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Everywhereyoulook™

PROTOCOL SOLUTIONS GROUP
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Summit Z2-16™

PCI Express Multi-Lane Exerciser

User Manual



For PCI Express Protocol Suite software version 7.30

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WEEE Program



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Section 1. General

Chapter 1: Overview

Designed for developers and validators, the Teledyne LeCroy Summit Z2-16™ is a Gen1/Gen2 PCI Express advanced verification system.

By leveraging years of experience in protocol analysis tools for emerging markets, Summit Z2-16 blends sophisticated functionality with practical features to speed the development of PCI Express™ IP cores, semiconductors, bridges, switches, add-in boards, and systems.

1.1 Summit Z2-16 Exerciser Hardware

Features and Benefits

Summit Z2-16 Exercisers have these features and benefits

Features	Benefits
Bidirectional x1-x16, 2.5 GBps to 5.0 GBps generation support	Accurate generation of PCI Express bus traffic
Script level traffic generation	Programmability to test PCI Express components with more precision and control
Manual Error injection	Verify fault handling and identify error recovery
Host/End-Point Emulation Support	Host emulation platform/end-point emulation Interposer allows for design and stress testing.
Programmable Physical Layer	Flexibility to program lane skews, link control bits, skip intervals and link states for more robust verification
Programmable Data Link Layer	Ability to modify flow control, ACK/NAK, and retry behaviors
Flexible/programmable Transaction Layer	User ability to define arbitrary sequence of transactions, payload generation, and conditional repeat of transactions provide users with maximum flexibility
Point and Click Script Editor	Complex scripts can be created quickly and easily
Read/modify/playback capability	Allows automatic generation of Exerciser scripts based on a captured CATC Trace recording.

Programmable ACK/NAK behavior	ACK all TLP packets NAK all TLP packets Automatic ACK/NAK behavior ACK/NAK delay timer
Programmable Flow control behavior	Set Credit values Disable Credit checking Set Update FC intervals
Automatic CRC calculation and Sequence number assignment	DLLP CRC calculation TLP LCRC calculation
Replay buffer	Programmable Transaction timeout timer Auto Recovery behavior after 4 Replays
Programmable configuration space	Full 4 KB configuration space configurable by user Accessible through Configuration Reads and Writes over PCI Express
Endpoint memory emulation	Up to 1 GB memory accessible through memory read and write
Fast Transit module	Special hardware-accelerated module to increase link utilization

1.2 Summit Z2-16 Exerciser

Teledyne LeCroy Summit Z2-16, a Gen2 PCI Express 16-lane advanced Exerciser system, is a critical test and verification tool intended to assist engineers in improving the reliability of their systems. It can emulate PCI Express root complexes or device endpoints. You can test PCI Express IP cores, semiconductors, bridges, switches, and systems.



The Summit Z2-16 is a stand-alone PCI Express Exerciser that can generate and respond to all types of PCI Express transactions. The scripting language allows creation of Transaction Layer Packets (TLPs), Data Link Layer Packets (DLLPs) and Ordered Sets. ACK's and NAK's can be automatically generated under user control.

A Configuration Space can be easily created using the Configuration Space Editor.

The scripting language is powerful yet easy to use. One way to create test scripts is to export traffic from a CATC Trace file captured with Teledyne LeCroy PETracer. You can then modify the exported script to generate different test cases, insert errors, or create loop tests. The “point and click” capability of the script editor simplifies modifying or creating scripts.

1.3 Other Documents

For more information, refer to the following documents:

- *Teledyne LeCroy Analyzers File-based Decoding Manual*
- *PETracer/Trainer Automation Manual*
- *PETracer VSE Manual*
- *PETracer Gen2 Multi Lead Probe User Manual*
- *PETrainer Scripting Language Reference Manual*
- *PETracer Online Help*

Chapter 2: Hardware Description

The PCI Express™ system features Summit Exercisers.

2.1 System Components

- **Summit Z2-16 exerciser system:**
 - Summit Z2-16™ exerciser box
 - One or two (for x8 or x16 recording) probe data cables
 - x16 to x1 Edge Adapter
 - x16 to x4 Edge Adapter
 - x16 to x8 Edge Adapter
 - PE *Tracer* Software program CD-ROM
 - Device Emulator Card or Host Emulation Test Fixture

2.2 Host Machine Requirements

Summit Z2-16 connects to a host machine. Please consult the **readme** file on the installation CD for the latest host machine requirements.

2.3 Summit Z2-16 Exerciser

A Multi-lane PCI Express Exerciser is designed to assist engineers in improving reliability of their solutions and providing advanced capabilities for stress and compliance testing.

- Summit Z2-16: x1 through x16 lane system



All models operate as standalone Exercisers capable of generating and responding to all types of PCI Express transactions. Exercisers also have the ability to create protocol variations and anomalies. Users may also create corner case and stress test scenarios to evaluate the robustness of their solutions. By utilizing the error injection feature, engineers can create worst-case PCI Express traffic scenarios allowing them to validate the error handling capabilities of their solutions.

When used in conjunction with an Analyzer, a complete expert test and analysis system is created. This integrated solution delivers traffic generation and expert protocol analysis to assist developers with early validation of designs along with error injection and stress testing in preparation for compliance testing.

2.4 Summit Z2-16 Front Panel Description

When powered on, the Summit Z2-16 Exerciser activates the user-accessible controls and LEDs on the front and rear panels.

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

Figure 2.1 Summit Z2-16 Front Panel



Power Switch

On/Off switch.

Outputs

To Device (15:8) Connector

Connects Summit Z2-16 to Device Emulator or Host Emulator (lanes 15:8).

Reference Clock In Connector

Connects external reference clock source to Summit Z2-16.

To Device (7:0) Connector

Connects Summit Z2-16 to Device Emulator or Host Emulator (lanes 7:0).

To Analyzer (15:8) Connector

Connects to PETracer Summit or Summit T2-16 Analyzer (lanes 15:8). This is an optional connection for users adding a PETracer Summit or Summit T2-16 Analyzer to their setup.

Reference Clock Out Connector

Provides external reference clock output.

To Analyzer (7:0) Connector

Connects to PETracer Summit or Summit T2-16 Analyzer (lanes 7:0). This is an optional connection for users adding a PETracer Summit or Summit T2-16 Analyzer to their setup.

Displays

Screen

Displays the setup and activity.

Up-Arrow Button

Scroll the screen up.

Select Button

Push to select the current screen item.

Down-Arrow Button

Scroll the screen down.

Link Speed LED

Indicates link speed: blue = 2.5 GT/s or red = 5.0 GT/s.

Link State LED

Indicates state of the link between the Exerciser and the DUT: blue = good or red = error.

Status LED

Indicates status of the Exerciser: blue = good or red = error.

Manual Action Button

(Not used at this time)

2.5 Summit Z2-16 Rear Panel Description

From left to right, the Summit Z2-16 rear panel contains the following components:

Figure 2.2 Summit Z2-16 Rear Panel



Wide-range AC Connector Module

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

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

Sync In and Sync Out Connectors

(not currently active) These connectors allow multiple Summit T2-16 or Summit Z2-16 analyzers to send synchronization and control messages to one another.

USB Type B Host Machine Connector

This connector links an Analyzer to the host machine for the purpose of transmitting commands from the host machine to the Analyzer and uploading traces from the Analyzer's recording memory to the PE *Tracer* software for viewing and analysis. This connector links an Exerciser to the host machine for the purpose of downloading scripts and controlling the behavior of the Exerciser. **Note:** For each Analyzer or Exerciser, use either USB or Ethernet, not both.

Ethernet Port

GIGE Connectivity allows connection to an Ethernet network and sharing of Analyzer/Exerciser resources by multiple engineers. **Note:** For each Analyzer or Exerciser, use either USB or Ethernet, not both.

BNC Connectors Trigger In and Trigger Out

These BNC connectors allow the Analyzer to transmit or receive trigger event signals. **Trigger In** can receive a signal from another device and use that signal to trigger the recording. Conversely, the **Trigger Out** connector can send an output signal from the Analyzer to another device.

RS-232 25-pin Data Input/Output Connector

This connector is not used by Summit Z2-16.

Teledyne LeCroy Bus Connector

The Teledyne LeCroy Bus Connector is not currently active.

Chapter 3: Installation

Summit Z2-16™ is a stand-alone system.

You can begin traffic generation after following the steps in this chapter.

3.1 Installing the PETracer Software

PETracer software operates all of Teledyne LeCroy's PCI Express protocol Analyzer and Exerciser products:

The PETracer software is installed on a Microsoft® Windows®-based host machine and serves as the interface for the Exerciser and/or Analyzer. An Exerciser enables traffic generation features.

To install the PETracer software on the host machine:

Step 1 Insert the CD into the CD ROM drive of the PC that controls the Exerciser. The installation window opens and displays links to the PETracer software, user manuals, a readme file, and Acrobat Reader.

Step 2 Select **Install Software** and follow the on-screen instructions.

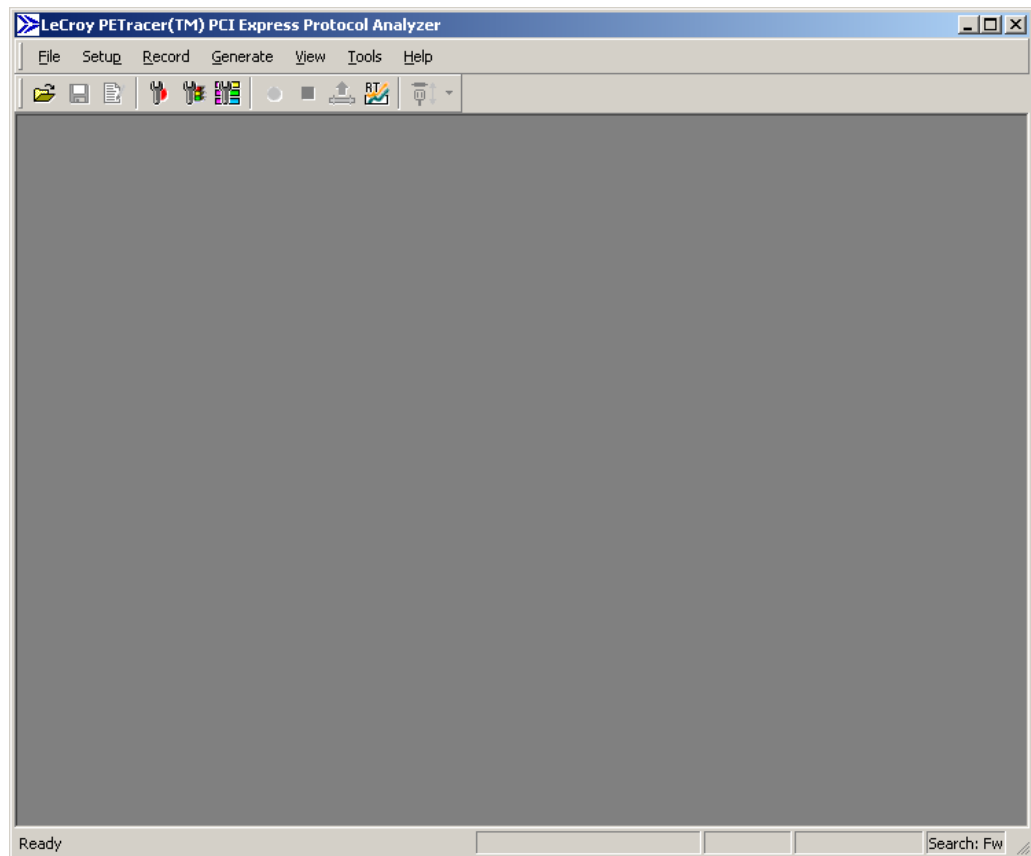
The PETracer software installs automatically on the host machine's hard disk. During installation, all necessary USB drivers are loaded automatically. Drivers included in the installation are:

- **summit.sys**: Summit T2-16/Summit Z2-16 driver

Step 3 To start the application, launch the PETracer program from the Start menu:

Start > Programs > LeCroy > PETracer > LeCroy PETracer

The *PETracer* program opens:



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

3.2 Setting Up the Summit Z2-16 Exerciser using an Ethernet Connection

Step 1 Remove the Exerciser from its shipping container.

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

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

Step 3 Connect the Ethernet cable between the Ethernet port on the back of the Exerciser and a Ethernet port (hub, switch or wall) in your local network. Continue with Step 4 below.

Note on USB: To connect using USB, see “Setting Up the Summit Z2-16 Exerciser using a USB Connection” on page 18.

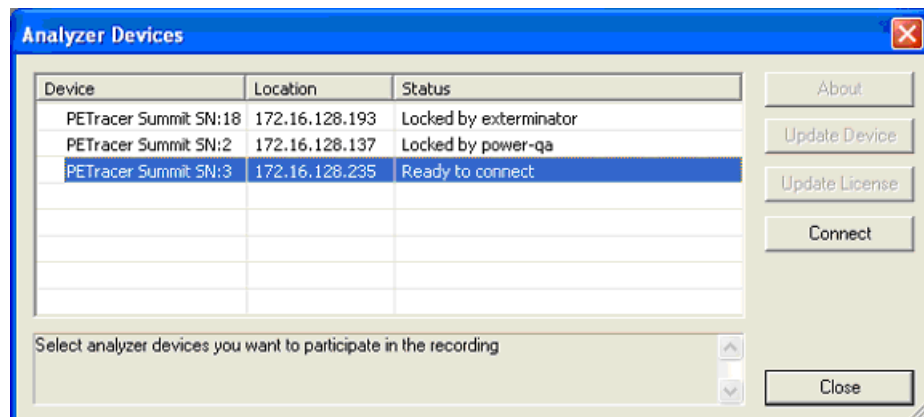
Step 4 Turn on the rear power switch and the front power switch.

Note: At power-on, the Exerciser initializes itself in approximately five seconds and performs an exhaustive self-diagnostic that lasts about forty seconds. The results are reflected by messages on the Summit Z2-16 LCD display (see “Summit Z2-16 Front Panel Description” on page 9). If the LCD display indicates failure, call Teledyne LeCroy Customer Support for assistance.

Connecting to a Summit Z2-16 Exerciser in the Local Network

After you have installed the *PETracer* application software, perform the following procedure to connect to a Summit Z2-16 Exerciser in the local network.

Step 1 Select the **Setup > All connected devices...** menu in the *PETracer* application to display the Analyzer Devices dialog.



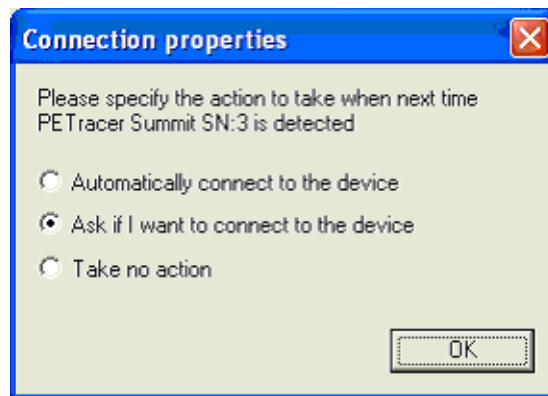
The *PETracer* software fills the list with devices that are connected over USB or discovered on the Ethernet network. The discovery mechanism works only within one network subnet. If a Summit is connected to the network on a different subnet, you can manually add the subnet to the list by clicking the **Add Device** button and specifying the IP address.

The Summit devices in the list are marked:

- **Locked:** Some other client on the network is already connected to that device
- **Ready to connect:** Available for connection

Step 2 If a Summit device is marked Ready To Connect, you can select that device and press the **Connect** button to execute the connection procedure.

After the connection is established, the application displays the Connection Properties dialog:



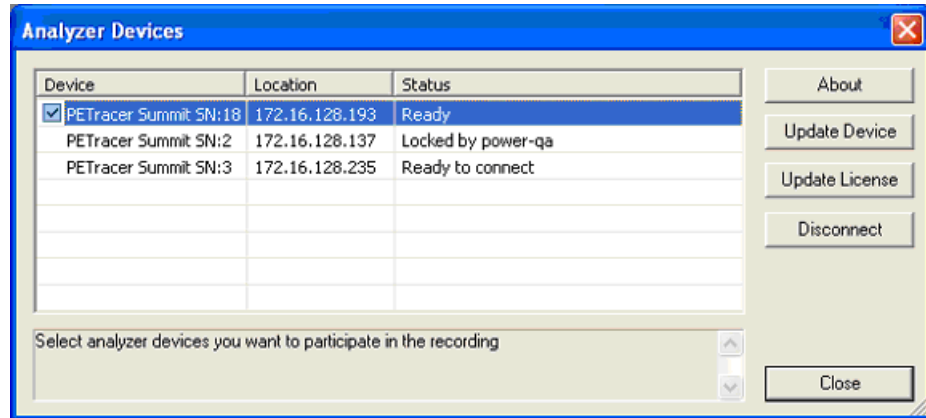
Step 3 Select an option:

- **Automatically connect to the device:** When the application is started or when the named device is added to the network while the *PETracer* application is running on this computer, the *PETracer* application will try to connect to the named device.
- **Ask if I want to connect to the device:** When the application is started or when the named device is added to the network while the *PETracer* application is running on this computer, the *PETracer* application will display a message box allowing you to connect to the named device.
- **Take no action:** When you start the application or when you want to add the named device to the network while the *PETracer* application is running on this computer, you must connect manually to use the named device.

Note: When you close the application on this computer (or you perform manual disconnect), the application disconnects from the device.

Step 4 Press **OK** in the Connection Properties dialog.

After you finish the connect procedure, the Summit device to which you have connected is marked as **Ready** and you can use it for recording:



Note: To disconnect from a device, display this dialog, select the device, and click the **Disconnect** button.

Warning! Do not change from USB to Ethernet, or back, without power cycling the Analyzer/Exerciser.

3.3 Setting Up the Summit Z2-16 Exerciser using a USB Connection

To set up the Exerciser using a USB connection:

Step 1 Remove the Exerciser from its shipping container.

Step 2 Insert the Installation CD.

Step 3 Connect the Exerciser to a 100-volt to 240-volt, 50 Hz to 60 Hz, 120 W power outlet using the provided power cord.

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

Step 4 Connect the USB port to a USB port on the host machine using a USB cable. Go to Step 4 below.

Note on Ethernet: To connect using Ethernet, see “Setting Up the Summit Z2-16 Exerciser using an Ethernet Connection” on page 15.

Step 5 Turn on the rear power switch and the front power switch.

Note: At power-on, the Exerciser initializes itself in approximately five seconds and performs an exhaustive self-diagnostic that lasts about forty seconds. The results are reflected by messages on the Summit Z2-16 LCD display (see “Summit Z2-16 Front Panel Description” on page 9). If the LCD display indicates failure, call Teledyne LeCroy Customer Support for assistance.

Step 6 Click **Next** after you see the Add New Hardware Wizard window.

Step 7 Follow the Microsoft® Windows® on-screen Plug-and-Play instructions for the automatic installation of the Exerciser as a USB device on your analyzing host machine. (The required USB files are included on the Installation CD.)

Step 8 Click **Finish** when you see the message that says “Windows has finished installing the software that your new hardware requires” and the file has been installed in your host machine.

Warning! Do not change from USB to Ethernet, or back, without power cycling the Analyzer/Exerciser.

3.4 Connecting Summit Z2-16 to the DUT

The Summit Z2-16 Exerciser can test both the host and device sides of a PCI Express link through the use of two types of adapter:

- **Motherboards and host controllers:** Using a **device emulator**. A device emulator is an adapter card that fits into motherboards and other slotted PCI Express devices.
- **PCI Express add-on cards:** Using a **host emulation test fixture**. A host emulation test fixture is a box-like adapter with a slot for testing PCI Express cards.

Both of these test devices can be purchased from Teledyne LeCroy.

Device Emulator



Figure 3.3 Summit Z2-16 Exerciser (bottom) connected to a Device Emulator (top).

The Teledyne LeCroy Device Emulator is an adapter that provides a way of connecting a Summit Z2-16 Exerciser to a PCI Express motherboard. The emulator has two connectors: a connector for a data cable and an edge connector for inserting the Device Emulator into a slotted DUT.

Installing the Device Emulator

To install the Device Emulator into the DUT, perform the following steps:

- Step 1** If not already powered off, power off the Summit Z2-16 system and the DUT.
- Step 2** Insert the edge connector on the Device Emulator into a PCI Express slot in the DUT. The Device Emulator is designed to fit into standard x16 PCI Express slot. To connect to a x1, x4, or x8 slot, you must install a slot reducer, available from Teledyne LeCroy.
- Step 3** The Device Emulator is shipped from Teledyne LeCroy with a metal face plate for attachment to a PC case. If you are working with a motherboard that is not in a PC case, you may prefer to remove the metal face plate so the emulator can sit flat with the motherboard. To remove the face plate, unscrew the two screws that hold it onto the emulator.
- Step 4** Attach probe data cables between the two connectors on the emulator and the **To Device (15:8)** and **To Device (7:0)** ports on the Exerciser.
- Step 5** At this point the emulator is ready for use. Skip ahead to See “Final Steps: Power on the Exerciser and then DUT” on page 22..

Host Emulation Test Fixture



Figure 3.4 Summit Z2-16 Exerciser (bottom) connected to a Host Emulator adapter (top). The Host Emulator has a PCI Express graphics card inserted.

Teledyne LeCroy Host Emulation Test Fixture

Hardware enclosure with a slot on top for accommodating a PCI Express card.

TX/RX 8-15 Connector: Connects to the To Device (15:8) port on Summit Z2-16.

TX/RX 0-7 Connector: Connects to the To Device (7:0) port on Summit Z2-16.

Reset button: Reset asserts PERST # for > 250 ms.

Clock Select: Selects from the following clocking options:

- **Ext:** a user supplied reference via the **RefCLK** SMA connector.
- **Int:** an internal supplied 100 MHz reference clock.
- **Int SSC:** an internal supplied Spread Spectrum Clock.

Power Select switch: Selects between the internal power supply and the external power jacks on the back of the emulator. When **External** power is selected, both 3.3V and 12V supplies must be provided by the user via the banana jacks on the back of the emulator.

Emulator Power LED: Lights when emulator is powered on.

PCI Slot Power LED: Lights when the PCI Express connector on the Host Emulator is supplying power. Power can be provided either via the internal power supply or by an external power supply via the banana jacks on the back of the emulator. If an external power source is provided, the Power Select switch should be set to **Ext**.

Installing the Host Emulation Test Fixture

- Step 1** If not already powered off, power off the Summit Z2-16 system and the DUT.
- Step 2** Insert the male edge connector of the DUT into the PCI Express slot on top of the Host Emulation Test Fixture.
- Step 3** Attach a probe data cable to the **Rx/Tx 0-7** port on the Host Emulator and the **To Device (7:0)** port on Summit Z2-16.
- Step 4** For x16 configuration, attach a second probe data cable to the **Rx/Tx 8-15** port on the Host Emulator and the **To Device (15:8)** port on Summit Z2-16.
- Step 5** If the DUT is a 150 watts or less device, such as a graphics card, you may connect the card's external power cables to the two external power ports on top of the Host Emulator.

Final Steps: Power on the Exerciser and then DUT

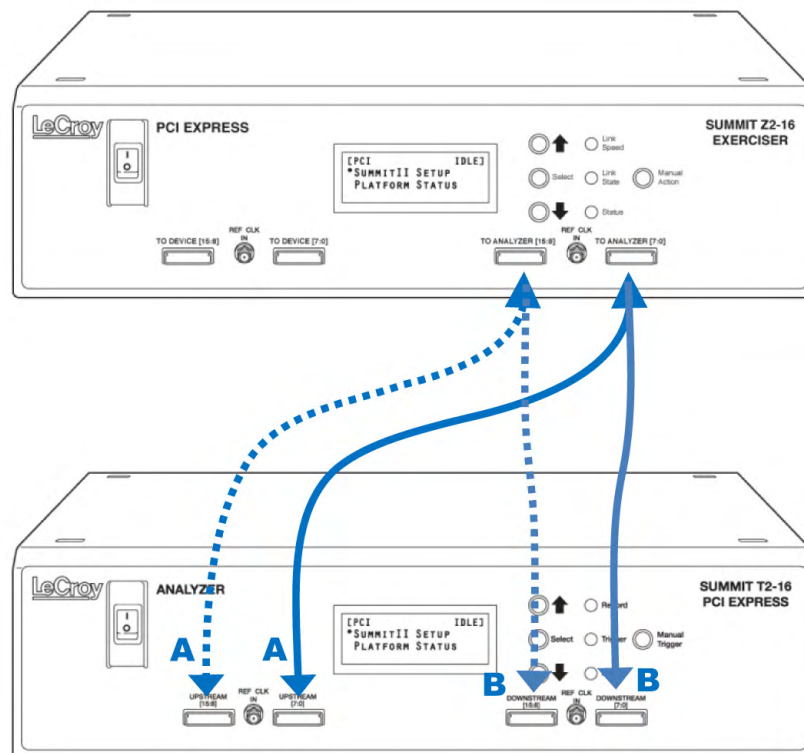
Important: Power on the Exerciser before you power on the DUT.

- Step 1** Power on the Summit Z2-16 Exerciser. The Exerciser's green power LED lights, and the red Status LED turns on for approximately one minute while the Exerciser performs self-diagnostics.
- Step 2** If testing a motherboard, power on the motherboard. If testing a PCI-Express device such as a graphics card, power on the Host Emulator.
- Step 3** Open the *PETracer* application on the host machine. The Exerciser is now ready for traffic generation.

3.5 Connecting Summit Z2-16 to a T2-16

The Summit Z2-16 Exerciser connected to a Summit T2-16 Analyzer.

- **For an x8 connection:** Connect one end of the iPass Y-Cable to the To Analyzer [7:0] connector of the Summit Z2-16. Connect the other two ends of the iPass Y-Cable to the Upstream [7:0] and Downstream [7:0] connectors of the Summit T2-16 respectively.
- **For an x16 connection:** In addition to the above connection, connect one end of the second iPass Y-Cable to the To Analyzer [15:8] connector of the Summit Z2-16. Connect the other two ends of the iPass Y-Cable to the Upstream [15:8] and Downstream [15:8] connectors of the Summit T2-16 respectively.



PE010UCA-X iPass Y-Cable
 One needed for x1 to x8
 Two needed for x16

Figure 3.5 Summit Z2-16 Exerciser (top) connected to a Summit T2-16 (bottom).

Section 2. Exerciser Traffic Generation

Chapter 4: Traffic Generation

A traffic generator can emulate PCI Express™ root complexes and endpoint devices. Traffic generation can be used to transmit known errors, allowing you to observe how your device handles faulty link conditions.

After the Summit Z2-16 Exerciser and DUT have been cabled and powered on, you can test the setup by generating some traffic. The following steps show how to configure the Exerciser to generate a Link Training sequence.

4.1 Theory of Operation

Overview

The Exerciser offers two mechanisms for implementing traffic generation: scripts, in which any type of traffic can be defined and executed, and the Generation Options dialog box, which offers a collection of PCI Express specific **behaviors** that can be enabled for automatic generation of traffic.

Using scripts, packets can be transmitted one after another or with certain timing or event-based pauses between them. This allows the Exerciser to act as a pattern generator with PCI Express-specific formatting and transmission rates. However, creating traffic that emulates real devices with relatively complex protocol behaviors using a simple pattern generator is quite complicated. Certain behaviors such as ACK policies, and flow control require concurrent processing. This is where the automated features become useful.

The Exerciser includes a collection of automated traffic generation circuits that commonly exist in other PCI Express devices. These circuits include ACK/NAK generation, flow control management, a Link Training and Status State machine (LTSSM), replay buffers, and transaction timers. What makes the Exerciser unique and so useful is that each of these behaviors can be individually modified or disabled. This allows the user to perform operations that might not otherwise be possible using an off the shelf PCI Express device. This can be particularly useful when doing compliance or fault recovery testing.

Starting Point

When the Exerciser first powers up, it is at electrical idle on all lanes. The link is not trained, but the Link Training and Status State Machine (LTSSM) is enabled and waiting for a command to train the link. To begin communication with a PCI Express device, the Link training must occur, but first the generation settings must be set. This involves setting the Link parameters such as link width, polarity inversion, and lane reversal, through the Generation Options dialog.

Note: Setting the options in the Generation Options dialog has no effect on the Exerciser behavior until the first script is executed. In fact, each time a script is executed, these behaviors are reprogrammed to the Exerciser and the behaviors are modified accordingly.

The **Link Connect** toolbar button can then be pressed to signal to the LTSSM to initiate Link training. Alternatively, a script can be executed with the **Link=L0** command.

The Status bar at the bottom of the screen shows the current state of the PCI Express Link. When the Link is down, it shows **Detect**. When it is up, it shows **L0**.

All of the intermediate link states, such as **Polling** and **Configuration**, are handled automatically. In fact, after the **Link=L0** command is executed and the LTSSM is alive, the Exerciser attempts to keep the Link active just as any other PCI Express device does. This includes handling of Recovery states and subsequent retraining events.

The next step is to enable flow control. This is done by executing the **Link=InitFC** command. This causes the Exerciser to perform flow control initialization and, if enabled, begin periodic transmission of **Update_FC DLLP**'s. If the Link connect toolbar button was used, the flow control initialization happens automatically.

By using these basic commands, the complicated process of link training is managed automatically. The Link is now trained and the script execution can now focus on sending TLP packets.

Script Execution

As mentioned above, each time a script is executed, the configuration settings for the Exerciser are reprogrammed. When the **Start generation** button is pressed, the script is uploaded to the Exerciser hardware and executed immediately. Progress of the script can be tracked in the status bar at the bottom of the screen. Subsequent executions of the same script do not require upload of the script to the Exerciser, however, as mentioned above, the generation options are still reprogrammed.

Script execution can be throttled using **Wait** commands inserted directly into the script. Waits can be time based, require receipt of certain packet types, or can even require **User** input from the GUI.

After the script is complete, any enabled PCI Express **behaviors**, such as SKIP insertion, Flow control, and ACK generation, continue. This allows you to run multiple scripts, one after another, without interrupting the Link state.

4.1 Traffic Generation Files

The **.peg** traffic generation files are text files consisting of a series of commands from a scripting language (see Chapter 12), and optionally, one or more **Include** statements linking other generation files into the current file.

```

1  packet = OrderedSet (
2      SetType = Skip
3      SkipCount = 0x3
4  )
5  packet = TLP (
6      PSN = 0xA
7      TLPTYPE = CfgRd0
8      TC = 0x0
9      TD = 0x1
10     EP = 0x0
11     Ordering = 0x0
12     Snoop = 0x0
13     Length = 0x1
14     RequesterID = (1:2:3)
15     Tag = 0xC
16     LastDwBe = 0x1
17     FirstDwBe = 0xF
18     DeviceID = (4:5:6)
19     Register = 0x0
20     ECRC = 0xC511ED3E
21     LCRC = 0x3DE21977
22 )

```

Note: To edit a generation file, use the Script Editor, a specially designed text editor tool. See “Editing Generation Files with the Script Editor” on page 34.


To generate traffic, open a traffic generation file (*.peg) and then run it.

The screenshot shows the LeCroy PETracer (TM) PCI Express Protocol Analyzer interface. The main window displays a list of generated traffic packets. The packets are as follows:

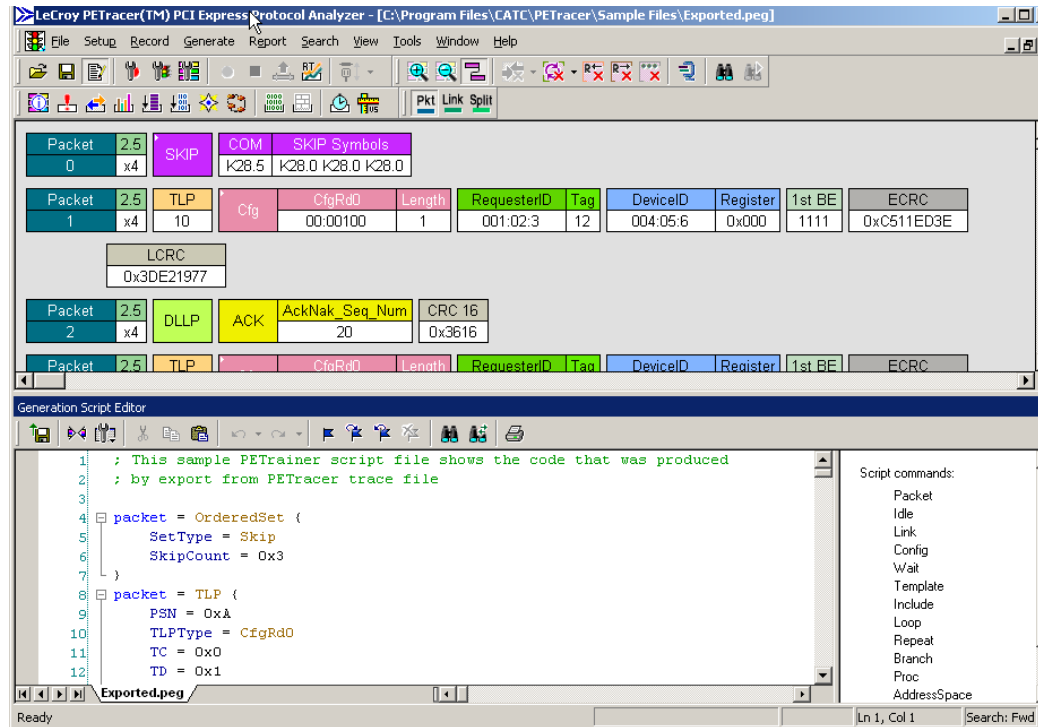
Packet	Size	Type	Symbol	Symbol Details
0	2.5 x4	SKIP	COM	SKIP Symbols K28.5 K28.0 K28.0 K28.0
1	2.5 x4	TLP	Cfg	CfgRd0 Length RequesterID Tag DeviceID Register 1st BE ECRC 00:00100 1 001:02:3 12 004:05:6 0x000 1111 0xC511ED3E
LCRC 0x3DE21977				
2	2.5 x4	DLLP	ACK	AckNak_Seq_Num CRC 16 20 0x3616
3	2.5 x4	TLP	Cfg	CfgRd0 Length RequesterID Tag DeviceID Register 1st BE ECRC 00:00100 1 001:02:3 13 004:05:6 0x004 1111 0x7906DCF2
LCRC 0x7E29BFF0				
Wait TLP Header Timeout: Infinite Fmt: 3DW header, with data Type: Cpl/CplID				
5	2.5 x4	DLLP	ACK	AckNak_Seq_Num CRC 16 21 0x970D
6	2.5 x4	TLP	Cfg	CfgRd0 Length RequesterID Tag DeviceID Register 1st BE ECRC 00:00100 1 001:02:3 14 004:05:6 0x008 1111 0x7EAF1E1D
LCRC 0x35552DD0				


The bottom status bar shows "Ready" and a search field.

When the file is opened, it appears in the CATC Trace window looking like a CATC Trace file.

To run the file, press  .

To create or edit a .peg file, use the Script Editor.



The Script Editor is a text-editing tool that can be opened by clicking  .

Alternatively, the traffic generation file can be created by exporting the data from a CATC Trace into a traffic generator file.

4.2 Creating a Traffic Generation File

There are four ways to create traffic generation script file:

- **Export an existing trace** to a script file
- **Save an existing script** to a new file
- **Select File > New** to create a new and empty script file that contains no text.
- **Create an empty file** using an OS shell (with **.peg** extension) and open it with **PETracer** software.

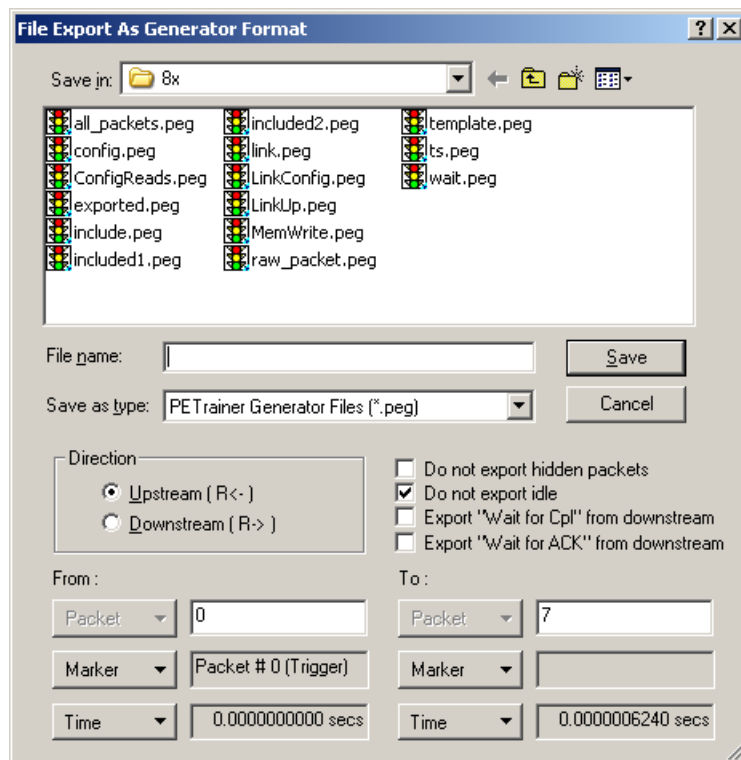
Exporting a CATC Trace to a Traffic Generation File

A simple way to create a script file is to open a CATC Trace and then to export the CATC Trace data to a generation file:

Step 1 Open a CATC Trace file.

Step 2 Select **File > Export > to Generator File Format**.

Step 3 Select the desired options from the File Export dialog box:



Direction: Selects the direction of the traffic to be exported.

From and To: Selects a range for exporting. You can export all or part of the CATC Trace.

Do not export hidden packets: Ignores any packets hidden through the various hide options.

Do not export Idle packets: Excludes Idles from the export.

Export “Wait for Cpl” from upstream: Exports all **Wait for Completions** from the opposite direction. **Wait = TLP** is a script command.

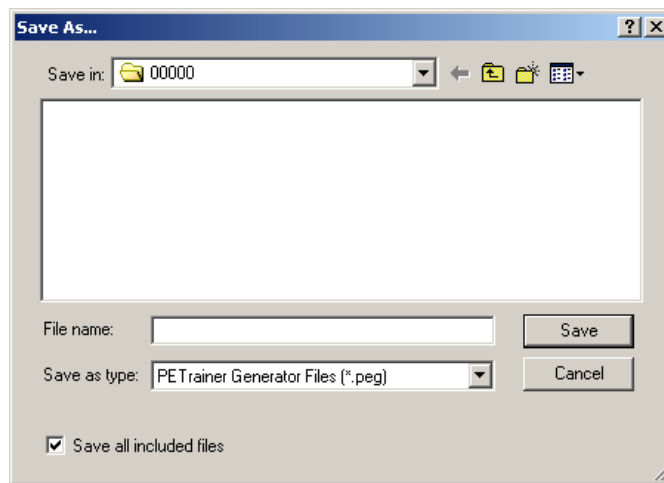
Export “Wait for ACK” from upstream: Exports all **Wait for ACK DLLPs** from the opposite direction.

Saving a Script to a New File

To save a script file as a generation file:

Step 1 Open an existing script file.

Step 2 Select **File > Save As...** or click  on the toolbar.



Step 3 Navigate to the desired folder and type a new file name where you want to save the current script, then click the **Save** button:

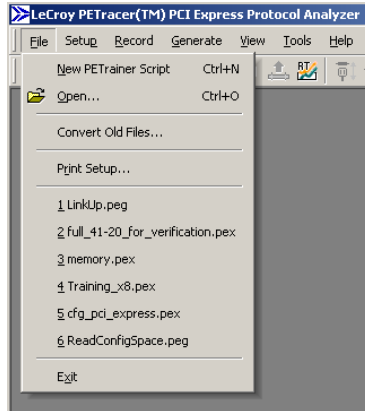
When the Save As command completes, the newly created script is displayed.

Note: The Save As dialog box includes the option **Save all included files**. This option causes the software to save any **include** files that have included into the script. The Included files are saved to the same directory as the traffic generation file.

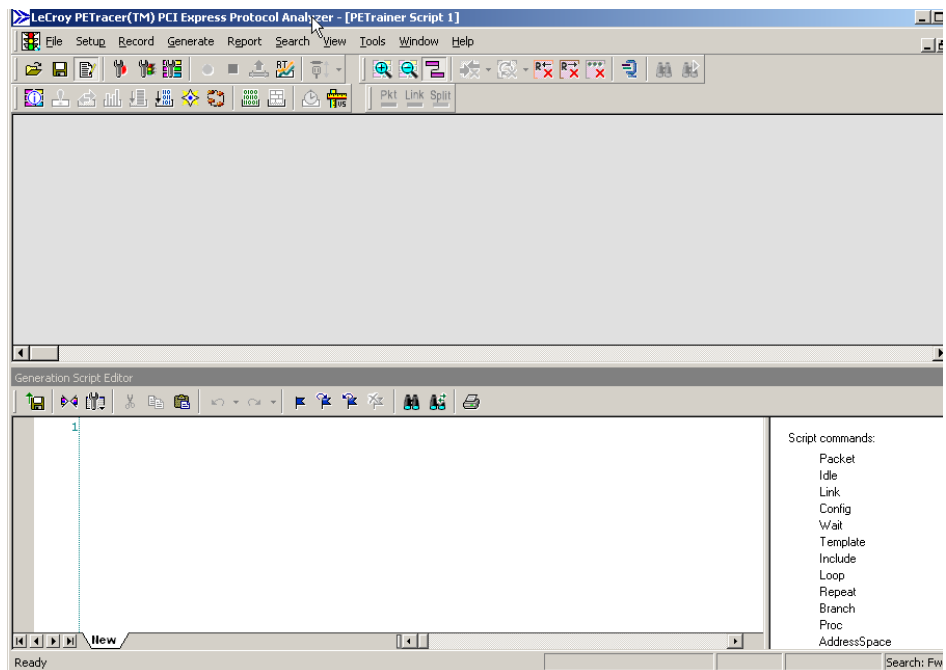
Creating a New Empty Generation File

To create a generation file from scratch:

Step 1 Select **File > New Script** or use the shortcut **Ctrl+N**.




An empty traffic generation file appears. You can also view the Script Editor.

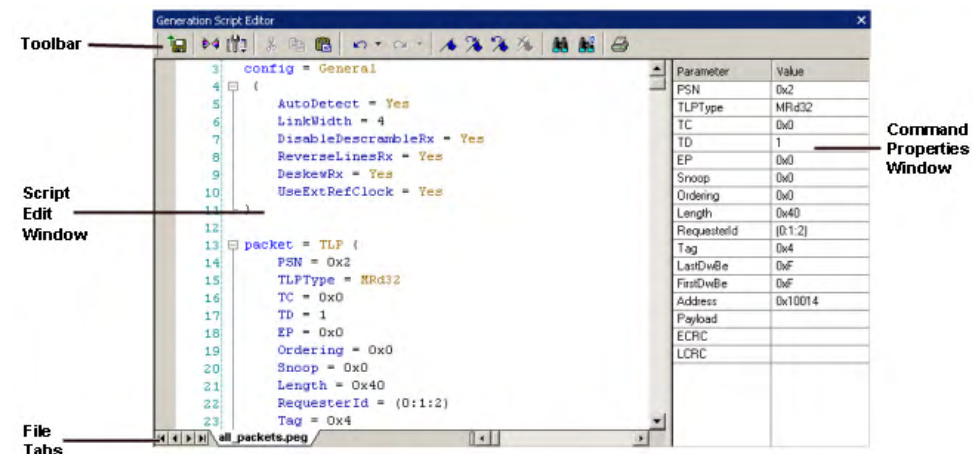


4.3 Editing Generation Files with the Script Editor

The Script Editor is an editing tool for traffic generation files (<filename>.peg). The generation script is presented in the Script Edit window. Parameters are presented in menus and text boxes in the Command Properties window in the right-hand portion of the Script Editor.

To launch the Script Editor: click the **Script Editor** button  on the toolbar or right-click the CATC Trace window and choose **Edit as Text** from the pop-up menu.

The Script Editor window displays in the lower portion of the CATC Trace window.



Layout: The Script Editor divides into four areas:

- **Script Editor toolbar:** Presents options for printing, saving, bookmarking, and other options.
- **Script Edit window:** Main window where the script is displayed and edited. Text in this window behaves as in most text editors. Text can be copied, pasted, and searched.
- **Command Properties window:** Presents editable parameters. Many parameters have menus. Click the parameter in the Command Properties window to see if a down-arrow appears.
- **File tabs:** Lists the name of the traffic generation file and any open **Include** files that are associated with the generation file. If the generation file has **Include** statements, the **Include** files automatically open and display as tabs in the File tabs section of the Editor window.

Error Log: An error log opens automatically at the bottom of the window any time a script error occurs. The window closes automatically whenever the error is corrected, after you save the script.

Script Editor Toolbar

The toolbar contains buttons for saving your edits, navigating, searching and other functions.



Save. Saves your edits and immediately updates the setting bars and Frames shown in the CATC Trace window.



Go to Trace View. Causes trace view to bring the currently selected script line to the top of the screen.



View Options. Opens a menu with three options:

- Enable Outlining
- Toggle Outlining
- Line Numbers.

See “View Options Menu” on page 40 for descriptions.



Cut.



Copy.



Paste.



Undo.



Redo.



Toggle Bookmark. Allows markers to be set or removed to aid in navigation.



Next Bookmark.



Previous Bookmark.



Clear All Bookmarks.



Find.



Replace. Find and replace.



Print.

Script Edit Window

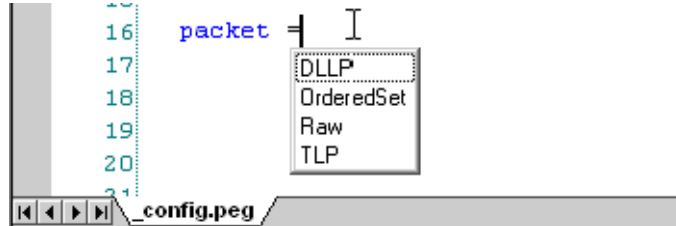
The Script Edit Window offers several features to simplify the process of editing.

Syntax Highlighting

All known commands and parameters are highlighted in **blue**.

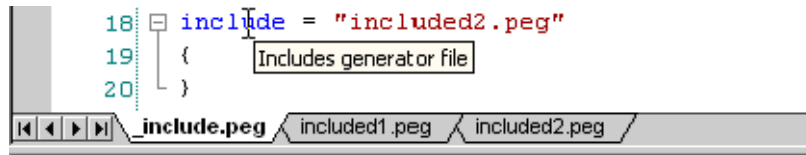
All predefined values and command modifiers are highlighted in **brown**.

Intellisense prompts for known predefined values/literals. This functionality is invoked when you type = after a known key or select **List values** from the Context menu.



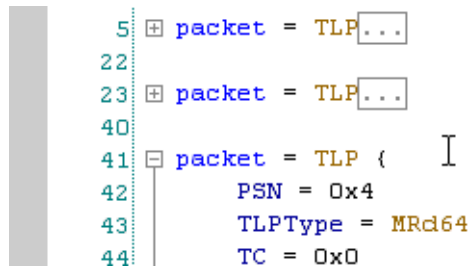
Tooltips

The Tooltips look like the following:



Outlining

When outlining is enabled user have the option to **collapse/expand** code blocks:



Text Editing Commands

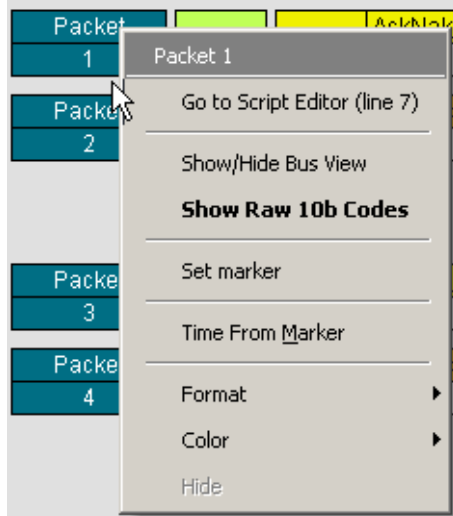
The Script Editor supports standard editor commands:

- Copy/Paste
- Undo/Redo
- Find/Replace
- Bookmarks

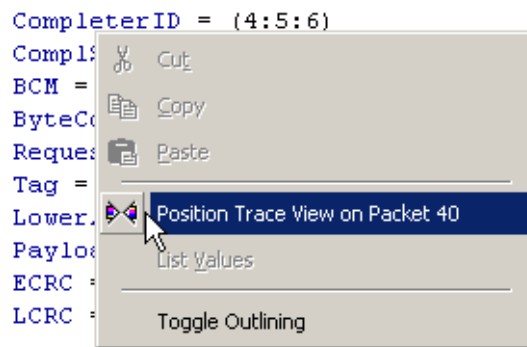
Synchronized Scrolling with the CATC Trace Window

You can navigate from the generation code window to the corresponding place in the CATC Trace representation, and visa versa.

From the CATC Trace window, right-click the **first cell in a packet** in the CATC Trace window and select **Go to Script Editor** from the pop-up menu. The Script Editor window then repositions to the corresponding code.

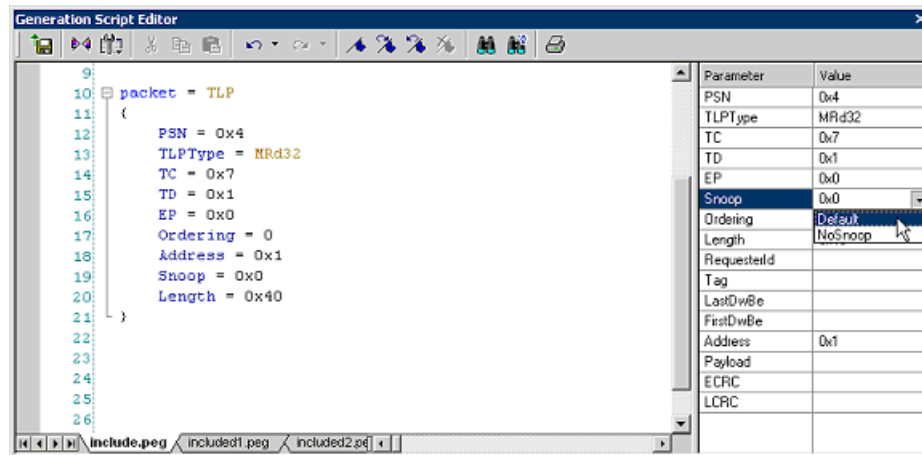


From the script editor, right-click some **code** within the Script Editor window and select **Position Trace view on packet x** from the pop-up menu (where **x** is a packet number). The CATC Trace window repositions to the corresponding packet number.

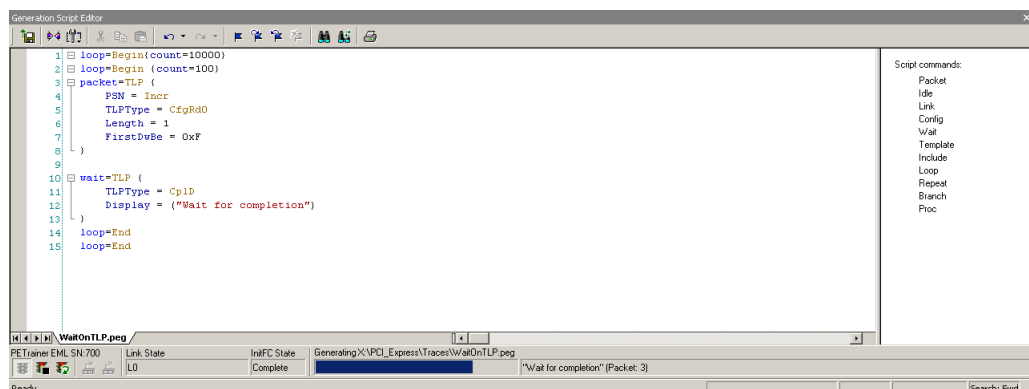
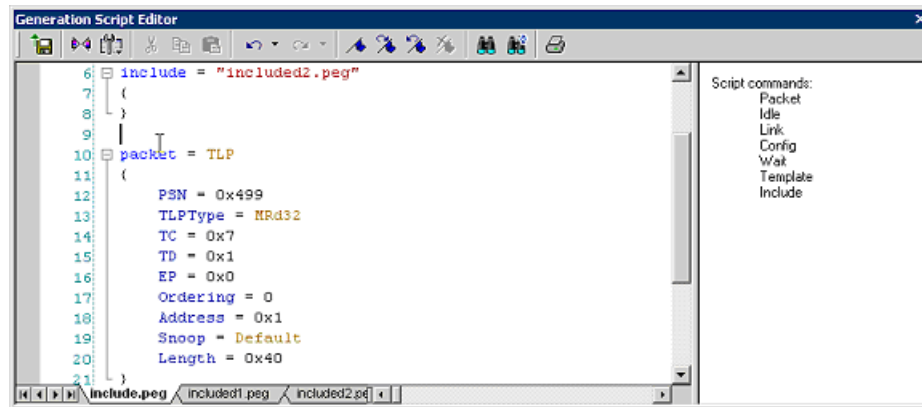


Command Properties Window

The Command Properties window lists all possible parameters for the current script command and all values for the parameters currently defined in this command. Entering parameters/values within the Edit window causes the Command Properties window to automatically update. Parameters/values can be changed by entering text into the text boxes or by selecting items from pull-down menus as shown in the example below.



In this case, the edit window is updated automatically. If the current script command does not have parameters or the current cursor position is outside of any script command, then a generic prompt is displayed in the window:



Script Editor File Tabs

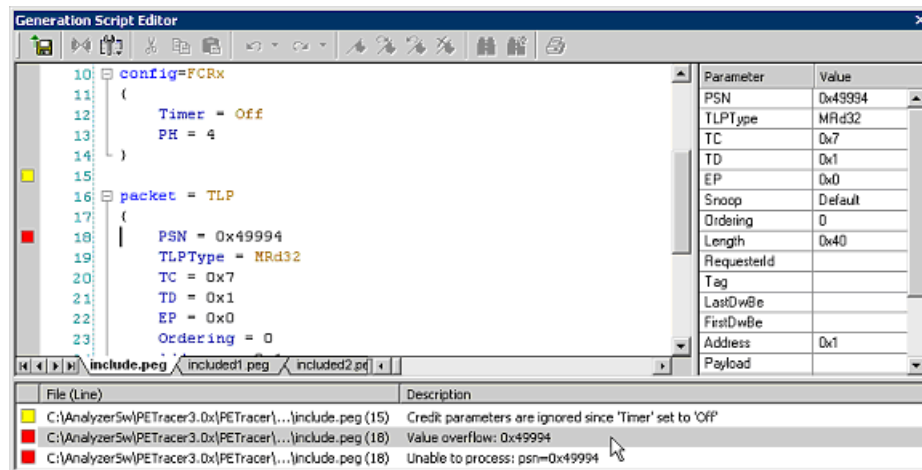
At the bottom of the Script Editor window is the name of the open generation file.

If there are **Include** statements in the generation file that link it to other generation files, these files automatically open and display as tabs at the bottom of the window. You can click the tabs to toggle between the open generation files.



Script Editor Error Log

Whenever you create a scripting error, a log opens at the bottom of the application window. When the error is corrected, the window automatically closes.



Errors: Marked by red squares.

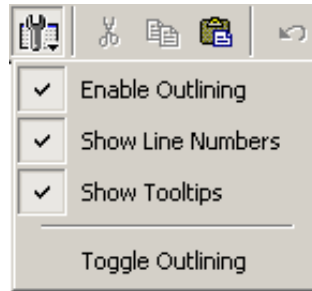
Warnings: Marked by yellow squares.

Double-clicking an error in the error log causes the cursor in the edit window to move to where the error was detected.

Note: You cannot run the script if it has syntax errors.

View Options Menu

The **View Options** button displays a menu with these options:



Enable Outlining: Adds an expandable/collapsible tree structure to the left side of the Script Editor showing the hierarchical relationships of the script lines.

Show Line Numbers: Adds line numbers to the left side of the Script Editor window.

Show Tooltips: Allows tooltip pop-ups, which provide descriptions of script keywords when cursor mouses over a keyword.

Toggle Outlining: Toggles the outline tree between collapsed and expanded states.

4.4 Generation Options Dialogs Overview

The Generation Options dialog box is used to set Config settings in a traffic generation script (for example, **Config = General** or **Config = Link**). This dialog duplicates the **Config** script command and is provided as a convenient alternative means of setting this command in the script.

Note: The Generation Options dialog is subordinate to the script itself, so script commands override options selected in this dialog box.

Opening the Dialog

To open the Generation Options dialog, select **Setup > Generation Options** or click

the **Generation Options** button  .

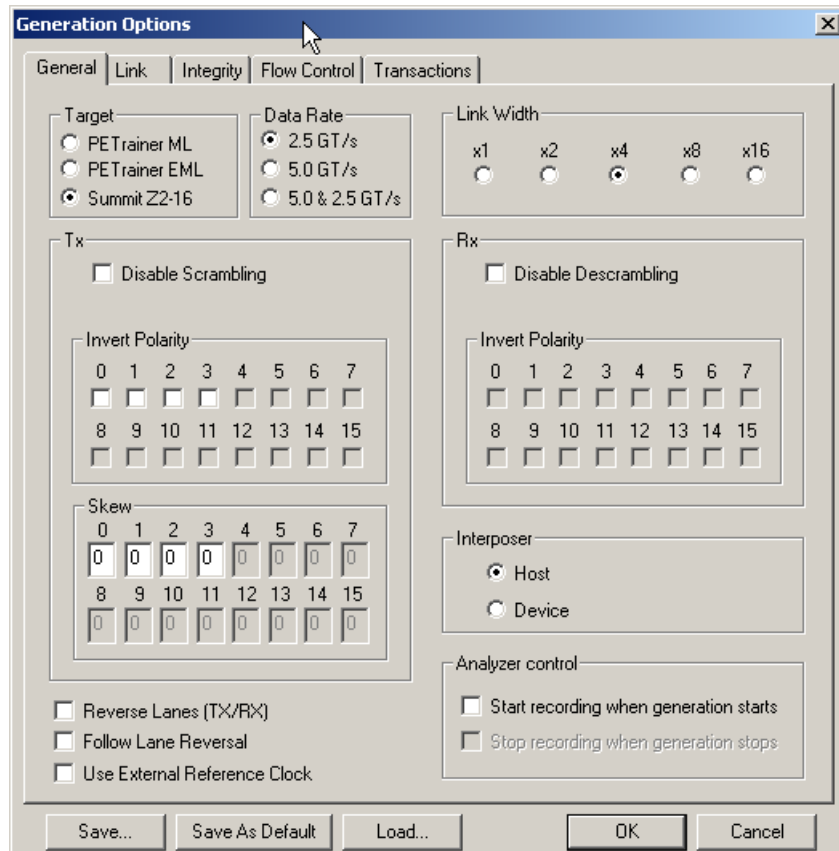
Dialog Layout

The Generation Options dialog is organized into five pages: General, Link, Integrity, Flow Control, and Transactions.



4.5 Generation Options for Summit Z2-16

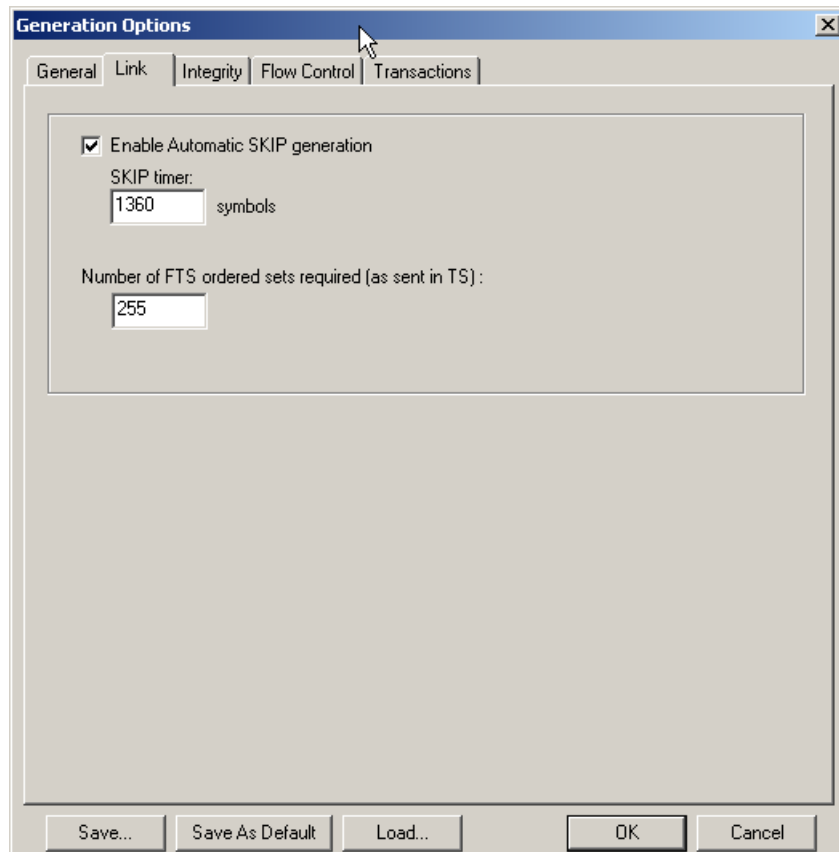
General



Parameter	Values	Default	Comment
Target			Specifies the generation platform. The choice affects some of the options presented in the Generation Options dialogs.
Data Rate 2.5 GT/s	Yes No	Yes	Specifies advertised data rate.
Data Rate 5.0 GT/s	Yes No	No	Specifies advertised data rate.
Data Rate 5.0 & 2.5 GT/s	Yes No	No	

LinkWidth	1 2 4 8 16	1	
DisableScrambleTx	Yes No	No	
DisableDescrambleRx	Yes No	No	
Reverse Lanes (TX/RX)	Yes No	No	
Follow Lane Reversal	Yes No	No	When set, the Summit Z2-16 Trainer responds to lane reversal requests from the DUT. When cleared, the Summit Z2-16 Trainer does not follow the lane reversal protocol.
Use External Reference Clock	Yes No	No	Use if you have an external reference clock.
InvertPolarityTx	(X,X,X,X)		
InvertPolarityRx			Disabled
SkewTx	(X,X,X,X)		
Interposer	Host Device	Host	Host = Host Emulation
Analyzer Control	Yes No	No No	Start recording when generation starts. Stop recording when generation stops.

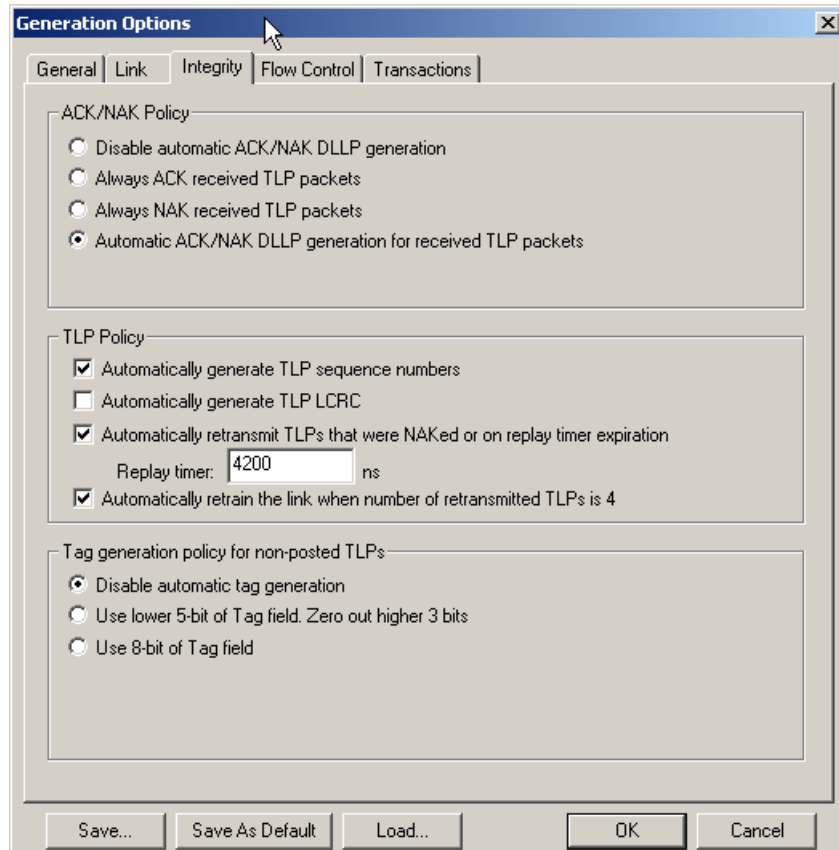
Link



Parameter	Values	Default	Comment
SkipTimer	number of symbols Off	1360	Periodic timer that controls sending of SKIP ordered sets at specific intervals. Timer's value is measured in number of symbols.
FTSCount	0 to 255	255	Number of FTS ordered sets required (as sent in TS)

Integrity

The Integrity page sets the parameters for two Config commands: **Config = TLP** and **Config = AckNak**



Parameter	Values	Default	Comment
AckNak Policy	Auto Ack Nak Disable	Auto	Auto: Automatic ACK/NAK DLLP generation for received TLP packets (default). Ack: Always ACK received TLP packets Nak: Always NAK received TLP packets Disable: Disable automatic ACK/NAK DLLP generation.
TLP Policy AutoSeqNumber	Yes No	Yes	If not set, overrides automatic generation of the TLP sequence number and uses user-defined value of the field in the Packet=TLP commands. This option overrides any sequence numbers specified in the script.
TLP Policy AutoGenerate LCRC	Yes No	Yes	If not set, overrides automatic generation of LCRC and uses user-defined value of the field in the Packet=TLP commands. This option overrides any LCRC specified in the script.
TLP Policy ReplayTimer	In ns (rounded to nearest 8) Off	4200	Timeout in TLP transmitter path that counts time since last Ack or Nak DLLP is received. If set, automatically retransmit TLPs that were NAKed or on replay timer expiration.
TLP Policy AutoRetrain	Yes No	Yes	If set, enable automatic retraining of the link in case the number of retransmitted TLP is 4. Valid only when AutoRetransmission is set.
Automatic Tag Generation	Yes No	No	Disable automatic tag generation. Prevents the Exerciser from automatically inserting a tag. Tags are a sub-field of the transaction ID field. When auto tag insertion is enabled, the tag field is only modified for non-posted transactions such as CfgRd , CfgWr , and MemRd . Options are: Use lower 5-bit of Tag field. Zero out higher 3 bits. Use 8-bit of Tag field.

Flow Control

The Flow Control page sets parameters for **Config = FCTx** and **Config = FCRx**.

The screenshot shows the 'Generation Options' dialog box with the 'Flow Control' tab selected. The dialog has a title bar with a close button (X) and a tabbed interface with 'General', 'Link', 'Integrity', 'Flow Control', and 'Transactions' tabs. The 'Flow Control' tab contains three sections:

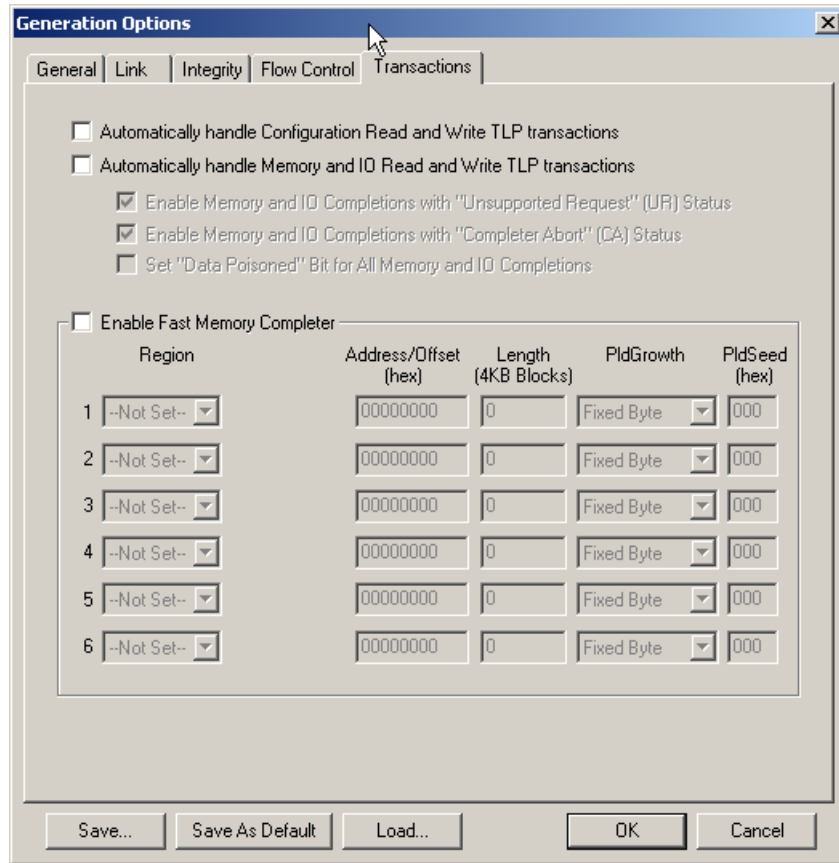
- Tx Flow Control:** A checkbox labeled 'Do not send TLP packet if credit amount is insufficient' is checked.
- Rx Flow Control:** A checkbox labeled 'Periodically schedule UpdateFC DLLP' is checked. Below it is the 'UpdateFC Timer:' field, which contains the value '4200' followed by 'ns'.
- Initial credits to advertise:** A grid of six input fields:
 - PH: 1
 - NPH: 1
 - CPLH: 1
 - PD: 1024
 - NPD: 1
 - CPLD: 1024

At the bottom of the dialog are five buttons: 'Save...', 'Save As Default', 'Load...', 'OK', and 'Cancel'.

FCRx Parameter	Values	Default	Comment
Enable Tx Flow Control	Yes No	Yes	When not set, the TLPs are being sent without the regard of how many credits are available. This option prevents TLP transmission if insufficient credits are available.
Enable Rx Flow Control	In ns (rounded to nearest 8) Off	4200	When enabled, allows automatic updating of these DLLPs. This option enables a periodic timer that controls sending of UpdateFC DLLPs. You should leave timer and credit values to defaults for correct behavior.
PH	0 to 255	1	Posted Request Headers
NPH	0 to 255	1	Non-Posted Request Headers
CpIH	0 to 255	1	Completion Headers
PD	0 to 4095	1024	Posted Request Data Payload
NPD	0 to 4095	1	Non-Posted Request Data Payload
CpID	0 to 4095	1024	Completion Data Payload

Transactions

Default

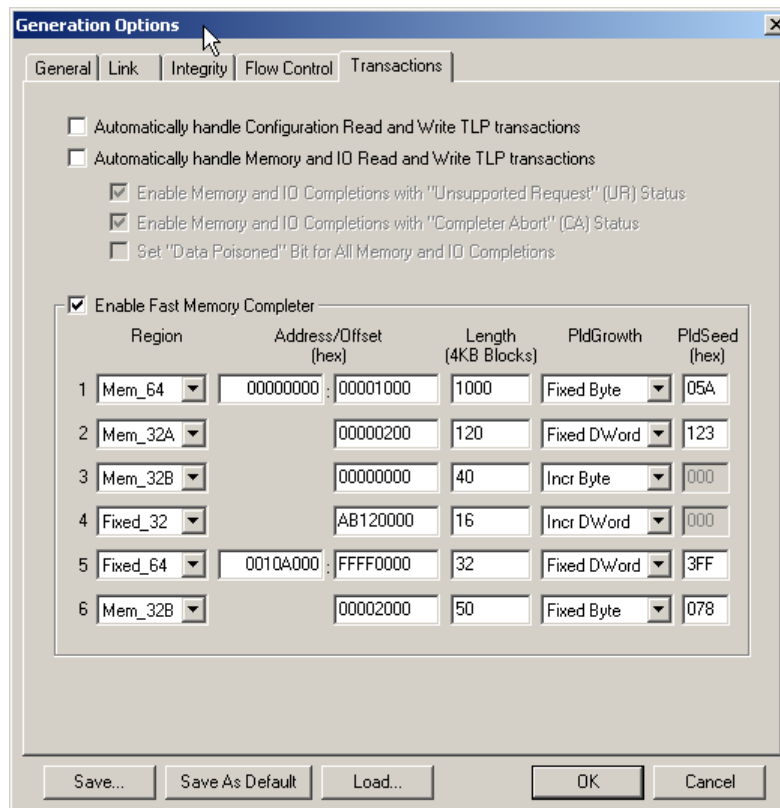


Parameter	Values	Default	Comment
Automatically handle Configuration Read and Write TLP transactions	Yes No	No	If set, automatically handles Configuration Read and Write TLP transactions. For Configuration Read transactions, Completion TLP contains the data read from the internal Configuration Space according to the specified register address. For Configuration Write transactions, the internal Configuration Space is updated at the address with the data from Configuration Write TLP, and Configuration Write Completion is returned. This option enables Read and Write access to 4-KB configuration space.

Automatically handle Memory and IO Read and Write TLP transactions	Yes No	No	If set, automatically handles Memory and IO Read and Write TLP transactions. For Memory and IO Read transactions, Completion TLP contains the data read from the internal Memory/IO Address Space according to the specified address. For Memory and IO Write transactions, internal Memory/IO Address Space is updated at the address with the data from TLP.
Enable Fast Memory Completer	Yes No	No	If set, enables the high-performance memory completer functionality.
Region	--Not Set-- Mem_64 Mem_32A Mem_32B Fixed_64 Fixed_32	--Not Set--	A Region is a range of addresses in PCI Express memory space, which the high-performance memory completer handles using a defined policy. There are two region types: <ul style="list-style-type: none"> • The first type is defined by the fixed address location, such as Fixed_32 and Fixed_64, and can be used for both Device and Host Emulation. • The second type is defined by the specific device memory space, such as Mem_64, Mem_32A, and Mem_32B, specified in the BAR setup (see "BARs Setup" on page 65) in the Configuration Space Editor, and can be used only for Device Emulation. The supplied Address is really the Offset from the beginning of the corresponding memory space. The actual address is calculated by the Summit Z2-16 Trainer when the BARs are configured. When a region is enabled, all Write data to the address range is consumed at high speed and discarded. All completion data for read requests is filled according to the rules specified by the PldGrowth and PldSeed parameters. Six regions are currently available for the fast memory completer. FastMemoryCompleter must be set to enable the Region .
Address/Offset (hex)	32-bit Address/Offset 64-bit Address/Offset	32-bit 0x00000000	If the corresponding Region is set, based on the region type, this field is a 32-bit Offset for Mem_32A and Mem_32B, 64-bit Offset for Mem_64, 32-bit Address for Fixed_32, and 64-bit Address for Fixed_64. The corresponding Region must be set to enable the Address/Offset .

Length (in 4-KB blocks)	0 to 1,048,576	0	If the corresponding Region is set, this field specifies the length of the address range in 4-kilobyte blocks, starting from the address/offset, in the Address/Offset field, to which the fast memory completer responds. The corresponding Region must be set to enable Length .
PldGrowth	Fixed Byte Fixed DWord Incr Byte Incr DWord	Fixed Byte	If the corresponding Region is set, this field specifies the expected payload format. Fixed Byte and Fixed DWord specify a payload of a byte or dword pattern consisting of PldSeed . Incr Byte and Incr DWord specify a payload of incrementing bytes or dwords starting from zero. The corresponding Region must be set to enable PldGrowth .
PldSeed (hex)	8-bit value 10-bit value	0	If the corresponding Region is set and PldGrowth is set to Fixed Byte or Fixed DWord, this field species the byte value repeated for PldGrowth of Fixed Byte or the 10-bit dword value for PldGrowth of Fixed DWord. For other types of PldGrowth , this field is set to zero. The corresponding Region and PldGrowth must be set to enable Pldseed .

Example .gen File



4.6 Generating Traffic: Set Generation Options

Before beginning generation, set options in the Generation Options dialog box:

- Step 1** Open the Generation Options dialog box by selecting **Setup > Generation Options** from the menu. The Generation Options dialog opens.
- By default the General page displays.
- Step 2** To test 1.0 devices, check the box next to **Base Spec Rev. 1.0 Compatibility Mode** to select 1.0 compatibility mode.
- To test 1.0A devices, leave this box unchecked.
- Step 3** Set the generation direction based on type of device you are emulating.
- Step 4** Select one of the two **Interposer** options:
- **Host Emulation:** Select **Host**
 - **Device Emulation:** Select **Device**
- Step 5** Select the **Link** tab. The Link page opens.
- Step 6** Select **Enable Automatic Skip Generation**, but leave the setting at the default value: 4720 ns.
- Step 7** Select the **Integrity** tab. The Integrity page opens.
- Step 8** Check to enable **Automatic ACK/NAK DLLP generation for received TLP packets**.
- Step 9** Enable all four TLP policies.
- Step 10** Select the **Flow Control** tab. The Flow Control page opens.
- Step 11** Check the checkbox to enable **Do not send TLP packet if credit amount is insufficient**.
- Step 12** Check the checkbox to enable **Periodically schedule UpdateFC DLLP**.
- Step 13** Use the defaults for all other boxes.
- Step 14** Click **OK** to apply all changes and close the Generation Options dialog.

4.7 Generating Traffic: Prepare Traffic Generation

To prepare for traffic generation, follow these steps:

Step 1 If it is not running, start the PETracer™ software.

Step 2 Open an existing script file or create a new script. For example, open the traffic generation file **Linkup.peg** by selecting **File > Open** from the menu. The following packets display in the main window.

Packet	2.5	SKIP	COM	SKIP Symbols							
0	x4			K28.5 K28.0 K28.0 K28.0							
Packet	2.5	TLP	Cfg	CfgRd0	Length	RequesterID	Tag	DeviceID	Register	1st BE	ECRC
1	x4	10		00:00100	1	001:02:3	12	004:05:6	0x000	1111	0xc511ED3E
LCRC 0x3DE21977											
Packet	2.5	DLLP	ACK	AckNak_Seq_Num	CRC 16						
2	x4			20	0x3616						
Packet	2.5	TLP	Cfg	CfgRd0	Length	RequesterID	Tag	DeviceID	Register	1st BE	ECRC
3	x4	11		00:00100	1	001:02:3	13	004:05:6	0x004	1111	0x7906DCF2
LCRC 0x7E29BFF0											
Wait		Timeout	Fmt	Type							
TLP Header		Infinite	3DW header, with data	Cpl/CpID							
Packet	2.5	DLLP	ACK	AckNak_Seq_Num	CRC 16						
5	x4			21	0x970D						
Packet	2.5	TLP	Cfg	CfgRd0	Length	RequesterID	Tag	DeviceID	Register	1st BE	ECRC
6	x4	12		00:00100	1	001:02:3	14	004:05:6	0x008	1111	0x7EAF1E1D
LCRC 0x35552DD0											

The CATC Trace window shows the type of traffic that is to be generated in the current generation session.

Step 3 If needed, make changes to the script file,

then save the file by clicking the **Save** button  .

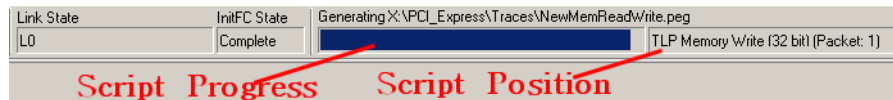
4.8 Generating Traffic: Begin Traffic Generation

To begin traffic generation:

Step 1 Start generation by clicking the **Start Traffic Generation**  button on the Status bar.

This action causes the software to download the script to the device. After the download completes, the device starts executing the script.

As the script executes, the Status bar displays the script's progress. The **Current script position** field displays the command description and CATC Trace packet number currently being generated.



Note: Script execution can be terminated at any time by clicking the

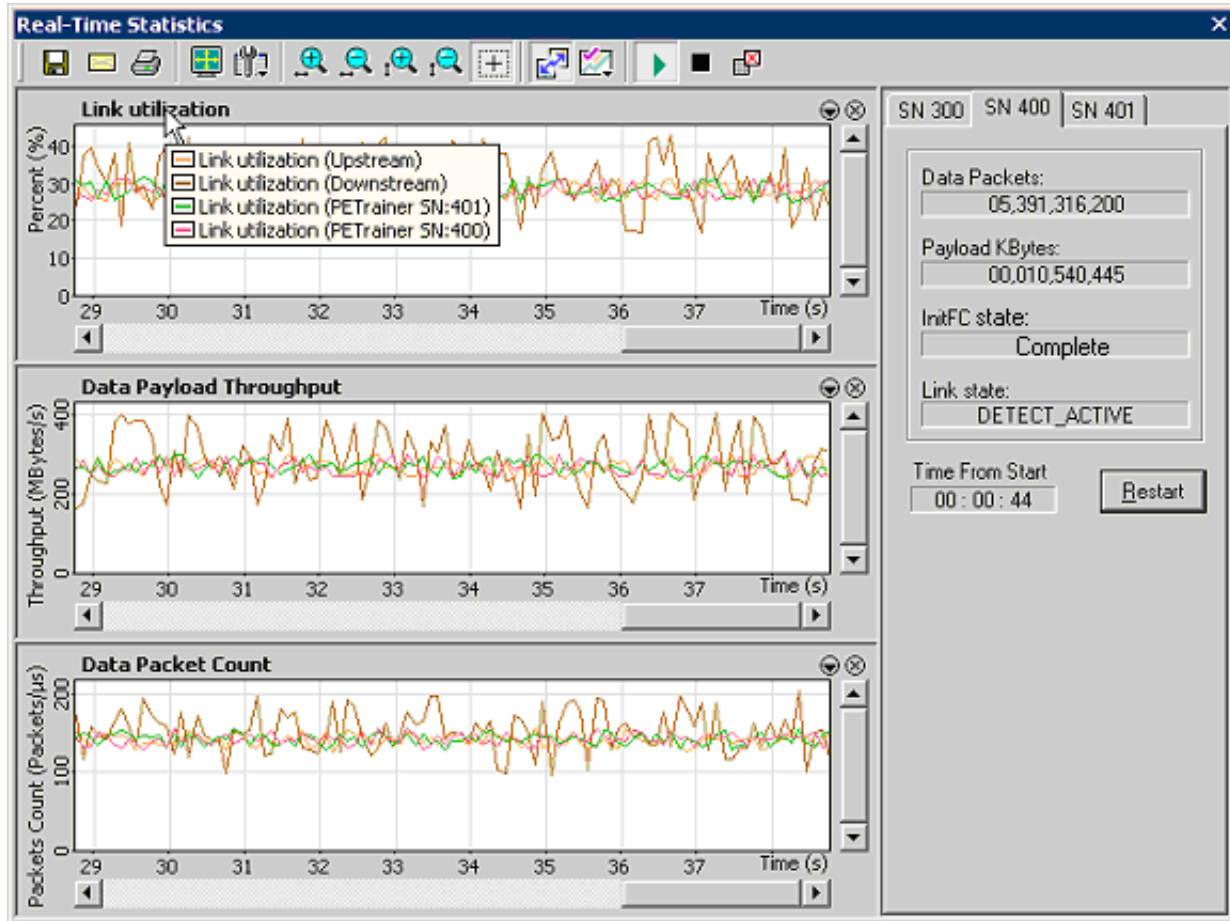
Stop Generation  button on the toolbar.

If a Wait command is executed where the Display parameter is specified, the user-defined text is displayed.

If a **wait=user** script command is executed, the script pauses until you click the

Resume Generation button  on the toolbar.

Step 2 Open the Real-Time Statistics window by clicking  .



To the right is a **Statistics Accumulation** area. In this area look for two messages:

- **InitFC State:** Complete (shown in the example above)
- **Link State:** LO

If the messages appear, then it means that the Exerciser successfully completed the Link training.

Note: Link training can also be performed by clicking the **Exerciser Connect** button on the Status bar.

Chapter 5: Macros

5.1 Macros

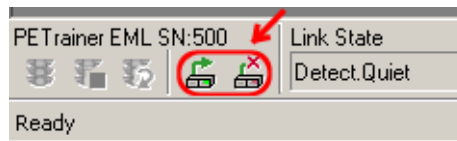
You can add buttons to the Status bar at the bottom of the window (and add commands to the Generate menu) to run traffic generation macros on the Exerciser.

After a macro script has been defined and assigned to a button on the Status bar, the macro can be run by clicking the macro button with the mouse or selecting the macro name from the Generate menu.

Default Macros: Connect and Disconnect

By default, the *PETracer*[™] software includes two macros, **Connect** and **Disconnect**. These buttons execute macros for creating and breaking a connection between the Exerciser and a DUT.

The buttons are on the Status bar when Exerciser hardware is present.



The commands are also on the Generate menu:



Connect Macro

The default code for this macro is the following:

```
Config = General {TrainerReset = 1}
Link = Detect
Wait = 500
Link = L0
Wait = 500
Link = InitFC
```

Disconnect Macro

The default code for this macro is the following:

```
Config = General {TrainerReset = 1}
Link = Detect
```

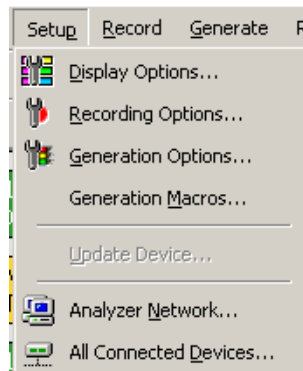
5.2 Adding New Script Macros

There are two ways to add script macros:

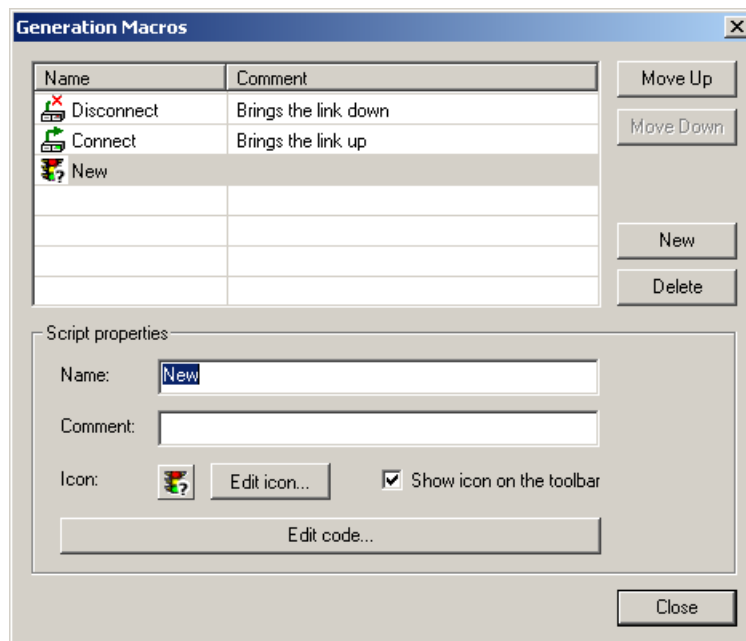
- Using the Generation Macros dialog
- Adding script files to the GenScriptMacros directory.

Using the Generation Macros Dialog

Step 1 Open the Generation Macros dialog by selecting **Setup > Generation Macros** from the menu.

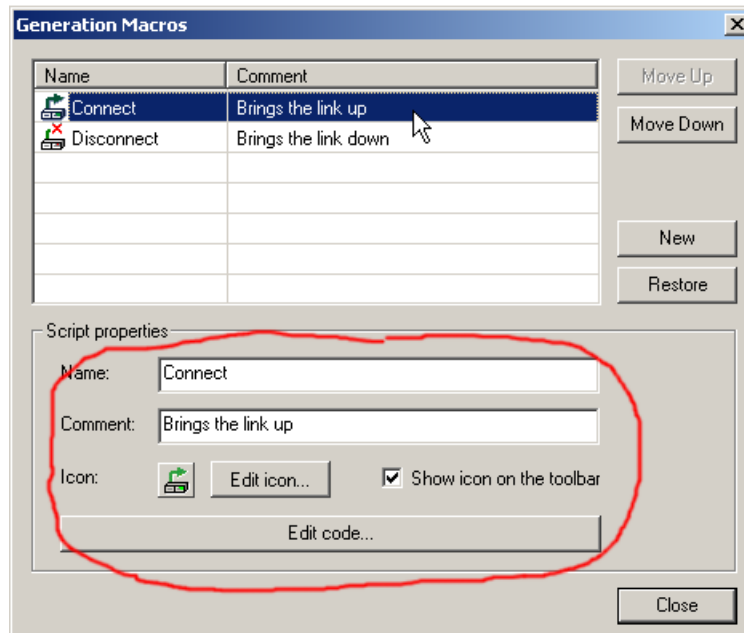


Step 2 In the Generation Macros dialog box, click the **New** button.



Step 3 Within **Script properties** area specify **script name**, **script comment**, **script icon**, and **whether or not to show script icon** on a toolbar.

- Step 4** Create a new icon for the script by clicking **Edit Icon...** button. The Edit Generation Macro Icon dialog appears.



- Step 5** Using the tools provided, paint the icon for new script macro and then press **OK**.
- Step 6** Edit the script code by clicking the **Edit code...** button. The dialog closes and an empty script editing window appears (see Section 4.3, “Editing Generation Files with the Script Editor” on page 34).
- Step 7** Type the script code and press the **Save** button. The script macro and icon are saved in the **GenScriptMacros** directory located under the *PETracer* directory (for example, **Program Files\CATC\PETracer\GenScriptMacros**).
- Step 8** Close the script window. The new macro script button automatically appears on the Status bar at the bottom of the window. Clicking this button causes the Exerciser to execute the script.

Adding Script Files to the GenScriptMacros Directory

The second way to add a new script macro is to copy an existing script file in the **GenScriptMacros** directory.

- Step 1** Copy a script file into the **GenScriptsMacros** directory located under the *PETracer* directory (for example, **Program Files\CATC\PETracer\GenScriptMacros**).
- Step 2** Switch to the *PETracer* application. You see that a new icon has been automatically added for the script file to the Status bar at the bottom of the window. The default icon is assigned to the new script macro and the file name is used as a script name.

5.3 Modifying Script Macros

To modify a macro assigned to a button:

Step 1 Select **Setup > Generation Macro** from the menu.

The Generation Macros dialog opens for modifying, creating, and deleting macros:

Name: Name of Macro

Comment: Descriptive comment so you can remember what the macro does

Icon: Currently assigned button for the macro.


Show icon on the toolbar: If checked, places the icon on the Status bar.


Edit Code: Opens a dialog for editing the macro script.

Step 2 Select the macro to be modified.

Step 3 Within the **Script properties** area, modify the **script name**, **script comment**, **script icon**, and whether or not to show script icon

Step 4 To edit script code, press the **Edit code...** button. The Generation Macros dialog closes and the Script Editing window appears, showing current code for the selected script macro.

Note: If the Generation Script Editor pane does not appear, click  .

Step 5 Modify the script code and press the **Save** button  .

Step 6 Close the script window. The macro has now been modified.

5.4 Changing the Order of Macro Icons on the Status Bar

To change the order of script macro icons on the Status bar:

Step 1 Open Generation Macro Scripts dialog by selecting **Setup > Generation Macros**.

Step 2 Click the **Up** and **Down** buttons to change the order of the script macros.

Step 3 Close the dialog. The button order is changed.

5.5 Deleting User-Defined Script Macros

To delete a script macro:

Step 1 Open the Generation Macro Scripts dialog by selecting **Setup > Generation Macros**.

Step 2 Select the macro you want to delete and press the **Delete** button:

All deleted scripts and icons are removed from **GenScriptMacros** directory. A backup copy is stored in the **GenScriptMacros\Deleted** directory.

Note: You cannot delete the Connect and Disconnect script macros.

5.6 Restoring the Default Appearance of the Connect and Disconnect Icons

You can restore the default appearance of the Connect and Disconnect icons by clicking the **Restore** button.

Step 1 Open the Generation Macro Scripts dialog by selecting **Setup > Generation Macros**.

Step 2 Select the macro you want to restore and press the **Restore** button.

Chapter 6: Configuration Space

For Device Emulation, *PETrainer™* provides features to emulate Address Spaces of a PCI Express device, including Configuration, Memory, and IO spaces. The following two chapters describe how to set up, configure, and manipulate Address Spaces.

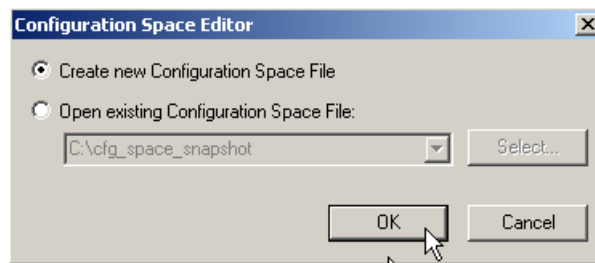
6.1 Configuration Space Editor

The Configuration Space Editor allows the Configuration Space to be modified on a field-by-field basis using hexadecimal or binary format.

The editor supports PCI-compatible Configuration Spaces and PCI Express enhanced Configuration Spaces.

6.2 Launching the Configuration Space Editor

Selecting **Tools > Configuration Space Editor** displays the following dialog:



- **Create new Configuration Space File:** Opens the Configuration Space Editor with the default (empty) configuration space.
- **Open existing Configuration Space File:** Activates the list of recently used configuration space files and enables the **Select...** button. After you select a file and click **OK**, the Configuration Space Editor opens.

Configuration Space Files

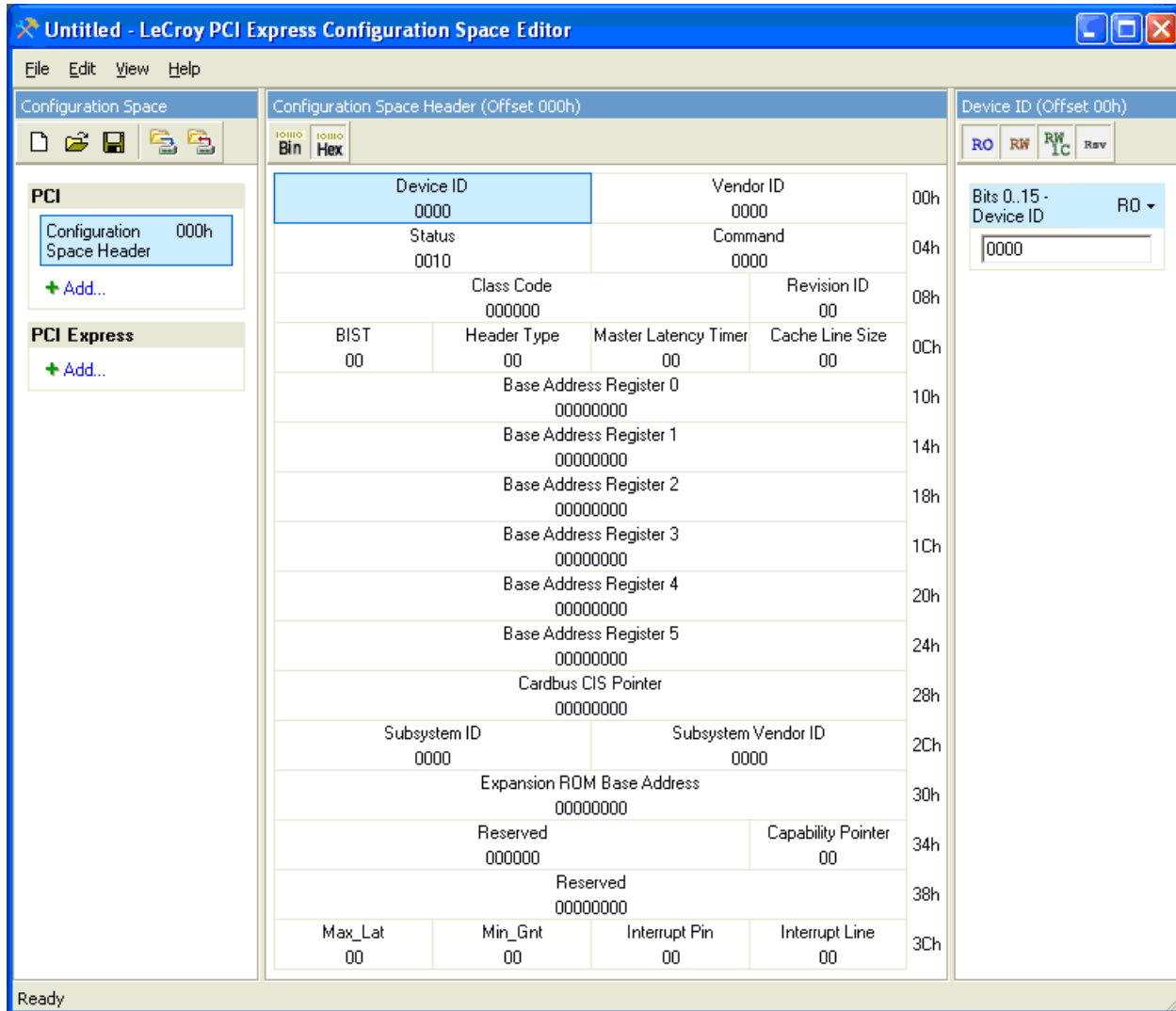
You can save configuration space files in the Configuration Space View (see “Configuration Space View” in the *Summit T2-16 User Manual*). Open a trace file, select a packet, and then select **Reports > Configuration Space View**. Click the **Save** button to display the Save As dialog and enter a file name (which has no special file extension).

You can save configuration space files in the Configuration Space Editor. Click the **Save** button to display the Save As dialog and enter a file name (which has no special file extension).

You can open saved configuration space files in the Configuration Space Editor and optionally edit them. You can then use them for generation.

Editing

When a new file is created, a blank PCI Configuration Space Header is loaded for editing. However, its position is not configurable, and the offset always starts at 000h.



In the Configuration Space View, at the left, you can add and define PCI-compatible or PCI Express Configuration-Space Capability Structures.

The toolbar allows you to create a New configuration space, Open a configuration-space file, Save a file, Write Configuration Space, and Read Configuration Space.

Click **+ Add** and then choose a Capability Structure from the context menu. You can also select **Edit > Add PCI Capability** or **Edit > Add PCI Express Capability**.

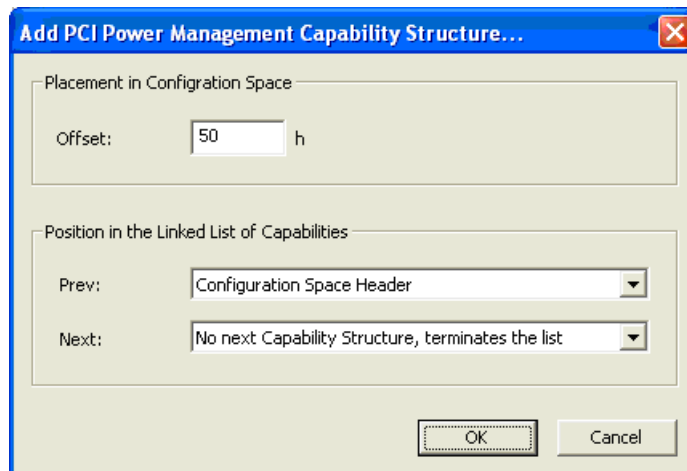
Available PCI Capability Structures are:

- Message Signaled Interrupts
- Accelerated Graphics Port
- Vital Product Data
- Vendor-Specific
- PCI Express
- Hyper Transport
- Generic

Available PCI Express Capability Structures are:

- Virtual Channel
- Virtual Channel for MFVC
- Device Serial Number
- Power Budgeting
- Root Complex Link Declaration
- Root Complex Internal Link Control
- Root Complex Event Collector Endpoint Association
- Vendor-Specific
- RCRB
- ACS
- MFVC
- Resizable Bar
- Multicast
- DPA
- ARI
- LTR
- SR IOV
- Generic

Selecting a structure displays a dialog in which you can define the structure.

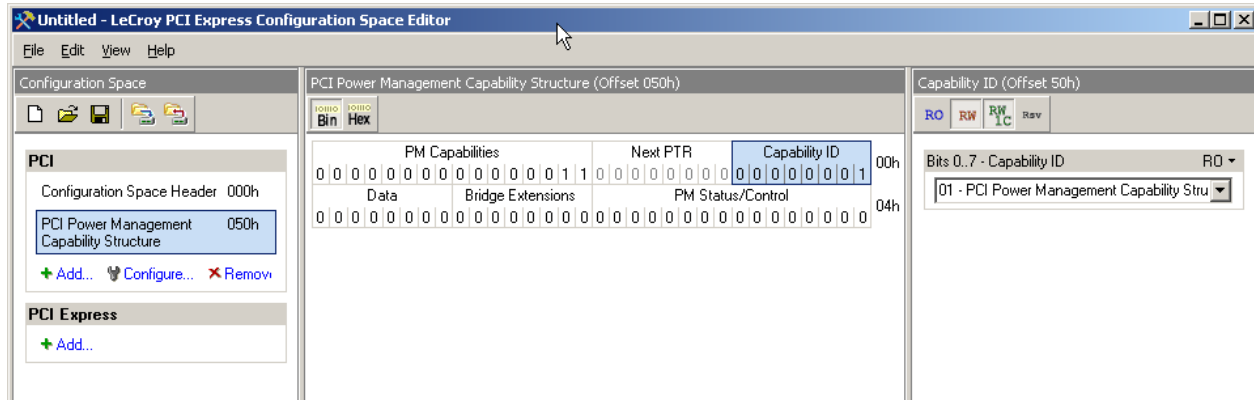


Enter an integer **Offset**.

Position the structure in the linked list of capabilities by selecting the **Previous** and **Next** capability structures.

Note: User-defined structures can be added to the above set of supported structures (see Appendix A “Configuration Space Decoding” on page 71). The Configuration Space View, from the Reports menu, reflects any added structures.

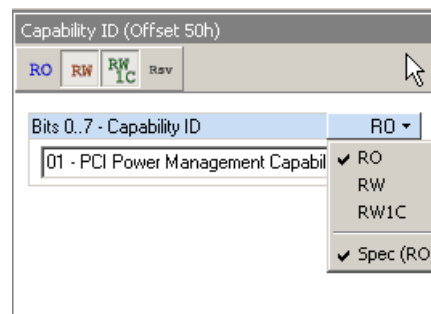
After you click **OK**, the center column displays the Capability Structure View, with the register layout. You can modify the selected Capability Structure by selecting registers and editing in binary or hex. The toolbar allows you to select Binary or Hexadecimal for editing.



Alternatively, after selecting a register, you can modify the register in the Field View in the right column.

The Field View allows you to override field attributes. By default, attributes are assigned according to the specification. The available options are:

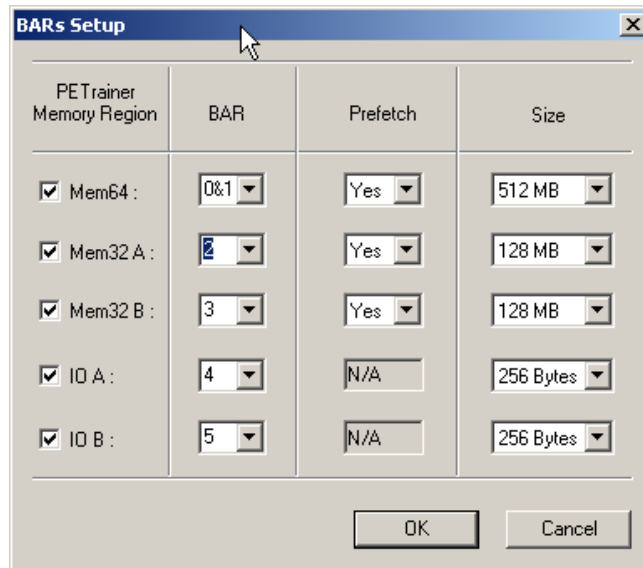
- **RO:** Read Only
- **RW:** Read-Write
- **RW1C:** Write-1-to-Clear



6.3 BARs Setup

The BARs Setup dialog helps set up Base Address Registers. It provides a more convenient way of defining BARs than setting up the BARs manually. In addition, it provides the mapping of BARs to PE *Trainer* and Summit Z2-16 memory regions.

To open the BARs Setup, select **Edit > BARs Setup**.



BAR1 and BAR2 are assigned to 64-bit memory address space and mapped to Mem64 PE *Trainer* memory region. BAR4 is assigned to 32-bit memory address space and mapped to Mem32A PE *Trainer* memory region.

You can specify Prefetch and Address Space Size. The sizes for each address space are limited to the values supported by PE *Trainer* hardware.

BAR and Prefetch fields affect the Hexadecimal/Binary in the middle column of the Configuration Space Editor.

Size field affects Field View in the right column of the Configuration Space Editor.

The mapping of BARs to PE *Trainer* memory regions is discussed at the AddressSpace Command in the Help section of the PE *Trainer* Script Language.

The BAR settings are used for Memory and IO completer.

6.4 Configuration Read and Write

PETrainer™ can automatically handle Configuration Read and Write TLP transactions:

- For a Configuration Read transaction, the Completion TLP contains the data read from the internal Configuration Space according to specified register address.
- For a Configuration Write transaction, the address for the internal Configuration Space is updated with the data taken from Configuration Write TLP, and Configuration Write Completion is returned.

You can specify the initial Configuration Space by editing the **AddressSpace=Write** command directly in the script or by using the UI provided in the Generator toolbar.

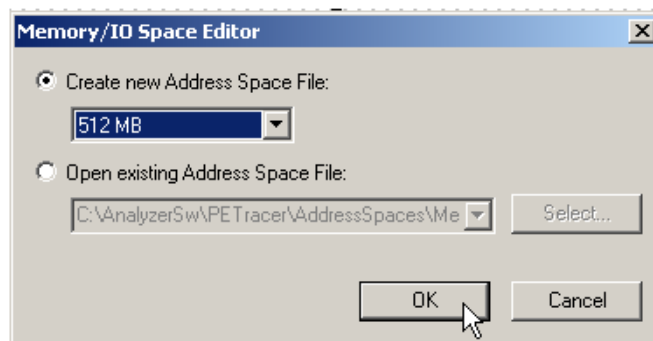
The PETracer™ software provides a special editor for editing this file called the Configuration Space Editor (see “Launching the Configuration Space Editor” on page 61).

Chapter 7: Address Spaces

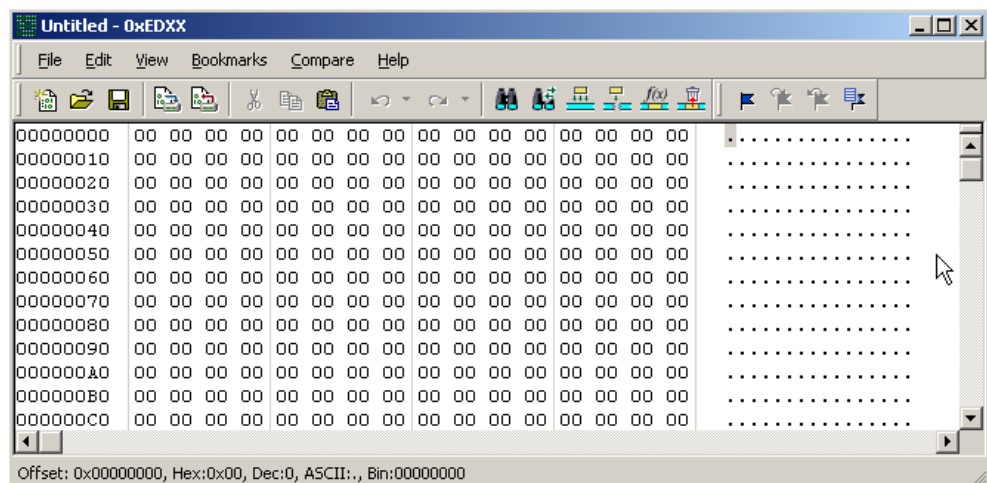
7.1 Memory/IO Space Editor

The Memory/IO Space Editor lets users write address space memory into the Exerciser and read address space memory from the Exerciser.

To access the Memory/IO Space Editor, select **Tools > Memory/IO Space Editor**. The following dialog opens:



- **Create new Address Space File:** Opens the Memory/IO Space Editor and displays an empty address space with the size specified.
- **Open existing Address Space File:** Activates the list of recently used Memory/IO Address Space files and enables the Select... button. After you have selected a file and then clicked **Select**, the Memory/IO Space Editor opens.



The Memory/IO Address Space editor is implemented as a standard hex editor.

The address space memory must be saved to a file so that it can be downloaded to the hardware using the *PETracer™* application.

If you prefer, you can write address space memory into the Exerciser and read address space memory from the Exerciser directly using the



and toolbar buttons or using the menu **File > Write Address Space** or **File > Read Address Space**.

7.2 Memory Region for Host Emulation

For Host Emulation, the Address Space mechanism on Summit Z2-16 does not support defining memory regions. However, you can enable one 32-bit memory region for Host Emulation by performing the following steps:

- Step 1** Enable automatic Configuration and Memory/IO handling in the Transactions tab of the Generation Options dialog.
- Step 2** Create and load a configuration space with one BAR configured for Mem32A with the desired size. For how to create a configuration space file and define the BAR, see Chapter 6 “Configuration Space” on page 61.

After linking with the device DUT, the DUT can access the defined 32-bit host memory region at fixed physical address 0x40000. The DUT can read back whatever it wrote in those memory locations, or whatever was loaded there by the script using the **AddressSpace** command.

Chapter 8: Updates and Licensing

8.1 Updating the Exerciser

BusEngine™ and/or Firmware updates are now automatic processes that run anytime a new version of the PETracer™ software is installed that is incompatible with the currently installed BusEngine or Firmware. The update process generates onscreen instructions.

If, however, you need to manually perform BusEngine or Firmware updates, follow these steps:

- Step 1** Select **Setup > Update Device ...** from the menu to display the Update Analyzer dialog box for **Summit Z2-16™**.
- Step 2** Select the appropriate file locations for the Firmware and/or BusEngine, using Browse, if necessary.
- Step 3** Check the appropriate options (if in doubt, check all options).
- Step 4** Click **Update** to initiate the updating of the Exerciser.

8.2 License Keys

A License Key is necessary to enable software maintenance. If you attempt to generate traffic with the Exerciser without an installed License Key, a message appears to indicate that a License Key is necessary in order to record traffic.

A License Key must be obtained from Teledyne LeCroy for each Exerciser.

After you obtain the License Key, follow these steps to install it:

Step 1 Select **Help > Update License...** from the menu bar. to display the Update License dialog box.

Step 2 Enter the **path** and **filename** for the License Key or use the Browse button to navigate to the directory that contains the License Key.

Step 3 Select the **.lic** file, and then click **Update Device**.

You can also update your licensing information by selecting **Setup > All Connected Devices ...**, then clicking **Update License**.

8.3 License Information

You can view Licensing information for your Exerciser by selecting **Help > Display License Information...** from the menu bar. The License Information window displays data about the maintenance expiration and purchased features.

Appendix A: Configuration Space Decoding

The decoded capability structures in the Configuration Space Viewer and Editor are based on programmed definitions in the *PETracer* software and on Configuration Space Decode Scripts.

Configuration Space Decode Scripts are tools to define capability structures and instruct the Configuration Space Viewer or Editor how to decode them. These scripts are in the `\CfgSpaceScripts` sub-directory below the `\Scripts` directory in the application directory.

You can write Configuration Space Decode Scripts using the CATC Scripting Language (CSL). See the *Teledyne LeCroy Analyzers File Based Decoding Manual* for reference.

PCI Express Configuration Space Decode Scripts have the file extension `.pecfgdec`.

A.1 Mandatory Definitions

Configuration Space Decode Scripts must set the following reserved variables.

- **CapabilityName**: Name of the capability structure
- **CapabilityID**: ID of the capability structure
- **ExtAddSpace**: Set to 1 if Extended Configuration Space. Otherwise, set to 0 for PCI.

A.2 Mandatory Module Functions

Modules are collections of functions and data dedicated to decoding a specific capability structure. Each module has one primary Configuration Space Decode Script file (extension `.pecfgdec`) and optionally has include files (`.inc`).

A module function is an entry-point into a decoding module. To help display a capability structure, the application calls a module function.

The Configuration Space Editor and Viewer support only the **DecodeRegister(offset)** and **GetSize()** functions.

DecodeRegister(offset)

The application calls this function while decoding a specific DWORD offset of the specified CapabilityID. The offset is the decoding entry point, where the decoding path starts.

The Configuration Space Editor calls this function to determine how to decode the assigned configuration space. The **offset** parameter is the DWORD to decode. An offset of 0 indicates bytes 00h-03h, an offset of 1 indicates bytes 04h-07h, and so on.

Note: The Configuration Space Editor can only decode one DWORD at a time.

GetSize()

This function returns the size of the capability structure specified by CapabilityID.

A.3 Configuration Register Types

The following reserved variables are defined global constants.

- CFGREG_UNDEFINED
- CFGREG_HWINIT
- CFGREG_RO
- CFGREG_RW
- CFGREG_RW1C
- CFGREG_ROS
- CFGREG_RWS
- CFGREG_RW1CS
- CFGREG_RSVDP
- CFGREG_RSVDZ

Note: These reserved variables match the Configuration Register Types of Table 7-2 in Section 7.4 of the PCI Express Base Specification, Rev. 2.1.

A.4 Primitives

Decoding uses the following primitives.

GetRegisterField(dword_offset, bit_offset, field_length)

This function returns a register field of length **field_length**, starting at bit position **bit_offset** in DWORD **dword_offset**.

- **dword_offset:** DWORD offset of the register field location
- **bit_offset:** Bit offset of the register field location
- **field_length:** Length of the register field

For example, **GetRegisterField(1, 9, 2);** means: Go to DWORD 1, bit offset 9, and returns 2 bits.

AddField(field_name, field_length, configuration_reg_type, tooltip, encoding_table = NULL)

This function adds a register field to the Capability View and returns a pointer to the field, for adding subfields.

- **field_name**: Name of the register field to display in the Capability View
- **field_length**: Length of the register field
- **configuration_reg_type**: Configuration register type of the register field.
Note: If subfields are defined, their configuration register types override this setting for their specified bits.
- **tooltip**: Tooltip displayed for the register field in the Capability View
- **encoding_table**: Optional. Displays encodings as lists for select values.
- For example, user input becomes a combo box for the field in the Field View.

As examples:

AddField("PCI Express Extended Capability ID", 16, CFGREG_RO, "");

means: Add the field "PCI Express Extended Capability ID" with length 16 and cfg register type CFGREG_RO.

capability_reg = AddField("Capability Register", 32, CFGREG_RW, "");

means: Added the field "Capability Register" with length 32 and cfg register type CFGREG_RW and stored a pointer to this field in variable capability_reg, which can be used to add subfields to this field.

AddSubField(parent_field, subfield_name, subfield_length, configuration_reg_type, tooltip, encoding_table = NULL);

This function adds a subfield to a register field in the Capability View. Subfields are modifiable and visible in the Field View and appear in the tooltips of register fields.

- **parent_field**: Pointer to a register field in the Capability View
- **subfield_name**: Name of the subfield, displayed in the Field View
- **subfield_length**: Length of the subfield
- **configuration_reg_type**: Configuration register type of the subfield field.
Note: This overrides the configuration_reg_type of the parent field.
- **tooltip**: Tooltip displayed for the subfield in the Capability View
- **encoding_table**: Optional. Displays encodings as lists for select values.
- For example, user input becomes a combo box for the field in the Field View

For example,

AddSubField(capability_reg, "Mode Supported", 4, CFGREG_RO, "Indicates the Function modes,"), ModeEncodings);

means: Add the subfield "Mode Supported" to the parent field "capability_reg" with length 4, type CFGREG_RO, a tooltip in the Capability View, and a combo box displaying "mode encodings" for input in the Field View.

A.5 Helper File

ConfigSpaceCommon.inc include file contains useful functions for script decoding.

Appendix B: China Restriction of Hazardous Substances Table

The following tables are supplied in compliance with China's Restriction of Hazardous Substances (China RoHS) requirements:

部件名称	有毒有害物质和元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr ⁶⁺)	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
PCBAs	X	O	X	X	X	X
机械硬件	O	O	X	O	O	O
金属片	O	O	X	O	O	O
塑料部件	O	O	O	O	X	X
电源	X	X	X	O	X	X
电源线	X	O	X	O	X	X
保护外壳(如有)	O	O	O	O	X	X
电缆组件(如有)	X	O	X	O	X	X
风扇(如有)	X	O	X	O	X	X
交流滤波器和熔丝组件(如有)	X	O	X	O	O	O
外部电源(如有)	X	X	X	O	X	X
探头(如有)	X	O	X	O	X	X
O: 表明该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T11363-2006 标准规定的限量要求之下。						
X: 表明该有毒有害物质至少在该部件的某一均质材料中的含量超过 SJ/T11363-2006 标准规定的限量要求。						

EFUP (对环境友好的使用时间) 使用条件: 参阅本手册“规范”部分规定的环境条件。

Part Name	Toxic or Hazardous Substances and Elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr ⁶⁺)	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
PCBAs	X	O	X	X	X	X
Mechanical Hardware	O	O	X	O	O	O
Sheet Metal	O	O	X	O	O	O
Plastic Parts	O	O	O	O	X	X
Power Supply	X	X	X	O	X	X
Power Cord	X	O	X	O	X	X
Protective Case (if present)	O	O	O	O	X	X
Cable Assemblies (if present)	X	O	X	O	X	X
Fans (if present)	X	O	X	O	X	X
AC Filter/Fuse Assy (if present)	X	O	X	O	O	O
Ext Power Supply (if present)	X	X	X	O	X	X
Probes (if present)	X	O	X	O	X	X
O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement specified in SJ/T11363-2006.						
X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement specified in SJ/T11363-2006.						

EFUP (Environmental Friendly Use Period) Use Conditions: refer to the environmental conditions stated in the specifications section of this Manual.

How to Contact Teledyne LeCroy

Type of Service	Contact
Call for technical support...	US and Canada: 1 (800) 909-7112 Worldwide: 1 (408) 653-1260
Fax your questions...	Worldwide: 1 (408) 727-6622
Write a letter...	Teledyne LeCroy Protocol Solutions Group Customer Support 3385 Scott Blvd. Santa Clara, CA 95054-3115 USA
Send e-mail...	psgsupport@teledynelecroy.com
Visit Teledyne LeCroy's web site...	teledynelecroy.com

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