

Keysight MIPI M-PHY Command Line Packet Generator

User's Guide

Notices

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Edition

First Edition, April 2015

Available in electronic format only

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Safety Notices

CAUTION










A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Safety Summary

Safety Symbols on Instruments

Safety Symbol	Description
	Indicates warning or caution. If you see this symbol on a product, you must refer to the manuals for specific Warning or Caution information to avoid personal injury or damage to the product.
	Frame or chassis ground terminal. Typically connects to the equipment's metal frame.
	Indicates hazardous voltages and potential for electrical shock.
	Indicates that antistatic precautions should be taken.
	Indicates hot surface. Please do not touch.
	Indicates laser radiation turned on.
	CSA is the Canadian certification mark to demonstrate compliance with the Safety requirements.
	The C-tick mark is a registered trademark of the Spectrum Management Agency of Australia. This signifies compliance with the Australia EMC Framework regulations under the terms of the Radio Communication Act of 1992.
	CE compliance marking to the EU Safety and EMC Directives. ISM GRP-1A classification according to the international EMC standard. ICES/NMB-001 compliance marking to the Canadian EMC standard.

General Safety Precautions

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument.

Keysight Technologies assumes no liability for the customer's failure to comply with these requirements.

Before operation, review the instrument and manual for safety markings and instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

General

This product is a Safety Class 1 instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

All Light Emitting Diodes (LEDs) used in this product are Class 1 LEDs as per IEC 60825-1.

Environment Conditions

This instrument is intended for indoor use in an installation category II, pollution degree 2 environment. It is designed to operate at a maximum relative humidity of 95% and at altitudes of up to 2000 meters.

Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

Before Applying Power

Verify that all safety precautions are taken. The power cable inlet of the instrument serves as a device to disconnect from the mains in case of hazard. The instrument must be positioned so that the operator can easily access the power cable inlet. When the instrument is rack mounted the rack must be provided with an easily accessible mains switch.

Ground the Instrument

To minimize shock hazard, the instrument chassis and cover must be connected to an electrical protective earth ground. The instrument must be connected to the ac power mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Do Not Operate in
an Explosive
Atmosphere


Do not operate the instrument in the presence of flammable gases or fumes.

Do Not Remove the
Instrument Cover

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified personnel.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

Environmental
Information

	<p>This product complies with the WEEE Directive (2002/96/EC) marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste.</p> <p><i>Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as a "Monitoring and Control instrumentation" product.</i></p> <p>Do not dispose in domestic household waste.</p> <p>To return unwanted products, contact your local Keysight office, or see www.keysight.com/environment/product/ for more information.</p>
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About This Guide

This guide describes how to use the Keysight Command Line Packet Generator tool for stimulus generation on an M-PHY link and for capturing bidirectional M-PHY data. This tool is a licensed software option for use with the Keysight U4431A MIPI M-PHY Protocol Analyzer module

The guide also describes the probing option available for use with the Keysight Command Line Packet Generator. It describes how to connect the U4432A SMA stimulus probe with the Command Line Generator (U4431A) module and DUT.

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1 Command Line Packet Generator (with Embedded Analyzer)

Introduction 4

Introduction

The Keysight Command Line Packet Generator (CLPG) acts as a stimulus device and exercises the M-PHY link. It also has an embedded analyzer with bidirectional data capture and analysis, that is, capturing the data that it transmits as stimulus as well as the data that it receives from DUT.

The CLPG tool is available as a licensed software option (U4431A-613) of the Keysight U4431A M-PHY Protocol Analyzer module, which is installed in a Keysight AXIe chassis such as the M9502A chassis.

Features as a Packet Generator

(See the chapter [“Transmitting Stimulus Using the Command Line Packet Generator”](#) for more details on packet generation.)

- It uses the Keysight U4432A SMA stimulus probe to transmit stimulus to a DUT. Refer to [“Setting up the CLPG Hardware”](#) on page 7 for more details about this probe and its setup.
- You control, configure, and use the Packet Generator features of CLPG using the COM interface via Tcl. The **KeysightCommandLinePacketGenerator.chm** online help installed with the CLPG software at the following location provides details on the COM interface.
C:\Program Files\Keysight Technologies\Logic Analyzer\Help
- You can configure 1 to 4 lanes for sending stimulus using a single CLPG (U4431A) module.
- It supports Low Speed Mode (PWM-mode) Gear1 to Gear7 as well as High Speed Mode (HS-Mode) Series A and B Gear 1, 2, and 3 (slow lock times only).
- It supports connection to a user-supplied external reference clock. Refer to [Table 1 on page 10](#) for more details about the probe pins available for external reference clock connection.
- It can act as a host on the link when sending stimulus. Device emulation is not supported.
- It allows you to insert errors such as M-PHY (8b/10b, disparity) and UniPro (CRC, incorrect reserved bits) in the stimulus to test DUT under error conditions.

Features as an Embedded Analyzer

(See the chapter [“Capturing Data using the Embedded Analyzer and Loopback Board”](#) for more details.)

- It can capture stimulus data that it transmits to the DUT as well as the data that it receives from the DUT. This allows you to display and analyze the DUT data in correlation with the stimulus data.
- It uses a loopback board that you connect to its Pod 2 to loop back and capture the stimulus that it transmits to a DUT. For more details about this loopback board, refer to [“Hardware Components for the CLPG Setup”](#) on page 8.
- You can control, configure, and use the capture and analysis features of CLPG using the Keysight Logic and Protocol Analyzer GUI.
- It can support a capture setup ranging from x1 to x4 link width using a single CLPG (U4431A) module.
- It supports *“One sublink”* that is, capturing data from DUT as well as *“Both sublinks”* that is, capturing data from DUT and Packet Generator. You can set the link width and link speed for data capture independently for each of these two sublinks.

Compliance to Specifications

The functionalities of the packet generator are in accordance with the layers implemented as defined in the M-PHY 2.0, UniPro 1.6, and UFS 2.0 specifications:

Relevant Layer and Specifications	Supported Packet Generator Functions
Physical layer (as defined in the M-PHY specification)	<ul style="list-style-type: none"> ▪ Support for 8b10b encoding/decoding ▪ Support for Link width 1, 2, 3, 4 per direction ▪ Support for HS G1, G2, G3 and LS PWM G1-G2 ▪ In PWM mode, for each Gear, data can be transmitted at fixed speeds. For alpha releases, data is transmitted at only a fixed speed for each Gear ▪ Automatic transmission of Fillers for a Burst that does not contain any traffic
PHY Adapter layer (as defined in the UniPro specification)	<ul style="list-style-type: none"> ▪ Automatic link startup ▪ Static Lane remapping ▪ Automatic Insertion of Deskew patterns for Lane re-initialization ▪ Support for PACP frames and their generation ▪ Automatic generation of PACP_CAP_IND frame ▪ Configuration and sending of the PACP_PWR_REQ, PACP_SET_REQ, PACP_GET_REQ, PACP_EPR_IND frames by users ▪ Automatic generation of responses to PACP requests
Data Link Layer (as defined in the UniPro specification)	<ul style="list-style-type: none"> ▪ Control Frames transmission/reception ▪ Data Frames transmission/reception ▪ Support for retransmission of Data Frames in the Alpha 2 release, in case of errors in the received data ▪ Flow control mechanism based on flow control credit information ▪ Support for TCO only
Network Layer (as defined in the UniPro specification)	<ul style="list-style-type: none"> ▪ Device ID insertion and checking
Transport Layer (as defined in the UniPro specification)	<ul style="list-style-type: none"> ▪ Data frame creation based on traffic setup ▪ Support for One CPort
Application Layer (as defined in the UniPro specification)	<ul style="list-style-type: none"> ▪ Messages passed to the Transport Layer are loaded via TCL scripts
	<ul style="list-style-type: none"> ▪ UFS host communications are achieved via TCL scripts. ▪ HCI is not supported. You must create the equivalent lower level commands using TCL scripts.

2 Setting up the CLPG Hardware

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Hardware Components for the CLPG Setup

The CLPG transmits and receives data according to the M-PHY protocol. You need the following hardware components to complete its stimulus and capture setup.

- **Keysight U4432A SMA Stimulus Probe** - You use this probe to connect the CLPG hardware to the target system for sending stimulus and receiving data from DUT. This probe is a MIPI M-PHY, 21 leads/6 Gbps SMA cable that provides coaxial SMA connections for each of the lines in the M-PHY bus. In addition to the M-PHY data lines driven out of the CLPG port(s), you can also drive a reference clock to the DUT.
- **Keysight MIPI M-PHY Loopback Board** - You need this board if you want to loop back the stimulus data transmitted from CLPG and receive this data on Pod 2 of the CLPG module to correlate stimulus data with the DUT data.

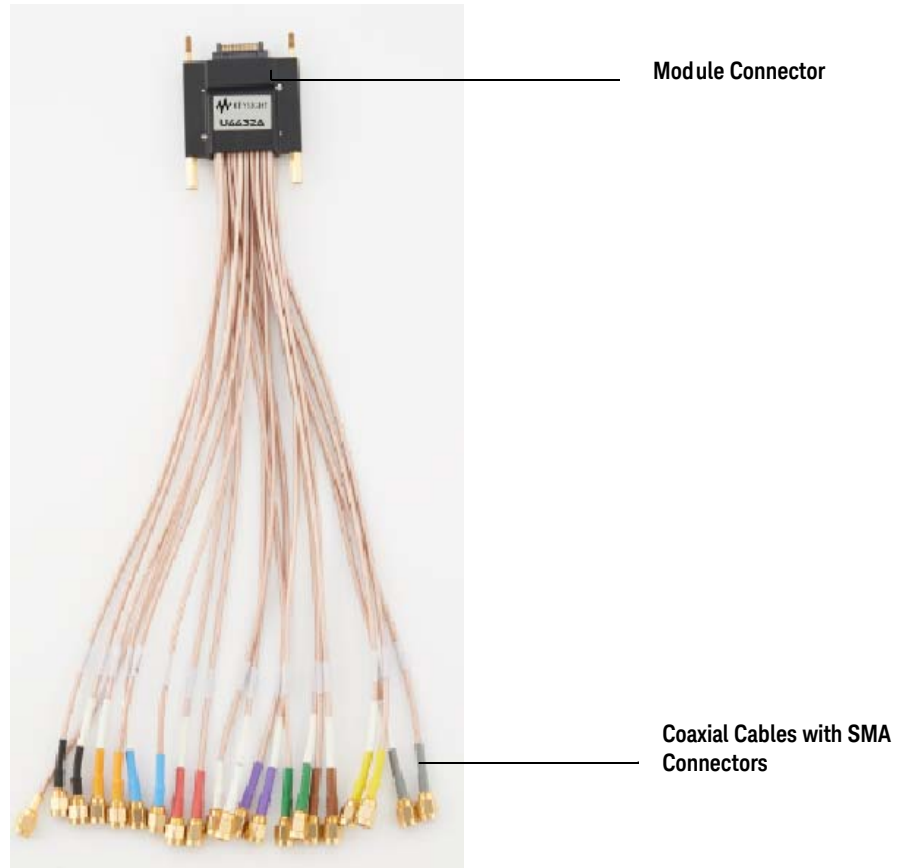


Figure 1 U4432A SMA Stimulus Probe

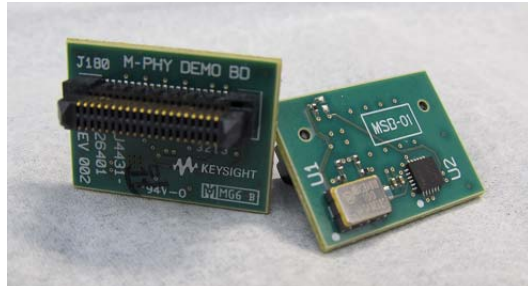


Figure 2 Front and back sides of a MIPI M-PHY Loopback Board

Labeling and Color Coding of U4432A Coaxial Cables

To help you identify the appropriate coaxial cable to use in a given situation, the coaxial cables of the U4432A probe are labeled and color coded. The following table lists the label, color coding, and specific purpose of each of these coaxial cables.

NOTE

RX and TX in the below table are in reference to the U4431A module.

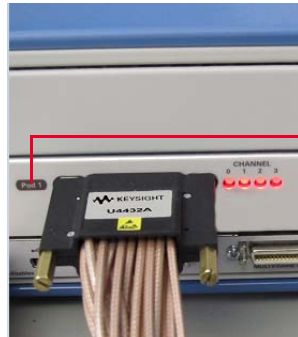
Table 1 Labeling and color coding of the coaxial cables of U4432A probe

Label	Color Coding	Pin Number
Refn	Red with white	5
Refp	Red	7
TX0n	White with white	11
TX0p	White	13
RX0n	Black with white	12
RX0p	Black	14
TX1n	Violet with white	18
TX1p	Violet	20
RX1n	Blue with white	17
RX1p	Blue	19
TX2n	Yellow with white	23
TX2p	Yellow	25
RX2n	Orange with white	24
RX2p	Orange	26
TX3n	Grey with white	30
TX3p	Grey	32
RX3n	Green with white	29
RX3p	Green	31
Clkp	Brown	38
Clkn	Brown with white	36
Vsense		8

Connecting the U4432A Probe and Loopback Board to the U4431A Module and DUT

The U4432A stimulus probe connects to the DUT via 50-ohm coaxial cables using SMA connectors.

- 1 Plug the module connector of the U4432A stimulus probe to the **Pod1** on the front panel of the CLPG (U4431A) module.



Pod1 on module to be used for the U4432A probe

- 2 Hand-tighten the thumb screws on both sides of the module connector of the probe.
- 3 Connect the appropriate coaxial cables (with SMA connectors) of the probe to the DUT. (Refer to [Table 1](#) to verify which coaxial cables to connect.)
 - a Connect the cables for M-Phy clock lane positive and negative signals (labeled *Clkp* and *Clkn*).
 - b Based on the required link width, connect the set of cables for M-Phy data lanes 0 to 3. You may leave the coaxial cables for the unused data lanes disconnected.
 - c If you plan to configure the CLPG module to use an external reference clock, connect the coaxial cables (labeled *Refp* and *Refn*) to drive the external reference clock signals.
 - d Connect the cable for the DUT's supply voltage sense signal (labeled *Vsense*) to the DUT's power supply. The DUT sends this signal to the module to indicate when the module can actively send M-Phy signals to the DUT.
- 4 If you want to loop back and capture the stimulus transmitted by CLPG, plug the Keysight MIPI M-PHY Loopback Board to the **Pod2** on the front panel of the CLPG (U4431A) module.



Pod2 on module to be used for the Loopback Board

3 Installing the CLPG Software Components

The CLPG software runs on a standard PC used to control, configure, and use the test instruments. You need to install the following software components in the specified sequence before you start using the CLPG.

Software Component	Installation steps
Keysight Logic and Protocol Analyzer (LPA) version 06.10.0000 or higher	<ol style="list-style-type: none">1 Download the Keysight Logic and Protocol Analyzer software from www.keysight.com/find/lpa-sw-download.2 Once the application software install package is downloaded to the host PC, double-click the <installer.exe> file. The Keysight Logic and Protocol Analyzer Installation Welcome message is displayed.3 Click OK to continue.4 Click Next if the system controller meets the minimum system configuration requirements displayed by the wizard.5 Accept the license agreement and click Next.6 Choose the setup type and click Next.7 Click Install to start the installation.8 Click OK to install the additional components such as Demo center.
Active Tcl 8.5 (32 bit)	<ol style="list-style-type: none">1 Install 32 bit version of Active Tcl 8.5 from the link http://www.tcl.tk/software/tcltk.
tcom package	<p>Pre-requisite: Ensure that you have an active Internet connection and that you are able to access the URL http://teapot.activestate.com/entity/name/tcom/ver/3.9/index.</p> <p>To install the tcom package.</p> <ol style="list-style-type: none">1 Double-click tclsh85.exe.2 Execute the command <code>teacup install tcom</code>. <p>To verify if the tcom package is properly installed:</p> <ol style="list-style-type: none">1 Execute the command <code>package require tcom</code>.
MIPI M-PHY Command Line Packet Generator (CLPG)	<p>To install the MIPI M-PHY CLPG package:</p> <ol style="list-style-type: none">1 Download MipiMphyCLPG installer package from the Keysight website www.keysight.com/find/lpa-sw-download.2 Once the application software install package is downloaded to the host PC, double-click the <installer.exe> file.3 Accept the license agreement and click Next.4 Click Install to start the installation.5 Once the installation is done, a screen appears with successful installation message. Click Finish to complete the installation and exit from the installation wizard.6 To verify if the MipiMphy CLPG package is properly installed, launch CLPG from Start -> All Programs.

4 Transmitting Stimulus Using the Command Line Packet Generator

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Launching and Preparing CLPG for Stimulus Transmission

Once the hardware and software components are installed, you can start using the CLPG to generate and transmit stimulus to DUT.

Use Tcl functions for generating packets using the CLPG software.

To use the Command Line Packet Generator

- 1 Launch the CLPG shell window from **Start -> All Programs**.

The following window is displayed.

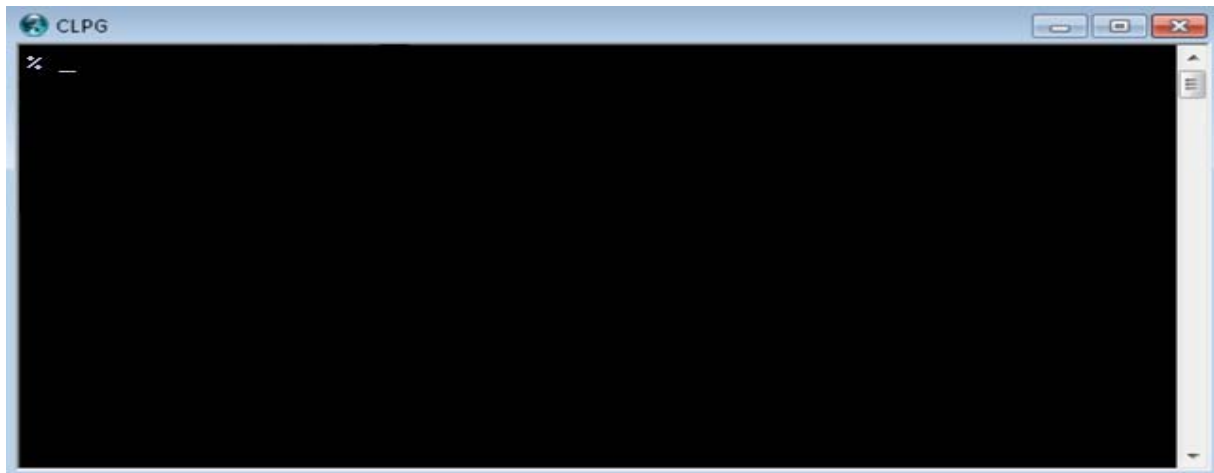


Figure 3 CLPG shell window

- 2 Load **AgRunCLPG** package as shown in [Figure 4](#). Use the command `<package require AgRunCLPG>` as displayed in the following screen.

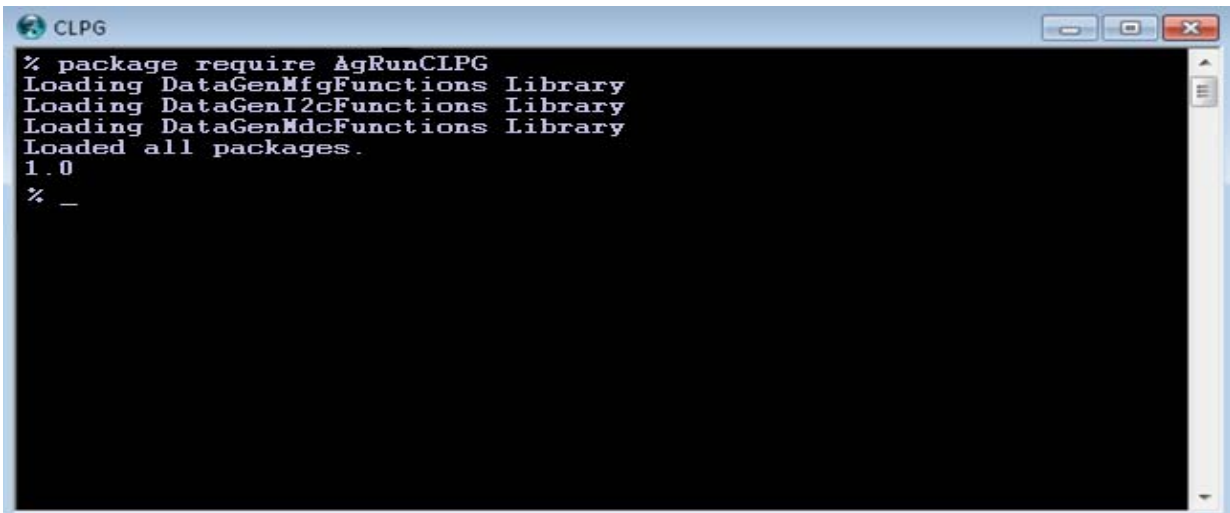
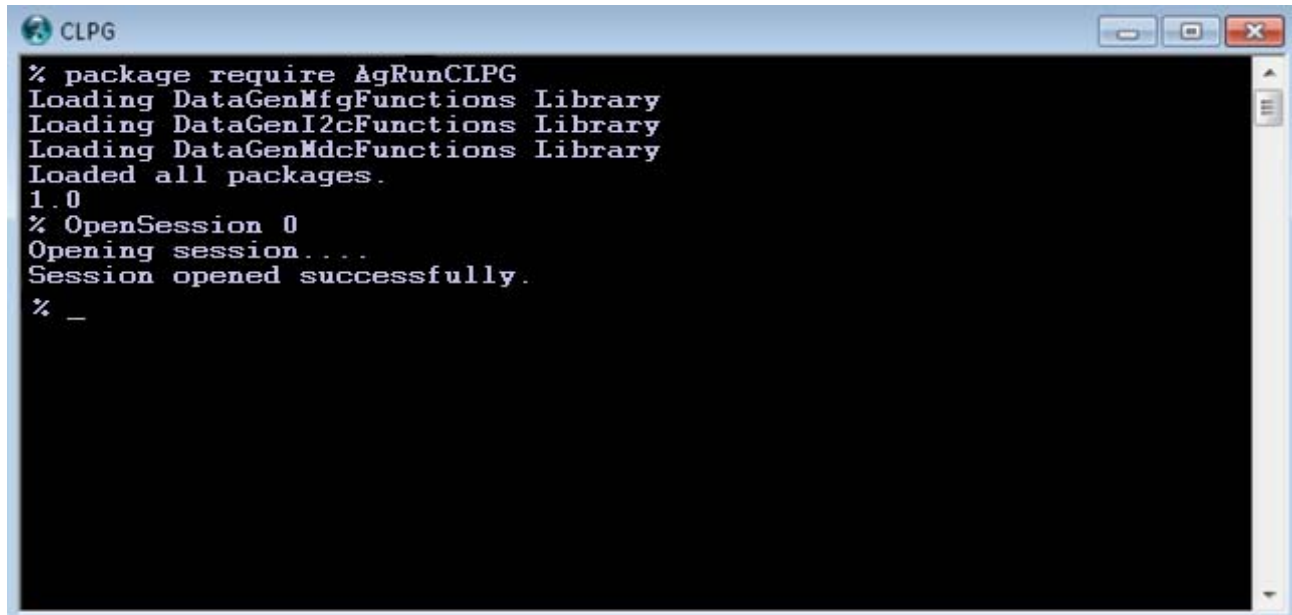


Figure 4 Load AgRunCLPG.tcl

- 3 Open the Data Generator session to establish connection with the Keysight LPA software as shown in Figure 5. Use the CLPG command `<OpenSession 0>` as displayed in the following screen.



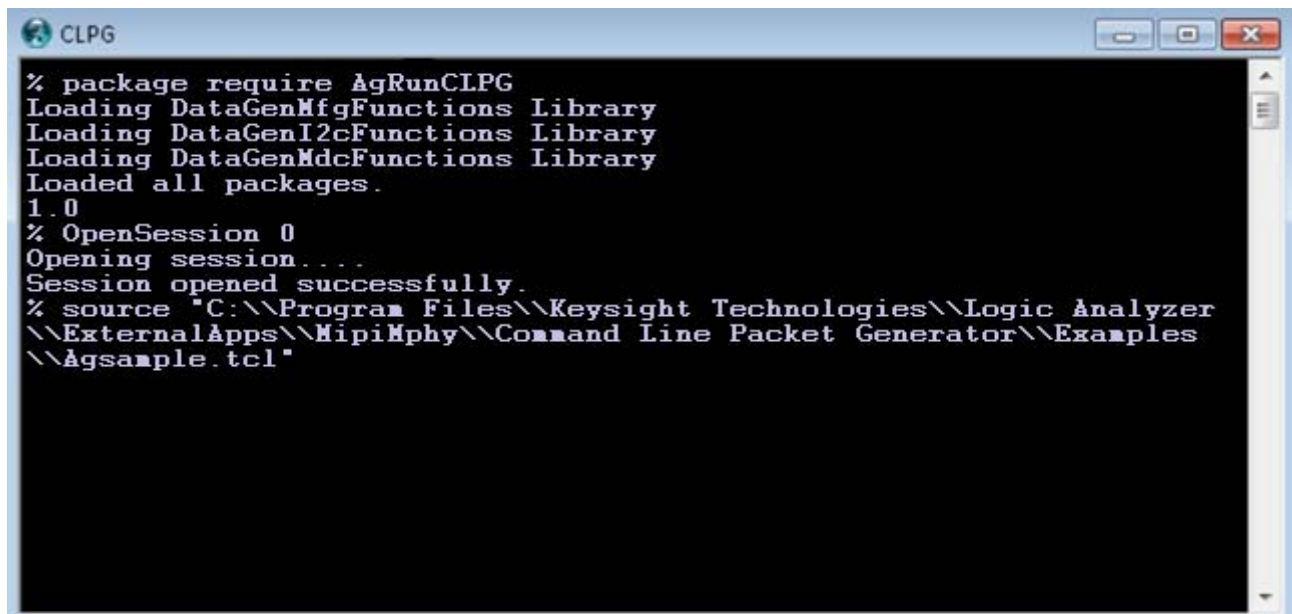
```

CLPG
% package require AgRunCLPG
Loading DataGenMfgFunctions Library
Loading DataGenI2cFunctions Library
Loading DataGenMdcFunctions Library
Loaded all packages.
1.0
% OpenSession 0
Opening session....
Session opened successfully.
% _

```

Figure 5 OpenSession to start a Data Generator session

- 4 Run the examples Tcl script as shown in Figure 6. Use the Tcl command `source <file path to AgSample.tcl>` as displayed in the following figure.



```

CLPG
% package require AgRunCLPG
Loading DataGenMfgFunctions Library
Loading DataGenI2cFunctions Library
Loading DataGenMdcFunctions Library
Loaded all packages.
1.0
% OpenSession 0
Opening session....
Session opened successfully.
% source "C:\\Program Files\\Keysight Technologies\\Logic Analyzer
\\ExternalApps\\MipiMphy\\Command Line Packet Generator\\Examples
\\AgSample.tcl"

```

Figure 6 AgSample.tcl example test cases sourced for execution

Creating Test Case Scripts

- 1 Create a new file and save it with the extension Tcl.
- 2 Copy the mandatory commands from **C:\Program Files\Keysight Technologies\Logic Analyzer\ExternalApps\MipiMphy\Command Line Packet Generator\Examples\AgSample.tcl** file and paste those commands in the new Tcl file that you created in the previous step.
- 3 Write exposed commands in the new Tcl file.
- 4 For information on various Tcl functions, refer to the example provided in **C:\Program Files\Keysight Technologies\Logic Analyzer\ExternalApps\MipiMphy\Command Line Packet Generator\Examples\AgSample.tcl** file.

For More Information

To get detailed information on each of the Tcl function defined in Keysight provided Tcl files, refer to the online help **KeysightCommandLinePacketGenerator.chm**. This online help describes usage, parameters, return values, and examples of these Tcl functions.

When you install the CLPG software, this online help also gets installed and can be accessed at the following location.

C:\Program Files\Keysight Technologies\Logic Analyzer\Help

Example CSV Files

The CLPG software provides a number of example CSV files that you can use to configure and customize the stimulus. You can find details of these CSV files in the **KeysightCommandLinePacketGenerator.chm** online help.

5 Capturing Data using the Embedded Analyzer and Loop-back Board

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Capture - Overview

This topic assumes that you have already set up the hardware needed for capturing data including the probe, loopback board, and U4431A module and installed the required software components.

The CLPG (U4431A) module comes with an embedded analyzer and provides the following two sublinks for data capture:

- Pod 1 for capturing the data transmitted from DUT.
- Pod 2 for capturing the data transmitted as stimulus from CLPG.

You use the Keysight Logic and Protocol Analyzer GUI to configure the connection and capture setup for these two sublinks of CLPG. In this GUI, you can configure the CLPG connection as:

- **One Sublink** - This sublink will only be used for capturing data transmitted from DUT. The data transmitted from CLPG will not be captured.
- **Both Sublinks** - The sublink on Pod 1 will be used for capturing data transmitted from DUT and the sublink on Pod 2 will be used for capturing the data transmitted as stimulus by CLPG.

In case of Both Sublinks scenario, all the capture features supported by the module are available for the Pod 1 sublink. A few capture features such as raw data capture and the pattern matchers in triggers are not available for Pod 2 sublink. The topics that follow provide details of the capture configuration and the features available for the two sublinks.

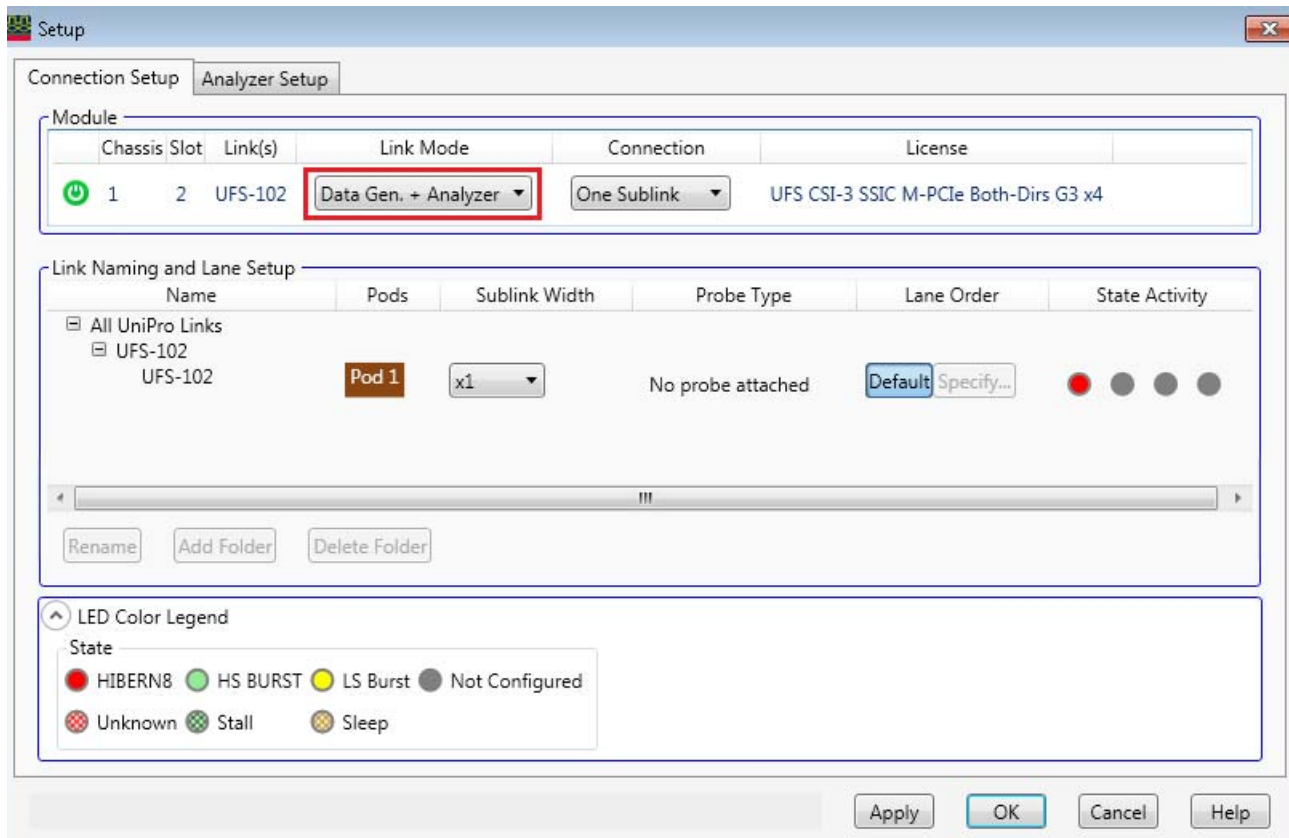
NOTE

For a "Both Sublinks" configuration, the CLPG always monitors the sublink on Pod 1 (used for DUT data capture) for tracking the link configuration requests. The sublink on Pod 2 is not used for this purpose in any scenario.

Steps for Configuring the Connection and Capture Setup for CLPG

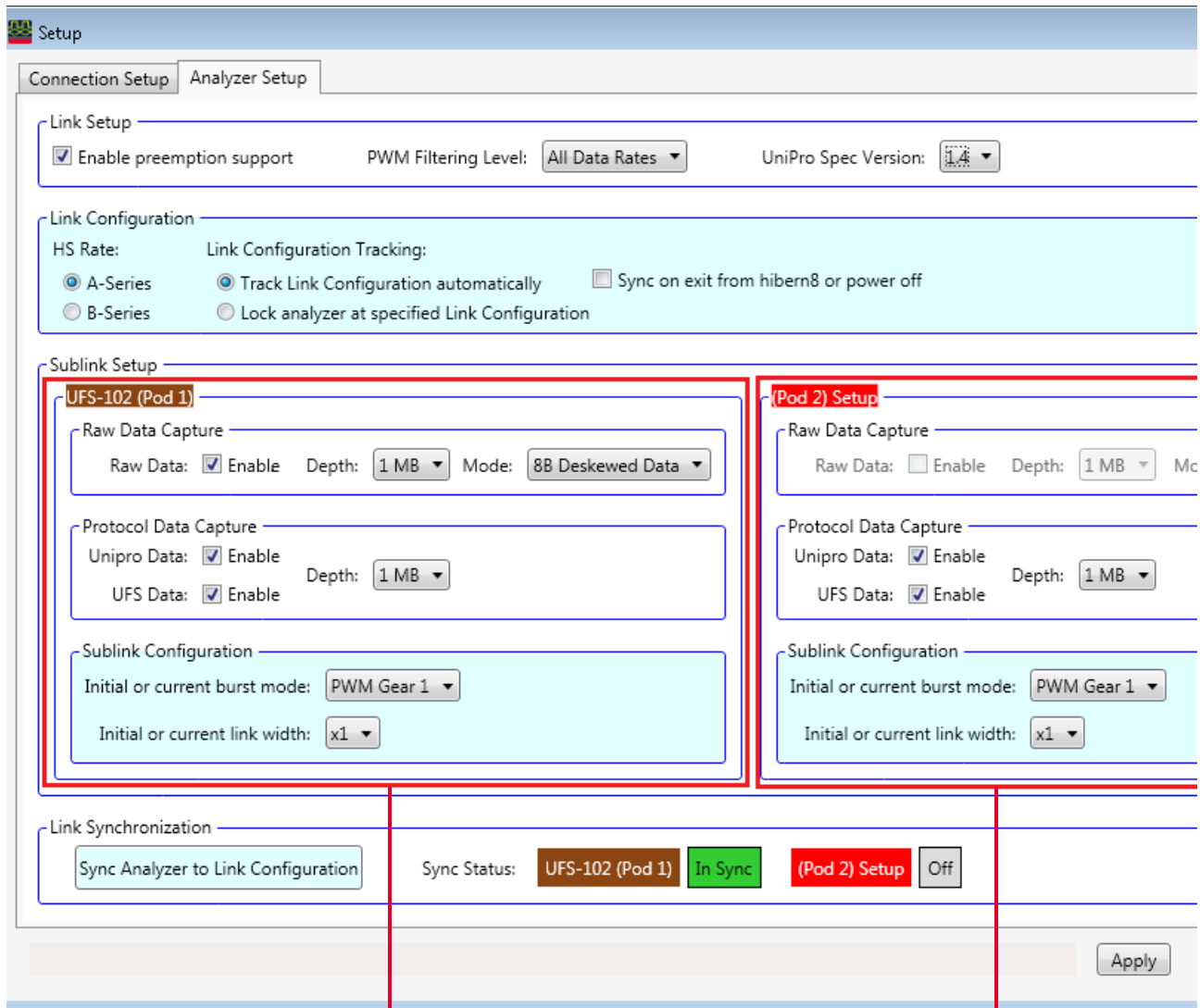
Perform the following steps to configure a One Sublink or a Both Sublinks setup for CLPG in the Keysight Logic and Protocol Analyzer GUI.

- 1 Launch the Keysight Logic And Protocol Analyzer GUI.
- 2 Access the **Setup** dialog for the CLPG module by clicking **Setup > Setup** from the menubar.
- 3 In the **Connection Setup** tab, select the **Data Gen + Analyzer** option from the **Link Mode** listbox. This ensures that the CLPG link is configured to transmit data as well as to capture data as an analyzer.



- 4 From the **Connection** listbox, select the **One Sublink** option if you want to capture data transmitted from DUT only and not from the CLPG. Select the **Both Sublinks** option if you want to capture data transmitted from DUT (on Pod1 sublink) and CLPG (on Pod2 sublink).
- 5 Configure the Sublink Width and Lane Ordering for the sublink(s). To know more about any of the fields displayed in the Connection Setup tab, you can click the **Help** button displayed at the bottom of the tab.
- 6 Click the **Analyzer Setup** tab.

If you selected the Both Sublinks option in step 4, two separate sections are provided for the two sublinks to allow you to configure the capture settings independently for the two sublinks. The settings you configure in the Pod 1 section are applicable for capturing data transmitted from DUT and the settings you configure in the Pod 2 section are applicable for capturing data transmitted from CLPG.



Capture settings for data transmitted from DUT

Capture settings for data transmitted from CLPG

NOTE

The raw data capture is not supported for capturing the data transmitted from CLPG. Therefore, the **Raw Data Capture** section is disabled for Pod 2 sublink setup.

- 7 Set the Analyzer Setup fields for the sublink(s). To know more about any of the fields displayed in the Analyzer Setup tab, you can click the **Help** button displayed at the bottom of the tab.
- 8 Click **Apply** and then **OK**.

After the setup is complete, you use the  **Run** toolbar button to start the data capture.

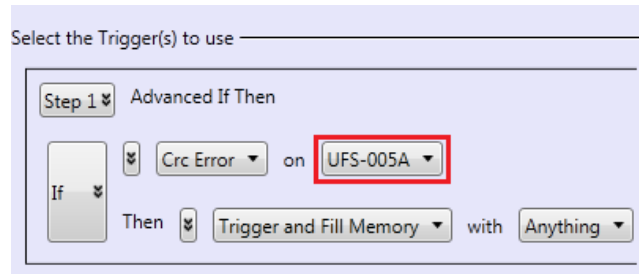
Configuring the Trigger Setup for CLPG

You configure the trigger setup for the data capture by CLPG using the **Trigger** dialog box. You can access this dialog box by clicking **Setup > Trigger** from the menubar of the Keysight Logic and Protocol Analyzer GUI.

NOTE

When using CLPG to capture data on both sublinks, the CLPG can trigger only when the trigger condition is met based on the transmission of data from DUT. It cannot be triggered based on the stimulus data that it transmits to DUT. Therefore, while creating a trigger event for a CLPG bidirectional setup, the packet direction is automatically set to Direction A (DUT to CLPG) in the trigger event. However, while creating a trigger event on physical layer errors, you must choose either **Direction A** (DUT to CLPG) or **Either direction** as the direction to be used in the event. If you choose Direction B, that is, CLPG to DUT, then the trigger will not work.

An example of a correct direction setting for a trigger event in a bidirectional CLPG setup is as follows.



For more details about trigger setup in detail, click the **Help** button displayed at the bottom of the Trigger dialog box. Or alternatively, you can also refer to the **Setting up Triggers** chapter in the **U4431A MIPI M-PHY Protocol Analyzer User guide**. This guide is installed with the Keysight Logic and Protocol Analyzer software. You can also download it from www.keysight.com/find/mphy_analyzer.

Viewing Unidirectional/Bidirectional Data Captured by Embedded Analyzer

You use the Protocol Viewer window in the Keysight Logic and Protocol Analyzer GUI to view the data captured using the embedded Analyzer of CLPG. The Protocol Viewer can display the data transmitted from DUT as well as stimulus transmitted from CLPG.

Examples

In the following screen, data has been captured for a “One Sublink” link configuration, that is, the data transmitted from DUT.

Sample Number	Time	Direction	Gear	UniPro Packet	Sequence Number	L4 Payload
190	4.694914227 s	UFS-102A	PWM G1	PACP_SET_cnf		
191	4.695729607 s	UFS-102A	PWM G1	End of Burst		
192	5.235961916 s	UFS-102A	PWM G1	Start of Burst /...		
193	5.235984993 s	UFS-102A	PWM G1	PACP_SET_req		
194	5.236346529 s	UFS-102A	PWM G1	PACP_SET_cnf		
195	5.237161913 s	UFS-102A	PWM G1	End of Burst		
196	5.791929967 s	UFS-102A	PWM G1	Start of Burst /...		
197	5.791953044 s	UFS-102A	PWM G1	PACP_PWR_req		
198	5.792314580 s	UFS-102A	PWM G1	PACP_PWR_cnf		
199	5.792645346 s	UFS-102A	PWM G1	End of Burst		
200	5.859107066 s	UFS-102A	HS G1	Start of Burst /...		

In the following screen, data has been captured for a “Both Sublinks” link configuration, that is, the data transmitted from DUT and data transmitted from CLPG.

Sample Number	Direction	Direction	Gear	UniPro Packet	Sequence N	Time
168		UFS-101B	PWM G1	Start of Burst / Deskew		14.067279 ms
169		UFS-101B	PWM G1	PACP_SET_req		19.760 us
1014	UFS-101A		PWM G1	Start of Burst / Deskew		291.647 us
1015	UFS-101A		PWM G1	PACP_SET_cnf		2.360 us
1016	UFS-101A		PWM G1	End of Burst		61.259 us
170		UFS-101B	PWM G1	End of Burst		342.867 us
171		UFS-101B	PWM G1	Start of Burst / Deskew		208.086237 ms
172		UFS-101B	PWM G1	TC0 Data Frame	00	144.895 us
1017	UFS-101A		PWM G1	Start of Burst / Deskew		368.788 us
1018	UFS-101A		PWM G1	AFC0 Frame	00	2.360 us
1019	UFS-101A		PWM G1	TC0 Data Frame	00	7.072 us

For More Information on Data Capture and Analysis

You can find detailed information on the Keysight Logic and Protocol Analyzer GUI as well as the capture features of the U4431A module in the following guides/online help systems.

- **U4431A MIPI M- PHY Protocol Analyzer User Guide**- This user guide describes how to configure and use the U4431A module to capture and analyze M-PHY data. This guide is installed with the Keysight Logic and Protocol Analyzer software. You can also download it from www.keysight.com/find/mphy_analyzer.
- **Context- sensitive help** - A context- sensitive HTML help page is available with each window and dialog box of the U4431A module on clicking the Help button displayed within the GUI element.

