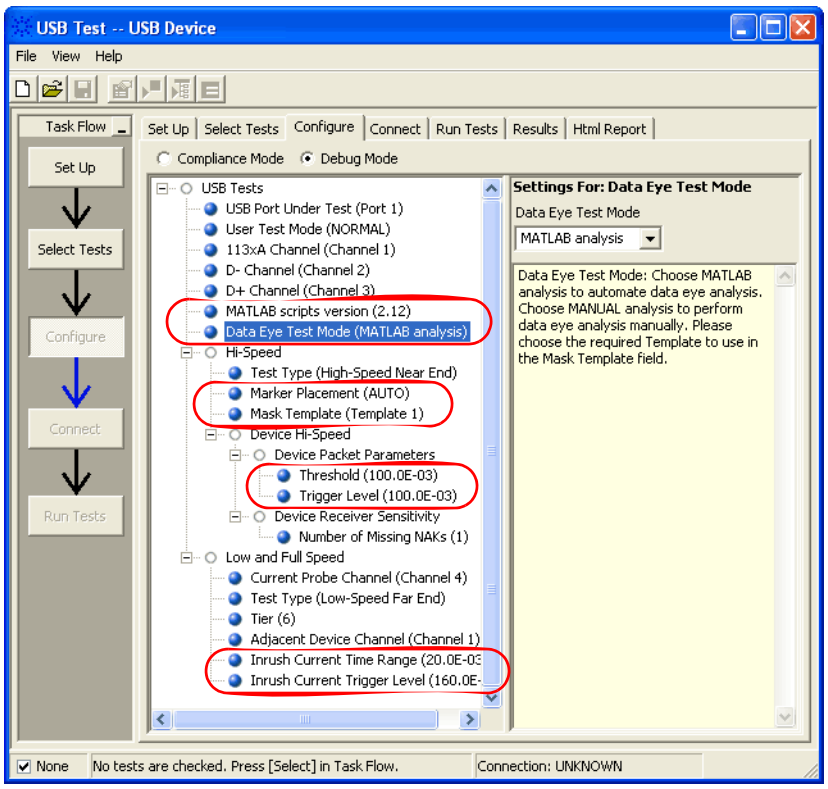


Figure 3 Debug Mode Options for Hi-Speed Testing

- Marker Placement — Lets you manually adjust the markers around the required packet/pattern before proceeding with the test analysis. When "MANUAL" is selected, the automated search for the correct pattern/packet to analyze is turned off.
- Data Eye Test Mode — Lets you perform the eye test without using the MATLAB scripts. The oscilloscope will form the eye diagram using the E2688A serial data analysis (SDA) and clock recovery software option.

- Mask Template – If you choose to use the SDA software option to perform data eye tests, you need to select the appropriate mask template to use for the eye diagram.
- MATLAB scripts version – Allows you to select between MATLAB scripts version 2.10 or 2.12.
- Threshold – Allows you to select or enter the voltage level to use when measuring SYNC field or EOP widths. Noisy signals may have ripples at the end of the EOP; therefore, a higher level should be chosen to avoid the ripples.
- Trigger Level – Allows you to select or enter the voltage level to use when triggering on the inter-packet gaps. Noisy signals may have low amplitudes; therefore, the trigger level should be reduced.
- Inrush Current Time Range – Allows you to select the total time range to capture inrush current.
- Inrush Current Trigger Level – Allows you to select the trigger level to use to capture inrush current. Self-powered devices may draw very little current, so the trigger level should be reduced.

Also useful for debugging problems is the EZJIT analysis software option for the oscilloscope.

7 Low and Full Speed Tests

Droop/Drop Test 166
Inrush Current Test 173
Signal Integrity Test 176
Back-Voltage Test Before Enumerate 197
Back-Voltage Test After Enumerate 199

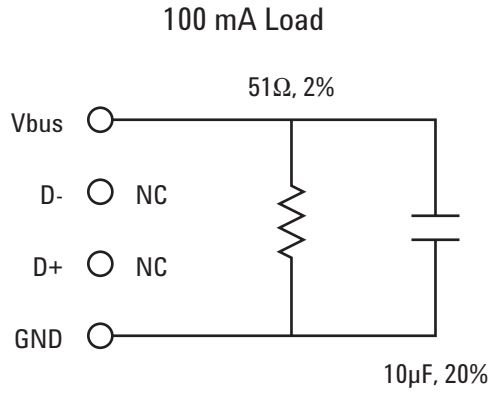


Figure 4 100 mA Load Board Schematic

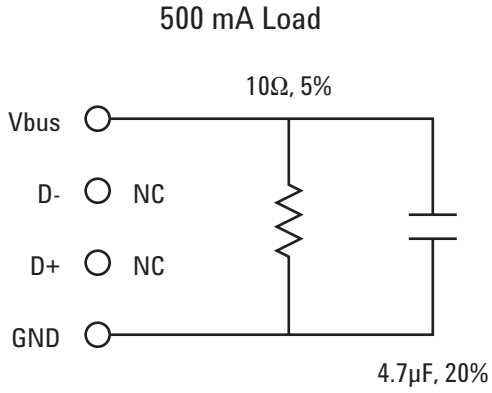


Figure 5 500 mA Load Board Schematic

Droop/Drop Test

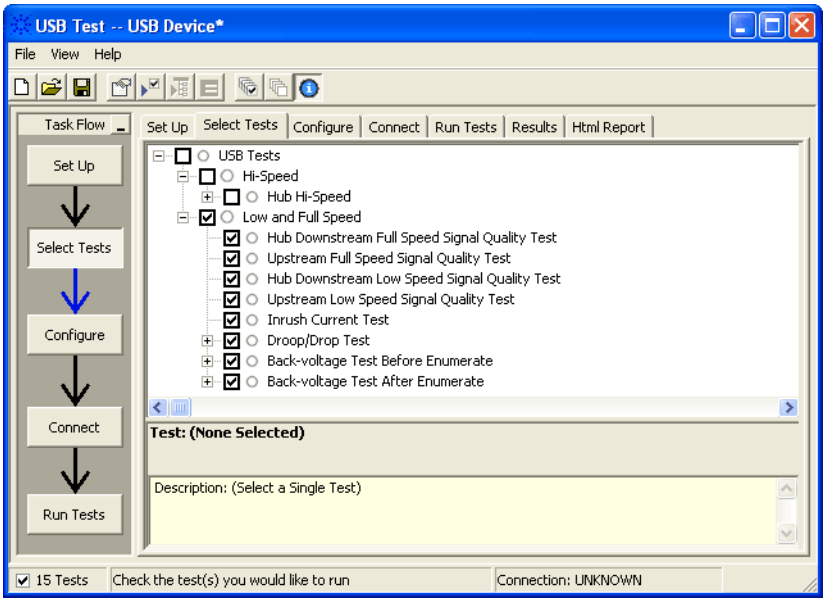
Host and Self-Powered Hubs

Equipment Used

Table 31 Equipment Used in Host and Self-Powered Hubs Droop/Drop Tests

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA, 80000 or 90000A Series, 54831B/D, or 54832B/D
2	Passive or active probes	For 5485x, 80000 and 90000A Series oscilloscopes: • Agilent E2697A with 10073C, or 1156A For 54831B/D and 54832B/D oscilloscopes: • Agilent 1165A
1	Digital Multimeter (DMM)	Agilent 34401A or equivalent
1	SQiDD board	Agilent E2646A
1	500 mA load board	(see the schematic in Figure 5 on page 165)
1	1 meter USB cable	Any listed on USB-IF web site

Selecting the Tests



Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

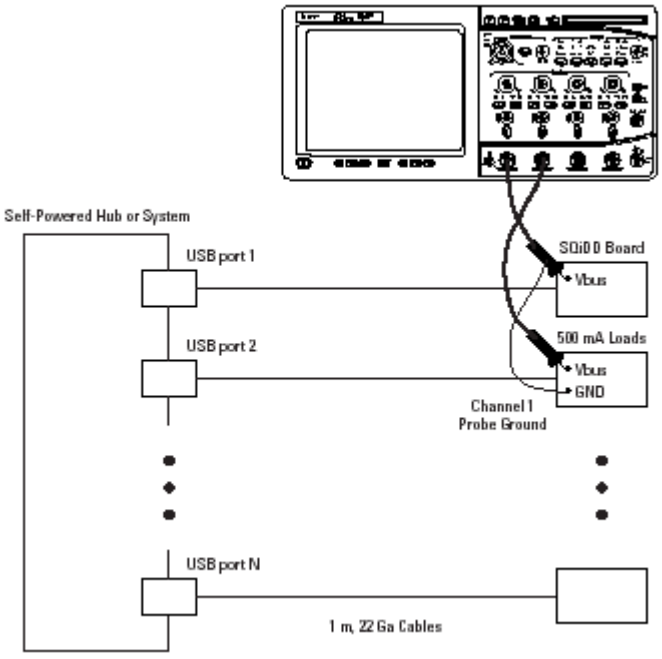
1 For 54831B/D and 54832B/D oscilloscopes, use 1165A passive probes. For the 5485XA, 80000 and 90000A Series oscilloscpes, use E2697A high-impedance converter with 10:1 passive probes, or 1156A active probes.

2 Connect 500mA load boards to all but the adjacent port on the host or self-powered hub under test. Connect the SQiDD board to the hub/host port under test prior to connecting the load board .

3 Attach the passive probes to the oscilloscope's Channel 1 and Channel 2 inputs.

4 Connect the Channel 1 probe to Vbus on the SQiDD board with the probe's ground to GND on one of the 500mA load boards. This is the port under test.

5 Connect the Channel 2 probe to the Vbus test point on the load board connected adjacent to the USB port to be measured. This provides the oscilloscope trigger.



6 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Test Instructions

The USB automated test application will prompt you to perform these steps:

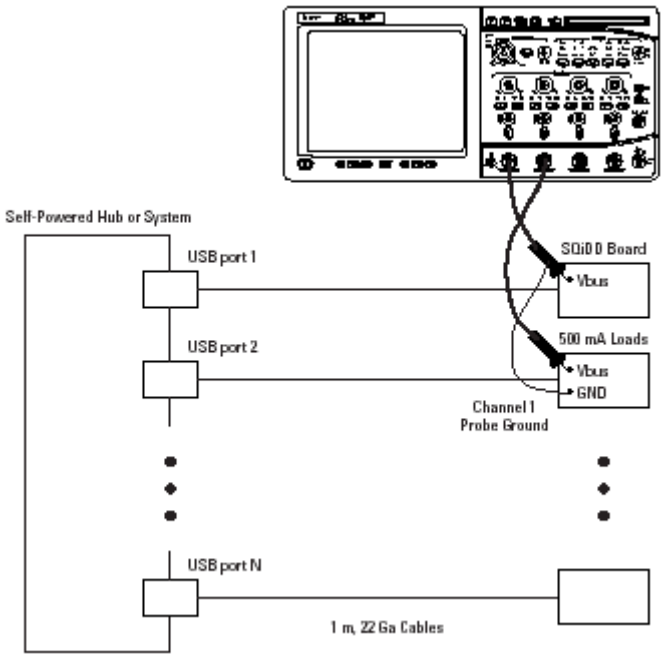
1 For 54831B/D and 54832B/D oscilloscopes, use 1165A passive probes. For the 5485XA, 80000 and 90000A Series oscilloscpes, use E2697A high-impedance converter with 10:1 passive probes, or 1156A active probes.

2 Connect 500 mA load boards to all but the adjacent port on the host or self-powered hub under test. Connect the SQiDD board to the hub/host port under test prior to connecting the load board .

3 Attach the passive probes to the oscilloscope's Channel 1 and Channel 2 inputs.

4 Connect the Channel 1 probe to Vbus on the SQiDD board with the probe's ground to GND on one of the 500mA load boards. This is the port under test.

5 Connect the Channel 2 probe to the Vbus test point on the load board connected adjacent to the USB port to be measured. This provides the oscilloscope trigger.



6 Click **OK** to close the Test Instructions dialog.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

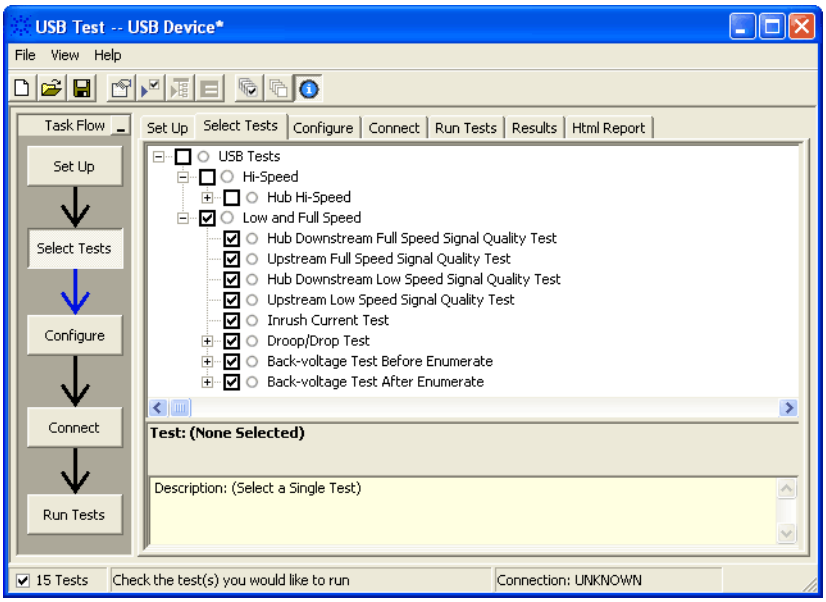
Bus-Powered Hubs

Equipment Used

Table 32 Equipment Used in Bus-Powered Hubs Droop/Drop Tests

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA Series, 80000 or 90000A Series, 54831B/D, or 54832B/D
2	Passive or active probes	For 5485x, 80000 and 90000A Series oscilloscopes: • Agilent E2697A with 10073C, or 1156A For 54831B/D and 54832B/D oscilloscopes: • Agilent 1165A
1	Digital Multimeter (DMM)	Agilent 34401A or equivalent
1	SQiDD board	Agilent E2646A
1	100 mA load board	(see the schematic in Figure 4 on page 165)
1	1 meter USB cable	Any listed on USB-IF web site

Selecting the Tests

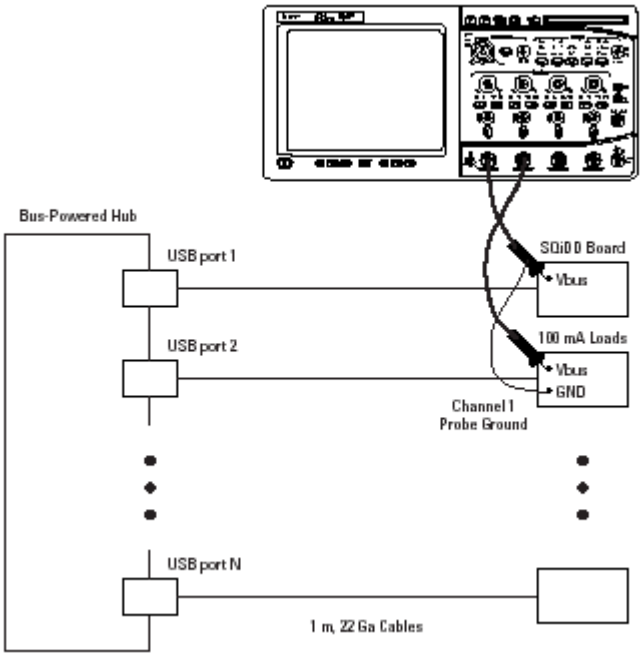


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1. For 54831B/D and 54832B/D oscilloscopes, use 1165A passive probes. For the 5485XA, 80000 and 90000A Series oscilloscpes, use E2697A high-impedance converter with 10:1 passive probes, or 1156A active probes.
2. Connect 100mA load boards to all but the adjacent port on the bus-powered hub under test. Connect the SQiDD board to the hub/host port under test prior to connecting the load board .
3. Attach the passive probes to the oscilloscope's Channel 1 and Channel 2 inputs.
4. Connect the Channel 1 probe to Vbus on the SQiDD board with the probe's ground to GND on one of the 100mA load boards. This is the port under test.
5. Connect the Channel 2 probe to the Vbus test point on the load board connected adjacent to the USB port to be measured. This provides the oscilloscope trigger.



6 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Test Instructions

The USB automated test application will prompt you to perform these steps:

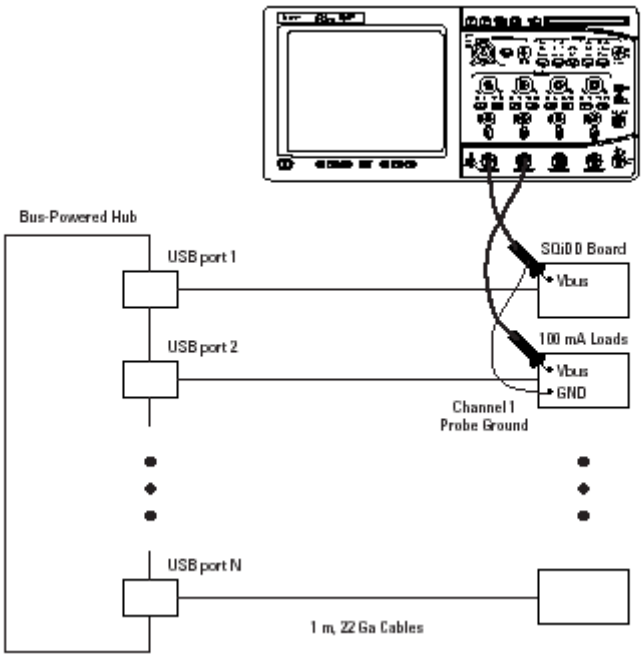
1 For 54831B/D and 54832B/D oscilloscopes, use 1165A passive probes. For the 5485XA, 80000 and 90000A Series oscilloscpes, use E2697A high-impedance converter with 10:1 passive probes, or 1156A active probes.

2 Connect 100 mA load boards to all but the adjacent port on the bus-powered hub under test. Connect the SQiDD board to the hub/host port under test prior to connecting the load board .

3 Attach the passive probes to the oscilloscope's Channel 1 and Channel 2 inputs.

4 Connect the Channel 1 probe to Vbus on the SQiDD board with the probe's ground to GND on one of the 100 mA load boards. This is the port under test.

5 Connect the Channel 2 probe to the Vbus test point on the load board connected adjacent to the USB port to be measured. This provides the oscilloscope trigger.



6 Click **OK** to close the Test Instructions dialog.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

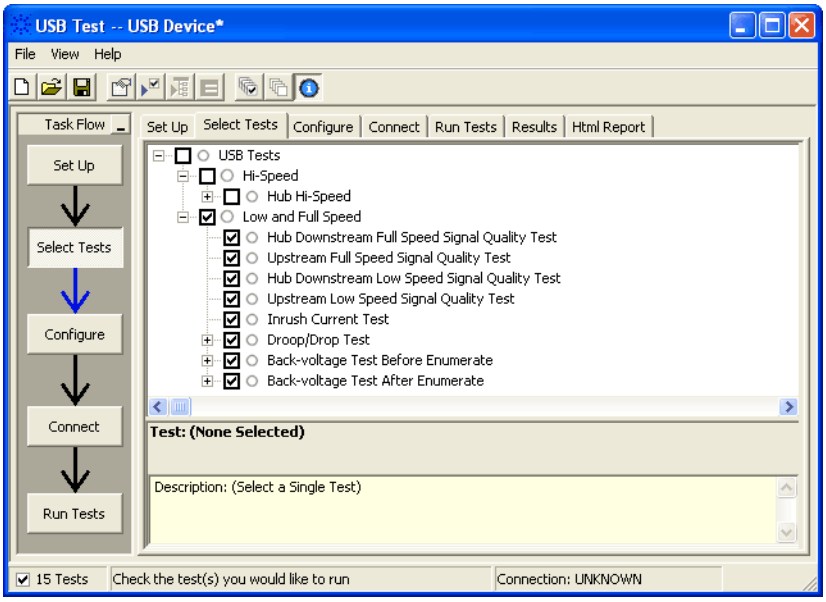
Inrush Current Test

Equipment Used

Table 33 Equipment Used in Inrush Current Test

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA Series, 80000 or 90000A Series, 54831B/D, or 54832B/D
1	Current probe	For 5485x, 80000 and 90000A Series oscilloscopes: • Agilent E2697A high impedance converter, N2774A current probe, and N2775A power supply For 54831B/D and 54832B/D oscilloscopes: • Agilent 1147A
1	Digital Multimeter (DMM)	Agilent 34401A or equivalent
1	SQiDD board	Agilent E2646A
1	USB self-powered hub	Any listed on USB-IF web site
1	1 meter USB cable	Any listed on USB-IF web site

Selecting the Tests



Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

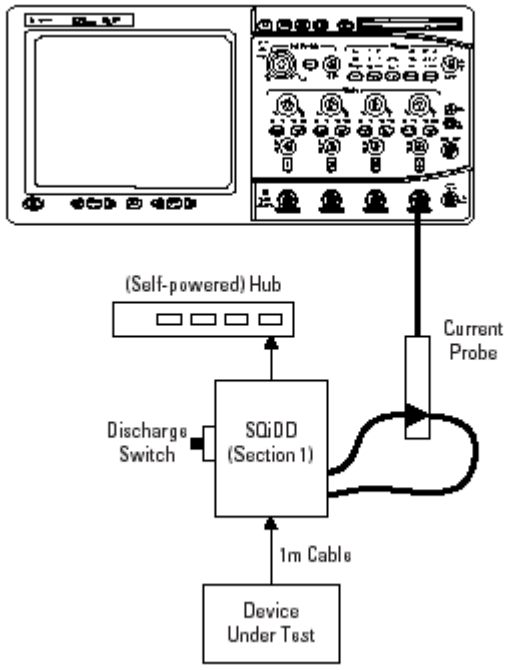
1 Attach the current probe:

For the 54831B/D or 54832B/D oscilloscope, attach the 1147A current probe to the oscilloscope's Channel 4 input.

For the 54853A, 54854A, 54855A oscilloscope:

- **a** Attach the E2697A high-impedance connector to the Channel 4 input.
- **b** Attach the N2774A current probe to the E2697A.
- **c** Attach the N2775A power supply to the N2774A.
- **d** Choose the Setup->Channel 4->Probes->Configure Probing System command and select "Connect N2774A Probe".

2 Zero the current probe.



3 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Test Instructions, Part 1

The USB automated test application will prompt you to perform these steps:

1 Attach the current probe to the current loop on the SQiDD board with the arrow on the probe toward the device under test.

2 Attach the device under test to the SQiDD board.

3 Place the switch on the SQiDD board to the discharge position (opposite the ON position) .

4 Disconnect the device under test from the SQiDD board.

5 Place the switch on the SQiDD board to the ON position.

6 Click **OK** to close the Test Instructions dialog.

Test Instructions, Part 2

The USB automated test application will prompt you to perform these steps:

1 Re- connect the device under test to the SQiDD board in order to capture the inrush current waveform.

2 Click **OK** to close the Test Instructions dialog.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

Signal Integrity Test

Host Downstream Signal Quality Test

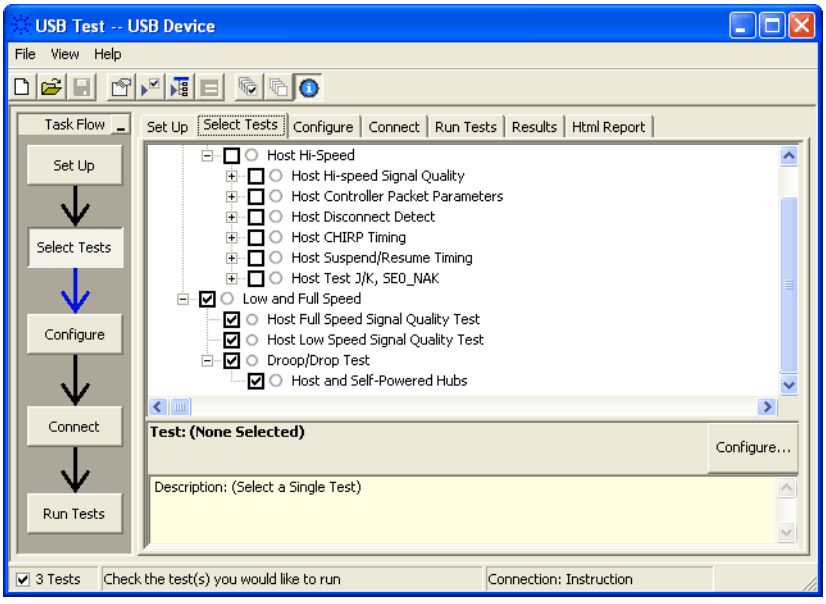
Host Low Speed Test

Equipment Used

Table 34 Equipment Used in Host Downstream Low Speed Signal Quality Test

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA Series, 80000 or 90000A Series, 54831B/D, or 54832B/D
2	Passive or active probes	For 5485x, 80000 and 90000A Series oscilloscopes: • Agilent E2697A with 10073C, or 1156A For 54831B/D and 54832B/D oscilloscopes: • Agilent 1165A
1	Host test bed computer	Any computer with hi-speed USB ports
1	SQiDD board	Agilent E2646A
1	low speed USB device	Logitech mouse, P/N 830311-1000, Model #: M-BB48

Selecting the Tests



Configuring the Tests Make sure you set the Test Type configuration option to "Low-Speed Near End" before running the test.

Connecting the Equipment The USB automated test application will prompt you to perform these connection steps:

1 For 54831B/D and 54832B/D oscilloscopes, use 1165A passive probes. For the 5485XA, 80000 and 90000A Series oscilloscpes, use E2697A high-impedance converter with 10:1 passive probes, or 1156A active probes.

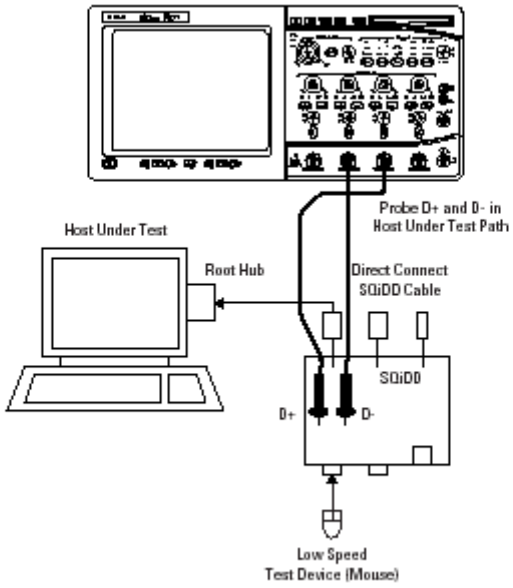
2 Attach the passive probes to the oscilloscope's Channel 3 and Channel 2 inputs.

3 Attach the SQiDD board to the root hub on the host under test.

4 Attach a low speed device to the same section of the SQiDD board. If the section has a switch, it should be set to ON.

5 Connect the oscilloscope Channel 2 probe to D- probe point on the SQiDD board. Connect the oscilloscope Channel 3 probe to the D+ probe point on the SQiDD board.

6 Exit the HS Electrical Test Tool if you have previously launched it.



7 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

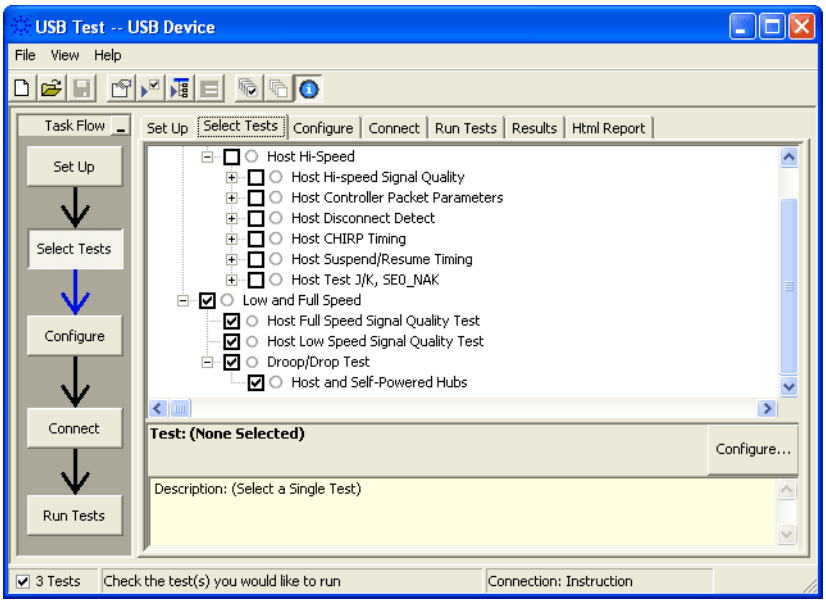
Host Full Speed Test

Equipment Used

Table 35 Equipment Used in Host Downstream Full Speed Signal Quality Test

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA Series, 80000 or 90000A Series, 54831B/D, or 54832B/D
2	Passive or active probes	For 5485x, 80000 and 90000A Series oscilloscopes: • Agilent E2697A with 10073C, or 1156A For 54831B/D and 54832B/D oscilloscopes: • Agilent 1165A
1	Host test bed computer	Any computer with hi-speed USB ports
1	SQiDD board	Agilent E2646A
1	full speed USB device	Intel Create and Share USB camera, P/N 735147-001, Model #: CS330
5	USB self-powered hubs	Any listed on USB-IF web site
6	5 meter USB cables	Any listed on USB-IF web site

Selecting the Tests



Connecting the Equipment The USB automated test application will prompt you to perform these connection steps:

1 For 54831B/D and 54832B/D oscilloscopes, use 1165A passive probes. For the 5485XA, 80000 and 90000A Series oscilloscpes, use E2697A high-impedance converter with 10:1 passive probes, or 1156A active probes.

2 Attach the passive probes to the oscilloscope's Channel 3 and Channel 2 inputs.

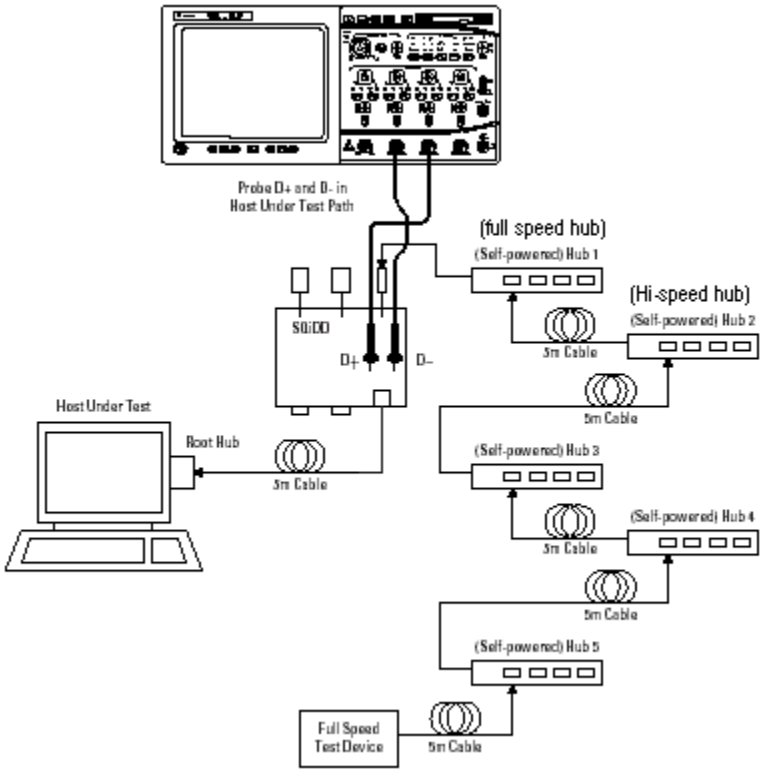
3 Attach the SQiDD board to the root hub on the host under test.

4 Attach 5 self-powered hubs and a full-speed device to the same section of the SQiDD board. If the section has a switch, it should be set to ON. Hub #1 has to be a full-speed hub and hub #2 a Hi-speed hub. The other hubs can be either full speed or hi-speed hubs.

NOTE Placing a full speed and/or a high-speed device downstream of a full speed hub forces both to operate in full speed mode.

5 Connect the oscilloscope Channel 2 probe to D- probe point of the device under test portion. Connect the oscilloscope Channel 3 probe to the D+ probe point of the device under test portion.

6 Exit the HS Electrical Test Tool if you have previously launched.



7 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

Hub Downstream Signal Quality Test

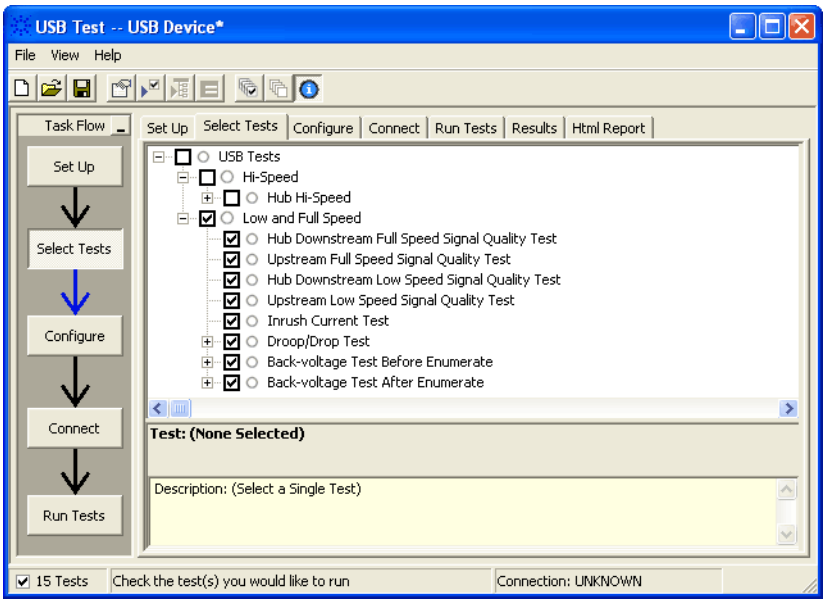
Hub Downstream Low Speed Test

Equipment Used

Table 36 Equipment Used in Hub Downstream Low Speed Signal Quality Test

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA Series, 80000 or 90000A Series, 54831B/D, or 54832B/D
2	Passive or active probes	For 5485x, 80000 and 90000A Series oscilloscopes: • Agilent E2697A with 10073C, or 1156A For 54831B/D and 54832B/D oscilloscopes: • Agilent 1165A
1	Host test bed computer	Any computer with hi-speed USB ports
1	SQiDD board	Agilent E2646A
1	low speed USB device	Logitech mouse, P/N 830311-1000, Model #: M-BB48
5	USB self-powered hubs	Any listed on USB-IF web site
5	5 meter USB cables	Any listed on USB-IF web site

Selecting the Tests



Configuring the Tests Make sure you set the Test Type configuration option to "Low-Speed Near End" before running the test.

Connecting the Equipment The USB automated test application will prompt you to perform these connection steps:

1 For 54831B/D and 54832B/D oscilloscopes, use 1165A passive probes. For the 5485XA, 80000 and 90000A Series oscilloscpes, use E2697A high-impedance converter with 10:1 passive probes, or 1156A active probes.

2 Attach the passive probes to the oscilloscope's Channel 3 and Channel 2 inputs.

3 Attach the SQiDD board to the hub under test.

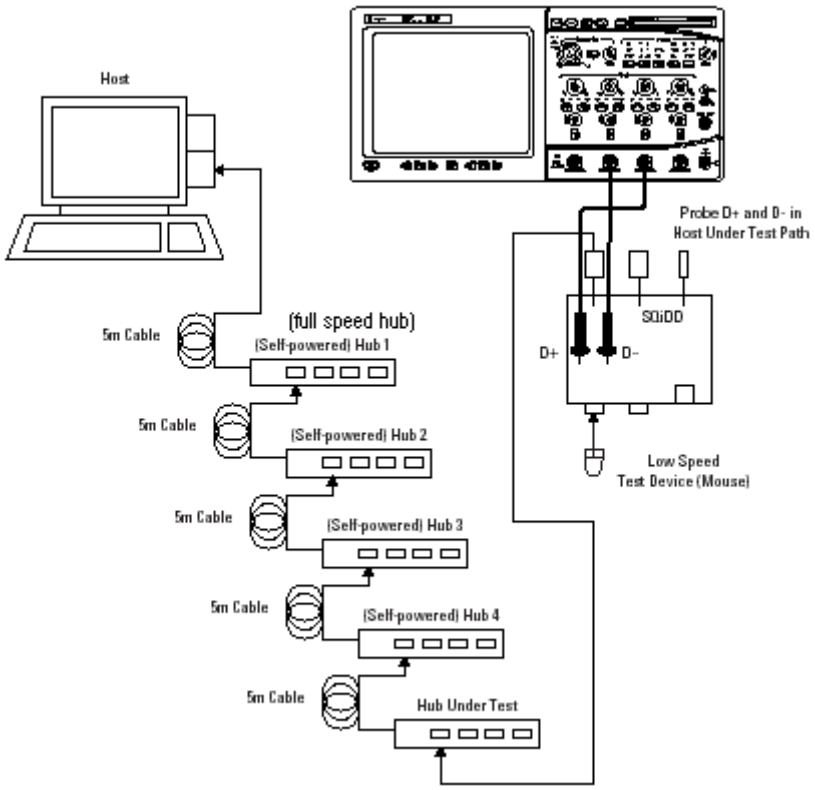
4 Attach the upstream port of the hub under test to the end of 4 self-powered hubs and a host system. Hub #1 has to be a full speed hub. The other hubs can be either full speed or hi-speed hubs.

NOTE The best method to capture and analyze low-speed downstream signal quality is to capture both a keep-alive (low speed EOP) if present and a SOF packet. Hubs are required to generate keep-alives when there is full speed traffic and pass them on to low speed devices.

5 Attach a low speed device to the same section of the SQiDD board. If the section has a switch, it should be set to ON.

6 Connect the oscilloscope Channel 2 probe to D- probe point of the device under test portion. Connect the oscilloscope Channel 3 probe to the D+ probe point of the device under test portion.

7 Exit the HS Electrical Test Tool if you have previously launched it.



8 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

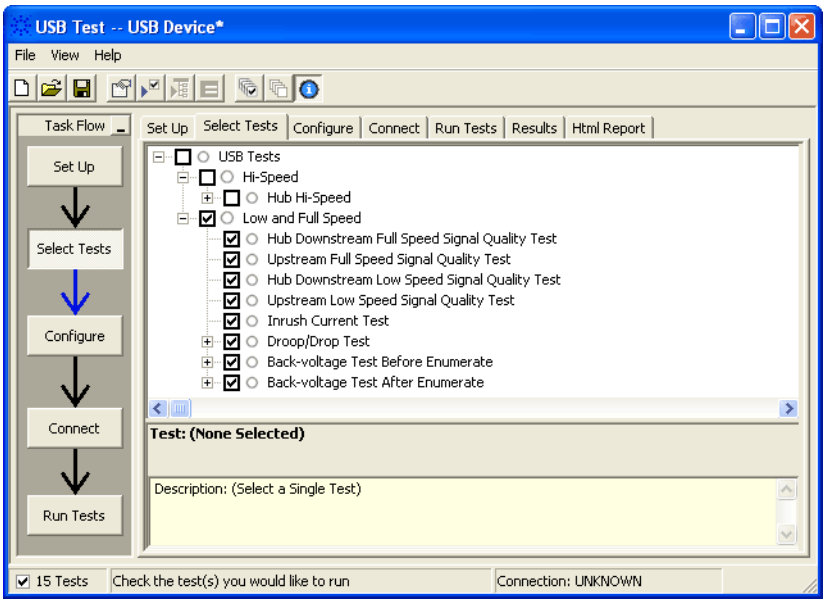
Hub Downstream Full Speed Test

Equipment Used

Table 37 Equipment Used in Hub Downstream Full Speed Signal Quality Test

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA Series, 80000 or 90000A Series, 54831B/D, or 54832B/D
2	Passive or active probes	For 5485x, 80000 and 90000A Series oscilloscopes: • Agilent E2697A with 10073C, or 1156A For 54831B/D and 54832B/D oscilloscopes: • Agilent 1165A
1	Host test bed computer	Any computer with hi-speed USB ports
1	SQiDD board	Agilent E2646A
1	full speed USB device	Intel Create and Share USB camera, P/N 735147-001, Model #: CS330
5	USB self-powered hubs	Any listed on USB-IF web site
6	5 meter USB cables	Any listed on USB-IF web site

Selecting the Tests



Connecting the Equipment The USB automated test application will prompt you to perform these connection steps:

1 For 54831B/D and 54832B/D oscilloscopes, use 1165A passive probes. For the 5485XA, 80000 and 90000A Series oscilloscpes, use E2697A high-impedance converter with 10:1 passive probes, or 1156A active probes.

2 Attach the passive probes to the oscilloscope's Channel 3 and Channel 2 inputs.

3 Attach the SQiDD board to the hub under test.

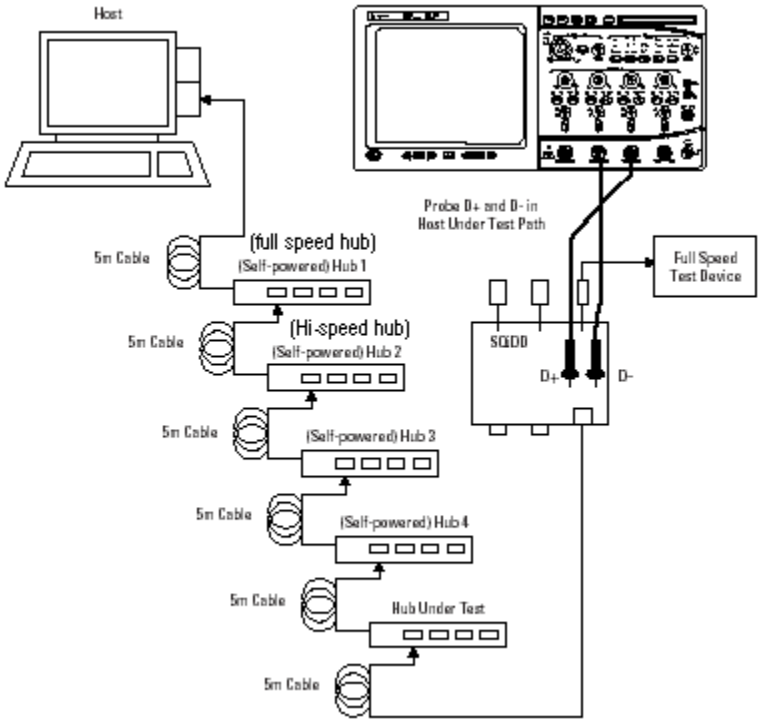
4 Attach the upstream port of the hub under test to the end of 4 self-powered hubs and a host system. Hub #1 has to be a full-speed hub and hub #2 a Hi-speed hub. The other hubs can be either full speed or hi-speed hubs.

NOTE Placing a full speed and/or a high-speed device downstream of a full speed hub forces both to operate in full speed mode.

5 Attach a full speed device to the same section of the SQiDD board. If the section has a switch, it should be set to ON.

6 Connect the oscilloscope Channel 2 probe to D- probe point of the device under test portion. Connect the oscilloscope channel Channel 3 probe to the D+ probe point of the device under test portion.

7 Exit the HS Electrical Test Tool if you have previously launched it.



8 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

Upstream Signal Quality Test

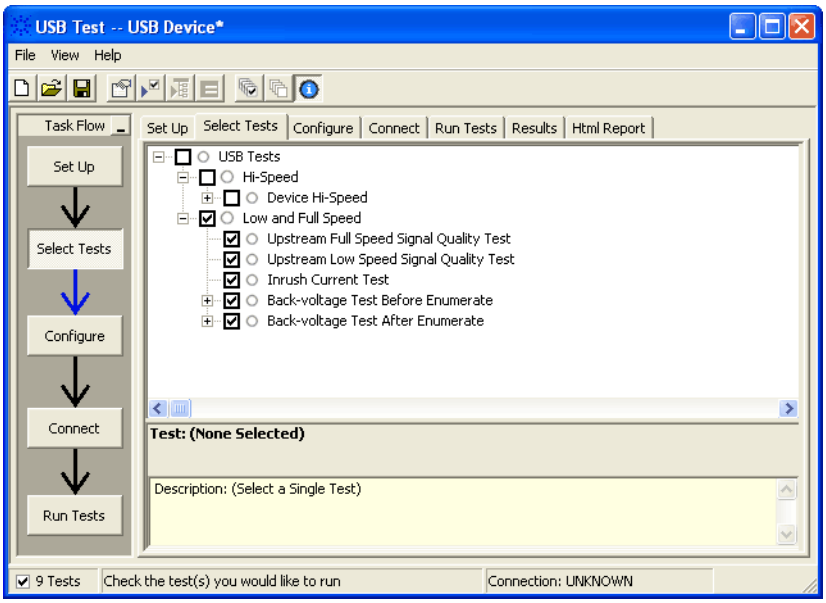
Upstream Low Speed Test

Equipment Used

Table 38 Equipment Used in Upstream Low Speed Signal Quality Test

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA Series, 80000 or 90000A Series, 54831B/D, or 54832B/D
3	Passive or active probes	For 5485x, 80000 and 90000A Series oscilloscopes: • Agilent E2697A with 10073C, or 1156A For 54831B/D and 54832B/D oscilloscopes: • Agilent 1165A
1	Host test bed computer	Any computer with hi-speed USB ports
1	SQiDD board	Agilent E2646A
1	low speed USB device	Logitech mouse, P/N 830311-1000, Model #: M-BB48
5	USB self-powered hubs	Any listed on USB-IF web site
6	5 meter USB cables	Any listed on USB-IF web site

Selecting the Tests



Configuring the Tests Make sure you set the Test Type configuration option to "Low-Speed Far End" before running the test.

Connecting the Equipment The USB automated test application will prompt you to perform these connection steps:

1 For 54831B/D and 54832B/D oscilloscopes, use 1165A passive probes. For the 5485XA, 80000 and 90000A Series oscilloscpes, use E2697A high-impedance converter with 10:1 passive probes, or 1156A active probes.

2 Attach the passive probes to the oscilloscope's Channel 2, Channel 3 and Channel 1 inputs.

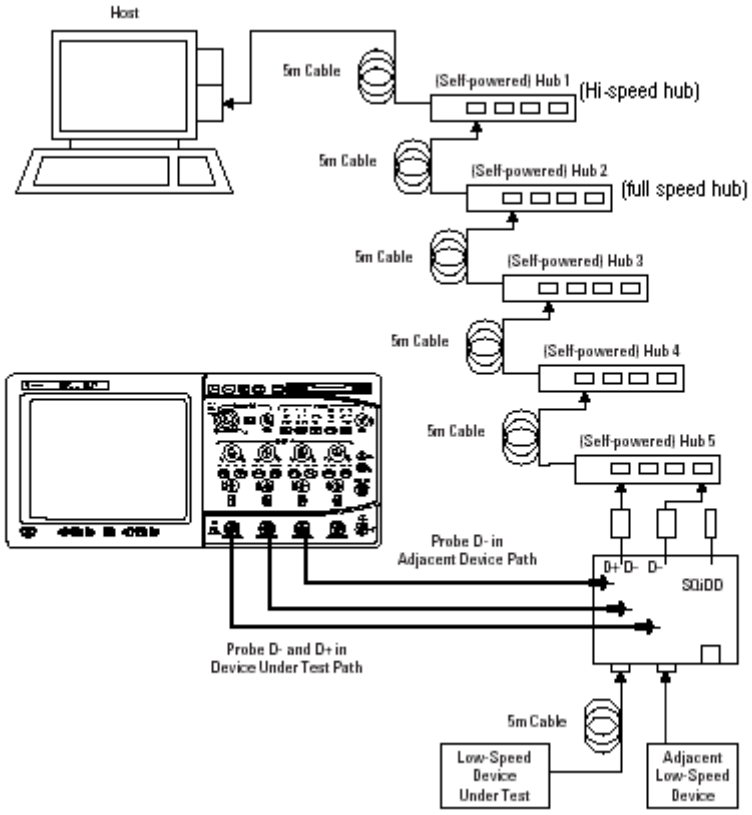
3 Attach the SQiDD board to two USB ports at the end of 5 self-powered hubs and a host system. Hub #1 has to be a hi-speed hub and hub #2 has to be a full speed hub. The rest of the hubs can be either hi-speed or full speed hubs.

NOTE Placing a full speed and/or a high-speed device downstream of a full speed hub forces both to operate in full speed mode.

4 Attach a low speed device under test to the same section of the SQiDD board. If the section has a switch, it should be set to ON.

5 Attach another low speed device to the adjacent section of the SQiDD board. This is for triggering purposes.

6 Connect the oscilloscope Channel 2 probe to D- probe point of the device under test portion. Connect the oscilloscope Channel 3 probe to the D+ probe point of the device under test portion. Connect the oscilloscope Channel 1 probe to the D- probe point on the adjacent device section of the SQiDD board.



7 Check **I have completed these instructions**.

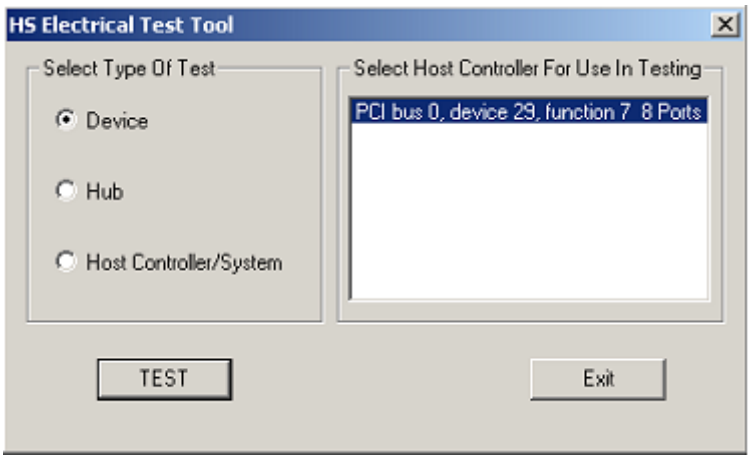
Running the Tests

1 Click **Run Tests**.

Test Instructions

The USB automated test application will prompt you to perform these steps:

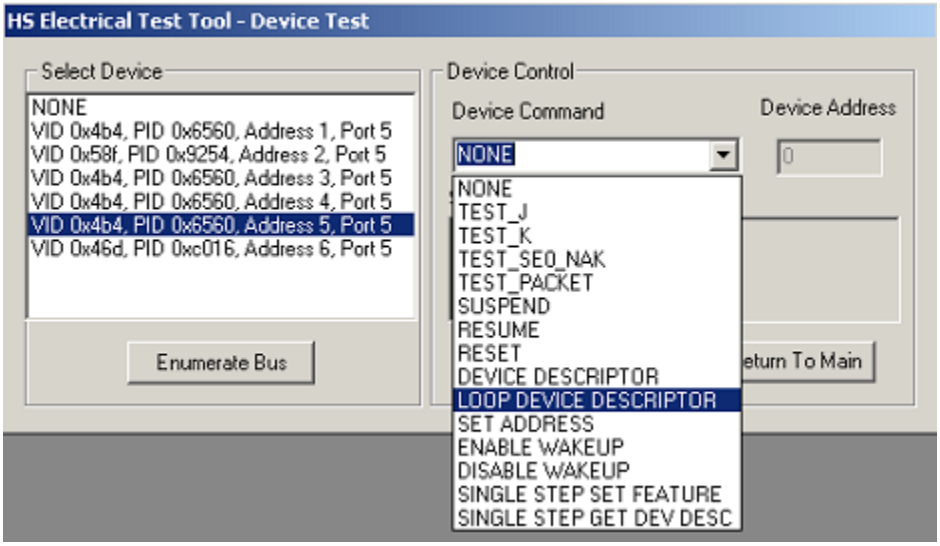
1 Invoke the HS Electrical Test Tool software on the Hi-Speed Electrical Test Bed computer. Select **Device** and click the **[TEST]** button to enter the Device Test menu.



2 On the Device Test Menu of the HS Electrical Test Tool software, click **[Enumerate Bus]** once. All devices attached to the host controller should appear in the device enumeration list.

3 Highlight the device under test and select **LOOP DEVICE DESCRIPTOR** from the Device Command drop down menu. Click **EXECUTE** once.

4 If you do not know which VID/PID belongs to the device under test, unattach the device under test and enumerate the bus once. Then reattach the device under test and enumerate again, this time paying attention to the new device attached.



5 Click **OK** to close the Test Instructions dialog.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

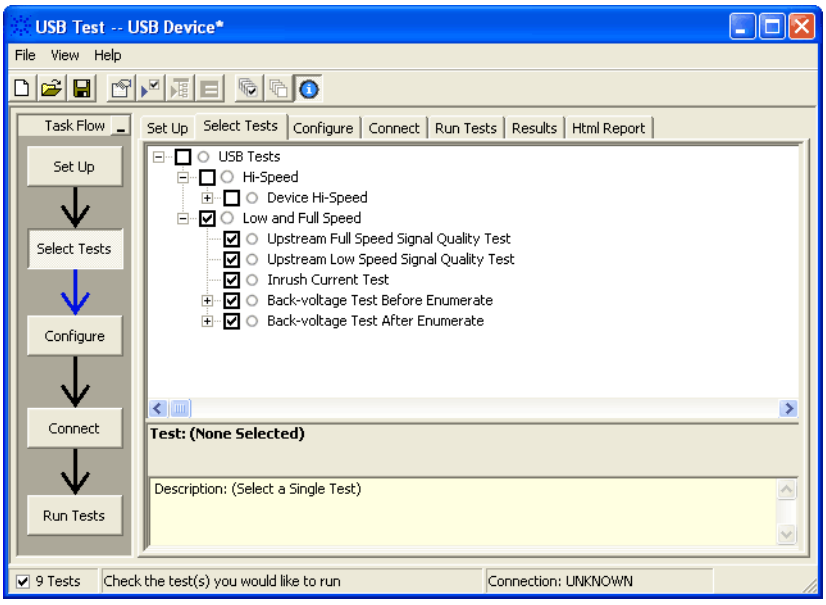
Upstream Full Speed Test

Equipment Used

Table 39 Equipment Used in Upstream Full Speed Signal Quality Test

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA Series, 80000 or 90000A Series, 54831B/D, or 54832B/D
3	Passive or active probes	For 5485x, 80000 and 90000A Series oscilloscopes: • Agilent E2697A with 10073C, or 1156A For 54831B/D and 54832B/D oscilloscopes: • Agilent 1165A
1	Host test bed computer	Any computer with hi-speed USB ports
1	SQiDD board	Agilent E2646A
1	full speed USB device	Intel Create and Share USB camera, P/N 735147-001, Model #: CS330
5	USB self-powered hubs	Any listed on USB-IF web site
6	5 meter USB cables	Any listed on USB-IF web site

Selecting the Tests



Connecting the Equipment The USB automated test application will prompt you to perform these connection steps:

1 For 54831B/D and 54832B/D oscilloscopes, use 1165A passive probes. For the 5485XA, 80000 and 90000A Series oscilloscpes, use E2697A high-impedance converter with 10:1 passive probes, or 1156A active probes.

2 Attach the passive probes to the oscilloscope's channel Channel 2, Channel 3 and Channel 1 inputs.

3 Attach the SQiDD board to two USB ports at the end of 5 self-powered hubs and a host system. Hub #1 has to be a hi-speed hub and hub #2 has to be a full speed hub. The rest of the hubs can be either hi-speed or full speed hubs.

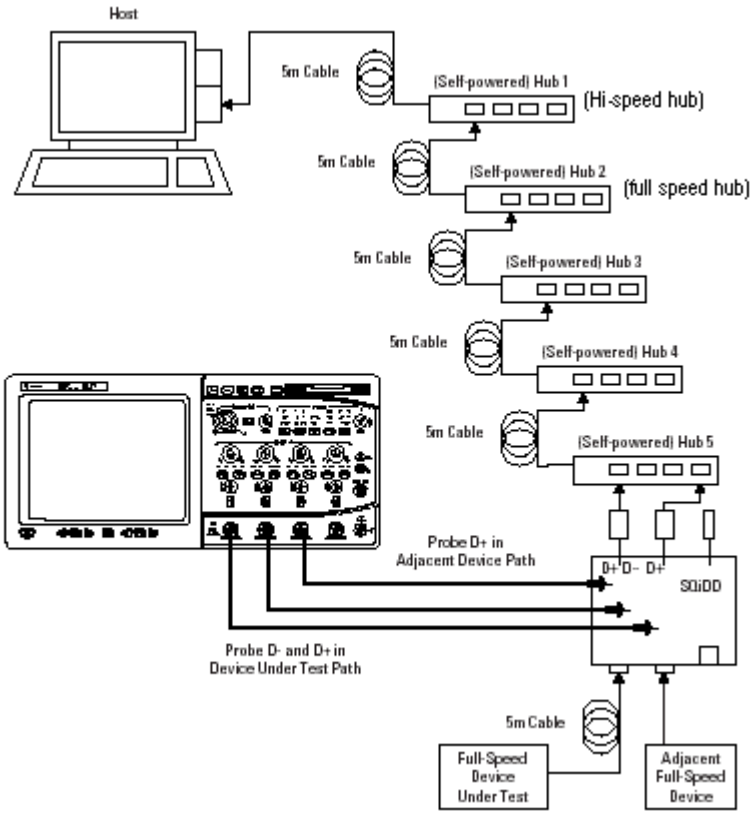
NOTE Placing a full speed and/or a high-speed device downstream of a full speed hub forces both to operate in full speed mode.

4 Attach a full speed device under test to the same section of the SQiDD board. If the section has a switch, it should be set to ON.

5 Attach another full speed device to the adjacent section of the SQiDD board. This is for triggering purposes.

NOTE Use a full-speed hub if device under test has embedded hub function. Otherwise the scope will falsely trigger.

6 Connect the oscilloscope Channel 2 probe to D- probe point of the device under test portion. Connect the oscilloscope Channel 3 probe to the D+ probe point of the device under test portion. Connect the oscilloscope Channel 1 probe to the D+ probe point on the adjacent device section of the SQiDD board.



7 Check **I have completed these instructions**.

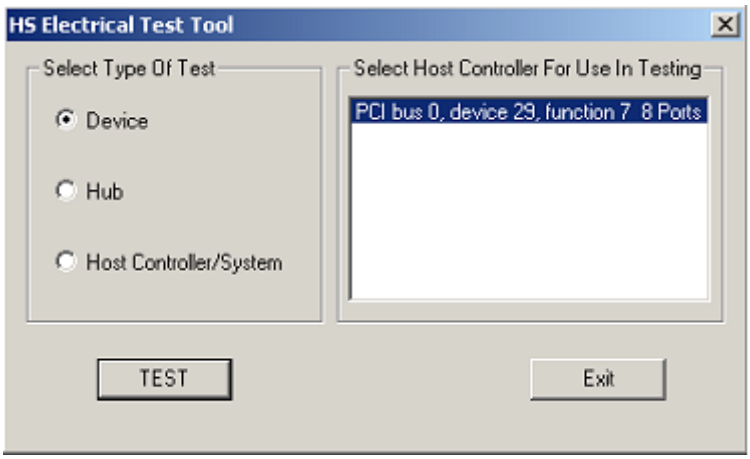
Running the Tests

1 Click **Run Tests**.

Test Instructions

The USB automated test application will prompt you to perform these steps:

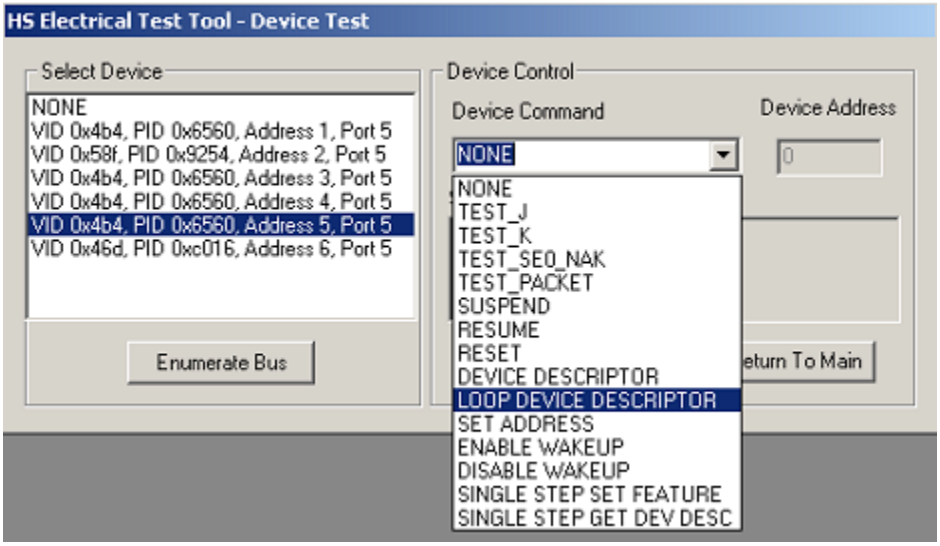
1 Invoke the HS Electrical Test Tool software on the Hi-Speed Electrical Test Bed computer. Select **Device** and click the **[TEST]** button to enter the Device Test menu.



2 On the Device Test Menu of the HS Electrical Test Tool software, click **[Enumerate Bus]** once. All devices attached to the host controller should appear in the device enumeration list.

3 Highlight the device under test and select **LOOP DEVICE DESCRIPTOR** from the Device Command drop down menu. Click **EXECUTE** once.

4 If you do not know which VID/PID belongs to the device under test, unattach the device under test and enumerate the bus once. Then reattach the device under test and enumerate again, this time paying attention to the new device attached.



5 Click **OK** to close the Test Instructions dialog.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

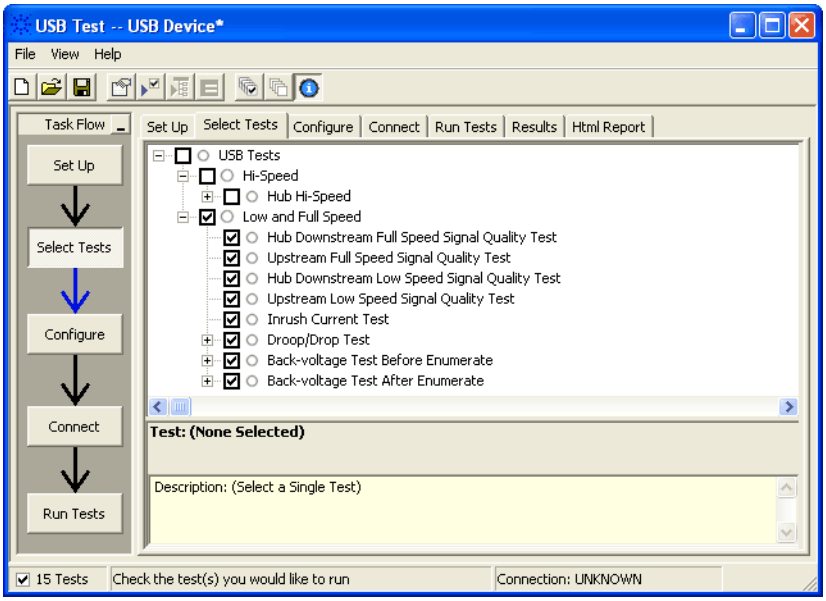
Back-Voltage Test Before Enumerate

Equipment Used

Table 40 Equipment Used in Back-Voltage Test

Quantity	Item	Description/Model
1	Digital Multimeter (DMM)	Agilent 34401A or equivalent
1	SQiDD board or back-voltage test fixture	Agilent E2646A
1	1 meter USB cable	Any listed on USB-IF web site

Selecting the Tests

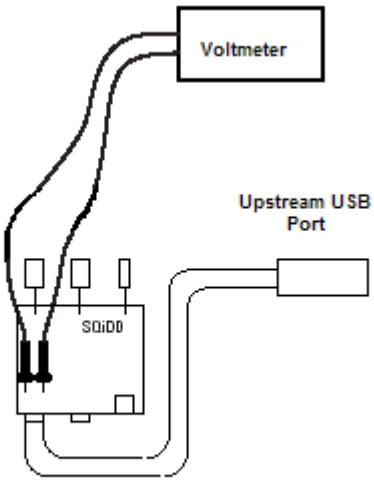


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1 Connect power supply to device/hub under test, and connect the device/hub upstream port to the SQiDD board using a known good USB cable.



2 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Test Instructions

VBUS

The USB automated test application will prompt you to: measure the voltage between Vbus and Gnd on the SQiDD board and record the value.

D+

The USB automated test application will prompt you to: measure the voltage between D+ and Gnd on the SQiDD board and record the value.

D-

The USB automated test application will prompt you to: measure the voltage between D- and Gnd on the SQiDD board and record the value.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

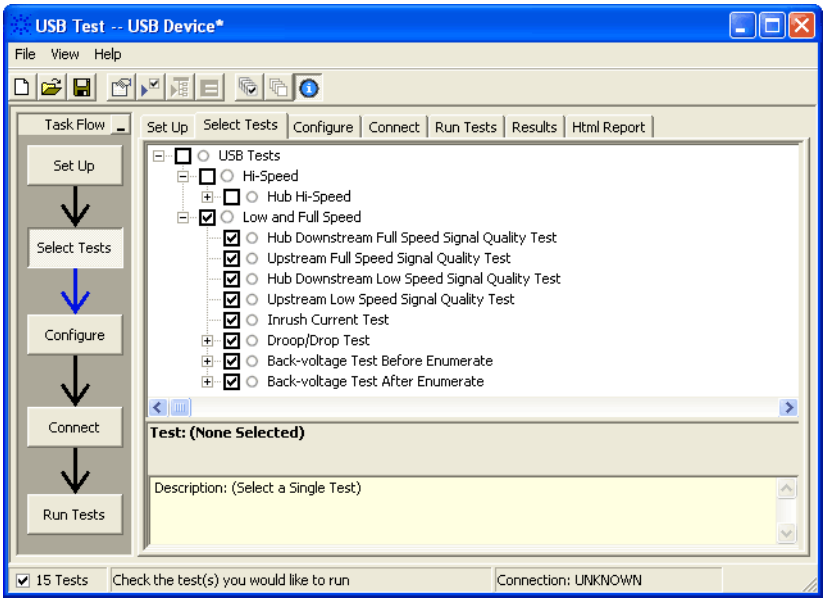
Back-Voltage Test After Enumerate

Equipment Used

Table 41 Equipment Used in Back-Voltage Test

Quantity	Item	Description/Model
1	Digital Multimeter (DMM)	Agilent 34401A or equivalent
1	SQiDD board or back-voltage test fixture	Agilent E2646A
1	1 meter USB cable	Any listed on USB-IF web site

Selecting the Tests

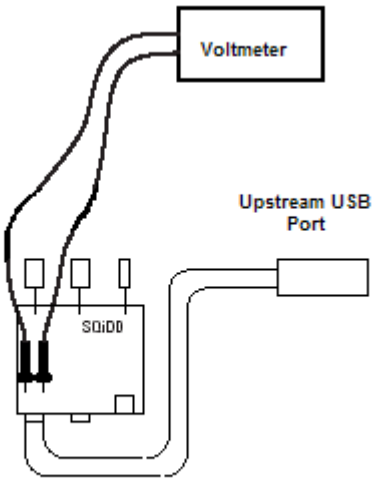


Configuring the Tests

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

1 Connect power supply to device/hub under test. Plug device/hub under test into a known good host. Verify proper enumeration. Unplug USB cable from the host. Connect the device/hub upstream port to the SQiDD board using a known good USB cable.



2 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

Test Instructions

VBUS

The USB automated test application will prompt you to: measure the voltage between Vbus and Gnd on the SQiDD board and record the value.

D+

The USB automated test application will prompt you to: measure the voltage between D+ and Gnd on the SQiDD board and record the value.

D-

The USB automated test application will prompt you to: measure the voltage between D- and Gnd on the SQiDD board and record the value.

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

8 On-The-Go Electrical Tests

Equipment Used 204
Installing the USB-OET (OTG Electrical Test) Fixture Driver 205
Selecting the Tests 205
Configuring the Tests 206
Connecting the Equipment 206
Running the Tests 207
Viewing Test Results 209

All of the On-The-Go electrical tests use the same test setup.

Equipment Used

Table 42 Equipment Used in On-The-Go Electrical Tests

Quantity	Item	Description/Model
1	Oscilloscope	Agilent 5485xA Series, 80000 or 90000A Series, 54831B/D, or 54832B/D
2	Passive or active probes	For 5485x, 80000 and 90000A Series oscilloscopes: • Agilent 1156A For 54831B/D and 54832B/D oscilloscopes: • Agilent 1165A
1	Digital Multimeter (DMM)	Agilent 34401A or equivalent
1	USB OTG test fixture	Agilent N5417A
1	Power supply	Agilent E3631A or equivalent
1	USB/GPIB interface	Agilent E2357A
1	GPIB cable	Agilent 10833B

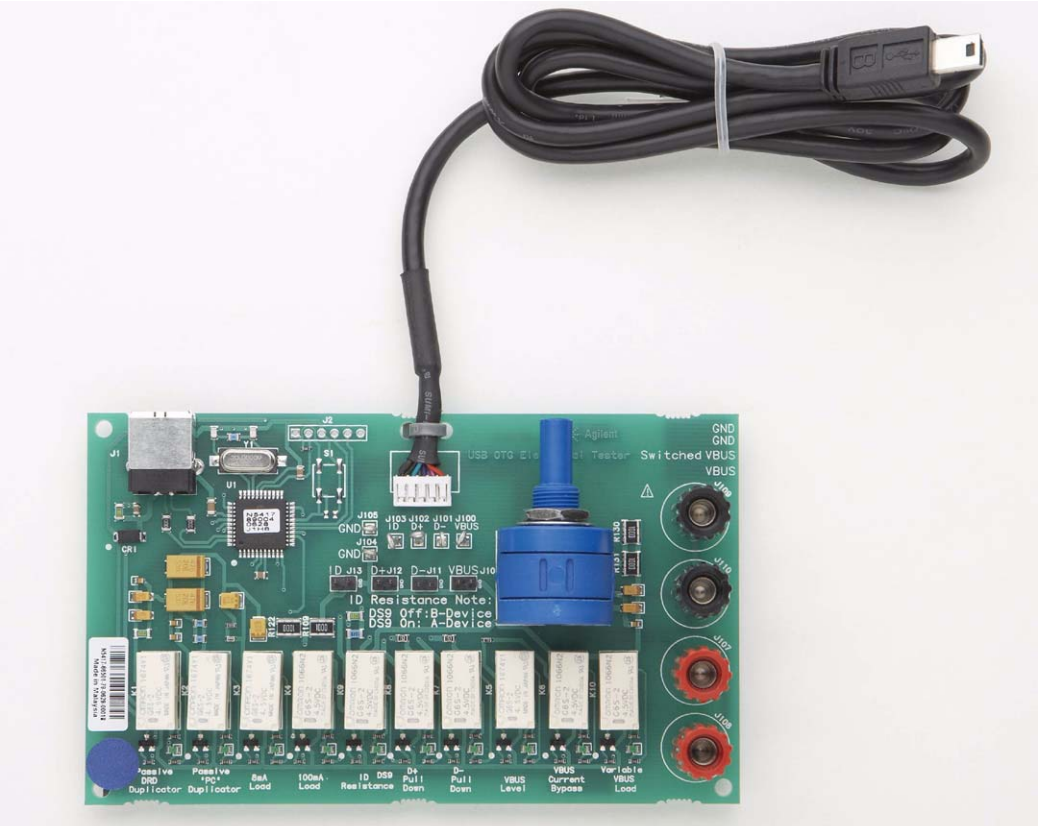
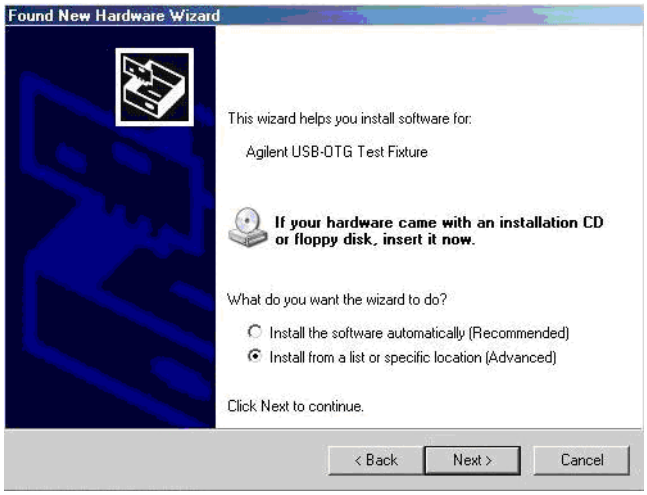


Figure 6 Agilent N5417A USB OTG Test Fixture

Installing the USB-OET (OTG Electrical Test) Fixture Driver

1 Plug the OET fixture to any USB port.

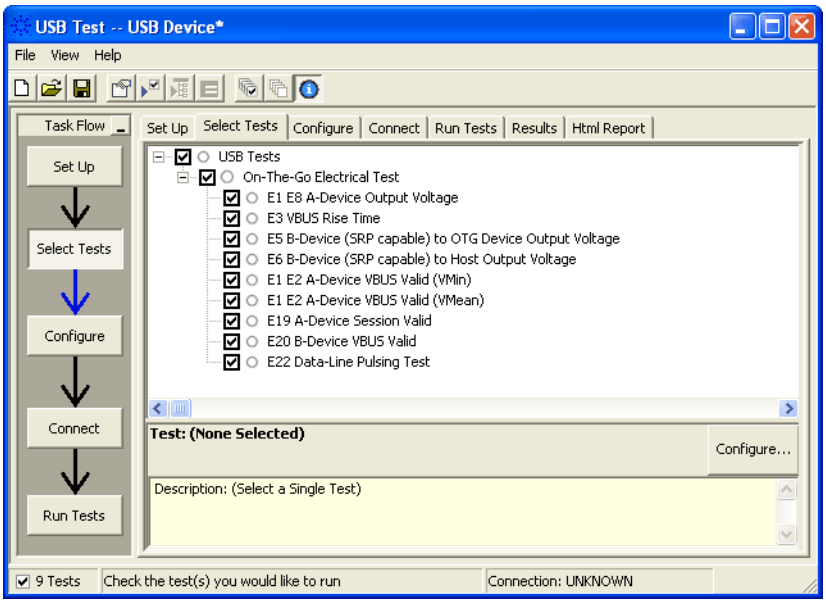
2 A Found New Hardware Wizard window will pop up (Windows XP).



3 Select **Install from a list or specific location** from the wizard window.

4 Locate the "USB-OTG.inf" file (C:\scope\apps\USBTest\), and continue with the installation.

Selecting the Tests



Configuring the Tests

If the power supply's SICL address is different from the default, make sure you set the E3631A Instrument Address configuration option to the power supply's SICL address.

Connecting the Equipment

The USB automated test application will prompt you to perform these connection steps:

NOTE Note: For 54831B/D and 54832B/D oscilloscopes, use 1165A passive probes. For the 5485XA, 80000 and 90000A Series oscilloscpes, use 1156A active probes.

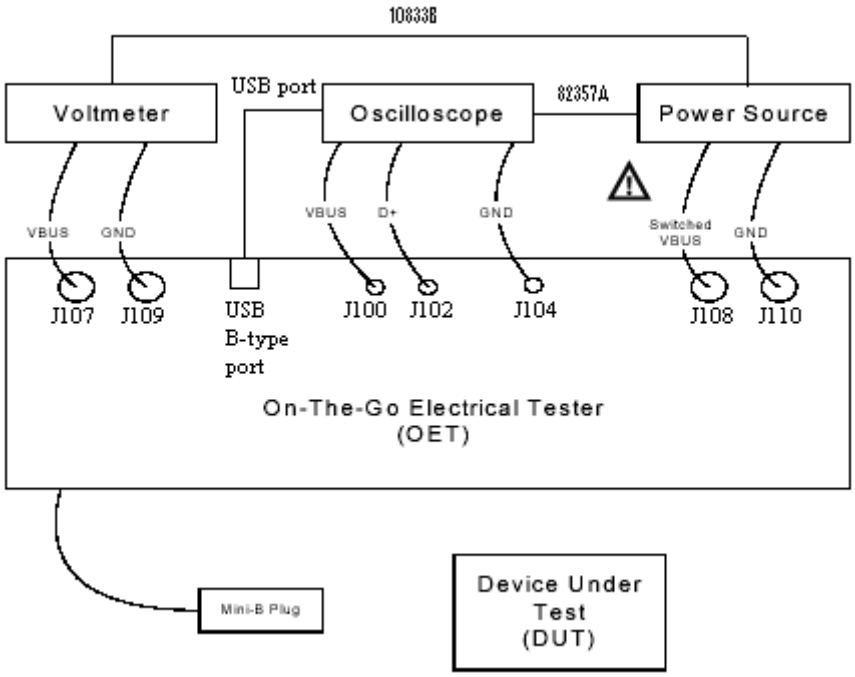
1. Please refer to the "Installing the USB-OET (OTG Electrical Test) Fixture Driver" on page 205 for instructions on installing the drivers for the N5417A OTG Electrical Test board.
2. Connect the Channel 1 probe of the oscilloscope to the J100, VBUS test point of the OET. Connect the probe's ground to the J104, GND test point nearest to the VBUS test point.
3. Connect the Channel 3 probe of the oscilloscope to the J102, D+ test point of the OET. Connect the probe's ground to the J105, GND test point nearest to the D+ test point.
4. Connect the black multimeter lead from INPUT LOW to J109, GND terminal, of the OET.
5. Connect the red multimeter lead from INPUT HI to J107, Switched VBUS terminal, of the OET.

WARNING **Make sure the power supply voltage is 6 V. An incorrect voltage can damage the USB-OET test fixture, and a damaged test fixture can be a shock hazard to the operator.**

6. Connect the black supply lead from the power supply 6 volt supply negative output to J110, GND terminal, of the OET.
7. Connect the red power supply lead from the power supply 6 volt supply positive output to J108, VBUS terminal, of the OET.
8. Connect the 34401A digital multi-meter to E3631A power supply using the 10833B GPIB cable.

9 Connect the E3631A power supply to the oscilloscope using the 82357A USB/GPIB Interface.

10 Connect the OET test fixture to the oscilloscope's USB port .



11 Check **I have completed these instructions**.

Running the Tests

1 Click **Run Tests**.

E1 E8 A-Device Output Voltage

1 Set the OET switches to the following settings.

Mode	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10
8 mA Load	OFF	OFF	**ON**	OFF	OFF	OFF	OFF	OFF	A-Device	OFF

E3 VBUS Rise Time

1 Set the OET switches to the following settings.

Mode	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10
8 mA Load	OFF	OFF	**ON**	OFF	OFF	OFF	OFF	OFF	A-Device	OFF

E5 B-Device (SRP capable) to OTG Device Output Voltage

1 Set the OET switches to the following settings.

Mode	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10
Passive OTG Device Duplicator	**ON**	OFF	OFF	OFF	OFF	OFF	**ON**	**ON**	B-Device	OFF

E6 B-Device (SRP capable) to Host Output Voltage

1 Set the OET switches to the following settings.

Mode	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10
Passive "PC" Duplicator	OFF	**ON**	OFF	OFF	OFF	OFF	**ON**	**ON**	B-Device	OFF

E19 A-Device Session Valid

1 Set the OET switches to the following settings.

Mode	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10
Pre-A-Device VBUS Level	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	A-Device	OFF

E20 B-Device VBUS Valid

1 Set the OET switches to the following settings.

Mode	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10
Pre-VBUS Current Bypass Test	OFF	OFF	OFF	OFF	OFF	OFF	**ON**	**ON**	B-Device	OFF

E22 Data-Line Pulsing Test

1 Set the OET switches to the following settings.

Mode	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10
Passive OTG Device Duplicator	**ON**	OFF	OFF	OFF	OFF	OFF	**ON**	**ON**	B-Device	OFF

A-Device VBUS Valid (VA_VBUS_VLD)

1 Set the OET switches to the following settings.

Mode	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10
100 mA Load	OFF	OFF	OFF	**ON**	OFF	OFF	OFF	OFF	A-Device	OFF

E1 E2 A-Device VBUS Valid (VMin)

E1 E2 A-Device VBUS Valid (VMean)

Viewing Test Results

1 When the Testing Complete dialog appears, click **OK**.

The Results tab shows the test results.

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