

# Simplifying Design, Debug and Validation of MHL Signals

U.N.Vasudev - Strategic Product Planner



# Tektronix is a Contributor Adopter for MHL CTS

## Welcome MHL Adopters

### **BizLink Technologies, Inc.**

[www.bizlinktech.com](http://www.bizlinktech.com)

Cable Assemblies and Wiring Harnesses

### **Compal Electronics Inc.**

[www.compal.com](http://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](http://www.fairchildsemi.com)

Delivers semiconductor solutions for power and mobile designs

### **Hosiden Corporation**

[www.hosiden.com](http://www.hosiden.com)

Manufactures and sells electronic components, electromechanical parts and LCD elements

### **Johnson Component and Equipment Co., Ltd.**

[www.jcecable.com](http://www.jcecable.com)

Cable Manufacturer

### **Niketech Electronic Corporation**

[www.niketech.com.tw](http://www.niketech.com.tw)

Provider of connectors for the electronics industry

### **Parade Technologies, Inc.**

[www.paradetech.com](http://www.paradetech.com)

Develops and supplies advanced and cost-effective high-speed display interface solutions

### **Sumitomo Electric Industries, Ltd.**

[global-sei.com](http://global-sei.com)

Designs, manufactures and sells cable and components and advanced electronic devices

### **Sunplus Technology Co., Ltd.**

[www.sunplus.com](http://www.sunplus.com)

Provider of multimedia IC solutions

### **Sure-Fire Electrical Corporation**

[www.sure-fire.com.tw](http://www.sure-fire.com.tw)

Global OEM/ODM supplier of cables, connectors and devices

### **Synopsys**

[www.synopsys.com](http://www.synopsys.com)

Provider of electronic design automation (EDA) software, IP and services

### **Tektronix**

[www.tek.com](http://www.tek.com)

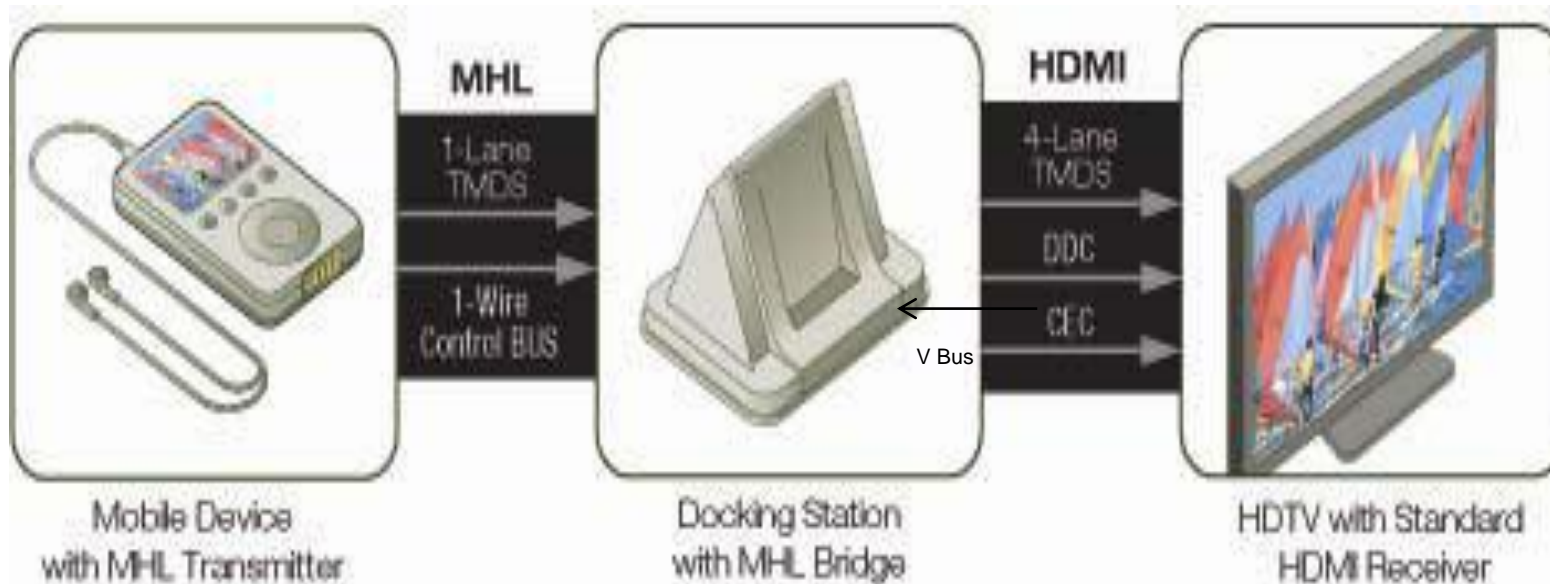
Test, measurement and monitoring solutions

### **YFC-BonEagle Electric Co., Ltd.**

[www.cables.com.tw](http://www.cables.com.tw)

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

# 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.

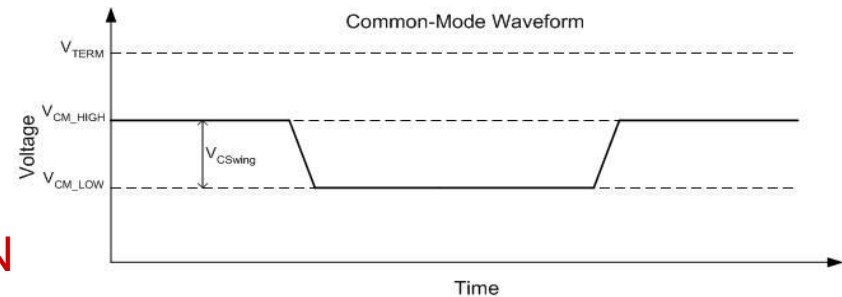
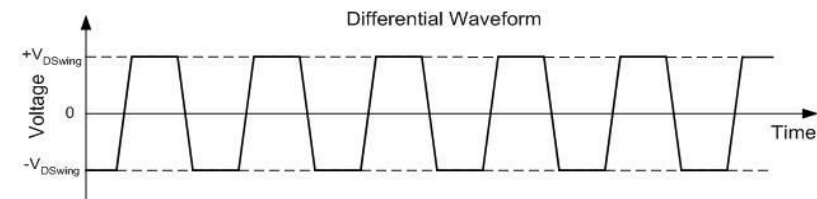
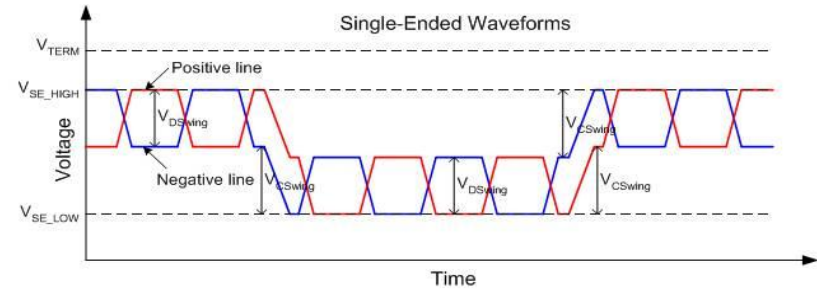
# MHL Signal Complexity

- 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 and Specification 1.2 in Feb 2012.

The Consortium released CTS 1.1 version in June 2011. CTS 1.2 is just announced.

**COMPLETE TEKTRONIX SOLUTION APPROVED in CTS1.1 and CTS 1.2.**

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



# Potential Customers-1

- Mobile Phone Design and Manufacturers
  - HTCs
  - Samsung
  - LG
  - RIM
  - Toshiba
  - Sharp
  - Nokia
  - and others
  
- HD TV manufacturers with MHL interface
  - LG
  - Samsung
  - Sony
  - Panasonic
  - Toshiba
  - Sharp, etc.

# Potential Customers-2

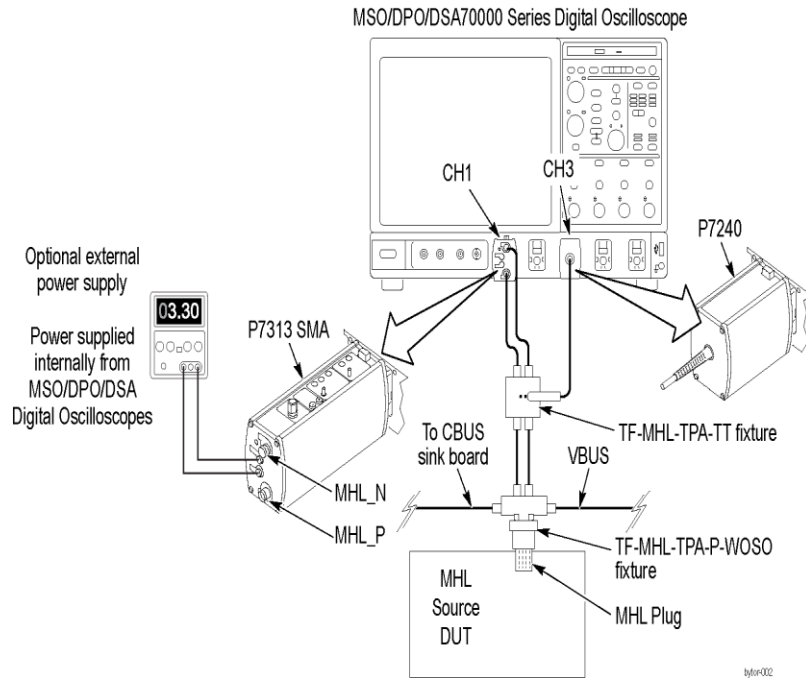
- MHL Cable and Dongle Manufacturers
- Silicon Companies, OEMs and ODMs
  - Silicon Image
  - Fairchild Semiconductor
  - Mediatek
  - On-Semiconductor
  - ASUS
- Authorized Test Centers
  - Simplay Labs
  - Samsung
  - Sony

# Tektronix MHL Solution

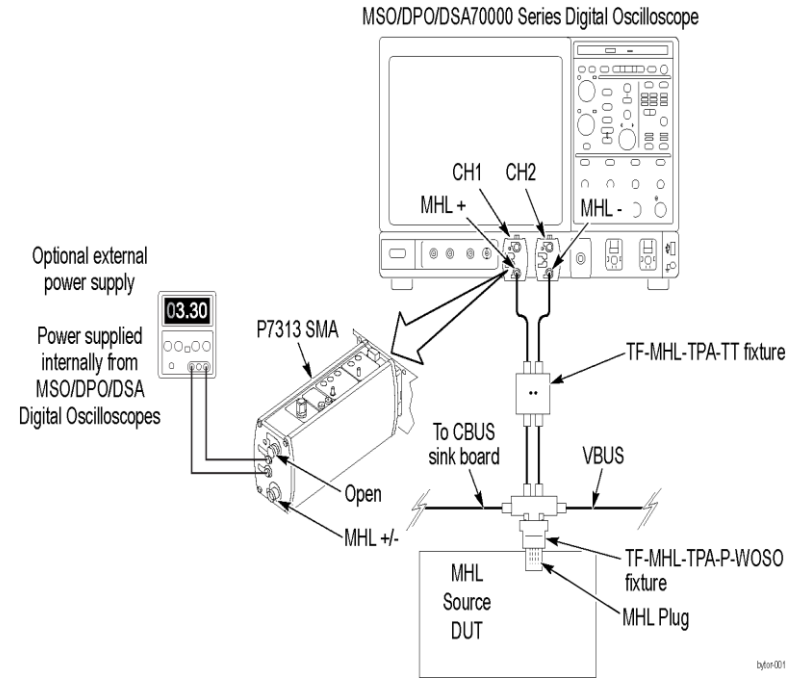
- DPO/DSA/MSO 70804B/C Series Real Time Oscilloscope with BW  $\geq$  8GHz
- MHL Compliance Software – Option MHD
- Innovative MHL Protocol Software from Third party – TEK-PGY-MHL-PA-SW
- Probes – P7313SMA (two) and P7240 (one)
- MHL Test Fixture – Available from Tektronix.
- AWG7122C with Opt 01,02 or 06 and 08 for the innovative direct Synthesis based MHL Rx/Dongle testing.
- AWG7122C based Sink and Dongle Protocol tests( manual method)
- C-Bus Sink and Source board is needed and is available from Simplaylabs
- 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 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 Simplay Labs



# MHL 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.X" and contains a tree view of test items, all of which are checked:

- MHL Clock
  - 3.1.1.1 Standby Output Voltage-VOFF
  - 3.1.1.7 Common-mode Rise and Fall Times-TR\_CM, TF\_CM
  - 3.1.1.10 MHL Clock Duty Cycle 24-Bit or Packed Pixel Mode
  - 3.1.1.11 MHL Clock Jitter
- MHL Data
  - 3.1.1.2 Single-ended High Level Voltage-VSE\_HIGH
  - 3.1.1.3 Single-ended Low Level Voltages-VSE\_LOW
  - 3.1.1.4 Differential Output Swing Voltage-VDF\_SWING
  - 3.1.1.5 Common-mode Output Swing Voltage-V\_CMSWING
  - 3.1.1.6 Differential Rise and Fall Times-TR\_DF, TF\_DF
  - 3.1.1.8 Differential Intra-Pair Skew-TSKEW\_DF
  - 3.1.1.12 MHL Data Eye Diagram

Buttons for "Deselect All" and "Select All" are located above the tree view. Below the tree view is a "Test Description" section with a text area containing: "This test measures that the MHL source output voltage is within the specified level limits when the source device is in Standby State or power off mode as specified in the CDF." To the right of the text area are "Schematic" and "Configure" buttons. On the far right of the interface are "Start" and "Pause" buttons. The bottom status bar shows "Tektronix" and "Status Ready".

# Innovative MHL Protocol Analyzer Solution

Introducing Tektronix' MHL Protocol Solution



**Tektronix**<sup>®</sup>

# 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

TEK-PGY MHL Protocol Analysis solution - Beta

**Mode**  
MHL

**Displays**  
 Image Viewer  
 Protocol Viewer  
 Bus Viewer  
 Event Viewer  
 Data Packet Viewer  
Clear All Select All

**List Of Tests**  
 Source Protocol Tests  
   Legal Codes  
   Basic Protocol  
   Packet Types  
 Source video  
   Video Formats Test  
   Pixel Encoding Test  
   Video Quantization Ranges  
   AVI InfoFrame  
 Source audio  
   Audio Test  
   Audio Clock Generation  
   Audio InfoFrame

Run  
Single  
Repetitive  
No Acq  
Analyze  
Export  
Report

Version :0.8.0

TEK-PGY MHL Protocol Analysis solution - Beta

**Signal Source**  
 Oscilloscope  
 Wfm Files  P/A/V Binary File

**Signal Assignment**  
**Source Type**  
 Data +Ve and Data -Ve  
 Common Mode Clock and Data

Data + CH1  
Data - CH2

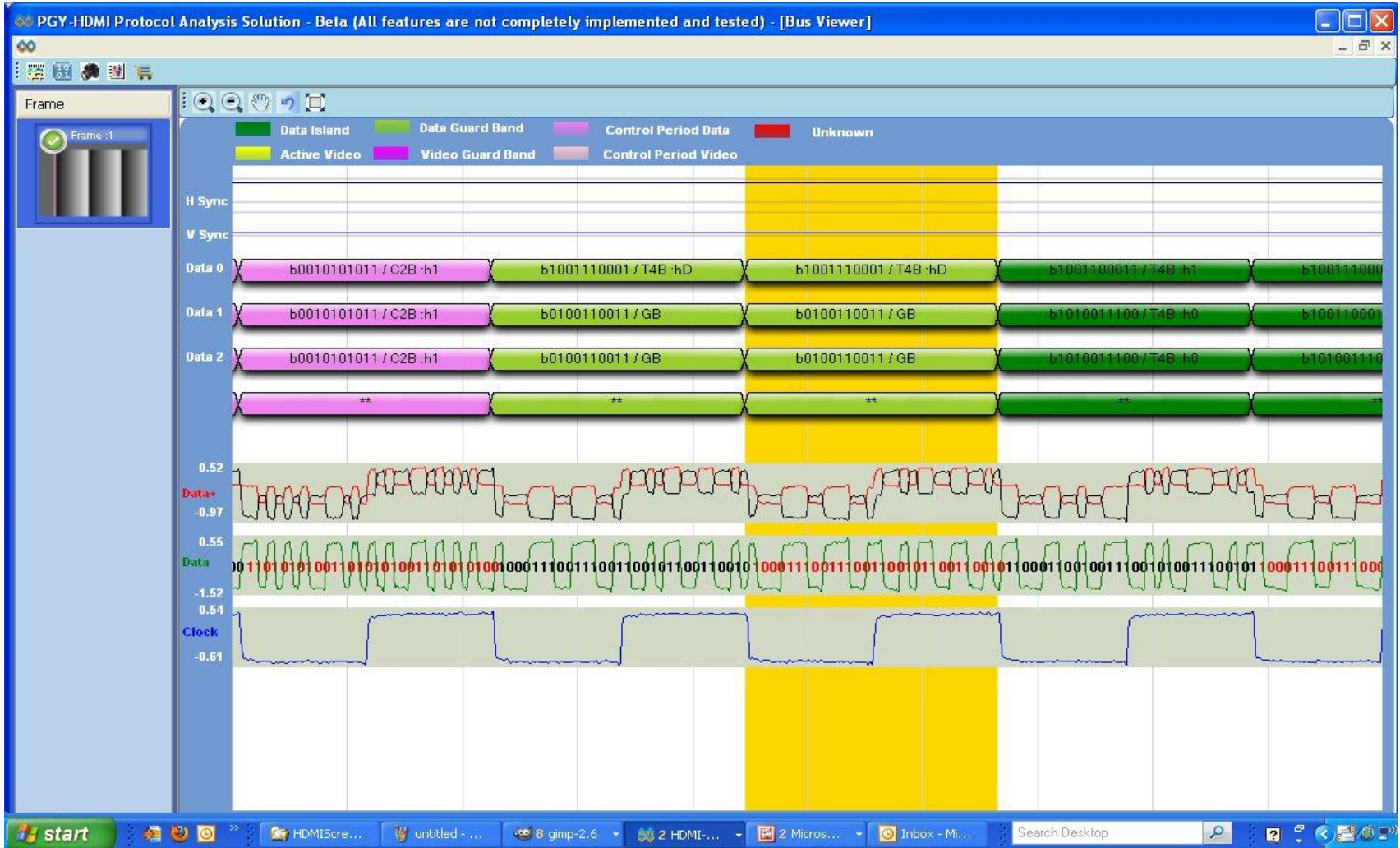
**Video Format**  
Pixel Encoding: RGB  
Bits Per Pixel: 24 Bits  
Format: Standard  
( 2 ) - 720x480p @ 60 Hz  
Source\_CN: Not Specified  
Non CEA Format  AVI Supported

Audio Sample Frequency: 32 kHz

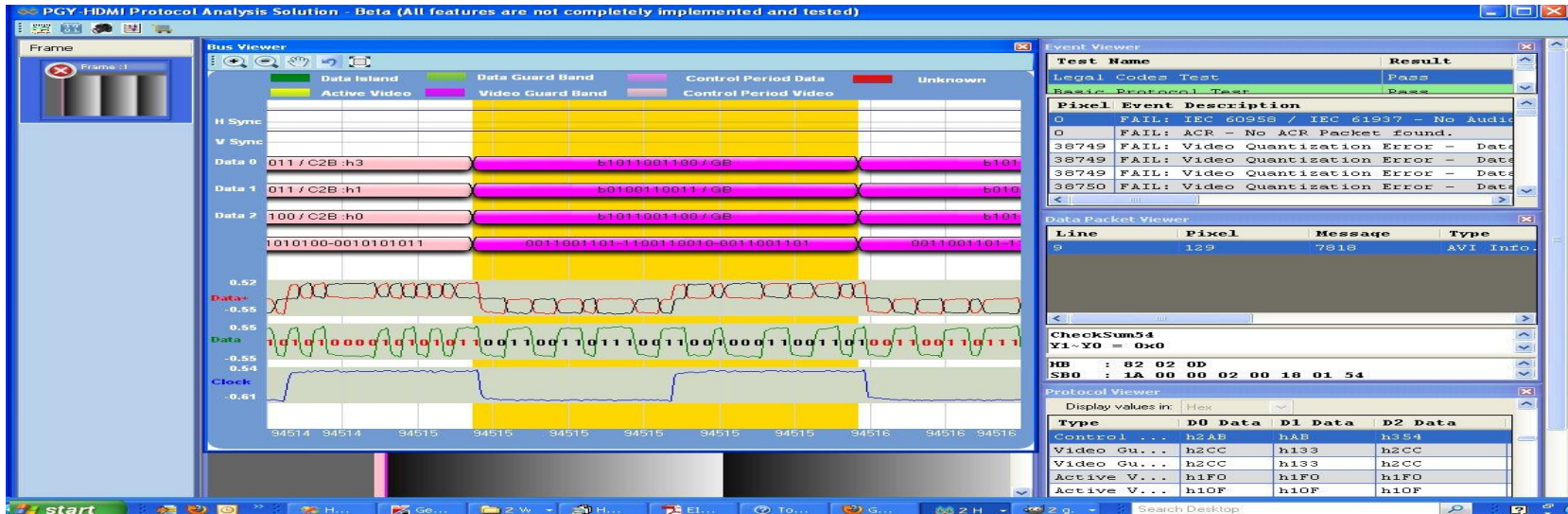
Run  
Single  
Repetitive  
No Acq  
Analyze  
Export  
Report

Version :0.8.0

# Tektronix MHL Protocol Analyzer: Seamless PHY and Link Layer Testing



# Tektronix MHL Protocol Analyzer



TEK-PGY HDMI/MHL Protocol Analysis solution - Beta

**Frame**

- .csv (Comma separated values)
- .txt (Text, Tab separated values)
- .bmp (Bitmap File)

**Event**

- .csv (Comma Separated Values)
- .txt (Text File)

**Protocol**

- HDMI P/A/V Analyzer format
- Data Island Packets

Export All Frames | Frame Range

Start Frame: [ ] Start Line: [ ]

End Frame: [ ] End Line: [ ]

Run: Single, Repetitive, No Acq

Analyze, Export, Report

Version : 0.8.0

# MHL Compliance Test Analysis

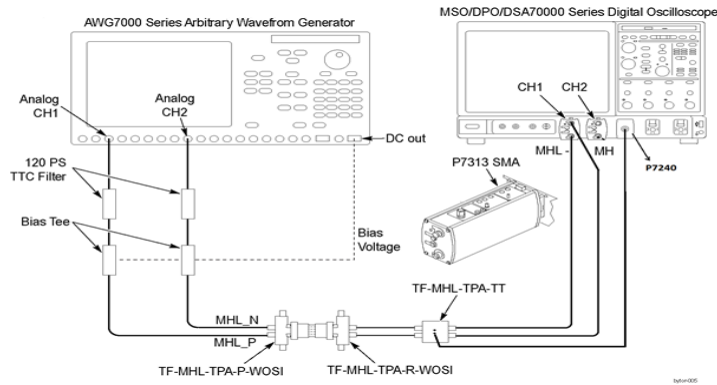
- All the tests pass/ fail depends on one frame data or maximum of two continuous frame data at a time.
- So with multiple acquisitions, the protocol analyzer can produce the same result as 2 sec data as per CTS requirement.

Source Protocol Tests	Source Video Test	Source Audio	Sink Protocol Tests
<ul style="list-style-type: none"><li>▪ Legal Codes</li><li>▪ Basic Protocol</li><li>▪ Packet Types</li></ul>	<ul style="list-style-type: none"><li>▪ Required Video Formats</li><li>▪ Optional Video Formats</li><li>▪ Required Pixel Encoding</li><li>▪ Optional Pixel Encoding</li><li>▪ Video Quantization Ranges</li><li>▪ AVI Infoframe</li></ul>	<ul style="list-style-type: none"><li>▪ IEC 60958/IEC 61937</li><li>▪ Audio Clock Regeneration</li><li>▪ Audio InfoFrame</li></ul>	<ul style="list-style-type: none"><li>▪ Supported by AWG MHL patterns</li></ul>

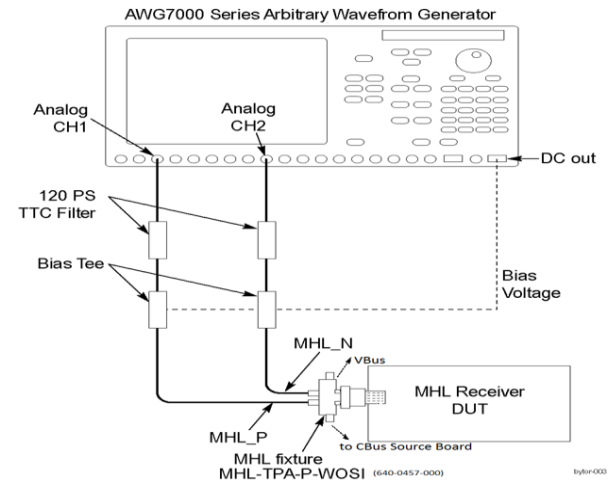
# Tektronix MHL Solution Setup: Simple and Easy Sink and Dongle Testing ( all tests except Min/Max test)-1

Setup based on Direct Synthesis Capability of AWG7122C Series

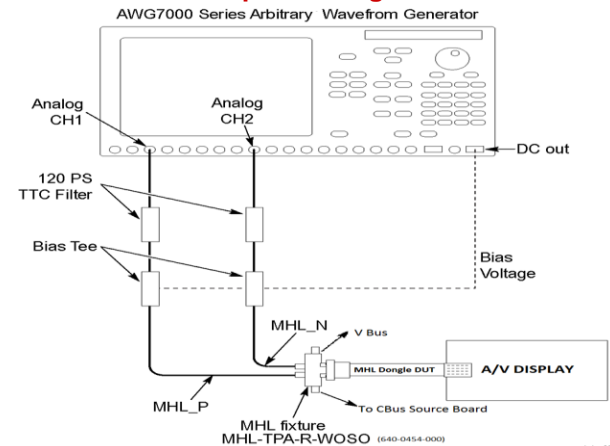
## AWG Signal ( CM,SE and Diff) Verification Using Real Time Oscilloscope



## Test Setup for Sink Tests



## Test Setup for Dongle Tests

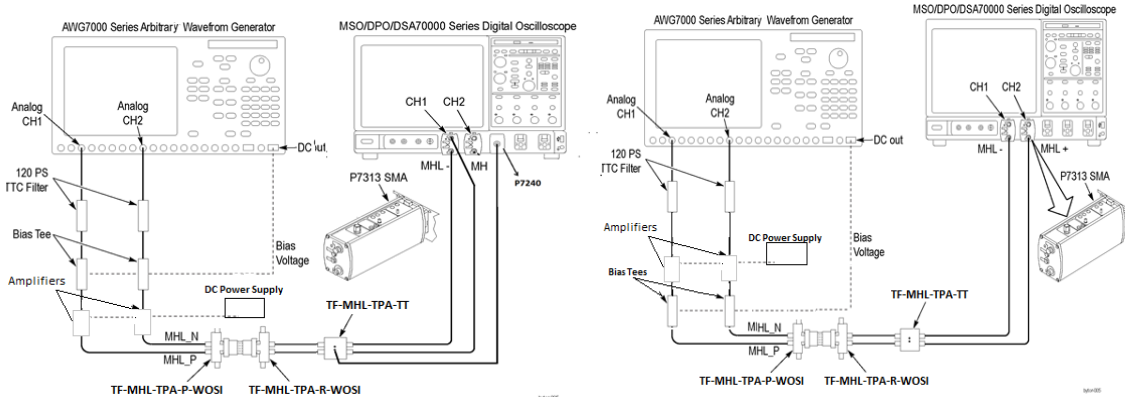




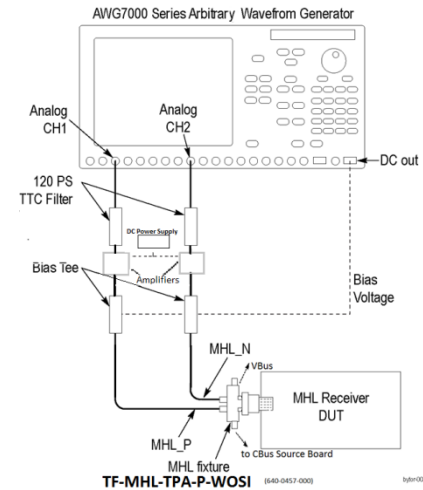
# Tektronix MHL Solution Setup: Simple and Easy Sink and Dongle Min/Max Testing -2

## Setup based on Direct Synthesis Capability of AWG7122C Series

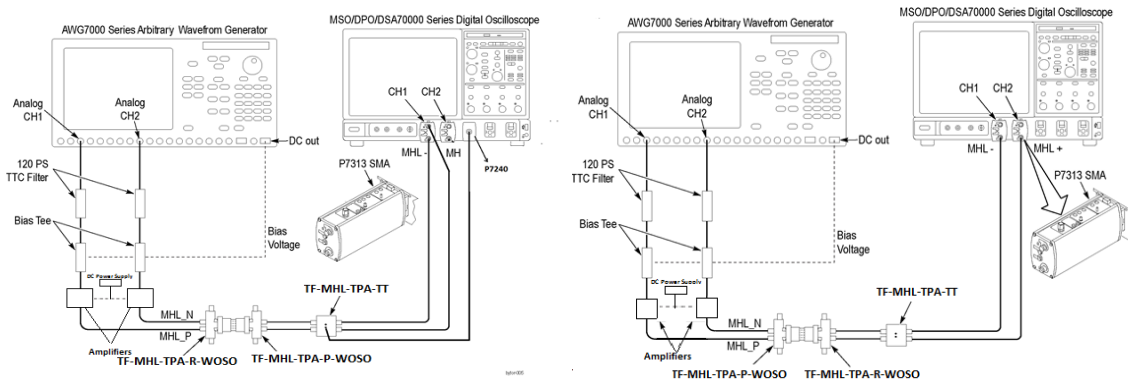
### AWG Sink Min/Max Signal ( CM,SE and Diff) Verification Using Real Time Oscilloscope



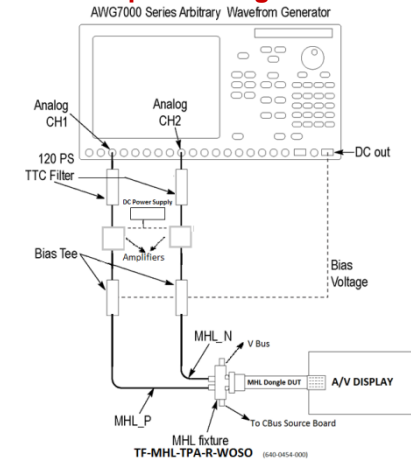
### Test Setup for Sink Min/Max Tests



### AWG Dongle Min/Max Signal ( CM,SE and Diff) Verification Using Real Time Oscilloscope



### Test Setup for Dongle Min/Max Tests



# MHL Compliance Software for Automated Rx Tests: Option MHD

The screenshot displays the TekExpress MHL software interface. The title bar reads "TekExpress MHL - (Untitled)\*" and includes an "Options" dropdown menu. On the left, a vertical navigation pane shows four steps: "1 DUT" (checked), "2 Test Selection" (highlighted with a red circle), "3 Configuration", and "4 Preferences". Below this are buttons for "Setup", "Status", "Results", and "Reports". The main workspace is titled "MHL Physical Layer Solution : MHL Receiver : CTS 1.X" and contains a tree view of test items, each with a checked checkbox:

- MHL Sink
  - 4.1.1.1 Input Signal DC Voltage Level Tolerance
  - 4.1.1.2 Input Signal Minimum and Maximum Swing Voltages Tolerance
  - 4.1.1.3 Intra-Pair Skew Tolerance
  - 4.1.1.4 Jitter Tolerance
- MHL Dongle
  - 5.1.1.1 Input Signal Single-Ended Voltage Level Tolerance
  - 5.1.1.2 Input Signal Minimum and Maximum Swing Voltages Tolerance
  - 5.1.1.3 Intra-Pair Skew Tolerance
  - 5.1.1.4 Jitter Tolerance

Buttons for "Deselect All" and "Select All" are located above the tree view. Below the tree is a "Test Description" section with a text area containing: "This test confirms that the MHL Clock output does not contain excessive jitter larger than the limit allowed by the specification." and a "Schematic" button. On the right side of the interface, there are "Start" and "Pause" buttons. The bottom status bar shows "Tektronix" and "Status Ready".

# MHL Sink and Dongle Protocol tests –Manual method

Using the same AWG setup the Sink and Dongle Protocol tests are performed manually.

## SINK PROTOCOL TESTS

4.2.1.1 Character Synchronization

4.2.1.2 Packet Types

4.2.2.1 Video Formats

4.2.2.2 Pixel Encoding

4.2.2.3 Video Quantization Range

4.2.3.1 IEC 60958 / IEC61937

4.2.3.2 Audio Clock Regeneration

## DONGLE PROTOCOL TESTS

5.2.1.1 Character Synchronization

5.2.1.2 Packet Types

5.2.2.1 Video Formats

5.2.2.2 Pixel Encoding

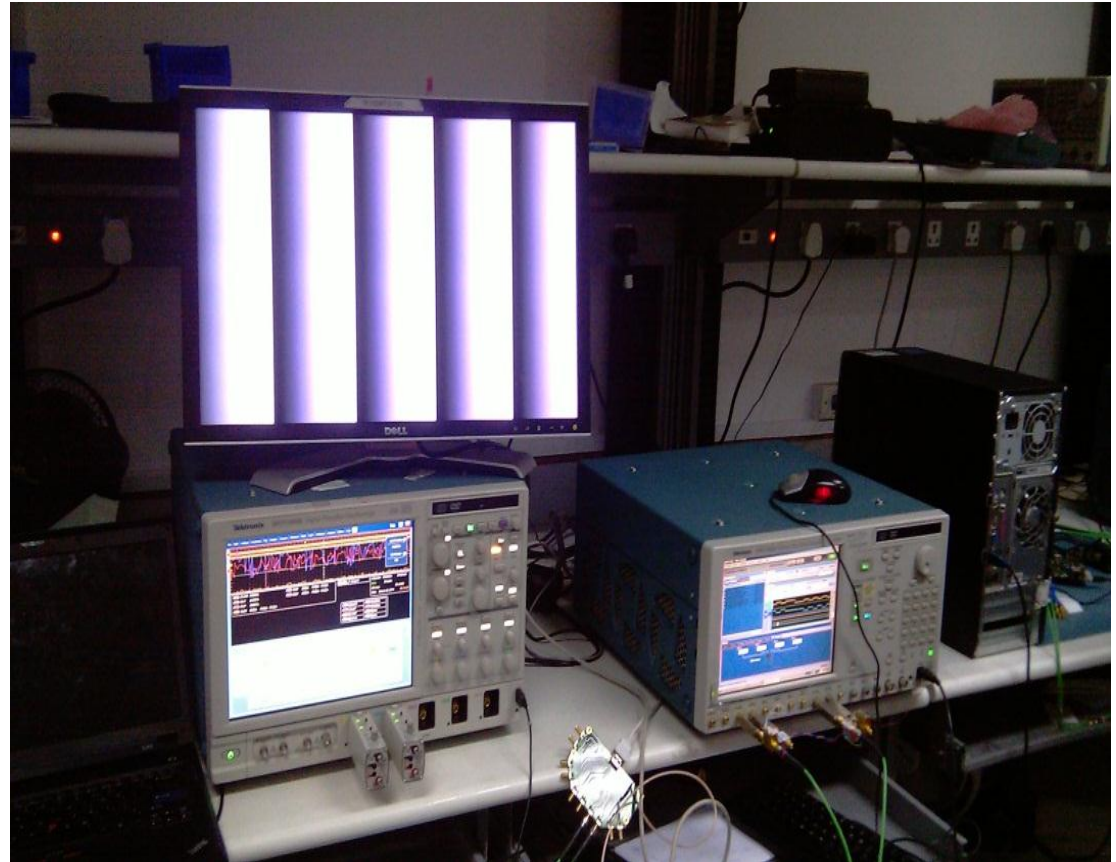
5.2.2.3 Video Quantization Range

5.2.3.1 IEC 60958 / IEC61937

5.2.3.2 Audio Clock Regeneration

# Tektronix Actual Sink and Dongle Setup: Simple and Easy A Snapshot

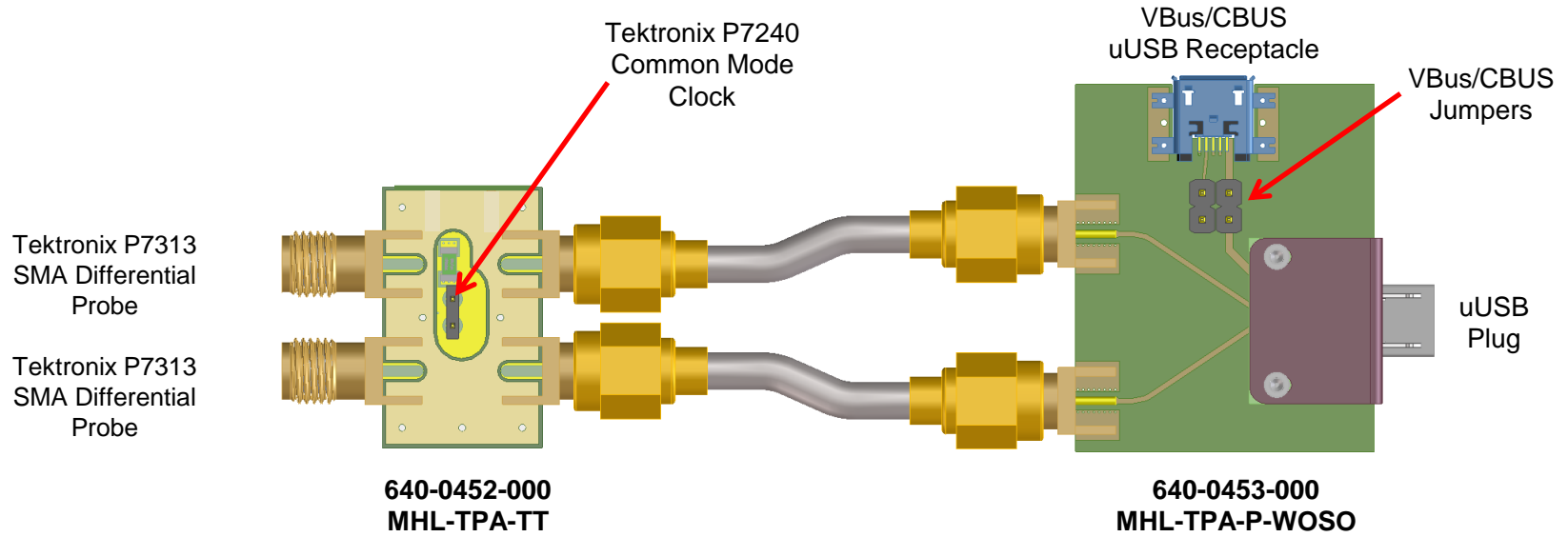
Setup based on real-time oscilloscope and Direct Synthesis capability of AWG7122C Series



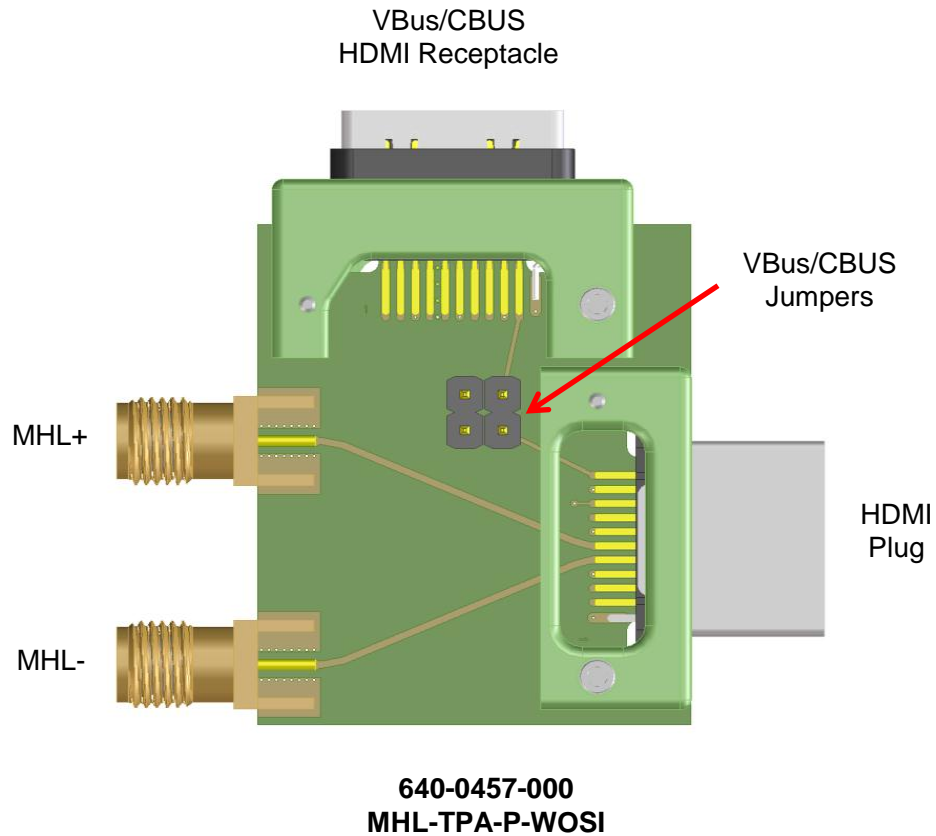
# MHL Fixtures :

Wilder P/N	Wilder Model #	Tektronix nomenclature	Description
640-0452-000	MHL-TPA-TT	TF-MHL-TPA-TT	MHL Termination Board
640-0453-000	MHL-TPA-P-WOSO	TF-MHL-TPA-P-WOSO	MHL Source Test Board Plug without Termination
640-0454-000	MHL-TPA-R-WOSO	TF-MHL-TPA-R-WOSO	MHL Dongle Test Board Receptacle without Termination
640-0455-000	MHL-TPA-R-WOC	TF-MHL-TPA-R-WOC	MHL Cable Test Board Receptacle without Termination
640-0456-000	MHL-TPA-R-WOSI	TF-MHL-TPA-R-WOSI	MHL Sink Calibration Test Board Receptacle without Termination
640-0457-000	MHL-TPA-P-WOSI	TF-MHL-TPA-P-WOSI	MHL Sink Test Board Plug without Termination
640-0458-000	MHL-TPA-R-SO-RSEN	TF-MHL-TPA-R-SO-RSEN	MHL Source RxSense Test Board Receptacle
640-0459-000	MHL-TPA-R-SI-RSEN	TF-MHL-TPA-R-SI-RSEN	MHL Sink and Dongle RxSense Test Board Receptacle
<b>MHL Fixture KITS</b>			
640-0475-000	MHL-TPA-TEK( Complete MHL Fixture kit)	TF-MHL-TPA-TEK( Complete MHL Fixture kit)	<b>MHL Test Kit</b> includes 640-0452-000 thru 640-0459-000
640-0476-000	MHL-TPA-TEK-SO( Source Fixture Only Kit)	TF-MHL-TPA-TEK-SO( Source Fixture Only Kit)	<b>MHL Source Test Kit</b> includes 640-0452 and 640-0453-000
640-0477-000	MHL-TPA-TEK-SI( Sink Fixture kit)	TF-MHL-TPA-TEK-SI( Sink Fixture kit)	<b>MHL Sink Test Kit</b> 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)	<b>MHL Dongle Test Kit</b> 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)	<b>MHL Cable Test Kit</b> includes 640-0455-000, 640-0456-000
640-0480-000	MHL-TPA-TEK-RSEN( RSEN Kit)	TF-MHL-TPA-TEK-RSEN( RSEN Kit)	<b>MHL RxSense Kit</b> includes 640-0458-000 and 640-0459-000

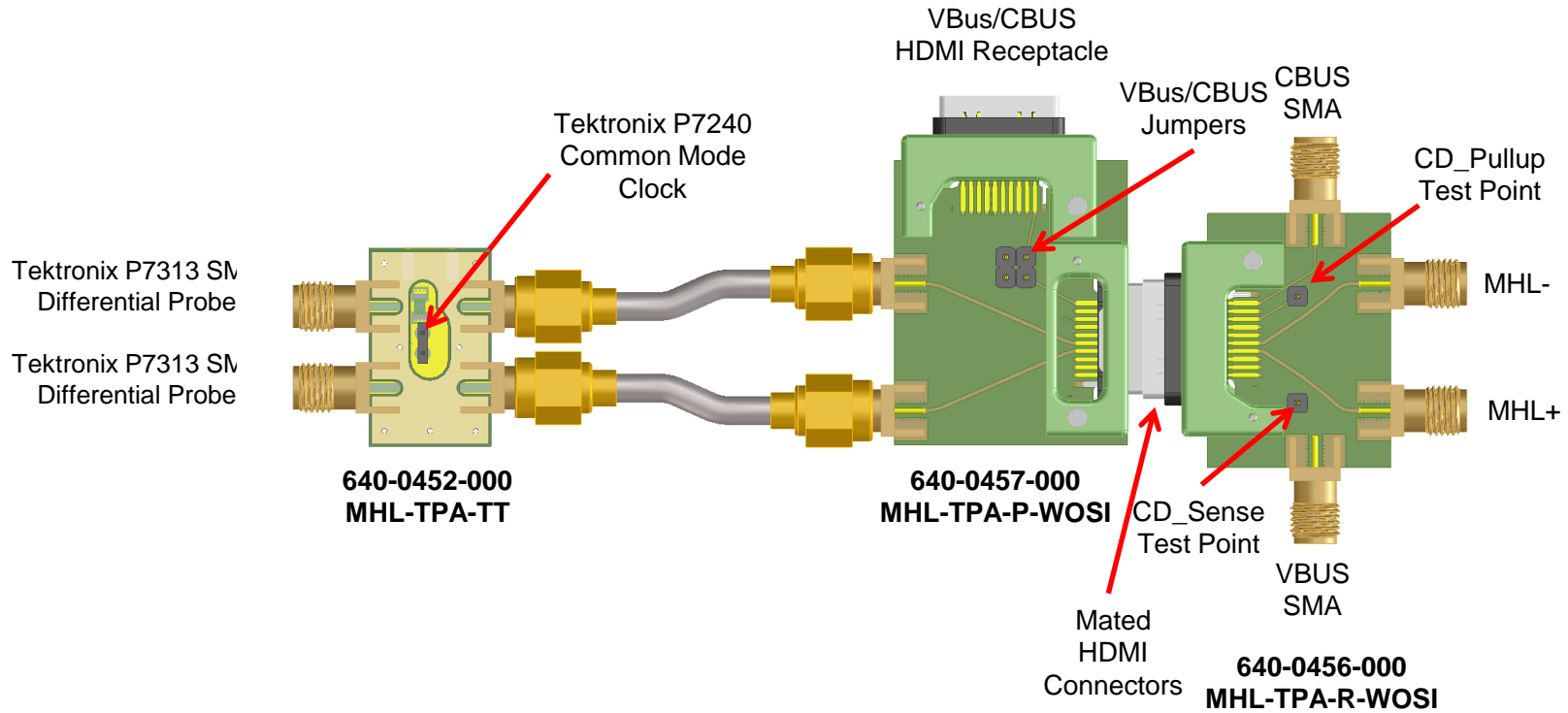
# Wilder Fixtures: Tektronix MHL Source Testing Setup



# Wilder Fixtures: Tektronix MHL Sink Testing Setup

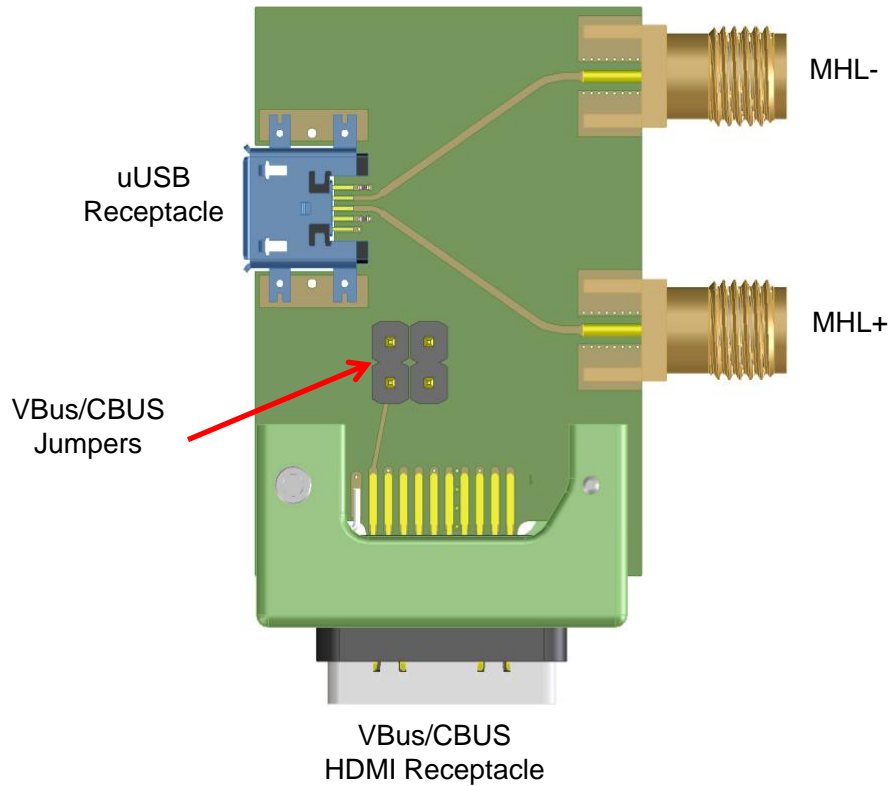


# Wilder Fixtures: Tektronix MHL Sink Signal Verification Setup



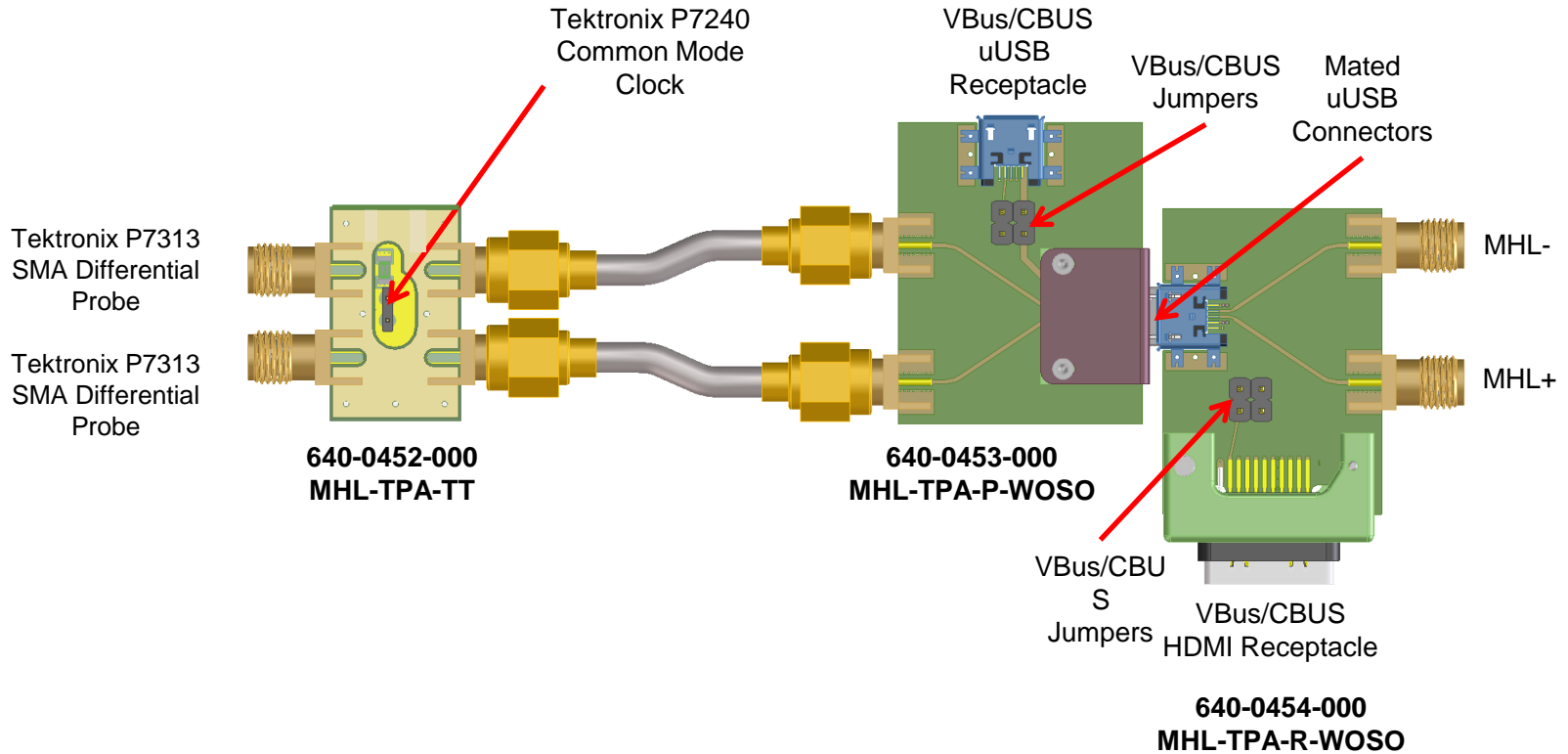


# Wilder Fixtures: Tektronix MHL Dongle Testing Setup

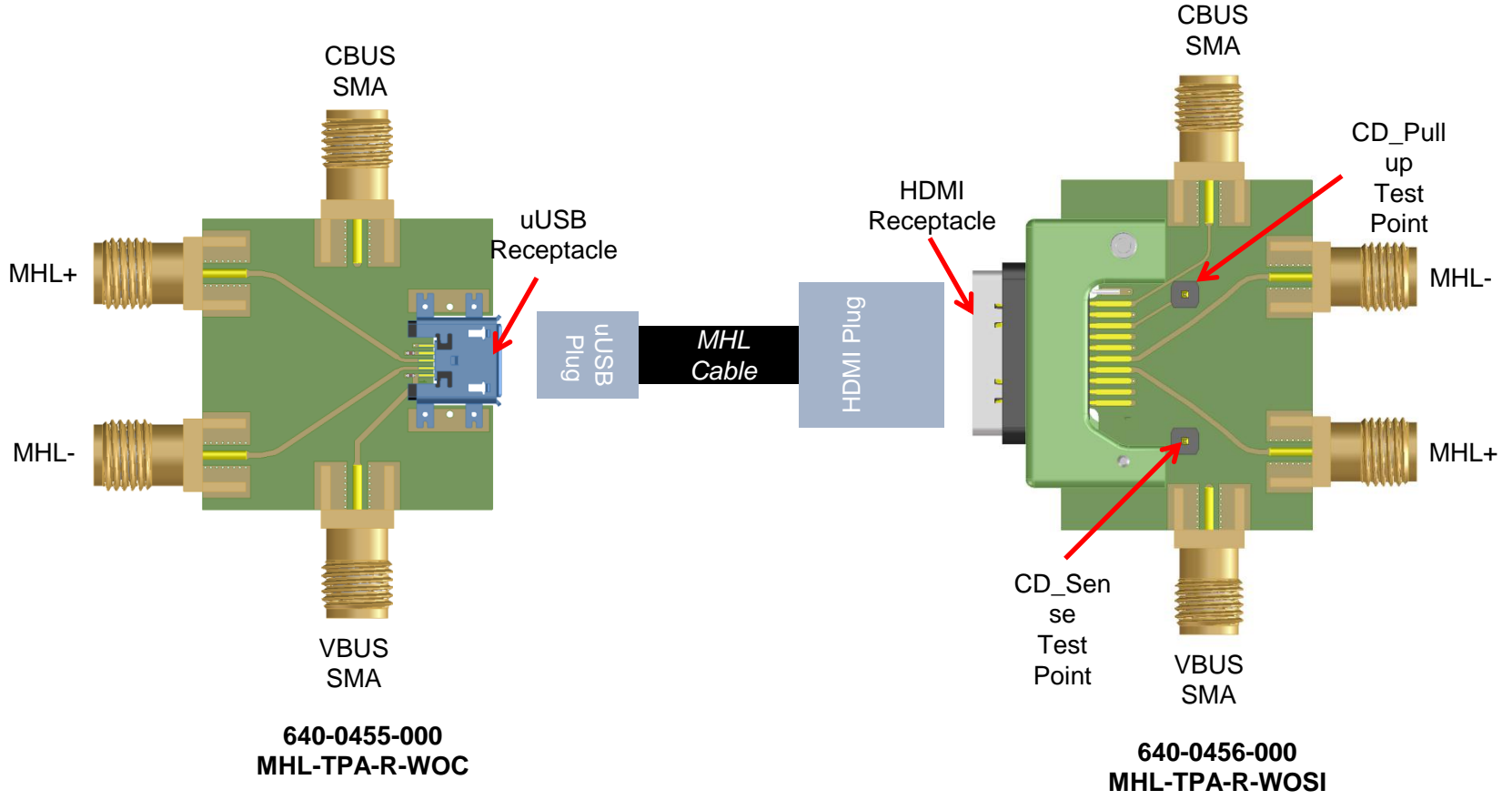


**640-0454-000**  
**MHL-TPA-R-WOSO**

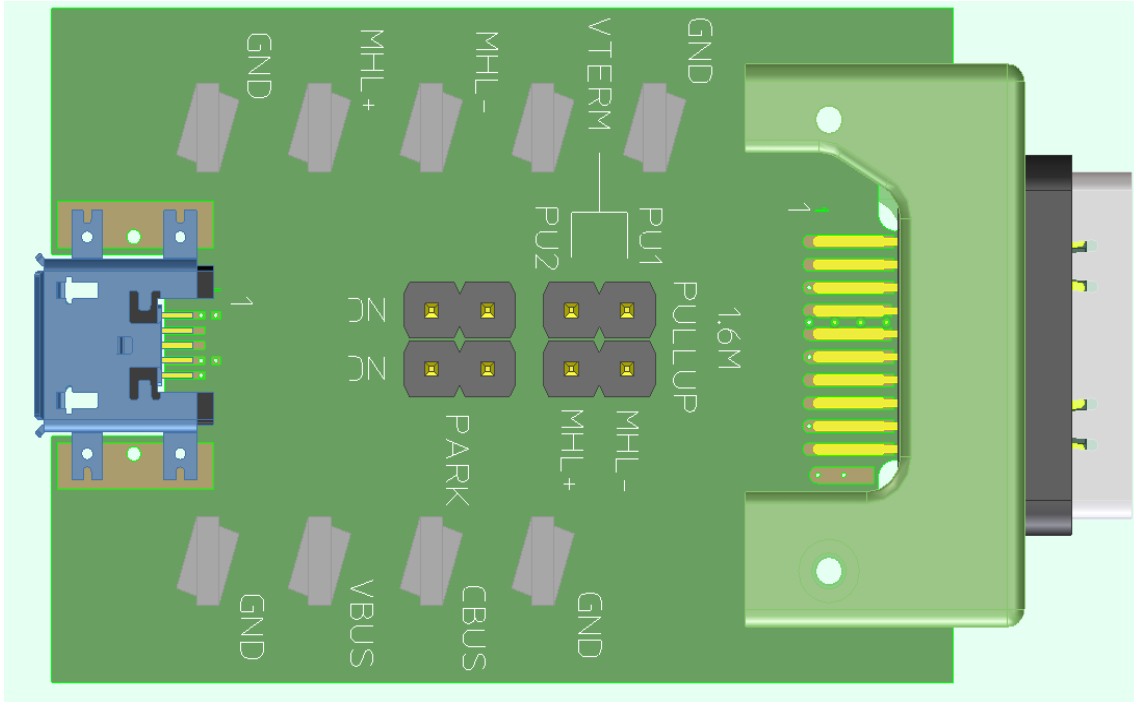
# Wilder Fixtures: Tektronix MHL Dongle Signal Verification Setup



# Wilder Fixtures: Tektronix MHL Cable Testing Setup

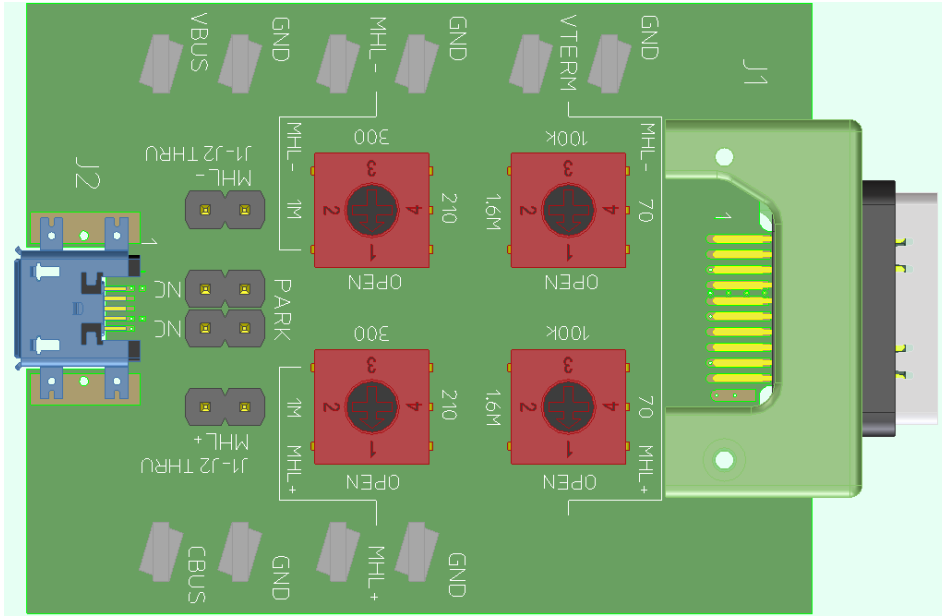


# Wilder Fixtures: Tektronix MHL Source RxSEN Testing



**640-0458-000**  
**MHL-TPA-R-SO-RSEN**

# Wilder Fixtures: Tektronix MHL Sink and Dongle RxSEN Testing



**640-0458-000**  
**MHL-TPA-R-SI-RSEN**

# Tektronix MHL Solution: Complete Solution Aligned to CTS1.2 Announcement

- 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 available from our Fixture partner Wilder Technologies
- Tektronix MHL Physical Layer Rx test setups are easy to use.
  - 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:
  - Providing seamless link between PHY and Link layer testing
  - An economical MHL test solution
    - ONE BOX solution for PHY and Protocol testing
  - 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-connect Software for MHL Cable testing (performed manually using MOIs)
  - Low Bandwidth Oscilloscopes
  - Keithley Source Meter (Now part of Tektronix)
  - Programmable Power Supply and
  - Digital Millimeter

# Tektronix MHL 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
- AWG7122C based Sink and Dongle Protocol test ( manual method)
- 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

# High-Speed Serial Data Test Solutions

Design

Verification

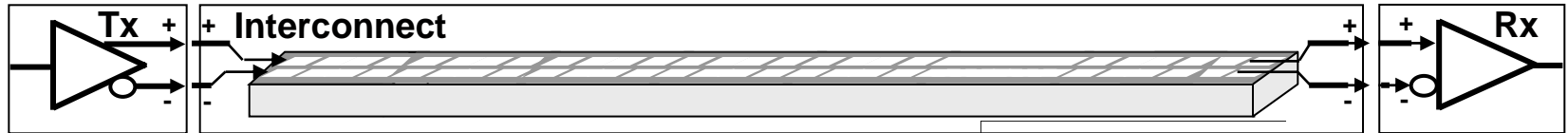
Compliance Test



GbE DisplayPort

HDMI™

MHL ...



Real-time Scopes



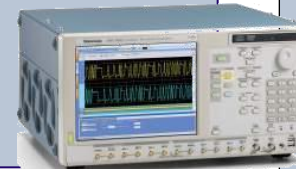
System Integration  
Digital Validation & Debug

Logic Analyzers

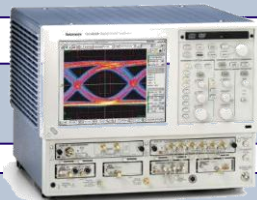


Transmitter Testing

Receiver Test  
Margin Testing



Pro  
Fixtures



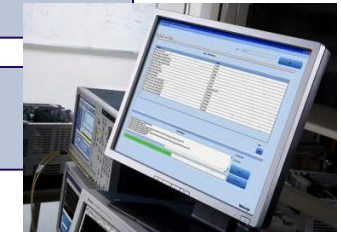
Arbitrary Waveform Generator

Interconnect Test

Sampling Scopes

Compliance Test

Compliance Test Software





THANK YOU