Tektronix Innovation Forum

Enabling Innovation in the Digital Age

移动多媒体及工业应用标准测试解决方案

泰克设计与制造仪器产品部

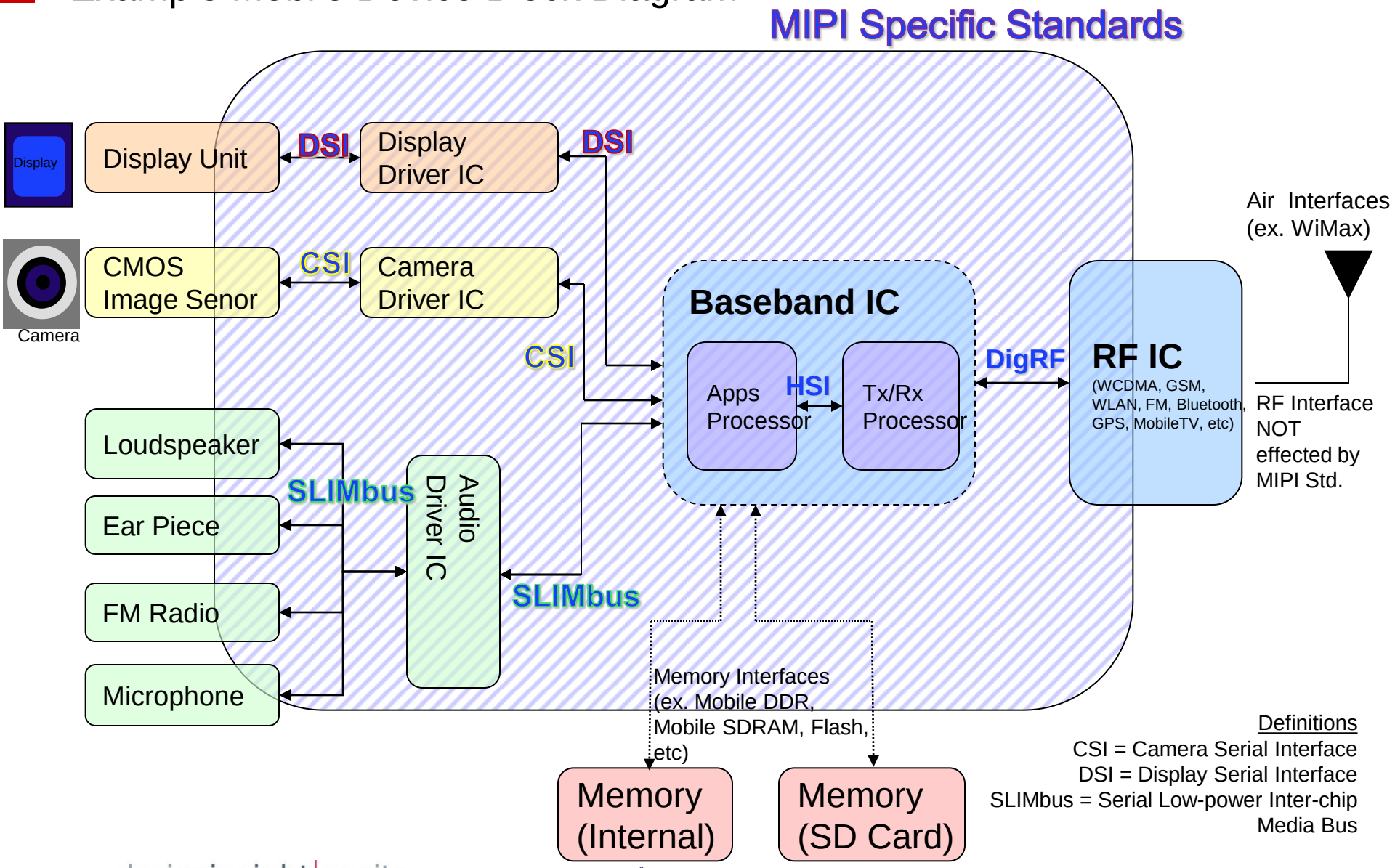
Tektronix®

Agenda

- MIPI® Standards Overview
- Tek Strategic Involvement in MIPI
- D-Phy/M-Phy testing
  - Tx, & CSI-DSI Decode
  - Rx
- MHL/HDMI-TX/RX
- MHL/HDMI-Protocol Analyze
- ThunderBolt/SAS/SATA/PCIE/USB3.0

MIPI Standards Overview

Example Mobile Device Block Diagram

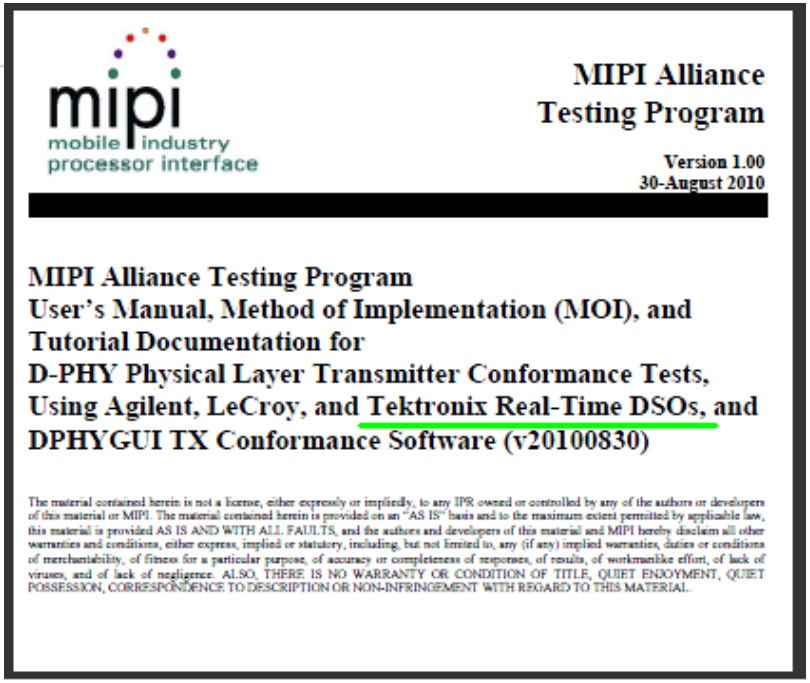


Tek Strategic Involvement with MIPI Alliance &UNH-IOL

- Tektronix is a **Contributor Member** of the MIPI Alliance
- Tektronix is actively-participating in several MIPI Working Groups
- Tektronix has a close working relationship with UNH-IOL.
- Combined Tek Press-Release with UNH &MIPI Alliance in Sept-2010:
  - http://www2.tek.com/cmswpt/prdetails.lotr%3Fct%3DPR%26cs%3DNews%2BRelease%26ci%3D17639%26lc%3DEN&urlhash=HZu6

- "…....Tektronix is spurring the adoption of D-PHY and M-PHY specifications. Tektronix is aiding the adoption of the new M-PHY interface by giving designers the testing tools they need to ensure signal integrity and verify performance of increasingly complex designs."
  - ***Joel Huloux, Chairman of the MIPI Alliance.***
- "Tektronix has been supportive of UNH-IOL's collaborative efforts…….,"
  - ***Andy Baldman, Senior technical staff, R&D, UNH-IOL.***

Tek Tools are listed on MIPI Alliance Webpage and CTS

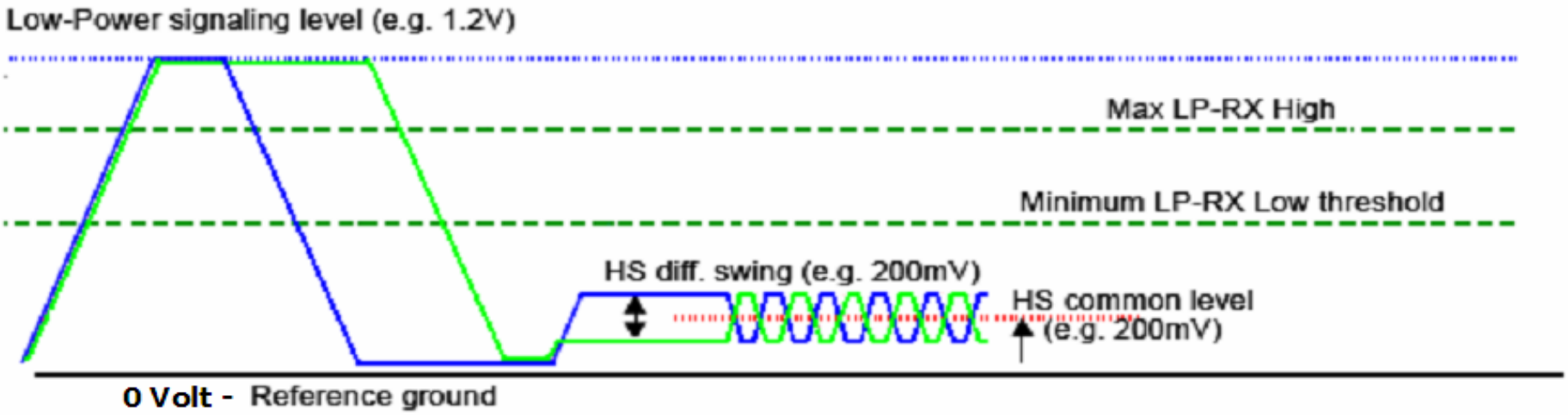


Tek MIPI setup used by UNH-IOL

UNH-IOL (University of New Hampshire) is a 3rd party test house for MIPI testing

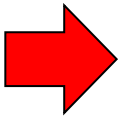
What is D-PHY ?

- It's a PHY standard for interfacing Camera (CSI) & Display (DSI)
- Two modes of transmission
  - High Speed (HS) and Low Power (LP)
- Modes are mixed during the operation
  - Transitions from LP to HS and back to LP on the fly
- Maximum Data Rate
  - High Speed mode: 80 Mbps – 1.5 Gbps, Typically at ~500 Mbps.
  - Low Power mode: Up to 10 Mbps
- Bus termination
  - 50 ohms in HS
  - Hi-Z in LP



D-PHY Testing Challenges

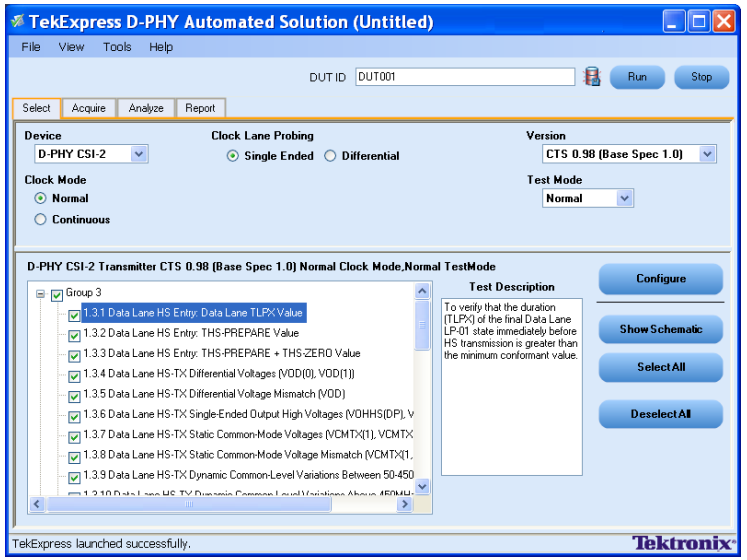
- Logo testing is not required, but Optional.
  - MIPI is Chip-to-Chip/ Chip-to-Peripheral interface, similar to a DDR bus.
  - Mobile Phones do not need compliance logo, unlike USB/SATA devices
- No two MIPI devices are the same
  - Variable Data Rates
  - Up to 4 lanes of Data traffic,
  - Multiple different data formats
  - Specification enables custom limits.
- Characterization is significantly important
  - Mobile OEMs select the suppliers based on characterization reports.



Test Equipment &Setups need to be Very Flexible

D-PHY Tx : Opt.D-PHYTX Conformance Test Solution

- Opt.D-PHYTX : D-PHY Automated Solution
  - TekExpress option for Fully-Automated testing
  - Provides Conformance and Characterization Testing
  - Based on D-PHY Base Spec v1.0 and UNH's Conformance Test Suite v0.98.
  - Runs on 7K/C and 70K/B/C scopes
- Opt.TEKEXP is Pre-Requisite
- Differentiation
  - Un-parallel Automation
    - Using Automatic cursor finding of Test Regions
  - 100% Widest Test Coverage
  - For Conformance testing to Latest CTS (v0.98)
  - Based on Latest Base spec (v1.0)
  - Fully-Automated Temperature Chamber testing
- Value proposition
  - Custom-limits/ Limits-Editing on the fly
  - Test Reports
    - Pass/Fail Summary with Margin details &Zoom-in waveform captures
  - Tek 3.5GHz scope is the minimal configuration for accurate testing



D-PHY Tx : Opt.D-PHYTX Conformance Test Solution Features &Benefits

Feature	Benefit
Unparallel-Automated Testing	• Performs Single-button Fully-Automated testing for set of Transmitter measurements • Enables designers to test devices faster
Comprehensive Tests coverage	• 100% Coverage • 49 out of 49 total CTS tests
Fully-Automated Temperature Chamber testing	• Validate All High Speed tests using differential probes, Socket XL cables, High-Temperature Tips and Standard Filter Files.
Clock Continuous mode	• Allows selective tests run in Clock Continuous mode
Escape mode	• Allows to perform ULPS &Normal Mode tests
Characterization/ Margin Testing	• Allows custom-limits or limits-editing to perform Margin testing. • Performs characterization of your design.
Detailed Test-Reports	• Provides Pass/Fail summary table, margin details on each test, and waveform screenshot of the testing region for each test.

D-PHY Tx : Opt.D-PHY Debug and Analysis Solution

- Opt.D-PHY : D-PHY Essentials
  - DPOJET option for Setup Library &MOI
  - Provides Debug Analysis and Characterization Testing
  - Based on D-PHY Base Spec v0.9 and UNH's Conformance Test Suite v0.08.
  - Runs on 7K/C and 70K/B/C scopes
- Opt.DJA is Pre-Requisite
- Differentiation
  - Flexible for Debug Analysis & Characterization
  - Breadth of Tests Coverage
- Value proposition
  - DPOJET Detailed Test Reports
  - DPOJET Scalable for early start on M-PHY (Next Generation Standard)
  - Tek 3.5GHz scope is the minimal configuration for accurate testing

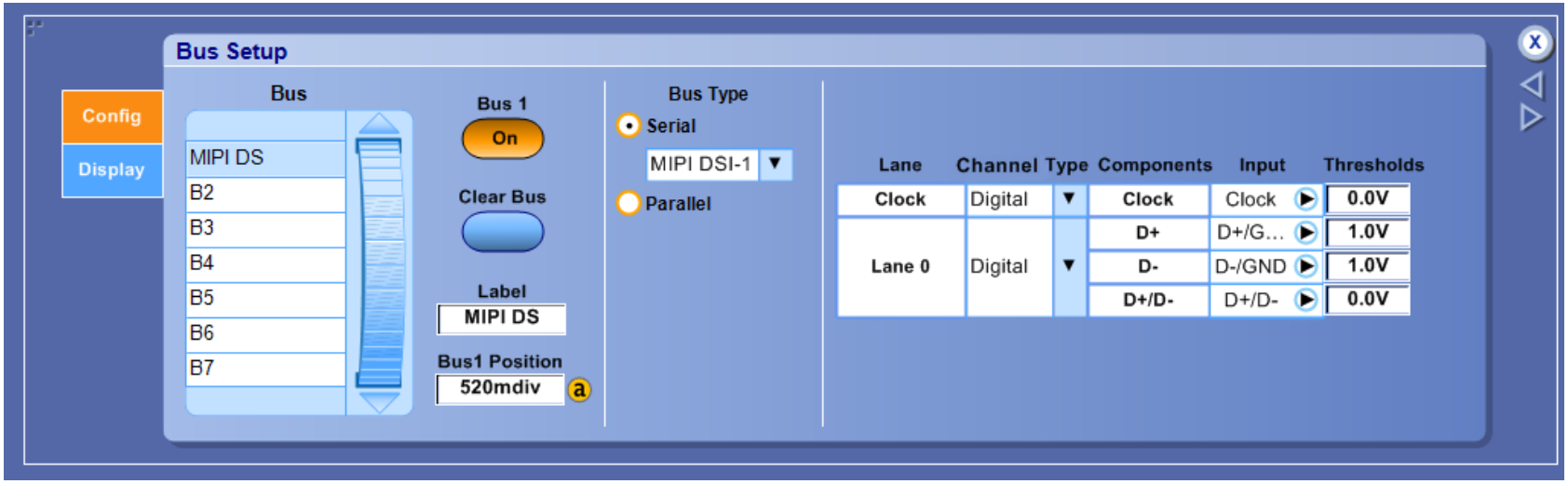
D-PHY Tx : Recommended Test Setup

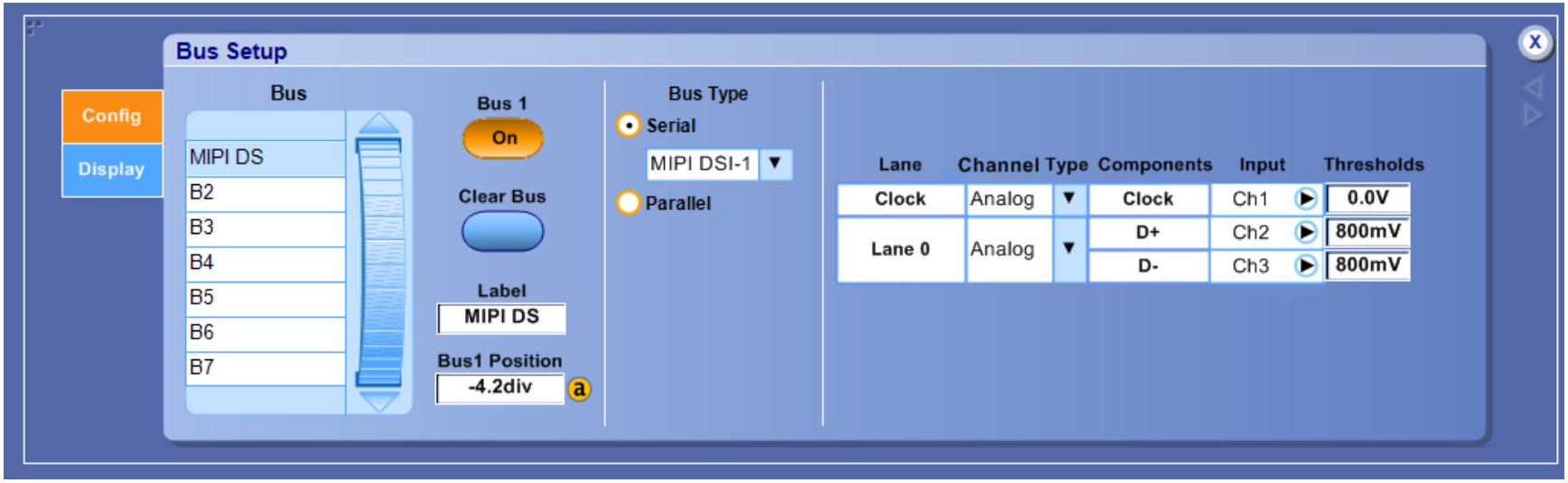
www.tek.com/applications/computing/serial/recommended_equipment.html#mipi

- Scope
  - Recommend: DPO7354/C or DPO/DSA/MSO70404/B/C or higher for risetime accuracies.
- Probes
  - For 7Ks: 4x TAPxx/ P6245/ P6249, or 3x TDP3500
  - For 70Ks: 4x P7240 or 3x P73xx with 020-3035-00 tips/ 3x P75xx.
- Scope Software
  - Opt.D-PHYTX on TEKEXP For Conformance Test
  - Opt.D-PHY on DPOJET for Debug, Analysis &Characterization

DSI/ CSI Decode (New)

Probe using Analog, Digital or Mixed Channels

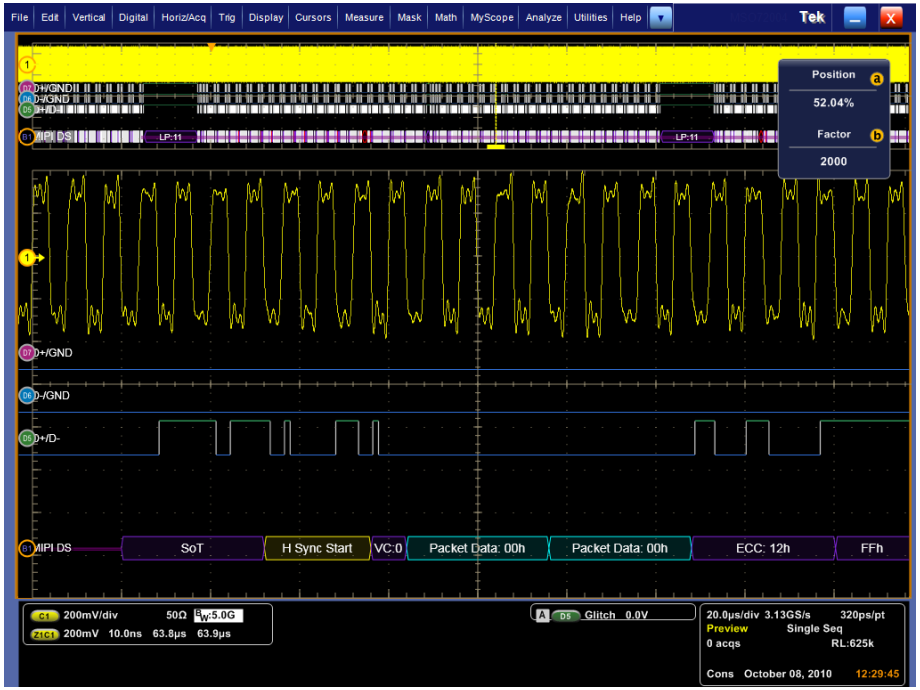




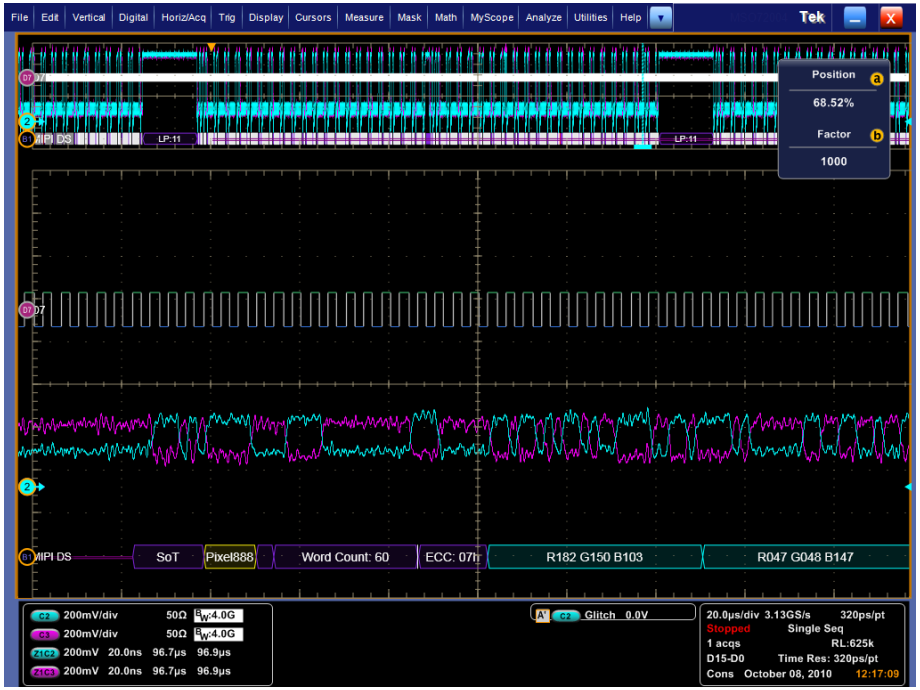
DSI/ CSI Decode (New)

Mix of Analog and Digital Channels

- Analog Clock, Digital Data



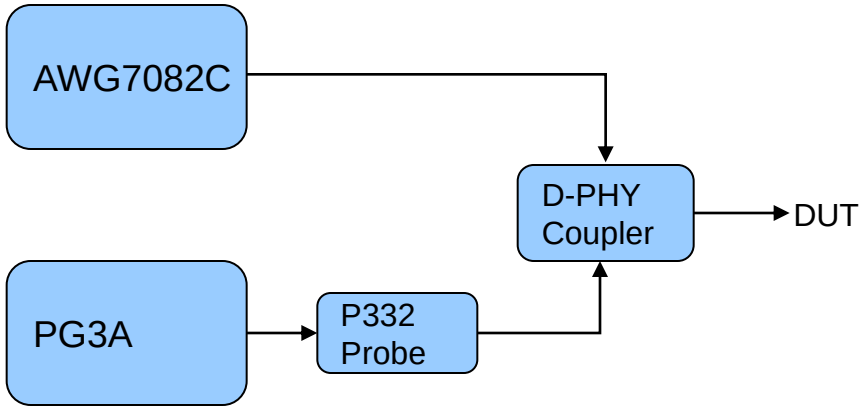
- Digital Clock, Analog Data



- Flexible, high performance MSO channels allow simultaneous probing of DSI and CSI buses
- Working on multi-lane solution, MSO70k is the only product on the market that could do this

D-PHY Rx : Test Solution Overview

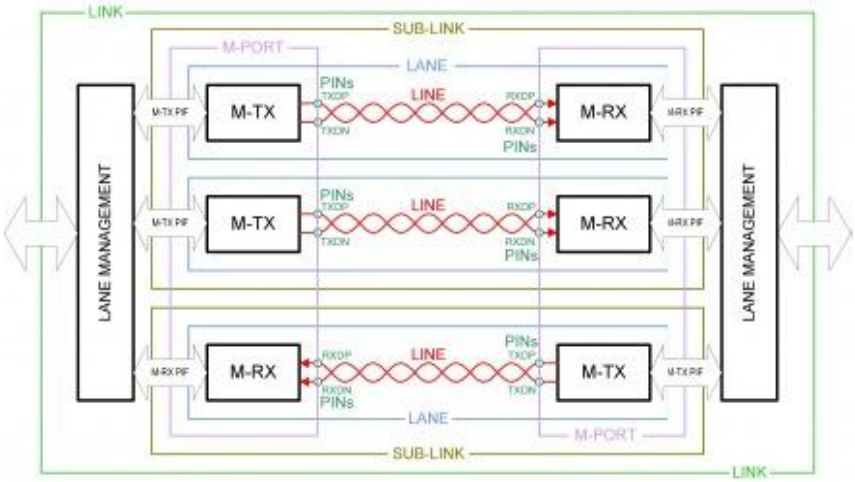
- 100% Complete solution for D-PHY Compliance testing
  - Meets all the requirements in UNH-IOL document (v0.98)
  - PG3A is only 4 channel solution available
- System set up is quick and easy
  - No complex VXI system, just stand alone instruments, a probe and a coupler
- Cost effective solution
  - Approx 66% lower list price than competition
- No extra equipment required for protocol testing
  - PG3A is only 4 channel solution for complete CSI and DSI protocol testing
- PG3A Pattern Generator provides
  - Controls clock and signaling to establish link with DUT
  - Adjusts voltage levels, packet type, etc to stress test receiver
- AWG7082C Arbitrary Waveform Generator
  - Adds jitter and interference to the D-PHY signals



What is M-PHY ?

- M-PHY is a flexible architecture that allows the implementer to support high data rates at minimal power, cost & I/O redesign, for applications such as High Definition Video
- A Fast, Scalable, Serial Communications Architecture
  - Link – Connects M-PHY Transmitter to an M-PHY Receiver
  - Sub-link – Manage one or more lanes
  - Lane – Operation defined in the protocol (DSI, CSI, UniPro, DigRF)

		D-PHY	M-PHY
Min. # of pins per direction		4	2
Min. # of pins for Min. configuration		4 only unidir or half-duplex	4 dual-simplex
Data rate per lane	HS	>80 Mb/s (Practical limit 1Gb/s)	~ 1¼ , 2½ , 5 Gb/s ~ 1½ , 3 , 6 Gb/s
	LS	< 10 Mb/s	10k-600Mb/s
Electrical signaling	HS	Diff (200mVpk)	Diff (200/120mVpk)
	LS	LVCMOS1.2V	Diff (400/240mVpk)
HS Clocking method		DDR Source-Sync Clk	Custom Clk
Line coding		None or 8b9b	8b10b
Power – Energy/bit		Low	Lower



M-PHY Testing Challenges

Signaling Mode	Speed	Level (V)	Impedance
MPHY-PWM	576Mbps	500e-3/250e-3 260e-3/130e-3	10k/50 ohms
MPHY-SYS	576Mbps	500e-3/250e-3 260e-3/130e-3	10k/50 ohms
MPHY-HS	5.83Gbps	250e-3/130e-3	50 ohms

- Higher data rate will increase importance of Signal Integrity of links
  - Acquisition capability of oscilloscope will need to increase
  - More emphasis on timing/jitter and noise (signal integrity)
  - Receiver testing will be needed to stress-test resulting BER
- Termination
  - Two types of terminations - Restive terminated, and not Terminated.
  - LS mode can operate either terminated or not terminated
  - HS mode it is always terminated, so the swing are halved.

Tektronix M-PHY Testing Solution

- Tektronix is **Industry 1st** tools for M-PHY measurements &Decode
  - Its announced in September 2010, during MIPI Conference in Athens
- Tek is Only tools available today for M-PHY Measurements &Decode
- PSD (Power Spectral Density) measurements are Uniquely supported

cf.us.biz.yahoo.com/iw/100927/0666379.html?.v=1&printer=1

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Press Release Source: Tektronix

Tektronix Introduces Industry's First Test Tools for MIPI M-PHY Debug and Validation

Monday September 27, 9:00 am ET

Support for New High-Speed M-PHY Specification Includes DPOJET toolset, and M-PHY DigRFv4 Decode for Tektronix Oscilloscopes

BEAVERTON, OR--(Marketwire - 09/27/10) - Tektronix, Inc., the world's leading manufacturer of oscilloscopes, today introduced the industry's first testing tools for the MIPI® Alliance M-PHY standard, allowing customers to immediately get started with performance verification and debug for this important new specification using Tektronix DPO/DSA/MSO70000B Series oscilloscopes.

The announcement was made in conjunction with the MIPI Alliance All-Members meeting taking place this week in Athens, Greece. The M-PHY specification is an essential part of the MIPI Alliance's vision for more efficient high-speed interfaces on mobile devices. Compared to the current D-PHY specification, M-PHY supports faster chip-to-chip connections while addressing EMI and power dissipation concerns. By moving quickly to offer M-PHY testing tools, Tektronix is stepping up to help ensure rapid delivery of next-generation mobile devices incorporating M-PHY at the physical layer.

"As an active MIPI contributor, Tektronix brings its test and measurement knowledge to the organization, spurring the adoption of D-PHY and M-PHY specifications," said Joel Huloux, chairman of the MIPI Alliance. "Tektronix is aiding the adoption of the new M-PHY interface by giving designers the testing tools they need to ensure signal integrity and verify performance of increasingly complex designs."

Based on the newly ratified MIPI Alliance M-PHY specification, the new Tektronix M-PHY test offering includes a setup library for the popular DPOJET jitter analysis software and methods of implementation (MOI) developed in the close cooperation with UNH-IOL. The solution also includes probing and protocol support from Tektronix partner, The Moving Pixel Company, as well as M-PHY DigRF(SM)v4 decode and verification.

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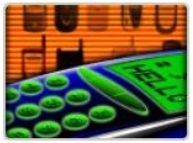
www.electronics-eetimes.com

New Products

Tektronix delivers for MIPI M-PHY

September 30, 2010 | Phil Ling | 222903926



Tektronix has introduced what it claims are the industry's first test tools for MIPI M-PHY debug and validation. Support for the new high-speed M-PHY specification includes DPOJET toolset and M-PHY DigRFv4 Decode for its oscilloscopes, allowing customers to immediately get started with performance verification and debug. The announcement was made in conjunction with the recent MIPI Alliance All-Members meeting in Athens, Greece.

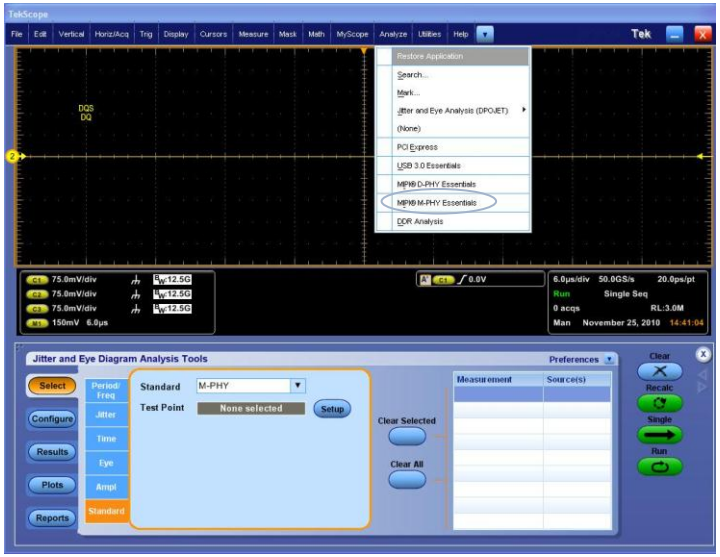
The M-PHY specification is an essential part of the MIPI Alliance's vision for more efficient high-speed interfaces on mobile devices. Compared to the current D-PHY specification, M-PHY supports faster chip-to-chip connections while addressing EMI and power dissipation concerns.

By moving quickly to offer M-PHY testing tools, Tektronix is striving to help ensure rapid delivery of next-generation mobile devices incorporating M-PHY at the physical layer.

"As an active MIPI contributor, Tektronix brings its test and measurement knowledge to the organization, spurring the adoption of D-PHY and M-PHY specifications," said Joel Huloux, chairman of the MIPI Alliance. "Tektronix is aiding the adoption of the new M-PHY interface by giving designers the testing tools they need to ensure signal integrity and verify performance of increasingly complex designs."

M-PHY Tx : Opt.M-PHY Testing Solution

- Opt.M-PHY: M-PHY Essentials
  - DPOJET option for Setup Library &MOI
  - Provides Debug Analysis and Characterization Testing
  - Based on M-PHY Base Spec v0.8 and Conformance Test Suite v0.1.
  - Runs on 70K/B/C scopes (6 GHz and above)
- Opt.DJA is Pre-Requisite
- Differentiation
  - Industry 1st Testing Tool
  - Flexible for Debug Analysis &Characterization
- Value proposition
  - One powerful tool (DPOJET) for all MIPI Debug &Characterization needs using Opt.M-PHY & Opt.D-PHY
  - Comprehensive DPOJET Reports.



M-PHY Decode: Opt.MPHYVIEW DigRFv4 Decode

- Automated Decoding:
  - Automatically recognizes data speeds, disassembles, and displays the decoded data in different readable-data formats
- 4 Lanes Decoding:
  - Acquires up to 4 lanes of data traffic at a time.
- On-line, Offline and Remote Analysis:
  - Uses TekVisa to connect to a scope.
  - Remote execution through LAN network.
- Filter Tab:
  - Fillter the records in the listing based on user criteria.
- Search Tab:
  - Searching &highlight records that satisfy given criteria
- Options Tab:
  - Set display, disassembly, and configuration options.

Summary - Tektronix MIPI Solutions

- Tektronix is 1st to Market for M-PHY testing, announced in Sept, 2010
- Tektronix is a **Contributor Member** of the MIPI Alliance
- Tektronix is actively-participating in MIPI PHY &other Working Groups
- Tektronix has a close working relationship with UNH-IOL

Tektronix MIPI Solutions Portfolio
www.Tektronix.com/applications/computing/serial/recommended_equipment.html#mipi

Standard	Physical Layer Trasmitter	Physical Layer Receiver	Protocol Analysis &Decode	Stimulus
D-PHY, DSI, CSI-2	1x DPO7354 or DPO70404B Oscilloscope	1x PG3ACAB PatternGenerator	1x TLA7012 or TLA7016 TLA	1x PG3ACAB or PG3AMOD
	4x P7240, TAPxx, P6245 or P6249 probes, OR	1x P331 D-PHY Probe for PG	1x LA ModuleTLA7BBx	1x P331 D-PHY Probe for PG
	3x P73xx with 020-3035-00 or TDP3500	1x PGRemote SW	1x P6980 LA Probe	1x PGRemote SW
	1x TEKEXP Opt.D-PHYTX, or DPOJET Opt.D-PHY	1x AWG7082C or above	1x D-PHY to P6980 Adapter	
	No Fixtures required for Live-Setups	1x D-PHY Coupler	1x CSI or DSI SW for TLA (Free)	
	UNH Fixtures for Non-Live setups			
M-PHY, DigRFv4, DSI-2, CSI-3	1xDPO70604 for GEAR1. 1x DPO70804 for others	1x AWG7122C with option#6		
	2x P73xx, P73xxSMA, or P75xx Probes per Lane	1x SerialXpress SW		
	1x Opt.M-PHY for Tx Debug, Analysis &Validation	1x **Early-Market AWG files Kit		
	1x Opt. MPHYVIEW DigRFv4 Decode SW	for PRBS, PWM &other patterns		

Notes:
Opt.D-PHYTX: Fully-Automated Single-button Solution for D-PHY Conformance & Characaterization
Opt.D-PHY: D-PHY Debug Analysis and Characterization
Opt.M-PHY: M-PHY Debug Analysis and Characterization
Opt.MPHYVIEW: M-PHY DigRFv4 Decode Solution

Physical Layer Analysis
D-PHY/ M-PHY

Protocol &Digital Analysis
CSI, DSI, DigRF, UniPro, SLIMbus

Signal Generation
D-PHY/ M-PHY

Tektronix MHL Solution

——the First Complete Compliance Solution Certificated by CTS

MHL
Mobile High-Definition Link

designinsight | onsite

Tektronix®

Tektronix is a **contributor** adopter for MHL CTS

Welcome MHL Adopters

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www.bizlinktech.com
Cable Assemblies and Wiring Harnesses

Compal Electronics Inc.
www.compal.com
Electronics manufacturer of notebook computers and monitors

Explore Microelectronics, Inc.
http://www.epmi.com.tw
Fabless company developing high-speed interface ICs

Fairchild Semiconductor
www.fairchildsemi.com
Delivers semiconductor solutions for power and mobile designs

Hosiden Corporation
www.hosiden.com
Manufactures and sells electronic components, electromechanical parts and LCD elements

Johnson Component and Equipment Co., Ltd.
www.jcecable.com
Cable Manufacturer

Niketech Electronic Corporation
www.niketech.com.tw
Provider of connectors for the electronics industry

Parade Technologies, Inc.
www.paradetech.com
Develops and supplies advanced and cost-effective high-speed display interface solutions

Sumitomo Electric Industries, Ltd.
global-sei.com
Designs, manufactures and sells cable and components and advanced electronic devices

Sunplus Technology Co., Ltd.
www.sunplus.com
Provider of multimedia IC solutions

Sure-Fire Electrical Corporation
www.sure-fire.com.tw
Global OEM/ODM supplier of cables, connectors and devices

Synopsys
www.synopsys.com
Provider of electronic design automation (EDA) software, IP and services

Tektronix
www.tek.com
Test, measurement and monitoring solutions

YFC-BonEagle Electric Co., Ltd.
www.cables.com.tw
Manufactures power cord sets, LAN cable, patch cords and networking accessories

Official : http://www.mhlconsortium.org/adopter.aspx

现有MHL协会会员

- 移动设备品牌厂商

  *Nokia, Samsung, Sony Ericsson, HTC, Acer, LG, Lenovo, Meizu, OPPO
- 显示设备品牌厂商

  *Samsung, Sony, Toshiba, LG, Funai
- OEM制造或服务提供厂商

  *Compal, Foxconn, Ever Win
- 芯片或IP授权方案厂商

  *Silicon Image, Explore, Fairchild, Mstar, Novatek, Parade, SMSC, Sunplus, Synopsys
- MHL到HDMI转换器制造厂商

  *Adaptertek, Amphenol, Bizlink, Chiang-Yu, Primax, Freeport, Hosiden, JCE, Master Hill, Niketech, Space Shuttle, Sumitomo, Sure-Fire, Yeonhab, YFC-BonEagle
- 测试设备提供厂商

  *Tektronix, Astrode

Silicon Image

What is Compliance Test?

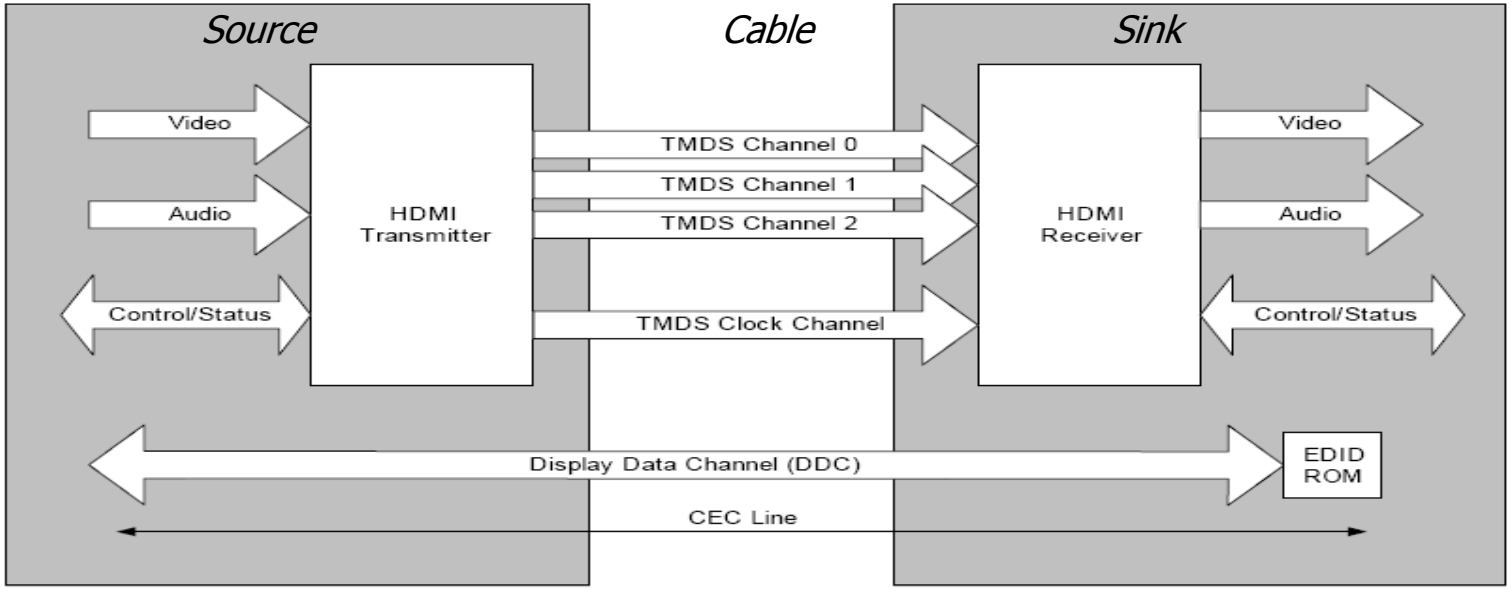
MHL Authorized Test Centers (ATC)

Samsung
www.samsungmhl.com

Simplay Labs, LLC
www.simplaylabs.com

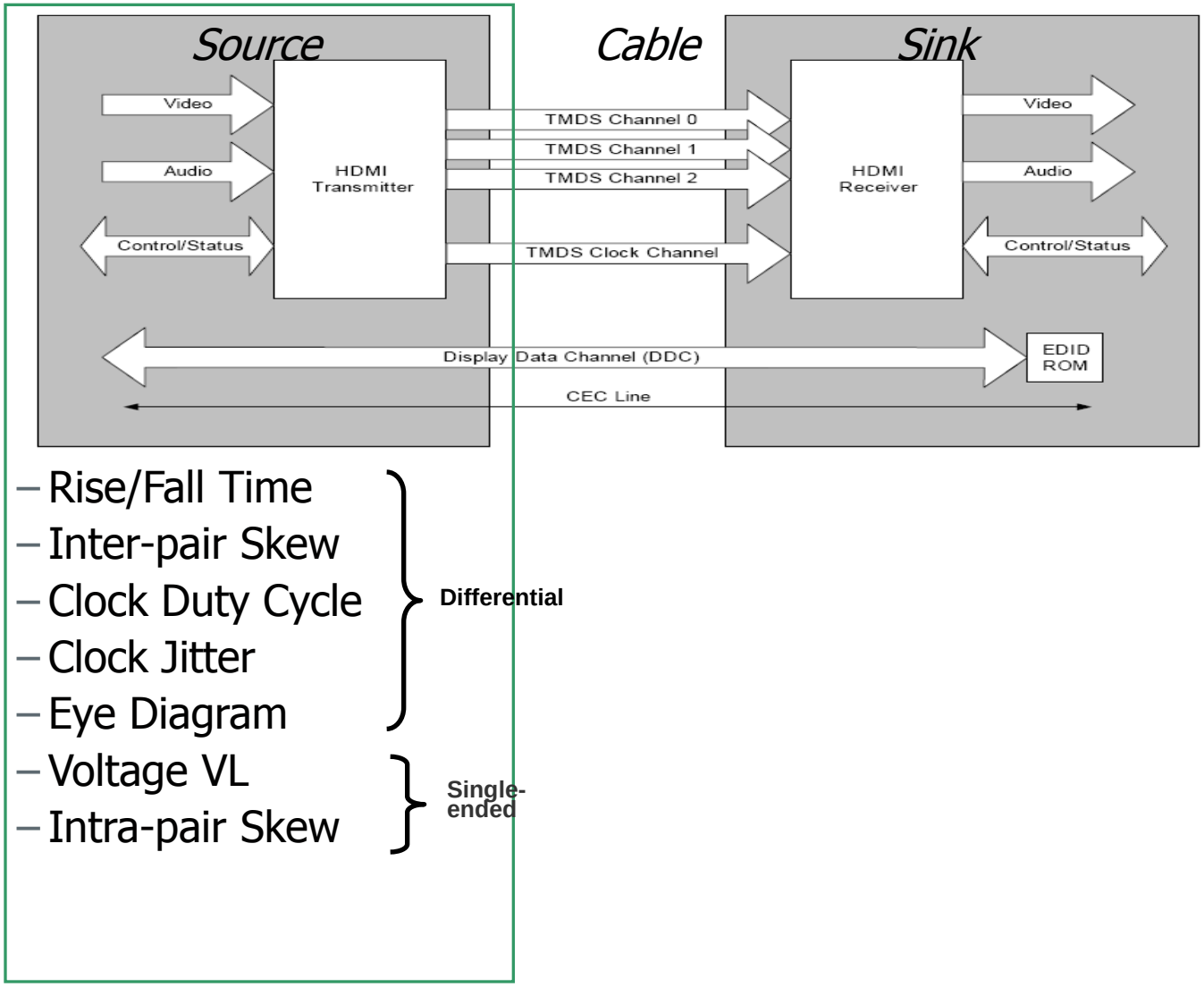
Sony
www.sony.net/Products/ATC/MHL/

HDMI briefing



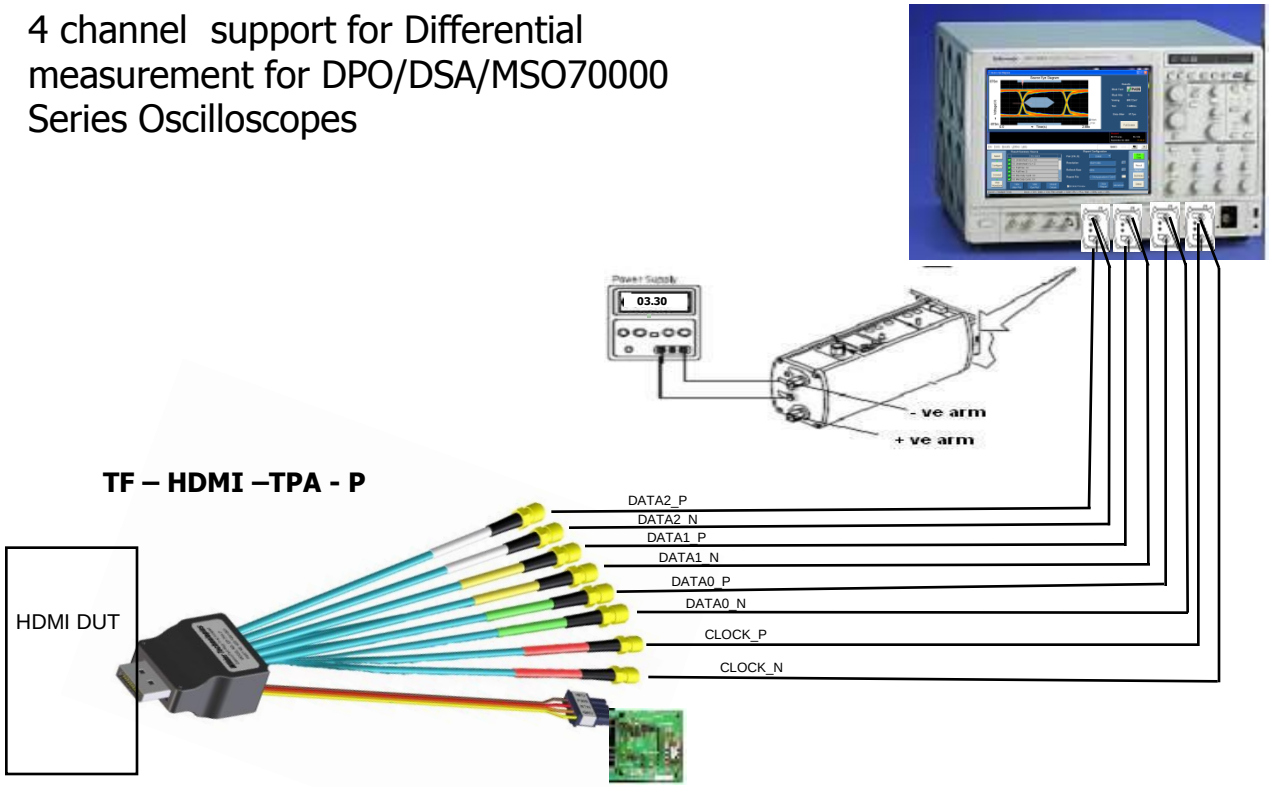
- **Clock**
  - 1 lane differential clock
  - $T_{clcck} = 10 * T_{BIT}$
- **Data**
  - 3 lanes TMDS differential data
- **DDC / EDID**
  - DDC (Display Data Channel) is used by the Source to read the Sink's E-EDID (Extended Display Identification Data) in order to discover the Sink's configuration and/or capabilities.

HDMI Source Testing



Typical Source Test Configuration Differential Measurement

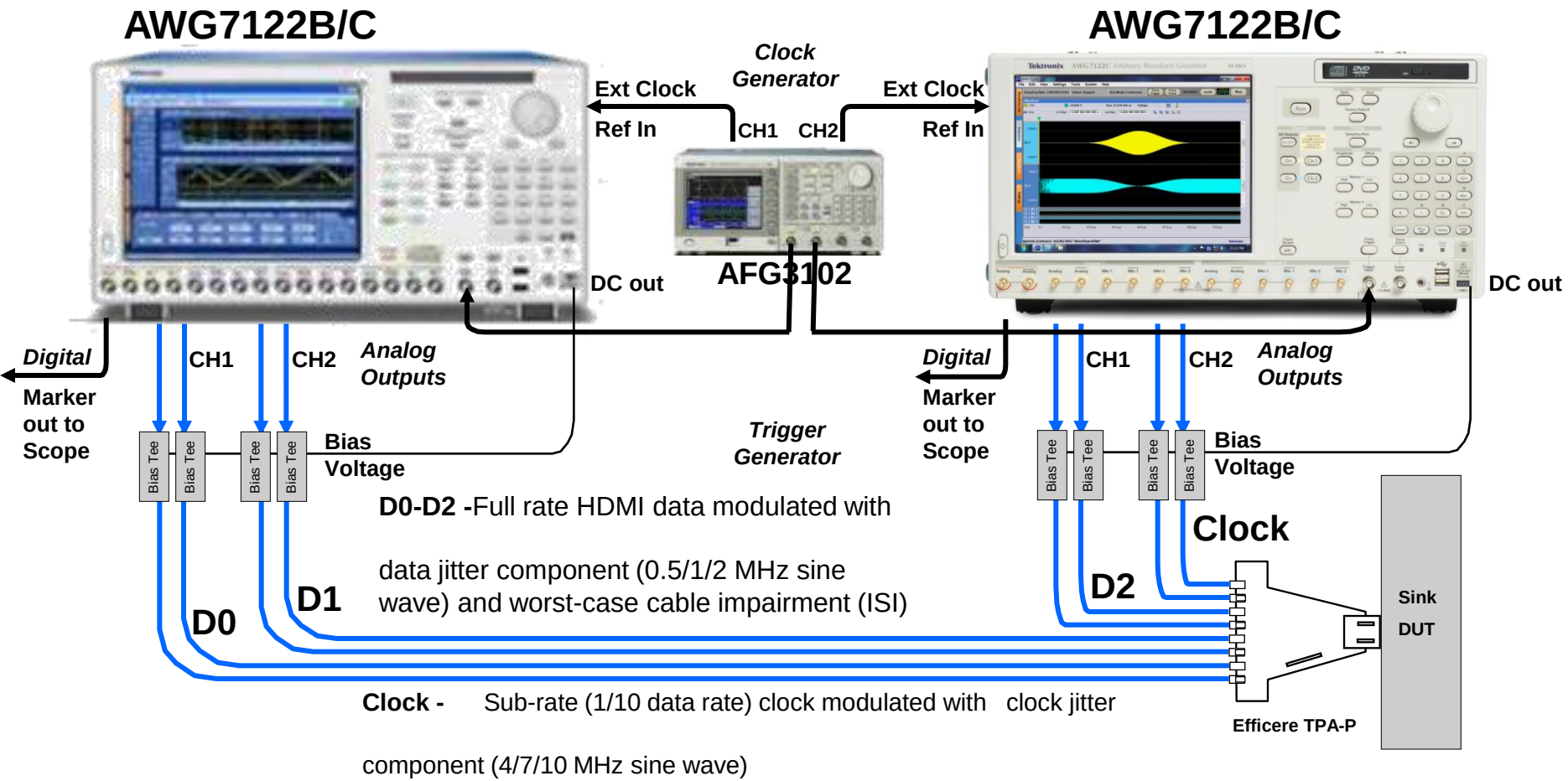
4 channel support for Differential measurement for DPO/DSA/MSO70000 Series Oscilloscopes



AWG7000B with Direct Synthesis Significantly Reduces Test Time

HDMI Jitter Tolerance Test with Direct Synthesis

27 MHz to 340 MHz

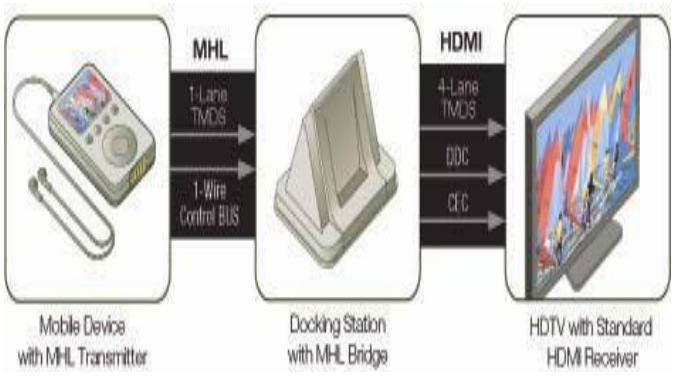


MHL Introduction

Mobile HD Link (MHL) technology is a low pin count HD audio and video interface that connects portable electronics devices such as mobile phones, digital cameras, camcorders and portable media players, to HDTVs.

The technology allows mobile devices to output digital 1080 Full HD resolution via the existing mobile connector without the real estate and cost of another dedicated video connector.

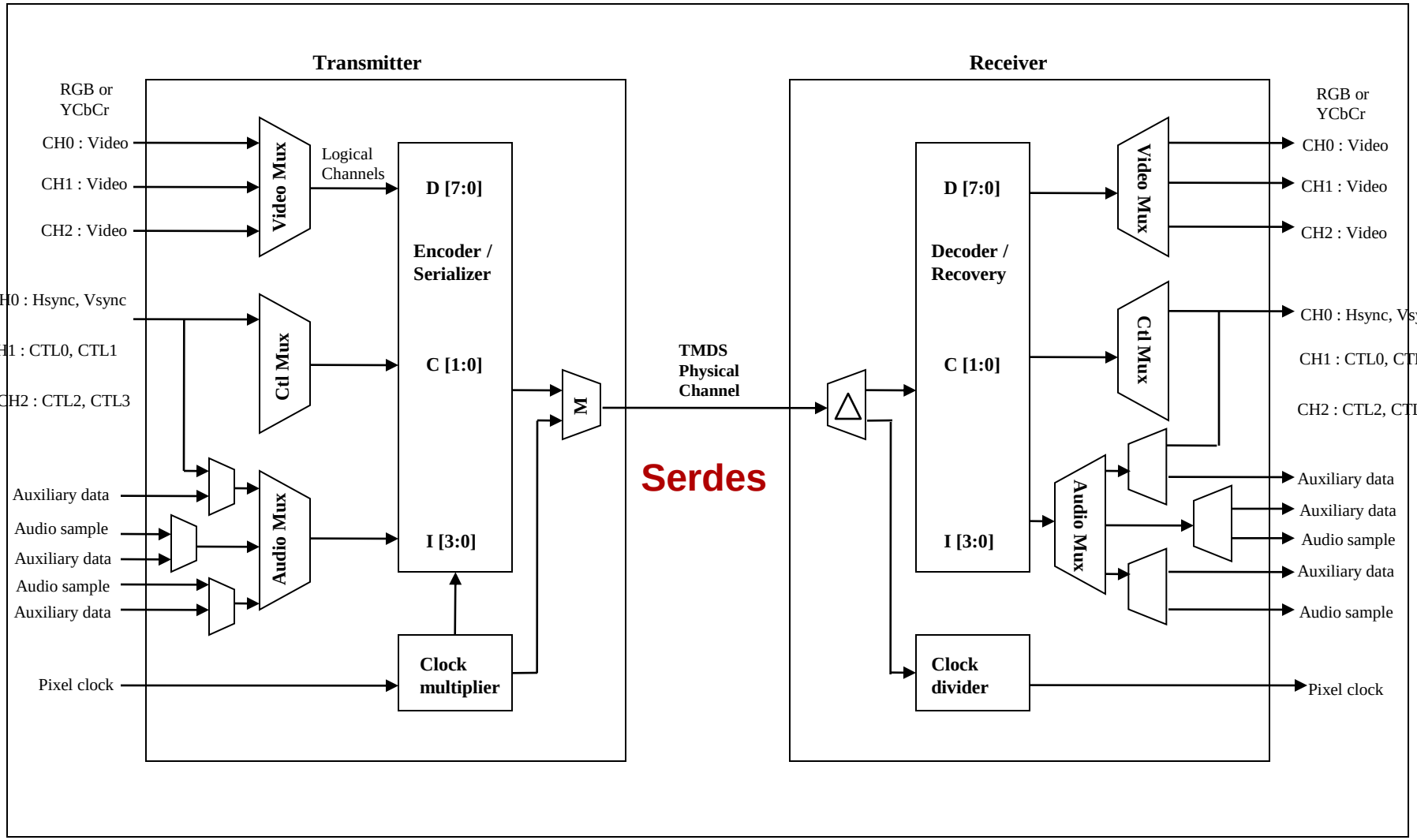
Together with an MHL-to-HDMI bridge, the MHL-enabled mobile device becomes a fully compliant HDMI source and can connect to the television's standard HDMI input port.



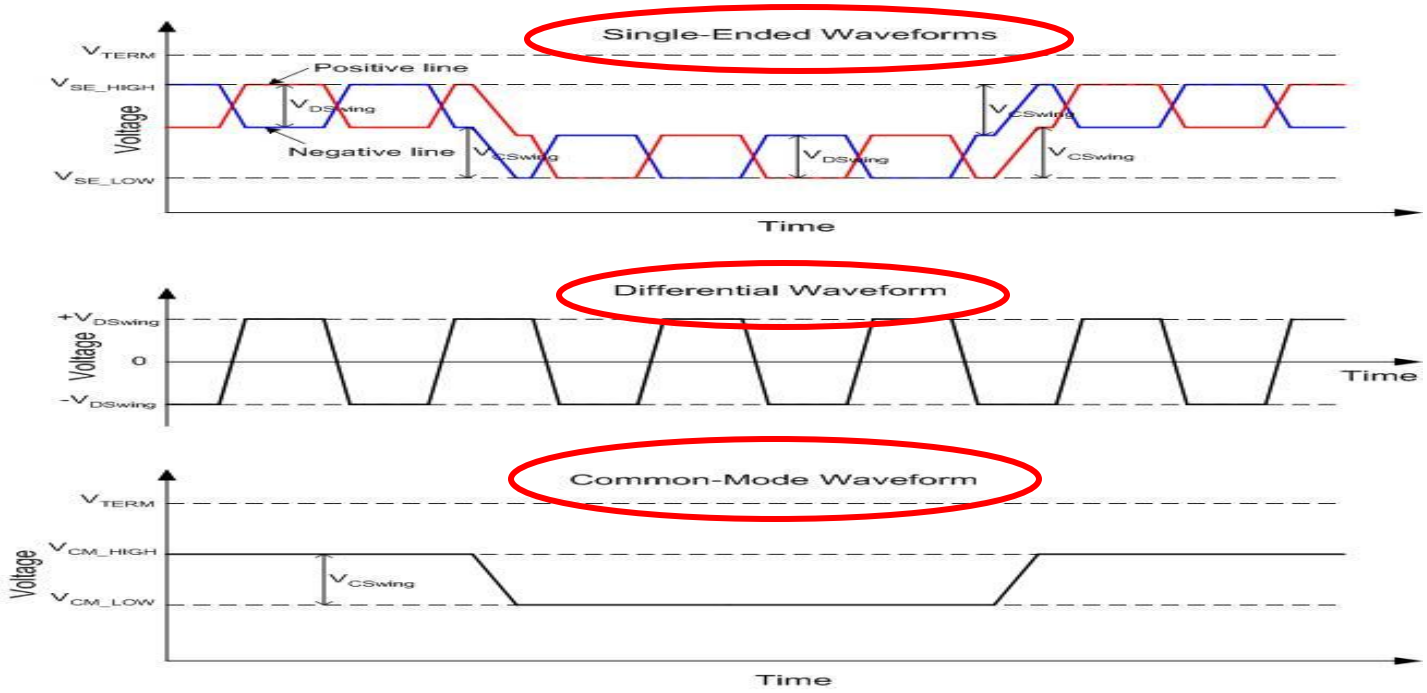
Difference between HDMI and MHL

- **HDMI**
  - Four lanes
    - One differential clock lane
    - Three differential TMDS data lanes
  - DDC
  - Max. 3.4GHz data rate/per lane @ 340MHz clock
  - HDMI connector
  - Max. resolution 4096 x 2160p24
  - Not support PackedPixel mode
  - For home multimedia
  - CTS 1.4
- **MHL**
  - Only one lane
    - One differential TMDS data lane
    - Clock is embedded
  - C-Bus
  - Max. 2.225GHz data rate @ 74.25MHz clock
  - Compatible with uUSB
  - Max. resolution 1920 x 1080i60Hz
  - Support PackedPixel mode
  - For mobile device
  - CTS 1.1 (June 2011)
  - CTS 1.2 (Mar 2012)

MHL Transmitter and Receiver block diagram

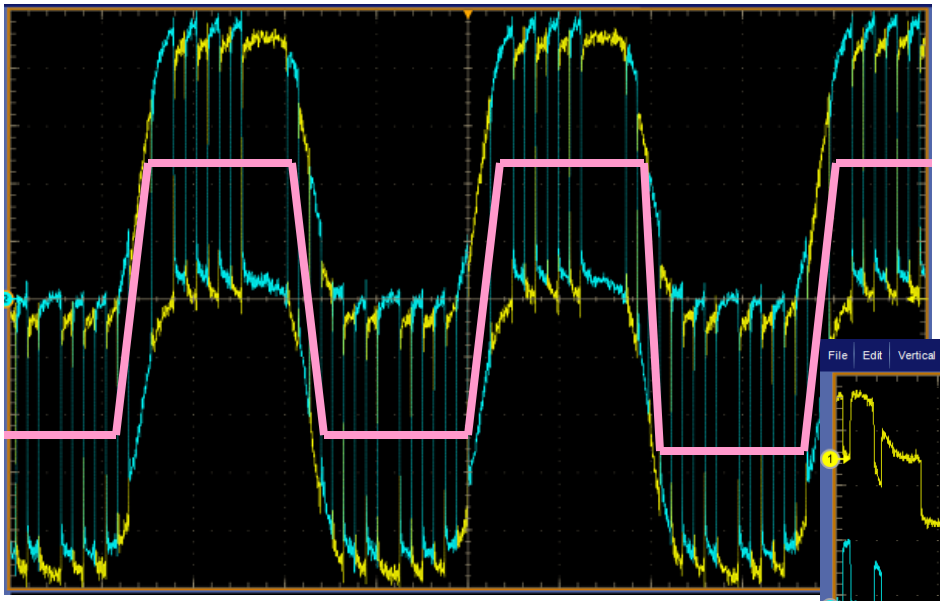


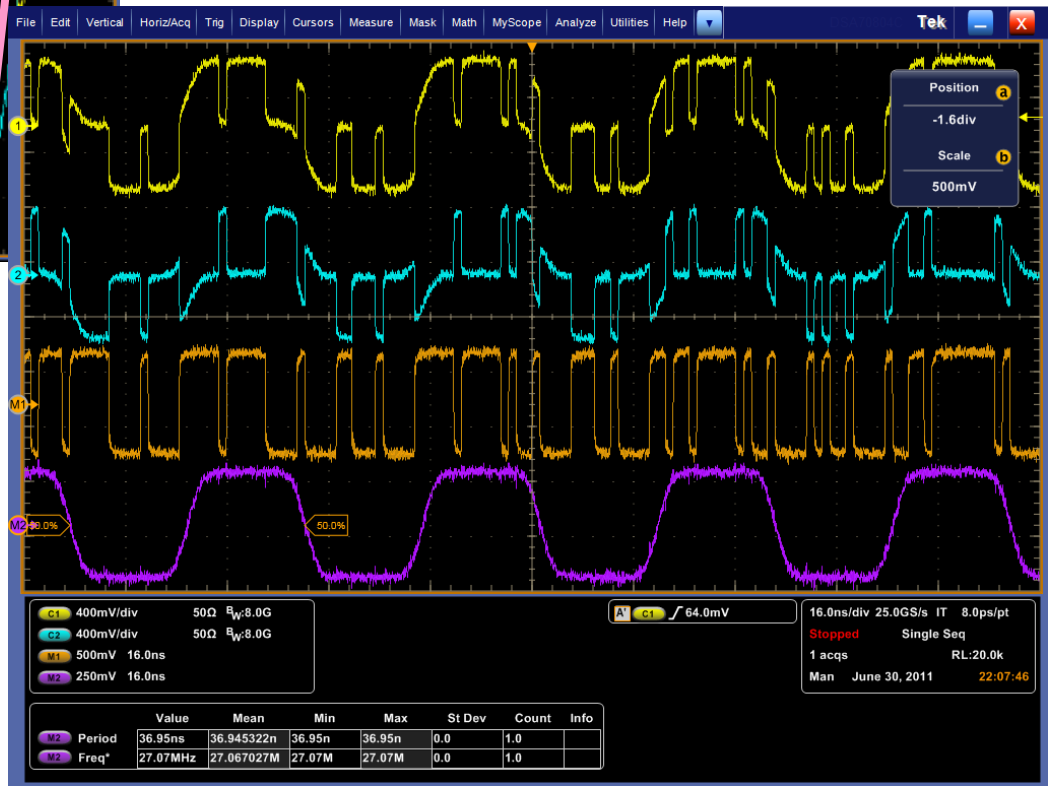
MHL Signal Complexity



- Clock rate / Date rate
  - Max. 75MHz MHL clock rate and 2.25GHz date rate (1080i/60Hz)
  - TMDS (Transition Minimized Differential Signaling) encoding in the Source converts the 8 bits of data into a 10 bit
  - Pack 3 data lanes and 1 clock lane into one lane
- Video mode minimum support requirement
  - 720x480p / 60Hz or 720x576p / 50Hz

MHL Signal (D+ and D-)





Differential

Common mode

TMDS Test Equipment

- **Digital Oscilloscope**
  - TMDS measurements require a High-bandwidth Digital Oscilloscope.
  - -3dB Bandwidth : DC to 8GHz or greater
  - Sampling rate > 25G sample/sec, when 4 channels are simultaneously sampling.
  - Sample memory : more than 20M samples per channel.

- **Differential Probe**
  - -3dB Bandwidth : DC to 8GHz or greater
  - Termination: 3.3V

- **MHL Pattern Generator *(For Sink Test)***
  - Generate MHL clock and data for all MHL defined format
  - Maximum output data bit rate > 3Gbps
  - Internal clock and data jitter generation (optional)
    - Two independent jitters
    - Jitter tolerance : 100KHz to 20MHz
    - Jitter amplitude : maximum 1 UI for 750Mbps ~ 3Gbps with 0.05 UI granulites

- **MHL Cable Emulator**
  - The MHL Cable Emulator shell represent the differential and common-mode insertion losses

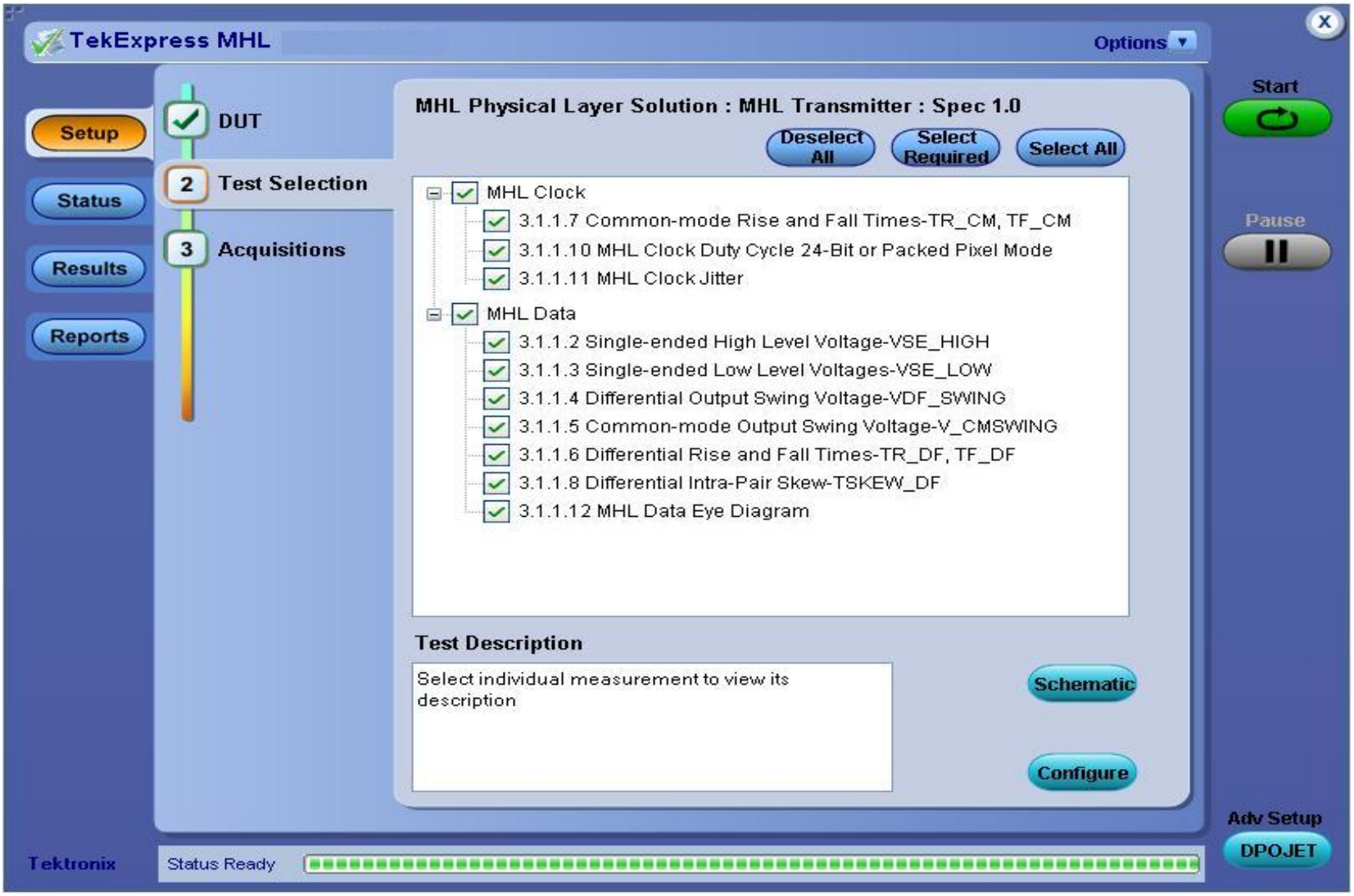
- **Transition Time Converter (TTC)**
  - 120ps TTC is required

Tektronix MHL test Setup

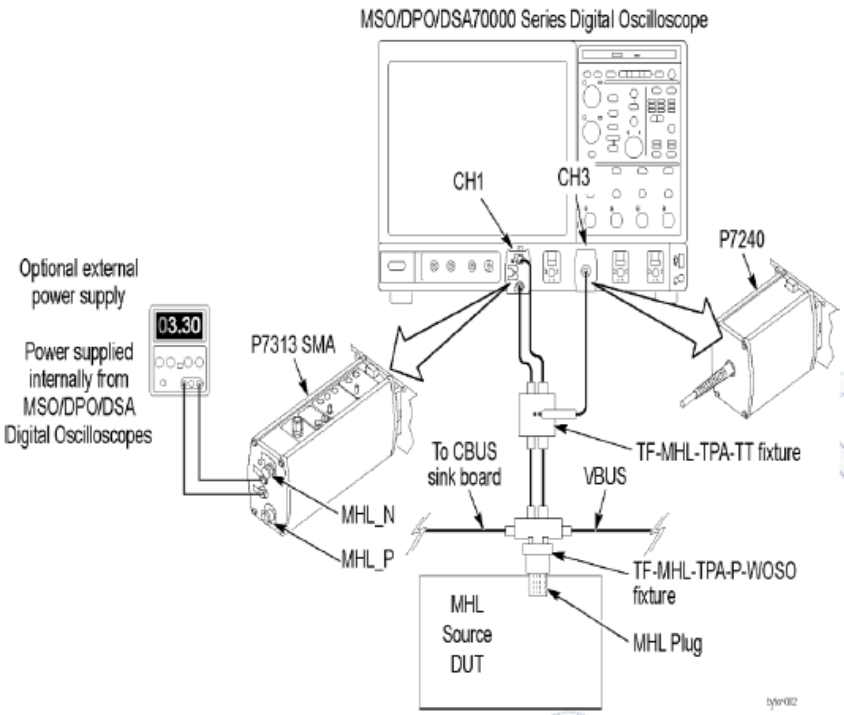
- DPO/DSA/MSO 70804C – Real Time oscilloscope with BW >/= 8GHz
- MHL Compliance software –**Option MHD**
- Probes : Qty.2 - P7313SMA and Qty.1 - P7240
- MHL Protocol Analyzer Software **TEK-PGY-MHL-PA-SW**
- MHL Test fixture- Available from Wilder Technologies our fixture partner
- AWG7122C with Opt 01, 02 or 06, 08 for innovative direct synthesis based MHL Rx/Dongle testing performed manually using AWG MHL patterns and MOI
- C-Bus Sink and Source board is needed and is available from Simplaylabs
- DSA8300 or Equivalent with 80E03/80E04 and I-Connect software for MHL cable testing (performed manually using MOIs)

Tektronix MHL Tx measurement

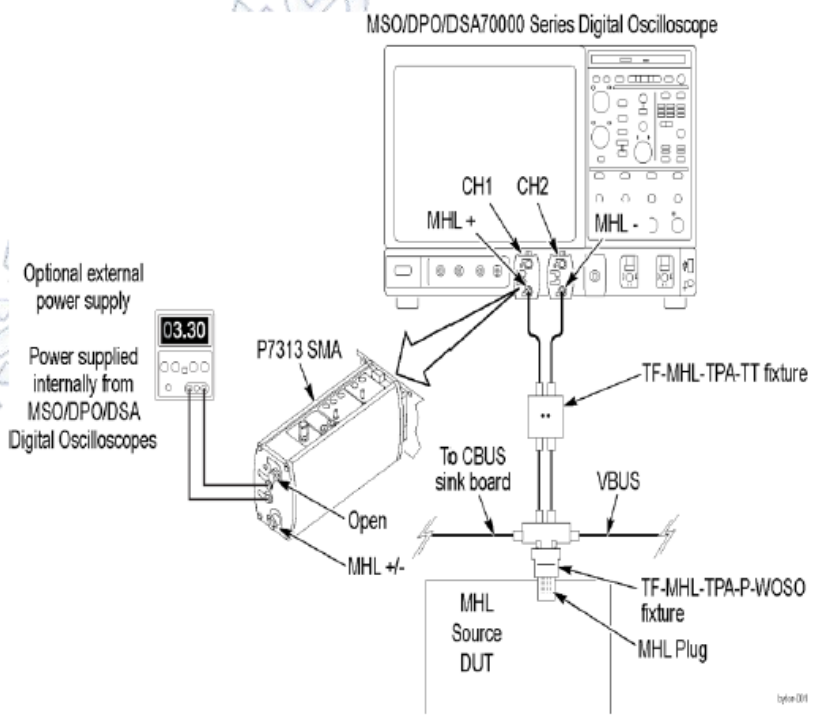
MHL Compliance Software for Tx test - Option MHD



Tektronix MHL Tx Setup



MHL Differential and CM test setup
7 tests



Single Ended and Intra Pair Skew test setup
3Tests

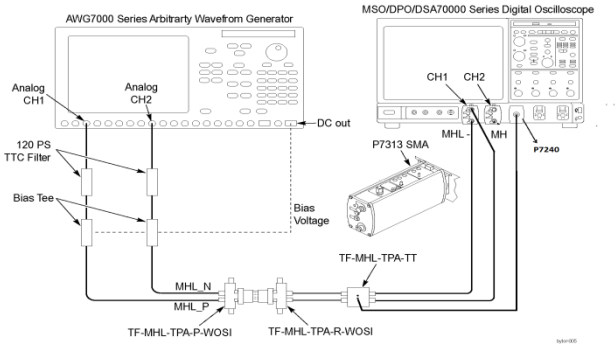
Also same setup is used for MHL Protocol Testing

C-Bus Sink and Source Board is needed for hand shaking and is available from Simplaylabs.

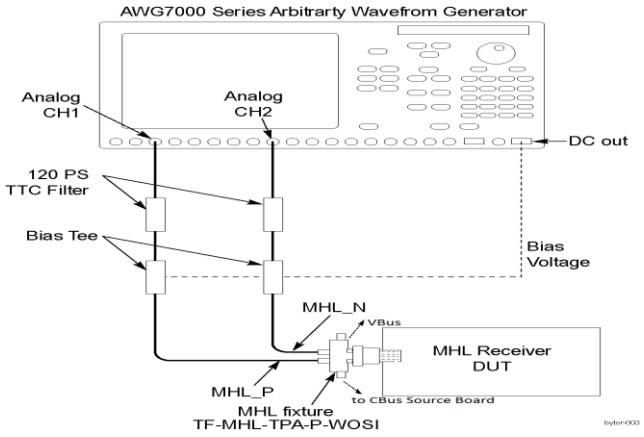
Tektronix MHL Rx measurement

Tektronix MHL solution setup for Sink and Dongle Testing- MOI based

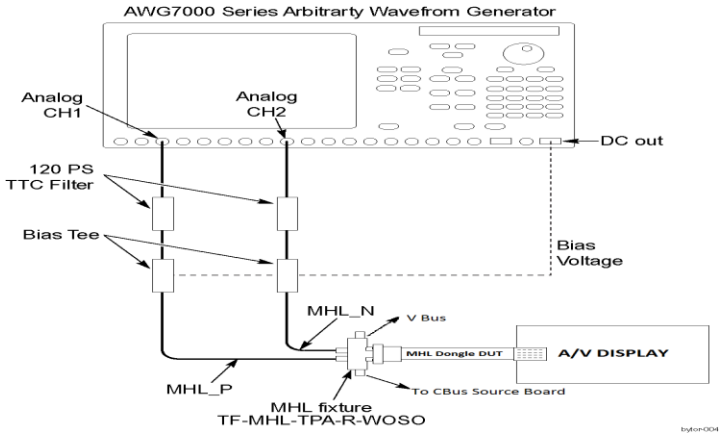
- **MHL Sink and Dongle Test setup based on Direct Synthesis capability of AWG7122C series shown below**
  - **Simple setup**
  - **Easy to use**



AWG Pattern Verification setup

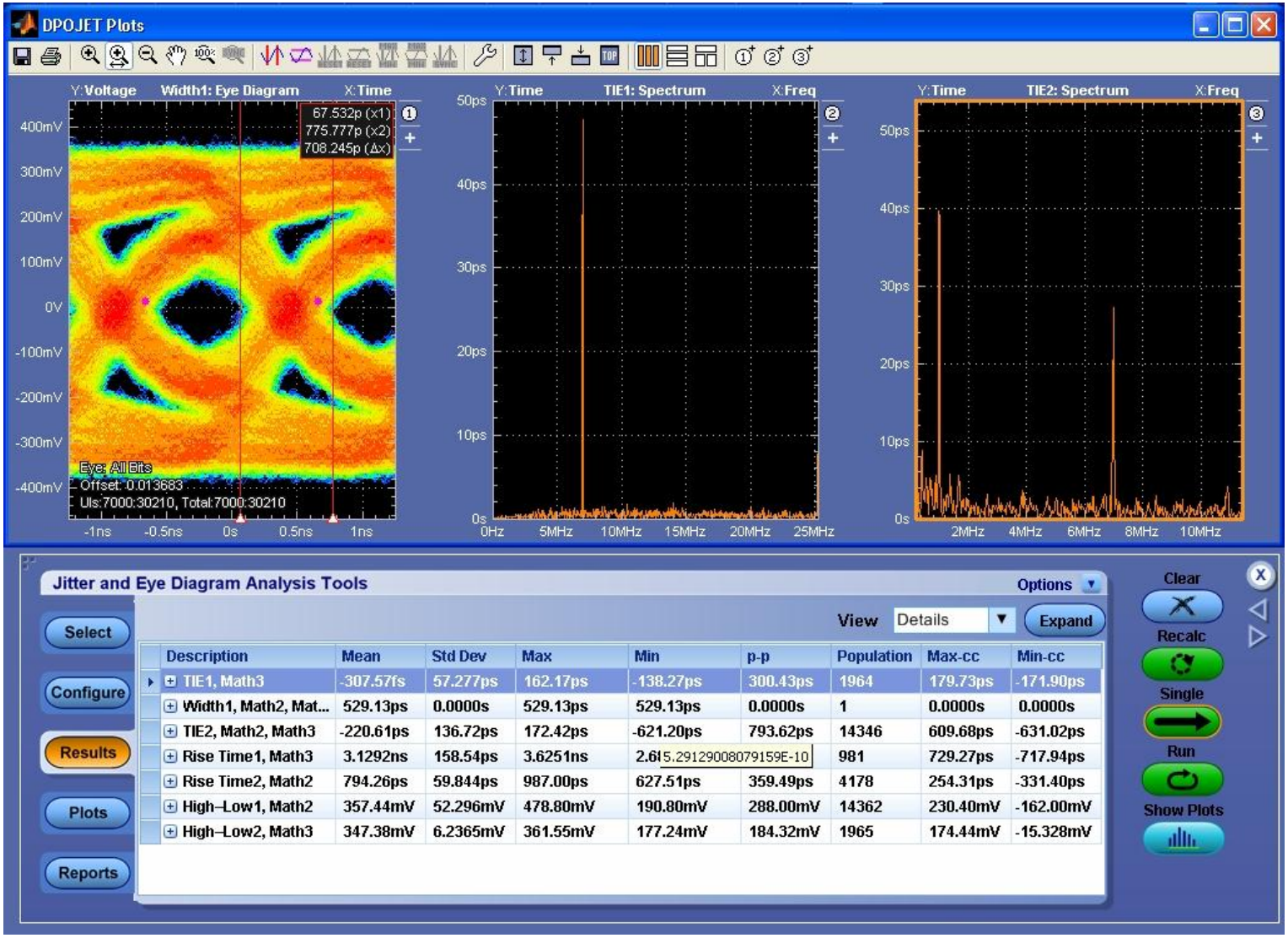


Common Test setup for all Sink Tests



Common Test setup for all Dongle Tests

Tektronix MHL solution setup for Sink and Dongle Testing- MOI based



Innovative MHL Protocol Analyser Solution

- Introducing Tektronix' MHL Protocol solution

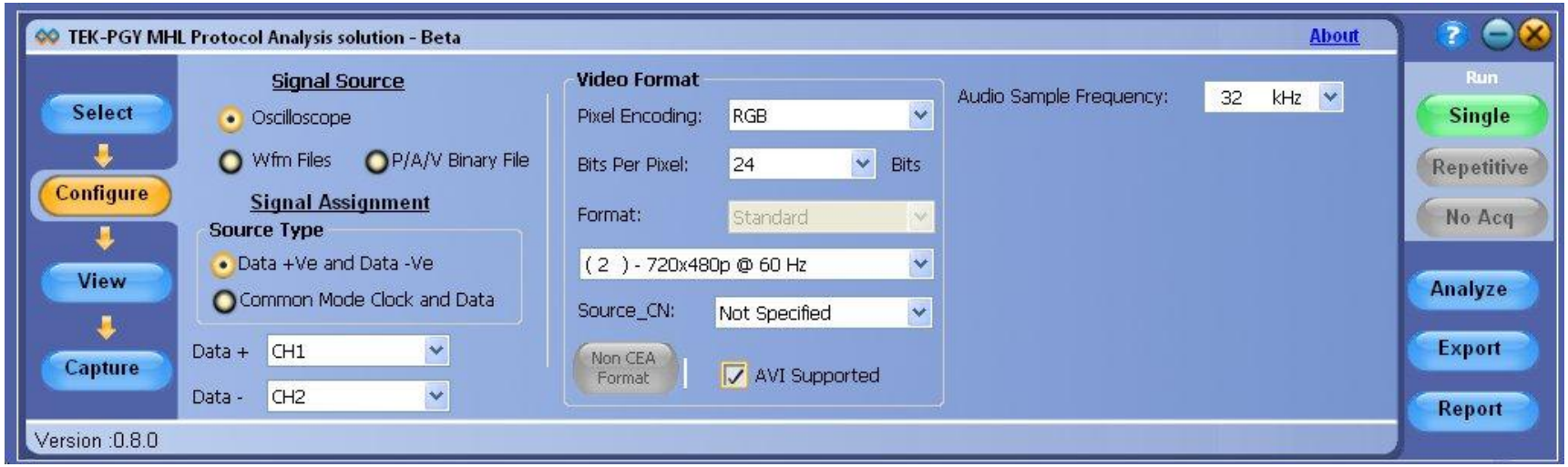
designinsight | onsite

Tektronix®

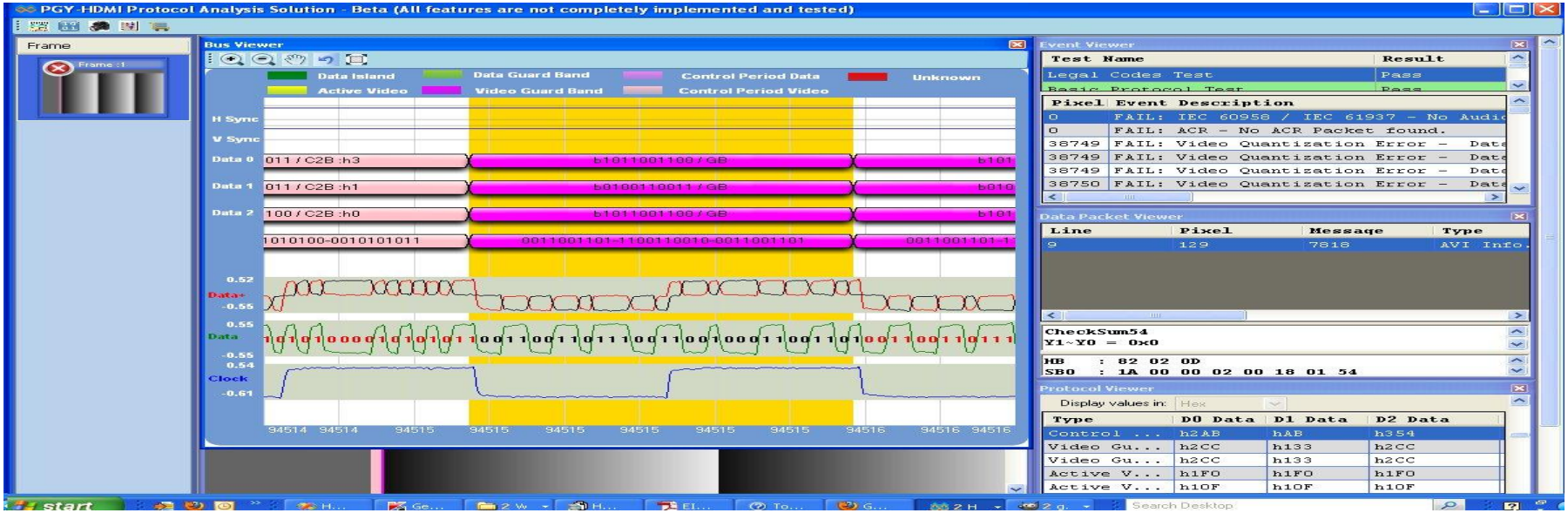
Tektronix MHL/HDMI Protocol Analysis Solution

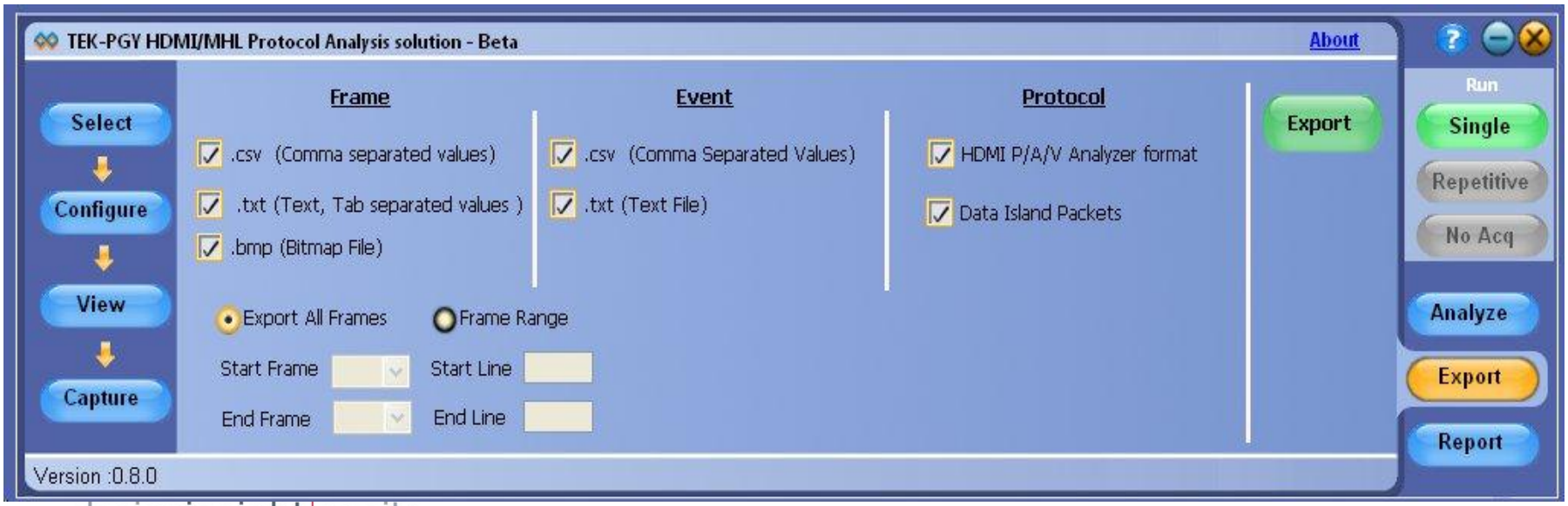
- MHL Protocol Analysis software running on the **Tektronix REAL TIME Oscilloscope**.
  - Unique value proposition as the same real time scope is used for both Physical layer testing and Protocol testing.
  - Gives the seamless transition from Phy layer to Protocol.
  - Cost effective solution.
- Features
  - Multi View support
    - Bus Analysis
    - Image Viewer
    - Event Viewer
    - Protocol Viewer
    - Linked to the analog waveform
- Tektronix Nomenclature – **TEK-PGY-MHL-PA-SW**
- Tektronix Nomenclature – **TEK-PGY-HDMI-PA-SW**

Tek MHL Protocol Analyser



Tek MHL Protocol Analyzer - Unique Multi View analysis





MHL Compliance test analysis

All the tests's pass/ fail depends on one frame data or maximum of two continuous frame data at a time. So with multiple acquisition the protocol analyzer can produce the same result as 2 sec data as per CTS requirement.

- Source Protocol Tests
  - Legal codes
  - Basic Protocol
  - Packet Types
- Source Video Test
  - Required Video formats
  - Optional Video formats
  - Required Pixel Encoding
  - Optional Pixel Encoding
  - Video Quantization ranges
  - AVI Infoframe
- Source Audio
  - IEC 60958/IEC 61937
  - Audio Clock Regeneration
  - Audio InfoFrame

Conclusion

- **Tektronix MHL Physical Layer Tx test setups are easy to use and automated.**
  - **Simple test setups common for most tests.**
  - **Vterm provided by scope itself.**
  - **MHL fixtures are available from our fixture partner Wilder Technologies.**

- **Tektronix MHL Physical Layer Rx test setups are easy to use (MOI based).**
  - **TRUE MHL SIGNAL Generation as there is no need for external combiners/Filters**
  - **No need for external ISI boards as we leverage our AWG direct Synthesis Capability with common setups for Sink and Dongle testing**

- **Tektronix introduces an innovative combined solution for Physical Layer Testing and Protocol Testing:**
  1. **Providing seamless link between PHY and Link layer testing.**
  2. **An economical MHL test solution.**
     - **ONE BOX solution for PHY and Protocol testing.**
  3. **Easy access to legacy P/A/V data format.**

- **Tektronix also offers complete MHL solution with**
  - **DSA8200 or Equivalent Sampling scope with 80E03/04 and I-connector S/W for MHL Cable testing (performed manually using MOIs)**
  - **Low Bandwidth Oscilloscopes,**
  - **Keithley Source Meter (Now part of Tektronix)**
  - **Programmable Power Supply**
  - **Digital Multi-meters**

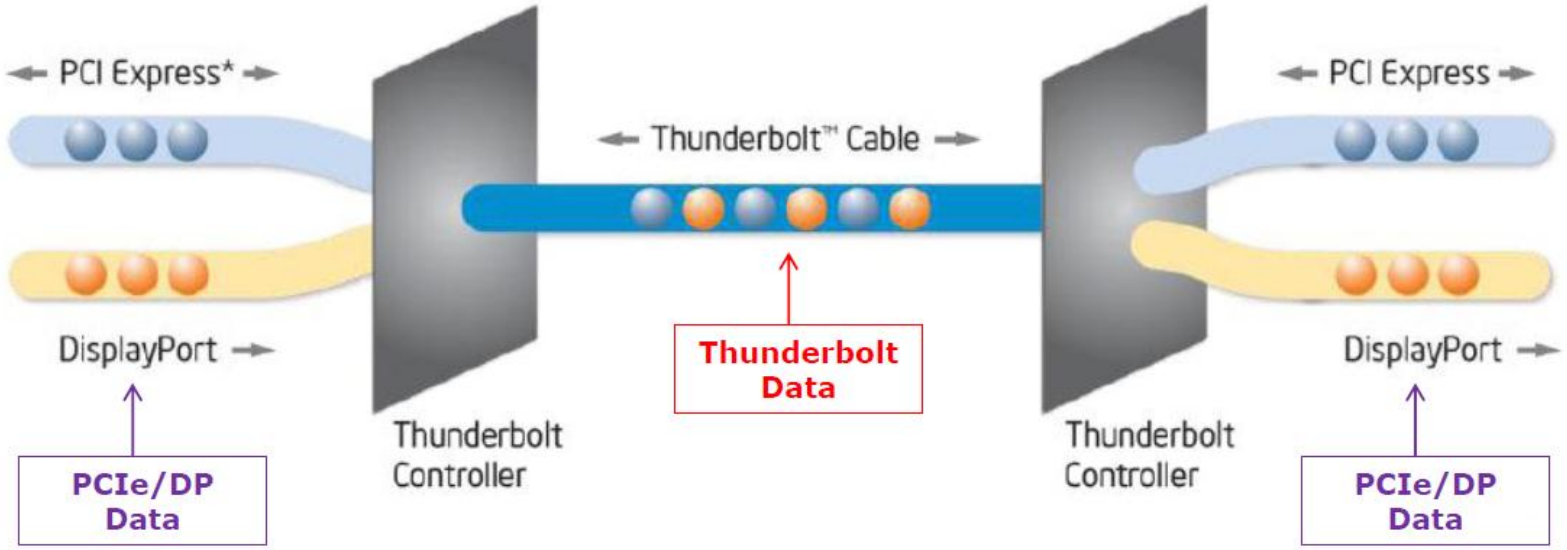
Complete MHL solution available from Tektronix aligned to CTS 1.1 announcement.

其他相关主流工业标准

Thundbolt/SAS/SATA/PCIE/USB3

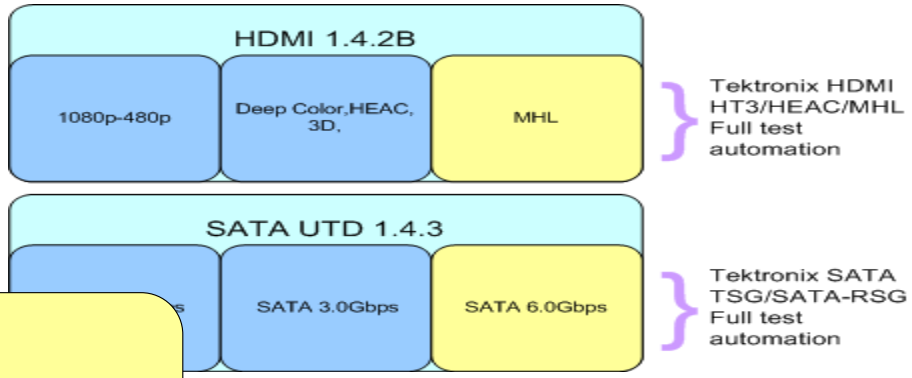
Thunderbolt概述

- PC使用的高速总线
  - 英特尔/苹果于2011年推向市场
  - 能够与DisplayPort互操作
- Thunderbolt信令是双NRZ (64/66b编码)
  - 10.3125 Gb/s数据速率
  - 它采用SFP+技术，有两对不同的Tx和Rx



Thunderbolt电接口验证

Tektronix DPOJET
Thunderbolt .7 MOI
Manual Test



Thunderbolt (.7 Spec Revision) 10.3125Gbps

Thunderbolt (future Interop)

Display Port DP1.2

RBR (1.6Gbps),

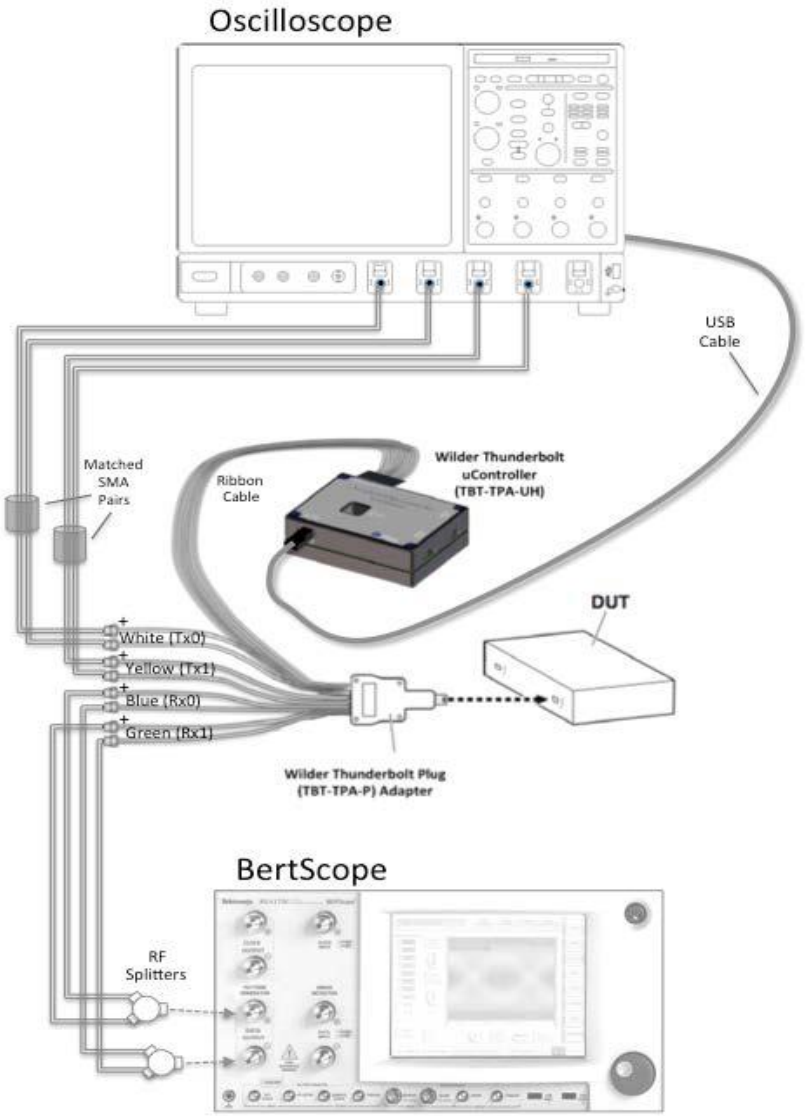
HBR (2.7Gbps)

HBR2 (5.4Gbps)

DP++

Tektronix DP12
Full test automation

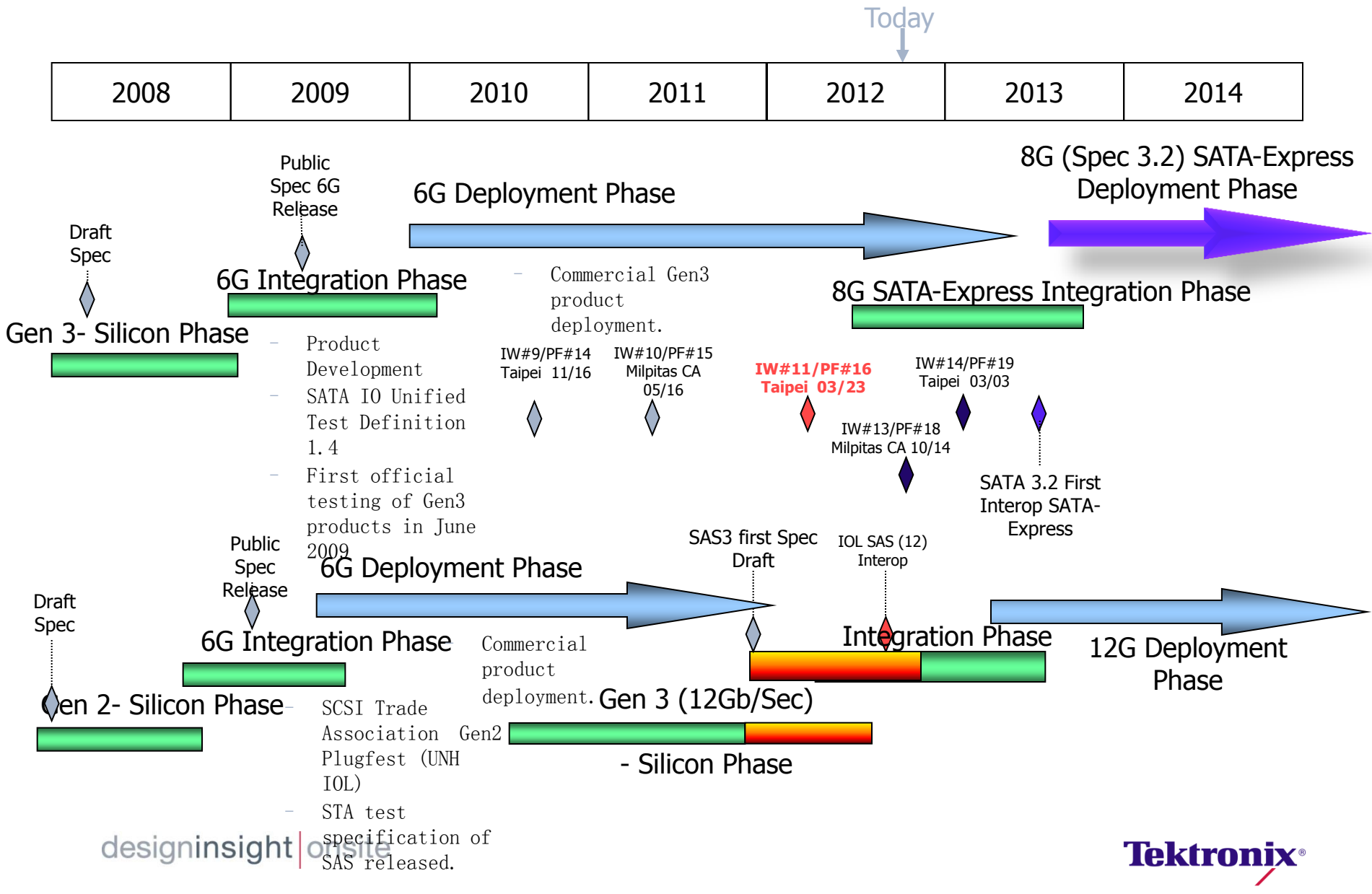
自动Thunderbolt Tx测试



推荐设备

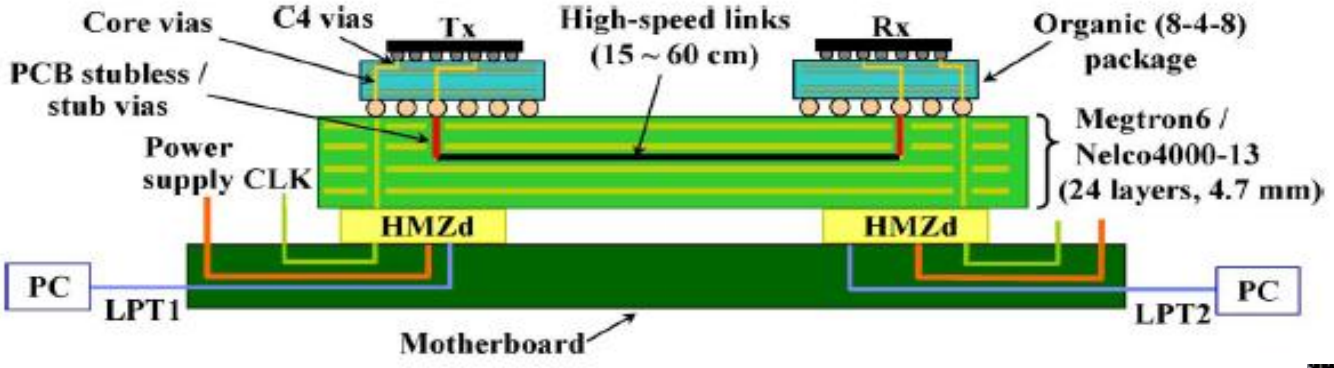
- DPO/DSA/MSO71604 (≥ 16 GHz带宽)
- BSA125C (串扰源)
- 选项DJA (DPOJET)
- 选项TBT-TX (TekExpress)
- TF-TB-TPA-P (插头夹具)和 TBT-TPA-UH (端口微控制器)

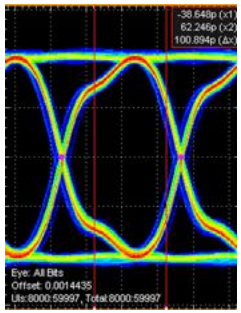
Storage Timelines and Solutions Development

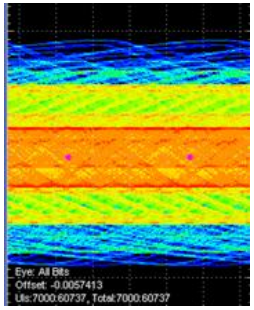


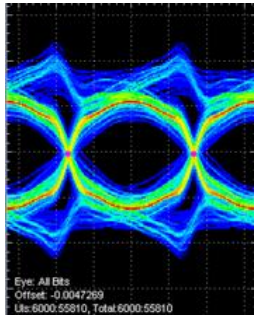
12G+ Design Problem:
1000mV, FFE, Crosstalk, DFE, 50mV

- Crosstalk and signal loss problems are the largest design challenge today.
- Significant advances in high tap count Decision Feedback Equalization are key to operating at 12G+.





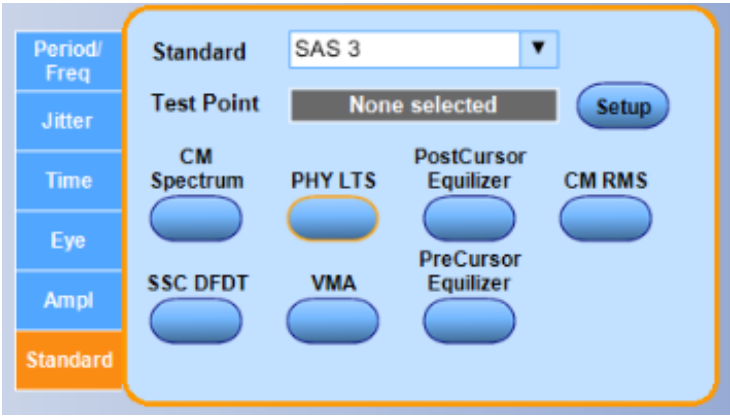




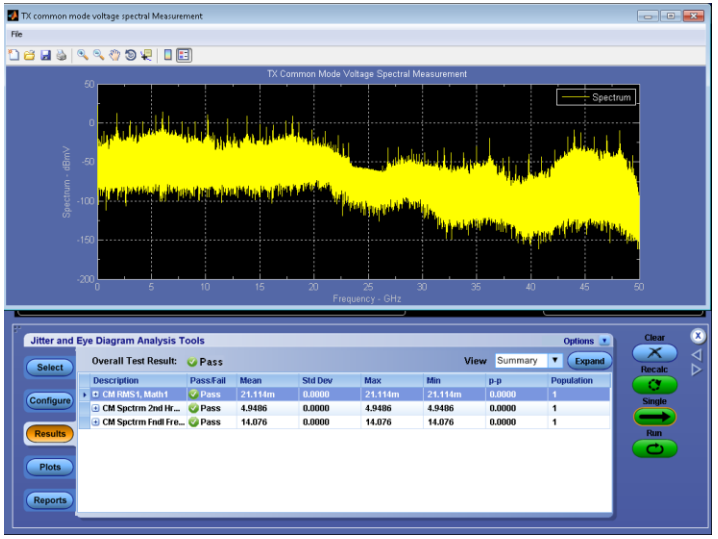
SAS-3 PHY Transmitter Solution – Option SAS3

Test0	Parameter	Conformance Min/Max
5.1.1	Maximum Noise During OOB IDLE	< 120 mV
5.1.2	OOB Burst Amplitude	> 240 mV
5.1.3	OOB Offset Delta	+/- 25 mV
5.1.4	OOB Common Mode Delta	+/- 50 mV
5.2.1	SSC Modulation Type	Center-, No- and Down-spreading
5.2.2	SSC Modulation Frequency	30 kHz < SSC_{freq} < 33 kHz
5.2.3	SSC Modulation Deviation	+/- 1000 ppm (center), 0 ppm (no spread) or +0/-1000 ppm (down)
5.2.4	SSC DFDT	850 ppm/µs
5.3.1	Physical Link Rate Long Term Stability	+/- 100 ppm
5.3.2	Common Mode RMS Voltage	< 30 mV
5.3.3	Common Mode Spectrum Mask Hits	Below Spectrum Limit Lines (0.1 to 6 GHz)
5.3.4	Peak to Peak Voltage	850 mV < Vpk-pk < 1200 mV
5.3.5	VMA	> 80 mV
5.3.6	Rise Time	> 20.8 ps
5.3.7	Fall Time	> 20.8 ps
5.3.8	Random Jitter	0.15 UI (12.5 ps)
5.3.9	Total Jitter	0.25 UI (20.8 ps)
5.3.10	SAS3_EYEOPENING	> 55 %
5.3.11	Pre Cursor Equalization	1 V/V < R_{pre} < 1.67 V/V
5.3.12	Post Cursor Equalization	1 V/V < R_{post} < 3.33 V/V

SAS3 12 Gb/s Tx Test Software



Common Mode Spectrum Measurement



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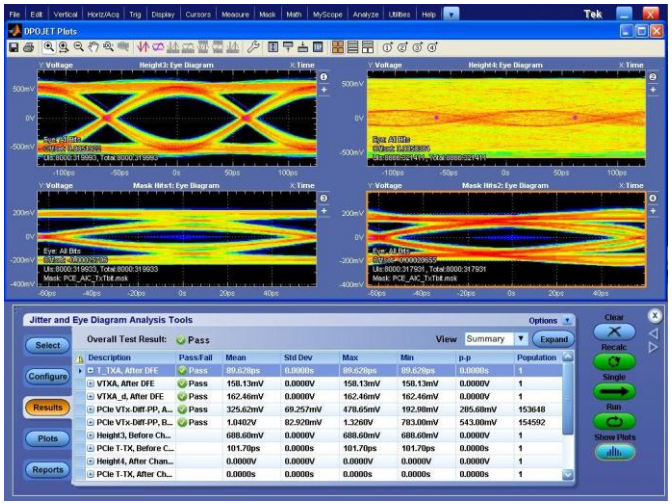
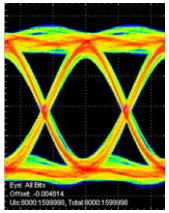
PCIe 3.0 Transmitter Compliance Testing

- Compliance testing is based on the CEM Specification, which is under development
- New compliance 128b/130b data pattern
- Two Tests
  - Electrical: Eye Height and Width must pass one pre-set value
  - Preset Test: all Pre-sets are tested to be within their limits
- Measurements are taken after the Compliance channel and RX Equalization using the Compliance Base or Load Board

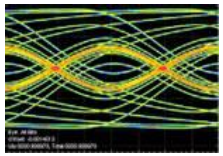


Add-In Card Compliance Signal Acquisition and Processing

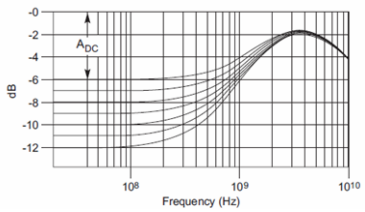


Signal Acquired from Compliance Board

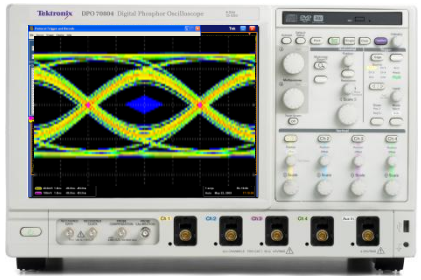
Embed the Add-In Card Compliance Channel



Closed Eye due to the Channel



Apply the Base Specification CTLE + Dfe for Long Channel



Open Eye for Measurements

System Board Eye Limits [1]

Parameter	Min	Max	Units
V_{TXS} V_{TXS_d}	34 34	1200 1200	mV mV
T_{TXS}	41.25		ps

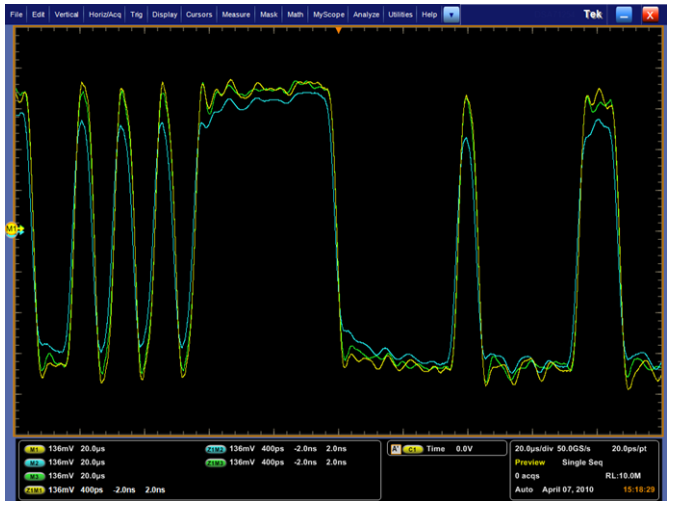
Add-In Card Eye Limits [1]

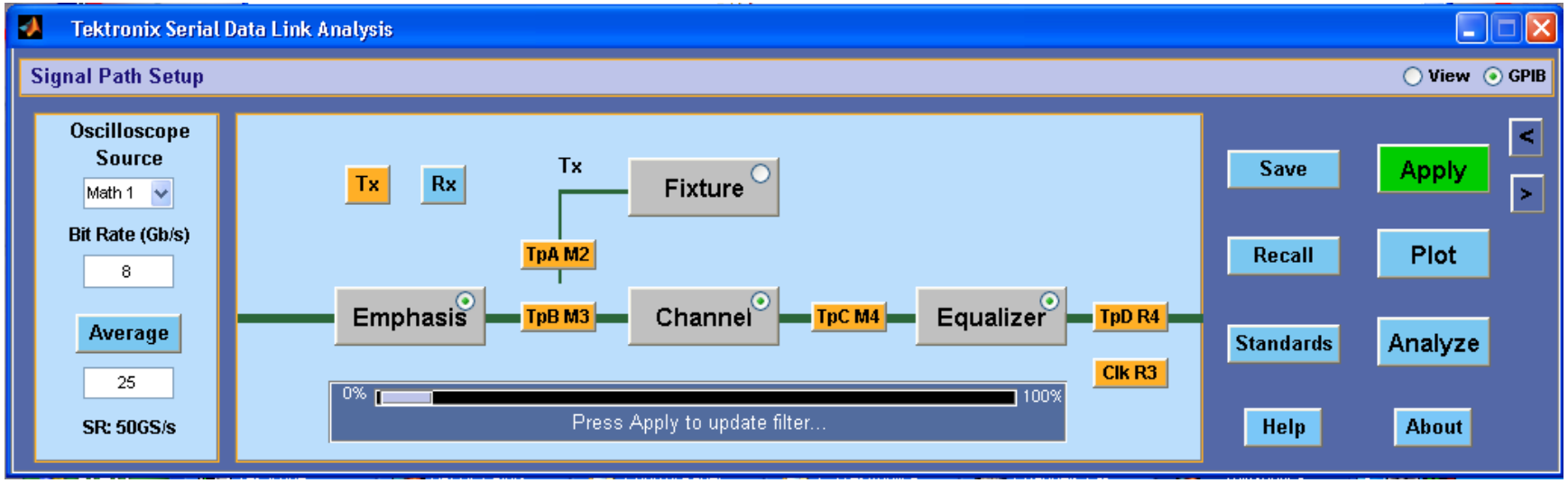
Parameter	Min	Max	Units
V_{TXA} V_{TXA_d}	34 34	1200 1200	mV mV
T_{TXA}		41.25	ps

1 Measurement Limits Under CEM Review

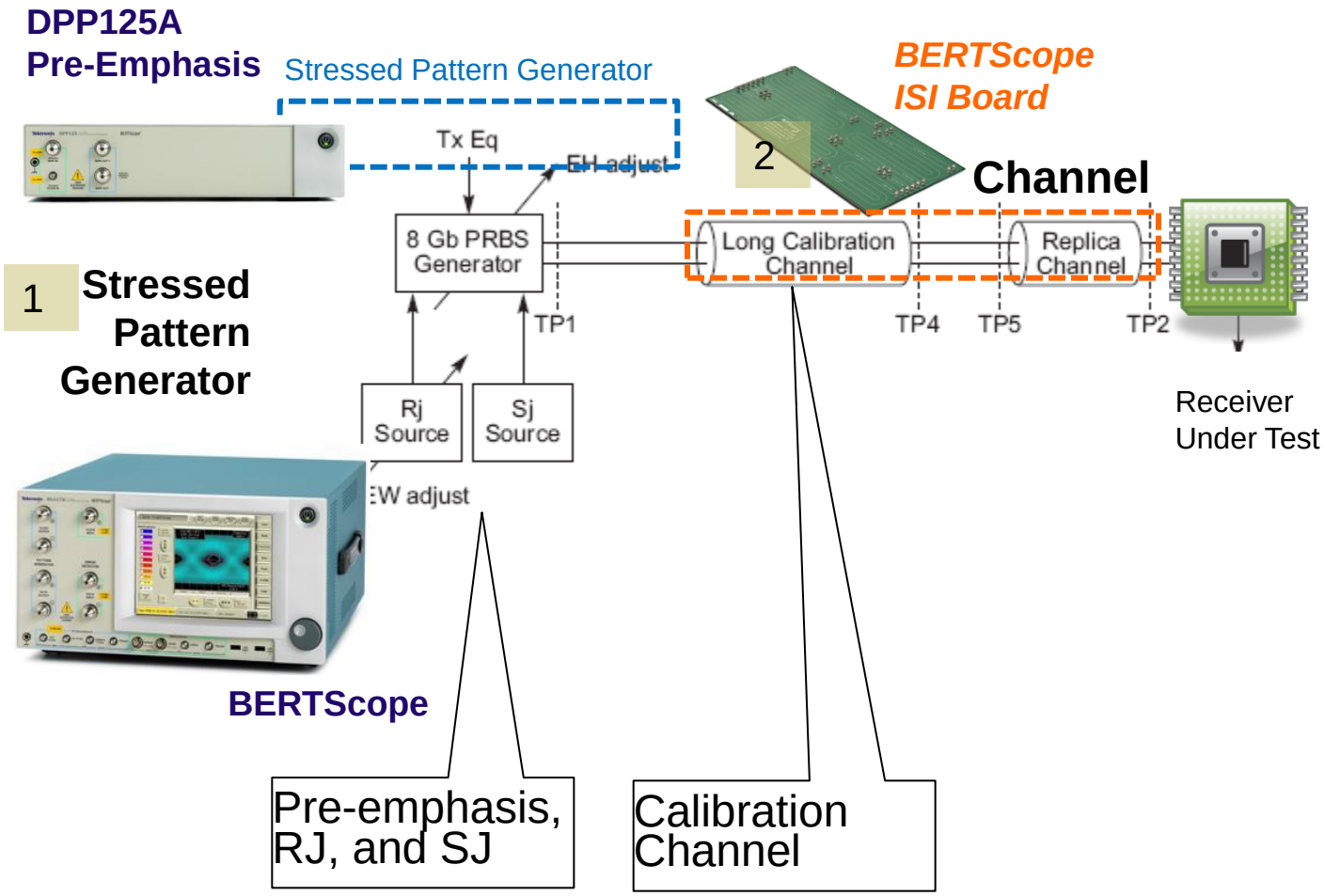
Serial Data Link Analysis

- De-embed the effects of a fixture
- Embed the effects of the channel
- Equalize the waveform using CTLE, FFE, and/or Dfe





Stressed Jitter Pattern Generation



Similar requirements as the Stressed Voltage Eye

USB 3.0 Key Considerations

- Receiver testing now required
  - Jitter tolerance
  - SSC, Asynchronous Ref Clocks can lead to interoperability issues
- Channel considerations
  - Need to consider transmission line effects
  - Software channel emulation for early designs
- New Challenges
  - 12” Long Host Channels
  - Closed Eye at Rx
  - Equalization
    - De-emphasis at Tx
    - Continuous Time Linear Equalizer (CTLE) at Rx

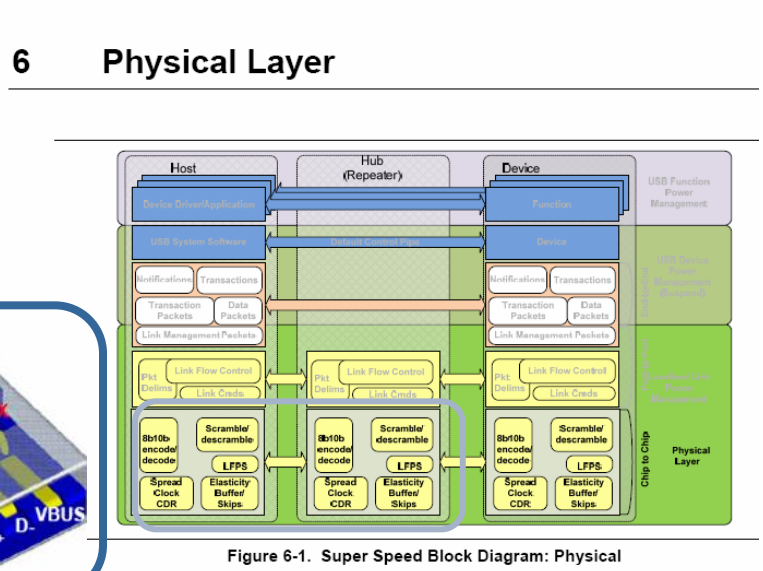


Figure 6-1. Super Speed Block Diagram: Physical

Source: USB 3.0 Rev 1.0 Specification

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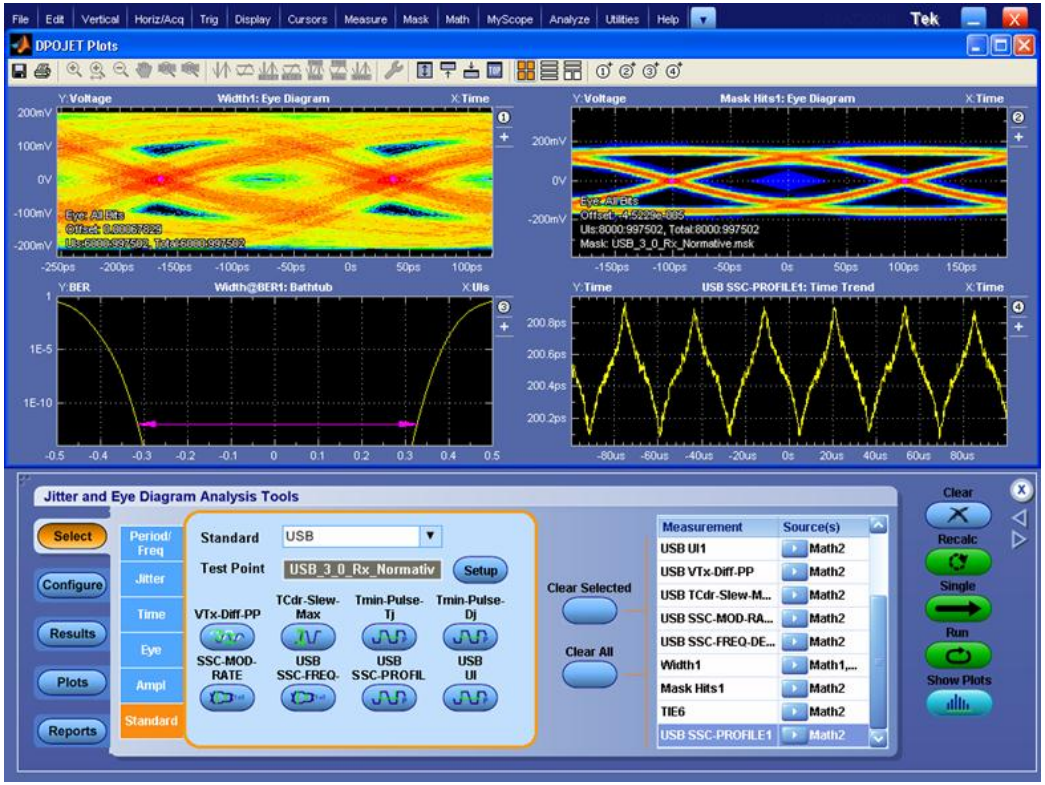
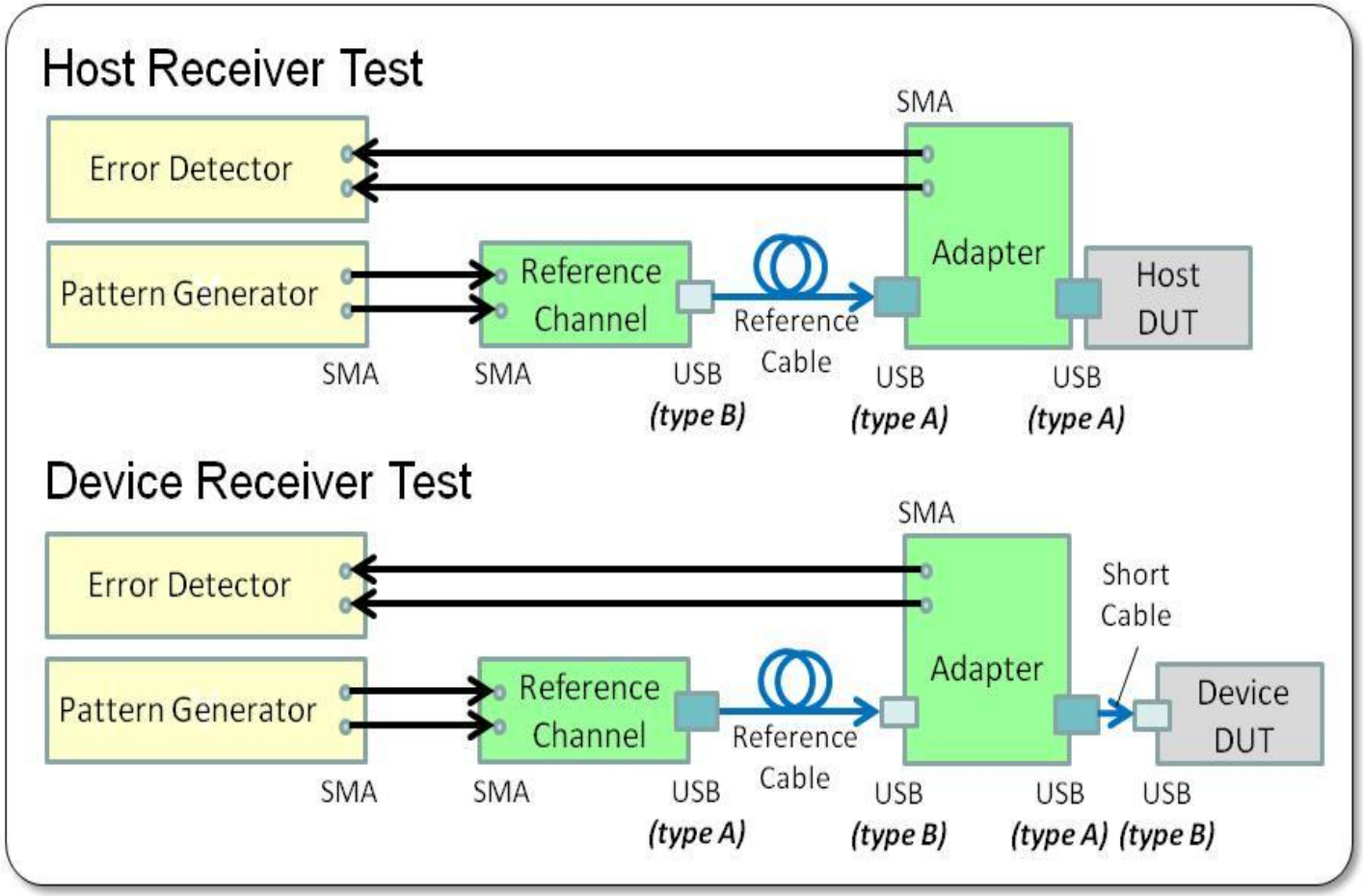
USB 3.0 Transmitter Measurement Overview

- Voltage and Timing
  - Eye Height
  - Pk to Pk Differential Voltage
  - RJ
  - DJ
  - TJ
  - Slew Rate
- Low Frequency Periodic Signaling (LFPS)
  - Pk to Pk Differential Voltage
  - Rise / Fall Time
  - AC Common Mode
  - tBurst
  - tRepeat
  - tPeriod
- SSC
  - Modulation Rate
  - Deviation

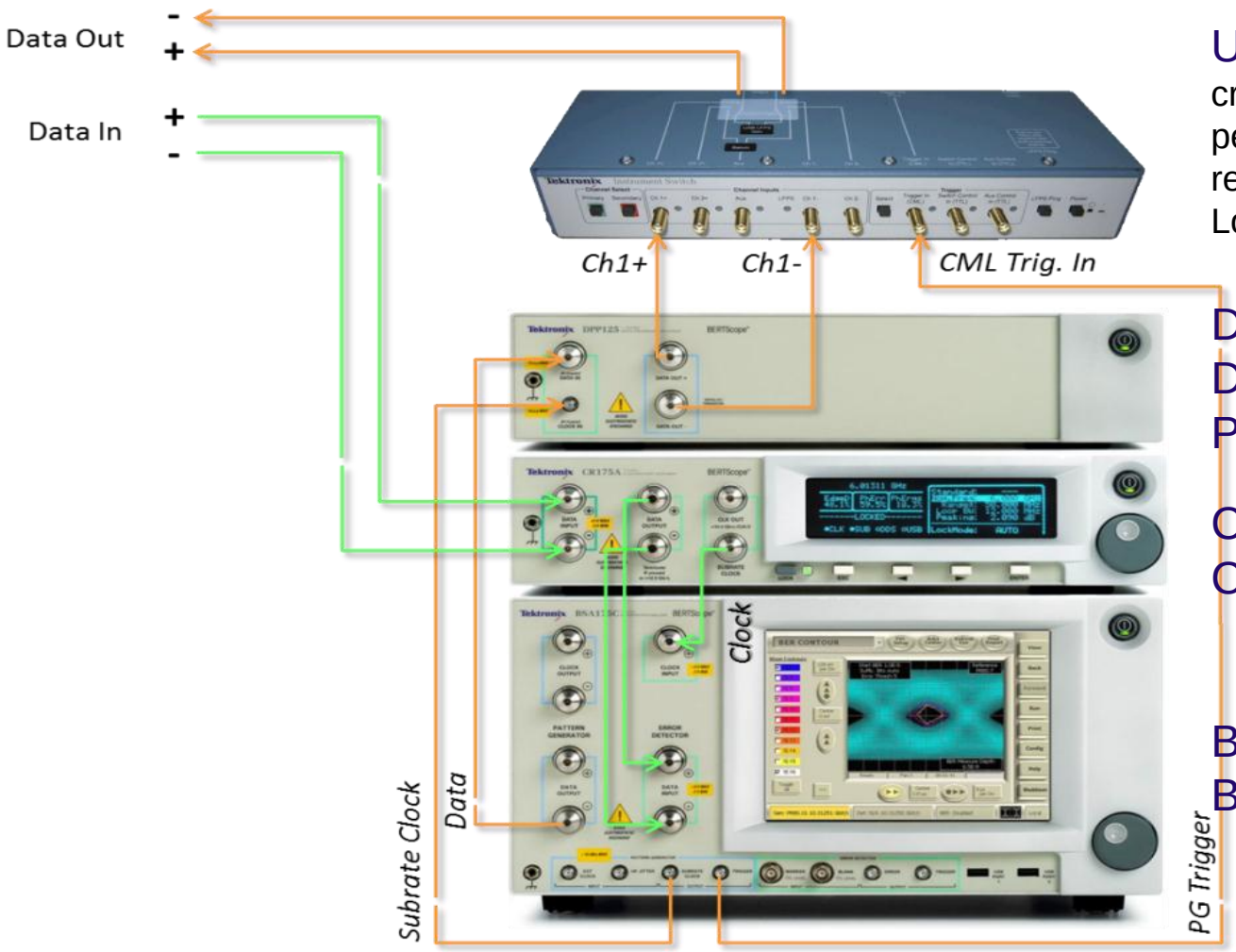


Tektronix®

Generic USB 3.0 RX Test Configuration



BERTScope USB 3.0 RX Test Configuration



USB Switch
creates the low-frequency periodic signaling (LFPS) required to initiate Loopback-mode

DPP125B
De-emphasis Processor

CR125A
Clock Recovery

BSA85C
BERTScope

THANK YOU