



# 2500A PCI Express Protocol Analyzer User Guide



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# 1. Introduction

This document describes the hardware and software functionality of the ITIC 2500A PCI Express Protocol Analyzer.

## 1.1. Hardware Overview

The 2500A PCI Express Protocol Analyzer supports the following features:

- PCI Express 1.1 (2.5 GBit/second) compliant
- User-selectable x4, x2 and x1 link width configurations.
- User-selectable 2 Gigabyte to 64 Kilobyte capture buffer. A selectable capture buffer size allows for smaller data files when saved to hard disk.
- A powerful 48 MHz Cypress FX2LP microprocessor implements on-demand upload of data via USB 2.0 after a completed capture. This allows you to immediately view data after the capture without having to wait for lengthy uploads of the full trace data.
- An Altera Arria II GX FPGA contains PCI Express x4 transceivers, a DDR2 Memory Controller and data upload interface to the microprocessor.
- Programmable Sequence Detectors allows the FPGA to detect the location of pre-defined as well as custom data sequences. This facilitates hardware-acceleration of PCI Express Protocol Item detection after capture. This, in turn, enables the software to display the data very quickly after a completed capture without a need for the software to locate the PCI Express Packets and Ordered Sets captured.
- An 8-level trigger with up to 2048 byte deep data detection per trigger level allows triggering on very long data sequences. In total, data sequences up to 16 Kbytes in length can be triggered upon.
- A TTL-compatible Trigger in / out port allows synchronization with external test instruments.
- A x4 slot probe with a 1 m (3.3ft) cable is included. 3<sup>rd</sup> party, custom probes can also be designed and connected to the 2500A unit.
- Microprocessor firmware and FPGA configuration are automatically updated with the PC application software. No separate and complex hardware re-programming is needed.

Overall, the 2500A hardware and software has been designed for maximum efficiency and simplicity. The hardware is small enough to fit on your pocket, the software is very easy to use but yet the complete package is very flexible and powerful.



## 1.2. Software Overview

The 2500A software runs on Microsoft Windows XP and newer operating systems. Both x86 and x64 systems are supported. The .NET Framework 2.0 is required.

The 2500A software supports the following features:

- The trigger position can be adjusted within the capture buffer (i.e. pre or post trigger).
- Lane Polarity, Lane Mapping and Descrambling can be adjusted / disabled as needed.
- The software dynamically acquires the data required to display the visible part of the trace as the data is browsed. This results in very quick and effortless browsing of the captured data regardless of the capture buffer size used.
- Multiple Views of the data are time-correlated; the Protocol View displays a hierarchical view of all Transactions as well as the Packets included within the transactions; the Lane View displays the raw data and control characters as they were received on the link under test; finally, the Detail View decodes details of the packet selected in the Protocol View. Together, these views give you a quick and easy way to browse the captured data from the highest to lowest information level.
- All Protocol Items in the trace are displayed in the 'Node Finder' View. This view allows direct jump to any protocol item in the trace. The Node Finder can also be used to hide / show packets of a particular type.
- The 'Search View' allows you to search for binary or string data in packet payload. Multiple searches can be started and run in the background as you continue working with the software. The Search View allows direct jumps to the search result locations.
- The 'Markers View' displays the trigger position as well as any markers you have added to the capture. Markers are saved with the project and allow you to quickly locate interesting areas in the trace at a later time.
- Protocol Item Filtering allows you to instantly hide any given Protocol Item Type from the Protocol View. Due to the dynamic data access of the Protocol View, filtering is very quick, even for a full 2 Giga-byte capture.
- The Protocol View and Lane View data can be exported to file in XML format and to the clipboard in CSV format. This allows easy post-processing of the captured data via your own or 3<sup>rd</sup> party software.
- Time can be shown in absolute (measured from capture start) or relative (measured from prior protocol item) mode.
- Protocol View and Lane View data can be print previewed as well as printed.



For best performance we recommend a newer Core i5 or Core i7 PC to be used. The minimum recommended PC requirements are a P4 / 2 GHz machine. The data upload speed as well as the Protocol View Filtering speed will be improved with the faster machines.

# 2. Installation

This section describes how to install the 2500A PCI Express Protocol Analyzer hardware and software.

## 2.1. Hardware Installation

The hardware is comprised of three components:

- 1) An Active Interposer Probe for analysis of 2.5 Gbps (Gen1) x1, x2 and x4 PCI Express plug-in cards.
- 2) A 1m external PCI Express Molex x4 iPass Cable.
- 3) The 2500A PCI Express Protocol Analyzer.

Figure 1 below shows how these hardware components are connected to the system under test.



Figure 1. Probe, Cable and 2500A Protocol Analyzer attached to the target system.

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## 2.2. Software Installation

To install the 2500A software, run the installation program and follow the instructions on screen. We recommend installing to the default directory path suggested by the installation program.

After the 2500A software has been installed to your hard disk, you need to install the 2500A Windows driver. To do this; follow the below steps:

- 1) Connect the 2500A PCI Express Protocol Analyzer to a high-speed USB 2.0 port on your computer.
- 2) Open the Windows Device Manager.
- 3) Right-click on the 2500A device (normally displayed as "Unknown Device") and click the 'Update Driver' menu item.
- 4) Direct Windows to the 'ITI2500A.inf' file located in the 'Drivers' directory within the installation directory. The driver is also located in the root directory on the CD that came with your 2500A unit.

You may have to do the above procedure twice since two different drivers are used by the 2500A unit. Once the driver is installed properly, you should see the 2500A device in the Device Manager as shown below in figure 2.

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Computer Management (Local ) System Tools ) O Task Scheduler ) Event Viewer ) Shared Folders ) Coal Users and Groups ) Performance Device Manager 2 Storage	Storage controllers System devices Universal Serial Bus controllers Generic USB Hub Generic USB Hub Intel(R) C600/X79 series chipset USB2 Enhanced Host Co Intel(R) C600/X79 series chipset USB2 Enhanced Host Co Truc 2500A PCI Express Protocol Analyzer Texas Instruments USB Root Hub	Actions Device Ma More
Services and Applications	Texas Instruments USB Root Hub Texas Instruments USB Root Hub Texas Instruments XHCI Controller USB Composite Device USB Mass Storage Device USB Root Hub USB Root Hub VIB Root Hub	

Figure 2. The 2500A device driver is installed via the Device Manager.



## 3. Reference

This section describes the 2500A hardware and software in more detail.

## 3.1. Hardware Reference

## 3.1.1. 2500A PCI Express Protocol Analyzer

The 2500A is designed to be extremely compact. As the below figure 3 shows, all the required 2500A electronics are integrated onto a single 120 mm x 100 mm circuit board. This makes the 2500A the most compact PCI Express Protocol Analyzer on the market.



Figure 3. The 2500A unit is very compact, which allows it to be easily carried in your pocket.

## 10-Layer High-Speed Printed Circuit Board

The 10-layer PCB has been manufactured with highest-quality, high-speed materials to ensure superior signal-integrity and power distribution. It has been constructed with four signal layers, four ground planes and two power planes. Blind vias were additionally utilized to facilitate the very compact form-factor. The design has additionally been fully analyzed with regards to Signal-Integrity and Power-Integrity via field-solver software to guarantee robust functionality under all operating conditions.



### Cypress FX2LP 48 MHz CPU

The 2500A is controlled by a 48 MHz Cypress FX2LP CPU. This handles, via USB 2.0, FPGA Configuration, PC software interaction with the FPGA as well as capture data upload.

### Altera Arria II GX FPGA

The Arria II GX FPGA contains a DDR2 Controller and capture buffer logic, eight Device-to-Host (D2H) and Host-to-Device (H2D) PCI Express Transceivers, byte ordering, PCI Express descramblers and PCI Express Lane Ordering Logic. Additionally, the FPGA contains the logic required to automatically generate the meta-data that identifies the location of all PCI Express protocol items (Packets and Ordered Sets) in the capture buffer.

The FPGA also implements the digital logic required for the 8-level, 16 Kilobyte deep trigger sequencer. The FPGA Digital Design has carefully been implemented as a set of discrete state machines for maximum efficiency. This enables the FPGA to deliver a very capable set of functionality in a minimal physical package.

#### Micron 2 Gigabyte DDR2 SODIMM

The captured data is stored in a ring-buffer in the DDR2 SODIMM which is running at 267 MHz. This allows the captured data to be stored with a bandwidth of roughly 4 Giga-bytes per second. With the maximum 2 GByte capture buffer size configured, the SODIMM will store about 820 ms worth of bi-directional data for a x4 link. This is equivalent to roughly 200 million unique timestamps in the capture buffer.

### **Texas Instruments Power Regulators**

The Power Distribution Network (PDN) on the 2500A has been designed to be extremely robust. The incoming 3.3V/3A from the probe connector is stepped down to 1.8V/4A and 0.9V/4A via two Texas Instruments TPS54418 Switched Mode Regulators. This powers the SODIMM and FPGA Core, respectively.

The FPGA, additionally, uses three Texas Instruments TPS74701 Linear LDO Regulators for absolutely lowest ripple. This powers various analog and digital power rails such as PLLs and transceivers.

All power rails have been carefully analyzed with field-solver software to ensure robust power rails to all FPGA, SODIMM and CPU power pins.

#### Molex iPass x4 Probe Connector

The 2500A unit connects to the 2500A probe via high-quality Molex iPass x4 external PCI Express cable connectors. We supply a 1m Molex iPass cable with the 2500A unit but you can replace it with a shorter or longer cable if needed. We recommend that you only replace it with an original Molex iPass x4 cable to avoid signal integrity issues between the probe and 2500A unit.

#### **TTL Compatible Bidirectional Trigger Port**

The trigger port allows you to either send a trigger signal to an external test instrument when the 2500A triggers ("Trig out") or trigger the 2500A via an external test instrument ("Trig In"). You control the trigger port settings via the 'Configure Trigger' dialog box in the 2500A application. The Trigger Port is 5V TTL compatible.

#### Warranty and Serviceability

The 2500A unit is covered by a 3 year warranty. We also offer replacement and/or repair service for out-of-warranty units.

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## 3.1.2. 2500A Active Interposer Probe

The Active Interposer Probe makes copies of the upstream and downstream data that is then sent to the 2500A PCI Express Protocol Analyzer for detailed analysis. A buffered copy of the 100 MHz PCI Express Reference Clock is also sent to the 2500A unit. The 2500A unit always uses the reference clock from the bus under test. This guarantees that the 2500A's transceivers never under-run or over-run with data.



Figure 4. The Active Interposer Probe is included in the 2500A Package.

Note that the Active Interposer Probe is designed with off-the-shelf parts which allow you to easily integrate the probe electronics in your own product. This is useful, for example, for embedded PCI Express solutions where a slot connector is not available.

Please contact us for the probe schematics and parts list.

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## 3.2. Software Reference

The 2500A is fully controlled via the 2500A software. This section describes the software features in detail.

## 3.2.1. The 2500A PC Application

Figure 5 below shows the various parts of the 2500A PC Application. The following tutorial describes the various features of the User Interface.

## Starting the application and opening a previously saved 2500A project

When starting the 2500A Application, you will see the application main window shown below in figure 5. Note that the Protocol Analyzer is not connected and, therefore, the 'Start' and 'Stop' Capture buttons and menu items are disabled.



Figure 5. The 'default\_project.pciea' opens automatically when the application is started.

To open a previously saved project, click the 'Open' button and select a previously saved '.pciea' project. There are sample projects in the application installation directory.

See the below screenshot (figure 6) for the 'test.pciea' project.



## Protocol View, Markers, Node Finder and Timestamps

Note in figure 6 how the upper area of the window (the 'Protocol View') shows a hierarchical view of the captured protocol items. All packets within a transaction are grouped together. This makes it very easy to identify which ACK Packets are associated with TLP Packets, for instance. For example, the below ACK DLLP at timestamp 81 is associated with the Msg TLP at timestamp 0 (since identical Sequence Numbers).

Figure 6 shows, additionally, that two markers have been added to the Protocol View; the first (yellow) marker has been manually added while the second (cyan) marker was automatically added by the 2500A software to indicate the trigger location. It will be, later in this section, explained how to add, edit and delete markers.

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⊟	(Assert INTA)	871	0A00 (Bus:0	Dev:0	7 Fnc:01 / 00	complexer to	Address			(G	Status	0	
🕂 TLP (Mso: As	ssert INTA)	871	0400 (Bus:0	Dev:0	) Fnc: 0) / 00							0	
<ul> <li>DLLP (Ack)</li> </ul>		871			,							81	
😑 🕂 MRd32 Transacti	ion	469	0028 (Bus: 00	Dev:05	i Fnc:0) / 00	0400 (Bus:04 Dev:00 Fnc:0)	FBEFC044	4 bytes	(D4 00 0	0 00)		337	
→ TLP(MRd3	2)	469	0028 (Bus:0	Dev:(	15 Fnc:0) / 00		FBEFCO.	4 byte	sreque	sted		337	
<ul> <li>DLLP (Ack)</li> </ul>		469										399	
<ul> <li>TLP (CpID)</li> </ul>		872	0028 (Bus:00	Dev:05	i Fnc:0) / 00	0A00 (Bus:0A Dev:00 Fnc:0)		4 bytes	(D4 00 0	0 00)		411	
표 🕂 Msg Transaction	(Deassert_INTA)	873	0400 (Bus:0/	Dev:0	0 Fnc:0) / 00							436	
😑 📢 MRd32 Transacti	← MRd32 Transaction → TLP (MRd32)		0028 (Bus: 00	Dev:05	i Fnc:0) / 00	0A00 (Bus:0A Dev:00 Fnc:0)	FBEFC044	4 bytes	4 bytes (FF FF FF FF)			555	
<ul> <li>TLP (MRd32</li> </ul>	→ TLP (MRd32)		0028 (Bus: 00	Dev:05	i Fnc:0) / 00		FBEFC044	4 bytes	requeste	ed		555	
🗧 DLLP (Ack)	TLP (MH032)     DLLP (Ack)     TLP (C-D)											617	
← TLP (CpID)		874	0028 (Bus:00	Dev:05	i Fnc:0) / 00	0A00 (Bus:0A Dev:00 Fnc:0)		4 bytes	(FF FF F	F FF)		629	
<ul> <li>DLLP (Ack)</li> </ul>		874										709	
🗉 👍 MsgD Transactio	n (Vendor_Defined Type 1)	471	0000 (Bus:00	Dev:00	Fnc:0) / 00			4 bytes	: (A4 00 0	0 00)		851	1
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Header. I ype	MHd		0	00		D2H TLPs			23,801	1	Go to Previous	Go to Next	
Header.TC	Traffic Class 0		0	0 0		D2H DLLPs			92,093	1	Go to Previous	Go to Next	
Header.TD	eader.TD TLP Digest/ECRC Not Pre 0 0		0	■ 1111	D2H Ordered Sets			152,822	1	Lio to Previous	Lio to Next		
Header.EP	TLP Not Poisoned		0	0									
Details View (#	Search View 🚍 Markers Vi	W	i		Node	Finder 010 Payload View	Lane View						
Je Soluis view UU					I the mode	101							
Protocol Analyzer Dis	sconnected												

Figure 6. Protocol View (upper), Details View (lower left) and Node Finder (lower right).

The 'Node Finder' view shows the number of Protocol Items of each type in the trace data. This information is provided by the 2500A hardware so the software requires no time to index the complete trace data. The Node Finder allows direct jump to any protocol item in the trace via the 'current', 'previous' or 'next' controls. Furthermore, the 'Hide' checkboxes allows protocol items of certain types to be hidden from view.

Note that the six views at the bottom of the 2500A application can be dragged and dropped in any order. This is, for instance, useful when the Node Finder is used to locate protocol items in the Lane View (both by default located on the same side of the lower tabs). The view locations are automatically saved and later restored the next time the application is started.



#### **Details View and Lane View**

The 'Details View' decodes the information carried by a TLP or DLLP and clearly displays it in spreadsheet form for easy analysis. When you click on an item in the Details View, the corresponding data is highlighted in the Lane View. For example, as shown below in figure 7, when the LCRC TLP field is selected, the CC5A0593 DWORD is highlighted in the Lane View.

Multiple fields can be selected in the Details View; for example, if all the fields between the starting and ending framing characters (STP, END) are selected, you can see exactly where, in the Lane View, the packet is located.

Note that the fields in the Details View can be copied to the clipboard in CSV format by selecting and copying via the keyboard (CTRL-A, CTRL-C) or via the context menu (right-click menu).

File Configuration	Canture Heln																
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🖨 TLP (Msg: Ass	ert_INTA)	871	0400 (Bi	is:0A Diev:00	Fnc:0) / 0	0										626.	767
<ul> <li>DLLP (Ack)</li> </ul>		871														626,	848
🗉 🗲 MRd32 Transaction	n	469	0028 (Bu	is:00 Dev:05	Fnc:0) / 0	nc:0) / 00 0A00 (Bus:0A Dev:00 Fnc:0) FE		FBEFC04	4 4 by	tes (D4 00	00 00)			627,	104		
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🗄 🥰 MRd32 Transaction	1	470	0028 (Bi	18:00 Dev:05	Fnc:0) / 0	) (A	00 (Bus:0	A Dev:00	Fnc:0)	FBEFC04	4 4 by	tes (FF FF	FF FF)			627,	322
	TLP (Msg: Assert_INTA	.) Details				Host to D	evice Lin	k Directio	n			Device to	Host Lin	k Directio	m		
Name	Value	C	ec	Hex	Status	Lane 0	Lane 1	Lane 2	Lane 3		Status	Lane 0	Lane 1	Lane 2	Lane 3	Time	
Framing	STP		251	FB	3:3:3:3	00	00	00	00		3:3:3:3	00	00	00	00	626,763	
Sequence Number	871		871	0367	3:3:3:3	00	00	00	00		3333	00	00	00	00	626,764 636,76F	
Header.Fmt	4 DW Header, No Data		1	1	3.3.3.3	00	00	00	00		3333	00	00	00	00	626,765	
Header, Type	Msg (Local - Terminate a	κB	20	14	3333	00	00	00	00		3.3.3.3	STP	13	57	34	626,760	
Header TC	Traffic Class ()		0	0	3:3:3:3	00	00	00	00		3:3:3:3	00	00	00	0A	626,768	_
Header TD	TLR Digest/ECBC Not E	Nac.	0		3:3:3:3	00	00	00	00		3:3:3:3	00	00	20	00	626,769	
	TLD N LD instal	100	0		3:3:3:3	00	00	00	00		3:3:3:3	00	00	00	00	626,770	
Header.EP	I LP Not Poisoned		U	0	3:3:3:3	00	00	00	00		3:3:3:3	00	00	00	CC	626,771	
Header.Attr	Attributes: None		0	0	3:3:3:3	00	00	00	00		3:3:3:3	5A	05	93	END	626,772	
Header.Length	Transfer Size: 0 DWs		0	0	3:3:3:3	00	00	00	00		3:3:3:3	00	00	00	00	626,773	
Header.1st DW BE	1st DW Byte Enable		0	0	3:3:3:3	00	00	00	00		3:3:3:3	00	00	00	00	626,774	
Header.Last DW BE	Last DW Byte Enable		2	2	3:3:3:3	00	00	00	00		33333	00	00	00	00	626,775	
Header.Requester ID	Bus:0A, Dev:00, Fnc:0		2,560	0A00	3.3.3.3	00	00	00	00		3.3.3.3	00	00	00	00	626,776	
Header, Tag	0		0	00	3333	00	00	00	00		3333	00	00	00	00	626,777	
	INTx Mag (Assert INTA)		32	20	3:3:3:3	00	00	00	00		3:3:3:3	00	00	00	00	626,779	
Data	No Data		02		3:3:3:3	00	00	00	00		3:3:3:3	00	00	00	00	626,780	
	Nu Data				3:3:3:3	00	00	00	00		3:3:3:3	00	00	00	00	626,781	
Digest/EUHL	Not Present				3:3:3:3	00	00	00	00		3:3:3:3	00	00	00	00	626,782	
LCRC	OK	3,4	28,451,731	CC5A0593	3:3:3:3	00	00	00	00		3:3:3:3	00	00	00	00	626,783	
Framing	END	-	253	FD	3:3:3:3	00	00	00	00		3:3:3:3	00	00	00	00	626,784	
Details View A Si	earch View 📃 Markers Vie	9W			3:3:3:3 No	00 de Finder	00 101 Pa	00 ayload Vie	00 w	Lane View	3:3:3:3	00	00	00	00	626,785	
Proto and Arab man Dire							1.01				1						_

Figure 7. The Details View breaks down packet contents in detail.

The Lane View has an identical context menu to the Protocol View which allows you to select and copy Lane View Items to the clipboard, export to XML, print etc.

Note, in figure 7, how each Transaction and Package are time-stamped with a 4ns resolution (a 2.5 Gbps PCI Express link transfers one byte per lane every 4 ns). The timestamp format can be changed to seconds via most views context menus which are displayed by right-clicking anywhere in a View.



## **Protocol View Context Menu**

As can be seen in figure 8 below, there are a number of operations that can be performed on the Protocol View Items via the Context Menu:

- Protocol View Items can be hidden / shown. Note; hidden Protocol Items can alternatively be shown again by un-checking the corresponding 'Hide' checkbox in the Node Finder.
- A range of Protocol View Items can be selected and copied to the clipboard in CSV format.
- Markers can be added, edited or deleted. Markers will be placed, time-stamp correlated, in the Protocol View, Markers View and Lane View such that easy cross-reference between the various views can be made.
- Packet Payload can be searched for binary or string patterns.
- Protocol View Items can be printed or exported to XML format.
- The time reference and timestamp format can be changed.

늘 Open 🔏 Save As   🔊	Capture 📒 Tri	gger 🚺 Star	t 🚺 Stop	🖻 Up	dates 🕤	Abo	out							
Item		Sequence #	Reque	ster ID /	Tag			Completer ID	Address	Data		Status	Time	
😑 🚭 Msg Transaction (Assert_IN	TA)	871	0A00 (Bus:0A	Dev:00	v:00 Fnc:0) / 00								0.000 ns	
TLP (Msg: Assert_INTA	J	871	0A00 (Bus:0A	Dev:00	Fnc:0) / 00	)							0.000 ns	
DLLP (Ack)							47							
🗉 🥰 MRd32 Transaction		469	0028 (Bus:00	Dev:05	Fnc:0) / 00	0	A 🏹	Hide Protocol Iten	ns of This Type	00 00 00)			1.348 us	
→ TLP (MRd32)		469	0028 (Bus: 00	Dev:0	5 Fnc:0) / (	)0	¥.,	Show All Protocol	Items	uested			1.348 us	
<ul> <li>DLLP (Ack)</li> </ul>		469					Ba	Conuto Clinhoard	Chille				1.596 us	
<ul> <li>TLP (CpID)</li> </ul>		872	0028 (Bus:00	Dev:05	Fnc:0) / 00	0	A 🖷	Copy to Chipboard		00 00 00)			1.644 us	
🗄 🥰 Msg Transaction (Deassert	INTA)	873	0A00 (Bus:0A	Dev:00	Fnc:0) / 00	)		Select All	Ctrl+A				1.744 us	
🖃 🕂 MRd32 Transaction		470	0028 (Bus:00	Dev:05	Fnc:0) / 00	0	A 🛶	Add Marker		F FF FF)			2.220 us	
→ TLP (MRd32)  ← DLLP (Ack)		470	0028 (Bus:00	Dev:05	Fnc:0) / 00		_	Edit Marker		ested			2.220 us	
		470					×	D. L. M. L					2.468 us	
<ul> <li>TLP (CpID)</li> </ul>		874	0028 (Bus:00 Dev:05 Fnc:0) /			0	A ×	Delete Marker		F FF FF)			2.516 us	:
<ul> <li>DLLP (Ack)</li> </ul>		874	0000 (Bus:00 Dev:00 Fnc					Delete All Markers					2.836 us	
🗄 浄 MsgD Transaction (Vendor	Defined Type 1)	471			Fnc:0) / 00		- 33	Search Davidead Data		0 00 00)			3.404 us	_
	DLLP (Ack) Det	ails								Cur	rent	Previous	Next	
Name		Value	Dec	Hex	🖃 🔶 H	2D Pro	ile 🍏	Print Protocol View	v Items	07	1	Go to Previous	Go to Next	
Framing	SDP			5C	± -	H2D	98	Export Protocol Vi	ew Iteros to XMI	73	1	Go to Previous	Go to Next	
	áck		0	00	🗉 🖻	🛿 H2D		Export rotocor wi	conterns co sumeri	86	1	Go to Previous	Go to Next	
AsliNali Cas Num	071		071	207		II H2D	T <sub>0</sub>	Set Time Referenc	e	48	1	Go to Previous	Go to Next	
eckinak_beq_inum	071		871	367	😑 🗲 D	2H Pro	ti 🗙	Clear Time Referen	nce	16	1	Go to Previous	Go to Next	
CRC	ок		5,084	13DC	🕀 🕈	D2H				01	1	Go to Previous	Go to Next	
Framing	END		253	FD	E (	🛛 D2H	1 🗹	Apsolute Time		93	1	Go to Previous	Go to Next	
	-				⊞ 11	tt D2H		Relative Time		22	1	Go to Previous	Go to Next	
								Show Time in Tick	s					
A Couch 16	uu 💳 Markara M				300.00		~	Show Time in Seco	onds N					

Figure 8. Each view has its own context menu with view-specific commands.

Figure 9 (on the next page) shows how markers can be added or edited via the Add / Edit Marker Dialog Box.



Item	Sequence #		Requester ID / T	ag	Completer ID	A	ddress	Da	ita	Status	Time
Msg Transaction (Assert_INTA)	871	040	0 (Bus:0A Dev:00 F	nc:0) / 00							0.000 ns
TLP (Msg: Assert_INTA)	871	0A0	0 (Bus:0A Dev:00 F	nc:0) / 00							0.000 ns
<ul> <li>DLLP (Ack)</li> </ul>	871	ſ	- Esta Mashar								324.000 ns
🗲 MRd32 Transaction	469	00	E CUIL IVIAIREI	3			FC044	4 bytes (D4 00 0	00 00)		1.348 us
→ TLP (MRd32)	469	002	Marker Calar	Yellow			FCO_	4 bytes reque:	sted		1.348 us
<ul> <li>DLLP (Ack)</li> </ul>	469		Marker Color	1 Calori							1.596 us
← TLP (CpID)	872	00	Marker text (us	e CTRL-Enter	to insert line-breaks);			4 bytes (D 4 00 0	00 00)		1.644 us
🕰 Msg Transaction (Deassert_INTA)	873	0A	ME								1.744 us
🗲 MRd32 Transaction	470	00	CALCULATION OF THE OWNER OWNER OF THE OWNER				FC044	4 bytes (FF FF F	FFF)		2.220 us
→ TLP (MRd32)	470	00					FC044	4 bytes requeste	ed		2.220 us
<ul> <li>DLLP (Ack)</li> </ul>	470										2.468 us
← TLP (CpID)	874	00						4 bytes (FF FF F	FFF)		2.516 us
→ DLLP (Ack)	874										2.836 us
MsgD Transaction (Vendor_Defined Type 1)	471	00						4 bytes (A4 00 0	00 00)		3.404 us
Msg Transaction (Asse	rt_INTA)						Hi	de Count	Current	Previous	Next
				Ok	Cancel			406,207	1	Go to Previous	Go to Next
issage Transaction of 'Misg' Type								22,573	1	Go to Previous	Go to Next
us Message Transaction transfers an event fro	m the Request	er to th	e =	🕀 📴 H.	2D DLLPs			230,586	1	Go to Previous	Go to Next
mpleter. The Red arrow in the Protocol View s!	hows the direct	ion of t	he	🖽 1111 H	2D Ordered Sets			153,048	1	Go to Previous	Go to Next
ssage (left: Device-to-Host, right: Host-to-Dev	vice).			🖃 🔶 D 2H F	rotocol Items			268,716	1	Go to Previous	Go to Next
				🕀 🔶 D.	2H TLPs		1	23,801	1	Go to Previous	Go to Next
Je Misg i ransaction contains a Request ILP of I P from the Completer. The Secuence Number	r misg type fo. re should match	uowed The I	oy an rick Vieccere	🗉 🛃 D.	2H DLLPs			92,093	1	Go to Previous	Go to Next
sa non no compreter. The bequeites Humber	woonabo	E 1111 D.	2H Ordered Sets			152.022	1	Go to Previous	Go to Next		

Figure 9. Markers can be added / edited via the Protocol or Lane Views.

#### Protocol View Payload Search

Figure 10 shows how a binary pattern search is set up. Note that the 'Search View' contains the results of the search.

2500A PCI Express Protocol Analyzer - test.pcie	ea		
File Configuration Capture Help		Search Payload Data	
📥 Onen 🚺 Save Ar 🔊 Canture 📰 Tri	inner 🔝 Start 🔳 Ston 📝 Undates 😝 Abo	Search Expression	
Gaptare 🔚 Save As 🔊 Capture 📒 Ini	igger and stop in opdates U Abo	F4 62 34 B1 E8 82 92 66	
Item	Sequence # Requester ID / Tag	Could Lot	Status Time 🔺
🗄 🚓 MW/r32 Transaction	886 0A00 (Bus:0A Dev:00 Fnc:0) / 1F	Search Type	6.167 ms
🗉 🖶 MWr32 Transaction	887 0A00 (Bus:0A Dev:00 Fnc:0) / 1F	Unicode String (example: "This is a Unicode string")	6.167 ms
🗉 🛻 MWr32 Transaction	888 0A00 (Bus:0A Dev:00 Fnc:0) / 1F	ASEII String (example: "This is an ASEII string")	6.167 ms
🗉 🖶 MWr32 Transaction	889 0A00 (Bus:0A Dev:00 Fnc:0) / 1F	Hau Campanya (auranala: "00 alt ad a0")	6.167 ms
🖃 🗲, MWr32 Transaction	890 0A00 (Bus:0A Dev:00 Fnc:0) / 1F	<ul> <li>Hex sequence (example: os ab cu er )</li> </ul>	6.168 ms
<ul> <li>TLP (MWr32)</li> </ul>	890 0A00 (Bus:0A Dev:00 Fnc:0) / 1F	Constitution and the	6.168 ms
🗉 🖶 MWr32 Transaction	891 0A00 (Bus:0A Dev:00 Fnc:0) / 1F		6.168 ms
😠 🛻 MWr32 Transaction	892 0A00 (Bus:0A Dev:00 Fnc:0) / 1F	Note: Quotes are not needed in the search expression.	6.170 ms
🗉 🖶 MWr32 Transaction	893 0A00 (Bus:0A Dev:00 Fnc:0) / 1F		6.170 ms
🗉 🛻 MW/r32 Transaction	894 0A00 (Bus:0A Dev:00 Fnc:0) / 1F	Link Direction	6.171 ms
🗉 🛻 MW/r32 Transaction	895 0A00 (Bus:0A Dev:00 Fnc:0) / 1F	Host to Device	6.171 ms
🗉 🔩 MWr32 Transaction	896 0A00 (Bus:0A Dev:00 Fnc:0) / 1F		6.171 ms
🗉 🔩 MWr32 Transaction	897 0A00 (Bus:0A Dev:00 Fnc:0) / 1F	Church Bruch Marrie Church	6.171 ms
🗉 🛻 MWr32 Transaction	898 0A00 (Bus:0A Dev:00 Fnc:0) / 1F	Liear Search Hesuits View Uk Lancel	6.171 ms 🔻
Item Type Link Dire	ction Progress Matches Current Previous	Addr Data	ASCII
F4 62 34 B1 E8 82 92 Hex Both	42% 66 1 Go to Previou	0000 F4 62 34 B1 E8 82 92 66 A6 A0 32 A6 8D 00 70 C6	.b4f2p. ^
	· · · · · · · · · · · · · · · · · · ·	0010 0C CF 07 BC D4 3B CD E2 EE 49 B9 0A 6F 40 B4 FE	;Io0
		0020 IF U/ 81 4/ 83 89 26 38 IA EU U/ 9D 2D A5 II 54 0030 84 53 92 4D 04 71 61 31 F6 44 02 68 B3 5F 67 30	S W gel h Age
		0040 3E DI 25 6F 7A 10 B8 3E 2A C8 32 4B ED BC DA C0	>.302>*.2K
		0050 46 92 BC 85 02 C1 52 36 34 50 51 FD 46 B9 56 5F	FR64PQ.F.V_
		0060 8F CE A4 3C 82 44 30 48 EA 7A A0 0D 19 8E 3E 36	<.DOH.z>6
		0070 01 D5 8C F8 0D 88 04 77 A9 04 3F 5E FE 3D 16 E8	w?^.=
<	•		-
🔎 Details View 👫 Search View 🚍 Markers Vi	iew	Node Finder 010 Payload View Lane View	
Protocol Analyzer Disconnected			.:

Figure 10. Payload data search setup dialog and Search View results.

Note that the one or more searches are executed on background worker threads. Therefore, you can continue working with the user interface while the background searches are active. Note the 'Progress' of the above search being 42% complete.

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To jump to a search result, click one of the 'current', 'previous' or 'next' controls in the Search Results View. Search results can be deleted via the Markers View context menu (right-click menu). Search results can be navigated to at any time, even before the overall search is 100% complete.

## Protocol View Print and Print Preview

To print Protocol View Items;

- 1) Define two markers that will define the beginning and end of the range of Protocol View Items to be printed.
- 2) Select 'Print Protocol View Items' from the Protocol View's context menu (right click in the Protocol View). The below dialog box will open:

2500A PCI Express Protocol Analyzer - test.pciez	a [not saved]						
File Configuration Capture Help							
늘 Open 🔏 Save As 🛸 Capture 📰 Trig	ger 🛛 💽 Star	: 📰 Stop   🚊 L	Jpdates 🕤 A	sbout			
Item	Sequence #	Requester ID	)/Tag	Completer ID	Address	Data	Status Time
🗉 🖶 MWr32 Transaction	886	0A00 (Bus:0A Dev:0	00 Fnc:0) / 1F		3BB52500	128 bytes (9E BE 1A C4 A3	6.167 ms
🗉 🖶 MWr32 Transaction							6.167 ms
🗉 🛻 MWr32 Transaction	888	0A00 (Bus:0A Depct	00 Enc:01 / 1E		3BB52600	128 butes (C7 19 18 AA 7F	6.167 ms
🗉 🖶 MWr32 Transaction	889	0A00 (Bus:0A De 🎕	Print Protoco	I View Items		(2C 09 A3 1A CC	6.167 ms
🗉 🔩 MWr32 Transaction	890	0A00 (Bus: 0A De		NL.		(F4 62 34 B1 E8	6.168 ms
🗉 🖶 MWr32 Transaction	891	QAOO (Bus:QA De	Select Printer			(04 38 EC 00 9B	6.168 ms
🗉 🔩 MWr32 Transaction	892	QAOO (Bus:QA De	HP LaserJet P	2035n (Lab)		<ul> <li>(97 FD B9 31 2C</li> </ul>	6.170 ms
🗉 🔩 MWr32 Transaction	893	0A00 (Bus: 0A De				(DF A6 F8 93 80	6.170 ms
🗉 🚓 MWr32 Transaction	894	0A00 (Bus: 0A De				(FE A5 76 2E 4F	6.171 ms
🗉 🚓 MWr32 Transaction	895	0A00 (Bus:0A De	Print Protocol V	lew Items between these Marke	rs	(CB B9 1A 36 D6	6.171 ms
🗉 🚓 MW/r32 Transaction	896	0A00 (Bus:0A De	P1			<ul> <li>(BC 60 AE 48 5C</li> </ul>	6.171 ms
🗉 🚓 MW/r32 Transaction	897	0A00 (Bus:0A De				(55 CA 1D 4A F5	6.171 ms
🗉 🖶 MWr32 Transaction	898	0A00 (Bus:0A De				(7E 43 79 CC D	6.171 ms
🖭 🛻 MWr32 Transaction	899	0A00 (Bus:0A De	Page Setup	Print Preview	Print	(1F CC 4C D6 C	6.171 ms
Item Type Link Direct F4 62 34 B1 E8 82 92 Hex Both	tion Progres 100%	Matches Cur 161		Close		70 45 2E 2D 8E 53 81 64 17 59	ASCII 5EQE.pE^ 0E u-F
< 「	w		Ņ	0020 56 E0 C0 79 8 0030 8D 74 30 32 3 0040 24 D8 56 3C 7 0050 63 EA 5D 67 2 0060 07 A0 F2 DE B 0070 1E 4F 6D BC 5	F 11 16 50 5 05 F7 5A 8 8D D6 91 B FA 91 F0 4 8B 21 CF 2 B9 CE 8E	C CD DL <sup>C</sup> C7 B9 49 82 46 A B2 A2 B1 PD 92 A1 DA 95 6E CF 2C CB D1 BB B1 1A 05 61 89 65 00 9 97 R 85 04 F6 87 28 38 10 B5 04 F6 87 28 38 Lane View	F0         V. y.
Protocol Analyzer Disconnected							

Figure 11. The 2500A Application contains advanced print and print preview functionality.

You can then select the printer to use for your printout, adjust page orientation, margins etc (via the Page Setup), Preview the printout and actually print the range of Protocol Items. Figure 12 below shows the Print Preview dialog.



2500A PCI Express Protocol Analyzer - test.pcie	ea [not saved]							
File Configuration Capture Help								
늘 Open 🔏 Save As  🛸 Capture 📰 Tri	gger 🛛 💽 Start	🔲 Stop 🛛 🛃 U	pdates 🕤 Abou	ıt				
Item	Sequence #	Requester ID	/Tag	Completer ID	Address	Data	Status T	ime
H + MWr32 Transaction	886	0A00 (Bus:0A Dev:0	0 Fnc:0) / 1F		3BB52500 1	28 bytes (9E BE 1A C4 A3	6.	167 ms
H + MWr32 Print Preview		TATIL Brief A Losell	I Freduz (F			28 Bullac (ALLELL SK FF F		
■ ← MWr321 → □   ○ Zoom = 14 4	1 of 1	Clara						
🗉 🛻 MWr321	1 011	Close						
test poice - Monday	March 17, 2014	- 9-59-42 DM		N				-
	Item	3.33.4ET W	Sequence #	Requester ID	/Tag	Completer ID	Address	
🗉 🖶 MWr32 T	nsaction		887	0A00 (Bus:0A Dev:0	0 Fnc:0) / 1F		3BB52580	128 b
	nsaction		888	NAM (BustlA Devr)	0 Enc:0) / 1E		38852600	128 b) =
	nsaction		889	NANN (Bus:NA Devr)	0.Enc:0)/1E		3BB52680	128 b
	nsaction		890	0A00 (Bus:0A Dev/0	0 Enc:0) / 1E		38852700	128 b
	nsaction		891	0A00 (Bus:0A Dev/0	0 Enc:0) / 1E		38852780	128 by
F4 62 34 B1 E8	neaction		892	0400 (Bus:04 Devro	0 Enc:0) / 1E		38852800	128 b
	neaction		893	0400 (Bus:04 Dev.0	0 Enc:0) / 1E		38852880	128 b
	naction		00.4	0A00 (BustoA Devid	0 Enc:0) / 1E		20052000	120 65
	naction		000	0A00 (Bus:0A Dev.0	0 Epc:0) / 1E		20052000	120 05
	nsaction		000	0400 (Dus.04 Dev.0	0 5 0 / 15		30052500	120 05
	nsacuon		096	UAUU (DUS:UA DEV:U	o Fricio) / TF		36852A00	120 05
🕀 🗲 MWr32 Trar	nsaction		897	0A00 (Bus:0A Dev:0	0 Fnc:0) / 1F		3BB52A80	128 by
🖌 🔚 🗲 MWr32 Trar	nsaction		898	0A00 (Bus:0A Dev:0	0 Fnc:0) / 1F		3BB52B00	128 by
Details Viet			III					
Protocol Analyzer Disconnecceu								

Figure 12. The print preview dialog allows zoom, page adjustments etc before printing.

## **Protocol View XML Export**

To export Protocol View Items to XML;

- 1) Define two markers that will define the beginning and end of the range of Protocol View Items to be exported.
- 2) Select 'Export Protocol View Items' from the Protocol View's context menu (right click in the Protocol View). The below dialog box will open:

2500A PCI Express Protocol Analyzer - test.pciea [not s	saved]				
File Configuration Capture Help					
늘 Open 🔏 Save As 🛸 Capture 📰 Trigger 📗	💟 Start 🔳 Stop 📔 Updates 🕤 .	About			
Item Sequ	ence # Requester ID / Tag	Completer ID	Address	Data	Status Time 🔺
🗉 🛻 MWr32 Transaction 🔰	886 0A00 (Bus:0A Dev:00 Fnc:0) / 1F	- 0	3BB52500	128 bytes (9E BE 1A C4 A3	6.167 ms
🛨 🛻 MWr32 Transaction 🔰					6.167 ms
🗉 🛻 MWr32 Transaction 🛛	888 0A00 (Bus:0A Dev:00 Fnc:0) / 1F		3BB52600	128 bytes (C7 19 1B AA 7F	6.167 ms
🗉 🛻 MWr32 Transaction 🕴	889 889 AD		20052680	128 bytes (2C 09 A3 1A CC	6.167 ms
🗉 🛻 MWr32 Transaction 🕴	890 Seport Protocol View Items		2700	128 bytes (F4 62 34 B1 E8	6.168 ms
	891 Export Protocol View Items betwee	ion those Markers	2780	128 bytes (04 38 EC 00 98	6.168 ms
	892	on allose markers	2800	128 bytes (97 FD B9 31 2C	6.170 ms
🗉 🛻 MWr32 Transaction	893 P1 •	• P2	▼ 2880	128 bytes (DF A6 F8 93 80	6.170 ms
🗉 🛻 MWr32 Transaction 🔰	894		2900	128 bytes (FE A5 76 2E 4F	6.171 ms
🗉 🛻 MWr32 Transaction 🔰	895 Progress		2980	128 bytes (CB B9 1A 36 D6	6.171 ms
🗉 🛻 MWr32 Transaction 🔰	896	0%	2A00	128 bytes (BC 60 AE 48 5C	6.171 ms
🗑 🕂 MWr32 Transaction	897		2480	128 bytes (55 CA 1D 4A F5	6.171 ms
H      MWr32 Transaction	898		800	128 bytes (7E 43 79 CC D.,	6.171 ms
🗉 🖶 MW/32 Transaction 1	899		2880	128 bytes (1F CC 4C D6 C	6.171 ms 👻
Item Type Link Direction	Progress				ASCII
F4 62 34 B1 E8 82 92 Hex Both	100% Export to XML Ab	ort Export Close	AF 9	0 45 BD 70 45 2E 2D 8E 5	EQE.pE^
			- pc 7	F 0A 7F 53 81 64 17 59 0	E u-FS.d.Y.
		0000 00 04 00 00 0	16 5	C CODC C7 B9 49 82 46 P	'8 Vy\I.F.
		0030 60 74 50 52 5	9 90 05 17 5. 9 90 06 9	A D2 A2 DI FD 92 AI DA L	C 6 Wey
		0050 63 EA 5D 6F 2	8 52 50 5 B FA 91 F	0 B1 1A 05 61 89 65 00 5	F c.lo+a.e
		0060 07 A0 F2 DE B	4 8B 21 C	B 99 7F 88 C7 OC 98 FO E	7
		0070 1E 4F 6D BC 5	2 B9 CE 8	E 10 B5 04 F6 87 28 3B 8	5 .Om.R(;.
		<b>x</b>			
🔎 Details View 🔠 Search View 🚍 Markers View		Node Finder 010 Payl	load View 📑	t Lane View	
Protocol Analyzer Disconnected					

Figure 13. Export data to XML via the 'Export Protocol View Items' dialog box.

Select the output file via the 'Export to XML' button. Figure 14 below shows the resulting XML data output.

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2500A PCI Express Protocol Analyzer - test.pciea [not saved	Evport Protocol View Items	2	
File Configuration Capture Help			
📥 Open 📈 Save As  🖎 Capture 📰 Trigger 📘	Export Protocol View Items between these Markers		
liem Sequence	P1 • P2 •	Address Data Status	Time
H + MW/32 Transaction     886		38852500 128 butes (9E BE 14 C4 43	6 167 ms
F 4 MV/32 Transaction 997	Progress	38852580 128 butes (AD CD 98 FE 5	6 167 ms
+ + MWr32 Transaction 888	Export Complete	38852600 128 bytes (C7 19 18 AA 7F.,	6.167 ms
H      MWr32 Transaction     889		38852680 128 bytes (2C 09 A3 1A CC	6.167 ms
🛞 🕂 MWr32 Transaction 890		38852700 128 bytes (F4 62 34 B1 E8	6.168 ms
📧 🗲 MWr32 Transaction 891		38852780 128 bytes (04 38 EC 00 98	6.168 ms
🗉 🔩 MW/32 Transaction 892		38852800 128 bytes (97 FD 89 31 2C	6.170 ms
🗉 🔩 MW/32 Transaction 893	Export to XML Abort Export Close	3BB52880 128 bytes (DF A6 F8 93 80	6.170 ms
⊞ ← MW/32 T-monostim     004		00050000 100 MAR (FF AE 70 0F AF	C 171 ms
🕀 🚓 MW/3 🦳 export.xml - Notepad			😐 🔜 ms
	2		ms
⊞ ← MW/3 xm] version="1.0" encoding="ut</td <td>f-8"?&gt;</td> <td></td> <td>ms</td>	f-8"?>		ms
🕂 🕁 MWn3 <itic_iti2500a_protocol_view_ite< td=""><td>ms_xmlns:xsi="http://www.w3.org/2001/XMLScl</td><td>hema-instance"</td><td>ms</td></itic_iti2500a_protocol_view_ite<>	ms_xmlns:xsi="http://www.w3.org/2001/XMLScl	hema-instance"	ms
MWr32 Transaction>	L/XMLSchema >		ms
<time>002116F6<!--</td--><td>Time&gt;</td><td></td><td></td></time>	Time>		
F4 62 34 B1 ( <tlp_mwr 32=""></tlp_mwr>	211666//Time>		~
<linkdir< td=""><td>ection&gt;DeviceToHost</td><td></td><td>•</td></linkdir<>	ection>DeviceToHost		•
<rawdata< p=""></rawdata<>	>FB 03 77 40 00 20 20 0A 00 1F FF 3B B5 25	80 AD CD 98 FE 51 AC AF 90 45 BD 70 45	2E .
35 05 F7 5A B2 A2 B1 FD 92 A1 DA	D5 24 D8 56 3C 78 8D D6 91 95 8E CF 2C CB	D1 BB EC 63 EA 5D 6F 2B FA 91 FO B1 1A	. 05 .
61 89 65 00 9F 07 A0 F2 DE B4 8E	21 CB 99 7F 88 C7 0C 98 F0 B7 1E 4F 6D BC	52 B9 CE 8E 10 B5 04 F6 87 28 3B 85 3B	; 3A .
<pre> <pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre>	_Start>FB		•
<sequend< td=""><td>e_Number&gt;0377</td><td></td><td>·</td></sequend<>	e_Number>0377		·
<header.< td=""><td>rmt&gt;z Type&gt;00</td><td></td><td></td></header.<>	rmt>z Type>00		
<header.< td=""><td>TC&gt;0</td><td></td><td></td></header.<>	TC>0		
<header.< td=""><td>TD&gt;0</td><td></td><td></td></header.<>	TD>0		
P Detais v			
Protocol Analyzer Disconnected			

Figure 14. The exported Protocol View Items in XML format.

Note that the exported XML contains all hierarchical and detail information available in the Protocol and Details Views. Therefore, there is no loss of information in the exported XML data. This allows XML export to be used as interface to custom analysis software.

## Markers View and Lane View

Figure 15 below shows the Markers View in which all markers can be sorted on any column (by clicking the column). The figure shows the markers sorted in time order. Note that the 'Time Reference' (T0) has been set to the Trigger Location (this is the default after a capture). Also note that the 'Trigger' Marker is also shown in the Lane View.

2500A PCI Express Protocol A	Analyzer - test.pc	iea [not saved]														×	
File Configuration Captu	ire Help																
늘 Open 🔏 Save As  🛸	Capture 📒 Tr	igger 🛛 💽 Start	Stop 📄	Updat	es 🕤 /	About											
Item		Sequence #	Requester	ID / Tag	,	Completer I	D	Add	ress	Data		S	tatus	Tim	e		
Msg Transaction (Assert_IN)	[A]	871	0A00 (Bus:0A De	v:00 Fnc	:0) / 00										-337		
↓ <sup>P1</sup> TLP (Msg: Assert_INTA)		871	0A00 (Bus:0A De	v:00 Fnc	:0) / 00										-337		
<ul> <li>DLLP (Ack)</li> </ul>		871													-256		
😑 🕂 MRd32 Transaction		469	0028 (Bus:00 De	v:05 Fnc	:0) / 00	0A00 (Bus:0A Dev:	00 Fnc:0)	FBEF	044	4 bytes (D 4 00 00 00	)				0		
→ TLP (MRd32)		469	0028 (Bus:00 De	ev:05 Fr	nc:0) / 00			FBEF	C0_	4 bytes requested					0		
+ DLLP (Ack)		469													62		
<ul> <li>TLP (CpID)</li> </ul>		872	0028 (Bus:00 De	v:05 Fnc	:0) / 00	0A00 (Bus:0A Dev:	00 Fnc:0)			4 bytes (D 4 00 00 00	)				74		
🗉 🕰 Msg Transaction (Deassert_	INTA)	873	0A00 (Bus:0A De	v:00 Fnc	:0) / 00										99		
😑 📢 MRd32 Transaction		470	0028 (Bus:00 De	v:05 Fnc	:0) / 00	QA00 (Bus:QA Dev:	00 Fnc:0)	FBEFG	2044	4 bytes (FF FF FF FF)					218		
TLP (MRd32)     DULP (Ack)		470	0028 (Bus:00 De	v:05 Fnc	:0) / 00			FBEFG	2044	4 bytes requested					218		
← DLLP (Ack) ← TLP (CpD)		470													280		
		874	0028 (Bus:00 De	v:05 Fnc	:0) / 00	QA00 (Bus: QA Dev:	00 Fnc:0)			4 bytes (FF FF FF FF)					292		
Item	Mar	ker Text	Time v -337		Time V		Host to De		Link Direction			Device ti	o Host Lin	k Directio	n		
🖞 Msg Transaction (Assert_INT	M1					Status Lane 0	Lane 1	Lane 2	Lane	Status Lane 0	Lane 1	Lane 2	Lane 3	Time			
→ TLP (MRd32)	Trigger		0	_		3333 00	00	00	00	3:3:3:3	00	00	00	00			
MWr32 Transaction	P1		1,541,462	Е	Edit Ma	rker	00	00	00	3:3:3:3	00	00	00	00			
<ul> <li>MWr32 Transaction</li> </ul>	P2		1,542,457		Delete I	Marker	00	00	00	3:3:3:3	00	00	00	00			
→ MRd32 Transaction	M2		23,916,328	₩.	Delete	All Markers	00	00	00	3:3:3:3	00	00	00	00			
MRd32 Transaction	M3		181,115,825	_			00	00	00	3:3:3:3	00	00	00	00			
				T <sub>o</sub>	Set Tim	e Reference	01	D5									
				X	Clear T	me Reference	00	01	00	3:3:3:3	00	00	00	00			
					Abaal	a Tina a	00	OF	FB	3:3:3:3	00	00	00	00			
				Ľ	Absolu	ie i ime	Þ0	44	51	3:3:3:3	00	00	00	00			
					Relative	Time	90	D8	END	3:3:3:3	00	00	00	00			
				~	Show T	ime in Ticks											
🔎 Details View 🎢 Search Vie	W 🚍 Markers \	liew			Show T	ime in Seconds	10 Pa	yload Vie	w  4	Lane View							
Protocol Analyzer Disconnecte	d																

Figure 15. The Markers View allows easy analysis of the markers in the project.

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Figure 15 also shows the Lane View which contains the raw data as it is received on the FPGA transceivers. Note that the FPGA first de-skews and de-scrambles the data before displaying it.

### **Capture Configuration Dialog Box**

The descrambling can optionally be disabled via the 'Configure Capture' dialog box shown below in figure 16 (accessible via the 'Configuration/Capture' main menu item or via the 'Capture' toolbar button.

2500A PCI Express P	rotocol Analyzer - test.pc	ea [not saved]								
File Configuration	Capture Help									
늘 Open 🔏 Save As   🗞 Capture 📰 Trigger   💽 Start 📗 Stop 📄 Updates 🚯 About										
	tem	Sequence #	Requester ID / Tag	Complete	r ID Address	Data		Status	Time	-
😑 🕂 Msg Transaction (#	Assert_INTA)	871	0A00 (Bus:0A Dev:00 Fnc:0) / 0	0		_			1	337
↓ <sup>M</sup> TLP (Msg: Assert_INTA) 871		871	Sa Capture Configuration						4	337
→ DLLP (Ack)		871	<ul> <li>Trigger Position within Capture B</li> </ul>	uffer						256
MRd32 Transactio	n	469	_		OK	tes (D 4 00 00 00)				0
→ DLLP (Ack)	1	469			Cancel	(es requested				62
← TLP (CpID)		872	Beginning	End	L	tes (D4 00 00 00)				74
🗉 🕰 Msg Transaction (l	Deassert_INTA)	873	· · · · · · · · · · · · · · · · · · ·							99
⊟ ← MRd32 Transaction 4		470	Capture Buffer Size Link	Width		tes (FF FF FF FF)				218
→ TLP (MRd32)		470	2 Gigabyte 🔹 🗴	•	Disable Descrambling	tes requested			;	218
<ul> <li>DLLP (Ack)</li> </ul>		470			3					280
← TLP(CpID)		874	Invert Polarity on These Lanes			tes (FF FF FF FF)				292 *
TLP (MRd32) Details		d32) Details	📄 H2D Lane 0 📄 H2D	Lane 1 📃 H2D L	ane 2 🛛 📄 H2D Lane 3		Device to Ho	ist Link Directio	n	
Name	Value	Dec	D2H Lane 0 D2H	Lane 1 👘 📃 D2H L	ane 2 👘 📄 D2H Lane 3	Status	Lane 0 La	ane 1 Lane 2	Lane 3	Time
Framing	STP					3:3:3:3	00	00 00	00	-5
Sequence Number	469		Lane Mapping			3(3)3(3)	00	00 00	00	-4
Header.Fmt	3 DW Header, No Data		Standard O Reve	ersed 💿 Custor	n (drag-and-drop below)	3333	00	00 00	00	.2
Header. Type	MRd		H2D Laws Order 10 17 12	D2H Lana	Order D T D D	3:3:3:3	00	00 00	00	-1
Header.TC	Traffic Class 0			D211 Carle		3:3:3:3	00	00 00	00	0
Header.TD	TLP Digest/ECRC Not					3:3:3:3	00	00 00	00	1
Header EP	TLP Not Poisoned		0			3:3:3:3	00	00 00	00	2
Header áttr	Attributes: None		0	3:3:3:3 EF	C0 44 51	3:3:3:3	00	00 00	00	3
Header Length	Transfer Size: 1 DW/s		1	3:3:3:3 99	30 D8 END	3:3:3:3	00	00 00	UU	4
Datals View A Search View										
Brotocol Apple gos Disc	opposited				1.00					
Protocor Analyzer Disc	onnecceu									

Figure 16. The Capture Configuration dialog box customizes the 2500A capture settings.

The Capture Configuration dialog box contains the following controls:

Control	Used For					
Trigger Position	This allows you to adjust where, in the capture buffer, you want the					
within Capture	trigger position to be located. If, for example, you want to capture the					
Buffer	data that leads up to the trigger position, you would set the trigger					
	position towards the end of the capture buffer.					
Capture Buffer	This allows you to choose how much trace memory will be used during					
Size	the capture. Smaller buffer sizes result in smaller trace files on disk.					
Link Width	Used to select the number of lanes your device uses to communicate					
	with the root complex.					
Disable	Checking this control will disable the PCI Express data descrambling.					
Descrambling	Normally, you would only check this when capturing the PCI Express					
	Compliance Pattern which is not scrambled.					
Invert Polarity	Checking one of these checkboxes will invert the polarity of one lane					
on These Lanes	in one link direction. This compensates for inverted physical wires on					
	the bus under test.					
Lane Mapping	This allows you to reverse the normal lane order per the PCI Express					
	1.1 Specification. You can also assign a custom lane order if needed to					
	compensate for a not specification compliant lane order.					

Table 1. Description of the Capture Configuration Dialog Box Controls.

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## **Trigger Configuration**

The Trigger Configuration dialog box allows you to:

- Configure a Trigger Sequence Detector for each of the 8 Trigger Levels.
- Configure the Trigger Input / Output Port.

2500A PCI Express	Protocol Analyzer - test.pciea [no	😑 Trigge	r Configuration		N				×	n i		-	
File Configuration	n Capture Help	. ngge											
Trigger Sequence													
open Ma save x	-s 🔊 Capture 📒 Ingger	Level	Source	Count Tr	igger on level			0.1		10000			
	ltem Se		Sequence Detector 0	1				Cancel		Status		Time	· ^
E C Msg Transaction	(Assert_INTA)	U	Sequence Detector 0		٩								-337
↓ TLP (Msg: As )	sert_INTAJ	1		1	$\odot$					-			-337
Here MBd22 Transacti	on.	2		1	0					-			-206
TIP((0)(2))				1	~								0
DLLP (Ack)		3			$\odot$								62
← TLP (CpID)		4	· · · · · ·	1	$\odot$								74
🗄 🕰 Msg Transaction	(Deassert_INTA)	5	-	1	0								99
😑 🗲 MRd32 Transacti	on			1	~								218
→ TLP (MRd32)		6			$\odot$					_			218
DLLP (Ack)		7	· · · · · · · · · · · · · · · · · · ·	1	$\bigcirc$					-			280
← TLP(LpD)	← TLP (CpID)									-			232 *
DITP BAK	TLP (MBd32) [	Sequen	nce Detector 0 Sequence Detector	1 Sequence	Detector 2	Gequence Dete	ector 3 S	equence Detec	tor 4 🔸 🕨	Link Dir	ection		.3//
Name	Value	Seler	ct Sequence to be Detected							e1 La	ne 2	Lane 3	Time
Framing	STP	Pre-	defined Sequences	Selected T	rigger Segueni	ce: 'Trigger on	TLP CplD'			0 1	00	00	-5
Sequence Number	469	Tric	ager on TLP CoID 🔹	Byte Offs	et Lane 0	Lane 1	Lane 2	Lane 3	*		00	00	-4
Header Frot	3 DW Header No Data			0	STP	××	$\times$	D01001			00	00	-3
Header Tues	NDJ		Copy to Custom Sequence	4	××	××	$\times$	$\times$			00	00	-2
Header.Type	Minu Di Di	Cust	tom Sequences	8	~~	$\times$	$\times$	$\times$			JU	00	•
Header. I L	Frame Class U			12	××	××	××	××			10	00	1
Header.TD	TLP Digest/ECRC Not			16	××	XX	>XX	XX			10	00	2
Header.EP	TLP Not Poisoned		Lopy Save	20	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	× ×	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			10	00	3
Header.Attr	Attributes: None	Lir	nk Direction	29	XX	XX	XX	XX			00	00	4
Header.Length	Transfer Size: 1 DWs	۲	Host to Device	32	XX	XX	××	XX			00	00	5
Header.1st DW BE 1st DW Byte Enable		0	Device to Host	36	××	××	××	××					÷
🔎 Details View 🏦	Search View 📃 Markers View			40	$\sim$	w.	$\sim$	$\sim$	T				
Protocol Analyzer Dis	connected												
										_			

Figure 17. The Trigger Sequencer allows up to 2048 byte long sequences per level to be detected.

To Configure the Trigger Sequencer, you need to:

- 1) Select a Sequence Detector for a trigger level (Trigger Source).
- 2) Configure the Sequence Detector with either a pre-defined Trigger Sequence or a custom trigger sequence.

Note that the software includes pre-defined trigger sequences for all standard TLP and DLLP Packet types.

You'll define a custom sequence by copying a predefined sequence to a custom sequence and then editing the custom sequence in the spreadsheet in the above dialog box.

## Trigger Sequence K and D symbol syntax

Specific D and K symbols can be entered in the Trigger Sequence editor per the following rules:

- Two-character cell data is interpreted as 'K don't care' hex data (i.e. either a D or K symbol will result in a match).
- Three or more characters in a cell is interpreted as binary data UNLESS one of the below explicit K character token strings (SKP, IDL etc).

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- An X is interpreted as a don't care nibble (for hex data) or a don't care bit (for binary data).
- A K symbol is represented as COM/K28.5/KBC, PAD/K23.7/KF7, SKP/K28.0/K1C, STP/K27.7/KFB, SDP/K28.2/K5C, END/K29.7/KFD, EDB/K30.7/KFE, FTS/K28.1/K3C, IDL/K28.3/K7C or any other K symbol via its KXX.Y or KHH code.
- A K don't care is represented as KXX.X or KXX (i.e. any K symbol results in a match).
- Data characters can be encoded HH, DXX.Y or DHH.

Examples

You want to detect	Examples
K or D, possibly don't	"6X", "XA", "6A"
care nibbles, hex data. K	
don't care.	
Explicit 10b Code	"DXX.X", "KXX.X"
K or D, possibly don't	"K6X", "KXA", "KXX", "D6X", "DXA", "DXX"
care nibbles, hex data	
(explicit K/D)	
Explicit control character	"COM", "STP"
token string	
Binary data	"10101010" (K or D), "K10101010" (K binary),
	"D10101010" (D binary), "Kx0x01010" (K binary with don't
	care bits)

Table 2. Examples of trigger sequence D and K symbol syntax.

## Capture Start / Stop

After the Capture Configuration and Trigger Configuration have been done, the capture is started via the 'Start' button (or menu command). Once all Trigger Sequences in all enabled trigger levels have found matching data, the capture stops automatically and the captured data is displayed in the application. The capture can also be stopped manually via the 'Stop' button/menu command.

Once the capture is stopped, the 2500A software programs the 2500A hardware to locate the location of all protocol items in the capture buffer. This data is called Meta-data since it is data describing the main data. The 2500A then uses the meta-data to build an in-memory hierarchical representation of all protocol items in the 2500A unit's capture buffer. Note that the data is retrieved on an as-needed basis from the 2500A hardware after a capture. This allows the complete 2 Gigabyte of data to be browsed effortlessly without having to upload the data to disk first. Once the project is saved via the 'File / SaveAs' menu item, the data is uploaded from the 2500A hardware and saved to disk file.



### License Configuration

Certain features, such as capturing data in x2 and x4 link width configuration requires a license. Licensing is not checked when viewing data, only when new data captures are made. For example, you can capture x4 data on a 2500A unit that has a x4 license and later view the captured data on any 2500A software installation.

Licenses are tied to the 2500A hardware unit; once licensed features are unlocked for a particular 2500A unit, it will follow the unit when moved to another computer. In other words, the license is stored in the 2500A unit, not on the computer running the 2500A software.

To view the current licensed features or enter a new license key, open the License Configuration dialog box shown below in figure 18. Note that this dialog is not available if a 2500A unit is not connected to the PC running the 2500A software.

100 2500A PCI Expres	ss Protocol Analyzer - de	efault project.pcjea								
File Configurati	ion Capture Help	nam <sup>2</sup> k. Y-nt-								
se o S Captu	re Configuration	Tringer Dona D		About						
Trigge	r Configuration	Trigger at start	Stop Stop	About						
		Sequence #	Requester ID / Tag		Completer ID	Address	Data	Status	Time	_
Se Licens	🖕 🔑 License Configura	ation	×							
	Currently Licensed	l Features								
	Serial Number: Rev	v4/002								
	Licensed Features:	: x1 Mode, x2 Mode, x4 Mode								
	Licone	T OMATON LOC.								
		La la								
	Enter License Kev									
			Apply License							
		Close			Item	Hide	Count Current	Previous	Next	
_										
🔎 Details View 🏦	🖞 Search View 🛛 🚍 Mark	kers View	87	Node Finder	10 Payload View	Lane View				
Protocol Analyzer (	Connected, No Probe Pc	ower								

Figure 18. A temporary or permanent license is entered in this dialog box.

If you need a trial license extension or want to upgrade your license, please contact support@InternationalTestInstruments.com. Please make sure to include the serial number of your unit (shown in the above dialog box) since issued licenses are tied to a specific 2500A unit.



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