# Keysight Technologies U4431A Protocol Analyzer for MIPI™ M-PHY Interfaces

## Product Fact Sheet

## Industries and Applications

- High-resolution cameras
- High-speed peripherals
- Advanced graphics adapters
- Massive memory buffers

## Designers and Validators of

- M-PHY
- IP
- Application processors
- Memory/chipsets
- Mobile devices
- Mobile embedded systems

## Product Description

#### Deep insight to help you win the race to M-PHY

The MIPI™ M-PHY standards are the backbone of nextgeneration mobile computing designs. Because these designs are replacing desktop PCs in many applications, these architectures are much faster and more complex than in the past. The increasing demand for bandwidth has driven the expansion of the M-PHY specification to include four-lane, 6.0-Gbs options. The U4431A offers up to 16 GB of analysis memory on each lane, allowing designers to capture tens of seconds of system traffic, even at these high speeds.

In addition, the Keysight U4431A offers "Raw Mode," a feature that lets designers see the time-correlated 8b/10b data that underlies each protocol. These states can be displayed as a waveform or listing, providing insight into how a packet is formed at the physical layer.



## Main Features and Benefits

#### Power to meet the needs of today's and tomorrow's designs

- Up to gear 3 HS data rates
- Up to 16 GB trace depth
- Up to 4 data lanes
- Complete insight into complex designs
  - Track multiple M-PHY busses from the PHY to the application layer
  - Raw Mode 8b/10b data views
  - Infiniium Oscilloscope integration
  - Powerful interface that allows unlimited customization of system views

#### Powerful triggers

- N-way if/then/else trigger branching with AND/OR logic
- Over 50 triggering macros
- PHY and protocol error triggers
- Event counters, flags, and timers

#### Flexible probing



## Module Configuration

|                  | U4431A/U Protocol Analyzer      |                       |                                     |
|------------------|---------------------------------|-----------------------|-------------------------------------|
| Analysis options | Single directi<br>Tx OR Rx (det |                       | Bi-directional –<br>Tx AND Rx (612) |
| Lane options     | 1-lane (default)                | 2-lanes (412)         | 4-lanes (414)                       |
| Speed options    | Increase to Gear 2              | (512) In              | crease to Gear 3 (514)              |
| Select memory    | 1 GB (default)                  | 4 GB (M04)            | 16 GB (M16)                         |
| Select protocols | UniPro (711)                    | UFS + UniPro<br>(712) |                                     |

## Specifications

| Minimum Vdiff100 mVInput impedance (DC)VU4433A probe + N5246A700 Ω, typicalZIF tips128 Ω, typicalU4432A SMA harness128 Ω, typicalTopologicalUp to 4 with option 414. Analyze<br>1, 2, 3, or 4-lane systemsClocking architectureType IAnalysis directionTx or Rx (Both Tx and Rx with op-<br>tion 612)Lane mappingUser-selectableLane polarityUser-selectableMultiple blade supportUp to 5 time-correlated blades in<br>one frame (configured as up to 3<br>separate busses), multiple frames<br>can be correlatedPerformanceG1 to G3PWM Modes supportedG0 to G7 (subject to limitations of<br>individual protocol)Rate Series supported (HS<br>and PWM)A and BSymbol lock time (subject<br>to protocol spec limit)1 symbol, typicalSlow (HS-G2, HS-G3)< 128 symbolsAuto speed detection and<br>trackingSupported (with no RSE-PO-TX<br>support)MemoryUser allocated (shared among<br>analyzer and raw mode)Standard1 GB | Electrical  |  |  |
|---|---|--|--|
| Input impedance (DC)U4433A probe + N5246A700 Ω, typicalZIF tips128 Ω, typicalU4432A SMA harness128 Ω, typicalTopologicalUp to 4 with option 414. Analyze<br>1, 2, 3, or 4-lane systemsLane widthUp to 4 with option 414. Analyze<br>1, 2, 3, or 4-lane systemsClocking architectureType IAnalysis directionTx or Rx (Both Tx and Rx with op-<br>tion 612)Lane remappingUser-selectableLane polarityUser-selectableMultiple blade supportUp to 5 time-correlated blades in<br>one frame (configured as up to 3<br>separate busses), multiple frames<br>can be correlatedPerformanceHSHS Modes supportedG1 to G3PWM Modes supportedG0 to G7 (subject to limitations of<br>individual protocol)Rate Series supported (HS<br>and PWM)A and BSymbol lock time (subject<br>to protocol spec limit)1 symbol, typicalFast (HS-G1)1 symbol, typicalSlow (HS-G2, HS-G3)< 128 symbols  |   | 100 mV   |  |
| U4433A probe + N5246A700 Ω, typicalZIF tips128 Ω, typicalU4432A SMA harness128 Ω, typicalTopological1, 2, 3, or 4-lane systemsLane widthUp to 4 with option 414. Analyze<br>1, 2, 3, or 4-lane systemsClocking architectureType IAnalysis directionTx or Rx (Both Tx and Rx with op-<br>tion 612)Lane remappingUser-selectableLane polarityUser-selectableMultiple blade supportUp to 5 time-correlated blades in<br>one frame (configured as up to 3<br>separate busses), multiple frames<br>can be correlatedPerformanceHSHS Modes supportedG1 to G3PWM Modes supported (HS<br>and PWM)A and BSymbol lock time (subject<br>to protocol spec limit)A and BFast (HS-G1)1 symbol, typicalSlow (HS-G2, HS-G3)< 128 symbols  |   | 100 1110   |  |
| ZIF tips       128 Ω, typical         Topological       Up to 4 with option 414. Analyze 1, 2, 3, or 4-lane systems         Clocking architecture       Type I         Analysis direction       Tx or Rx (Both Tx and Rx with option 612)         Lane remapping       User-selectable         Lane polarity       User-selectable         Multiple blade support       Up to 5 time-correlated blades in one frame (configured as up to 3 separate busses), multiple frames can be correlated         Performance       G0 to G7 (subject to limitations of individual protocol)         Rate Series supported (HS and PWM)       A and B         Symbol lock time (subject to protocol spec limit)       1 symbol, typical         Slow (HS-G2, HS-G3)       < 128 symbols  | • •   | 700 0 typical  |  |
| U4432A SMA harness128 Ω, typicalTopologicalUp to 4 with option 414. Analyze<br>1, 2, 3, or 4-lane systemsClocking architectureType IAnalysis directionTx or Rx (Both Tx and Rx with op-<br>tion 612)Lane remappingUser-selectableLane polarityUser-selectableMultiple blade supportUp to 5 time-correlated blades in<br>one frame (configured as up to 3<br>separate busses), multiple frames<br>can be correlatedPerformanceG0 to G7 (subject to limitations of<br>individual protocol)Rate Series supportedG0 to G7 (subject to limitations of<br>individual protocol)Rate Series supported (HS<br>and PWM)A and BSymbol lock time (subject<br>to protocol spec limit)1 symbol, typicalSlow (HS-G2, HS-G3)< 128 symbols   |   | 700 <u>9</u> , typicat   |  |
| TopologicalLane widthUp to 4 with option 414. Analyze<br>1, 2, 3, or 4-lane systemsClocking architectureType IAnalysis directionTx or Rx (Both Tx and Rx with op-<br>tion 612)Lane remappingUser-selectableLane polarityUser-selectableMultiple blade supportUp to 5 time-correlated blades in<br>one frame (configured as up to 3<br>separate busses), multiple frames<br>can be correlatedPerformanceG1 to G3PWM Modes supportedG1 to G3PWM Modes supportedA and Band PWM)Symbol lock time (subject<br>to protocol spec limit)Fast (HS-G1)1 symbol, typicalSlow (HS-G2, HS-G3)< 128 symbols   |   | 128 O typical  |  |
| Lane widthUp to 4 with option 414. Analyze<br>1, 2, 3, or 4-lane systemsClocking architectureType IAnalysis directionTx or Rx (Both Tx and Rx with op-<br>tion 612)Lane remappingUser-selectableLane polarityUser-selectableMultiple blade supportUp to 5 time-correlated blades in<br>one frame (configured as up to 3<br>separate busses), multiple frames<br>can be correlatedPerformanceG1 to G3PWM Modes supportedG1 to G3PWM Modes supportedG0 to G7 (subject to limitations of<br>individual protocol)Rate Series supported (HS<br>and PWM)A and BSymbol lock time (subject<br>to protocol spec limit)1 symbol, typicalFast (HS-G1)1 symbol, typicalSlow (HS-G2, HS-G3)< 128 symbols   |   |  |  |
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| tion 612)Lane remappingUser-selectableLane polarityUser-selectableMultiple blade supportUp to 5 time-correlated blades in<br>one frame (configured as up to 3<br>separate busses), multiple frames<br>can be correlatedPerformanceG1 to G3HS Modes supportedG1 to G7 (subject to limitations of<br>individual protocol)Rate Series supported (HS<br>and PWM)A and BSymbol lock time (subject<br>to protocol spec limit)1 symbol, typicalFast (HS-G1)1 symbol, typicalSlow (HS-G2, HS-G3)< 128 symbols   | Clocking architecture                             | Туре I   |  |
| Lane polarityUser-selectableMultiple blade supportUp to 5 time-correlated blades in<br>one frame (configured as up to 3<br>separate busses), multiple frames<br>can be correlatedPerformanceG1 to G3HS Modes supportedG1 to G7 (subject to limitations of<br>individual protocol)Rate Series supported (HS<br>and PWM)A and BSymbol lock time (subject<br>to protocol spec limit)1 symbol, typicalSlow (HS-G2, HS-G3)< 128 symbols  | Analysis direction                                | •  |  |
| Multiple blade supportUp to 5 time-correlated blades in<br>one frame (configured as up to 3<br>separate busses), multiple frames<br>can be correlatedPerformanceImage: Configured as up to 3<br>separate busses), multiple frames<br>can be correlatedHS Modes supportedG1 to G3<br>G0 to G7 (subject to limitations of<br>individual protocol)Rate Series supported (HS<br>and PWM)A and BSymbol lock time (subject<br>to protocol spec limit)A and BFast (HS-G1)1 symbol, typicalSlow (HS-G2, HS-G3)< 128 symbolsAuto speed detection and<br>trackingSupported (with no RSE-PO-TX<br>support)MemoryUser allocated (shared among<br>analyzer and raw mode)Standard1 GBOption M044 GB   | Lane remapping                                    | User-selectable  |  |
| And PerformanceHS Modes supportedG1 to G3PWM Modes supportedG0 to G7 (subject to limitations of individual protocol)Rate Series supported (HS and PWM)A and BSymbol lock time (subject to protocol spec limit)1 symbol, typicalSast (HS-G1)1 symbol, typicalSlow (HS-G2, HS-G3)< 128 symbols  | Lane polarity                                     | User-selectable  |  |
| HS Modes supportedG1 to G3PWM Modes supportedG0 to G7 (subject to limitations of<br>individual protocol)Rate Series supported (HS<br>and PWM)A and BSymbol lock time (subject<br>to protocol spec limit)  | Multiple blade support                            | one frame (configured as up to 3 separate busses), multiple frames |  |
| PWM Modes supportedG0 to G7 (subject to limitations of<br>individual protocol)Rate Series supported (HS<br>and PWM)A and BSymbol lock time (subject<br>to protocol spec limit)Fast (HS-G1)Fast (HS-G1)1 symbol, typicalSlow (HS-G2, HS-G3)< 128 symbols   | Performance                                       |  |  |
| individual protocol) Rate Series supported (HS A and B and PWM) Symbol lock time (subject to protocol spec limit) Fast (HS-G1) 1 symbol, typical Slow (HS-G2, HS-G3) < 128 symbols Auto speed detection and tracking Supported (with no RSE-PO-TX support) Memory User allocated (shared among analyzer and raw mode) Standard 1 GB Option M04 4 GB   | HS Modes supported                                | G1 to G3   |  |
| and PWM) Symbol lock time (subject to protocol spec limit) Fast (HS-G1) Slow (HS-G2, HS-G3) Auto speed detection and tracking User allocated (shared among analyzer and raw mode) Standard 1 GB Option M04 4 GB   | PWM Modes supported                               | -  |  |
| to protocol spec limit) Fast (HS-G1) Slow (HS-G2, HS-G3) Auto speed detection and tracking User allocated (shared among analyzer and raw mode) Standard Option M04 4 GB   | Rate Series supported (HS and PWM)                | A and B  |  |
| Slow (HS-G2, HS-G3)< 128 symbolsAuto speed detection and<br>trackingSupported (with no RSE-PO-TX<br>support)MemoryUser allocated (shared among<br>analyzer and raw mode)Standard1 GBOption M044 GB  | Symbol lock time (subject to protocol spec limit) |  |  |
| Auto speed detection and<br>trackingSupported (with no RSE-PO-TX<br>support)MemoryUser allocated (shared among<br>analyzer and raw mode)Standard1 GBOption M044 GB  | Fast (HS-G1)                                      | 1 symbol, typical  |  |
| tracking support) Memory User allocated (shared among<br>analyzer and raw mode) Standard 1 GB Option M04 4 GB   | Slow (HS-G2, HS-G3)                               | < 128 symbols  |  |
| MemoryUser allocated (shared among<br>analyzer and raw mode)Standard1 GBOption M044 GB  | Auto speed detection and                          | Supported (with no RSE-PO-TX                                       |  |
| analyzer and raw mode)Standard1 GBOption M044 GB  | tracking  | support)   |  |
| Standard1 GBOption M044 GB  | Memory  | •  |  |
| Option M04 4 GB   |   | -  |  |
| •   | Standard  | 1 GB   |  |
| Option M16 16 GB  | Option M04  |  |  |
|   | Option M16  | 16 GB  |  |



## Chassis and Probing Configuration

| Chassis options                     |   |  |  |
|-------------------------------------|---|--|--|
| M9502A                              | 2-slots   |  |  |
| M9505A                              | 5-slots   |  |  |
| M9502A-020                          | USB 2.0 host connection for either chassis  |  |  |
| M9505A-020                          | Lower-speed alternative to PC control options,<br>not recommended for > 1 GB memory |  |  |
| PC control options                  |   |  |  |
| M9536A                              | Embedded PC module (no cables or adapters needed)                                   |  |  |
| Connecting via PCIe to a desktop PC |   |  |  |
| M9047A                              | PCIe desktop adapter  |  |  |
| Y1202A                              | PCIe cable (x8 to x8)   |  |  |
| Connecting via PCIe to a laptop PC  |   |  |  |
| M9045A                              | ExpressCard adapter   |  |  |
| Y1200B                              | PCIe cable (x4 to x8)   |  |  |
| Analyzer probes                     |   |  |  |
| U4433A 1                            | Probe, ZIF flying leads, MIPI M-PHY (one probe for both directions)                 |  |  |
| U4432A                              | SMA cable, MIPI, M-PHY (one probe for both directions)                              |  |  |
| N5426A                              | ZIF Tip, 12 GHz InfiniiMax – Kit of 10  |  |  |
|                                     |   |  |  |

## Keysight Modular Products

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