

TLA7S08 & TLA7S16 Serial Analyzer Modules PCI Express Instruction Manual

This document applies to TLA System Software Version 5.5 or higher.

Warning

These servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

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Tektronix

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Ground the Product. This product is indirectly grounded through the grounding conductor of the mainframe power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

The inputs are not rated for connection to mains or Category II, III, or IV circuits.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Power Disconnect. The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Do Not Operate With Suspected Failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Provide Proper Ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Terms in this Manual These terms may appear in this manual:



WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*



CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Symbols and Terms on the Product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

The following symbol(s) may appear on the product:



CAUTION
Refer to Manual



Earth Terminal



Chassis Ground

Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect Power. To avoid electric shock, switch off the instrument power, then disconnect the power cord from the mains power.

Use Care When Servicing With Power On. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Environmental Considerations

This section provides information about the environmental impact of the product.

Product End-of-Life Handling

Observe the following guidelines when recycling an instrument or component:

Equipment Recycling. Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. In order to avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



This symbol indicates that this product complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). For information about recycling options, check the Support/Service section of the Tektronix Web site (www.tektronix.com).

Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment, and is outside the scope of the 2002/95/EC RoHS Directive. This product complies with the RoHS Directive requirements except for the presence of hexavalent chromium in the surface coating of the aluminum chassis parts, assembly hardware, and 63/37 tin/lead solder used in the fabrication of the circuit boards.

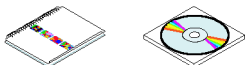
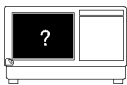
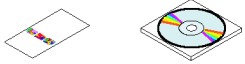
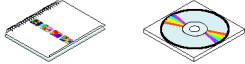





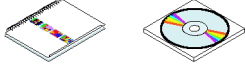
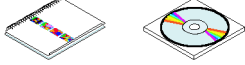
Preface

This manual contains information needed to install and use a Tektronix serial analyzer module to debug, validate, and verify computer and embedded systems.

Related Documentation

The following table lists related documentation for your serial analyzer. The documentation is available on the TLA Documentation CD and on the Tektronix Web site (www.tektronix.com/manuals). You can also check the release notes on the instrument for additional information. To access the release notes, select Start > All Programs > Tektronix Logic Analyzer > TLA Release Notes.

Related Documentation

Item	Purpose	Location
TLA Quick Start User Manuals	High-level operational overview	
Online Help	In-depth operation and UI help	
Installation Quick Reference Cards	High-level installation information	
Installation Manuals	Detailed first-time installation information	
XYZs of Logic Analyzers	Logic analyzer basics	 www.Tektronix.com
Declassification and Security instructions	Data security concerns specific to sanitizing or removing memory devices from Tektronix products	 www.Tektronix.com
Application notes	Collection of logic analyzer application specific notes	
Product Specifications & Performance Verification Procedures	TLA Product specifications and performance verification procedures	
TPI.NET Documentation	Detailed information for controlling the logic analyzer using .NET	
Field upgrade kits	Upgrade information for your logic analyzer	
Optional Service Manuals	Self-service documentation for modules and mainframes	

List of Terms

The following table lists terms that appear in this manual. For a more extensive list of PCI Express-specific terms, refer to the latest PCI Express Base Specification document.

Table i: Terms used in this document

Term	Description
Link	A connection between two PCI Express devices. A link consists of a number of lanes. A link described as by-N (or xN) consists of a number (N) lanes.
Differential Pair	A set of two signals, positive and negative, transmitting data from one device to another.
Lane	A single differential pair (two signals) that transmit data in one direction of a PCI Express Link. A unidirectional lane.
Root complex	A device (or other element) (typically a controller hub) that is located closest to the connection between the I/O system, the CPU and memory.
Upstream	Relative device location: The relative position of a device (or other element) in a system where the device is closer (topologically) to the root complex. Examples: The port on a switch that is closest to the root complex is the upstream port. The port on an endpoint or bridge component is an upstream port. The upstream component on a link is the component closer to the root complex. Relative direction of data flow: The direction of data flow where data is flowing towards the root complex.
Downstream	Relative device location: The relative position of a device (or other element) in a system where the device is farther (topologically) from the root complex. Examples: The port on a switch that is farther from the root complex is the downstream port. The upstream component on a link is the component closer to the root complex. Relative direction of data flow: The direction of data flow where data is flowing away from the root complex.

Introduction

The TLA7S08 & TLA7S16 Serial Analyzer modules are tools used to acquire and analyze data traveling on a PCI Express (PCIe) Gen1 or Gen2 serial bus. The serial analyzer modules can be installed in either a Tektronix portable or benchtop logic analyzer mainframe. Specially designed probes connect from the module to a circuit board in your system under test (SUT), or to a PCI Express card device.

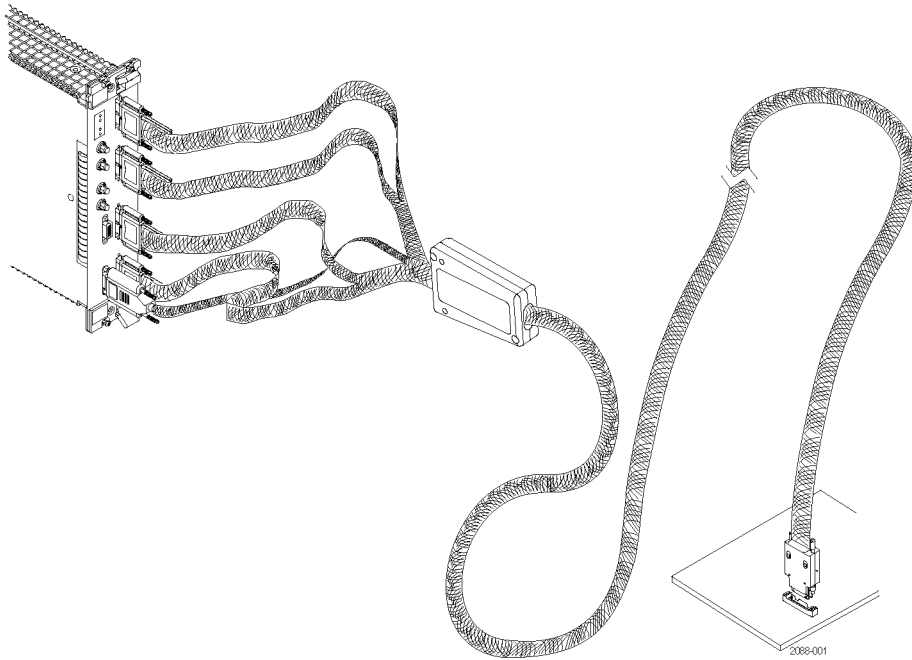


Figure 1: TLA7S16 Module and P6716 midbus probe

Product Description

Tektronix provides two different serial analyzer modules. Both modules can acquire PCIe Gen 1 and Gen 2 data. They provide packet-level triggering, sequence triggering, and error triggering. The modules can acquire up to 32 million 8b/10b symbols. The main difference between the modules is the number of input channels.

TLA7S16 16-Channel Serial Analyzer Module

The TLA7S16 Serial Analyzer Module supports x1, x4, and x8 bidirectional PCIe links and x16 unidirectional links.

TLA7S08 8-Channel Serial Analyzer Module

The TLA7S08 Serial Analyzer Module supports x1 and x4 bidirectional PCIe links and x8 unidirectional links.

Front Panel

The front panel provides indicators for checking the basic status of the serial analyzer, four probe connectors, two probe power connectors, and four connectors for a reference clock. (See Figure 3 on page 4.) A description of the indicators and connectors is provided. (See Table 1 on page 3.)

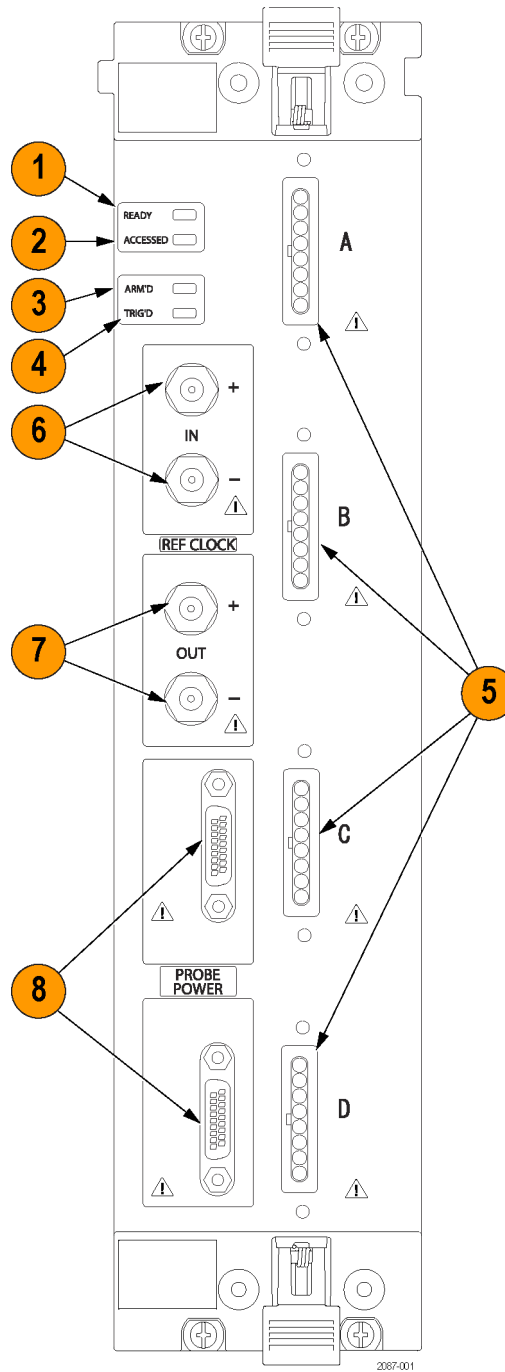


Figure 2: TLA7S16 Serial analyzer front panel

Table 1: Front panel indicators and connectors

Item number	Indicator or connector	Description
1	READY indicator	The READY indicator lights continuously after the serial analyzer module successfully completes the power-on process. If the indicator fails to light within five seconds of power-on, an internal module failure may be present.
2	ACCESSED indicator	The ACCESSED indicator lights anytime the controller accesses the serial analyzer module.
3	ARM'D indicator	The ARM'D indicator lights when the serial analyzer module is armed during an acquisition.
4	TRIG'D indicator	The TRIG'D indicator lights when the serial analyzer module triggers and stays on until the module finishes acquiring data.
5	Probe connectors	Four connectors in the module accept the probe(s). Each connector is labeled A, B, C, or D. The letters correspond to the graphic display in the Setup window.
6	Reference Clock Input connectors	Two SMA connectors (labeled + and –) provide clock input connections from the SUT or from another module.
7	Reference Clock Output connectors	Two SMA connectors (labeled + and –) provide clock output connections to another module.
8	Probe Power connectors	The probe power connectors provide power to the probes.

Rear Panel

The serial analyzer rear panel provides rear-panel connectors to connect the module to the mainframe. The rear panel also includes two logical address switches. Tektonix recommends that you leave the switches at the default switch setting of FF (Dynamic Auto Configuration). When the switches are set to FF, the instrument automatically sets the address to an unused value.

NOTE. Do not set any module to logical address 00. Logical address 00 is reserved exclusively for the controller.

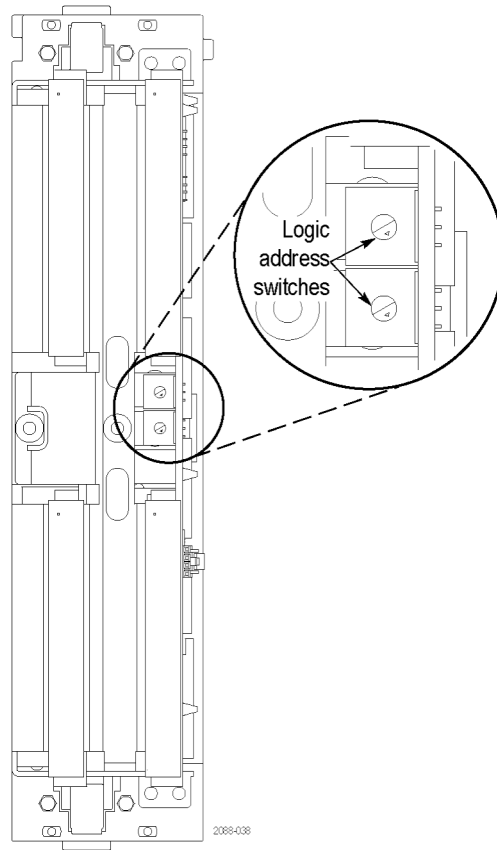


Figure 3: TLA7S16 Serial analyzer rear panel

Serial Analyzer Compatibility

A TLA7S08 & TLA7S16 Serial Analyzer module can be installed in either a TLA7012 portable mainframe logic analyzer, or a TLA7016 benchtop mainframe logic analyzer. The logic analyzer must have TLA Software Version 5.6 or higher installed, and the latest version of the Tektronix PCI Express Support software.

Installing the Serial Analyzer Module

This manual is written assuming that your logic analyzer mainframe is already installed properly. However, a high-level module installation overview is provided. If you need additional help installing your mainframe, refer to the *TLA7000 Series Logic Analyzers Installation Manual*.

CAUTION. To avoid damaging the mainframe, do not install or remove any modules while the mainframe is powered on. Always power off the instrument before installing or removing modules

Cover any empty module slots with a blank cover (Tektronix part number, 333-4206-xx).

Install the modules in the mainframe. (See Figure 4.) Use a screwdriver to tighten the retaining screws to 2.5 in-lbs after seating the modules in place.

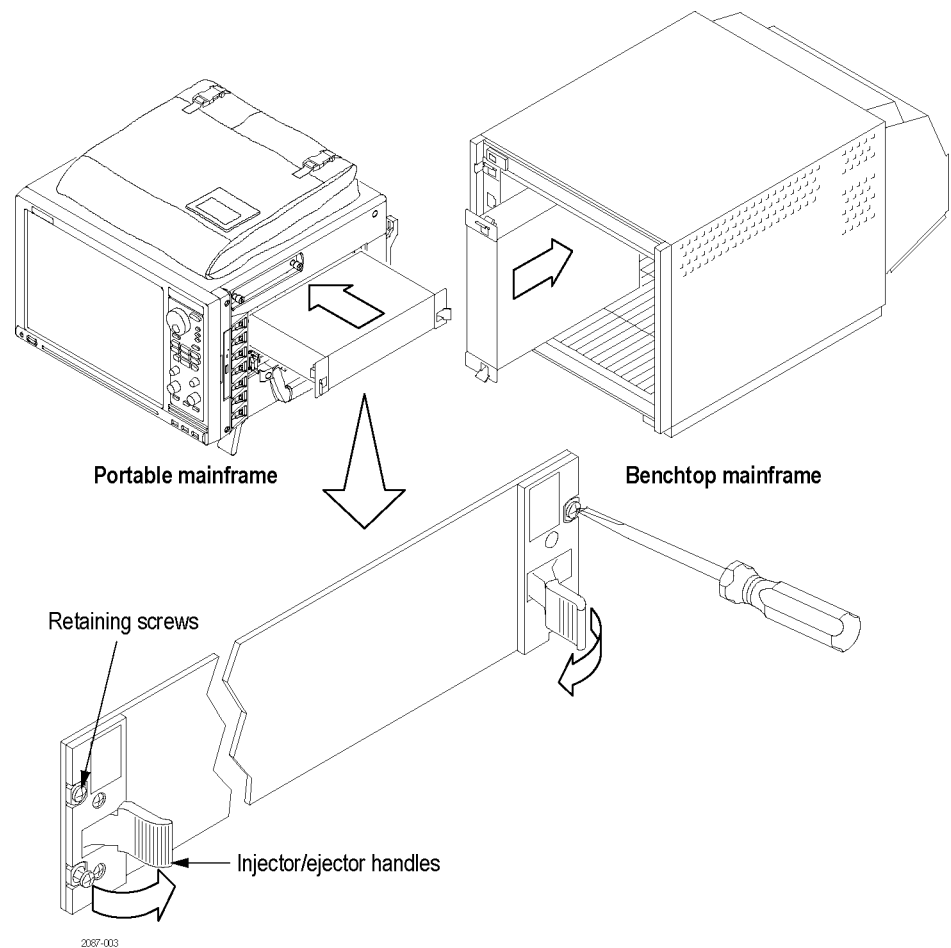


Figure 4: Installing a serial analyzer module

List of Compatible Probes

The following probes are compatible with the serial analyzer module:

Table 2: Serial analyzer probes

Probe	Description
P6708	8-Channel PCI Express Mid-bus probe
P6716	16-Channel PCI Express Mid-bus probe
P6701S	2-Channel PCI Express x1 Slot Interposer probe
P6704S	8-Channel PCI Express x4 Slot Interposer probe
P6708S	16-Channel PCI Express x8 Slot Interposer probe
P6716S	32-Channel PCI Express x16 Slot Interposer probe
P6701SD	Single-channel solder down probe

For detailed information on these probes, refer to the *P67xx Series Probe Instruction Manual*.

Connecting the Serial Analyzer to the System Under Test (SUT)

The probe connects your serial analyzer module to your SUT. For details on probes, and how to install a mid-bus probe retention mechanism, refer to the *P67xx Series Probe Instruction Manual*.

Handling the Probe Head

Handle the probe head with care. Keep the following points in mind:

- Handle the probe head by the outer plastic casing. Do not touch the contacts in the center with fingers, tools, wipes, or any other devices.
- Do not expose the connector to liquids or dry chemicals.
- When connecting the probe, be careful not to touch the probe head contacts to any other surfaces or components on your circuit board.



CAUTION. *Static discharge can damage the probe head. Always wear a grounded antistatic wrist strap whenever handling the probe head. Also verify that anything to which the probe head is connected does not carry a static charge.*

Connecting a Mid-bus Probe to Your SUT

Follow these steps to connect a mid-bus probe to the retention mechanism on your circuit board:

1. Locate the correct retention mechanism. If you intend to use multiple probes, your PCB has multiple retention mechanisms. Be careful to select the correct one.

2. Align the probe head with the retention mechanism. Both are keyed so that the probe can only be inserted one way.
3. Press the probe head into the retention mechanism.

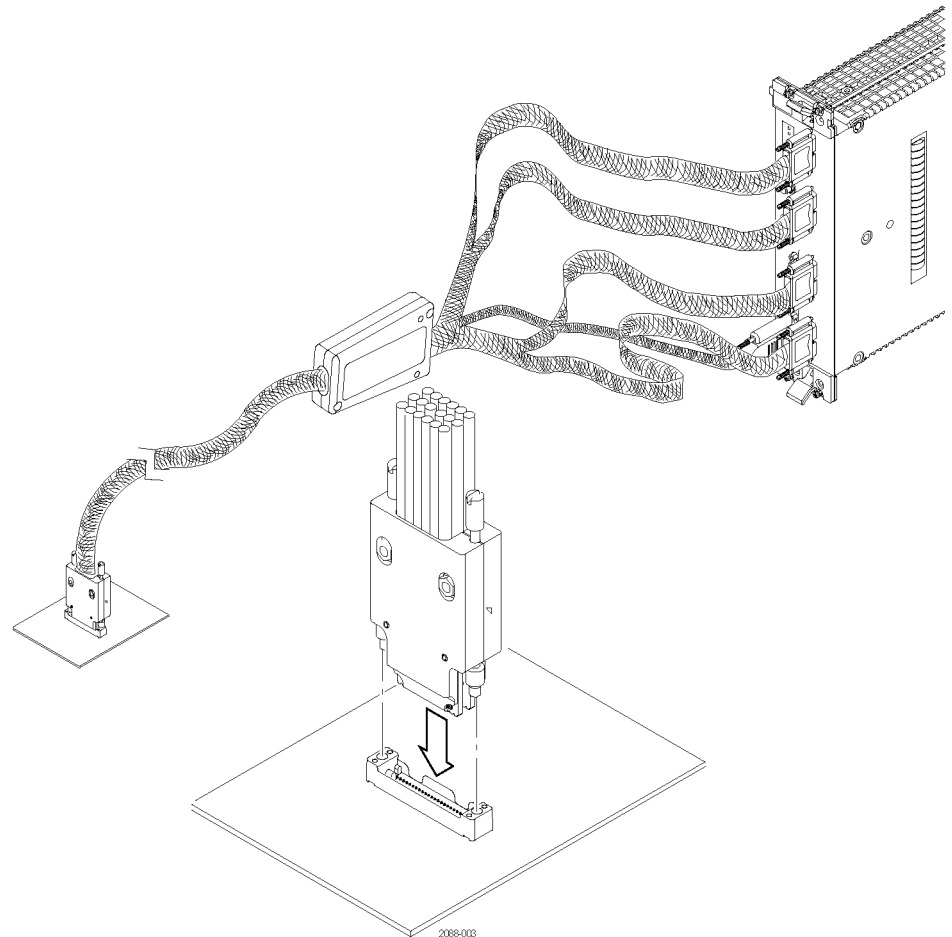


Figure 5: Connecting a mid-bus probe to your SUT

4. Start both mounting screws in the posts, and tighten them evenly to ensure that the probe approaches and mates squarely to the PCB. If access is limited, use the adjustment tool included with your probe. The probe is completely fastened to the PCB when both mounting screws are seated.

Connecting a Slot Interposer Probe to Your SUT

Follow these steps to connect a slot interposer probe to a PCI Express slot on your SUT:

NOTE. Although you do not need to power off the TLA before connecting the slot probe to the SUT, Tektronix recommends that you **DO NOT** connect the probe power to the TLA until after making all other connections.

1. Disconnect the power supply to your SUT. Unplug the PC power supply if your SUT is connected to one.
2. Locate the correct PCI Express slot.
3. Align the probe with the slot.
4. Press the probe head into the slot.

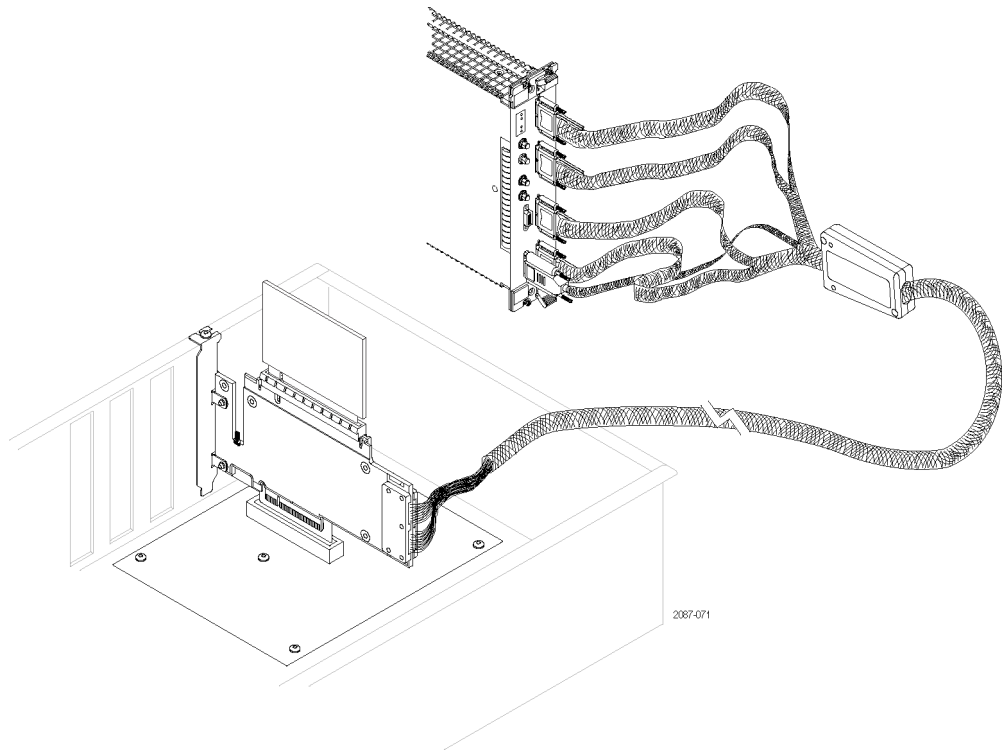


Figure 6: Connecting a slot interposer probe

5. Position the mounting bracket and attach the screws.
6. Press your PCI Express card device into the probe.

Connecting a Probe to the Serial Analyzer Module

Follow these steps to connect a probe to the serial analyzer:

1. Connect the module ends of the probe from the downstream data link to the serial analyzer module that will acquire the downstream data. (See Figure 7.)

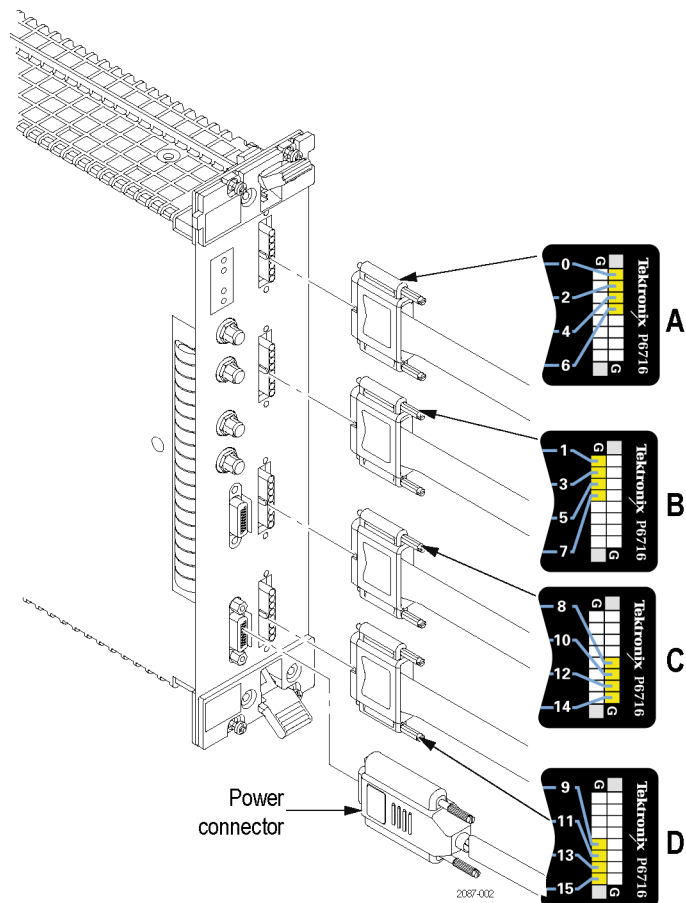


Figure 7: Connecting a 16-channel probe to the TLA7S16 serial analyzer module

- a. Plug the probe connector labeled 0, 2, 4, and 6 (channels) into the top connector on the module (A).
 - b. Plug the probe connector labeled 1, 3, 5, and 7 (channels) into the second connector (B).
 - c. Plug the probe connector labeled 8, 10, 12, and 14 (channels) into the third connector (C).
 - d. Plug the remaining probe connector into the fourth connector (D) on the module.
2. Connect the probe power connector to one of the power connectors on the front panel of the module.

3. Tighten the connector screws using the adjustment tool included with your probe.
4. Power on the SUT.

Connecting a Clock Cable

Two clock connection cables are included with your serial analyzer module. One is for connecting the reference clock input of the module to the SUT or slot interposer probe, and the other is a jumper cable for connecting one module to another.

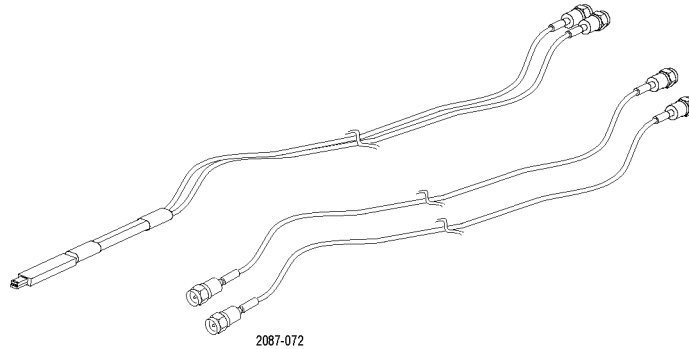


Figure 8: Clock cable and clock jumper cable

Connect a clock cable by following these steps:

Connecting a clock cable.

1. Connect one end of the cable to the Ref Clock input connectors (+ and –) on the serial analyzer module; screw the SMA connectors down until they are snug.
2. Connect the other end of the correct cable to the SUT three-pin connector or the slot interposer probe three-pin connector.

Connecting a clock jumper cable.

1. Connect one end of the cable to the Ref Clock input connectors (+ and –) on the serial analyzer module; screw the SMA connectors down until they are snug.
2. Connect the other end of the cable to the Ref Clock output connectors (+ and –) on another module.

NOTE. *Clock Reference Source must be set to SUT if either clock cable is used. (See page 17, Selecting a Clock Signal Source.)*

Applying and Removing Power

After you have connected all probes to your SUT, apply power to your SUT and then power on the serial analyzer.

Setting Up the Serial Analyzer

Before you use the serial analyzer, you need to verify that your mainframe has the most current TLA Application software and TLA PCI Express Support software. The software must be installed on all mainframes and PCs that will use the serial analyzer modules, including any PCs that will remotely control the serial analyzer.

Updating the TLA Application Software

The serial analyzer requires TLA Application software V5.5 or higher. Complete the following steps to update the software on your mainframe or PC:

1. Insert Disc 1 of the TLA Application software in the media drive.
2. Start Windows Explorer, navigate to D:\TLA Application SW, and execute the file Setup.exe. If you insert the CD in a different drive, use the appropriate drive.
3. Click Yes to start the installation and follow the on-screen instructions. If you are asked for permission to overwrite any read-only files, select Yes to All.

Installing the TLA PCI Express Support Software

After updating the TLA Application software, you need to install the TLA PCI Express Support software (extensions to the TLA Application software) so that the instrument will recognize signals transmitted on a PCI Express bus. Follow these steps:

1. Insert the TLA PCI Express Support software CD in the media drive.
2. Start Windows Explorer, navigate to the media drive and execute the file Setup.exe.
3. Click Yes to start the installation and follow the on-screen instructions. If you are asked for permission to overwrite any read-only files, select Yes to All.
4. After you have logged on to Windows, a message may appear instructing you to update the module firmware. If so, update the firmware described under *Updating the Serial Analyzer Module Firmware*.

Updating the Serial Analyzer Module Firmware

After you install the software and restart the instrument, a message may appear on the screen indicating that your current module firmware is unsupported by the currently installed serial analyzer software. A new version of the firmware must be installed on the instrument so that it will work with the latest TLA PCI Express Support software.

1. If you haven't already done so, exit the TLA application.
2. Click Start → All Programs → Tektronix Logic Analyzer → TLA Firmware Loader.
3. Select your mainframe instrument from the TLA Connection dialog box.

You are given a choice to load Mainframe or Instrument Module Firmware. Click the Load button in the Instrument Module Firmware section (bottom part of the dialog box).

4. You may be prompted about cycling the power on the mainframe after completing the upgrade operation. Click Yes to continue.

The instrument will scan the mainframe to detect all installed modules, and to determine which modules have firmware that needs to be upgraded.

5. Select your module(s) from the list displayed in the Supported list box near the top of the window. If you are updating the firmware for more than one module, note the locations of the modules in the mainframe and select them from the list.
6. Select Load Firmware from the Execute menu.
7. Navigate to C:\Program Files\TLA 700\Firmware and select the file TLA7Sxx.lod.

NOTE. *Be sure to correctly associate your module with this file. Note the slot number in the title bar so that you select the correct module.*

8. Click OK. You will be prompted to confirm your action; click Yes.

The program will begin to load the firmware. The process may take several minutes.

9. When the process is complete, the firmware has been loaded for the module. Exit the firmware loader program and power off the instrument. You must power off the instrument to allow the software application to start up properly.

Open the Setup Window

NOTE. There is a separate Setup window for each installed module. Make sure to select the Setup window that applies to the correct module.

Open the serial analyzer Setup window by doing one of the following:

- Click the serial analyzer Setup Icon in the TLA Explorer.
By default the serial analyzer is identified as SA 1 in the TLA Explorer.
- Click the Setup button in the System Navigation toolbar.
If your system has more than one module, select SA 1 from the Setup button.
- Click the Setup button on the Serial Analyzer icon in the System window.

The default Setup window is shown below. (See Figure 9.) The color of the status indicators near the center of the window will vary depending on the signal activity at the probe tip.

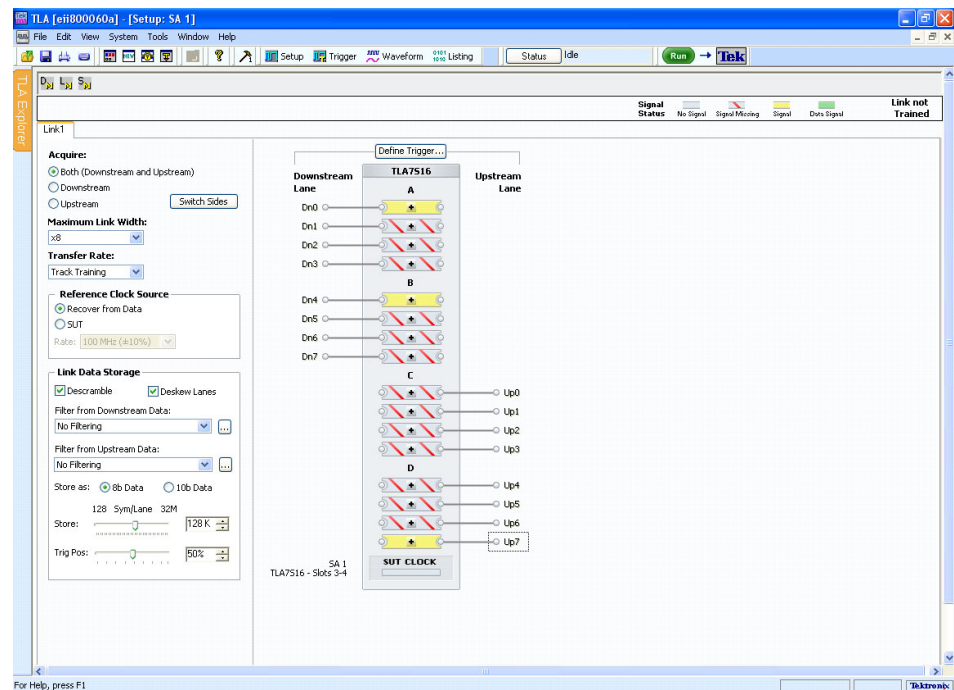






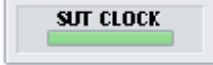
Figure 9: Default Setup window

Monitoring Signal Activity

After you have connected the probes and installed the software and firmware, you can begin monitoring signal activity on each of the channels to make sure that your system is operating correctly and that the probes are connected properly. A graphic representation of the serial analyzer module shows a status indicator for each channel. Use the status indicators to determine if the SUT produces the signals that the module can recognize. The serial analyzer is constantly monitoring the status of each channel, even when data is not being acquired.

A description of each status indicator is listed below. The status indicators are also defined in the Status area in the Setup window.

Table 3: Status indicators in the Setup window

Indicator	Description
	No signal. The channel has not been assigned to a lane. (See page 18, <i>Assigning Channels to Lanes.</i>)
	Signal missing. The channel has been assigned to a lane, but a signal is not recognized. This symbol will appear on a channel connected to a lane that is inactive.
	Signal. A signal is detected, but data is not recognized.
	Data signal. A signal is detected and recognized as data.
	Clock signal. A clock signal is detected via the clock cable connected to your SUT or slot interposer probe. This indicator will be gray if Recognize an Imbedded Clock signal is selected. (See page 17, <i>Selecting a Clock Signal Source.</i>)

Defining the Link

To define a link, specify the following information about your SUT; you can define one link per module:

Link Name. The default link name is Link1. Double-click on the Link tab to enter a meaningful name.

Autoset. After the link has completed a training sequence, the Autoset button in the Status area becomes active. Click Autoset to automatically complete the setup for the entire link.

Acquire. Select one of the Acquire buttons to identify the upstream and downstream lanes for capturing data. The selection that you make impacts the appearance of the channel-lane assignments on the right side of the Setup window. For example, if you select downstream data, the upstream channel-lane assignments become unavailable.

Switch Sides. Use the Switch Sides button to quickly switch the channel-lane assignments between the downstream and upstream sides.

Maximum Link Width. Specify the maximum number of lanes in your link.

Transfer Rate. Tektronix recommends setting Transfer Rate to Track Training (default) when analyzing a bus operating at PCI Express Gen2 specifications. The serial analyzer module recognizes data as the link trains up in speed from 2.5 GT/s to 5.0 GT/s. If you intend to more closely observe the data rate transition, set Transfer Rate to 2.5 GT/s or 5.0 GT/s. The serial analyzer will only recognize data at that rate, but it will recognize data for a longer period of time during the transition.

Selecting a Clock Signal Source

The serial analyzer can recognize a clock signal from a cable connection to the SUT (or slot interposer probe), or by recovering the clock signal embedded in the data.

Recognize the clock signal embedded in the data stream. Select Recover from Data. A stable reference signal is generated by the serial analyzer and synchronized with the embedded clock signal. A clock cable connection is not required, since the serial analyzer recognizes the embedded signal from the probe.

Recognize the clock signal by directly connecting to the SUT with a clock cable. Tektronix recommends connecting a clock cable to assure that data is accurately synchronized with the clock signal. Select SUT and select an approximate frequency (100 \pm 10% or 125 MHz \pm 10%). Make sure the reference clock cable is connected correctly. (See page 10, *Connecting a Clock Cable*.)

NOTE. *If SSC (spread spectrum clocking) is enabled, and your PCI Express link uses power management states, you must connect a clock cable to the SUT and set the reference clock source to SUT to ensure that all symbols are recognized by the serial analyzer during the link's transition from a power management state to the L0 state.*

An external clock is also required to conduct frequency margin testing when the SUT is operating at rates other than 2.5 GT/s or 5 GT/s.

Storage Settings

Specify the amount of data to store (symbols per channel), and set the trigger position relative to the amount of data stored. A trigger position setting of 0% indicates that data will be stored after the trigger event occurs. A trigger position setting of 100% indicates that data storage will stop when the trigger event occurs.

Descramble and Deskew

The following guidelines provide information on when you should select items in the Link Data Storage area.

NOTE. *Only 8b data is available for triggering.*

Data can not be descrambled unless Store as: 8b Data is selected.

- Select Descramble to store data in a descrambled format.
- Select Store as 10b Data store data in 10b format (a post-processing operation).
- Select Store as 8b Data to store the more conventional 8b data.
- Select Deskew Lanes to view time-aligned lane data in the listing window.

Defining a Data Filter

The Setup window provides a means of filtering data so that you can focus on the data you are interested in. Data that is filtered out is still available for Triggering. Select a common downstream or upstream data filter, or click Define Filter and select what you want to filter from the data stream. Click OK when you are done.

Assigning Channels to Lanes

On the right side of the Setup window, the graphic representation of the serial analyzer module shows lines drawn between numbered lanes and channels. If you click Autoset, the serial analyzer assigns channels to lanes based on the current trained link configuration; it also updates the Acquire and Maximum Link Width selections. If you want to change the assignments, click and drag the lines so that the channels are connected to the lanes as your design dictates.

A line must connect each channel to a lane so that data will be recorded and displayed properly in the Listing or Waveform windows. (See page 32, *Acquiring and Viewing Data.*)

NOTE. *If you have a bidirectional link, one side of the link (upstream or downstream) must be connected to channels of the top two connectors on a 16-channel module, or the top connector on an 8-channel module. The other side of the link must be connected to the other connector(s).*

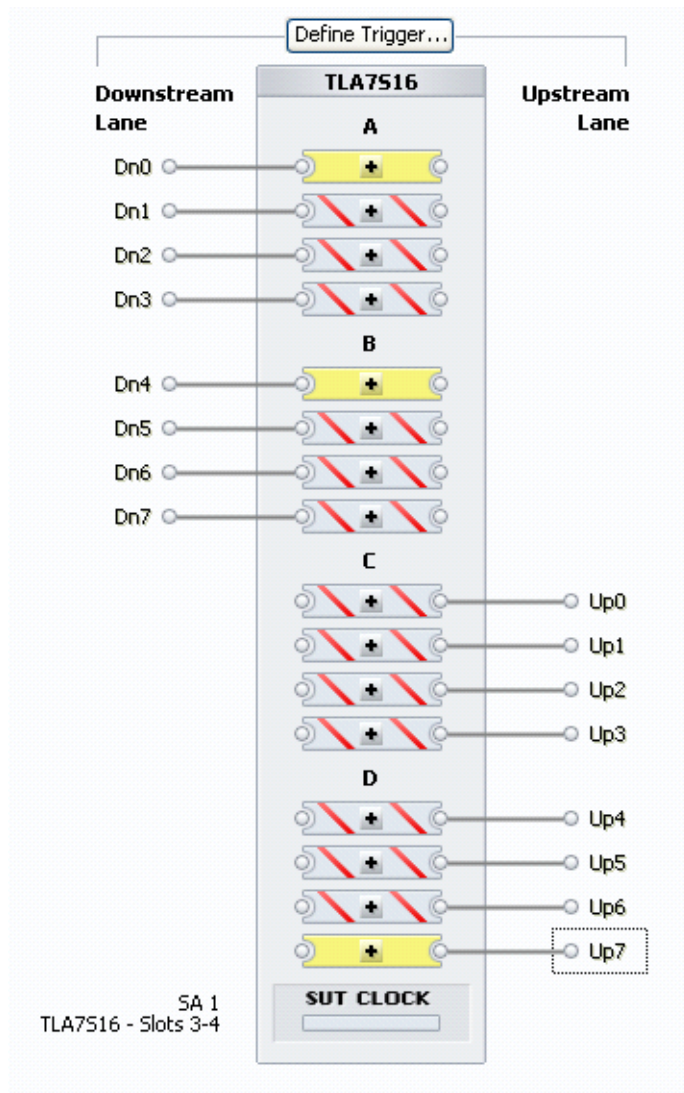


Figure 10: Assigning channels to lanes

Perform the following steps to assign input channels to lanes:

1. Determine the correlation between each lane and each input channel.
2. Select the left edge of the input channel indicator.

The left edge becomes highlighted to show that it has been selected.

3. Drag the mouse from the left edge of the channel indicator to the appropriate lane indicator on the right.

When you release the mouse button, a solid line connects the two indicators together.

4. Repeat the above steps for each channel indicator and lane connector.
5. To change the polarity of a channel, click the center of the indicator.

NOTE. *The plus/minus sign is a polarity setting, not an indicator of polarity.*

6. If data is being transmitted on the bus, the indicator of each channel assigned to a lane will turn green (data signal recognized). If data is not being transmitted but a signal is present, the indicators will turn yellow. Gray indicators with red stripes indicate that the channel has been properly assigned to the lane, but a signal is missing.

Indicators must be green for data to be recorded and analyzed in the Waveform or Listing window.

Specific Considerations for Testing Link Power Management States, Link Degradation, and Link Training

If you intend to observe the timing of link transitions (link width, power savings state transitions, lane reversal) there are certain considerations about the module that must be noted.

Detector Channels and Listener Channels

The serial analyzer module can accurately detect when a link transitions to and from a link state where no data is transmitted on the link. The module recognizes these link transitions by detecting the presence or absence of electrical signals only on lanes connected to the top and bottom channel on each connector (two of the four channels on each connector). All other channels infer the presence or absence of electrical signals by "listening to" these channels. By default, each of the two listener channels on each connector are set to listen to one of the two detector channels on that connector.

Any listener channel on connector A or B can be assigned to listen to any detector channel on connector A or B. Any listener channel on connector C or D can

be assigned to listen to any detector channel on connector C or D (16-channel module only).

On each probe connector the top and bottom channel are defined as detector channels. The center two channels of each connector are defined as listener channels. The default settings for each connector are shown in the following illustration, in this case for the A probe connector. (See Figure 11.) To view or edit the detector channel settings, right click and select Define Electrical Idle Detection Method.

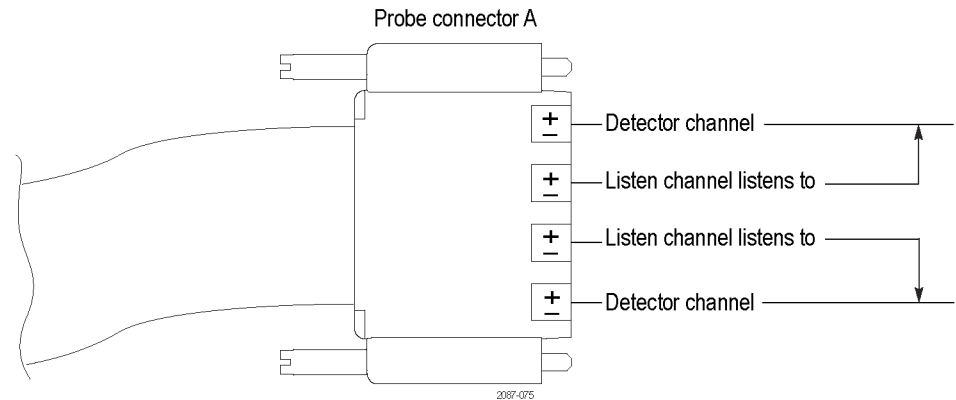


Figure 11: Default detector and listener channels on the probe connector

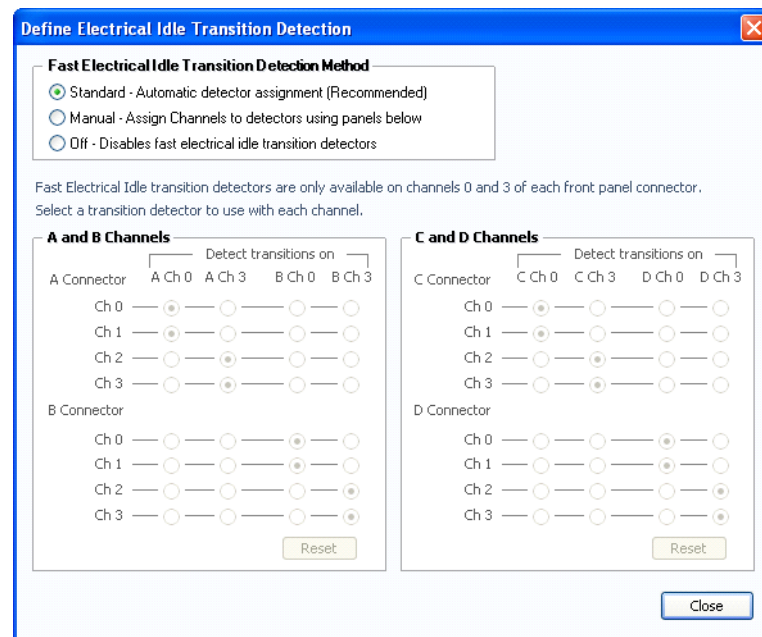


Figure 12: L0s Detector settings

You should not have to change any settings for most configurations. Tektronix recommends that you use the standard (default) settings. If necessary, you can manually change the settings. Some link configurations will require that you

change the detector channel that a listener channel listens to, while very few configurations will require you to rewire the module-end probe connector.

In general, any time that your link transitions to a x2 or x1 width, and Lanes 0 or 1 are no longer connected to detector channels, your link will appear to be in an idle state when it is not. Be aware of when this situation occurs and follow the suggested link formats provided in the *P67xx Series Probes Instruction Manual*. Contact your local Tektronix representative for assistance.

To temporarily bypass the detectors to observe data on all lanes at a slower transition detection rate, you can turn off the L0s detection. (*See Bypassing the Detectors.*)

Bypassing the Detectors

Select Off - Disables fast electrical idle transition detection to place the serial analyzer in a troubleshooting/debugging mode. The electrical idle detectors are bypassed, and signal activity on all lanes is recognized. However, this mode inhibits the speed at which the link recovers from an L0s state (up to 6 μ s). When you have finished troubleshooting or debugging and are ready to begin acquiring data, disable the selection by selecting Standard - Automatic detector assignment (Recommended).

Here is an example of a situation when you should use this setting:

A x4 link on a mid-bus footprint has been mistakenly wired in a non-standard format, so that Lane 0 is connected to Channel 1 instead of Channel 0 (connector A). It is not clear where Lane 0 is. Channel 1 listens to Channel 0 (default), but when the link trains down to a x1 (on Channel 1), Channel 1 is listening (and detecting) an electrical idle signal on Channel 0. It appears that the link is in an electrical idle state when it is not. When you turn the detection off, you can see that the footprint or the module-end probe connector must be rewired.

Defining a Trigger

After defining parameters in the Setup window, you need to define a trigger that tells the serial analyzer when to begin recording data. You define a trigger in the Trigger window.

Open the Trigger Window

Open the Trigger window by doing one of the following:

- Click the Serial Analyzer Trigger icon in the TLA Explorer.
- Select the Serial Analyzer from the Trigger button in the TLA toolbar.
- Click the Trigger button on the Serial Analyzer icon in the System window.
- Right-click the mouse from the Setup window and select Go To Trigger.

The default Trigger window is shown below.

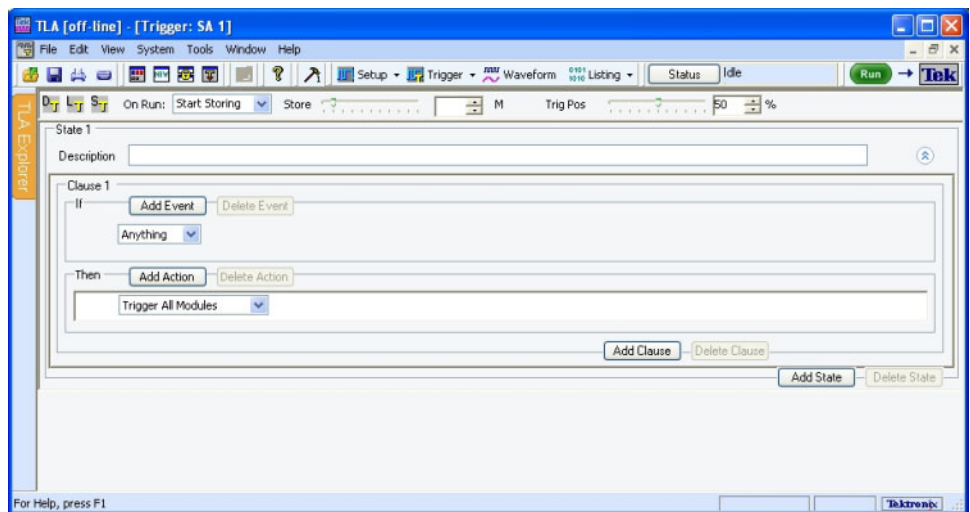









Figure 13: Default Trigger window

Quick Tips

- Click  to collapse the current trigger state to provide more room on the screen.
- Click  to expand the current trigger state.
- Look for the  or  to expand or collapse information in the current Clause. They are indicators that there may be more or less information to display on screen.
- Click one of the three icons at the top of the Trigger window to open the default trigger window , load a trigger , or save a trigger .
- The Store and Trigger Position controls are identical to those in the Setup window.

Adding States, Clauses, Events, and Actions

A trigger definition is a logical expression consisting of events and actions within clauses, within states. The default Trigger window starts with one state (State 1). and one clause (Clause 1). A trigger definition can have up to eight trigger states with eight trigger clauses per state.

- Begin editing the clause by selecting Events (IF) and Actions (THEN).
- To add additional events or actions to the clause, click Add Event or Add Action.
- Multiple events can be joined by a logical AND or an OR. Click AND to change it to an OR. Actions can only be joined by an OR.
- To add another clause or state, click Add Clause or Add State.
- You can also add states, clauses, events, and actions by right-clicking and selecting from the context menu.

Deleting States, Clauses, Events, and Actions

Delete states, clauses, events, and actions by clicking the appropriate button in the Trigger window, selecting from the Edit menu, or by right-clicking and selecting from the context menu.

Trigger Events

Trigger events are listed in the following table.

Table 4: Trigger events

Event	Description
Anything	Recognizes any data.
TLP	Recognizes the presence or absence of a specific TLP. You can choose the TLP from a list, or define a TLP.
DLLP	Recognizes the presence or absence of a specific DLLP. You can choose the DLLP from a list, or define a DLLP.
Sequence	Recognizes a specific ordered set or symbol sequence. You can choose the Sequence from a list, or define a Sequence.
Link Event	Recognizes link events and link errors. You can choose the Link Event from a list, or define a Link Event and specify which lanes to monitor.
Timer	Recognizes a specified timer value.
Counter	Recognizes a specified counter value.
Signal In	Recognizes a signal from another module.

The following table provides additional information about the event recognizer resources. You may need to be aware of these when setting up the Trigger window.

Table 5: Trigger event recognizer resources

Event recognizer	Description
DLLP packet recognizers	8 separate DLLP recognizers. The total number of unique DLLPs that can be detected depend on the link width and direction.
x1, x2, or x4 links	8 unique DLLP packet recognizer resources
x8 and x16 links	4 unique DLLP packet recognizer resources
TLP packet recognizers	4
Symbol and ordered set recognizers	8
Ordered set recognizer depth	16 symbols

TLP. Select TLP from the list and specify your TLP.

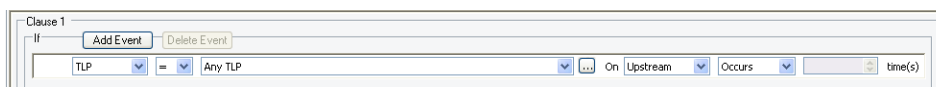


Figure 14: Specifying a TLP event

Click on the ellipsis to define a more detailed TLP.

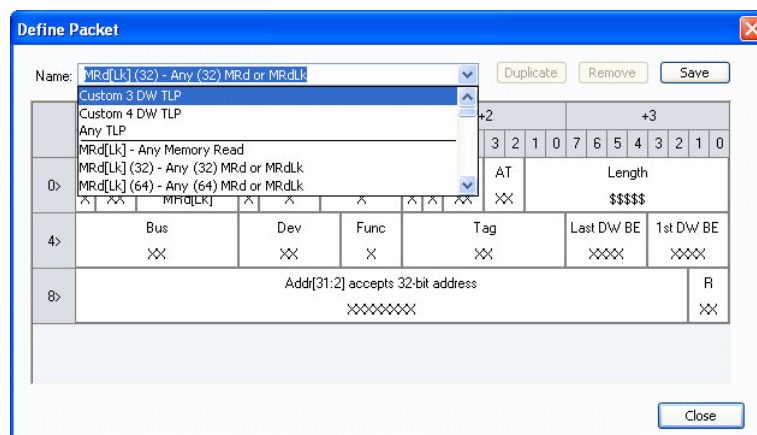


Figure 15: Defining a TLP

You can enter a meaningful name for the TLP or select one from the list and a copy will be created. To change the radix, right-click and select from the list. Edit the TLP definition and click Close when you are finished. The new TLP will now appear in the list.

NOTE. The *X* and *\$* characters appear whenever you define a TLP, DLLP, or a symbol sequence Event. An *X* represents any character, often known as a "don't care" character. The *X* can represent a binary, octal, or hexadecimal digit depending on the radix selection. The *\$* character appears when you select a radix where the binary combination contains a combination of *X* and non-*X* characters. To identify the contents of a *\$* character change the radix to binary.

DLLP. Select DLLP from the list and specify your DLLP.

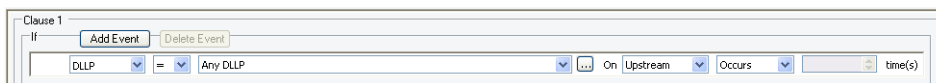


Figure 16: Specifying a DLLP event

Click on the ellipsis to define a more detailed DLLP.

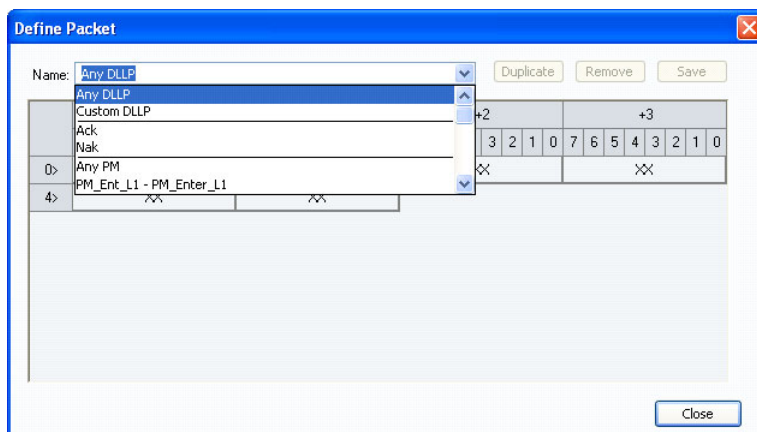


Figure 17: Defining a DLLP

You can enter a meaningful name for the DLLP or select one from the list and a copy will be created. To change the radix, right-click and select from the list. Edit the DLLP definition and click Close when you are done. The new DLLP will now appear in the list.

Link Event. Select Link Event from the list and specify your Link event.

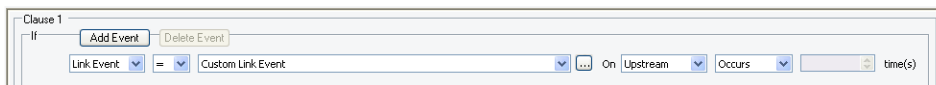


Figure 18: Specifying a Link event

Click on the ellipsis to define a more detailed DLLP.

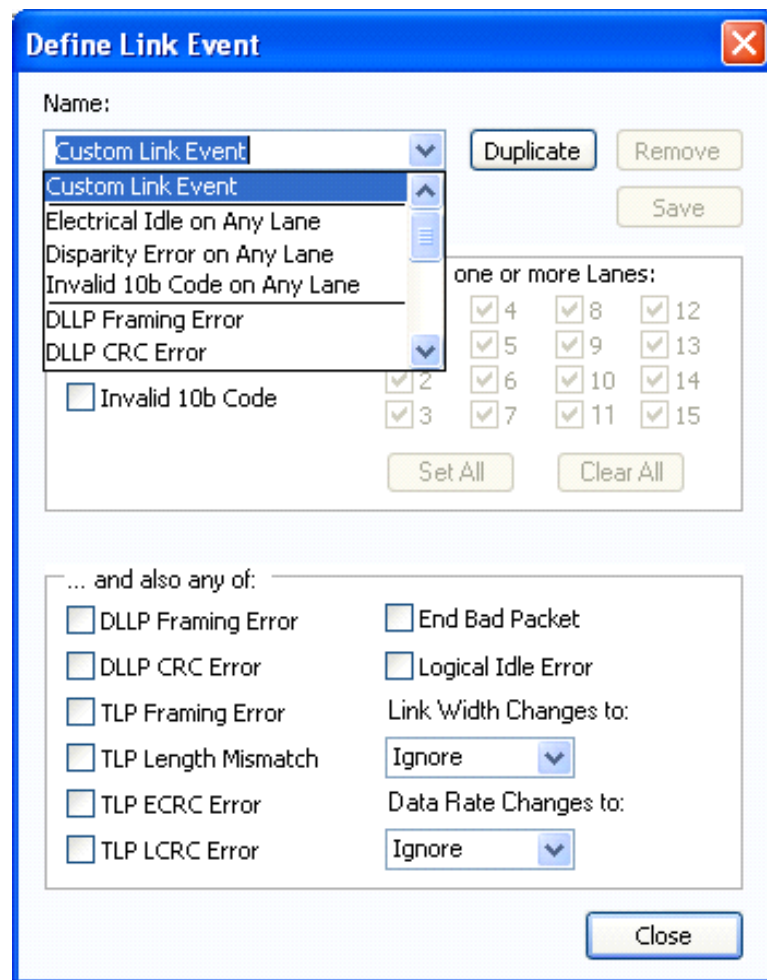


Figure 19: Defining a Link event

You can enter a meaningful name for the Link event or select one from the list and a copy will be created. Edit the Link event definition and click Close when you are done. The new event will now appear in the list.

Sequence. Select Sequence from the list and specify your symbol sequence or ordered set.

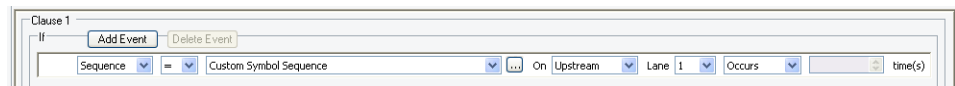


Figure 20: Specifying a symbol sequence

Click on the ellipsis to define a more detailed symbol sequence.

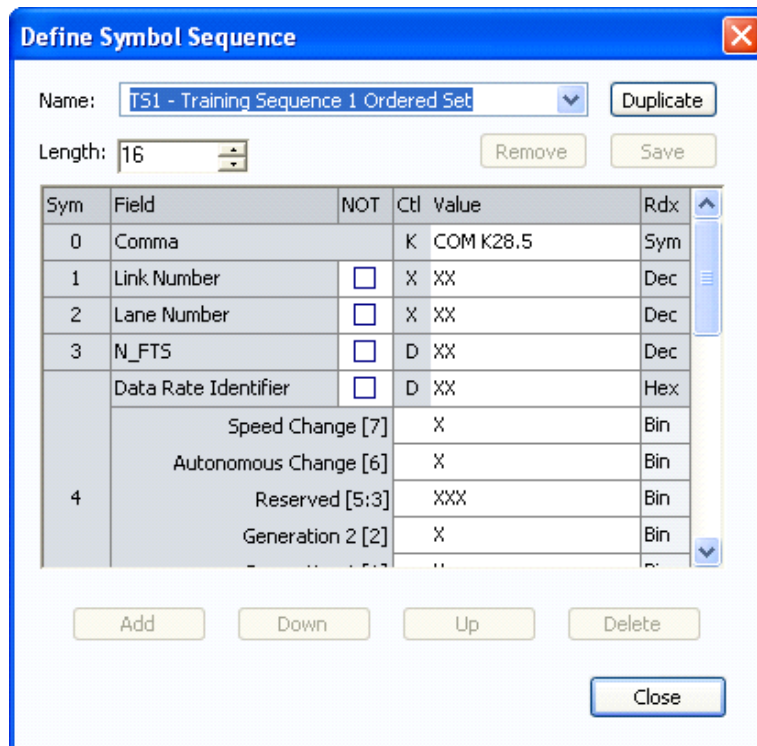


Figure 21: Defining a symbol sequence

You can enter a meaningful name for the symbol sequence or select one from the list and a copy will be created. You can define a symbol sequence with a maximum of 16 symbols per lane. Click on the K to change it to a D or an X. An X indicates that the trigger will recognize either a K or a D control bit. To change the radix, right-click and select from the list, or just click on the radix text. Edit the symbol sequence definition and click Close when you are done. The new symbol sequence will now appear in the list.

Event Counters, Global Counters, and Timers. Four types of events have counters associated with them. The counter will increment every time the event occurs (or does not occur). These counters are called event counters and are associated with the following events:

- TLP
- DLLP
- Sequence
- Link Event

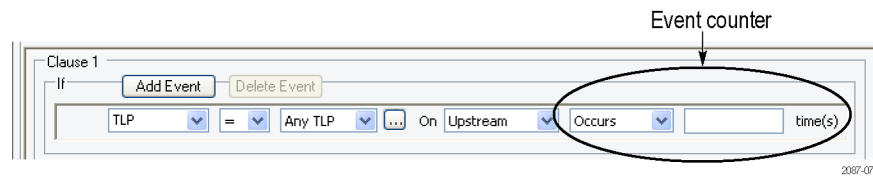


Figure 22: Event counter

You can use a maximum of two event counters in each clause. Event counters are limited to counting only the event they are associated with. If you want to create a counter that can be incremented, decremented, and reset by any clause in any state, select Counter from the event list. This type of counter is called a global counter.

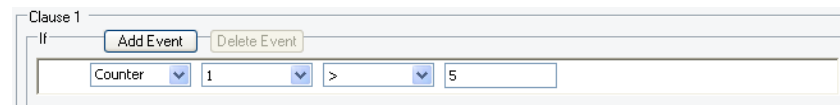


Figure 23: Specifying a global counter

Global counters are usually combined with another clause or state that increments, decrements, or resets the counter with an action. *See Actions.*

Timers are also global, meaning that they can be started, stopped and reset by any clause in any state. Select Timer from the event list and specify your timer.

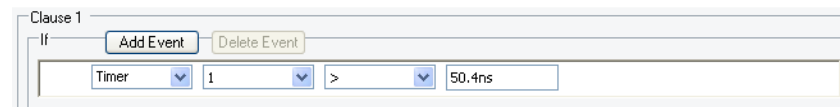


Figure 24: Specifying a timer

Timers are usually combined with another clause or state that starts, stops, or resets the timer with an action. *See Actions.* You can add a maximum of four global counters or timers.

Signal In. Select Signal In from the event list and specify a signal number.

There are four global signals that can be used for triggering by any module installed in the logic analyzer mainframe.



Actions When an event (IF) in a clause becomes TRUE, the associated action (THEN) is taken. Click Add Action to join multiple actions with a logical AND.

Trigger Actions are listed in the following table.

Table 6: Trigger actions

Action	Description	Interactions
Trigger	Triggers the current module and causes acquisition memory postfill to begin.	When Trigger is used in the trigger program, Trigger All Modules cannot be used.
Trigger All Modules	Also known as a System trigger. This signal is also available at the System Trigger Out connector.	When Trigger All Modules is used in the trigger program, Trigger cannot be used.
Wait for System Trigger	Used for a module that does not trigger itself or any other module, but waits to be triggered by another module.	Capable of receiving the following three (mutually exclusive) trigger actions: Trigger, Trigger all Modules, or Wait for System Trigger.
Go To	Causes a change to a different trigger state.	Use only one in clause definition.
Counter actions	Increments, decrements, or resets counters.	Counter 1 and 2 actions conflict with Timer 1 and 2 actions respectively. The actions also conflict with their respective events.
Timer actions	Starts, stops, or resets timers.	Counter 1 and 2 actions conflict with Timer 1 and 2 actions respectively. The actions also conflict with their respective events.
Set and Clear Signal	Sets or clears one of the four internal system signals.	Use only one in a trigger program. Mutually exclusive with Arm Module action.
Arm Module	Sends an Arm signal to another module. The other module begins running its trigger program.	Can only arm one module in a trigger program, but actions can be taken throughout the trigger program.
Start and Stop Storing	Begins or ends storing of samples.	
Do Nothing	Used as a placeholder when defining a complicated trigger program.	Does not override other actions specified in a clause.

Saving and Loading Triggers

You can save a trigger definition as a .tla file by clicking the save trigger icon  at the top of the Trigger window. Give the file a meaningful name and save it to a specified location. Similarly, you can load a trigger file by clicking . Only files created by a TLA7S08 or TLA7S16 serial analyzer module can be loaded.

Acquiring and Viewing Data

After defining Setup parameters and defining trigger conditions, you can now acquire data.

Acquiring Data

Click the Run button to begin the data acquisition sequence.

When data meets the conditions defined in the Trigger window, the instrument temporarily stores the data based on the Link Data Storage settings specified in the Setup window. You can now display the data in a waveform format in the Waveform window or in a list format in the Listing window.

Viewing Data

Data can be viewed in either the Waveform window or Listing window.

Waveform Window

The Waveform window shows each lane of data in rows. This data is not disassembled.



Figure 25: Waveform window data

Adding Both Sides of a Bidirectional Link to a Single Listing Window

If you are using two serial analyzer modules and one is connected to the upstream side of a bidirectional link and the other module is connected to the downstream side, you can display both sides of the link in a single listing window. To do this, complete the following steps:

1. Select New Data Window from the Window menu to start the New Data Window wizard.
2. Click Listing and then Click OK.
3. Press the Ctrl key on your key board and select the two modules from the Data from list.

Both modules should be selected in the wizard.


4. Click Next >.
5. Enter a name for the new Listing window and then click Finish.

The wizard will close and display the data from both modules in the new listing window.

6. If necessary, edit the window by adding or moving columns to display the data that you are interested in.

Changing How Data is Displayed

The serial analyzer provides different ways for viewing data in Listing and Waveform windows. You can change the display settings in the properties pages of either display window:

1. Click the Properties icon  in either display window to open the property pages for the respective display.
2. Click the Disassembly tab to select the Disassembly property page.
3. Change the display items as needed.

The following table lists some of the display settings that you can change in the Listing window.

Table 8: Serial analyzer disassembly display options

Disassembly property page selections	Settings	Description
Show	All (default)	All required data is disassembled and shown including logical idle samples
	Non-Idle Samples	Logical idle samples are hidden
	TLP/DLLPs Only	Only samples containing TLPs and DLLPs are shown
	TLPs Only	Only samples containing TLPs are shown
	TLP Headers Only	Only samples containing TLP headers are shown
Highlight	None (default)	Nothing is highlighted
Disassemble Across Gaps	Yes or No (default)	General listing window setting. (not recommended for PCI Express data)

Any errors in link traffic detected by the disassembler are displayed regardless of the display option that you selected.

Bus-Specific Fields

In the Controls area of the Disassembly property page, you can select any of the following controls to change the way data is displayed.

Disassemble and Display. When working with bidirectional data with a single module, the data window can only disassemble and display either upstream or downstream data. Select the data that you want to view in the Listing window

Extended Link Details. Set the Extended Link Details mode to ON or OFF to show or hide extended packet information in the Listing window. If you set it to OFF, the Link_Details column displays general packet information on a single line. If you set it to ON, the Link_Details column displays extended packet information on multiple lines. All packet fields are decoded and displayed in the Link_Details column. TLP payload data is displayed double word aligned along with the lower word address starting with the address acquired in the TLP header.

Calculate CRC. The disassembler calculates the CRCs for all packets when Calculate CRS is set to ON. If the calculated value differs from the value acquired from the link, an error message is displayed in the Link_Details column. The default setting is OFF.

By default, the field values are aligned with the sample containing the STP if it is a TLP, or with the sample containing the SDP if it is a DLLP. By setting this property to ON, the packet field values are displayed on the same line as the TLP_fmttype and DLLP_type group values.

10-Bit Mode Acquisition

When the serial analyzer is configured to acquire the link in 10-bit mode, the Listing window displays the symbol encoding in the individual lane columns. No further link analysis is performed.

Changing from Binary Listing Symbol Tables to 10-Bit Mode

To change the radix of a binary listing symbol table to radix in 10-bit mode acquisition, select a column and right-click the mouse. Select Radix and then Symbolic. Select one of the symbol files from the list, or click Other and navigate to the location of the symbol file.

Special Messages

The disassembler uses special messages to indicate significant events. These messages are highlighted in red in the Link Details column of the listing window. The following tables list the messages and their descriptions.

The special messages are in addition to the errors detected by the serial analyzer hardware listed in the PCIe_RuleViol.tsf file. The file is located in the C:\Program Files\TLA 700\Serial\PCIe folder under the Bidir, Uni_Up, or Uni_Dn subfolders.

Table 9: Training sequence messages

Message	Description
Error - Duplicate Lane Number Assignment in Lanes:	More than one lane has been assigned the lane number. The lane numbers are listed below the message.
Error - Lanes That Exceed Maximum Link Width:	The lane number as acquired in the training sequence is higher than the link width. The lane numbers are listed below the message.
Lane??: Lane Polarity Inversion	The lane is inverted. Click on the center of the channel polarity indicator (+ or -) in the graphical display in the Setup window.

Table 10: Packet framing messages

Message	Description
Error: Abnormal packet termination	The packet was interrupted and terminated by a skip ordered set, training sequence, or FTS, TLP, DLLP.
Non-Idle Bus	The link is supposed to be in logical idle at this sample, but a nonzero value is found in one or more lanes.

Table 11: DLLP messages

Message	Description
Error reading DLLP	A general error occurred while trying to decode the DLLP. This was possibly caused by a gap/suppression of data.

Table 12: TLP header messages

Message	Description
Error reading TLP	A general error occurred while trying to decode the TLP header, possibly caused by a gap/suppression of data.
Error Forwarding/Poisoned TLP	The EP field of TLP header is HIGH.
Error: Invalid 1stDWBE/Length values for Req TLP	The TLP length field > 1 and First DWBE field is 0 for request TLPs.
Error: Invalid LastDWBE/Length values for Req TLP	The TLP length field is 1 and Last DWBE field is not 0, or TLP length field > 1 and Last DWBE field is 0 for request TLPs.
Zero Length Read Request – Possible Flush	The TLP length field is 1, Last DWBE is 0, First DWBE is 0, for Memory Read Request.
Error: Invalid Traffic Class for Message TLP	The TC field was not zero.
Completion Status: + 'Unsupported Request', 'Config Req Rtry Stat', or 'Completer Abort'	A completion status other than 'Successful Completion'.
TLP: Msg - + 'ERR_COR', 'ERR_NONFATAL', or 'ERR_FATAL'	An error message TLP was acquired.

Table 13: CRC checking messages

Message	Description
Error: ECRC mismatch	The ECRC value acquired in the TLP digest field does not match the ECRC value calculated by applying the ECRC algorithm to the acquired data. Possible causes include incorrect ECRC at the transmitter, poor signal quality at probe head, different algorithm used between transmitter and software, incorrect polarity or ordering of cables at the input of the serial analyzer, problem with the cables or connection to the serial analyzer.
Error: CRC mismatch	The TLP or DLLP CRC acquired does not match the CRC value calculated by applying the CRC algorithm to the acquired data

Table 14: General acquisition messages

Message	Description
Error: Missing Data - Gap in TLP header	Complete decode of TLP header was not possible due to a gap or suppression of data
Error: Missing Data - Gap in DLLP	Complete decode of DLLP was not possible due to a gap or suppression of data
Error: Missing Data - Gap in Training Sequence	Complete decode of Training Sequence ordered set was not possible due to a gap or suppression of data
Error: Missing Data - Gap in packet	Complete decode of Training Sequence ordered set was not possible due to a gap or suppression of data
Lane-to-Lane Deskew Error	The link was not properly deskewed by the serial analyzer serial analyzer. Also displayed when the sample contains SKP (K28.0) symbols in one or more lanes but not all lanes of the link. This error message is displayed until a sample containing all SKP (K28.0) symbols is found. No further post processing of packets is performed when the link is not deskewed.

Maintenance

This section contains the information needed for periodic and corrective maintenance of the serial analyzer modules.

Diagnostics

The serial analyzer module performs power-on diagnostics each time you power on the mainframe. The Calibration and Diagnostics property sheet appears at power-on if one or more of the diagnostics fail.

Power-On Diagnostics

Power-on diagnostics check basic functionality of the serial analyzer at every power on. If any failures occur at power on, the screen displays the calibration and diagnostics property sheet.

If there are no diagnostic failures when you power on the mainframe, you can display and run the calibration and diagnostics property sheet by selecting Calibration and Diagnostics from the System menu.

Extended Diagnostics

The extended diagnostics execute more thorough tests than the power-on diagnostics. Using the extended diagnostics, you can do the following tasks:

- Run tests individually or as a group
- Run tests once or continuously
- Run tests until failures occur

NOTE. *For best results, only run the diagnostics with the probes disconnected from the module.*

To run the extended diagnostics, do the following steps:

1. Disconnect the probes from the serial analyzer module.
2. Start the TLA application if it is not already running.
3. From the System menu, select Calibration and Diagnostics.
4. Select the Extended Diagnostics property page.
5. Select the individual tests, group of tests, or all tests.
6. Click Run to start the extended diagnostics.

While the tests are executing, the word Running displays adjacent to the tests. When the tests are complete, either a Pass or Fail indication displays adjacent to each test.

Troubleshooting

This section describes some high-level procedures that you can perform to try to isolate common problems with your serial analyzer or probes. The following table lists some common problems and possible causes. Contact your local Tektronix representative for additional help in resolving problems and, if necessary, repairing the module or probes.



CAUTION. *To avoid damaging the serial analyzer module or the mainframe, be sure to power down the mainframe before removing or reinstalling any modules.*

Table 15: Failure symptoms and possible causes

Symptom	Possible cause(s)
Modules not recognized in the mainframe	<ul style="list-style-type: none"> ■ Modules not fully inserted in the mainframe. Turn off the mainframe and make sure that the module is flush with the front panel of the mainframe. ■ Mainframe power supply failure. Contact your local Tektronix service center. ■ Corrupted module firmware or incorrect module firmware. Reinstall the module firmware. (See page 14, <i>Updating the Serial Analyzer Module Firmware.</i>) ■ Module logical address switches on the rear of the module set to 00. Turn off the mainframe, remove the module and reset the switches to FF.
Module does not pass the normal power on diagnostics (READY indicator not green)	<ul style="list-style-type: none"> ■ Modules not fully inserted in the mainframe. Turn off the mainframe and make sure that the module is flush with the front panel of the mainframe. ■ Module failure; contact your local Tektronix service center.
Module loses settings when power is turned off	<ul style="list-style-type: none"> ■ Module failure; contact your local Tektronix service center.
Module will not acquire data or the acquired data is incorrect	<ul style="list-style-type: none"> ■ Module failure; contact your local Tektronix service center. ■ Faulty probe connections. Check the probe connections at the front of the module and at the SUT. ■ Faulty probe. See <i>Probe Troubleshooting.</i>

Probe Troubleshooting

If the serial analyzer module acquires no data or faulty data, the probes may be at fault. Perform the following procedure to isolate faults to a probe or to the serial analyzer module.

NOTE. *The following procedure requires that the mainframe is functional and operates normally when modules are installed.*

1. Verify that the probe is correctly connected to the module and to the SUT.
2. Move the suspected probe to another probe connection on the SUT and observe if the problem follows the probe. If the problem does not follow the probe, the module may be faulty.
3. Substitute the suspected probe with a known good probe and observe if the problem is still present. If the problem still occurs, the module may be faulty.

Care and Maintenance

Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent malfunctions and enhance reliability.

Preventive maintenance consists of visually inspecting and cleaning the instrument, and using general care when operating it. How often to perform maintenance depends on the severity of the environment in which the instrument is used. A proper time to perform preventive maintenance is during an incoming inspection.

Exterior Inspection

Inspect the outside of the instrument for damage, wear, and missing parts. (See Table 16.) Instruments that appear to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and performance.

Contact your local Tektronix representative to repair any defects. In particular, immediately repair any defects that can cause personal injury or lead to further damage to the serial analyzer module or mainframe where it is used.

Table 16: Internal inspection checklist

Item	Inspect for
Front panel and side cover	Cracks, scratches, deformations, missing or damaged retainer screws, ejector handles, or EMI shields.
Front panel connectors	Broken shells, cracked insulation, and deformed contacts. Dirt in connectors.
Rear connectors	Cracked or broken shells, damaged or missing contacts. Dirt in connectors.
Accessories	Missing items or parts of items, bent pins, broken or frayed cables, and damaged connectors.

Cleaning Procedures

Inspect and clean the instrument as often as operating conditions require. Collection of dirt on internal components can cause them to overheat and breakdown. Dirt acts as an insulating blanket, preventing efficient heat dissipation. Dirt also provides an electrical conduction path that can cause failures, especially under high-humidity conditions.



CAUTION. *Avoid using chemical cleaning agents that might damage the plastics and external labels used in the instrument.*

Use a cloth dampened with water to clean external surfaces. To prevent damage to electrical components from moisture during external cleaning, use only enough liquid to dampen the cloth or applicator.

Exterior Cleaning Procedure

To clean the exterior, perform the following steps:

1. Remove loose dust on the outside of the module with a lint free cloth.
2. Remove remaining dirt with a lint-free cloth or applicator and water, using only enough liquid to dampen the cloth or applicator. Do not use abrasive cleaners.

Cleaning the Probes

To clean the exterior surfaces of the probes, remove dirt and dust with a soft brush. For more extensive cleaning, use only a damp cloth. Never use abrasive cleaners or organic solvents



CAUTION. *Static discharge can damage any semiconductor component in the probe head. Always wear a grounded antistatic wrist strap whenever handling the probe head. Also verify that anything to which the probe head is connected does not carry a static charge.*

Repackaging Instructions

If at all possible, use the original packaging to ship or store the instrument. If the original packaging is not available, use a corrugated cardboard shipping carton having a test strength of at least 275 pounds (125 kg) and with an inside dimension at least six inches (15.25 cm) greater than the instrument dimensions. Add cushioning material to prevent the instrument from moving around in the shipping container. Seal the shipping carton with an industrial stapler or strapping tape.

Shipping the Instrument to the Service Center

Contact the Service Center to get an RMA (return material authorization) number, and any return or shipping information you may need.

If the instrument is being shipped to a Tektronix Service Center, enclose the following information:

- The RMA number
- The owner's address
- Name and phone number of a contact person
- Type of instrument and serial number
- Reason for returning
- A complete description of the service required

Mark the address of the Tektronix Service Center and the return address on the shipping carton in two prominent locations.

Storage

When not used in a mainframe, store the serial analyzer module in a clean, dry environment. The following environmental characteristics apply for both shipping and storage:

- Temperature range: -40 °F to +160 °F (-40 °C to +71 °C)
- Altitude: To 9843 feet (3000 meters)

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