Keysight Protocol Exerciser for PCI Express

Hardware Guide

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Notices

Installation Guide

You can find the installation guides for different components of the product on the product CD. Keysight recommends you to do not switch on the instrument before you have understood all the applicable installation instructions and have met all the installation prerequisites.

Where to find more information

You can find more information about System Protocol Tester from the following link:

http://www.keysight.com/find/spt

You can also look for search a local contact for assistance on the following link:

http://www.keysight.com/find/assist

Warranty

Technology Licenses

Restricted Rights Legend

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.

Keysight Protocol Exerciser for PCI Express Hardware Guide

Safety Summary

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 or operating instructions in the product manuals 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. Product manuals are provided with your instrument on CD-ROM and/or in printed form. Printed manuals are an option for many products. Manuals may also be available on the Web. Go to www.keysight.com and type in your product number in the Search field at the top of the page.

General — Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

Before Applying Power — Verify that all safety precautions are taken. Make all connections to the unit before applying power. Note the instrument's external markings described in "Safety Symbols".

Ground the Instrument — If your product is provided with a grounding type power plug, the instrument chassis and cover must be connected to an electrical ground to minimize shock hazard. The ground pin must be firmly connected to an electrical ground (safety ground) terminal 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.

Fuses — See the user's guide or operator's manual for information about line-fuse replacement. Some instruments contain an internal fuse, which is not user accessible.

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 — Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover.

Cleaning — Clean the outside of the instrument with a soft, lint-free, slightly dampened cloth. Do not use detergent or chemical solvents.

Do Not Modify the Instrument — Do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Keysight Sales and Service Office for service and repair to ensure that safety features are maintained.

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

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 Symbols

Table 1   **Safety Symbol**

Symbol	Description
	Direct current
	Alternating current
	Both direct and alternating current
	Three phase alternating current
	Three phase alternating current
	Earth ground terminal
	Protective earth ground terminal
	Frame or chassis ground terminal
	Terminal is at earth potential
	Equipotentiality
N	Neutral conductor on permanently installed equipment
L	Line conductor on permanently installed equipment
	On (mains supply)
	Off (mains supply)
	Standby (mains supply). The instrument is not completely disconnected from the mains supply when the power switch is in the standby position
	In position of a bi-stable push switch

Symbol	Description
	Out position of a bi-stable push switch
	Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION
	Caution, refer to accompanying documentation
	Caution, risk of electric shock
	Do not apply around or remove from HAZARDOUS LIVE conductors
	Application around and removal from HAZARDOUS LIVE conductors is permitted
	Caution, hot surface
	Ionizing radiation
CAT I	IEC Measurement Category I
CAT II	Measurement Category II
CAT III	Measurement Category III
CAT IV	Measurement Category IV

Compliance and Environmental Information

Table 2   **Compliance and Environmental Information**

Safety Symbol	Description
	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.

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.

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.

Do not dispose in domestic household waste.

To return unwanted products, contact your local Keysight office, or see www.keysight.com/environment/product for more information.

Printing History

Keysight Technologies can issue revisions between the product releases to reflect the latest and correct information in the guide. Keysight Technologies also reserves its right to not issue a new edition of the guide for every system release.

Manual Name: Keysight Protocol Exerciser for PCI Express- Hardware Guide

The edition number of the guide, publishing time of the guide, and applicable release number of the product are given in the following table.

Edition	Published	Applicable Release
1.3	October, 2014	8.74

Keysight Protocol Exerciser for PCI Express Hardware Guide

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1   U4305A Exerciser Card

This chapter provides information on the U4305A exerciser card used for testing PCIe devices. This chapter describes the card's emulation modes, hardware features, components, and sample hardware configuration scenarios for this card in the overall setup.

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U4305A Exerciser Card – Introduction

The Keysight U4305A exerciser card is a test and debug tool that provides features for testing the next generation of PCI Express technology. You can use this card to stimulate PCIe components on system boards and cards with various test scenarios. The Exerciser card can emulate a PCIe device or a topology with or without SRIOV / MRIOV capabilities and can provide test conditions to test components on system boards and cards.

The U4305A Exerciser card provides the functions of an LTSSM as well as an Exerciser to help you perform thorough PCIe link testing and validation testing for the DUT. As an LTSSM Tester, the Exerciser card helps you verify the DUT's LTSSM state transitions and timeout implementations. As an Exerciser, it exercises DUT with the configured stimulus traffic. It can send TLP requests as well as completions to a DUT.

The U4305A Exerciser card can emulate a PCIe endpoint and act as a Downstream Component (DSC) for a System Under Test. It can also emulate a root complex and act as an Upstream Component to stimulate a PCIe Device Under Test. Refer to the topics "U4305A Exerciser Card as an Endpoint and "U4305A Exerciser Card as a Root Complex to know more.

NOTE	For information on installing and configuring the U4305A exerciser card, refer to Keysight PCIE Exerciser Gen3, Installation Guide.
	For information on how to use the U4305A exerciser card, refer to Keysight Protocol Exerciser for PCI Express, User Guide.

Features

This topic describes the features of the U4305A exerciser card.

- U4305A is a standard height, half-length card as described in the PCI Express specification, and fits into every system including blade servers.
- U4305A supports LTSSM functions for upto x16 link widths.
- U4305A supports simultaneous use of LTSSM and Protocol Exerciser functions, without requiring any configuration.
- U4305A supports Gen1 (2.5 GT/s), Gen2 (5.0 GT/s), and Gen3 (8.0 GT/s) speeds as per PCIe specifications.
- U4305A provides non IOV, SRIOV, and MRIOV capabilities based on the licensed options.
- You can manage, control, and use the U4305A Exerciser card using the Protocol Exerciser GUI and APIs.

Components

This topic describes the hardware components of the U4305A exerciser card.

Figure 1 and Figure 2 display the U4305A exerciser card to indicate the various components of this card.
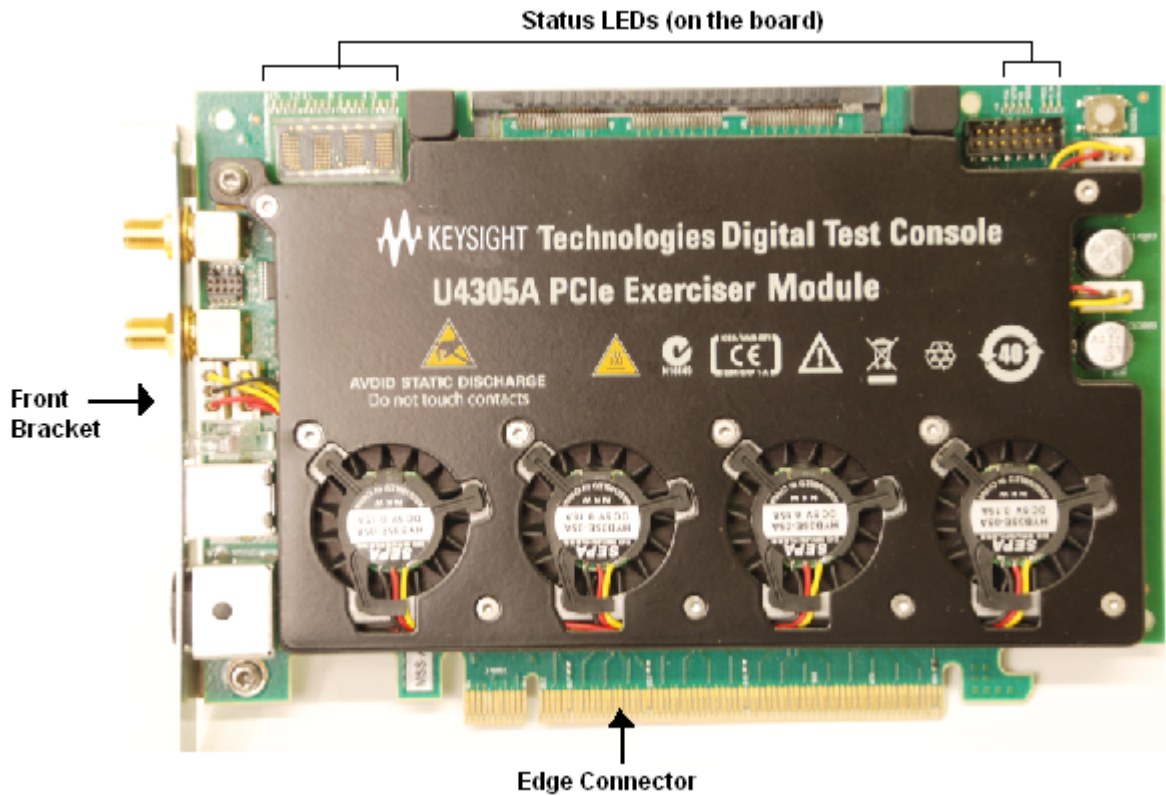

Figure 1   U4305A Exerciser Card
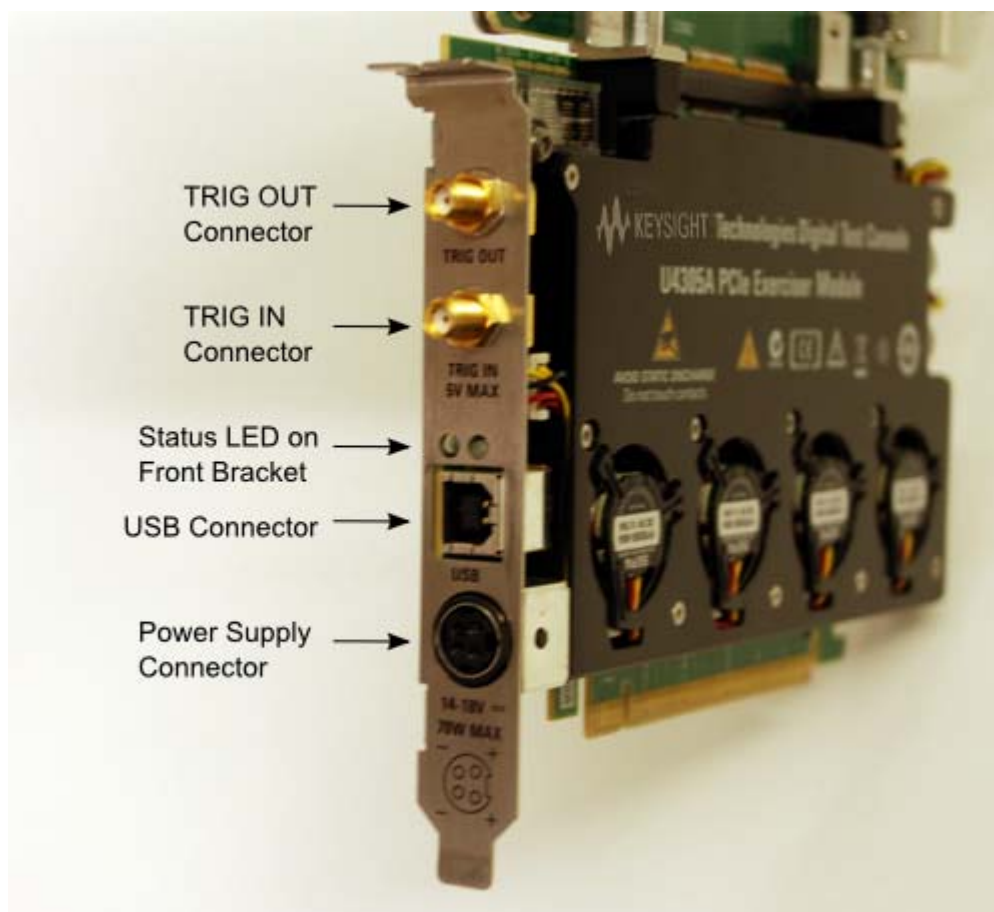
Figure 2   U4305A Exerciser Card components on front bracket

The hardware components displayed in the above figures of the U4305A Exerciser card are described:

- **Edge Connector**: This component is used to connect the U4305A card with a PCIe Connector on the backplane board, or with a system.
- **Status LEDs (on board)**: This component has the LEDs to display the status information about the participating lanes of the link and power status of board and exerciser card. 16 LEDs displaying the lane status are in the upper left corner of the board and the rest of the 7 LEDs are in the upper right corner of the board. The module number to which U4305A is configured is also displayed in the upper left corner.

   To get a description of each LED on the board, refer to the topic "Exerciser Card Status LEDs in this chapter.

- **Status LEDs (on front bracket)**:

   The green LED represents the link speed status and has the following different states:
   - *No light* means there is no link up between the Exerciser card and DUT.
   - *Green light* means there is a link up at the Gen3 speed (8.0 GT/s).
   - *Fast blinking light* means there is a link up at the Gen2 speed (5.0 GT/s).
   - *Slow blinking light* means there is a link up at the Gen1 speed (2.5 GT/s).

   The red LED on the front bracket will be on until the FPGA receives a valid configuration.

- **USB Connector**: This component is used to connect U4305A with the controller PC using the USB cable.
- **Power Supply Connector**: This component is used to connect U4305A with the external power supply. Use the power supply delivered with U4305A only.
- **TRIG OUT Connector**: This component is used to connect the U4305A card with other test equipments such as Protocol Analyzer to trigger these test equipments. The Exerciser card generates a trigger out pulse when a specified trigger out condition is met.
- **TRIG IN Connector**: This component is used to connect the U4305A card with other test equipments such as Protocol Analyzer to receive a trigger from these test equipments when a specified condition is met.

  The electrical characteristics of the Trigger In/Out are as follows:

  - **Trigger In**: Vin Low Max = 0.9V, Vin High Min = 2.0V max, Input current +/- 5uA. The width of the trigger in pulse should be greater than 32 ns.
  - **Trigger Out**: TTL levels series terminated with 50 Ohms. Vout High Min (no load termination) = 2.4V, Vout Low Max (no load termination) = 0.4V; Vout High Min (with 50 Ohms External termination to GND) = 1.2V, Vout Low Max (with 50 Ohms External termination to GND) = 0.2V. The width of the trigger out pulse is 125 ns.

WARNING	Do not directly touch any component on the U4305A exerciser card. It may be hot.

CAUTION	Components on the U4305A exerciser card are sensitive to the static electricity. Therefore, take necessary anti-static precautions, such as wear a grounded wrist strap, to minimize the possibility of electrostatic damage.

This component comes with a protective foam cover to protect it from electrostatic damage (Figure 3).

Figure 3   Protective Foam Cover for Edge Connector

NOTE	Please remove the protective foam cover before using the card, and attach it again when the card is not in use.

Exerciser Card Status LEDs

The U4305A Exerciser card has a number of status LEDs on the board and on the front bracket. This topic describes the meaning of each of these status LEDs.

The following figure displays the status LEDs on board.
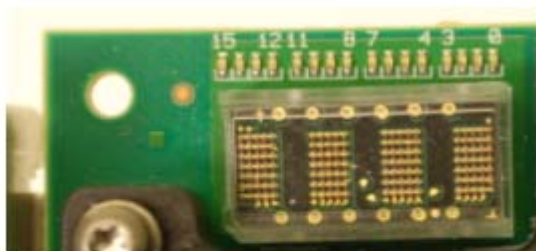
16 Status LEDs in the left corner of card

7 status LEDs in the right corner of card

Figure 4   Exerciser card status LEDs

The following table describes the status LEDs on board and on the front bracket.

Table 3   **Exerciser card status LEDs**

LED Name/Label	Description
Status LEDs on the board	
16 status LEDs in upper left corner of the board	Displays the status of the lanes (x1-x16) in the link. All these LEDs are off if the link is not up. If the link is up, then the LEDs are on for only those lanes that are participating in the link.
POK	When this LED is ON, it indicates that the FPGA power supplies are operating. This is displayed in the upper right corner of the board.
UPOK	When this LED is ON, it indicates that the Power supplies for the microprocessor system and USB are operating. This is displayed in the upper right corner of the board.
HB	This LED represents the Heartbeat. It blinks at about 1 second rate to indicate that the microprocessor is operating. This is displayed in the upper right corner of the board.
DONE	When this LED is on, it indicates that FPGA has been programmed successfully. This is displayed in the upper right corner of the board.
PE3.3	When this LED is on, it indicates that the +3.3V PCI Express power supply from the bottom (SYS) connector is up. This is displayed in the upper right corner of the board.
3.3VA	When this LED is on, it indicates that the +3.3V Aux PCI Express power supply from the bottom (SYS) connector is up. This is displayed in the upper right corner of the board.
PE12V	When this LED is on, it indicates that the +12V PCI Express power supply from the bottom (SYS) connector is up. This is displayed in the upper right corner of the board.
Status LEDs on front bracket	
No light	There is no link up between the Exerciser card and DUT.
Green	There is a link up at the Gen3 speed (8.0 GT/s).
Fast Blinking light	There is a link up at the Gen2 speed (5.0 GT/s).
Slow Blinking light	There is a link up at the Gen1 speed (2.5 GT/s).
Red LED	The red LED on the front bracket will be on until the FPGA receives a valid configuration.

U4305A Exerciser Card as an Endpoint

This topic introduces you to the U4305A exerciser card emulating a PCIe endpoint.

NOTE	For detailed information on how to set up the U4305A exerciser card as a PCIe endpoint, refer to the Keysight PCIE Exerciser Gen3 Installation guide.

You can use the U4305A exerciser card as an endpoint to stimulate a System Under Test into various test scenarios. To accomplish this, you plug the exerciser card as a normal PCIe device into the motherboard under test through the Edge connector of the card.

A controller system hosts the Protocol Exerciser software and hardware support services to control and manage the Exerciser card. Exerciser card is connected to this controller system through a USB cable. The following figure displays a sample hardware setup in which the U4305A exerciser card is emulating a PCIe endpoint.
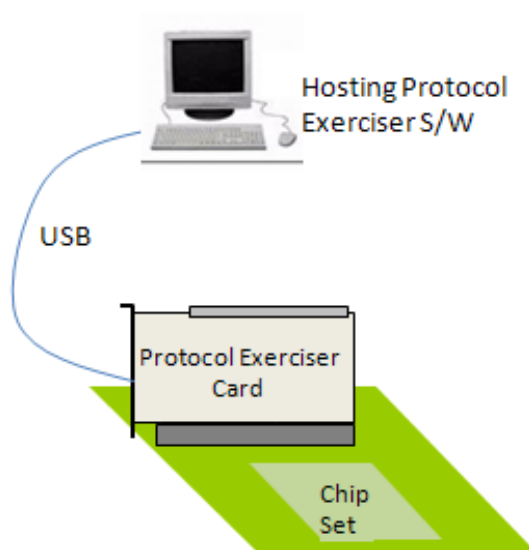

Figure 5   Exerciser card emulating a PCIe endpoint

U4305A Exerciser Card as a Root Complex

This topic introduces you to the U4305A exerciser card emulating a root complex.

NOTE	For detailed information on how to set up the U4305A exerciser card as a root complex, refer to the Keysight PCIE Exerciser Gen3 Installation guide.

You can use the U4305A exerciser card as a root complex to stimulate a DUT into various test scenarios. To accomplish this, you plug the exerciser card into a passive backplane board through the Edge connector of the card. In this case, the Exerciser card communicates to the DUT through the bottom connectors.

A controller system hosts the Protocol Exerciser software and hardware support services to control and manage the Exerciser card. Exerciser card is connected to this controlling system through a USB cable. The following figure displays a sample hardware setup in which the U4305A exerciser card is emulating a PCIe root complex.
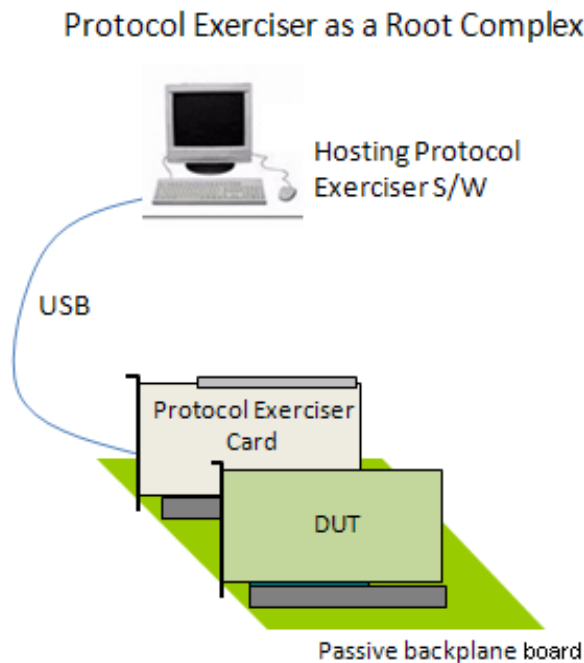

Figure 6   Exerciser card emulating a root complex

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