SFF-8431 SFP+ Technology
Agenda

- Tektronix Ethernet Solution – Background Information
- SFP-TX – SFP+ Automation and Debug Solution
- Questions and open discussion
Tektronix Ethernet Solution – Background Information

- Tektronix has strong portfolio of products and solution in Ethernet Space – RT Scope, Sampling scope, BERTScope and now Optametra products
- TDSET3 – available since 2003 with over 2500+ end-users and still growing
- XGbT – Tektronix released 10GBASE-T solution in 2009 and we have added over 60 end-users worldwide
- 802.3az – EEE – Software and Fixture are used by many customers worldwide over 15 customer added since Dec 2010
- SFP-TX will be launched in AUG 2011, Tektronix will be first to market
- 10GBASE-KR - 802.3ap™-2007 – currently working on KR and we have a phase zero solution available – Plan to launch Automation and Debug solution in Q3/Q4-2011
SFP-TX – SFP+ Automation and Debug Solution
10Gigabit Ethernet Interface Evolution

MSA Form Factors
- XENPAK Transceiver
- X2 Transceiver
- XFP Transceiver
- SFP+ Transceiver
- SFP+ direct attach
- QSFP

10GBE Standards
- IEEE 802.3ae SR/LR/ER/LX4 2002
- IEEE 802.3ak CX4 2004
- IEEE 802.3an 10GBASE-T 2006
- IEEE 802.3aq LRM 2008
- SFF-8431 SFP+ 2010

Source: Ethernet Alliance
SFF-8431 SFP+ Technology overview

1. SFP+ is a next-generation hot-pluggable, small footprint, serial-to-serial multi-rate optical transceiver for 8.5GbE and 11.1GbE Datacom and Storage Area Networks (SAN) applications.

2. SFP+ technology moved the clock and data recovery units out of the module and onto the line card – Reducing size drastically.

3. As a result, the modules are smaller, consume less power, allow increased port density, and are less expensive compared to XFP.

4. High density capable Up to 48 ports in a rack

5. Low power per port - Host Port power < 1 W and Low Latency
SFP-TX – SFP+ Compliance and Debug Solution

- Tektronix is first in market to provide a Comprehensive Automated and Debug Solution for SFF-8431 SFP+ host and module

- Brand new UI and software which is very well integrated with scope

- One-button Selection of Multiple Tests

- Remote Programming Interface - NI LabVIEW or NI TestStand™ or other scripting languages

- Real-time waveform capture and Pre-recorded waveform support
Tektronix SFP-TX – Automation & DPOJET Option

- One part number enables both Automation and DPOJET options
- No Dongle required, Floating license available
- TekExpress SFP-TX option lets compliance users automate their setup & quickly generate reports
- DPOJET SFP-TX option lets debug users get into debug mode and analyze their devices
- Meets Compliance needs of SFF-8431 revision 4.1
- User defined mode lets users perform measurements on different signal type like 8180, PRBS9 & PRBS31
Test connection
# SFP-TX Host Transmitter Measurements

<table>
<thead>
<tr>
<th>SL No.</th>
<th>Measurements</th>
<th>Signal Type</th>
<th>Min</th>
<th>Target</th>
<th>Max</th>
<th>Units</th>
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<tbody>
<tr>
<td></td>
<td><strong>Host Transmitter output electrical Specifications:</strong></td>
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<tr>
<td>1</td>
<td>Single Ended Output Voltage Range</td>
<td>PRBS31</td>
<td>-0.3</td>
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<td>4</td>
<td>V</td>
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<td>2</td>
<td>Output AC Common Mode voltage (RMS)</td>
<td>PRBS31</td>
<td></td>
<td></td>
<td>15</td>
<td>mV(RMS)</td>
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<tr>
<td></td>
<td><strong>Host Transmitter Jitter and Eye Mask specifications</strong></td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>Crosstalk source rise/fall time (20%-80%) (Tr, Tf)</td>
<td>8180</td>
<td>34</td>
<td></td>
<td></td>
<td>ps</td>
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<tr>
<td>4</td>
<td>Crosstalk source amplitude (p-p differential)</td>
<td>8180</td>
<td>1000</td>
<td></td>
<td></td>
<td>mV</td>
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<tr>
<td>5</td>
<td>Signal rise/fall time (20%-80%) (Tr, Tf)</td>
<td>8180</td>
<td>34</td>
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<td>ps</td>
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<td>6</td>
<td>Total Jitter (p-p) (Tj)</td>
<td>PRBS31</td>
<td>0.28</td>
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<td></td>
<td>UI(p-p)</td>
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<td>7</td>
<td>Data Dependent Jitter (p-p) (DDJ)</td>
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<td>0.1</td>
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<td>UI(p-p)</td>
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<td>8</td>
<td>Data Dependent Pulse Width Shrinkage (p-p) (DDPWS)</td>
<td>PRBS9</td>
<td>0.055</td>
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<td></td>
<td>UI(p-p)</td>
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<td>9</td>
<td>Uncorrelated Jitter (RMS) (UJ)</td>
<td>PRBS9</td>
<td>0.023</td>
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<td></td>
<td>UI(p-p)</td>
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<tr>
<td>10</td>
<td>Transmitter Qsq</td>
<td>8180</td>
<td>50</td>
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<td></td>
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</tr>
<tr>
<td>11</td>
<td>Eye mask hit ratio (Mask hit ratio of 5×10⁻⁵)</td>
<td>PRBS31</td>
<td></td>
<td>1×0.12UI, 2×0.33UI, Y1=95mV, Y2=350mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Host Transmitter output specifications for Cu (SFP+ host supporting direct)</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Voltage Modulation Amplitude (p-p)</td>
<td>8180</td>
<td>300</td>
<td></td>
<td></td>
<td>mV</td>
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<tr>
<td>13</td>
<td>Transmitter Qsq Output AC Common Mode voltage</td>
<td>8180</td>
<td>63.1</td>
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<td></td>
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<tr>
<td>14</td>
<td>Output AC Common Mode Voltage</td>
<td>PRBS31</td>
<td></td>
<td></td>
<td>12</td>
<td>mV(RMS)</td>
</tr>
<tr>
<td>15</td>
<td>Host Output TWDPC</td>
<td>PRBS9</td>
<td></td>
<td></td>
<td>10.7</td>
<td>dBe</td>
</tr>
</tbody>
</table>
Eye Mask hit ratio: less than $5 \times 10^{-5}$
Tj

Tj @ 10-12 <0.28UI
DDJ and DDPWS measurement

![Graph showing DDJ and DDPWS measurement]

\[ DDJ = \max(\Delta t_1, \Delta t_2, \ldots, \Delta t_n) - \min(\Delta t_1, \Delta t_2, \ldots, \Delta t_n) \]

\[ DDPWS = T - \min(t_2-t_1, t_3-t_2, \ldots, t_{n+1}-t_n) \]
UJ measurement

Uncorrelated jitter (rms) = $\sqrt{\sigma_r^2 + \sigma_f^2}/2$

where
\( \sigma_r \) is the standard deviation of the jitter on the rising edge
\( \sigma_f \) is the standard deviation of the jitter on the falling edge

Uj measurement is defined in IEEE 802.3 CL 68 P361
Transmitter Qsq

- Qsq = 1/RN
- RN:
  \[ RN = \frac{2 \times \text{noise}(RMS)}{(xMA)} \]
- Noise:
  \[ \text{noise}(RMS) = \sqrt{(\text{logic ONE} \text{noise}(RMS)^2 + \text{logic ZERO} \text{noise}(RMS)^2)/2} \]
- XMA : VMA/OMA

Figure 48: Example xMA waveform showing xMA measurement windows
SFP-TX - Report

- SFP-TX software provides summary-reporting capability in .mht (HTML) format with pass/fail status.
- A detailed report includes test configuration details, waveform plots, and margin analysis.
- Report also provides additional details like calibration status, scope model, probe model, software version, date, execution time etc.
- Report configuration menu lets user configure reports, it provides options like auto increment, appending etc.
The Host Compliance Board (HCB) allows predictable, repeatable and consistent results among Host vendors and will help to ensure consistency and true compliance in the testing of Hosts.

Proposed SFP+ Host Compliance Board (HCB) from Wilder
Wilder - Host Compliance Board(HCB) - Test Fixture

- Part Number: 640-0540-000
- Description: SFP+-TPA-HCB-P Host Compliant Plug Test Adapter includes
  - One # Plug Test Adapter w/Switch Board
  - Two # Pico Pulse Lab 5501A DC Blocks
  - Two # Suhner 65_SMA-50-0-1/111_NE 50 Ohm Terminators
- Website: [www.wilder-tech.com/sfp-plus.htm](http://www.wilder-tech.com/sfp-plus.htm)
SFP-TX Recommended Equipment

Mapping Technology to Oscilloscope Bandwidth Requirements

- SFF-8431 SFP+ provides 10.3125 Gbit/second connections with the minimum rise time requirement of 34 ps
- DPO/DSA/MSO 16 & 20 GHz scope has a rise time of 24.5ps & 18ps respectively
- 16GHz and above bandwidth oscilloscope meets the rise time requirements of SFF-8431 SFP+ signal

<table>
<thead>
<tr>
<th>Oscilloscope</th>
<th>Accessories</th>
<th>Software</th>
<th>Fixture</th>
<th>Demo DUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPO/DSA/MSO71604</td>
<td>Matched Pair SMA Cables</td>
<td>SFP-TX &amp; DJA</td>
<td>Wilder /Spirent SFP+ Test Fixture</td>
<td>Intel X520 Server</td>
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<td>Server Adapter Card</td>
</tr>
</tbody>
</table>
DEMO setup

SFP+ Setup Configuration Diagram
SFP-TX : Features and Benefits

- Simplified Instrument Setup – Save Time and Resources
- SMA Cable Support – Reduced solution cost
- Margin Testing capability
- One-button Testing
- Fine Grain Programming Interface support helps in Automation, LabVIEW from NI can also be used to automated
- Detailed report available
- Auto Deskew – few hundred femtoseconds on C series scope
- No dongle required
- Tightly integrated with scope
- Node locked and Floating license mechanism supported
SFP-TX - Solution Roadmap

- SFP-TX solution release 1 will be available AUG 2011

- SFP-TX solution Release 2 will be available in Q3/Q4 2011

- HCB from Tektronix will be available by AUG/Sep 2011* timeframe

*SFP-TX - Solution Roadmap

SFF Committee members

AMCC
Amphenol
Arista Networks
Avago
Broadcom
Cinch
Clariphy
Cortina Systems
EMC
Emulex
ETRI
Finisar
Foxconn
Fujitsu CPA
Hewlett Packard
Hitachi GST
JDS Uniphase
Luxtera
Molex
NetLogic uSyst
OpNext
Panduit
Picolight
QLogic
Samsung
Sumitomo
Sun Microsystems
Tyco
Vitesse Semiconductor
W L Gore

* Tentative
Tektronix SFP-TX - Solution – Key Takeaway

- Tektronix is first to market, no one else has a solution yet

- One Product i.e. SFP-TX will enable both DPOJET and Automation option

- Both Node locked and Floating license mechanism is available and dongle is not required

- HCB from Tektronix will be available by AUG/SEP 2011* timeframe

* Tentative
SFP-TX Demo