CEI-VSR
Compliance and Debug Testing

Pavel Zivny – Technology Specialist
Anshuman Bhat – Product Manager

Tektronix
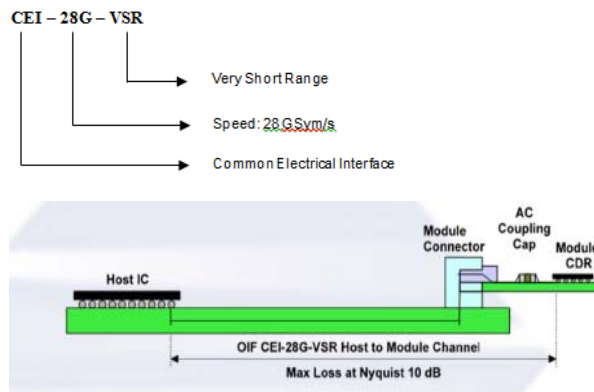

Agenda

- CEI-VSR
  - Technology Overview
  - Testing challenges
- Solution for Debug & Compliance Testing
  - Automation
  - Debug
- Tektronix CEI-VSR Solution
- Features and Benefits

Tektronix

CEI-VSR Technology and Related Testing Challenges

CEI-28G-VSR Technology Evolution

OIF-CEI-VSR - Optical Internetworking Forum - Common Electrical Interface - 28G-VSR (CEI-28G-VSR)

CEI-28G-VSR Technology Evolution

- CEI-28G-VSR - This clause details the requirements for the CEI-28G-VSR very short reach high speed chip-module electrical I/O of nominal baud rates of 19.60 Gsym/s to 28.05 Gsym/s.

- The industry is transitioning from 10x10G to a more efficient 4x25 electrical interconnect.

- The first standard body in the move to 25 Gb/s signaling is the OIF CEI, with the VSR, SR, and LR (very short reach, short reach, long reach) standards

- Under development is the Ethernet's 802.3bm 100GBASE-KR4 backplane standard, as well as the Ethernet interconnect standard, 802.bj CAUI4.

- The electrical I/O is based on high speed, low voltage logic, and connections are point-to-point balanced differential pairs.

Tektronix

CEI-VSR Test Challenges – Bandwidth Requirements

- "K" Vs 2.4mm Connector
  - 2.4mm connector upto 50 GHz bandwidth
  - Longer interconnect, e.g. cables are very harmful to signal integrity

  - Scope BW Requirements
  - For characterization of important components e.g. silicon, Tektronix recommends a higher bandwidth interconnect, e.g. 50 GHz.
  - Using a connector/cable system interconnect with just 40 GHz of BW might be interpreted as allowable by standards; however it is marginal.

- Extra challenges abound when transferring these signals on printed circuit boards, even for short distances. The Implementation Agreement for Optical Internetworking Forum Common Electrical Interface (OIF CEI) 3.0 specifies the tests and limits for these devices

- The parameters can take a full day when characterized manually, and the recalculation of factors and CTLE values adds to the time the designer spends on testing.

Tektronix

CEI-VSR Test Challenges – De-embedding

- 25+ Gb/s standards, exhibit two main applications where de-embedding can be considered:
  - De-embedding of the fixture – e.g. the test board
  - De-embedding of the interconnect between the oscilloscope and the fixture

- Sampling oscilloscopes offer higher resolution, and de-embedding is more practical. De-embedding turns loss into noise, thus minimizing the amount of de-embedding is also important.

- In case of de-embedding, it is critical to acquire high quality network description (S-parameters) of the signal under test.

- Focus needs to be on effort to minimizing the length and loss of the interconnect, its quality and repeatability. Only after this has been accomplished, applying de-embedding helps generate realistic results.

Tektronix

CEI-VSR Test Challenges – Clock Recovery

- Typically the DUT's – the Serial Data transmission devices themselves - operate with the clock recovery circuit (CR) in the receiver (RX). The measurement device (e.g. oscilloscope) therefore also need CR.

- T&M CR: Internal or External?
  The advantage of an external clock recovery include higher flexibility (e.g. the same CRU can be used with an oscilloscope or with a BERT), and higher functionality – such as access to the analog PLL control voltage for troubleshooting of clock problems.

- In case of real time oscilloscope the clock recovery can be implemented in software.

- The clock recovery is required by standards and emulates the behavior of the physical receiver.

- CR may not be necessary in cases of simple tests of devices that do not include a re-timer.

Tektronix

CEI-VSR Test Challenge–Clock & Data Path Delay

- The need for Data and Clock path delay matching
  - The high-speed data path should be of as limited length as possible
  - The data should be acquired based on timing derived from the clock recovered with near-zero delay from the data.

- In sampling oscilloscope setup above listed two requirements are in conflict with each other
- The solution lies in delaying not the data path, but instead in delaying the timing reference to the PhaseRef module – the module which acquires the phase clock generated by the clock recovery, and thus the precise timing between data and clock.

CEI-VSR Automation and Debug Solution

CEI-VSR Transmitter Measurements

Parameters	CEI-28G-VSR H2M	CEI-28G-VSR M2H	Components used for performing Measurements
Baud rate	1.1	1.1	Clock Recovery
Rise times / fall times	1.3.2	1.3.3	AL – Algorithm Library
Differential output voltage	1.3.2	1.3.3	Base Scope
Output Common mode voltage	1.3.2	1.3.3	Customer need to enter value, if we do this measurement on scope it will demage the scope
TX Common Mode Noise RMS	1.3.2	1.3.3	Base Scope
UUGJ–Uncorrelated Unbounded Gaussian Jitter			RJ in 80SJNB
UBHPJ–Uncorrelated Bounded High Probability Jitter			PJ in 80SJNB
Eye width (EW15)	1.3.2	1.3.3	80SJNB
Eye height (EH15)	1.3.2	1.3.3	80SJNB
Vertical eye closure		1.3.3	80SJNB

Tektronix

Option CEI-VSR - Compliance and Debug Solution

- Automated Tests
  - One-button selection of critical H2M & M2H Tests reduces testing time

- Integrated Debugging
  - Popular 80SJNB-based interface enables deeper debug of timing root cause analysis without moving to a different instrument/measurement setup
  - CTLE Filters
  - Option CEI-VSR determining the optimal value of CTLE peaking, which is required by the CEI 28G Very Short Reach for the Host-to-Module interface. The best CTLE filter is chosen from the given set of filters and used for performing the measurement.

- J2 & J9 Measurements
  - Rely on off-the-shelf products to perform this complex measurement rather than developing custom lab setup reducing testing time and complexity

- Documentation/Reporting

- Signal Validation

Tektronix

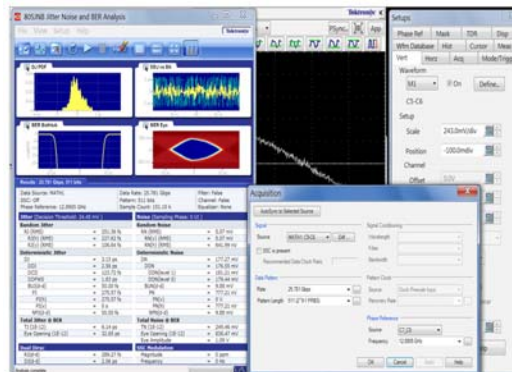## Option CEI-VSR – Automation Part

- Operates on Tektronix DSA8300 Series Oscilloscopes
- Automate setup & quickly generate reports
- Meets Compliance needs of CEI-28G-VSR
- PRBS9 for all measurements and 8180 support in addition for Transition time measurement.
- VEC – Vertical Eye Closure as Informative Test under H2M

13   9/2013

Tektronix

Tektronix CEI-VSR – Debug Part

- Performs advanced jitter and noise analysis (RJ, DDJ, PJ, DCD, TJ@BER, and RN, DDN(high) and
- DDN(low), TN@BER, vertical and horizontal eye opening at BER
- Acquires complete pattern waveform at 100 Samples/UI
- Performs random and deterministic jitter analysis including BER estimation
- Isolates and measures crosstalk in form of bounded uncorrelated jitter (BUJ)

14   9/2013

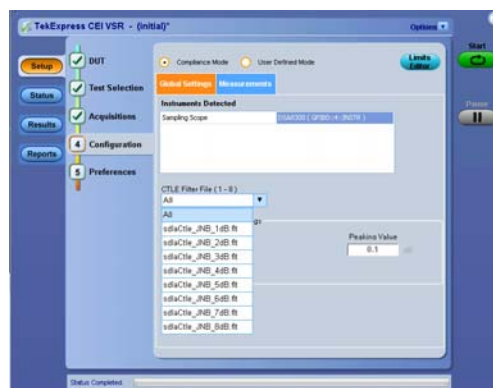**Tektronix**

Option CEI-VSR – Set BER Measurements
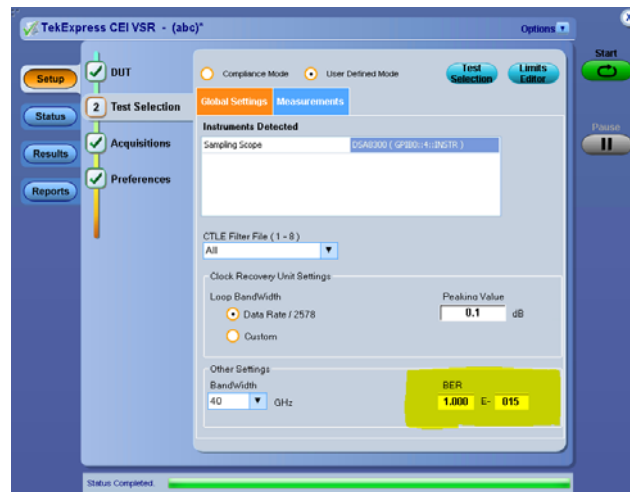
- Under user defined mode users can configure BER and Rely on off-the-shelf products to perform this complex measurement rather than developing custom lab setup reducing testing time and complexity

Tektronix

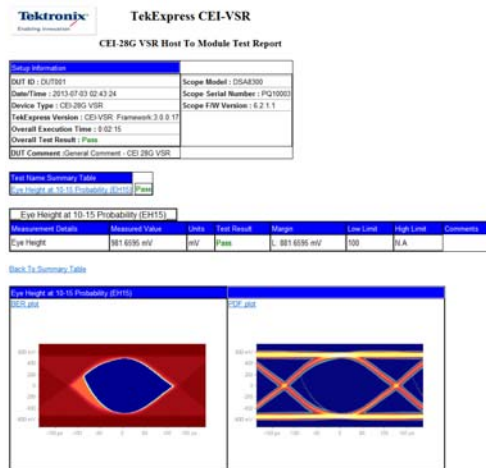
Option CEI-VSR – CTLE Filters

- Option CEI-VSR determining the optimal value of CTLE peaking, which is required by the CEI 28G Very Short Reach for the Host-to-Module interface. The best CTLE filter is chosen from the given set of filters and used for performing the measurement.
- Peaking Value and Loop BW are configurable and helps in better measurement accuracy

Tektronix

Reporting and Documentation

- Summary-reporting capability in .mht (HTML) format with pass/fail status

- Detailed report includes
  - Measurement results:
    - Test configuration details, waveform plots, and margin analysis
  - Test Setup details:
    - Calibration status, oscilloscope model, software version, date, execution time etc.

- Flexible report configuration provides options like auto increment, appending etc.

CEI-VSR Solution

Option CEI-VSR Recommended Test Equipment

Platform	DSA8300
Software Options	1. Option CEI-VSR - OIF CEI 3.0 Compliance Solution for DSA8300 2. Option JNB01 - 80SJNB ADVANCED 3. Option ADVTRIG - Advanced triggers with pattern sync
BERTScope® Clock Recovery	CR286A* *CR may not be necessary in cases of simple tests of devices that do not include a re-timer.
Remote Sampling Scope Module	80E10B - 8000 Series, Dual Channel, 50 GHz, Remote Electrical Sampling Module w/ TDR (includes D1) **OR** 80E09B - 8000 Series, Dual Channel, 60 GHz, Remote Electrical Sampling Module (includes D1)80E10/B** **Will not support TDR based measurement
Phase reference module	82A04B - 8000 Series, Phase Reference Module (includes D1)
Module Extender Cable	Module Extender Cable : 1 # 80X01 & 1 # 80X02(Status : Please contact Product Marketing for availability and Status)
Other Accessories	1. 2 # Trigger Pick-off T 2.4 mm M-F-F 5361-237-14DB(PSPLabs) 2. 6 # 50mm Cable, 2.4 mm M-M SF1611-60003(SV Microwave) 3. 2 # DC Block 2.4 mm M-F 5509-205-224(PSPLabs) 4. 2 # 2.4 mm F-Crown PN 7005A-12(Aeroflex) 5. 2 # 420 mm Cable 2.4 mm M-M, SF1611-60003(SV Microwave) 6. 1 # NI GPIB-USB-HS - GPIB Controller for Hi-Speed USB

Tektronix

Option CEI-VSR - Features & Benefit

| Features	Benefits
Developed on Platform of choice for Debug and Compliance	Tektronix CEI-VSR is developed on a Equivalent Time Oscilloscope platform, which is the platform of choice for engineers working on designing their products around CEI-28G-VSRtechnology.
Seamless movement from Compliance to Debug Environment	Customers can seamlessly move from compliance to debug environment and use world-class debug tool from Tektronix i.e. 80SJNB.
Reduces Testing Time	Tektronix Automated CEI-VSR Compliance and Debug solution meets compliance needs of CEI-28G-VSR specifications 8.0. Users can save up to 80% on testing time as compared to manual testing.
"One Stop Shop"	Engineers working on CEI-28G-VSR can turn to Tektronix for their complete PHY testing solution needs including scope, CR and all other modules
Automatic application of Filter	Option CEI-VSR determining the optimal value of CTLE peaking, which is required by the CEI 28G Very Short Reach for the Host-to-Module interface. The best CTLE filter is chosen from the given set of filters and used for performing the measurement.

Tektronix

Option CEI-VSR Demonstration

Host Transmitter Test Setup
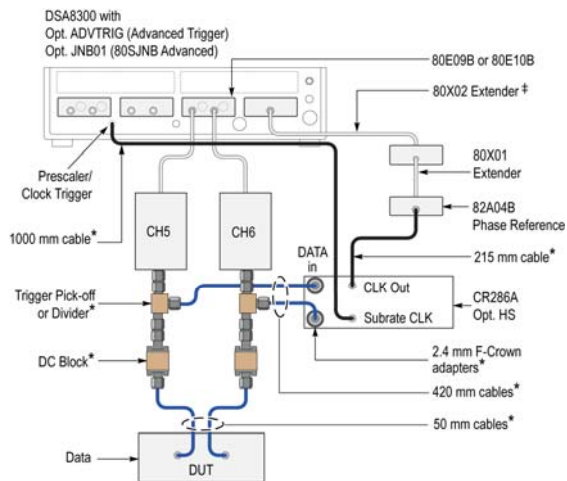
Measurement setup with direct HW Clock Recovery.

Tektronix Ethernet Solution – Information

- Tektronix has strong portfolio of products and solution in Ethernet Space – RT Scope, Sampling scope, BERTScope and Optametra products

- TDSET3 – Available since 2003 with, ET3 is widely used solution across industry

- XGbT –10GBASE-T Compliance solution is the only "One Box" solution available in the market

- SFP-TX & SFP-WDP provides comprehensive solution for SFP+ & QSFP+, Tektronix is first to market

- 10GBASE-KR - 802.3ap™-2007 – We now have a Compliance, Debug and Decode Solution

- FC-16G – Fiber Channel 16G Compliance and Debug solution available on RT Scopes

- 802.3az – Energy Efficient Ethernet –Tektronix was the first T&M company to develop a solution in this space

- 10GBASE-KR and SFP+ RX MOI are available on BERT Scope

Tektronix

Tektronix®

Tektronix

Backup

Tektronix

Option CEI-VSR Interconnect Module

Interconnect Components		
Name	Description	Part #
DC Blocks	some SerDes will be damaged when loaded with 50 Ohm DC to ground.	Marki Microwave DCZM24F24 DC block 4 kHz-65 GHz 2.4mm connector M/F.
Trigger Pick-off T	Advantages of Pick-off T include best flatness and best (lowest) loss.	Marki DCZM24F24 DC block 4 kHz-65 GHz (sic) 2.4 mm conn M/F
Cables - 2.4mm	Supports Frequenct till 50GHz	TEK50PF18PP - 2.4mm male connector
Cables - 1.85mm	Supports Frequenct till 65GHz	TEK67HF06PS - Gore 152 mm (6") Male "V" both ends, match for pair skew < 5 ps. 1.85mm
Connector Adapters	From {1.85 mm, 2.4 mm} to 2.92 mm	Marki ADPM24F29 adapter, (M) 2.4mm to (F) 2.92mm Tektronix PN 011-0187-00 adapter, (M) 2.4mm to (F) 2.92mm

Tektronix