Open Networking Testing Service

Open Network Systems Interoperability Test Report

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April 18, 2018

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

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

Vendor and Device Type	10Gtek QSFP
Part Number	ALQ10-LR4-10

Host Under Test (HUT):

Host System 1 Composition	
Network Operating System	Cumulus
OS Version	3.5
Bare Metal Switch	Edge-Core 7712
Part Number	7712
ONIE Version	2018.02

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

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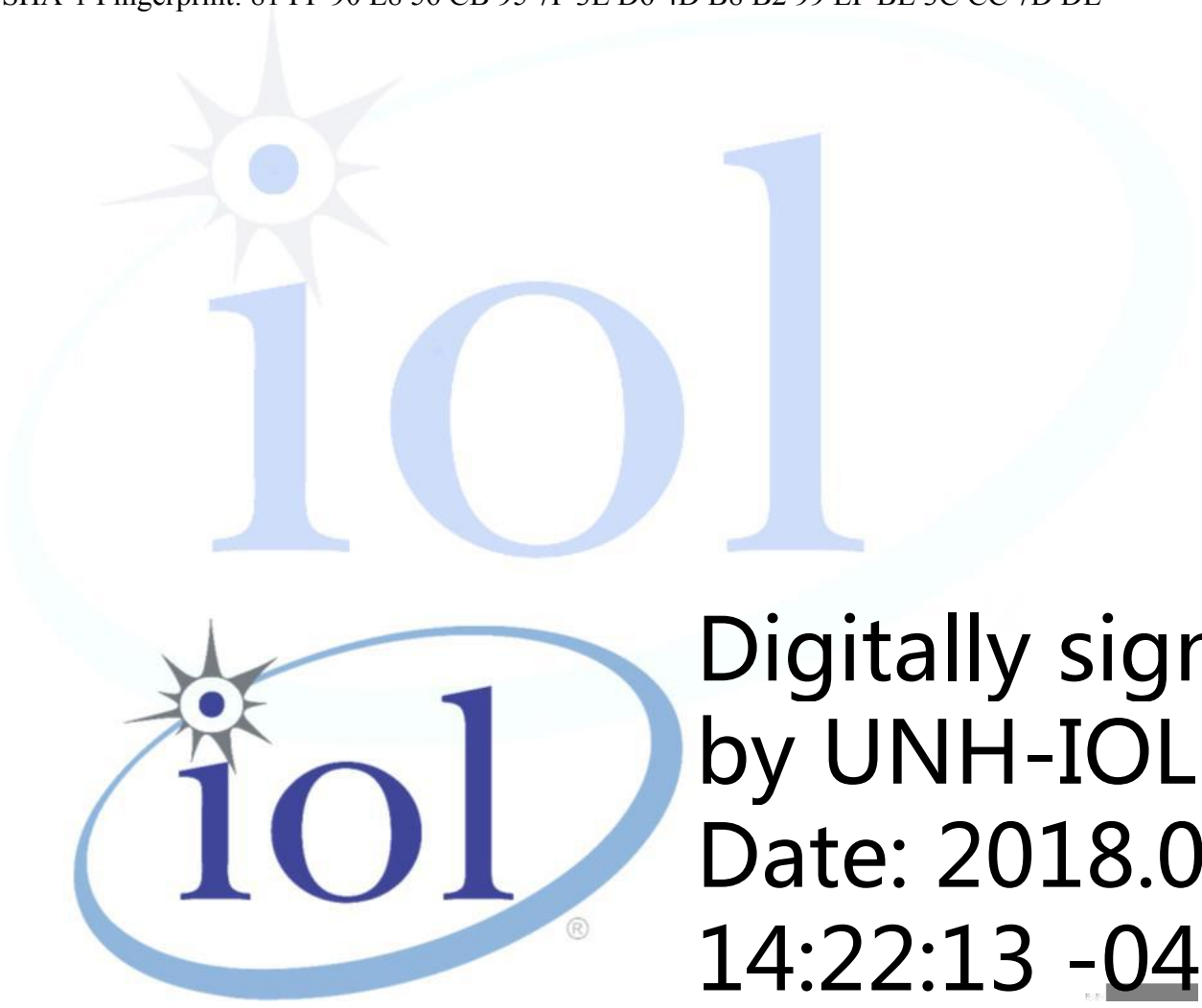


In section 2, the following equipment was used:

Test System Hardware	
EEPROM Reader	I2C Elite Reader

In section 3, the following equipment was used:

Test System Hardware	
Network Analyzer	PNA –Performance Network Analyzer

In section 4, the following equipment was used:

Test System Hardware	
Wide Bandwidth Oscilloscope	Keysight DCA-X 86100D Wide Bandwidth Oscilloscope
Waveform Analyzer	Keysight 86105C Optical Waveform Analyzer
50GHz Waveform Analyzer	Keysight 86108B Mega Module, 50GHz Bandwidth Waveform Analyzer
Clock Recovery Module	Keysight 83496B Optical/Electrical Clock Data Recovery Unit
High Performance Serial BERT	Tektronix BERTScope
Signal Quality Analyzer	BERTScope PRBS9 at 10.3125Gbps
De-Emphasis Signal Converter	Agilent N4916B

*Two modules used during testing

In section 6, Ostinato software was used to generate test traffic:

Test System Hardware	
Ethernet Traffic Generator	Ostinato
Software Version	Ostinato
Port Types	40/100G

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:	**N/A**
Test 1.2:	**PASS**
Test 3.1.1: Return Loss for 10G Passive Cable	**PASS**
Test 3.1.2: Insertion Loss for 10G 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:	**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: *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: *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 10G 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: $11, \quad 22 \geq \{ \begin{matrix} 12 - 2\sqrt{\ }, & 0.01 \leq \ < 4.1 \\ 6.3 - 13\log_{10} 5.5 , & 4.1 \leq \ \leq 11.1 \end{matrix} \} (\ )$	
Additional Comments	

Test Information	**Test Result**
Test 3.1.2: **Insertion Loss for 10G 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. $3 \quad \leq \quad 21, \quad 12 \leq \ 17.04 \quad , \quad 5.15625$	
Additional Comments	

Test Information	**Test Result**
Test 5.1.1: **Output Rise and Fall Times for 10G 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 10G 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: *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 10G 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: *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: *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: *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	

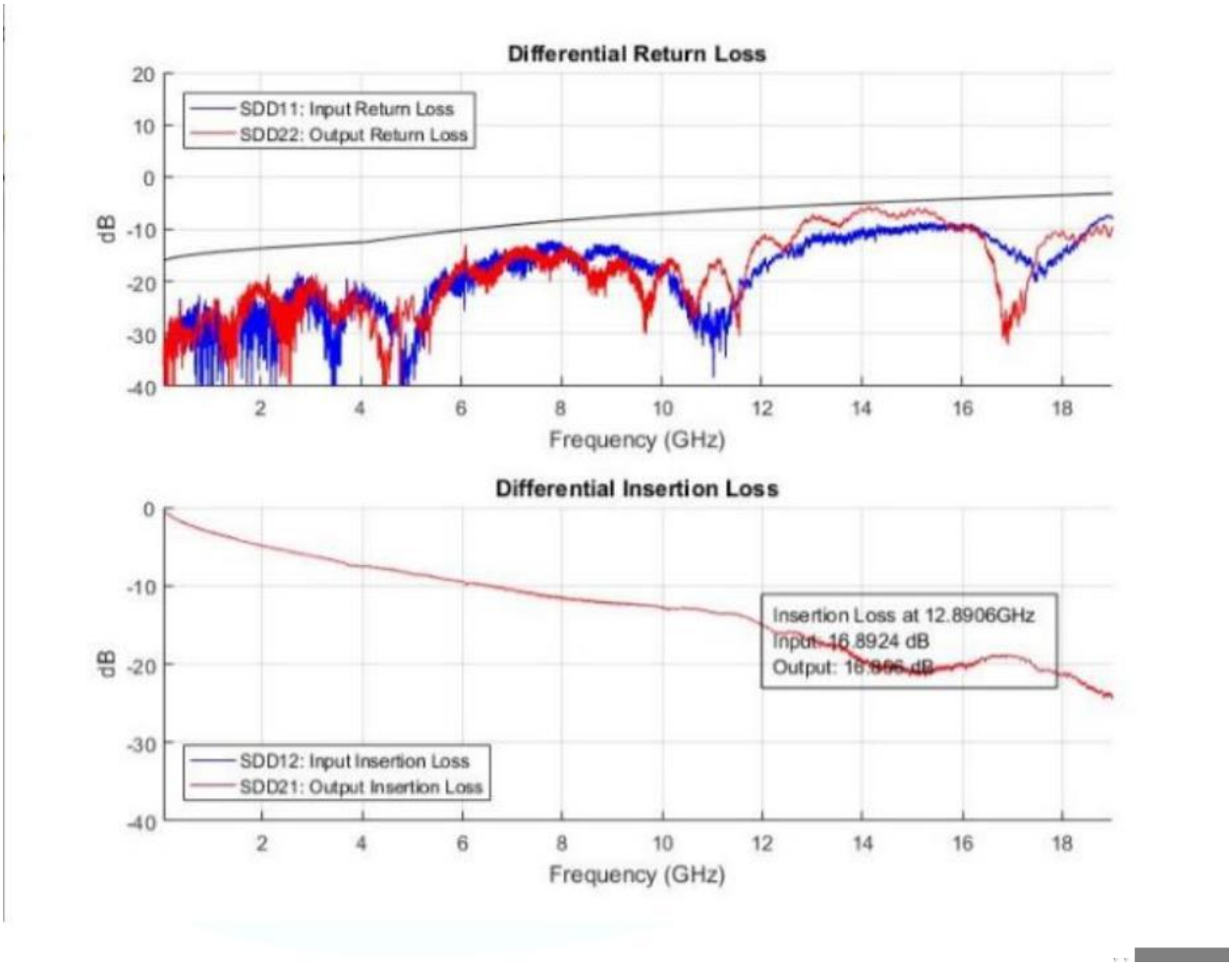
Test Information	**Test Result**
Test 6.3:**Packet Error Rate Estimation** *Purpose*: To determine if a Host can exchange packets with a Module or Cable Assembly such that a bit error rate of 10^{-12} is achieved	**PASS**
Comments on Test Procedure	
This test was completed using the standard procedure.	
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	

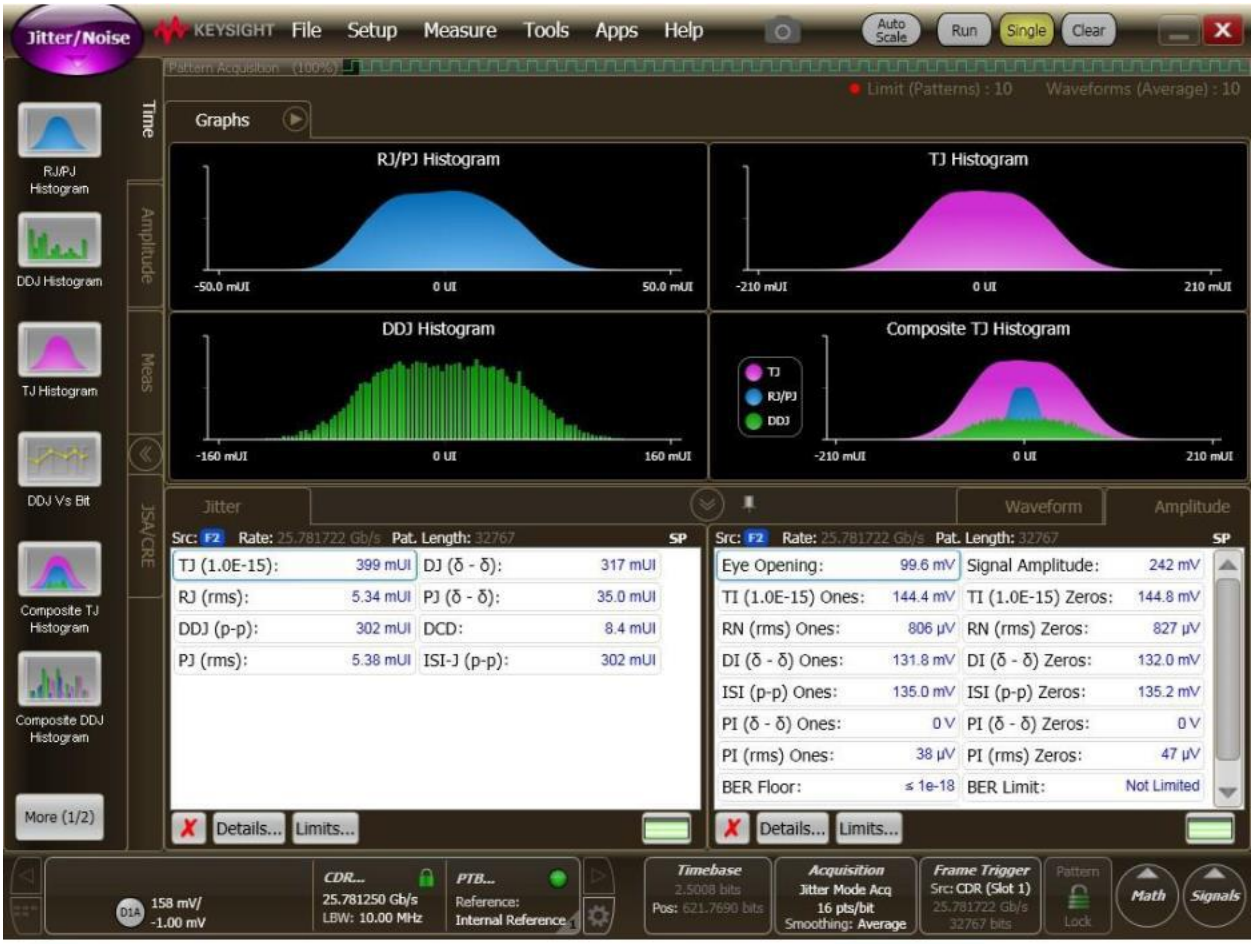
Appendix A: EEPROM Data

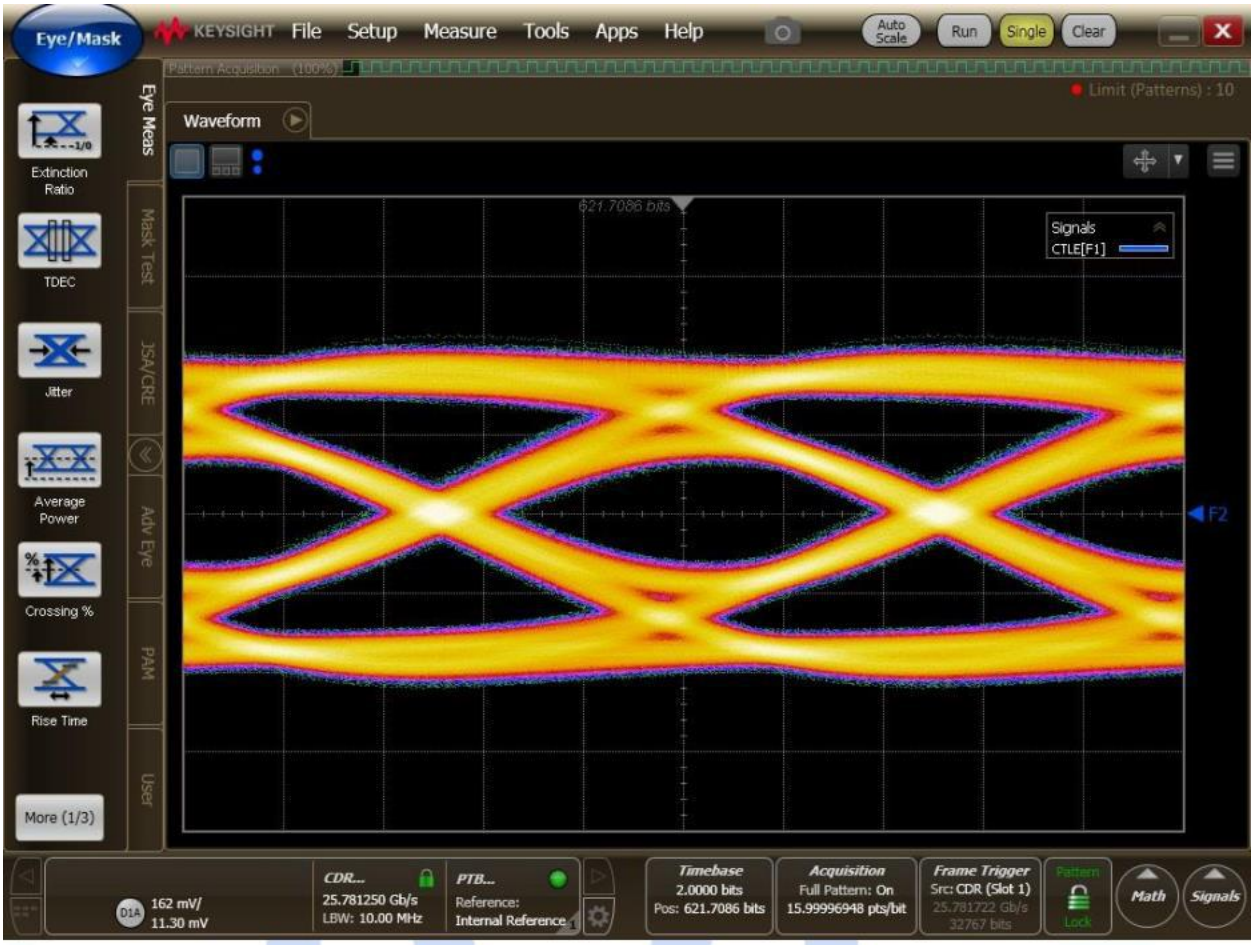
```
10Gtek           QSFP28 module
Part Number: CAB-ZQP-ZQP-P3M   Serial Number: WTZ31HA0002
10Gtek___WTZ31HA0002_____EEPROMdecode_20180320202712.txt

SERIAL_ID Keys:
BR_NOMINAL: 25750
CONNECTOR: 33
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: 17
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: 0x80 0x0 0x0 0x0 0x0 0x0 0x0 0x0
VENDOR_NAME: 10Gtek
VENDOR_OUI: 0x0 0x0 0x0
VENDOR_PN: CAB-ZQP-ZQP-P3M
VENDOR_REV: 01
WAVELENGTH: 0.0
WAVELEN_TOLERANCE: 0.0

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:  11050600 00000000 00000000 00000000
0010x:  00000000 00001c5a 00008228 00000000
0020x:  00000000 00000000 00000000 00000000
0030x:  00000000 00000000 00000000 0000001c
0040x:  00000000 00000000 00000000 00000000
0050x:  00000000 00000000 00000000 00000000
0060x:  00000000 00000000 00000000 02000400
0070x:  00000000 00000000 00000000 00000000

I2C Address A0h, page 0, bytes 128-255, in hex
0000x:  11002180 00000000 00000000 ff000000
0010x:  000003a0 31304774 656b2020 20202020
0020x:  20202020 1f000000 4341422d 5a51502d
0030x:  5a51502d 50334d20 30310000 00004679
0040x:  0b000000 57545a33 31484130 30303220
0050x:  20202020 31373130 30312020 00006730
0060x:  00000000 00000000 00000000 00000000
0070x:  00000000 00000000 00000000 00000000
```

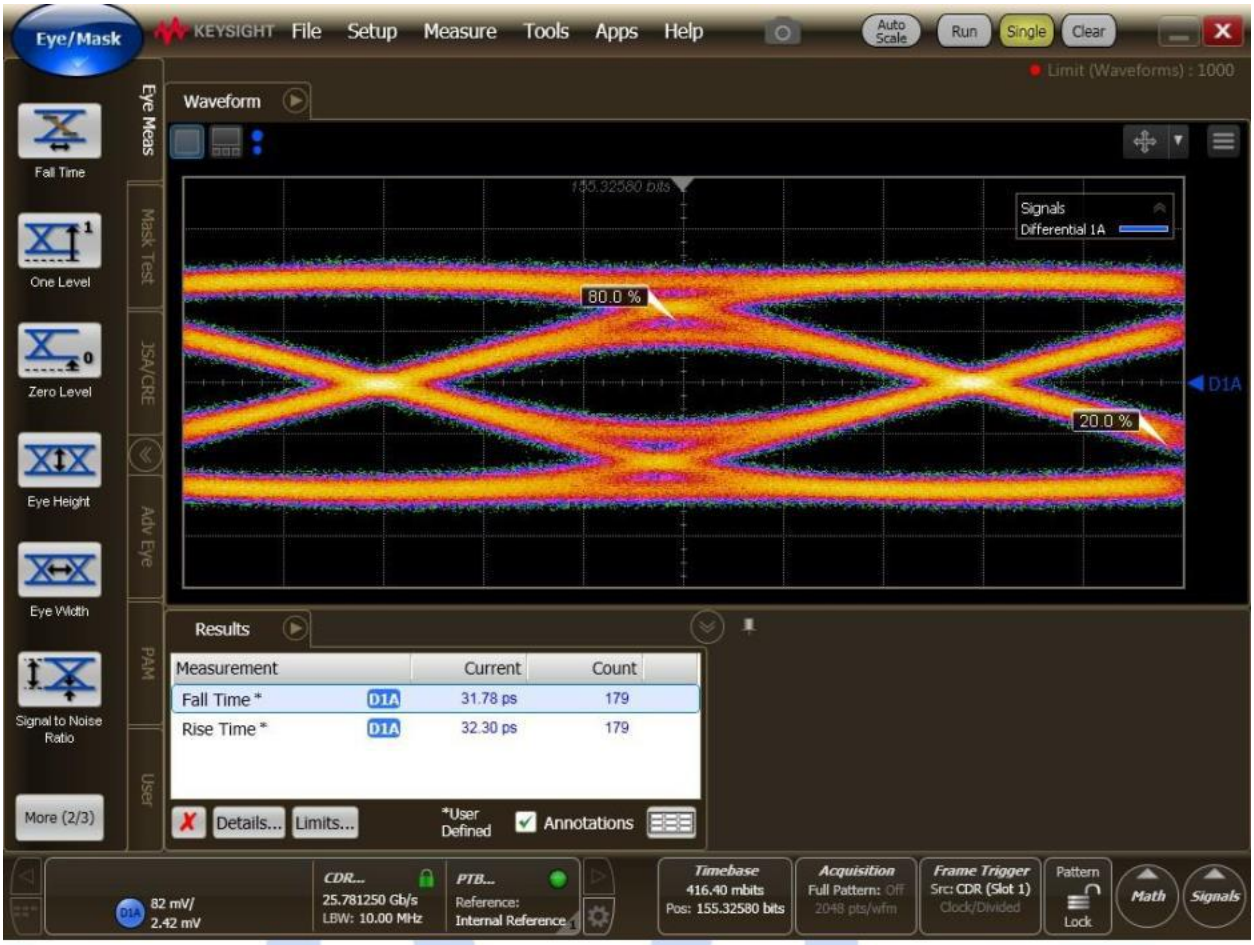
Appendix B: Pluggable Module / Cable Electrical Data



Appendix C: Host Electrical Data




Eye/Mask
KEYSIGHT
File
Setup
Measure
Tools
Apps
Help
Auto Scale
Run
Single
Clear
Limit (Patterns) : 10
Waveform
Eye Meas
Mask Test
JSA/CRE
Adv Eye
PAM
User
Extinction Ratio
TDEC
Jitter
Average Power
Crossing %
Rise Time
More (1/3)
621.7086 bits
Signals
CTLE[F1]
F2
162 mV/
11.30 mV
CDR...
25.781250 Gb/s
LBW: 10.00 MHz
PTB...
Reference:
Internal Reference
Timebase
2.0000 bits
Pos: 621.7086 bits
Acquisition
Full Pattern: On
15.99996948 pts/bit
Frame Trigger
Src: CDR (Slot 1)
25.781722 Gb/s
32767 bits
Pattern
Lock
Math
Signals


Eye/Mask
KEYSIGHT
File
Setup
Measure
Tools
Apps
Help
Auto Scale
Run
Single
Clear
Limit (Waveforms) : 1000
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
155.32580 bits
Signals
Differential 1A
80.0 %
20.0 %
D1A
Results
Measurement
Current
Count
Fall Time *
D1A
31.78 ps
179
Rise Time *
D1A
32.30 ps
179
Details...
Limits...
*User Defined
Annotations
82 mV/
2.42 mV
CDR...
25.781250 Gb/s
LBW: 10.00 MHz
PTB...
Reference:
Internal Reference
Timebase
416.40 mbits
Pos: 155.32580 bits
Acquisition
Full Pattern: Off
2048 pts/wfm
Frame Trigger
Src: CDR (Slot 1)
Clock/Divided
Pattern
Lock
Math
Signals