

最新高速串行接口的规范以及测试方法

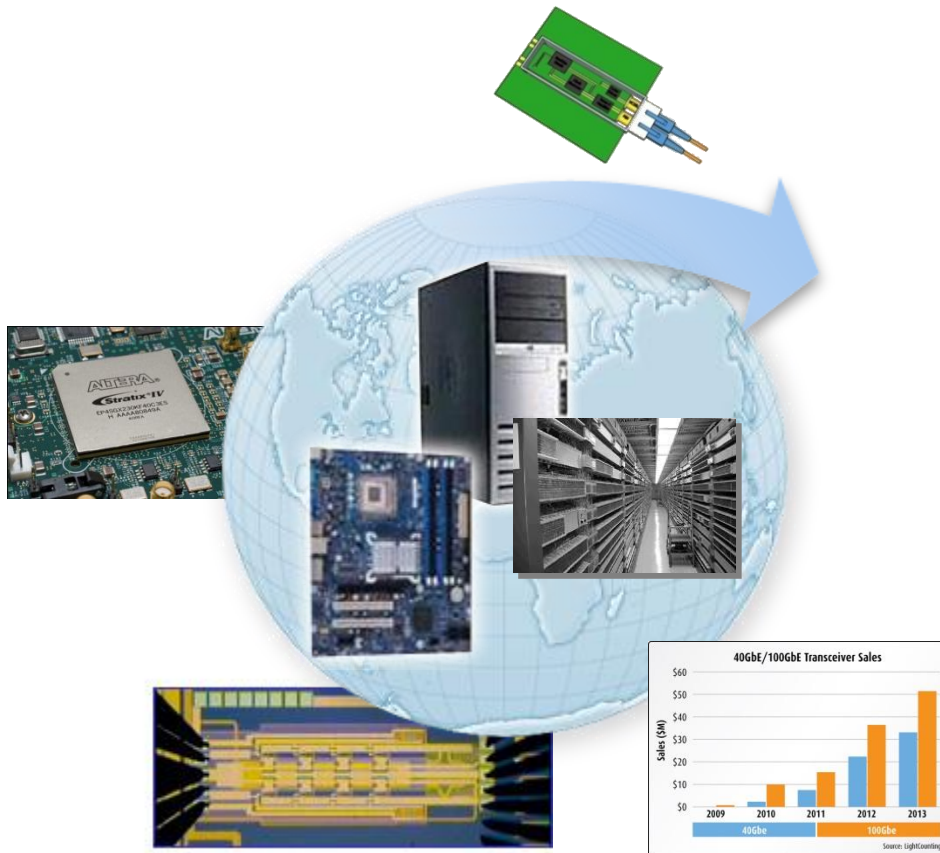
Yu Ocean
2014.10



Agenda

- Industry Trend
- HDMI – Introducing new HDMI 2.0
- MHL – HDMI for Mobile
- MIPI – D-Phy to M-Phy, C-Phy is coming soon

High-Speed Serial Test Trends and Implications

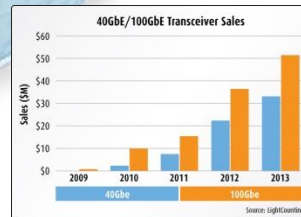


Industry/Technology Trends

- 100 GbE is becoming more relevant as data centers and communications networks ask for more bandwidth
- SAS 12G is needed by data centers for efficient transport of internet traffic (YouTube, Facebook, Smart Phone, etc)
- High-Speed FPGA's are increasing in complexity to support early designs above 28Gb/sec
- Proliferation of 10+ Gb/sec signaling in the communications network

Implications

- Closed data eyes requiring new techniques for transmitter and receiver equalization
Higher data rate signals have less margin – requires de-embedding
- Edge/Slew rate speeds are difficult to characterize
- New Jitter Separation Measurements are required
- Complex 8b/10b signaling difficult to verify in PHY





HDMI – Introducing new HDMI 2.0

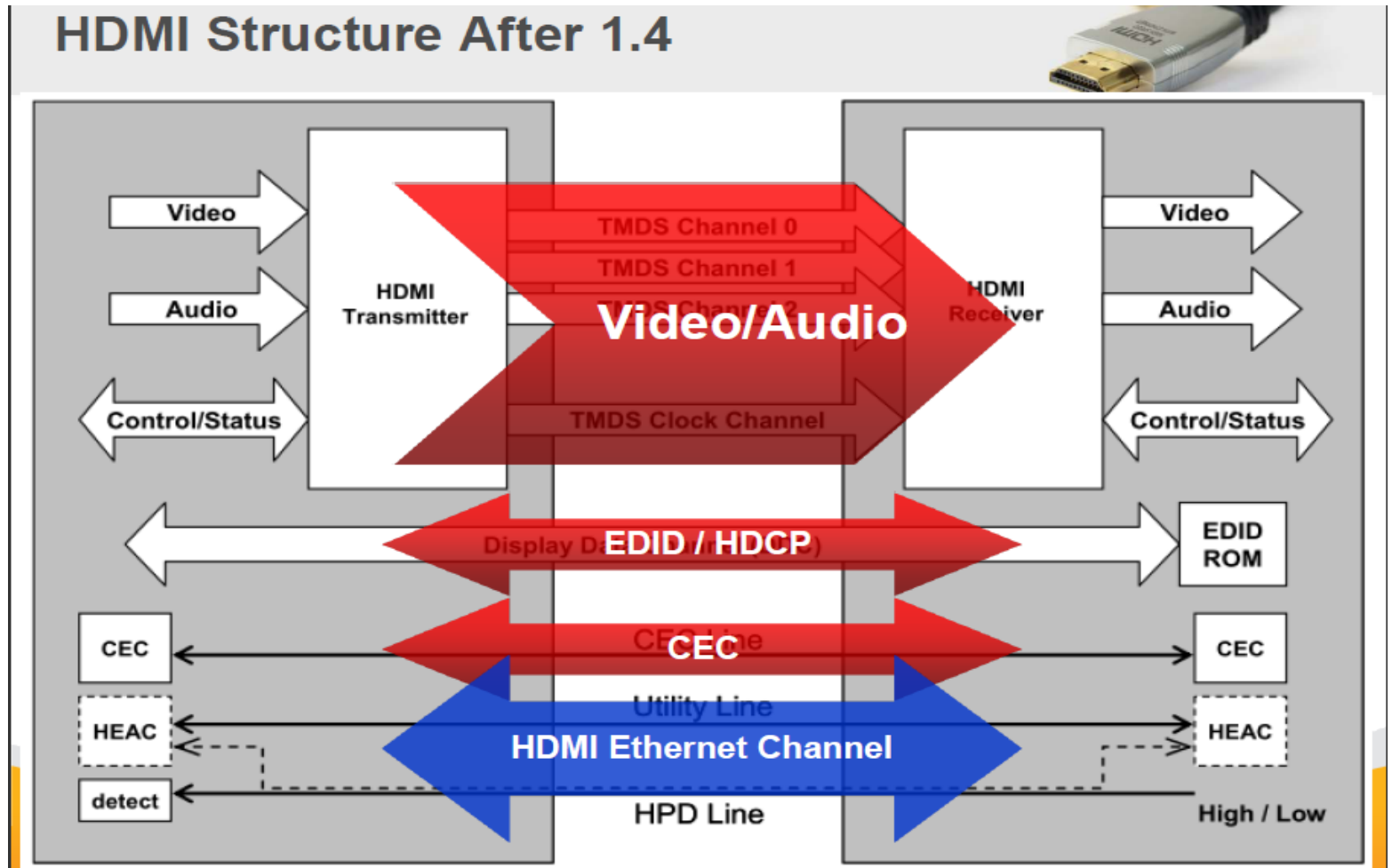
Overview of HDMI

- From 2003 till date and looking ahead...
 - Tek only solution provide for HDMI from 2003 to 2007
 - Contributor of SoftCRU method to the Specification
 - Innovative Sink solution leveraging Direct Synthesis method of AWG
- Hdmi 1.0 ---- 1.65GBps
- Hdmi 1.4—3.4GBps
- Hdmi 2.0..... 6GBps



HDMI[™]
HIGH-DEFINITION MULTIMEDIA INTERFACE

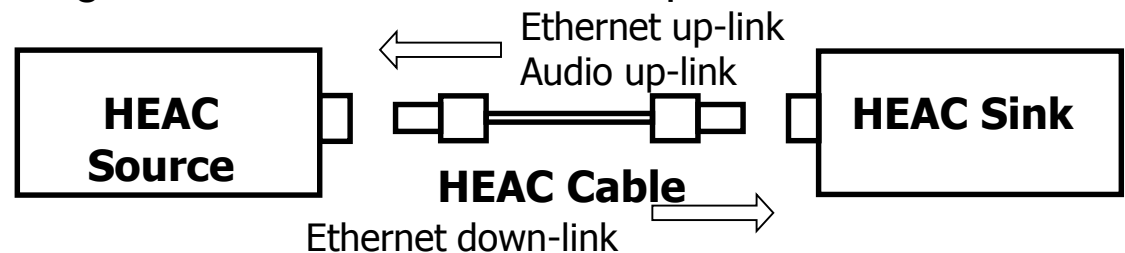
HDMI Basics



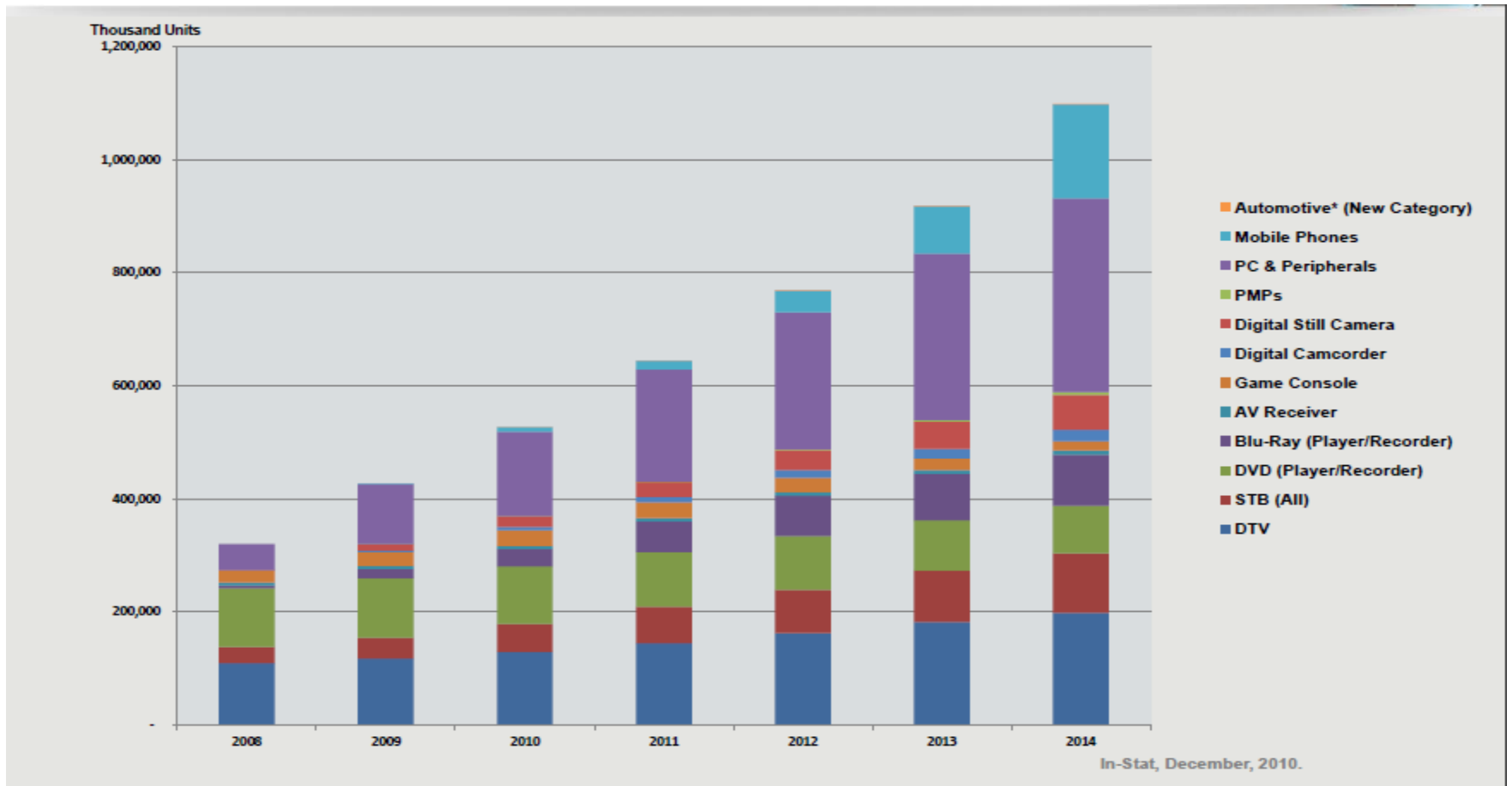
HDMI Technology and solution status

Source: HDMI LLC

- Over 1000+ adopters till date
- HDMI Expands Footprint
 - HDMI has made inroads into PC industry
 - New computer platforms have HDMI interfaces
 - Hand held devices with miniature HDMI devices
 - New connectors Type C and Type D introduced
 - HDMI Forays into Automotive – Type E
 - Year 2011 – 3D Year
 - Still camera
 - Advertising billboards
- HDMI NOW Truly Single Digital Interconnect for uncompressed Audio/Video
 - HEAC (A R C)



HDMI Market overview



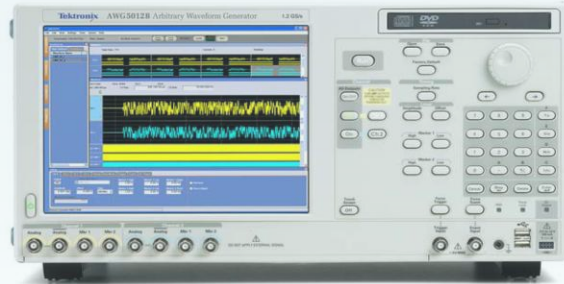
Source: HDMI Forum

Tektronix HDMI 1.4b solution- Approved in CTS 1.4b

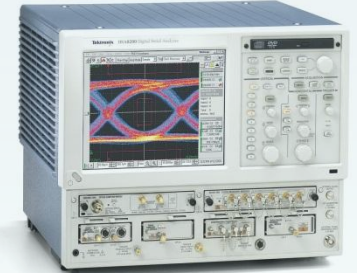
**DPO/DSA/MSO
Real Time Oscilloscopes**



**AWG5K/B or AWG7K/B
Arbitrary Waveform Generators**



**DSA8200 Sampling
Scope
with i-connect software**



Common Set of test equipment for HDMI and HEAC

HDMI Fixtures:

1. Type A(TF-HDMI-TPA-S/-STX)
2. Type C(TF-HDMIC-TPA-S/-STX)
3. Type D(TF-HDMID-TPA-P/-R)
4. Type E(TF-HDMIE-TPA-KIT)
5. HEAC Fixtures(TF-HEAC-TPA-KIT)

Probes and accessories

- HDMI Probes
- HEAC Probes
- HDMI Accessory Kit

GAME Changer - HDMI Protocol Analyser

Tektronix and HDMI Forum

- 89 companies in the HDMI forum as of date. source HDMI Forum
- Tektronix is member of this HDMI Forum. Actively participating in weekly/monthly calls and face-face meetings
- **Tektronix's U.N.Vasudev is co-chair for HDMI forum test sub-group**
- HDMI Forum released HDMI 2.0 specifications on Sept 4th 2013
 - Target
 - CTS 2013 Q4
 - MOI Q4 2013

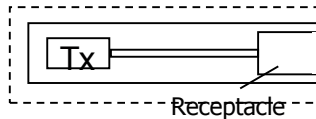
HDMI 2.0 features

- Uses same Cat 2 Cable and HDMI 1.4b connector
- Support 4K 2K 4:4:4 60 Hz – 594Mcsc(Mega Characters per second per channel)
- Support 4K 2K 4:2:0 – 297Mcsc
- 3D, 21:9 ; Audio
- Low level Bit error rate testing
- Scrambling is MUST for rates >340Mcsc.
- Direct Attach Device support
- HDMI 2.0 products must pass HDMI 1.4 CTS testing

Ecosystem update

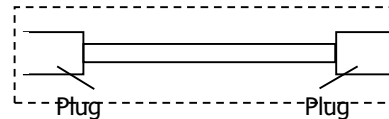
- Same HDMI customers for Source Devices, Sink Devices, Cable ,Repeater

Source Devices



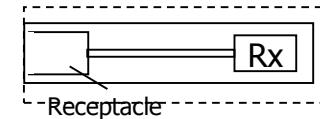
- Set-top Boxes, DVDs, Repeaters, Gaming devices

Cable Assemblies



- Cables

Sink Devices




- TVs, Monitors, Repeaters, etc.

- Direct Attach Devices – New category devices

- Roku
- Apple TV





HDMI 2.0 Solutions Portfolio

(Source setup, Sink Setup,
Protocol Decode, Probes)

Rise time Needs

Table 4-24 Source AC Characteristics at TP1

Item	Value
Rise time / fall time (20%-80%)	<u>if attached Sink supports < 340MHz</u> <u>75psec ≤ Rise time / fall time</u> <u>if attached Sink supports > 340MHz and transmitted TMD5 Character Rate > 340MHz</u> <u>42.5psec ≤ Data Rise time / Data fall time</u> <u>75psec ≤ Clock Rise time / Clock fall time</u>

Table 4-30 TP7 Direct Attach AC Characteristics at 6Gbps

Item	Value
Rise time / fall time (20%-80%)	<u>if attached Sink supports > 340MHz and transmitted TMD5 Character Rate > 340MHz</u> <u>42.5psec ≤ Data Rise time / Data fall time</u> <u>75psec ≤ Clock Rise time / Clock fall time</u>

- HDMI 1.4b, should be capable of measuring 75 psec, but no word about the System Rise time.
- **HDMI 2.0 should be capable of measuring 42.5 psec, but no word about System Rise time.**
- The Error contribution of RT measurement due to System and DUT generally not accounted when we refer to specification

What is the system bandwidth needed to measure 42.5 (20-80%)psec or less DUT Rise time

- System bandwidth should be around $(42.5/1.5)$ 28psec
- Scope bandwidth of 16 Ghz and 16 Ghz DSP enhanced probe has System Rise time of about 23 psec. It can measure the DUT Rise time of 42.5 psec with error of 1%. And can measure DUT Rise time of 37 psec with error of 7%.
- We can indicate Pass or fail confidently only when the System band. width is close to 16 Ghz scope .
- Is it fact for all scope vender ??
 - Spec says it should not be less than 42.5psec.
 - Max Rise time is limited by Eye diagram slope.
 - Both scope and Probe rise time cannot be less or equal to the DUT rise time because it can measure the signal rise time accurately only if DUT RT is slower than system rise time by 1.5 X times.
- How it is handled in HDMI 1.4b today???
 - We recommend 8Ghz scope and 13 Ghz probe, then system rise time is 38 psec which is close 2X faster than 75 psec

Conclusion

- 16GHz BW scope will give 1% error and hence is recommended for HDMI 2.0 testing.
- HDMI 2.0 RT/FT (20%-80%) data signals is 42.5ps

Note: We also support 12.5GHz BW scope for HDMI 2.0 but will have a 10% error in RT/FT measurements

Source Testing 1.4b Vs 2.0

Eye Diagram and Clock Jitter test is now performed at TP2

Rest of the tests is same as HDMI 1.4b

1.4b CTS test is a pre-requisite for HDMI 2.0

Min 8GHz scope to 16GHz scope

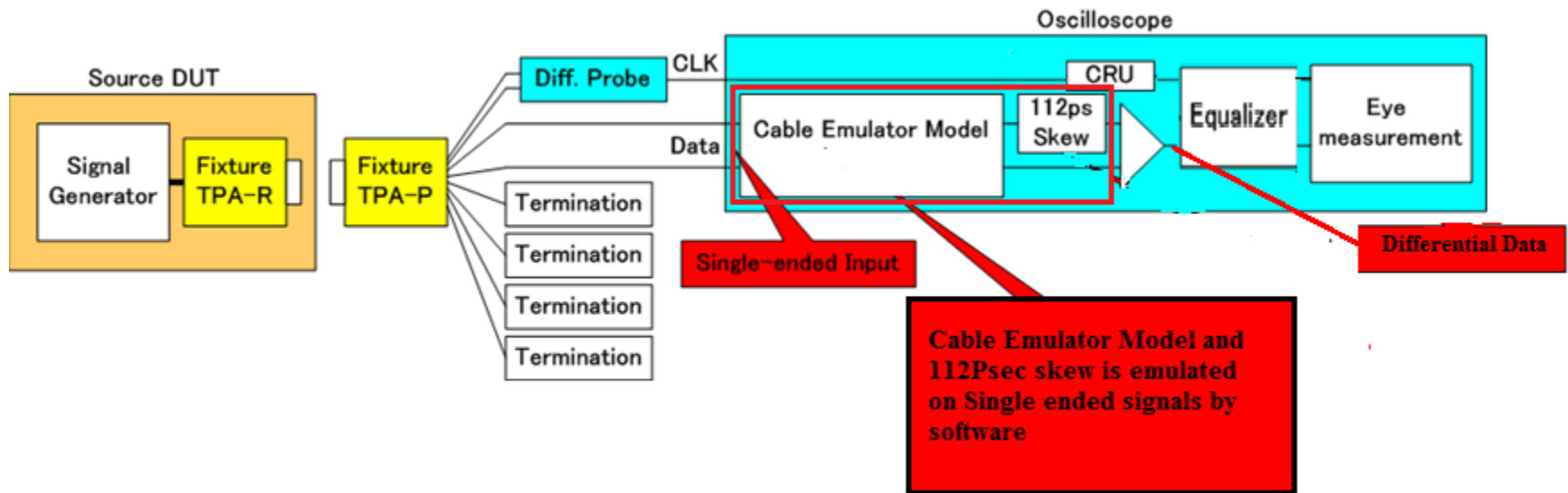
New Fixtures

Same Probes

HDM and HDM-DS Software

Source Testing

- Source Eye Diagram test is measured at TP2_EQ.
- TP2 is the signal after passing along a worst cable.
 - Worst cable has worst attenuation and skew of 112ps.



Source Electrical tests

Test ID HF1-1: Source TMDS Electrical – 340-600Mcsc – V_L

Test ID HF1-2: Source TMDS Electrical – 340-600Mcsc – T_{RISE} , T_{FALL}

Test ID HF1-3: Source TMDS Electrical – 340-600Mcsc – Inter-Pair Skew

Test ID HF1-4: Source TMDS Electrical – 340-600Mcsc – Intra-Pair Skew

Test ID HF1-5: Source TMDS Electrical – 340-600Mcsc – Differential Voltage

Test ID HF1-6: Source TMDS Electrical – 340-600Mcsc – Clock Duty Cycle

Test ID HF1-7: Source TMDS Electrical – 340-600Mcsc – Clock Jitter

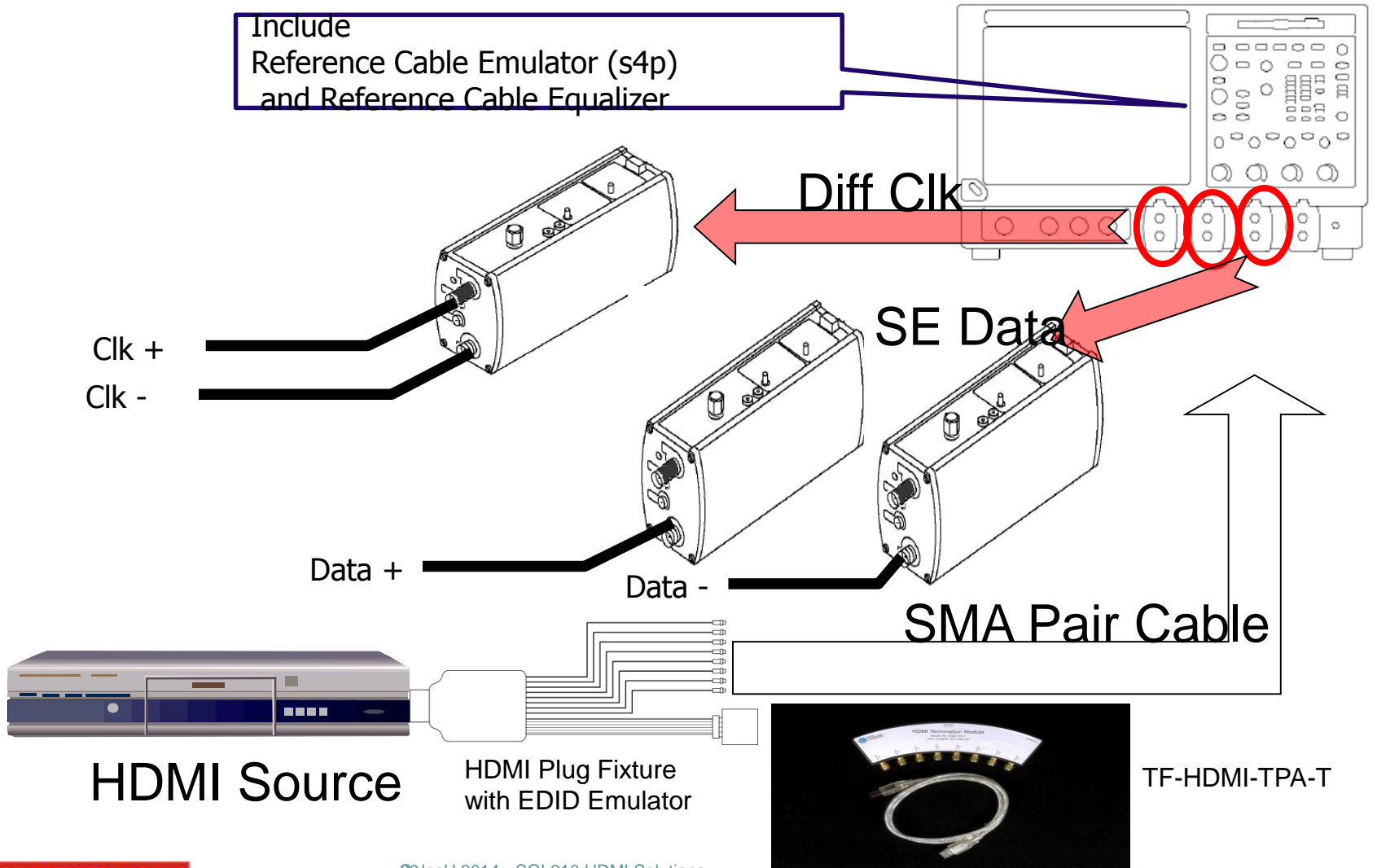
Test ID HF1-8: Source TMDS Electrical – 340-600Mcsc – Data Eye Diagram

Test ID HF1-9: Source TMDS Electrical – 340-600Mcsc – Differential Impedance

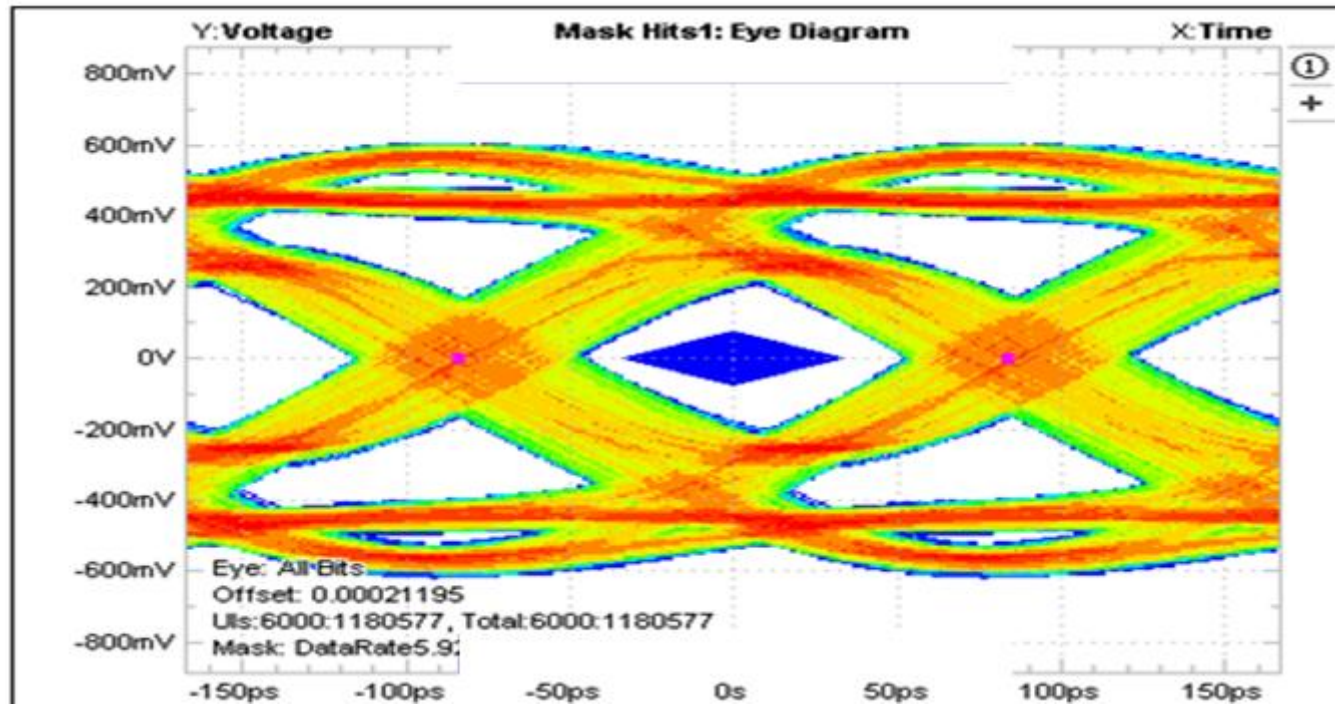
Source Eye Diagram Test

Tektronix Oscilloscope
DPO/DSA/MSO70000 Series \geq 16GHz

Include
Reference Cable Emulator (s4p)
and Reference Cable Equalizer

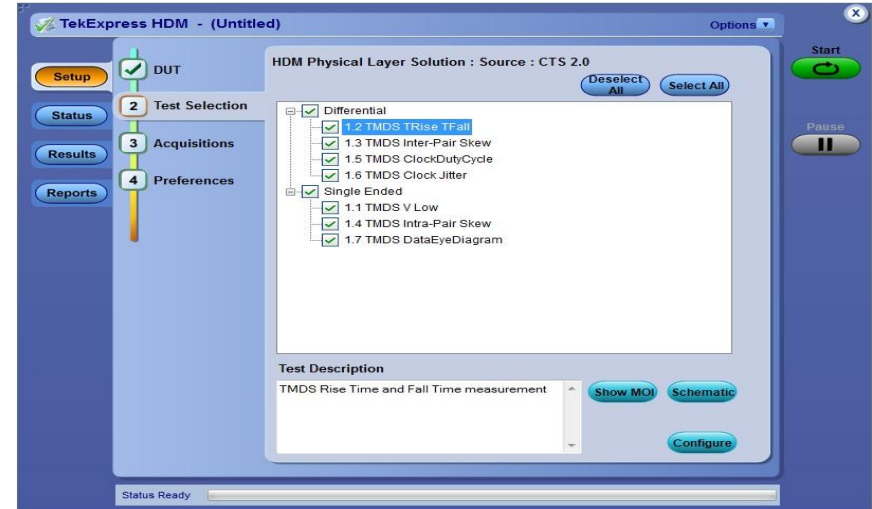
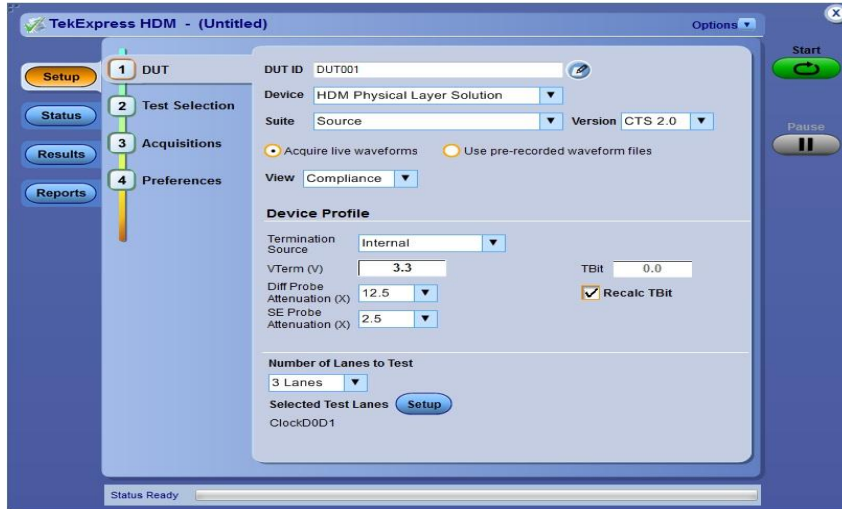


TP2 Source Eye for HDMI 2.0 6G signal



Single End Input eye rendered at Tek lab

HDMI 2.0 Tx Compliance Software



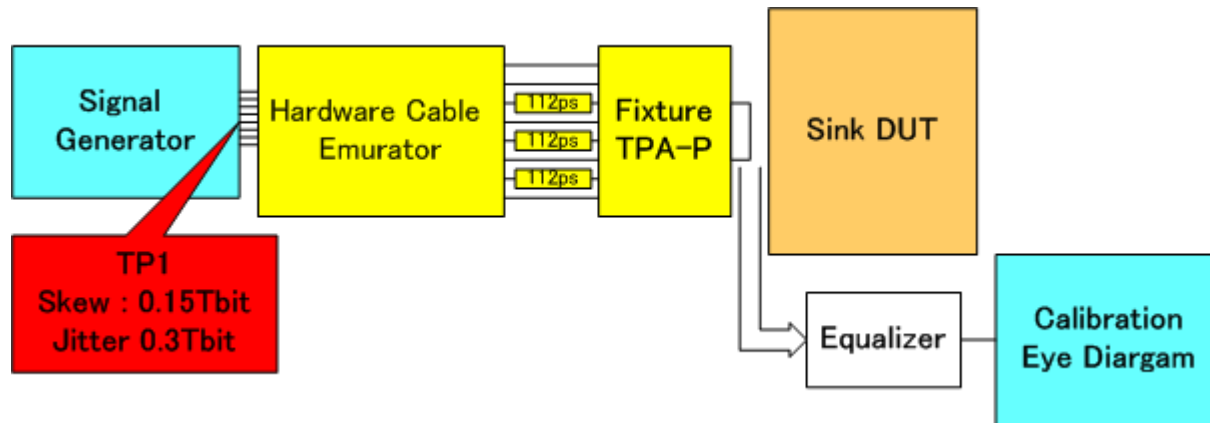
HDMI 2.0 Sink testing Equipment needs

- 16GHz BW scope will give 1% error and hence is recommended for HDMI 2.0 Sink testing for Jitter Verification/Calibration/Controller.
- P7313SMA probes > 3
- Option HDM and HDM-DS
- HDMI 2.0 Fixture set
- 2# AWG7122C with Opt 01,02 or 06, 08 for **HDMI 2.0 Compliance only setup.**
OR
2# AWG70002A with Opt 01,03 and 225 for **HDMI 2.0 Compliance and Margin Test setup.(Margin test feature will be available later and is part of roadmap)**

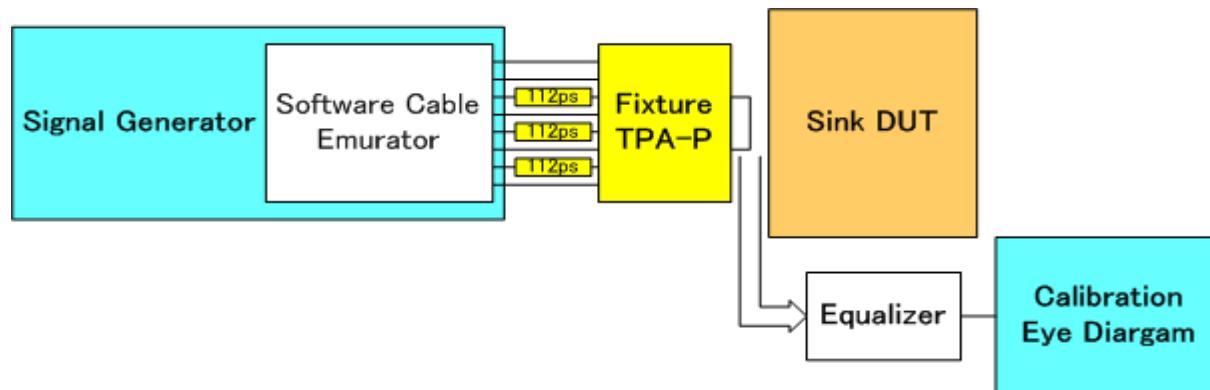
Note- We shall also support a 12.5GHz BW scope which would result in appx. 10% inaccuracy in RT/FT results .

Requirement for Signal generation

Cable Emulation and Skew by Hardware



Hardware Skew and Software Cable Emulation



Sink Electrical tests

Test ID HF2-1: Sink TMDS Electrical – 340-600Mcsc – Min/Max Differential Swing Tolerance

Test ID HF2-2: Sink TMDS Electrical – 340-600Mcsc – Intra-Pair Skew

Test ID HF2-3: Sink TMDS Electrical – 340-600Mcsc – Jitter Tolerance

Test ID HF2-4: Sink TMDS Electrical – 340-600Mcsc – Differential Impedance (performed using sampling scope)

HDMI 2.0 Rx solution positioning statement

- Tektronix will support HDMI 2.0 Sink Electrical and protocol tests using either 2# AWG7122C (w/ Opt 01,02/06,08) OR 2# AWG70002A (W/ Opt 01,03 ,225)
- Solution Positioning:
 - **Compliance solution** for HDMI 2.0 Rx
 - 2# AWG7122C with opt 01, 02/06 and 08
 - 1# AFG3102/C

Customers can use common test setup for HDMI 1.4b and HDMI 2.0 giving value for their investment in Tektronix HDMI 1.4b Rx solution.

- **Compliance and Margin solution** for HDMI 2.0 Rx
 - 2# AWG70002A with Opt 01,03 and 225.
 - 1# AFG3102/C

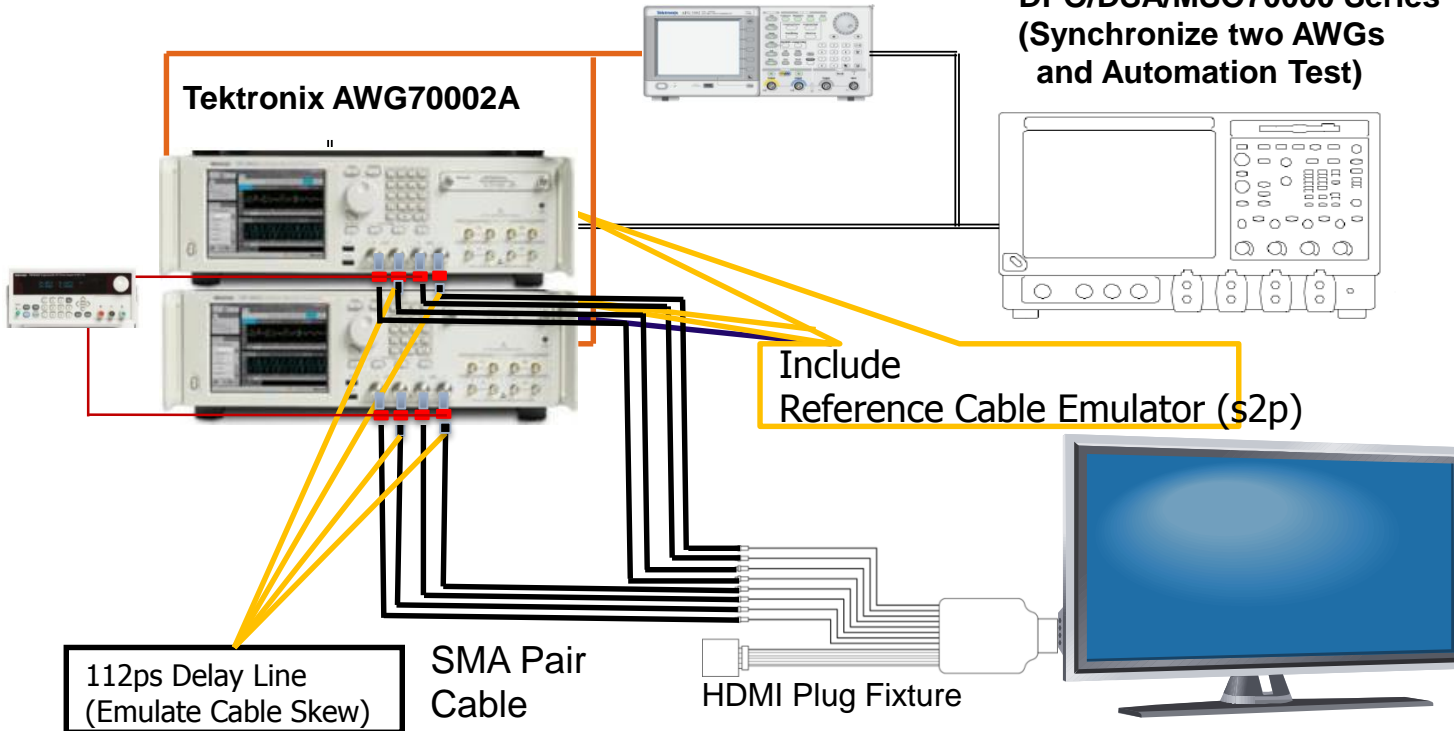
Customers can use common test setup for HDMI 1.4b and HDMI 2.0 giving value for their investment in Tektronix HDMI 1.4b Rx solution

HDMI 2.0 Sink Test setup

Tektronix AFG3000
(Synchronize two AWGs)

Tektronix Oscilloscope
DPO/DSA/MSO7000 Series
(Synchronize two AWGs
and Automation Test)

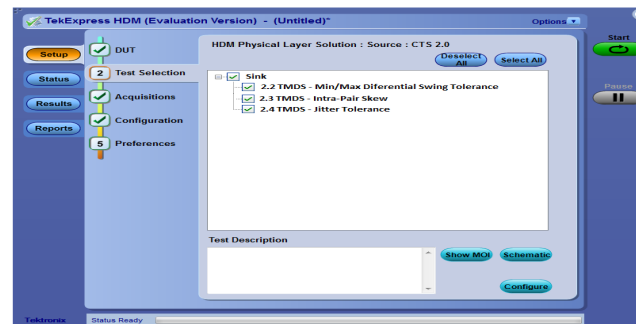
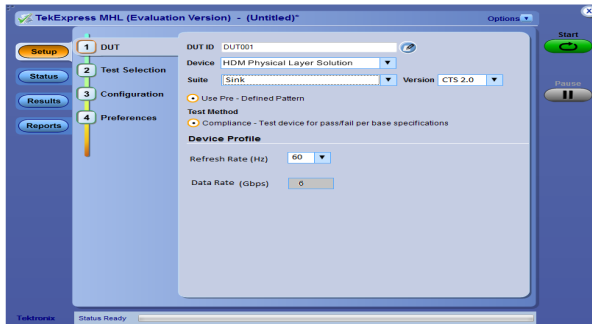
Tektronix AWG70002A



112ps Delay Line
(Emulate Cable Skew)

SMA Pair
Cable

HDMI Plug Fixture



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Sink Testing 1.4b Vs 2.0

Jitter Tolerance test needs +ve and –ve lanes tested with 112ps delay line

Rest of the tests is similar to HDMI 1.4b tests

1.4b CTS test is a pre-requisite for HDMI 2.0

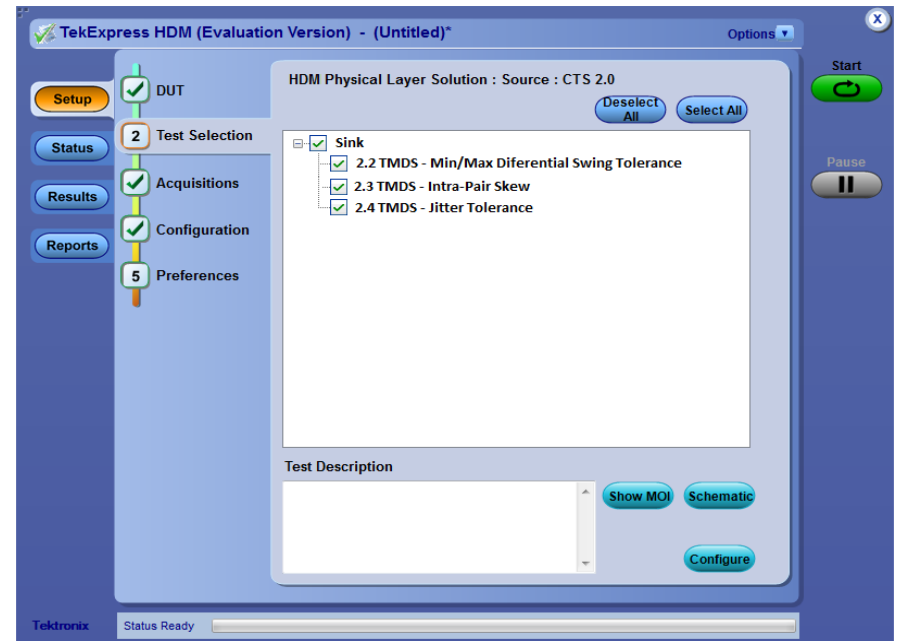
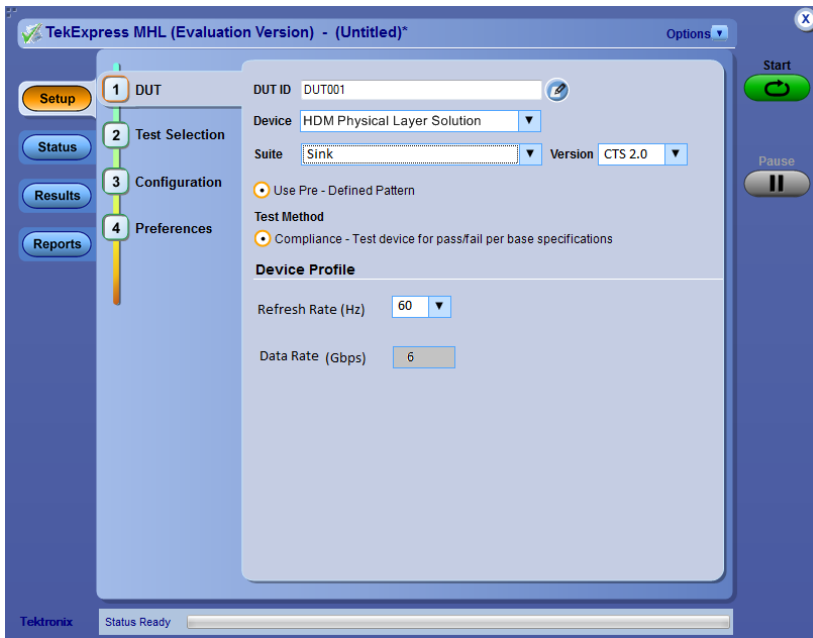
Need AWG 70002A for HDMI 2.0 Compliance and Margin needs while AWG7122C is suitable for HDMI 2.0 Compliance testing only..

Min 8GHz scope to 16GHz scope

Fixtures and Probes

HDM and HDM-DS Software

HDMI 2.0 Rx Compliance Software



HDMI 2.0 Equipment List

- DPO/DSA /MSO 70004C/B/D/DX with 10XL-Minimum 16GHz BW(we also support 12.5GHz BW scope)- needs Opt DJA, Opt SR-EMBD and SR-CUST.
 - Option HDM
 - Option HDM-DS

- AWG70002A With Option 01, 03 and 225
 - Rack Mount Kit
 - AFG3102/C

OR

AWG7122C with Option 01,02/06 and 08

 - AFG3102/C

- HDMI 2.0 Fixture set

- Termination Fixture (TF-HDMI-TPA-T)

- P7313SMA probes –Quantity 4

- HDMI DS accessory kit (Same 1.4b DS accessory kit is good enough)

- Programmable Dual Channel Power supply



MHL – HDMI for Mobile

Tektronix is a Contributor Adopter for MHL CTS

Welcome MHL Adopters

BizLink Technologies, Inc.

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

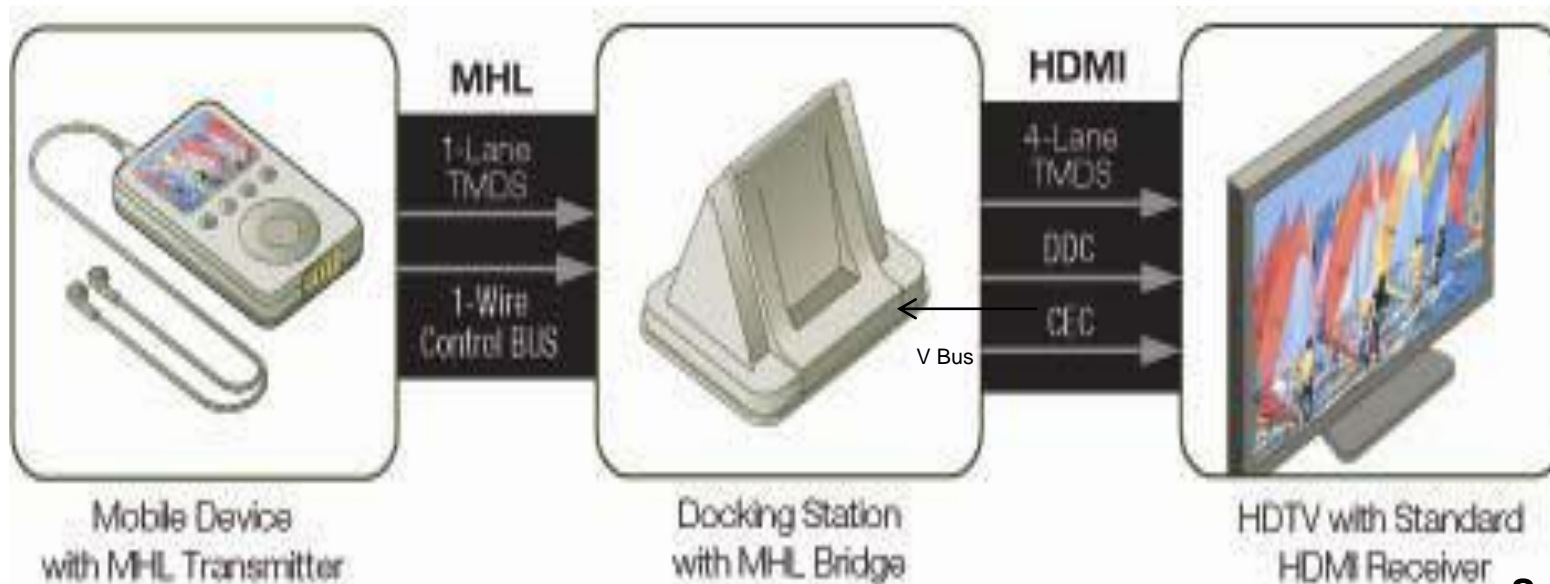
Manufactures power cord sets, LAN cable, patch cords and networking accessories

Tektronix is a Contributor Adopter for MHL CTS

<p>MHL Authorized Test Centers (ATC)</p> <p>Samsung www.samsungmhl.com</p> <p>Simplix Labs, LLC www.simplixlabs.com</p> <p>Sony www.sony.net/Products/ATC/NPL/</p>	<p>CE LINK LIMITED www.ce-link.com Cable Manufacturer</p> <p>Chang Uei Precision Industry Co., Ltd. (Foxlink Group) www.foxlink.com Designer and manufacturer of connectors and cable assemblies</p> <p>Compal Electronic Inc. www.compal.com Electronics manufacturer of notebook computers and monitors</p> <p>Dawlin Information & Technology Co., Ltd. www.dawlin-bus.com Mobile consumer electronics and PC accessories manufacturer</p> <p>DSR Holdings Inc. www.dsr-holdings.com Manufacturer of audio and video products</p> <p>David Electronics Co., Ltd. (DABC) www.dabc.com.tw Manufacturer of Cables and Connectors</p> <p>Datapower Development Ltd. Cable Manufacturer</p> <p>Dell Inc. www.dell.com PC Manufacturer</p> <p>Dewey ASV Science And Technology Co., Ltd www.dasv.com DVD or Blu-ray Manufacturer</p> <p>Dolby Laboratories www.dolby.com CS Manufacturer</p> <p>Dong Guan Primec Electronic & Telecommunication Products, Ltd. www.gpma.com.tw Global supplier in consumer and business electronics</p> <p>Allcom Test Labs, Inc www.allcom.com Test and validation solutions</p> <p>Amphenol Assembled Tech www.asatm.com Provider of custom cables and contract manufacturing services</p> <p>Analog Devices, Inc www.analog.com Supplier of high performance analog front end devices in CCD / CMOS imaging applications</p> <p>Astrodesign, Inc. www.astrodesign.com Provider of digital video products</p> <p>Audio Partnership I/TC www.audiopartnership.com HIFI Equipment Manufacturer</p> <p>Batlink Technology, Inc. www.batlink.com Cable assemblies and Wiring Harnesses</p> <p>BWV www.bwv.com Submodule</p> <p>C.S.L Wire & Plug Company www.cs-cable.com Cable Manufacturer</p>	<p>Fujitsu Limited www.fujitsu.com/global ICT Solutions Provider</p> <p>Fumei Electric Co. Ltd. www.fumei.com Consumer electronic products manufacturer</p> <p>Fuzon Garage I/TC, Ltd www.fuzongarage.com Mobile Handset Manufacturer</p> <p>Future Technology (Shenzhen) Co., Ltd www.future.com.cn Connector Manufacturer</p> <p>Gionee Communication Equipment Co., Ltd Shenzhen www.gionee.com Mobile Handset Manufacturer</p> <p>Glory Mark Electronics Ltd. www.glorymark.com.tw Cable Manufacturer</p> <p>Goodway Technology Co., Ltd www.goodway.com.tw Accessories Manufacturer</p> <p>Gopod Group Limited www.gopod.com Mobile Accessories Manufacturer</p> <p>GuangDong CHYO Mobile Telecommunications Corp., Ltd www.ygpo.com Mobile Handset Manufacturer</p> <p>Hama GmbH & Co. KG www.hama.de Accessories Manufacturer</p> <p>Handong Linc Co., Ltd. (HDLNC) www.hdlnc.com Smartphone Software Solution</p> <p>Hank Electronics Ltd www.hank-tech.com Cable Manufacturer</p> <p>HdSib! Electronic Co., Ltd. www.hdsib.com Systems and Media Specialist</p> <p>Himax Technology Limited www.himax.com Fabless semiconductor solution provider</p> <p>Hi-tech Electronic (Dongguan) Co., Ltd www.hitec.com Cable Manufacturer</p> <p>HL Technology Group Limited www.hong-hu.com Cable Manufacturer</p> <p>Hoazen Corporation www.hoazen.com Manufactures and sells electronic components, electromechanical parts and LCD elements</p> <p>Hobron www.hobron.com.cn Cable Manufacturer</p> <p>HIC Corporation www.hic.com Handheld wireless telecommunications devices</p> <p>Huawei www.huaweicom.com ICT Solutions Provider</p>	<p>Huawei www.huaweicom.com ICT Solutions Provider</p> <p>Hangzhou Shenghua Industry Co., Ltd. www.sh.com Cable Manufacturer</p> <p>Innobest Corporation www.innobest.com Semiconductor Trading Company</p> <p>I-Tech Inc. www.it.com.tw Semiconductor Manufacturer</p> <p>I-Tech Korea www.itkorea.com CE Manufacturer</p> <p>Jiangxi Ship Electronics Co., Ltd www.jshipgroup.net Cable Manufacturer</p> <p>Johnson Component and Equipment Co., Ltd. www.jecable.com Cable Manufacturer</p> <p>JVC Kenwood Corp www.jvckenwood.com Consumer Electronics Manufacturer</p> <p>KYOCERA Corporation www.kyocera.com Mobile Handset Manufacturer</p> <p>Lanovo www.lanovo.com PC manufacturer</p> <p>LG Electronics www.lg.com Consumer electronics and mobile communications</p> <p>Luxshare-ICT Co., Ltd www.luxshare-ict.com Cable Manufacturer</p> <p>Masfer Hill Electric Wire & Cable Co., Ltd. www.mscable.com Develops and Produces Wire and Cable Products</p> <p>Maxim Integrated Products Inc www.maxim-ic.com Analog and Mixed-Signal Semiconductor Company</p> <p>Mediatek www.mediatek.com Fabless Semiconductor Company</p> <p>Mitsu Technology Co., Ltd www.mitsu.com Mobile Handset Manufacturer</p> <p>MSB www.msbsystem.com ASICs for consumer and communication products</p> <p>Mumbai Manufacturing Co., Ltd. www.mms.com Provider of core electronics for mobile phones, computers and IT equipment</p> <p>National Instruments Denmark www.ni.com Test Equipment Manufacturer</p>	<p>Nititech Electronic Corporation www.nititech.com Provider of connectors for the electronics industry</p> <p>Novatek Microelectronics Corporation www.novatek.com Fabless chip design company specializing in display driver ICs and SoC solutions</p> <p>ON Semiconductor www.onsemi.com Supplier of high performance silicon solutions for energy efficient electronics</p> <p>Onkyo www.onkyo.com CE Manufacturer</p> <p>Pantech Co., Ltd. www.pantech.com Mobile Phone Manufacturer</p> <p>Panade Technology, Inc. www.panade.com Develops and supplies advanced and cost-effective high-speed display interface solutions</p> <p>Pioneer www.pioneer.co.jp CE Manufacturer</p> <p>PNY Technologies, Inc www.pny.com Cable Manufacturer</p> <p>Qualcomm Inc. www.qualcomm.com Fabless Semiconductor & Wireless Chipset and Software Technology Provider</p> <p>Realtek Semiconductor Corp. www.realtek.com IC Design</p> <p>Renesas Electronic Corporation www.renesas.com Semiconductor Solutions Supplier</p> <p>ROHM Co., Ltd. www.rohm.co.jp Semiconductor manufacturer</p> <p>Roku, Inc www.roku.com Smartstream</p> <p>Seko Epson Corporation www.seko.com Printer and Projector Manufacturer</p> <p>Sharp Corporation www.sharp.co.jp DTV Manufacturer</p> <p>Shenzhen Comlink Electronics Co., Ltd. www.chinacomb.com Cable Manufacturer</p> <p>SHENZHEN D&S INDUSTRIES LIMITED www.dscable.com Mobile accessories manufacturer</p> <p>Shenzhen Tronxon Electronics Co., Ltd. www.tronxon.com Cable Manufacturer</p> <p>Shenzhen Xian Ying Electronic Co., Ltd (Pullink Enterprise) www.hxlink.com Cable and Accessory Manufacturer</p> <p>ZLT Corporation www.zl.com.cn Global provider of telecommunications equipment and network solutions</p>	<p>Sky Tech Worldwide, Inc www.skytech-wire.com Cable Manufacturer</p> <p>SMK Corporation www.smk.com Accessories Manufacturer</p> <p>Space Shuttle Hi-Tech Co., Ltd. www.apcable.com Producer of PC and communication cables</p> <p>Standard Microsystems Corporation (SMSC) www.smsc.com Global supplier of semiconductor solutions for hard drive, video, sound, phone and data</p> <p>Sunroute Electronic Industries, Ltd. www.global-eic.com Design, manufactures and sells cable and components and advanced electronic devices</p> <p>Sunplus Technology Co., Ltd. www.sunplus.com Provider of multimedia IC solutions</p> <p>Sure-Pine Electrical Corporation www.sure-pine.com Global CE/EMI supplier of cables, connectors and devices</p> <p>Synopsys www.synopsys.com Provider of electronic design automation (EDA) software, IP and services</p> <p>T.E. Connectivity www.te.com Connector Manufacturer</p> <p>TEC Mobile Limited www.tecmobile.com The Supplier's Computer/IT/CE</p> <p>Tektronix www.tek.com Test measurement and monitoring solutions</p> <p>Teledyne (TI) www.ti.com Semiconductor IC Design and Manufacturing Company</p> <p>Top Victory Investments Ltd www.topv.com DTV Manufacturer</p> <p>TSY-B (BVI) International Inc. www.tsy.com Cable manufacturer</p> <p>UDVET.OX, Inc www.udvet.com Smartphone Solution</p> <p>Wanhsin Electronic Co., Ltd www.wanhsin.com Cable Manufacturer</p> <p>Wireless Accessory Solutions LLC www.wasol.com Smartphone Accessory Solutions</p> <p>Wiretek International Investment Ltd. www.wiretek.com Smartphone Manufacturer</p> <p>Yachub Precision Co., Ltd www.yachub.com Cable Manufacturer</p> <p>YTC-Donbagle Electronic Co., Ltd. www.cables.com Manufactures power cord sets, LAN cable, patch cords and monitoring accessories</p>
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148 Adopters till now and growing

MHL Introduction



Source: MHL.org

- 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.

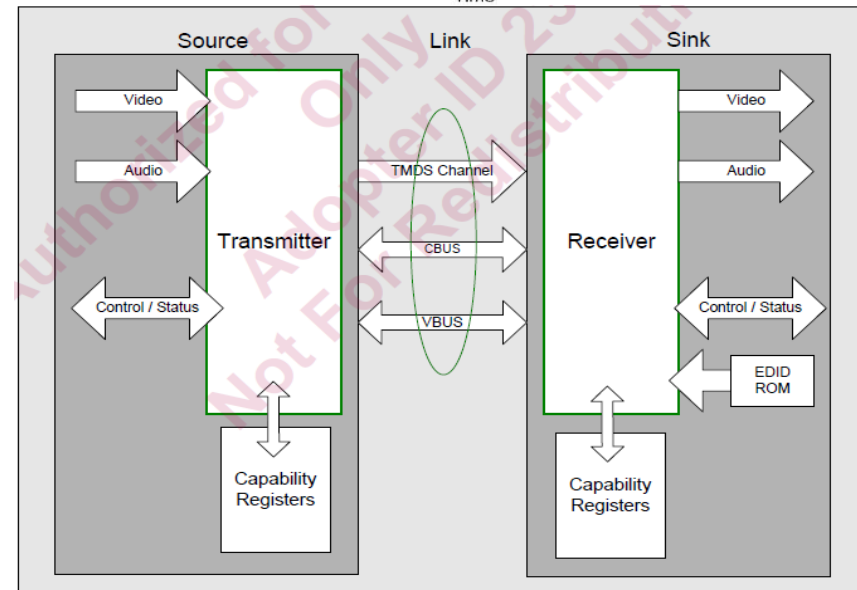
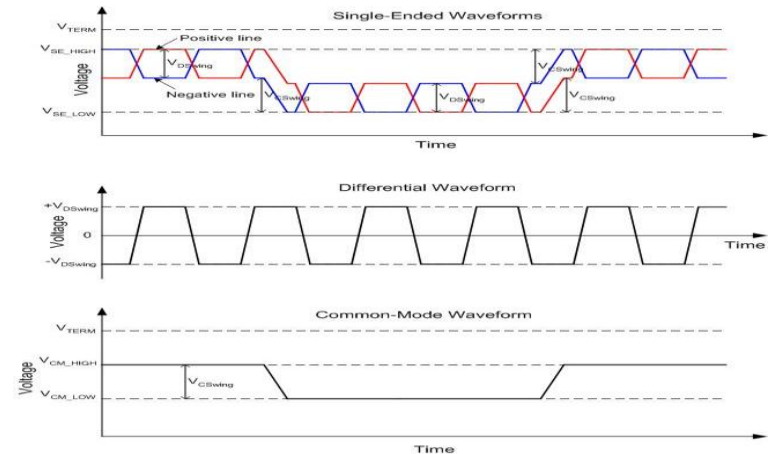
MHL Introduction

- MHL Consortium was formed in Sept 2009 with the following founding members:
 - NOKIA
 - SAMSUNG
 - Silicon Image
 - Sony
 - Toshiba
- The Specification 1.1 version was announced in Q12011 , Specification 1.2 in Dec 2011, Specification 2.0 in Feb 2012 and Specification 2.1 NOW.

The Consortium released CTS 1.1 version in June 2011, CTS 1.2 in Jan 2012, CTS 2.0 in Sept 2012 and CTS 2.1 is just announced.

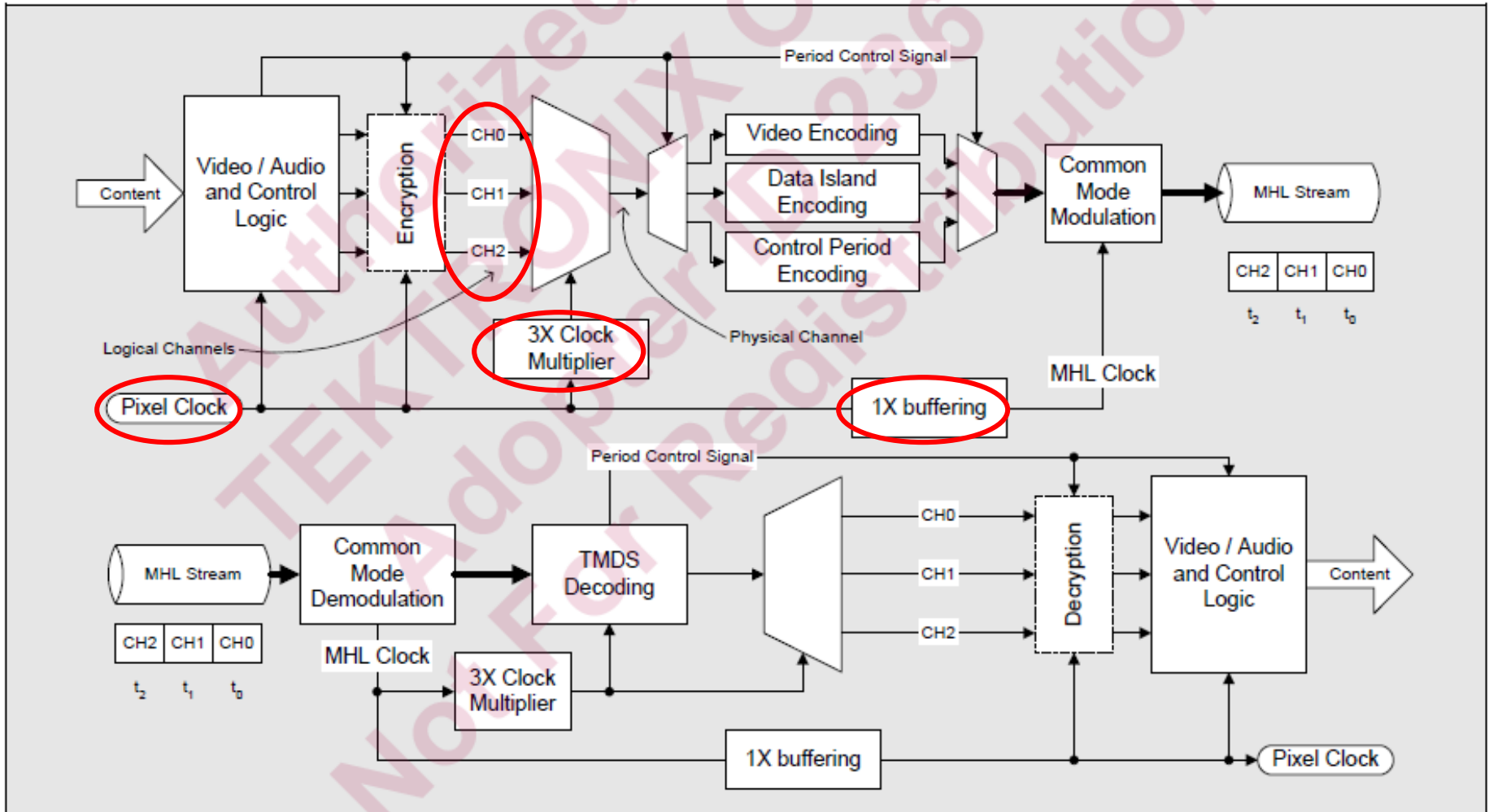
COMPLETE TEKTRONIX SOLUTION APPROVED in CTS1.1 , CTS 1.2 , CTS 2.0 and CTS 2.1 solution

- Tektronix is a **Contributor adopter** and actively involved in defining the CTS 2.1.



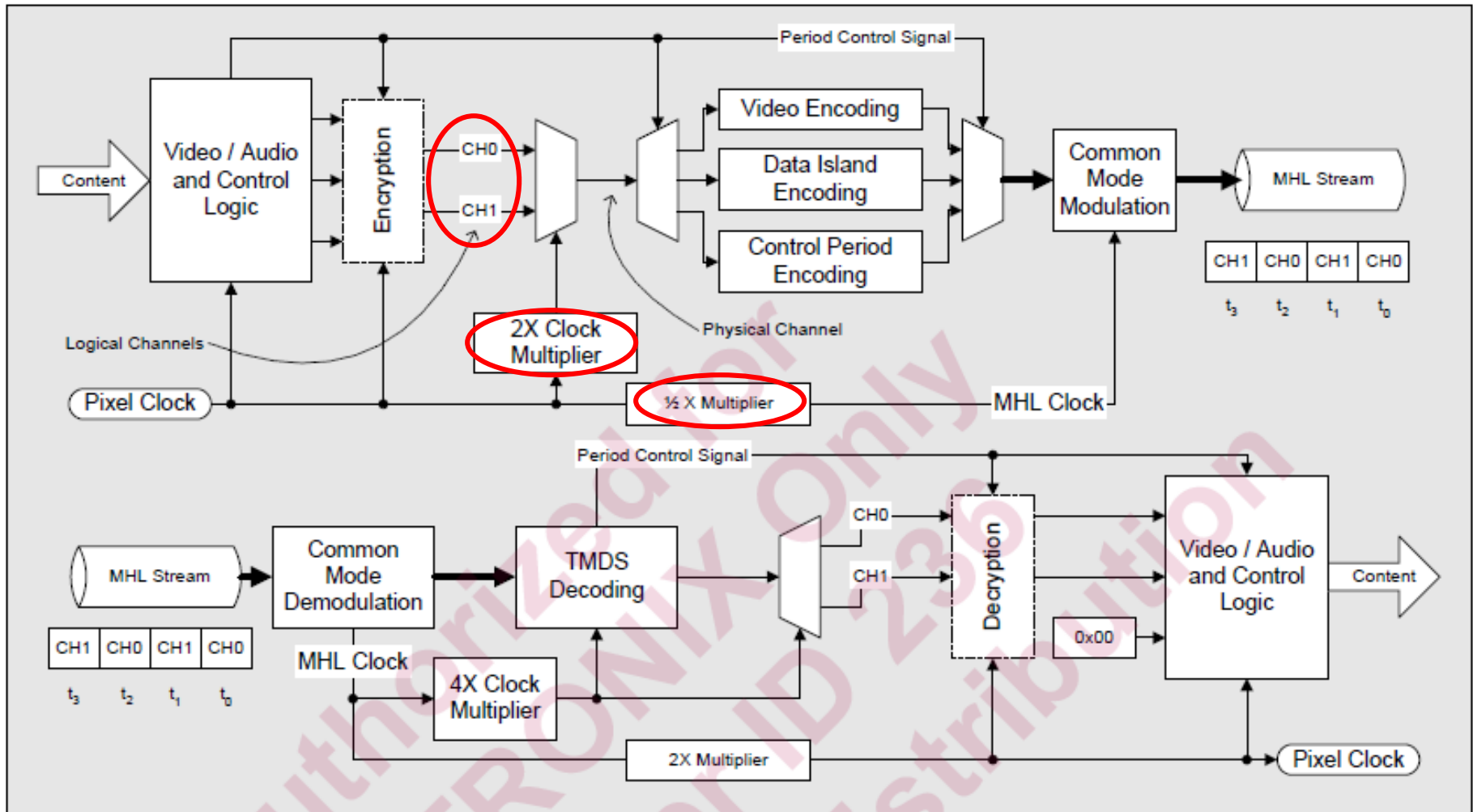
Source: MHL 1.2 specification document

MHL Encoder/Decoder Overview – 24 bit mode



Source: MHL 1.1 specification

MHL Encoder/Decoder Overview – PackedPixel mode



Source: MHL 1.1 specification

MHL – 2.1

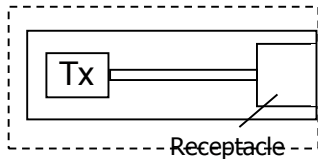
- MHL Consortium and Tektronix has worked together on the 2.1 version MHL specifications.
 - Data rate does not change from 3Gbps.
 - Packed Pixel implementation does not change
 - 3D capability does not change
 - New test procedure introduced for Source Clock Jitter and Data Eye Diagram
 - These tests will now be Single ended tests and will have worst case skew filters in the path of the signals before we analyze.
 - Sink Jitter Tolerance now needs to be tested with and without cable emulator
 - New Cable Electrical introduced
 - Minimum CLK Swing Test
 - Eye Diagram Test
 - Support for Direct Attach Source and Sink devices



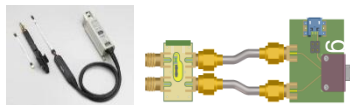
MHL Ecosystem and Tektronix Solution



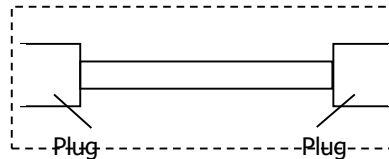
Source Devices



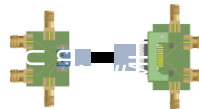
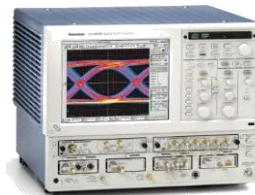
- Mobile Devices, STBs



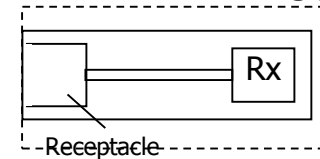
Cable Assemblies



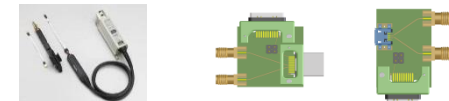
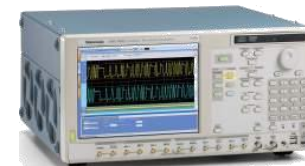
- Dongles , Cables



Sink Devices



- TVs, Monitors, .



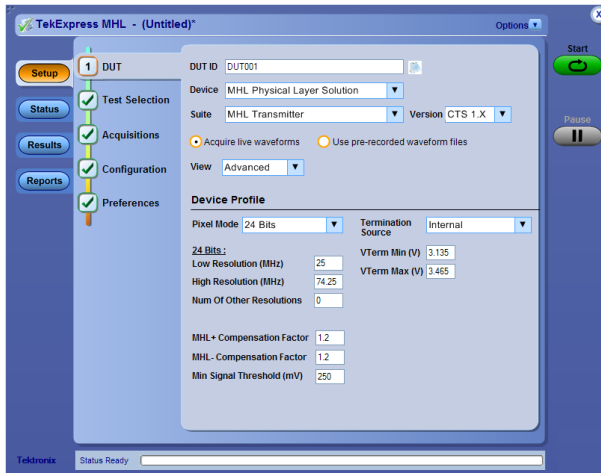
Source: MHL.org

Electrical and Protocol

Electrical and Protocol

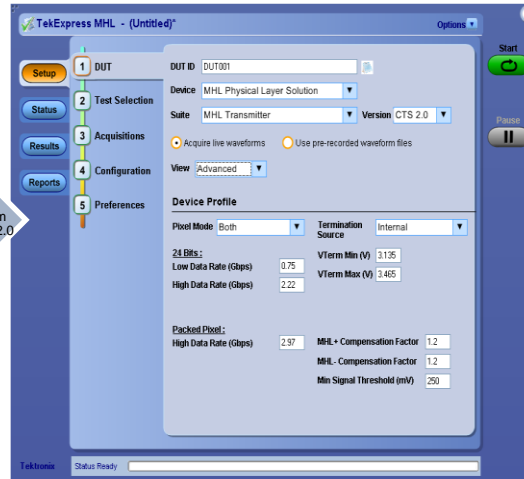
Tektronix MHL 2.1 Transmitter Solution

- Tektronix has worked closely with MHL consortium to define the next CTS version 2.1 and MHL 2.1 TX SW.



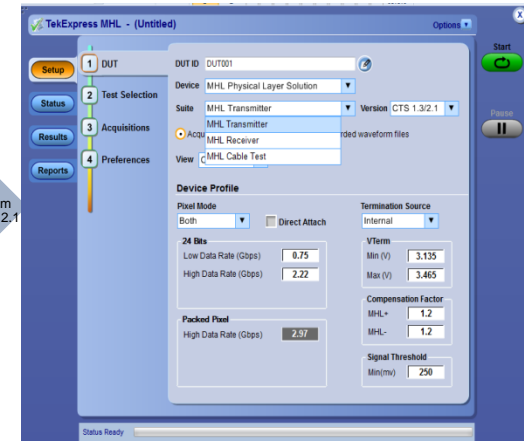
CTS 1.x

Switch from CTS 1.x to 2.0



CTS 2.0

Switch from CTS 2.0 to 2.1



CTS 2.1

- MHL Protocol Analyzer SW is MHL 2.1 version available
- MHL 2.1 Sink Patterns for Direct Attach Device testing is available
- MHL 2.1 Cable Electrical testing patterns are available
- **No changes in test gear for MHL 2.1 only new feature support.**

Tektronix MHL 2.1 Solution

- DPO/DSA/MSO 70804B/C Series Real Time Oscilloscope with BW \geq 8GHz
- MHL Compliance Software – Option MHD
- Innovative MHL Protocol Software from Third party – TEK-PGY-MHL-PA-SW
- Probes – P7313SMA (two) and P7240 (one)
- MHL Test Fixture including Direct Attach Fixture – Available from Tektronix.
- AWG7122C with Opt 01,02 or 06 and 08 for the innovative direct Synthesis based MHL Rx/Dongle testing.
- C-Bus Sink and Source board is needed and is available from Tektronix
- DSA8200 or Equivalent with 80E03/80E04 and I-Connect Software for MHL cable testing (performed manually using MOIs)

Please contact local Tektronix account managers for further details.

Tektronix MHL 2.1 Tx Solution with Direct Attach Test Support

The screenshot displays the TekExpress MHL software interface. The main window is titled "TekExpress MHL - (Untitled)*" and includes a navigation sidebar on the left with buttons for "Setup", "Status", "Results", and "Reports". A vertical progress indicator shows four steps: 1. DUT, 2. Test Selection (checked), 3. Acquisitions, and 4. Preferences. The "Setup" section is active, showing the following configuration:

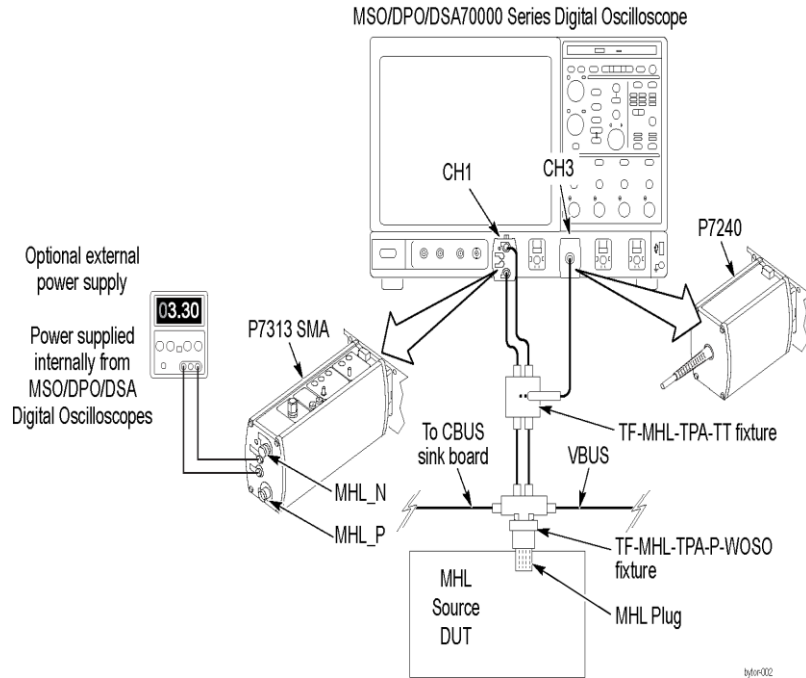
- DUT ID: DUT001
- Device: MHL Physical Layer Solution
- Suite: MHL Transmitter
- Version: CTS 1.3/2.1
- Acquire live waveforms (selected) / Use pre-recorded waveform files
- View: Compliance

The "Device Profile" section is expanded, showing:

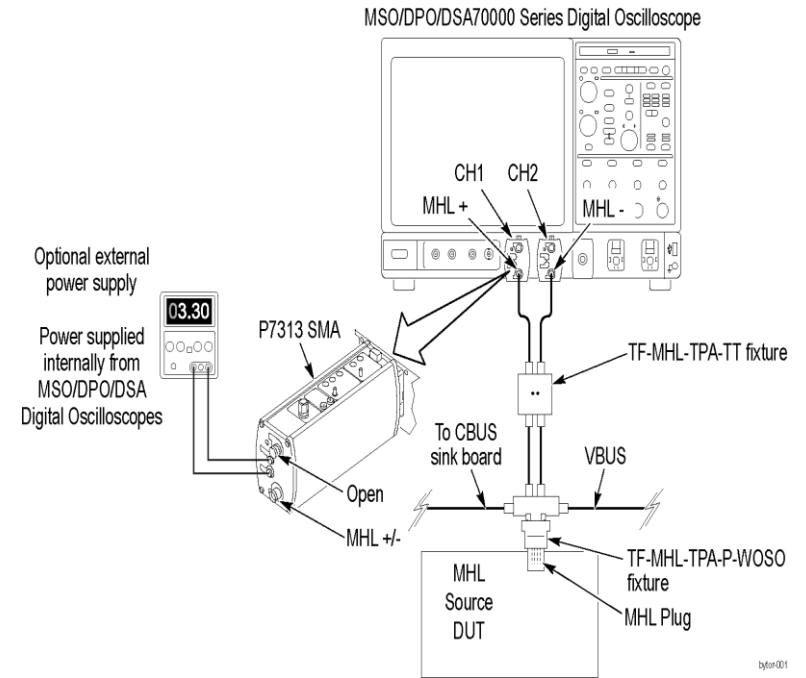
- Pixel Mode: Both (selected) / Direct Attach (checked)
- Termination Source: Internal
- 24 Bits: Low Data Rate (Gbps) 0.75, High Data Rate (Gbps) 2.22
- Packed Pixel: High Data Rate (Gbps) 2.97
- VTerm: Min (V) 3.135, Max (V) 3.465
- Compensation Factor: MHL+ 1.2, MHL- 1.2
- Signal Threshold: Min(mv) 250

On the right side of the interface, there are "Start" and "Pause" buttons. At the bottom, a status bar indicates "Status Ready".

Tektronix MHL Tx Setup



MHL Differential and CM Test Setup
6 tests



Single Ended and Intra Pair Skew Test Setup
6Tests

Also same setup is used for MHL Protocol Testing

** C-Bus Sink and Source Board is needed for hand shaking and is available from Tektronix

MHL 2.1 Compliance Software for Automated Tx Tests: Option MHD

The screenshot displays the TekExpress MHL software interface. The window title is "TekExpress MHL - (Untitled)". On the left, a vertical navigation bar shows four steps: 1. DUT (checked), 2. Test Selection (highlighted), 3. Acquisitions, and 4. Preferences. Below this are buttons for Setup, Status, Results, and Reports. The main area is titled "MHL Physical Layer Solution : MHL Transmitter : CTS 1.3/2.1" and contains a tree view of test items. The "MHL Clock" folder is expanded, showing several sub-items, with "3.1.1.5 Common-mode Output Swing Voltage-V_CMSWING (Low)" selected. Below the tree is a "Test Description" box containing the text: "This test confirms that common-mode output voltage swing amplitude is within the specified limits when the source device operates in normal mode." To the right of the description are "Schematic" and "Configure" buttons. On the far right, there are "Start" and "Pause" buttons. The status bar at the bottom indicates "Status Ready".

MHL Physical Layer Solution : MHL Transmitter : CTS 1.3/2.1

- MHL Clock
 - 3.1.1.1 Standby Output Voltage-VOFF
 - 3.1.1.5 Common-mode Output Swing Voltage-V_CMSWING (Low)
 - 3.1.1.7 Common-mode Rise and Fall Times-TR_CM, TF_CM (High)
 - 3.1.1.10 MHL Clock Duty Cycle in Normal Mode (High)
 - 3.1.1.14 MHL Clock Duty Cycle in PackedPixel Mode (High)
 - 3.1.1.17 TP2 Clock Jitter in Normal Mode (Low, High)
 - 3.1.1.19 TP2 Clock Jitter in PackedPixel Mode (High)
- MHL Data
 - 3.1.1.2 Single-ended High Level Voltage-VSE_HIGH (Low)
 - 3.1.1.3 Single-ended Low Level Voltages-VSE_LOW (Low)
 - 3.1.1.4 Differential Output Swing Voltage-VDF_SWING (Low)
 - 3.1.1.6 Differential Rise and Fall Times-TR_DF, TF_DF (High)
 - 3.1.1.18 TP2 Eye Diagram in Normal Mode (Low, High)
 - 3.1.1.20 TP2 Eye Diagram in PackedPixel Mode (High)

Test Description

This test confirms that common-mode output voltage swing amplitude is within the specified limits when the source device operates in normal mode.

Status Ready

MHL 2.0 Tests – Detailed Information on MHL 2.0 TX Tests

Physical Layer Tests

MHL Transmitter Tests

- 3.1.1.1 Standby Output Voltage V_{OFF}
- 3.1.1.2 Single-ended High-level Voltage V_{SE_HIGH}
- 3.1.1.3 Single-ended Low-level Voltage V_{SE_LOW}
- 3.1.1.4 Differential Output Swing Voltage $V_{ODSWING}$
- 3.1.1.5 Common Mode Output Swing Voltage $V_{COMSWING}$
- 3.1.1.6 Differential Rise and Fall Times T_{R_DF} , T_{F_DF}
- 3.1.1.7 Common Mode Rise and Fall Times T_{R_CM} , T_{F_CM}
- 3.1.1.8 Differential Intra Pair Skew T_{skew_DF}
- 3.1.1.10 MHL Clock Duty Cycle in Normal mode
- 3.1.1.11 MHL Clock Jitter in Normal mode (not needed as per CTS 2.1)
- 3.1.1.12 MHL Data Eye Diagram in Normal mode (not needed as per CTS 2.1)
- 3.1.1.14 MHL Clock Duty Cycle in PackedPixel mode
- 3.1.1.15 MHL Clock Jitter in PackedPixel mode (not needed as per CTS 2.1)
- 3.1.1.16 MHL Data Eye diagram in Packed Pixel mode (not needed as per CTS 2.1)
- 3.1.1.17 TP2 Clock Jitter in Normal Mode (new in CTS 2.1)
- 3.1.1.18 TP2 Eye Diagram in Normal Mode (new in CTS 2.1)
- 3.1.1.19 TP2 Clock Jitter in PackedPixel Mode (new in CTS 2.1)
- 3.1.1.20 TP2 Eye Diagram in PackedPixel Mode (new in CTS 2.1)

Tektronix MHL Protocol Analysis Solution

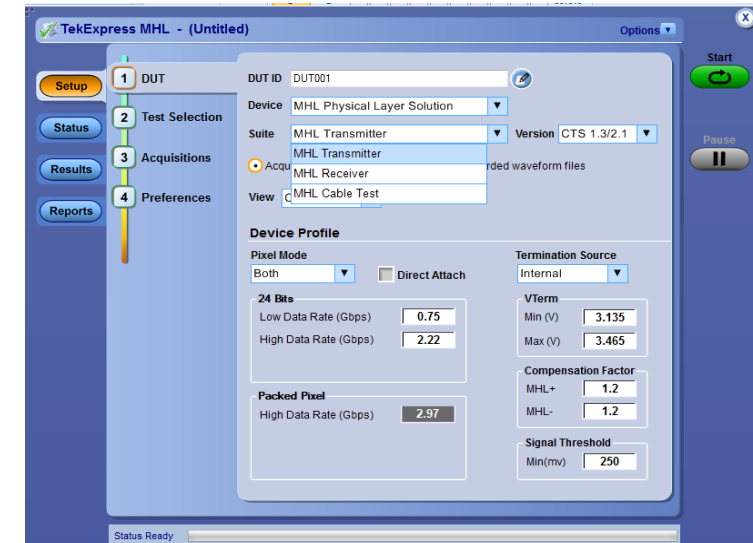
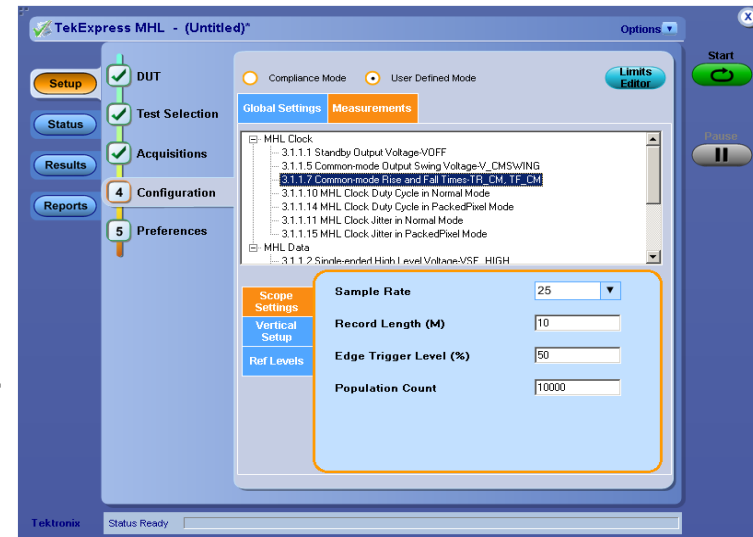
- MHL Protocol Analysis software running on the Tektronix REAL TIME Oscilloscope
 - Unique value proposition as the same real time scope is used for both Physical layer testing and Protocol testing.
 - Gives the seamless transition from Phy layer to Protocol.
 - Cost effective solution.
- Features
 -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

Tektronix MHL Protocol Analyzer - Seamless PHY and Link Layer Testing

Test Name	Result
Legal Codes Test	Pass
Basic Protocol Test	Pass

Advanced Analysis and Debug of MHL

- MHL Compliance Software provides the user defined mode which can be used for advanced analysis needs as it allows changes to the settings.
- Clock Jitter and Data Eye leverages DPOJET so we can use DPOJET for debug needs.
- Option MHD allows saving of sessions file which has all the wfms of the session which can be used for debug needs.
- On the Protocol analyzer we have wfms saved on scope hard disk to enable advanced debug and the PA SW provides exhaustive information on why a test failed.



Tektronix MHL 2.1 Rx Solution with Direct Attach Test Support

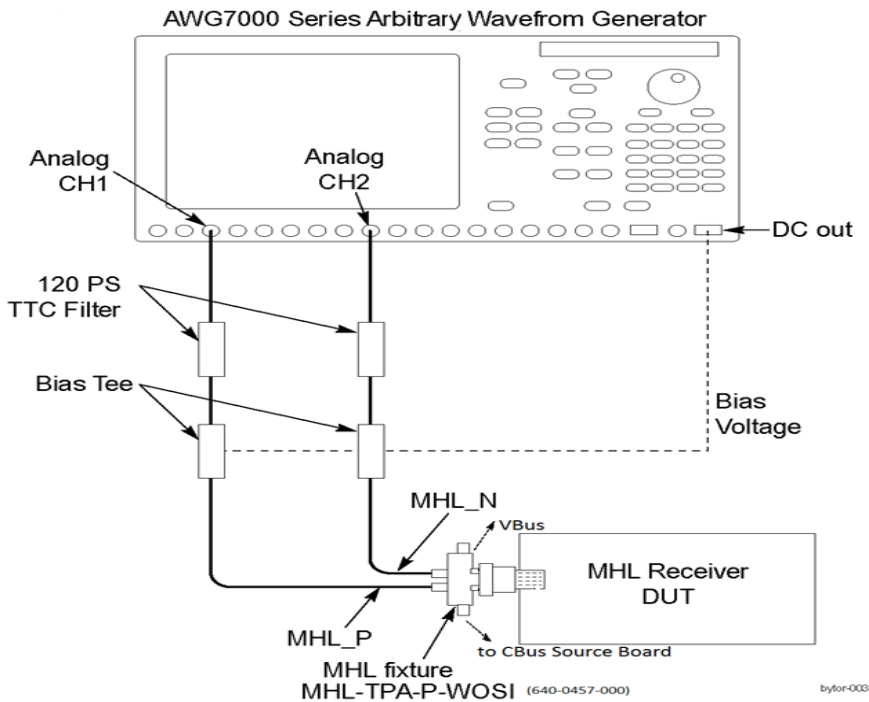
The screenshot displays the TekExpress MHL software interface, titled "TekExpress MHL - (Untitled)*". The interface is divided into several sections:

- Left Navigation Panel:** Contains buttons for "Setup", "Status", "Results", and "Reports". A vertical progress indicator shows four steps: 1. DUT (highlighted), 2. Test Selection, 3. Configuration, and 4. Preferences.
- Main Configuration Area:**
 - DUT ID:** DUT001
 - Device:** MHL Physical Layer Solution
 - Suite:** MHL Receiver
 - Version:** CTS 1.3/2.1
 - Test Method:** Use Pre - Defined Pattern, Compliance - Test device for pass/fail per base specifications
 - Device Profile:**
 - Pixel Mode:** Both
 - Refresh Rate:** 60 Hz
 - Direct Attach:**
 - 24 Bits:**
 - Low Data Rate (Gbps): 0.75
 - High Data Rate (Gbps): 2.22
 - Packed Pixel:**
 - High Data Rate (Gbps): 2.97
- Right Panel:** Contains "Start" (green circular button with refresh icon) and "Pause" (grey button with pause icon) controls.
- Bottom Status Bar:** Shows "Status Ready" with a progress indicator.

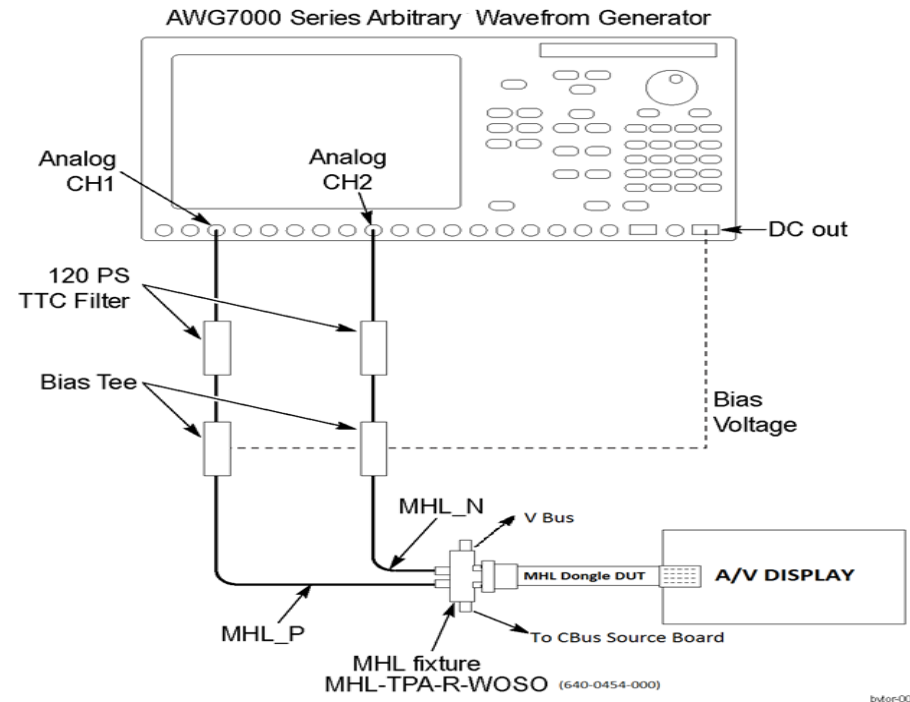
Tektronix MHL Solution Setup - Simple and Easy Sink and Dongle Testing (all tests except Min/Max test)-1

Setup based on Direct Synthesis Capability of AWG7122C Series

Test Setup for Sink Tests



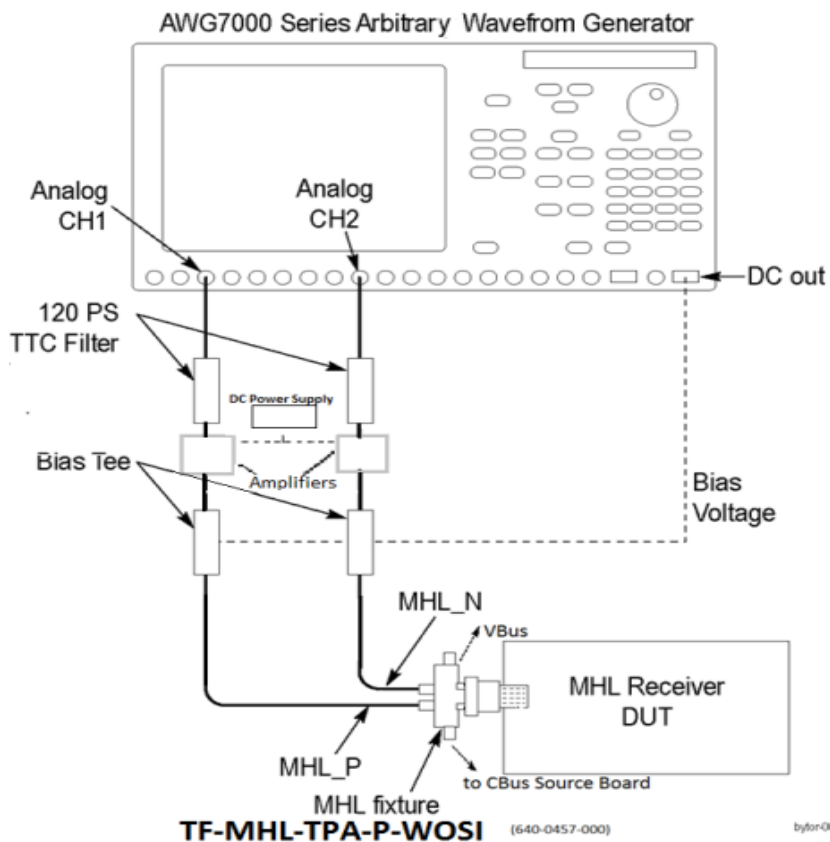
Test Setup for Dongle Tests



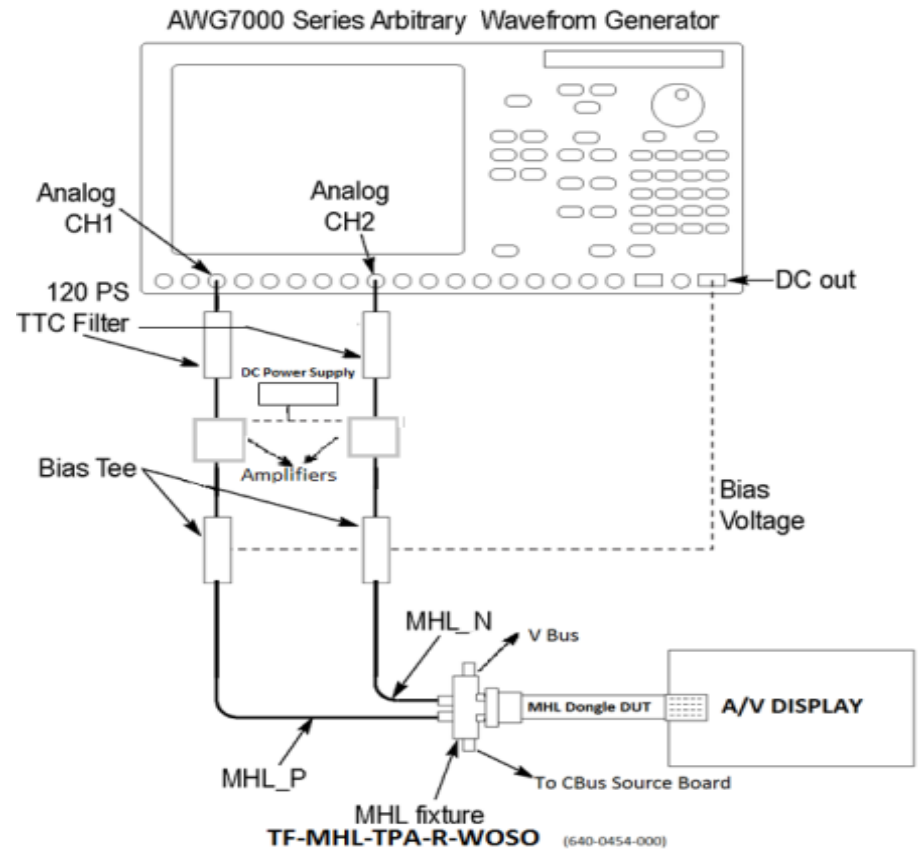
Tektronix MHL Solution Setup - Simple and Easy Sink and Dongle Min/Max Testing -2

Setup based on Direct Synthesis Capability of AWG7122C Series

Test Setup for Sink Min/Max Tests



Test Setup for Dongle Min/Max Tests



MHL 2.1 Tests – Detailed Information on Sink/Dongle Electrical Tests

Physical Layer Tests

MHL Receiver Tests

- 4.1.1.2 Input Signal DC Voltage Level Tolerance
- 4.1.1.3 Input Signal Minimum and Maximum Swing Voltage Level Tolerance
- 4.1.1.4 Intra Pair Skew Tolerance
- 4.1.1.5 Jitter Tolerance in Normal mode
- 4.1.18 Jitter Tolerance in PackedPixel mode

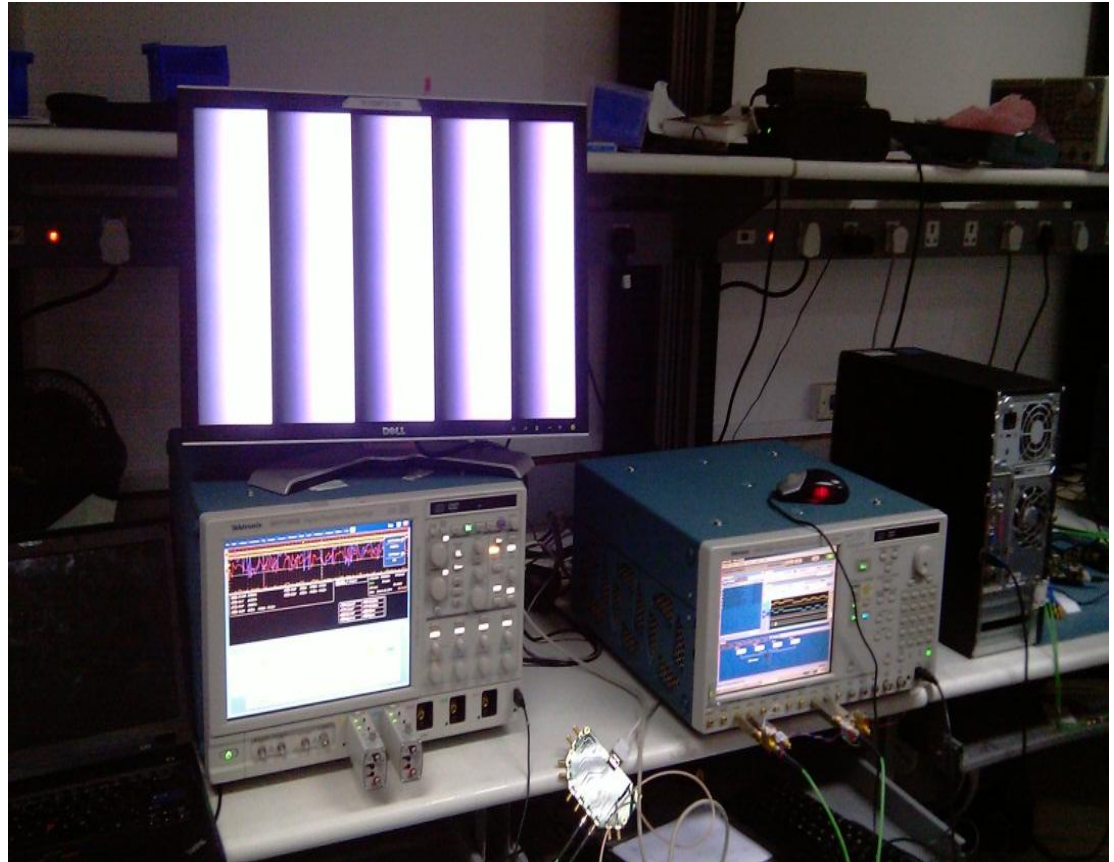
MHL Dongle Tests

- 5.1.1.1 Input Signal Single-ended Voltage Level Tolerance
- 5.1.1.2 Input Signal Minimum and Maximum Swing Voltage Level Tolerance
- 5.1.1.3 Intra Pair Skew Tolerance
- 5.1.1.4 Jitter Tolerance in Normal mode
- 4.1.1.9 Jitter Tolerance in PackedPixel mode

The CTS 2.1 mandates Sink Jitter Tolerance test to be performed with and without Cable emulator.

Tektronix Actual Sink and Dongle Setup – Simple & Easy A Snapshot

Setup based on real-time oscilloscope and Direct Synthesis capability of AWG7122C Series



Tektronix MHL 2.1 Cable Electrical Test

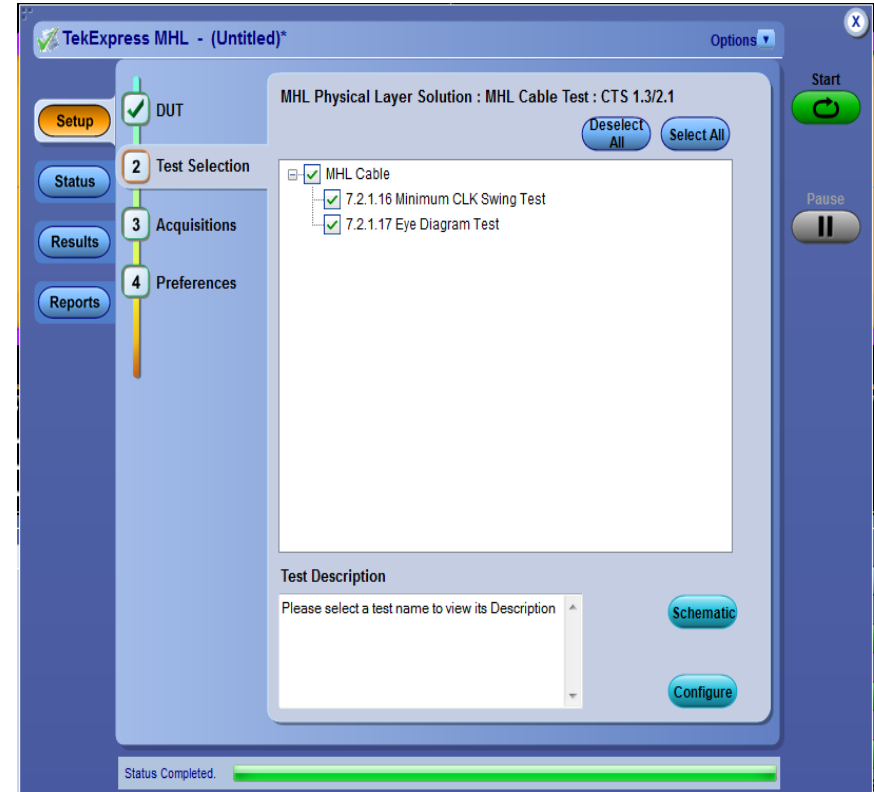
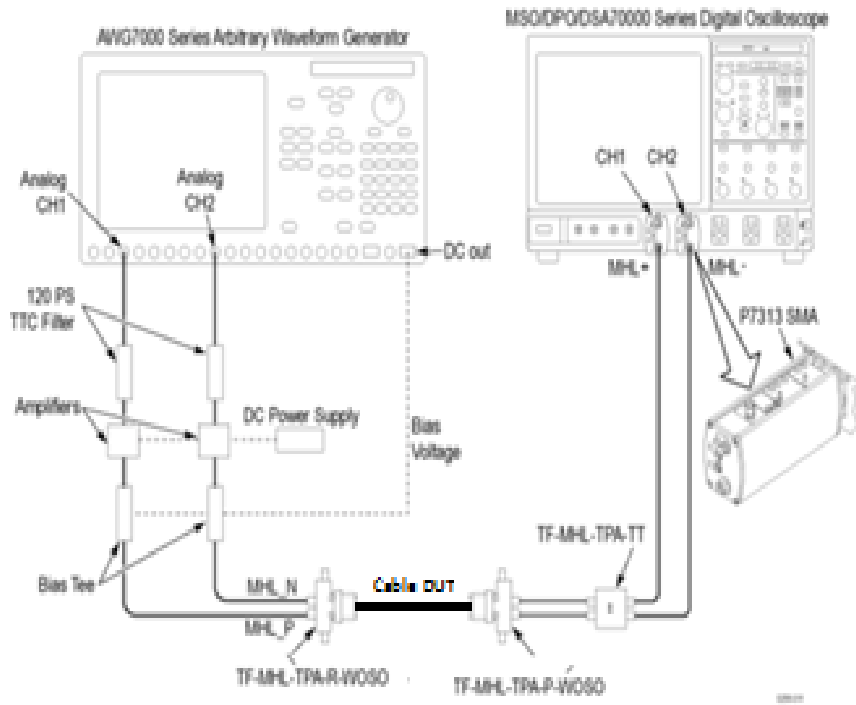
The screenshot displays the TekExpress MHL software interface for configuring an MHL 2.1 Cable Electrical Test. The interface is titled "TekExpress MHL - (Untitled)*" and includes a navigation sidebar on the left with buttons for "Setup", "Status", "Results", and "Reports". A vertical progress indicator shows four steps: 1. DUT, 2. Test Selection (checked), 3. Acquisitions, and 4. Preferences.

The main configuration area includes the following settings:

- DUT ID:** DUT001
- Device:** MHL Physical Layer Solution
- Suite:** MHL Cable Test
- Version:** CTS 1.3/2.1
- Acquisition Options:** Acquire live waveforms (Using Pre-Defined Patterns) and Use pre-recorded waveform files
- View:** Compliance
- Device Profile:**
 - Pixel Mode:** Packed Pixel
 - Refresh Rate:** 60 Hz
 - Packed Pixel High Data Rate (Gbps):** 2.97

On the right side of the interface, there are "Start" and "Pause" buttons. At the bottom, a status bar indicates "Status Completed." with a green progress bar.

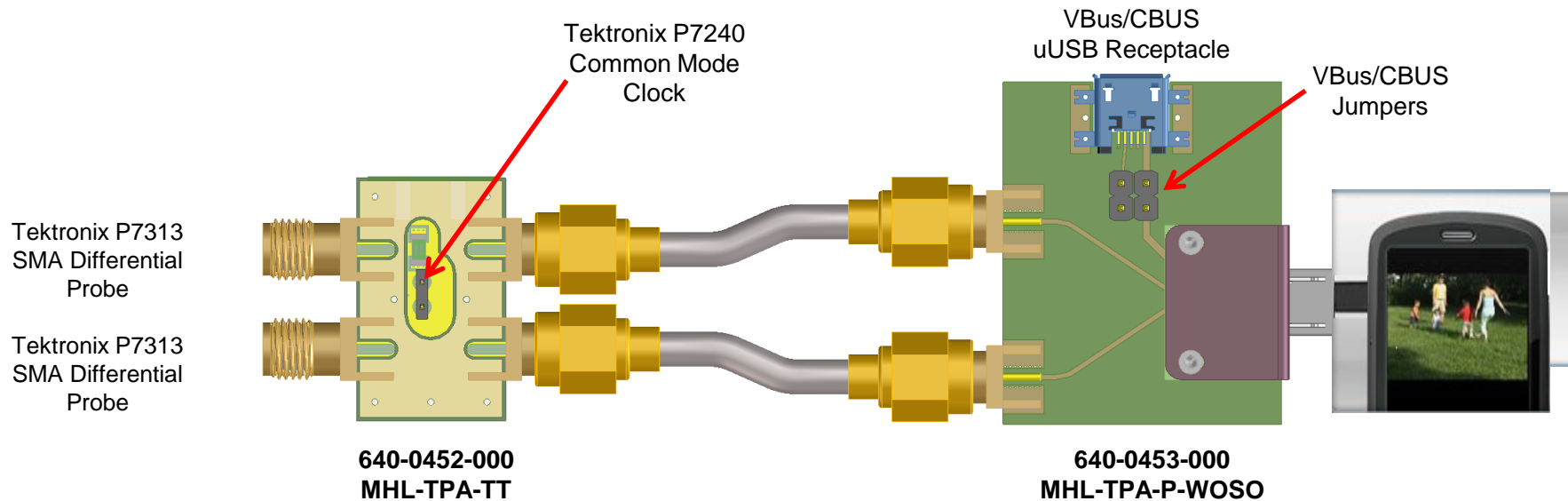
Tektronix MHL 2.1 Cable Electrical Test Selection



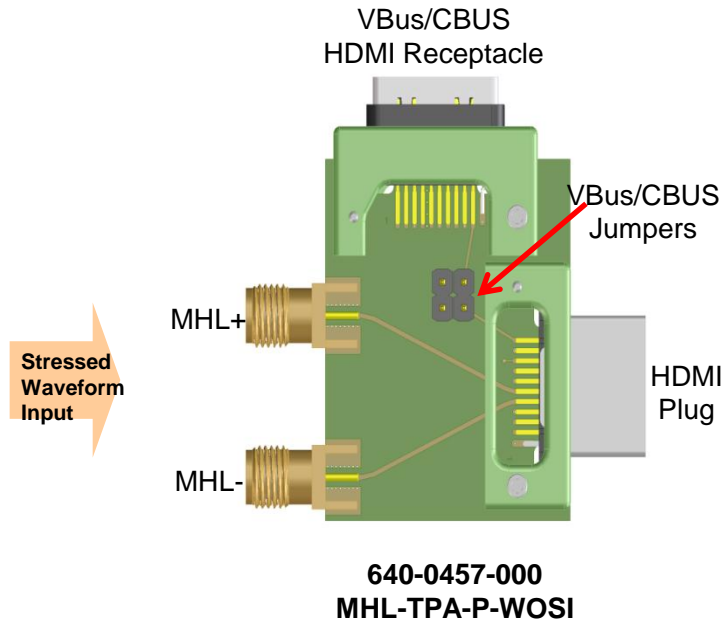
MHL Fixture Kits

Wilder P/N	Wilder Model #	Tektronix nomenclature	Description
640-0475-000	MHL-TPA-TEK(Complete MHL Fixture kit w Cbus Board)	TF-MHL-TPA-TEK(Complete MHL Fixture kit w Cbus board)	MHL Test Kit includes 640-0452-000 thru 640-0459-000 and 640-0485-000 with associated power cords per country code
		TF-MHL-TPA-TEK A0	North America Power Cord Option - 640-0485-100
		TF-MHL-TPA-TEK A1	Universal EURO Power Cord Option -640-0485-110
		TF-MHL-TPA-TEK A2	United Kingdom Power Cord option - 640-0485-120
		TF-MHL-TPA-TEK A5	Switzerland Power cord option - 640-0485-130
		TF-MHL-TPA-TEK A6	Japan Power cord option -640-0485-140
		TF-MHL-TPA-TEK A10	China Power cord Option -640-0485-150
		TF-MHL-TPA-TEK A12	Brazil Power cord option -640-0485-160
		TF-MHL-TPA-TEK A11	India Power cord option -640-0485-170
640-0476-000	MHL-TPA-TEK-SO(Source Fixture Only Kit)	TF-MHL-TPA-TEK-SO(Source Fixture Only Kit)	MHL Source Test Kit includes 640-00452 and 640-0453-000
640-0477-000	MHL-TPA-TEK-SI(Sink Fixture kit)	TF-MHL-TPA-TEK-SI(Sink Fixture kit)	MHL Sink Test Kit includes 640-0452-000, 640-0456-000, 640-0457-000
640-0478-000	MHL-TPA-TEK-DG(Dongle Fixture Kit)	TF-MHL-TPA-TEK-DG(Dongle Fixture Kit)	MHL Dongle Test Kit includes 640-0452-000, 640-0453-000, 640-0454-000
640-0479-000	MHL-TPA-TEK-CB(Cable Fixture Kit)	TF-MHL-TPA-TEK-CB(Cable Fixture Kit)	MHL Cable Test Kit includes 640-0455-000, 640-0456-000
640-0480-000	MHL-TPA-TEK-RSEN(RSEN Kit)	TF-MHL-TPA-TEK-RSEN(RSEN Kit)	MHL RxSense Kit includes 640-0458-000 and 640-0459-000

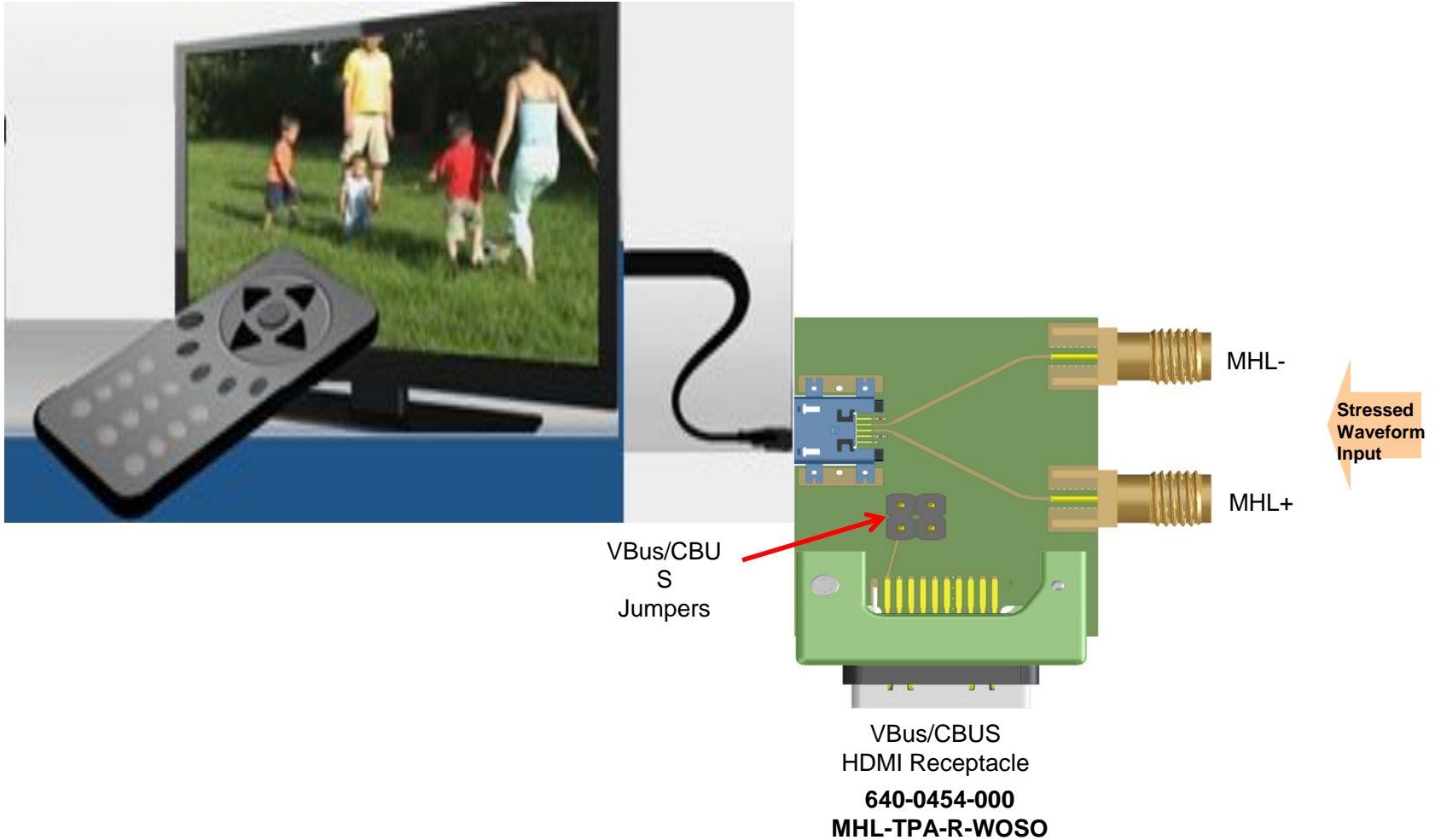
Wilder Fixtures - Tektronix MHL Source Testing Setup



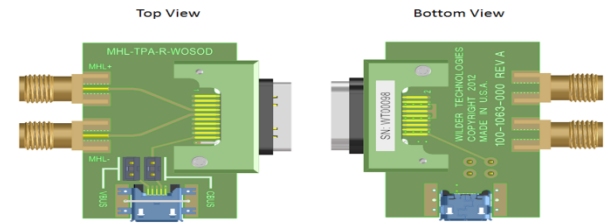
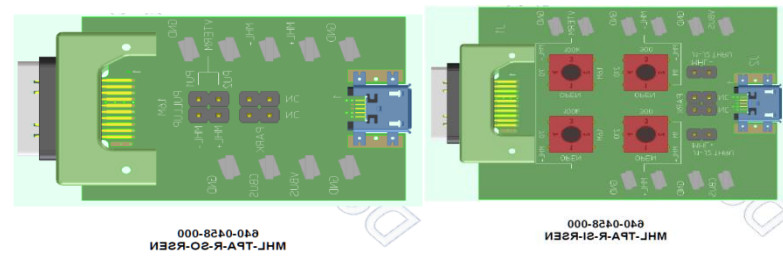
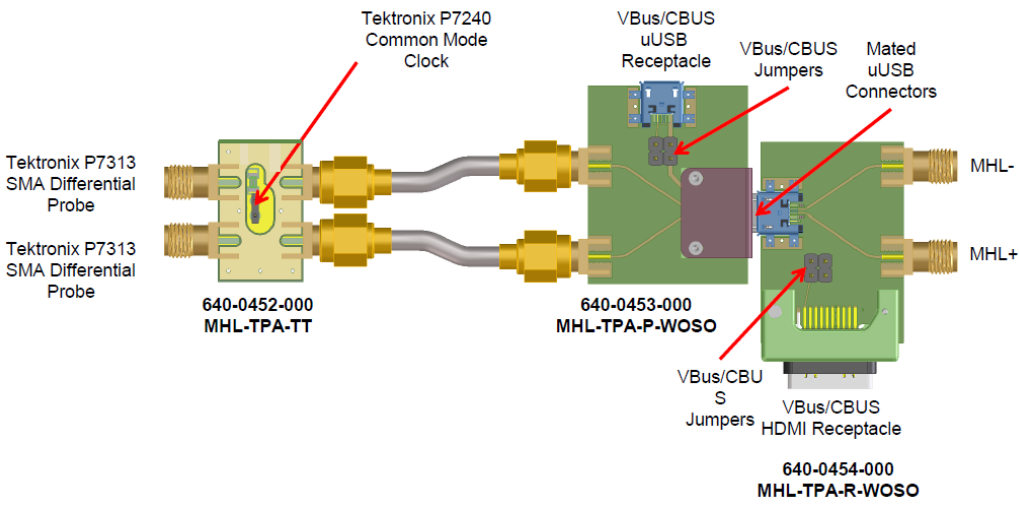
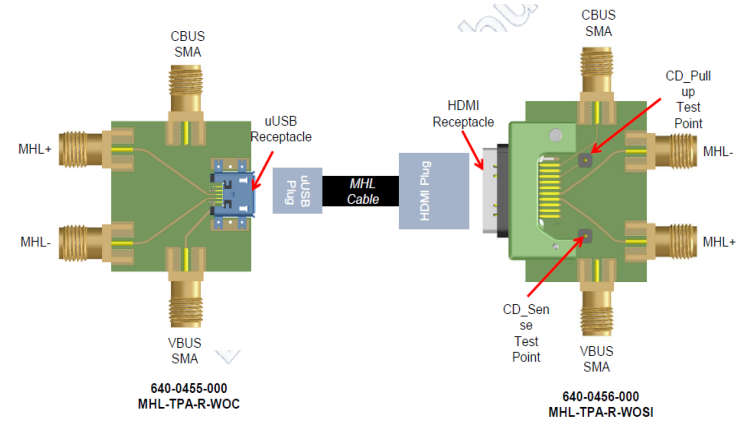
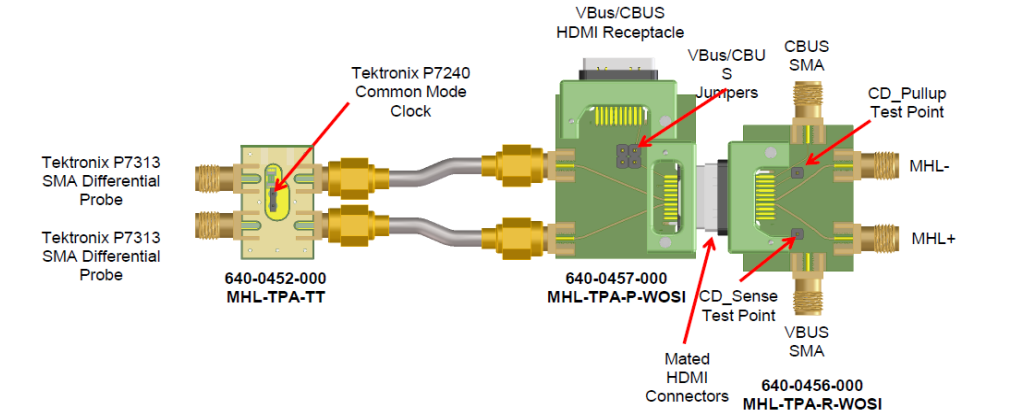
Wilder Fixtures - Tektronix MHL Sink Testing Setup



Wilder Fixtures - Tektronix MHL Dongle Testing Setup



Wilder Fixtures for Tektronix MHL Testing



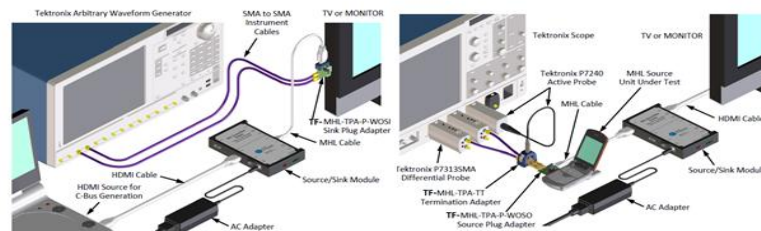
Direct Attach
 fixture **Tektronix**

Wilder Fixtures for Tektronix MHL Testing

- Source Sink Board- A low cost alternative to C-Bus analyzer(TF-MHLCBS2-SOSI)
 - The low cost SOSI board can be used for the following :
 - Source tests Electrical: 3.1.1.1 to 3.1.1.12(excluding 3.1.1.13)
 - Source System Tests: 3.2.2.1 to 3.2.2.3 ; 3.2.3.1 to 3.2.3.4 ; 3.2.4.1 to 3.2.4.3
 - Sink Tests Electrical: 4.1.1.1 to 4.1.1.6(excluding 4.1.1.7)
 - Sink System tests: 4.2.1.1 to 4.2.1.2; 4.2.2.1 to 4.2.2.3; 4.2.3.1 to 4.2.3.2
 - Dongle tests: 5.1.1.1 to 5.2.1.2 (excluding 5.1.1.7 and 5.1.1.8) ; 5.2.2.1 to 5.2.2.3; 5.2.3.1 to 5.2.3.2
 - This low cost board cannot be used for C-Bus tests: id 3.3.x.x and 4.3.x.x.



Source: Wilder SOSI user manual



SOSI board used as C-BUS Source board in Sink setup

SOSI board used as C-BUS Sink board in Source setup

- Cable Calibration Fixture - TF-MHL-TPA-CBC

Tektronix MHL 2.1 Solution

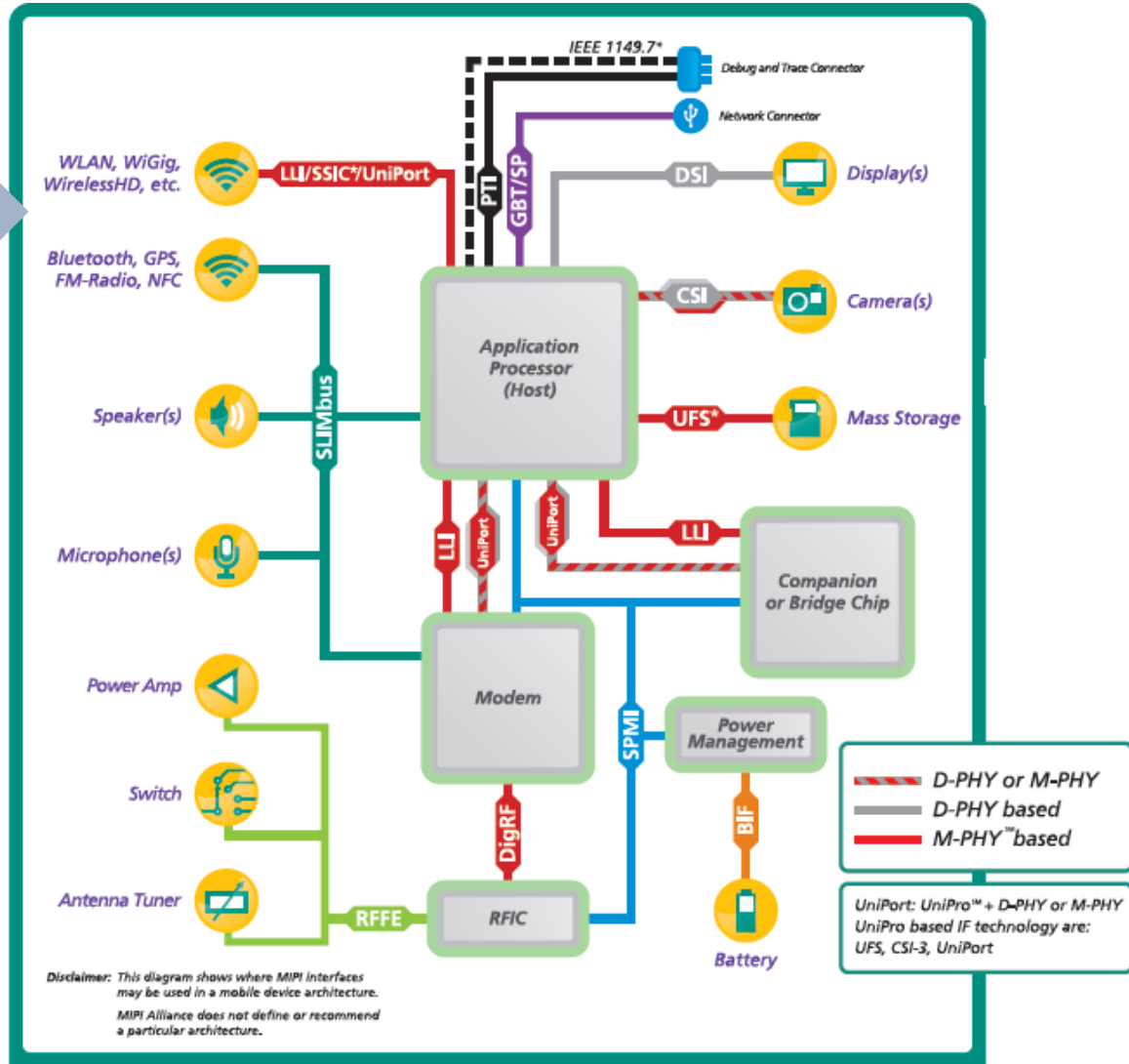
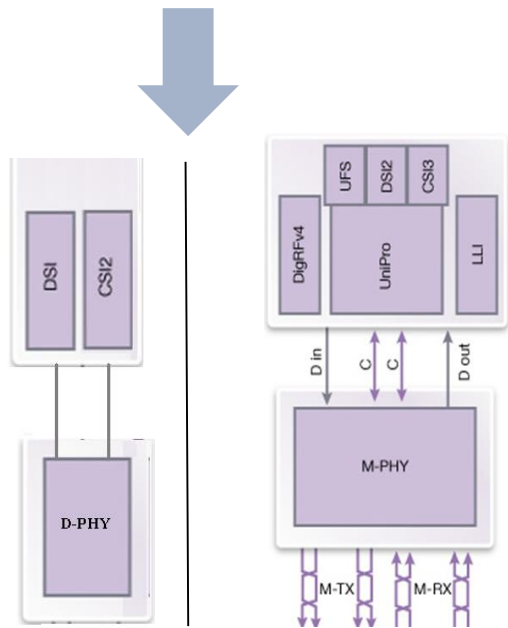
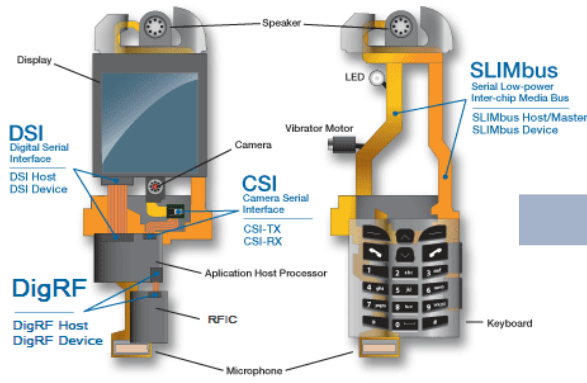
- DPO/DSA/MSO 70000 B/C Series Real-time Oscilloscope with **BW ≥8GHz**
- MHL Compliance software – **Option MHD**
- Innovative MHL Protocol Software – **TEK-PGY-MHL-PA-SW**
- Probes- **Qty.2 - P7313SMA** and **Qty.1 – P7240**
- MHL Test fixture- **Available from Tektronix.**
- AWG7122C with Opt 01,02 or 06 and 08 for the innovative direct Synthesis based MHL Rx/Dongle testing
- C-Bus Sink and Source Board is needed and is available from Simplay Labs. Look out for new C-Bus Source Sink board from Tek.
- DSA8200 or Equivalent with 80E03/80E04 and I-Connect Software for MHL cable testing (performed manually using MOIs)

For Demos and Placing Orders - Contact Local Tektronix Account Managers

MIPI – D-Phy to M-Phy, C-Phy is coming soon

MIPI Technologies Overview

Example of a Mobile Platform



Source: MIPI Alliance

Tek Strategic Involvement

With MIPI Alliance & UNH-IOL

- Tektronix is a **Contributor Member** of the MIPI Alliance
- M-PHY Tx/Rx CTS Test Document **“Co-Authored”** by Tektronix
- Tektronix has a close working relationship with UNH-IOL.
- **Joint Press-Announcements** of Tek with MIPI Alliance and UNH.
 - <http://www2.tek.com/cmswpt/prdetails.lotr?ct=PR&cs=News+Release&ci=19076&lc=EN>
 - "As an active MIPI contributor, Tektronix products speed the assessment of D-PHY and M-PHY performance and signal integrity. Tektronix is helping to simplify physical-layer test and validation."
 - *Joel Huloux, Chairman of the MIPI Alliance, Sept'2011*
 - <http://www2.tek.com/cmswpt/prdetails.lotr%3Fct%3DPR%26cs%3DNews%2BRelease%26ci%3D17639%26lc%3DEN&urlhash=HZu6>
 - "...Tektronix spurring the adoption of D-PHY and M-PHY specifications.."
 - *Joel Huloux, Chairman of the MIPI Alliance, Sept'2010*
 - "Tektronix has been supportive of UNH-IOL's collaborative efforts of physical layer measurement methodologies"
 - *Andy Baldman, MIPI Interop - R&D Technical Staff, UNH-IOL, Sept'2010*

Tek Strategic Involvement

Tek Tools listed on MIPI Official Webpage, UNH Webpage & CTS Spec

www.mipi.org/news-events/member-press-releases

Tektronix Unveils Industry's Most Cost-Effective Solution for MIPI® Alliance M-PHY Testing

September 27, 2011

Global Line Announces Availability of the World's First MIPI® M-PLL (M-PLL) Optical Media Converter

www.mipi.org/news-events/member-press-releases

Tektronix Adds One-button Conformance Test to MIPI D-PHY Solutions

JEDEC and MIPI® Announce Plans to Collaborate on Universal Storage C

MIPI Alliance
Testing Program
Version 1.00
30-August 2010

MIPI Alliance Testing Program
User's Manual, Method of Implementation (MOD), and
Tutorial Documentation for
D-PHY Physical Layer Transmitter Conformance Tests,
Using Agilent, LeCroy, and Tektronix Real-Time DSOs, and
Software (v20100830)

Through a collaborative agreement with Tektronix, the UNH-IOL is using the Tektronix DSA72004B Digital Serial Analyzer for MIPI testing. Combined with UNH-IOL's D-PHY GUI software, this platform provides the ability to capture and analyze D-PHY signalling, in order to perform the UNH-IOL D-PHY Transmitter Physical Layer Conformance Test Suite.

For more information on the Tektronix DSA72004B please visit <http://www.tek.com>

The Moving Pixel Company P331 MIPI D-PHY Probe is used to implement many protocol layer tests for both CSI-2 and DSI for up to 4 lanes.

For more information on the P331 MIPI D-PHY Probe, visit <http://www.movingpixel.com/main.pl?products.html>



provided by any of the authors or developers
in whole or in part without the express
written consent of the MIPI Alliance. All other
rights reserved. No warranty is made by the
MIPI Alliance for any use of the material
without the express written consent of the
MIPI Alliance. TITLE, QUIET ENJOYMENT, QUIET
HARD TO THIS MATERIAL.

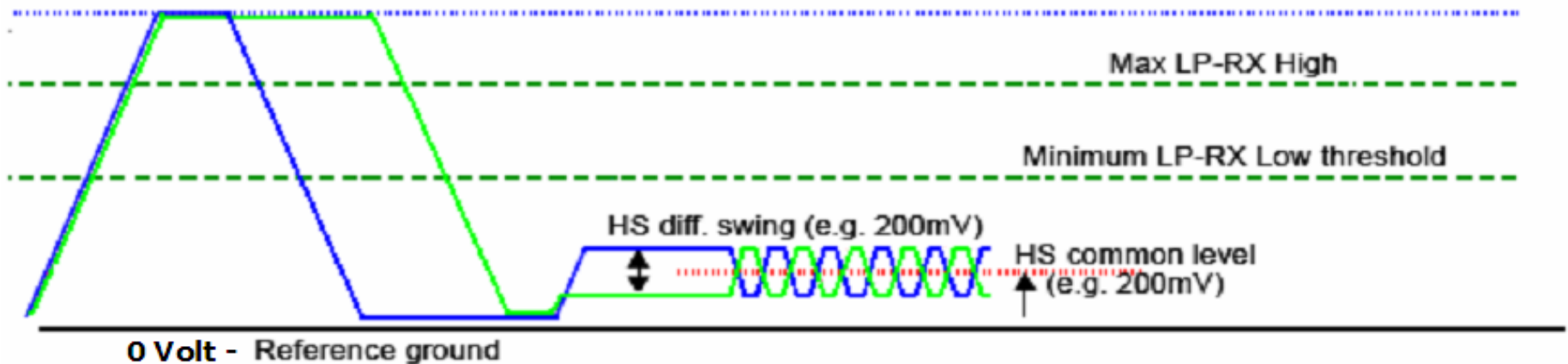
UNH (University of New Hampshire)
is a 3rd party test house Using Tektronix setup



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 Gbps, Typically at ~500 Mbps.
 - Low Power mode: Up to 10 Mbps
- Bus termination
 - 50 ohms in HS
 - Hi-Z in LP

Low-Power signaling level (e.g. 1.2V)



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.
- Several measurements (Total 49) to be performed.
 - Clock Lane
 - Data Lane
 - Clock-Data Timing

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

■ Opt.D-PHYTX : D-PHY Automated Solution

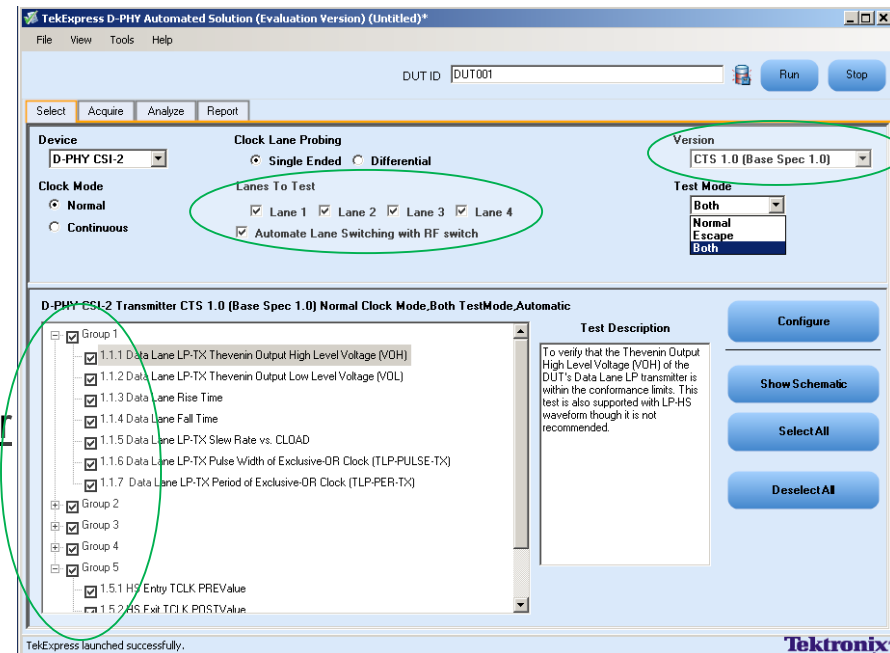
- TekExpress option for Fully-Automated testing
- Provides Conformance and Characterization Testing
- Runs on 7K/C and 70K/B/C/D scopes
- Opt.TEKEXP is Pre-Requisite

■ Differentiation

- Un-parallel Automation (Auto-Cursors)
- 100% Widest Test Coverage
- Fully-Automated for Multi-lane DUTs
- Fully-Automated Temperature Chamber
- Conformance to Latest CTS (v1.0)
- Based on Latest Base spec (v1.0)

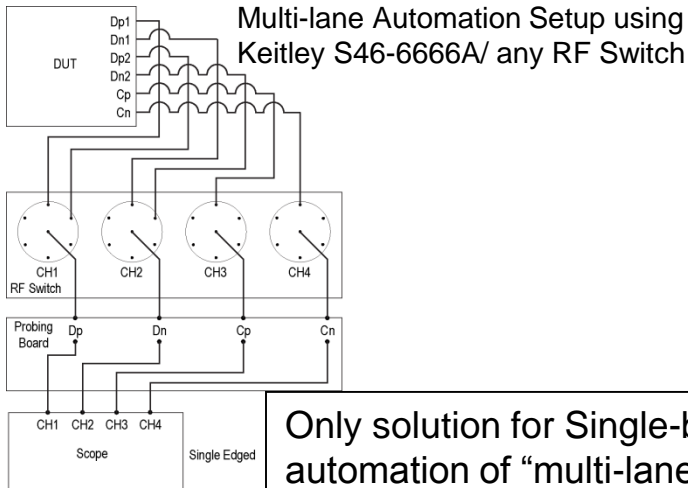
■ Value proposition

- Custom-limits/ Limits-Editing
- Test Reports with Pass/Fail summary, margins, & "Zoom-in" Waveform Captures
- Tek 3.5GHz scope is the minimal configuration for accurate testing
- D-PHY extension spec (1.5G) ready

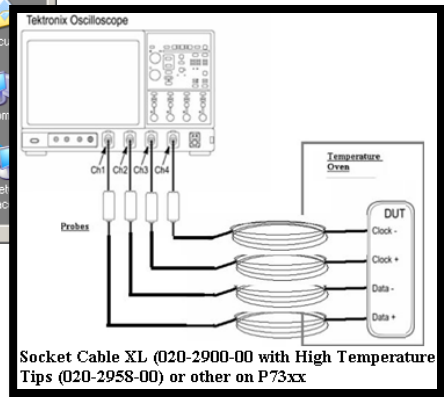
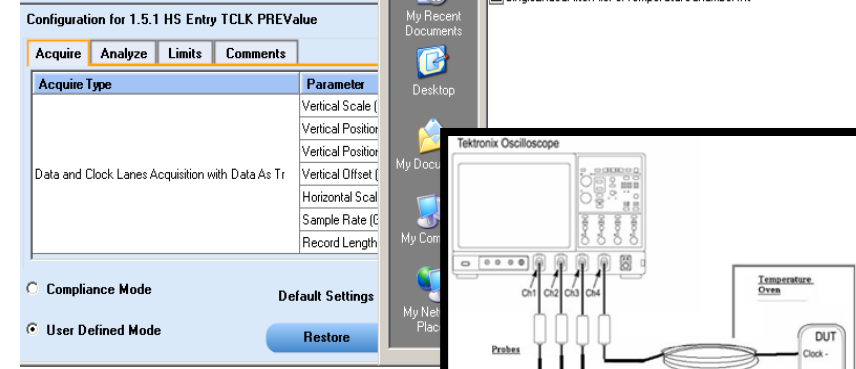
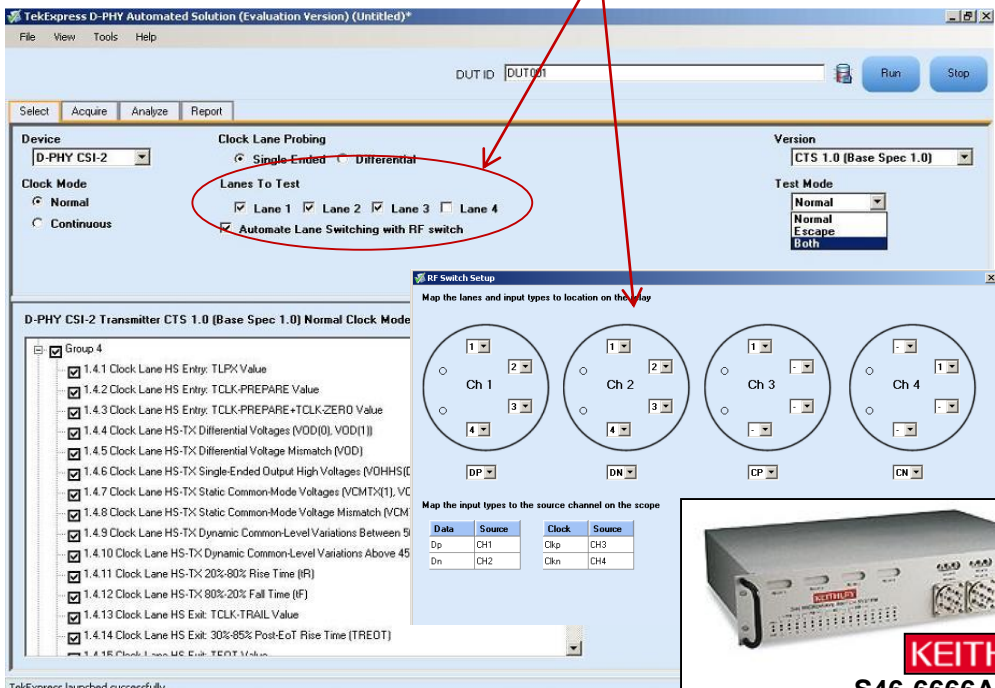
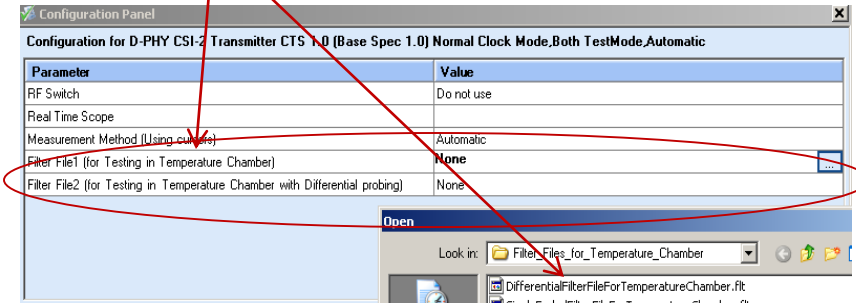


D-PHY Tx : Opt.D-PHYTX Features

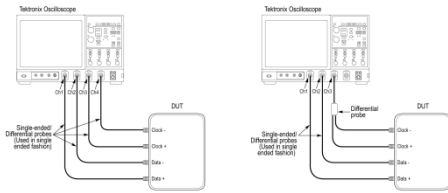
Provision to Load Filter-files for Temperature Chamber or Channel De-embedding



Only solution for Single-button automation of "multi-lane" DUTs.



D-PHY Tx : Opt.D-PHYTX Features



Single-Lane Automation Setup using SE/Diff probes

Test Reports with “ZOOM-IN” screenshots of the cursors placement for each test.

Switch between Automatic and Manual cursor placement. In Automatic mode, software can find the LP/HS regions automatically. Switch to Manual for debug or if your signal is too noisy.

Configuration Panel

Configuration for D-PHY CSI-2 Transmitter CTS 1.0 (Base Spec 1.0) Normal Clock Mode Both TestMode:Automatic

Parameter	Value
RF Switch	Do not use
Real Time Scope	
Measurement Method (Using cursors)	Automatic
Filter File1 (for Testing in Temperature Chamber)	Automatic
Filter File2 (for Testing in Temperature Chamber with Differential probing)	Manual

Configuration for 1.5.1 HS Entry TCLK PREValue

Acquire Type	Parameter	Value
	Vertical Scale (mV)	200
	Vertical Position for Data (div)	-2.6
	Vertical Position for Clock (div)	-2.6

TekExpress D-PHY Automaterd Solution (151, 200)

OUT ID: OUT001

Select Acquire Analyze Report

D-PHY CSI-2 Transmitter CTS 1.0 (Base Spec 1.0) Normal Clock Mode Normal TestMode:Automatic

Tektronix TekExpress Automation Framework
D-PHY Transmitter Signal Characteristics Test Report

OUT ID: OUT001
Date/Time: 3/14/2011 16:34
Device Type: D-PHY
Execution Time: 7 Min
CTS Version: CTS
Overall Compliance: Pass
Overall Test Result: Pass

Scope Model: MS20904 Scope Serial Number: 020002 Scope FW Version: E1.1 DEVBAD 34 SPC Factory Calibration: PASS
OH Probe Model: 1X OH Probe Serial Number: 104 OH Probe Model: 1X OH Probe Serial Number: 104
OH Probe Model: P7323MA OH Probe Serial Number: 5200F_1
VTS Probe Model: 104 OH Probe Serial Number: 104

Overall Summary

Lane	Lane 1	Lane 2	Lane 3	Lane 4	Clock Lane	Compliance (US)
Status	Pass	Pass	Pass	Pass	N/A	1.95161/26

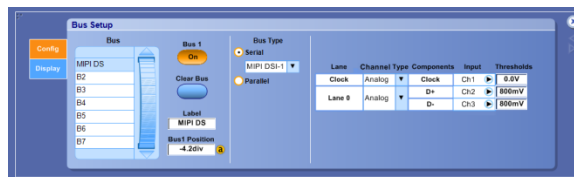
Test Name	Measurement Details	Low Limit	Measured value	High Limit	Margin	Units	Test Result	Compliance Mode	Analysis Time
Lane1									
1.5.1 HS Entry TCLK PREValue	HS Entry TCLK PRE Value ± Value(TU)	> 14.915614152	112.400000000	-	87.6845	nS	Pass	Yes	7 Sec
Lane2									
1.5.1 HS Entry TCLK PREValue	HS Entry TCLK PRE Value ± Value(TU)	> 14.915697968	112.400000000	-	87.6844	nS	Pass	Yes	6 Sec

Measurement (V/C/D)

Click Lane HS Entry: Click Lane TCLK Value

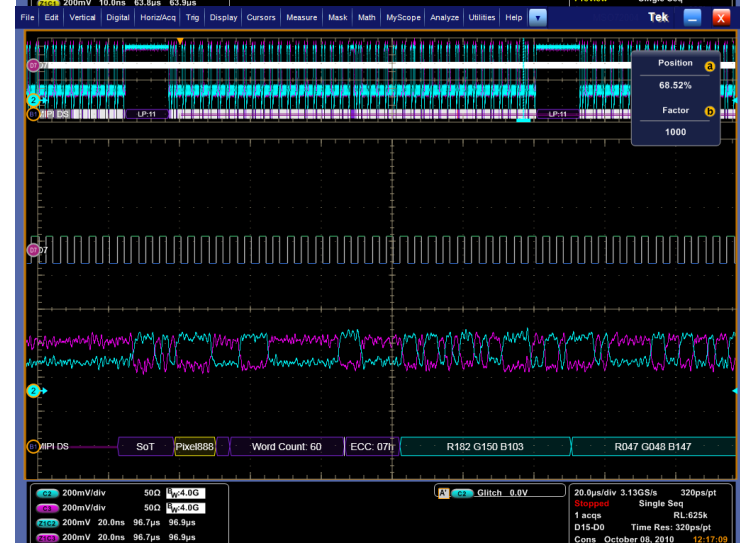
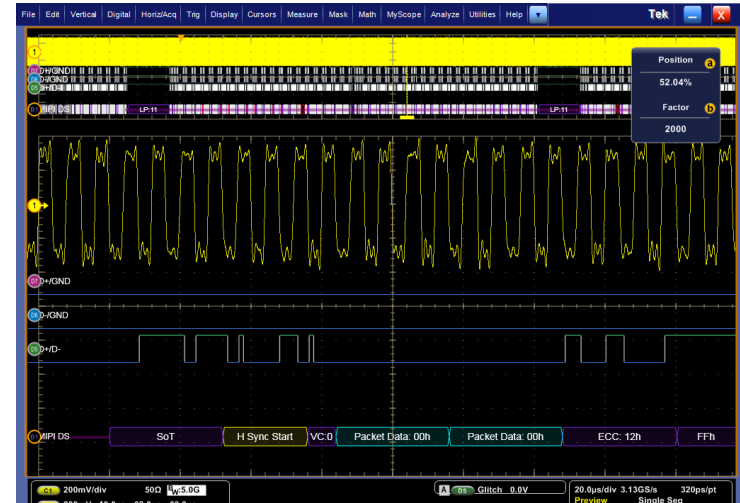
D-PHY Decode: Opt.SR-DPHY for DSI/ CSI-2 Decode Simultaneous Acquisition

- Probe using Analog, Digital or Mixed Channels
- Simultaneous probing of DSI & CSI using MSO channels
- Working on multi-lane support, using high performance MSO digital channels
- Supported on all 7KC, 70KC and MSO70K scopes. (**Win7-OS only**)
 - Option key bit #25
- Software installed as part of TekScope firmware v6.1.2.4 or later.
 - Browse to TekScope Menu --> Vertical --> Bus Setup --> Select Bus Type as Serial--> Select MIPI DSI or CSI from the drop down list.



Probe using Mixed Channels

Analog Clock, Digital Data



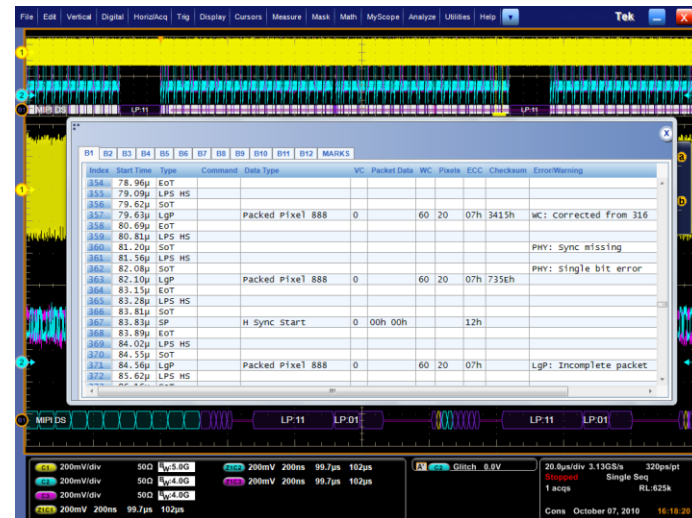
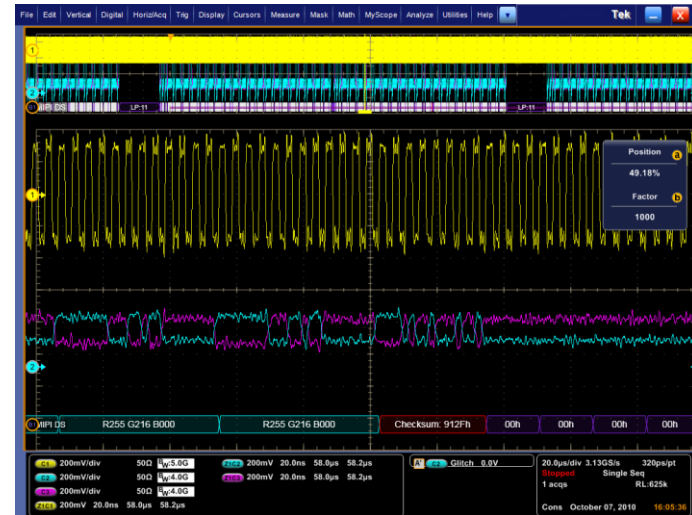
Digital Clock, Analog Data

D-PHY Decode: Opt.SR-DPHY for DSI/ CSI-2 Decode Errors/ Warnings indicated in Decode waveform & Event Table

Missing Sync



Checksum Error



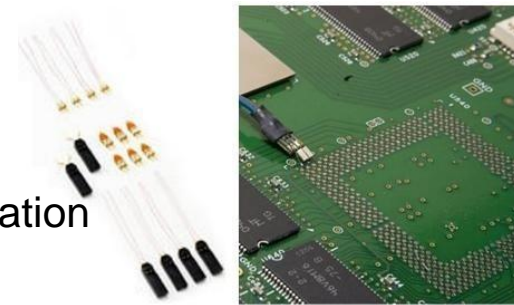
ECC error

Errors and Warnings indicated in event table

D-PHY Tx & Decode: Recommended Test Setup

www.Tek.com/MIPI

- Scope
 - DPO7354/C or DPO/DSA/MSO70404/B/C/D or higher for rise time accuracies
- Probes
 - For 7Ks: 4x TAPxx/ P6245/ P6249, or 4x TDP3500/P73xx (clock is non-continuous), or 3x TDP3500/P73xx (clock is continuous).
 - For 70Ks: 4xP7240, or 4xP73xx (clock is non-continuous), or 3xP73xx (clock is continuous).
- Scope Software
 - Opt.D-PHYTX on TEKEXP for Conformance Test
 - Opt.D-PHY on DPOJET for Debug, Analysis & Characterization
 - Opt.SR-DPHY for Decoding CSI-2 and DSI traffic
- Fixtures
 - As MIPI is a chip-to-chip interface, most DUT setups are LIVE with Master-Slave/ Receiver-end connected.
 - For live-setups: No Fixtures required.
 - For non-live setups: We recommend following UNH-IOL Termination board



P7380 probe used with a probe-tip

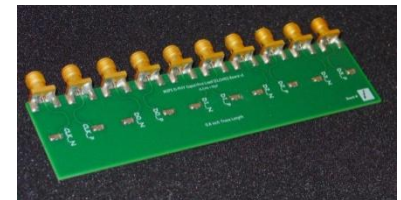
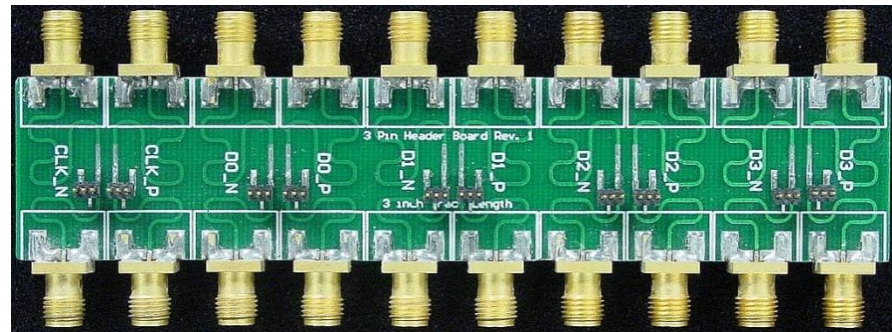
– <http://www.iol.unh.edu/services/testing/mipi/fixtures.php>

– www.iol.unh.edu/services/testing/mipi/MIPI_Test_Fixture_Order_Form.doc

D-PHY Tx: Optional Accessories

Optional Based on DUT Scenarios (i.e. SMA/ Non-live setup/ Multi-lane)

- UNH-IOL RTB Reference Termination Board (list price: \$2,895.), UNH-IOL Probing Board (list price: \$450.), and Capacitive Load Board for Clock and Data Lane LP-TX Signaling tests (list price: \$295.).
 - <http://www.iol.unh.edu/services/testing/mipi/fixtures.php>
 - www.iol.unh.edu/services/testing/mipi/MIPI_Test_Fixture_Order_Form.doc



- RF Switch,
 - Keithley S46-6666A, for multi-lane automation:
 - <http://www.keithley.com/products/switch/rfmicrowave/?mn=S46>



D-PHY Decoder Features Highlights

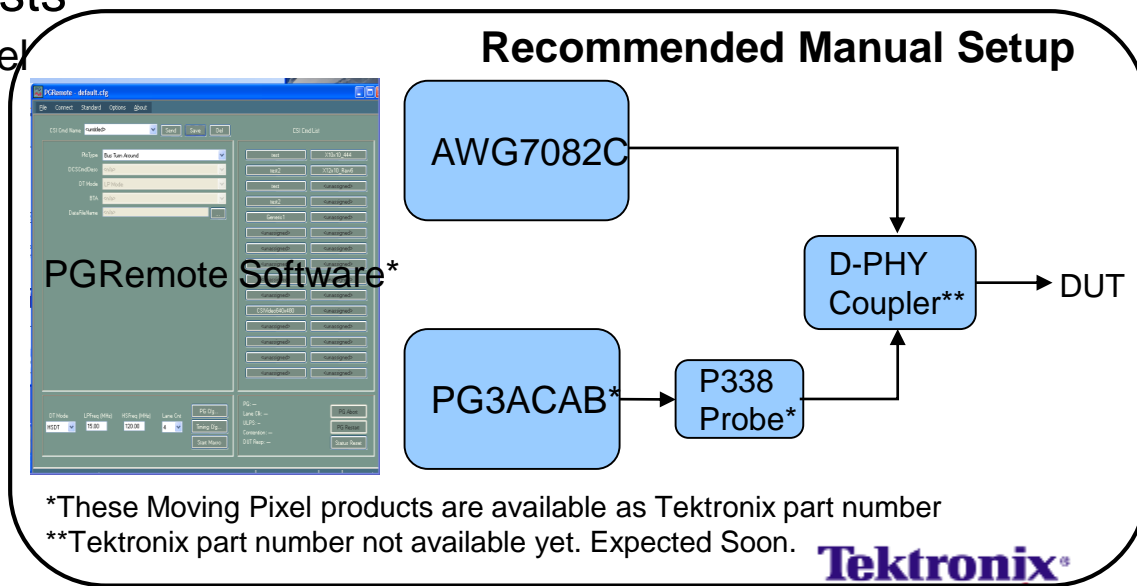
- Up to 4 data lanes and 1 clock lane. Data rate operation up to 1.5 Gb/s
- Connection to the DUT is via 5 active solder-down probes (supplied), one per lane
- Sophisticated real-time triggering
- real-time record filtering
- status monitoring
- activity statistics
- status LED indicators
- active probes, solder-down, for minimal loading of the device under test
- Configuration control
- Disassembly of the captured information in a logic analyzer- like format
- Reassembly and display of any video information captured
- Storage of captured video frame(s) to a file(s)



D-PHY Rx : Test Solution Overview

Manual Setup based on PG with PGRemote Software

- 100% Coverage to Rx CTS
 - Meets all the requirements in UNH-IOL CTS document (v0.98)
- Quick and Easy setup
 - No complex VXI system, just stand alone instruments, and a probe.
- Cost effective solution
 - 70% Lower list price vs Competition
- Re-usable for Protocol tests
 - PG3A is the Only 4 channel solution for CSI & DSI test
- PG3A Pattern Generator
 - Controls clock and signaling to establish link with DUT
 - Adjusts voltage levels, packet type, etc to stress test receiver
- AWG7082C Generator
 - Adds jitter and interference to the D-PHY signals



D-PHY Rx : Test Solution Overview

100% Test Coverage to CTS v0.98

Group 1 LP - RX voltage and timing requirements

Test	Title	Page	Equipment
2.1.1	LP - RX Logic 1 Input Voltage (V_{L1})	108	PG
2.1.2	LP - RX Logic 0 Input Voltage, non-ULP State (V_{L0})	110	PG
2.1.3	LP - RX Logic 0 Input Voltage, ULP State ($V_{L0(ULP)}$)	112	PG
2.1.4	LP - RX Minimum Pulse Width Response ($T_{PW(R)}$)	113	PG
2.1.5	LP - RX Input Hysteresis (T_{HYST})	114	PG
2.1.6	LP - RX Input Pulse Rejection (R_{PWR})	116	PG + AWG + DC Power Supply
2.1.7	LP - RX Interference Tolerance (V_{INT} and f_{INT})	120	PG + AWG
2.1.8	LP - CD Logic Contention Thresholds (V_{LCC} and V_{LCC2})	122	PG + AWG

Group 2 LP - RX Behavioral Requirements

Test	Title	Page	Equipment
2.2.1	LP - RX Initialization Period (T_{INIT})	125	PG
2.2.2	ULPB Exit: LP - RX $T_{ULPB(ULP)}$ Timer Value	126	PG
2.2.3	Clock Lane LP - RX Invalid/Aborted ULPB Entry	127	PG
2.2.4	Data Lane LP - RX Invalid/Aborted Escape Mode Entry	128	PG
2.2.5	Data Lane LP - RX Invalid/Aborted Escape Mode Command	130	PG
2.2.6	Data Lane LP - RX Escape Mode Invalid Exit (Informative)	132	PG
2.2.7	Data Lane LP - RX Escape Mode, Ignoring Post Trigger-Command Extra Bits	134	PG
2.2.8	Data Lane LP - RX Escape Mode Unsupported/Unassigned Commands	136	PG

Group 3: HS - RX Voltage and Setup/Hold Requirements

Test	Title	Page	Equipment
2.3.1	HS - RX Common Mode Voltage Tolerance (V_{COMMON})	139	PG
2.3.2	HS-DX Differential Input High Threshold (V_{DH})	141	PG
2.3.3	HS-DX Differential Input Low Threshold (V_{DL})	143	PG
2.3.4	HS - RX Single-Ended Input High Voltage ($V_{IH(S)}$)	144	PG
2.3.5	HS - RX Single-Ended Input Low Voltage ($V_{IL(S)}$)	146	PG
2.3.6	HS - RX Common Mode Interference 50MHz - 450MHz (delta VCMRX(LF))	148	PG + AWG
2.3.7	HS - RX Common Mode Interference Beyond 450MHz (delta VCMRX(HF))	150	PG + AWG
2.3.8	HS - RX Setup/Hold and Jitter Tolerance	151	PG + AWG

Group 4: HS - RX Timer Requirements

Test No.	Title	Page	Equipment
2.4.1	Data Lane HS - RX $T_{D(ENHANCE)}$ Value	166	PG
2.4.2	Data Lane HS - RX $T_{D(ENHANCE)} + T_{D(ENHANCE)}$ Tolerance	168	PG
2.4.3	Data Lane HS - RX $T_{D(ENHANCE)}$ Value	160	PG
2.4.4	Data Lane HS - RX $T_{D(ENHANCE)}$ Tolerance	162	PG
2.4.5	Data Lane HS - RX $T_{D(ENHANCE)}$ Value	164	PG
2.4.6	Clock Lane HS - RX $T_{CLOCK(ENHANCE)}$ Value	166	PG
2.4.7	Clock Lane HS - RX $T_{CLOCK(ENHANCE)} + T_{CLOCK(ENHANCE)}$ Tolerance	167	PG
2.4.8	Clock Lane HS - RX $T_{CLOCK(ENHANCE)}$ Value	169	PG
2.4.9	Clock Lane HS - RX $T_{CLOCK(ENHANCE)}$ Tolerance	171	PG
2.4.10	Clock Lane HS - RX $T_{CLOCK(ENHANCE)}$ Value	173	PG
2.4.11	Clock Lane HS - RX $T_{CLOCK(ENHANCE)} + T_{CLOCK(ENHANCE)}$ Tolerance	175	PG

PG3A and P338 MIPI D-PHY Rx Solution

Key Features

- MIPI D-PHY Probe for use with PG3AMOD and PG3ACAB
- Generate CSI2 and DSI data over D-PHY
- 4-Data Lanes and 1-Clock lane
- 1.5Gbps @ 4Lane and 800Mbps @ 8 lanes
- 1.5Gbps @ 8Lanes if using two PG3A
- SMA outputs for each lane
- LP and HS Voltage and Timing adjustable on a each lane separately

Preserve your investment with the **ONLY** >4 lane, 1.5Gbps stimulus solution in the market.

PG3A



P338

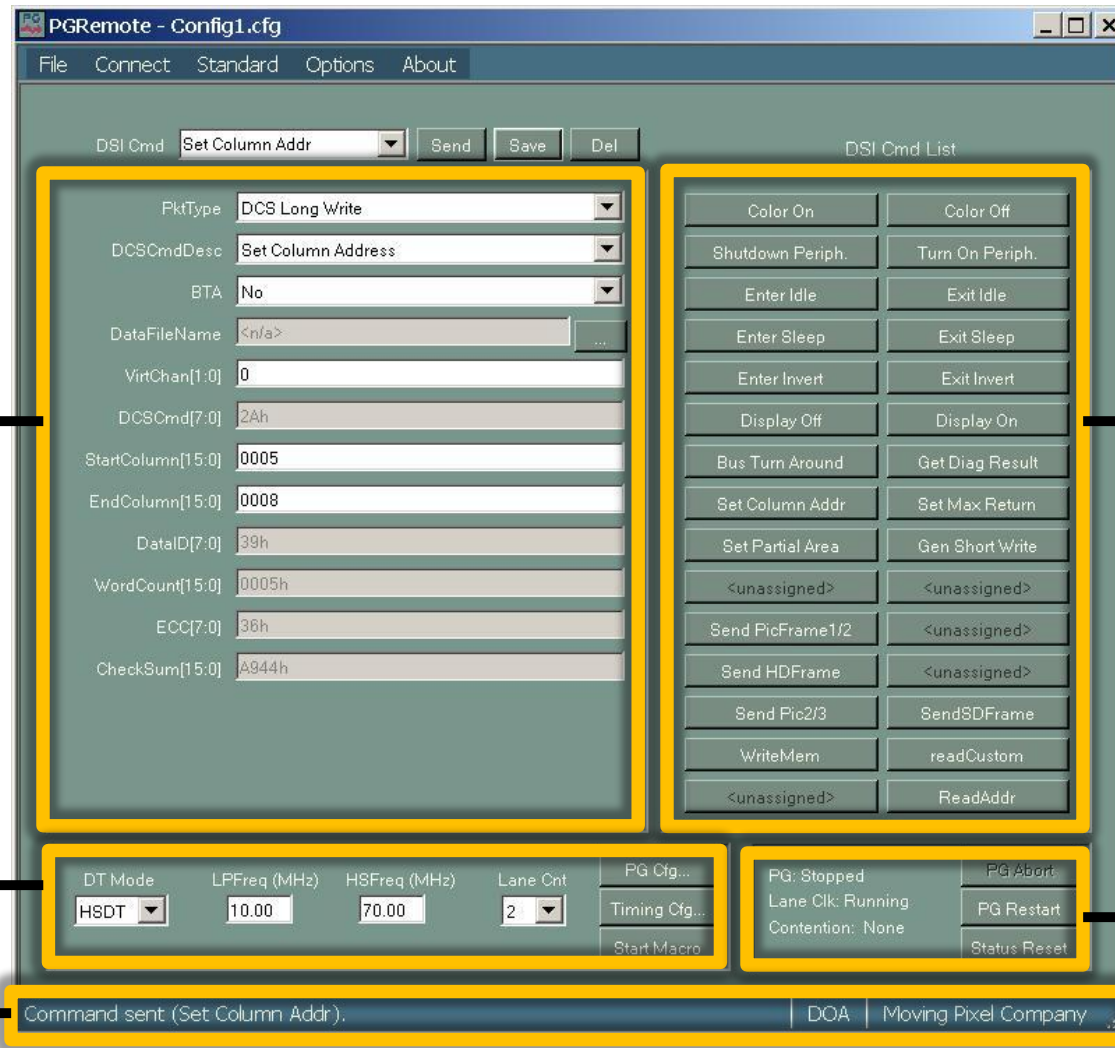


Practice Connection



PGRemote

Push Button Interface to generate CSI2 / DSI Vectors



Define CSI/DSI commands and arguments

Command Buttons

Configuration Parameters for PG playback, and D-PHY

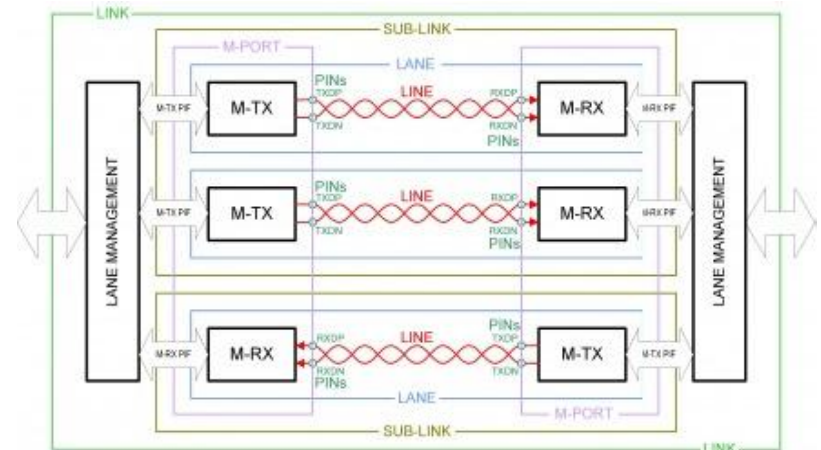
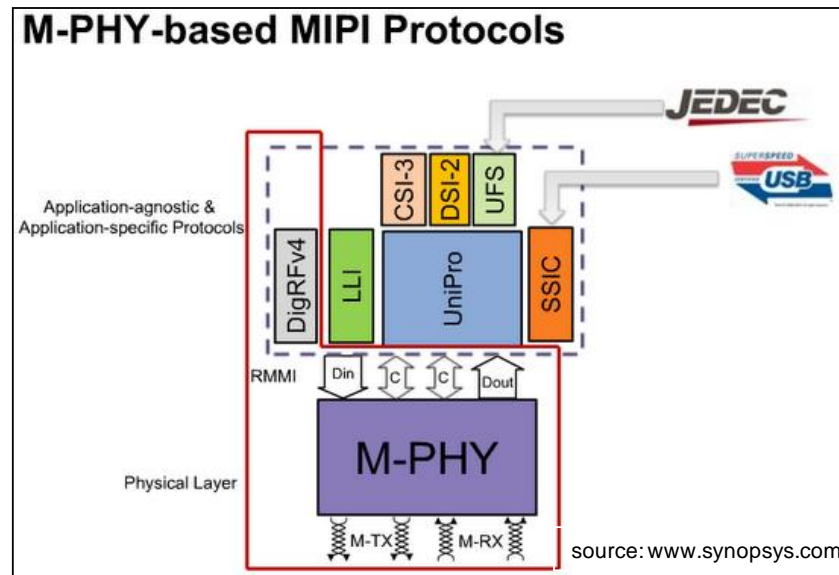
PG, probe status and operational controls

Status Bar

PGRemote Main Window

What is M-PHY ?

- M-PHY is a high-speed serial interface to the DigRFv4, UniPro, LLI, CSI-3 and DSI-2 interconnect standards of the MIPI Alliance, and the UFS and SSIC protocol standards of JEDEC and USB-IF respectively.
- 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)



M-PHY Transmitter Testing Challenges

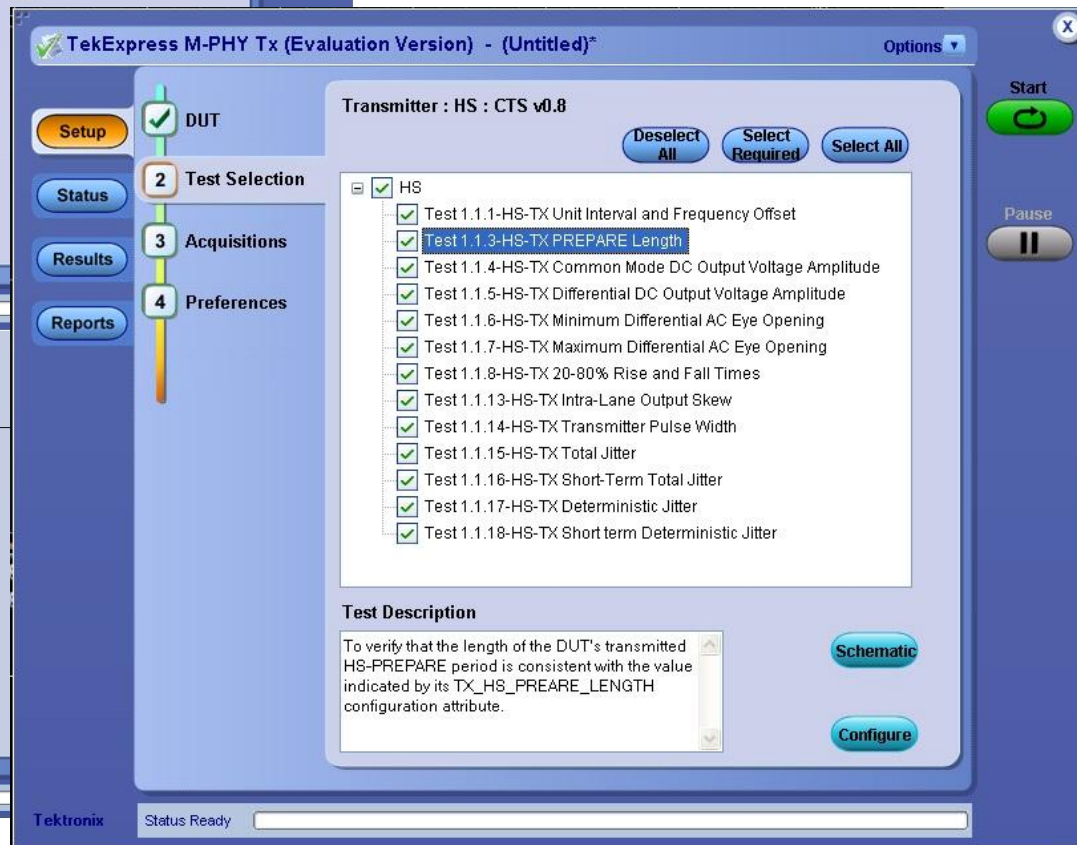
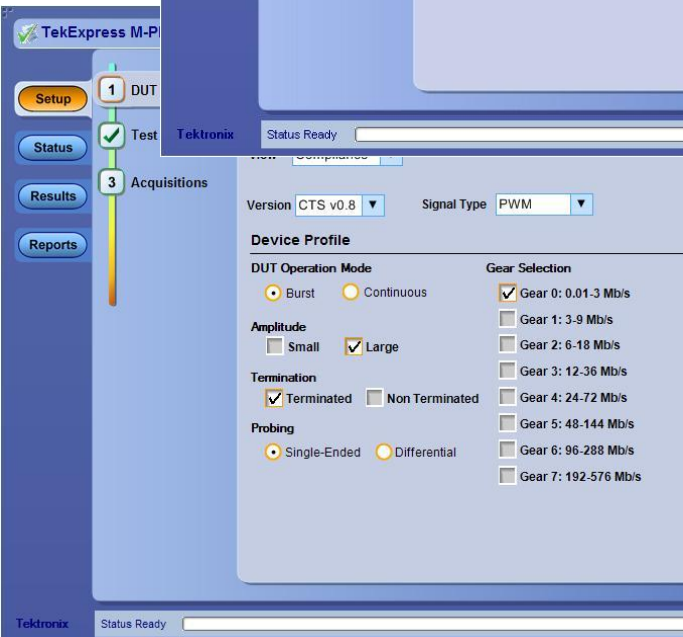
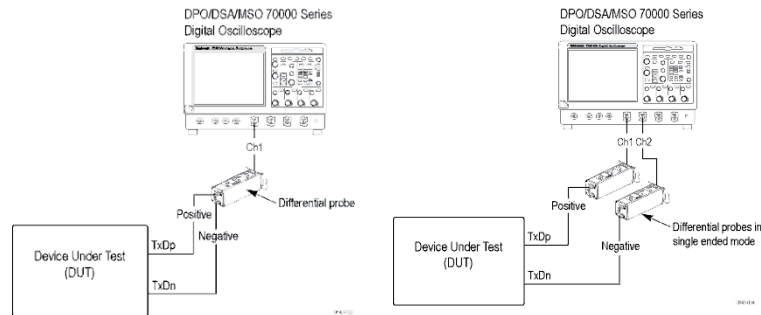
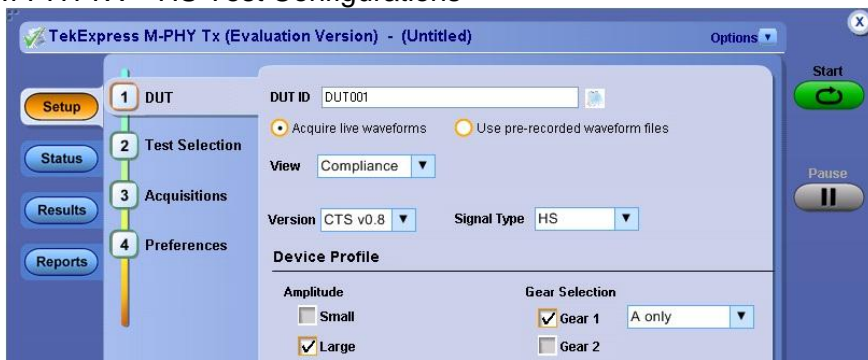
M-PHY Signal Characteristics

Signaling mode	Datarates			Amplitudes		Impedance			
High Speed (HS)	Gears	A (Gbps)	B (Gbps)	Large	Small	Resistive Terminated	Non Terminated		
	G1	1.25	1.45	Terminated: 160-240mV, Non-Terminated: 320-480mV	Terminated: 100- 130mV, Non-Terminated: 200-260mV	50 ohms	-		
	G2	2.5	2.91			50 ohms	-		
G3	5	5.83	50 ohms			10k ohms			
PWM (ie. TYPE-I)	Gears	Min (Mb/s)	Max (Mb/s)			50 ohms	10k ohms	50 ohms	10k ohms
	G0	0.01	3						
	G1	3	9						
	G2	6	18						
	G3	12	36						
	G4	24	72						
SYS (ie. TYPE-II)	G5	48	144			50 ohms	10k ohms	50 ohms	10k ohms
	G6	96	288						
	G7	192	576						
			576 (Mb/s)						

- Higher data rate will increase importance of Signal Integrity of links
 - More emphasis on timing/jitter and noise (signal integrity)
 - Receiver testing will be needed to stress-test resulting BER
- 1000+ tests per lane, covering multiple Gears, Terminations, Amplitudes.
- Termination – Restive or not Terminated.
 - LS mode can operate either of them
 - HS mode it is always terminated, so swings are halved.
- Type-I and Type-II are Low speed modes, and are NOT interoperable
 - Type-I operates on independent local clocks. Type-II requires a shared Ref-clock.
 - DUTs may support both

M-PHY Tx : Opt.M-PHYTX Automation Features

M-PHYTX – HS Test Configurations



M-PHY Tx : Opt.M-PHYTX Automation Features

Comprehensive Test Reports

Tektronix
Enabling Innovation

TekExpress HS-TX
Report

DUT ID: DUT001
 Date/Time: Feb. 13, 2012 / 05:00:50
 CTS Version: CTS v0.8
 Overall Compliance Mode: TRUE
 Overall Test Result: FAIL

Device Type: Transmitter
 Execution Time: 47 Min

Scope Model: DPO70804
 Scope Serial Number: Q434
 Probe Model (CH1): N/A
 Probe Serial Number (CH1): N/A
 Probe Model (CH2): N/A
 Probe Serial Number (CH2): N/A
 Probe Model (CH3): "TCA2920"
 Probe Serial Number (CH3): "N/A"
 Probe Model (CH4): "TCA2920"
 Probe Serial Number (CH4): "N/A"

Scope FW Version: 5.3.4 BUILD 25
 SPC, Factory Calibration: PASS:PASS
 TekExpress Version (FW, App): 2.0.0.198_0.0.0.44
 DPOJET Version: "3.5.0 Build 17"

Single-printable report covering results from Multiple lane, Multiple Gears, Amplitudes, etc

Test Name	Lane	Termination	Gear	Ampl-itude	Measurement Details	Measured value	Units	Test Result	Margin
Test 1.1.1-HS-TX Unit Interval and Frequency Offset	Lane0	RT	Gear1A	LA	SSCFREQDEV(Fig-1)	8.308	ppm	Pass	1991.892
				SSCPROFILE(Fig-2)	801.282	pS	Informative	-N/A-	
			Gear2A	LA	SSCFREQDEV(Fig-3)	4.608	ppm	Pass	1996.392
				SSCPROFILE(Fig-4)	400.641	pS	Informative	-N/A-	
Test 1.1.4-HS-TX Common Mode DC Output Voltage Amplitude	Lane0	RT	Gear1A	LA	Test_HS_CommonModeVoltage (Fig-5)	202.489	mV	Pass	42.499, 57.511
				LA	Test_HS_CommonModeVoltage (Fig-5)	202.959	mV	Pass	42.959, 57.041
			Gear2A	LA	Test_HS_DifDCCdIFVoltage (Fig-7)	230.898	mV	Pass	70.898, 9.102
				LA	Test_HS_DifDCCdIFVoltage (Fig-8)	-234.252	mV	Pass	5.748, 74.252
Test 1.1.5-HS-TX Differential DC Output Voltage Amplitude	Lane0	RT	Gear1A	LA	Test_HS_DifDCCdIFVoltage (Fig-9)	218.96	mV	Pass	56.96, 23.04
				LA	Test_HS_DifDCCdIFVoltage (Fig-10)	-228.903	mV	Pass	13.097, 66.903
			Gear2A	LA	MASKHITS(Fig-11)	0	#hits	Pass	0
				LA	MASKHITS(Fig-11)	0	#hits	Pass	0

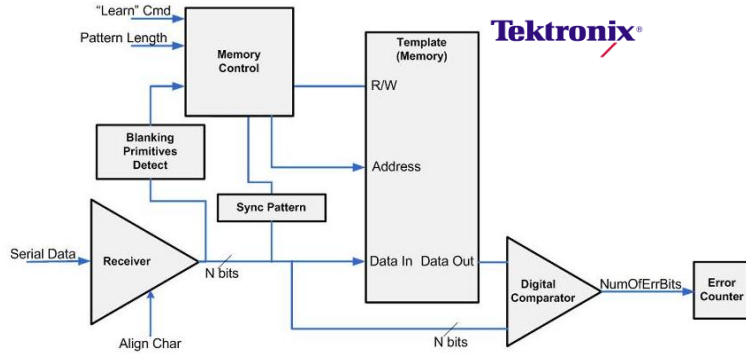
Results from multiple test-configuration, of a single-test

Test Name	Lane	Termination	Gear	Amplitude	Measurement Details	Measured value	Units	Test Result	Margin	Low Limit	High Limit	Compliance Mode
Test 1.1.7-HS-TX Maximum Differential AC Eye Opening	Lane0	RT	Gear0	SA	Transmit Bit Duration	1	Mbps	Pass	0.99, 2	>= 0.01	<= 3	Yes
				LA	Transmit Bit Duration	1	Mbps	Pass	0.99, 2	>= 0.01	<= 3	
Test 1.1.8-HS-TX 20-80% Rise and Fall Times	Lane0	RT	Gear1	SA	Transmit Bit Duration	5	Mbps	Pass	2, 4	>= 3	<= 9	Yes
				LA	Transmit Bit Duration	5	Mbps	Pass	2, 4	>= 3	<= 9	
Test 1.2.1-PWM-TX Transmit Bit Duration	Lane0	RT	Gear2	SA	Transmit Bit Duration	10	Mbps	Pass	4, 8	>= 6	<= 18	Yes
				LA	Transmit Bit Duration	10	Mbps	Pass	4, 8	>= 6	<= 18	
Test 1.2.1-PWM-TX Transmit Bit Duration	Lane0	RT	Gear3	SA	Transmit Bit Duration	36	Mbps	Pass	24, 0	>= 12	<= 36	Yes
				LA	Transmit Bit Duration	36	Mbps	Pass	24, 0	>= 12	<= 36	
Test 1.2.1-PWM-TX Transmit Bit Duration	Lane0	RT	Gear4	SA	Transmit Bit Duration	36	Mbps	Pass	12, 36	>= 24	<= 72	Yes
				LA	Transmit Bit Duration	36	Mbps	Pass	12, 36	>= 24	<= 72	
Test 1.2.1-PWM-TX Transmit Bit Duration	Lane0	RT	Gear5	SA	Transmit Bit Duration	60	Mbps	Pass	12, 84	>= 48	<= 144	Yes
				LA	Transmit Bit Duration	60	Mbps	Pass	12, 84	>= 48	<= 144	
Test 1.2.1-PWM-TX Transmit Bit Duration	Lane0	RT	Gear6	SA	Transmit Bit Duration	100	Mbps	Pass	4, 188	>= 96	<= 288	Yes
				LA	Transmit Bit Duration	100	Mbps	Pass	4, 188	>= 96	<= 288	
Test 1.2.1-PWM-TX Transmit Bit Duration	Lane0	RT	Gear7	SA	Transmit Bit Duration	200	Mbps	Pass	8, 376	>= 192	<= 576	Yes
				LA	Transmit Bit Duration	200	Mbps	Pass	8, 376	>= 192	<= 576	

M-PHY Rx : Based on Scope built-in Error Detector

Scope-Integrated M-PHY BER using Opt.ERRDT Shipping Today

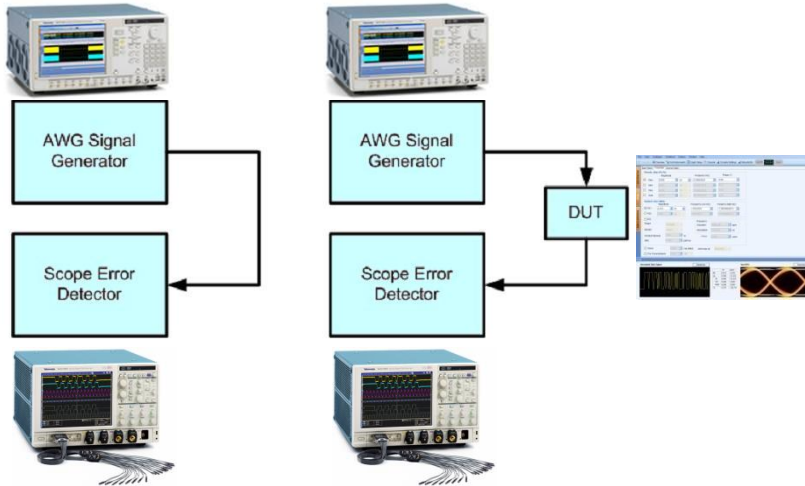
Bit Error Detector Block Diagram



8B/10B Data:

- Hardware Serial trigger: 1.25 Gb/s to 6.25 Gb/s
- BER covers PRBS 312Mbs and above data rates.

MIPI® M-PHY Receiver
Methods of Implementation (MOI)



MIPI M-PHY Receiver - TEKTRONIX MOI

RX ERROR DETECTOR

Overview:

This section of tests verifies the M-PHY receiver error detection mechanism as defined in the M-PHY Specification.

GROUP 1: M-RX Error Detection Requirements

Overview:

This group of tests verifies various requirements of error detection on MIPI M-PHY receiver. Scope error detector is used for this purpose. For M-PHY error detector, ERRDT and STU option should be enabled in scope and Tekscope firmware v6.1.1.32 or later is required.

Status:

The test descriptions contained in this group are considered to be in initial draft form. Additional modifications to both the test descriptions and implementations are expected.

Pay Load:

Continuous PRBS 7/PRBS 9 Pattern with NRZ signaling (HS-Gear1, HS-Gear2 and DigRF data rates)
Custom burst pattern with 8b/10b encoded with NRZ/PWM/SYS signaling.

Note:

Please refer to the MPHY specification ver .90

M-PHY Rx : Opt.M-PHYRX Automated Solution

■ Opt.M-PHYRX

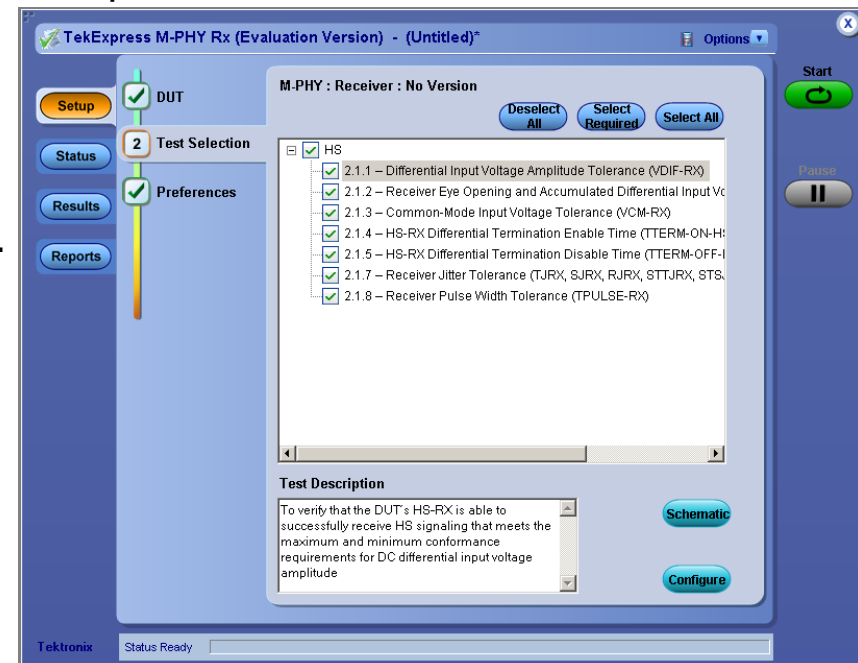
- TekExpress (2.0) option for Fully-Automated receiver testing
- Provides Conformance Testing
- Based on Latest M-PHY Base Spec v1.0 & UNH's Conformance Test Suite
- Runs on DPO/DSA70KB/C or MSO70K/C scopes
- TekExpress framework is included.

■ Differentiation

- Simply 2-box setup.
- Built upon Scope ErrorDetector ERRDT.
- Wide HS test coverage

■ Value proposition

- Test Reports with Pass/Fail summary, with Bit-Error counts



M-PHY Tx &Rx Recommended Test Setup www.tek.com/MIPI

Scopes

- DPO70604/B/C or above, for HS-Gear1 Only (Tx &Rx).
- DPO70804/B/C or above, for HS-Gear1&2 Only (Tx &Rx)
- DPO71254/B/C or above, for All HS-Gears (Rx Only)
- DPO72004/B/C or above, for All HS-Gears (Tx &Rx).

Probes

- 2x P73xxSMA/P73xx, for Tx HS upto Gears2, or 2x P75xx with P75LRST for Tx HS upto Gear3.
- 2x P73xxSMA/P73xx, for Tx PWM All Gears.
- 1x P73xxSMA, for Rx.

Signal Generators for Rx

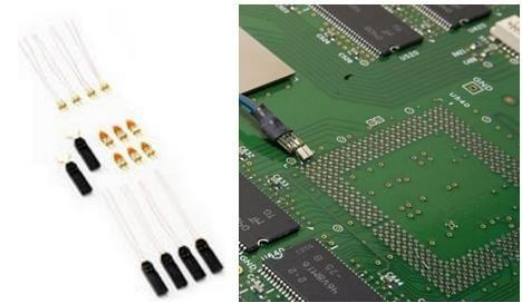
- AWG7082C, AWG7102 or above, for HS-Gear1 Only.
- AWG7122C without Interleave, for HS-Gear1&2 Only.
- AWG7122C with Interleave (option 06), for All HS-Gears.

Software

- **New** Opt.M-PHYTX Transmitter Automated Solution (Opt.DJA is pre-requisite).
- **New** PGY-UPRO Protocol Decode (Opt.ST6G optionally required).
- **New** PGY-LLI Protocol Decode (Opt.ST6G optionally required).
- Opt.M-PHYRX Receiver Automation (Opt.ERRDT is pre-requisite).
- Opt.SR-810B, for 8b-10b Decode
- MPHYVIEW, for DigRFv4 Protocol Decode
- Optional: Opt.M-PHY Essentials based on DPOJET
- Optional: SerialXpress for custom-patterns using AWG

Fixtures

- As MIPI is chip-to-chip interface, most DUT setups are LIVE with Master-Slave/ Receiver-end connected. For live-setups: No Fixtures required. For non-live setups UNH-IOL Termination boards expected to be available soon



P7380 probe used with a probe-tip

M-PHY Rx Recommended Test Setup – Continued

- Recommended Accessories, for opt.M-PHYRX Receiver Automation setup
 - 2x Matched pair of SMA cables
 - 1x GPIB Cable
 - 2x Rise Time Filter – 120 ps (part number 5915-121-120PS from Picosecond) with barrel connectors

- Optional: Accessories for Rx “custom-patterns” using SerialXpress (manual setup)
 - 2x Matched pair of SMA cables, , for AWG custom patterns creation
 - 2x Rise Time Filter – 120 ps (part number 5915-121-120PS from Picosecond) with barrel connectors
 - 2x BiasTee (part number 5542 from Pico Second), for AWG Interleave Option (for HS-Gear3)
 - 2x TCA-SMA Connectors, for AWG custom patterns creation
 - Option 01 –Memory expansion to 64 M enabled on AWG
 - Option 08 – Fast Sequence Switching enabled on AWG
 - Option 09 – Subsequence and Dynamic Jump enabled on AWG.

**MODEL 5542
BIAS TEE**

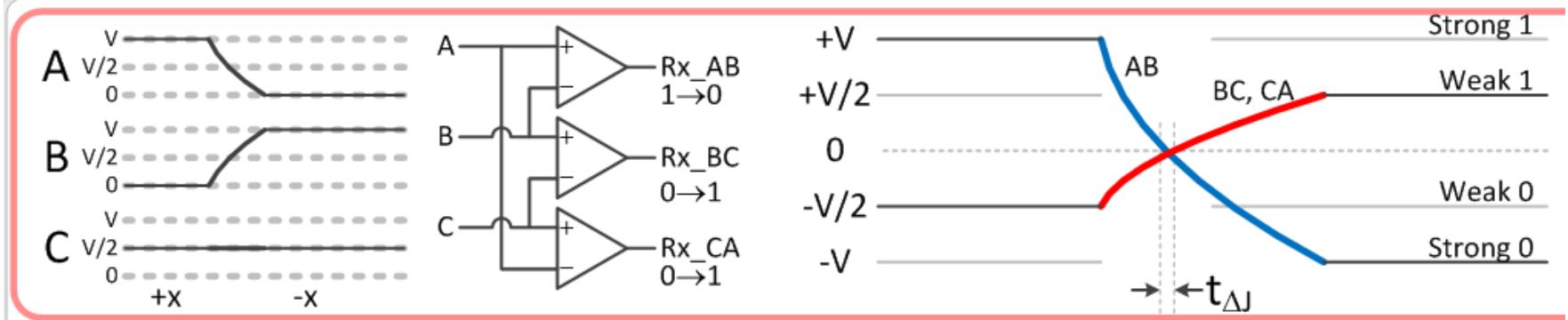


CPHY Solution Offering in 2014-15 - Details

- Scope analysis software
- 4-lane probing & termination board
- New solder-in scope probe tips
- AWG pattern and stress software – C-PHYXpress
- Python automation conformance software
 - Source TX
 - Sink RX
 - RF switch control
- 4-lane pattern generator
- 1-lane scope-based packet decoder
- 4-lane protocol analyzer

CPHY Signal Levels

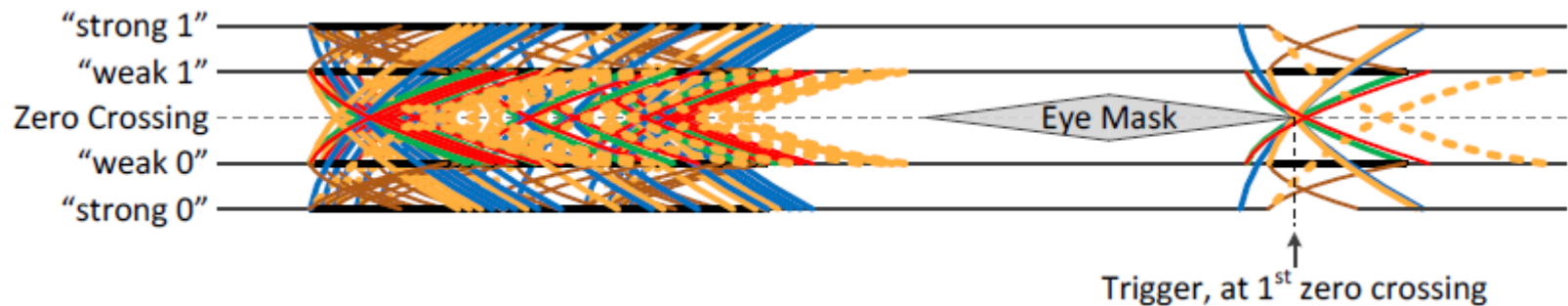
- VA, VB, VC
 - HS Line Voltage { High, Low, Mid }
 - { V, 0, V/2 }
- VAB, VBC, VCA – Differential Signals



Source: MIPI Workgroup Proceedings

CPHY Eye Diagrams

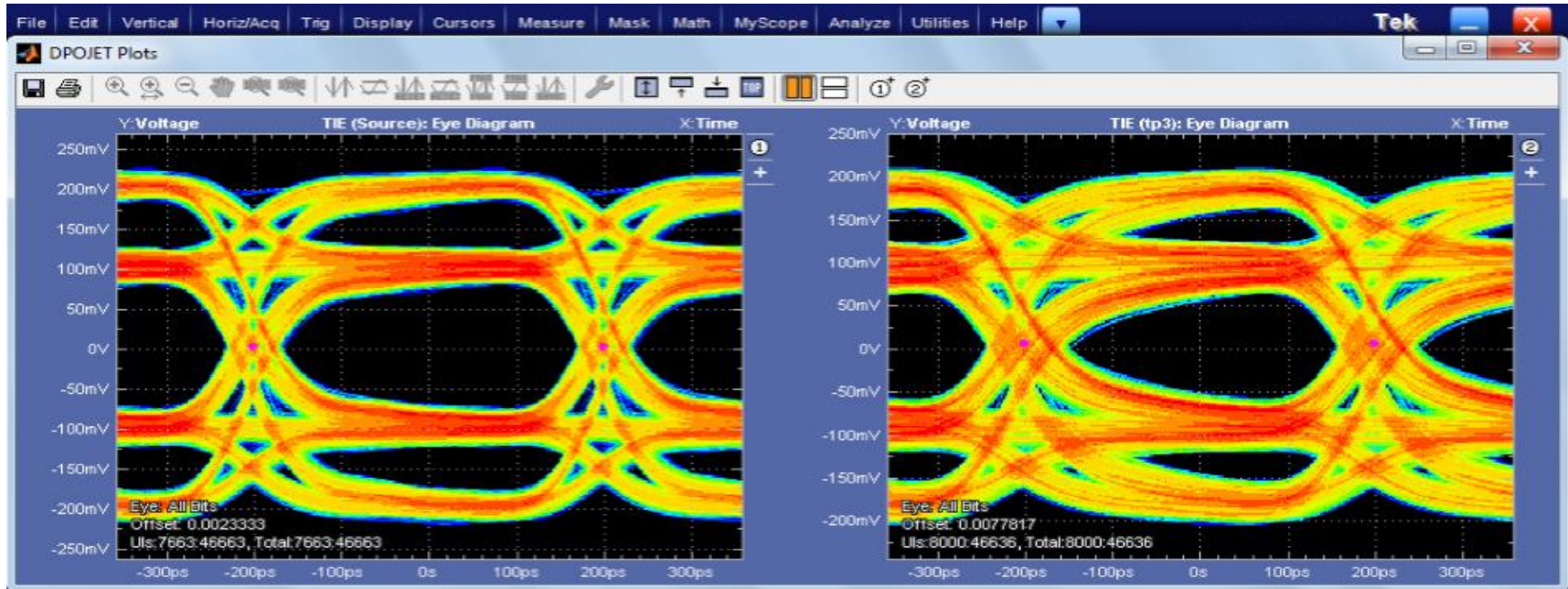
- CPHY uses a “triggered eye” method to render eye diagrams for analysis
 - Specified to model how three CPHY differential receivers work
- “Trigger” refers to the first crossing of V_{ab} , V_{bc} , or V_{ca} across the 0V threshold per UI
- This “trigger” is used as a reference point for plotting the eye diagram



Example:

Embed Results Verification

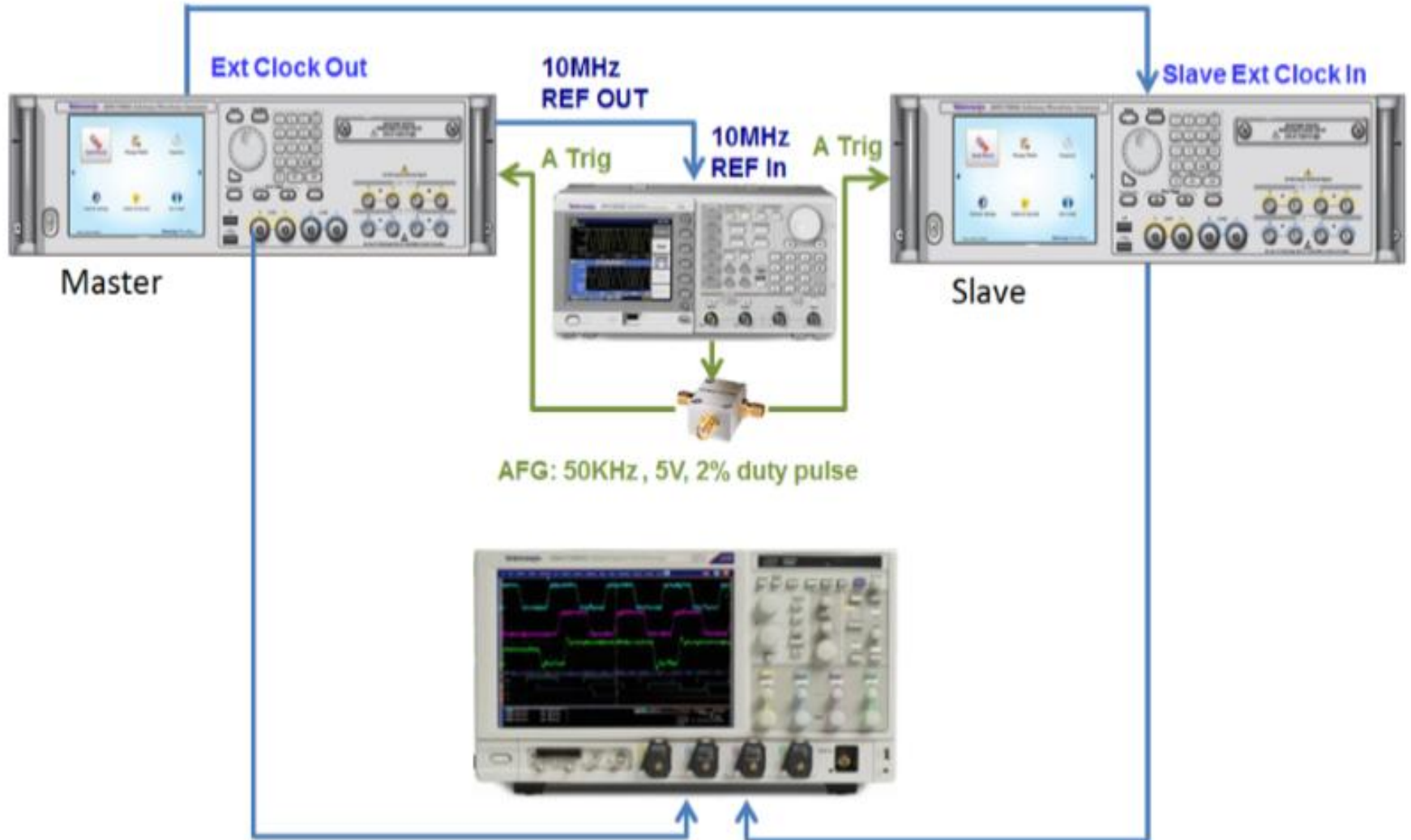
- Results can be quickly verified by using DPOJET jitter & eye diagram software
- CPHY analysis is then performed on these signals in accordance with spec requirements.



Before embed

After embed

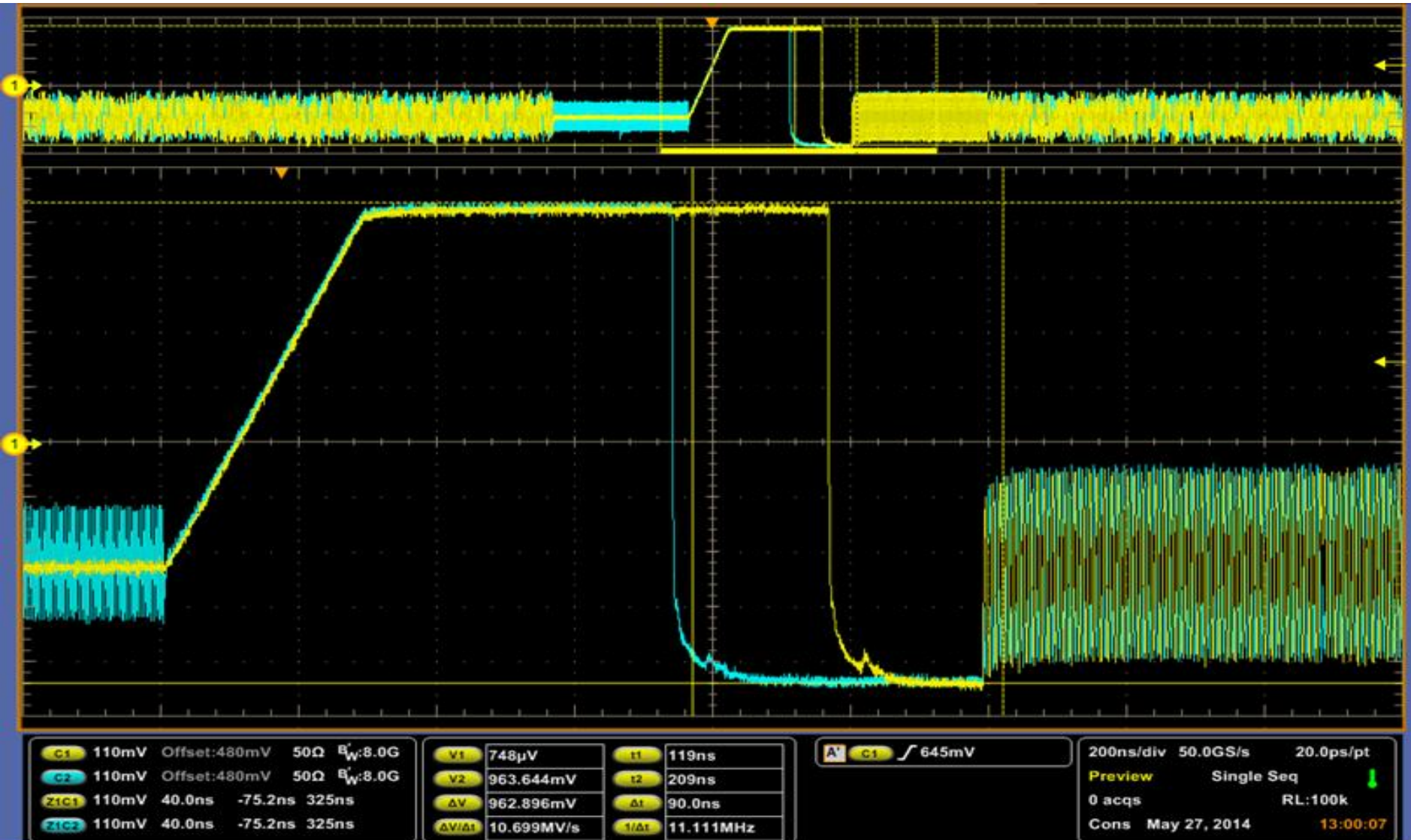
Example Setup Dual AWG70000



Generate CPHY Traffic



LP-HS Transition – (LP swing 0V up to 1V, HS swing 50mV up to 435mV)



Thanks !

