Open Networking Consortium

Open Network Systems Interoperability Test Report

UNH-IOL — 21 Madbury Road, Suite 100 — Durham, NH 03824 — +1-603-862-0090

Robert Lockwood
Siemon Company
Robert_lockwood@siemon.com

August 15, 2016

Enclosed are the results from the Open Network Systems Interoperability Plugfest performed on:

Module or Cable Assembly Under Test (MUT/CUT):

Vendor and Device Type	Siemon QSFP28 100G DAC
Part Number	QSFP28-30-02

Host Under Test (HUT):

Host System 1 Composition	
Network Operating System	Cumulus
OS Version	3.1
Bare Metal Switch	Mellanox
Part Number	SN2700
ONIE Version	2014.08

This testing pertains to the Open Network Systems Interoperability Test Plan, which outlines a series of tests performed on a variety of optical transceivers and cables with bare-metal open switches running Network Operating Systems from multiple vendors. The focus of these tests was basic interoperability which aims to validate the operation of open network systems.

As always, we welcome any comments regarding this Test Suite. If you have any questions about the test procedures or results, please feel free to contact me via e-mail at david@iol.unh.edu or by phone at +1-603-862-0090.

Regards,
David Woolf

Digital Signature Information

This document was created using an Adobe digital signature. A digital signature helps to ensure the authenticity of the document, but only in this digital format. For information on how to verify this document's integrity proceed to the following site:

https://www.iol.unh.edu/testing/reports/certificate-install

If the document status still indicates "Validity of author NOT confirmed", then please contact the UNH-IOL to confirm the document's authenticity. To further validate the certificate integrity, Adobe 6.0 should report the following fingerprint information:

MD5 Fingerprint (2016): 39 96 A4 8C 02 E0 38 DA F7 AB E1 ED BD E9 B5 F0
SHA-1 Fingerprint (2016): 41 EE 65 F4 8A 6A 3A A6 3D AF 63 F4 78 7D 97 7B 48 49 C9 DD

Digitally signed by UNH-IOL
Date: 2017.01.27 13:52:41 -05'00'

In section 2, the following equipment was used:

Test System Hardware	
EEPROM Reader	Avago Aport USB-MDIO/TWI Interface Controller

In section 3, the following equipment was used:

Test System Hardware	
Network Analyzer	Agilent E5071C

In section 4, the following equipment was used:

Test System Hardware	
Wide Bandwidth Oscilloscope	Agilent DCA-X 86100D
Waveform Analyzer	Agilent 86105C
50GHz Waveform Analyzer	Agilent DCA-86108B
Clock Recovery Module	Agilent 83496A
High Performance Serial BERT	Agilent N4903B
Signal Quality Analyzer	Anritsu MP1800A with MU181020B 14Gbps PPG* Modules
De-Emphasis Signal Converter	Agilent N4916B

*Two modules used during testing

In section 6, an Ixia XM12 was used to generate test traffic:

Test System Hardware	
Ethernet Traffic Generator	Ixia XM12
Software Version	IxOS 8.10 EA
Port Types	QSFP28

The following table contains possible results and their meanings.

Result	Interpretation
PASS	The Device Under Test (DUT) was observed to exhibit conformant behavior.
PASS W/ Comments	The specified behavior is demonstrated by the DUT, however this result indicates that either changes were made to the standard test procedure or results other than the expected results were observed.
FAIL	The DUT was observed to exhibit non-compliant behavior.
INFO	This Test is designed for informational purposes only. While the results may help ensure the interoperability of the DUT, a PASS/FAIL is not given for this test.
WARN	The DUT was observed to exhibit behavior that is not recommended.
N/A	Not Applicable. This test is not applicable for the DUT.
N/S	Not Supported. This test was not run due to features not implemented on the DUT.
N/T	Not tested. This test was not run.

Summary of Results- Conformance	
Test	**Result**
Test 1.1: ONIE Compliance Environment	**N/A**
Test 1.2: Installing and uninstalling a NOS through ONIE via HTTP server	**PASS**
Test 3.1.1: Return Loss for 100G Passive Cable	**PASS**
Test 3.1.2: Insertion Loss for 100G Passive Cable	**PASS**
Test 5.1.1: Output Rise and Fall Times for 100G Host	**PASS**
Test 5.1.2: Transmitter Eye Mask for 100G Host	**PASS**
Test 5.1.3: Total Jitter for 100G Host	**PASS**
Test 5.1.4: Input and Output Return Loss on 100G Host	**PASS**

Summary of Results - Interoperability	
Test	**Result**
Test 2.1: Physical Compatibility with Supporting Devices	**PASS**
Test 2.2: Host Management of Module or Cable Assembly	**PASS**
Test 2.3: Diagnostic Optical Monitor Support	**PASS**
Test 6.1: Establish Baseline Performance Analysis	**PASS**
Test 6.2: Link Detection on Power Up	**PASS**
Test 6.3:Packet Error Rate Estimation	**PASS**
Test 6.4: Packet Loss/Stress Test	**PASS**

Notes

Conformance Test Results	
Test Information	**Test Result**
Test 1.1: **ONIE Compliance Environment** *Purpose*: To verify that a host can pass a random sampling of ONIE Compliance Environment tests.	**N/A**
Comments on Test Procedure	
The random sampling of tests from the ONIE Compliance Environment was not used.	
Comments on Test Results	
Additional Comments	
This test is only applicable to Hosts which have not performed ONIE compliance testing previously.	

Test Information	**Test Result**
Test 1.2: **Installing and uninstalling a NOS through ONIE via HTTP server** *Purpose*: To verify that a NOS can be successfully installed through ONIE.	**PASS**
Comments on Test Procedure	
This test was completed using the standard procedure as written in the Test Plan. The random sampling of tests from the ONIE Compliance Environment was not used.	
Comments on Test Results	
Part A: The DUT was able to install the NOS via ONIE. **Part B:** The DUT was able to uninstall the NOS via ONIE.	
Additional Comments	

Test Information	**Test Result**
Test 3.1.1: **Return loss for 100G Passive Cable** *Purpose*: To verify that the return loss of the DUT is within the conformance limits provided by SFF-8431 Appendix E, Table 37.	**PASS**
Comments on Test Procedure	
This test was completed using the standard procedure.	
Comments on Test Results	
The differential return loss observed did not violate the limits governed by SFF-8431 Appendix E.4, Table 37 for 10GBASE-CR passive cables: $$SDD11, SDD22 \geq \begin{Bmatrix} 12 - 2\sqrt{f}, & 0.01 \leq f < 4.1 \\ 6.3 - 13\log_{10}\frac{f}{5.5}, & 4.1 \leq f \leq 11.1 \end{Bmatrix} (db)$$	
Additional Comments	

Test Information	**Test Result**
Test 3.1.2: **Insertion Loss for 100G Passive Cable** *Purpose*: To verify that the insertion loss of the Cable under test is within the conformance limits provided by IEEE Std. 802.3-2012 Annex , Table 37.	**PASS**
Comments on Test Procedure	
This test was completed using the standard procedure.	
Comments on Test Results	
The insertion loss of the cable under test does not violate the requirements passive cable assemblies. $$3dB \leq SDD21, SDD12 \leq 17.04dB, \quad at\ 5.15625\ GHz$$	
Additional Comments	

Test Information	**Test Result**
Test 5.1.1: **Output Rise and Fall Times for 100G Host** *Purpose*: To verify that the Eye Mask Hit Ratio is within the conformance limits.	**PASS**
Comments on Test Procedure	
The test was completed with the standard procedure.	
Comments on Test Results	
The device under test exhibited the expected behavior.	
Additional Comments	

Test Information	**Test Result**
Test 5.1.2: **Transmitter Eye Mask on 100G Host** *Purpose*: To verify that the Eye Mask Hit Ratio is within the conformance limits.	**PASS**
Comments on Test Procedure	
The test was completed with the standard procedure.	
Comments on Test Results	
The device under test exhibited the expected behavior.	
Additional Comments	

Test Information	**Test Result**
Test 5.1.3: **Total Jitter for 100G Host** *Purpose*: To verify that the Total Jitter (TJ) is within the conformance limit.	**PASS**
Comments on Test Procedure	
The test was completed with the standard procedure.	
Comments on Test Results	
The device under test exhibited the expected behavior.	
Additional Comments	

Test Information	**Test Result**
Test 5.1.4: **Input and Output Return Loss on 100G Host** *Purpose*: To verify that the differential input and output return loss of the DUT is within conformance limits.	**PASS**
Comments on Test Procedure	
The test was completed with the standard procedure.	
Comments on Test Results	
The device under test exhibited the expected behavior.	
Additional Comments	
See Appendix B	

Interoperability Test Results	
Test Information	**Test Result**
Test 2.1: **Physical Compatibility with Supporting Devices** *Purpose*: To verify that the mechanical form factor is compatible with devices for interoperability purposes.	**PASS**
Comments on Test Procedure	
The test was completed with the standard procedure.	
Comments on Test Results	
Part A: The MUT/CUT was able to be inserted into the Host. **Part B:** This test is not applicable to Cable Assemblies. **Part C:** The MUT/CUT was able to be removed from the Host.	
Additional Comments	

Test Information	**Test Result**
Test 2.2: **Host Management of Module or Cable Assembly** *Purpose*: To verify that the MUT/CUT is manageable via the Host complex.	**PASS**
Comments on Test Procedure	
The test was completed with the standard procedure.	
Comments on Test Results	
Part B: The EEPROM data of the MUT/CUT was readable. The serial number and vendor information extracted from the EEPROM data matches the serial number and vendor information of the part.	
Additional Comments	

Test Information	**Test Result**
Test 2.3: **Diagnostic Optical Monitor Support** *Purpose*: To verify that the MUT/CUT (active optical cable only) supports diagnostic functions via the Host complex.	**PASS**
Comments on Test Procedure	
The test was completed with the standard procedure.	
Comments on Test Results	
Part A: The MUT/CUT supports diagnostic monitoring and the diagnostic information from the EEPROM was readable by the NOS.	
Additional Comments	

Test Information	**Test Result**
Test 6.1: **Establish Baseline Performance Analysis** *Purpose*: To establish a baseline performance analysis of the HUT.	**PASS**
Comments on Test Procedure	
This test was completed using a modified procedure. Because of a lack of 40G Golden Modules, the Host was baselined using each 40G MUT/CUT.	
Comments on Test Results	
The baseline performance of the Host was determined to be 90% line rate. All proceeding tests in Group 6 were conducted using this line rate.	
Additional Comments	

Test Information	**Test Result**
Test 6.2: **Detection on Power Up** *Purpose*: To determine if the MUT/CUT, HUT and LP establish a link while varying the power up sequence.	**PASS**
Comments on Test Procedure	
This test was completed using the standard procedure.	
Comments on Test Results	
Part A: The Host and Link Partner were able to establish a valid link with this MUT/CUT while fully powered and operational. **Part B:** The Host and Link Partner were able to establish a valid link with this MUT/CUT when the Link Partner was powered on after the Host. **Part C:** The Host and Link Partner were able to establish a valid link with this MUT/CUT when the Host was powered on after the Link Partner.	
Additional Comments	

Test Information	**Test Result**
Test 6.3:**Packet Error Rate Estimation** *Purpose*: To determine if a Host can exchange packets with a Module or Cable Assembly such that a bit error rate of 10^{-12} is achieved	**PASS**
Comments on Test Procedure	
This test was completed using the standard procedure.	
Comments on Test Results	
Part A: All 247,000,000 frames transmitted by TS1 were received by TS2. **Part B:** All 10,506,539,320 frames transmitted by TS1 were received by TS2.	
Additional Comments	

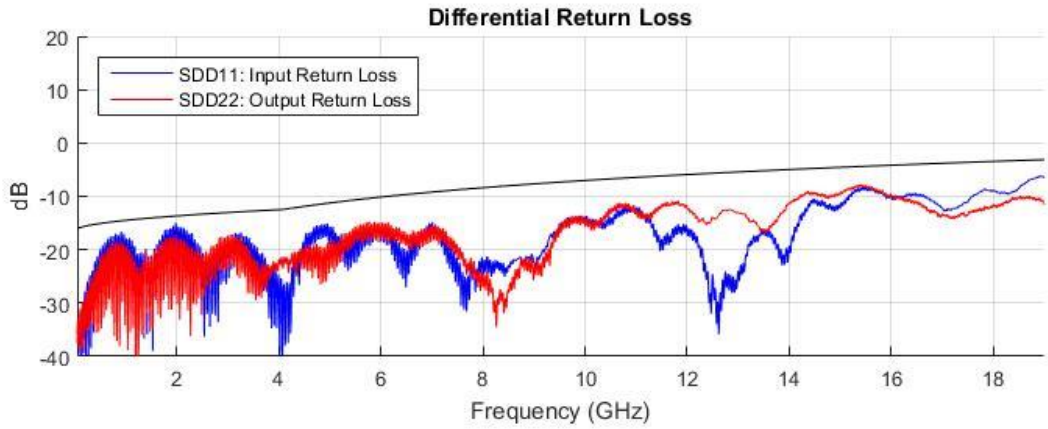
Test Information	**Test Result**
Test 6.4: **Packet Loss/Stress Test** *Purpose*: To verify that no obvious buffer management problems occur when directing a large volume of traffic at the Host and Module/Cable Assembly combination.	**PASS**
Comments on Test Procedure	
This test was completed using the standard procedure.	
Comments on Test Results	
Parts A-D: All 1,000,000,000 64-byte frames transmitted by TS1 were received by TS2. All 1,000,000,000 1518-byte frames transmitted by TS1 were received by TS2.	
Additional Comments	
**Test 6.4 C&D N/T	

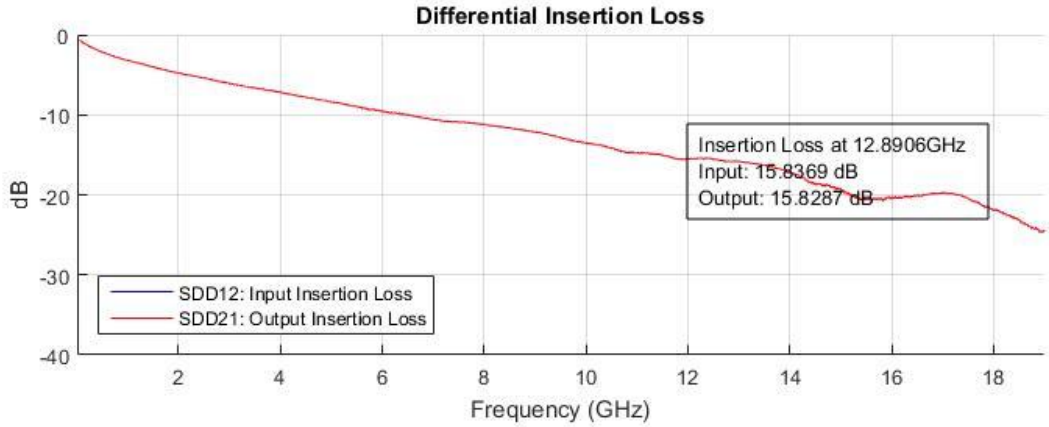
Appendix A: EEPROM Data

```
Siemon           QSFP+ module
Part Number: QSFP28-26-03      Serial Number: 16189001749
Siemon___16189001749______EEPROMdecode_20160808175735.txt

SERIAL_ID Keys:
BR_NOMINAL: 25750
CONNECTOR: 35
CU_ATTENUATE_2_5: 0
CU_ATTENUATE_5_0: 0
DEVICE_TECH: 0xa0
ENCODING: 0
EXTENDED_MODULE: 0x1f
EXT_IDENTIFIER: 0
EXT_RATE_COMPLY: 0
IDENTIFIER: 13
LENGTH_OM1_62_5UM: 0
LENGTH_OM2_50UM: 0
LENGTH_OM3_50UM: 0
LENGTH_OM4_OR_CU: 3
LENGTH_SMF_KM: 0
MAX_CASE_TEMP: 70
SPEC_COMPLIANCE: 0x88 0x0 0x0 0x0 0x0 0x0 0x80 0xf5
VENDOR_NAME: Siemon
VENDOR_OUI: 0x0 0x1e 0x62
VENDOR_PN: QSFP28-26-03
VENDOR_REV: 00
WAVELENGTH: 64.4
WAVELEN_TOLERANCE: 12.88

Vendor Specific: 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0
0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0 0x0
0x0 0x0

I2C Address A0h, bytes 0-127, in hex
0000x:  0d070600 00000000 00000000 00000000
0010x:  00000000 00000000 00000000 00000000
0020x:  00000000 00000000 00000000 00000000
0030x:  00000000 00000000 00000000 00000000
0040x:  00000000 00000000 00000000 00000000
0050x:  00000000 00000000 00000000 00000000
0060x:  00000000 00000000 00000000 00003800
0070x:  00000000 00000000 00000000 00000000

I2C Address A0h, page 0, bytes 128-255, in hex
0000x:  0d002388 00000000 0080f500 ff000000
0010x:  000003a0 5369656d 6f6e2020 20202020
0020x:  20202020 1f001e62 51534650 32382d32
0030x:  362d3033 20202020 30300508 0a10462f
0040x:  0c000000 31363138 39303031 37343920
```

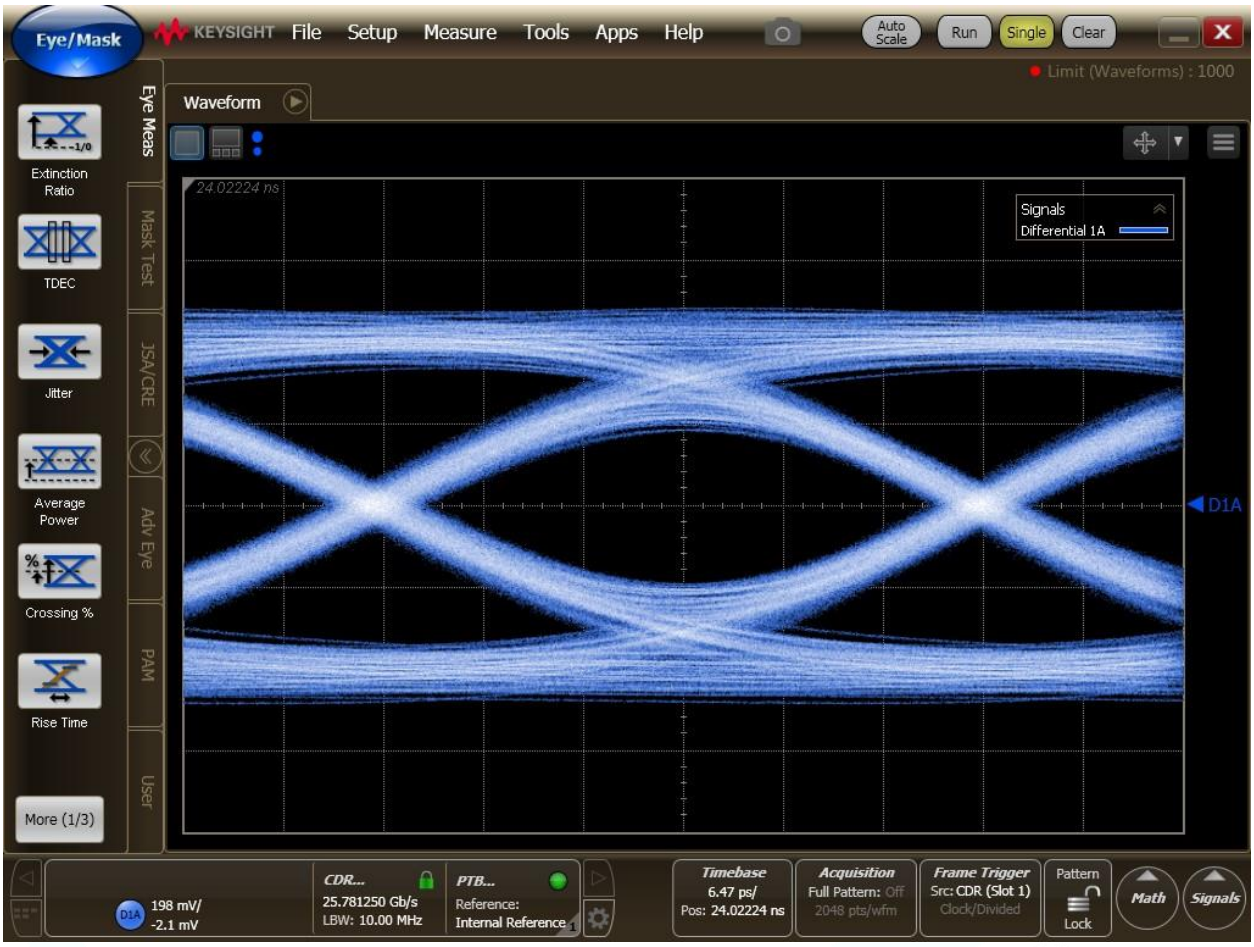
```
0050x:  20202020 31363037 30373030 000067e6
0060x:  00000000 00000000 00000000 00000000
0070x:  00000000 00000000 00000000 00000000
```

Appendix B: Pluggable Module / Cable Electrical Data

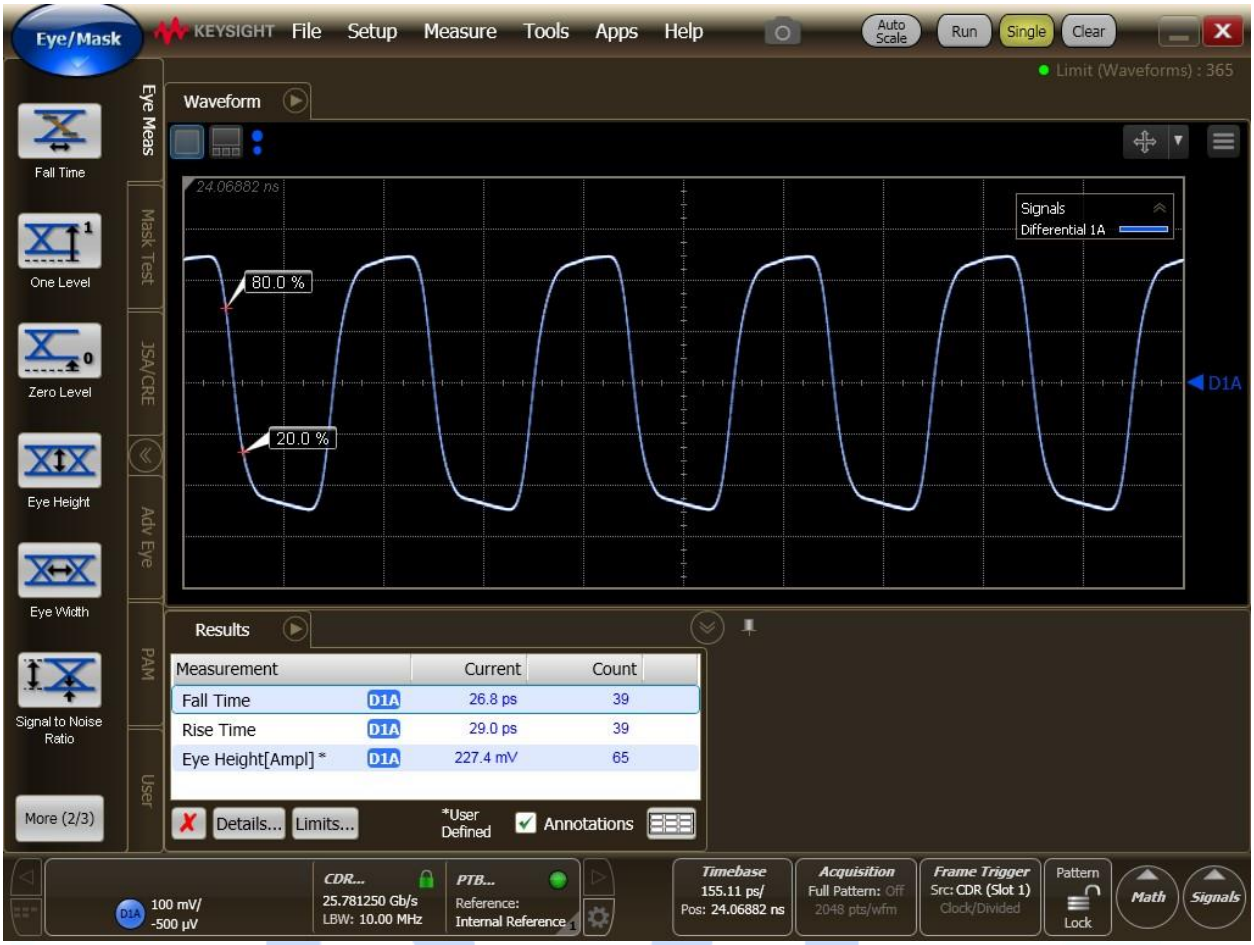


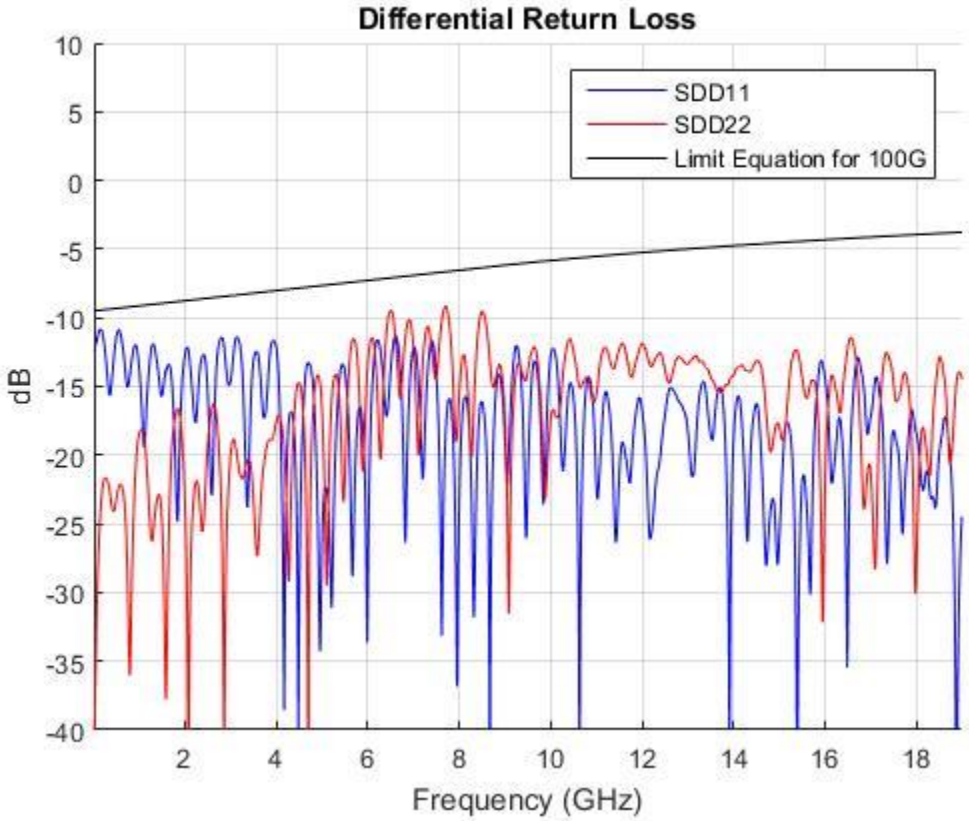


Appendix C: Host Electrical Data



Jitter/Noise
KEYSIGHT
File
Setup
Measure
Tools
Apps
Help
Auto Scale
Run
Stop
Clear
Graphs
RJ/PJ Histogram
Samples: 1.82M
-70.0 mUI
0 UI
70.0 mUI
TJ Histogram
Samples: 2.73M
-140 mUI
0 UI
140 mUI
DDJ Histogram
Samples: 914k
-80.0 mUI
0 UI
80.0 mUI
Composite TJ Histogram
TJ
RJ/PJ
DDJ
-140 mUI
0 UI
140 mUI
Amplitude Meas ON
RN/PI Histogram
ISI Histogram
TI Histogram
ISI vs Bit
Composite TI Histogram
More (1/2)
Time
Amplitude
Meas
JSA/CRE
Jitter
Waveform
Amplitude
Src: D1A Rate: 25.782311 Gb/s Pat. Length: 511
TJ (1.0E-15): 306.6 mUI
DJ (δ - δ): 143.4 mUI
RJ (rms): 10.50 mUI
PJ (δ - δ): 18.6 mUI
DDJ (p-p): 153.2 mUI
DCD: 3.4 mUI
PJ (rms): 8.20 mUI
ISI-J (p-p): 153.2 mUI
Details...
Limits...
Measurement
Current
Count
Eye Opening D1A 337.20 mV 174
Signal Amplitude D1A 627 mV 176
TI (1.0E-15) Ones D1A 317.30 mV 174
TI (1.0E-15) Zeros D1A 299.35 mV 174
RN (rms) Ones D1A 864 µV 174
RN (rms) Zeros D1A 862 µV 174
DI (δ - δ) Ones D1A 303.85 mV 174
DI (δ - δ) Zeros D1A 285.98 mV 174
198 mV/
2.8 mV
CDR...
25.781250 Gb/s
LBW: 10.00 MHz
PTB...
Reference:
Internal Reference
Timebase
6.46 ps/
Pos: 24.03457 ns
Acquisition
Jitter Mode
Acquisition
Frame Trigger
Src: CDR (Slot 1)
25.782311 Gb/s
511 bits
Pattern
Lock
Math
Signals


Eye/Mask
KEYSIGHT
File
Setup
Measure
Tools
Apps
Help
Auto Scale
Run
Single
Clear
Limit (Waveforms) : 365
Eye Meas
Mask Test
JSA/CRE
Adv Eye
PAM
User
Fall Time
One Level
Zero Level
Eye Height
Eye Width
Signal to Noise Ratio
More (2/3)
Waveform
24.06882 ns
Signals
Differential 1A
80.0 %
20.0 %
D1A
Results
Measurement
Current
Count
Fall Time
D1A
26.8 ps
39
Rise Time
D1A
29.0 ps
39
Eye Height[Ampl] *
D1A
227.4 mV
65
Details...
Limits...
*User Defined
Annotations
D1A
100 mV/
-500 µV
CDR...
25.781250 Gb/s
LBW: 10.00 MHz
PTB...
Reference:
Internal Reference
Timebase
155.11 ps/
Pos: 24.06882 ns
Acquisition
Full Pattern: Off
2048 pts/wfm
Frame Trigger
Src: CDR (Slot 1)
Clock/Divided
Pattern
Lock
Math
Signals


Differential Return Loss
SDD11
SDD22
Limit Equation for 100G
dB
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
2
4
6
8
10
12
14
16
18
Frequency (GHz)