EXPRESSCARD SIGNAL QUALITY CHECKLISTS

Release 1.0

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REVISION HISTORY

Date	Specification Version	Revisions
February 16, 2009	1.0 Release	Signal Quality Checklists updated with affidavit section Minor spelling corrections, editorial changes

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CONTENTS

FIGURES

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1. INTRODUCTION

1.1 Scope

Signal quality tests for ExpressCard modules and host systems are required. This document defines a test procedure for PCI Express and USB signal quality for both modules and host systems and provides a standard reporting checklist for results.

> *IMPORTANT NOTE*
>
> *For detailed test methodologies to be followed in actual signal quality testing, please see the addendum appropriate for the equipment that will be used (see* **1.2 Related Documents** *for list of currently available Addenda.)*

1.2 Related Documents

ExpressCard Signal Quality Test Procedure Addendum 1 - Agilent Infinium DSO80604B, Release 1.0 – Personal Computer Memory Card International Association (PCMCIA)

ExpressCard Compliance Program Overview, Release 2.2 – Personal Computer Memory Card International Association (PCMCIA)

The following reference documents provide normative requirements as specified in this document.

ExpressCard Standard, Release 1.2 – Personal Computer Memory Card International Association (PCMCIA)

ExpressCard Compliance Checklists, Release 1.2 – Personal Computer Memory Card International Association (PCMCIA)

PCI Express Base Specification 1.1 – PCI Special Interest Group (PCI-SIG)

USB Specification, Release 2.0 – Universal Serial Bus Implementers Forum (USB-IF)

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2. REQUIRED EQUIPMENT

The basic hardware requirement, test fixture and test software listed here are based on the specification and positive experience in executing the ExpressCard compliance tests. This test procedure is written for vendor testing reference and for equipment manufacturer reference to develop their specific test procedure.

2.1 Digital Storage Oscilloscope and Probe

2.1.1 For USB Signal Quality

- Any oscilloscope which has 2 GHz (or above) bandwidth and 20GS/s (or above) sampling rate capability
- Any differential probe which has 1.5GHz (or above) bandwidth
- Any positive/ active probe which has 600MHz (or above)

2.1.2 For PCI Express Signal Quality

- Any oscilloscope which has 6 GHz (or above) bandwidth and 20GS/s (or above) sampling rate capability

2.2 Test Fixture

- ExpressCard Test Fixture Board/Slot (PEC-1X)
- ExpressCard PCI Express Test Fixture Module (EC-SI-P)
- ExpressCard USB Test Fixture Module (EC-SQ-U)
- USB Signal Quality Inrush Drop Droop Board (SQiDD)
- PCI Express Compliance Base Board (CBB)

2.3 Test Tools

- PCI Express Electrical Test Software: SigTest
- USB Electrical Analysis Tool: USBET
- USB-IF HS Electrical test Tool: USBHSET

2.4 Test Bed

- Any high-speed USB capable system with ExpressCard slot.

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3. MODULE SIGNAL QUALITY TEST PROCEDURE

3.1 Testing for Modules Utilizing the PCI Express Interface

1. Test connection:
   a. Refer to Figure 3-1 below, Connect SMA cables up as follows:
      - Oscilloscope channel 1 to the CBB TX LANE1 P
      - Oscilloscope channel 3 to the CBB TX LANE1 N
   b. Plug PEC-1X test fixture to PCI Express slot of the CBB
   c. Insert DUT to ExpressCard slot of the PEC-1X test fixture

Figure 3-1: CBB SMA Probing Option and PEC-1X Test Board

2. Scope setting and waveform export:
   a. Set 1us/dvi, 20GS/s (50ps/pt)
   b. Export waveform as .csv file
3. SigTest Setting:
   a. Make sure Data Type, Technology, Template File are selected correctly

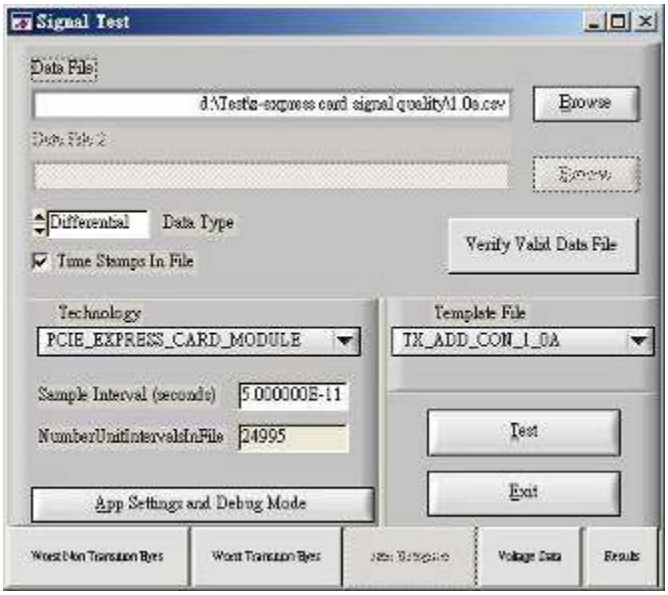


Figure 3-2: The SigTest Application

b. Check Full Test Result is passed:

Figure 3-3: SigTest Full Test Result

3.2 Testing for Modules Utilizing the USB Interface

3.2.1 USB High Speed

1. Test connection:

   a. Plug the EC-SQ-U test fixture into Express Card slot of the Test Bed system

   b. Attach the USB cable from USB port of the Test Bed system to USB B receptacles connecter of the EC-SQ-U test fixture for 5V power supply

   c. Verify the red Power LED (D1) is lit, and the green Test LED (D2) is not lit

   d. If the LED is lit, move the test switch on the test fixture to the OFF position

   e. Connect the device under test to the test fixture

   f. Attach the differential probe to J6 of the test fixture as shown as Figure 3-4

   - Ensure the header adapter is used between J6 and the test fixture
   - Ensure the + Polarity on the probe line up with D+

Figure 3-4: Differential Probe Connection

2. USBHEST Setting:

   a. Select correct device and issue TEST_PACKET Command

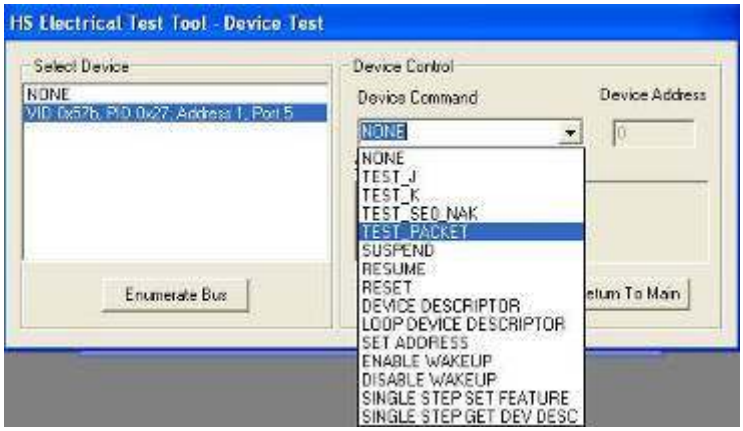


Figure 3-5: USBHSET

3. Scope Setting:
   a. 200ns/dvi, 20GS/s (50ps/pt)
   b. Export waveform as .csv file
4. USBET Setting:
   a. Make sure Test Type is selected correct
   b. Check Overall Result is passed

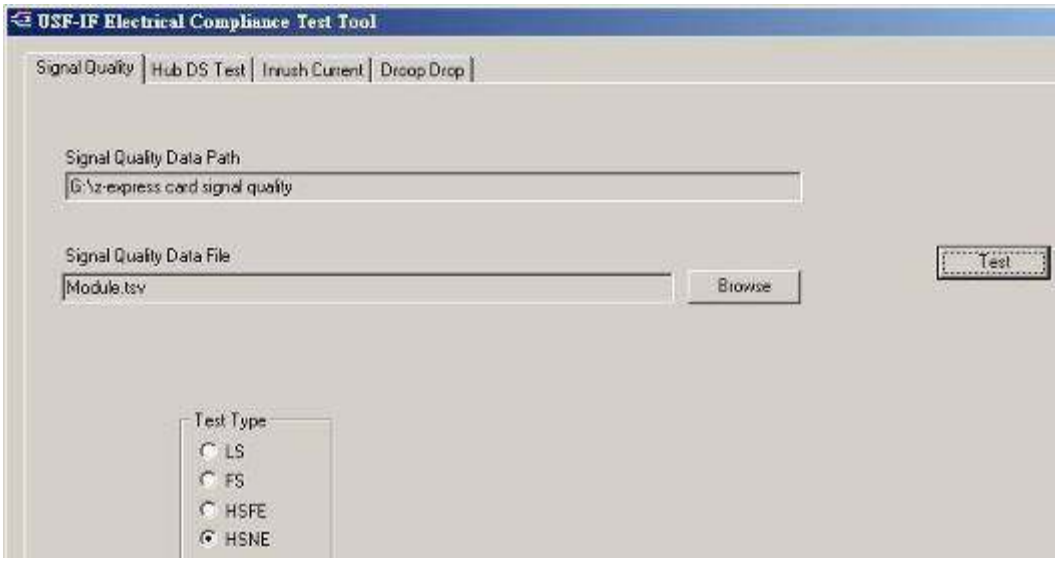


Figure 3-6: USBET – High Speed Signal Quality

3.2.1.1 Near End High Speed Signal Quality Test Results for Module

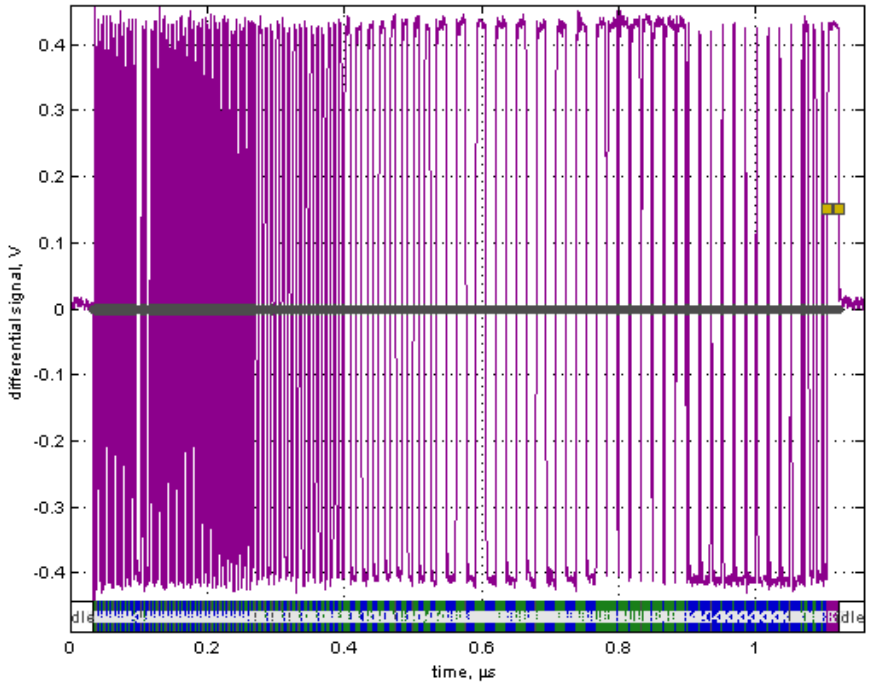
For details on test setup, methodology, and performance criteria, please consult the signal quality test description at the USB-IF Compliance Program web page.

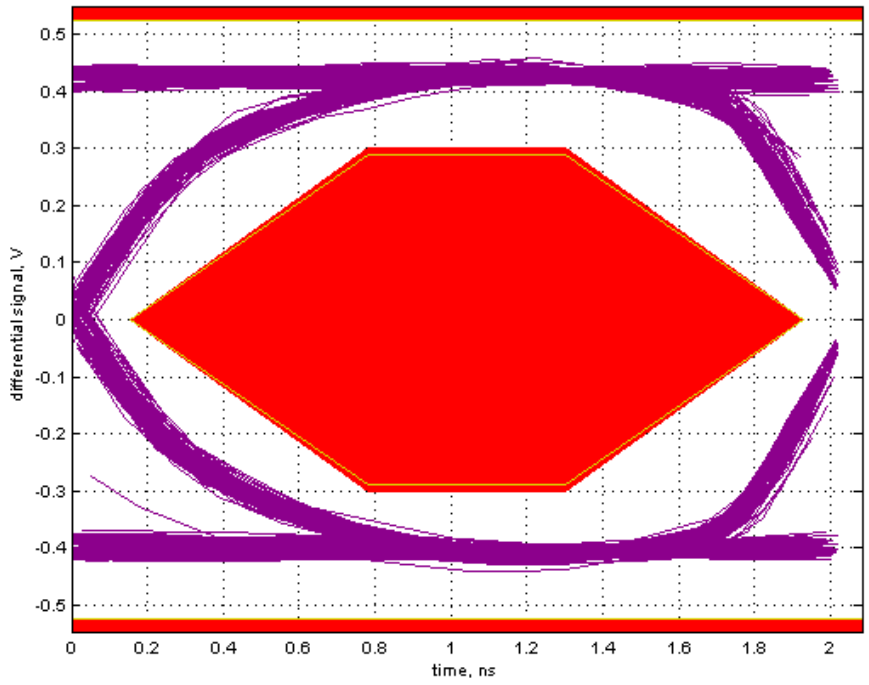
3.2.1.2 Required Tests

- Overall result:
  pass!

- Signal eye:
  eye passes
- EOP width: 7.98 bits
  EOP width passes
- Measured signaling rate: 480.0158MHz
  signal rate passes
- Rising Edge Rate: 940.29 V/us
  passes
- Falling Edge Rate: 847.17 V/us
  passes
- Additional Information
  Consecutive jitter range: -42.888ps to 75.694ps, RMS jitter 22.380ps
  Paired JK jitter range: -32.421ps to 35.245ps, RMS jitter 11.305ps
  Paired KJ jitter range: -50.590ps to 39.377ps, RMS jitter 12.457ps

3.2.1.3 Signal Data and Eye





3.2.2 USB Full Speed

1. Test Connection:

   a. Plug the EC-SQ-U test fixture into ExpressCard slot of the Test Bed system

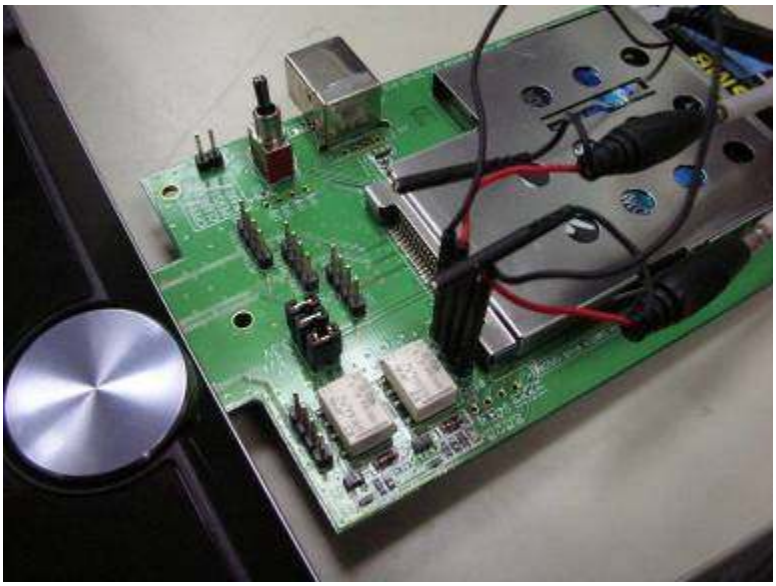
   b. Plug in the adjacent device to SQiDD board to USB port of the Test Bed system (Connect to the same USB controller with ExpressCard connector)

   c. Connect the device under test to the EC-SQ-U test fixture

   d. Attach the probe to J6 of the test fixture as shown as Figure 3-1

   e. Ensure the header adapter is used between J6 and the test fixture

   - Channel 1 D-, Channel 2 D+
   - Connect Channel 3 to D+ of the test fixture SQiDD for Upstream Full speed test



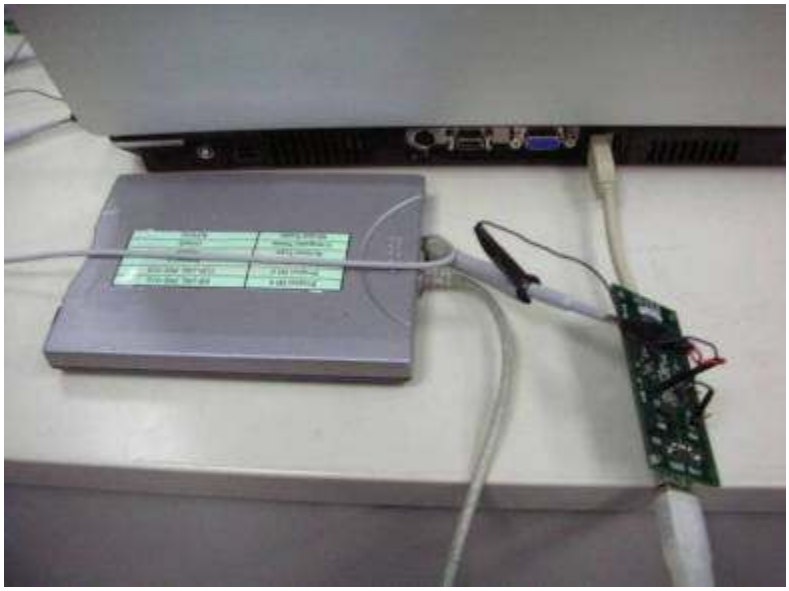


Figure 3-7: Probe Connection

2. USBHEST Setting:
   a. Select correct device and issue DEVICE DESCRIPTOR Command

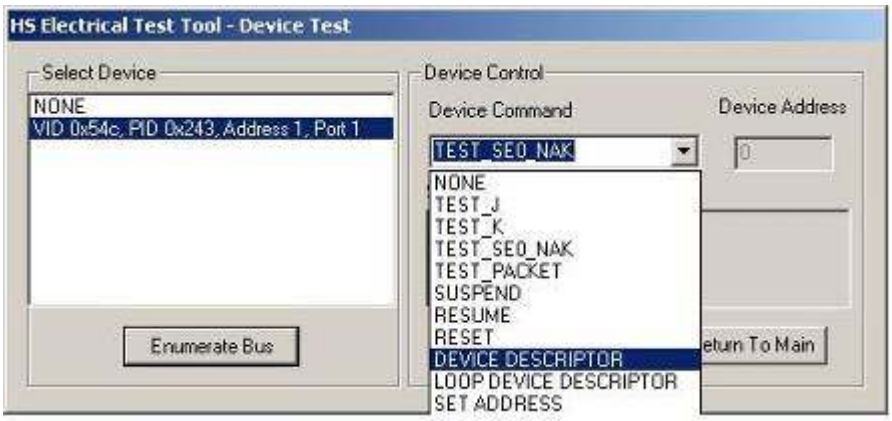


Figure 3-8: USBHSET

3. Scope Setting:
   a. 500ns/dvi, 2GS/s (500ps/pt)
   b. Export waveform as .csv file
4. USBET Setting:
   a. Make sure Test Type is selected correct
   b. Check Overall Result is passed

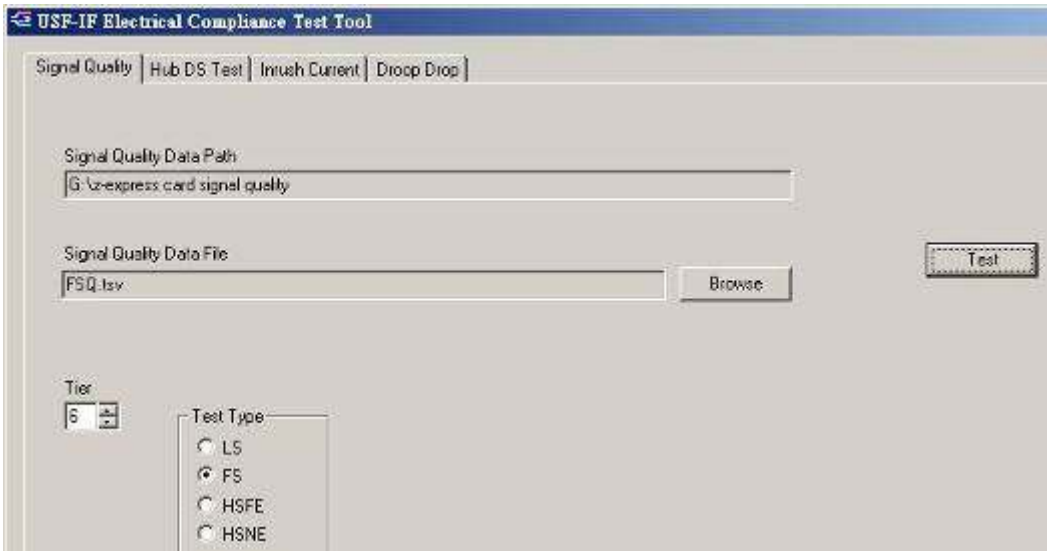


Figure 3-9: USBET – Full Speed Signal Quality

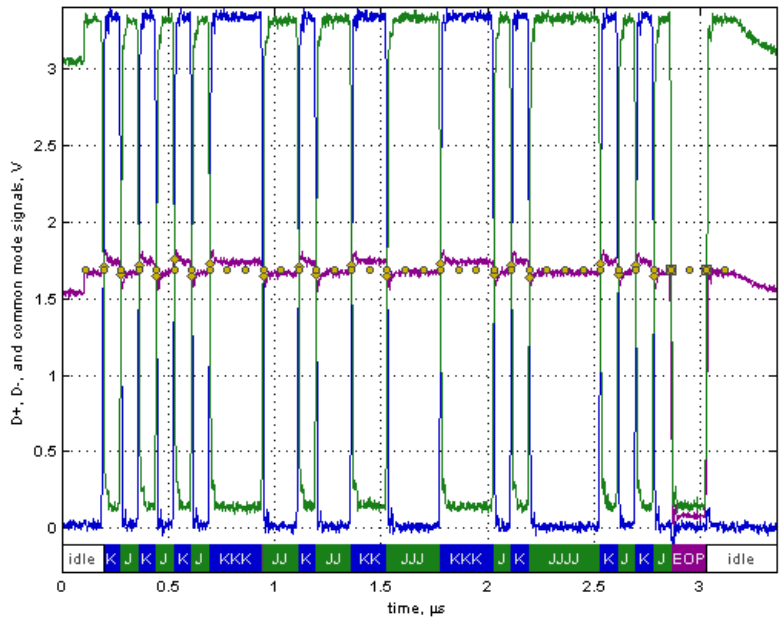
3.2.2.1 Full Speed Signal Quality Test Results for FSQ

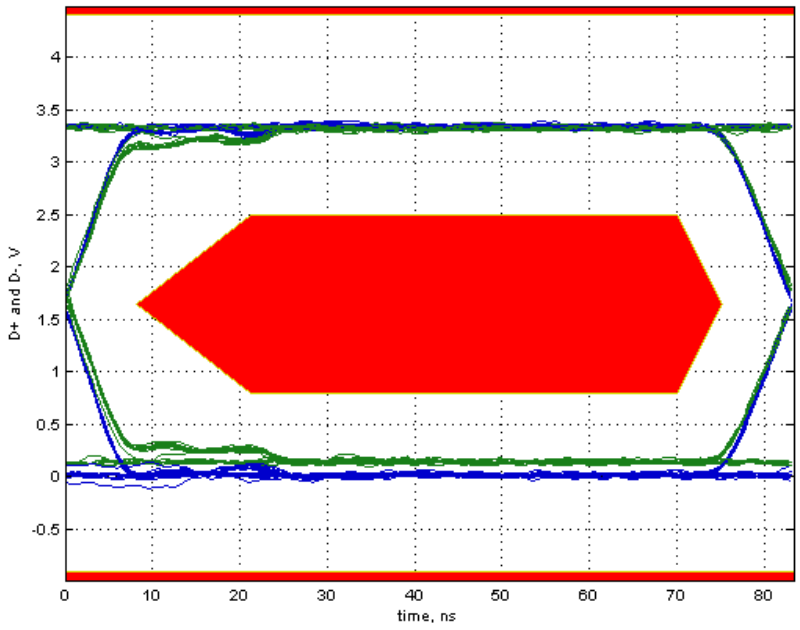
For details on test setup, methodology, and performance criteria, please consult the signal quality test description at the USB-IF Compliance Program web page.

3.2.2.2 Required Tests

- Overall result:
  pass!
- Signal eye:
  eye passes
- EOP width: 166.37ns
  EOP width passes
- Receivers: reliable operation on tier 6
  receivers pass
- Measured signaling rate: 11.9992MHz
  signal rate passes
- Crossover voltage range: 1.63V to 1.75V, mean crossover 1.69V
  (first crossover at 1.70V, 19 other differential crossovers checked)
  crossover voltages pass
- Consecutive jitter range: -191.983ps to 260.057ps, RMS jitter 173.198ps
  Paired JK jitter range: -179.920ps to 152.311ps, RMS jitter 120.929ps
  Paired KJ jitter range: -38.454ps to 58.334ps, RMS jitter 32.325ps
  jitter passes
- Additional Information
  Rising Edge Rate: 220.99 V/us (minimum 132.00 V/us, maximum 660.00 V/us)
  Falling Edge Rate: 224.96 V/us (minimum 132.00 V/us, maximum 660.00 V/us)
  Edge Rate Match: 1.77% (limit +/-10%)

3.2.2.3 Signal Data and Eye





4. HOST SYSTEM SIGNAL QUALITY TEST PROCEDURE

4.1 Host System PCI Express Interface Testing

1. Test Connection:
   a. Referring to Figure 4-1 below, Connect cables up as follows:
      - Digital Storage Oscilloscope channel 1 to the test fixture (EC-SI-P)TX LANE P
      - Digital Storage Oscilloscope channel 3 to the test fixture (EC-SI-P)TX LANE N

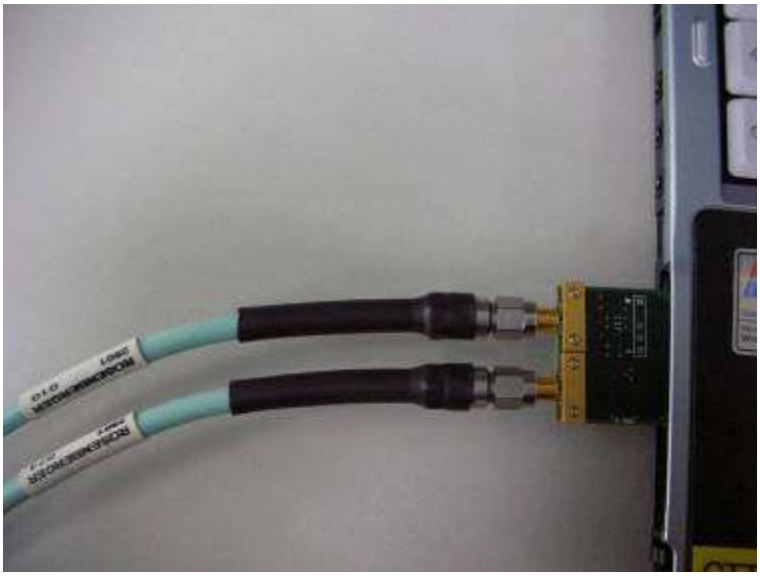


Figure 4-1: Express Card PCI Express Test Fixture Module (EC-SI-P)

2. Scope setting and waveform export:
   a. Set 1us/dvi, 20GS/s (50ps/pt)
   b. Export waveform as .csv file

3. SigTest Setting:
   a. Make sure Data Type, Technology, Template File are selected correctly

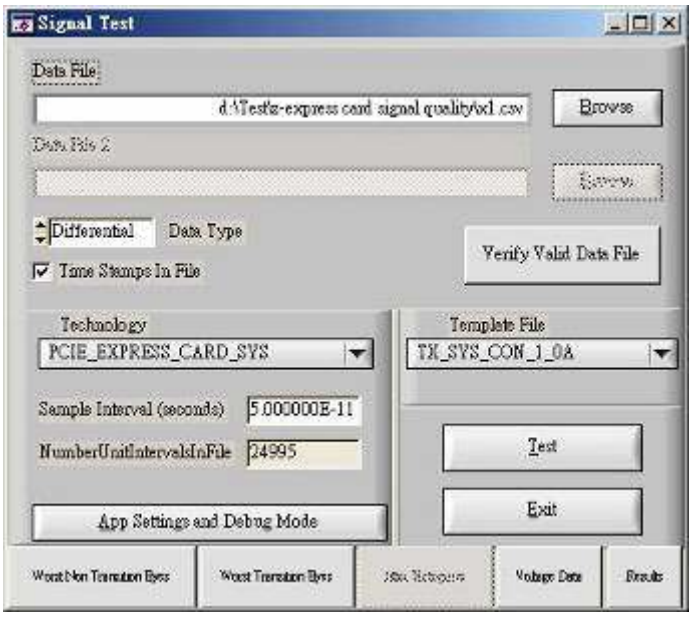


Figure 4-2: The SigTest Application

b. Check Full Test Result is passed

Figure 4-3: SigTest Full Test Result

4.2 Host System USB Interface Testing

4.2.1 USB High Speed

1. Test connection:

   a. Plug the EC-SQ-U test fixture into Express Card slot of the Test Bed system

   b. Attach the USB cable from USB port of the HUT to USB B receptacles connecter of the EC-SQ-U test fixture for 5V power supply

   c. Verify the red Power LED (D1) and the green Test LED (D2) are both lit

   d. Attach the differential probe to J5 of the test fixture as shown as Figure 4-4

   - Ensure the + Polarity on the probe line up with D+

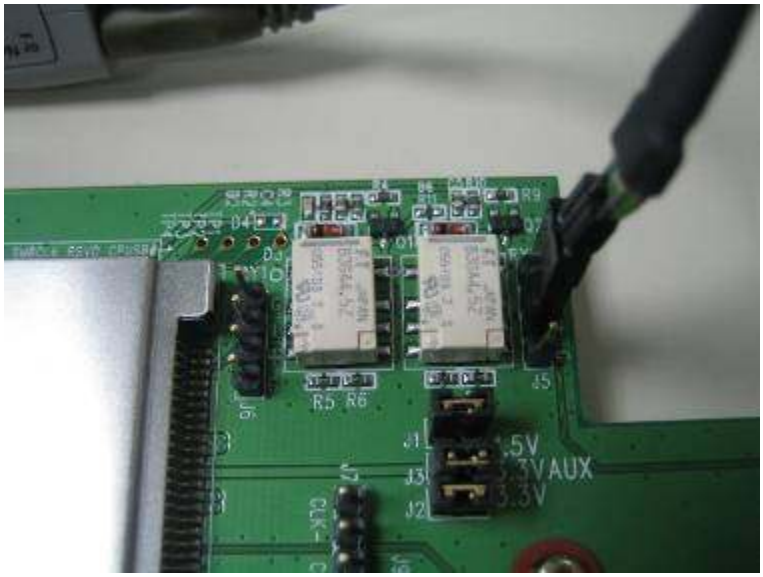


Figure 4-4: Differential Probe Connection

2. USBHEST Setting:
   a. Select correct controller and Port then issue TEST_PACKET Command

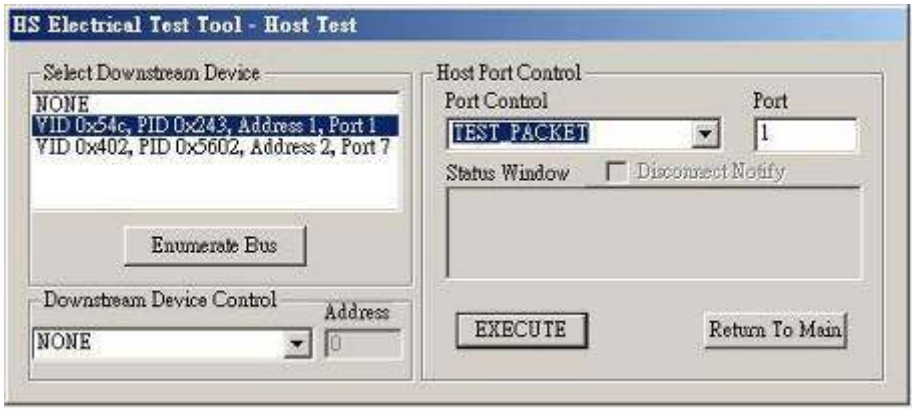


Figure 4-5: USBHSET

3. Scope Setting:
   a. 200ns/dvi, 20GS/s (50ps/pt)
   b. Export waveform as .csv file
4. USBET Setting:
   a. Make sure Test Type is selected correct
   b. Check Overall Result is passed

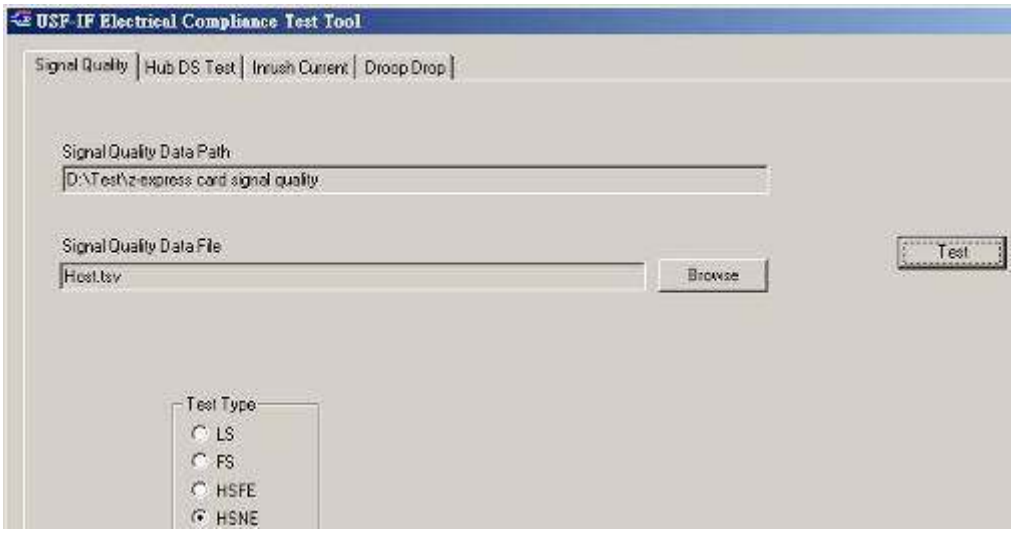


Figure 4-6: USBET – High Speed Signal Quality

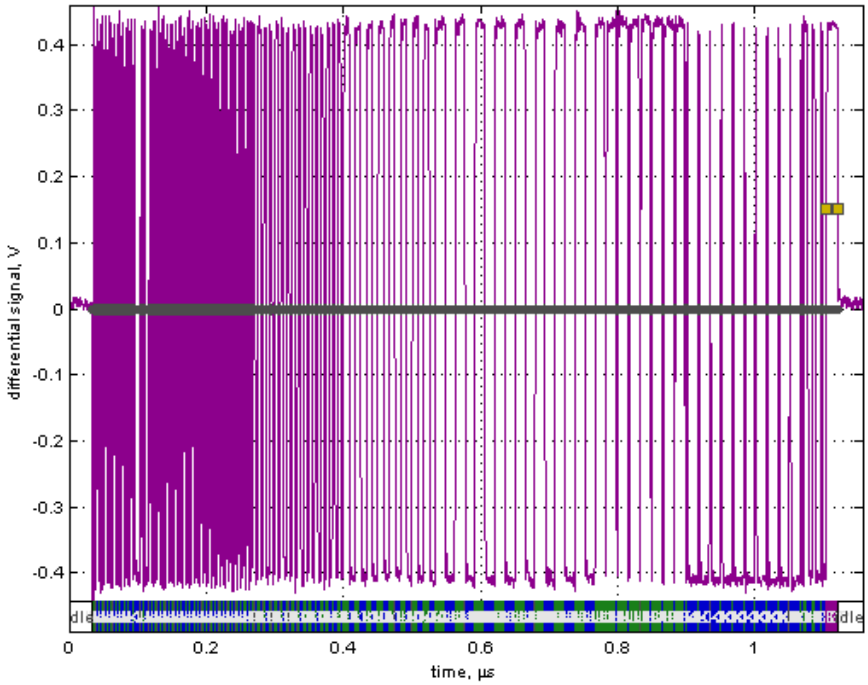
4.2.1.1 Near End High Speed Signal Quality Test Results for Module

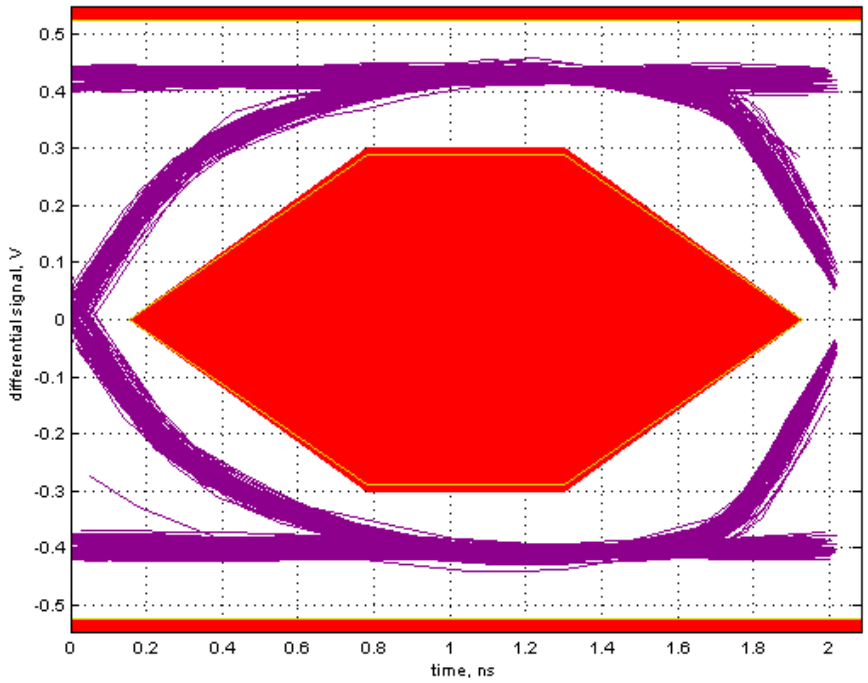
For details on test setup, methodology, and performance criteria, please consult the signal quality test description at the USB-IF Compliance Program web page.

4.2.1.2 Required Tests

- Overall result:
  pass
- Signal eye:
  eye passes
- EOP width: 7.98 bits
  EOP width passes
- Measured signaling rate: 480.0158MHz
  signal rate passes
- Rising Edge Rate: 940.29 V/us
  passes
- Falling Edge Rate: 847.17 V/us
  passes
- Additional Information
  Consecutive jitter range: -42.888ps to 75.694ps, RMS jitter 22.380ps
  Paired JK jitter range: -32.421ps to 35.245ps, RMS jitter 11.305ps
  Paired KJ jitter range: -50.590ps to 39.377ps, RMS jitter 12.457ps

4.2.1.3 Signal Data and Eye





4.2.2 USB Full Speed

1. Test Connection:
   a. Connect any Gold Module which implement USB interface to the test fixture(EC-SQ-U)
   b. Plug the test fixture into Express Card slot
   c. Attach the probe to J6 of the test fixture as shown as Figure 4-7
      - Ensure the header adapter is used between J5 and the test fixture
      - Channel 1 D-, Channel 2 D+

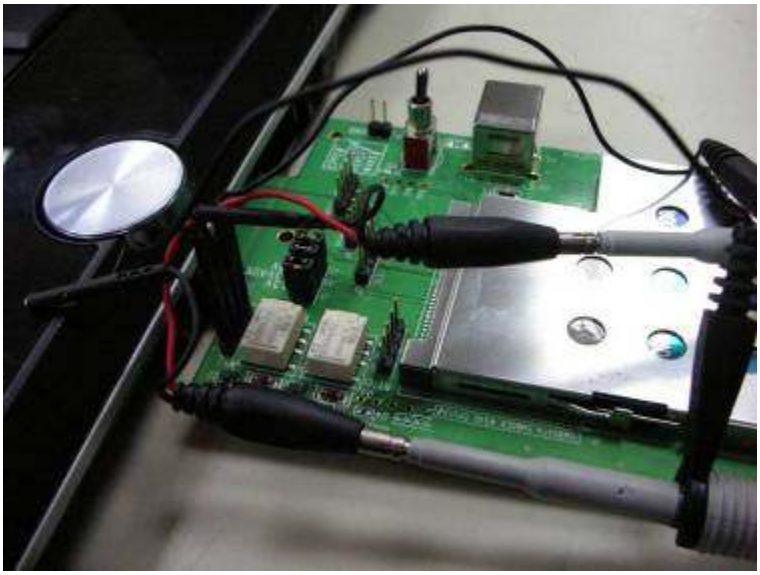


Figure 4-7: Probe Connection

2. Scope Setting:
   a. 500ns/dvi, 2GS/s (500ps/pt)
   b. Export waveform as .csv file
3. USBET Setting:
   a. Make sure Test Type is selected correct
   b. Check Overall Result is passed

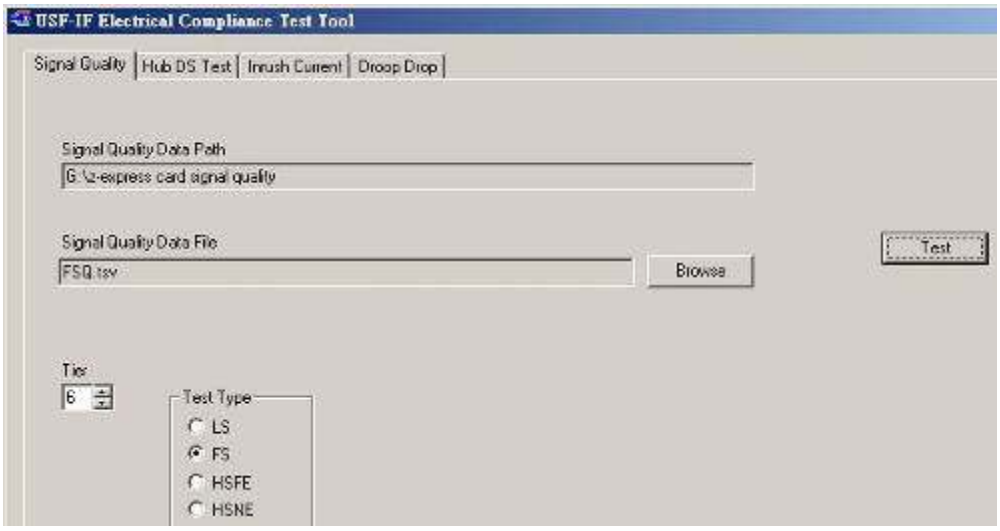


Figure 4-8: USBET – Full Speed Signal Quality

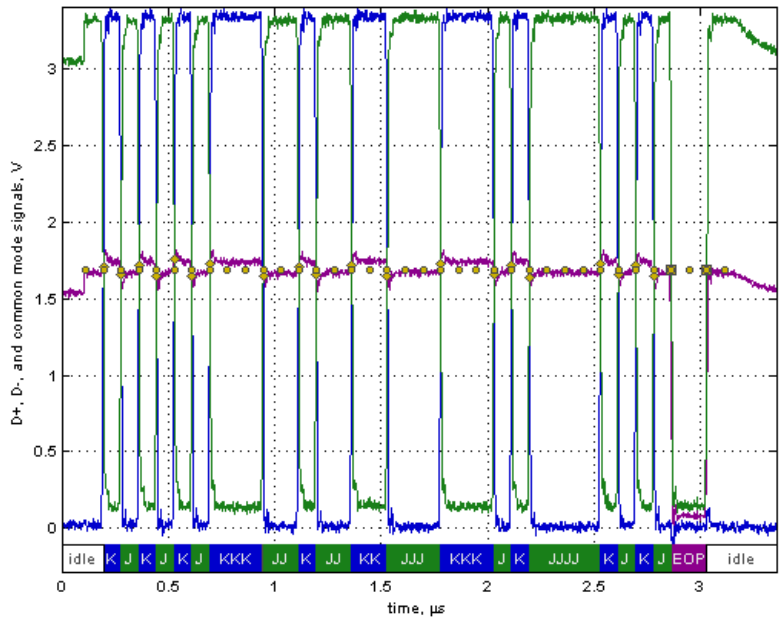
4.2.2.1 Full Speed Signal Quality Test Results for FSQ

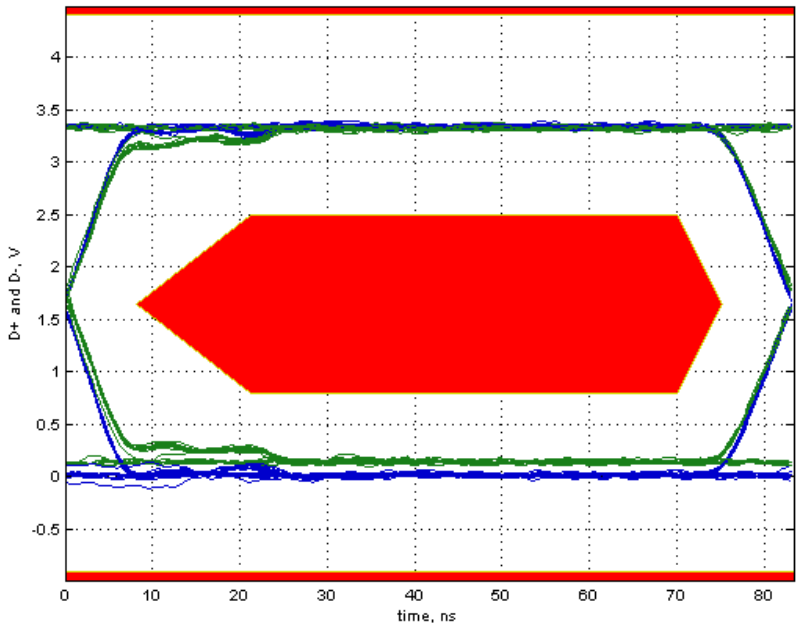
For details on test setup, methodology, and performance criteria, please consult the signal quality test description at the USB-IF Compliance Program web page.

4.2.2.2 Required Tests

- Overall result:
  pass
- Signal eye:
  eye passes
- EOP width: 166.37ns
  EOP width passes
- Receivers: reliable operation on tier 6
  receivers pass
- Measured signaling rate: 11.9992MHz
  signal rate passes
- Crossover voltage range: 1.63V to 1.75V, mean crossover 1.69V
  (first crossover at 1.70V, 19 other differential crossovers checked)
  crossover voltages pass
- Consecutive jitter range: -191.983ps to 260.057ps, RMS jitter 173.198ps
  Paired JK jitter range: -179.920ps to 152.311ps, RMS jitter 120.929ps
  Paired KJ jitter range: -38.454ps to 58.334ps, RMS jitter 32.325ps
  jitter passes
- Additional Information
  Rising Edge Rate: 220.99 V/us (minimum 132.00 V/us, maximum 660.00 V/us)
  Falling Edge Rate: 224.96 V/us (minimum 132.00 V/us, maximum 660.00 V/us)
  Edge Rate Match: 1.77% (limit +/-10%)

4.2.2.3 Signal Data and Eye





5. APPENDIX A – RESOURCE INFORMATION

5.1 Digital Storage Oscilloscope and Probe:

Please refer to manufacturer website

5.2 Test Fixtures

5.2.1 ExpressCard Test Fixture Board/Slot (PEC-1X)

http://www.expresscard.org/web/site/testtools.jsp

5.2.2 ExpressCard PCI Express Test Fixture Module (EC-SI-P)

http://www.expresscard.org/web/site/testtools.jsp

5.2.3 ExpressCard USB Test Fixture Module (EC-SQ-U)

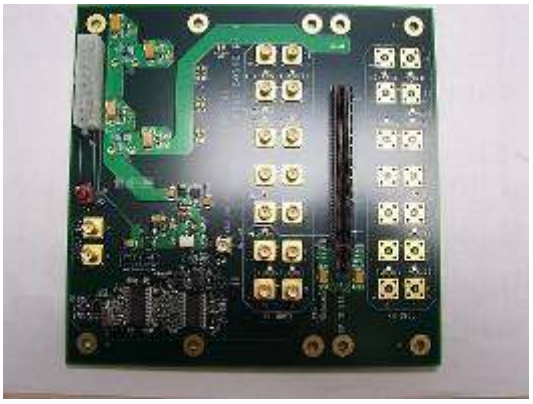
http://www.expresscard.org/web/site/testtools.jsp

5.2.4 USB Signal Quality Inrush Drop Droop Board (SQiDD)

http://www.allion.com/s_test-tool_fixtures.html

5.2.5 PCI Express Compliance Base Board (CBB)

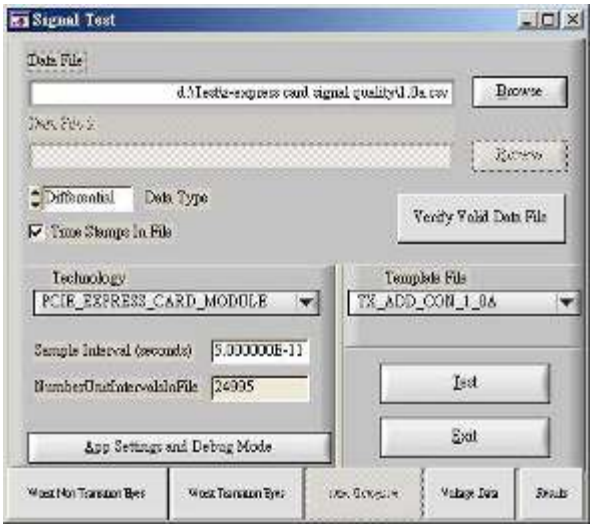
http://www.pcisig.com/specifications/order_form



5.3 Test Tools

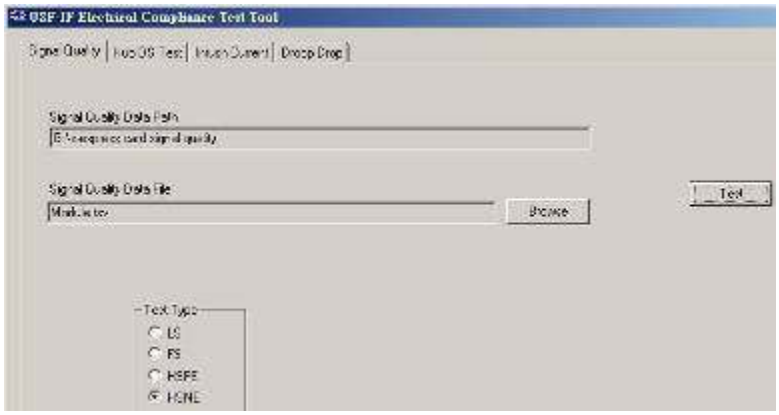
5.3.1 PCI Express Electrical Test Software: SigTest

http://www.pcisig.com/specifications/pciexpress/compliance/compliance_library



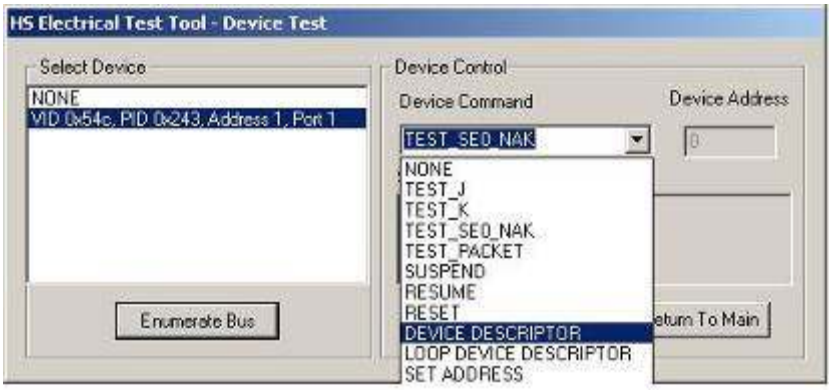
5.3.2 USB Electrical Analysis Tool: USBET

http://www.usb.org/developers/tools/



5.3.3 USB-IF HS Electrical test Tool: USBHSET

http://www.usb.org/developers/tools/



6. APPENDIX B – SIGNAL QUALITY CHECKLISTS

6.1 Signal Quality Checklist for Modules

Vendor Information			
Company Name:			
Contact Name:			
Tel:		Email:	
ExpressCard Module Product Information			
Model Name:			
Revision:		**Compliance Case ID #:**	
Module Interface:	☐ USB ☐ PCI Express	Module Width:	☐ 34mm ☐ 54mm

PCI-E Electrical Test	☐ **Yes**	☐ **N/A**
ExpressCard Module Tx, Unit Interval	☐ Pass	☐ Fail
ExpressCard Module Tx, Template Tests	☐ Pass	☐ Fail
ExpressCard Module Tx, Median to Max Jitter	☐ Pass	☐ Fail
ExpressCard Module Tx, Eye-Width	☐ Pass	☐ Fail
ExpressCard Module Tx, Peak Differential Output voltage	☐ Pass	☐ Fail
USB Electrical Test	☐ **Yes**	☐ **N/A**
High-Speed		
Transmitter Data Rate:	☐ Pass	☐ Fail
Eye Pattern:	☐ Pass	☐ Fail
Rising and Falling Time:	☐ Pass	☐ Fail
Monotonic Data Transition:	☐ Pass	☐ Fail
Full Speed Signal Quality	☐ Pass	☐ Fail

The section below must be completed by an authorized representative of the vendor applying for product compliance certification and by the Third Party Test House representative who performed the Interoperability Testing. Your signature affirms that the information provided above is true, that the product being submitted for compliance registration meets the stated requirements of the checklist and that it is understood that if any changes are made to these products that may potentially impact the product's ability to continue to meet these requirements that the modified product should be re-verified to these requirements and resubmitted for a new registration.

Third Party Test House Representative		**ExpressCard Module Vendor**	
Test House:		Company:	
Name:		Name:	
Title:		Title:	
Signature:		Signature:	
Date:		Date:	

6.2 Signal Quality Checklist for Host Systems

Vendor Information			
Company Name:			
Contact Name:			
Tel:		Email:	
ExpressCard Host System Product Information			
Model Name:			
Revision:		**Compliance Case ID #:**	
Socket:	☐ Universal ☐ 34 mm ☐ Multiple (describe):		

PCI-E Electrical Test	☐ **Yes**	☐ **N/A**
ExpressCard Module Tx, Unit Interval	☐ Pass	☐ Fail
ExpressCard Module Tx, Template Tests	☐ Pass	☐ Fail
ExpressCard Module Tx, Median to Max Jitter	☐ Pass	☐ Fail
ExpressCard Module Tx, Eye-Width	☐ Pass	☐ Fail
ExpressCard Module Tx, Peak Differential Output voltage	☐ Pass	☐ Fail
USB Electrical Test	☐ **Yes**	☐ **N/A**
High-Speed		
Transmitter Data Rate:	☐ Pass	☐ Fail
Eye Pattern:	☐ Pass	☐ Fail
Rising and Falling Time:	☐ Pass	☐ Fail
Monotonic Data Transition:	☐ Pass	☐ Fail
Full Speed Signal Quality	☐ Pass	☐ Fail

The section below must be completed by an authorized representative of the vendor applying for product compliance certification and by the Third Party Test House representative who performed the Interoperability Testing. Your signature affirms that the information provided above is true, that the product being submitted for compliance registration meets the stated requirements of the checklist and that it is understood that if any changes are made to these products that may potentially impact the product's ability to continue to meet these requirements that the modified product should be re-verified to these requirements and resubmitted for a new registration.

Third Party Test House Representative		**ExpressCard Host System Vendor**	
Test House:		Company:	
Name:		Name:	
Title:		Title:	
Signature:		Signature:	
Date:		Date:	