# **MHL/HDMI** Protocol Analysis Software

TEK-PGY-MHL/HDMI-PA Data Sheet

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### Features

- Industry's first MHL/HDMI Protocol analysis software offers in-depth visibility from physical layer to video frames with unmatched data correlation between all the layers of MHL/HDMI protocol.
- Transforms the general purpose oscilloscope into sophisticated MHL/HDMI Protocol Analyzer.
- Debugging and troubleshooting made easy by crosscorrelating the MHL/HDMI protocol data using frame summary viewer, frame viewer, Bus viewer, data packet and event viewers.
- Frame summary view helps to quickly locate error frames for detailed analysis.
- The Frame Viewer helps to view the transmitted frame with color coded MHL/HDMI operating modes as per the specification and eliminates the need of a Sink device in MHL/HDMI test setup by reproducing transmitted image in Oscilloscope display.
- Bus viewer with the Physical layer analog waveforms offers unmatched flexibility in correlating protocol errors with physical layer.
- The Protocol Viewer displays the tabular view of protocol information with decoded values.

- The Event Viewer lists detailed protocol errors and events in the MHL/HDMI compliance tests to quickly locate the protocol failures.
- Raw and detailed packet information in the Data packet viewer helps to identify the problems in Data Island periods.
- Supports 24, 30, 36, and 48 bits per video pixel for HDMI and 24 bits per pixel for MHL.
- Oscilloscope setup assistant automatically sets up the oscilloscope to obtain accurate and reliable test results.
- Performs the protocol Tests as per the MHL Compliance Test specification 2.0, HDMI Compliance Test specification 1.4a and displays quick Pass/Fail results.
- Conforms to HDMI Specification 1.4a and MHL Specification 2.0.
- Supports Oscilloscope live channels, Tektronix .wfm waveform files and .bin (P/A/V file format of HDMI Capture card) files
- Generates comprehensive and customizable reports.
- Ability to export the analyzed data to .bmp, txt, csv, .bin (P/A/V File format) for advanced analysis.



## MHL/HDMI Protocol Analysis Software TEK-PGY-MHL/HDMI-PA Data Sheet

The industry's first Oscilloscope based TEK-PGY-MHL/HDMI Protocol Analysis software lets you see every event in the MHL/HDMI stream from MHL/HDMI frame to physical layer analog signals which conventional protocol analyzer can not show.

TEK-PGY-MHL/HDMI Protocol Analyzer software performs the MHL/HDMI protocol compliance tests as per MHL CTS 2.0 and HDMI CTS 1.4a. It provides unmatched flexibility in analyzing, debugging, and correlating the test results from MHL/HDMI Frame to physical layer analog waveforms to address the MHL/HDMI design challenges.

For efficient debugging, TEK-PGY-MHL/HDMI software provides unique multi viewer which comprises of frame summary viewer, frame viewer, bus viewer, Protocol viewer, Data Island viewer and Event and test results viewer. Automatic cross-linking between all these viewers enables you to see and correlate the data in different parts of the MHL/HDMI protocol stack

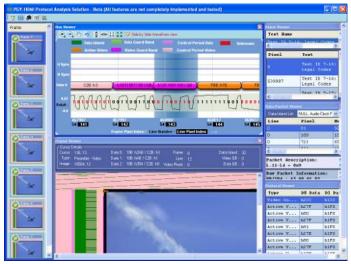


Figure 1: Multi viewer

TEK-PGY-MHL/HDMI protocol analysis software along with Tektronix physical layer compliance test solutions and Industry leading Tektronix high performance oscilloscope offers a single box solution for physical and protocol layer testing.

### **Comprehensive MHL/HDMI Protocol Analysis**

For efficient debugging and troubleshooting the MHL/HDMI protocol, TEK-PGY-MHL/HDMI Protocol analysis software offers Frame summary viewer, Frame viewer, Bus viewer, Protocol viewer, Data packet viewer and Event and test results viewers.

**Frame summary viewer** provides each frame's thumb nail image with summary of pass/fail test results of the corresponding frame. Frame summary viewer enables to quickly navigate to the failure frames for detailed analysis.

Frame Viewer shows the transmitted complete frame image as per the MHL/HDMI Specification. For easy identification of the operating modes, the Control period, preamble video, preamble data, data guard band, data island and video guard band, active video are shown with the different colours. Hovering over the image using mouse provides the respective operating mode's type, relative pixel information, transmitted data value corresponding 10bit and decoded information for the respective operating mode. Frame viewer eliminates the need for a MHL/HDMI sync device for viewing the image transmitted by the source.

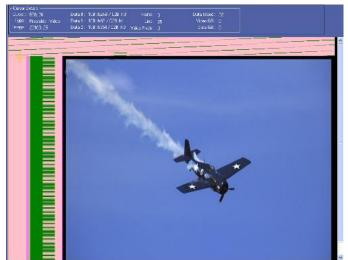


Figure 3: Frame viewer



## MHL/HDMI Protocol Analysis Software TEK-PGY-MHL/HDMI-PA Data Sheet

**Bus Viewer** provides a way to visually inspect the transmitted MHL/HDMI information in Bus Diagram display along with the analog waveforms.

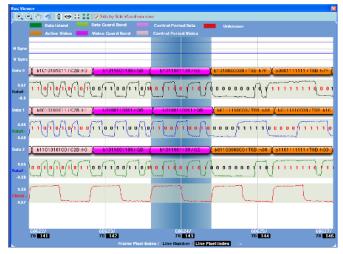


Figure 4: HDMI Bus viewer with Physical layer waveforms

The industry's first MHL/HDMI bus diagram and analog waveform with overlapped protocol data helps to identify the inter pair data skew, clock to data skew related problems. Each line is colour coded for Control period, preamble video, preamble data, data guard band, data island and video guard band, active video for easy error deduction. Apart from the bus information, the HDMI bus viewer also provides information about the H-Sync, V Sync active periods.



Figure 5: MHL Bus viewer with Physical layer waveforms

MHL bus viewer allows viewing the Data Positive and Data Negative waveforms and the corresponding common mode clock and data which are created using the captured MHL signals. MHL bus diagram also provides the transmitted multiplexed logical channel details as it is along with the de-multiplexed logical channels as per the MHL Protocol Specification.

For identifying and locating the errors in a specific period bus viewer provides pixel index in the selected frame, line number and pixel index with in the line.

Utility functions such as zoom, un-zoom, pan, undo, fit horizontal, fit vertical, fit horizontal and vertical and side by side waveform and bus view helps to manoeuvre the bus diagram and analyze the MHL/HDMI protocol

The **Protocol Viewer** provides the table view of protocol listing with transmitted 10 bit data for each channel along with the decoded 8bit for active video, 4 bit TERC4 data for Data Island and 2 bit for Control period encoding along with the time stamp.

Type	DO Data	D1 Data	D2 Data	R Data	G Data	B Data	Time
Control Period Video	h354	hAB	h354	C2B :hO	C2B :h1	C2B :hO	13.968 mS
Control Period Video	h354	hAB	h354	C2B :hO	C2B :h1	C2B :h0	13.968 mS
Control Period Video	h354	hàB	h354	C2B :h0	C2B :h1	C2B :h0	13.968 mS
Control Period Video	h354	hàB	h354	C2B :h0	C2B :h1	C2B :h0	13.968 mS
Control Period Video	h354	hAB	h354	C2B :hO	C2B :h1	C2B :h0	13.968 mS
Control Period Video	h354	hAB	h354	C2B :hO	C2B :h1	C2B :hO	13.968 mS
Control Period Video	h354	hAB	h354	C2B :hO	C2B :h1	C2B :hO	13.968 mS
Control Period Video	h354	hàB	h354	C2B :h0	C2B :h1	C2B :h0	13.968 mS
Video Guard Band	h2CC	h133	h2CC	GB	GB	GB	13.968 mS
Active Video	h1F0	h1F0	h1F0	T8B :h10	T8B :h10	T8B :h10	13.968 mS
Active Video	h10F	h10F	h10F	T8B :h11	T8B :h11	T8B :h11	13.968 mS
Active Video	h10E	h3F1	h10E	T8B :h12	T8B :h12	T8B :h12	13.968 mS
Active Video	h1F1	h3OE	h3OE	T8B :h13	T8B :h13	T8B :h13	13.968 mS
Active Video	h3OE	h3OE	h3OE	T8B :h13	T8B :h13	T8B :h13	13.968 mS
Active Video	h10C	Figur	e 6: Prot	:ocol₁vie	<b>₩€</b> Γ:h14	T8B :h14	13.968 mS
Active Video	h1F3	h30C	h30C	T8B :h15	T8B :h15	T8B :h15	13.968 mS
Active Video	h1F2	h3OD	h3OD	T8B :h16	T8B :h16	T8B :h16	13.968 mS
Active Video	h10D	h10D	h3F2	T8B :h17	T8B :h17	T8B :h17	13.968 mS
Active Video	h108	h3F7	h108	T8B :h18	T8B :h18	T8B :h18	13.968 mS
Active Video	h1F7	h308	h1F7	T8B :h19	T8B :h19	T8B :h19	13.968 mS
Active Video	h308	h308	h1F7	T8B :h19	T8B :h19	T8B :h19	13.968 mS
Active Video	h309	h309	h1F6	T8B :h1&	TSB :h1Å	T8B :h1A	13.968 mS
Active Video	h109	h109	h3F6	T8B :h1B	T8B :h1B	T8B :h1B	13.968 mS
Active Video	h30B	h30B	h30B	T8B :h1C	T8B :h1C	T8B :h1C	13.969 mS
Active Video	h10B	h10B	h3F4	T8B :h1D	T8B :h1D	T8B :h1D	13.969 mS
Active Video	hAO	h25F	h25F	T8B :h1E	T8B :h1E	T8B :h1E	13.969 mS

**Data Packet Viewer** lists the entire data packets transmitted in the selected frame. Each data island period type, line number, the pixel number, data island period's BCH data are displayed in the tabular format. Depending on the packet type the data packet viewer also provides the details of the data packet as per the CEA 861 specification.



# **MHL/HDMI** Protocol Analysis Software

## **TEK-PGY-MHL/HDMI-PA Data Sheet**

oata Packet V	lewer						
	st: NULL, Audio Cla	ck Regeneration (N/C	TS), Audio Sample (L-P	CM and IEC 61937 co	mpres 🔽		
Line	Pixel	Message	Туре	всно	всн1	всн2	BCI
0	91	58	Audio Sa	Ox1DO8FD	0x000000	0x000000	0x0
0	189	156	Audio Sa	OxA508FD	0x000000	0x000000	0x0
0	723	690	Audio Sa	0x1488FC	0x000000	0x000000	0x0
1	421	1252	Audio Sa	OxCAOSFC	0x000000	0x000000	0x0
2	120	1815	Audio Sa	OxCCOOFC	0x000000	0x000000	0x0
2	682	2377	Audio Sa	OxDE88FC	0x000000	0x000000	0x0
3	381	2940	Audio Sa	OxOF80FE	0x000000	0x000000	0x0
4	79	3502	Audio Sa	0x7B00FF	0x000000	0x000000	0x0
				0x6580FF	0x000000	0x000000	0x0
4	642	4065	Audio Sa	UX6580FF	0x000000		
Z Packet de: CheckSum	scription: = 0x98	4240	Andio Tr	07200000	02000000	0+000000	0.0
Active Fo	scription: = 0x98 bCr, Y1-Y0 = rmat Informat	Ob10 (YCbCr ion Present,	4:4:4) of PB1 A0 = 0blof PB1	(0x5d)			0.00
Checket de: CheckSum RGB or YC Active Fo Bar Info, Scan Info	scription: = 0x98 bCr, Y1-Y0 = rmat Informat B1-B0 = 0b11 rmation, S1-S	Ob10 (YCbCr ion Present, of PB1 (0x54 0 = 0b01 of P	4:4:4) of PB1 A0 = Oblof PB1 ) B1 (0x5d)	(0x5d)			
Packet de: CheckSum RGB or YCI Active Fo Bar Info, Scan Info; Colorimet:	scription: = 0x98 bCr, X1-Y0 = rmat Informat B1-B0 = 0b11 rmation, S1-S ry, C1-C0 = 0	0b10 (YCbCr ion Present, of PB1 (0x5d 0 = 0b01 of P b01 of PB2 (0	4:4:4) of PB1 A0 = Oblof PB1 )) B1 (0x5d) x68)	(0x5d)			0.00
Packet de: CheckSum RGB or YCI Active Fo: Bar Info, Scan Info Colorimet: Picture A:	scription: = 0x98 bCr, ¥1-¥0 = mat Informat B1-B0 = 0b11 rmation, \$1-S ry, C1-C0 = 0 spect Ratio,	0b10 (YCbCr ion Present, of PB1 (0x5d 0 = 0b01 of PB2 (0 b01 of PB2 (0 M1-M0 = 0b10	4:4:4) of PB1 A0 = 0b1of PB1 )) B1 (0x5d) x68) of PB2 (0x68)	0.4200000 (0x5d) (0x5d)			0.00
Packet de CheckSum RGB or YC Active Fo Bar Info, Scan Info Colorimet: Picture A Active Fo	scription: = 0x98 bCr, Y1-Y0 = rmat Informat B1-B0 = 0b11 rmation, S1-S ry, C1-C0 = 0 spect Ratio, rmat Aspect R	0b10 (YCbCr ion Present, of PB1 (0x5d 0 = 0b01 of PB2 (0 M1-M0 = 0b10 atio, R3-R0 =	4:4:4) of PB1 A0 = Oblof PB1 )) B1 (0x5d) x68)	(0x5d) (0x5d) (0x5d)			0.00
Packet de: CheckSum RGB or YCC Bar Info, Scan Info Colorimet Picture A: Active Fo: Raw Packe	scription: = 0x98 bCr, X1-Y0 = rmat Informat B1-B0 = 0b11 rmation, S1-S ry, C1-C0 = 0 spect Ratio, rmat Aspect R m Disture So t Information	0b10 (YCbCr ion Present, of PB1 (0x5d 0 = 0b01 of P b01 of PB2 (0 M1-M0 = 0b10 atio, R3-R0 = b1ing \$61_50	4:4:4) of PB1 A0 = 0b1of PB1 ) B1 (0x5d) x68) of PB2 (0x68) 0b1000 of PB2	(0x5d) (0x5d) (0x5d)			0.00
Packet de: CheckSum RGB or YCI Active Fo Bar Info, Scan Info; Colorimet Picture A: Active Fo Non_unifo Raw Packe HB/SB4 : 1	scription: = 0x98 bCr, Y1-Y0 = mmat Informat B1-B0 = 0b11 rmation, S1-S ry, C1-C0 = 0 spect Ratio, rmat Aspect R rm Dicture Sc t Information E4 0D 02 82	Obi0 (YCbCr ion Fresent, of PB1 (0x50 0 = 0b01 of P b01 of PB2 (0 M1-M0 = 0b10 atio, R3-R0 =	4:4:4) of PB1 A0 = 0b1of PB1 ) B1 (0x5d) x68) of PB2 (0x68) 0b1000 of PB2	(0x5d) (0x5d) (0x5d)			0.00
Packet de: CheckSum RGB or YCC Bar Info, Scan Info Colorimet: Picture A: Active Fo: Non-unifo Raw Packe BB/SB4 : 1 SB0 :	scription: = 0x98 bcr, X1-X0 = mat Informat B1-B0 = 0b11 mmation, S1-S yr, C1-C0 = 0 spect Ratio, rmat Aspect R D bioture Sc t Information E4 0D 02 82 B 00 00 12 0	0b10 (YCbCr ion Present, of PB1 (0x5d 0 = 0b01 of PB2 (0 M1-M0 = 0b10 atio, R3-R0 = stings SC1-SC :: 0 68 5D 98	4:4:4) of PB1 A0 = 0b1of PB1 ) B1 (0x5d) x68) of PB2 (0x68) 0b1000 of PB2	(0x5d) (0x5d) (0x5d)			0.00
Packet de: CheckSum RGB or YC Active Fo: Bar Info, Scan Info, Colorimet: Picture A: Active Fo: Raw Packe HB/SB4 : 1 SB0 : 1	scription: = 0x98 bCr, Y1-Y0 = mmat Informat B1-B0 = 0b11 rmation, S1-S ry, C1-C0 = 0 spect Ratio, rmat Aspect R rm Dicture Sc t Information E4 0D 02 82	0b10 (YCbCr ion Present, of PB1 (0x50 0 = 0b10 of P b01 of PB2 (0 M1-H0 = 0b10 atio, R3-R0 = bling SC1-SC : : 0 68 5D 98 0 60 00 00	4:4:4) of PB1 A0 = 0b1of PB1 ) B1 (0x5d) x68) of PB2 (0x68) 0b1000 of PB2	(0x5d) (0x5d) (0x5d)			0.00

Figure 7: Data Packet viewer

MHL/HDMI Protocol compliance testing MHL/HDMI

Protocol Software makes comprehensive test as per HDMI Compliance Test Specification 1.4a and MHL Compliance test specification 2.0

**Event and Test results viewer** list the selected tests results along with the description of each test pass/ fail information.

Event Viewer			E
Test Name		Result	1
Test ID 7-10	5: Legal Codes	Pass	
Test ID 7-17	7: Basic Protocol	Pass	
Test ID 7-18	8: Extended Control Period	Pass	
Test ID 7-19	9: Packet Types	Pass	
Test ID 7-23	/24: Pixel Encoding	Fail	I.
Pixel	Test	Event Description	ľ
0	Test ID 7-23/24: Pixel Encoding	(7-23 and 7-24) Source DUT should always outputs required pixel encoding and also correlates with AVI fields YO and Y1.	
4372	Test ID 7-23/24: Pixel Encoding	Error: AVI InfoFrame field Y1 and Y0 does not indicate RGB encoding.( Actual = 2, Expected =0 ).	
o	Test ID 7-25: Video Format Timing	 (7-25) Video Format Timing should be valid	
1	Test ID 7-25: Video Format Timing	Pixel clock should be within allowable range -> No Error	
1	Test ID 7-25: Video Format Timing	Pixel clock frequency is 27.000 MHz. Selected format pixel clock frequency is 27.000 MHz.	
2	Test ID 7-25: Video Format Timing	HSYNC/VSYNC polarity should be equal to NEGATIVE/NEGATIVE -> No Error	
3	Test ID 7-25: Video Format Timing	Number of pixels that HSYNC remains active should be equal to 64 (HS_LEN) -> No Error	
4	Test ID 7-25: Video Format Timing	Number of pixels from end of Video Data Period to HSYNC active edge should be equal to 12 (VIDEO_TO_HS) -> No Error	
		Number of pixels in Video Data Period minus 2 (for	ľ

Figure 8: Event and Test results viewer

#### Seamless oscilloscope integration

TEK\_PGY-MHL/HDMI-PA software runs inside the Tektronix high performance windows oscilloscope. The oscilloscope setup assistant helps to set up the Oscilloscope automatically for reliable and accurate test results.

Software offers the flexibility of capturing 2sec video frames as per MHL/HDMI test procedure or few frames for quick debugging purpose.

Duration of capture:	2 Sec 💙	ODisplay all captured data	<ul> <li>Test all captured data</li> </ul>
O Total frames to be test	ed: 100	Display only complete frames	O Test only complete frames
scilloscope Setup Assist	ant		
ixel clock frequency	27 MHz		
Setup			



## Automated customizable Report and Export

MHL/HDMI software's in-built automated report generator offers a customizable report generation capability helps to communicate the test reports effectively between the fellow team members and management.



To further analyze the data, the software also provides image, protocol and data island period data in multiple export formats. The P/A/V Binary format helps to cross correlate the TEK-PGY-MHL/HDMI data with the conventional protocol analyzer software.

#### Applications

Analyzing and Debugging HDMI and MHL protocol in:

- Mobile smart phones / PDAs
- Digital home appliances
- Portable Video Players
- Netbooks
- Gaming machines



# **MHL/HDMI** Protocol Analysis Software

TEK-PGY-MHL/HDMI-PA Data Sheet

Channel and a start			Audio InfoFrame		
Characteristics			3D Video Timing		
		3D Video Tests	3D Video Mode Indicator		
Select panel					
Modes	HDMI / MHL	Source	Oscilloscope/ Tektronix .wfm files/ PAV Analyzer .bin file		
	Frame summary viewer	HDMI Source	Clock, Data0, Data1, and Data2		
	Frame Viewer	MHL Source	Data+ and Data-/ Common mode clock and Data		
Displays	Bus Viewer	Pixel Encoding	RGB/ YCbCr 4:4:4/ YCbCr 4:2:2		
	Protocol Viewer	Bits per pixel (HDMI)	24/30/36/48		
	Data Packet Viewer	Bits per pixel (HDMI)	24		
	Event and Test results viewer		IEC 861-D/ IEC 861-E/ 3D – Frame Packed/ 3D Side		
HDMI Protocol Tests (A	s per CTS 1.4a)	Format	by Side/ 3D Top and Bottom / 4Kx2K		
	7-16 Legal Codes	Export			
Source Protocol Tests	7-17 Basic Protocol	Export formats	Image ( .BMP / .JPEG/ CSV), Protocol (TXT/ CSV/.BIN), Events (CSV/ TXT)		
	7-18 Extended Control Period				
	7-19 Packet Types	Report			
	7-23/7-24 Pixel Encoding	Report format	HTML / MHL		
	7-25 Video Format Timing	DHCP			
Source Video	7-26 Pixel Reception	DHCP	Not supported		
	7-27 AVI Infoframe				
	7-28 IEC 60958/IEC 61937				
	7-29 ACR				
Source Audio	7-30 Audio Sample Packet Jitter				
	7-31 Audio InfoFrame				
	7-32 Audio Sample Packet Layout				
Interoperability	7-33 Source Interoperability with DVI				
	7-34 Deep Color				
	7-35 Gamut Metadata Transmission				
Source Advanced	7-36 High Bitrate Audio				
features	7-37 One Bit Audio				
	7-38 3D Video Format Timing				
	7-39 4KX2K Video Format Timing				
	7-40 Extended Colorimetry Transmission				
MHI Brotocol Complian	ce Tests (As per CTS 2 0)				

#### MHL Protocol Compliance Tests (As per CTS 2.0)

Source Protocol Tests	Legal Codes
(Normal and packed	Basic Protocol
pixel Mode)	Packet Types
Courses \/idea /Nermal	Pixel Encoding
Source Video (Normal	Video Format Timing
and packed pixel Mode)	Video Quantization test
	AVI Infoframe
Source Audio Tests	Audio Test
	Audio Clock Regeneration Test



## MHL/HDMI Protocol Analysis Software TEK-PGY-MHL/HDMI-PA Data Sheet

### **Oscilloscopes Supported**

Following Tektronix Oscilloscopes are supported. It is recommended to have option 20XL (Maximum of 250M record length per channel) for protocol compliance testing.

- DPO70000 Series Oscilloscope
- MSO70000 Series Oscilloscope
- DSA70000 Series Oscilloscope

#### **Ordering Information**

#### **Option:**

MHL Protocol Analyzer – TEK-PGY-MHL-PA-SW HDMI Protocol Analyzer - TEK-PGY-HDMI –PA-SW MHL/HDMI Protocol Analyzer – TEK-PGY-HDMI-MHL

To order contact the nearest Tektronix Sales office or Prodigy Technovations Pvt Ltd

E- Mail: Contact@prodigytechno.com

Phone: +91-80-3-255-1030

For more details, visit <u>www.prodigytechno.com</u>

#### **About Prodigy Technovations Pvt Ltd**

Prodigy Technovations Pvt Ltd (<u>www.prodigytechno.com</u>) is a leading global technology provider of Protocol Decode and PHY layer testing solutions on test and measurements equipments. The company's ongoing efforts include successful implementation of innovative and comprehensive protocol decode solutions as well as PHY Layer testing solutions that span the serial data, telecommunications, automotive, and defence electronics sectors worldwide.

#### **Other products**

- I2S Electrical, Audio and Protocol Testing Software.
- I2C Electrical and Protocol Analysis Software.
- FlexRay Protocol and SI Analysis Software.
- USB 2.0 Protocol Decode Software.
- SPI Protocol Analysis Software.
- UART/RS232 Protocol Decode solution.

