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CATC PETracer™

PCI Express Protocol Analyzer

QuickStart User Manual



For Software Version 4.30
Manual Version 4.30

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1. Overview

LeCroy PETracer™ is a PCI Express 1X Advanced Verification System. The new LeCroy PETracer hardware taps transparently into a PCI Express 1x link to capture and display PCI Express traffic for analysis. Developers use PETracer Software running on a PC to define recording, triggering and filtering conditions and to view, analyze and print the trace. By leveraging years of experience in protocol analysis tools for emerging markets, LeCroy's PETracer blends sophisticated functionality with practical features to speed the development of PCI Express IP cores, semiconductors, bridges, switches, and systems.

The LeCroy PETracer Advanced Verification System provides fast, efficient and accurate debug, test and verification of PCI Express semiconductors, devices, systems and software. PETracer taps into standard copper 1x PCI Express links to record PCI Express traffic on the link. The CATC Trace software runs on a PC and controls the PETracer hardware to upload the trace as it records and, most importantly, to analyze how your PCI Express components work together, diagnose problems, and ensure interoperability and standards compliance. PETracer offers many innovative features to dramatically reduce time-to-market for PCI Express solutions.

Developers use PETracer's easy software tools to define sophisticated event conditions to trigger recording of trace data. For integration with a test environment, the user can trigger recording of trace data by external devices such as logic analyzers. Recorded trace data is uploaded from the PETracer Analyzer to a PC and displayed as color-coded packets using the expert analysis CATC Trace software. Using its powerful analysis functionality, developers can easily search for specific data, errors or other conditions and quickly pinpoint areas of interest.

No matter what layer of the protocol interests you, the CATC Trace makes it easy to find what you are looking for. PCI Express trace data can be viewed at the packet or at the transaction and split transaction level or as decodes of Transaction Layer Packets (TLPs) and Data Layer Link Packets (DLLPs). For deeper analysis, you can display packet contents as raw 10-bit codes.

1.1 General Description

PETracer is a hardware module that installs into the LeCroy Universal Protocol Analyzer System (UPAS) 2500H. The UPAS 2500H is a base system designed to accommodate different protocol modules.

Together, PETracer and the UPAS connect to a PC that runs the PETracer user interface. This interface administers the analyzer, displays traces, and analyzes the performance of the devices under test.

PETracer uses hardware triggering to capture real-time events, and hardware filtering to filter in or out different types of packets from the recording. Filtering allows users to focus recordings on events of interest and to preserve recording memory so that the recording time can be extended. All traffic is recorded non-intrusively, meaning that PETracer does not affect the link it is recording.

Recorded data is presented in colored graphics in a trace viewer application. This application has advanced search and viewing capabilities that allow the user to quickly locate specific data, errors, and other desired conditions, thereby focussing the user's attention on events of interest.

The PETracer Protocol Analyzer functions with any personal computer using the Windows 98SE, Window 2000, Windows ME, or Windows XP operating systems and equipped with a functional USB interface.

PETracer provides on-the-fly detection of and triggering on PCI Express events. Whether recording manually or with a specified trigger condition, PETracer continuously records the link data in a wrap-around fashion until manually stopped or until the Trigger Event is detected and a specified amount of post-Trigger link data is recorded.

Upon detection of a triggering event, the analyzer continues to record data up to a point specified by the user. Real-time detection of events can be individually enabled or disabled to allow triggering on events as they happen. This includes predefined exception or error conditions and a user-defined set of trigger events. The unit can also be triggered by an externally supplied signal. An external DB-25 connector provides a path for externally supplied data or timing data to be recorded along with traffic.

This DB-25 connector also provides a path for PETracer to transmit externally signals for purposes of probing and use by other circuitry.

The PETracer software provides powerful search functions that enable investigation of particular events and allow the software to identify and highlight specific events. In addition to immediate analysis, you can print

any part of the data. Use the **Save As** feature to save the data on disk for later viewing. The program also provides a variety of timing information and data analysis reports.

1.2 Features - Benefits

- UPAS 2500H-based Protocol Analyzer - Protects customer investment as the UPAS supports other protocols with purchase of additional plug-in technology modules
- PETracer Plug-In Module - Plug-in module for the UPAS 2500H. Connections include the following:
 - Probe Data (HSSDC2 receptacle)
 - Probe Power
- Sophisticated viewing - View Packet, Data Link, and Transaction layers of the PCI Express protocol
- Field-upgradeable firmware and engine - Position customers to receive latest PETracer enhancements and future additional capabilities and functionality with our flexible UPAS 2500H architecture
- Hi-Speed USB port - Access PCI Express recordings up to 40x faster than USB 1.1
- 512MB recording capacity
- CATC Trace display - Expert Analysis software makes it easy to identify problems and explain behavior
- Extensive decoding - Complete, accurate and reliable decoding of TLPs (Transaction Layer Packets) and DLLPs (Data Link Layer Packets) and all PCI Express Primitives
- Advanced triggering - Isolate important traffic, specific errors or data patterns
- Hardware filtering - Extend capture window by removing non-essential items from the trace
- Performance Statistics - Quickly identify and track error rates, abnormal bus or timing conditions
- Traffic Summary Reports - Understand error rates and other events at a glance
- Collapsible / expandable headers - Increased drill-down detail on Packets, Link, and Split Transactions
- Field upgradeable BusEngine™ technology - Real-time triggering and filtering of PCI Express traffic at full wire speed

- Real time performance monitoring and statistics - Help identify throughput problems and anomalies
- Universal Protocol Analyzer System (UPAS) - Flexible platform is expandable for other protocols
- ToolTips - Context sensitive descriptors improve understanding of the PCI Express specification
- Intelligent reporting - Quickly identify and track error rates, abnormal Link or timing conditions
- Downloadable trace viewer - Share and annotate trace recordings within a development team

General

- Upgradeable firmware and recording engine
- PETracer software can operate as a stand-alone application on any Microsoft Windows 98SE or later computer as a "Trace Viewer" for viewing and analyzing traces
- Errors are highlighted in red
- Online Help

Physical Components

- PETracer plug-in module
- UPAS/PETracer can be administered by any desktop or portable Microsoft Windows-based computer with USB capability
- Convenient Plug-and-Play USB installation
- External interface for probing and monitoring auxiliary digital signals and for cross triggering between other test instruments

Recording Options

- Record up to 512 MB of PCI Express data
- Three recording modes: Snapshot, Manual Trigger, and Event Trigger
- Selectable recording buffer size and trigger position
- Record the full data rate of a single 2.5 Gbit/sec PCI Express Link
- Trigger on a comprehensive list of error conditions
- Optionally filter captured data
- Breakout board data
- Counters

Display Options

- Extensive use of color and graphics within the trace
- Packet errors and protocol violations are highlighted in red
- Packet color clearly indicates position before or after the trigger point
- Packets can be marked with text annotations that become tool-tips for future reference
- Tool-tips with complete definitions of most fields
- Search, show, or hide only the data of interest using PCI Express-specific criteria
- Packets are accurately time-stamped (4 ns resolution)
- Measure time, or data throughput between packet markers or relative to the trigger position

PETracer BusEngine

LeCroy's BusEngine™ Technology is at the heart of the new PETracer Analyzer. The revolutionary BusEngine core uses state-of-the-art Field Programmable Gate Array (FPGA) technology and incorporates both the real-time recording engine and the configurable building blocks that implement data/state/error detection, triggering, capture filtering, external signal monitoring and event counting and sequencing. Like the flash-memory-based firmware that controls its operation, all BusEngine logic is fully field upgradeable, using configuration files that can be downloaded from the LeCroy website.

1.3 Specifications

The following specifications describe a combined PETracer and Universal Protocol Analyzer System.

Package

Dimensions:	UPAS 2500H: 12.2 x 3.5 inches (31.1 x 31.1 x 8.9 cm) PETracer Plug-in: 4.5 x 6.7 x 1.3 inches (11.3 x 17.0 x 3.2 cm)
Connectors:	UPAS AC power connection External trigger connection (DB-25, BNC) PC connection (USB2.0) Break-out board (type "D") PETracer Plug-In Recording Channel (MicroGigaCN)
Weight:	UPAS 2500H: 7.5 lbs (3.4 kg) PETracer Plug-in: 1 lb (0.5 kg)

Power Requirements

90-254 VAC, 47-63 Hz, 100W maximum (universal input)

Environmental Conditions

Operating Range:	0 to 55 °C (32 to 131°F)
Storage Range:	-20 to 80 °C (-4 to 176°F)
Humidity:	10 to 90%, non-condensing

Switches

Power:	On/Off
Manual Trigger:	When pressed forces a trigger event

Indicators (LEDs)

UPAS:	Power (PWR): Illuminated when analyzer is powered on
Status (STATUS):	Illuminated during Power-On Self Test (POST)
Recording (REC):	Illuminated when the analyzer is actively recording traffic data
Triggered (TRG):	Illuminated when the analyzer has a trigger condition
Uploading (UPLD):	Illuminated when the analyzer is uploading its recording memory to the Host PC for displaying the CATC trace and during the memory-testing step of the POST
PETracer Plug-in:	Illuminated when analyzer detects valid traffic for at least one of the two dual-simplex connections of the PCI Express Link

Probing Characteristics

Connection: PCI Express Slot Interposer

Recording Memory Size

512 MBytes for trace capture, timing, and control information.

Basic Trigger Events

Link Conditions	Link Alive, Electrical Idle Link Condition, TS1 Ordered Set, TS2 Ordered Set, Skip Ordered Set, Electrical Idle Ordered Set, FTS Ordered Set, Compliance Pattern Ordered Set, Comma, DLLP, TLP
TLP Headers	TLP Type: Mem, I/O, Cfg, Msg, Cpl, Any Traffic Class number
DLLP Messages Payload	Ack/Nak, InitFC1, InitFC2, UpdateFC, PM, Vendor Customizable Payload, Mask, Match
Errors	DLLP CRC, TLP LCRC, TLP ECRC, Delimiter, EDB (End-of-Bad Packet), Disparity, Symbol, Idle data, Skip late, Ordered Set Format
Breakout Board	Filter in/out capabilities

Reporting and Statistics

Transport Layer Packet	Memory Read 32-bit, Memory Read 64-bit, Memory Write 32-bit, Memory Write 64-bit, I/O Read Request, I/O Write Request, Configuration Read Type 0, Configuration Write Type 0, Configuration Read Type 1, Configuration Read Type 1, Message, Message with Data, Completion, Completion with Data, Completion for Locked Memory Read, Completion for Locked Memory Read with Data, Requesters, Completers, Traffic Class Number, Virtual Channel ID Number
Data Link Layer Packet (DLLP)	Ack, Nak, PM, Vendor, InitFC1-P, InitFC1-NP, Init-FC1-Cpl, Update FC-P, Update FC-NP, Update FC-Cpl, InitFC2-P, InitFC2-NP, Init-FC2-Cpl, Flow Control
Link Transactions Split Transaction	Implicit, Explicit, Incomplete Successful Completion, Unsupported Request, Cfg Request Retry, Completer Abort, Incomplete
Error Reports	Bad ECRCs, Bad LCRCs, Invalid 10b code, Running Disparity Error, End of Bad Packet, Delimiter Error, TS Data Error, Ordered Set Format Error, Idle Error

2. Installation

PETracer is a factory-installed hardware module that is sold as part of the Universal Protocol Analyzer System 2500H (UPAS 2500H).

The UPAS 2500H, the analyzer module, and associated software are easily installed. You can begin making PCI recordings after following the steps in this chapter.

2.1 System Components/Packing List

- Factory-installed PETracer Analyzer module(s)
- One USB cable
- PETracer software program CD-ROM
- Probe power cable
- Probe data cable
- Breakout board with cable
- PCI Express Slot Interposer probe
- User Manual

2.2 Host PC Requirements

PETracer connects to a Host PC. Please consult the readme file on the installation CD for the latest PC requirements.

2.3 Analyzer LED Descriptions

When powered on, the PETracer activates the user-accessible controls and LEDs on the front and rear panels of the UPAS.

Warning Do not open the UPAS enclosure. There are no operator serviceable parts inside. Refer servicing to LeCroy.

UPAS LEDs (from left to right)

- Green **PWR** (power) indicator LED for UPAS - lights when the unit power is switched on.
- Red **Status** indicator LED for UPAS - lights during initialization/power up of UPAS base unit. Blinks if a self-test fails.

The following LEDs and the **Manual Trigger** button on the UPAS enclosure under the left module slot function in conjunction with the PETracer module inserted above it.

- Green **REC** (recording) LED - lights when the unit is recording.
- Orange **TRG** (triggered) LED - lights when the unit triggers on an event.
- Green **UPLD** (Upload) - lights when unit is uploading data to PC.
- The **Manual Trigger** push-button - allows a manual Trace capture.

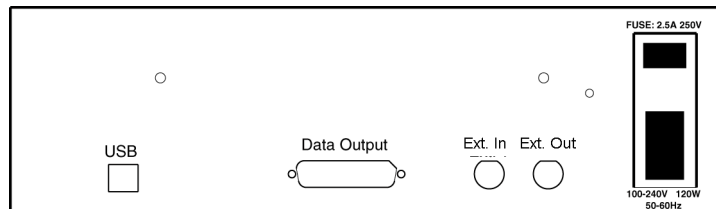
LEDs and Connectors on the PETracer Module

- Green **Status** LED (Illuminates when there is traffic on either the host or device side of the link).
- 1x Probe Data Connector
- Probe Power Connector

2.4 Rear Panel Description

From left to right, the UPAS rear panel contains the following components:

Figure 1: Rear Panel



USB type "B" host computer connector

This connector links the analyzer to the Host PC. for the purpose of transmitting commands from the PC to the analyzer and uploading traces from the analyzer's recording memory to the PETracer software for viewing and analysis.

RS-232 25 pin "Data Output" Connector

This connector links a 25 pin RS-232 cable to an external breakout board. The breakout board allows signals to be sent from the analyzer to an external device such as an oscilloscope or from an external device to the analyzer for the purpose of triggering on an external input. You configure input/output signalling through the Recording Options dialog box. Breakout board use is described at the end of this chapter.

BNC Connectors "Ext. In" and "Ext. Out"

These connectors allow BNC cables to be attached to the analyzer for the purpose of triggering on external input signals or for sending an output signal from the analyzer to another device. These connectors have the same function as the 25 pin RS-232 connector - i.e., they channel input and output signals but do not support the use of a breakout board.

Wide range AC connector module

- Power socket
- Power on/off switch
- Enclosed 5x20 mm 2.0A 250 V fast acting glass fuse

Warning For continued protection against fire, replace fuse only with the type and rating specified above.

2.5 Setting Up the Analyzer

Step 1 Remove the Analyzer/UPAS from its shipping container.

The Analyzer module will already be installed in the left slot.

The blank face plate that covers the right slot bay should be left in place to facilitate proper airflow and venting.

Step 2 Connect the Analyzer unit to a 100-volt to 240-volt, 50 Hz to 60 Hz, 120 W power outlet using the provided power cord.

Note The Analyzer is capable of supporting supply voltages between 100-volt and 240-volt, 50 Hz or 60 Hz, thus supporting all known supply voltages around the world.

Step 3 Turn on the power switch on the rear of the UPAS.

Note At power-on, the analyzer initializes itself in approximately ten seconds and performs an exhaustive self-diagnostic that lasts about five seconds. The Status LED of the UPAS base unit turns red on power up/initialization. The LED remains on approximately 25 seconds while the analyzer performs self-diagnostic testing. If the diagnostics fail, the Status LED will blink red, indicating a hardware failure. If this occurs, call LeCroy Customer Support for assistance.

Step 4 Insert the CD into the CD ROM drive of the PC that will be controlling the analyzer.

Step 5 Connect the USB cable between the USB port on the back of the analyzer and a USB port on the PC.

The host operating system detects the analyzer and begins to install the USB driver.

Step 6 Follow Windows on-screen Plug-and-Play instructions for the automatic installation of the analyzer as a USB device on the Host PC (the required USB files are included on the PETracer CD). Step through the Windows hardware wizard. The wizard will see that the

UPAS has an internal USB hub and will begin loading hub drivers. Afterwards, the wizard will automatically install the Analyzer as a USB device on the PC. When the wizard prompts you for driver information, point it to the CD which should be in your disk drive and install **catc25h.sys** and **pcitracer.sys**.

2.6 Installing the Analyzer Software

Once PETracer has been recognized as a USB device, install the PETracer software on the Host PC.

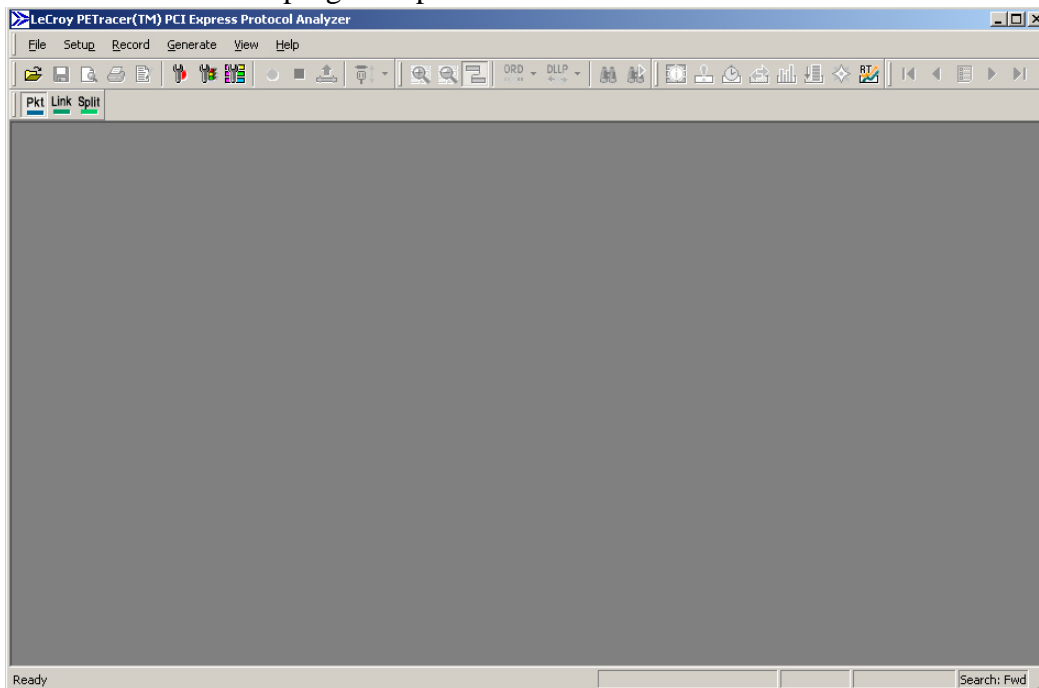
Step 1 On the PC, run **setup.exe** on the installation CD and follow the on-screen instructions.

The PETracer software will install on the PC hard disk.

Step 2 To start the application, launch the CATC PETracer program from the Start menu:

Start > Programs > CATC > PETracer.

The PETracer program opens.



Note The software may be used with or without the analyzer. When used without an analyzer attached to the computer, the program functions as a Trace Viewer to view, analyze, and print captured traffic.

2.7 Connecting the Analyzer to the Device Under Test

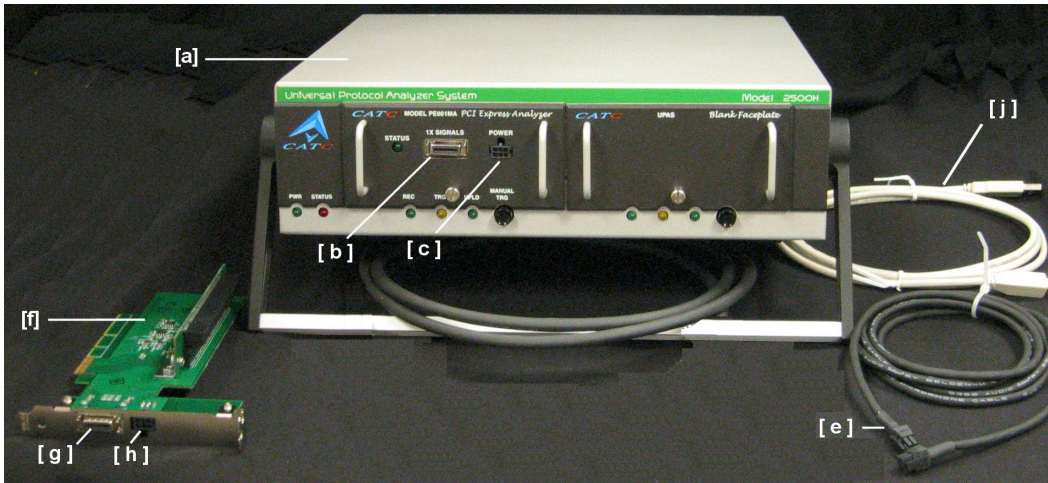


Photo of PETracer components

- [a] - UPAS2500H w/PETracer plug-in module
- [b] - PETracer plug-in module Probe Data connector
- [c] - PETracer plug-in module Probe Power connector
- [d] - Probe Data cable
- [e] - Probe Power cable
- [f] - PETracer Slot Interposer probe
- [g] - Slot Interposer Probe Data connector
- [h] - Slot Interposer Probe Power connector
- [j] - USB cable

- Step 1** With the UPAS2500H analyzer and the Device Under Test (DUT) powered off, insert the PETracer slot interposer probe [f] into a PCI Express slot in the DUT. The slot interposer is designed to fit tightly into any standard PCI Express slot (x1, x4, x8, x16).
- Step 2** Insert the PCI Express DUT into the slot interposer probe's device connector. The PETracer slot interposer's device connector can accommodate any standard PCI Express device (x1, x4, x8, x16).
- Step 3** The slot interposer is shipped from LeCroy with an attached 90 degree angle adapter, allowing the device under test to be inserted parallel to the slot interposer probe. If (due to space constraints) it

is necessary to insert the device under test perpendicular to the slot interposer probe, the 90 degree angle adapter may be removed from the probe and the card may be inserted directly into the connector on the interposer.

- Step 4** Connect the Probe Data cable [d] between the PETracer plug-in module (connector [b]) and the slot interposer probe (connector [g])
- Step 5** Connect the Probe Power cable [e] between the PETracer plug-in module (connector [c]) and the slot interposer probe (connector [h])
- Step 6** Connect the provided USB cable [j] between the UPAS2500H analyzer and the PC host system that will run the PETracer software.
- Step 7** Power on the UPAS2500H analyzer. The analyzer's green power LED will light, and the red status LED will turn on for approximately 25 seconds while the analyzer performs self-diagnostics.
- Step 8** After the analyzer's red status LED turns off, power on the PCI Express system under test.
- Step 9** Open the PETracer software on the PC host system. The analyzer is now ready for PCI Express traffic recording.

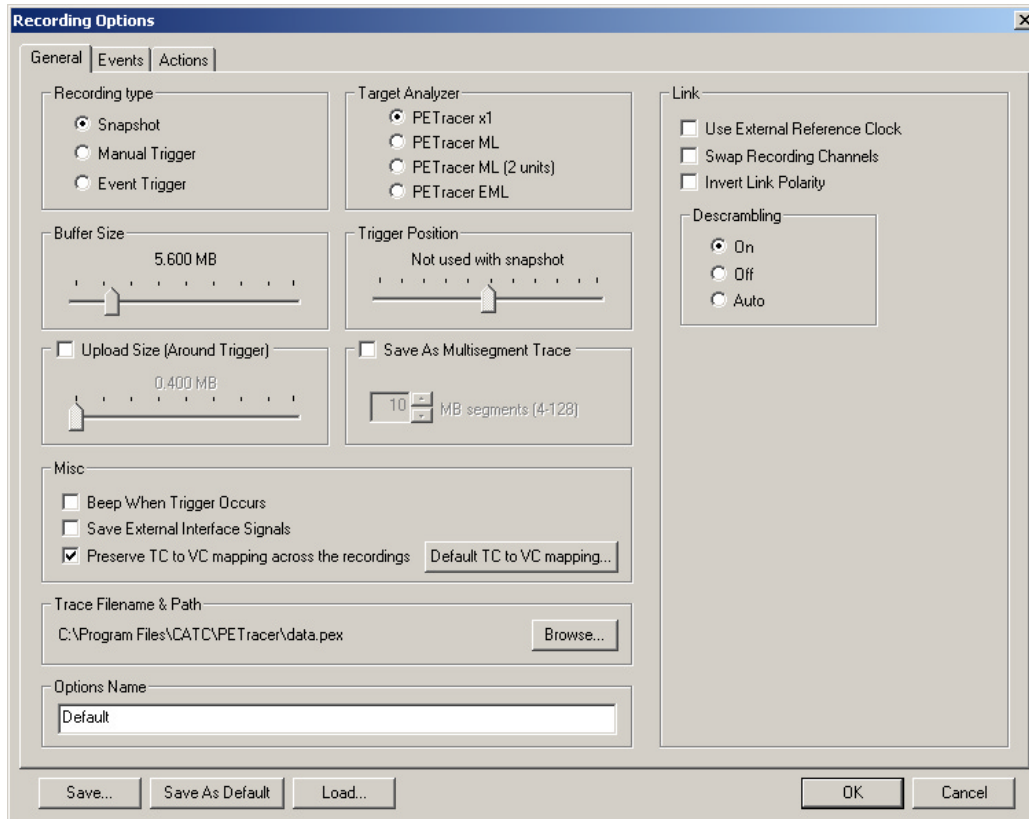
2.8 Making a PCI Express Recording

After connecting the analyzer to the device(s), you will need to configure the Recording Options. Then you can test the analyzer by creating a 4-Mbyte snapshot recording.

To make this recording, follow these steps:


- Step 1** From the **Setup** menu, select **Recording Options**.
- Step 2** Select the **General** tab.

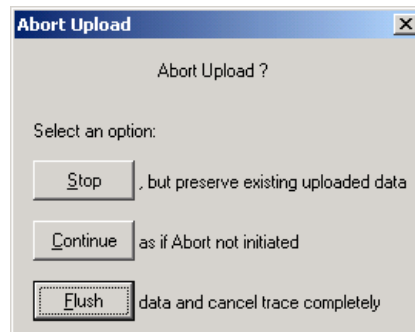
The following window displays the factory default settings such as “Snapshot” and 4 Mbytes buffer size are displayed. For your first recording, you can leave these settings unchanged.



Step 3 Click the **Record**  button.

Stopping a Recording

You can stop the recording process at any time by pressing the Stop button . This will cause the analyzer to stop the recording and upload the trace to the host PC. If you press the Stop button again, the analyzer will temporarily halt the upload process and open the following dialog box:



This dialog presents options for stopping, continuing, or aborting the upload:

- **Stop** - Aborts further trace upload and displays whatever trace data that has already been uploaded.
- **Continue** - Resumes the upload. This command tells the analyzer to finish uploading whatever trace data is still in its buffer.
- **Flush** - Flushes the trace without saving or displaying it.

If you allow the traffic data to be uploaded, it is automatically saved on the PC's hard drive as a file named **data<sn>.pex** (where <sn> is the serial number of the analyzer unit) or the name you assign as the default filename.

Packet	TS2	COM	LaneID	TS2 Symbols	Idle	Time Stamp		
39	Rx	K28.5	0x00	45 45 45 45 45 45 45 45 45 45 45 45 45 45 45 45	112 ns	00000.6770 3326		
40	Rx	DLID	SLID	BTH	RDMA WRITE	RETH	Virtual Address	
		0x375C	0x17D2		RC 0A		0x01710A1C015D4002	
		Data		ICRC	VCRC	Idle	Time Stamp	
		BB884D85 FD5CFBA4 728BC069 0ED40000		0x9625B75A	0x45FA	0 ns	00000.6770 3348	
41	Rx	Op	FCTBS	VL	FCCL	LPCRC	Idle	Time Stamp
		0x0	0x10D	0x5	0x21B	0xF9C9	112 ns	00000.6770 3378
42	Rx	DLID	SLID	BTH	RDMA WRITE	RETH	Virtual Address	
		0x375C	0x17D2		RC 0A		0x01710A1C015D4002	
		Data		ICRC	VCRC	Idle	Time Stamp	
		BB884D85 FD5CFBA4 728BC069 0ED40000		0x9625B75A	0x45FA	0 ns	00000.6770 3398	
43	Rx	Op	FCTBS	VL	FCCL	LPCRC	Idle	Time Stamp
		0x0	0x10D	0x5	0x21B	0xF9C9	112 ns	00000.6770 3426

Step 4 To save a current recording for future reference, select **Save As** from the **File** menu.

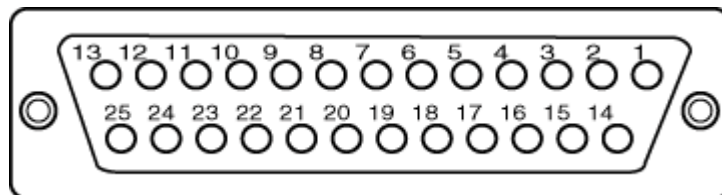
Step 5 Give the recording a unique name, and save it to the appropriate directory.

2.9 External Interface Breakout Board

With each analyzer, LeCroy includes an External Interface Breakout Board for accessing several potentially useful standard, LV TTL output and input signals. The breakout board also offers a simple way to connect logic analyzers or other tools to the PETracer Analyzer unit. Six ground pins and one 5-volt pin are provided.

The Breakout Board connects via a cable to the **Data In/Out** connector located on the rear of the analyzer unit. Each signaling pin is isolated by a 100Ω series resistor and a buffer inside the Analyzer unit.

Data In/Out Connector (on cable)



Pin-Outs for the Data In/Out Connector

The following table lists the pin-out and signal descriptions for the **Data In/Out** connector on a cable that connects to the Breakout board.

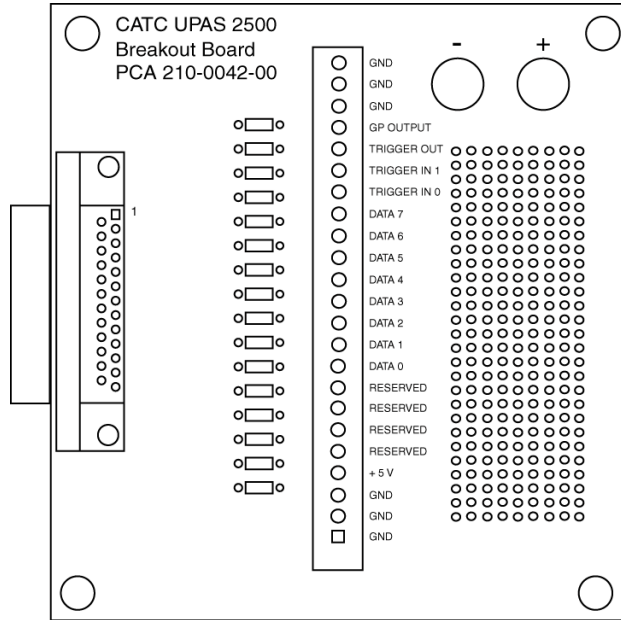
Data In/Out Connector – Pin-Out

Pin	Signal Name	Signal Description
1	RSV	Reserved
2	GND	Ground
3	GP OUT	General Purpose Output
4	TRG IN 1	Trigger In 1
5	GND	Ground
6	DATA 6	Data 6
7	DATA 4	Data 4
8	DATA 3	Data 3
9	DATA 1	Data 1
10	GND	Ground
11	RSV	Reserved
12	RSV	Reserved
13	+5V	+5 Volts, 250 mA DC Source
14	RSV	Reserved
15	GND	Ground
16	TRG OUT	Trigger Out
17	TRG IN 0	Trigger In 0
18	DATA 7	Data 7
19	DATA 5	Data 5
20	GND	Ground
21	DATA 2	Data 2
22	DATA 0	Data 0
23	GND	Ground
24	RSV	Reserved
25	RSV	Reserved

Note (*) Pins 4 and 17 have the same function: they allow external signals to be used to cause triggering or recording. Pins 3 and 16 are used to transmit output signals. Pins 6, 7, 8, 9, 18, 19, 21, and 22 (data pins) are used to define data patterns for external input signals.

Note PCTracer only supports Data 0 - Data 3.

External Interface Breakout Board



Prototype Rework Area

The Breakout Board contains a prototype rework area for making custom circuits for rapid development. The area consists of plated-through holes, 20 columns wide by 27 rows long. The top row of holes is connected to GND and the bottom row is connected to +5V. The remaining holes are not connected. Use the rework area to insert custom components and wire-wrap their respective signal, power, and ground pins.

Configuring the Analyzer for the Breakout Board

To configure the analyzer for the breakout board, see the chapter on Recording Options.

How to Contact LeCroy

Type of Service	Contact
Call for technical support...	US and Canada: 1 (800) 909-2282 Worldwide: 1 (408) 727-6600
Fax your questions...	Worldwide: 1 (408) 727-6622
Write a letter...	LeCroy Protocol Solutions Group Customer Support 3385 Scott Blvd. Santa Clara, CA 95054 USA
Send e-mail...	support@CATC.com
Visit LeCroy's web site...	http://www.lecroy.com/

Limited Hardware Warranty

So long as you or your authorized representative ("you" or "your"), fully complete and return the registration card provided with the applicable hardware product or peripheral hardware products (each a "Product") within fifteen days of the date of receipt from LeCroy or one of its authorized representatives, LeCroy warrants that the Product will be free from defects in materials and workmanship for a period of three years (the "Warranty Period"). You may also complete your registration form via the internet by visiting <http://www.lecroy.com/support/register/>. The Warranty Period commences on the earlier of the date of delivery by LeCroy of a Product to a common carrier for shipment to you or to LeCroy's authorized representative from whom you purchase the Product.



What this Warranty Does Not Cover

This warranty does not cover damage due to external causes including accident, damage during shipment after delivery to a common carrier by LeCroy, abuse, misuse, problems with electrical power, including power surges and outages, servicing not authorized by LeCroy, usage or operation not in accordance with Product instructions, failure to perform required preventive maintenance, software related problems (whether or not provided by LeCroy), problems caused by use of accessories, parts or components not supplied by LeCroy, Products that have been modified or altered by someone other than LeCroy, Products with missing or altered service tags or serial numbers, and Products for which LeCroy has not received payment in full.

Coverage During Warranty Period

During the Warranty Period, LeCroy or its authorized representatives will repair or replace Products, at LeCroy's sole discretion, covered under this limited warranty that are returned directly to LeCroy's facility or through LeCroy's authorized representatives.

How to Obtain Warranty Service

To request warranty service, you must complete and return the registration card or register via the internet within the fifteen day period described above and report your covered warranty claim by contacting LeCroy Technical Support or its authorized representative.

LeCroy Technical Support can be reached at 800-909-7112 or via email at support@catc.com. You may also refer to LeCroy's website at <http://www.lecroy.com> for more information on how to contact an authorized representative in your region. If warranty service is required, LeCroy or its authorized representative will issue a Return Material Authorization Number. You must ship the Product back to LeCroy or its authorized representative, in its original or equivalent packaging, prepay shipping charges, and insure the shipment or accept the risk of loss or damage during shipment. LeCroy must receive the Product prior to expiration of the Warranty Period for the repair(s) to be covered. LeCroy or its authorized representative will thereafter ship the repaired or replacement Product to you freight prepaid by LeCroy if you are located in the continental United States. Shipments made outside the continental United States will be sent freight collect.

Please remove any peripheral accessories or parts before you ship the Product. LeCroy does not accept liability for lost or damaged peripheral accessories, data or software.

LeCroy owns all parts removed from Products it repairs. LeCroy may use new and/or reconditioned parts, at its sole discretion, made by various manufacturers in performing warranty repairs. If LeCroy repairs or replaces a Product, the Warranty Period for the Product is not extended.

If LeCroy evaluates and determines there is "no trouble found" in any Product returned or that the returned Product is not eligible for warranty coverage, LeCroy will inform you of its determination. If you thereafter request LeCroy to repair the Product, such labor and service shall be performed under the terms and conditions

of LeCroy's then current repair policy. If you chose not to have the Product repaired by LeCroy, you agree to pay LeCroy for the cost to return the Product to you and that LeCroy may require payment in advance of shipment.

General Provisions

THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS. YOU MAY HAVE ADDITIONAL RIGHTS THAT VARY BY JURISDICTION. LECROY'S RESPONSIBILITY FOR DEFECTS IN MATERIALS AND WORKMANSHIP IS LIMITED TO REPAIR AND REPLACEMENT AS SET FORTH IN THIS LIMITED WARRANTY STATEMENT. EXCEPT AS EXPRESSLY STATED IN THIS WARRANTY STATEMENT, LECROY DISCLAIMS ALL EXPRESS AND IMPLIED WARRANTIES FOR ANY PRODUCT INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF AND CONDITIONS OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ANY WARRANTIES THAT MAY ARISE FROM ANY COURSE OF DEALING, COURSE OF PERFORMANCE OR TRADE USAGE. SOME JURISDICTIONS MAY NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE PRECEDING LIMITATION MAY NOT APPLY TO YOU.

LECROY DOES NOT ACCEPT LIABILITY BEYOND THE REMEDIES SET FORTH IN THIS LIMITED WARRANTY STATEMENT OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING, WITHOUT LIMITATION, ANY LIABILITY FOR THIRD PARTY CLAIMS AGAINST YOU FOR DAMAGES, PRODUCTS NOT BEING AVAILABLE FOR USE, OR FOR LOST DATA OR SOFTWARE. LECROY'S LIABILITY TO YOU MAY NOT EXCEED THE AMOUNT YOU PAID FOR THE PRODUCT THAT IS THE SUBJECT OF A CLAIM. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE PRECEDING EXCLUSION OR LIMITATION MAY NOT APPLY TO YOU.

The limited warranty on a Product may be transferred for the remaining term if the then current owner transfers ownership of the Product and notifies LeCroy of the transfer. You may notify LeCroy of the transfer by writing to Technical Support at LeCroy, 3385 Scott Blvd., Santa Clara, CA 95054 USA or by email at: support@catc.com. Please include the transferring owner's name and address, the name and address of the new owner, the date of transfer, and the Product serial number.

