TELEDYNE LECROY
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Instruction Manual

MIPI M-PHY Decoder
UniPro Decoder
DigRF v4 Decoder
M-PHY Physical Layer Tests

MIPI M-PHY Decoders and Physical Layer Tests Operator's Manual

922269 Rev A
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Contents

About This Manual

Teledyne LeCroy offers a wide array of toolsets for decoding and debugging serial data streams. These toolsets may be purchased as optional software packages, or are provided standard with some oscilloscopes.

This manual explains how to use the following software:

Assumptions

This manual is presented with the assumption that:

- You have purchased and installed one of the serial data products described in this manual.
- You have a basic understanding of the serial data standard physical and protocol layer specifications, and know how these standards are used in embedded controllers.
- You have a basic understanding of how to use an oscilloscope, and specifically the Teledyne LeCroy oscilloscope on which the option is installed. Only features directly related to serial data decoding are explained in this manual.

Compatibility

Teledyne LeCroy is constantly expanding coverage of serial data standards and updating software. Some capabilities described in this documentation may only be available with the latest version of our firmware. You can download the free firmware update from teledynelecroy.com.

While some of the images in this manual may not exactly match what is on your oscilloscope display—or may show an example taken from another standard—be assured that the functionality is identical, as much functionality is shared. Product-specific exceptions will be noted in the text.

About the Options

Decode

Teledyne LeCroy decoders apply software algorithms to extract serial data information from physical layer waveforms measured on your oscilloscope. The extracted information is displayed over the actual physical layer waveforms, color-coded to provide fast, intuitive understanding of the relationship between message frames and other, time synchronous events.

Measure

The PROTObus MAG option adds a protocol-specific set of measurements to the oscilloscope's standard measurement capabilities and enables you to quickly plot the measurement results.

Graph Measurements

Measurement data can be viewed as a Histogram, Track, or Trend plot of the digitally encoded data values for a specific input versus time. These plots effectively perform a digital-to-analog conversion that can be viewed right next to the decoded waveform.

Filter and Gate Measurements

Measurements can be filtered to include only the specified frame types, IDs, or data patterns. As with all traces, you can set a gate to restrict measurements to a horizontal range of the grid corresponding to a specific time segment of the acquisition.

About the MIPI M-PHYbus Decoder Option

The M-PHYbus D option decodes the lowest physical layers of high-speed, source synchronous interfaces based on the MIPI Alliance specification.

The M-PHYbus DP option adds a complement of physical layer test tools to the decoder. Run 12, simultaneous Clock and/or Data tests selected from a full set of MIPI conformance measurements in High Speed, Pulse Width Modulated, or System Clock Synchronous modes. This advanced set of time-saving measurement and analysis tools shows physical layer measurements and decoded protocol information side-by-side, providing correlation between the physical layer and protocol details. The combination of physical layer test and protocol decode is crucial for quickly determining the root cause of compliance failures.

An installation of SDAII or SDAIII is required to run the MIPI-M-PHY DP option.

The UniPro and DigRF v4bus options may be installed on the same instrument as the MIPI M-PHYbus options to provide a complete MIPI debug toolset. Viewing the UniPro or DigRF v4 layers next to the time-synchronous physical layer provides a unique view that bus analyzers cannot.

About the UniPro Decoder Option

The UniPro D option provides frame- and symbol-level decoding (L1, L1.5, and L2) of MIPI waveforms across four lanes of up- and/or downstream data. Tabular results share the same colorization as the waveform decoding for a highly intuitive view of the signal down to the bit level.

About the DigRF v4bus Decoder Option

The DigRF v4bus D option displays the digital conversion of I and Q RF signals, then decodes the entire DigRF v4 protocol frame structure.

Other features include:

- Automated measurement of IVRms, QVRms, PIQ, IDC, and QDC
- Support for Low-speed (26 Mb/s), Medium-speed (1248 Mb/s), or High-speed (1456 Mb/s) signals
- Conversion of I and Q digital data payload into an I and Q analog waveform (when used with an installation of PROTObus MAG)

Contact Teledyne LeCroy

Registered users can receive free technical support, online and by phone.

For the most complete and up-to-date list of sales and service centers by country, visit teledynelecroy.com/support/contact.

Decoding

Serial Decode Technical Overview

The algorithms described here at a high level are used by all Teledyne LeCroy serial decoders sold for oscilloscopes. They differ slightly between serial data signals that have a clock embedded in data and those with separate clock and data signals.

Bit-level Decoding

The first software algorithm examines the embedded clock for each message based on a default or user-specified vertical threshold level. Once the clock signal is extracted or known, the algorithm examines the corresponding data signal at the predetermined vertical level to determine whether a data bit is high or low. The default vertical level is set to 50% and is determined from a measurement of peak amplitude of the signals acquired by the oscilloscope. It can also be set to an absolute voltage level, if desired. The algorithm intelligently applies a hysteresis to the rising and falling edge of the serial data signal to minimize the chance of perturbations or ringing on the edge affecting the data bit decoding.

NOTE: Although the decoding algorithm is based on a clock extraction software algorithm using a vertical level, the results returned are the same as those from a traditional protocol analyzer using sampling point-based decode.

Logical Decoding

After determining individual data bit values, another algorithm performs a decoding of the serial data message after separation of the underlying data bits into logical groups specific to the protocol (Header/ID, Address Labels, Data Length Codes, Data, CRC, Parity Bits, Start Bits, Stop Bits, Delimiters, Idle Segments, etc.).

Message Decoding

Finally, another algorithm applies a color overlay with annotations to the decoded waveform to mark the transitions in the signal. Decoded message data is displayed in tabular form below the grid. Various compaction schemes are utilized to show the data during a long acquisition (many hundreds or thousands of serial data messages) or a short acquisition (one serial data message acquisition). In the case of the longest acquisition, only the most important information is highlighted, whereas in the case of the shortest acquisition, all information is displayed with additional highlighting of the complete message frame.

User Interaction

Your interaction with the software in many ways mirrors the order of the algorithms. You will:

- Assign a protocol/encoding scheme, an input source, and a clock source (if necessary) to one of the four decoder panels using the Serial Data and Decode Setup dialogs.
- Complete the remaining dialogs required by the protocol/encoding scheme.
- Work with the decoded waveform, result table, and measurements to analyze the decoding.

Decoding Workflow

We recommend the following workflow for effective decoding:

1. Connect your data and strobe/clock lines (if used) to the oscilloscope.
2. Set up the decoder using the lowest level decoding mode available (e.g., Bits).
3. Acquire a sufficient burst of relevant data, then run the decoder.

   NOTE: See Failure to Decode for more information about the required acquisition settings.
4. Use the various decoder tools to verify that transitions are being correctly decoded. Tune the decoder settings as needed.
5. Once you know you are correctly decoding transitions in one mode, continue making small acquisitions and running the decoder in higher level modes (e.g., Words). The decoder settings you verify on a few bursts will be reused when handling many packets.
6. Run the decoder on acquisitions of the desired length.

You can disable/enable the decoder as desired without having to repeat the set up and tuning provided the basic signal characteristics do not change.

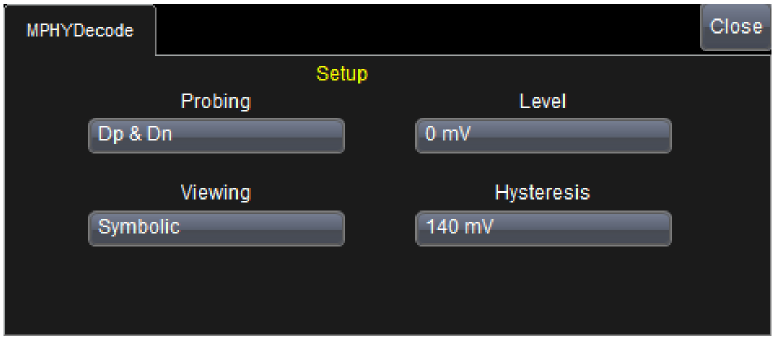
Setting Up the Decoder

The main Serial Decode dialog allows you to preset up-to-four, independent decoders, Decode 1 to Decode 4. Each decoder can use different (or the same) protocols and data sources, or have other variations, giving you maximum flexibility to compare different signals or view the same signal from multiple perspectives.

TIP: After completing setup for one decoder, you can quickly start setup for the other decoders by using the Decode # buttons at the left of the Decode Setup dialog. You don't have to step back to the Serial Decode dialog. Controls with the same label on either dialog share the same function.

1. Touch the **Front Panel Serial Decode button** (if available on your oscilloscope), or choose **Analysis > Serial Decode** from the oscilloscope menu bar to access the Serial Decode dialog.
2. On the same row as the **Decode #**:
   - Check **On** to enable the decoder now. This will let you view the decoding on screen as soon as there is an acquisition, which helps to begin tuning. If you wish, you can wait until all settings are complete to enable the decoder.
   - Select the desired **Protocol** to use.
   - Select the **Data (Source)** to be decoded. This can be any signal input channel (C*x*), memory (M*x*), or math function (F*x*).
3. Touch the **Setup** button (next to Search) to open the Decode Setup dialog. If you use this method rather than the tab, your settings will be correctly pre-selected on the Decode Setup dialog.
4. Go on to complete the settings on the right-hand dialogs next to the Decode Setup dialog.

MIPI M-PHY Decoder Settings



Choose your **Probing** method, one differential probe (Ddiff) or two single-ended probes (Dp & Dn.

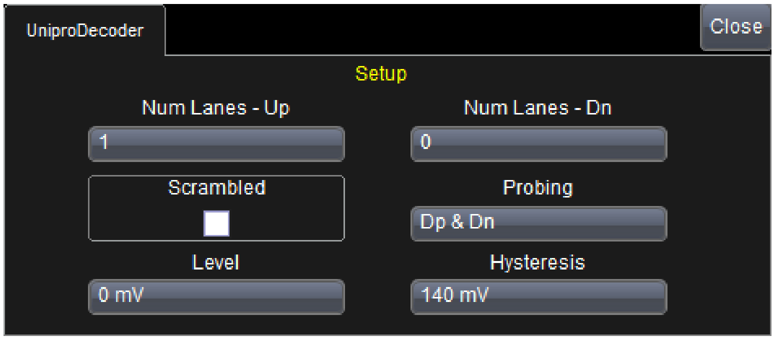
NOTE: The number of Source selectors on the Decode Setup dialog changes to accommodate your Probing choice. If using two probes, be sure to enter both the Dp and Dn inputs.

In **Viewing**, choose to view the extracted data in **Binary**, **Hex**(adecimal), **Symbolic**, or **Symbolic 10b** format.

Enter the voltage **Level** used to determine the edge crossings of the signal.

In **Hysteresis**, enter the amount the signal may rise or fall without affecting bit transition as a voltage value. This can help to stabilize the decoding on noisy signals.

UniPro Decoder Settings



Enter the **Num**(ber of) **Lanes - Up** and **Num**(ber of) **Lanes - Dn**.

NOTE: The total number of lanes is four (4). The number you may select in each field depends on your probing method. The software will enforce this limit.

Select **Scrambled** if the signal is scrambled.

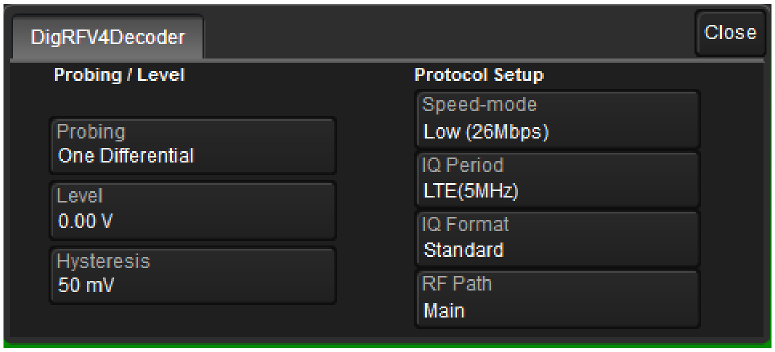
Choose your **Probing** method, either one differential probe (Ddiff) or two single-ended probes (Dp & Dn).

NOTE: The number of Source selectors on the Decode Setup dialog changes to accommodate your Probing choice. If using two probes, be sure to enter both the Dp and Dn inputs.

Enter the voltage **Level** used to determine the edge crossings of the signal.

In **Hysteresis**, enter the amount the signal may rise or fall without affecting bit transition as a voltage value. This can help to stabilize the decoding on noisy signals.

DigRF v4 Decoder Settings



Choose your **Probing** method, either One Differential Probe or Two Single Ended Probes.

NOTE: The number of Source selectors on the Decode Setup dialog changes to accommodate your Probing choice. If using two probes, be sure to enter both the Dp and Dn inputs.

Enter the voltage **Level** used to determine the edge crossings of the signal.

In **Hysteresis**, enter the amount the signal may rise or fall without affecting bit transition as a voltage value. This can help to stabilize the decoding on noisy signals.

Select the **Speed-mode** - Low (26Mbps), Medium (1248Mbps), or High (1456Mbps).

Select the **IQ Period** from the list.

Select an **IQ Format** of either Standard or Custom values. Custom rescales I & Q by a factor of 16.

The **RF Path** control determines how the decoder will extract I and Q data from LC packets. Choose from:

- **Main** - LC packet **ID5**
- **Diversity** - LC packet **ID6**

Enabling/Disabling the Decoder

Once set up, the decoders can be enabled simultaneously or separately, although this number may be limited depending on the type of source channels selected. Decoders can be easily disabled without disrupting the configuration.

To enable: press the **Front Panel Serial Decode button** (if available on your oscilloscope) or choose **Analysis > Serial Decode** to open the Serial Decode dialog, then check **Decode On** next to the respective decoder.

If **View Decode** is checked (default) for that decoder on the Decode Setup dialog, a result table and decoded waveform appear. The number of rows of data displayed on each table will depend on the **Table#Rows** setting. The default is one, which can be increased, but doing so will decrease the amount of the screen available to display traces.

To disable: deselect the **Decode On** box individually, or touch **Turn All Off**.

Failure to Decode

Three conditions in particular may cause the decoder to fail, in which case a failure message will appear in the first row the the decoder result table, instead of in the message bar as usual:

- **Under sampled**. If the sampling rate (SR) is insufficient to resolve the signal adequately based on the bit rate (BR) setup or clock frequency, the message "Under Sampled" will appear. The minimum SR:BR ratio required is 4:1. It is suggested that you use a slightly higher SR:BR ratio if possible, and use significantly higher SR:BR ratios if you want to also view perturbations or other anomalies on your serial data analog signal.
- **Too short acquisition**. If the acquisition window is to short to allow any meaningfull decoding, the message “Too Short Acquisition” will appear. The minimum number of bits required varies from one protocol to another, but is usually between 5 and 50.
- **Too small amplitude**. If the signal’s amplitude is too small with respect to the full ADC range, the message “Decrease V/Div” will appear. The required amplitude to allow decoding is usually one vertical division.

In each case, the decoding is turned off to protect you from incorrect data. Adjust your acquisition settings accordingly, then re-enable the decoder.

NOTE: It is possible that several conditions are present, but you will only see the first relevant message in the table. If you continue to experience failures, try adjusting the other settings, as well.

Reading Waveform Annotations

When a decoder is enabled, an annotated waveform appears on the oscilloscope display, allowing you to quickly read the results of the decoding. A colored overlay marks significant bit-sequences in the source signal. The overlay contains annotations corresponding to the Header/ID, Address, Labels, Data Length Codes, Data, CRC, Parity Bits, Start Bits, Stop Bits, Delimiters, Idle segments, etc. Annotations are customized to the protocol or encoding scheme.

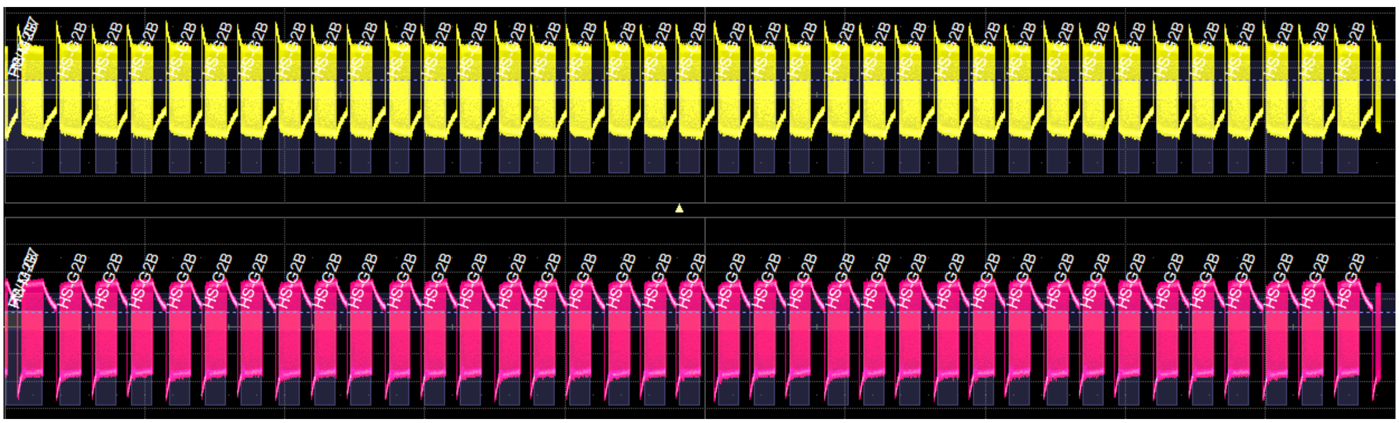
The amount of information shown on an annotation is affected by the width of the rectangles in the overlay, which is determined by the magnification (scale) of the trace and the length of the acquisition. Zooming a portion of the decoder trace will reveal the detailed annotations.

TIP: An easy way to zoom is to touch the row number column of the result table.

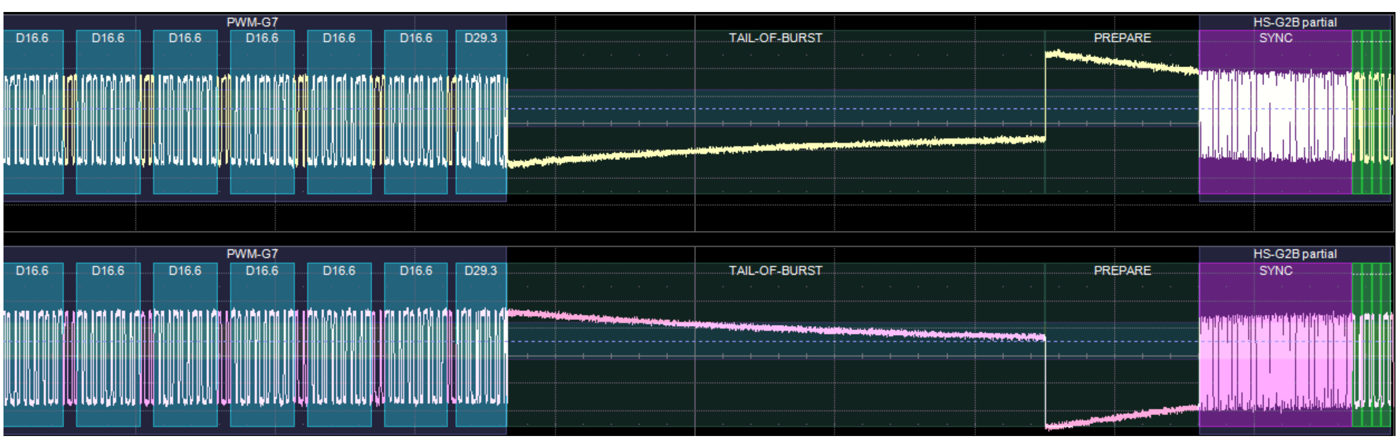
MIPI M-PHY Waveform Annotations

Annotation	Overlay Color (1)	Text (2)
Message burst	Navy Blue (behind data fields)	<Message ID>
Prepare sequence	Dark Green	PREPARE
Sync sequence	Purple	SYNC
Control bits	Green	<Marker>
Payload Data	Aqua Blue	<byte> (e.g., D.16.6)
Tail-of-Burst	Dark Green	TAIL-OF-BURST

1. Combined overlays affect the appearance of colors.
2. Text in brackets < > is variable. The amount of text shown depends on your zoom factors.
3. Data values are shown in Symbolic, Binary, or Hexadecimal format depending on your Viewing selection.



Decoded waveform. At this resolution, little information appears on the overlay.

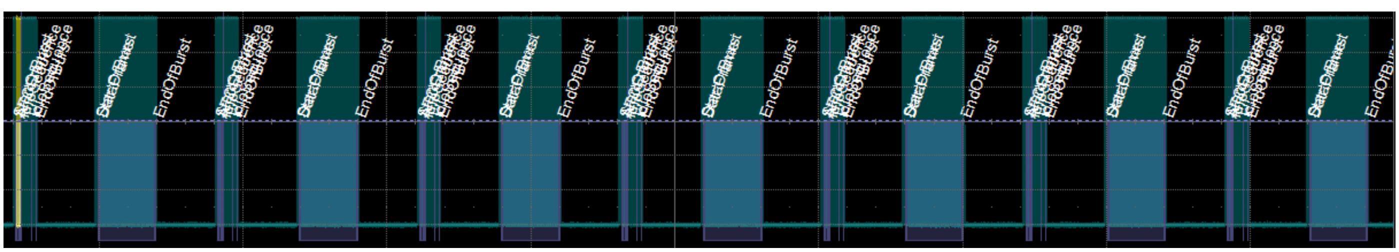


Zoom showing annotation details.

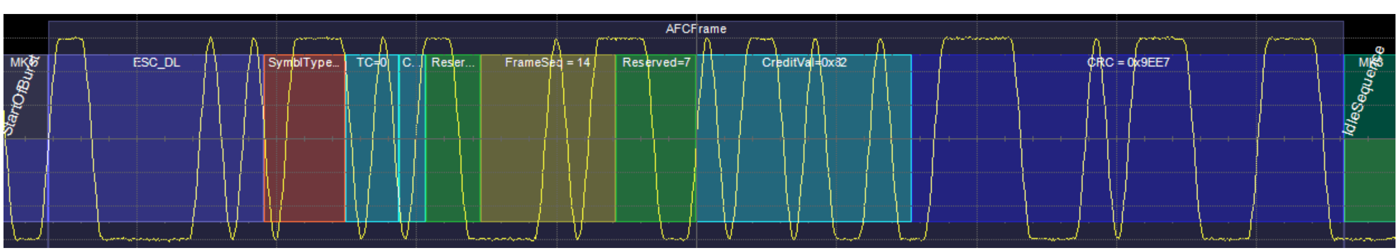
UniPro Waveform Annotations

Annotation	Overlay Color (1) (2)	Text (3)
Frame	Navy Blue (behind other fields)	<Frame Type>
Start of Burst	Violet	MK0 MK1
End of Burst	Violet	MK2
Escaped Data PDU Type	Violet	ESC_<DL | PA>
Symbol Type	Red-Orange	SymbolType=<type>=<number>
End of Frame	Red-Orange	EOF_<Odd=2 | Even=1>
Traffic Class	Cyan	TC = <number>
Credit Value	Blue-green	CReq = <number>
Reserved Bits	Green	Reserved = <number>
Idle Sequence	Green	MK3 FILLER if unscrambled MK3 <symbol> if scrambled
Frame Sequence	Tan	FrameSeq = <number of frame in sequence>
Credit Value	Cyan	CreditVal = <hex code>
Payload Data	Aqua Blue	Data = <hex code>
Cyclic Redundancy Check	Royal Blue	CRC = <hex code>
Skip Sequence Symbol	Purple	SKYPSYM
Error	Red	<Error Message> (e.g., Unknown PA Frame Type)

1. Combined overlays affect the appearance of colors.
2. Similar colors demarcate boudaries between sub-fields within a UniPro symbol which fall into the same category (e.g., adjacent data bytes or adjacent control flags/symbols).
3. Text in brackets < > is variable. The amount of text shown depends on your zoom factors.



Decoded waveform. At this resolution, little information appears on the overlay.

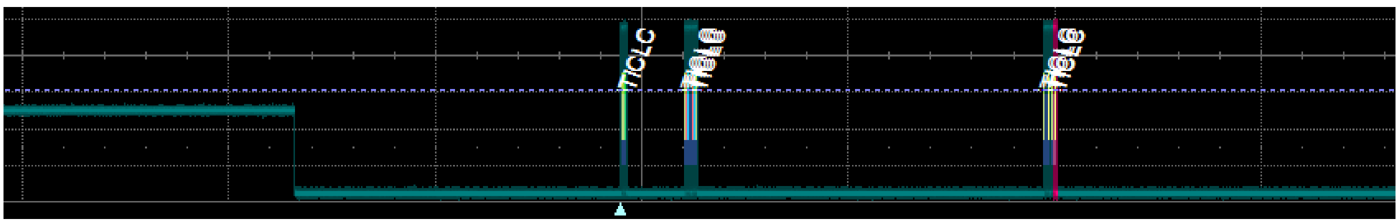


Zoom showing annotation details.

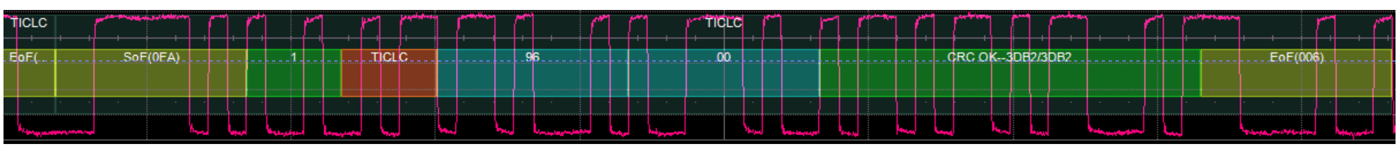
DigRF v4 Waveform Annotations

Annotation	Overlay Color (1)	Text (2)
Message burst	Navy Blue (behind other fields)	<Message ID> [1]
Start/End of Frame	Olive Green	SoF(<decoded bits>) EoF(<decoded bits>)
CRI number	Green	<number>
Logical Channel	Red	<logical channel type code>
Data	Aqua Blue	<decoded data words>
Cyclic Redundancy Check	Green	CRC OK--<decoded bits>

1. Combined overlays affect the appearance of colors.
2. Text in brackets < > is variable. The amount of text shown depends on your zoom factors. Data is shown in Binary or Hexadecimal format depending on your Viewing selection.



Decoded waveform. At this resolution, little information appears on the overlay.



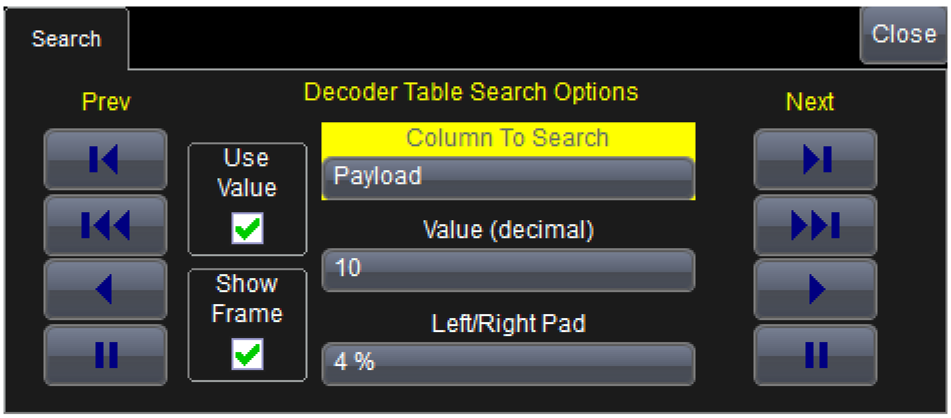
Zoom showing annotation details.

Searching Waveforms

Selecting the **Search** Action button on the Decode Setup dialog opens the decoder Search dialog, where you can enter criteria for finding events of interest in the waveform: various protocol elements, data values, errors, etc. **Prev** and **Next** buttons then navigate to matches found in the decoded waveform, simultaneously creating a zoom of each match.

The default zoom always shows the matching data (plus any padding) at the full width of the grid. Use the standard Zoom controls to rescale the zoom to the desired level of magnification.

NOTE: The functionality of this dialog is the same for all MIPI decoders, although the data fields available in Column to Search will change.



Choose the result table **Column to Search** for matching data. Unless you enter a Value, search will go to the beginning of the next occurence of that data field in the acquisition.

Optionally:

- Enter the **Value** to find in that column. Check **Use Value** to enable this control.

  TIP: These controls will not appear when there is no capability to find a specific value in that column.

- Enter a **Left/Right Pad**, the percentage of horizontal division around matching data to display on the zoomed waveform.
- Check **Show Frame** to mark on the overlay the frame in which the event was found.

Use the **Prev** and **Next** buttons to view the search results.

Serial Decode Result Table

By default, a table summarizing the decoder results appears below the grids whenever a decoder is enabled. The result table provides a view of message data as decoded during the most recent acquisition, even when messages are too compact to allow annotation on the waveform trace.

The table is displayed only when the **View Decode** checkbox is marked on the Decode Setup Dialog *and* a source signal has been decoded using that protocol.

Selecting a number in the first (index) column of the table will display a zoom of the corresponding position in the decoded waveform.

You can customize the result table, changing both the number of rows and the columns displayed. The default is one row. On a single-row table, touch the Down arrow at the far right to open a scrollbar that lets you display the previous or next row of data.

NOTE: If a selected column is not relevant to the decoding selections, the column will not appear in the table.

You can also export result table data to a .CSV file, and the table itself is useful for measuring.

MIPI M-PHY Decoder Result Table

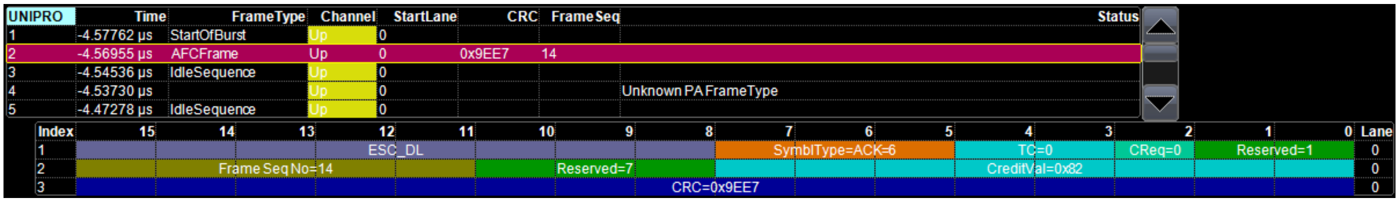
Column	Extracted or Computed Data
Index (always shown)	Number of the line in the table; also number of the message in the annotation overlay on the trace.
Time	Time elapsed from start of acquisition to Start of Frame.
Msg	Transmission mode and GEAR.
Data	Decoded data bytes.
BitRate/Msg	Calculated bitrate of the message.

MIPI M-P...	Time	Msg	Data	Bit Rate/Msg
1	-9.63901 µs	PWM-G7	D16.6	434.647 Mbit/s
2	-9.61326 µs	HS-G2B		1.699484 Gbit/s
3	-8.84640 µs	HS-G2B		2.912296 Gbit/s

Section of typical MIPI M-PHY decoder result table.

UniPro Result Tables

Two result tables are shown beneath the annotated waveform display.



Typical UniPro decoder result tables showing frame decoding on top and symbol decoding below it.

Frame Table

This table shows a frame-level decoding of the signal. Columns can be hidden by customizing the result table.

Column	Extracted or Computed Data
UniPro (Idx)	Number of the line in the table; also the number of the frame in the transmission.
Time	Time elapsed from start of acquisition to start of frame.
FrameType	Frame type description (e.g., Start of Burst, Data Frame, AFC Frame, Idle Sequence, End of Burst).
Channel	Upstream (Up) or downstream (Down) channel. Up is colored yellow. Down is colored blue.
Start Lane	Lane on which frame started. If there is only one lane, the value is always 0.
CRC	Cyclic Redundancy Check sequence hexadecimal value. A green cell indicates a correct CRC; a red cell indicates an error.
FrameSeq	Sequence number of data link frame.
Status	Any errors or other processing messages.

Symbol Table

The symbol table shows a decoding of the frame elements and their values as transmitted across all 16 bits of the symbol. The colorization of the table cells matches what is shown on the waveform annotation overlay. This table cannot be customized.

Column	Extracted or Computed Data
Index	Number of the line in the table; also number of the symbol in the frame.
(Bits) 15 - 0	Frame element and value transmitted by that bit. Where multiple bits are used to transmit a single element, those cells share the same color. They are the same elements and colors as appear in the waveform decoding.
Lane	The lane on which the symbol was transmitted, 0 to 3.

DigRF v4 Result Table

Column	Extracted or Computed Data
Index (always shown)	Number of the line in the table; also number of the message in the annotation overlay on the trace.
Time	Time from start of acquisition to Start of Frame.
SoF	Start of Frame symbol.
LCID	Logial Channel type (e.g., TICLC, THLCLC, TACLC).
CRI	Cyclic Running Index number.
TxRx	Tx = transmitter side message; Rx = receiver side message.
WordName	Decoded word name.
Comment	Plain text description of word.
Size	Payload size.
Payload	Data bytes.
I Data	Decoded I data.
Q Data	Decoded Q data.
Header Type	Header type code (1 = 8-bit | 2 = 16-bit) .
RTI	Retransmission Indicator (0 = original | 1 = retransmitted).
CRC	16-bit Cyclic Redundancy Check sequence.
EoF	End of Frame symbol.

MIPI DigR...	Time	SoF	LCID	CRI	TxRx	Word Name	Comment	Si...	Payload	I Data	Q Data	H...	RT	CRC	E
7	410 µs	SoF(0FA)	TICLC	6	Tx	TXDATA_SUB_R...	TxData Sublink Rate	2	30 01				0	CRC OK--4243/4243	E
8	413 µs	SoF(305)	TICLC	7	Tx	DUMMY_FRAME	Dummy Frame	2	96 00				0	CRC OK--A6D9/A6D9	E
9	417 µs	SoF(0FA)	TICLC	0	Tx	CONF_TRIG	Configuration Trigger	2	08 3D				0	CRC OK--A2CB/A2CB	E
10	420 µs	SoF(0FA)	TICLC	1	Tx	DUMMY_FRAME	Dummy Frame	2	96 00				0	CRC OK--3DB2/3DB2	E

Section of typical DigRF v4 decoder result table.

Customizing the Result Table

NUMBER OF COLUMNS

Follow these steps to change what data appears in the result table:

1. Press the Front Panel **Serial Decode button** or choose **Analysis > Serial Decode**, then open the **Decode Setup tab**.
2. Touch the **Configure Table** button.
3. On the **View Columns** pop-up dialog, mark the columns you want to appear in the table, clear any columns you wish to remove. Only those columns selected will appear on the oscilloscope display.

   To return to the preset display, touch **Default**.
4. Touch the **Close** button when finished.

BIT RATE TOLERANCE

On some decoders, you may also use the View Columns pop-up to set a **Bit Rate Tolerance** percentage. When implemented, the tolerance is used to flag out-of-tolerance messages (messages outside the user-defined bitrate +- tolerance) by colorizing in red the Bitrate shown in the table.

NUMBER OF ROWS

You may customize the size of the result table by changing the **Table # Rows** setting on the Decode Setup dialog. Keep in mind that the deeper the table, the more compressed the waveform display on the grid, especially if there are also measurements turned on.

Zooming with the Result Table

Besides displaying the decoded serial data, the result table enables you to quickly Zoom regions of the decoded waveform and access other functionality.

Touching the **Index (row) number** in the first column opens a Zoom of the corresponding region in the decode trace. This is a quick way to navigate to events of interest in the acquisition.

The **Index column heading** (top, left-most cell of the table header) bears the name of the corresponding protocol, and the cell's fill color matches the color of the input source. Touching this cell opens the Decode Setup dialog if it has been closed.

Touching any other **data cell** in the table opens a pop-up menu with several choices of action:

- **Off** turns off the decoder .
- **Zoom** creates a zoom of the region where the data appears (same as touching the row number).
- **Setup** opens the Decoder Setup dialog (same as touching the first column heading).
- **Export** exports the decode results table to a .CSV file.
- **Measure** displays a choice of measurements that can be made on the decoded signal.

Exporting Result Table Data

You can manually export the decoder result table data to a **.CSV** file:

1. Press the Front Panel **Serial Decode button**, or choose **Analysis > Serial Decode**, then open the **Decode Setup tab**.
2. Optionally, touch **Browse** and enter a new **File Name** and output folder.
3. Touch the **Export Table** button.

Export files are by default created in the D:\Applications\<protocol> folder, although you can choose any other folder on the oscilloscope or any external drive connected to a host USB port. The data will overwrite the last export file saved in the protocol directory, unless you enter a new filename.

In addition, the oscilloscope Save Table feature will automatically create tabular data files with each acquisition trigger. The file names are automatically incremented so that data is not lost. Choose **File > Save Table** from the oscilloscope menu bar and select **Decode#** as the source. Make other file format and storage selections as you wish.

Measuring

If you have installed any -TDM option or PROTObus MAG, these general measurements designed for debugging serial data streams can be applied to the decoded waveform. Measurements appear in a tabular readout below the grid (the same as for any other measurements) and are in addition to the result table that shows the decoded data. You can set up as many measurements as your oscilloscope has parameter locations.

NOTE: Depending on the protocol, measurements may appear in a sub-menu of the Measure Setup menu and may have slightly different names. For example, the CAN sub-menu has measurements for CANtoValue instead of Message to Value, etc. The measurements are the same.

Measurement	Description
View Serial Encoded Data as Analog Waveform	Automatically sets up a Message to Value parameter and then tracks the assigned measurement. In doing so, a Digital-to-Analog Conversion (DAC) of the embedded digital data is performed and the digital data is displayed as an analog waveform.
Message to Value	Extracts and converts a specific portion of the data/payload in the message and displays it as an analog value.
MsgToAnalog (Message to Analog)	Computes time from start of first message that meets conditions to crossing threshold on an analog signal. Result is negative if analog event precedes message. You must choose the digital input in Source1 and the analog input in Source 2 for this measurement to work properly.
AnalogToMsg (Analog to Message)	Computes time from crossing threshold on an analog signal to start of first message that meets conditions. Result is negative if message precedes analog event. You must choose the analog input in Source 1 and the digital input in Source 2 for this measurement to work properly.
MsgToMsg (Message to Message)	Computes time difference from start of first message that meets conditions to start of next message.
DeltaMsg (Delta Message)	Computes time difference between two messages on a single decoded line.
Time@Msg (Time at Message)	Computes time from trigger to start of each message that meets conditions.
BusLoad	Computes the load of user-defined messages on the bus (as a percent).
MsgBitrate	Computes the bitrate of user-specified messages on decoded traces.
NumMessages (Number of Messages)	Computes the total number of messages in the decoding that meet conditions.

Graphing Measurements

Measure and graph options include simplified methods for plotting measurement values as:

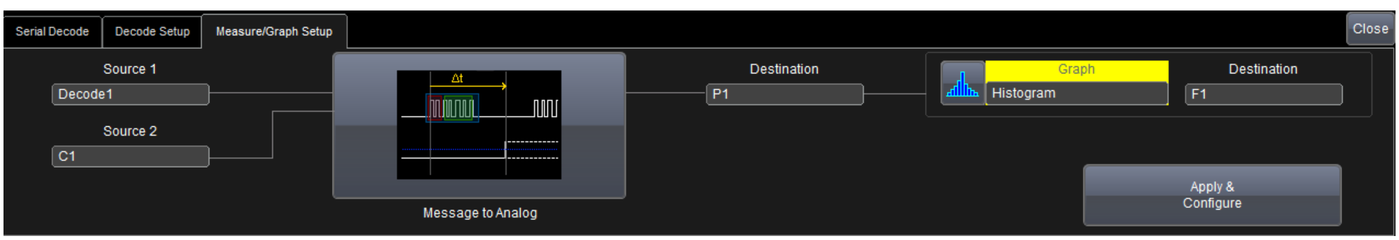
- **Histogram** - a bar chart of the number of data points that fall into statistically significant intervals or bins. Bar height relates to the frequency at which data points fall into each interval/bin. Histogram is helpful to understand the modality of a parameter and to debug excessive variation.
- **Trend** - a plot of the evolution of a parameter over time. The graph's vertical axis is the value of the parameter; its horizontal axis is the order in which the values were acquired. Trending data can be accumulated over many acquisitions. It is analogous to a chart recorder.
- **Track** - a time-correlated accumulation of values for a single acquisition. Tracks are time synchronous and clear with each new acquisition. Track can be used to plot data values and compare them to a corresponding analog signal, or to observe changes in timing. A parameter tracked over a long acquisition could provide information about the modulation of the parameter.

To graph a measurement, just select the plot type from the Measure/Graph dialog when setting up the measurement.

All plots are created as Math functions, so also select a function location (Fx) in which to draw the plot. The plot will open along side the deocoding in a separate grid.

Using the Measure/Graph Dialog

The Measure/Graph dialog, which appears behind the Decode Setup dialog when measurements are supported, is a quick way to apply parameters specifically designed for serial data measurement and simultaneously graph the results.



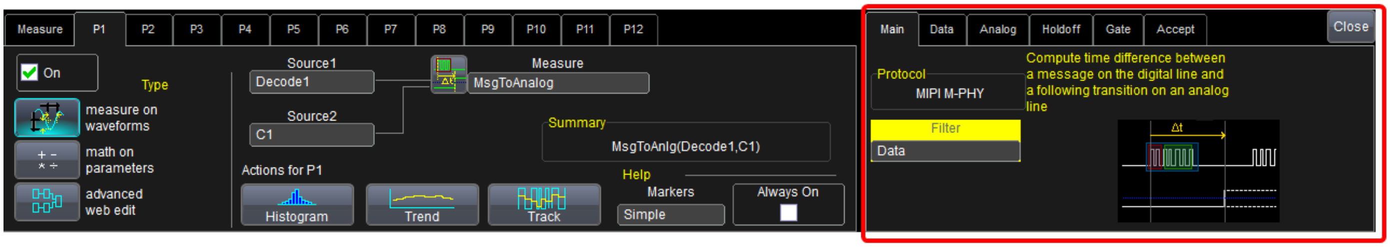
1. Select the **Measurement** to apply and the **Destination** parameter location (Px) in which to open it.
2. The **Source 1** decode is preselected; change it if necessary. If the measurement requires it, also select Source 2.
3. Optionally, choose a **Graph** format and the **Destination** math function location (Fx) in which to open it.
4. Optionally, set a measurement gate or filter. Touch **Apply & Configure** and make all required settings on the Measure right-hand dialogs that appear.

NOTE: The Serial Decode measurements are also available from the standard Measure setup menu. You can use the that functionality to set up as many measurements as your instrument has parameters.

Filtering Serial Decode Measurements

After applying a measurement to the decoded waveform on the Measure/Graph dialog, set filter conditions on the right-hand dialogs that appear next to the P*x* dialogs.

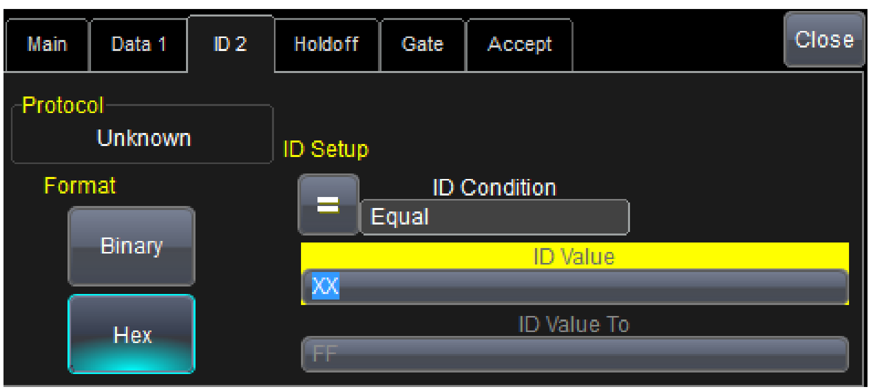
NOTE: Not all protocols or measurements support all filter types.



Frame ID Filter

This filter restricts the measurement to only frames with a specific ID value.

1. On the Main dialog, in **Filter** choose ID or ID+Data.
2. Open the **ID tab** that appears.



3. Choose to enter the frame ID value in **Binary** or **Hex**(adecimal) format.
4. Using the **ID Condition** and **ID Value** controls, create a condition statement that describes the IDs you want included in the measurement. To set a range of values, also enter the **ID Value To**. On the pop-up dialog that appears when you touch ID Value:
    - Use the Left and Right arrows to position the cursor.
    - Use Back to clear the previous character (like Backspace), Use Clear to clear all characters.

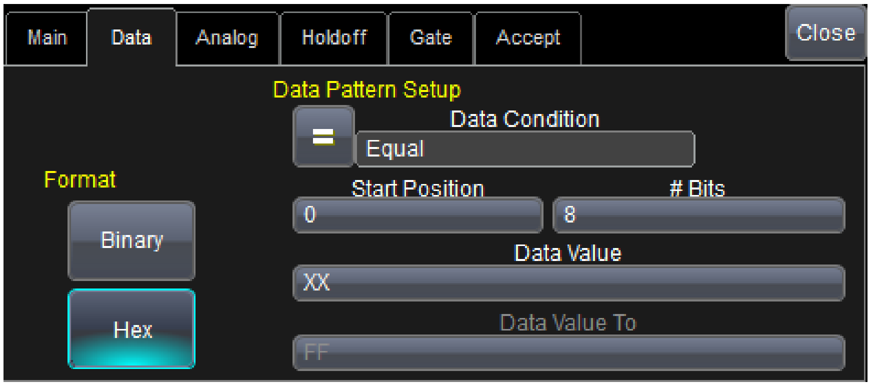
Data Filter

This restricts measurements to only frames containing extracted data that matches the filter condition. It can be combined with a Frame ID filter by choosing ID+Data on the Main dialog.

Use the same procedure as above to create a condition describing the **Data Value(s)** to include in the measurement. Use "X" as a wild card ("Don't Care") in any position where the value doesn't matter.

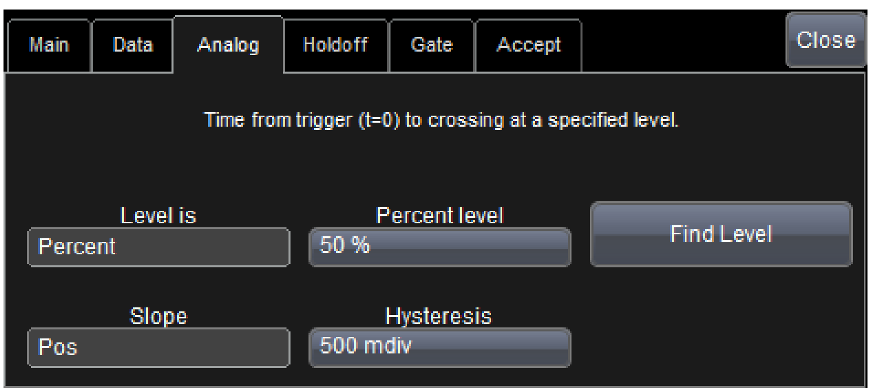
Optionally, enter a **Start Position**within the data field byte to begin seeking the pattern, and the **# Bits** in the data pattern. The remaining data fields positions will autofill with "X".

NOTE: For MsgtoMsg measurements, the data condition is entered twice: first for the Start Message and then for the End Message. The measurement computes the time to find a match to each set of conditions.



Analog Filter

This filter applies only to parameters that measure the decoded waveform relative to an analog signal: AnalogtoMsg and MsgtoAnalog. It allows you to set the crossing level and slope of the Analog signal event that is to be used in the measurement. Level may be set as a percentage of amplitude (default), or as an absolute voltage level by changing Level Is to Absolute. You can also use Find Level to allow the oscilloscope to set the level to the signal mean.



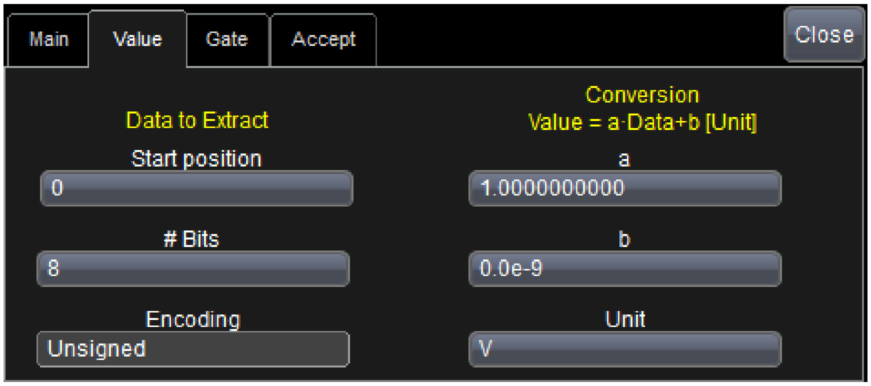
The optional Hysteresis setting imposes a limit above and below the measurement Level, which precludes measurements of noise or other perturbations within this band. The width of the band is specified in milli-divisions.

Observe the following when using Hysteresis:

- Hysteresis must be larger than the maximum noise spike you wish to ignore.
- The largest usable hysteresis value must be less than the distance from the Level to the closest extreme value of the waveform.

Value Conversion Filter

This filter applies only to the MsgtoValue parameter. It enables you to apply a value conversion to extracted data. The converted values appear in the result table.



1. Under Data to Extract, begin by entering the **Start position** and the **# Bits** to extract.
2. Choose the **Encoding** type if the signal uses encoding, otherwise leave it Unsigned.
3. Under Conversion, enter the **a. Coefficient** and **b. Term** that satisfy the formula:
   *Value = Coefficient * Raw Value + Term*.
4. Optionally, enter a **Unit** for the extracted decimal value.

Holdoff, Gate, and Accept

Certain measurements support holdoff, gating, or additional qualifiers (Accept). You will see the tab appear among the Measure set up dialogs when the function is supported. When applied to serial data measurement, these functions work exactly as they do elsewhere in the oscilloscope:

- **Holdoff** specifies the amount of time or number of events to wait before starting the measurement.
- **Gate** specifies the Start Div and Stop Div that bound the portion of the acquisition to include in the measurement.
- **Accept** allows you to set qualifiers based on waveform state, either the measurement source or a second "gating" waveform, or to only accept measurement values that fall within pre-defined ranges.

See the oscilloscope *Operator's Manual* or *Getting Started Manual* for more information.

Using the Result Table

To quickly apply serial data measurements when the serial data setup dialogs are closed:

1. Touch any **data cell** of the decode result table.

   NOTE: If you're running more than one decoder simultaneously, be sure to select a cell from the correct table, as the measurement source will be whichever waveform belongs to the table you touch.

2. From the pop-up menu, select **Measure** to display the Select Operation... dialog.

3. Touch any measurement operation to select it.
4. On the next dialog, choose a **parameter** location (P1-Px) in which to run the measurement.

   NOTE: If you choose a location that already stores a measurement, this selection will overwrite that setup.

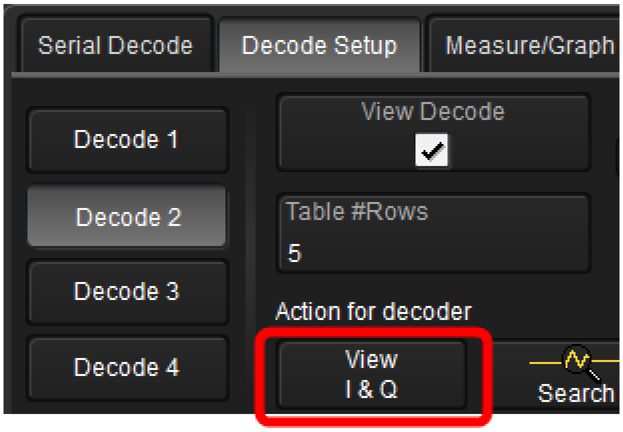
5. To filter or gate the parameter, touch the Px cell of the readout table and make the desired settings on the right-hand dialogs that appear.

Using the Decode Setup Dialog

You can also access serial data measurements by touching the **Measure button** on the Decode Setup dialog. When using this button, measurements are set on the source of whichever Decoder (1-4) is currently selected on the Decode Setup dialog.

I and Q Signal Constellation Diagram and Measurements

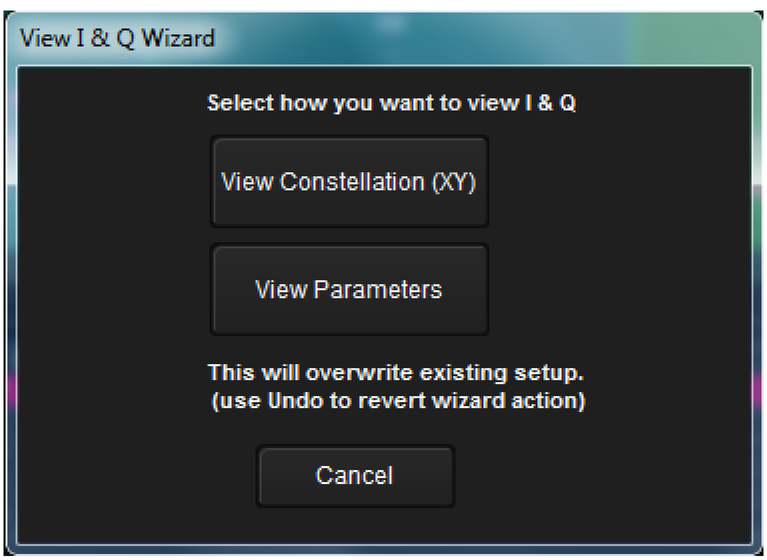
The installation of PROTObus MAG activates the **View I & Q** button on the main Decode Setup dialog when the DigRF v4 protocol is selected.



This feature enables you to:

- Generate a constellation (XY) diagram from the converted I and Q signals. The diagram appears next to the decoded waveform.
- Display the full set of DigRF v4-specific parameters (IVrms, QVrms, PIQ, IDC, QDC) in the measurement table below the display grid.

Touch **View I & Q** to display the **View I & Q Wizard** and make your selection.



NOTE: The diagram and parameters can be displayed together, but you will have to go into the dialog twice and select them separately.

DigRF v4 I and Q display available with PROTObus MAG.

M-PHY Physical Layer Tests

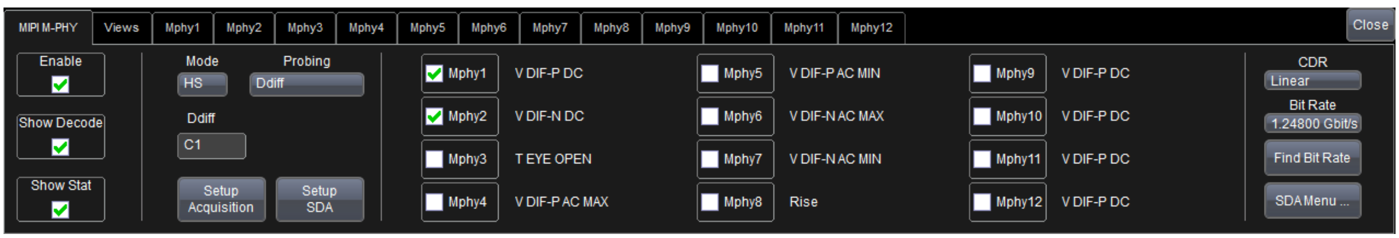
The MIPI M-PHY DP option enables you to run Transmitter-side (Tx) physical layer tests defined by the MIPI specification concurrent with the waveform decoding. This allows you to gain insight into signal performance that is useful for debugging prior to compliance testing. Tests are available in all categories (electrical, timing, slew rate, etc.) and may be run in High Speed (HS), Pulse Width Modulated (PWM), or System-Clock Synchronous (SYS) modes.

NOTE: The MIPI M-PHY DP option requires an installation of the Teledyne LeCroy SDAII or SDA III option. You will not be able to access the dialogs without it.

To access the M-PHY physical layer tests, choose **Analysis > MIPI M-PHY** from the menu bar.

Define Test Mode and Inputs

To begin physical layer testing, select the test mode in which to run and define the test inputs. The available tests will vary depending on the test mode.



1. From the menu bar, choose **Analysis > MIPI M-PHY**.
2. Select the **Enable** checkbox. This turns on the waveform with the decoding overlay and the test measurement table. To turn off the overlay, deselect **Show Decode**.
3. To add statistics to the M-PHY measurement table, select **Show Stats**. The default table shows only the last calculated measurement.
4. Choose the **Test Mode**: HS (High Speed), PWM (Pulse Width Modulated), or SYS (System-Clock Synchronous).
5. Choose the **Probing** method in use: Ddiff (single differential probe), Dp & Dn (two single-ended probes), or CM (single probe acquiring Common Mode).
6. For each input required by the probing method, select the source channel.
7. Choose a **CDR** (Clock Data Recovery) method of:
   - Linear—best-fit recovered clock to acquired data
   - Filtered—using the second-order JTF function defined in the M-PHY Specification, Section 5.1.2.7, for HS-TX Total Jitter and HS-TX Deterministic Jitter.
   - Short-Term—filtered with the HSTJ-TX(f) highpass filter defined in the M-PHY Specification, Section 5.1.2.7, for HS-TX Short Term Total Jitter.
8. Enter the **Bit Rate** of the bus. If you do not know the bit rate, Choose **Find Bit Rate** to allow the software to calculate a bit rate based on the signal average.

Set Up Acquisition

If you have not already done so, make acquisition settings for the selected input sources. To do this, you may:

- Manually enter the settings on the channel setup dialogs. Use the Vertical menu to access the dialogs. Be sure to also set up the acquisition trigger.
- Use the **Setup Acquisition** button on the MIPI M-PHY dialog. The software makes the following settings:
  - **HS Mode**: channels are set to 200 mV/div, -600 mV offset, and an Edge trigger is applied to the signal.
  - **PWM Mode**: channels are set to 200 mV/div, -600 mV offset, and a Qualified-Pattern trigger is applied to the signal for capturing the ULPS sequence.
  - **SYS Mode**: channels are set to 200 mV/div, -600 mV offset, and a Qualified-Pattern trigger is applied to the signal for capturing the ULPS sequence.

The **SDA Setup** button will copy the acquisition settings made in MIPI- MPHY to the SDA application.

To quickly access the SDA dialogs, touch the **SDA Menu** button at the far right of the MIPI M-PHY dialog.

TIP: If you exit the MIPI M-PHY dialog to manually make acquisition settings, touch the far left cell of the MIPI M-PHY measurement table to return to the M-PHY dialogs.

Choose Tests and Waveform Views

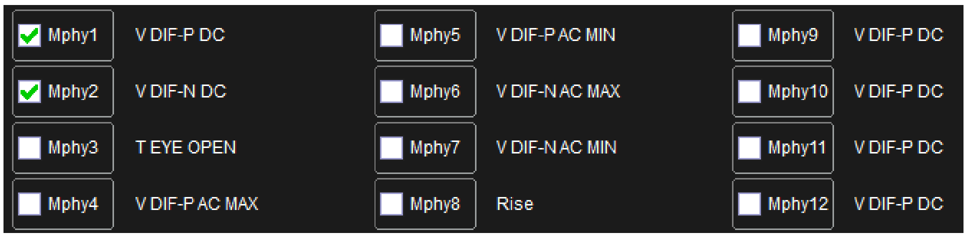
After setting up the acquisition, go on to choose the test measurements and waveform views.

Running PHY Test Measurements

Up to 12 test measurements may be run simultaneously on the acquisition. You choose from among the standard MIPI conformance tests in each category (electrical, Tx, etc.) and configure them for your signal. As with the waveform views, the options will vary depending on the test mode selection.

Enable/Disable Tests

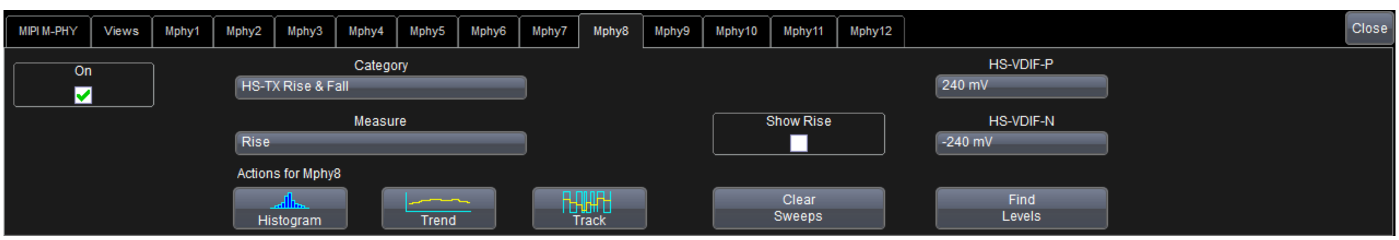
All tests are enabled by default when you select a test mode. If a measurement has been turned off, you can quickly re-enable it by marking its respective checkbox (Mphy#) in the test summary area of the MIPI M-PHY dialog.



TIP: You can also enable/disable measurements from the Mphy# dialogs.

Configure Tests

1. Complete the test mode and input selection on the MIPI-M-PHY dialog.
2. For each of the 12 possible tests, open the Mphy# dialog and make any other settings required for the measurement. These are described with the tests below.



3. Use the Histogram, Track, and Trend buttons on the Mphy# dialog to quickly plot the test measurements on a separate grid.

HS Tests

These tests are available when in HS test mode.

NOTE: Some tests may not be available depending on your probing method.

HS-TX Electrical Tests

These tests are only available when probing Ddiff or Dp & Dn.

Measure	Description
V DIF-P DC	To verify that the Differential DC Output Voltage Amplitude (VDIF_DC_xx_xx_TX) of the DUT's transmitter is within the conformance limits, for both Large and Small Amplitudes, and for both terminated and unterminated cases.
V DIF-N DC	
T EYE-OPEN	The transmitter eye opening TEYE_TX is defined as the duration in an eye diagram over which the absolute value of the differential HS-TX output signal is larger than the lower limit of VDIF_AC_TX when the HS-TX transmits a test pattern into a reference load RREF. Enter the voltage level at which to measure the Eye width in **Opening Level**. Check **Auto threshold** to automatically calculate the level.
V DIF-P AC MAX	To verify that the Differential AC Output Voltage Amplitude (VDIF_AC_xx_xx_TX) of the DUT's transmitter is within the conformance limits, for both Large and Small Amplitudes, and for both terminated and unterminated cases.
V DIF-P AC MIN	
V DIF-N AC MAX	
V DIF-N AC MIN	

HS-TX Common-Mode Tests

These tests are only available when probing Dp & Dn or CM.

Measure	Description
VCM-TX-PREPARE	To verify that the Common-Mode DC Output Voltage Amplitude (VCM-TX) of the DUT's HS-TX is within the conformance limits, for all combinations of supported Amplitudes, Terminations, LANEs, and HS GEARs.
VCM-TX-TAIL	
VCM-TX	
PSD Margin	To verify that the Common-Mode AC Power Spectral Magnitude of the DUT's HS-TX is below the conformance limit, for Large and Small Amplitudes, in Terminated mode, for all Lanes, for HS-G1.

HS-TX Rise & Fall Tests

These tests are only available when probing Ddiff or Dp & Dn.

Measure	Description
Rise	To verify that the 20%-80% Rise and Fall Times of the DUT's HS-TX are within the conformance limits. Enter the voltage level for **HS-VDIF-P** and **HS-VDIF-N**, or choose **Find Level** to autoset the level. Check **Show Rise/Fall** to turn on the rise time plot.
Fall	

HS-TX Slew Rate Tests

These tests are only available when probing Ddiff or Dp & Dn.

Measure	Description
SR DIF P SR DIF N	To verify the Slew Rate of the DUT's HS-TX is within the conformance limits, for all supported Amplitudes, in Terminated mode. This measurement is also used to verify the Slew Rate Monotonicity and Resolution of the DUT. Enter the voltage level in **HS-VDIF-P** and **HS-VDIF-N**, or choose **Find Level** to autoset the level.

HS-TX Skew Tests

These tests are only available when probing Dp & Dn.

Measure	Description
Intra-L Skew	To verify that the Intra-Lane Output Skew of the DUT's HS-TX is within the conformance limits, for all combinations of supported Amplitudes, Terminations, LANEs, and HS GEARs. Enter the transmitter common-mode voltage in **VCM-TX**.

HS-TX Jitter Tests

These tests are only available when probing Ddiff or Dp & Dn.

Measure	Description
Tj	To verify that the Total Jitter (TJTX) and the Short-Term Total Jitter (STTJTX) of the DUT's HS-TX transmitter is within the conformance limits, for all combinations of supported Amplitudes, Terminations, and Lanes. Select a **CDR** of either Filtered (Jitter) or Short-Term (Short-Term Jitter).
Dj	To verify that the Deterministic Jitter (DJTX) and Short-Term Deterministic Jitter (STDJTX) of the DUT's HS-TX transmitter is within the conformance limits, for all combinations of supported Amplitudes, Terminations, and Lanes. Select a **CDR** of either Filtered (Jitter) or Short-Term (Short-Term Jitter).

HS-TX Timing Tests

These tests are only available when probing Ddiff or Dp & Dn.

Name	Purpose
TPULSE	To verify that the Pulse Width (TPULSE_TX) of the DUT's HS-TX transmitter is within the conformance limits, for all combinations of supported Amplitudes, Terminations, and Lanes.
HS Bitrate	To verify that the Frequency Offset (ƒOFFSET_TX) of the DUT's HS-TX transmitter is within the conformance limits.
UI HS	To verify that the measured UIHS value for a given burst or continuous capture corresponds to the inverse of the mean ƒOFFSET-TX value for that burst/capture.
Min foffs Mean foffs Max foffs	To verify that the minimum, mean, and maximum Frequency Offset (ƒOFFSET-TX) values are within the conformance limits.

Name	Purpose
THS PREPARE	To verify that the length of the DUT's transmitted HS PREPARE period is consistent with the value indicated by its TX_HS_PREPARE_LENGTH configuration attribute.

PWM Tests

These tests are available when in PWM test mode.

NOTE: Some tests may not be available depending on your probing method.

PWM-TX Electrical Tests

These tests are only available when probing Ddiff or Dp & Dn.

Measure	Description
V DIF-P DC	To verify that the Differential DC Output Voltage Amplitude (VDIF_DC_xA_xT_TX) of the DUT's PWM-TX transmitter is within the conformance limits, for all combinations of supported Amplitudes, Terminations, Gears, and Lanes.
V DIF-N DC	
V DIF-P AC MAX	To verify that the Differential AC Output Voltage Amplitude (VDIF_AC_xx_xx_TX) of the DUT's transmitter is within the conformance limits, for both Large and Small Amplitudes, and for both terminated and unterminated cases.
V DIF-P AC MIN	
V DIF-N AC MAX	
V DIF-N AC MIN	

PWM-TX Common-Mode Tests

These tests are only available when probing Dp & Dn.

Measure	Purpose
VCM-TX PREPARE	To verify that the Common-Mode Output Voltage Amplitude (VCM-TX) of the DUT's PWM-TX is within the conformance limits, for all combinations of supported Amplitudes, Terminations, LANEs, and PWM GEARs.
VCM-TX-TAIL	
VCM-TX	

PWM-TX Rise and Fall Tests

These tests are only available when probing Ddiff or Dp & Dn.

Measure	Purpose
Rise	To verify that the Rise and Fall times (TR_PWM_TX and TF_PWM_TX) of the DUT's PWM-TX transmitter are within the conformance limits, for all combinations of supported Amplitudes, Terminations, PWM gears, and Lanes. Enter the voltage level in **PWM-VDIF-P** and **PWM-VDIF-N**, or choose **Find Level** to autoset the level. Check **Show Rise/Fall** to turn on the rise time plot.
Fall	

PWM-TX Timing Tests

These tests are only available when probing Ddiff or Dp & Dn.

Measure	Purpose
PWM Bitrate	To verify that the Transmit Bit Duration (TPWM_TX) of the DUT's PWM-TX transmitter is within the conformance limits, for all combinations of supported Terminations, PWM gears, and Lanes.
TPWM-TX	
kPWM-TX-b0	To verify that the Transmit Ratio (kPWM_TX) of the DUT's PWM-TX transmitter is within the conformance limits, for all Lanes.
kPWM-TX-b1	
MINOR-b0	To verify that the PWM-G0 Minor Duration (TPWM_MINOR_G0_TX) of the DUT's PWM-TX transmitter is within the conformance limits, for all Lanes.
MINOR-b1	
TPWM PREPARE	To verify that the length of the DUT’s transmitted PWM-PREPARE period is consistent with the value indicated by its TX_LS_PREPARE_LENGTH configuration attribute.

SYS Tests

These tests are available when in SYS test mode.

NOTE: Some tests may not be available depending on your probing method.

SYS-TX Electrical Tests

These tests are only available when probing Ddiff or Dp & Dn.

Measure	Description
V DIF-P DC	To verify that the Differential DC Output Voltage Amplitude (VDIF_DC_xA_xT_TX) of the DUT's HS-TX transmitter is within the conformance limits, for all combinations of supported Amplitudes, Terminations, Reference Frequencies, and Lanes.
V DIF-N DC	
V DIF-P AC MAX	To verify that the DUT's HS-TX transmitter meets the requirements for the maximum Differential AC Output Voltage Amplitude (VDIF_AC_xA_xT_TX), for all combinations of supported Amplitudes, Terminations, Reference Frequencies, and Lanes.
V DIF-P AC MIN	
V DIF-N AC MAX	
V DIF-N AC MIN	

SYS-TX Common-Mode Tests

These tests are only available when probing Dp & Dn or CM.

Measure	Description
VCM-TX-PREPARE	To verify that the Common-Mode Output Voltage Amplitude (VCM-TX) of the DUT's SYS-TX is within the conformance limits, for all combinations of supported Amplitudes, Terminations, LANEs, and Reference Frequencies.
V DIF-P CM	
V DIF-N CM	

SYS-TX Rise & Fall Tests

These tests are only available when probing Ddiff or Dp & Dn.

Measure	Description
Rise	To verify that the Rise and Fall times (TR_SYS_TX and TF_SYS_TX) of the DUT's SYS-TX transmitter are within the conformance limits, for all combinations of supported Amplitudes, Terminations, Reference Frequencies, and Lanes. Enter the voltage level in **SYS-VDIF-P** and **SYS-VDIF-N**, or choose **Find Levels** to autoset the level. Check **Show Rise/Fall** to turn on the rise time plot.
Fall	

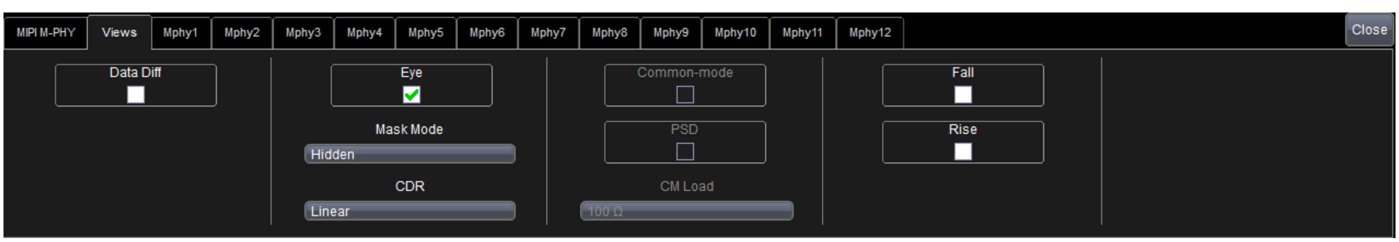
SYS-TX Timing Tests

These tests are only available when probing Ddiff or Dp & Dn.

Name	Purpose
SYS Bitrate	To verify that the Transmit Bit Duration (TSYS_TX) of the DUT's SYS-TX transmitter is within the conformance limits, for all combinations of supported Terminations, SYS gears, and Lanes.
UI SYS	To verify that the Unit Interval (UISYS) of the DUT’s SYS-TX are within the conformance limits, for all supported Reference Frequencies.
Min foffs	To verify that the minimum, mean, and maximum Frequency Offset (ƒOFFSET-TX) of the DUT’s SYS-TX are within the conformance limits, for all supported Reference Frequencies.
Mean foffs	
Max foffs	
TSYS PREPARE	To verify that the length of the DUT’s transmitted SYS-PREPARE period is consistent with the value indicated by its TX_LS_PREPARE_LENGTH configuration attribute.

Waveform Views

The Views dialog enables you to create different types of diagrams and plots required by the MIPI M-PHY test specification. The available selection depends on the test mode in which you are running, so complete the input setup on the main MIPI M-PHY dialog before turning on views.



These alternative views may be displayed in combination with the input traces or each other. Each view selected appears on the touch screen with a dedicated trace descriptor box.

Data Diff View

The Data Diff view shows a calculated differential trace when probing DP & DN.

Data Diff is available in all test modes. On the **Views** dialog, select the **Data Diff** checkbox.

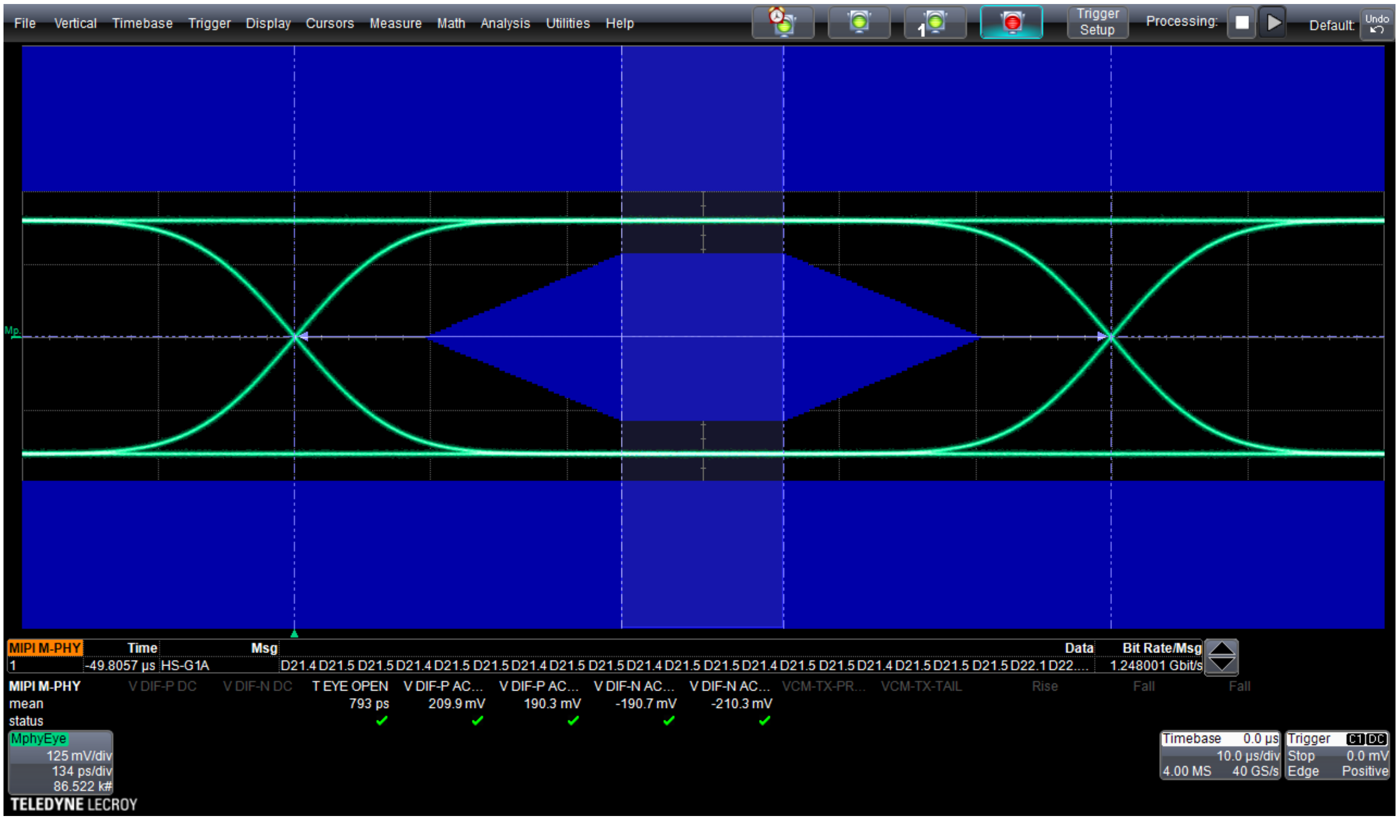
Eye Diagram View

The Eye view constructs an eye diagram by recovering a clock using a second-order PLL (specified in the CTS). The acquired eye is compared to the selected mask.

Eye diagramming is available when running in HS or SYS test mode. On the **Views** dialog, select the **Eye** checkbox.

A selection of standard eye diagram mask tests are available. A red overlay marks those areas where the eye intersects the mask, showing a "fail." Choose the **Mask Mode** and a **CDR** (Clock Data Recovery) method of:

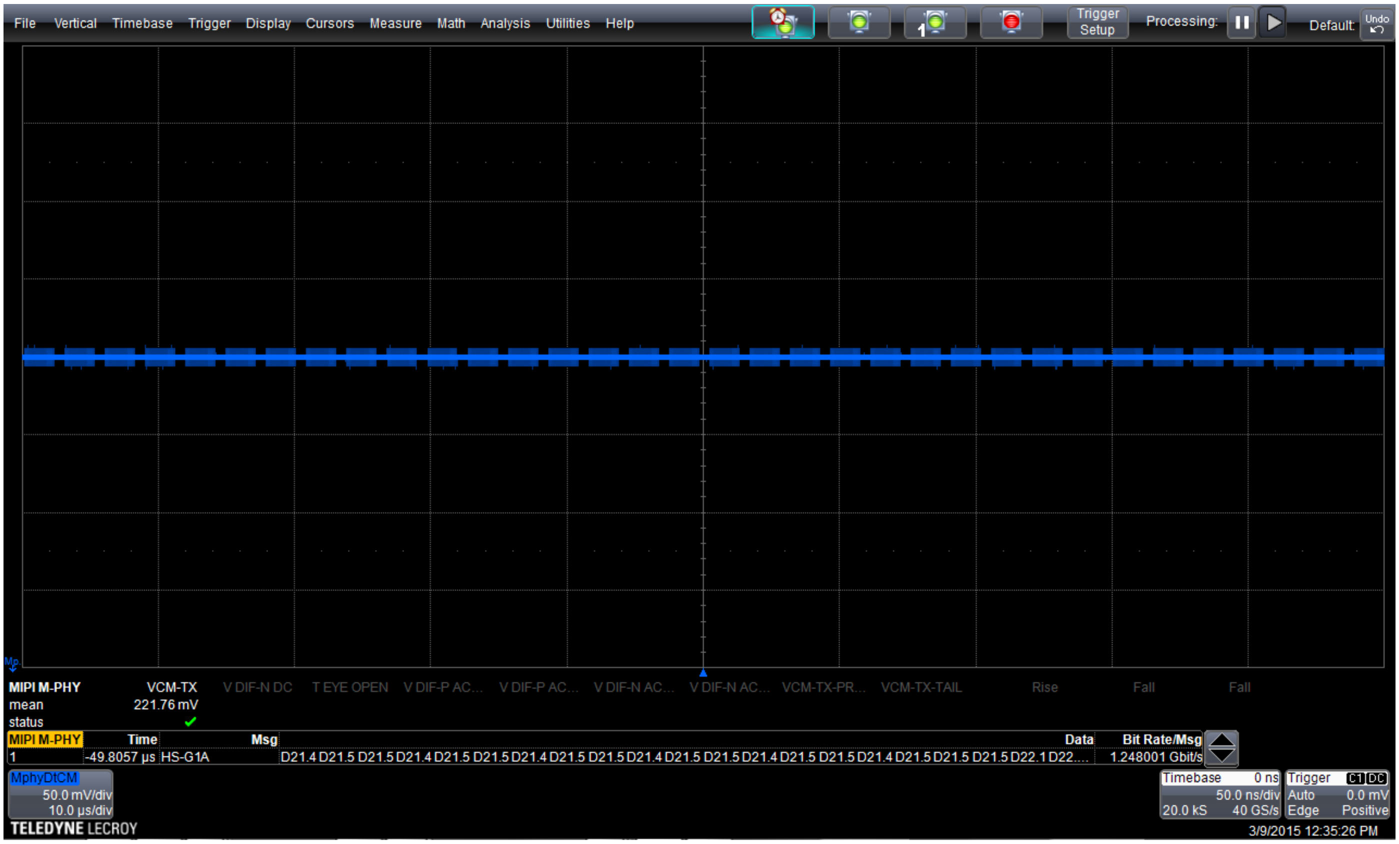
- Linear—best-fit recovered clock to acquired data
- Filtered—using the second-order JTF function defined in the M-PHY Specification, Section 5.1.2.7, for HS-TX Total Jitter and HS-TX Deterministic Jitter.
- Short-Term—filtered with the HSTJ-TX(f) highpass filter defined in the M-PHY Specification, Section 5.1.2.7, for HS-TX Short Term Total Jitter.



Common Mode View

The Common Mode view shows the calculated common mode signal. You cannot generate this view when probing DDiff.

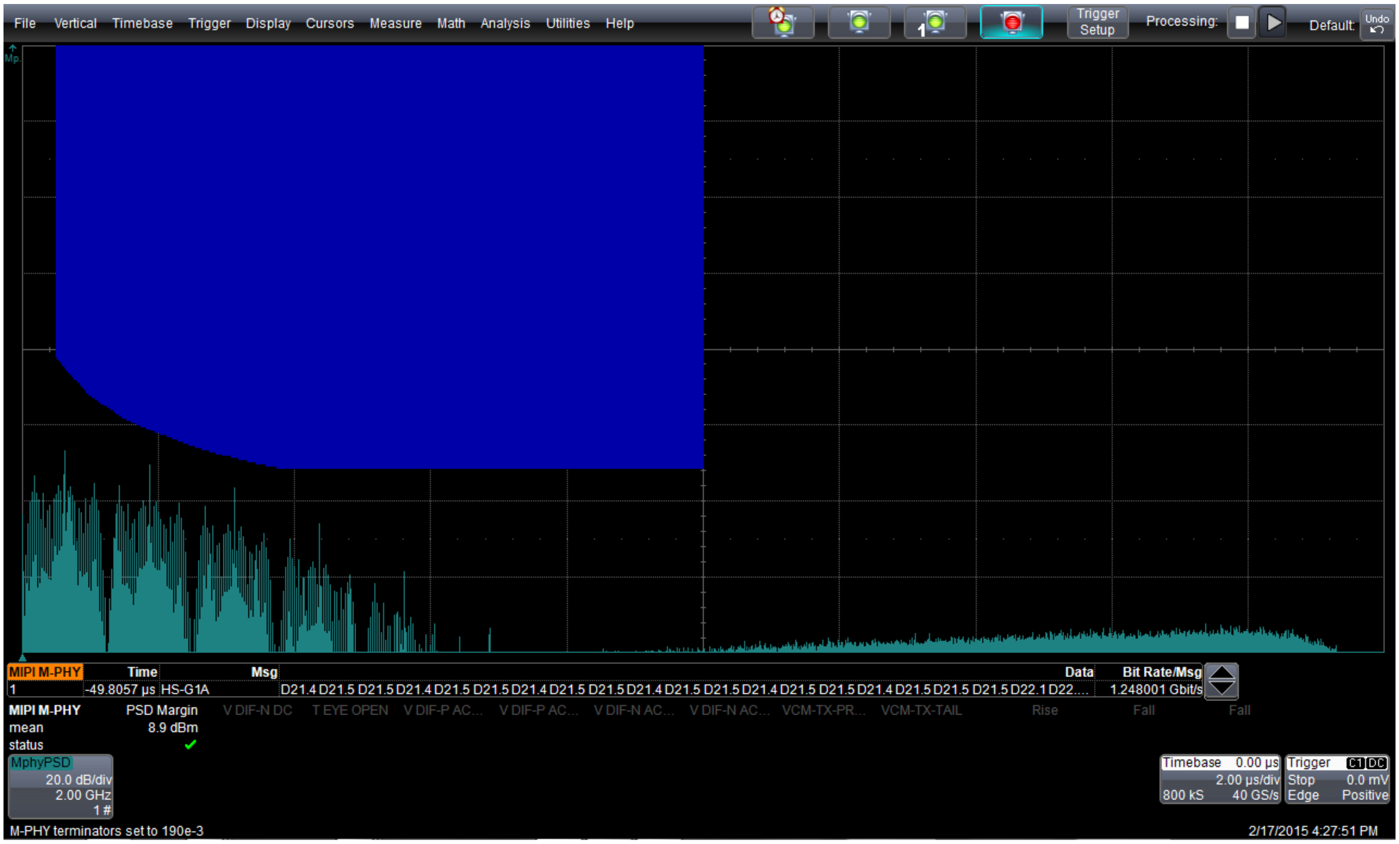
Common Mode is available in all test modes. On the **Views** dialog and select the **Common-mode** checkbox.



PSD View

The PSD view displays the common-mode spectrum. The blue mask represents the spectral limit line below which the samples should fall. You cannot generate this view when probing DDiff.

PSD is available only in High Speed mode. On the **Views** dialog, select the **PSD** checkbox, then enter the load impedance in **CM Load**.

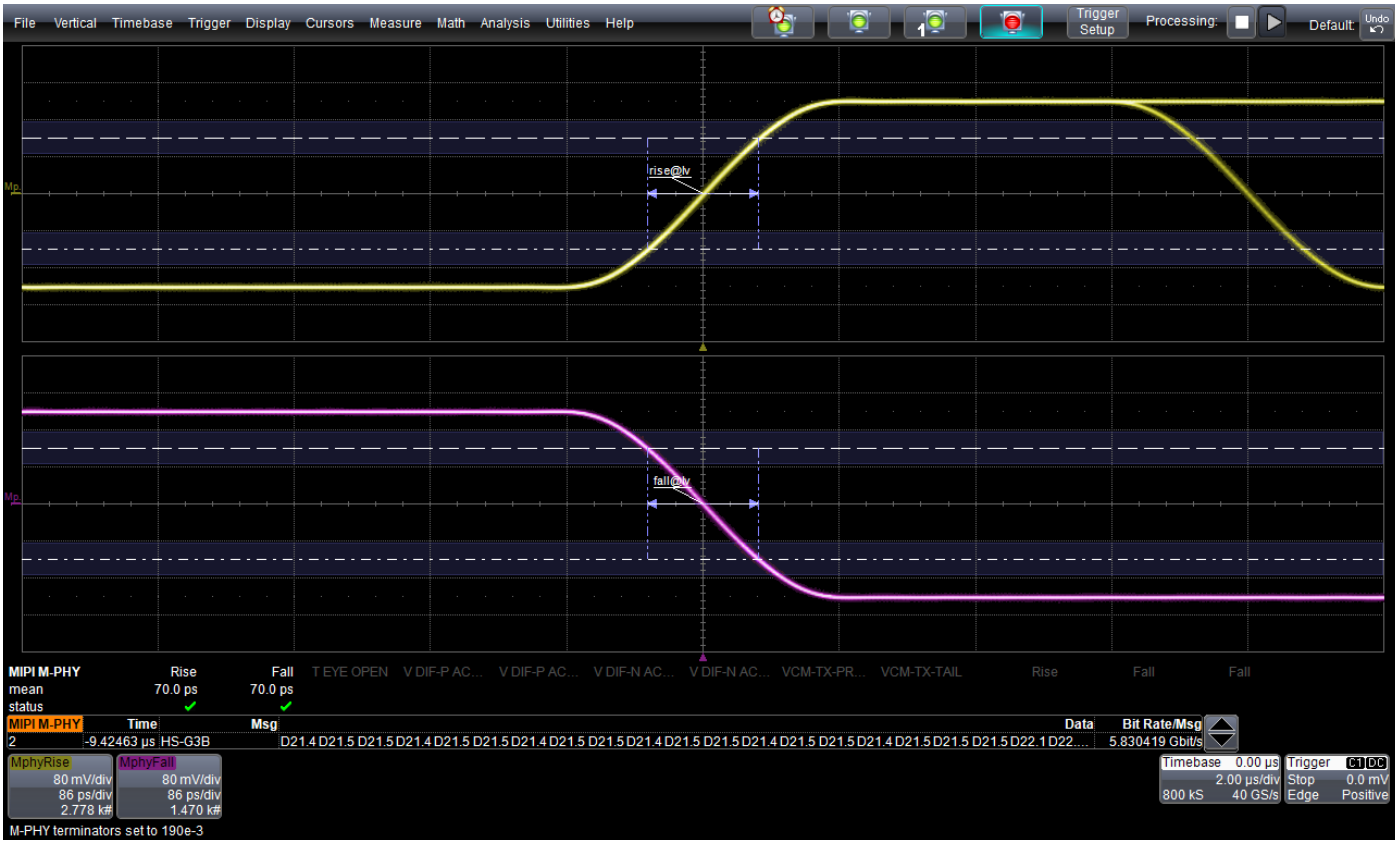


Rise and Fall Views

The Rise view plots the averaged rising-edge signal used to calculate TR-HS-TX.

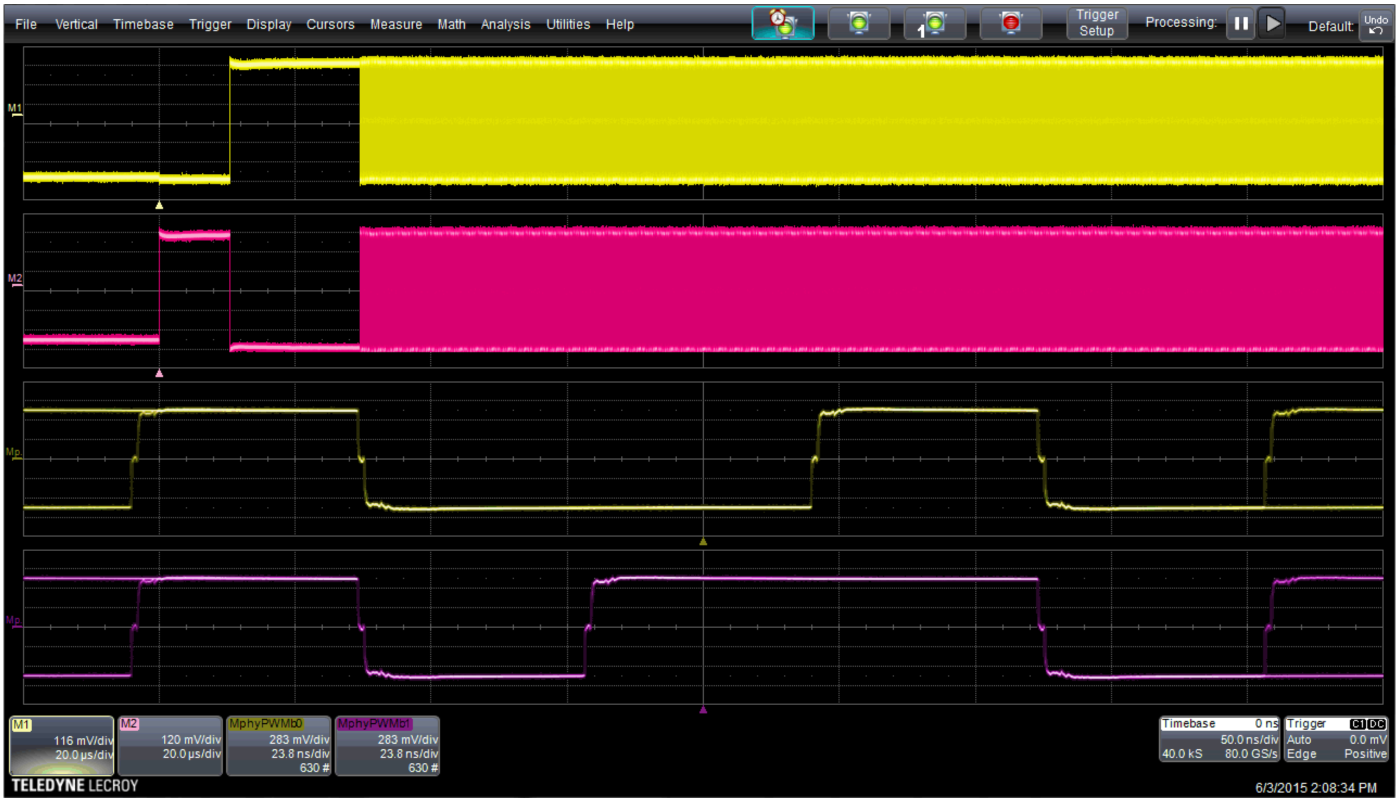
The Fall view plots the averaged falling-edge signal used to calculate TF-HS-TX.

Rise and Fall are available in all test modes. On the **Views** dialog, select the respective checkbox.



PWM b0 and PWM b1 Views

The PWM views generate a persistance trace of a b0 or b1 bit.



PWM views are available only in PWM test mode. On the **Views** dialog, select the **PWM b0** or **PWM b1** checkbox.

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