

D9010MCDP

MIPI C-PHY and D-PHY

Protocol Trigger and Decode

for Infiniium Oscilloscopes

DATA SHEET



The D9010MCDP software package for Infiniium oscilloscopes gives you the ability to decode MIPI C-PHY and D-PHY signals.

This package applies to all Infiniium Oscilloscopes

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Product overview

C-PHY and D-PHY are MIPI Alliance's physical layer (PHY) standards that provide high-throughput performance over bandwidth-limited channels to connect displays and cameras to an application processor. The standards provide a PHY for the MIPI Alliance's various Camera Serial Interface (CSI) and Display Serial Interface (DSI) specifications. This enables engineers to scale their implementations to support a wide range of higher resolution image sensors and displays, while keeping power consumption low. However, because both D-PHY and C-PHY support two application layers, engineers implementing a D-PHY or C-PHY interface must be able to see a device's signal integrity and protocol data to ensure it conforms to the MIPI specification.

MIPI serial buses are the backbone for communication in mobile products. The serial bus interface provides content-rich points for debug and test. However, since these protocols transfer bits serially, using a traditional oscilloscope has limitations. Manually converting captured 1's and 0's to protocol requires significant effort, can't be done in real-time, and includes potential for human error. As well, traditional scope triggers are not sufficient for specifying protocol-level conditions.

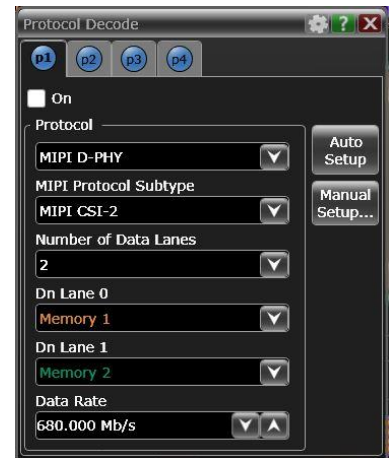


Figure 1. Configure the Infiniium oscilloscope to display D-PHY protocol decode in under 1 minute.

Key features

Protocol searching

Included in Keysight's D9010MCDP software is a suite of configurable, protocol-level conditions for CSI-2 or DSI-2 interface buses that give engineers access to a rich set of integrated protocol-level searching capabilities. This protocol searching feature enables engineers to find and isolate error packets or specific patterns of interest from acquired data.

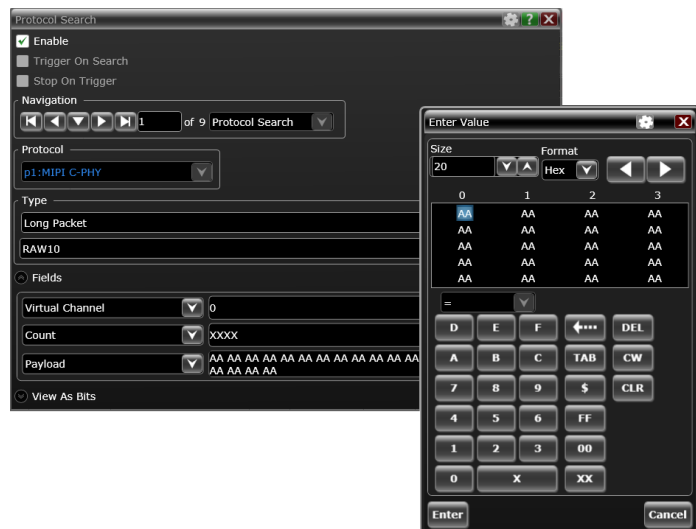


Figure 2. Search specific CSI-2 or DSI-2 packets from the acquired protocol listing.

Protocol decode

D9010MCDP supports CSI-2 and DSI-2 protocol decode based on MIPI D-PHY and C-PHY.

Perform and view decode information on both live and saved waveforms. Decode up to any combination of 4 live or saved waveforms.

The protocol list window is correlated between the waveform and selected packet on the list. The selected packet (highlighted blue row), is time-correlated with the blue line in the waveform display so that engineers can easily see the signal shape of specific packet data.

Keysight provides a unique C-PHY triggered eye diagram function for simultaneously monitoring signal quality and protocol. With this feature, engineers gain greater insight into the C-PHY signal and can better determine whether issues are due to signal quality or protocol data.

Keysight MIPI D-PHY protocol decoder software provides multilane decode up to 4 data lanes. User can select number of data lane from 2 to 4 lanes. However, due to oscilloscope's channel limitation, multilane decode will use recovered clock instead of existing clock in D-PHY. Also, same reason, multilane decode will support only HS data decoding, not LP data.

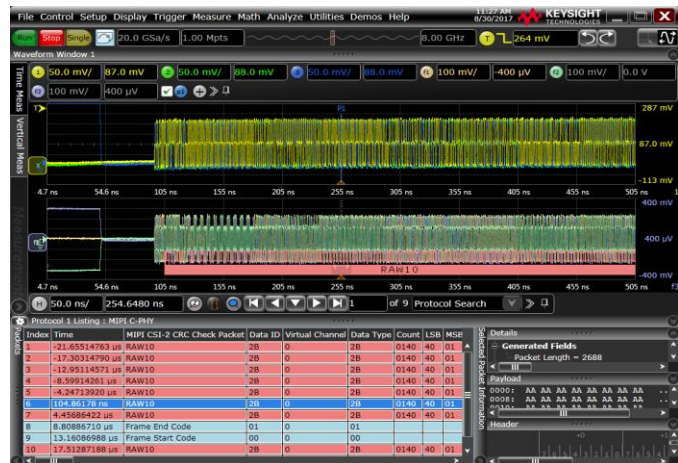


Figure 3. The C-PHY protocol list window

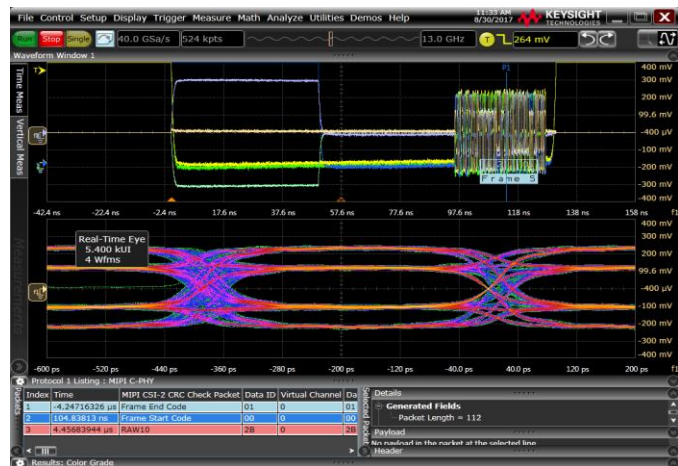


Figure 4. C-PHY triggered eye diagram.

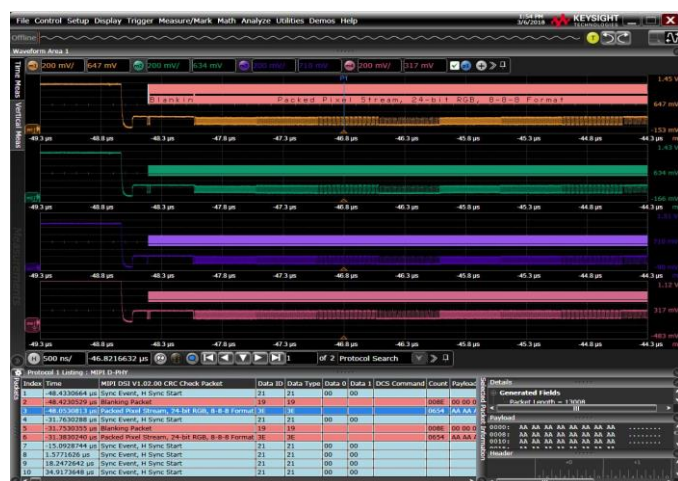


Figure 5. The MIPI D-PHY multilane can decode up to 4-lane design implementation.

MIPI C-PHY

Overview

C-PHY requires few connectors than D-PHY, also does not require a separate clock lane, and provides flexibility to assign individual lanes in any combination to any port on the application processor via software control. Due to similarities in basic electrical specifications, C-PHY and D-PHY can be implemented on the same device pins. 3-phase symbol encoding technology delivers approximately 2.28 bits per symbol over a three-wire group of conductors per lane. This enables higher data rates at a lower frequency, further reducing power.

Recommended connection

To achieve a higher symbol rate from the DUT, Keysight recommends connecting 3 differential active probes for single-end probing. It is also possible to probe differentially so that data can be obtained without having to configure functions. However, due to the long length between positive and negative pins on the differential active probe, the probe bandwidth may not fully cover the signal's bandwidth range as required to see the right signal shape.

The C-PHY decoder software requires 3 differential signals for decoding C-PHY data. A single-end probed signal must therefore be changed to a differential signal for decoding. To accomplish this, use the "Subtract" function to make 3 differential signals from a 3-wire signal before starting to decode the C-PHY protocol. The required signals will be $VAB(VA-VB)$, $VBC(VB-VC)$ and $VCA(VC-VA)$.

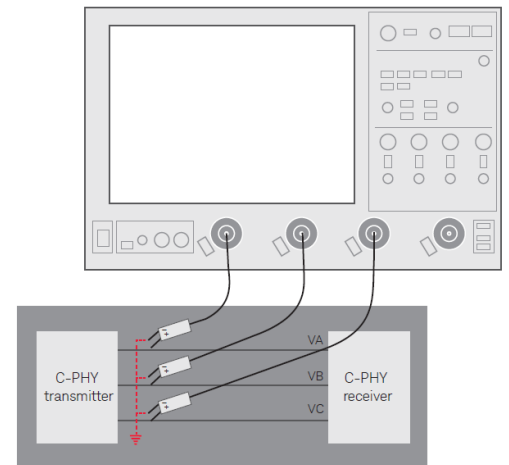


Figure 6. Recommended Probe connection

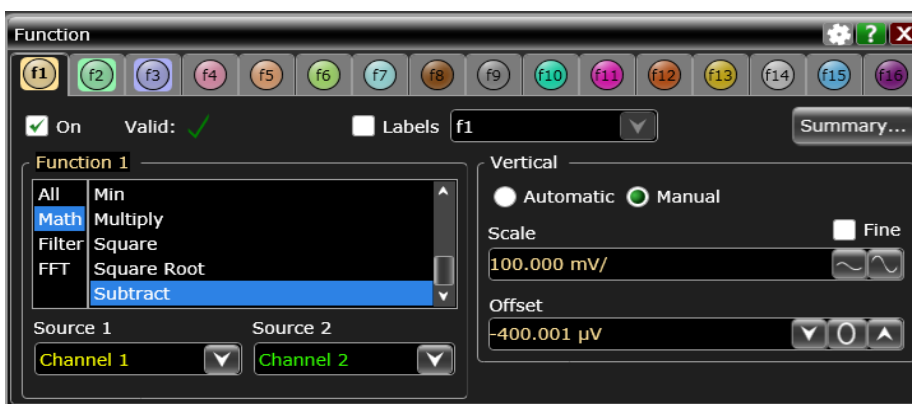


Figure 7. Channel configuration using waveform math.

MIPI C-PHY Specifications and Characteristics

Signal sources (VA, VB, VC)	Any analog channel Any waveform memory
Protocols supported	CSI-2 v1.3 DSI-2 v1.0
Data rate	Up to 3.5 Gsps
Supported lanes	One lane (3 wires) only
Auto setup	Automatically configures trigger levels, decode thresholds, sample rate, memory depth, holdoff, and trigger
Decode options (via search)	Short packet Long packet Errors: any error, bad CRC, bad PHCRC, unknown packet

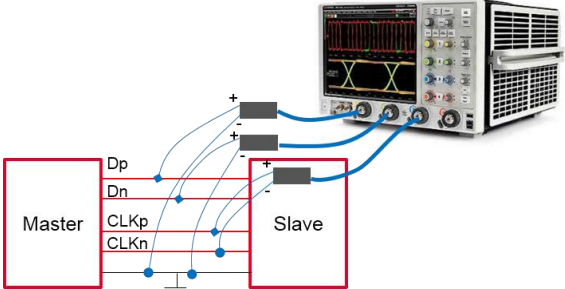
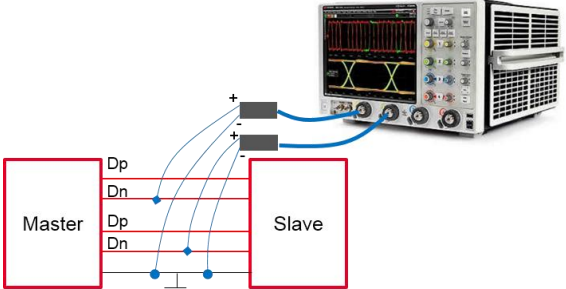
MIPI D-PHY

Overview

D-PHY is a serial interface technology using differential signaling for bandlimited channels with scalable data lanes and a source synchronous clock to support power efficient interfaces for streaming applications such as displays and cameras. It offers half-duplex behavior for applications that benefit from bidirectional communication at transmission rates up to 4.5 Gigabit per lane.

Recommended connection

Keysight MIPI D-PHY decoder supports both one lane and multilane decoding, based on your DUT configuration, each decoding mode require different connection. The table below describes each setup.

One Data Lane	Multilane (2-4 Lanes)
 <p>The diagram shows a Keysight oscilloscope connected to a Master and a Slave device. The Master is connected to the Slave via four differential signal lines: Dp (differential positive), Dn (differential negative), CLKp (clock positive), and CLKn (clock negative). The oscilloscope's input channels are connected to these lines to capture the signals.</p>	 <p>The diagram shows a Keysight oscilloscope connected to a Master and a Slave device. The Master is connected to the Slave via four differential signal lines: Dp (differential positive), Dn (differential negative), Dp (differential positive), and Dn (differential negative). The oscilloscope's input channels are connected to these lines to capture the signals.</p>
<ul style="list-style-type: none">▪ Data Source (Dp) - Selects the Dp (differential positive) lane data source.▪ Data Source (Dn) - Selects the Dn (differential negative) lane data source.▪ Clock - Selects the clock source.	<ul style="list-style-type: none">▪ Dn Lane 0-3 — Selects the waveform source for the Dn (differential negative) data lane number.▪ Dn is used so the low power signal can be detected.▪ Data Rate — Specifies the data rate.▪ The decode requires a Low Power to High Speed transition.

For more information, please refer oscilloscope's help file which installed with oscilloscope software.

MIPI D-PHY Specifications and Characteristics

Signal sources (Clock, Data)	Any analog channel Any waveform memory
Protocols supported	CSI-2 v1.3 DSI v1.01, v1.02, v1.30.10
Data rate	Up to 4.5 Gbps
Supported lanes	One data lane with clock (LPDT supports) 2-4 data lanes without clock (internal clock recovery)
Auto setup	Automatically configures trigger levels, decode thresholds, sample rate, memory depth, holdoff, and trigger
Decode options (via search)	Short packet Long packet Low power data transmission (one data lane case only) Errors: Any error, Bad CRC, Bad ECC, Unknown packet

Hardware Requirements

Recommended oscilloscopes

This protocol decode software is compatible with Keysight's Infiniium Series oscilloscopes running software version 6.30 or higher. Bandwidth recommendations are as follows:

Standard	Data Rate	Minimum Bandwidth	Minimum Channels	Recommended Models
C-PHY	< 1.5 Gsps	4 GHz	3	S-Series
C-PHY	< 2.5 Gsps	6 GHz	3	V, Z, or UXR-Series
C-PHY	< 3.5 Gsps	10 GHz	3	V, Z, or UXR-Series
D-PHY	< 1.5 Gbps	4 GHz	3	S-Series
D-PHY	< 2.5 Gbps	6 GHz	3	V, Z, or UXR-Series
D-PHY	< 4.5 Gbps	12 GHz	3	V, Z, or UXR-Series

Recommended probes

Oscilloscope used	Probes recommended	Accessories recommended
S-Series V-Series Z-Series UXR-Series ¹	Model: 1169B 12 GHz InfiniiMax II C-PHY: 3 active probes D-PHY: 4 active probes	N5442A 50 Precision BNC adapter

1. Depending on the bandwidth of UXR-Series, the channel connector size may vary, requiring different adapters. See UXR-Series datasheet for details.

Ordering Information and Related Literature

Flexible Software Licensing and KeysightCare Software Support Subscriptions

Keysight offers a variety of flexible licensing options to fit your needs and budget. Choose your license term, license type, and KeysightCare software support subscription.

License Terms

- **Perpetual** – Perpetual licenses can be used indefinitely.
- **Time-based** – Time-based licenses can be used through the term of the license only (6, 12, 24, or 36 months).

License Types

- **Node-locked** – License can be used on one specified instrument/computer.
- **Transportable** – License can be used on one instrument/computer at a time but may be transferred to another using Keysight Software Manager (internet connection required).
- **USB Portable** – License can be used on one instrument/computer at a time but may be transferred to another using a certified USB dongle (available for additional purchase with Keysight part number E8900-D10).
- **Floating (single site)** – Networked instruments/computers can access a license from a server one at a time. Multiple licenses can be purchased for concurrent usage.

KeysightCare Software Support Subscription provides peace of mind amid evolving technologies.

- Ensure your software is always current with the latest enhancements and measurement standards.
- Gain additional insight into your problems with live access to our team of technical experts.
- Stay on schedule with fast turnaround times and priority escalations when you need support.

KeysightCare Software Support Subscriptions

Perpetual licenses are sold with a 12 (default), 24, 36, or 60-month software support subscription. Support subscriptions can be renewed for a fee after that.

Time-based licenses include a software support subscription through the term of the license.

Selecting your license

- Step 1.** Choose your software product (e.g. D9010MCDP).
- Step 2.** Choose your license term: perpetual or time-based.
- Step 3.** Choose your license type: node-locked, transportable, USB portable, or floating.
- Step 4.** Depending on the license term, choose your support subscription duration.

Examples

If you selected:	Your quote will look like:	
D9010MCDP node-locked perpetual license with a 12-month support subscription	Part Number D9010MCDP R-B5P-001-A R-B6P-001-L	Description MIPI CSI and DSI Protocol Decode/Trigger Software Node-locked perpetual license KeysightCare software support subscription, node-locked–12 months
D9010MCDP transportable time- based 6-month license	Part Number D9010MCDP R-B4P-001-F	Description MIPI CSI and DSI Protocol Decode/Trigger Software 6-months, node-locked KeysightCare software support subscription

To configure your product and request a quote:

<http://www.keysight.com/find/software>

Contact your Keysight representative or authorized partner for more information or to place an order:

www.keysight.com/find/contactus

Related literature

Type	Description / URL
Brochure	Infiniium S-Series (500 MHz to 8 GHz real time oscilloscope)
Brochure	Infiniium V-Series (8 GHz to 33 GHz real time oscilloscope)
Data Sheet	Infiniium UXR Series (13 GHz to 110 GHz real time oscilloscope)
Brochure	30 Things Only Infiniium Oscilloscopes Can Do

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