Sierra M124
SAS/SATA Protocol Analyzer

User Manual

For software version 5.70

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Teledyne LeCroy Protocol Solutions Group

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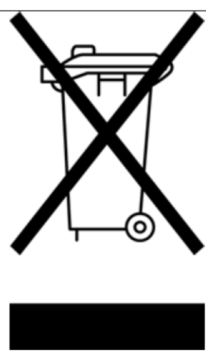

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Chapter 1

Introduction

This manual describes installation and operation of the Teledyne LeCroy Sierra M124™ Protocol Analyzer and includes examples of typical applications.

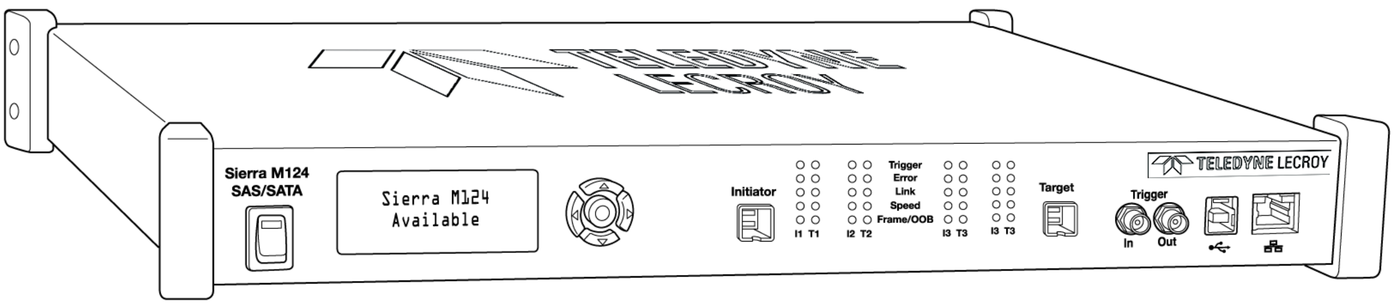

Figure 1.1: Teledyne LeCroy Sierra M124 Protocol Analyzer

1.1 Analyzer Overview

The Sierra M124 SAS/SATA Protocol Analyzer is a serial bus analyzer. The SAS/SATA Protocol Suite software performs serial bus analysis for Serial Attached SCSI (SAS) data transfers, as well as Serial ATA (SATA) data transfers through STP data transfers and Serial ATA (SATA) data transfers.

The Sierra M124 Analyzer helps Hardware, Firmware, Design, and Application Engineers troubleshoot and diagnose SAS and SATA problems within their product. The analyzer supports the following:

- Capture, triggering, and filtering of Serial Attached SCSI packets or Serial ATA packets
- CATC API

The analyzer provides for bi-directional trigger and capture of commands, primitives, patterns and all bus conditions. You can capture all frames and/or exclude traffic.

The Sierra M124 Analyzer has a USB port and an Ethernet port to connect to a computer. You can cascade analyzer units for higher port counts. The analyzer allows you to select frames to include and exclude for capture. Capturing can be triggered based on a specific event or manually.

The Sierra M124 Analyzer provides a full range of views and statistical reports.

1.2 Features

- Up to 12 Gb/s SAS and 6 Gb/s SATA protocol analysis or error injection
- Capture, triggering, and filtering of Serial Attached SCSI or Serial ATA packets
- Easy mode triggering
- Cascade up to 8 analyzers
- Sync with Teledyne LeCroy Sierra family products
- CrossSync
- Hardware filtering by Analyzer at Wire speed
- Automatic error detection
- Comprehensive decoding of SAS and SATA data traffic
- Logical and chronological traffic displays
- Statistical reporting
- Trace memory of up to 32 GB (Sierra M122) or 64 GB (Sierra M124)
- GbE & USB 3.0 host interfaces to connect to a host machine
- CATC API
- Automation API
- Error Injection Functionality (InFusion Jammer)
- Traffic Generation Functionality (Trainer)

1.3 Receiving Your Analyzer

The analyzer package includes the following components:

- 1 Sierra M124 Analyzer identified in the packing list
- 2 miniSAS HD cables, 1 meter
- 1 USB A-B 2.0 cable, 1.8 meter
- 1 USB A-B 3.0 cable, 1 meter
- 1 Ethernet cable, 10 feet
- 1 Three-Prong AC power cord
- 1 Installation CD ROM with software and documentation
- 1 Sierra M124 Getting Started manual

1.4 Unpacking Your Analyzer

Inspect the received shipping container for any damage. Unpack the container and account for each of the system components listed on the accompanying packing list. Visually inspect each component for absence of damage. In the event of damage notify the shipper and Teledyne LeCroy Corporation. Retain all shipping materials for shipper's inspection.

1.5 Analyzer Features

The Analyzer has the following features:

- Power Switch
- Frame, Speed, Link, Error, and Trigger LEDs
- External Trigger Input and Output
- Initiator and Target mini-SAS connectors (4)
- Expansion In/Out data ports and Clock In/Out connectors
- Status and Configuration LCD Display

- USB port for host connectivity
- Gigabit Ethernet port for network connectivity
- Power In (on back)

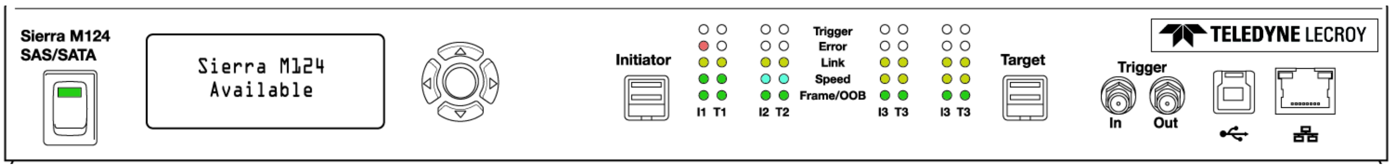

Figure 1.2: Front Panel

1.6 LEDs

Each link is supported by LEDs with the following functionality:

GreenThis LED is illuminated during the OOB (Out of Bound) sequence before the link is established and after link is established it indicates traffic on the bus.

Orange This LED is illuminated as follows:

Speed	Initiator	Target
1.5G	On	On (Green)
3.0G	On	On (Green)
6.0G	On	On (Yellow)
12.0G	On	On (Blue)

Yellow This LED is illuminated when a link is established.

Red This LED illuminates when an error occurs.

Blue This LED is illuminated when a trigger occurs.

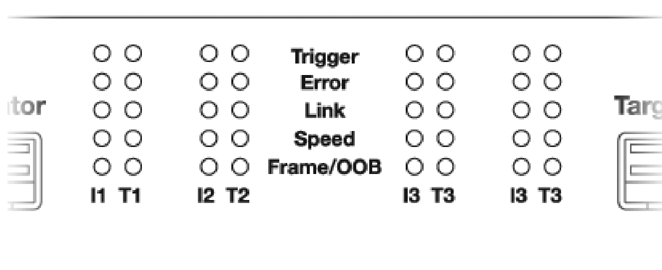

Figure 1.3: LEDs

1.6.1 Status and Configuration Display

The Analyzer front LCD display indicates the configuration and status of operations. For example, during initialization, the LCD panel displays boot status messages.

1.6.2 Temperature and Humidity

The hardware should operate flawlessly in the following temperature ranges:

- ❑ Operating 0 °C to 55 °C (32 °F to 131 °F)
- ❑ Non-Operating -20 °C to 80 °C (-4 °F to 176 °F)

The hardware should operate in the following humidity range:

- ❑ 10% to 90% RH (non-condensing)

1.7 Installing Your Analyzer

1.8 Software Installation

The SAS and SATA software works on systems using the Windows® XP, Windows 7 (x86, x64) Windows 8 (x86, x64), Windows Server 2003, Windows Server 2008 and Windows Server 2012 R2 operating systems. 64-bit Windows OS is recommended because it allows using more RAM memory. Other Operating Systems limit the RAM to 3GB.

1. Insert the Installation CD ROM into the CD/DVD drive on the host machine.
2. The installation automatically starts setup, unless Auto Run is off. In that case, select the CD ROM from “My Computer” and click **Setup**.
3. After the warning to close all other programs and before starting the installation, the Install component selection opens.
4. Select components for installation.
5. Click **Next** to complete the installation.

1.8.1 System restart

You must restart your computer before you can use your Protocol Suite software.

1.8.2 Error Message

If you get an error message during installation of the drivers for Window, consult your system administrator. Your system may allow only administrator-level users to copy such driver files.

1.9 Hardware Setup

1.9.1 Separate Systems

When using the analyzer, it is recommended to use a system to generate bus traffic and a second system to run the software, to avoid characterization of traffic generated by the analyzer.

1.9.2 Connecting in General

Note: You must install the software before connecting the analyzer to the host machine for the first time.

To set up the analyzer:

1. Plug the power adapter into the unit, and then plug the power adapter into a 100V–240V, 50Hz–60Hz, power outlet. Turn on the Power switch.
   At power on, the analyzer will go through initialization as shown on the LCD display.
2. Connect the USB cable between the Sierra M124 USB port and a USB port on the host machine. The host machine's operating system detects the analyzer and driver files.
3. Connect the analyzer as shown in Figure 1.4.

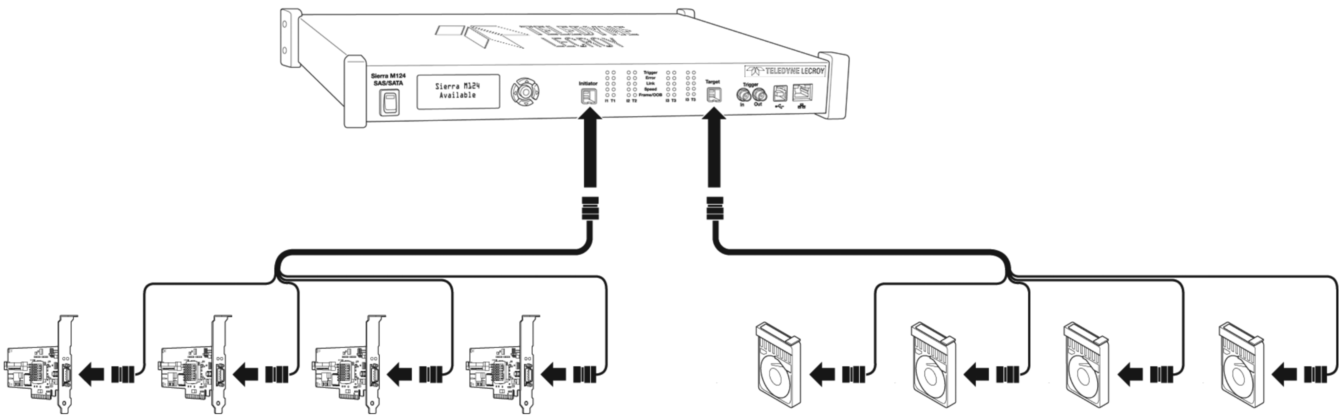

Figure 1.4: Analyzer Single Lane Connections

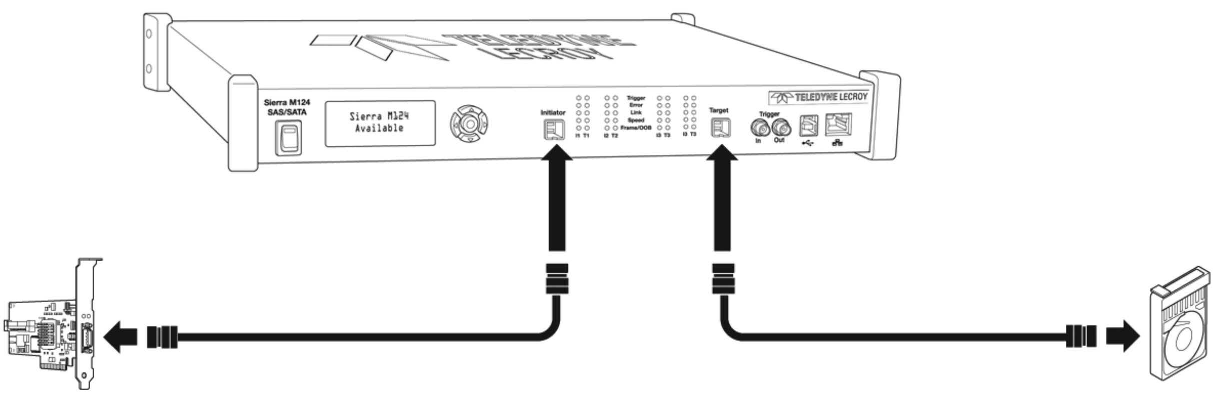

Figure 1.5: Analyzer MiniSAS HD Connections

1.9.3 Cables to Use

When connecting between a HBA and a disk drive, use a crossover MiniSAS HD from the initiator port on the Sierra to MiniSAS HD, and a MiniSAS HD from the target port to SATAx4, connecting the SATA connector to the disk drive.

1.10 Expandability

The Analyzer provides cascading, external power and other functions through optional expansion cards on the back panel. You can expand by:

- Cascading with CATC SYNC Expansion Cards
- Using the Power Expansion Card

You can remove expansion cards with two simple tools.

Cascading and Memory Size
For example, you have two units. The first one has 2 GB memory. The second one has 4 GB memory. The system shows the entire memory as 6 GB. If you set buffer size to 6 GB, the system programs the first board for 2 GB and the second board for 4 GB. You can consider this ratio when you set buffer size to any value. For example, if you set buffer size to 2 GB, the system programs the first board for (2*2)/6 GB and the second board for (2*4)/6 GB. Any unit that has more memory will have larger buffer size.

1.10.1 Cascading with CATC SYNC Expansion

You can use cascading of analyzer units for higher port count, by connecting the units through the optional CATC SYNC Expansion Card on the analyzer back. Using the CATC SYNC Expansion Cards will not sequentially trigger the State Machine in Advanced mode.

Connecting a Sierra M124 and a Summit T3-16 via the CATC Sync Expansion Card (ACC-EXP-002-X)

A Sierra M124 and a PCIe Summit T3-16 are connected using their CATC Sync ports which require an optional expansion card (ACC-EXP-002-X) (see Figure 1.6 on page 15).

Note: Refer to the relevant protocol analyzer user manual for instructions on how to install the expansion board.

To do so perform the following steps:

1. Make sure to stop any recordings in progress.

Note: You may plug/unplug the sync cable while the analyzer unit is powered on.

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2. Connect the female end of the sync cable to the SYNC OUT port of the Sierra M124.
3. Connect the male end of the sync cable to the SYNC IN port of the PCIe Summit T3-16.

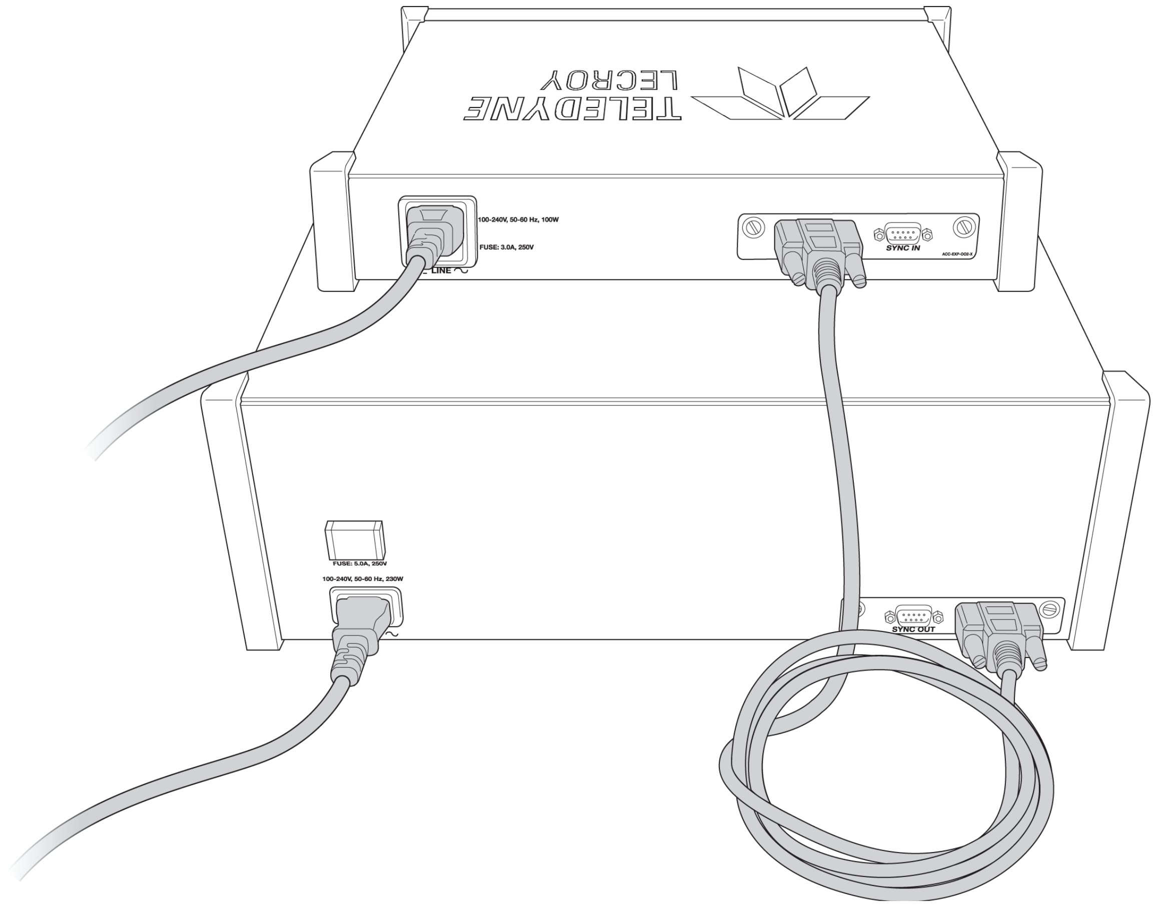


Figure 1.6: An Example of Connecting a Sierra M124 and a Summit T3-16

You can cascade up to eight Sierra Analyzers, if they all have a CATC SYNC expansion card.

Note: If the Sierra M 124 has a CATC SYNC Expansion Card, you can cascade with Sierra M6-4, M6-2 and M6-1.

1.10.2 Select Device

After starting the software, click on **Setup a**nd select **All Connected Devices** (see Figure 1.7 on page 16).

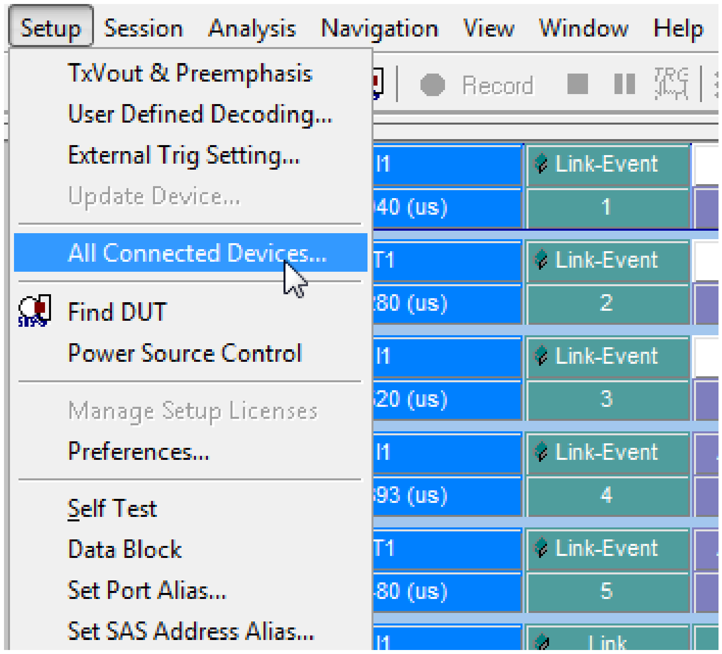


Figure 1.7: Connecting to All SAS/SATA Device(s)

The **Select Device** dialog allows connecting and disconnecting analyzers on the fly, without restarting the application.

The new Device List (introduced in version 4.10) mandates using updated firmware in order to detect the analyzer over Ethernet. Thus, the analyzer must be updated over USB before it can be used remotely over Ethernet. This is applicable for any update from version 4.00 or earlier to any version from 4.10 or later.

The following **Select Device** dialog displays (see Figure 1.8 on page 17). The colors in the 'Location' column mean the following:

- Red: Firmware and/or BusEngine components need to be updated to the latest version
- Light Blue: The device is ready to be connected.
- Yellow: The device is locked.
- Green: The software is connected and ready to run.

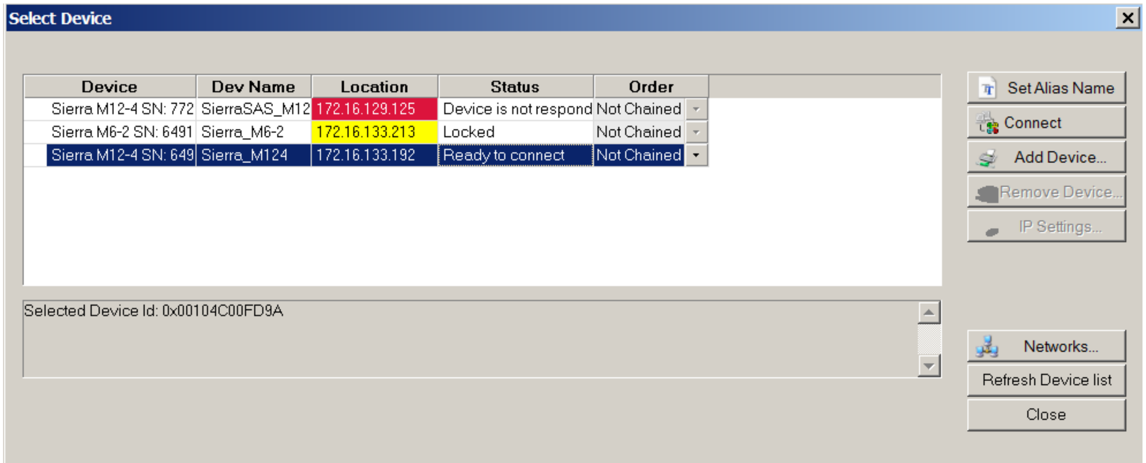


Figure 1.8: Select Device Dialog

Note: Click **Refresh Device List** to display all the devices on the network.

The Select Device dialog displays the following buttons:

Set Alias Name

Click **Set Alias Name** to display the Set device alias name dialog as shown below.

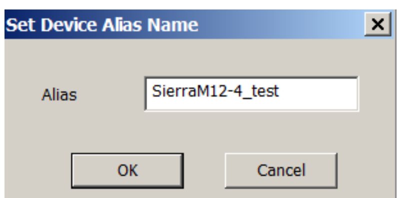


Figure 1.9: Set Device Alias Name Dialog

Disconnect

Click **Disconnect** to disconnect a device.

Add Device...

Click **Add Device** to add a device with a static IP address.

Note: You must close and re-open the application when changing to static IP mode through the front panel instead of the application.

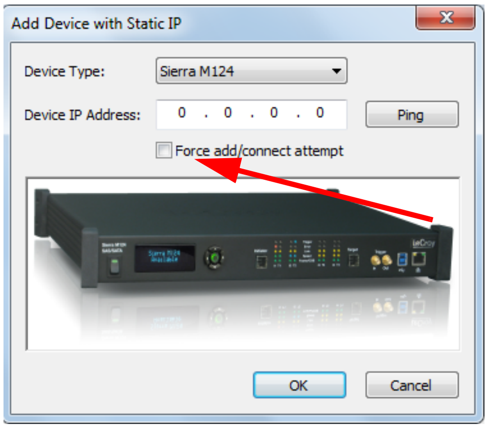


Figure 1.10: Add Device with Static IP Dialog.

Force Add/Connect Attempt

Use this option if the application's Ping function fails (the button in the upper right corner), but you are sure that the address is correct, and you still want to attempt the connection. This setting is stored in the device.

Remove Device

Click **Remove Device** to remove a previously added device.

IP Settings...

Click **IP Setting** to reset IP settings of a device. The following IP Setting dialog displays.

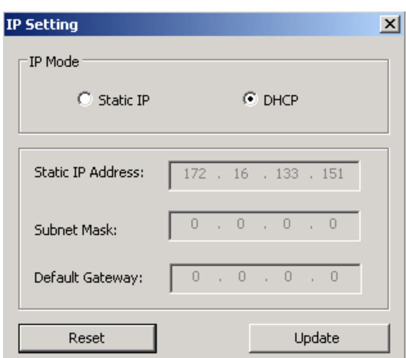


Figure 1.11: IP Setting Dialog

Networks...

Click **Networks** to select a network adapter. The following dialog displays.

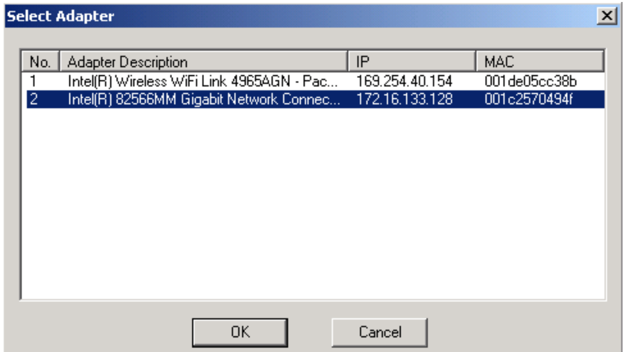


Figure 1.12: Select Adapter Dialog

Refresh Device List

Click **Refresh Device List** to refresh the device list.

To connect to a device, select a device which is Ready to Connect and click the **Connect** button on the right. The Connection Properties dialog is displayed (see the following screen capture).

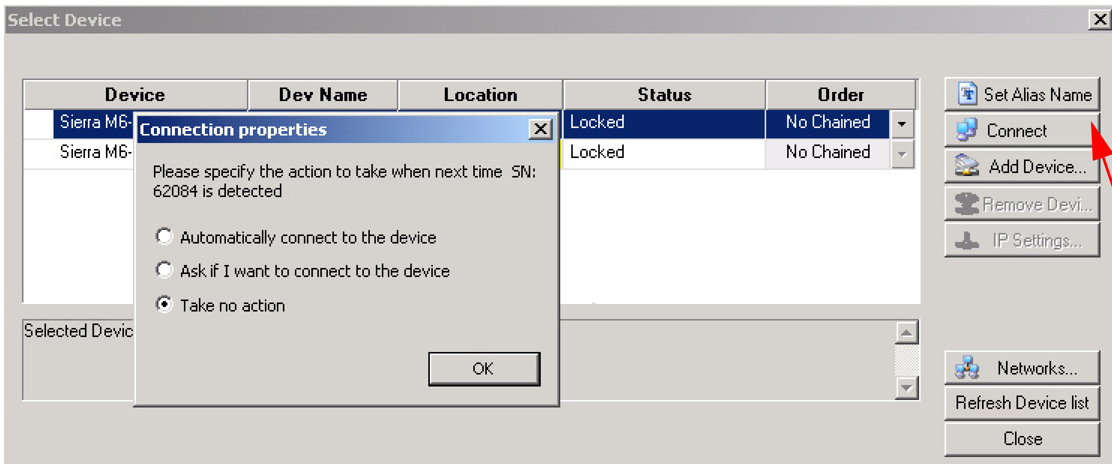


Figure 1.13: Connection Properties Dialog

Specify one of the actions from the following:

- Automatically connect to the device
- Ask if I want to connect to the device
- Take no action

If 'Automatically connect to the device' is selected, the next time the application opens the device will be automatically connected.

In the **Select Device** dialog chained or cascaded units are displayed in the **Device** column with a **[** (square bracket) icon. The sequence of the units is displayed in the **Order** column. See the following screen capture.

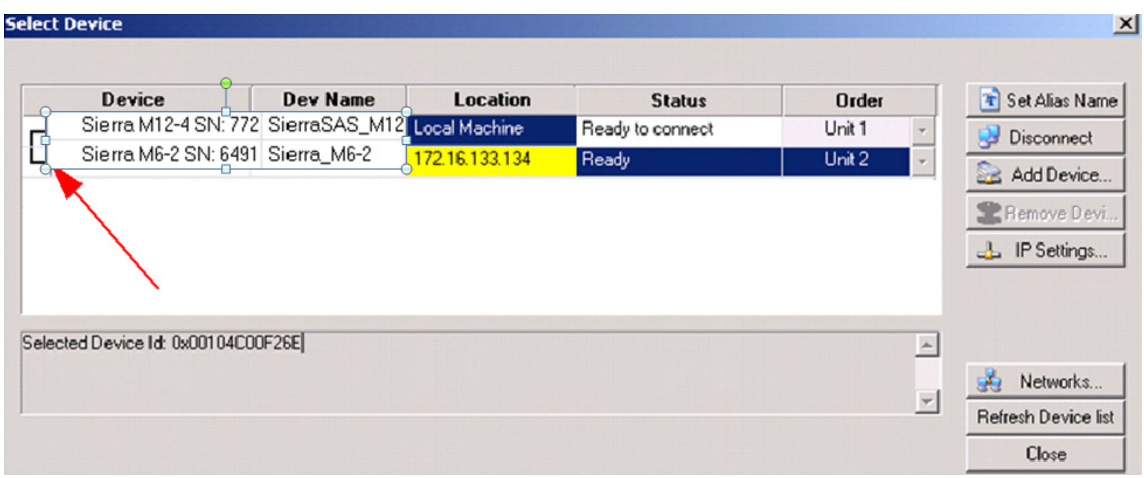


Figure 1.14: Select Device Dialog Displaying Unit 1 and Unit 2 Chained

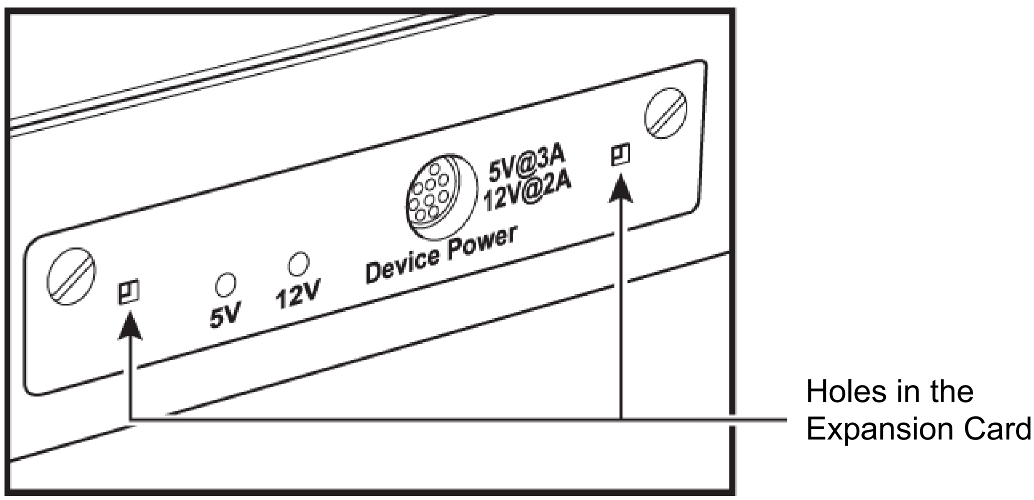
1.10.3 Using the Power Expansion Cards

Two types of Power Expansion Cards are available and the type must be specified when ordering the unit.

- Power Expansion Card (part number: ACC-EXP-004-X)
- Power Expansion Card 2 (part number: ACC-EXP-005-X)

Power Expansion Card (part number: ACC-EXP-004-X)

You can use the Power Expansion Card to power the drives to test for Emulation, SATA Compliance, and SAS Verification. The Power Expansion Card can supply 5 V or 12 V.



Power Expansion Card 2 (part number: ACC-EXP-005-X)

This card has several capabilities:

- Supplies power to devices at 12v, 5v, 3.3v, 1.5v and/or 1.2v.
- Allows monitoring in the trace of the DevSlp signal as generated by the Trainer or Host Emulator, as well as when generated directly from a Host (using a dedicated DevSlp cable). See "DevSlp" on page 336 and "Exit_DevSlp" on page 336). Also see "Device Sleep (DevSlp)" on page 119.
- Allows CATC Sync functionality to enable cascading, so there is no need to toggle between the Power Expansion Card and the Sync Expansion Card.
- Allows power measurement to monitor and record the power, current and voltage being used by the device it powers (will be supported in a future software release).

Note: When it runs, the Host Emulator turns on the voltage on all channels, whether they are turned on or off previously. The emulator does not execute any command until its link is established. So if the power is off on any channel, the emulator will not proceed even if the first command is a Power On command.

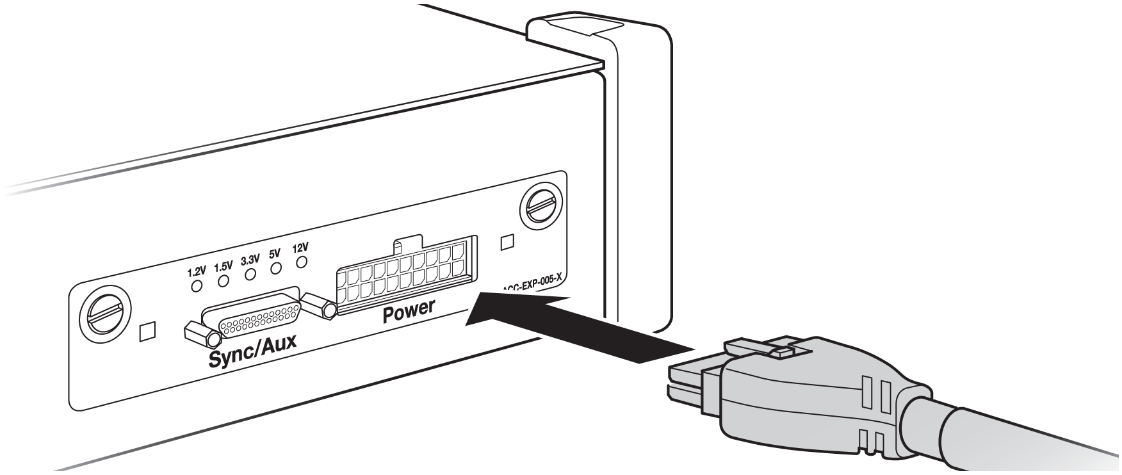


Figure 1.15: Power Expansion Card 2

It is shipped with the following three cables:

- Standard 4-pin power connector (ground, 5v, 12v only): This is a direct replacement for the existing Power Expansion Card cable.
- SATA 15-pin power segment connector: This plugs in to the power segment of the standard SATA connector, allowing to control and monitor its power and DevSlp.
- DevSlp cable: This cable is used to monitor DevSlp levels when the Device is connected directly to the Host. It is up to the user to supply a copy of the DevSlp signal coming from the Host to connect to the DevSlp wire of this cable, as well as to connect the adequate ground wire of this cable.

Activating the Power Expansion Cards

Select **Setup > Power Source Control** to display the Power Source Control dialog (see Figure 1.16 on page 23). Depending on the Power Expansion Card/s ordered the applicable device controls are enabled. Make the appropriate selections and click **Close**.

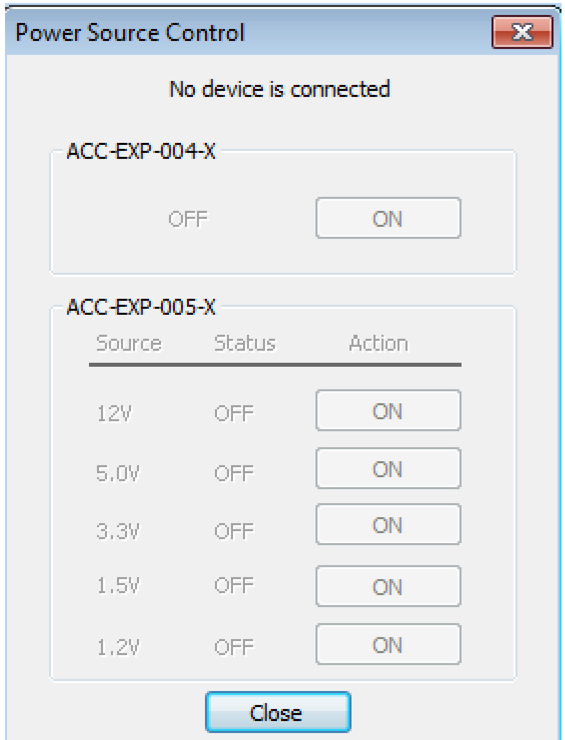
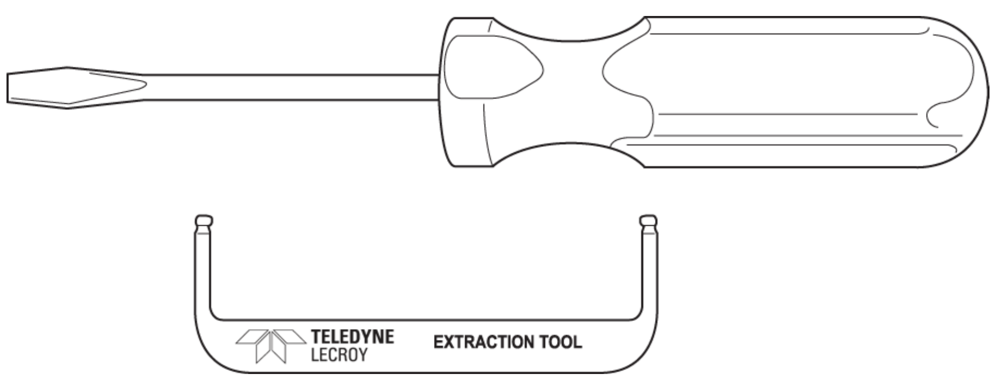


Figure 1.16: Power Source Control Dialog

1.10.4 Removing Expansion Cards

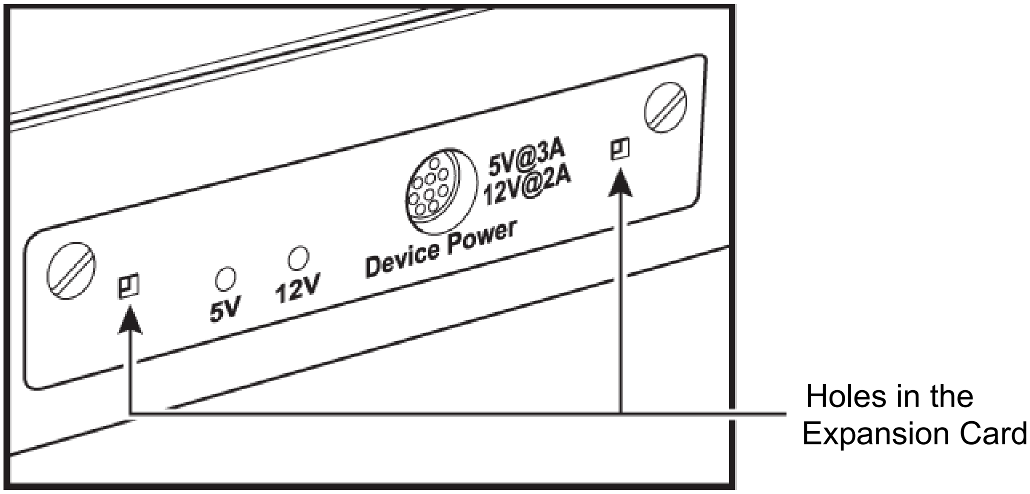
You can remove expansion cards using two tools:

- Standard (flat blade) 3/16” screwdriver
- Teledyne LeCroy Extraction Tool (part number 230-0160-00)



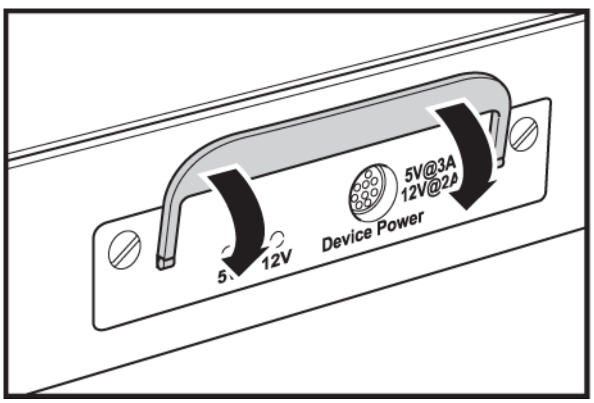
To remove an expansion card, follow these steps:

1. Unplug the system from AC power and turn the system so the expansion port is facing you. Note the two retaining screws and the holes for the extraction tool that are located on the panel of the expansion card.

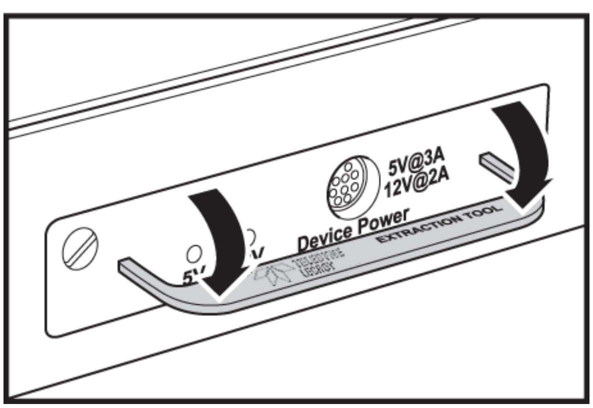


2. Insert the extraction-tool prongs into the holes in the expansion card panel.

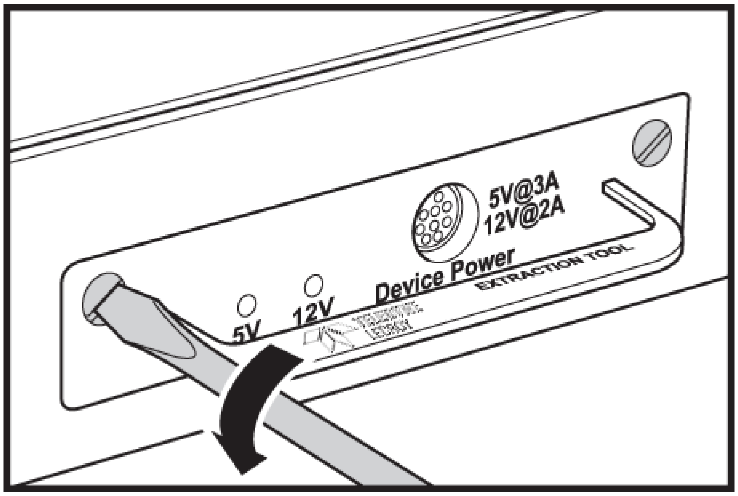
Note: If the prongs do not slip easily into the holes, use a small nail file or similar device to remove paint from the prongs.



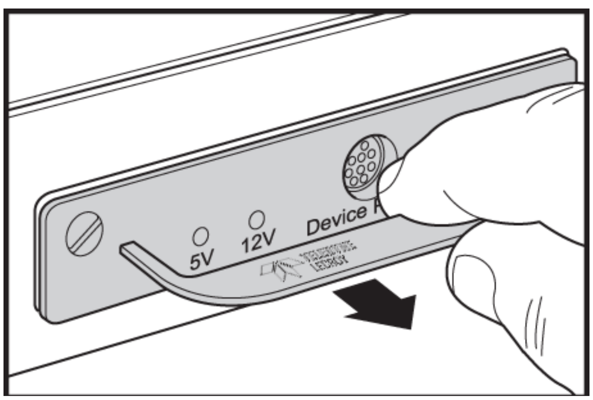
3. Rotate the extraction tool to a horizontal position to lock the prongs into place and make a handle.



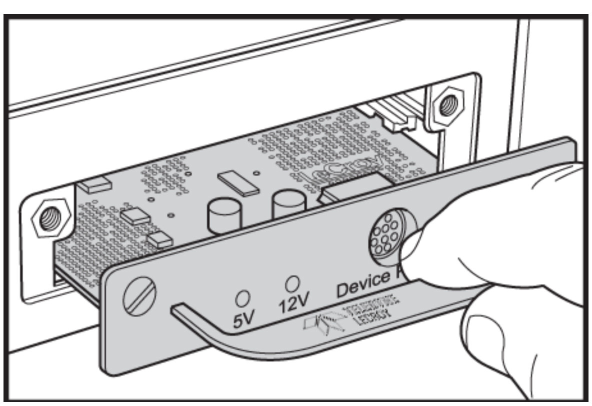
4. Using the screwdriver, loosen both retaining screws by rotating them counter-clockwise approximately two full turns, until feeling slight resistance. **Do not force the retaining screws** after two turns.



5. Using the extraction tool as a handle, gently wriggle the expansion card forward about 1/8”.



6. Repeat steps 4 and 5 approximately three times, until the card is free from the retaining screws and you can remove the card from the system.



1.11 Connecting via Ethernet

The Ethernet connection can have any of these configurations:

1. Analyzer connected to a network using a hub or switch, Gigabit Ethernet interface, or similar device.
2. Analyzer connected to the host machine (machine running the application software), using a hub or switch, Gigabit Ethernet interface, or similar device.
3. Analyzer connected directly to the host machine using a crossover cable.

1.12 Connecting to a Network

When connected to a network, the analyzer can communicate with the DHCP server to obtain IP address configuration information in order to establish a connection. Refer to “Select Device” on page 15.

1.13 Connecting over Different Subnets

If the host machine (with the Sierra software) and Sierra M124 are on the same subnet, they will see each other’s broadcasts, and the Sierra M124 application will automatically appear in the Select Device dialog, from which you can select a device (as described in the previous section).

If the host machine and Sierra M124 do not reside on the same subnet, they will not see each other automatically. You must add the Sierra M124 IP address manually. To add the IP address, use the Add Device button (see Figure 1.10 on page 18)

1.14 TCP and UDP Ports Must be Open to Connect over Ethernet

WARNING: Check your firewall settings before making Ethernet connections. Incorrect firewall settings can prevent Teledyne LeCroy applications from detecting analyzers on the network, though Ping works correctly. Consult your Firewall documentation to allow Teledyne LeCroy applications access to the network.

The following TCP and UDP ports must be open to connect over the Ethernet:

- **TCP Port**: 4000 to 4003
- **UDP Ports**: 4015 to 4017

1.15 Launching Your Analyzer

To launch the software, double-click the **SAS** Icon in the Program Manager Window.

1.16 Operating in Simulation Mode

The SAS/SATA application operates in the Simulation Mode by default if the hardware is not detected.

The Protocol Suite software launches and displays the appropriate tool bar, but with the limitation that the Analyzer operates only on static, previously captured, bus data.

Limitations The Simulation mode lets you try all of the available functions, but keep in mind that the system is not capturing any real data and is displaying only pre-captured results.

1.17 Using the Software

The Sierra M124 application uses the Teledyne LeCroy SAS/SATA Protocol Suite.

The Teledyne LeCroy SAS/SATA Protocol Suite can is a:

- **Protocol Analyzer:** Captures data, triggers on events, and saves. **Easy Mode** allows standard Trigger and Data capture. **Advanced Mode** allows you to program custom triggering in and out, capturing, state jumps, and timers (see "Protocol Analysis" on page 37).

The SAS/SATA application now provides functionality for both protocols. Either protocol can now be accessed via the **File** menu and choosing the protocol to work with. Click **File> New** and select the desired protocol and application.

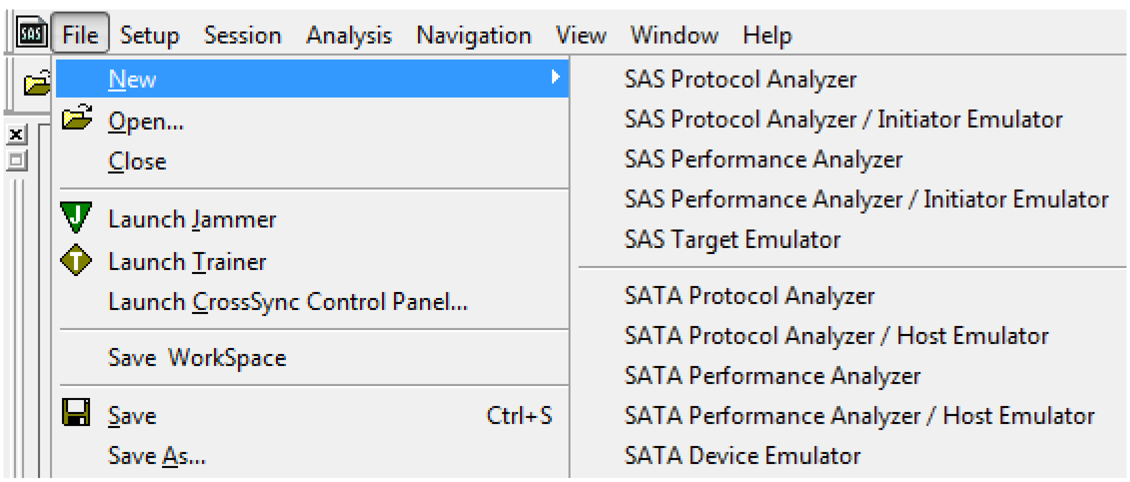


Figure 1.17: File Menu

To switch between protocols click **Window** and the select the trace or application to use.

Depending on the protocol in use, the relevant functions and menu options are available and the others are greyed out (see Figure 1.18 on page 28).

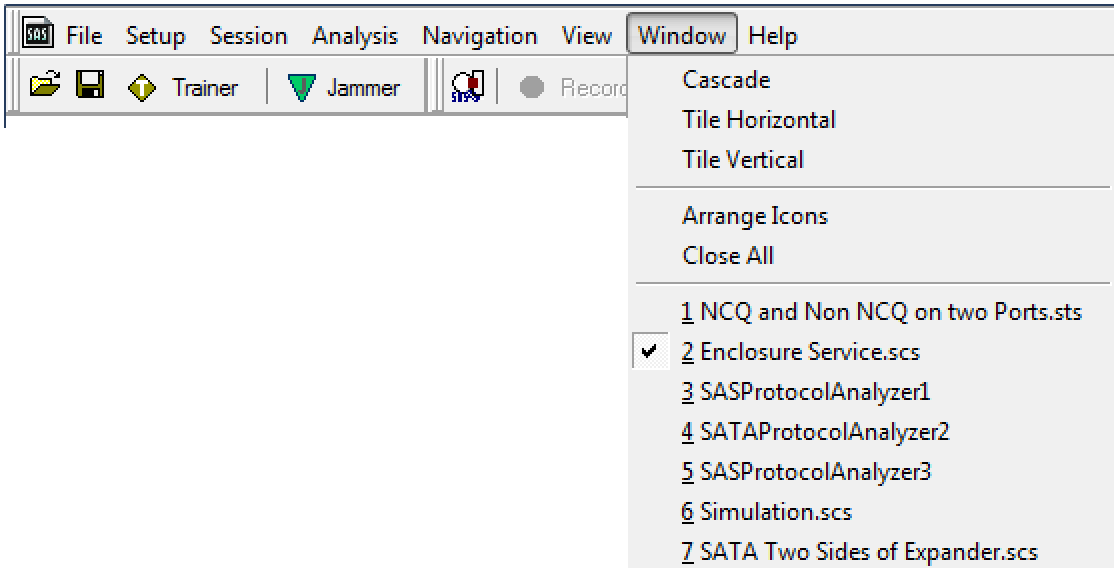


Figure 1.18: Window Dialog

1.18 Getting Started with the Protocol Analyzer

To use the software for protocol analysis, first select **File > New > SAS Protocol Analyzer**

or **File > New > SATA Protocol Analyzer** for a new project or **File > Open** an existing protocol analysis file: .**sac** for a SAS file or .**stc** for a SATA file (see "Protocol Analysis" on page 37). You can also open a **.scs** SAS Sample file or **.sts** SATA Sample file. Example files are in the Examples folder.

Note: Project files created on the Sierra M6-X family of analyzer products are not compatible with the Sierra M124 Analyzer. Open the files and perform a **Save As** to use them with the Sierra M124 Analyzer.

On the Capture tab, select to capture **Everything** or **Pattern**. For Pattern, select a Pattern. You can exclude patterns and frames. You can use different patterns for pre-trigger and post-trigger.

On the Trigger tab, select the trigger type. For Pattern, select the pattern.

On the Settings tab, select trigger position and memory use.

Change the Analyzer settings if necessary. Change the port Speed if necessary.

Use Advanced Mode only after you become familiar with the hardware and software and have special needs.

1.19 Teledyne LeCroy SAS/SATA Protocol Suite Menu Options and Toolbars

This section lists all the SAS/SATA Protocol Suite application menu options and the toolbars.

1.19.1 File

The File menu options allows you to perform common tasks such as open, close, save, export, print, send files and exit the application.

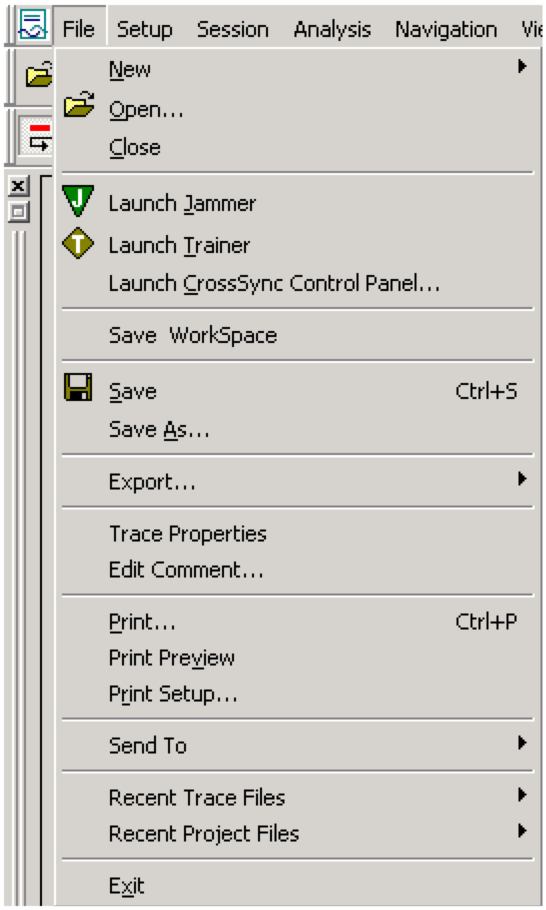


Figure 1.19: File Menu Option

1.19.2 Setup

For special work, you can use the Setup menu (see Figure 1.20 on page 30) to perform the following actions:

- TxRxVout & Pre-emphasis (see “TxRxVout & Preemphasis” on page 204)
- User Defined Decoding (see “User-Defined Decoding” on page 222)
- External Trig Setting (see “Floating Licence Dialog” on page 219)
- Update Device (see “Update Device” on page 221)
- All Connected Devices (see “Select Device” on page 15)
- Find DUT finds the Device Under Test (see “Find DUT” on page 225)
- Power Source Control turns the Device Under Test on and off
- Manage Setup Licences (see “Floating License” on page 219)
- Preferences (see “Preferences” on page 210)
- Self Test (see “Self Test” on page 324)
- Data Block (see “Data Blocks” on page 139)
- Set Port Alias (see “Set Port Alias” on page 202)

- Set SAS Address Alias (see "SAS Address Alias (SAS only)" on page 203)

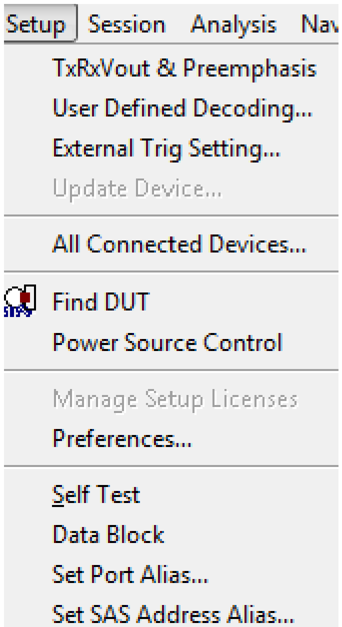


Figure 1.20: Setup Menu Option

1.19.3 Session

The Session menu has the following options:

- Start Capture/Record - Start capture or record a trace
- Pause Capture/Record - Aborts the capture without saving
- Stop Capture/Record - Stops the hardware

1.19.4 Analysis

The Analysis menu allows you to view captured data (see Figure 1.21 on page 31).

Menu items and toolbar options are enabled or disabled and displayed or hidden based on the type of window open. The following types of windows can be displayed:

- No active window
- Project file open
- Trace file open

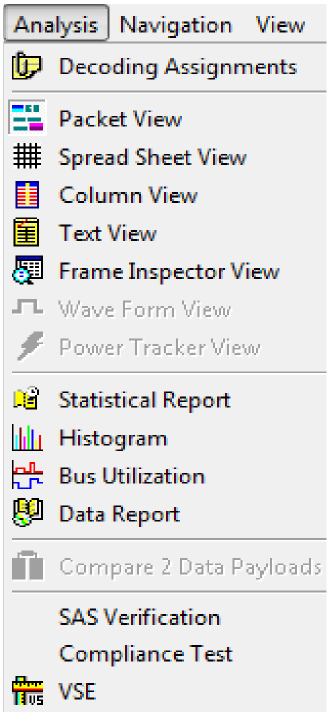


Figure 1.21: SAS/SATA Analysis Menu

1.19.5 Viewing Captured Data

Captured data can be displayed in several views. Select **Analysis** from the drop-down menu to access the different views (see “Analysis” on page 114). You can display the same data in:

- **Packet View**: Displays packets
- **Spreadsheet View**: Displays Packet View fields by time
- **Column View**: Displays packets in columns
- **Text View**: Shows transaction frames, grouped in columns by port
- **Frame Inspector View:** Has lots of information that is available in Packet View, but not Spreadsheet View, so it is most useful in conjunction with the Spreadsheet View
- **Waveform Display**: Shows waveform display for all active ports, on which you can perform timing measurements
- **Statistical Report**: generate statistics for all transports, commands, primitives, bus conditions, addresses, lanes, and errors
- **Histogram View**: Shows frame-type transfers
- **Bus Utilization:** Displays the utilization of the bus
- **Data Reports**: Displays data payloads
- **Compare 2 Data Payloads**: Compare two data payloads
- **VSE**: Perform custom post-process analysis of the open trace by running a verification script over the trace

1.19.6 Navigation

The Navigation menu has the following options to navigate through the application (see Figure 1.22 on page 32).

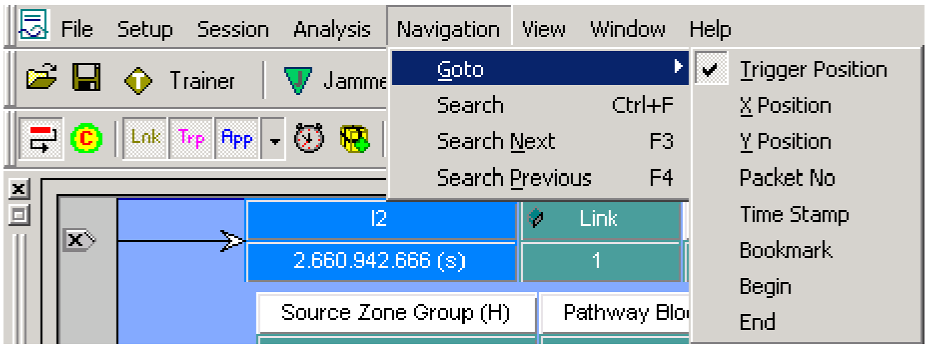


Figure 1.22: Navigation Menu Option

- Goto
  - Trigger Position
  - X Position
  - Y Position
  - Packet No
  - Time Stamp
  - Bookmark
  - Begin
  - End
- Search
- Search Next
- Search Previous

1.19.7 View

The View menu options allows the user to zoom in and out, enable/disable filtering and toolbars among other actions. It has the following options (see Figure 1.23 on page 33).

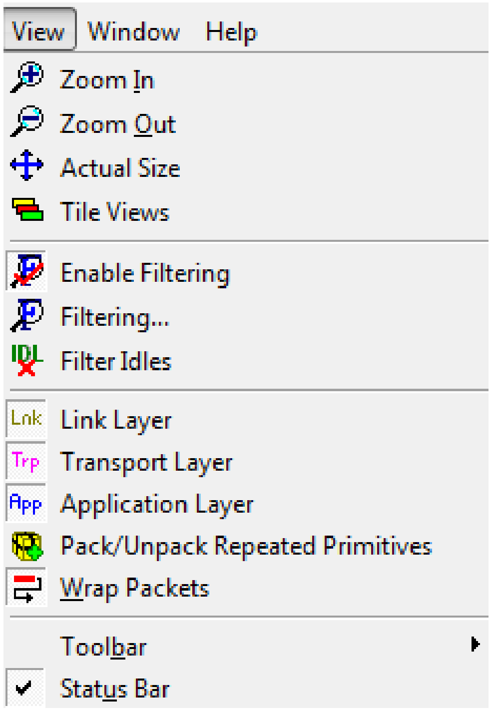


Figure 1.23: View Menu Option

- Zoom In (refer to "Navigation + View Toolbar" on page 161)
- Zoom Out (refer to "Navigation + View Toolbar" on page 161)
- Actual Size (refer to "Navigation + View Toolbar" on page 161)
- Tile Views (refer to "Navigation + View Toolbar" on page 161))
- Enable Filtering (refer to "Filter Setup" on page 167)
- Filtering (refer to "Filter Setup" on page 167)
- Filter Idles (refer to "Filter Setup" on page 167)
- Link Layer-SAS only (refer to "Packet View Toolbar" on page 186)
- Transport Layer-SAS only (refer to "Packet View Toolbar" on page 186)
- Application Layer-SAS only (refer to "Packet View Toolbar" on page 186)
- Pack/Unpack Repeated Primitives-SAS only (refer to "Packet View Toolbar" on page 186)
- Physical Layer-SATA only (refer to "Packet View Toolbar" on page 186)
- FIS Layer-SATA only (refer to "Packet View Toolbar" on page 186)
- Command Layer-SATA only (refer to "Packet View Toolbar" on page 186)
- Wrap Packets (refer to (refer to "Packet View Toolbar" on page 186)
- Toolbar (allows you to customize the toolbar with the options given below)
  - Main
  - Record+Capture
  - Analysis
  - Navigation+View
  - Packet View
  - Column View
  - Cursor position
  - Target Emulator

- Status Bar (refer to “Cursor Position Status Bar” on page 197)

1.19.8 Window

The Window menu has the following options:

- **Cascade:** Displays all open windows in an overlapping arrangement.
- **Tile Horizontal:** Displays all open windows in a above-below arrangement.
- **Tile Vertical:** Displays all open windows in a side-by-side arrangement.
- **Arrange Icons:** Arranges minimized windows at the bottom of the display.
- **Close All:** Closes all windows.

1.19.9 Help

For more information see “Help Menu” on page 223.

1.19.10 Toolbars

The toolbars enable you to perform several actions, some of which are listed below.

- Show or hide fields and ports, change port names, and change data format.
- Show the layers and channels using their toolbars.
- Decode using the Decode toolbar.
- Search and Filter.

There are five sets of toolbars (see Figure 1.24 on page 35):

- Main Toolbar - For details on the Main Toolbar refer to “SAS Main Toolbar” on page 41 and “SATA Main Toolbar” on page 41.
- Record Capture Toolbar - For additional information see “SAS Main Toolbar” on page 41 and “SATA Main Toolbar” on page 41.
- Navigation + View Toolbar - For additional information see “Navigation + View Toolbar” on page 161.
- Show Analysis Toolbar - For additional information see “Show Analysis Toolbar” on page 114.
- Packets View Toolbar - For additional information see “Packet View Toolbar” on page 186.
- Column View - For additional information see “Column View” on page 123.
- Cursor Position- For additional information see “Using the Cursors and Bookmarks” on page 197.

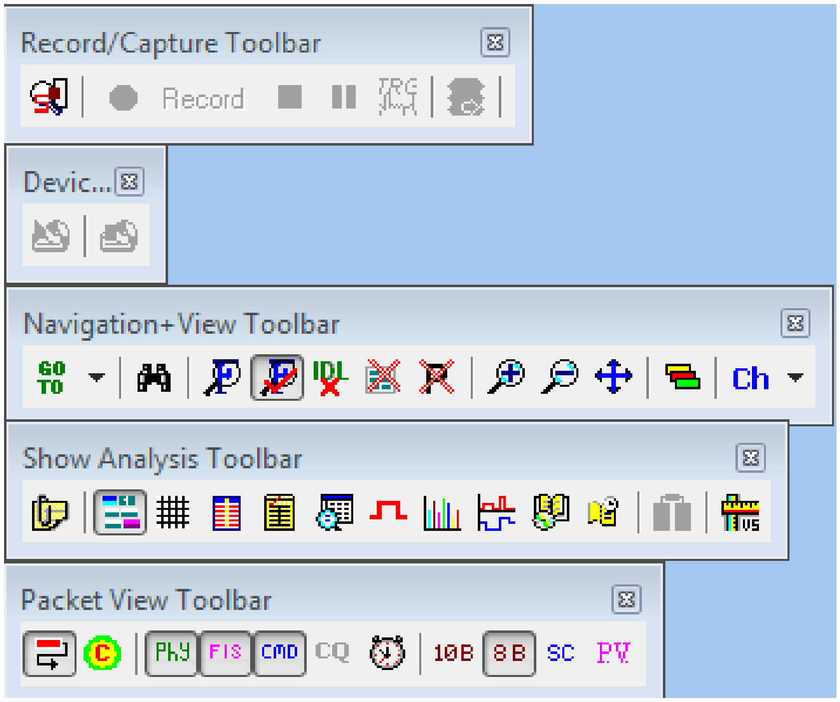


Figure 1.24: SAS/SATA Protocol Suite Toolbars

1.20 Port Status

You can display an overview of the active ports by clicking the buttons at the bottom right of the main window (see “Port Status” on page 195).

1.21 InFusion

The Teledyne LeCroy InFusion™ Error Injector and Traffic Modifier is an error injector and traffic modification tool for traffic passing through the Jammer. It allows you to verify real-world fault handling for Serial Attached SCSI (SAS) and Serial ATA (SATA) systems. Click on the Jammer icon 

to invoke the Teledyne LeCroy SAS or SATA InFusion, see “InFusion Overview” on page 345.

You can toggle between the InFusion and Analyzer panes by using the Alt+Tab keys, the Windows Task Bar or by pressing the respective toolbar button in each pane.

1.22 Trainer

The SAS *Trainer* is a traffic generator that can emulate a SAS initiator/target or SATA host/device. Traffic generation enables engineers to test designs under realistic conditions and to transmit known errors, allowing engineers to observe how devices handle faulty link conditions.

Traffic generation is performed via the execution of text-based scripts. These traffic generation files (*.**ssg**) contain statements about the types of traffic to be generated. These script files can be edited with either a simple text editor such as Notepad or with the included Script Editor utility.

Click on the Trainer icon 

to invoke the Teledyne LeCroy SAS or SATA Trainer, see “Sierra Trainer Traffic Generation” on page 407.

You can toggle between the Trainer and Analyzer panes by using the Alt+Tab keys, the Windows Task Bar or by pressing the respective toolbar button in each pane.

Chapter 2

Protocol Analysis

A default analyzer project is created automatically when the application starts. An analyzer project contains all the settings for capturing, triggering and memory usage. A project can be saved as a ***.sac** files for later use.

2.1 Easy Mode (Pre-Defined Setups)

After you install the Protocol Suite software (see "Software Installation" on page 12) and set up the Analyzer (see "Hardware Setup" on page 12), launch the Protocol Suite software (see "Launching Your Analyzer" on page 26) to display the default Protocol Analyzer in Easy Mode at the Capture tab.

The default Protocol Analyzer uses the Easy Mode which allows triggering and data capture.

2.1.1 Main Window

Use the Easy Mode to get a comprehensive overview of your analyzer's capabilities. Use the default Analyzer Project or create a new project.

For **SAS**: on the Analyzer Menu Bar, click **File > New > SAS Protocol Analyzer** to open a SAS Protocol Analyzer dialog (see Figure 2.1 on page 38).

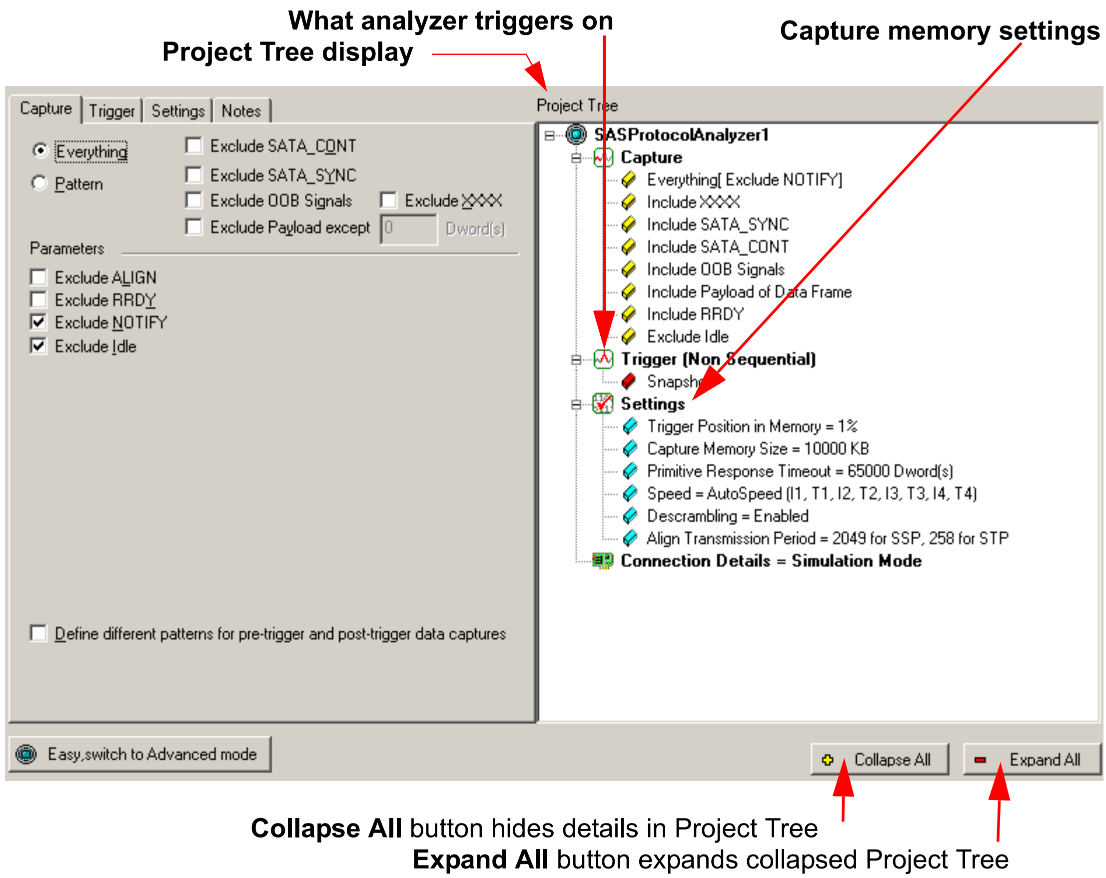


Figure 2.1: SAS: New Analysis Project Dialog.

The New Project dialog opens with default settings to capture Everything on the bus and to Trigger On on Snapshot. (The analyzer captures everything immediately without triggering on anything in particular.)

For **SATA:** On the Analyzer Menu Bar, click **File > New > SATA Protocol Analyzer** to open a SATA Protocol Analyzer dialog.

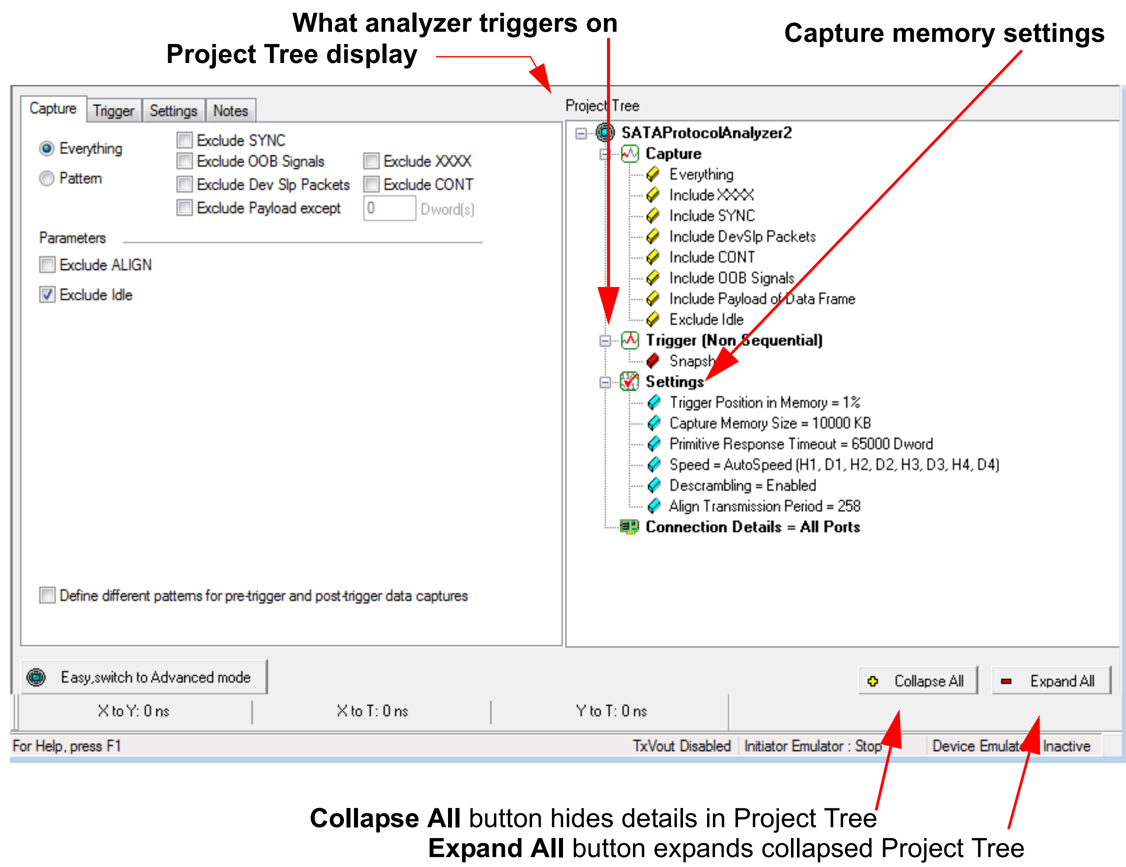


Figure 2.2: SATA: New Analysis Project Dialog.

SAS vs. SATA: SATA Dialog does not show “Exclude RRDY” or “Exclude NOTIFY”. SATA Dialog replaces “Exclude SATA_CONT” with “Exclude CONT” and “Exclude SATA_SYNC” with “Exclude SYNC”.

2.1.2 Project Tree

The Project Tree on the right side of the main window displays a comprehensive tree structured overview of the project. The project tree shows the capture configuration, trigger setups, and the capture memory settings.

Capture Tab Fields

The Capture tab has the following fields:

Exclude SATA_CONT (SAS) or Exclude CONT (SATA)

Check this to exclude SATA_CONT primitives from the data capture.

Exclude SATA_SYNC (SAS) or Exclude SYNC (SATA)

Check this to exclude SATA_SYNC primitives from the data capture.

Exclude OOB Signals

Check this to exclude OOB signals from the data capture.

Exclude XXXX

Check this to exclude XXXX patterns from the data capture.

Note: The validity of time stamps during Idles is traded off against good buffer memory utilization when using ‘Exclude XXXX’.

Exclude Dev Slp Packets (SATA)

Check this to exclude Dev Slp Packets from the data capture.

Exclude Payload except

Check this to exclude Payload of Data Frames from the data capture. You can except a number of DWORD(s).

Note: The Data Report (refer to “Data Report” on page 152) does not reflect excluded Payload of Data Frames.

Note: When showing truncated data in the Data Payload View, the truncation points are marked with a separator placed between payloads. You can get more information about the data exclusion using the tooltip over the separator.

Exclude ALIGN

Check this to exclude ALIGN primitives from the data capture.

Exclude RRDY (SAS only)

Check this to exclude RRDY primitives from the data capture.

Exclude NOTIFY (SAS only)

Check this to exclude NOTIFY primitives from the data capture.

Exclude Idle

Check this to exclude Idles from the data capture.

Define different patterns for pre-trigger and post-trigger data captures

Replaces the Capture tab with a Pre-Trigger Capture tab and a Post-Trigger Capture tab.

2.2 SAS/SATA Software Menus and Toolbars

The SAS and SATA software has the following menus and toolbars.

2.2.1 SAS Main Toolbar

The following figure displays the SAS main toolbar.

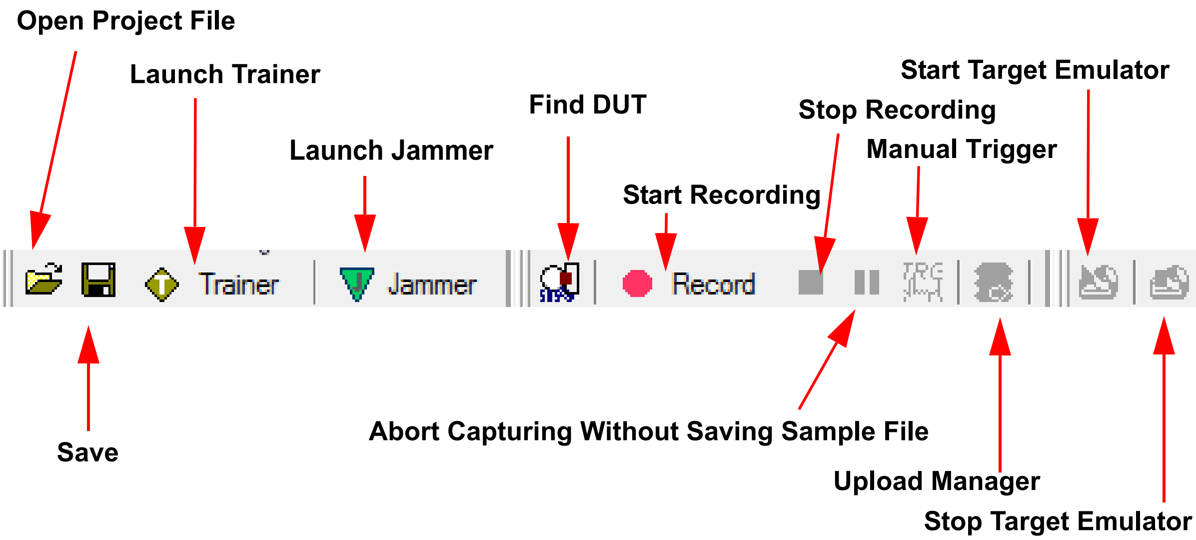


Figure 2.3: SAS: Software Menus and Toolbar.

2.2.2 SATA Main Toolbar

The following figure displays the SATA main toolbar.

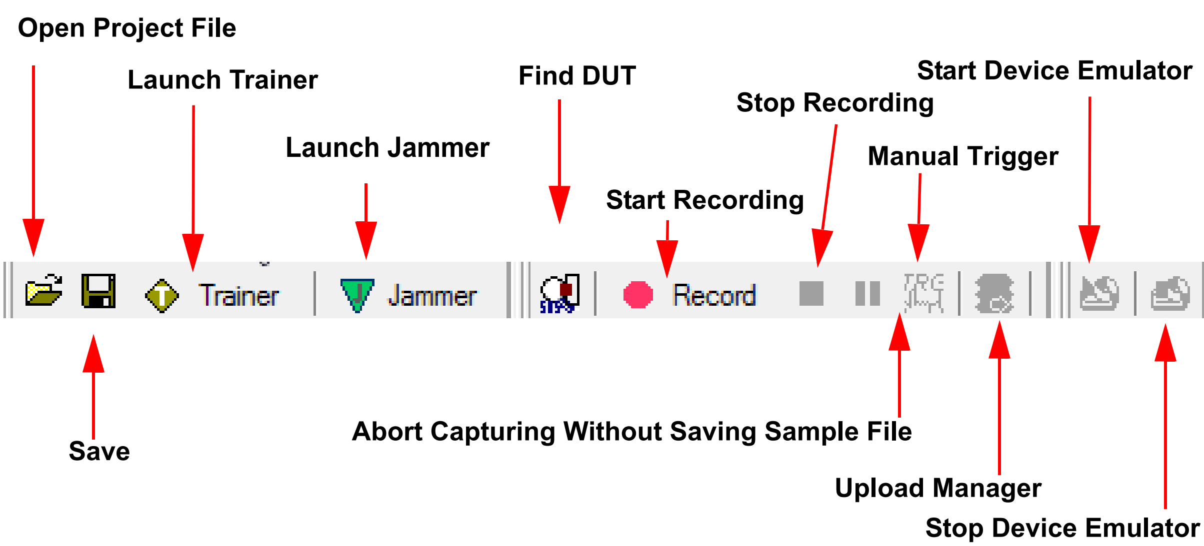


Figure 2.4: SATA: Software Menus and Toolbar.

2.2.3 Start Recording

To get an immediate overview of the bus traffic to and from your Analyzer:

1. Click the  **Record** button.
2. The analyzer begins filling the defined memory buffer with traffic captured from the bus. After the traffic fills the memory buffer, the traffic is uploaded to the viewer and the Packet View display opens. Packet View is the default display. However, more views are available by selecting **View** on the menu bar and choosing the desired View.

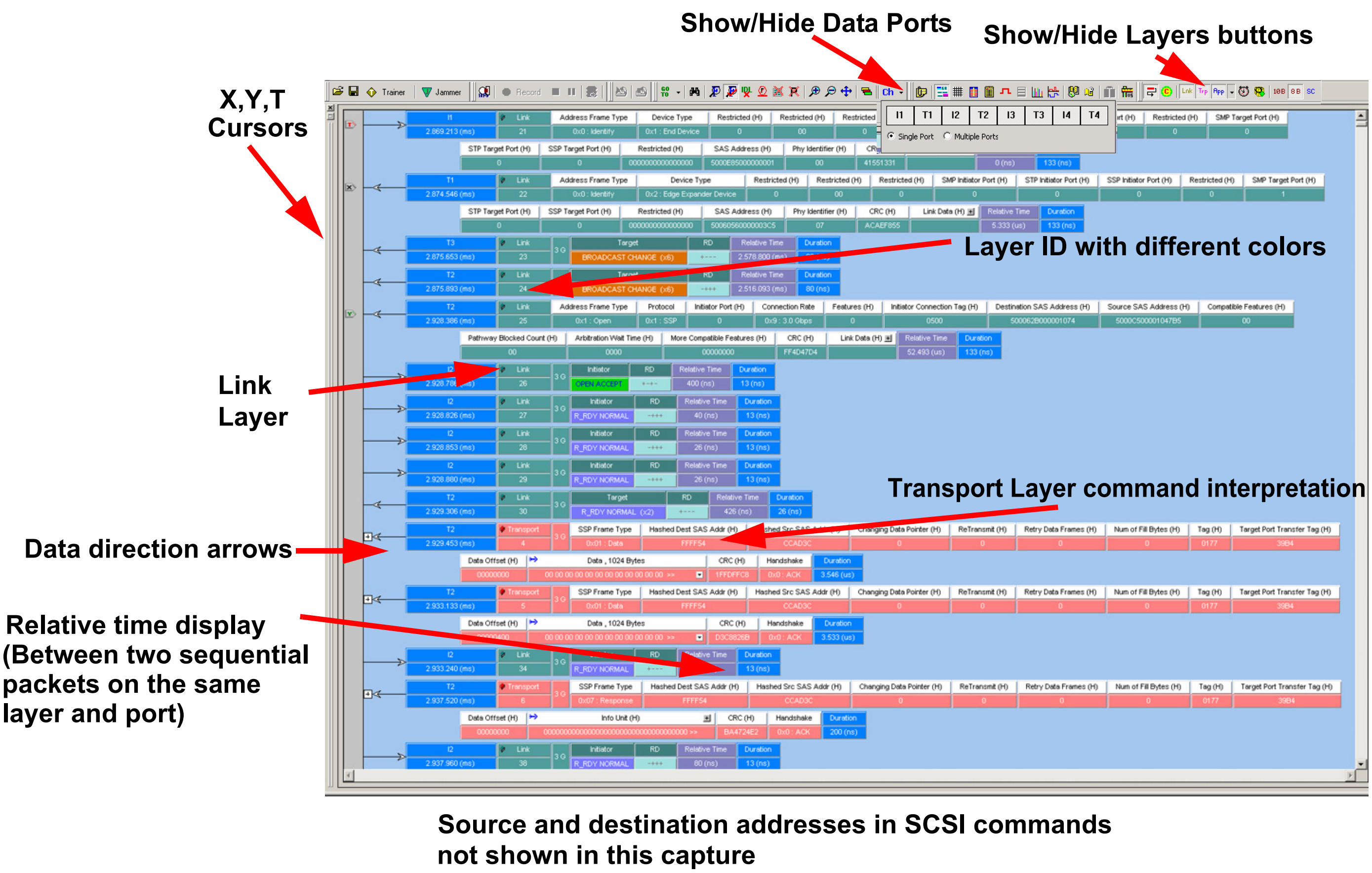


Figure 2.5: SAS: Typical Packet View .

Note: When using the Advanced Mode sequencer, the analyzer logs the state transitions in the trace, with the name the user gives to the state.

In the Packet View, right-click on any packet and select **Show->State**, to display the states and their transitions in the trace.

SAS: In case of an STP interface, the expander displays STP addresses provided to the SATA drive and the SAS software integrates the STP addresses in the ATA command.

The results display shows each transaction for every layer identified in a different color and the data direction identified with data direction arrows. Upstream traffic has an arrow from right to left: ⇐. Downstream traffic has an arrow left to right: ⇒.

Layers can be hidden by clicking the corresponding **Show/Hide** button on the menu bar. The system retains all captured data, but the display has fewer data layers for simpler viewing.

You can configure the viewer display for test and viewing preferences (see “Viewer Display” on page 111 for details about configuring the viewer display).

The Analysis Project dialog offers you a comprehensive set of choices to create a trigger and capture project satisfying some specific need. You can set the Analyzer to:

- Capture specific patterns (see “Patterns and Data Capture Setup” on page 54).
- Capture different patterns pre- and post-trigger.
- Exclude parameters from capture.
- Trigger on a pattern or sequence of patterns (see "Trigger Setup" on page 68).
- Configure trace capture memory (Settings tab).
- Select file to save trace capture in memory (Settings tab).
- Include a project note (Notes tab).

2.2.4 Launch Jammer

The Launch Jammer option invokes InFusion. For more information refer to “InFusion Overview” on page 231.

2.2.5 Launch Trainer

The Launch Trainer option invokes Trainer. For more information refer to “Sierra Trainer Traffic Generation” on page 291.

2.2.6 CrossSync Control Panel

The CrossSync Control Panel allows you to select analyzers for synchronization and manage the recording process. It supports a wide combination of Teledyne LeCroy’s flagship analyzers including PCI Express, USB, DDR, Serial ATA (SATA), Serial Attached SCSI (SAS), Fibre Channel (FC) and Ethernet.

CrossSync is Teledyne LeCroy’s analyzer synchronization solution that enables time-aligned display of protocol traffic from multiple daisy-chained analyzers showing packet traffic from multiple high-speed serial busses. A lightweight software control panel allows users to select analyzers for synchronization and manage the recording process. Captured traffic is displayed using the latest Protocol Suite software (in separate windows) with all the protocol specific search and reporting features.

Captured packets are displayed in separate windows that share a common time scale. Navigating the traffic in either direction will scroll to the same timestamp in a synchronized window. When using the CrossSync option, users can access the full complement of analysis capabilities available within the individual Teledyne LeCroy software. Search, reporting, and decoding all operate normally.

This feature is available with the Teledyne LeCroy SAS/SATA Protocol Suite application.

Launching the CrossSync Control Panel

To launch CrossSync from the SAS/SATA Protocol Suite software application, click on **File** and select **Launch CrossSync Control Panel** (see the screens below). Or, you can launch CrossSync from the '**Start**' menu.

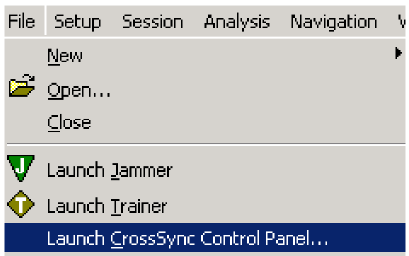


Figure 2.6: Launching CrossSync from the SAS/SATA Protocol Suite Application.

Please refer to the ***CrossSync Control Panel User Manual*** for more information.

2.2.7 Save Workspace

Viewing parameters can be saved in a workspace as a **.wss** file.

After you open a trace and select views, you can save the viewing parameters in a workspace file. Select **File > Save Workspace** to open a Save As dialog. Save the current workspace as a **.wss** file.

To set default workspace viewing parameters, select **Setup > Preferences** . In the Default Workspace field, enter the path and name of a saved workspace **.wss** file.

The workspace can be switched after opening a trace file. Select **File > Open** to open another workspace and select a **.wss** file.

2.2.8 Saving a Trace Capture

You can save a Trace Capture by selecting **Save** from the **File** menu, or select **Save As** to save as the trace capture for review at a later time using the following dialog (see Figure 2.7 on page 45).

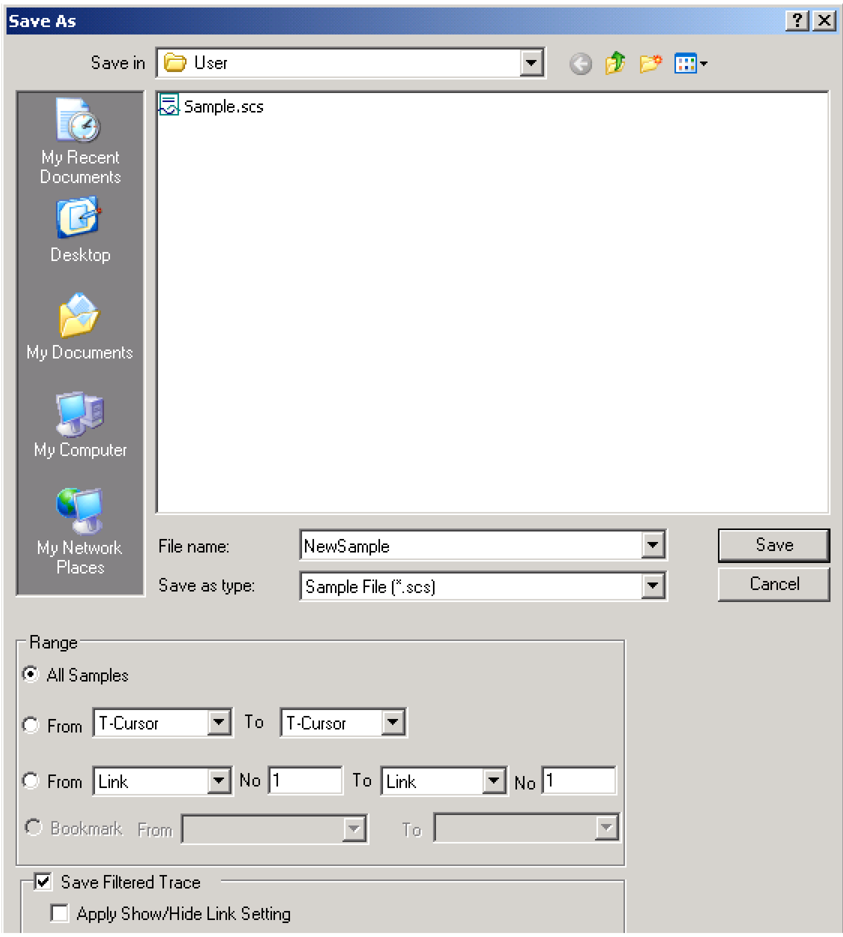


Figure 2.7: Save As Dialog.

You can limit the range of the saved file. You can save:

- All Samples
- Range between selected cursors
- Range between selected Idle, link, commands
- Range between bookmarks

The **Save Filtered Sample** checkbox saves a trace file without filtered data. The **Apply Show/Hide Link Setting** checkbox filters the saved data further by also applying the current status of the port buttons of the toolbar.

2.2.9 Exporting

From the File menu, you can Export to Text/Excel, Export Read-Write Command Report, or Export Paired SAS Address Report.

Export to Text/Excel

From the File menu, you can export to Text/Excel, using the **Export to Text/Excel.** The **Save as Text** dialog displays (see Figure 2.8 on page 46).

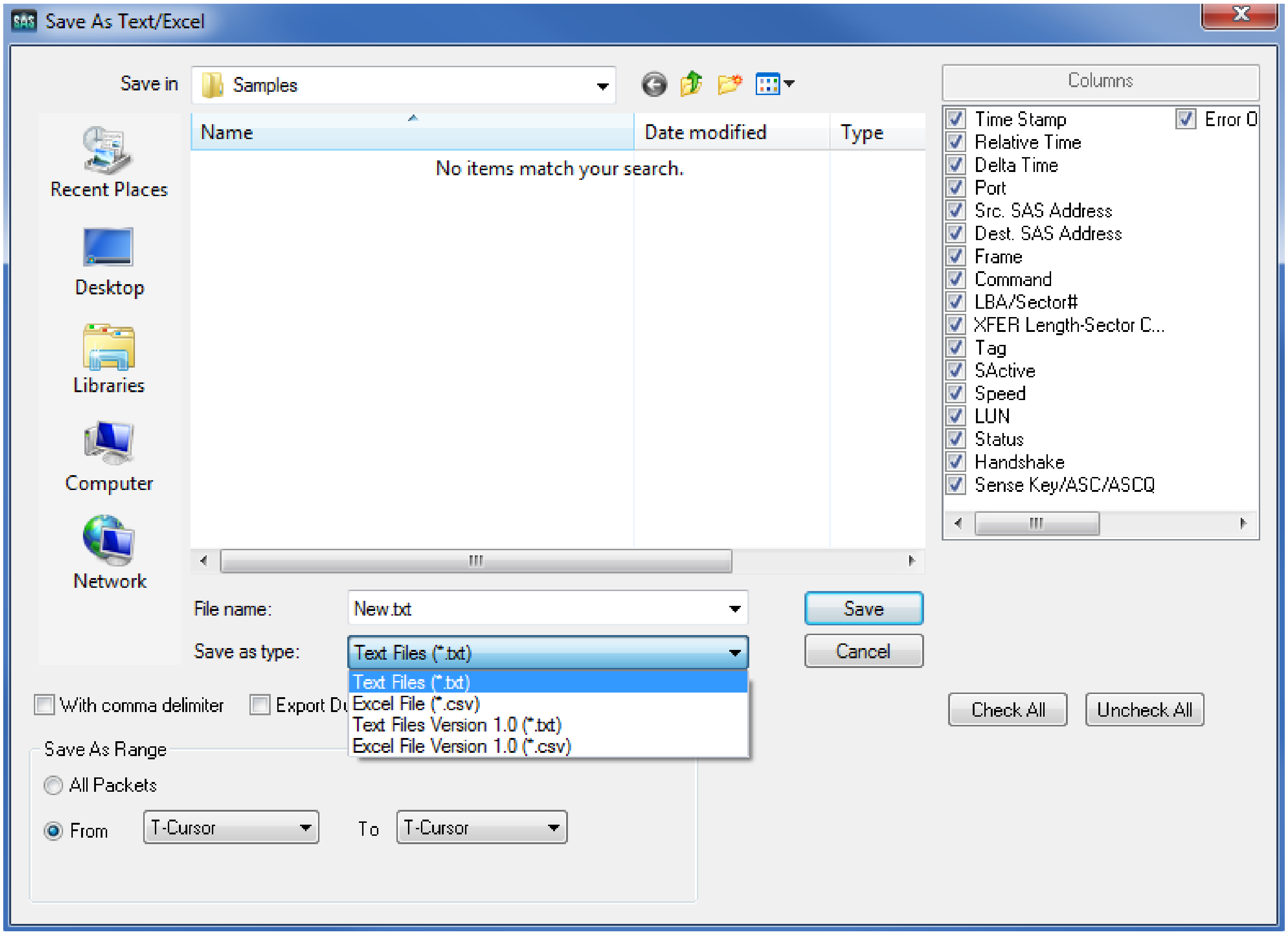
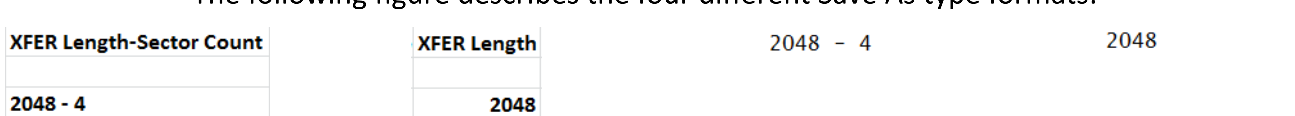


Figure 2.8: Save As Text Dialog.

- From the Save as type: drop-down select Text Files.txt or Text Files Version 1.0 .txt for text format or Excel File.csv or Excel Files Version 1.0.csv for Excel format (see “Save As Display Formats” on page 46).
- Check the box **Export the whole payload (more than 32KB)** to export the whole payload (more than 32KB).
- You can limit the range of the saved file. You can save:
  - All Packets
  - Range between selected cursors
- Range between bookmarks

Save As Display Formats

The following figure describes the four different Save As type formats:



Excel File.csv format   Excel Files Version 1.0.csv format   Text Files.txt format   Text Files Version 1.0.txt format

Export to Initiator Emulator (SAS) or Host Emulator (SATA)

From the File menu, you can Export to Initiator Emulator (SAS) or Export to Host Emulator (SATA), using the Extract Sample File dialog (see following figures).

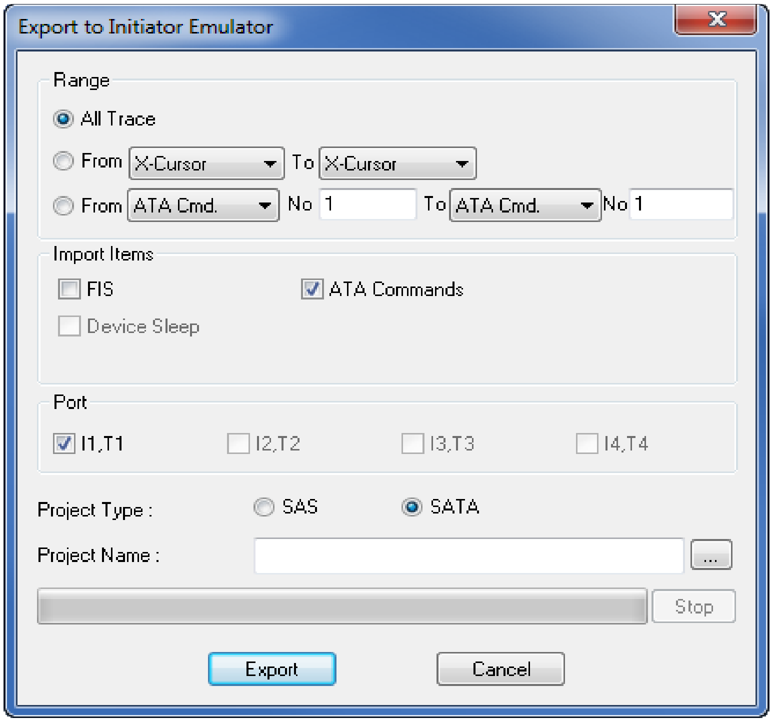


Figure 2.9: Export to Initiator Emulator (SATA) Dialog.

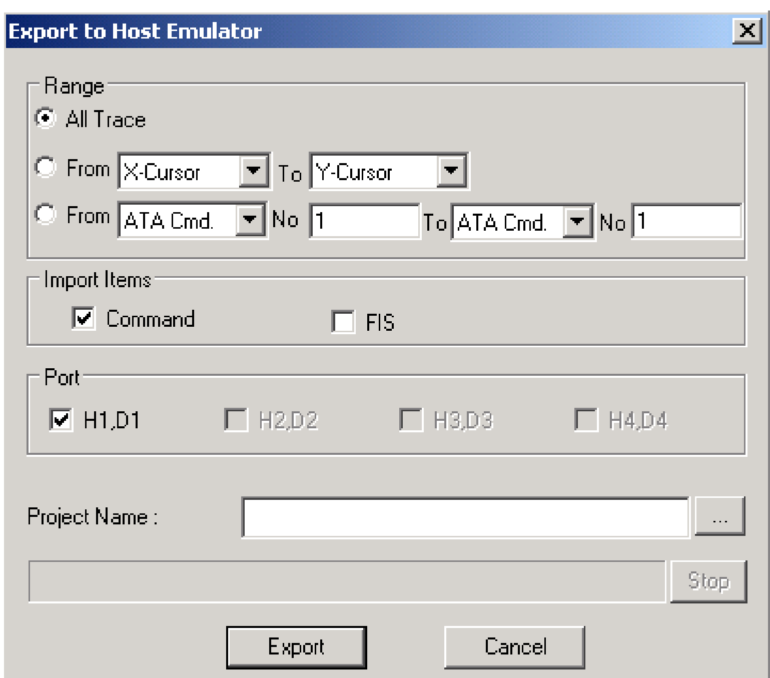


Figure 2.10: Export to Host Emulator (SAS) Dialog.

You can limit the range of the saved file. You can save:

- All Trace
- Range between selected cursors
- Range between SCSI Commands or Transport

You can export **SCSI Commands, Task Management, FIS, ATA Commands, Device Sleep, SSP Frames, SMP Frames, SMP Commands**, or **STP Frames**.

You can select the **Port**.

In the **Project Name**, enter a valid file name.

2.2.10 Export to Trainer

The Export to Trainer dialog, accessible from the File menu, allows exporting data to a file in a format supported by the timer.

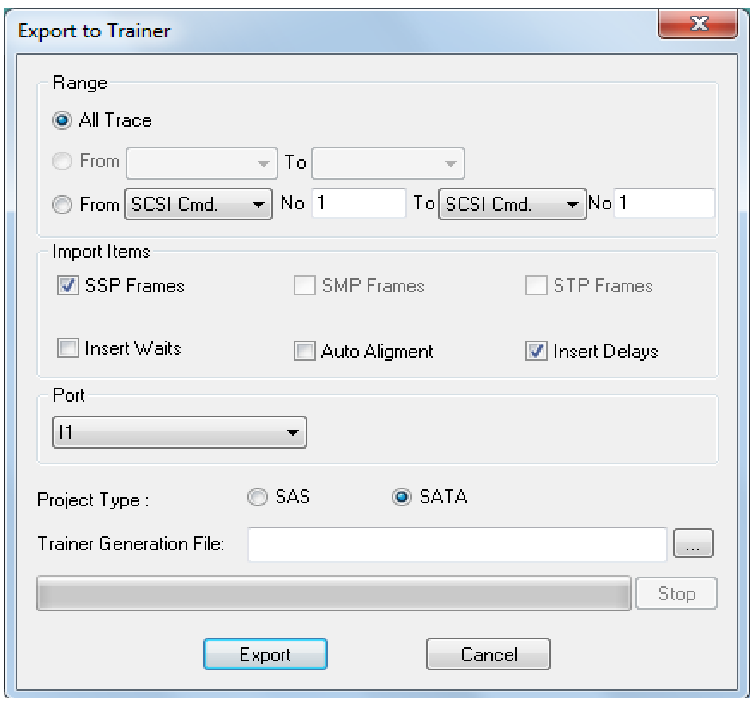


Figure 2.11: Export to Trainer Dialog (SATA).

In the Export to Trainer dialog you can:

- Limit the range of the saved file. You can save:
  - All Traces
  - Range between selected cursors
  - Range between SCSI Commands, SMP Commands or Transport
- Import **SSP Frames, SMP Frames,** or **STP Frames** (see “Events and Event Properties” on page 372).
- **Insert Waits** inserts the appropriate **Wait_for** commands in the Trainer script as a function of the protocol state machine. An example would be to insert a **Wait_for open_accept** after an **open** command is exported. This allows the script to work, even if the DUT has different timing than the DUT in the original trace. See “Wait Commands” on page 346.

- **Insert Delays** inserts the exact delays as they appear in the original exported trace. This may result in the closest match in terms of timing to the original trace, but may not work with other DUTs.
- Use **Auto Alignment** (see "The Global Setting "AutoAlign"" on page 303).
- Select the **Port** (see "Setup Menu" on page 293).
- Indicate **Trainer Generation File Name** and click **Export** to export the trainer generation file.

Note: The resulting Trainer Generation file cannot exceed 2 MB or 1,000,000 packets.

SATA has different options including Device Sleep.

Export Read/Write Command Report

You can create an **Export Read/Write Command Report** as an Excel file (*.csv), using the **Export...** dialog from the File menu.

In **Setup > Preferences > Trace Viewer**, you must first select **Create statistical report read/write page** in order to create this report.

If this choice was not made when the trace was taken, then use **Save As** to save the trace file with this preference. This will append the **Read/Write Command Report** to the trace file, so this action need only be done once. When you re-open the trace file, you should be able to export the report as described above.

2.2.11 Export Paired SAS Address Report

If Text View is activated, from the File menu you can save a Paired SAS Address Report as an Excel file, using the Export Paired SAS Address Report dialog.

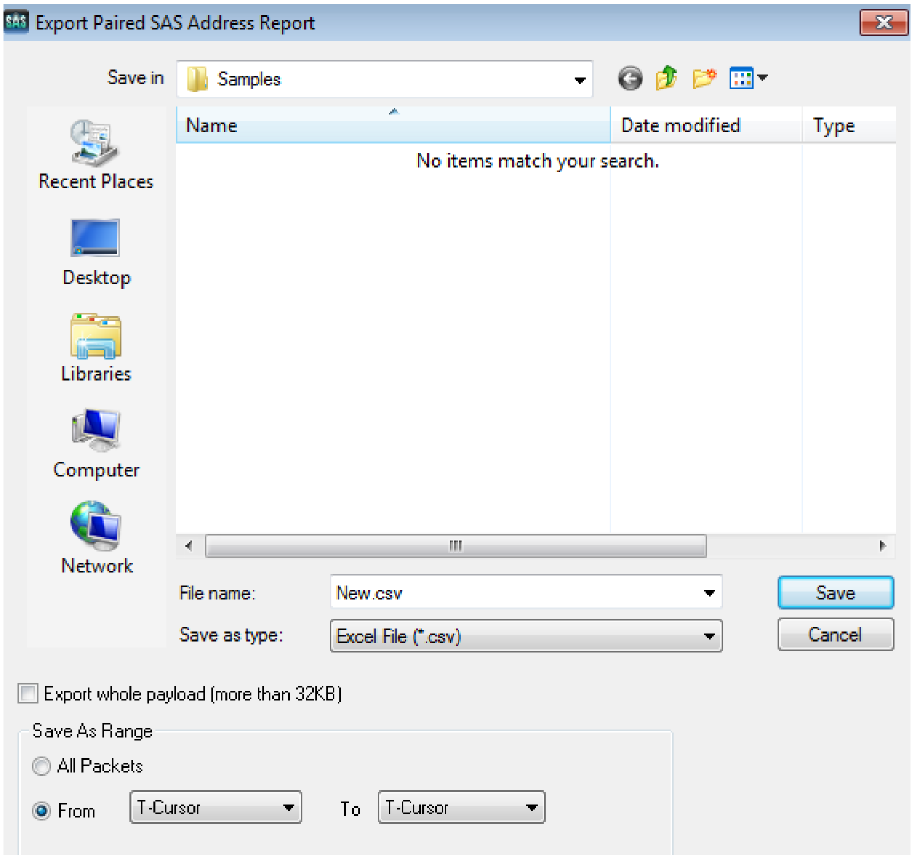


Figure 2.12: Export Paired SAS Address Report Dialog.

- Check the box **Export the whole payload (more than 32KB)** to export the whole payload (more than 32KB).
- You can limit the data range of the saved file. You can save:
  - All Packets
  - Range between selected cursors

You can view expanded traffic (particularly during discovery) in a spreadsheet format. You can use column headers with SAS Address Pairs. For example, instead of I1, T1, I2, T2, and so on, the columns are Source/Destination SAS Address pairs, such as S1:SEP or S2:EXP 0.

2.2.12 Trace Properties

Select **File > Trace Properties** to see the properties of the trace. For more information refer to "Trace Properties" on page 113.

2.2.13 Edit Comment

You can write comments and edit them for a trace for future use. Select **File > Edit Comment** to view the edit window. Key in the comments and close the window.

2.2.14 Projects

You can define a new project, starting with the default project definition, or modify the settings for the last project run.

New Default Project

To start a New project, select File > New on the main menu bar and choose SAS Protocol Analyzer or SATA Protocol Analyzer to open a new project with default settings that you can modify (see "Main Window" on page 37).

Last Project

Clicking the Green button  opens the last project run, so you can modify it.

Project File Types

Projects have the following file types:

*.asl	Decoding script file (in the Examples folder "User Define Decoding Script" subfolder)
*.cfg	Display Configuration file (in the System folder "Config" subfolder)
*.dat	DataBlock file (in the System folder "DataBlock" subfolder)
*.sac	SAS Protocol Analyzer/Capture Project/Viewer file (in the Examples folder "EasyCaptr", "AdvanceCaptr", or "Exerciser" subfolders)
*.saf	Device Identifier file
*.scs	SAS Sample file (in the SAS Examples folder "Sample" subfolder)
*.sfl	Filter configuration file
*.spg	Single-role Pattern Generator file (in the Examples folder SAS "PatternGenerator\Single role (spg files)" subfolder and SATA "PatternGenerator\Single Role" subfolder). Single role means the file is for a Device or Host.
*.ssh	SAS Search configuration File
*.stc	SATA Protocol Analyzer/Capture Project/Viewer file (in the Examples folder "EasyCaptr", "AdvanceCaptr", or "Exerciser" subfolders)
*.sts	SATA Sample file (in the SATA Examples folder "Sample" subfolder)
*.tsh	SATA Search configuration file
*.wss	SAS Workspace file (in the SAS System folder "Predefined\Workspace" subfolder)
*.wst	SATA Workspace file (in the SATA System folder "PreDefined\Workspace" subfolder)

Example Projects

The Analyzer includes example projects that you can use to perform an immediate analysis without any setup.

The Analyzer system software has a pre-defined folder (directory) structure for storing all files. All example files are in the Examples folder under the Sierra M124 folder.

It is strongly recommended that you open some example files to see types of projects that you can create.

Run an Example Analysis Project

To run an example project:

1. Select **File > Open.**
2. Locate example analysis projects by looking in the Examples folder. Examples are available for AdvanceCaptr, EasyCaptr, Exerciser, Samples, and User Define Decoding Script.
3. In the EasyCaptr folder, choose an example ***.sac** file and click **Open** to display the example project dialog.

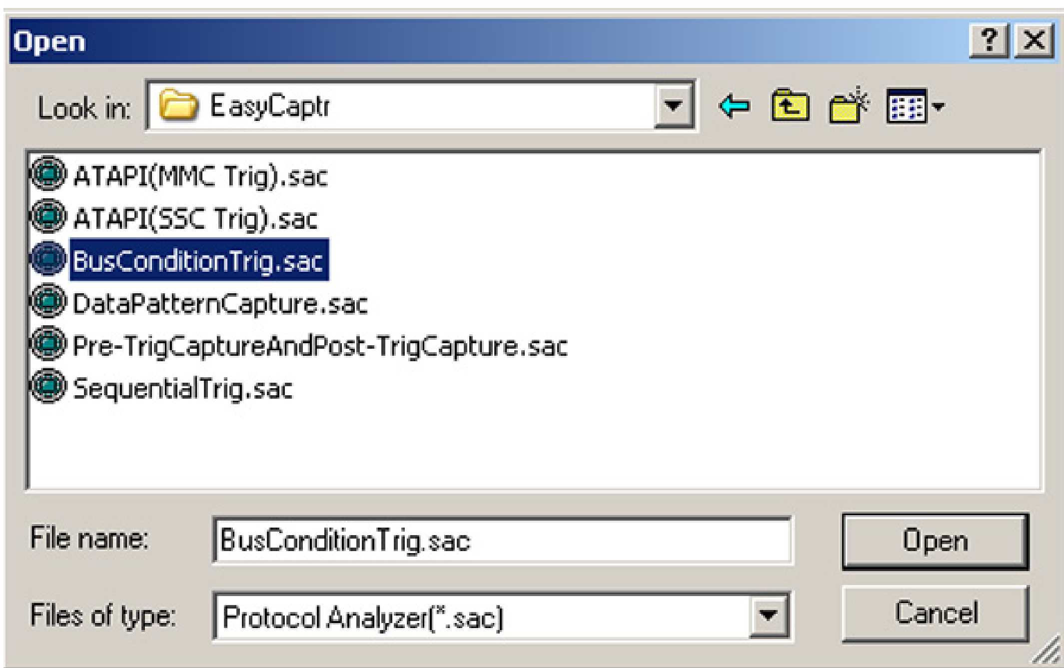


Figure 2.13: File Open Dialog

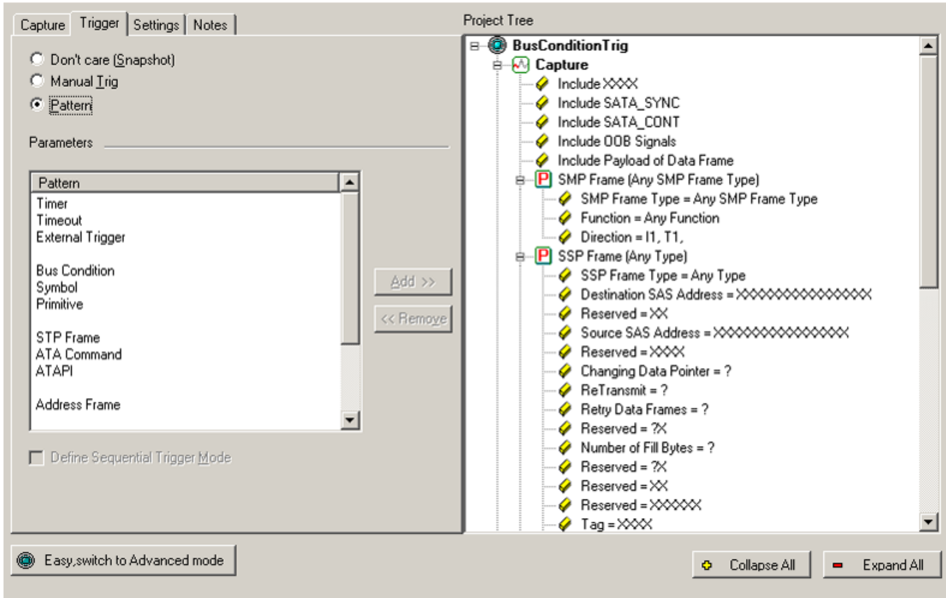


Figure 2.14: SAS: Sample Protocol Analysis Project

SAS vs. SATA: For Pattern Parameters, SATA Dialog adds FIS, FIS Pattern, and ATA Command Pattern and does not have SSP Frame, SMP Frame, and Address Frame.

4. Click the **Record** button to execute the pre-defined example.
5. After the project runs, you see an analyzer trace capture display similar to the one shown in Figure 2.15 on page 54

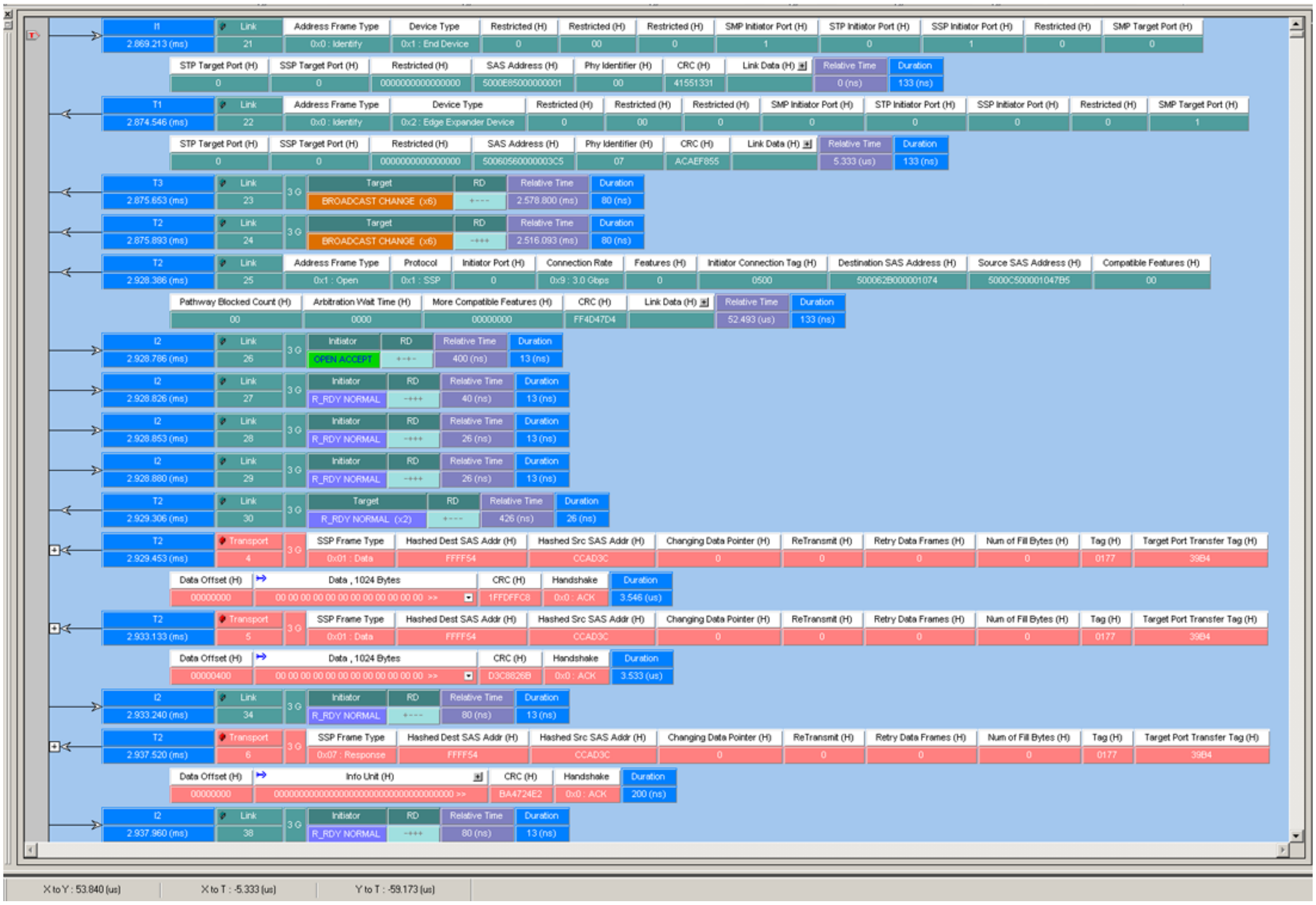


Figure 2.15: SAS: Analyzer Trace Capture Display

For details about the results display, see “Display Manipulation” on page 111 and “Display Configuration” on page 198.

Patterns and Data Capture Setup

You can refine data capture by choosing Pattern and then selecting specific patterns for capture. Additionally, you can define a different set of patterns to capture after trigger.

To define specific patterns for capture, click the **Pattern** button (see Figure 2.16 on page 55.)

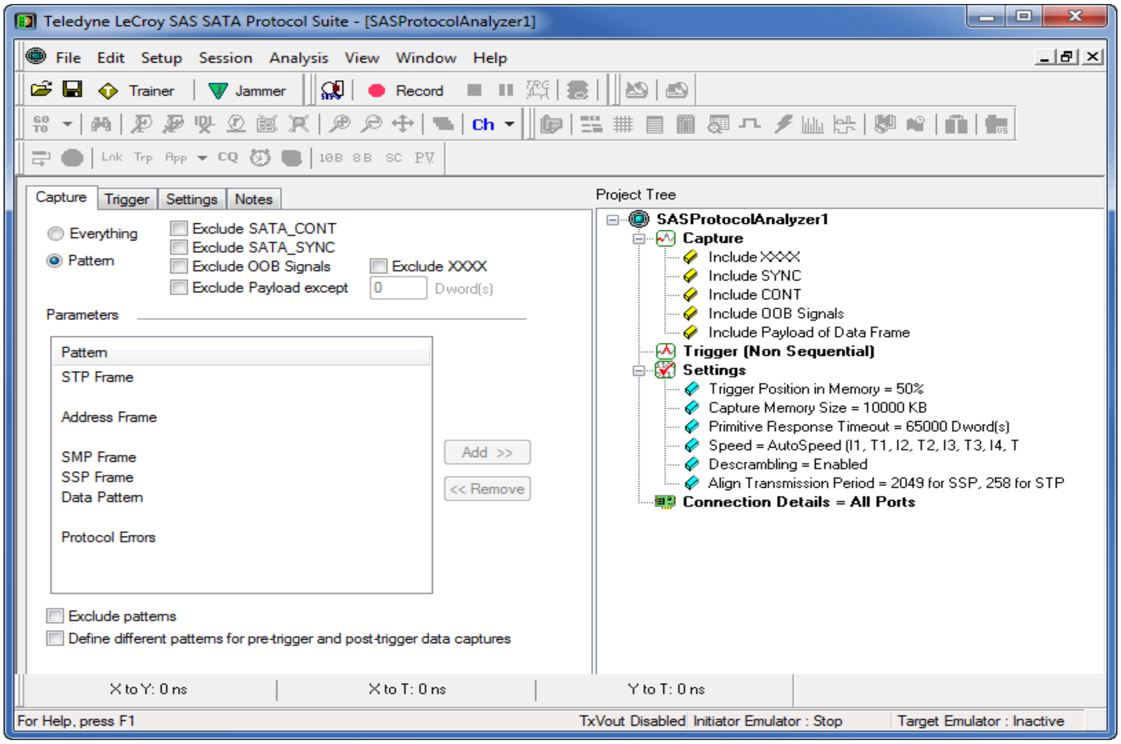


Figure 2.16: SAS: Choosing Capture Patterns

SAS vs. SATA: SATA Dialog replaces "Exclude SATA_CONT" with "Exclude CONT" and "Exclude SATA_SYNC" with "Exclude SYNC".

The SAS Parameters window displays the following pattern capture choice categories:

- STP Frame
- Address Frame
- SMP Frame
- SSP Frame
- Data Pattern
- Protocol Errors

The SATA Parameters window displays the following pattern capture choice categories:

- FIS
- STP Frame
- Data Pattern
- Protocol Errors

Choose a Parameter

To choose a parameter for capture from any of these categories, highlight the category in the parameter window and click the **Add>>** button. This opens selection dialogs for each of the categories, displaying all parameters for that category. All of the patterns added appear in the project tree.

Exclude Patterns

Check this box to allow capture of everything **except** the patterns added to the Project Tree. When you check this box, the system adds the Primitive category to the parameter window and enables Exclude Idle.

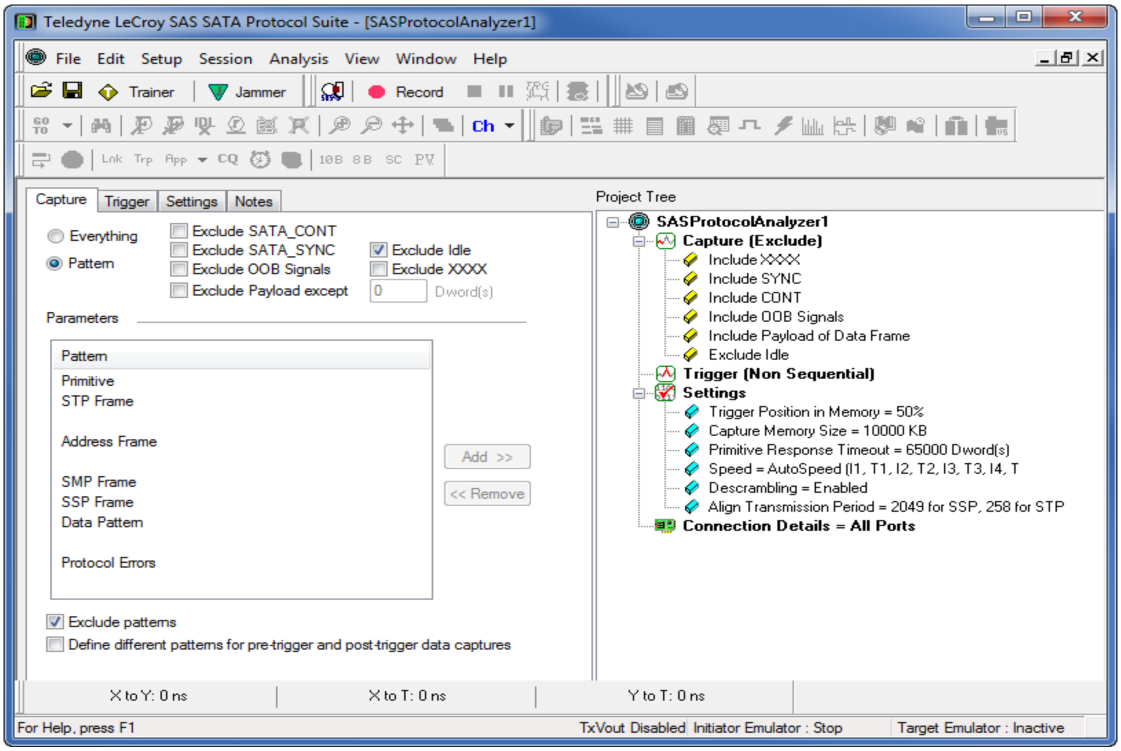


Figure 2.17: SAS: Exclude Patterns Checked

SAS vs. SATA: SATA Dialog replaces “Exclude SATA_CONT” with “Exclude CONT” and “Exclude SATA_SYNC” with “Exclude SYNC”. SATA Dialog has “ Exclude Dev Slp Packets”. SATA Dialog has different Pattern Parameters (see “Patterns and Data Capture Setup” on page 54.)

To remove an item from capture, highlight it in the Project Tree and click the **<<Remove** button.

Pre- and Post-Trigger Data Capture

You can define one set of patterns for capture prior to the occurrence of a trigger and another set of patterns for capture after the occurrence of a trigger. The selections and setup procedure is the same for both, the Pre-Trigger capture and the Post-Trigger capture. To define different patterns for pre-trigger and post-trigger data capture, check **Define different patterns for pre-trigger and post-trigger data capture** to enable the Post-Trigger Capture tab (see Figure 2.18 on page 57).

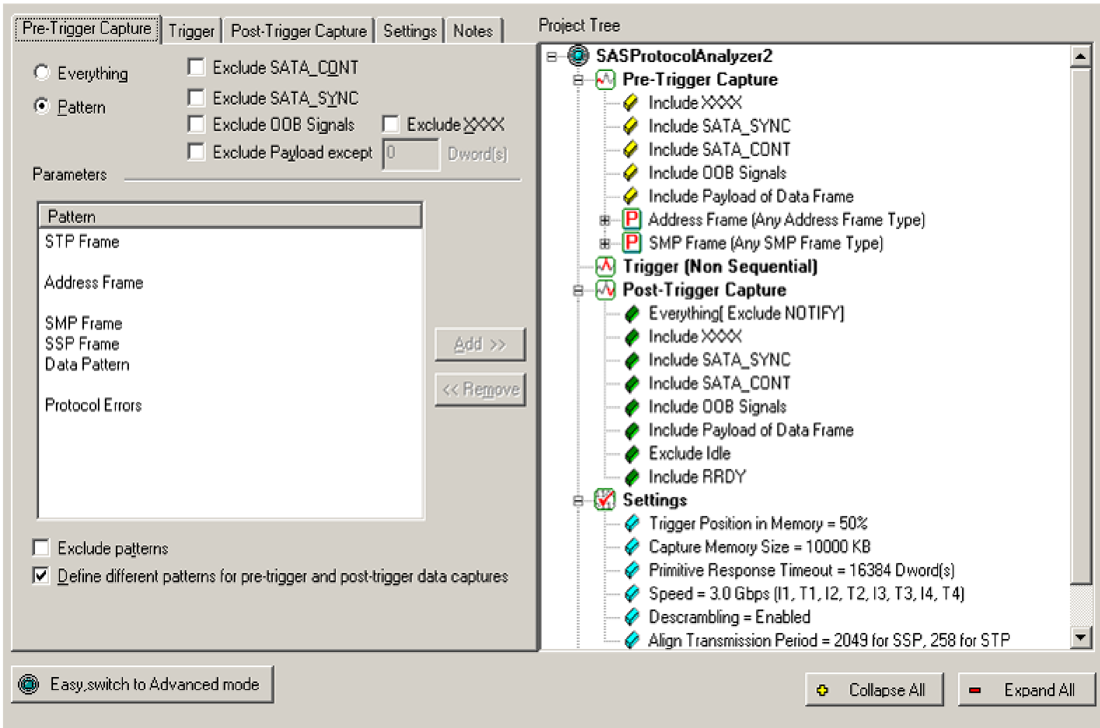


Figure 2.18: SAS: Post-trigger Capture Dialog Enabled

SAS vs. SATA: SATA Dialog replaces “Exclude SATA_CONT” with “Exclude CONT” and “Exclude SATA_SYNC” with “Exclude SYNC”. SATA Dialog has different Pattern Parameters (see “Patterns and Data Capture Setup” on page 54.)

Defining Patterns

To select an item for capture, either highlight the category and click the **Add>>** button or double-click the category to open a corresponding definition dialog. You can define patterns for specific ports by checking or unchecking Port ID.

Primitive

Double-click **Primitive** (available only if you check Exclude Patterns) to open the Primitive selection dialog.

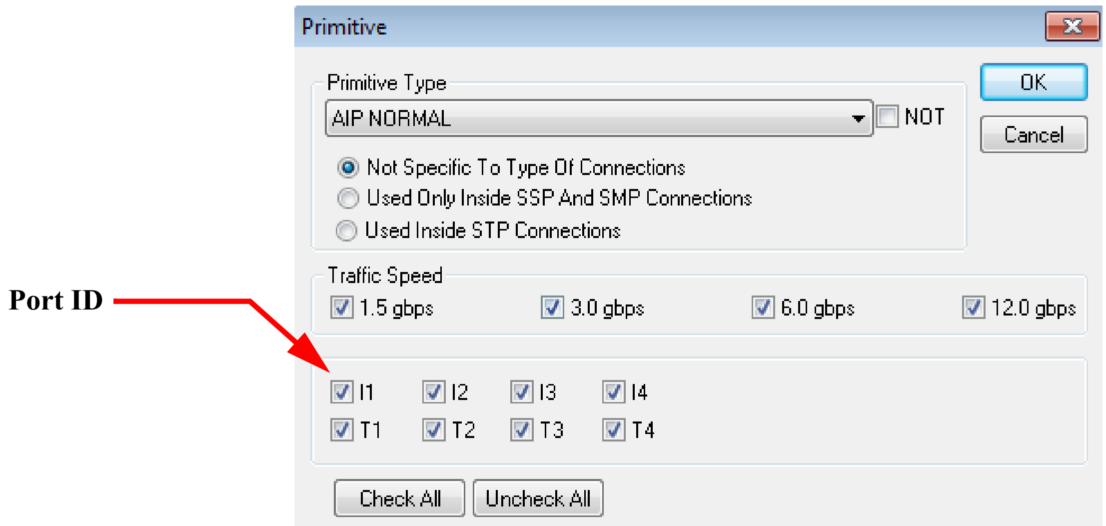


Figure 2.19: SAS: Primitive Dialog

SAS vs. SATA: SATA Dialog has no radio buttons and has different drop-down options.

Click the down arrow next to the Primitive drop-down list, choose a Primitive to exclude, and click **OK.** Repeat for additional Primitives.

Data Pattern

Double-click **Data Pattern** to open the Data Pattern definition dialog.

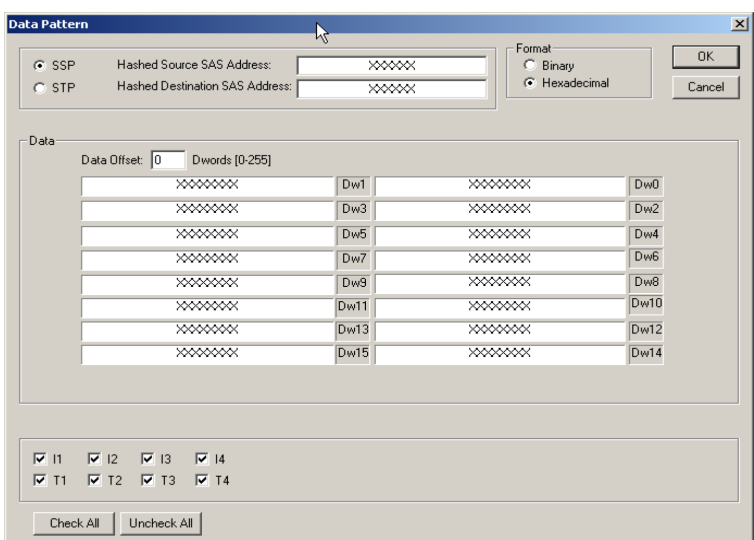


Figure 2.20: SAS: Data Pattern Dialog

SAS vs. SATA: SATA Dialog shows Port at the top and does not show SSP or STP.

Define the data pattern for capture or exclusion from capture and click **OK**.

Note: When entering the data pattern in the "data" section of this screen, if you are reading the data pattern from a recorded trace, you must reverse the order of the bytes listed for each DWORD entered. For example, if you want to capture (or exclude) "00 01 02 03" (as displayed in the trace), you must enter this pattern as "03 02 01 00".

Protocol Errors

Double-click **Protocol Errors** to open the Protocol Errors selection dialog.

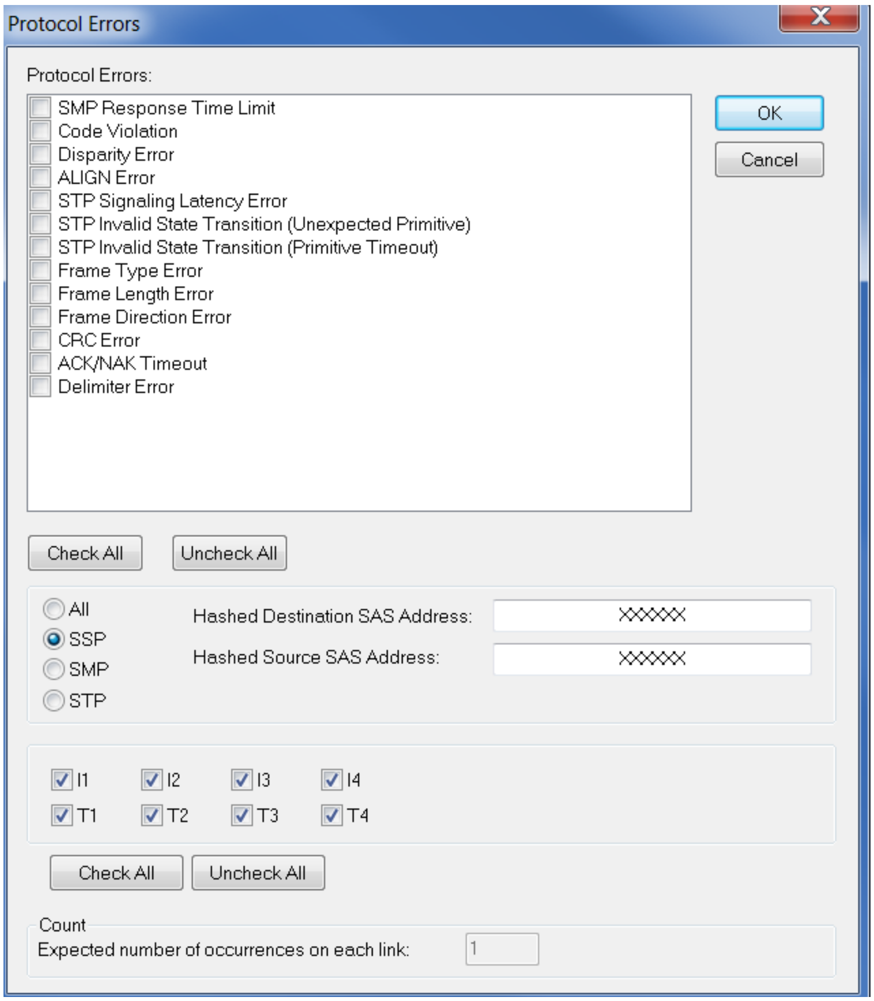


Figure 2.21: SAS: Protocol Errors Dialog

SAS vs. SATA: SATA dialog does not show ACK/NAK Timeout and has FIS signal-latency and state-transition errors, not STP ones. SATA dialog does not show ALL. SSP and SMP radio buttons.

Check protocol error(s) to omit or not capture, then click **OK**.

Protocol Errors

SMP Response Time Limit: is outside the specification requirements.

Code Violation: Wrong 10b symbol detected.

Disparity Error: Wrong disparity detected.

ALIGN Error: ALIGN primitive frequency is outside the specification requirements.

STP Signaling Latency Error [SAS only] or **FIS Signaling Latency Error [SATA only]**: DWORD difference between HOLD and HOLDA is greater than entered value in the HOLD/ HOLDA Response Timeout field.

STP Invalid State Transition (Unexpected Primitive) [SAS only] or **FIS Invalid State Transition (Unexpected Primitive) [SATA only]**: Second SATA_SOF is encountered before SATA_EOF, and other unexpected primitives.

STP Invalid State Transition (Primitive Timeout) [SAS only] or **FIS Invalid State Transition (Primitive Timeout) [SATA only]**: Timeout between two paired primitives is above entered value. 65000 DWORDs is default. For example, it can occur between WTRM and R_OK, or X_RDY and R_RDY. It expects device (or host) to send a response, but response is not received after 65000 DWORDs. You can configure Primitive Response Timeout and HOLD/HOLDA Response Timeout in the Settings tab Analyzer Settings section.

Frame Type Error: Wrong frame type.

Frame Length Error: Reported frame length is different than actual frame length.

Frame Direction Error: Wrong frame direction. For example, Register Device to Host coming from the Host.

CRC Error: CRC error detected.

ACK/NAK Timeout [SAS only]: ACK or NAK primitive missing or encountered unexpectedly.

Delimiter Error: Detects two SOF primitives without an EOF between them. Also detects two EOF primitives without an SOF between them.

Radio Buttons: All, SSP, SMP and STP - By selecting one of these radio boxes you can specify that you want to trigger(or filter) on a specific protocol error on a specified frame type. If you check CRC error and select the SSP radio button, if a CRC error occurs on a SMP frame, the analyzer does not trigger on it.

Hashed Destination SAS Address (SSP trigger only): Specify the destination address for the analyzer to locate specific protocol errors.

Hashed Source SAS Address (SSP trigger only): Specify the source address for the analyzer to locate specific protocol errors.

STP Frame

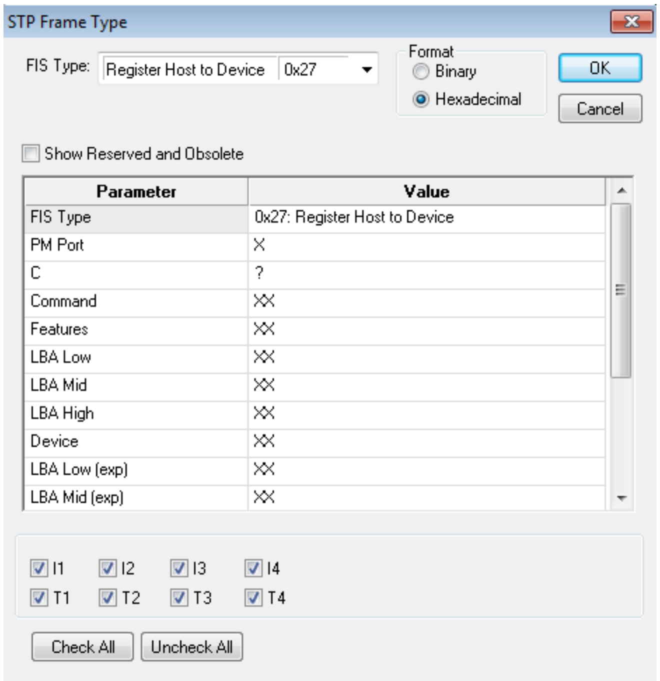


Figure 2.22: STP Frame Type Dialog

Click the down arrow next to the Type drop-down list box, choose an FIS type to capture or exclude, and click **OK**. Repeat for additional types.

Available FIS Types:

- Register Host to Device
- Register Device to Host
- Set Device Bits
- DMA Activate
- DMA Setup
- BIST
- PIO Setup
- Data
- Vendor

Address Frame (SAS only)

Double-click **Address Frame** to open the Address Frame Type Pattern dialog.

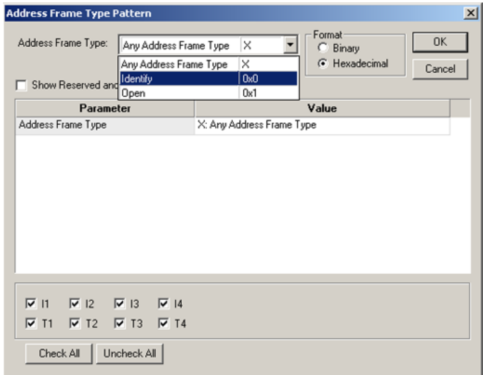


Figure 2.23: Address Frame Type Pattern Dialog

SAS vs. SATA: Not available in SATA.

Click the down arrow next to the Address Frame Types list box and choose an address frame type.

SMP Frame (SAS only)

Double-click **SMP Frame** to open the SMP Frame Pattern dialog.

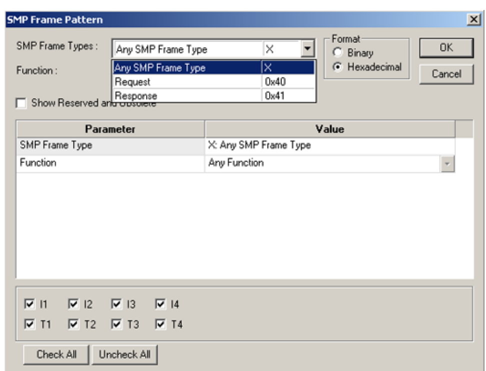


Figure 2.24: SMP Frame Pattern Dialog

SAS vs. SATA: Not available in SATA.

Click the down arrow next to the SMP Frame Type list box and choose a frame type. Assign a specific function to the frame by clicking the down arrow next to the Function list box and choose a function.

SSP Frame (SAS only)

Double-click **SSP Frame** to open the SSP Frame Pattern dialog.

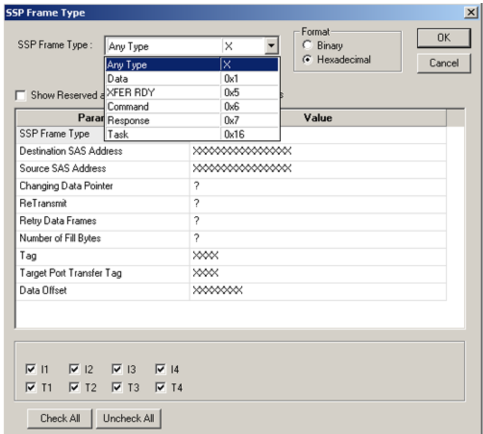


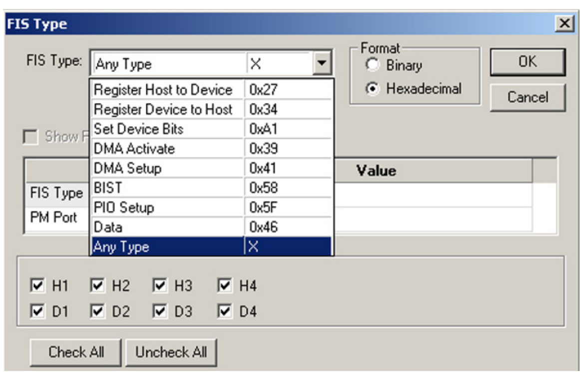
Figure 2.25: SSP Frame Type Dialog

SAS vs. SATA: Not available in SATA.

Click the down arrow next to the SSP Frame Type list box and choose an SSP Frame type.

FIS (SATA only)

Double-click **FIS (Frame Information Structure)** to open the FIS Type selection dialog.



SAS vs. SATA: Not available in SAS.

Click the down arrow next to the Type drop-down list box, choose a FIS type to capture, and click **OK**. Repeat for additional types.

Available FIS Types:

- Register Host to Device
- Register Device to Host
- Set Device Bit
- DMA Activate
- DMA Setup
- BIST
- PIO Setup
- Data
- Any Type

STP Frame Pattern

Double-click STP Pattern to open the STP Pattern selection dialog.

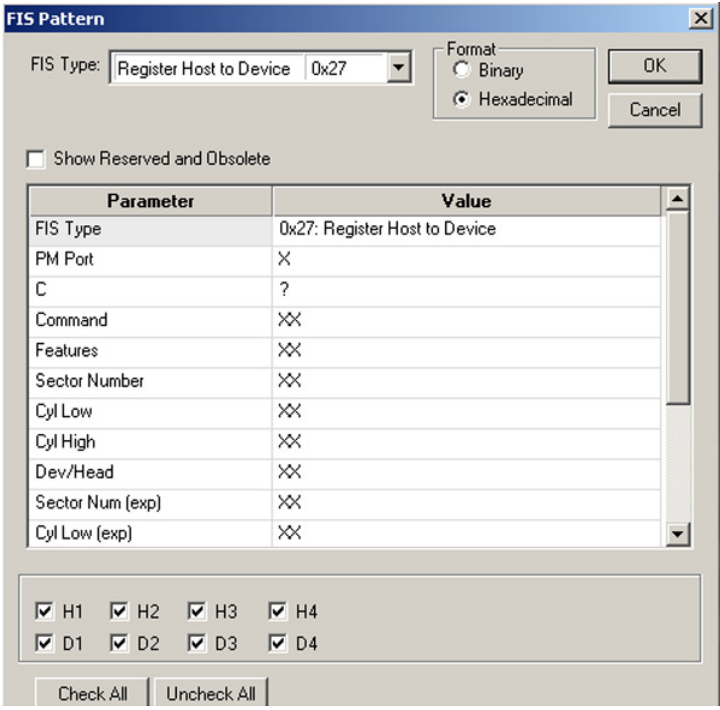


Figure 2.26: SATA: STP Pattern Dialog

The STP Pattern dialog opens with the default FIS Type as **Register Host to device.** To choose another available FIS Type, click the down arrow next to the FIS Type list box.

Choose FIS Type and complete the corresponding dialog.

Register Host to Device

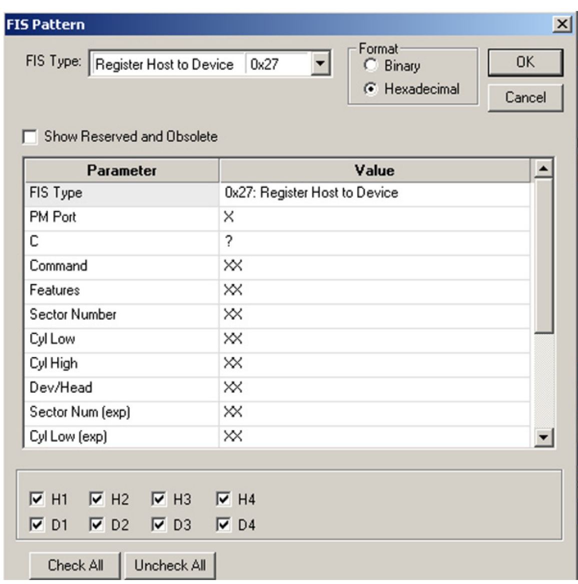


Figure 2.27: FIS Pattern - Register Host to Device Dialog

Register Device to Host

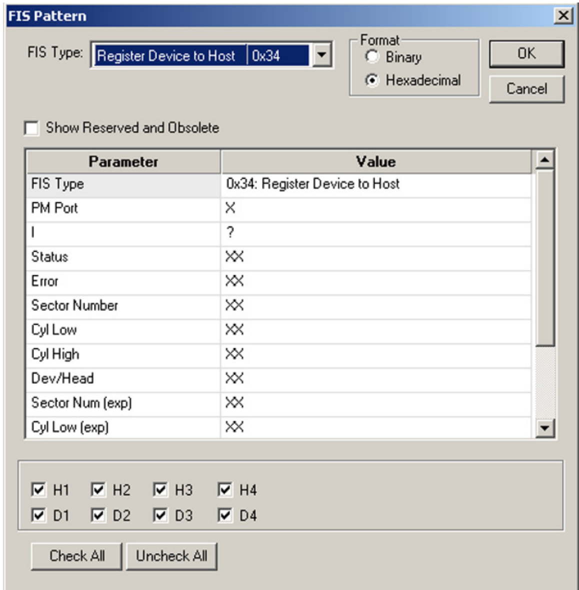


Figure 2.28: FIS Pattern - Register Device to Host Dialog

Set Device Bits

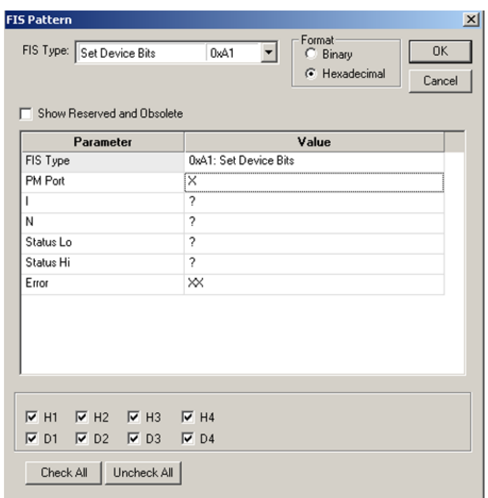


Figure 2.29: FIS Pattern - Set Device Bits Dialog

DMA Activate

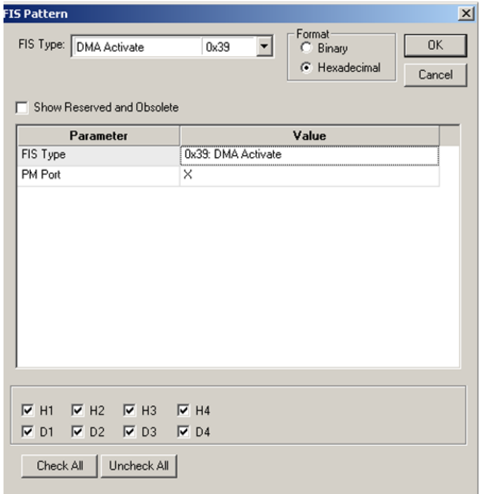


Figure 2.30: FIS Pattern - DMA Activate Dialog

DMA Setup

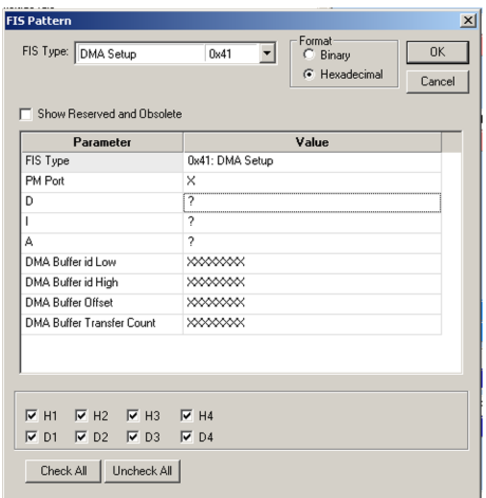


Figure 2.31: FIS Pattern - DMA Setup Dialog

BIST

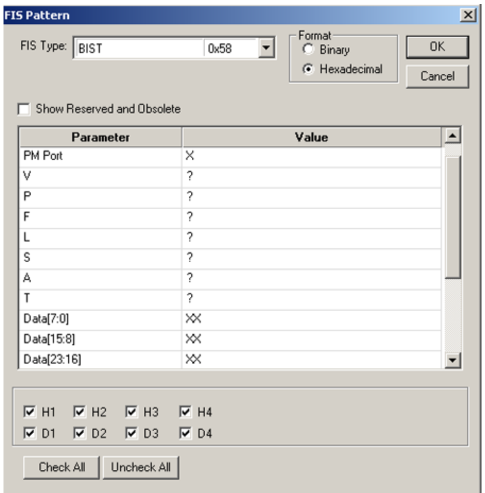


Figure 2.32: FIS Pattern - BIST Dialog

PIO Setup

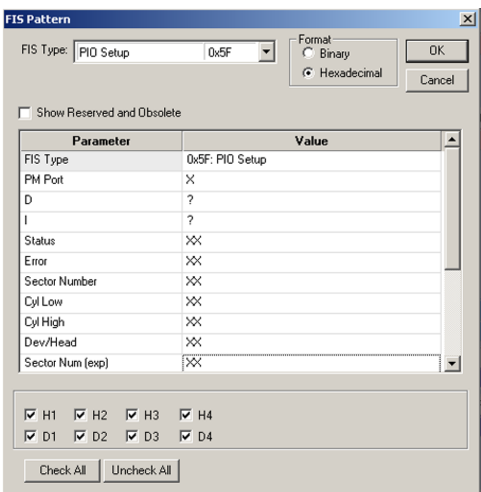


Figure 2.33: FIS Pattern - PIO Setup Dialog

Data

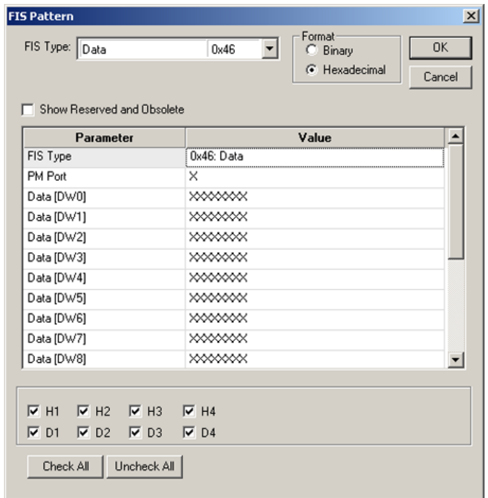


Figure 2.34: FIS Pattern - Data Dialog

Vendor

Vendor is for FIS Pattern.

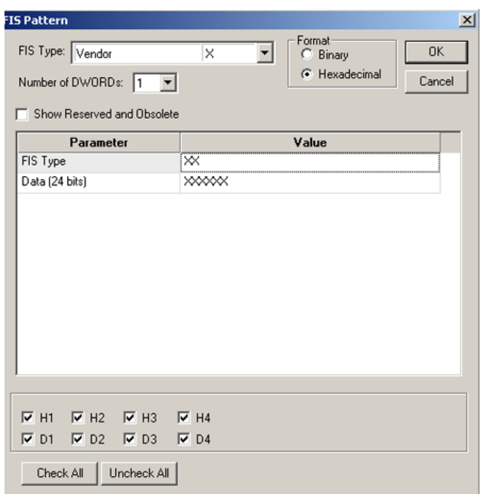


Figure 2.35: FIS Pattern - Vendor Dialog

2.2.15 Trigger Setup

The **Trigger** tab in the analysis project dialog allows you to specify when the analyzer completes a data capture. Three trigger modes are available:

- Don’t care (Snapshot) is the default
- Manual Trig
- Pattern

When data capture starts with **Don’t care (Snapshot)** selected, the analyzer triggers on the first data pattern on the bus.

Starting a data capture with **Pattern** selected triggers when specific pattern(s) are detected in the captured data stream. The following three ways can trigger the analyzer with **Pattern** selected.

- Trigger on any pattern (Any Trigger Mode)
- External Trigger
- Trigger on a sequence of patterns (Sequential Trigger Mode)

Snapshot Mode

To trigger immediately on any pattern, check the **Don't care (Snapshot)** button.

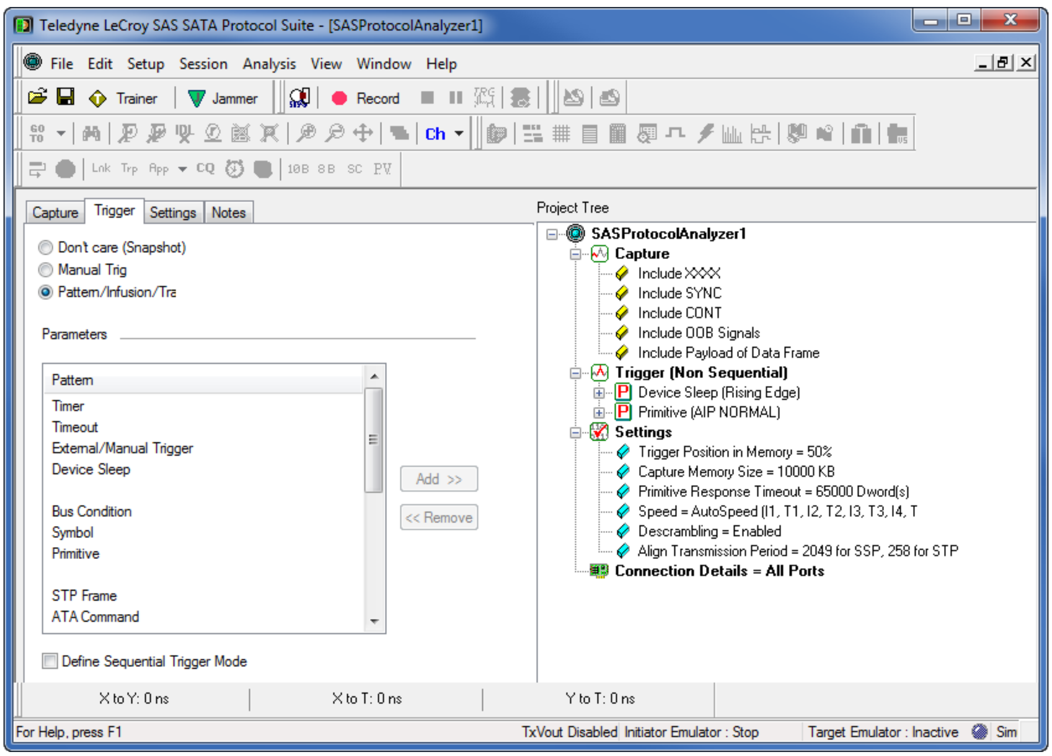


Figure 2.36: Default Trigger Selected

Manual Trigger Mode

To perform a manual trigger, check the **Manual Trig** radio button. In the **Manual Trigger** mode, the analyzer captures bus traffic continually from when you use the Manual Trigger until you click the **Stop Recording** button (on the analyzer toolbar), which triggers the analyzer. Clicking the **Manual Trigger**  button on the application toolbar creates a Trigger Event and uploads the trace with the specified trigger position.

Any Trigger in Pattern Mode

In **Pattern** mode, the Analyzer triggers whenever any of the patterns selected for triggering occurs (an OR condition). The procedure for selecting trigger parameters is identical to that for selecting capture parameters. All items selected for triggering appear in the Project Tree.

To define patterns for triggering, check the **Pattern** button in the Trigger dialog (see Figure 2.37 on page 70.)

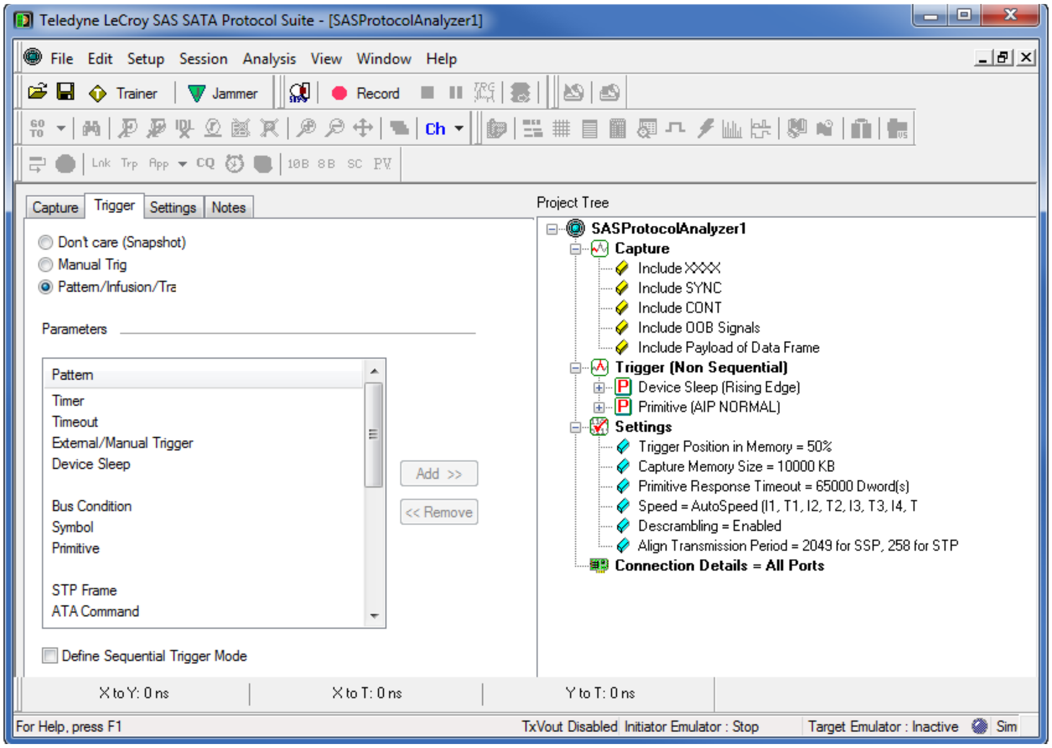


Figure 2.37: SAS: Select Patterns for Trigger

The SAS **Parameters** window displays the following trigger pattern categories:

- Timer
- Timeout
- External/Manual Trigger
- Device Sleep
- Bus Condition
- Symbol
- Primitive
- STP Frame
- ATA Command
- ATAPI
- Address Frame
- SMP Frame
- SSP Frame
- SCSI Command
- Data Pattern
- Training Sequence
- Protocol Errors

Define Sequential Trigger Mode

This is enabled when more than one pattern is used. It allows for the use of a simple state machine of “pattern A then pattern B”. When checked, the Count field in each pattern’s dialog is enabled (see Figure 2.38 on page 71).

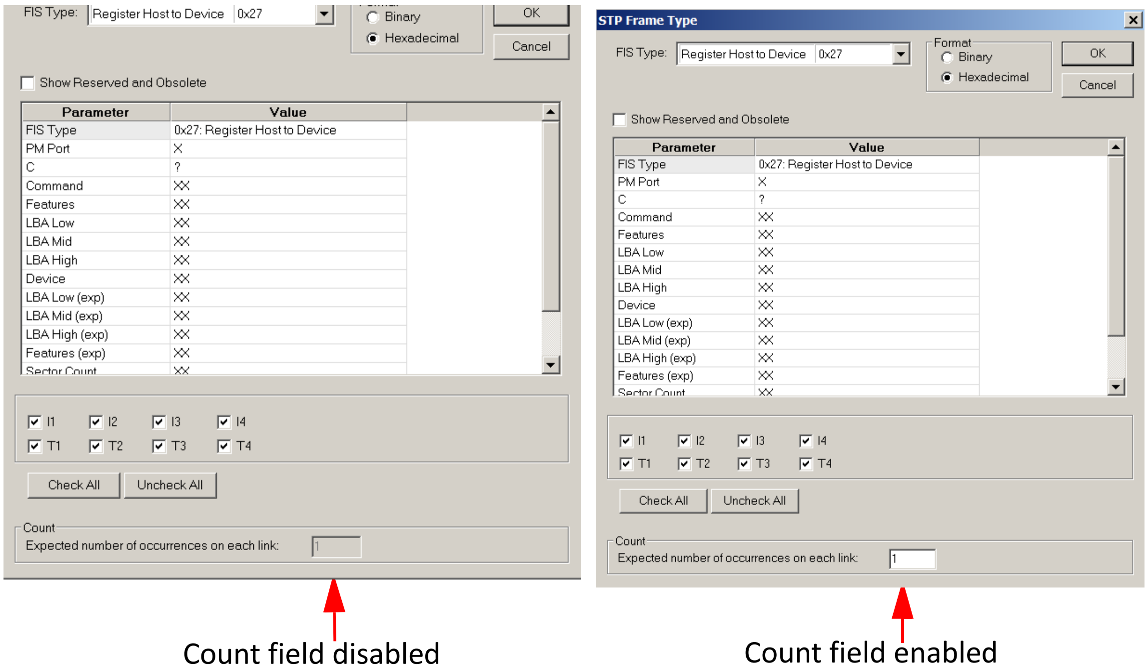


Figure 2.38: Count Field Dialog

The SATA **Parameters** window displays the following trigger pattern categories:

- Timer
- Timeout
- External/Manual Trigger
- Device Sleep
- Bus Condition
- Symbol
- Primitive
- FIS
- STP Frame
- ATA Command
- ATA Command Pattern
- ATAPI
- Soft Reset
- Data Pattern
- Protocol Errors

Note: In packet view, you can right-click on any frame, select **Add to Trigger**, and add the pattern to **DataPatternCapture** to make it a trigger pattern.

Choosing a Parameter

Either highlight the category and click the Add>> button, or double-click the category, to open a corresponding definition dialog.

To remove an item, highlight it in the Project Tree, then click the **<<Remove** button.

Triggering on a Timer

Selecting a timer for a trigger in the **Any Trigger Mode** limits the time that the analyzer looks for selected triggering conditions before triggering. The timer activates when the Project runs. If none of the selected triggering conditions occurs during the timer's active time, the Analyzer triggers at the end of the time set for the timer.

You can set a timer independently of any other trigger selection, to cause an unconditional trigger after a set time.

To set the timer value, double-click **Timer** in the Pattern window to open the Timer dialog.

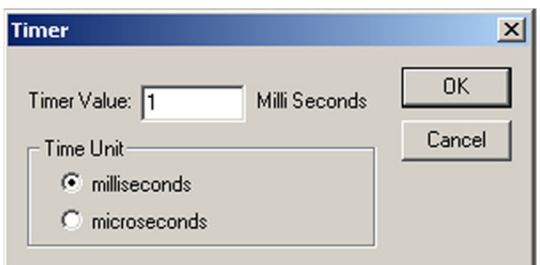


Figure 2.39: Timer Dialog

Check a Time Unit, enter the Timer Value, and click OK.

Timeout

Selecting **Timeout** for the pattern opens the Timeout Pattern dialog.

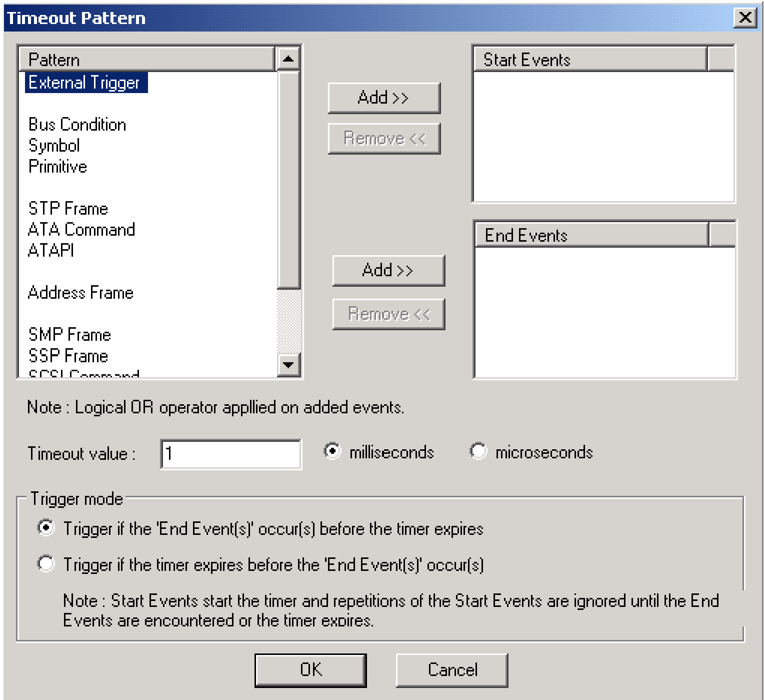


Figure 2.40: Timeout Dialog

"Start Events" starts the timer in Timeout Trigger and "End Events" triggers the analyzer (if first trigger mode is selected) or resets the trigger (if second trigger mode is selected). Repetitions of the Start Events are ignored until the End Event is encountered or the timer expires.

Select a pattern for Start Events or End Events, enter a Timeout value, then select Trigger Mode:

- If End Events occur before timer expires
- If timer expires before End Events

Note: Timeouts can only be configured from the Timeout Pattern dialog. The Timeout Pattern dialog allows configuring other patterns as triggers in combination with timeouts. Other pattern dialogs do not allow configuration of timeouts.

External/Manual Trigger

To set up an external trigger click the **External/Manual Trigger** category.

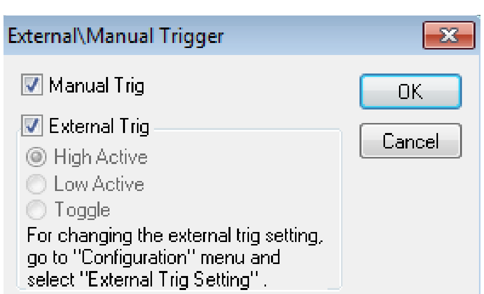


Figure 2.41: External/Manual Trigger Dialog

Device Sleep

To set up Device Sleep click the **Device Sleep** category. Select **Rising Edge** or **Falling Edge**.

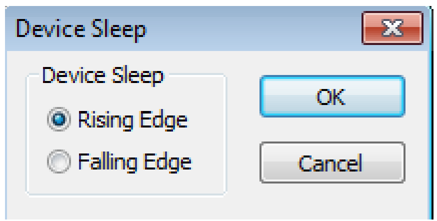


Figure 2.42: Device Sleep Dialog

Bus Condition

Double-click **Bus Condition** in the Patterns window of the Capture Project dialog to open the Bus Conditions dialog.

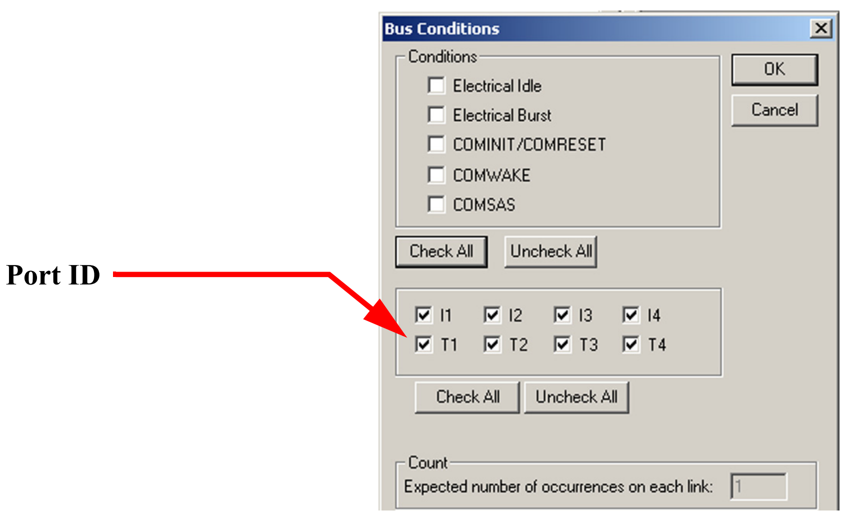


Figure 2.43: SAS: Bus Condition Dialog

SAS vs. SATA: SATA Dialog separates the COMINIT and COMRESET check boxes and replaces COMWAKE with Host COMWAKE and COMSAS with Device COMWAKE.

Check the Conditions to trigger on and click **OK**.

Note: You can define triggering for specific ports by checking or unchecking Port IDs.

Symbol

Double-click **Symbol** in the Patterns window of the Capture Project dialog to open the Symbol dialog.

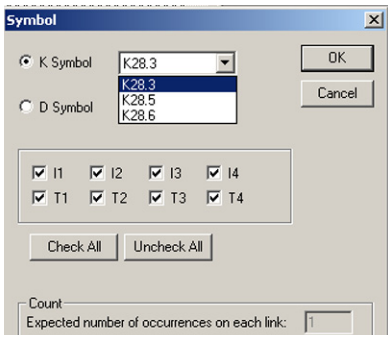


Figure 2.44: SAS: Symbol Dialog

Choose a symbol type by checking either the K Symbol or D Symbol option, then click the down arrow in the Symbol drop-down list, choose a symbol to trigger on, and click **OK**. Note that the D Symbol choice does not have a down arrow.

To choose a **D symbol**, click the D symbol option button and enter a Hex value.

Primitive

Double-click Primitive in the Patterns window of the Trigger dialog to open the Primitive dialog.

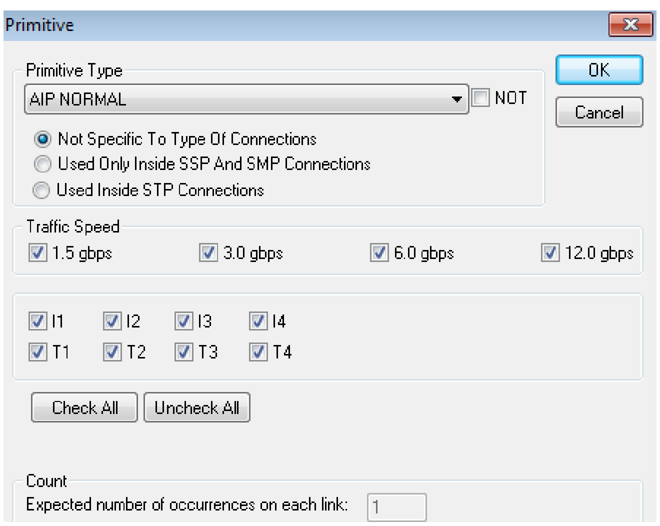


Figure 2.45: SAS: Primitive Dialog

SAS vs. SATA: SATA Dialog has no radio buttons and has different drop-down options.

Click the down arrow next to the Primitive dropdown list, scroll the list to choose a primitive on which to trigger, and click **OK**.

Note: Users need to exclude the ALIGN capture for the SAS SOF / EOF trigger and exclude the XXX capture for the SATA SOF / EOF trigger, in order for the trigger to precisely display on those primitives in the Link Data frame.

Note: Check the box to the right of the Primitive Type to use the logical NOT.

.

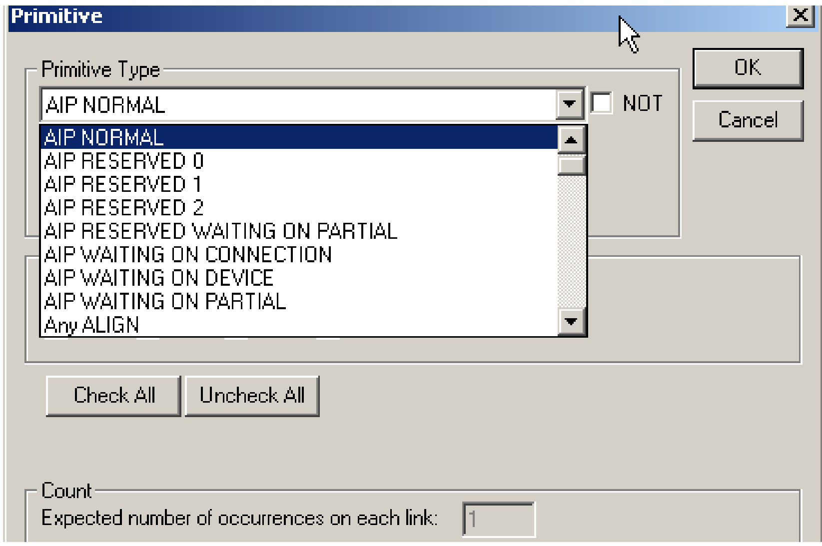


Figure 2.46: SAS: Primitive Selection Choices
SAS vs. SATA: SATA Dialog has different choices.

Primitive Traffic Speed Option (SATA only)

You can change the speed for triggering as well as search by speed for Primitives.

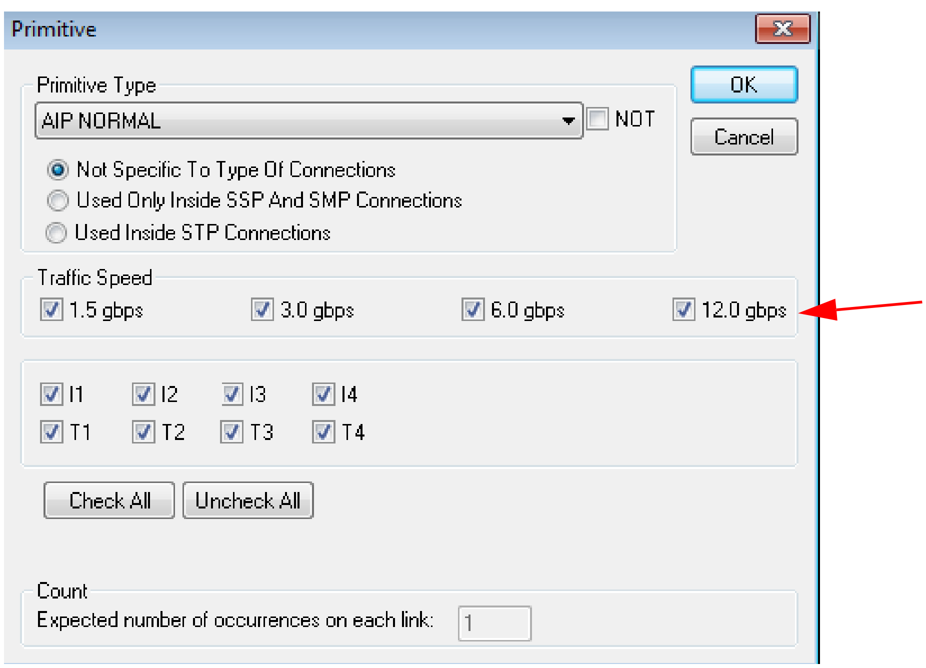


Figure 2.47: Primitive Dialog

ATA Command

Double-click **ATA Command** in the Patterns window of the Trigger dialog to open the ATA Command dialog (see Figure 2.48 on page 77) and (see Figure 2.49 on page 77).

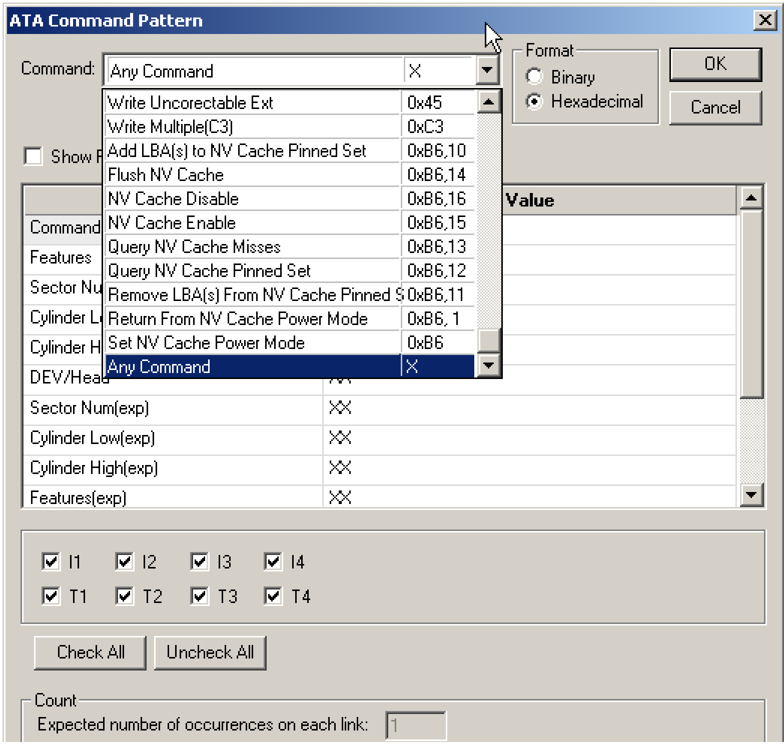


Figure 2.48: SAS: ATA Command Pattern Dialog

SAS vs. SATA: SATA Dialog has different dropdown options.

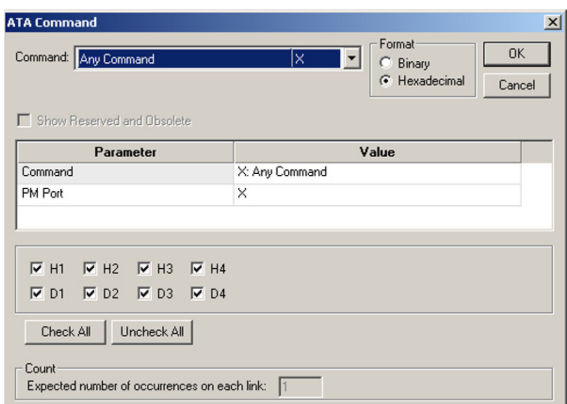


Figure 2.49: SATA: ATA Command Dialog

Click the down arrow next to the Command dropdown list, scroll the list to choose a command to trigger on, and click **OK**.

A powerful triggering choice is **Any Command**, which causes the analyzer to trigger on any ATA command.

Note: The command code and feature set are not the only parameters that describe an ATA command. For parameters such as LBA and sector count, you must use the **ATA Command Pattern** dialog.

Data Pattern

Double-click **Data Pattern** in the Patterns window of the Trigger dialog to open the Data Pattern dialog (see Figure 2.50).

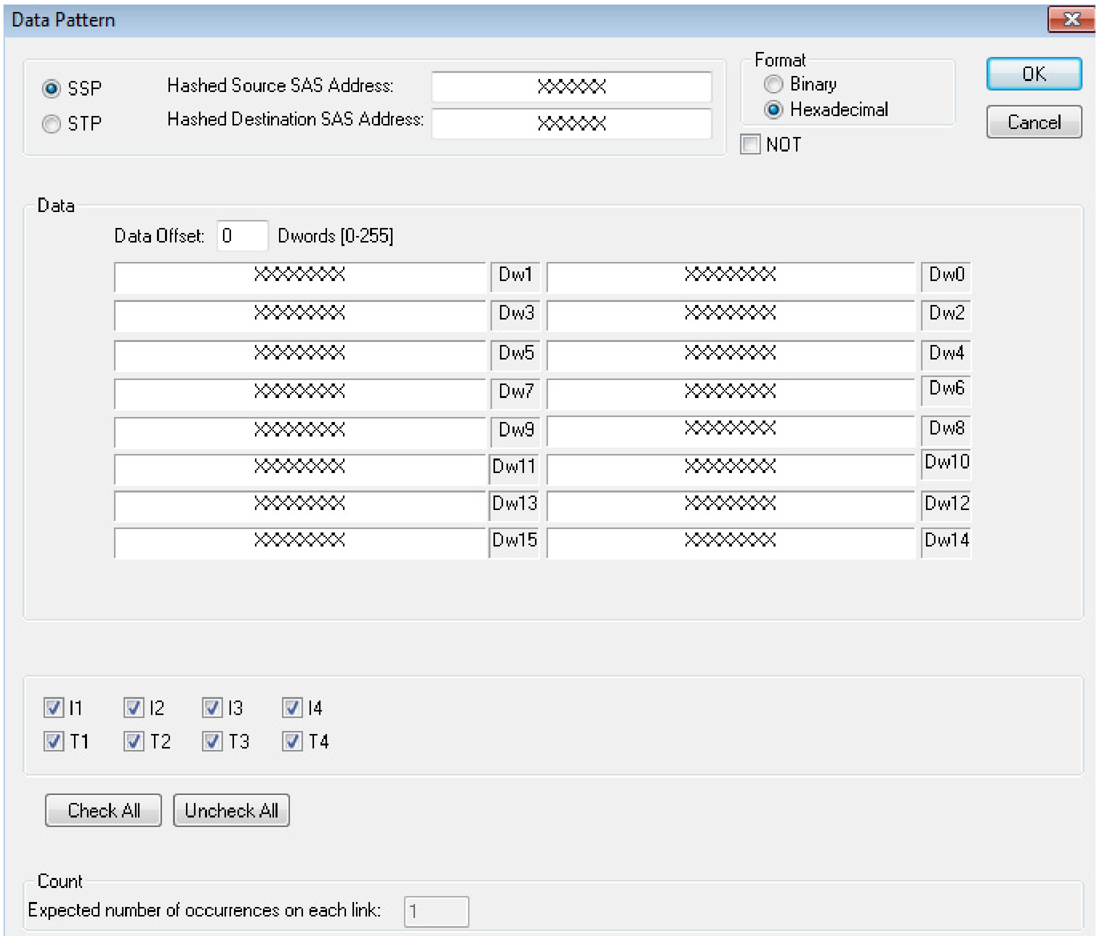


Figure 2.50: SAS: Data Pattern Dialog

SAS vs. SATA: SATA Dialog shows Port at the top and does not show SSP or STP.

Define the data pattern for triggering and click **OK**.

Note: When entering the data pattern in the “Data” section of this screen, if you are reading the data pattern from a recorded trace, you must reverse the order of the bytes listed for each DWORD entered. For example, if you want to trigger on “00 01 02 03” (as displayed in the trace), you must enter this DWORD pattern as “03 02 01 00”.

Training Sequence

Double-click Training Sequence in the Patterns window of the Trigger dialog to open the Training Sequence dialog.

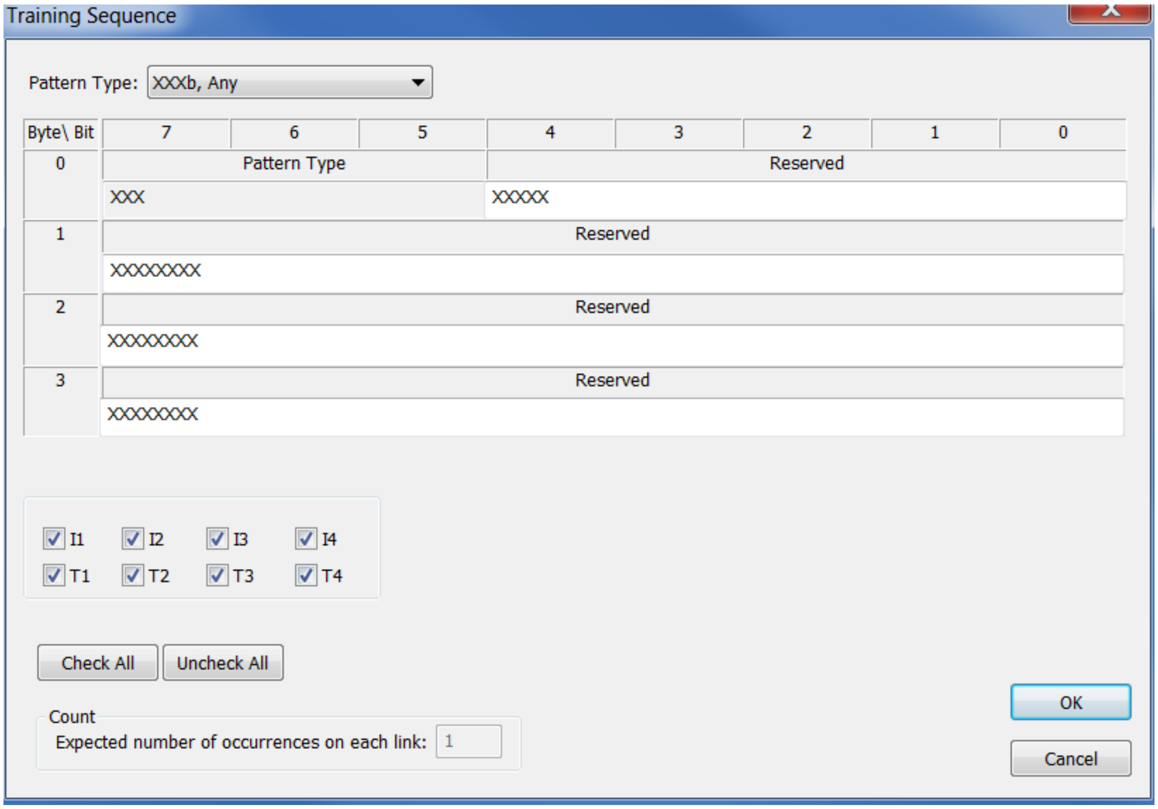


Figure 2.51: SAS: Training Sequence Dialog

SAS vs. SATA: Not available in SATA.

Define the training sequence for triggering and click **OK**.

Protocol Errors

Double-click **Protocol Errors** in the Patterns window of the Trigger dialog to open the Protocol Errors dialog.

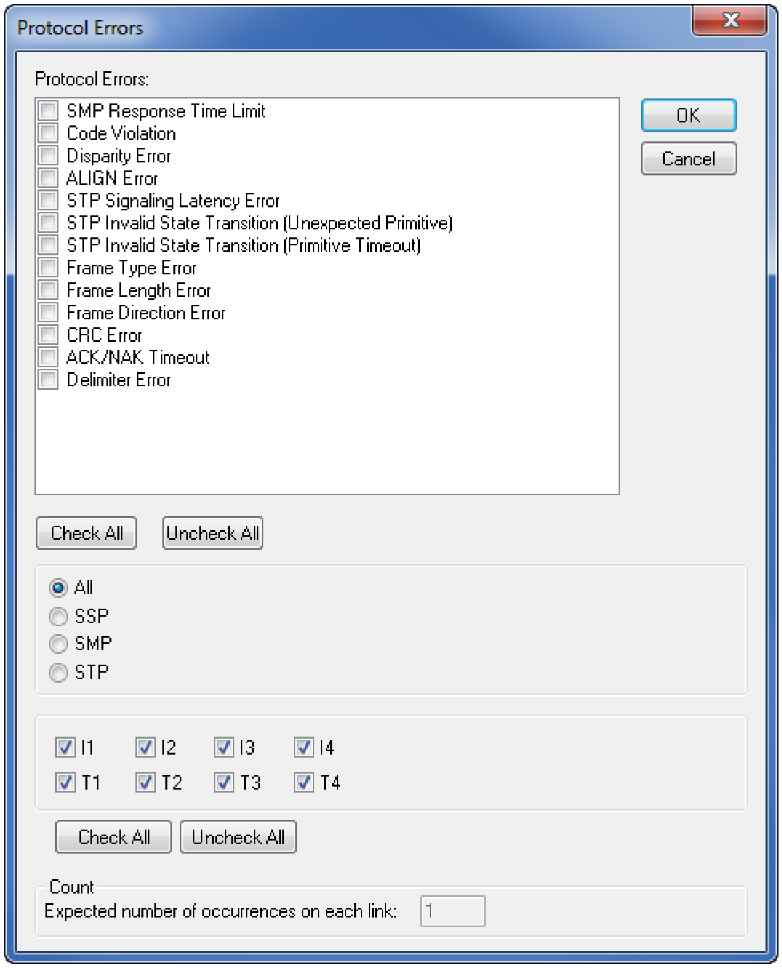


Figure 2.52: SAS: Protocol Errors Dialog

SAS vs. SATA: SATA Dialog shows Port and does not show SSP, SMP, or STP radio buttons.

Check the protocol error(s) on which to trigger and click **OK**.

ATAPI

Double-click **ATAPI** in the Patterns window of the Trigger dialog to open the ATAPI Patterns dialog.

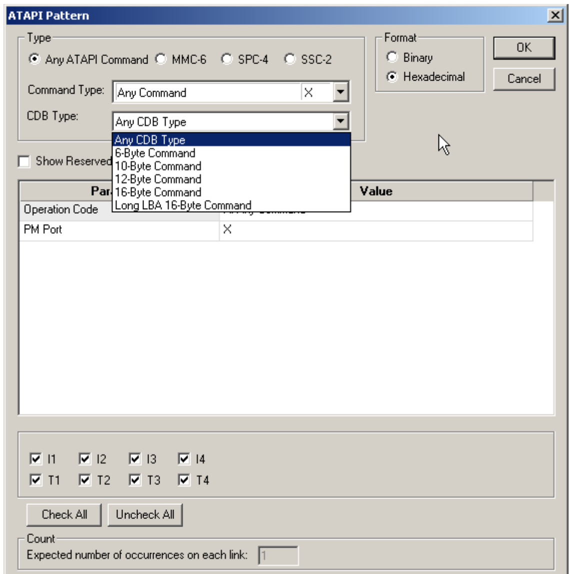


Figure 2.53: SAS: ATAPI Patterns Dialog

SAS vs. SATA: SATA Dialog has different dropdown options.

Click the down arrow next to the CDB dropdown list, scroll the list to choose a CDB Type, and click **OK**.

Address Frame (SAS only)

Double-click **Address Frame** in the Patterns window of the Trigger dialog to open the Address Frame Type Pattern dialog.

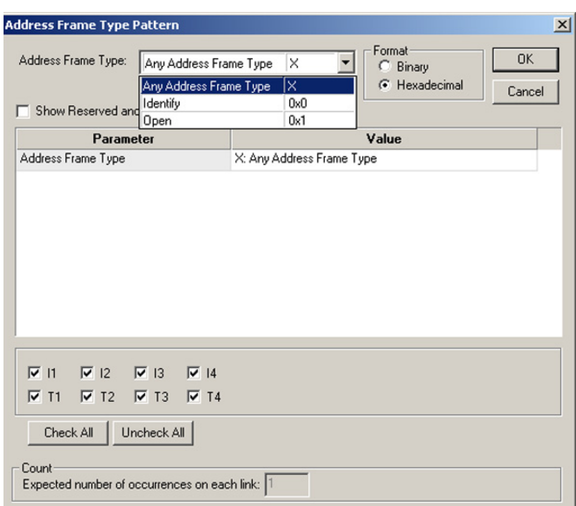


Figure 2.54: SAS: Address Frame Type Pattern Dialog

SAS vs. SATA: Not available in SATA.

Click the down arrow next to the Address Frame Type dropdown list, scroll the list to choose an address frame type on which to trigger, and click **OK**.

STP Frame

Double-click **STP Frame** in the Patterns window of the Trigger dialog to open the STP Frame Type dialog.

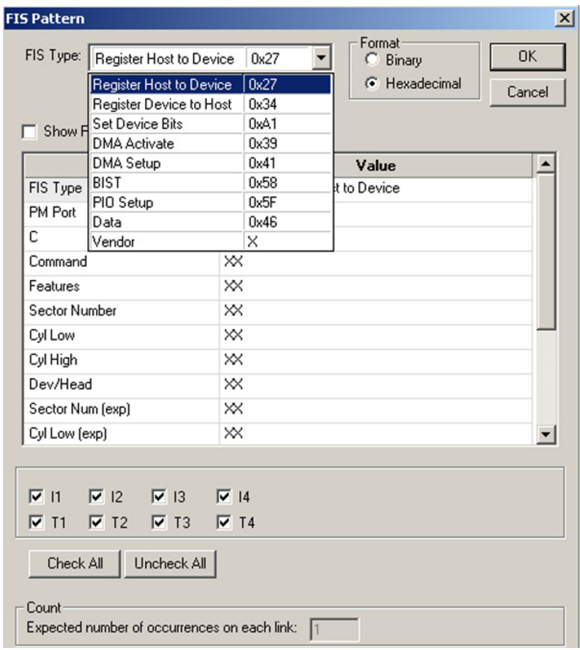


Figure 2.55: SATA: FIS Pattern Dialog

Click the down arrow next to the FIS type dropdown list, scroll the list to choose an FIS type on which to trigger, and click **OK**.

SMP Frame (SAS only)

Double-click **SMP Frame** in the Patterns window of the Trigger dialog to open the SMP Frame Pattern dialog.

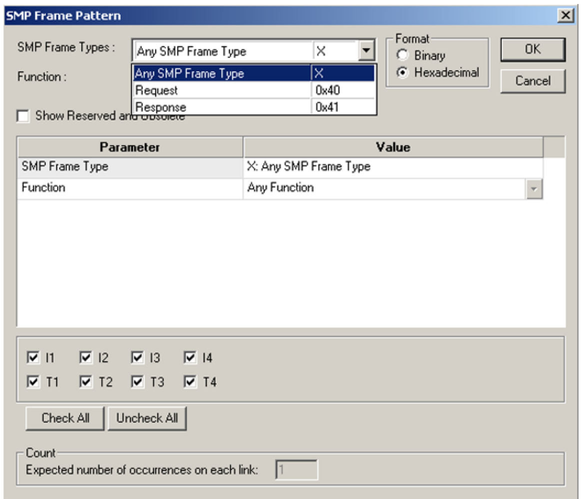


Figure 2.56: SAS: SMP Frame Pattern Dialog

SAS vs. SATA: Not available in SATA.

Click the down arrow next to the SMP Frame Types dropdown list and scroll the list to choose an SMP frame type on which to trigger. Then click the down arrow next to the Function dropdown list, choose a function, and click **OK**.

SSP Frame (SAS only)

Double-click **SSP Frame** in the Patterns window of the Trigger dialog to open the SSP Frame Pattern dialog.

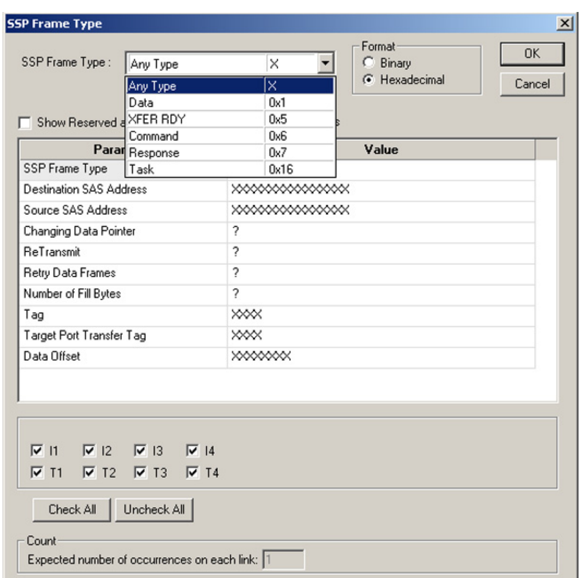


Figure 2.57: SAS: SSP Frame Type Dialog

SAS vs. SATA: Not available in SATA.

Click the down arrow next to the SSP Frame Type dropdown list, scroll the list to choose an SSP frame type on which to trigger, and click **OK**.

SCSI Command (SAS only)

Double-click **SCSI Command** in the Patterns window of the Trigger dialog to open the SCSI Command Pattern dialog.

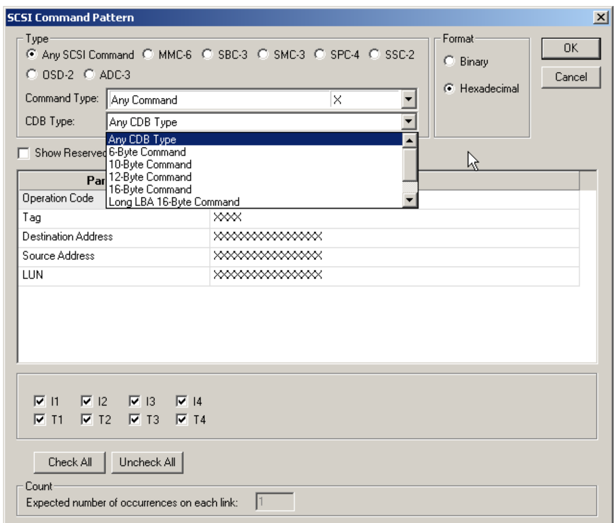


Figure 2.58: SAS: SCSI Command Pattern Dialog

SAS vs. SATA: Not available in SATA.

Click the down arrow next to the CDB dropdown list, scroll the list to choose a CDB Type, and click **OK**.

Timeout

Choosing timeout as a trigger condition allows you to define a timer with a timeout value that is reset to 0 and starts by occurrence of any events that you add to the Start Events list. You can then add one or more events to the End Events list and then choose a trigger to occur if an End event occurs before the timer expires, or if the timer expires before the occurrence of an end event.

You add and define the Start and End events identically to the way that you define and add patterns to capture.

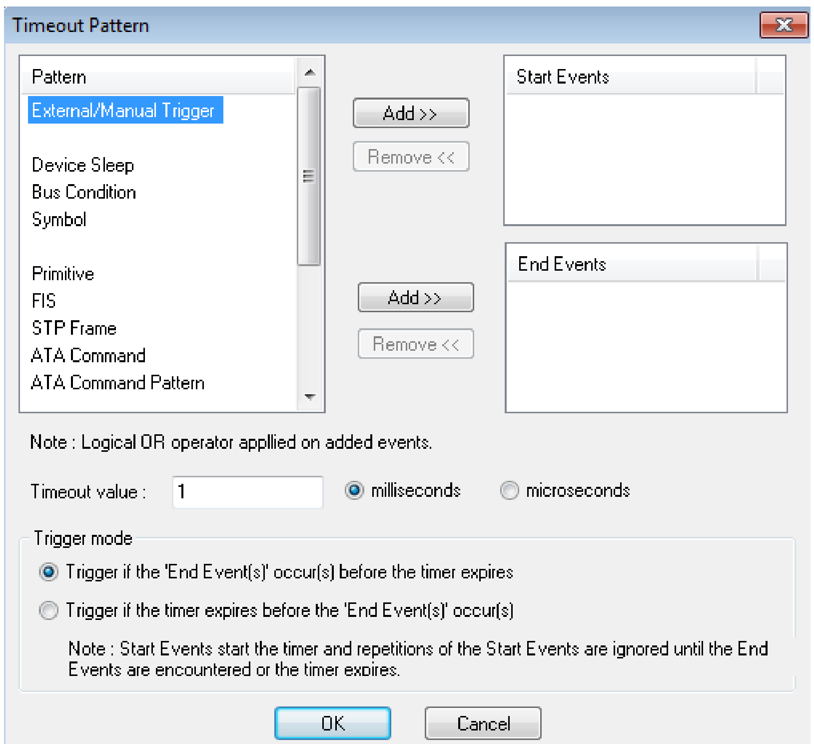


Figure 2.59: Timeout Pattern Dialog

ATA Command Pattern (SATA only)

Double-click **ATA Command Pattern** to open the ATA command pattern selection dialog.

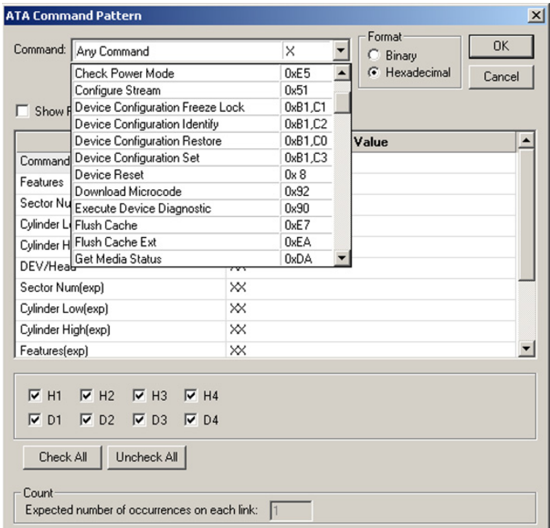


Figure 2.60: SATA: ATA Command Pattern Dialog

SAS vs. SATA: Not available in SAS.

Click the down arrow next to the Command list box, choose an ATA command, and click **OK**.

FIS (SATA only)

Double-click **Frame Information Structure (FIS)** to open the FIS Type selection dialog.

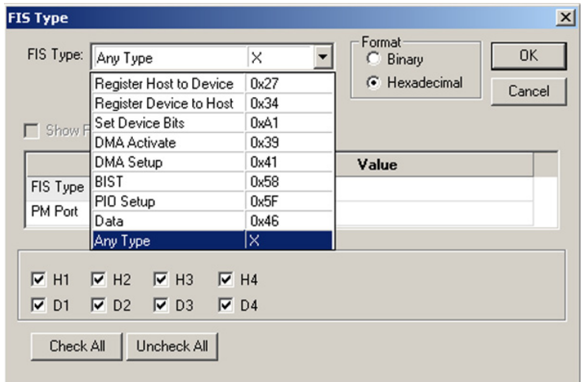


Figure 2.61: SATA: FIS Type Dialog

SAS vs. SATA: Not available in SAS.

Click the down arrow next to the Type drop-down list box, choose a FIS type on which to trigger, and click **OK**. Repeat for additional types.

Available FIS Types

- Register Host to Device
- Register Device to Host
- Set Device Bit
- DMA Activate
- Any Type
- DMA Setup
- BIST
- PIO Setup
- Data

Note: You cannot trigger on a Vendor FIS.

FIS Pattern (SATA only)

Double-click **FIS Pattern** to open the FIS Pattern selection dialog (see Figure 2.62 on page 88).

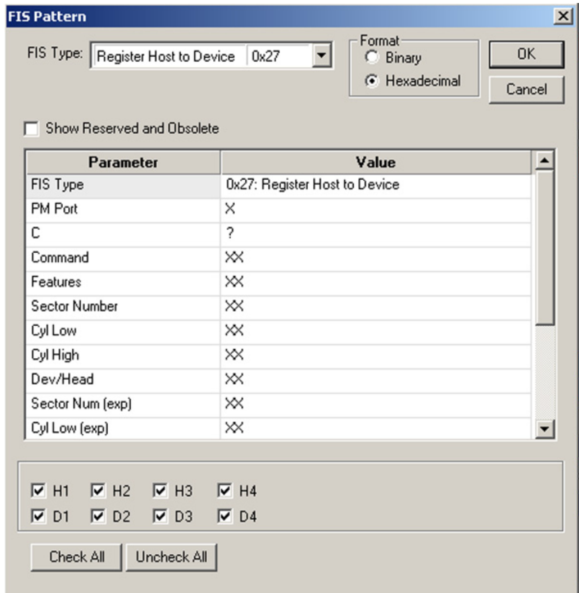
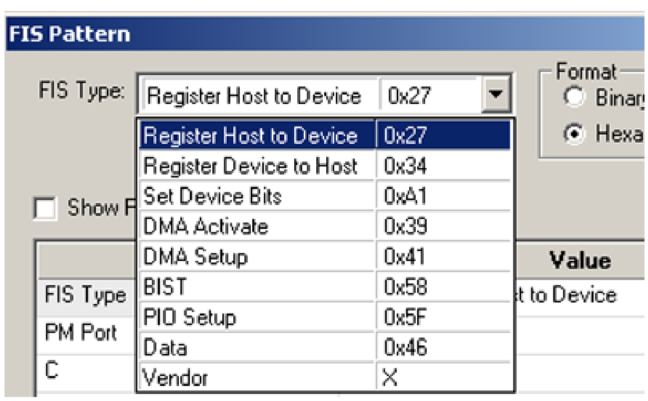


Figure 2.62: SATA: FIS Pattern Dialog

SAS vs. SATA: Not available in SAS.

The FIS Pattern dialog opens with the default FIS Type as **Register Host to device.** To choose another available FIS Type, click the down arrow next to the FIS Type list box.



SATA: FIS Pattern Dialog Choices

SAS vs. SATA: Not available in SAS.

Choose a FIS Type and complete the corresponding dialog.

ATA Command Pattern (SATA only)

Double-click **ATA Command** to open the ATA Command Pattern selection dialog.

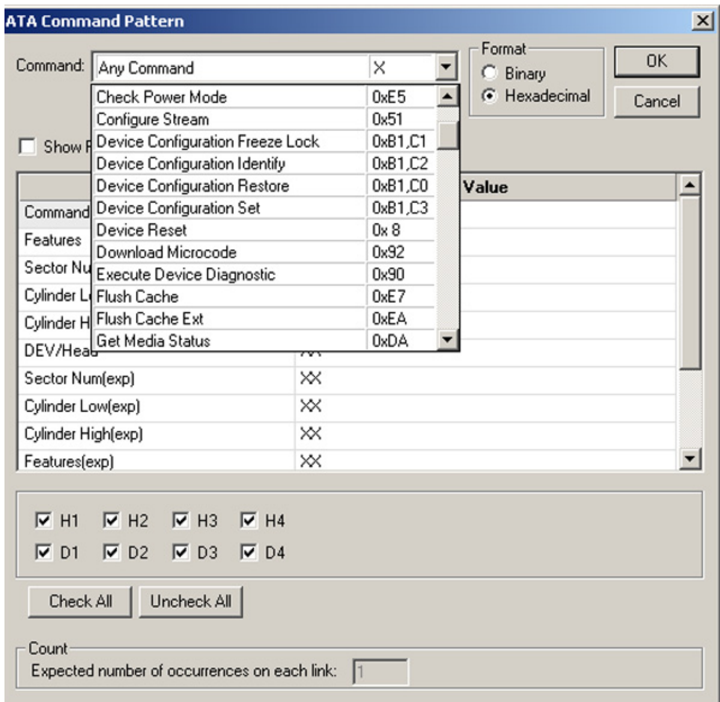


Figure 2.63: SATA: ATA Command Pattern Dialog

SAS vs. SATA: Not available in SAS.

Click the down arrow next to the Command list box, choose an ATA command, and click **OK**.

Soft Reset (SATA only)

Double-click **Soft Reset** to open the Soft Reset dialog.

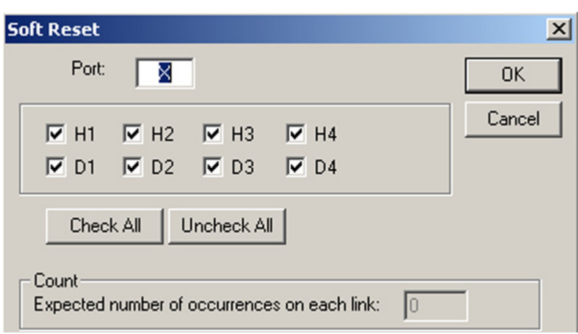


Figure 2.64: SATA: Soft Reset Dialog

SAS vs. SATA: Not available in SAS.

Sequential Trigger Mode

In the Sequential Trigger mode, triggering occurs whenever the system detects a specific sequence of patterns. The order in which you define triggering patterns establishes the sequence. You must define at least two patterns to enable the selection of the sequential trigger mode.

Note: Primitives and Symbols or Frames occurring very close together on different ports cause an error in triggering.

To define a triggering sequence, select more than one pattern, then check the **Define Sequential Trigger Mode** check box.

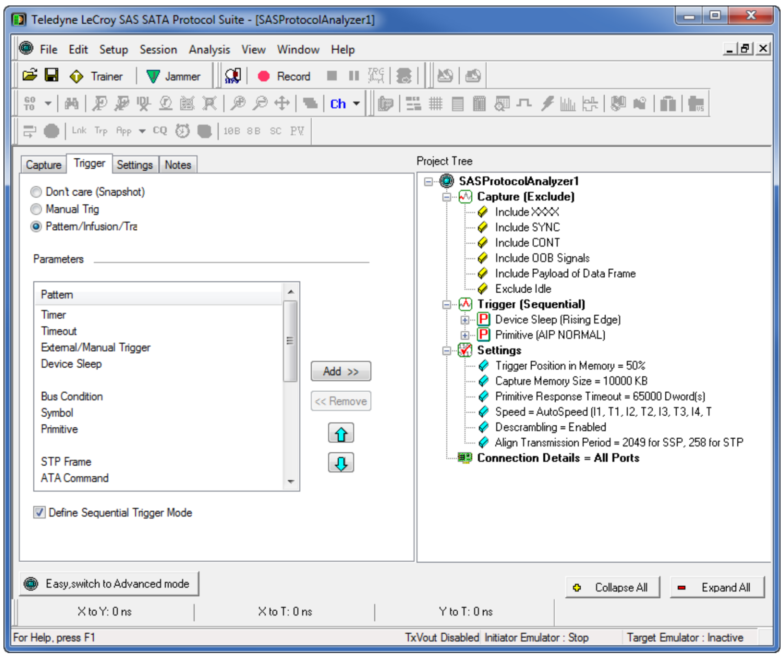


Figure 2.65: SAS: Select Sequential Trigger Mode

SAS vs. SATA: SATA Dialog has different patterns.

Timer

The sequential triggering mode offers the option of triggering on a timer or inserting a timer in the triggering sequence to delay detection of the next pattern in the sequence. To insert a timer in the trigger list, double-click **Timer** to open the Timer definition dialog.

Enter a **Time Value**, choose the **Time Unit**, and click **OK**.

Defining Patterns

The definition of patterns for the sequential trigger mode is identical to the Any Trigger mode, with the following exception:

In the sequential triggering mode, the definition dialogs for these triggering patterns have an additional setting, to count the number of occurrences. This setting allows you to specify the number of times that the pattern must occur before triggering or proceeding in the trigger sequence.

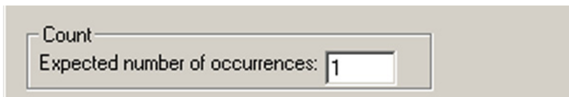


Figure 2.66: Number of Occurrences DIalog

Note: The system counts events on each link independently, causing a trigger whenever the number of occurrences on any link equals the specified value.

Triggering Order

As you define and add triggering patterns, they display under the Trigger category in the Project Tree sequentially, in the order in which you entered them. When the project runs, the Analyzer detects the occurrence of each pattern in order and triggers on the last one.

You can reorder the sequence of triggering patterns. To change the sequence order, highlight a trigger pattern and use the **Up** or **Down** arrow to move it to a new position.

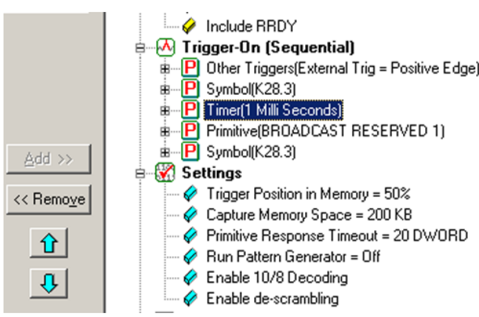


Figure 2.67: Triggering Order

Pre-Trigger

You can set the amount of data to capture before and after the trigger, as a percentage of pre-trigger, between 1% and 99%. Position the pre-trigger slider to a percentage. This feature allows the evaluation of bus activity leading up to and after the triggering event. Figure 2.68 illustrates the operation of pre-trigger in data memory.

Pre-trigger data is capture of the specified percentage of data prior to the triggering event. It cannot be guaranteed and may be 0. This can occur when the triggering event occurs before storing the required amount of pre-trigger event data. In such a case, the data display shows fewer than the specified data points prior to the triggering event.

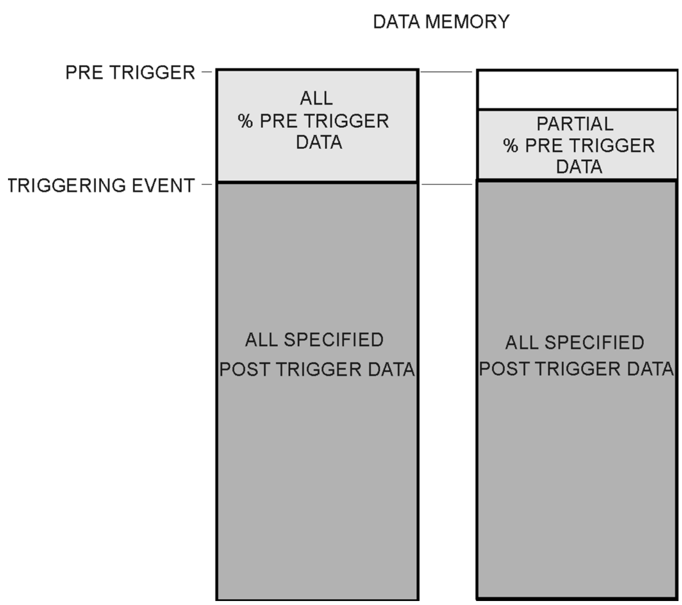


Figure 2.68: Pre-Trigger Example, 20% Pre-Trigger

2.2.16 Project Settings

To set project options, click the **Settings** tab (see Figure 2.69 on page 93).

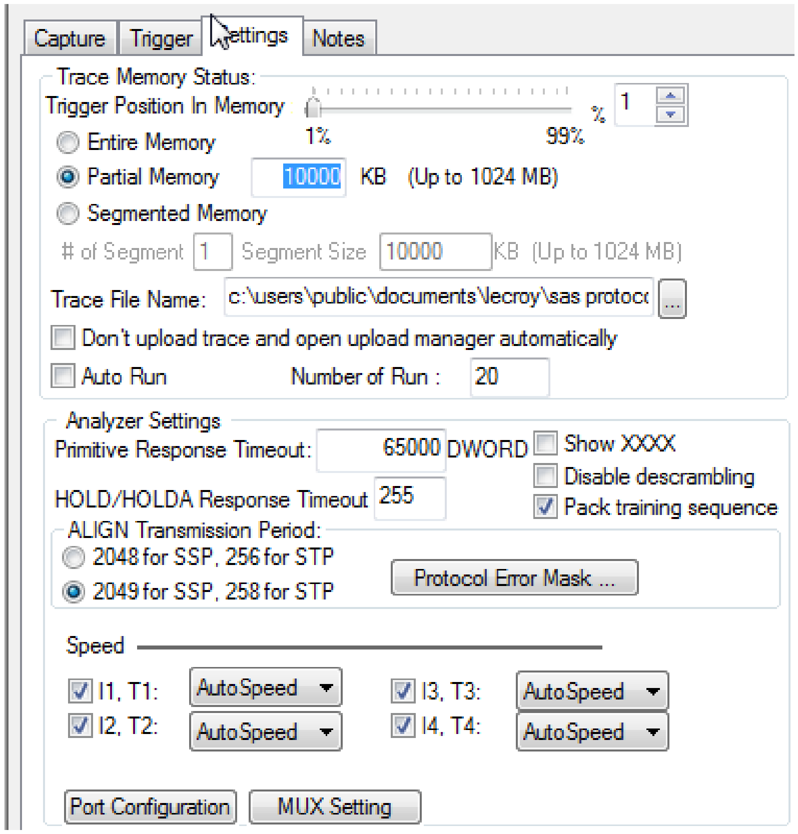


Figure 2.69: SAS: Setting Project Options

SAS vs. SATA: For the ALIGN Transmission Period section, SATA Dialog shows options 256 and 258, and does not show 2048 or 2049.
For Speed, SATA Dialog shows H1, D1 to H4, D4 and does not show I1, T1 to I4, T4.
SATA Dialog does not show MUX Setting button.

SATA dialog shows DevSlp min detection time field to enter the debouncer value.

Memory Settings

The Trace Memory Status section has the following fields.

Trigger Position

Pre-Trigger defaults to 50%, which defines the percentage of data to capture before and after the triggering event. You can change this percentage by dragging the slider.

Capture of the specified percentage of the data prior to the triggering event cannot be guaranteed and may be 0. This can occur if the triggering event occurs before storing the required amount of pre-trigger event data. In such a case, the data display shows fewer than the specified data points prior to the triggering event. For more detail, (see “Pre-Trigger” on page 92.)

Note: Trigger Position only works when the triggering option is Pattern.

In certain cases, when one port is recording traffic and filling up the memory much faster than another port, you might see traffic appearing only on one port for a while, and the other port's traffic will only appear later. This occurs as a function of the trigger position, and is normal, expected behavior of the analyzer.

Trace File Name

Click the ellipses next to the Sample File Name text box and choose a file name and location for the results of your current project.

Auto Run

To repeat the current capture and trigger setup automatically, check the Auto Run checkbox and enter the number of times in the Number of Run text box. The capture and trigger repeat automatically for the specified number of times, and the results are saved in consecutively numbered Sample.scs files.

Memory Size

In the Protocol Analyzer Settings tab, you can allot memory for the trace recording. Check **Entire Memory** to allow recording to use the whole memory, to capture the maximum amount of trace data. (Minimum size of memory is 2 GB. Maximum size of memory is 16 GB.)

Partial Memory

To reduce the memory size, check **Partial Memory** and enter a buffer size in kilobytes, up to the memory size in megabytes.

Note: If the size of a data packet exceeds the buffer memory allocation, the project runs, but no data capture occurs. You must increase buffer memory size to a value greater than the packet size.

Segmented Memory

Alternatively, you can use **Segmented Memory**. Enter an integer **# of Segment**, from 1 to 32, then enter an integer **Segment Size** in kilobytes, up to the memory size in megabytes divided by the number of segments. The default segment size is 10 MB.

Each time a trigger condition occurs, the system records a new segment. You can use a Snapshot or Pattern trigger, but not Manual Trigger. As the same trigger automatically repeats, the system makes the number of segments that you entered.

Upload Manager

To upload segments manually in the Upload Manager, select the **Don't upload segments and open upload manager automatically** checkbox.
To upload segments automatically for display as the system creates them, do not select the checkbox.

To view segmented trace files, click the **Upload Manager**  button, beside the Record button, to display the Upload Manager dialog (see Figure 2.70 on page 95.)

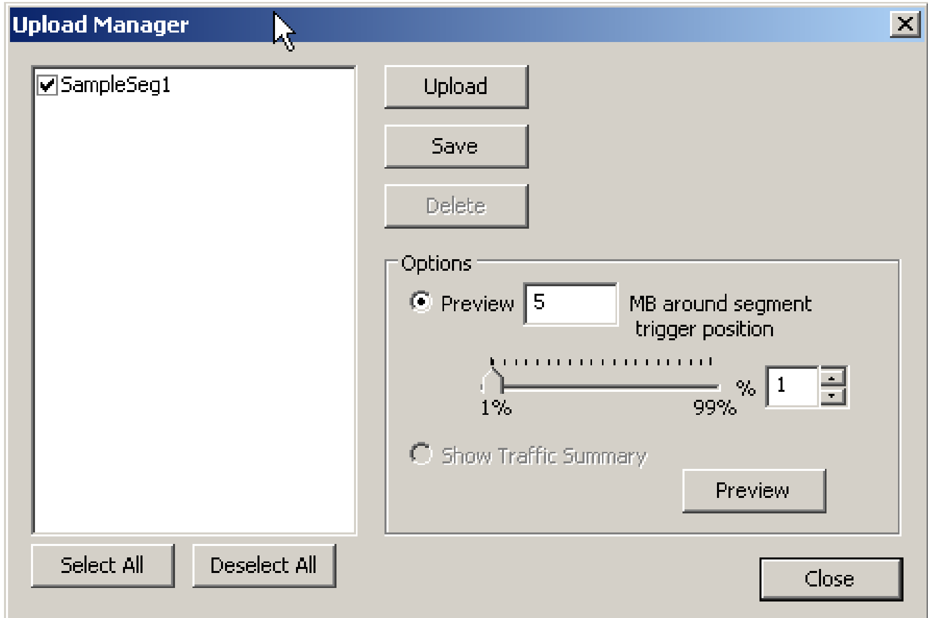


Figure 2.70: Upload Manager Dialog

The dialog displays the segments in the format Segment1, Segment2, and so on.

Select segments by clicking the checkbox. You can also **Select All** or **Deselect All** segments.

You can **Upload** segments for display, **Save** segments as sample files, and **Delete** segments.

The **Preview** radio button allows a preview of an integer number of megabytes around the trigger position. You can set the trigger position as a percentage and select the segment number. Click the radio button to **Show Traffic Summary** with the preview. To show the preview, click the **Preview** button.

2.2.17 Analyzer Settings

Primitive Response Timeout

The Primitive Response Timeout parameter specifies the number of DWORDs between two pair primitives after which the analyzer detects a protocol error. Default value is 65000. When host or device sends a primitive, such as X_RDY, HOLD, or WTRM, it expects device or host to reply with a primitive, such as R_RDY, HOLDA, or R_OK. This parameter detects FIS Signaling Latency error, between HOLD and HOLDA, and FIS State Transition error, between X_RDY and R_RDY, between SOF and EOF, or between WTRM and R_OK or R_ERR.You can set a trigger on these protocol errors.

Disable Scrambling

If checked, causes the Analyzer to assume that no traffic is scrambled. By default, the Analyzer assumes the scrambling state of the devices under test.

Show XXXX value

Check this option to display XXXX values.

Pack Training Sequence

Checking this option allows hiding the details of the Training Sequence, which can take up large portions of the trace unless packed.

ALIGN Transmission Period (differs for SAS and SATA)

Choose the ALIGN Transmission Period for SSP and STP by clicking the corresponding option button, then open the Protocol Error Mask dialog.

Protocol Error Mask

Click the Protocol Error Mask button to open the Protocol Error Mask dialog.

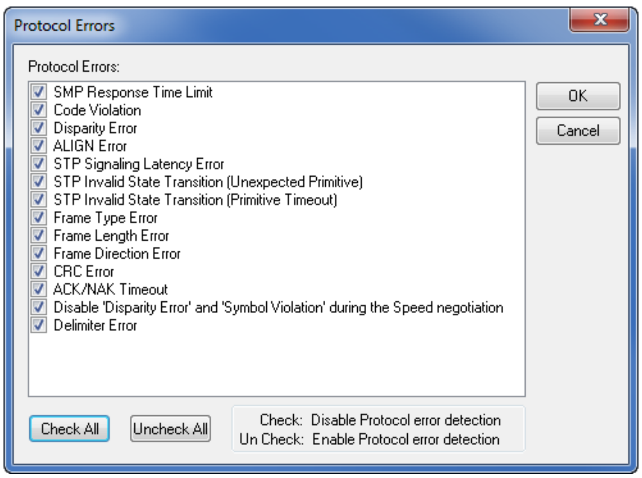


Figure 2.71: Protocol Errors Dialog

Check the Protocol Errors that you want the Analyzer to ignore.

When “RD Error” and “Code violation Error” are set as trigger events:
“RD Error” or “Code violation Error” can occur right after the OOB sequence.
“RD Error” or “Code violation Error” can occur right after the recovery from the PM state.

These errors are mainly caused by the long synchronization time of the analyzer. If these errors, caused by the Analyzer, become triggers, you cannot detect some other errors that you really need to detect. To NOT detect the above two errors, enable the software setting **Disable ‘Disparity Error’ and ‘Symbol Violation’ during Speed negotiation**. After this, the code violation is not triggered during the speed negotiation phase, but is triggered if the violation happens after the speed negotiation phase.

External Trig Out Setting

The Analyzer can send a Low or High external signal when a trigger occurs. Under **Setup** select **External Trig Setting** to choose Trig Out Setting: High Active, Low Active, or Toggle from High to Low or Low to High once (3.3 V output). Enter the External TrigOut pulse width.

The pulse width is programmable in the software. The Voltage level is 0 to +3.3 Volt. The trigger out is derived by NL17SZ126 buffer. The delay for OOB traffic external trigger out is 190 ns. The delays for non OOB external trigger out are:

- 12G ~ 380 ns
- 6G ~ 530 ns
- 3G ~ 730 ns
- 1.5G ~ 1020 ns

External Trig In Setting

An external Low or High input signal can cause triggering. Under **Setup** select **External Trig Setting** to choose External Trig In Setting: High Active, Low Active, or Toggle from High to Low or Low to High once (3.3 V output).

Choose Port Speed

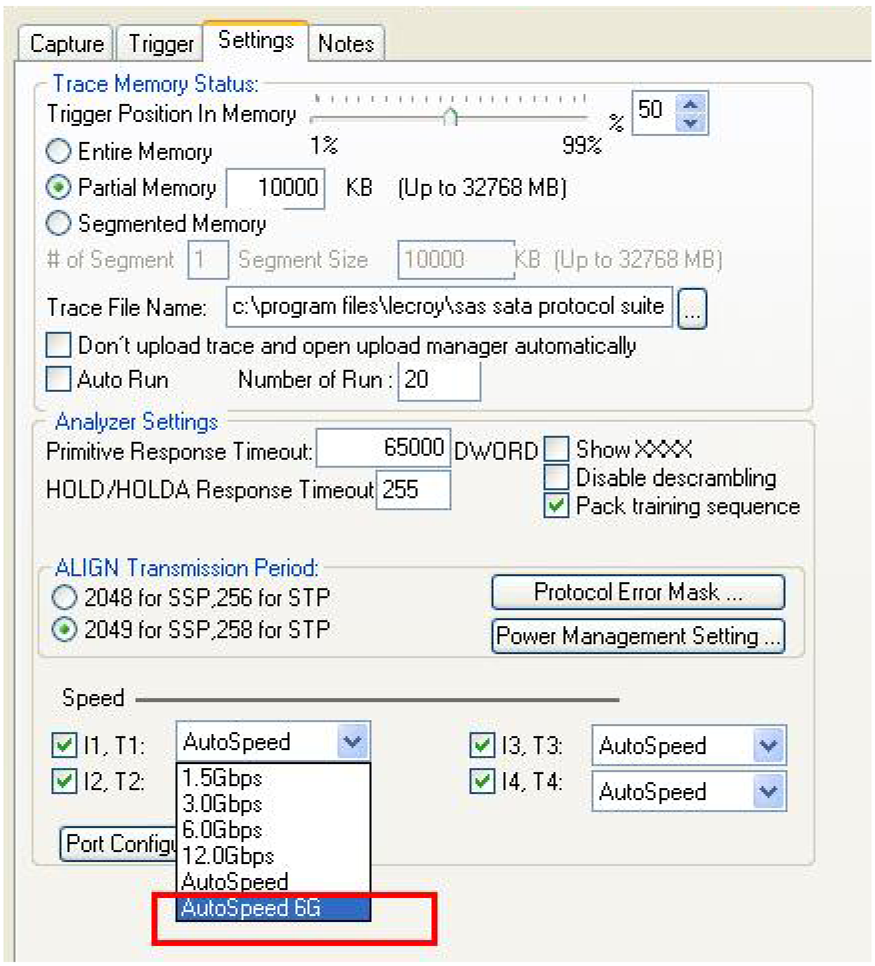


Figure 2.72: Speed Setting

The default speed is Autospeed. You can also select the port speed from the drop-down list: 1.5 Gbps, 3.0 Gbps, 6.0 Gbps or 12.0 Gbps.

By selecting Autospeed 6G, you can limit the port speed to 6 Gbps, to eliminate the possibility of some speed-related errors.

Note: If a Port ID check box has no check, the analyzer does not capture any patterns for that port. The system allocates trace memory for that port to its adjacent port, for example: I1, T1 <-> I2, T2 or I3, T3 <-> I4, T4.

Ports Configuration

Click the **Port Configuration** button to display the Set Port Configuration dialog.

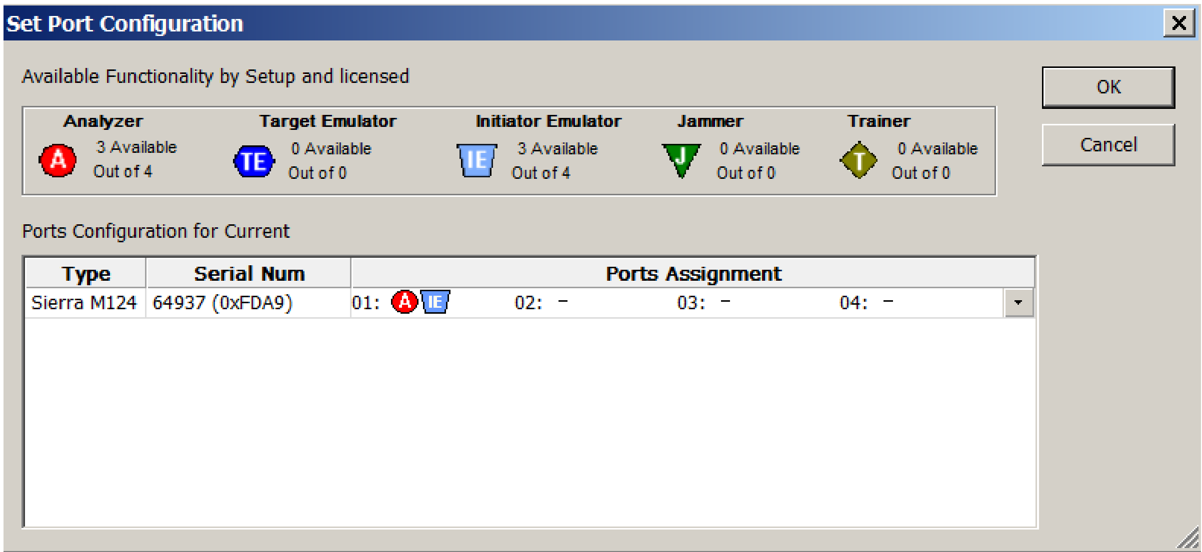


Figure 2.73: SAS: Set Port Configuration Dialog

The dialog shows the current port configuration. To select a port configuration, click the down arrow to display the Select Port Configuration dialog.

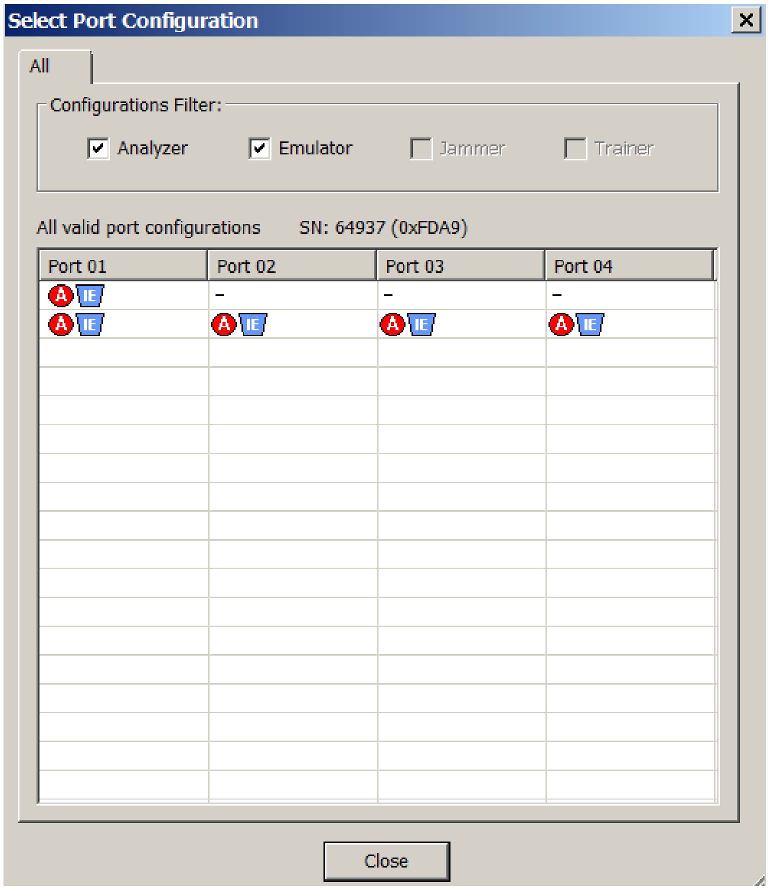


Figure 2.74: SAS: Select Port Configuration Dialog

Port configuration depends on the application you run. Use the checkboxes at the top to filter the list of port configurations by the required function.

Note: To display the current Port Configuration, click the green button in the lower right corner to display the Port Status window (see "Port Status" on page 195).

2.2.18 Add a Project Note

To enter and save information about the current project, click the **Notes** tab and enter the data about the project.

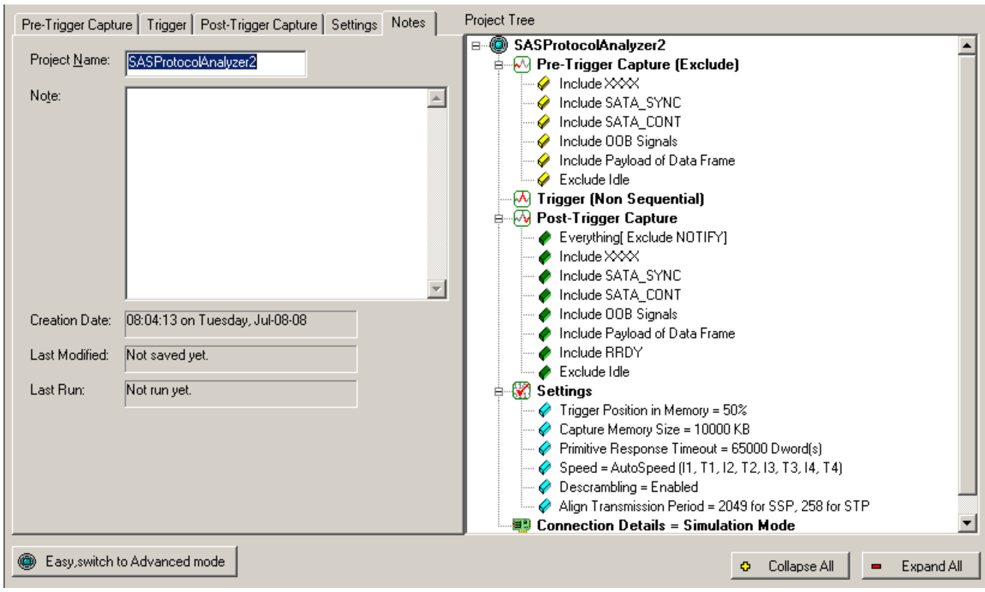


Figure 2.75: Project Notes Tab

2.2.19 Advanced Mode (User-Defined)

Advanced Mode expands Analysis capability by allowing you to program complex triggering and data capture projects.

The Advanced Mode is a state machine with up to 23 different states. You can program each state individually to:

- Trigger on a different event or trigger unconditionally.
- Capture Everything, Nothing, or a user-defined pattern.
- Include up to three ELSE IF statements, allowing a jump to any other state based on a user definition.
- Use up to three timers, which you can set to a maximum value of 42949 ms. You can set a timer in the state or continue the timer set in the previous state.
- Output an external trigger High or Low.

Note: In Advanced Mode, events on each link are counted independently. A condition is met if the number of events on a link equals the defined occurrence.

Working in Advanced Mode

To start working in the Advanced Mode, click the **Easy, Switch to Advanced Mode** button in an open Analyzer window.

You can:

- Display the state definition
- Set Output Trigger level
- Select up to three timers
- Define the If condition and up to three Else If conditions
- Set number of occurrences before trigger
- Set captured data
- Set excluded data
- Go to next state
- Add state
- Choose link for Sequencer setup

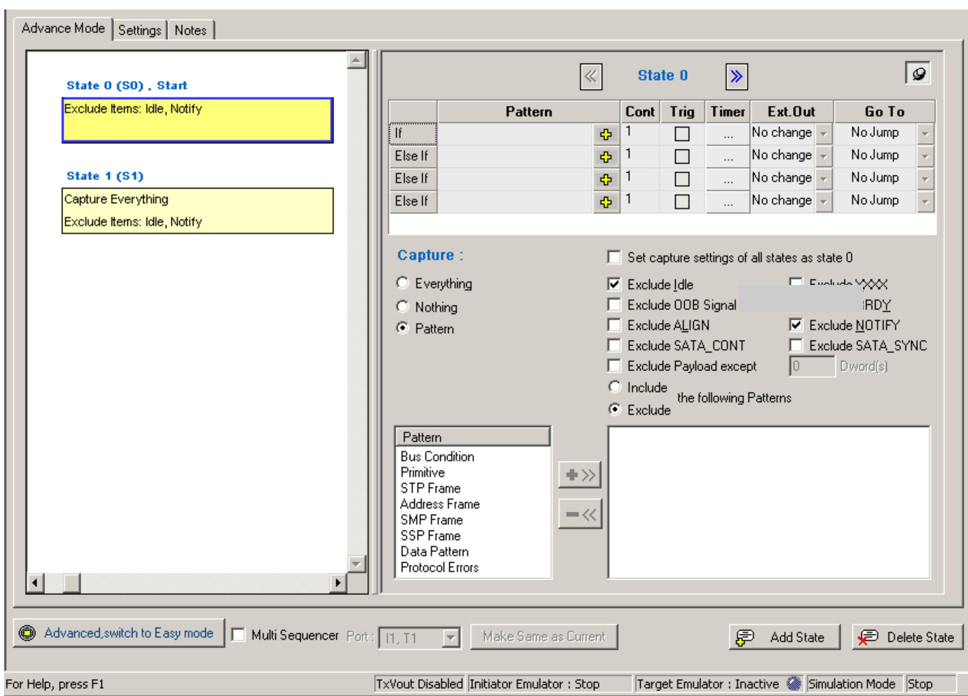


Figure 2.76: SAS: State Programming Dialog

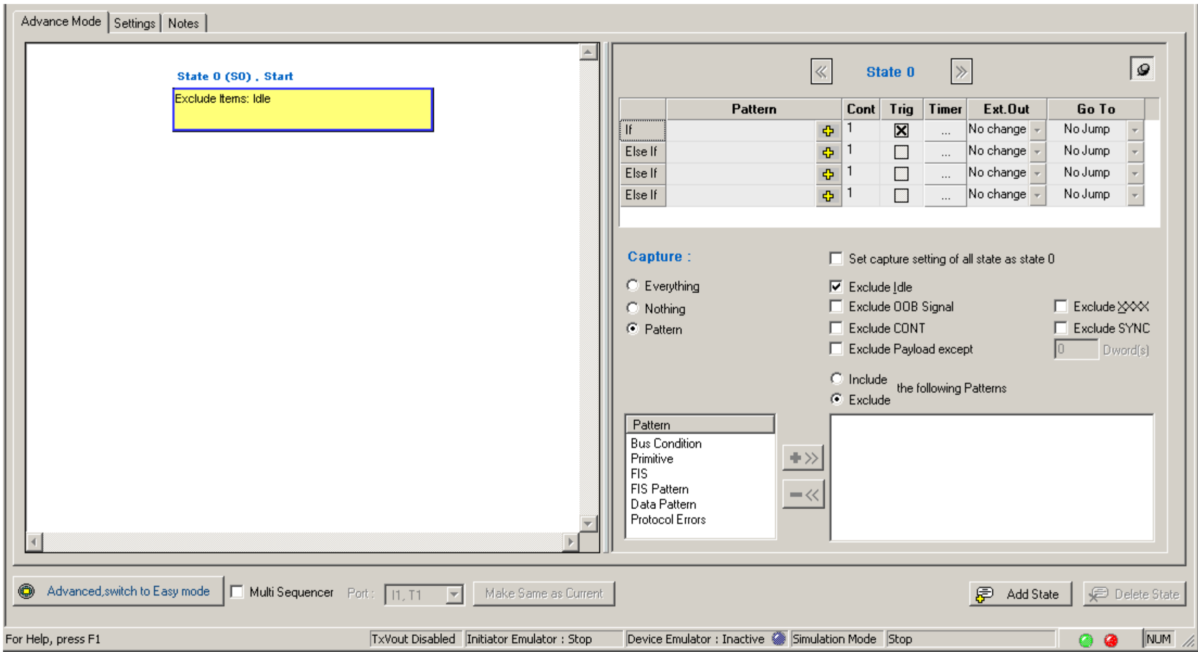


Figure 2.77: SATA: State Programming Dialog

SAS vs. SATA: SATA Dialog removes Exclude ALIGN, Exclude RRDY, and Exclude NOTIFY. SATA Dialog replaces Exclude SATA_CONT with Exclude CONT and Exclude SATA_SYNC with Exclude SYNC.
SATA Dialog has patterns Bus Condition, Primitive, FIS, FIS Pattern, Data Pattern, and Protocol Errors and does not have STP Frame, SMP Frame, STP Frame, or Address Frame.

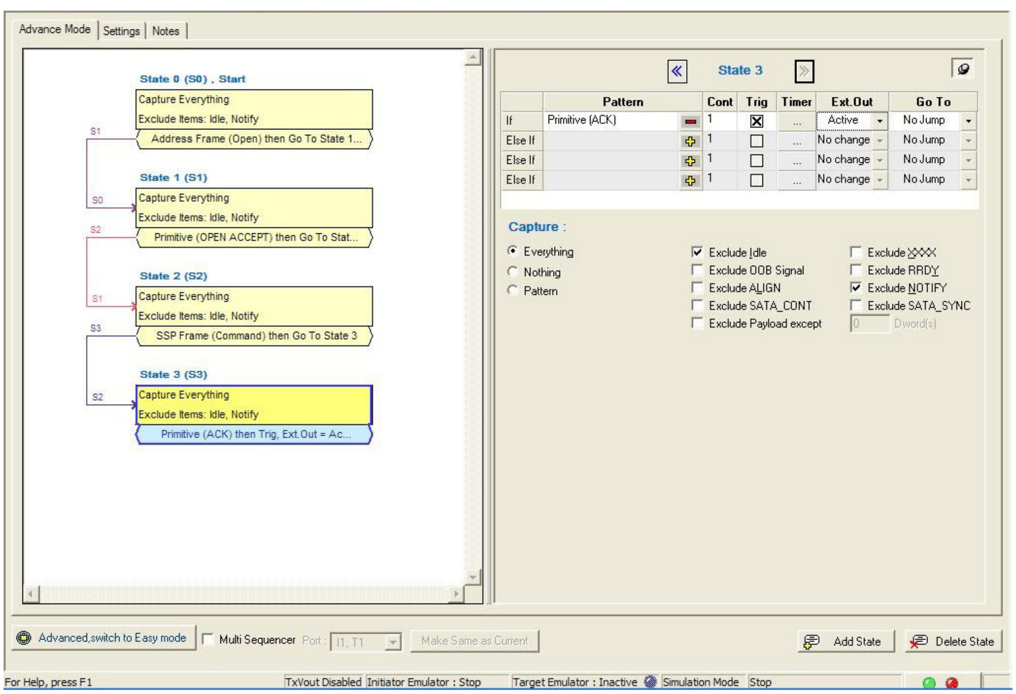


Figure 2.78: SAS: Advanced Trigger with Multiple Branches

State Number for Complex Trigger Sequences

To follow the path of complex trigger sequences, you can display state number.

To see state number, in Packet View right-click a link layer packet, show field, and select state number.

Setting Trigger Conditions

To set the If and Else If trigger condition:

1. Click the **Add Pattern** button  for a Pattern field and choose a trigger condition from the drop-down list.

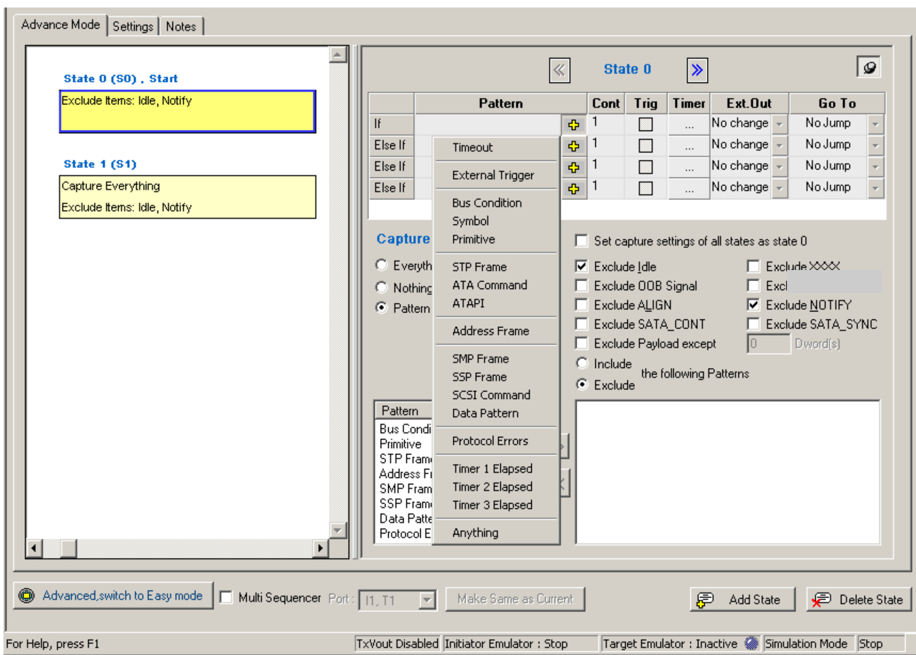


Figure 2.79: SAS: Choosing a Trigger Condition

2. Define each selected pattern in the same way as in Easy Mode, as described starting on page 57. To use a timer, define it first.

Note: You can set a timer for any If or Else If condition.

---

3. Enter a value for the number of occurrences before trigger in the **Cont** field, up to a maximum of 65535 occurrences.
4. Choose a capture option: **Everything, Nothing,** or **Pattern**.
5. If you choose Pattern, you can select patterns for inclusion or exclusion. Clicking the **Pattern** option enables a pattern definition dialog (see Figure 2.80 on page 104).

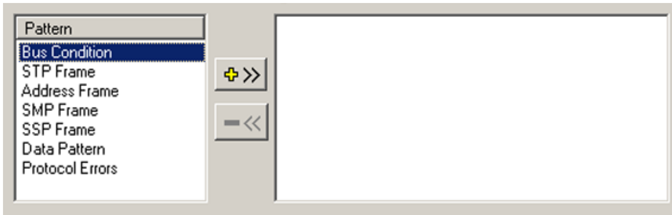


Figure 2.80: SAS: Choosing a Pattern

6. Choose pattern(s) and click the **+>>** button to add them for capture or exclusion. You define each pattern the same way as in Easy mode (see "Defining Patterns" on page 57).
7. For an output trigger, click the down arrow in the **Ext. Out** field and choose an output trigger level. **Note:** Do not use the LOW setting in Advanced Mode.
8. To go to another state, click the down arrow in the **Go To** field and select a state. If no other state has been defined, choose **New State** to add a state.

2.2.20 Multi - Link Triggering

You can set different triggering for each link. To set different trigger conditions for a link, check the **Multi Sequencer** check box and select the link for setup from the Port drop-down list. Clicking the **Make Same as Current** button displays a warning: all sequencers will be changed to have same states as current sequencer. Click **Yes** to do so.

Figure 2.81: SAS: Multi - Link Triggering Setup

2.2.21 Set Timers

You can set and use up to three timers for triggering. You can set each timer for each state, or set it to continue from one set in the previous state. The timer defined for a particular state starts when the system enters that state. You can set a timer for any IF or ELSE IF condition. To set up the timers, click the **ellipses** in the **Timer** field next to the IF or ELSE IF condition in each state and define each of the timers in the Set Timers dialog (see Figure 2.82 on page 105).

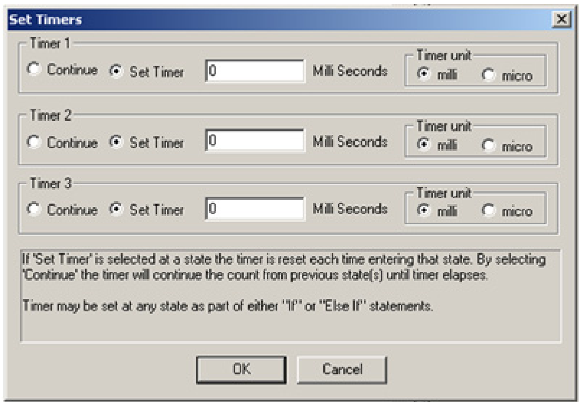


Figure 2.82: Set Timers Dialog

Note: Three timers are available. You have to set and start each timer in order to continue the next timer. For example, you have to start Timer 1, continue it, then set Timer 2 in order to continue it. It will not allow you to continue Timer 2 until you first set it.

2.2.22 Timeout

In the Timeout Pattern dialog (see Figure 2.83 on page 106) you can do the following:

- Set a Timeout.
- Select a Pattern for the Start Event. (Start Event resets the timer.)
- Select a Pattern for the End Event.
- Enter the Timeout Value in milliseconds or microseconds.
- Select a Trigger Mode:
  - If End Event occurs before timer expires.
  - If timer expires before End Event occurs.

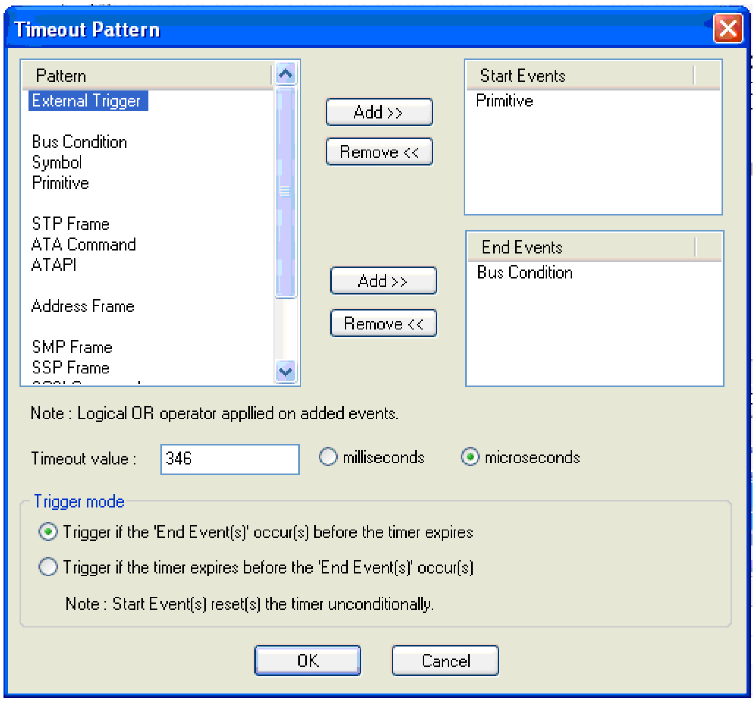


Figure 2.83: Timeout Dialog

WARNING: In Advanced Mode, Short State Jump Intervals Can Cause Hardware Queue Overflow and Corrupt Frames.

When using Advanced Mode, if too many state jumps occur in a short time, the hardware queue can overflow, which may corrupt frames. For example, an infinite loop can cause many state jumps in a short time. Hardware overflow can occur if interval between state jumps is less than 60 DWORDs.

In Advanced Mode, infinite loops are usually used to check if an event occurs before a timeout. In this case, you can use the Timeout dialog to avoid hardware queue overflow.

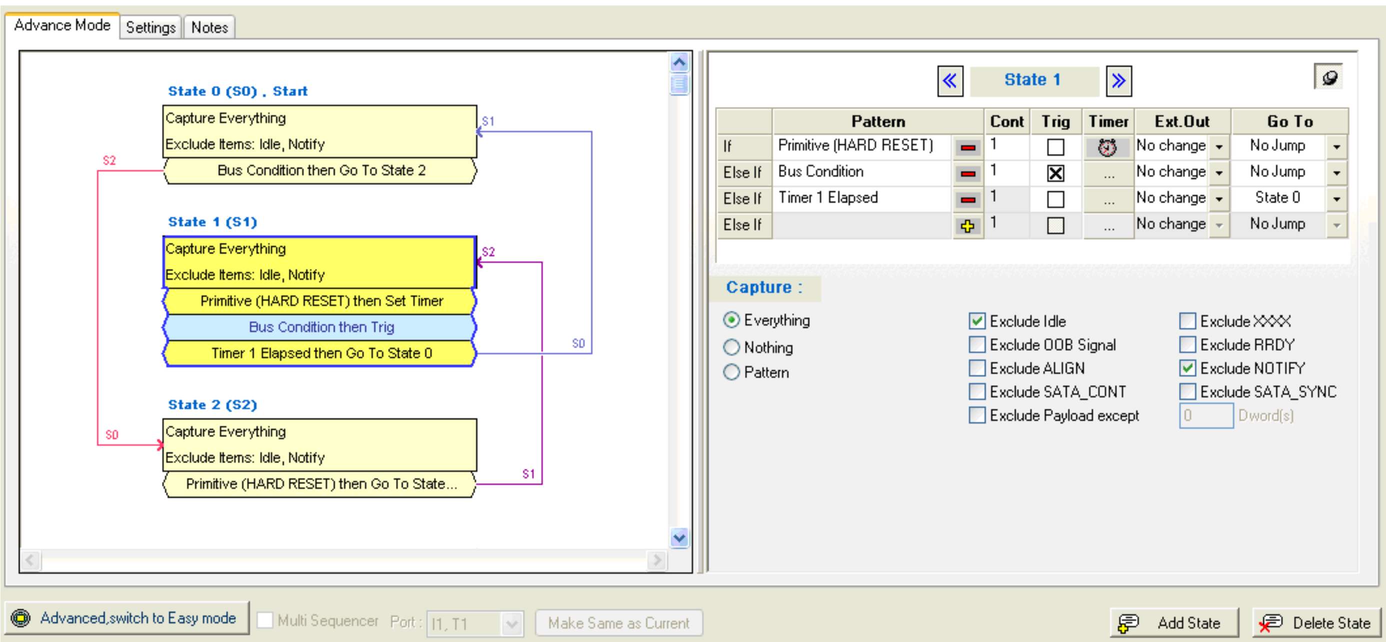


Figure 2.84: State Machine with Multiple Patterns and Timer Elapse

In Figure 2.84, the port detects HARD_RESET, which starts the Timer. When the timer expires, it jumps to another state. If a trigger occurs between timer start and end, the captured trace will have corrupt frames because of hardware queue overflow.

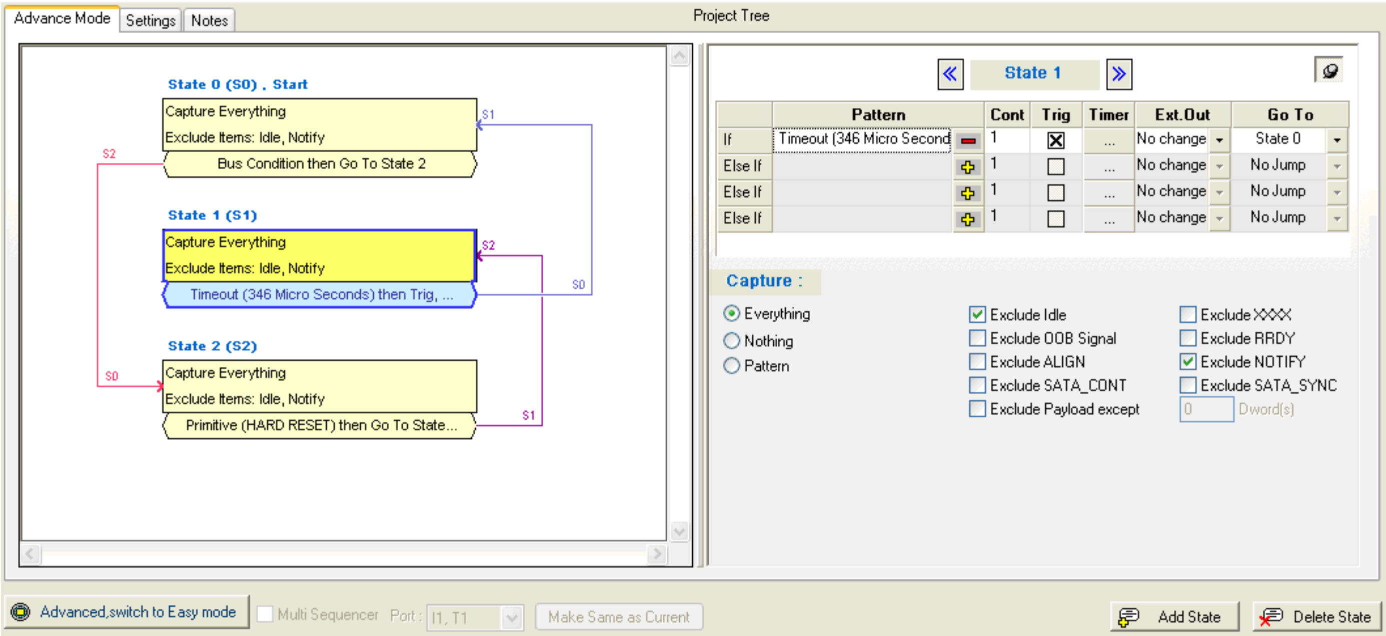


Figure 2.85: State Machine with Timeout Pattern to Replace Timer

To overcome this limitation, use a Timeout Pattern instead of Timer. Figure 2.85 shows the state machine using Timeout instead of Timer.

Figure 2.86 on page 108 shows the Timeout settings.

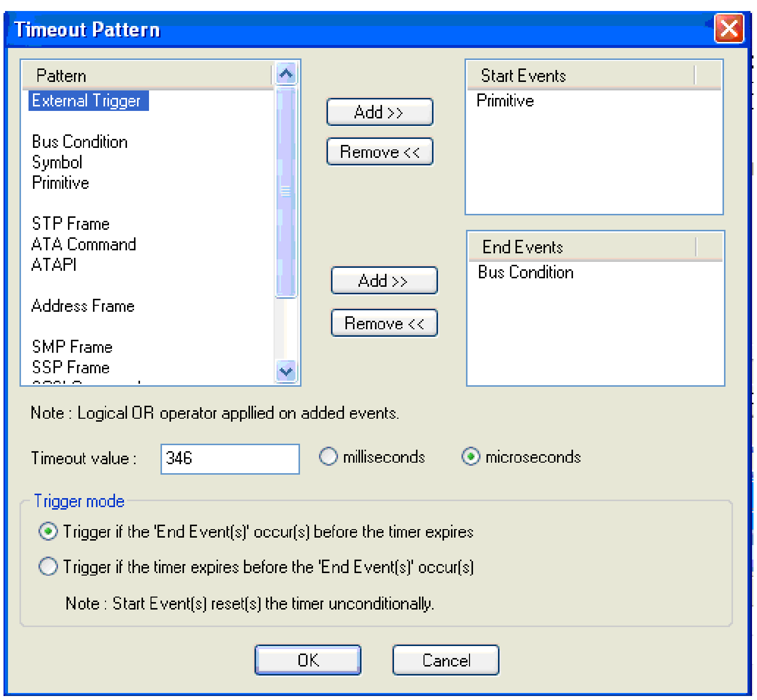


Figure 2.86: Timeout Settings

Timeout begins when the port detects the Start Event. Timer begins when the port detects the Hard RESET primitive. In the Trigger Mode window, set the Trigger to trigger when the port detects the End Event, before the Timeout occurs. In our example, this is the Bus Condition. Capture begins when the ports detects the Bus Condition before the Timeout occurs. If the port does not detect the Bus Condition until the Timeout occurs, the State Machine in Figure 2.85 on page 108 jumps to State 0.

2.2.23 Useful Key Sequences

The following key sequences are active to assist you in navigating a defined state machine:

Ctrl+a	Add State
Insert	Insert State
Del	Delete State
Ctrl+c/Ctrl+Ins	Copy
Ctrl+v/Shift+Ins	Paste
Up/Down arrow keys	Moves selection between states
Page Up/Page Down	Page Up and Page Down states
Home	Go to first page
End	Go to end page

2.3 Project Settings

Prior to running the Advanced mode project, click the **Settings** tab. The options in the Settings dialog are the same as for the Easy Mode, described starting on page 92.

SAS vs. SATA: For the ALIGN Transmission Period section, SATA Dialog shows options 256 and 258, and does not show 2048 or 2049.

For Speed, SATA Dialog shows H1, D1 to H4, D4 and does not show I1, T1 to I4, T4. SATA Dialog does not show MUX Setting button.

2.3.1 Notes

To include some descriptive information about the project, click the **Notes** tab and enter a brief descriptive note (see “Add a Project Note” on page 100).

Chapter 3

Display Manipulation

3.1 Viewer Display

After data is captured (Recorded), the Viewer displays a sample file (**.scs** for SAS and **.sts** for SATA) in Packet View.

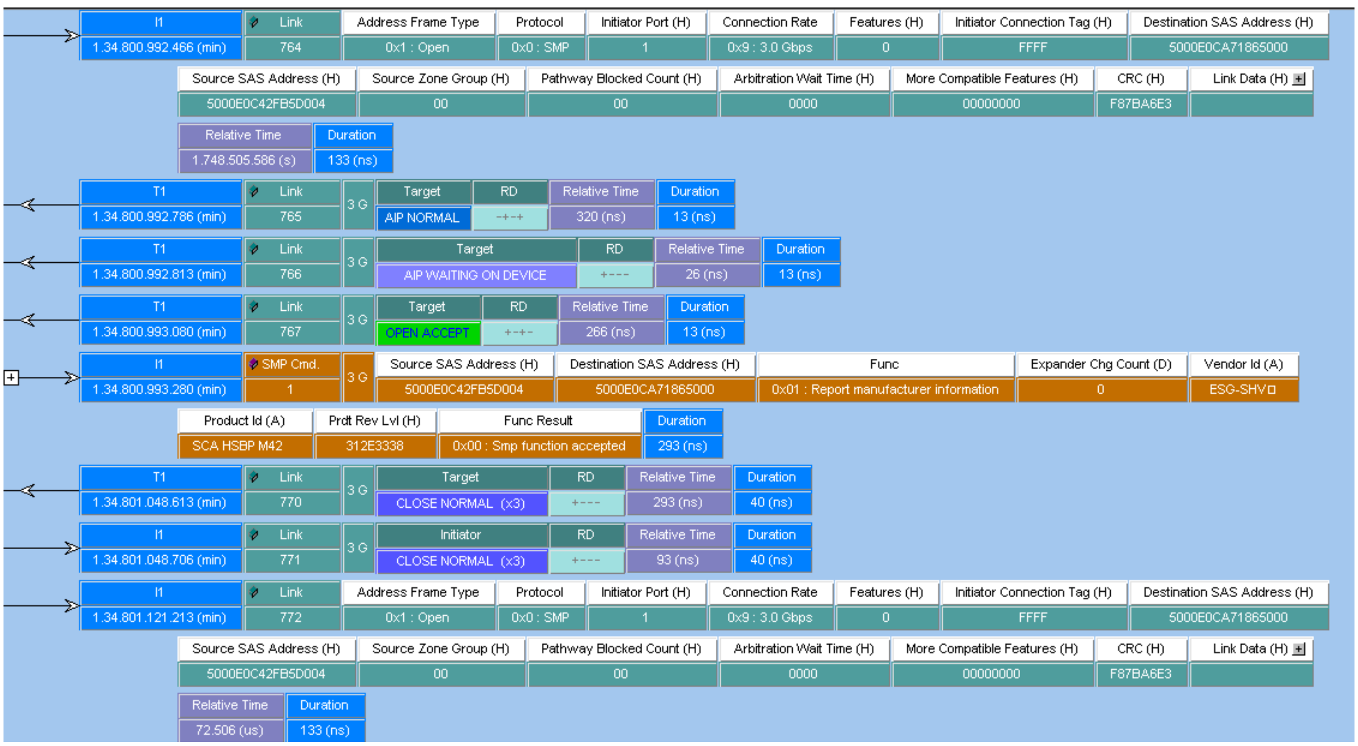


Figure 3.1: SAS: Packet View of .scs Sample File.

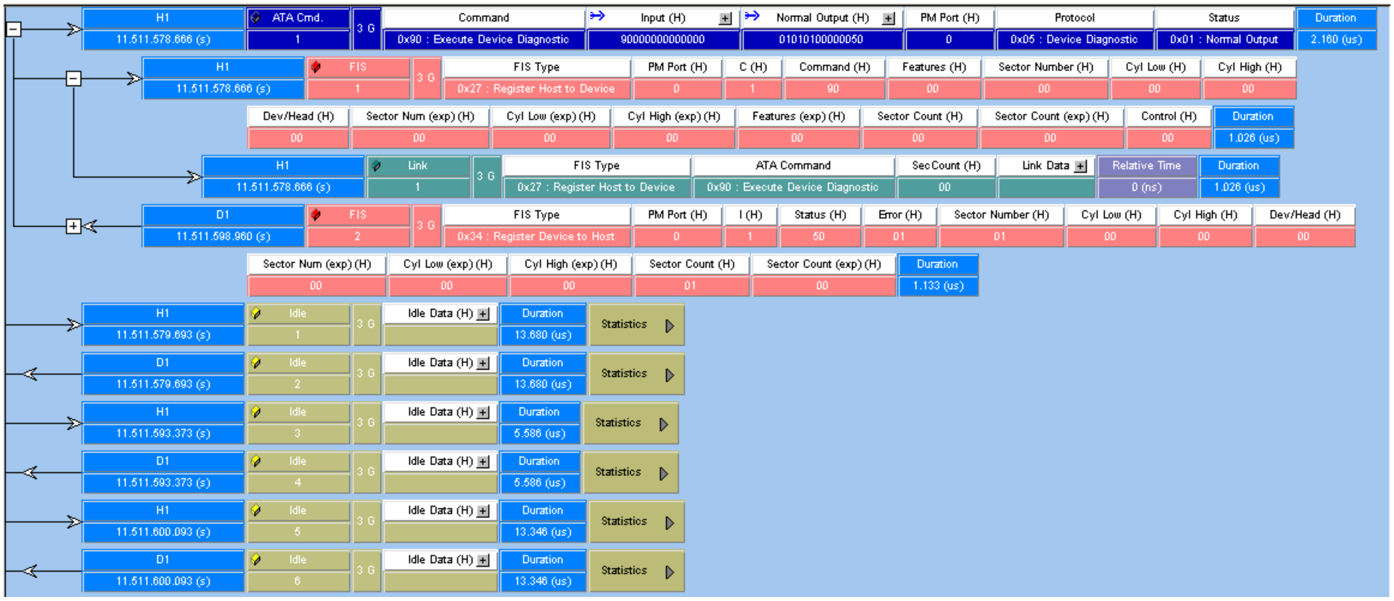


Figure 3.2: SATA: Packet View of .sts Sample File.

3.1.1 Quick View

Quick View is enabled as the default setting in **Preferences > Trace Viewer** tab. Quick View allows full access to the whole trace more quickly, especially when using a Gigabit Ethernet connection. However, the trace is NOT written to the host machine's hard drive. To save the trace, you must manually click **Save**.

If you uncheck **Quick View** in the **Preferences > Trace Viewer** tab to disable Quick View, the trace loads more slowly, but is automatically saved to the host machine's hard drive. When Quick View is disabled, the Viewer displays successive parts of trace data as they upload. As soon as a trace part uploads, it is available in all trace views.

If you only need quick successive traces, and do not need to save them, keep the default setting to enable Quick View.

If you need to save all captured traces, unchecking the Quick View setting loads traces faster, especially for larger traces and slower connections than Gigabit Ethernet.

To refresh the viewer display with more uploaded data, scroll to the end of the trace, using scroll bars, page down, arrow down, or CTRL-End. Newly uploaded data then appears there.

Note: High-level decoding and statistics are available only after the whole trace has uploaded.

The software automatically switches to full trace view after trace uploading finishes.

Note: Users must press **CTRL Home** to go to the beginning of an uploaded trace, and **CTRL End** to go to the end of an uploaded trace.

3.1.2 Using the Viewer Display

To configure the data viewer display, use the toolbars. You can display the same data in:

- Packet view
- Spreadsheet view
- Column view, with transactions grouped for each active port
- Text view, with transactions grouped for each active port
- Waveform view
- Frame Inspector view
- Histogram view
- Bus Utilization view
- Data Report
- Statistical Report view
- Power Tracker View (SATA)

To change the view type when opening a sample, change the default workspace or save options in the **Preferences** dialog.

To toggle among open windows, use **CTRL - TAB**.
To reverse toggle order, use **CTRL - SHIFT - TAB**.

To make a frame a trigger pattern, in Packet View, right-click any frame, select **Add to Trigger**, and add the pattern to **DataPatternCapture**.

Viewer Display enables you to also perform the following:

- Decode Assignments (Refer to Decoding Assignments on page 115 for more details.)
- Compare Two Data Payloads (Refer to Compare Two Data Payloads on page 155 for more details.)
- Run Verification Scripts (Refer to Running Verification Script Engine (VSE) on page 157 for more details.)

3.2 Trace Properties

You can view the Trace Properties from the File menu. Click **File > Trace Properties**, the Trace Properties dialog displays (see Figure 3.3 on page 114) with the following information:

- Software version
- Sample file version
- Grouping Type
- Hardware bin file version
- Analyzer armed at
- Analyzer triggered at
- Sample saved at
- Original Capture Project: **Open** displays the project settings used to capture the sample.
- Licensing Information
- Simpass Information

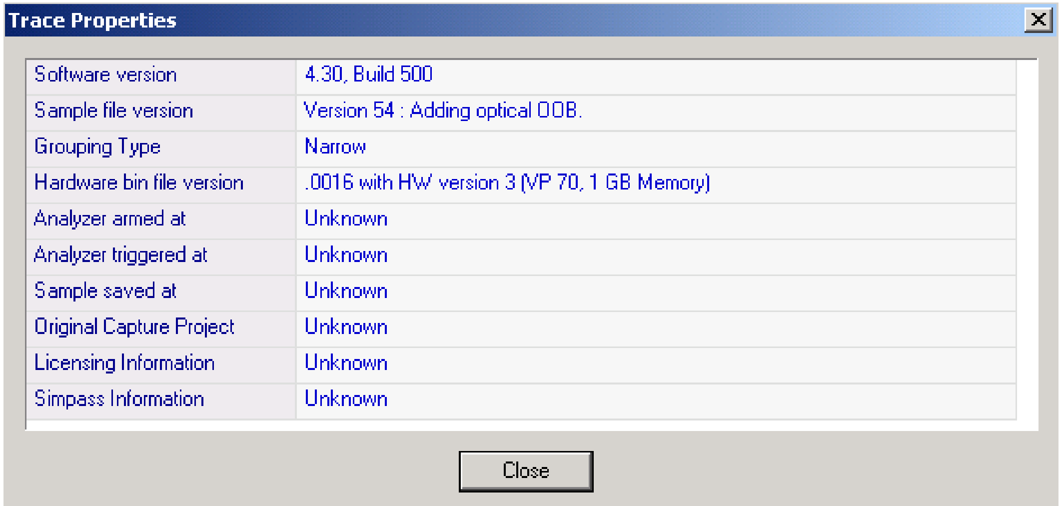


Figure 3.3: Trace Properties Dialog

3.3 Analysis

The Analysis menu options allows you to see the trace in various views and switch views.

3.3.1 Show Analysis Toolbar

To display the capture in any of the other available views you can make the selection on the View Type toolbar as shown below or select the menu option under Analysis as shown in Figure 3.5 on page 115.

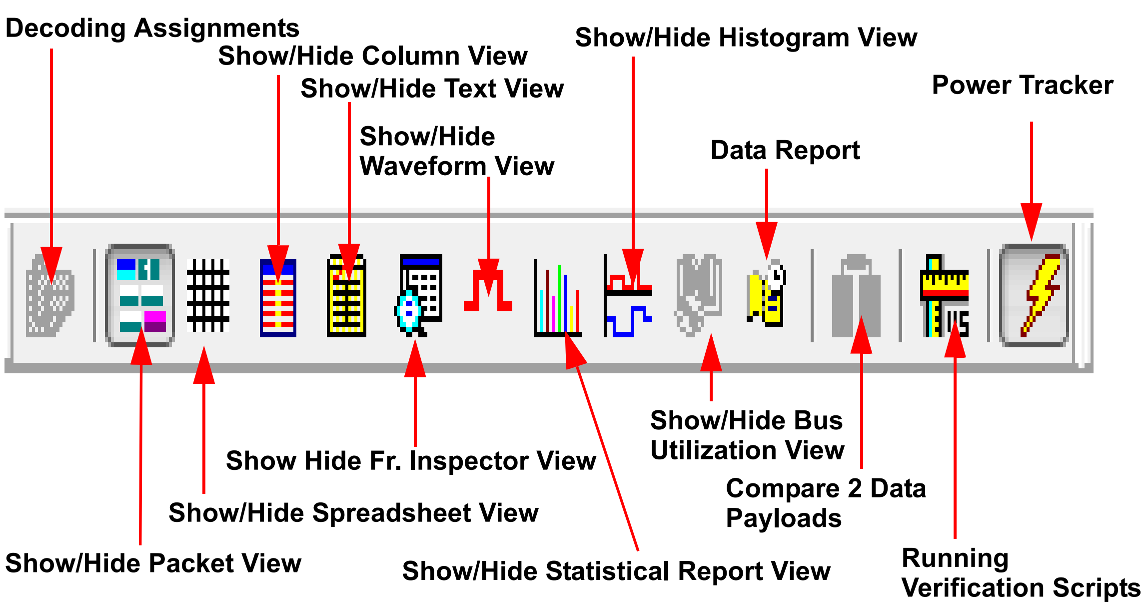


Figure 3.4: View Type Toolbar

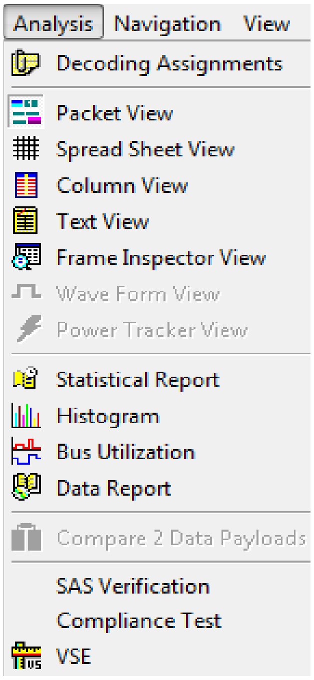
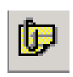


Figure 3.5: SAS/SATA Analysis Menu

3.3.2 Decoding Assignments

Click on the Decoding Assignments icon  to display the Decoding Assignment dialog. Check a **Hash Destination SAS Address** checkbox to select it and select a **SCSI Spec(s)**. Click the **Add to Assigned List** button to decode. Select a spec and click **Remove it** or click on **Remove All** to remove all the specs.

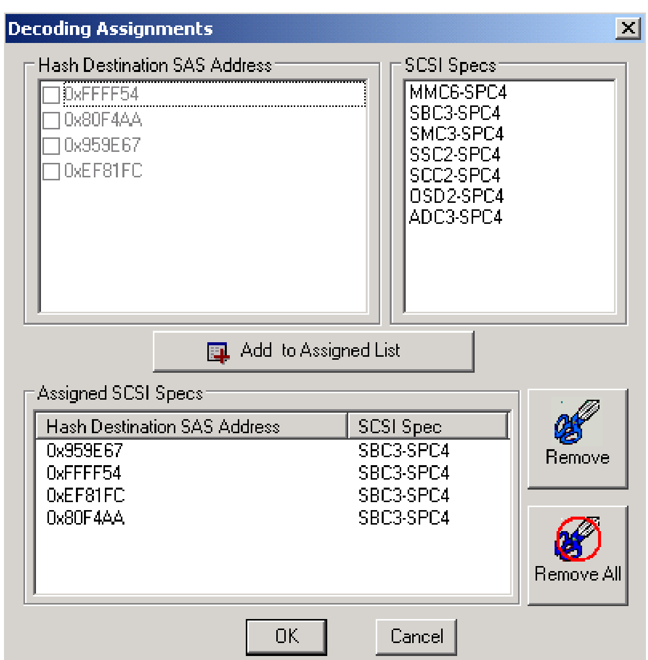


Figure 3.6: Decoding Assignments Dialog for SAS

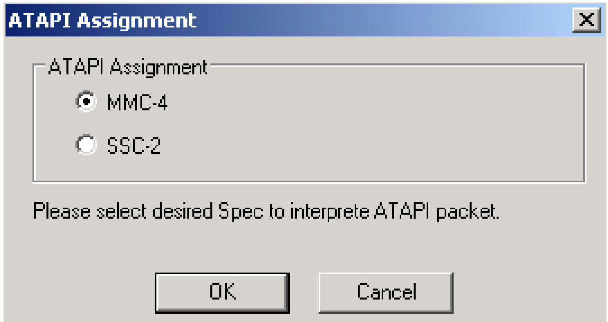


Figure 3.7: ATAPI Assignment Dialog for SATA

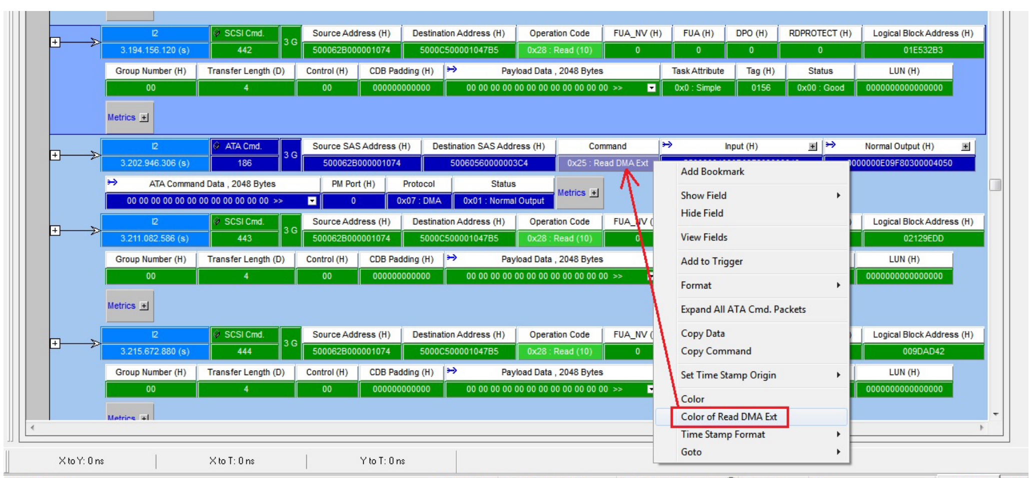
3.3.3 Packet View

After you select a view, it appears in a separate window. To increase the new window display size, select **Analysis > Packet View** or, click the  **Show/Hide Packet View** button.

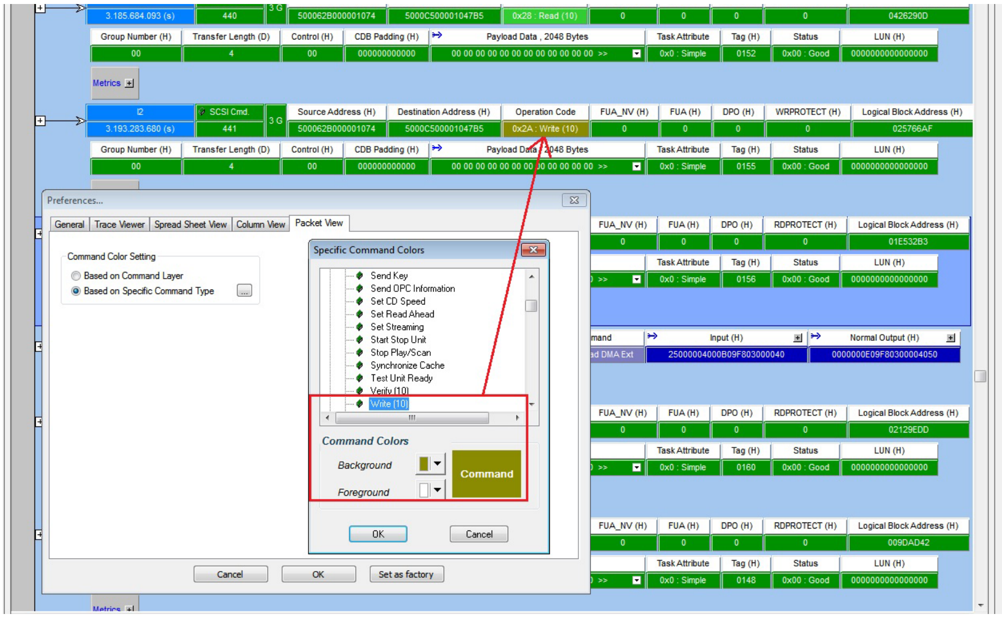
When you scroll through either display using the scroll bar, the corresponding display in the other view scrolls with it.

You can rearrange the tiling by clicking **Window** and choosing **Vertical** or **Horizontal** tiling.

You can customize the color of any operation code field using either of the following two methods:



1. Right-click on any command field in the trace. Select "Color of ..." option to set the color for the selected operation code field.



2. In the Preferences window, select the Packet View tab. select the "Based on Specific Command Type" option. In the commands list, search for any command that you want, and change the background and foreground colors.

Packet View Metrics

The Metrics feature provides quick access to additional information about the packet data. Click the Metrics + icon as shown in Figure 3.8 to display the details.

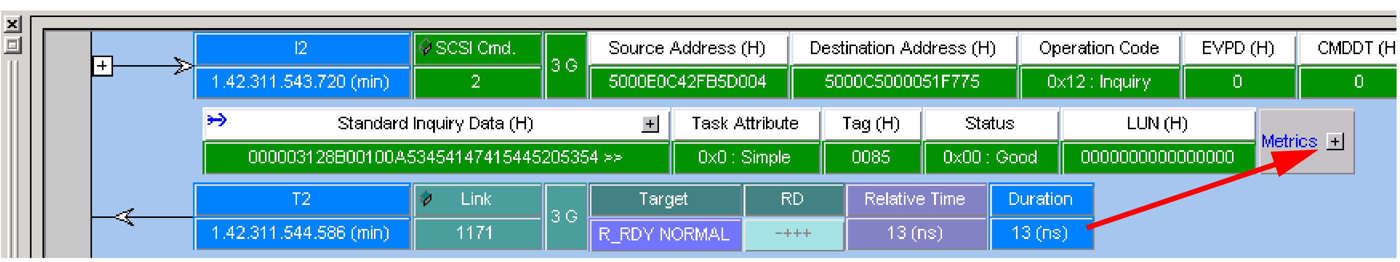


Figure 3.8: Packet View Metrics

The following additional information of the packet is displayed when the Metrics field is expanded. Refer to Figure 3.9 on page 118.

Trp. No. - Number of Transports

The total number of transports that compose this exchange.

Resp. Time - Response Time

The time taken to transmit this command on the link(s) from the beginning of the first frame in the command to the end of the last frame in the command.

Pld. Bytes - Payload Bytes

The number of payload bytes this operation transferred.

Latency Time

The time measured from the transmission of the command to the first data transmitted for this IO operation.

Data-Stat. Time - Data to Status Time

The time between the end of data transmission for this command and the Status frame.

Thrpt MB/s- Data Throughput

The payload divided by response time expressed in MB per second.

Duration

The time taken from the first DWord to the last DWord in a line.

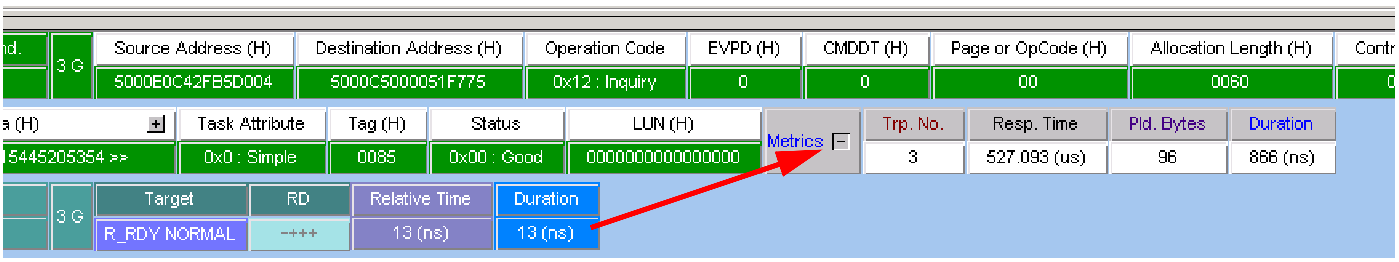


Figure 3.9: Packet View Metrics Expanded

Copying Packets from a Trace to a Host Emulator Script

This check mark in the illustration below shows packet (s) selected to copy. You can copy packet(s) from a trace and paste it into a host emulator script. That is why you can only mark packets that we support in emulator and host side packets. You can also mark multiple packets by left-clicking and moving the mouse over multiple packets and then right-click to select them, and paste them in an emulator script.

Figure 3.10: Packets Selected to Copy

This is applicable only when using M6-4 or M6-2 as only they support emulation.

Device Sleep (DevSlp)

The Device Sleep status is displayed throughout the trace by right-clicking and selecting **Device Sleep** in Packet View.

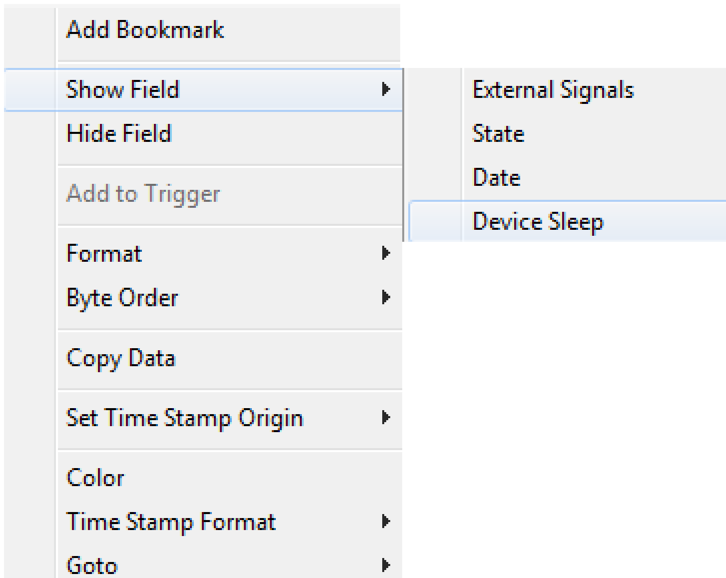


Figure 3.11: Right-click Device Sleep Menu.

The trace now displays the Device Sleep fields of all the packets (see Figure 3.12 on page 119). Current measurement accuracy is +/- 10mA for 5V and lower signals, and +/- 100mA for 12V. Voltage measurement accuracy is +/- 100mV for 5V and lower and +/- 150mV for 12V.

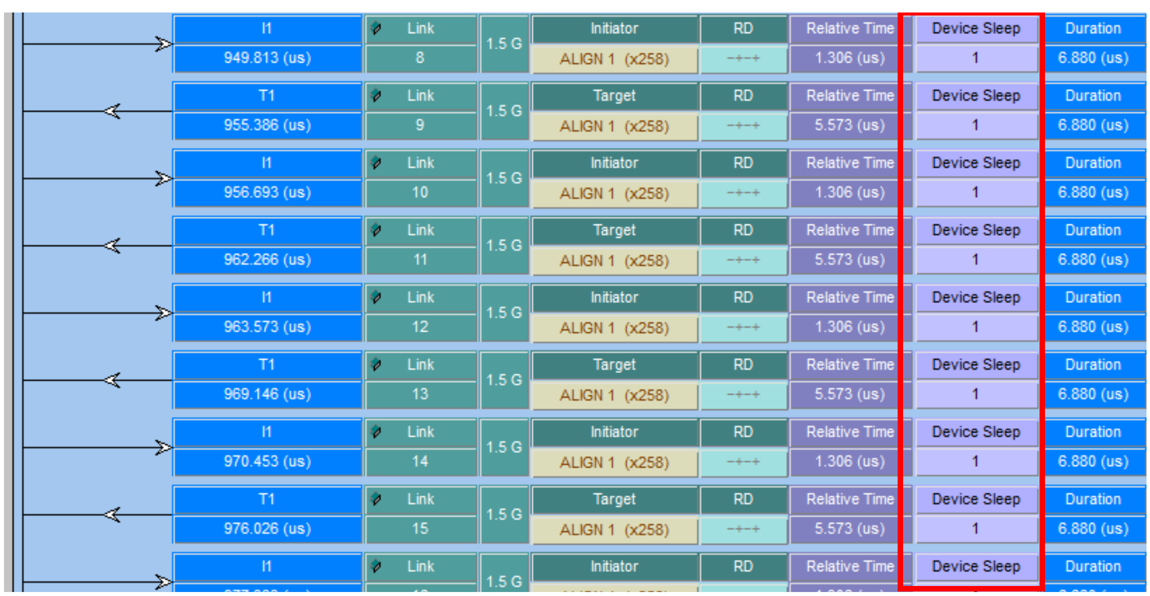


Figure 3.12: Device Sleep Fields.

Viewing Check Condition Sense Data

When a Check Condition error occurs, you can view decode data from it. This info is shown in Packet View. Under Transport layer, expand Info Unit, then expand Sense Data. In Column View, check the "Show Field View in Column View" check box in SW settings, then display Field View while column View is open.

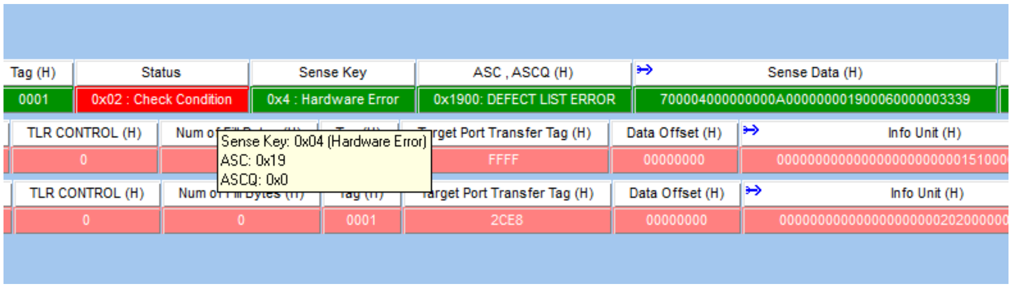


Figure 3.13: Check Condition Data.

1. Open Packet View.

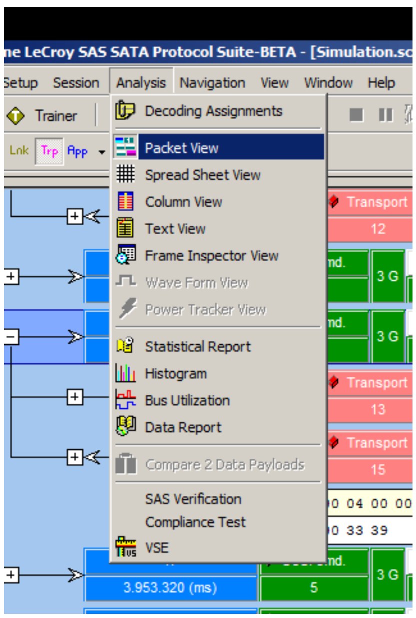


Figure 3.14: Packet view.

2. Show Transport layer.

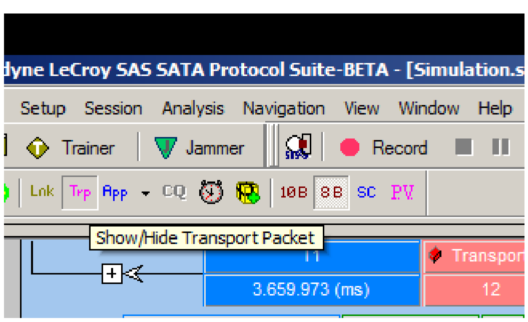


Figure 3.15: Transport layer.

3. Expand the Information Unit.

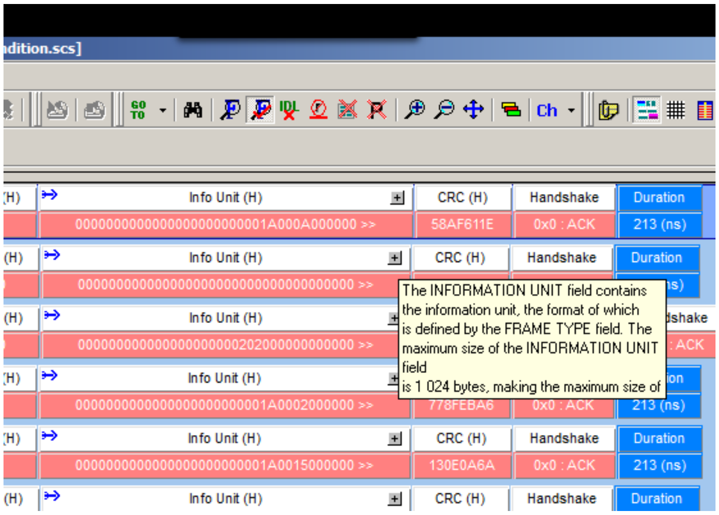


Figure 3.16: Information unit.

4. Expand Sense Data. The hidden fields are revealed.

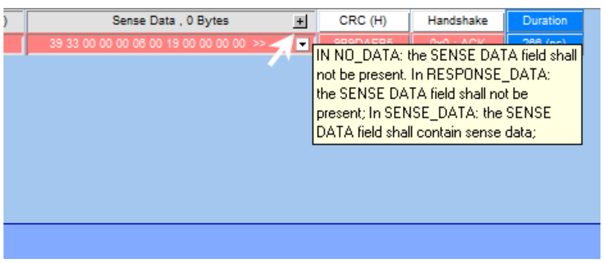


Figure 3.17: Sense data.

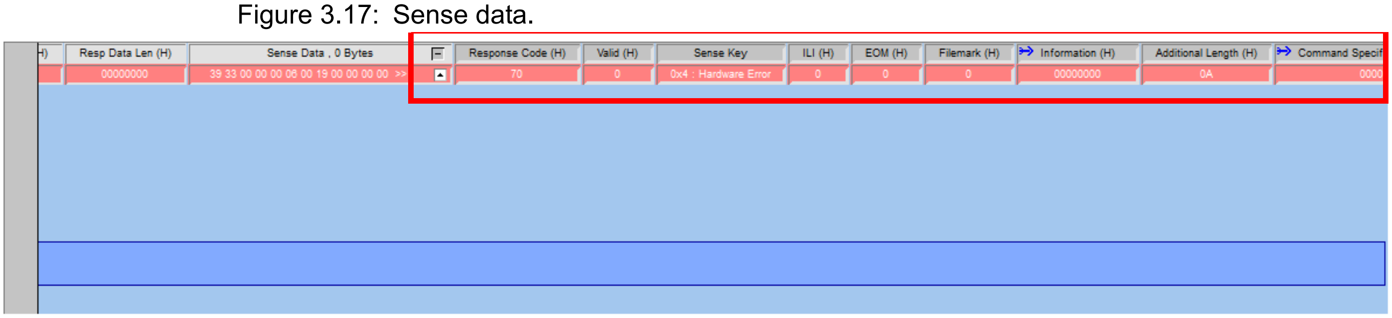


Figure 3.18: Figure 3.18: Sense data expanded.

3.3.4 Changing the Default View

Perform the following steps to change the default view of all trace files to Packet View:

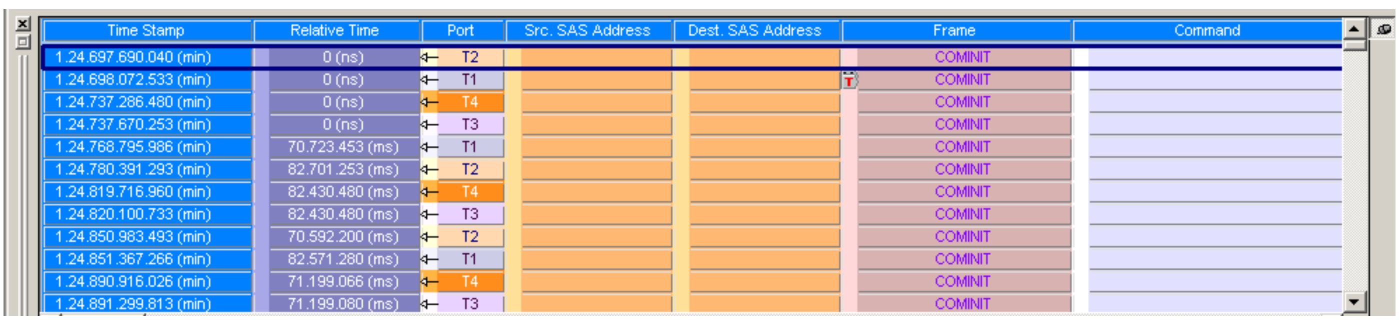
1. Open a trace file.
2. Select the **Packet View**. Close all other views.
3. Select **File > Save Workspace** to open a Save As dialog. Save the current workspace as a **.wss** file.
4. Select **Setup > Preferences** to open the Preferences dialog.
5. In the Default Workspace field, enter the path and name of the workspace **.wss** file that you saved in step 3.

Because the default workspace contains only Packet View, the software opens trace files in Packet View.

3.3.5 Spreadsheet View

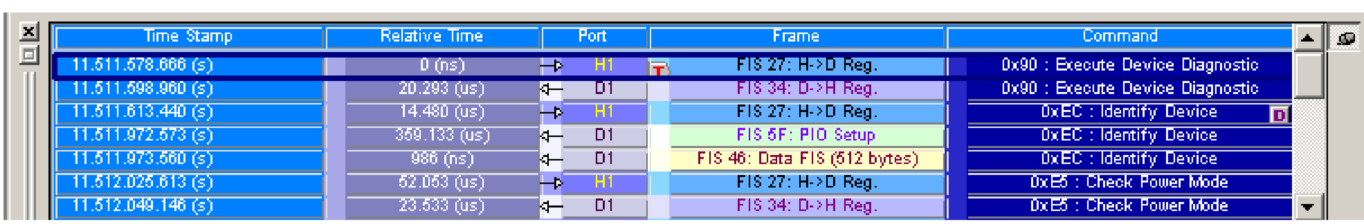
Spreadsheet View displays all of the Packet View fields in a time sequential spreadsheet format. To display the Spreadsheet View of the current capture, click

Analysis > Spreadsheet View or click the  button on the toolbar.



Time Stamp	Relative Time	Port	Src. SAS Address	Dest. SAS Address	Frame	Command
1.24.697.690.040 (min)	0 (ns)	T2			COMINIT	
1.24.698.072.533 (min)	0 (ns)	T1			COMINIT	
1.24.737.286.480 (min)	0 (ns)	T4			COMINIT	
1.24.737.670.253 (min)	0 (ns)	T3			COMINIT	
1.24.768.795.986 (min)	70.723.453 (ms)	T1			COMINIT	
1.24.780.391.293 (min)	82.701.253 (ms)	T2			COMINIT	
1.24.819.716.960 (min)	82.430.480 (ms)	T4			COMINIT	
1.24.820.100.733 (min)	82.430.480 (ms)	T3			COMINIT	
1.24.850.983.493 (min)	70.592.200 (ms)	T2			COMINIT	
1.24.851.367.266 (min)	82.571.280 (ms)	T1			COMINIT	
1.24.890.916.026 (min)	71.199.066 (ms)	T4			COMINIT	
1.24.891.299.813 (min)	71.199.080 (ms)	T3			COMINIT	

Figure 3.19: SAS: Spreadsheet View.



Time Stamp	Relative Time	Port	Frame	Command
11.511.578.666 (s)	0 (ns)	H1	FIS 27: H->D Reg.	0x90 : Execute Device Diagnostic
11.511.598.960 (s)	20.293 (us)	D1	FIS 34: D->H Reg.	0x90 : Execute Device Diagnostic
11.511.613.440 (s)	14.480 (us)	H1	FIS 27: H->D Reg.	0xEC : Identify Device
11.511.972.573 (s)	359.133 (us)	D1	FIS 5F: PIO Setup	0xEC : Identify Device
11.511.973.560 (s)	986 (ns)	D1	FIS 46: Data FIS (512 bytes)	0xEC : Identify Device
11.512.025.613 (s)	52.053 (us)	H1	FIS 27: H->D Reg.	0xE5 : Check Power Mode
11.512.049.146 (s)	23.533 (us)	D1	FIS 34: D->H Reg.	0xE5 : Check Power Mode

Figure 3.20: SATA: Spreadsheet View.

Right-click a column heading to go to **Preferences**, make all columns the same width, choose **Time Stamp Format**, or **Goto** a position.

Right-click a column heading to **Hide** or **Show** the column. To show the same columns permanently, select **Setup> Preferences > Trace Viewer > As Previously Saved**.

Right-click a packet to change the background and foreground color.

Right-click the column to **Add Bookmark** or **Edit Bookmark**, **Set Time Stamp Origin**, go to **Preferences**, choose **Time Stamp Format**, **Change Background (or Foreground) Color**, or **Goto** a position.

Note: You can double-click a data frame to display the data payload view.
The Status column can show ABRT and UNC status.

Export As Text/Excel

Select **File > Export > Export to Text/Excel** to open the Save As Text dialog.

For Save As Type, select **Text Files** or **Excel Files**.

Select options from With comma delimiter, Export Duration and Save in a Single CSV File.

For Save As Range, select **All Packets** or enter a cursor range.

Enter a **File Name** and click **Save**.

Note: When SpreadSheet View is exported to text, the XFER-Length field is always in hexadecimal format.

Note: The Export As Excel option is available only for Column View and Spreadsheet View.

Change Format of Logical Block Address (LBA)

You can set different LBA formats in Packet View and Spreadsheet View. To change the LBA format, right-click the LBA column to display the popup menu, select **Format,** and change the format to **Decimal, Hexadecimal,** or **Binary**.

In Spreadsheet View, you can also click the **Trace Viewer Configuration** icon to display the Trace Viewer Configuration dialog. Expand the **Frame List/Spread Sheet View**, select **LBA/Sector#**, and change the **Format**. If you cannot change the format there, select the **Link Fields, Transport Fields, ATA Cmd. Fields**, or **SCSI Cmd. Fields** node, select the field (such as “LBA High”), and then change the **Format**.

3.3.6 Column View

Column View displays the captured data grouped in columns by port (see Figure 3.21 on page 124). Each row shows captured DWORDs on different ports related to the timestamp. It also shows different speed (1.5G, 3G, 6G, 12G) DWORDs. Different DWORD cell height shows the duration of the DWORD. To display Column View of the current capture, click **Analysis > Column View** or click the  button on the toolbar.

You can click the + sign to expand the packet and - sign to collapse the packet. Hovering over the signs displays a tooltip showing the contents of the packet (see the arrows in Figure 3.21 on page 124). Right-click a packet to change the background and foreground color.

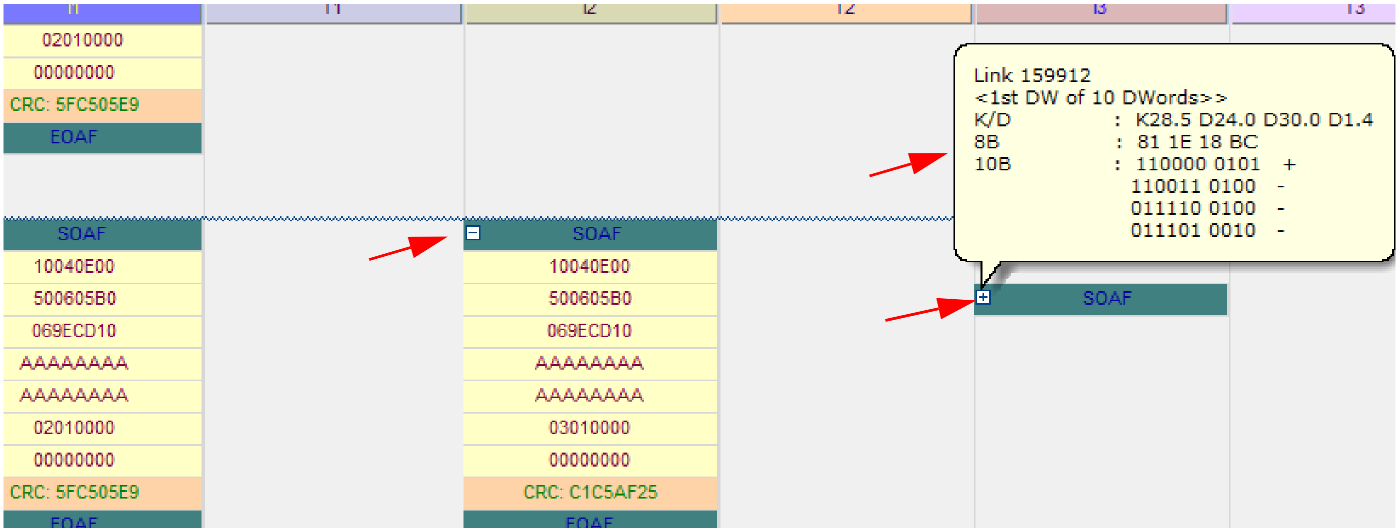


Figure 3.21: SAS: Column View

Right-click in the Column View to display commands:

- Add Bookmark
- Expand All
- Preferences
- Time Stamp Format (LeCroy Format, Milli Second, Micro Second)
- Go to (Trigger Position, X Position, Y Position, Packet Number, Time Stamp, Bookmark, Begin, End)
- Set X-Pointer
- Set Y-Pointer
- Change Background Color
- Change Foreground Color

Note: The Column View displays the CRC value. To see different formats (10b, 8b, scrambled, and so on), select a format by clicking its Tool menu button.

Resize Columns

You can resize the columns in Column View by clicking in the column boundary and dragging the boundary to a new position.

Rearrange Columns

You can rearrange columns by left-clicking in the column title and then dragging the drag-and-drop icon  to a new position.

3.3.7 Text View

Text View displays the captured data interpreted as transaction frames, grouped in columns by port.

To display Text View, select **Analysis > Text View** or click the  button on the toolbar.

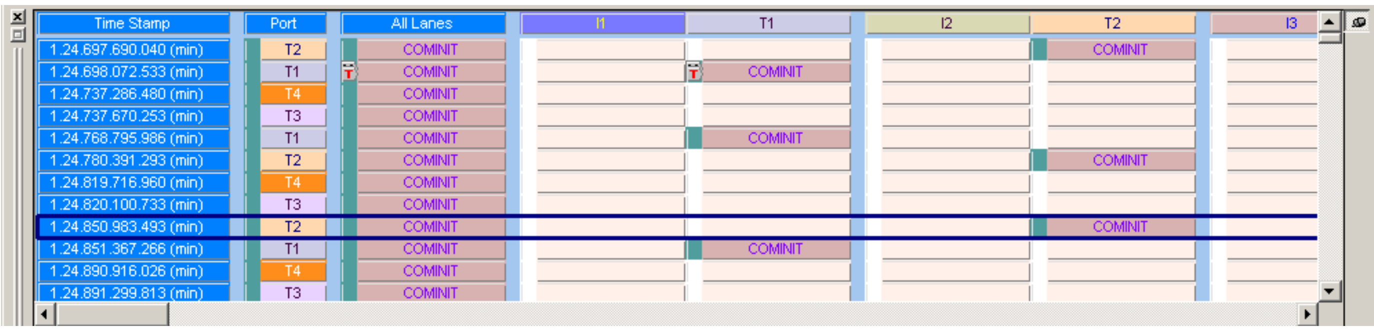


Figure 3.22: SAS: Text View

.

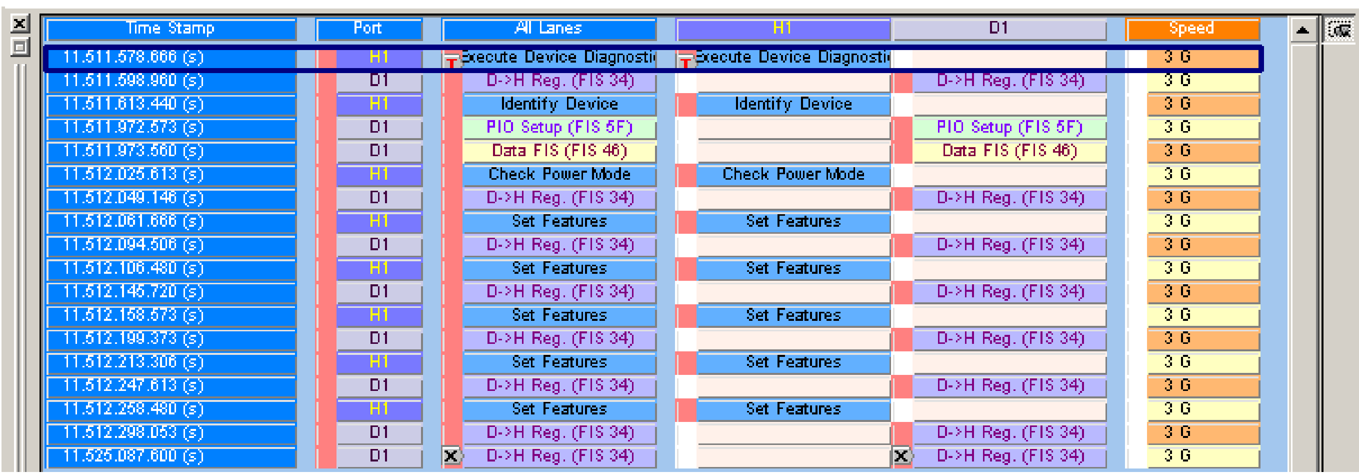


Figure 3.23: SATA: Text View

Note: The LBA and Tag Number value are shown in the All Lanes column.

3.3.8 Frame Inspector View

Frame Inspector View has lots of information that is available in Packet View, but not Spreadsheet View, so it is most useful in conjunction with the Spreadsheet View. This view has the following three tabs:

Spec View:

This view shows the Frame as it would appear in the spec, with the field names and values spelled out clearly. Fields that are too short to clearly contain the description can be viewed as tooltips by hovering the mouse over them. Some fields might have a a lowercase ‘e’ button at the top right corner. Pressing this button displays an ‘expanded’ view of the sub-fields in this field.

Field View:

This view shows, when applicable, a hierarchical display of the selected Packet, with the relevant fields in each level.

To open a Frame Inspector View of the current capture, select **View > Frame Inspector View** or click the  button on the View Type toolbar.

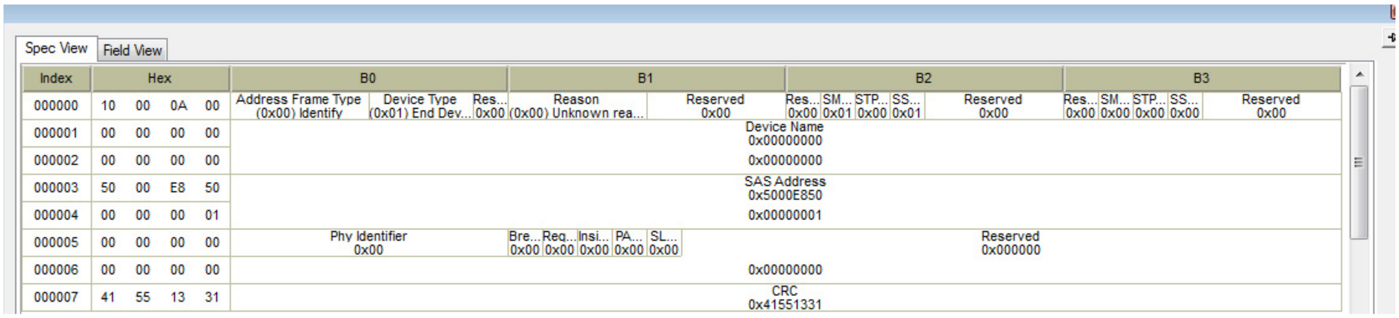
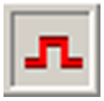


Figure 3.24: Frame Inspector View

3.3.9 Waveform Display

You can enable a waveform display for all active ports, and perform timing measurements, by positioning timing cursors within the waveform display.

Select **Analysis > Wave Form View** or click the  **Show/Hide Waveform** button on the toolbar to enable the waveform display (see Figure 3.25 on page 126).

The Compact View shows the OOB Sequence with speed negotiation.

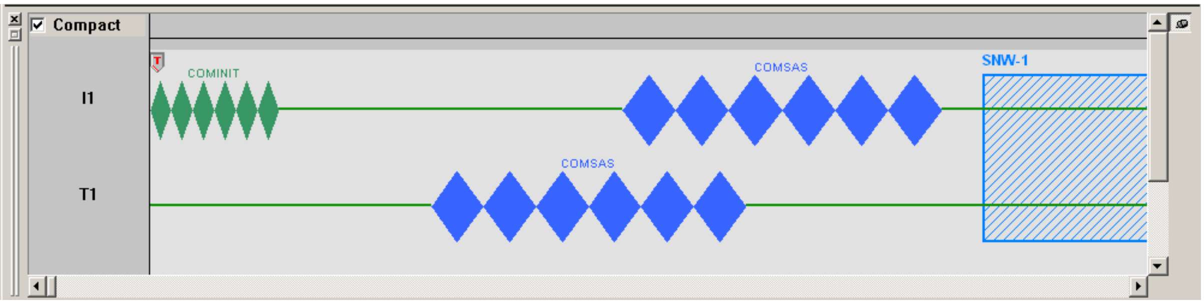


Figure 3.25: SAS: Waveform View

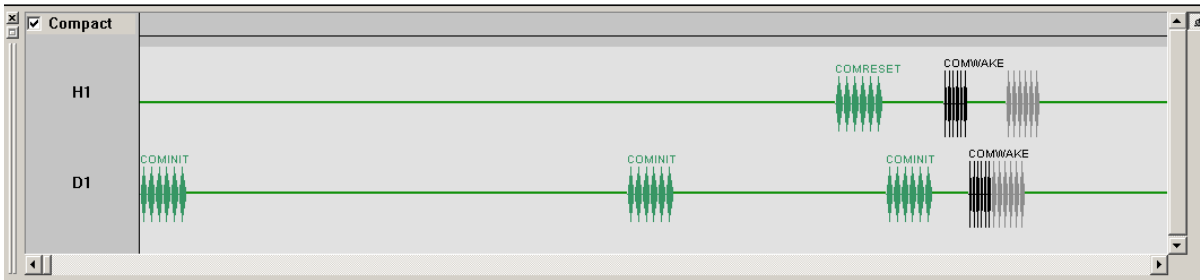


Figure 3.26: SATA: Waveform View

Making a Timing Measurement

Timing measurements are made with two timing cursors T1 and T2. Click the left mouse button in the gray bar on the top of the waveform display at a point for the T1 cursor, and the right mouse button at a point for the T2 cursor. The time difference between the cursors is on a line connecting the two cursors (see Figure 3.27 on page 127).

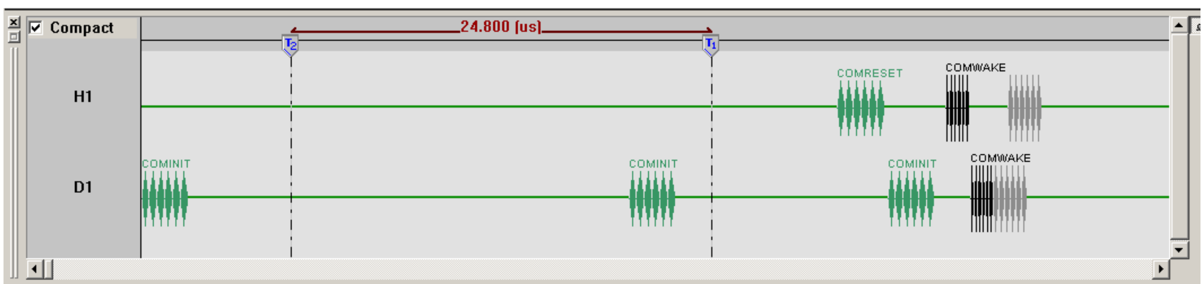


Figure 3.27: SATA: Timing Cursors Enabled

Expanded Waveform View

To see a 10x time scale expansion of the waveform, uncheck the **Compact View** checkbox in the Waveform View window. The OOB Sequence has speed negotiation (Hardware version 4 or later).

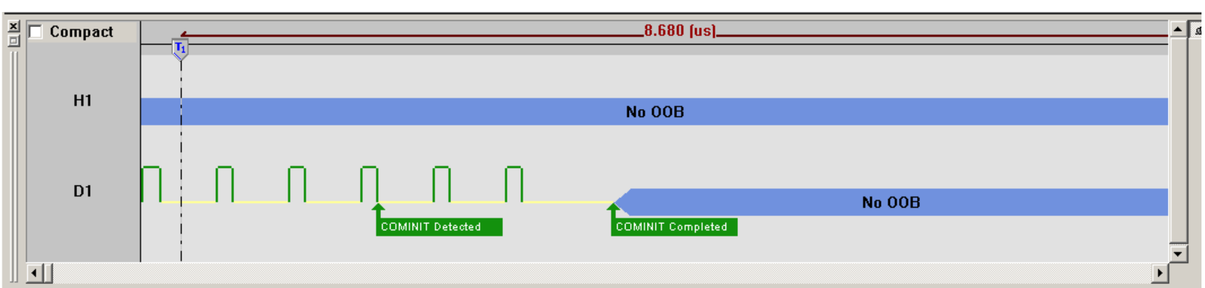


Figure 3.28: SATA: Expanded Waveform View

3.3.10 Statistical Report

Whenever a captured sample is in the Sample Viewer, a **Statistical Report** selection in the **Report** menu and a **Statistical Report Button** on the viewer toolbar are enabled. You can create a Statistical Report for the entire capture or select a portion of it.

To display a Statistical Report, click the  **Statistical Report** button on the viewer toolbar or select **Report > Statistical Report** to display the Select Statistical Report Range dialog (see Figure 3.29 on page 128).

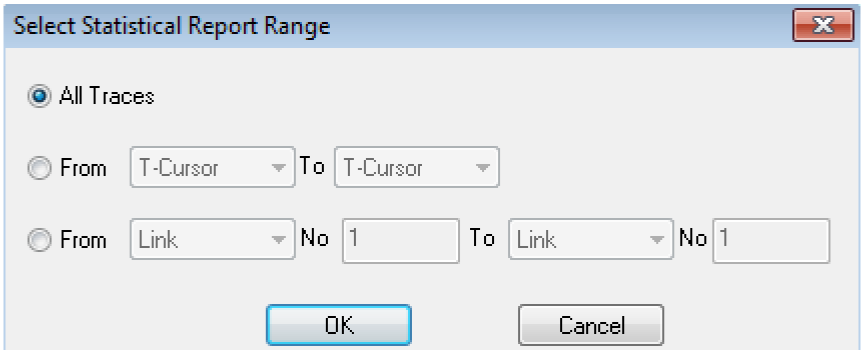


Figure 3.29: Statistical Report Range Dialog

The default statistical report has All Samples. You can set a specific Statistical report range between defined cursor positions or events.

Generating Statistical Read/Write Report

To create a statistical read/write page perform the following steps:

1. Click on **Setup > Preferences**.
2. Click on the **Trace Viewer** tab.
3. Check the box **Create statistical report read/write page** (see Figure 3.30 on page 129.)

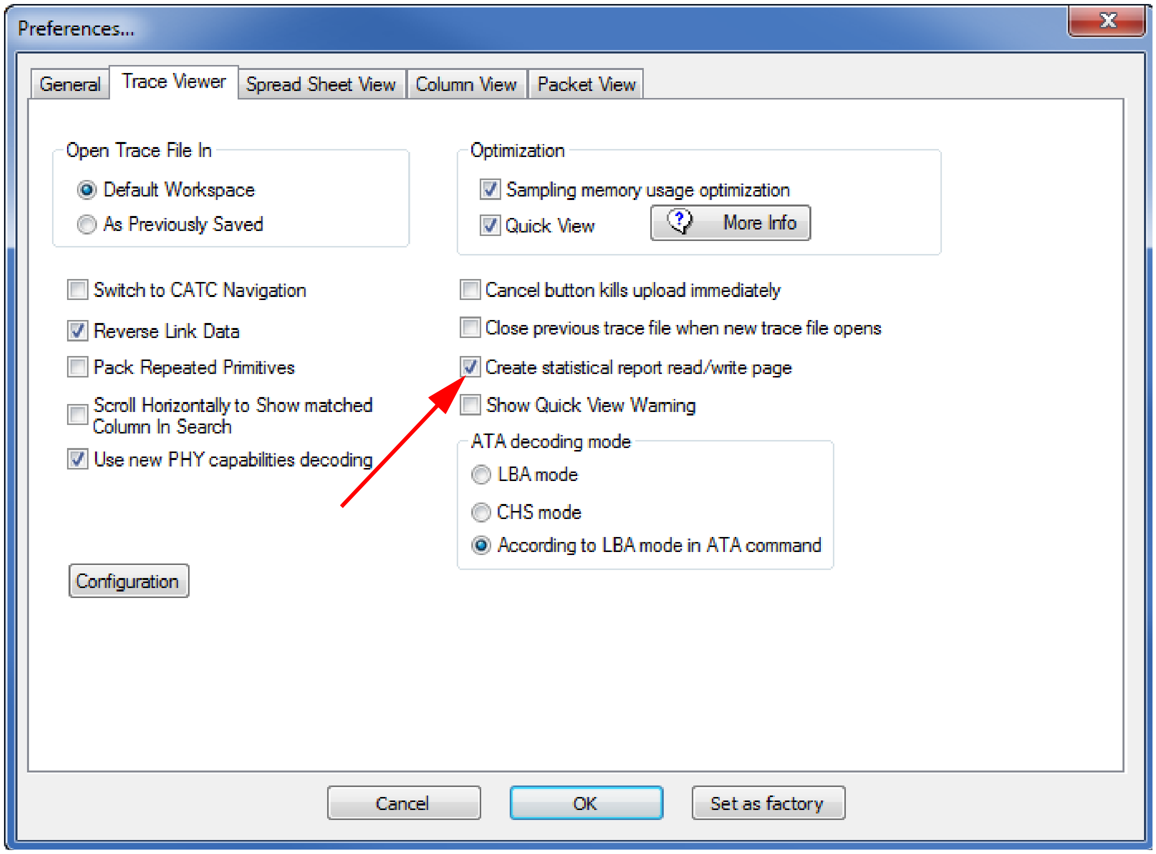


Figure 3.30: Enabling Read/Write Statistical Report

Note: This setting should be enabled before you capture the trace file.

If you have already captured a trace file and want to create a read/write statistical report for the sample, perform the following steps:

1. Enable the read/write settings as mentioned above.
2. Open the trace file.
3. Set the X pointer on the first packet in the viewer.
4. Set the Y pointer on last packet in the viewer.
5. Save as the trace file using the X to Y option.

   Now the saved trace file will contain the read/write statistical report.

Report Between Cursors

Click the option button next to the **From** cursor selection drop down list. Then click the **From** down arrow and choose the 1st cursor, click the **To** down arrow to choose the 2nd cursor, and click **OK.** The resulting report has only the capture between the cursors (see Figure 3.31 on page 130).

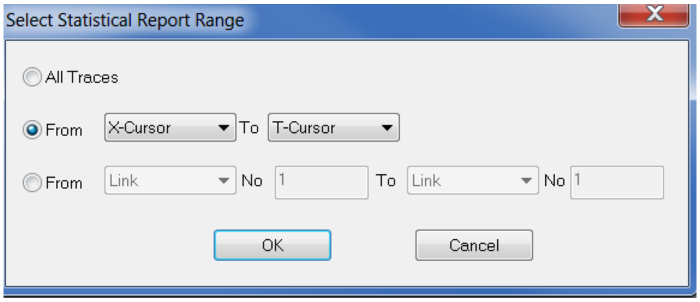


Figure 3.31: Report between Cursors

Report Between Events

Click the option button next to the **From** the event selection dropdown list, click the **From** down arrow to choose the 1st event, then enter the number of its occurrence. Next click the **To** down arrow to choose the 2nd event, then enter the number of its occurrence.

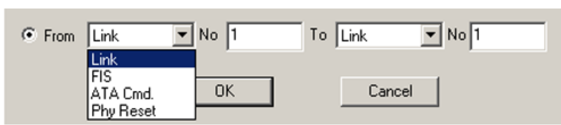


Figure 3.32: SATA: Report between Events

Click **OK.** The resulting report are limited to the capture between the defined events.

SAS vs. SATA: SAS adds Transport, SCSI Cmd, SMP Cmd, and Task Mng to the drop-down list and deletes FIS and Phy Reset.

Statistical Report Content

SAS: A complete SAS statistical report consists of the following reports, accessed by clicking the corresponding tab in the dialog:

- General
- Bus Condition
- Primitive
- SSP Transport
- SMP Transport
- STP Transport
- ATA Command
- SCSI Command
- SMP Command
- Task Command
- SAS Address
- Read/Write Command
- Protocol Error
- Performance
- Lanes
- Others

SATA: A complete SATA statistical report consists of the following reports, accessed by clicking the corresponding tab in the dialog:

- General
- Bus Condition
- Primitive
- FIS
- ATA Command
- ATAPI Command
- Read/Write Command
- Protocol Error
- Performance
- Others
- PM Statistic
- PM Performance

Note: Results are displayed only for items that have been captured in the sample.

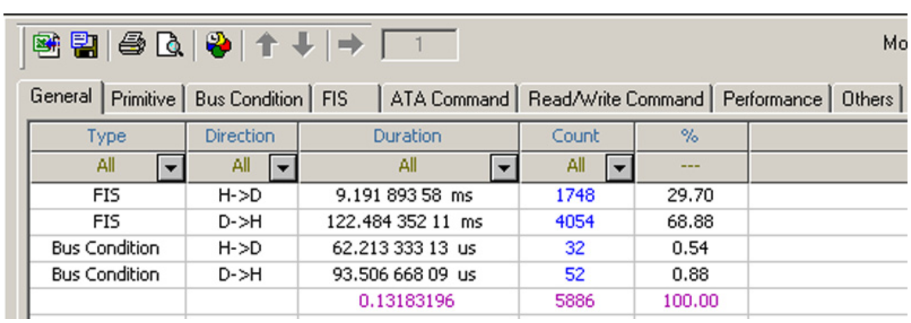
Report Options

Some report categories offer options to display only specific items.These report categories incorporate drop-down list boxes offering pre-defined and custom options. For details see Formatting the Statistical Report View on page 146.

General Report

To display the General Report, click the **General** tab. The General Report displays the report data in columns with the following information (see Figure 3.33 on page 131).

- Type: All, Custom, Bus Condition, FIS, Identify Address Frame, Open Address Frame, SMP Frame, SSP Frame, STP Frame
- **Direction**: All, H->D, D->H, I->T, T->I, or Custom
- **Duration**: All, Custom, or time unit
- **Count**: All, Custom, or a number of occurrences
- **%**: of total count



Type	Direction	Duration	Count	%
All	All	All	All	---
FIS	H->D	9.191 893 58 ms	1748	29.70
FIS	D->H	122.484 352 11 ms	4054	68.88
Bus Condition	H->D	62.213 333 13 us	32	0.54
Bus Condition	D->H	93.506 668 09 us	52	0.88
		0.13183196	5886	100.00

Figure 3.33: General Statistical Report

Primitive Report

To display the Primitive Report, click the **Primitive** tab. The Primitive Report displays information in the following columns:

- **Primitive**: All, Custom, Unknown
  For SATA: CONT, EOF, HOLD, HOLDA, R_IP, R_OK, R_RDY, SOF, SYNC, WTRM, X_RDY, ALIGN
  FOR SAS: SATA_CONT, SATA_EOF, SATA_R_IP, SATA_R_OK, SATA_R_RDY, SATA_-SOF, SATA_SYNC, SATA_WTRM, SATA_X_RDY, ACK, EOF, SOF, EOAF, SOAF, AIP_WAITING_ON_DEVICE,AIP_NORMAL, DONE_NORMAL, READY_NORMAL, CLOSE_NORMAL, OPEN_ACCEPT, ALIGN0, ALIGN1, NOTIFY_ENABLE_SPINUP
- **Direction**: All, H->D, D->H, I->T, T->I, or Custom
- **Count**: All, Custom, or a number of occurrences
- **%**: of total count

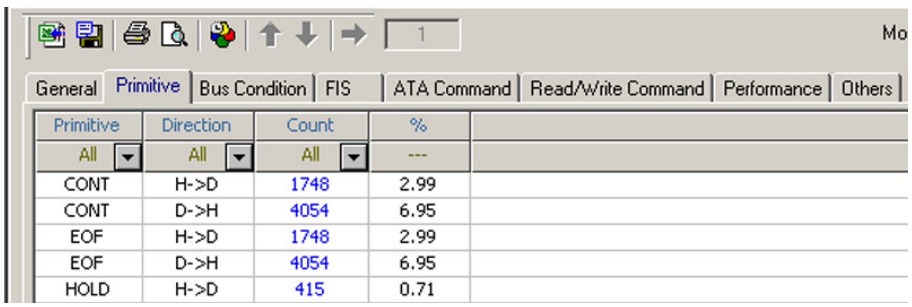


Figure 3.34: Primitive Report

Bus Condition Report

To display the Bus Condition Report, click the **Bus Condition** tab. The Bus Condition Report displays information in the following columns.

- Bus Condition: All, Custom, Activity On, COMININT/COMRESET, COMSAS, COM-WAKE, Keep Alive Activity
- Direction: All, H->D, D->H, I->T, T->I, or Custom
- **Count**: All, Custom, or a number of occurrences
- **%**: of total count

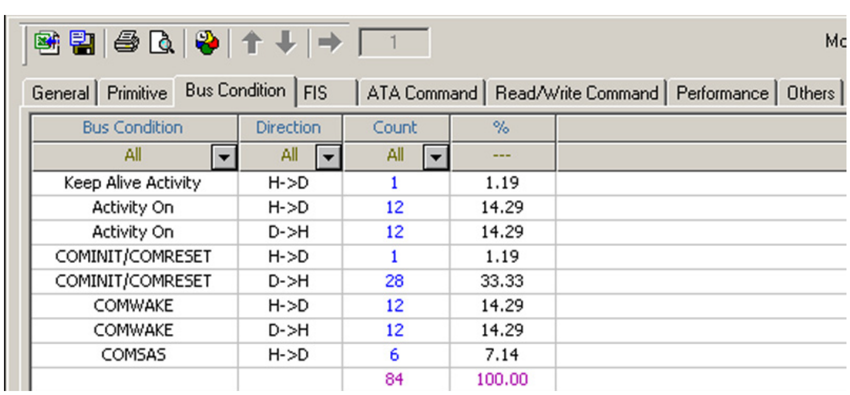
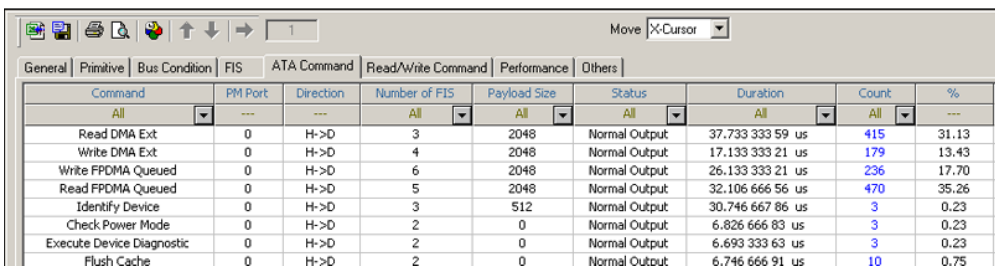


Figure 3.35: Bus Condition Report

ATA Command Report

To display the ATA Command Report, click the **ATA Command** tab. The ATA Command Report displays information in the following columns:

- Command: All, Custom, Check Power Mode, Execute Device Diagnostic, Flush Cache, Identify Device, Read DMA Ext, Read FPDMA Queue, Set Feature, Write DMA Ext, Write FPDMA Queue
- PM Port
- Direction: All, H->D, D->H, I->T, T->I, or Custom
- Number of FIS: All, Custom, or a number
- **Payload Size**: All, Custom, or a number of DWORDs
- Status: All, Custom, Incomplete, Normal Output
- Timeout: such as All, Custom, N/A, Yes, No (see Time out of ATA Command Report on page 133)
- **Duration**: All, Custom, or time unit
- **Count**: All, Custom, or a number of occurrences
- **%**: of total count



Command	PM Port	Direction	Number of FIS	Payload Size	Status	Duration	Count	%
All	---	---	All	All	All	All	All	---
Read DMA Ext	0	H->D	3	2048	Normal Output	37.733 333 59 us	415	31.13
Write DMA Ext	0	H->D	4	2048	Normal Output	17.133 333 21 us	179	13.43
Write FPDMA Queued	0	H->D	6	2048	Normal Output	26.133 333 21 us	236	17.70
Read FPDMA Queued	0	H->D	5	2048	Normal Output	32.106 666 56 us	470	35.26
Identify Device	0	H->D	3	512	Normal Output	30.746 667 86 us	3	0.23
Check Power Mode	0	H->D	2	0	Normal Output	6.826 666 83 us	3	0.23
Execute Device Diagnostic	0	H->D	2	0	Normal Output	6.693 333 63 us	3	0.23
Flush Cache	0	H->D	2	0	Normal Output	6.746 666 91 us	10	0.75

Figure 3.36: SATA: ATA Command Report

Time out of ATA Command Report

The Time out shows the NCQ time out. It is applicable for only NCQ commands. A threshold can be set in the "NCQ commands Timeout Threshold", the default value is 1000 µsec (the user can change it to any value). The statistical report provides a "Time out" report based on this threshold. Any NCQ command that takes more than the given threshold is flagged as "yes", which means that a timeout occurred for that command.

ATAPI Report

To display the ATAPI Report (see Figure 3.37 on page 134), click the **ATAPI** tab. The ATAPI Report displays information in the following columns:

- **Command**: All, Custom, Inquiry, Mode Sense 10, Read10, Request Sense
- **Direction**: All, H->D, D->H, or Custom
- **Number of FIS** or **Number of Transport**: All, Custom, or a number
- **Payload Size**: All, Custom, or a number of DWORDs
- **Status**: All, Custom, Check Condition, Good
- **Duration**: All, Custom, or time unit (accumulative)
- **Count**: All, Custom, or a number of occurrences
- **%:** of total count

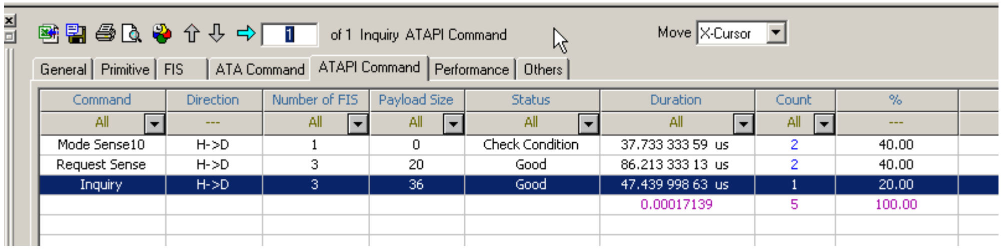


Figure 3.37: SATA: ATAPI Report

Protocol Error Report

To display the Protocol Error Report, click the **Protocol Error** tab.The Protocol Error Report displays the report data in columns with the following information:

- **Protocol Error**: All, Custom, Code Violation, CRC Error, Disparity Error, Align-Notify Error
- Direction: All, H->D, D->H, I->T, T->I, or Custom
- Count: All, Custom, or a number of occurrences
- **%**: of total count

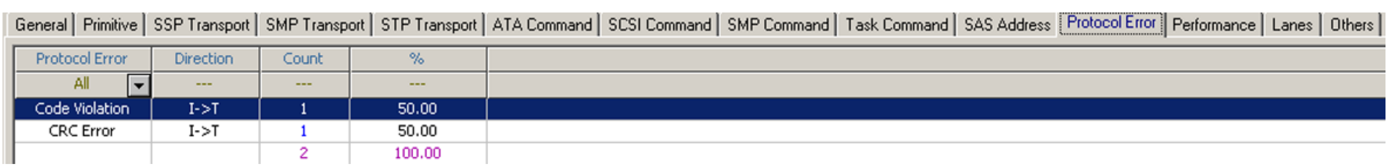
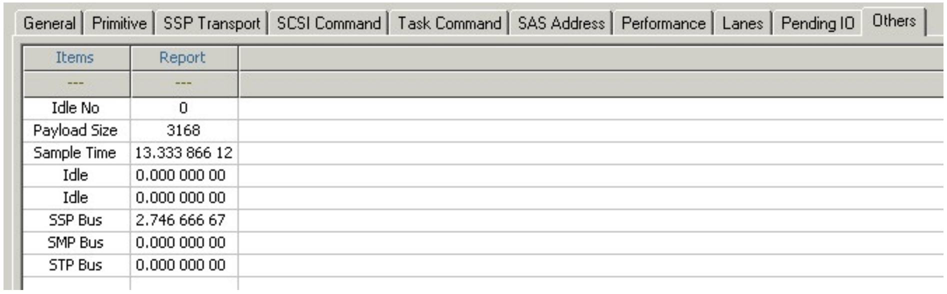


Figure 3.38: SAS: Protocol Error Report

Others Report

To display the Others Report (see Figure 3.39 on page 135), click the **Others** tab. The Others Report displays information in the following columns:

- Items
  - Idle No: Number of idle packets
  - Payload Size: Total number of payloads in trace files (SCSI + ATA commands)
  - Sample Time: Sample time
  - Idle (Initiator): Host idle time
  - Idle (Target): Device idle time (total)
  - SSP Bus Utilization: SSP bus utilization time (SSP frames)
  - SMP Bus Utilization: SSP bus utilization time (SMP frames)
  - STP Bus Utilization: SSP bus utilization time (STP frames)
- Report
  - Count or Time



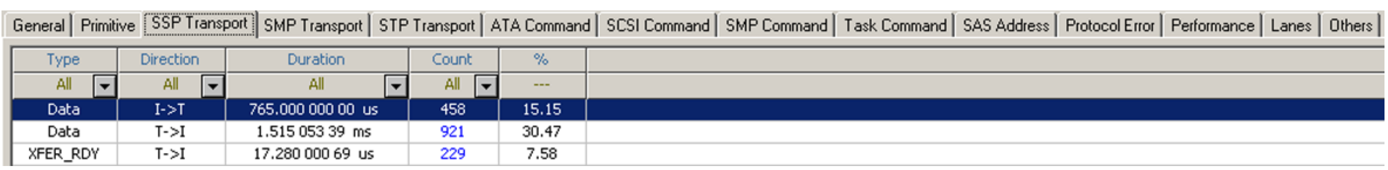
Items	Report
---	---
Idle No	0
Payload Size	3168
Sample Time	13.333 866 12
Idle	0.000 000 00
Idle	0.000 000 00
SSP Bus	2.746 666 67
SMP Bus	0.000 000 00
STP Bus	0.000 000 00

Figure 3.39: Others Report

SSP Transport Report (SAS)

To display the SSP Transport Report, click the **SSP Transport** tab. The SSP Transport Report displays the report data in columns with the following information:

- Type: All, Custom, Command, Data, Response, XFER_RDY
- Direction: All, I->T, T->I, or Custom
- Duration: All, Custom, or time unit
- Count: All, Custom, or a number
- **%:** of total count



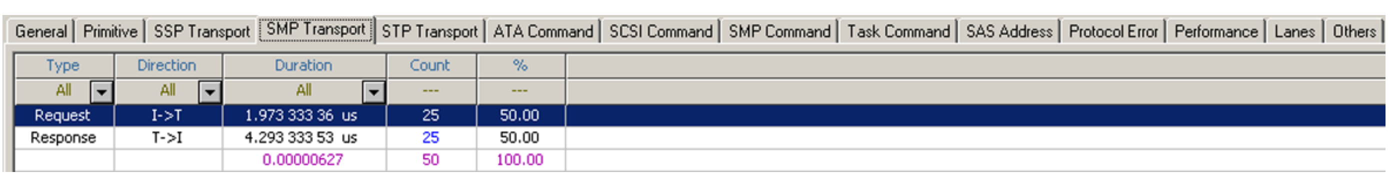
Type	Direction	Duration	Count	%
All	All	All	All	---
Data	I->T	765.000 000 00 us	458	15.15
Data	T->I	1.515 053 39 ms	921	30.47
XFER_RDY	T->I	17.280 000 69 us	229	7.58

Figure 3.40: SAS: SSP Transport Report

SMP Transport Report (SAS)

To display the SMP Transport Report, click the **SMP Transport** tab. The SMP Transport Report displays the report data in columns with the following information:

- Type: All, Custom, Request, Response
- Direction: All, I->T, T->I, or Custom
- Duration: All, Custom, or time unit
- Count: All, Custom, or a number
- **%:** of total count



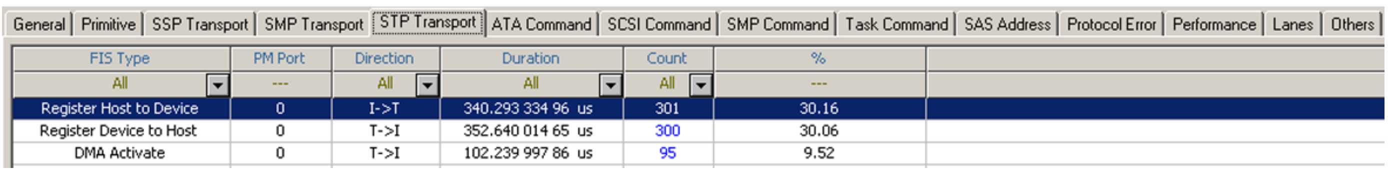
Type	Direction	Duration	Count	%
All	All	All	---	---
Request	I->T	1.973 333 36 us	25	50.00
Response	T->I	4.293 333 53 us	25	50.00
		0.00000627	50	100.00

Figure 3.41: SAS: SMP Transport Report

STP Transport Report (SAS)

To display the STP Transport Report, click the **STP Transport** tab. The STP Transport Report displays the report data in columns with the following information (see Figure 3.42 on page 136):

- FIS Type: All, Custom, Data, PIO Setup, Register Host To Device, Register Device To Host
- PM Port
- Direction: All, I->T, T->I, or Custom
- Duration: All, Custom, or time unit
- Count: All, Custom, or a number
- **%:** of total count


General | Primitive | SSP Transport | SMP Transport | STP Transport | ATA Command | SCSI Command | SMP Command | Task Command | SAS Address | Protocol Error | Performance | Lanes | Others

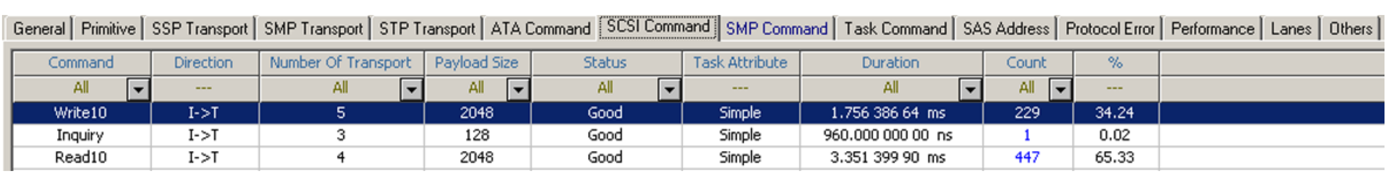
FIS Type	PM Port	Direction	Duration	Count	%
All	---	All	All	All	---
Register Host to Device	0	I->T	340.293 334 96 us	301	30.16
Register Device to Host	0	T->I	352.640 014 65 us	300	30.06
DMA Activate	0	T->I	102.239 997 86 us	95	9.52

Figure 3.42: SAS: STP Transport Report

SCSI Command Report (SAS)

To display the SCSI Command Report, click the **SCSI Command** tab. The SCSI Command Report displays the report data in columns with the following information:

- Command: All, Custom, Inquiry, Mode Sense6, Pause Resume, Play Audio 10, Read Capacity, Read10, Receive Diagnostic Results, Send Diagnostic, Write10, Start Stop Unit, Test Unit Ready, Report Luns, Synchronize Cache10
- Direction: All, I->T, T->I, or Custom
- Number of Transport: All, Custom, or a number
- Payload Size: All, Custom, or a number of DWORDs
- Status: All, Custom, Good, Incomplete, Response Data Present
- Task Attribute: Simple
- Duration: All, Custom, or time unit
- Count: All, Custom, or a number
- %: of total count


General | Primitive | SSP Transport | SMP Transport | STP Transport | ATA Command | SCSI Command | SMP Command | Task Command | SAS Address | Protocol Error | Performance | Lanes | Others

Command	Direction	Number Of Transport	Payload Size	Status	Task Attribute	Duration	Count	%
All	---	All	All	All	---	All	All	---
Write10	I->T	5	2048	Good	Simple	1.756 386 64 ms	229	34.24
Inquiry	I->T	3	128	Good	Simple	960.000 000 00 ns	1	0.02
Read10	I->T	4	2048	Good	Simple	3.351 399 90 ms	447	65.33

Figure 3.43: SAS: SCSI Command Report

SMP Command Report (SAS)

To display the SMP Command Report (see Figure 3.44 on page 137), click the **SMP Command** tab. The SMP Command Report displays the report data in columns with the following information:

- Function: All, Custom, Discover, Report General, Report Manufacture Information, Report PHY Error Log

- Function Result: SMP Function Accepted
- Direction: All, I->T, T->I, or Custom
- Duration: All, Custom, or time unit
- Count: All, Custom, or a number
- **%:** of total count

General | Primitive | SSP Transport | SMP Transport | STP Transport | ATA Command | SCSI Command | SMP Command | Task Command | SAS Address | Protocol Error | Performance | Lanes | Others

Function	Function Result	Direction	Duration	Count	%
All	---	---	All	All	---
Report General	SMP Function Accepted	I->T	186.666 671 75 ns	1	4.00
Discover	SMP Function Accepted	I->T	3.519 999 98 us	12	48.00
Report Phy Error Log	SMP Function Accepted	I->T	2.559 999 94 us	12	48.00
			0.00000627	25	100.00

Figure 3.44: SAS: SMP Command Report

Task Command Report (SAS)

To display the Task Command Report, click the **TASK Command** tab. The Task Command Report displays the report data in columns with the following information:

- Function
- Status
- Direction: All, I->T, T->I, or Custom
- Duration: All, Custom, or time unit
- Count: All, Custom, or a number
- **%:** of total count

General | Primitive | SSP Transport | SMP Transport | STP Transport | ATA Command | SCSI Command | SMP Command | Task Command | SAS Address | Protocol Error | Performance | Lanes | Others

Function	Status	Direction	Duration	Count	%
---	---	---	---	---	---
Abort Task	Good	I->T	426.666 656 49 ns	1	100.00
			0.00000043	1	100.00

Figure 3.45: SAS: TASK Command Report

SAS Address Report (SAS)

To display the SAS Address Report, click the **SAS Address** tab.The SAS Address Report displays the report data in columns with the following information. See the following screen capture:

- Source SAS Address: All, Custom, or an address
- Destination SAS Address: All, Custom, or an address
- Protocol Type: SMP, SSP, STP
- Frame Type: All, Custom, Command, Data, DMA Activate,
  Register Host To Device, Register Device To Host, Response, XFER_RDY
- **Count**: All, Custom, or a number

General | Primitive | SSP Transport | SMP Transport | STP Transport | ATA Command | SCSI Command | SMP Command | Task Command | SAS Address | Protocol Error | Performance | Lanes | Others

Source SAS Address	Destination SAS Address	Protocol Type	Frame Type	Count
All	All	All	All	All
50060560000003C4	500062B000001074	STP	Data	206
50060560000003C4	500062B000001074	STP	Register Device to Host	300
500062B000001074	50060560000003C4	STP	Register Host to Device	301

Figure 3.46: SAS: SAS Address Report

Lanes Report (SAS)

To display the Lanes Report, click the **Lanes** tab. The Lanes Report displays the report data in columns with the following information:

- Port
- Open Accept: All, Custom, or a number
- Open Reject: All, Custom, or a number
- AIP Waiting on Con.
- Break
- SCSI Command: All, Custom, or a number
- ATA Command: All, Custom, or a number
- SMP Command: All, Custom, or a number
- Out Standing Command: All, Custom, or a number
- Transfer Bytes: All, Custom, or a number
- Link Utilization (time)
- Link Utilization%

General | Primitive | SSP Transport | SMP Transport | STP Transport | ATA Command | SCSI Command | SMP Command | Task Command | SAS Address | Protocol Error | Performance | Lanes | Others

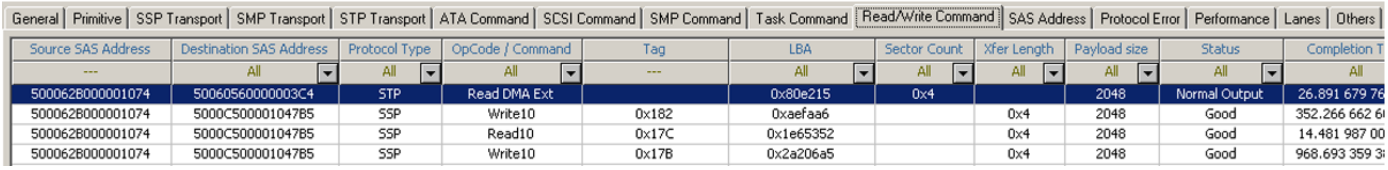
Port	Open Accept	Open Reject	AIP Waiting on Con.	Break	SCSI Command	ATA Command	SMP Command	Out Standing Cmd	Transfer Bytes	Link Utilization	Link Utiliza
All	All	All	---	---	All	All	All	All	All	---	---
I1	9	0	0	0	6	0	0	1	0	4.293 334 us	0.03
T1	7	0	0	0	0	0	0	0	172	5.360 000 us	0.03
I2	776	102	0	0	700	300	25	2	661504	4.552 893 ms	29.1

Figure 3.47: SAS Lanes Report

Read/Write Command Report (SAS)

To display the Read/Write Command Report (see Figure 3.48 on page 139), click the **Read/Write Command** tab. You can enable or disable creation of this page by selecting **Create statistical report read/write page** in the Trace Viewer tab (see Trace Viewer Tab on page 212). The Read/Write Command report displays the report data in columns with the following information:

- Source SAS Address
- Destination SAS Address
- Protocol Type
- OpCode/Command
- Tag
- LBA
- Sector Count
- Xfer Length
- Payload Size: All, Custom, or a number of DWORDs
- Status: All, Custom, Good
- Completion Time
- Performance
- Standard Deviation
- **Count**: All, Custom, or a number



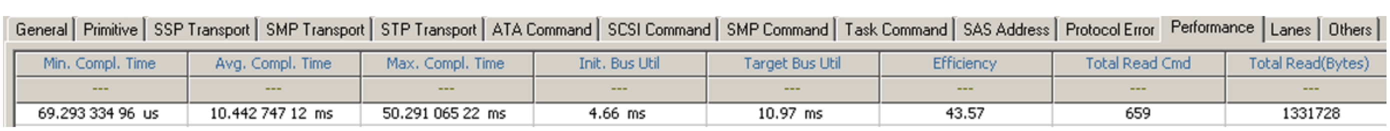
Source SAS Address	Destination SAS Address	Protocol Type	OpCode / Command	Tag	LBA	Sector Count	Xfer Length	Payload size	Status	Completion T
---	All	All	All	---	All	All	All	All	All	All
500062B000001074	50060560000003C4	STP	Read DMA Ext		0x80e215	0x4		2048	Normal Output	26.891 679 76
500062B000001074	5000C500001047B5	SSP	Write10	0x182	0xaefaa6		0x4	2048	Good	352.266 662 6
500062B000001074	5000C500001047B5	SSP	Read10	0x17C	0x1e65352		0x4	2048	Good	14.481 987 00
500062B000001074	5000C500001047B5	SSP	Write10	0x17B	0x2a206a5		0x4	2048	Good	968.693 359 3

Figure 3.48: SAS: Read Write Command Report

Performance Report (SAS)

To display the Performance Report, click the **Performance** tab.The Performance Report displays the report data in columns with the following information:

- Minimum Completion Time
- Average Completion Time
- Maximum Completion Time
- Initiator Bus Utilization
- Target Bus Utilization
- Efficiency
- Total Read Cmd
- Total Read (Bytes)
- Total Read Duration
- Cmd Minimum Read (MB/S)
- Cmd Average Read (MB/S)
- Cmd Maximum Read (MB/S)
- Total Write Cmd
- Total Write (Bytes)
- Total Write Duration is the sum of all write commands duration.
- Cmd Minimum Write (MB/S)
- Cmd Average Write (MB/S) is the Total Write (Total payload size of all write commands in sample file in MB) / Total Completion Time (Total completion time of all write commands in sample file in seconds).
- Cmd Maximum Write (MB/S)
- Average Byte per SSP Frame
- Average Byte per STP Frame



Min. Compl. Time	Avg. Compl. Time	Max. Compl. Time	Init. Bus Util	Target Bus Util	Efficiency	Total Read Cmd	Total Read(Bytes)
---	---	---	---	---	---	---	---
69.293 334 96 us	10.442 747 12 ms	50.291 065 22 ms	4.66 ms	10.97 ms	43.57	659	1331728

Figure 3.49: SAS: Performance Report

Performance Report (SATA)

To display the Performance Report, click the **Performance** tab. The Performance Report (see Figure 3.50 on page 140) displays information in the following columns:

- Minimum Completion Time
- Average Completion Time
- Maximum Completion Time

- Host Bus Utilization
- Device Bus Utilization
- Efficiency (%)
- Total Read Cmd
- Total Read (Bytes)
- Total Read Duration
- Cmd Minimum Read (MB/S)
- Cmd Average Read (MB/S)
- Cmd Maximum Read (MB/S)
- Total Write Cmd
- Total Write (Bytes)
- Total Write Duration is the sum of all write commands duration.
- Cmd Minimum Write (MB/S)
- Cmd Average Write (MB/S) is the Total Write (Total payload size of all write commands in sample file in MB) / Total Completion Time (Total completion time of all write commands in sample file in seconds).
- Cmd Maximum Write (MB/S)
- Average Byte Per FIS
- FIS Minimum Difference Time
- FIS Average Difference Time is the difference between two back to back FIS in the same link and is the average.
- FIS Maximum Difference Time

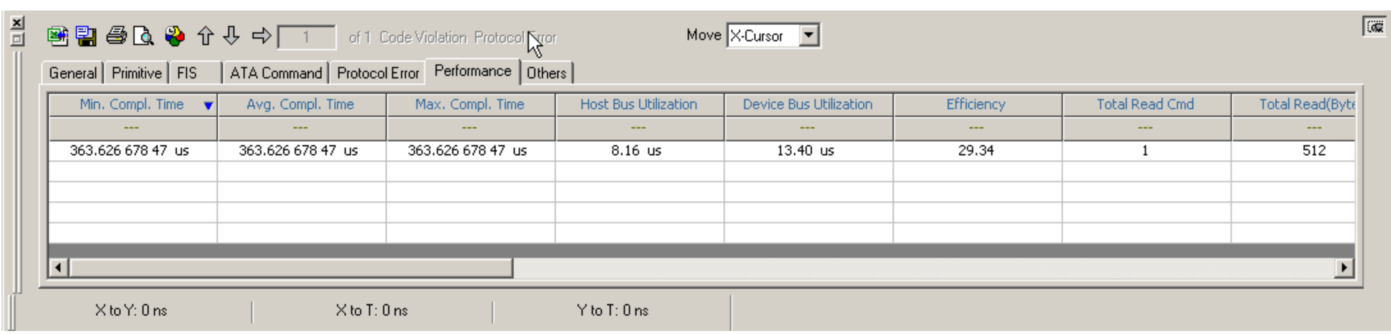
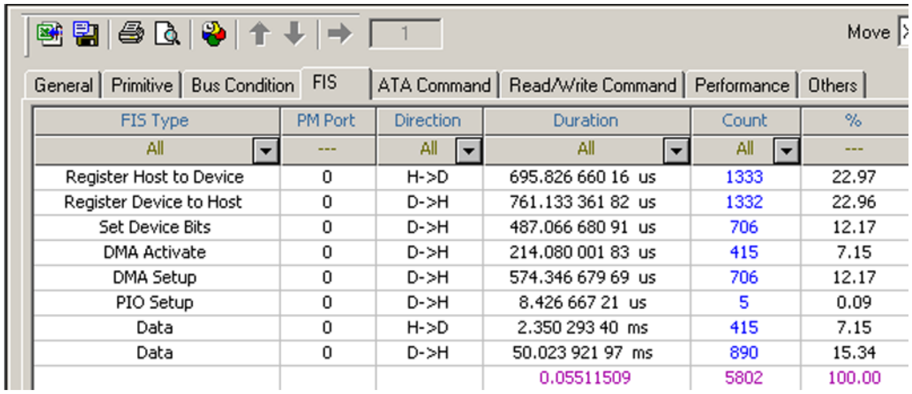


Figure 3.50: SATA: Performance Report

FIS Report (SATA)

To display the FIS Report (see Figure 3.51 on page 141), click the **FIS** tab. The FIS Report displays information in the following columns:

- **FIS Type**: All, Custom, Data, PIO Setup, Register Host To Device, Register Device To Host
- PM Port
- **Direction**: All, H->D, D->H, or Custom
- **Duration**: All, Custom, or time unit (accumulative)
- **Count**: All, Custom, or a number of occurrences
- **%:** of total count



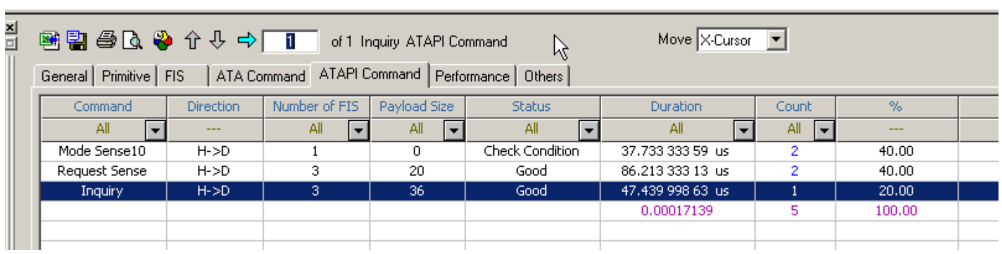
FIS Type	PM Port	Direction	Duration	Count	%
All	---	All	All	All	---
Register Host to Device	0	H->D	695.826 660 16 us	1333	22.97
Register Device to Host	0	D->H	761.133 361 82 us	1332	22.96
Set Device Bits	0	D->H	487.066 680 91 us	706	12.17
DMA Activate	0	D->H	214.080 001 83 us	415	7.15
DMA Setup	0	D->H	574.346 679 69 us	706	12.17
PIO Setup	0	D->H	8.426 667 21 us	5	0.09
Data	0	H->D	2.350 293 40 ms	415	7.15
Data	0	D->H	50.023 921 97 ms	890	15.34
			0.05511509	5802	100.00

Figure 3.51: SATA: FIS Report

Queue Command Report (SATA)

To display the Queue Command Report, click the **Queue Command** tab. The Queue Command Report displays information in the following columns:

- **Command**: All, Custom, Read DMA Queued
- PM Port
- **Status**: All, Custom, Normal Output
- **Payload Size**: All, Custom, or a number of DWORDs
- **Direction**: All, H->D, D->H, or Custom
- **Duration**: All, Custom, or time unit (accumulative)
- **Count**: All, Custom, or a number of occurrences
- **%:** of total count



Command	Direction	Number of FIS	Payload Size	Status	Duration	Count	%
All	---	All	All	All	All	All	---
Mode Sense10	H->D	1	0	Check Condition	37.733 333 59 us	2	40.00
Request Sense	H->D	3	20	Good	86.213 333 13 us	2	40.00
Inquiry	H->D	3	36	Good	47.439 998 63 us	1	20.00
					0.00017139	5	100.00

Figure 3.52: SATA: Queue Command Report

PM Statistic Report (SATA)

To display the PM Statistic Report (see Figure 3.53 on page 142), click the **PM Statistic** tab. The PM Statistic Report displays information in the following columns:

- Request Type: PMREQ_P
- Request Port
- Response Type: All, Custom, PMACK
- Response Time
- Request Entering Delay
- Response Entering Delay
- Wakeup Type
- Request DC Idle Time
- Response DC Idle Time

- Request Wakeup Time
- Response Wakeup Time
- **Count**: All, Custom, or a number

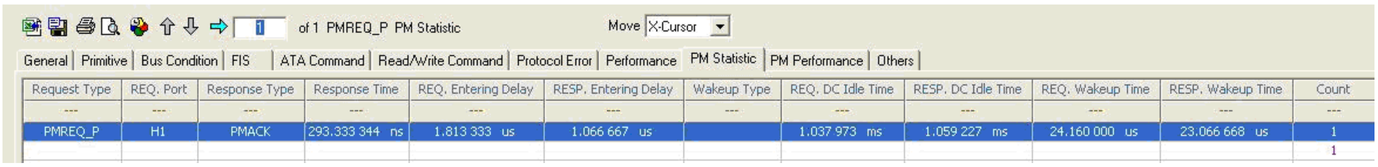


Figure 3.53: SATA: PM Statistic Report

PM Performance Report (SATA)

To display the PM Performance Report, click the **PM Performance** tab. The PM Performance Report displays information in the following columns:

- Port
- Partial Request
- Partial ACKed
- Partial NACKed
- Slumber Request
- Slumber ACKed
- Slumber NACKed
- Partial Time / Slumber Time %
- Partial Time / Total Time %
- Slumber Time / Total Time %

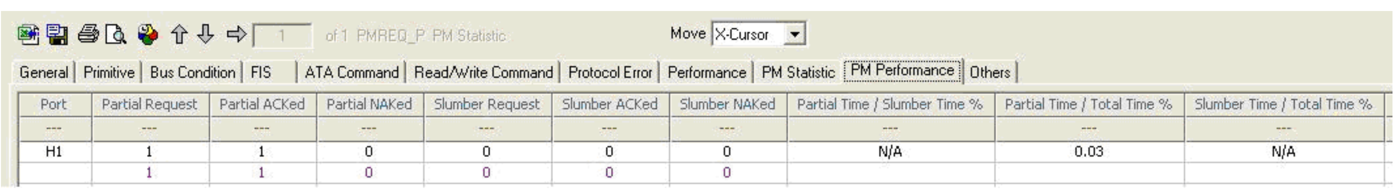


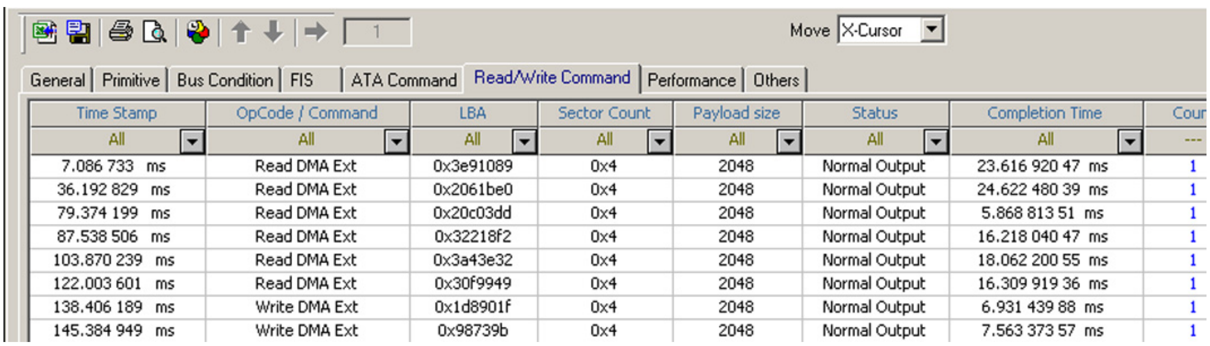
Figure 3.54: SATA: PM Performance Report

Read Write Command Report (SATA)

To display the Read/Write Co

To display the Read/Write Command Report, click the **Read/Write Command** tab. You can enable or disable creation of this page by selecting **Create statistical report read/write page** in the Trace Viewer tab (see Trace Viewer Tab on page 212). The Read/Write Command Report displays information in the following columns:

- Time Stamp
- OpCode/Command
- LBA
- Sector Count
- Payload Size: All, Custom, or a number of DWORDs
- Status: All, Custom, Good
- Completion Time
- **Count**: All, Custom, or a number

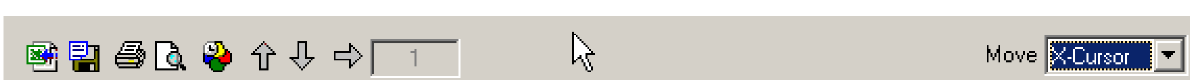


Time Stamp	OpCode / Command	LBA	Sector Count	Payload size	Status	Completion Time	Cour
All	All	All	All	All	All	All	---
7.086 733 ms	Read DMA Ext	0x3e91089	0x4	2048	Normal Output	23.616 920 47 ms	1
36.192 829 ms	Read DMA Ext	0x2061be0	0x4	2048	Normal Output	24.622 480 39 ms	1
79.374 199 ms	Read DMA Ext	0x20c03dd	0x4	2048	Normal Output	5.868 813 51 ms	1
87.538 506 ms	Read DMA Ext	0x32218f2	0x4	2048	Normal Output	16.218 040 47 ms	1
103.870 239 ms	Read DMA Ext	0x3a43e32	0x4	2048	Normal Output	18.062 200 55 ms	1
122.003 601 ms	Read DMA Ext	0x30f9949	0x4	2048	Normal Output	16.309 919 36 ms	1
138.406 189 ms	Write DMA Ext	0x1d8901f	0x4	2048	Normal Output	6.931 439 88 ms	1
145.384 949 ms	Write DMA Ext	0x98739b	0x4	2048	Normal Output	7.563 373 57 ms	1

Figure 3.55: SATA: Read Write Command Report

3.3.11 Statistical Report Toolbar

- The Statistical Report toolbar provides the following functions accessible by buttons on the toolbar:
- Export to Excel
- Save as Text
- Print Report
- Print Preview
- Report Display Settings
- Move to **X-Cursor, Y-Cursor**, or **None**



Export as Microsoft® Excel file

The **Export to Excel** button opens the Export to Excel dialog. Choose a folder in which to save the Excel file, choose an appropriate file name, and click **Save.**

Save as Text file

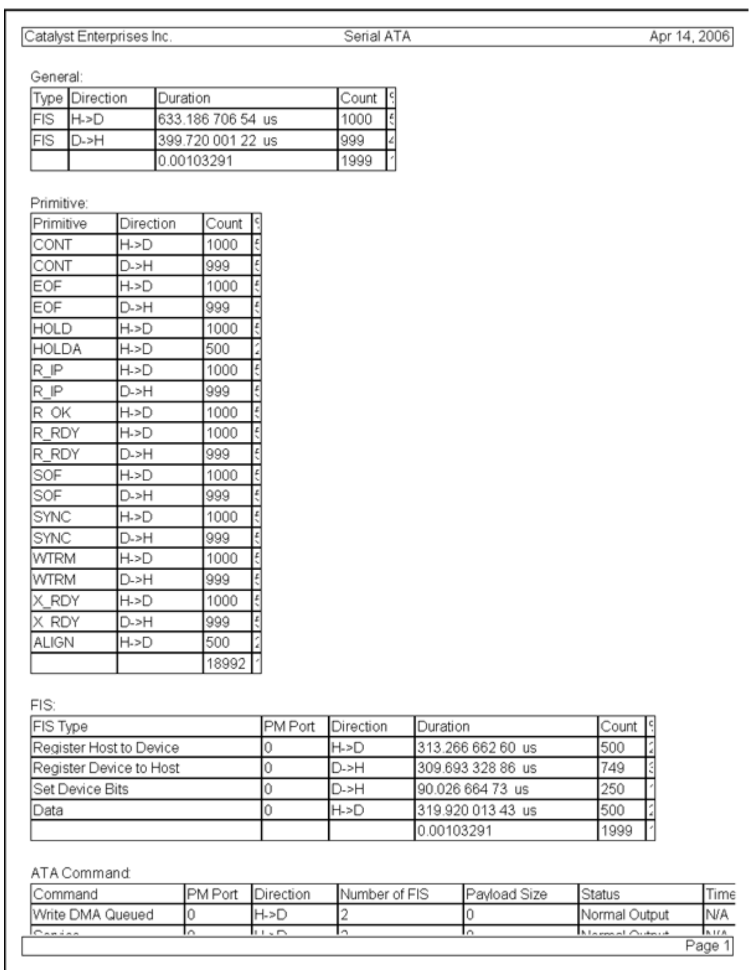
The **Save as Text** button opens the Export to Text dialog. Choose a folder in which to save the Text file, choose an appropriate file name, and click **Save.**

Print Statistical Report

The **Print** button opens the select printer dialog. Choose an available printer and click **OK.**

Print Preview

The **Print Preview** button displays a preview of the report to print.



Catalyst Enterprises Inc. Serial ATA Apr 14, 2006

General:

Type	Direction	Duration	Count
FIS	H->D	633.186 706 54 us	1000
FIS	D->H	399.720 001 22 us	999
		0.00103291	1999

Primitive:

Primitive	Direction	Count
CONT	H->D	1000
CONT	D->H	999
EOF	H->D	1000
EOF	D->H	999
HOLD	H->D	1000
HOLDA	H->D	500
R_IP	H->D	1000
R_IP	D->H	999
R_OK	H->D	1000
R_RDY	H->D	1000
R_RDY	D->H	999
SOF	H->D	1000
SOF	D->H	999
SYNC	H->D	1000
SYNC	D->H	999
WTRM	H->D	1000
WTRM	D->H	999
X_RDY	H->D	1000
X_RDY	D->H	999
ALIGN	H->D	500
		18992

FIS:

FIS Type	PM Port	Direction	Duration	Count
Register Host to Device	0	H->D	313.266 662 60 us	500
Register Device to Host	0	D->H	309.693 328 86 us	749
Set Device Bits	0	D->H	90.026 664 73 us	250
Data	0	H->D	319.920 013 43 us	500
			0.00103291	1999

ATA Command:

Command	PM Port	Direction	Number of FIS	Payload Size	Status	Time
Write DMA Queued	0	H->D	2	0	Normal Output	N/A

Page 1

Figure 3.56: Sample Print Preview of Report

Report Display Settings

The **Setting** button opens the Setting dialog.

You can set up the report columns for display to suit a particular analysis need, eliminating the need to show/hide columns individually. Use the **Setting** dialog to configure the display for each page (see Figure 3.57 and Figure 3.58).

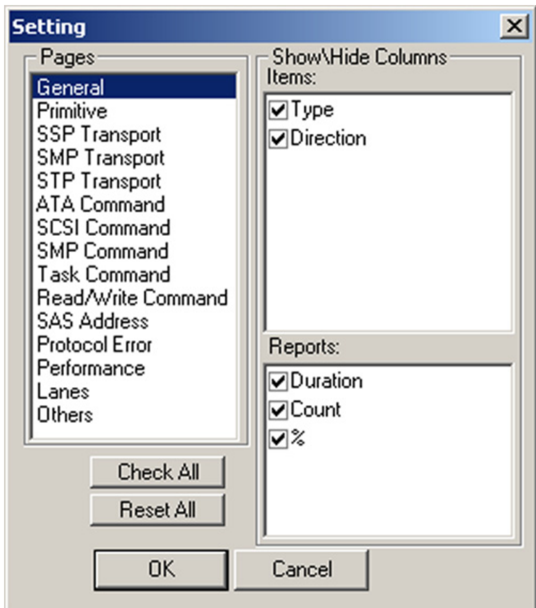


Figure 3.57: SAS: Statistical Report Column Setting

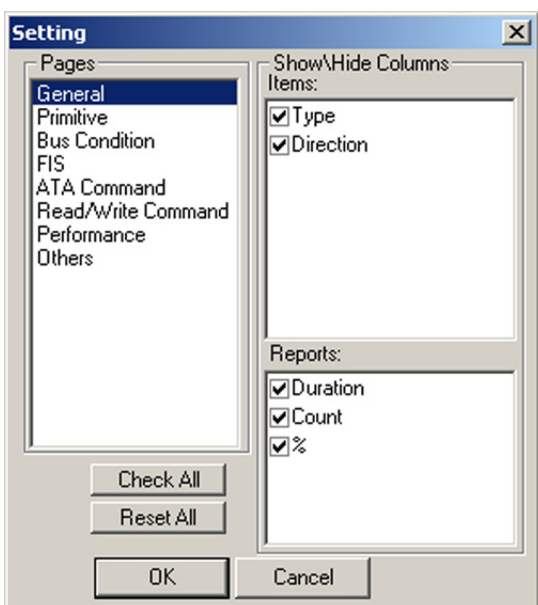
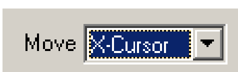


Figure 3.58: SATA: Statistical Report Column Setting

Link With Sample View

When you select a type on any page of the Statistical Report, a set of navigation buttons allows you to examine each instance of that type in the Sample Viewer.

	The **Jump to Previous** button goes to the previous instance of the selected type in the Sample Viewer.
	The **Jump to Next** button goes to the next instance of the selected type in the Sample Viewer.
	The **Jump to Specific** button goes to the instance specified as N of M items on the Statistical Report toolbar.
	The **Move** drop-down list moves to the X-Cursor, Y-Cursor, or None.

3.3.12 Formatting the Statistical Report View

Initially the Statistical Report View contains all of the information in columns, but you can customize the display by:

- Filtering columns by item
- Sorting items by column
- Hiding any column on the display

Filtering Column Content

To filter column content, click the down arrow in the heading for that column and choose the items to display. The default is All. By checking a specific item, you exclude everything but that item for display.

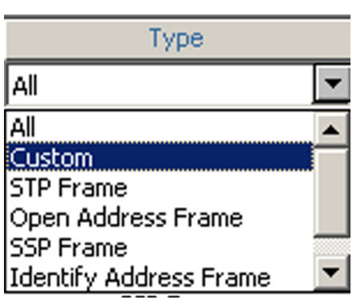


Figure 3.59: SAS: Type

Choosing **Custom** allows you to specify more than one item for display (see Figure 3.60).

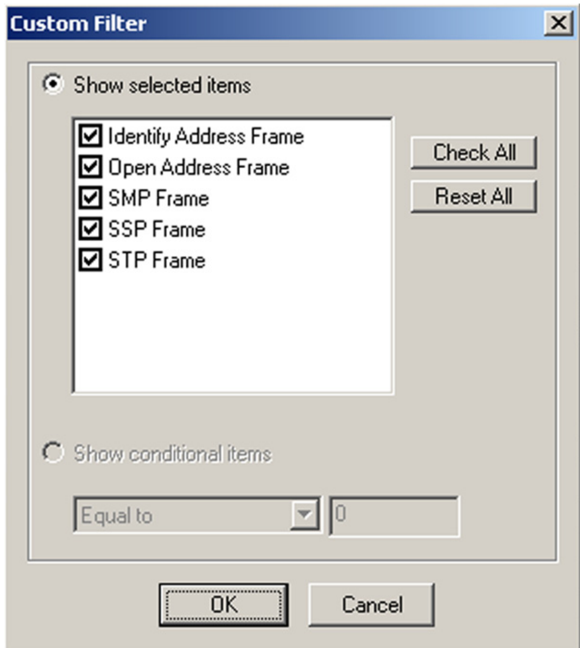


Figure 3.60: SAS: Custom Filter

.

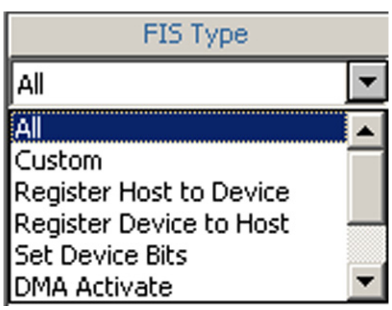


Figure 3.61: SATA: FIS Type

Choosing **Custom** allows you to specify more than one item for display (see Figure 3.62 on page 148).

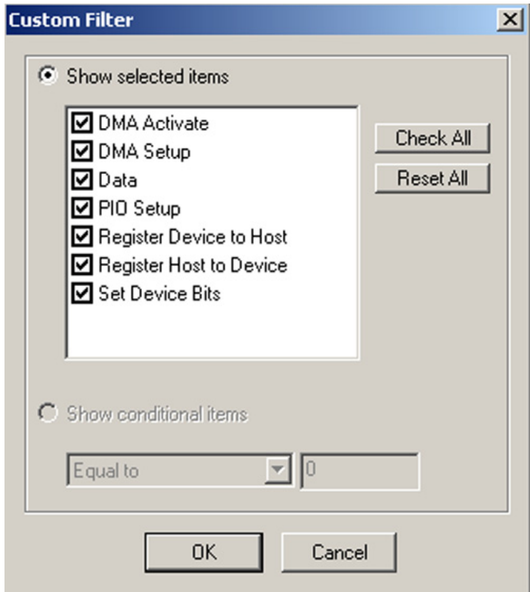


Figure 3.62: SATA: Custom Filter

Check the items to display and click **OK**.

Sorting Column Content

To sort column content, click the **heading** for that column. Repeated clicking of the column heading sorts the column in ascending or descending order.

Type ▲	Direction	Duration	Count	%
All	All	All	All	---
Open Address Frame	I->T	18.39999962 us	69	28.51
SMP Frame	T->I	4.53333330 us	17	7.02
SMP Frame	I->T	1.81333339 us	17	7.02
SSP Frame	T->I	23.12000084 us	53	21.90
SSP Frame	I->T	14.48000050 us	35	14.46
STP Frame	T->I	85.89333344 us	34	14.05
STP Frame	I->T	7.03999996 us	17	7.02
		0.00015528	242	100.00

Type ▼	Direction	Duration	Count	%
All	All	All	All	---
STP Frame	I->T	7.03999996 us	17	7.02
STP Frame	T->I	85.89333344 us	34	14.05
SSP Frame	I->T	14.48000050 us	35	14.46
SSP Frame	T->I	23.12000084 us	53	21.90
SMP Frame	I->T	1.81333339 us	17	7.02
SMP Frame	T->I	4.53333330 us	17	7.02
Open Address Frame	I->T	18.39999962 us	69	28.51
		0.00015528	242	100.00

Figure 3.63: Toggling Type Sort Order

Hiding Columns

To hide a column, right-click in the column and choose **Hide**. To unhide a column, right-click any column and choose **Unhide**.

3.3.13 Histogram View

The Histogram View displays a histogram of frame-type transfers.

To display the Histogram View of the current capture, click **Analysis > Histogram View** or

click the  button on the toolbar.

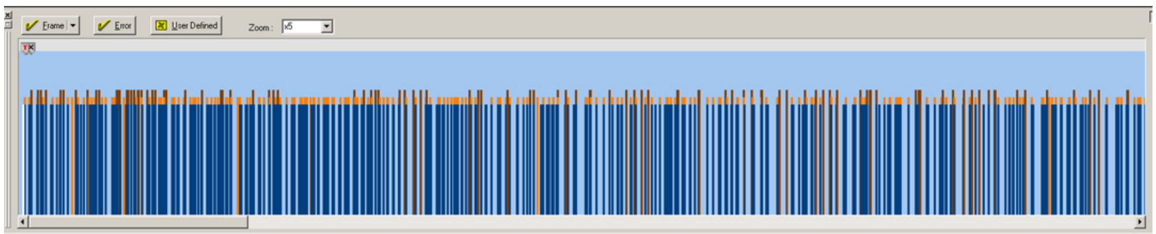


Figure 3.64: Histogram View

Hide Frames

You can customize the histogram by including only frame types that you want.

To choose frame types to include in the display, click the down arrow on the **Frame** button on the Histogram toolbar and check frame types:

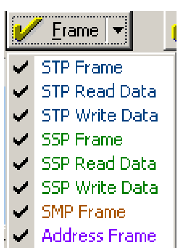


Figure 3.65: SAS: Histogram Frames

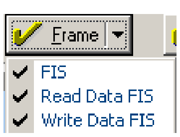


Figure 3.66: SAS: Histogram Frames

Hide Error Frames

Frames with errors are displayed in red. To hide error frames from the histogram, click the 

button.

Note: To display the error code of a protocol error, click the error icon (with the red 'x').

User Defined

You can define additional items for inclusion in the Histogram by clicking the

button to open the User Defined dialog.

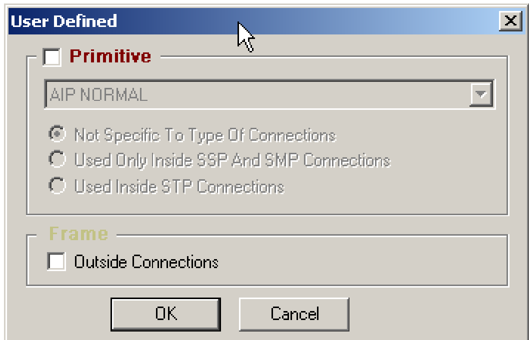


Figure 3.67: SAS: Histogram User Defined Dialog

You can include Primitive and/or Outside Connections frames.

Primitives

To include Primitives, check the **Primitive** check box, click the down arrow on the Primitive list box, and choose a Primitive.

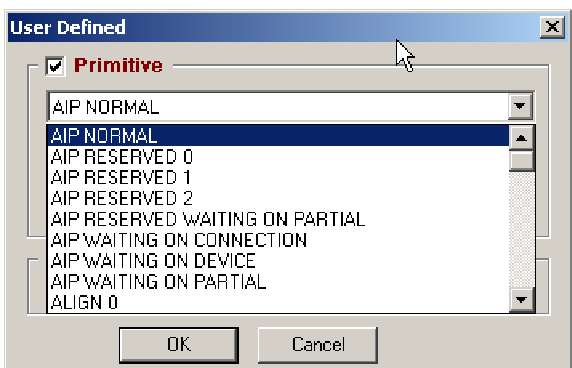


Figure 3.68: SAS: Choosing a Primitive

Figure 3.69: SATA: Choosing a Primitive

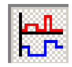
Check a Connection Type option radio button, if available, and click **OK**.

Zoom

You can Zoom from x1 to x256.

3.3.14 Bus Utilization View

The Bus Utilization View displays information on pending IO. To display the Bus Utilization View of the current capture,

click **Analysis > Bus Utilization View** or click the  button on the tool bar.

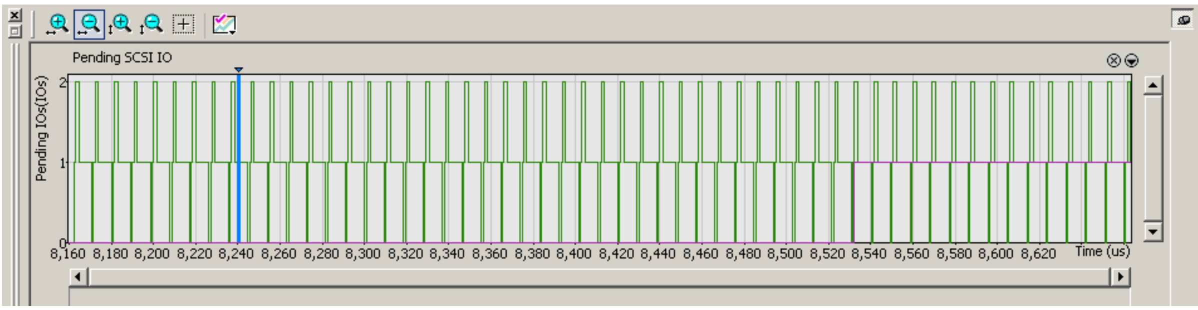


Figure 3.70: SAS: Bus Utilization View for Pending SCSI IO

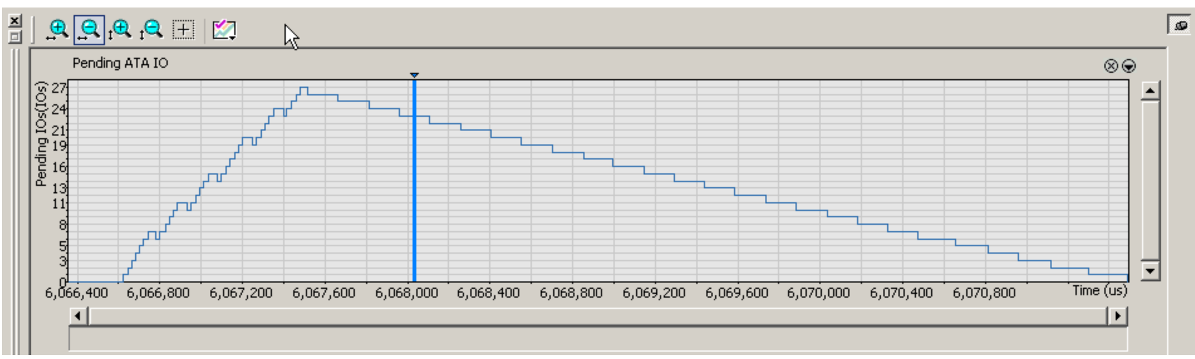


Figure 3.71: SATA: Bus Utilization View for Pending ATA IO

Available Bus Utilization Views are:

- Pending SCSI IO (for SAS)
- Pending ATA IO (for SATA)

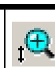
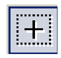
Hovering the mouse over the graph heading displays the graph legend:

- **Go to ATA/SCSI Cmd. #**: Jump to command.
- **Synchronize with Trace View**: Synchronize all open views to that location in the trace.
- **Fit to Graph Area**: Zoom to fit.
- **Hide**: Do not display the graph.

To synchronize all open views to that location in the trace, double-click the graph.

Bus Utilization Buttons

The Bus Utilization window has a row of buttons for changing the format of the displayed data. The buttons have the following functions:

	Horizontal zoom in		Vertical zoom in
	Horizontal zoom out		Vertical zoom out
	Graph Areas Presents options for displaying additional graphs.		Click and Drag zoom Click diagonally to select and zoom in on part of the graph.
	Hide graph.		Graph legend (see previous page)

3.3.15 Data Report

When a captured sample is in the Sample Viewer, the Data Report button is on the Viewer toolbar, and Data Report is in the Report menu.

The data report displays all the data sent from the host to the device and from the device to the host. All PIO In =>In commands are grouped as a data packet until the occurrence of a PIO Out =>Out command, creating a new data packet.

To display a Data Report, click the  **Data Report** button on the Viewer toolbar or select **Analysis > Data Report**.

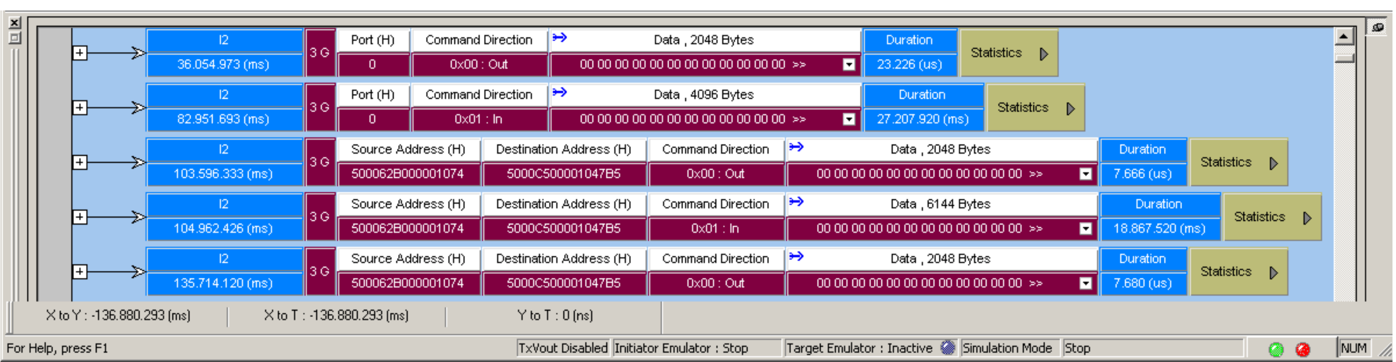


Figure 3.72: SAS: Data Report

Click the **Down Arrow** in a data field to display Data Report details (see Figure 3.73 on page 153).

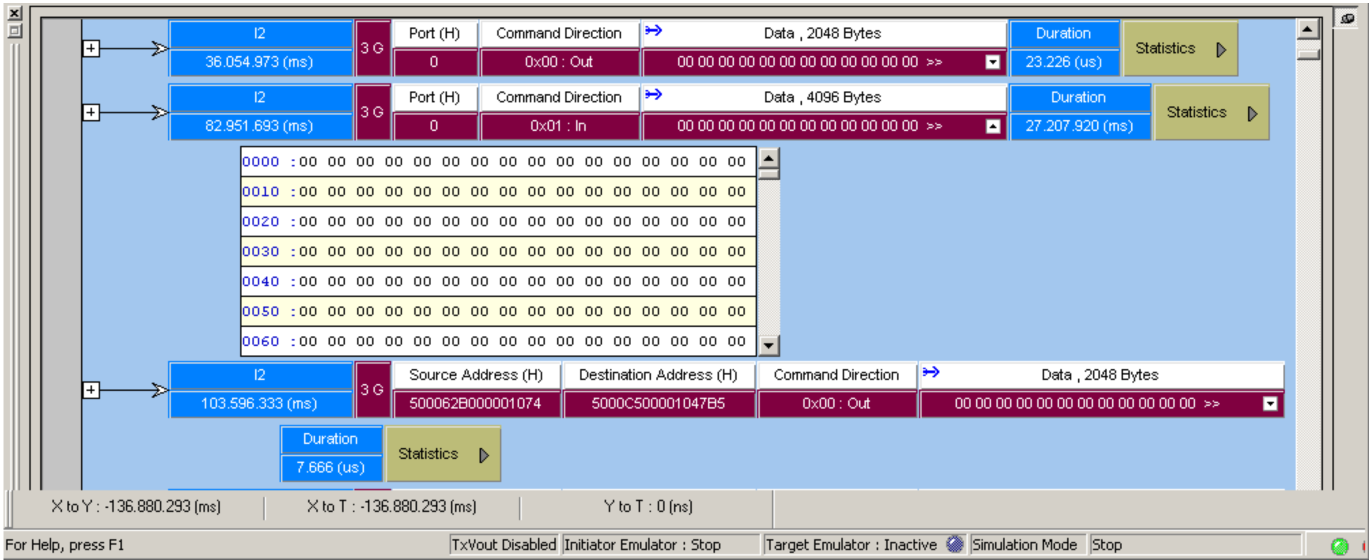


Figure 3.73: SAS: Data Report Details

Click the **Statistics** button  at the end of a row to display data report statistics.

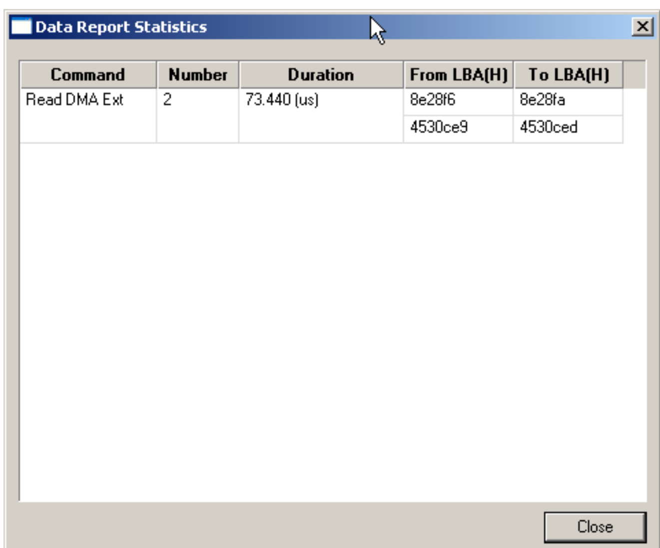


Figure 3.74: SAS: Data Report Statistics

Data Payload View

To display the Data Payload View, double-click a data payload field in a Packet or Spreadsheet view, or right-click a data payload field and select **Open as Data View** (see Figure 3.75 on page 154).

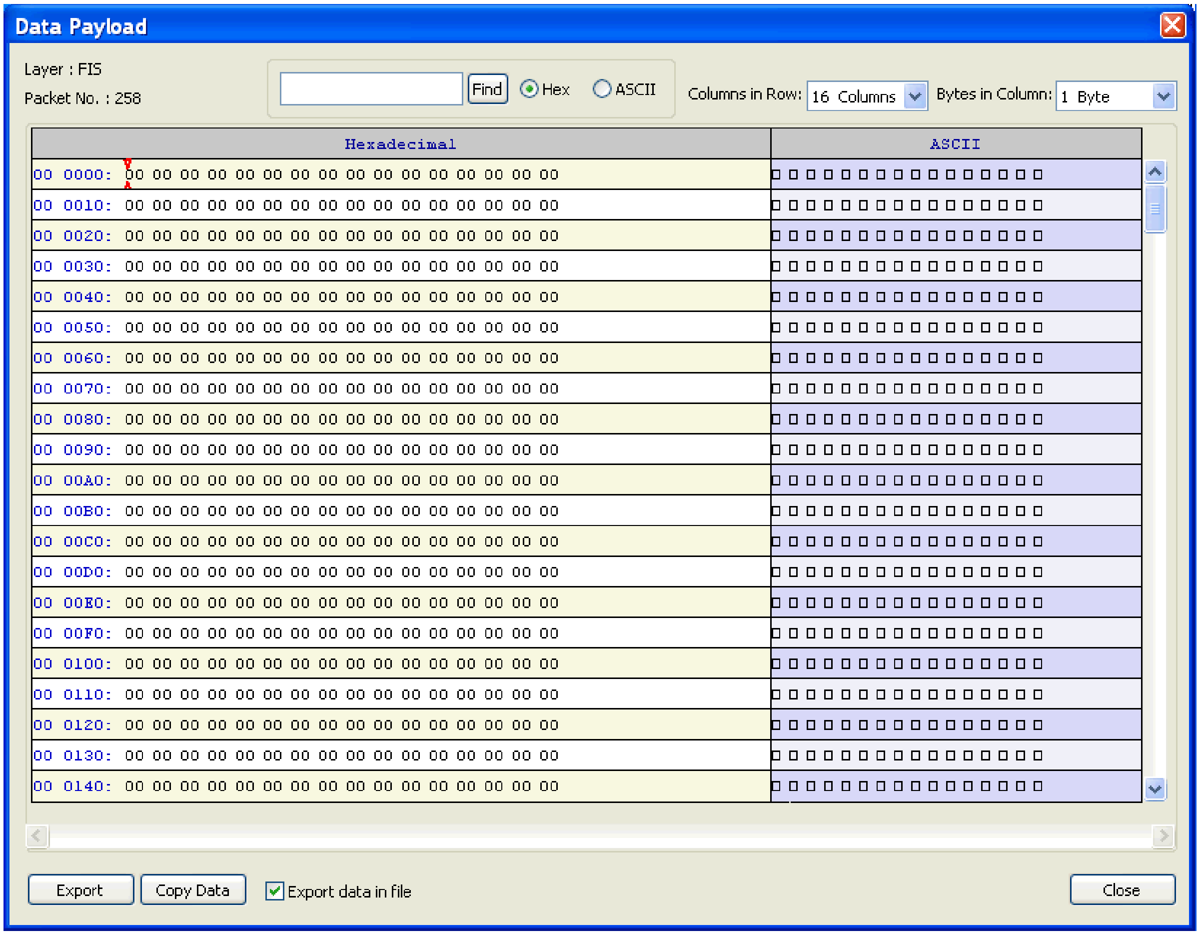


Figure 3.75: Data Payload View

Note: When showing truncated data in the Data Payload View, the truncation points are marked with a separator placed between payloads. You can get more information about the data exclusion using the tooltip over the separator.

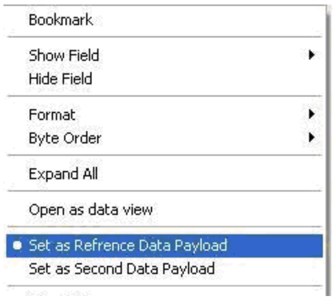
Note: You can control the number of bytes per line.

Find Data Pattern

To quickly locate a data pattern in the current frame, enter the pattern in the Text Box and click the **Find** button.

3.3.16 Compare Two Data Payloads

To compare two data payloads, select two different payload packets, one as reference. Right-click a payload field in Packet View or a related frame in Text View or Spreadsheet View to display a menu, then select **Set As Reference Data Payload**.



Right-click a payload field in Packet View or a related frame in Text View or Spreadsheet View to display a menu, and choose **Set as Second Data Payload**.

To compare data payloads, click the  **Show/Hide Compare 2 Data Payloads** button on the toolbar:

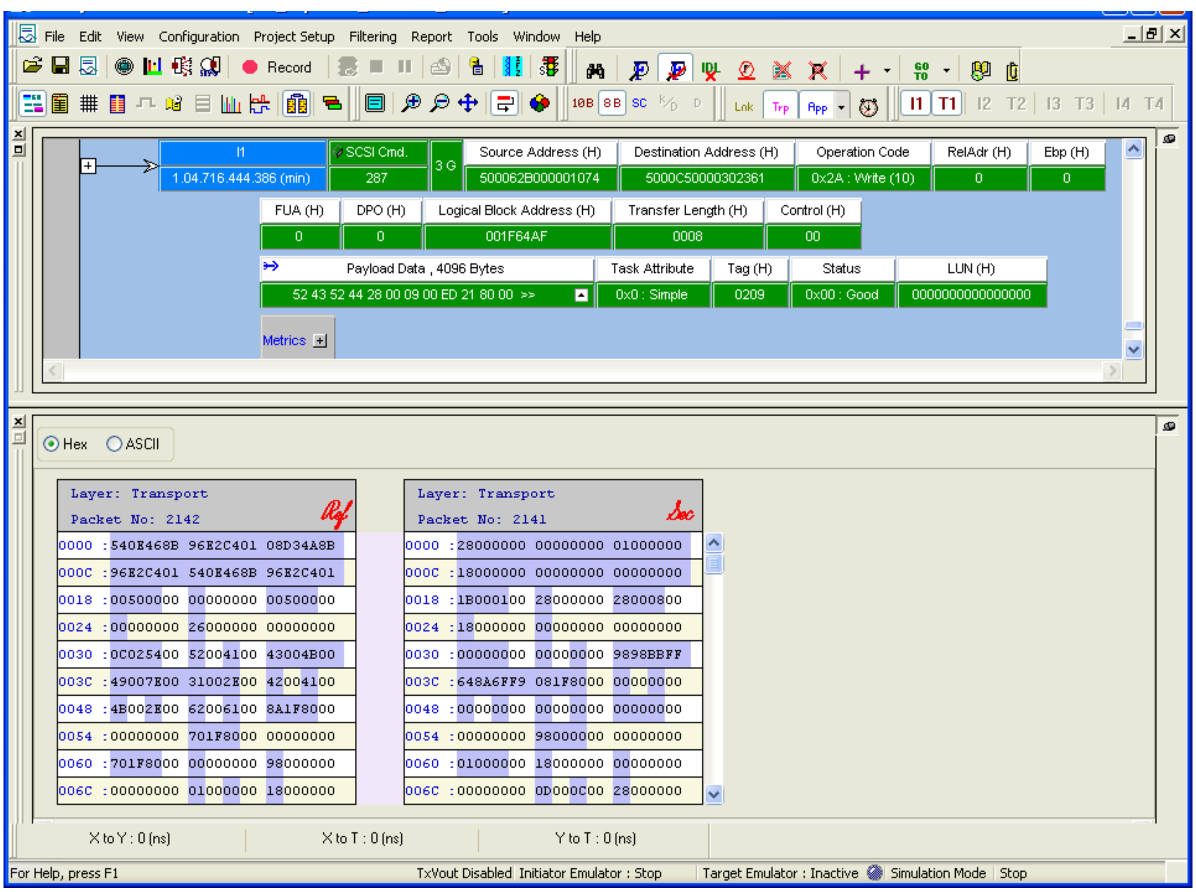


Figure 3.76: Compare Two Data Payloads

3.4 Power Tracker View (SATA only)

Click the  **Power Tracker View** button on the Viewer toolbar or select **Analysis > Power Tracker View**. The Power Tracker View displays all the power, current and voltage information captured while recording a trace as well as the sample time. See Power Management Setting (SATA only) on page 107 for more information.

The power, voltage and current is displayed on the vertical axis and time on the horizontal axis. Hover anywhere over the view to display the information pop-up.

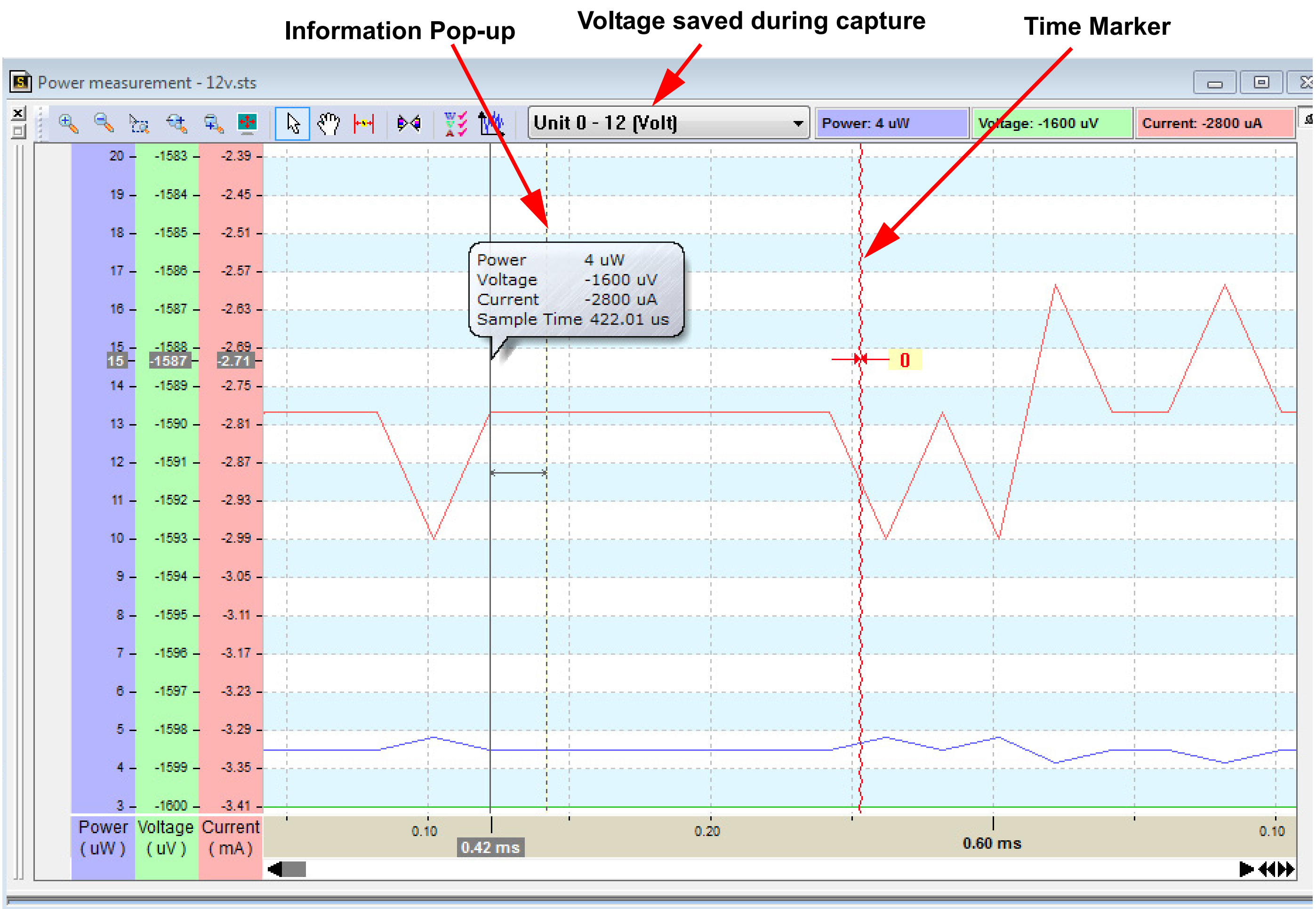
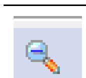
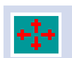
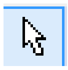
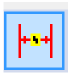
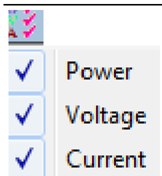
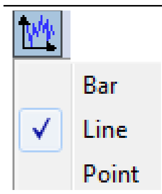


Figure 3.77: SATA: Power Tracker View

	The **Zoom In** button on the toolbar magnifies the data display area on the screen.
	The **Zoom In** button on the toolbar magnifies the data display area on the screen.
	The **Zoom By Selection** button on the toolbar magnifies the user selected area in the view.

	The **Zoom By H Drag** button on the toolbar magnifies the area selected by horizontally dragging and selecting in the view.
	The **Zoom By V Drag** button on the toolbar magnifies the area selected by vertically dragging and selecting in the view.
	The **Full Screen** button on the toolbar Toggles between normal and full screen view.
	The **Pointer Mode** button on the toolbar changes the cursor to a pointer.
	The **Hand Panning** button on the toolbar changes the cursor to a hand for panning.
	The **Insert Time Marker** button on the toolbar enables inserting a time marker at selected spot in the view (see Figure 3.77 on page 156).
	The **Sync by Time** button on the toolbar toggles between synchronizing and un-synchronizing all the views by time.
	The **Show/Hide Power Tracker types: W, V, A** button on the toolbar allows the user to select the parameters to view from the list.
	The **Change Power Tracker graph type: W, V, A** button on the toolbar allows the user to select one of the three graph types to view from the list.
	Displays the voltage saved during trace capture. This is selected in the Power Management Setting dialog (see Power Management Setting (SATA only) on page 107).

3.5 Using the Power Expansion Card

You can use the Power Expansion Card to power the drives under test. See Using the Power Expansion Cards on page 21.

3.6 Running Verification Script Engine (VSE)

You can perform custom post-process analysis of the open trace by running a verification script over the trace. A verification script instructs the application to send trace and analysis information to the script. A verification script also contains script code, written using CATC Script Language (CSL) (see the **CSL_RefManual.pdf** document in the **docs** directory of the installation), used to process trace data and output that data in different formats.

Note: You may write your own verification scripts to perform custom verification and analysis. For information on how to write a verification script, see the *Verification Script Engine Reference Manual*.

To run a verification script over a trace:

1. Select the main menu item **Analysis > VSE** or click the **Running verification scripts** button  on the main tool bar. The Run Verification Scripts dialog opens, from which you choose and then run one or several verification scripts.

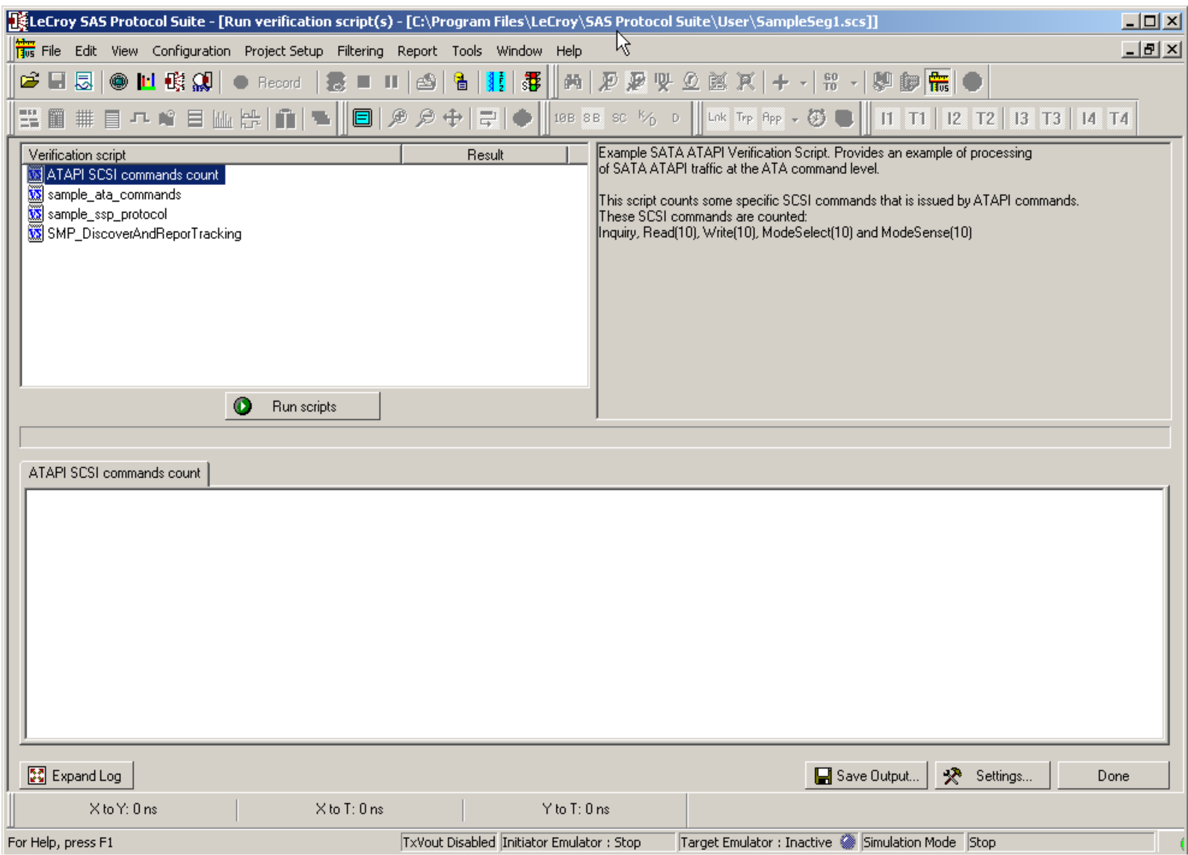


Figure 3.78: Run Verification Scripts Dialog.

To expand the Log window, click the **Expand Log** button. The Log window fills the whole window. To see the Verification Scripts window again, click the Collapse Log button.

To save output, click the **Save Output** button.

2. After choosing **Settings** from the drop-down list or the button, the Settings dialog displays:

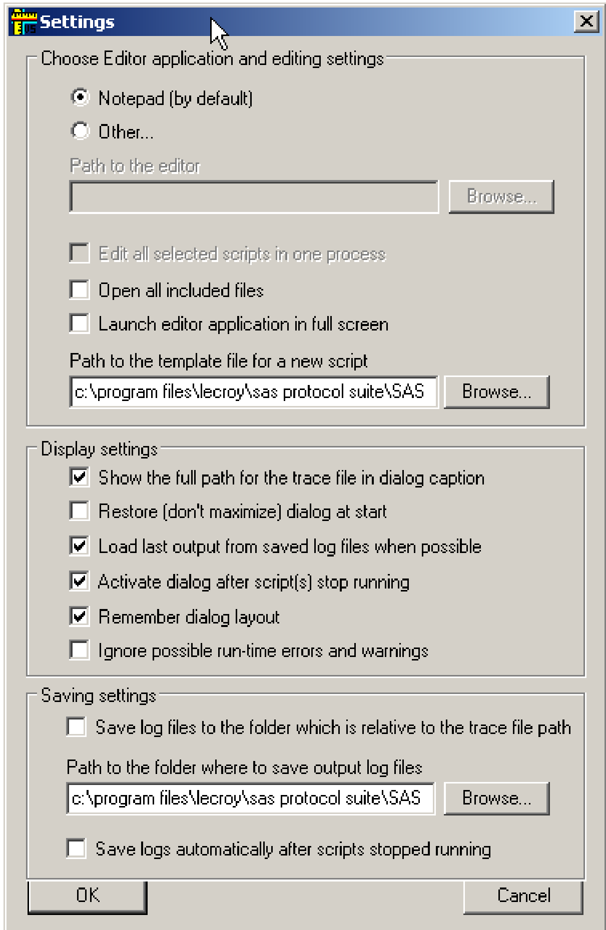


Figure 3.79: Run Verification Scripts - Settings Dialog.

Choose the editor application: Notepad or other.

Edit all selected scripts in one process: If the editor supports multiple documents, you can edit all scripts in the editor.

Open all included files: You can edit included files, as well as the main script.

Launch editor application in full screen: You can use whole screen.

Path to the template file for a new script: You can use a template for the script.

Display Settings can show full trace-file path, restore dialog at start, load last output from save log files, activate dialog after scripts have run, remember dialog layout, and ignore errors and warnings.

Saving Settings can save log files to relative file folder, indicate output-log-file path, and save logs automatically.

3. Click the **Run scripts** button after you select scripts to run. VSE starts running the selected verification scripts, shows script report information in the output windows, and presents the results of verifications in the script list:

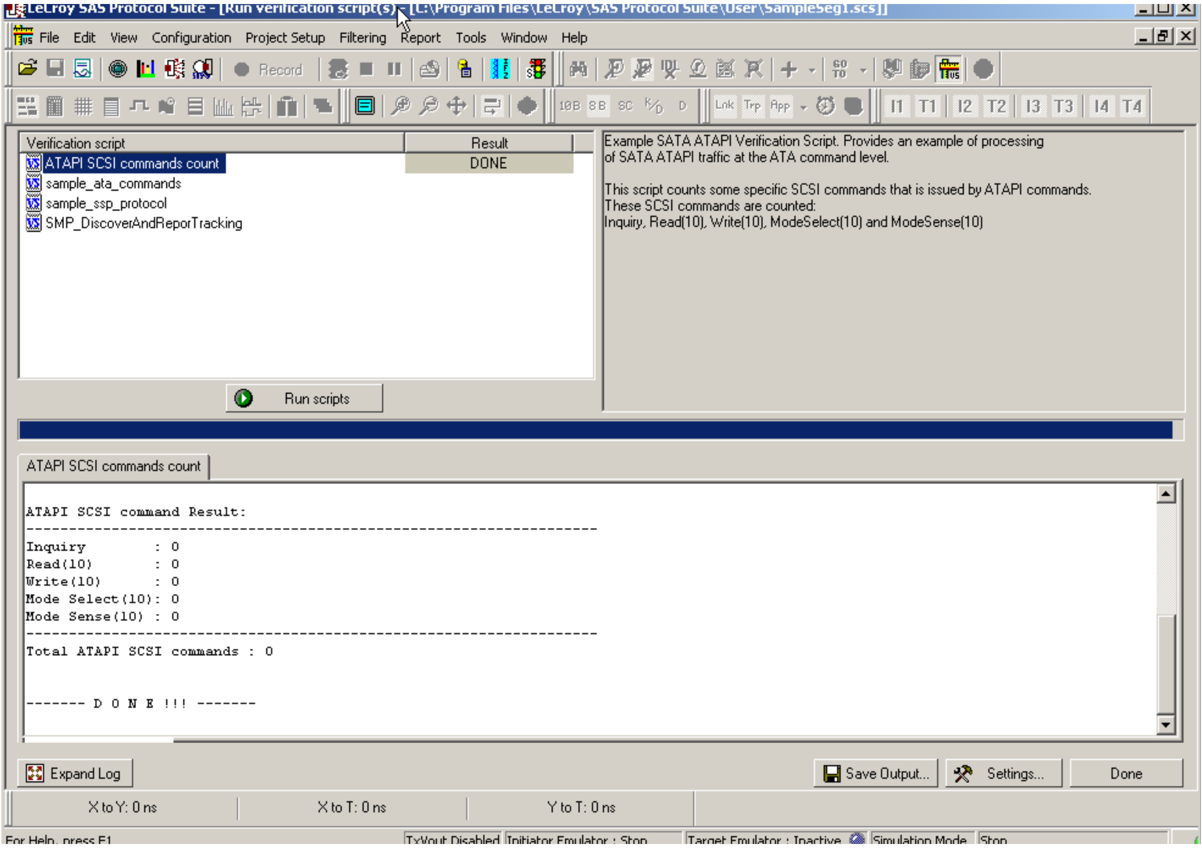


Figure 3.80: Run Verification Scripts Dialog.

4. Right-clicking in the script list displays some additional operations over selected scripts:

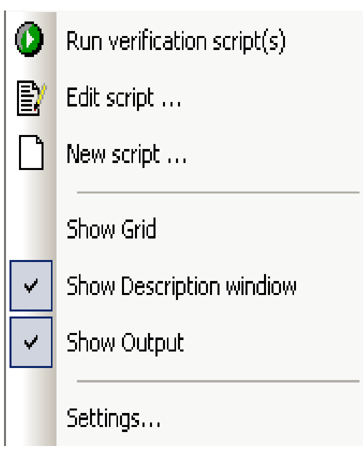


Figure 3.81: Run Verification Scripts - Menu new.

Run verification script(s): Start running selected script(s).

Edit script: Edit selected scripts in the editor application specified in Editor settings.

New script: Create a new script file using the template specified in Editor settings.

Show Grid: Show/hide a grid in the verification script list.

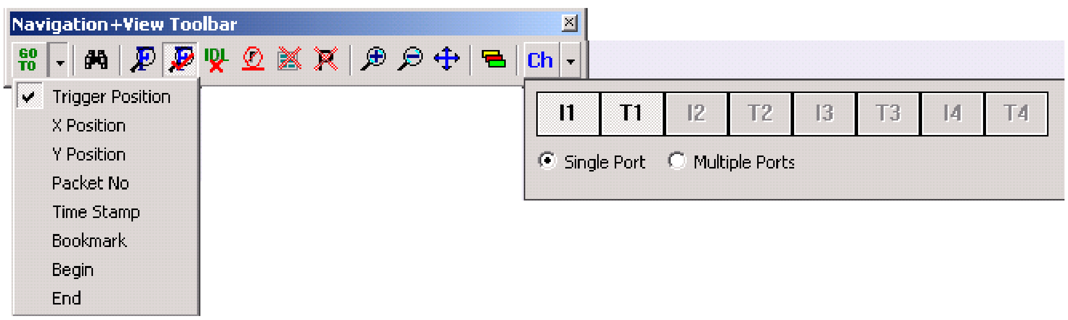
Show Description window: Show/hide the script description window (Shortcut key F2).

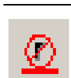
Show Output: Show/hide the script output windows (Shortcut key F3).

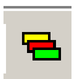
Settings: Open a special Setting dialog to specify different settings for VSE.

3.7 Navigation + View Toolbar

The Navigation + View toolbar allows you to navigate, search filter, hide RRDY/all primitives and unassociated traffic, zoom, tile views and select ports.



	The down arrow on the **Go To** button allows location of cursors or specific packets: Trigger Position, X Position, Y Position, Packet Number, Timestamp, Bookmark, Begin, and End.
	The **Search** button opens the search dialog (see Search on page 179).
	The **Filtering Setup** button opens the Filter dialog (see Filtering on page 166) and allows you to specify the criteria for filtering the result.
	The **Enable Disable Filtering** button toggles the result between a filtered and unfiltered view (see Filtering on page 166).
	The **Filter Idle** button toggles the display to show/hide idle packets (see Filtering on page 166).
	The **Hide RRDY Primitives** button toggles the display to show/hide RRDY primitives (see Filtering on page 166).
	The **Hide Unassociated Traffic** button toggles the display to show/hide unassociated traffic (see Filtering on page 166).
	The **Hide All Primitives** button toggles the display to show/hide all primitives (see Filtering on page 166). **Note:** When capturing PM traces, you need the ability to filter the PM primitives so you can find commands quicker.

	The **Zoom In** button on the Viewer Setting Toolbar magnifies the data display area on the screen. Clicking this button in Column or Text View increases column width only.
	The **Zoom Out** button on the Viewer Setting Toolbar scales the data display area to display more data lines on the screen. Clicking this button in Column or Text View decreases column width only.
	The **Normal Zoom** button on the Viewer Setting Toolbar resets the zoom to default normal on the screen. Clicking this button in Column or Text View resets column width only.
	You can use **Tile Horizontally All Views icon** or select **View > Tile Views** to revert any unintended window docking or sizing, or maximize screen utilization. This function only tiles views inside a trace window. Note that there is no command to tile views vertically.

3.7.1 Go To Menu

Locate Cursors

To quickly locate any cursor within the data viewer display, click the **Go To** button and choose the cursor to locate. You can also locate a cursor by selecting **Go To** from the Edit menu and choosing the cursor to locate.

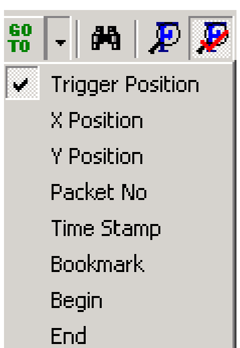


Figure 3.82: Locate Cursor

Go to Time Stamp

To locate a timestamp, click the **Go To** button and choose **Timestamp** (see the following screen capture.)

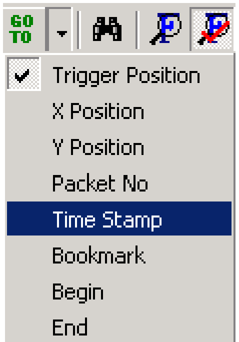


Figure 3.83: Time Stamp.

Enter a time stamp value in the Go To Timestamp dialog and click **OK**.

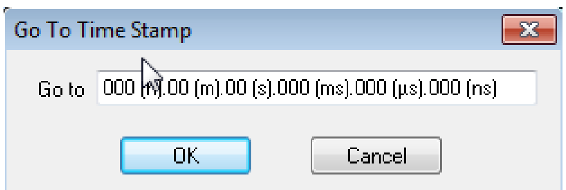


Figure 3.84: Go to Time Stamp.

Bookmarks

Bookmarks are a convenient way to mark a point in the data viewer display by name, so that you can rapidly return to that point. To create a bookmark, right-click the mouse in the data viewer area on a packet in which to place the bookmark.

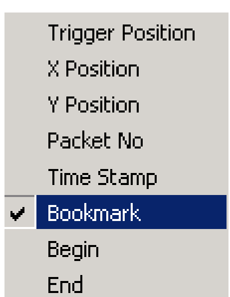


Figure 3.85: Bookmark.

Click **Bookmark** from the fly out menu to open the Bookmark Comment Dialog.

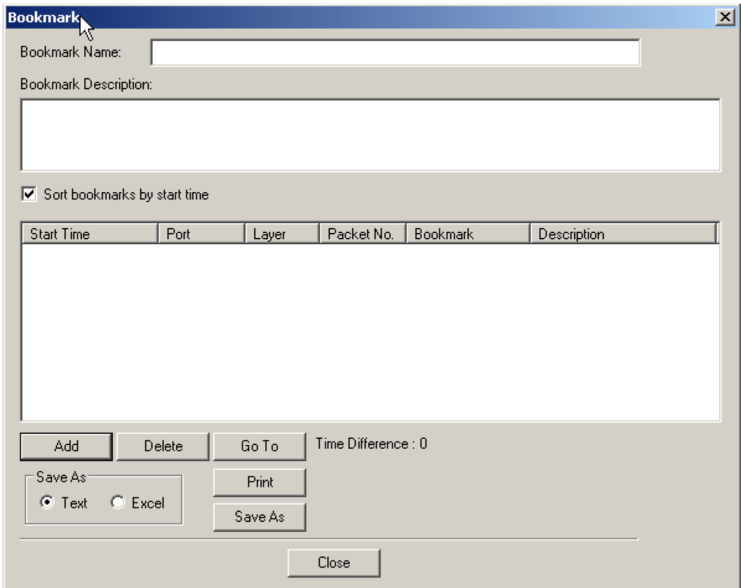


Figure 3.86: Bookmark Dialog.

Enter a description for the bookmark and click the **Add** button. Repeat for additional **bookmarks.**

You can save the bookmark as a text file or Excel CSV file.

Note: Column View has a different bookmark mechanism than other views, and you can set a bookmark on each DWORD in the view. This makes Column View bookmarks unavailable in other views and vice versa.

Editing a Bookmark

If a packet has a bookmark, you can edit the bookmark by right-clicking the data viewer area of the packet, selecting the **Edit Bookmark** command from the pop-up menu, and changing the information in the Bookmark dialog (see above).

Finding a Bookmark

To find a bookmark in the data viewer display, right-click the mouse in the sample viewer and select **Bookmark** (see Figure 3.87 on page 165).

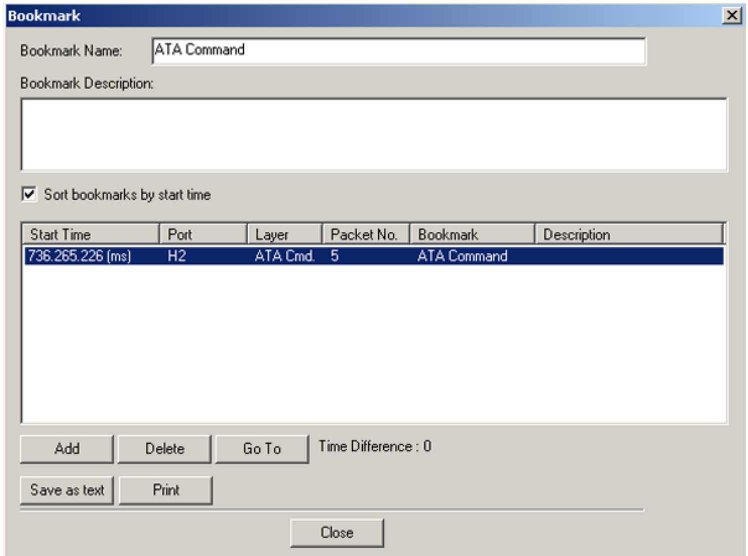


Figure 3.87: Go To Bookmark Dialog Box

Highlight the bookmark to which to go, then click the **Go To** button, or double-click the selection.

Figure 3.88: Bookmark Found Example in Data Viewer Display

Bookmark Description

To get a quick description of a displayed bookmark, position the tool tip over a bookmark. The name and description of the bookmark display.

Set Time Stamp Origin

Right-click in the sample viewer to open the fly out menu (see Figure 3.88 on page 165):

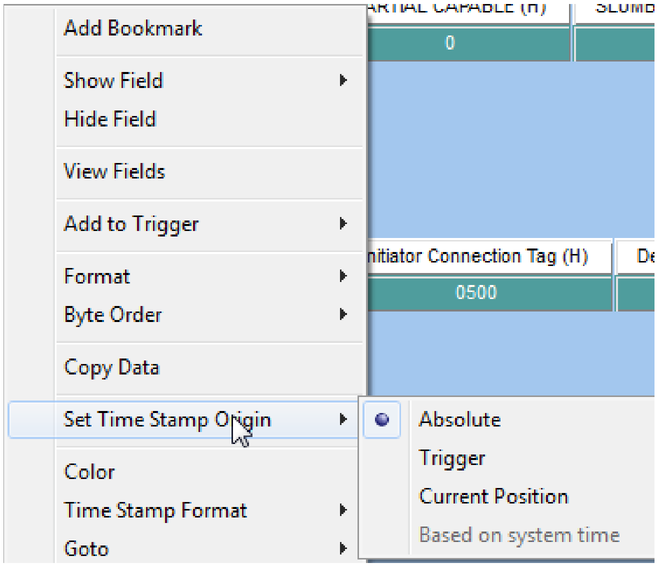


Figure 3.89: Bookmark Found Example in Data Viewer Display

Highlight **Set Time Stamp Origin** and choose either Absolute, Trigger, Current Position, or Based on system time.

3.7.2 Filtering

The Filtering menu and options allow you to modify data in the sample viewer display to exclude packets with a set of user-defined patterns and show the results in all views.

To set up filtering, you must have a viewer display open.

The Filtering menu has the options:

- Enable Filtering (see Enable Filter on page 178)
- Filtering (see Filter Setup on page 167)
- Link Layer (SAS)
- Transport Layer (SAS)
- Application Layer (SAS)
- Physical Layer (SATA)
- FIS Layer (SATA)
- Command Layer (SATA)
- Filter Idles (see Filter Idle on page 179)

3.7.3 Filter Setup

To display the Filter setup dialog, click the  **Filter** button on the Viewer tool bar or select **View > Filtering**.

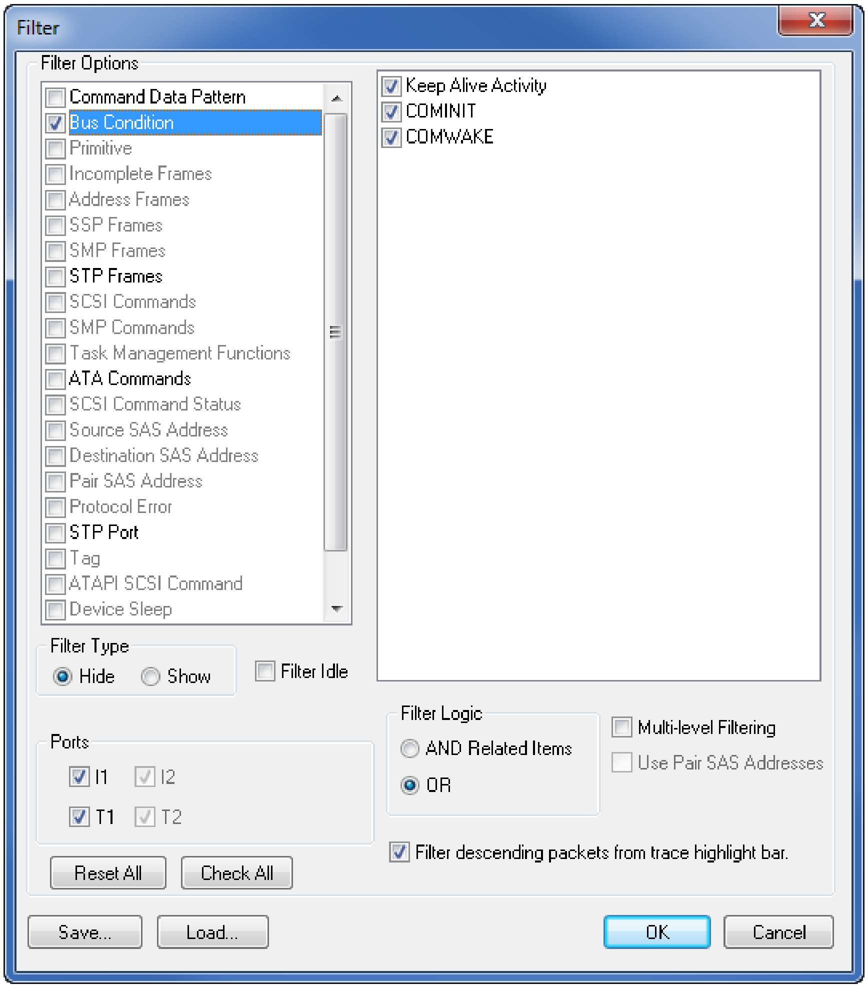


Figure 3.90: SAS/SATA: Filter Setup Dialog

You can select or deselect each of the items shown in the Filter Options window for filtering, by checking or unchecking a corresponding check box. Items not in the current sample are in shade. See Selectable Filter Options for SAS on page 171 and Selectable Filter Options for SATA on page 177.

Note: If you select a group, that also selects all child items.

Note: Only packets captured at run time are available for selection for filtering.

Filter Type

You can choose to show or hide the Filter Type items by checking the **Show** or **Hide** option button.

Note: When capturing PM traces, you need the ability to filter the PM primitives so you can find commands quicker.

Filtering Direction

You can select items for filtering in a single direction or both directions by checking the corresponding Port. By default, all ports are enabled. Uncheck the port check boxes for ports not to include in the filter.

Filter Idle

Depending on the Filter Type (Hide/Show), Idle packets in the Sample Viewer are shown or hidden.

Save Filter Setup

After you have set up a Filter configuration, you can save it as an SAS Filter file (***sfl**) or SATA Filter file (***.tfl**) by clicking **Save**. You can then use it on a different capture by clicking **Load** in the Filter dialog.

Filter Logic

After you have set up Filter options, you can set filter logic to **And Related Items** to apply “AND” logic on related selected options (for example, SCSI commands and SAS Addresses) or **OR** to apply “OR” logic on all selected options.

After you have set up Filter options, you can set filter logic to **And Related Items** to apply "AND" logic on related selected options (for example, SCSI commands and SAS Addresses) or **OR** to apply "OR" logic on all selected options.

Filter only applies to entities in a trace. When you choose SCSI command **AND** SSP frame, for instance, Filter affects all entities in the trace that are SCSI commands, **AND** are SSP frames. Any SCSI commands that are **NOT** SSP frames, will not, in this case, be filtered.

If you choose **OR**, Filter affects all entities that are SCSI commands, as well as all SSP frames.

The AND operator is only applicable for certain cases, such as:

- A SCSI command AND a Tag.
- A SCSI command AND a source/destination address.

For example, when you choose a SCSI command AND a tag = 0x1, you will filter all entities on a trace that are SCSI commands that have tags equal to "0x1" in that SCSI command.

As a general rule, it is not possible to apply AND to two packet types (frames, commands, primitives, training sequences or bus conditions). It only works when you apply AND to one packet type with other items such as source/Destination Addresses, TAG, Task attribute.

Multilevel Filtering

You can set up a filter in a sequential steps by **Multi level filtering**. In each level, you can select specific items to “AND” to the previous level. The results of all levels show in views (see the following three figures).

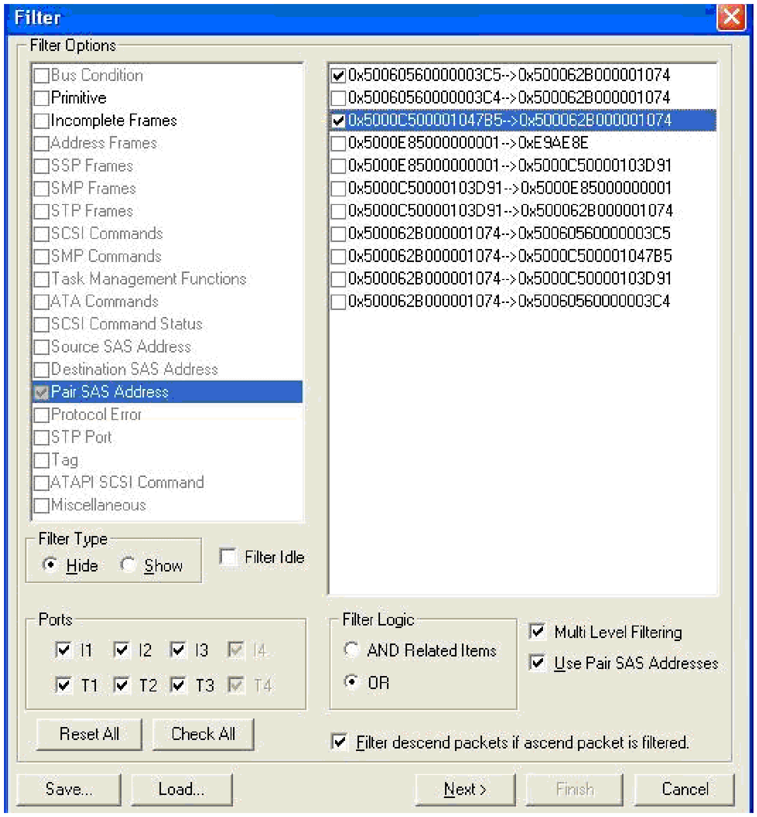


Figure 3.91: First Level of Multilevel Filtering

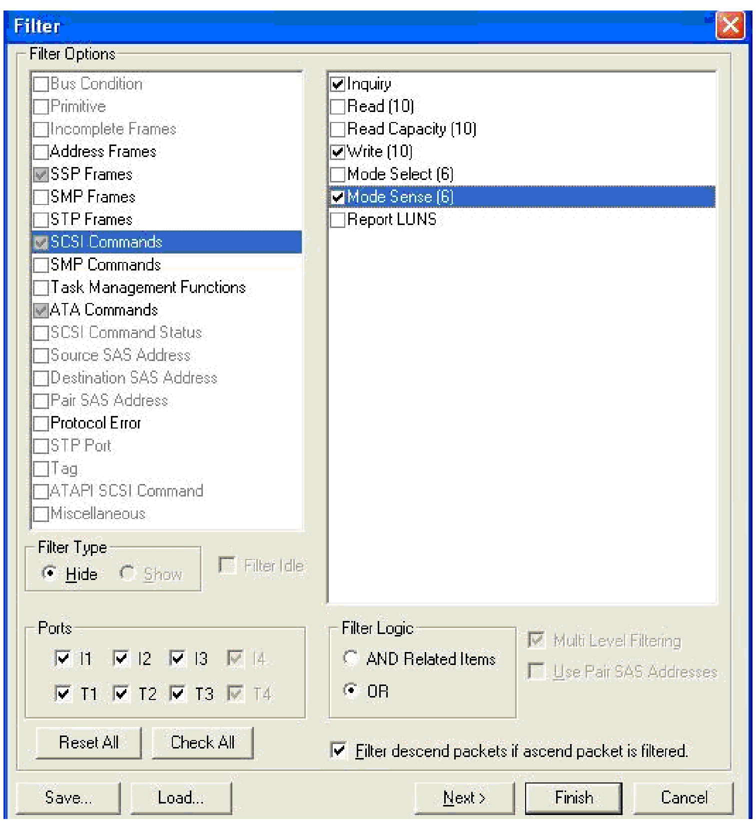


Figure 3.92: Second Level of Multilevel Filtering

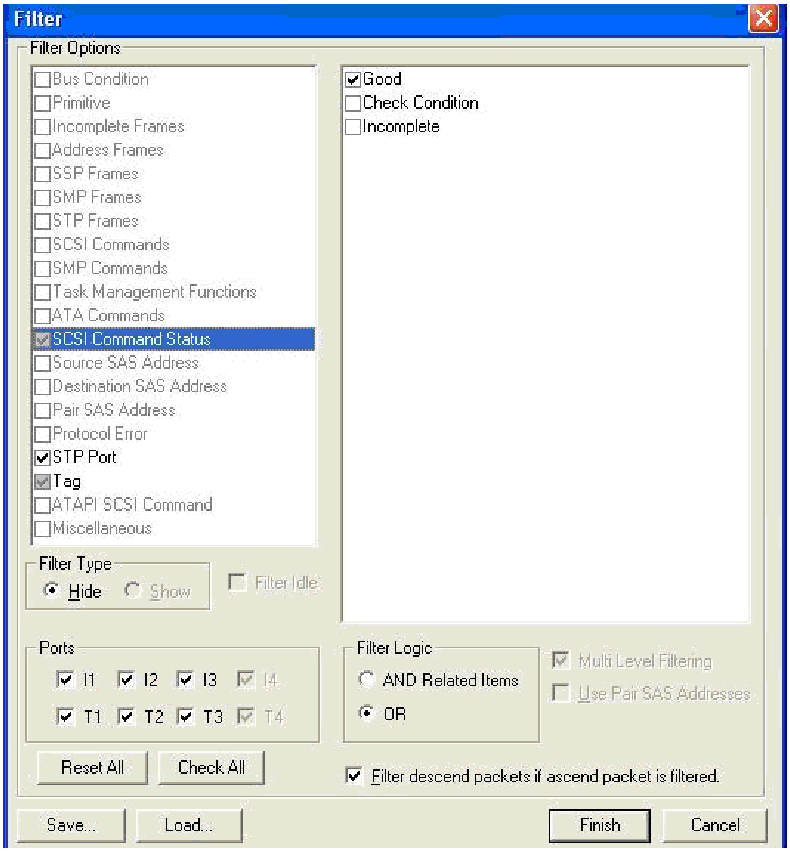


Figure 3.93: Third Level of Multilevel Filtering

Filter descending packets from trace highlight bar

If you check the **Filter descending packets from trace highlight bar** checkbox, the application will only filter onward from the highlighted trace selection bar.

If you uncheck this option, the software only filters the filtered packet. For example, if this option is checked and any SCSI command is selected, all transport and link packets of this command are filtered. If you unchecked this option, only selected SCSI commands are filtered.

3.7.4 Selectable Filter Options for SAS

The SAS Filter Options are:

- Command Data Pattern
- Bus Condition
- Primitive
- Incomplete Frames
- Address Frames
- SSP Frames
- SMP Frames
- STP Frames
- SCSI Commands
- SMP Commands
- Task Management Functions

- ATA Commands
- SCSI Command Status (see Filter Check Condition on page 173)
- Source SAS Address
- Destination SAS Address
- Pair SAS Address
- Protocol Error
- STP Port
- Tag (see Filter by Tag Number on page 174)
- ATAPI SCSI Command
- Device Sleep
- Miscellaneous (see Filter Miscellaneous on page 174)
- Training Sequence

Command Data Pattern

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured Command Data Patterns in the Trace Viewer.

Bus Condition

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured Bus Conditions in the Trace Viewer.

Incomplete Frames

When selected, depending on the Filter Type, the Hide/Show selection shows or hides Incomplete Frames in the Trace Viewer.

ATA Command

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured ATA commands in the Trace Viewer.

Protocol Error

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured packets with the specified Protocol Errors in the Trace Viewer.

ATAPI SCSI Command

When selected, depending on the Filter Type, the Show/Hide selection shows or hides ATAPI SCSI commands (see Figure 3.94 on page 173).

Filter Check Condition

Checking the **SCSI Command Status** check box enables Check Condition for filtering.

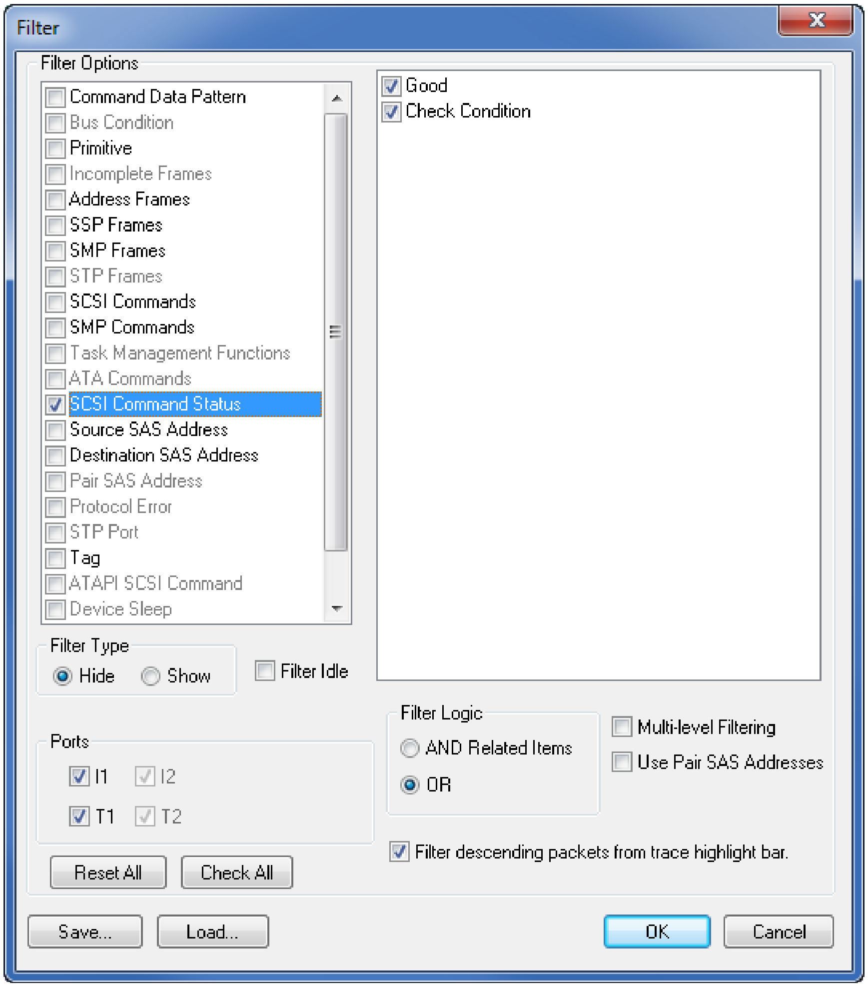


Figure 3.94: SAS: Filter Check Condition

Filter by Tag Number

Checking the **Tag** check box displays tags available for filtering. Check the corresponding check boxes for tags to filter.

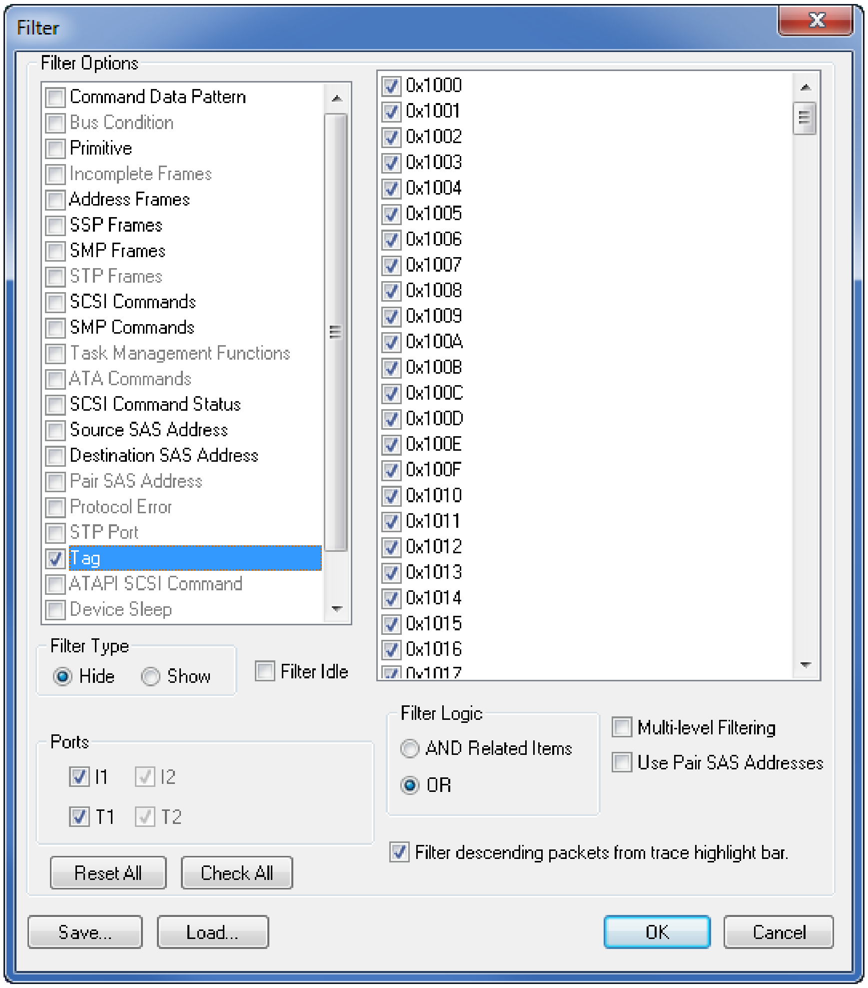


Figure 3.95: SAS: Filter by Tag Number

Filter Miscellaneous

When you choose **Miscellaneous**, an additional dialog displays, allowing you to specify the filtering of State Range and/or External Signal In (see Figure 3.96 on page 175).

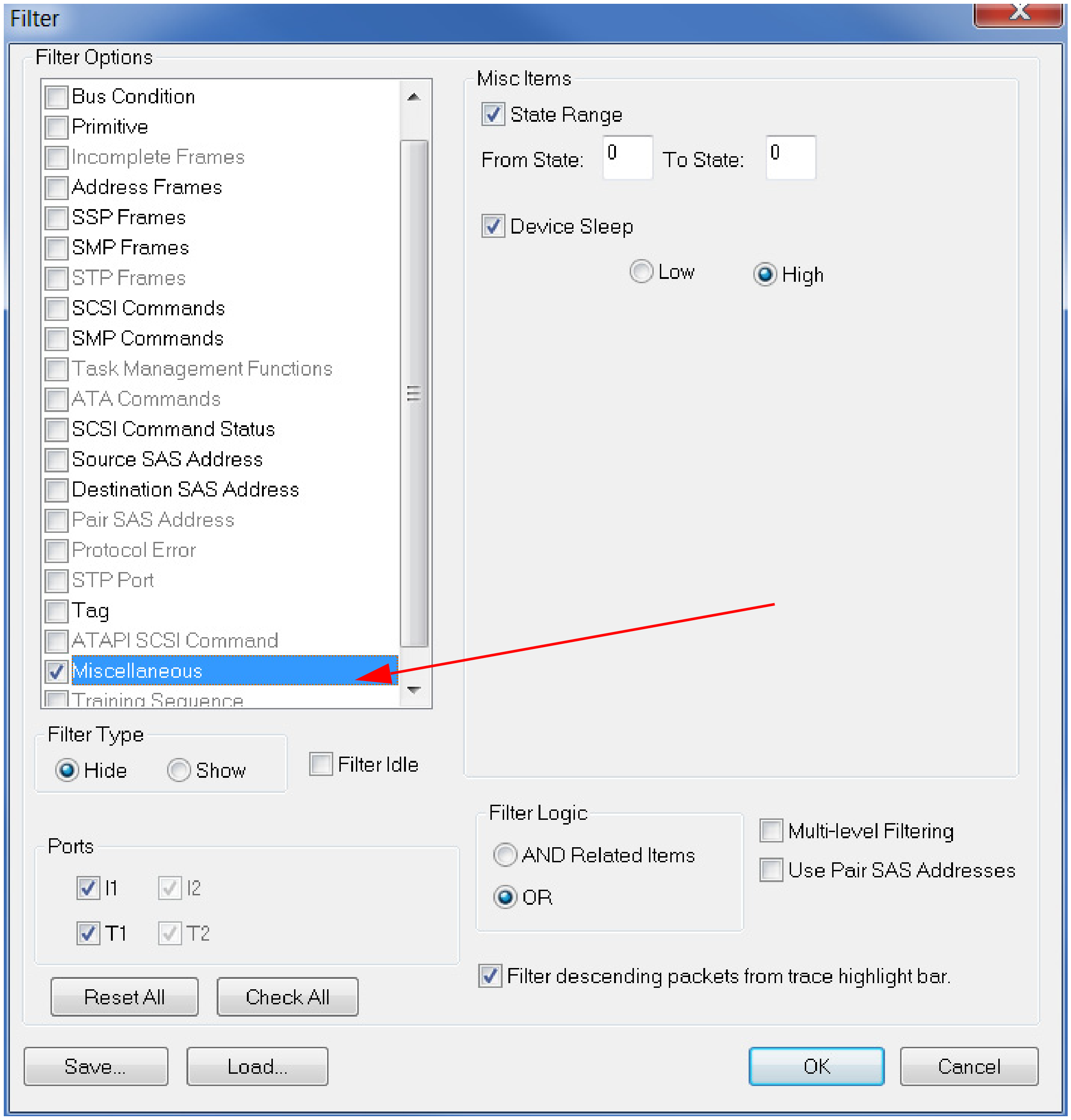


Figure 3.96: Filter State and/or Device Sleep

Filter TTIU Events

When you choose **Training Sequence**, an additional dialog displays, allowing you to filter Training Sequence TTIU fields in a Training Sequence trace (see Figure 3.97 on page 176). Select **Training Sequence > Control Status** and click **Advanced** to display the Control Status dialog (see Figure 3.98 on page 176). Select the Fields and the Values for them from the drop-down list.

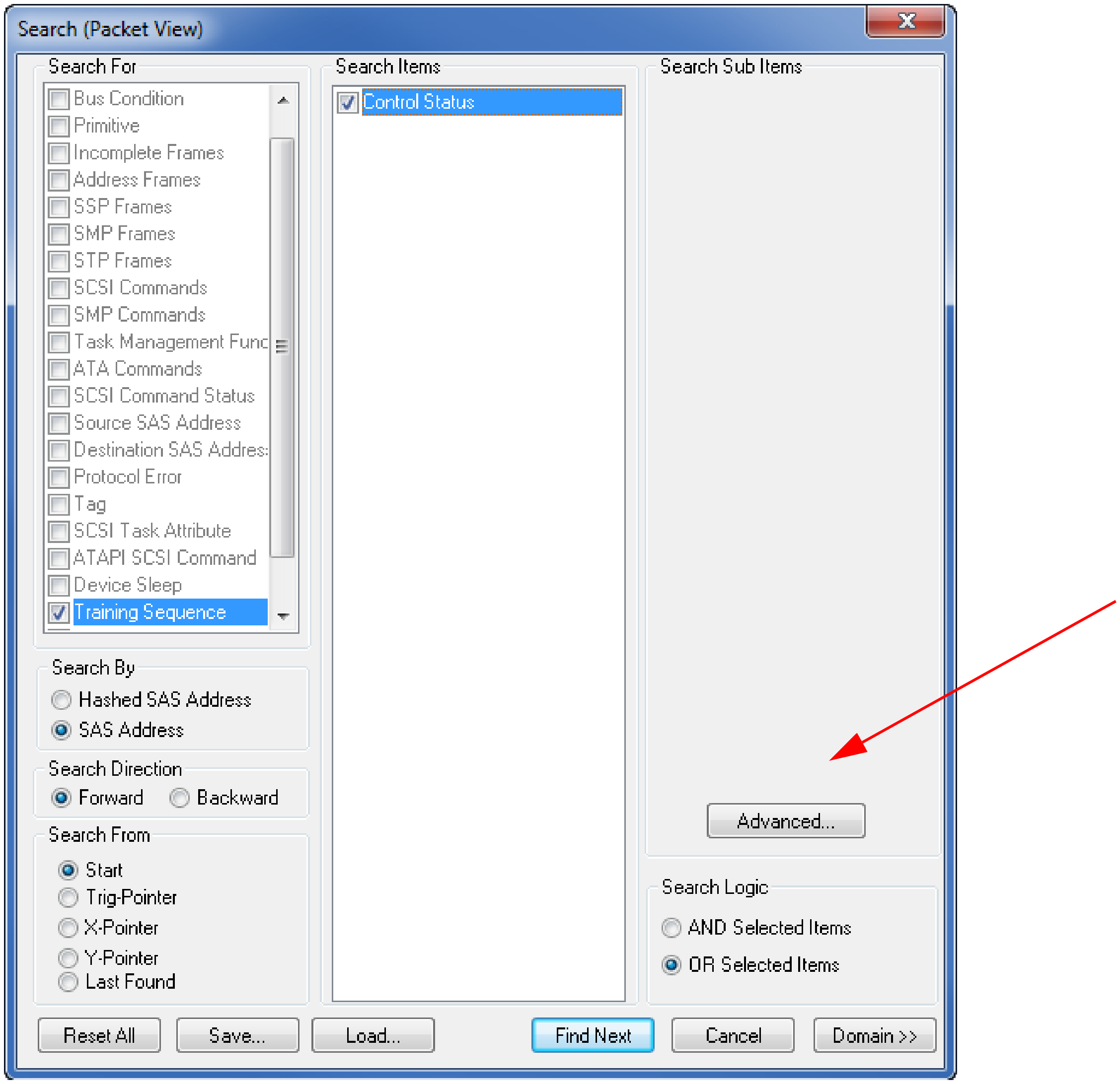


Figure 3.97: Filter Training Sequence TTIU Fields

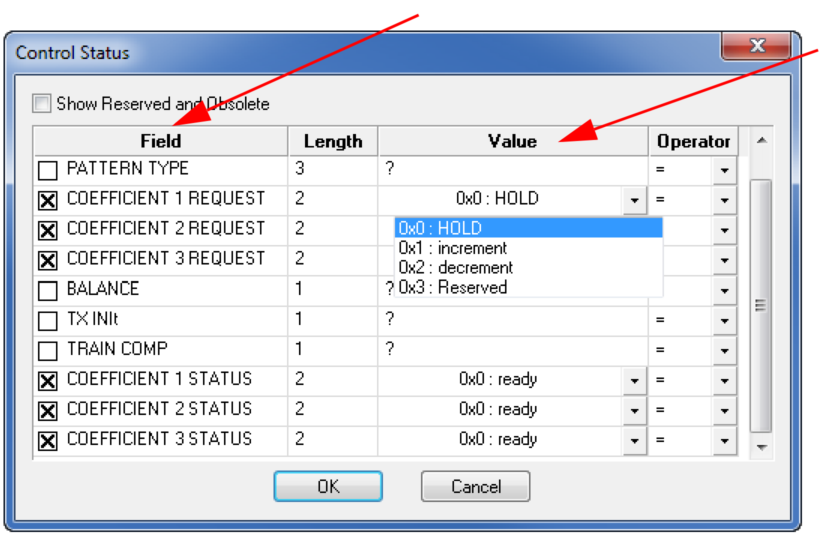


Figure 3.98: Select Field and Values to Filter

Use Pair SAS Addresses

You can use all available pair SAS addresses (Source -> Destination) instead of using SAS source and destination addresses. To enable the pair SAS address filter option, check **Use Pair SAS Addresses** check box in the Filter dialog (see Figure 3.99 on page 177).

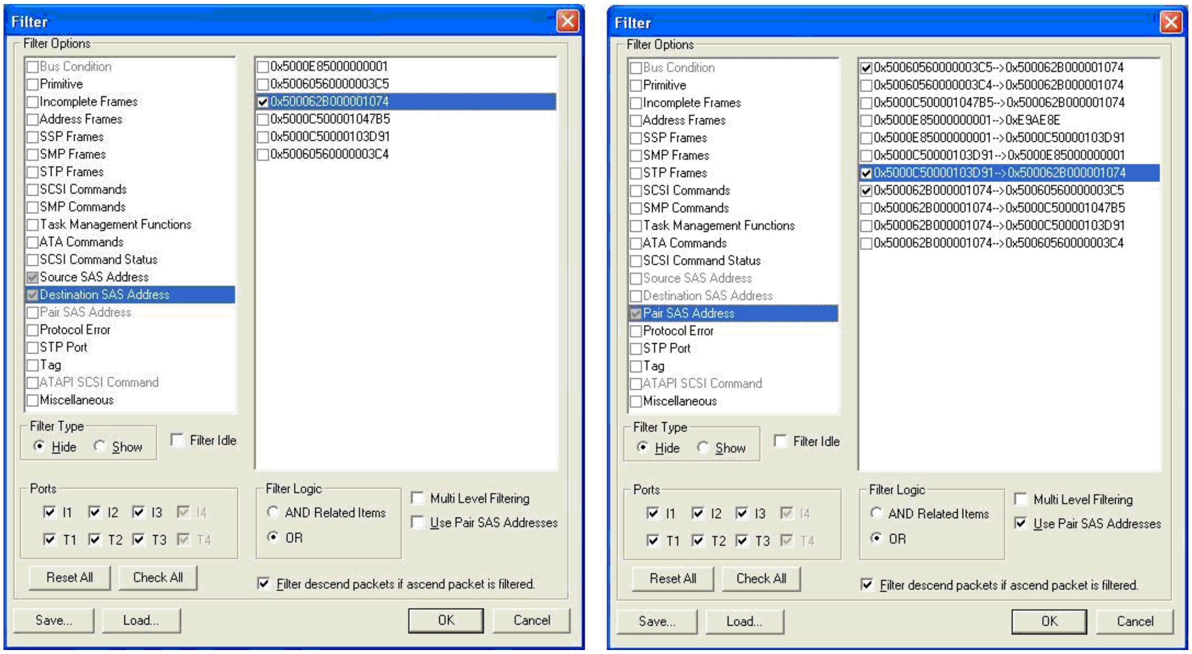


Figure 3.99: SAS: SAS Address Filtering before and after Using Pair SAS Addresses

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Note: If you enable pair SAS addresses, the source/destination SAS addresses options are disabled and filtering on them is ignored at filtering time. If you disable pair SAS addresses, the pair SAS address option is disabled and filtering on it is ignored at filtering time.

Training Sequence

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured Training Sequences in the Trace Viewer.

3.7.5 Selectable Filter Options for SATA

The SATA filter options are:

- Bus Condition
- Incomplete Frames
- FIS
- ATA Command
- Protocol Error
- Port
- ATAPI SCSI Command
- Device Sleep
- Miscellaneous

Bus Condition

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured Bus Conditions in the Trace Viewer.

Incomplete Frames

When selected, depending on the Filter Type, the Hide/Show selection shows or hides Incomplete Frames in the Trace Viewer.

FIS

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured FIS items in the Trace Viewer.

ATA Command

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured ATA commands in the Trace Viewer.

Protocol Error

When selected, depending on the Filter Type, the Hide/Show selection shows or hides captured packets with the specified Protocol Errors in the Trace Viewer.

Port

When selected, depending on the Filter Type, the Show/Hide selection shows or hides packet traffic for the selected port.

ATAPI SCSI Command

When selected, depending on the Filter Type, the Show/Hide selection shows or hides ATAPI SCSI commands.

Miscellaneous

When you choose Miscellaneous, an additional dialog displays, allowing you to specify the filtering of State Range and/or External Signal In (see Filter Miscellaneous on page 174).

3.7.6 Enable Filter

Select **Filtering > Enable Filtering** or click the  **Filter Enable** button on the display menu bar to toggle between Filtered and Unfiltered display.

3.7.7 Filter Idle

Depending on the Filter Type (Hide/Show), Idle packets in the Sample Viewer are shown or hidden.

You can quickly filter idles by clicking the 

Filter Idle button. This button toggles between Show and Hide items.

3.7.8 Search

The Search menu and toolbar options permit you to examine any data capture file to quickly locate the packet or data pattern.

To perform an initial search, select **Navigation > Search** or click the  **Search** button to open the Search setup dialog (see Figure 3.100 on page 180).

Note: Only items captured in the sample file are enabled for search.

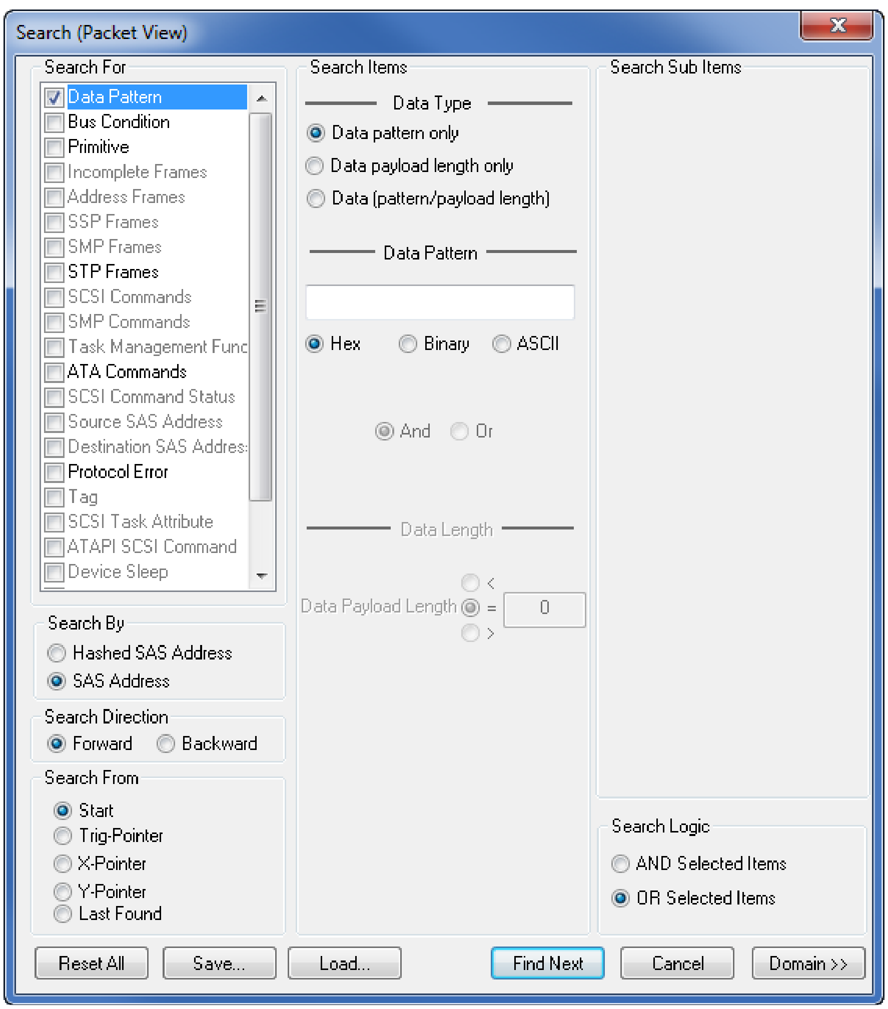

Figure 3.100: SAS/SATA: Search Data Pattern

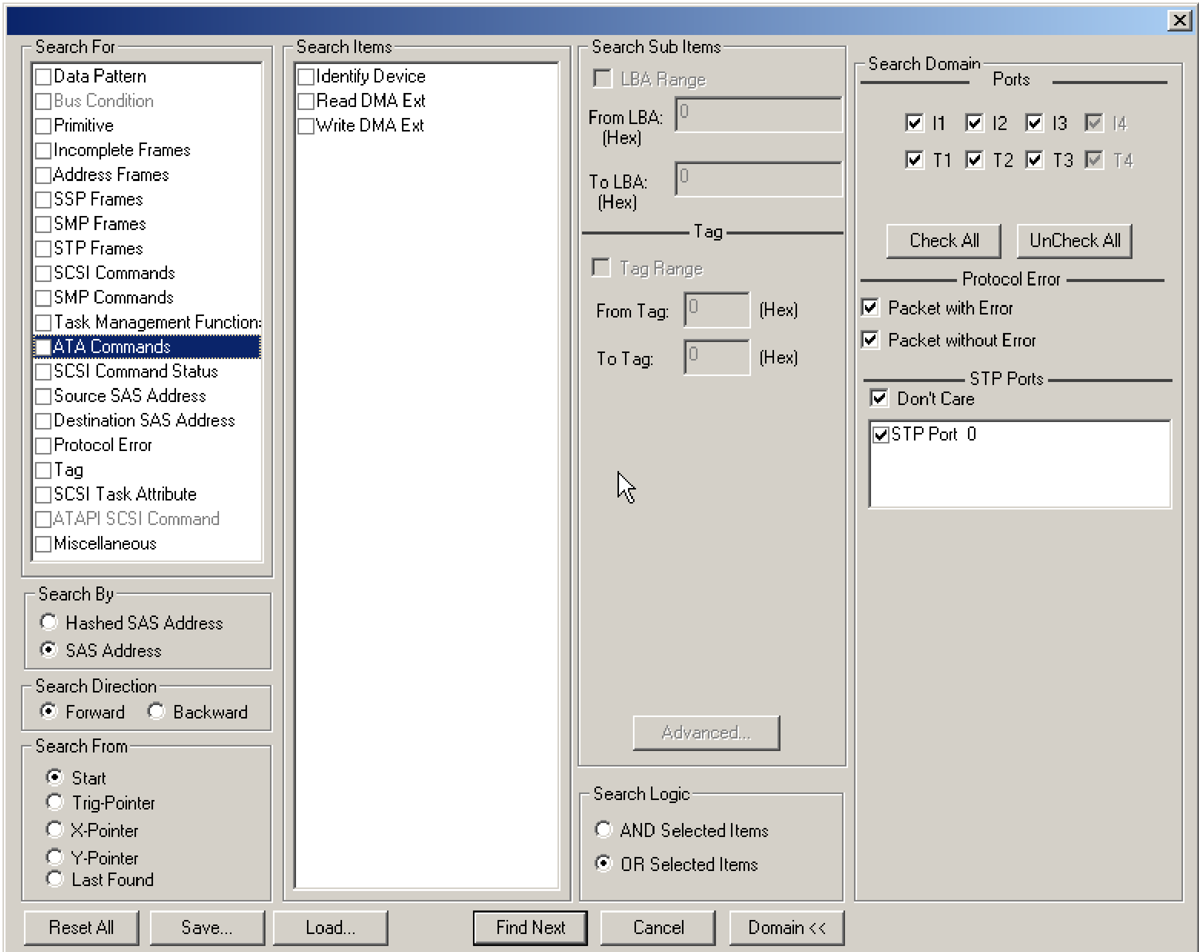

Figure 3.101: Search Parameter Definition Dialog

You can continue to search the output file using **Next Search (F3)** or **Previous Search (F4)** for the same pattern, until you redefine the data capture search parameters.

Save Search Setup

After you have set up a Search configuration, you can save it as a SAS Search configuration file (***.ssh**) or a SATA Search configuration file (***.tsh**) by clicking **Save**. You can then use it on a different capture by clicking **Load** in the Search dialog.

Search By

Choose **Hashed SAS Address** to search on hash address, or choose **SAS Address** to search for address.

Search Direction

Choose either **Forward** or **Backward** direction in which to perform the search.

Search From

Choose a starting point to begin or continue a search: Start of the sample file, Trigger Pointer, X Pointer, Y Pointer, or Last Found.

Search Logic

The default setting is **Or Selected Items**. With this setting, clicking **Find Next** locates all selected items in turn. If you choose **And Selected Items,** you can set a logical AND combination of items to find. Both options allow setting Advanced search features.

Search looks for entities in a trace. When you choose SCSI command **AND** SSP frame, for instance, search will return all entities in the trace that are SCSI commands, **AND** are SSP frames. Any SCSI commands that are **NOT** SSP frames, will not, in this case, be returned.

If you choose **OR**, search will return all entities that are SCSI commands as well as all SSP frames.

The AND operator is only applicable for certain cases, such as:

- ❑ A SCSI command AND a Tag.
- ❑ A SCSI command AND a source/destination address.

For example, when you choose a SCSI command AND a tag = 0x1, you will get all entities on a trace that are SCSI commands that have tags equal to "0x1" in that SCSI command.

As a general rule, it is not possible to apply AND on two packet types (frames, commands, primitives, training sequences or bus conditions). It only works when you apply AND on one packet type with other items such as source/Destination Addresses, TAG, Task attribute.

Search For

Choose a category to search in the **Search For** window. Each of the search categories offers additional choices in the **Search Items window** to refine the search. Check items for the selected category.

Data Pattern

Search for Data Pattern allows you to search for a specific Data Type, Pattern, and Length (see Figure 3.100 on page 180).

- ❑ Data Pattern Only
- ❑ Data Payload Length Only
- ❑ Data Pattern and Data Payload Length

Advanced options

Some of the Search For categories offer advanced options for search. To set these options, highlight the search item in a category and click the **Advanced** button to open the Advanced options dialog.

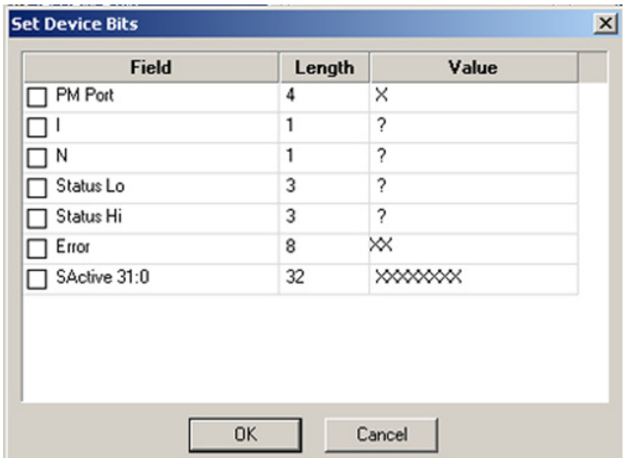

Figure 3.102: Advanced Options Dialog Example: Set Device Bits

Set the options and click **OK.**

Search Domain

Click the **Domain** button and choose a search domain from all ports or a specific port.

Protocol Error

You can refine the search to locate packets with an error or without an error.

Note: When searching for Protocol Errors in Column View, you cannot search for a specific Protocol Error type. Search returns any protocol error.

Search Sub Items

When searching SCSI Command Status, you can refine the search by selecting from a list of Sub Items.

Note: Some of the search categories allow you to refine the search by specifying specific SAS addresses and STP ports to search.

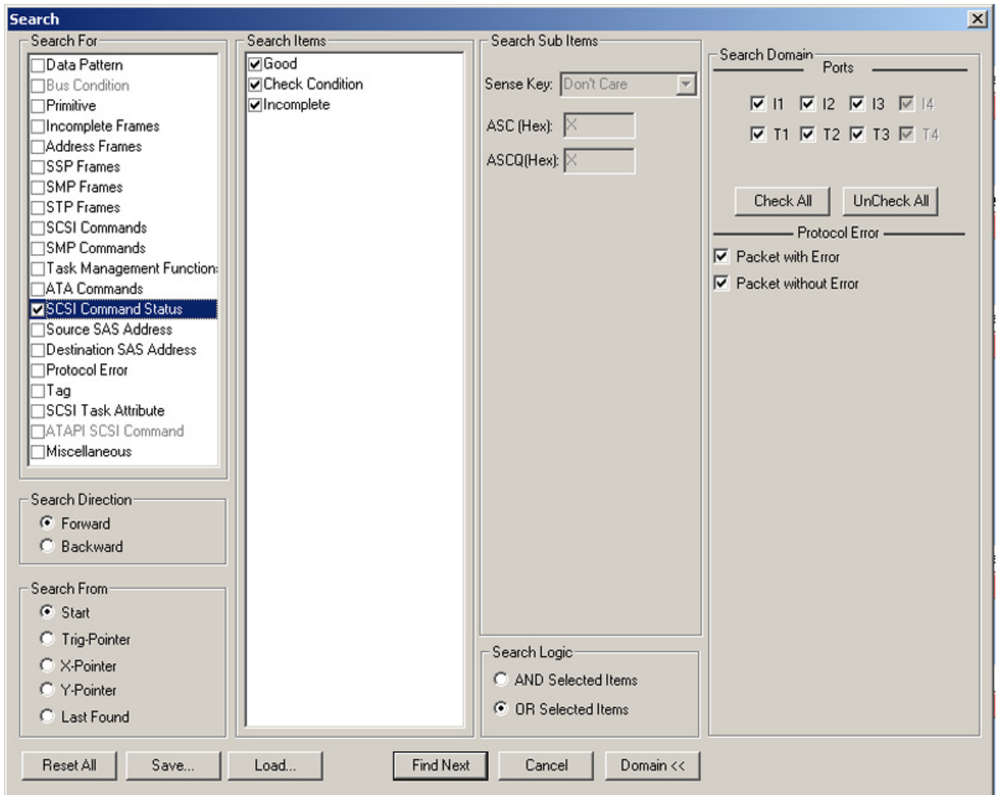

Figure 3.103: Search Sub Items

When you check the **SCSI Command Status,** the **Check Condition** item appears in the Search Items Window, if a check condition has occurred. Clicking this enables **Search Sub Items,** allowing you to refine the search by specifying **Sense Key, ASC,** and **ASCQ.**

Search by Tag Number

To search by Tag Number, check the **Tags** box in the Search For window and then check the Tag(s) for which to search in the Search Items dialog (see Figure 3.104 on page 184).

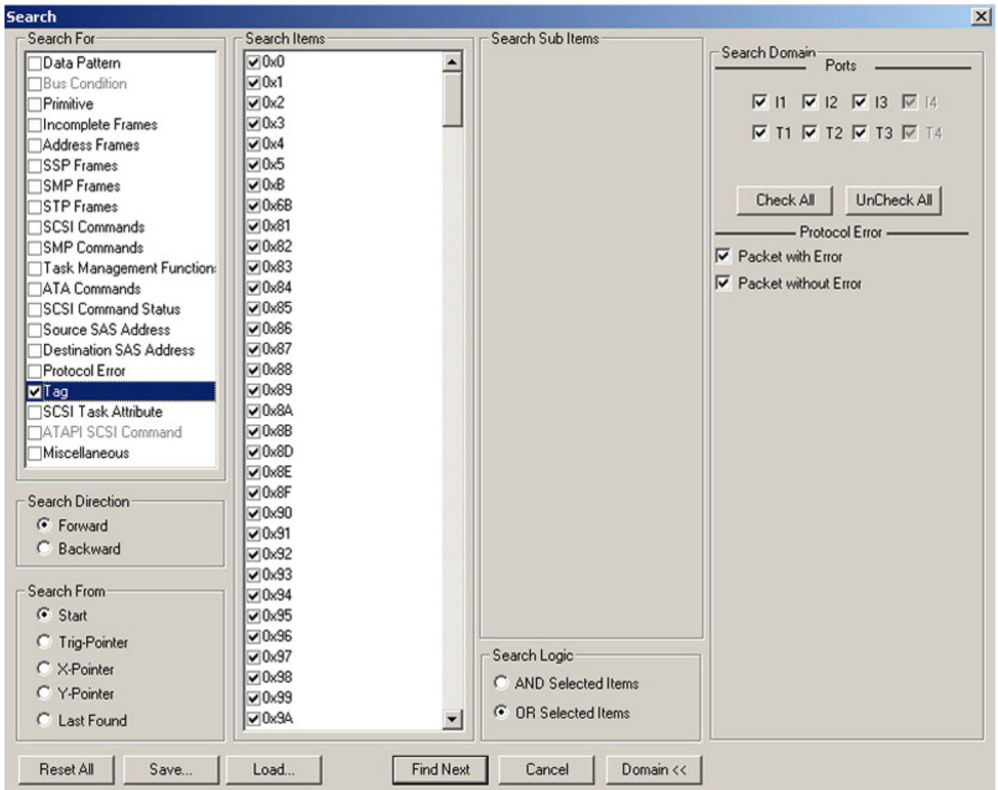

Figure 3.104: Search by Tag Number

Search TTIU Events

See Filter TTIU Events on page 175 for details.

Search by Speed

To search by **Speed**, check the **Speed** box in the Search For window to look for points where speed changes occurred in the trace.

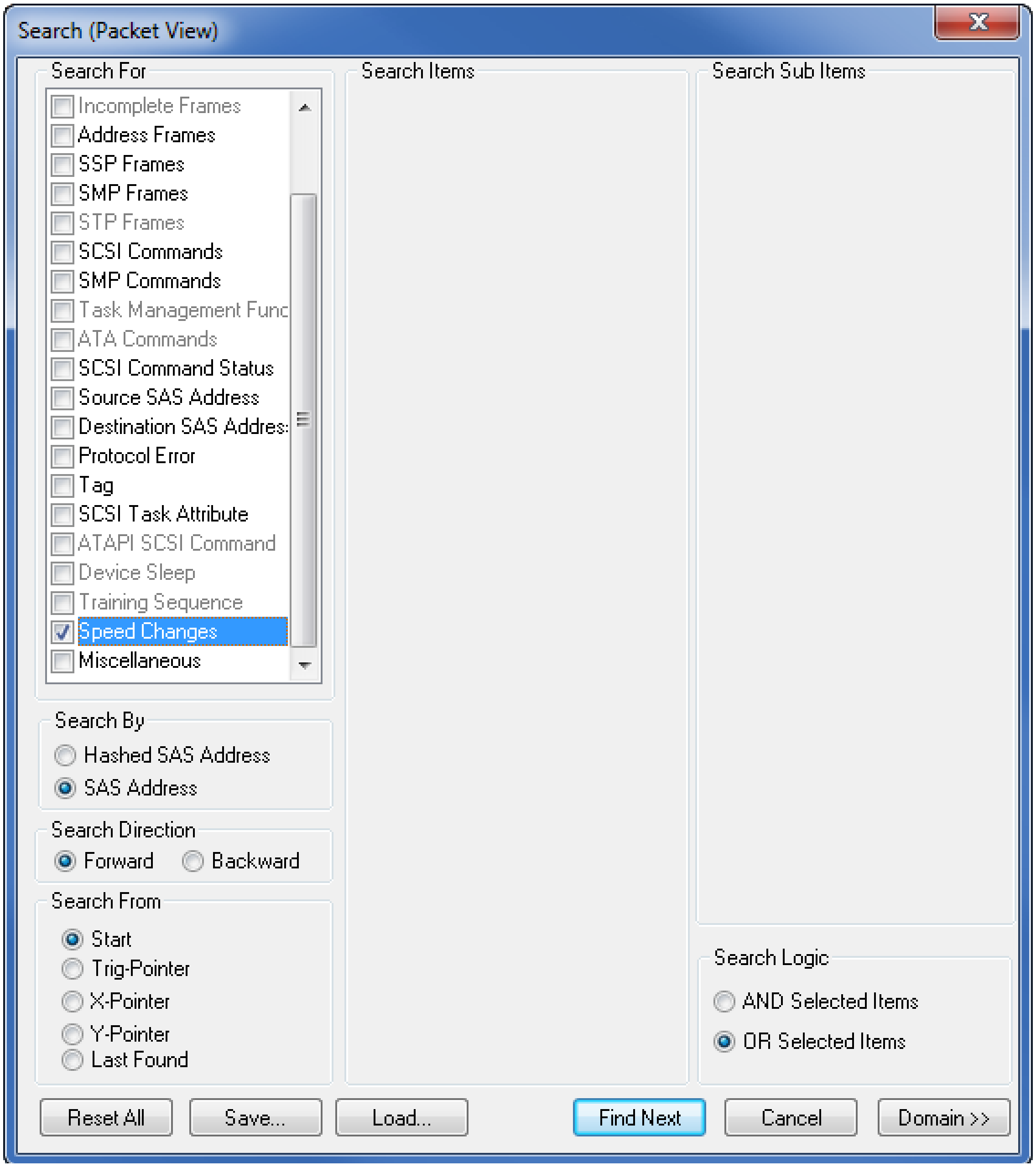

Figure 3.105: Search by Speed Changes

3.7.9 Show/Hide Ports

You can **Show/Hide a Single Port** or you can **Show/Hide Multiple Ports**. To do so click on the **Ch Down Arrow.**

Show/Hide Single Port

If Show/Hide Single Port is selected, you can click on one port button at a time to show/ hide the capture for that port. Show/Hide Single Port is time consuming as it shows or hides one port at a time.

Show/Hide Multiple Ports

If Show/Hide Multiple Ports is selected, you can click on multiple ports to show or hide them. This mode is much faster. Click on multiple ports to show or hide them.

Figure 3.106: SAS: Show/Hide Ports Toolbar

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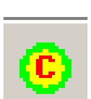
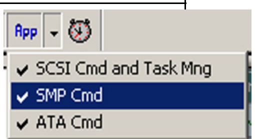
Figure 3.107: SATA: Show/Hide Ports Toolbar

You can also show or hide a port by right-clicking a **Port ID** in Text View or Column View and choosing **Show** or **Hide** (see Figure 3.111 on page 190).

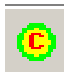
3.8 Packet View Toolbar

The Packet View toolbar allows wrapping, zooming, and configuration.

	The **Wrap Packets** button on the Viewer Toolbar wraps the packet data in the display to eliminate the need for horizontal scrolling.
	Go to CATC Navigation View. Click this button to change the trace display to a CATC Trace™. You can change the colors, fonts, and so on, in the Trace Viewer Configuration (see Trace Viewer Configuration on page 198).
	The **Show/Hide Link Packet** button displays/hides the Link layer (SAS only).

	The **Show/Hide Transport Packet** button on the Layers Toolbar displays/hides the Transport layer and below (SAS only).
 	The **Show/Hide All Commands Packet** button shows/hides the Command layer and all layers below: SCSI Cmd and Task Mng, SMP Cmd, and ATA Cmd (SAS only). Click the down arrow on the **Show/Hide All Commands Packet** button to choose command types to show/hide.
	The **Show/Hide Physical Packet** button toggles the display of physical layer packets (SATA only).
	The **Show/Hide FIS packet** button toggles the display of FIS layer packets. When “OFF”, the FIS layer and its links are hidden (SATA only).
	The **Show/Hide CMD packet** button toggles the display of the CMD packets. When “ON”, only the command layer displays (SATA only).
	The **Show/Hide Command Queue** button displays queued commands. (SATA only.) The CQ button’s hierarchy only applies to **ReadDMAQueued** and **WriteDMAQueued**. The hierarchy for other queued commands is displayed as part of the regular application layer decoding.
	The **Order/Reorder** button toggles the time order of packets. (SATA only)
	The **Pack/Unpack Repeated Primitives** toggles packing repeated primitives in one port. (SAS only)
	The **10B** button displays the payload data as 10-bit encoded data.
	The **8B** button displays the payload as 8-bit scrambled or unscrambled data, depending on the Scrambled setting.
	The **SC** button selects scramble/unscramble for the 8-bit payload data.
	The **PV** button shows/hides the primitive value.

3.8.1 CATC Navigation View

To change the trace display to a CATC Trace™ (see Figure 3.108 on page 188), click the **CATC Navigation**  button. You can change the colors, fonts, and so on, in the Trace Viewer Configuration (see Trace Viewer Configuration on page 198).

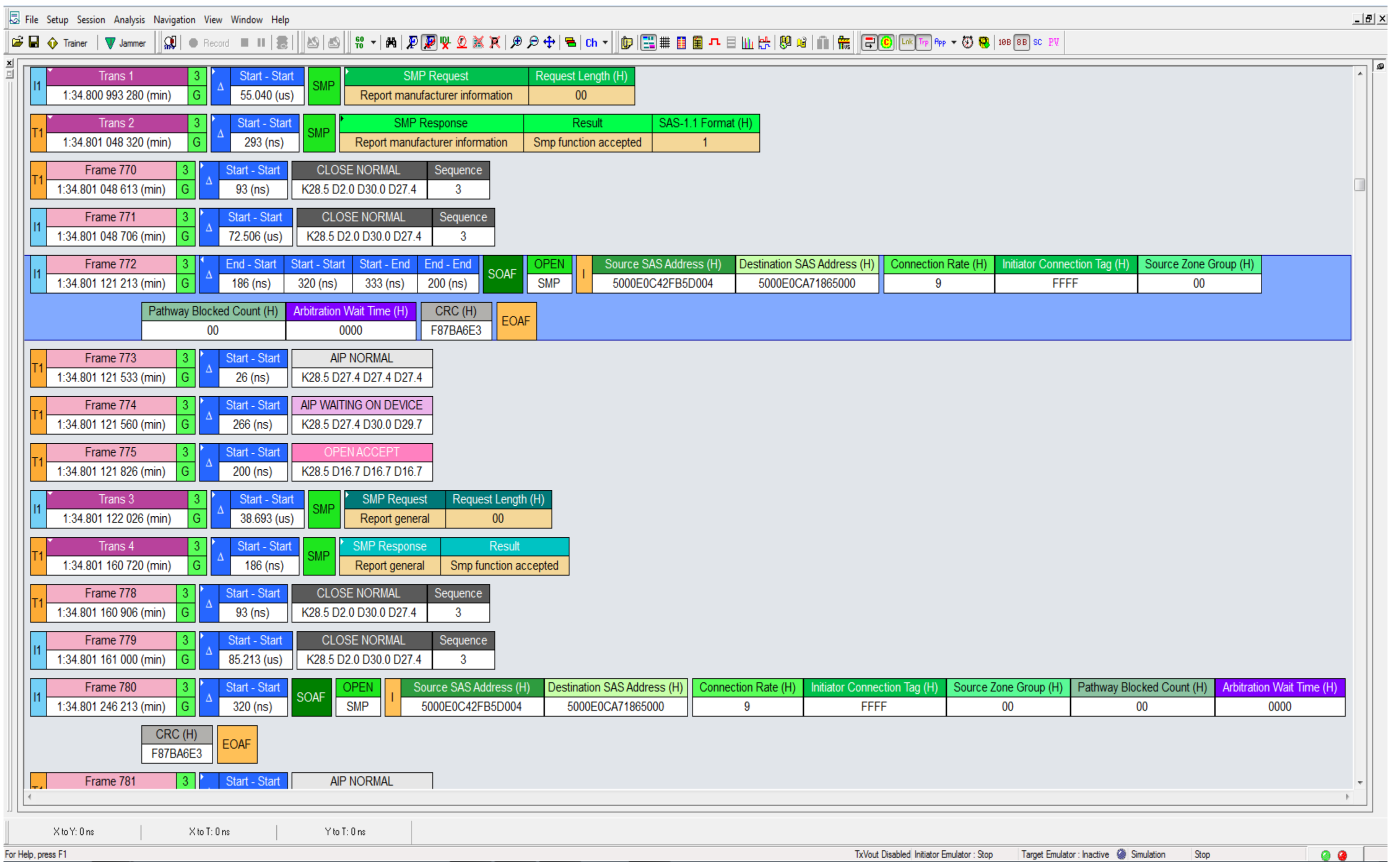


Figure 3.108: CATC Navigation View

3.8.2 Spec View

Spec View shows packet header information.

To obtain the Spec View from the CATC View, left-click to display a popup menu, then select the **View Fields** option (see Figure 3.109 on page 189).

To obtain the Spec View from the Catalyst View, right-click to display a popup menu, then select the **View Fields** option.

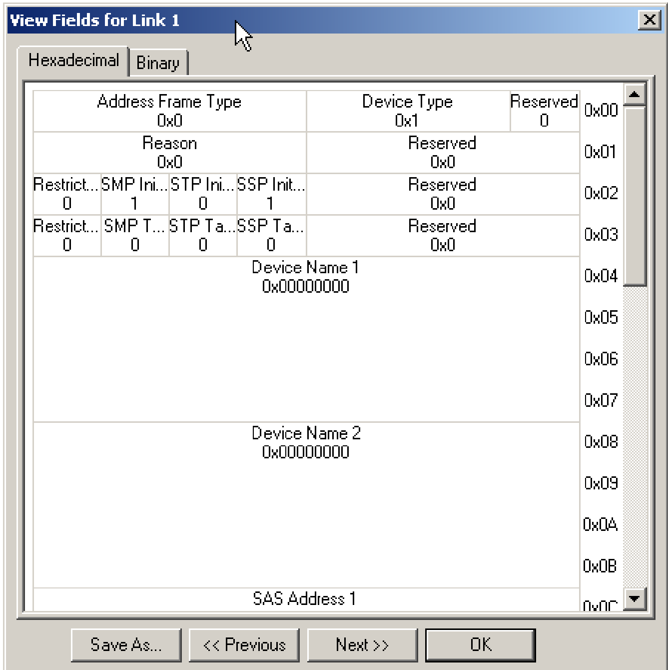


Figure 3.109: Spec View

The tabs allows you to display **Hexadecimal** or **Binary**.

The buttons allow you to go to **Previous** or **Next**.

You can **Save As** a text file.

3.8.3 Decode Icons

The **Decode Toolbar** controls encoding and scrambling features.

To view corresponding Unscrambled and Scrambled payload data values instantaneously, position the mouse pointer over a data field.

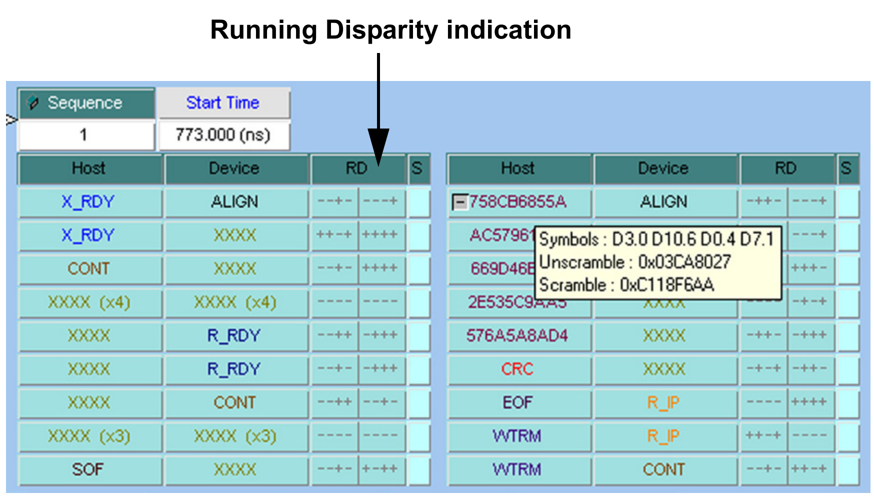


Figure 3.110: Payload Data Display

3.8.4 Customize Display

You can customize the display as explained below.

Rename Port

You can rename each port for easy identification. To rename a port, right-click the **port ID** in Text View or Column View.

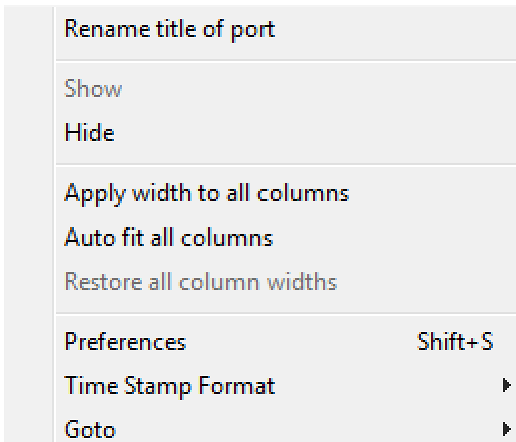


Figure 3.111: Rename Port

Choose **Rename title of port** to open the Rename Title of Port dialog.

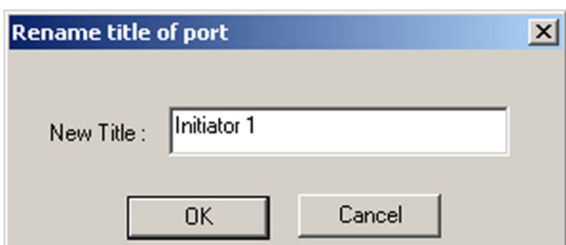


Figure 3.112: Rename Title of Port

Show/Hide Single Port

If Show/Hide Single Port is selected, you can click on one port button at a time to show/ hide the capture for that port. Show/Hide Single Port is time consuming as it shows or hides one port at a time.

Show/Hide Multiple Ports

If Show/Hide Multiple Ports is selected, you can click on multiple ports to show or hide them. This mode is much faster. Click on multiple ports to show or hide them.

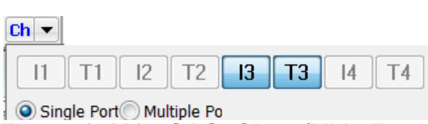


Figure 3.113: SAS: Show/Hide Ports Toolbar

Figure 3.114: SATA: Show/Hide Ports Toolbar

You can also show or hide a port by right-clicking a **Port ID** in Text View or Column View and choosing **Show** or **Hide** (see Figure 3.111).

Show/Hide Field

You can simplify the Viewer display by hiding some fields. You can hide the **Duration**, **Relative Time**, **External Signals,** and **Packet number** fields by right-clicking the corresponding field title and choosing **Hide Field**.

Figure 3.115: Hide Field

To restore a field to the display, right-click a **Port ID** field and choose the hidden field to restore

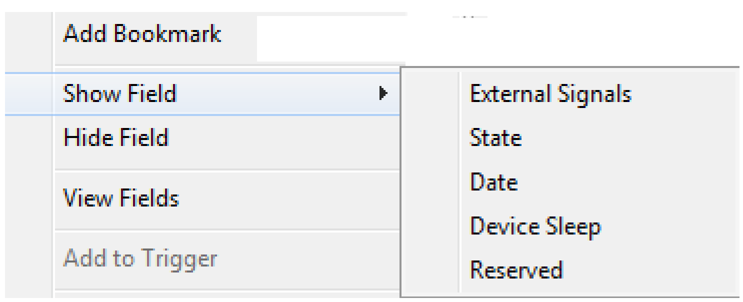


Figure 3.116: Show Field

Note: Only the fields previously hidden appear in the restore list.

Related Frames

Right-click a **Command frame** for an SSP frame, or **Register Device to Host** for an STP frame, to open a short-cut menu (see Figure 3.117 on page 192), then choose **Goto Response** to jump to the corresponding Response frame in the viewer.

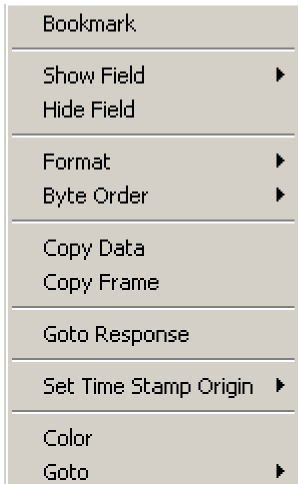


Figure 3.117: Goto Response

Similarly, right-click a **Response frame** for an SSP Frame, or **Register Device to Host** for an STP frame, to open a short-cut menu, then choose **Goto Command** to jump to the corresponding Command frame in the viewer.

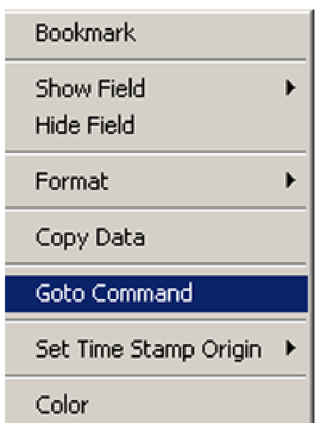


Figure 3.118: Goto Command

In Column View, you can right-click a DWORD inside a frame to display the **Goto Within Packet** command. You can jump to an SOF, EOF, HOLD, or R_IP.

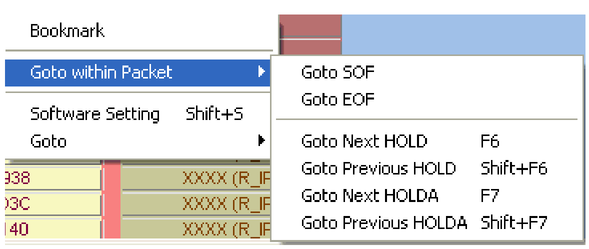


Figure 3.119: Goto Within Packet Command

Byte Order

You can change the byte order in fields marked by an arrow and other fields.

Right-click in the field, select **Byte Order,** and choose the ordering.

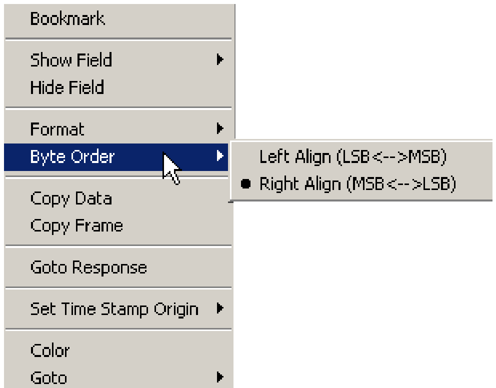


Figure 3.120: Byte Order

Note: A blue arrow in the byte order field indicates that it has been changed.

Choose Data Format

You can display data values either in hexadecimal (default) or binary. To choose data format, right-click the mouse over a data field, and choose **Format** and the format.

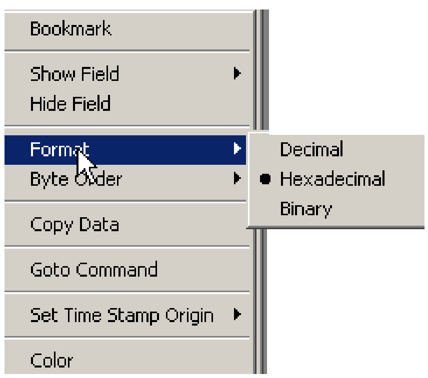


Figure 3.121: Format

Show All Data

To display all captured data, click the **data expand** toggle arrow in a data field, to examine the data in detail.

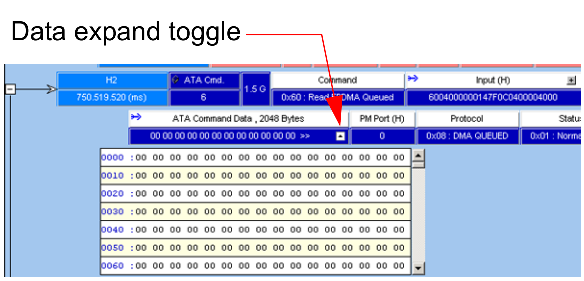


Figure 3.122: Show All Data

You can expand or collapse all data fields globally. To expand all data fields, right-click the mouse in a data field and choose **Expand All**.

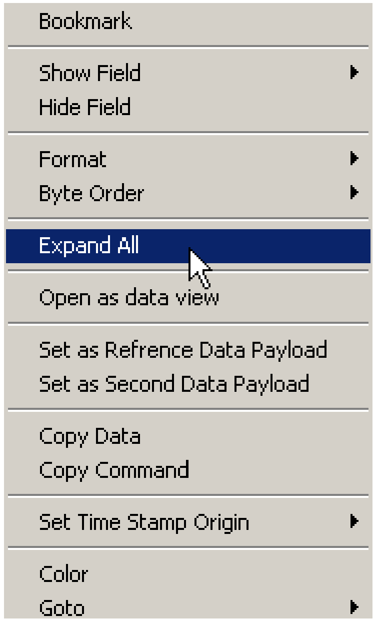


Figure 3.123: Expand All

To collapse all fields, right-click the mouse in a data field and choose **Collapse All.**

You can expand or collapse all FIS's and commands. To expand, right-click the mouse in a data field and choose **Expand All FIS's** or **Expand All ATA Cmd.s.** See Figure 3.124.

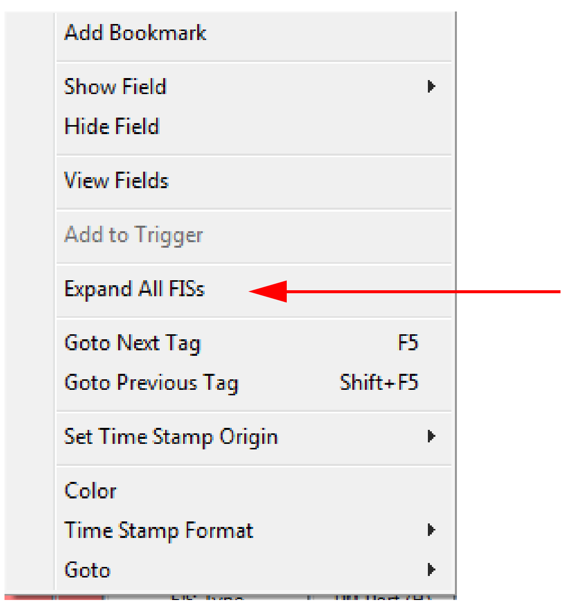
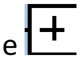
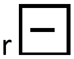


Figure 3.124: Expand All FIS's

To collapse, right-click the mouse in a data field and choose **Collapse All FIS's** or **Collapse All ATA Cmd.s.**

You can expand or collapse specific packets and commands by clicking on the  or  buttons.

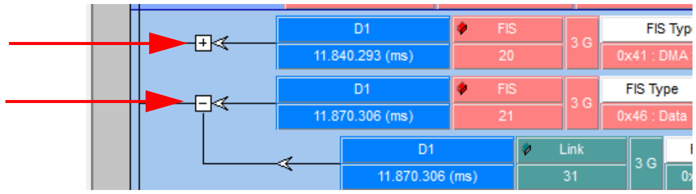


Figure 3.125: Expand/Collapse Specific Layers.

3.9 Port Status

You can get an overview of the active ports by clicking the **Port Status** button at the bottom right of the application window.

The Port Status displays the Port, Speed, and Analyzer.

In addition to displaying OOB, Link, Frame, and Error, a display showing the % buffer full opens when a trigger occurs.

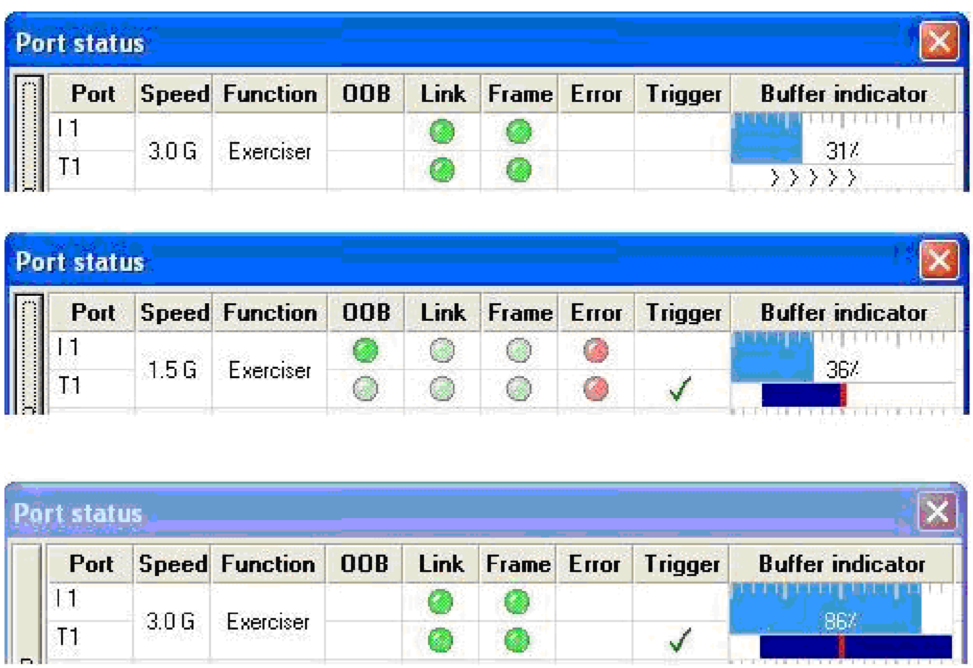
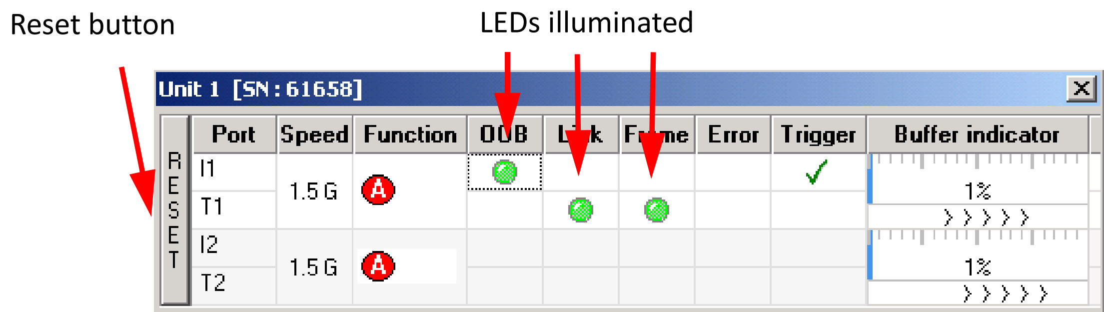


Figure 3.126: Port Status Window and Capturing Time

1.Pre-trig capturing (trig is 50%)
2. Trig point (shown by red bar; 36% pre trig was captured)
3. Post-trig capturing (50% post-trig was captured and capturing has stopped)

Note: If sample capture occurs with more than one unit active, additional Port Status windows display.

The OOB, Link, Frame and Error LEDs in the Port Status dialog mimic/follow the LEDs on the Front panel of the unit.



When the LEDs are dim, it indicates they were lit in the past. Pressing the Reset button erases this history and the illuminated LEDs are removed from the dialog.

3.10 Toolbars

3.10.1 Enabling Tool Bars

To customize the Viewer Display workspace, you can enable and reposition the available toolbars. To display or hide toolbars, select **View > Toolbar**, then check or uncheck toolbars.

Toolbars are:

- Main
- Record + Capture
- Analysis
- Navigation + View
- Packet View
- Column View
- Cursor Position

Once enabled, the toolbars can dock at the Viewer Display window or float on the windows desktop.

3.10.2 Cursor Position Status Bar

To display the cursor position status bar, select **View > Status Bar**.

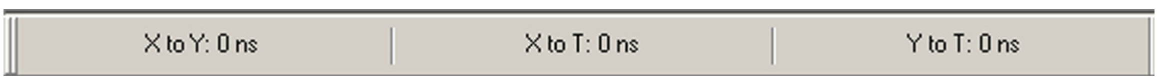


Figure 3.127: Cursor Position Toolbar

See Using the Cursors and Bookmarks on page 197.

3.11 Status Bar

The Status bar is located at the bottom of the main display window.

3.11.1 Search Status

The right most segment displays the current search direction: **Fwd** (forward) or **Bwd** (backward). Change the search direction from the Search Menu or double-click the Search Status segment.

3.12 Using the Cursors and Bookmarks

3.12.1 Cursors

The data viewer display incorporates three cursors labeled **X, Y,** and **T.** All cursors are initially overlaid and positioned at location 0, which is the trigger position of the display. The Trigger, or **T**, cursor is the measurement reference and is always at location 0 in the display.

Positioning the X Cursor

To position the X-Cursor within the viewer data display, click the left mouse button in the gray bar on the left side of the sample viewer next to the line in which to place the cursor.

Positioning the Y Cursor

To position the Y-cursor within the viewer data display, click the right mouse button in the gray bar on the left side of the sample viewer next to the line in which to place the cursor.

Note: You can also left-click to set the X-cursor and right-click to set the Y cursor in the Frame and Column View by clicking in the narrow strip on the very left side of a cell. Similarly, you can set the cursors in the Waveform View by left and right clicking at the beginning of a waveform.

Time

Time differences between the cursors are displayed in the Cursor Position toolbar. To display the cursor position tool bar, select **Toolbar** from the view menu and choose Cursor Position.

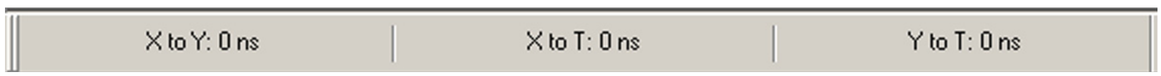


Figure 3.128: Cursor Position Toolbar

3.13 Display Configuration

The Analyzer ships with a default display configuration of field and viewer settings. You can define your own field and viewer settings for a particular testing scenario. Right-click in the Packet View and select **Preferences** or select **Setup>Preferences>Trace Viewer>Configuration**. The Trace Viewer Configuration dialog displays (see Figure 3.129 on page 199).

3.13.1 Trace Viewer Configuration

The Trace Viewer Configuration dialog allows you to change the following display settings:

- Field Setting
  - Format (Decimal, Hexadecimal, Binary)
  - Visible
  - Byte Order (Right Align, Left Align)
- Field Header Setting
  - Text (color)
  - Name
  - Abbreviation
  - Foreground (color)
- Viewer Setting
  - Wrap Packet
  - Enable Tooltips
- Data Payload
  - Columns in Row (1, 2, 4, 8, 16)
  - Bytes in Column (1, 2, 4, 8, 16)
- Time Stamp Origin: Absolute, Trigger, User Defined, Based on System Time
- Same color for start time and port
- Enable Packet View Condense Mode
- Time Stamp Format (LeCroy, Milli, Micro)
- Save Trace Viewer Configuration in a file
- Load Trace Viewer Configuration from a file
- Factory Setting (restores default settings)

- ❑ Font (opens Font dialog)

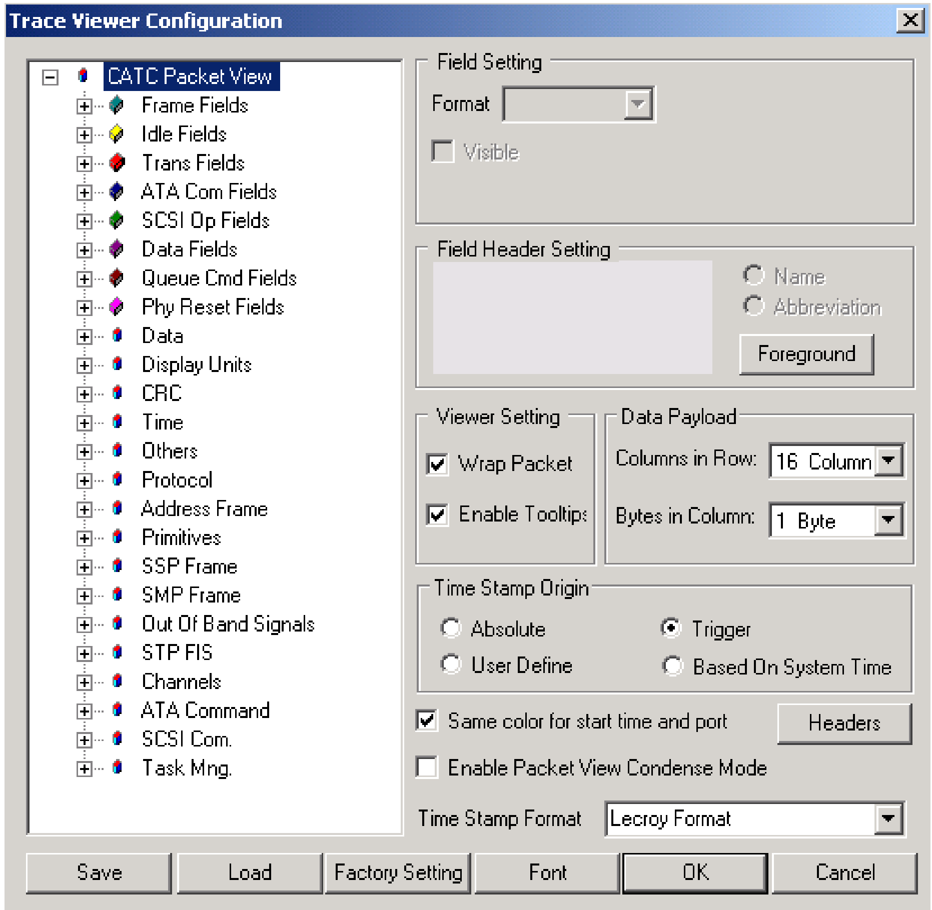


Figure 3.129: Trace Viewer Configuration

Field Settings

To view a packet field, select a field from the packet field tree and check the **Visible** box. Uncheck it to hide the field. To change the data format of a packet field, select the field and choose a data format from the Format drop-down list.

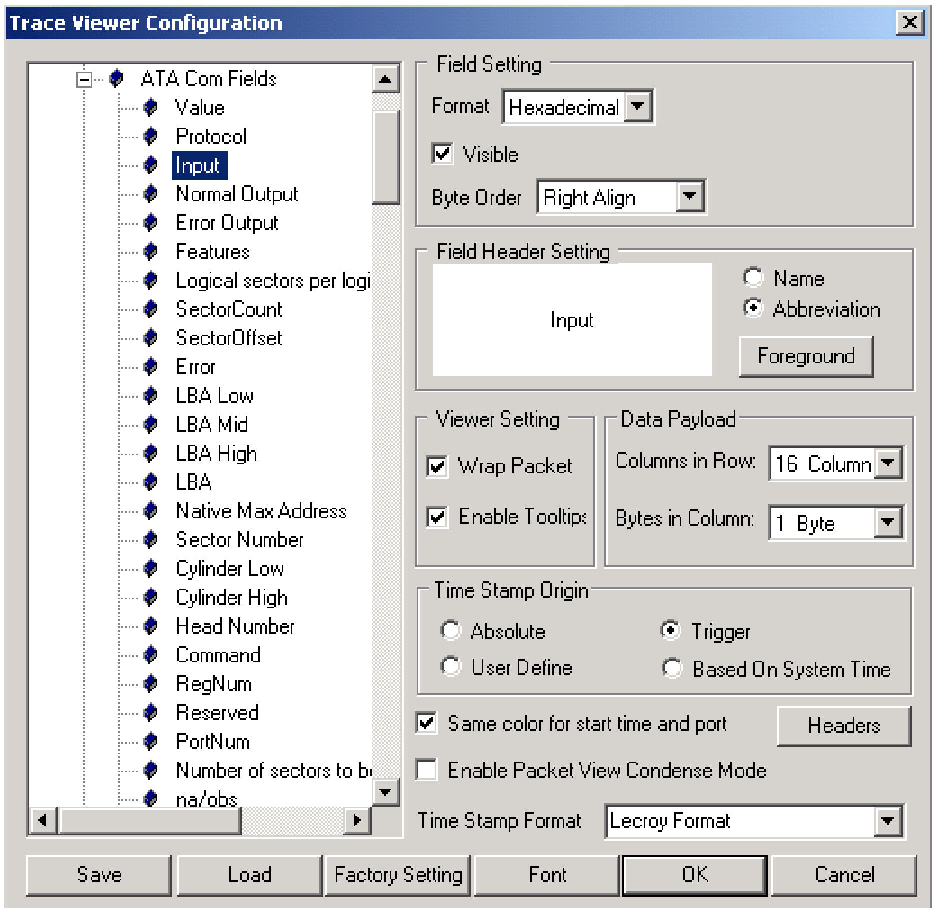


Figure 3.130: ATA Command Fields

Field Header Setting

You can use the Name or Abbreviation.

To change the color of the text in a packet field header, select a field from the packet field tree and click the **Foreground** button.

Figure 3.131: Color

Choose an appropriate color and click **OK.**

Viewer Setting

Check the **Wrap Packet** box to enable the wrapping of packets in the display.

Check the **Enable Tooltip** box to enable tool tips for packet fields.

Data Payload

You can format the Data Payload display.

For Columns in Row, select 1, 2, 4, 8, or 16.

For Bytes in Column, select 1, 2, 4, 8, or 16.

Time Stamp Origin

Select Absolute, User Defined, Trigger, or Based on System Time.

Start Time and Port

You can use the same color for the start time and port.

Packet View Condense Mode

You can enable Packet View Condense Mode to minimize Packet View rows.

Time Stamp Format

Select Teledyne LeCroy, Milliseconds, or Microseconds.

Font

To change display fonts, click the **Font** button to open the Font dialog box.

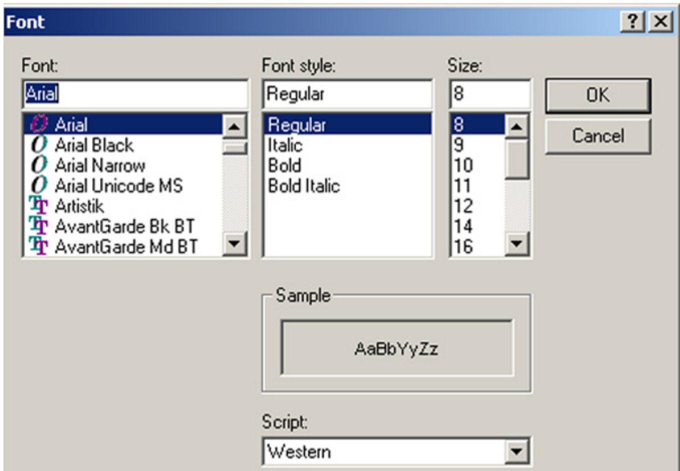


Figure 3.132: Font

Choose the font, font style, and size, and click **OK.**

Save/Load Settings

You can save the customized configuration settings in a ***.cfg** file by clicking the **Save** button and completing the Save As procedure. To load a previously saved configuration file, click **Load** and choose an appropriate file.

3.14 Set Port Alias

Port Alias allows you to assign a meaningful name to each port to assist in interpreting the results displayed in the sample view (see Figure 3.133 on page 203).

To assign port names in an open sample view, select **Setup > Set Port Alias**.

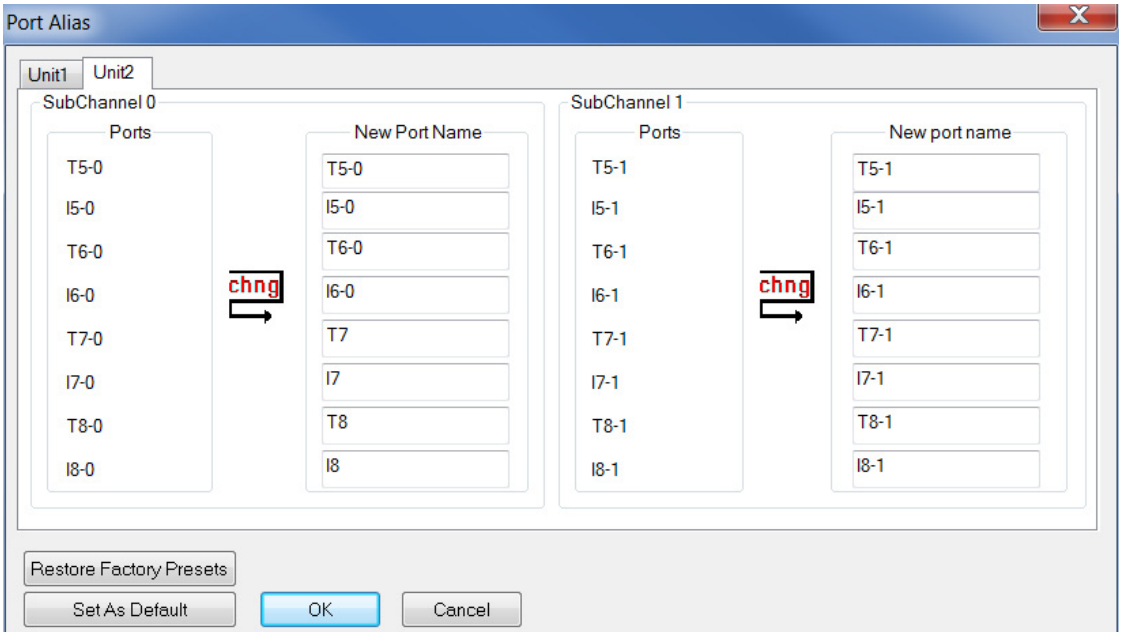


Figure 3.133: Assign Port Alias

Assign a meaningful name to each port in use and click **OK**. The assigned names replace the port numbers in the sample view.

If you elect to save the capture sample file, the assigned port names are saved together with the result, so that when you open the sample file later, the assigned names are retained.

Restore Factory Presets

Click the **Restore Factory Presets** button to restore the settings to the factory settings.

Set As Default

If you want to set these port aliases for sample files that will be captured later, you can set them as default, and new samples will be opened by these default port aliases.

3.15 SAS Address Alias (SAS only)

SAS Address Alias allows you to assign a meaningful name to each SAS address to assist in interpreting the results displayed in the sample view. To assign SAS address names in an open sample view, select **Setup > Set SAS Address Alias** to display the SAS Address Alias dialog (see Figure 3.134 on page 204).

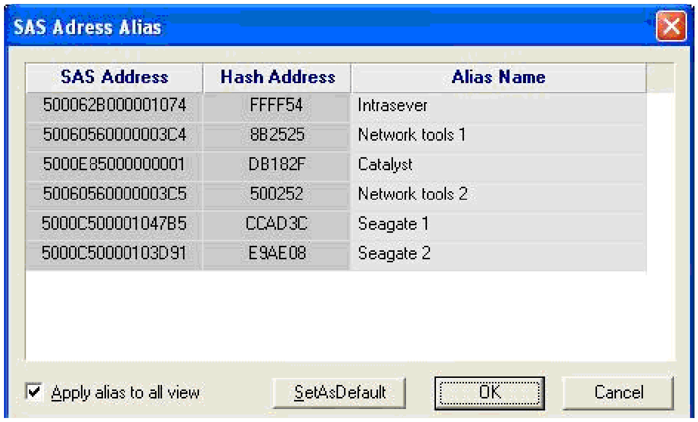


Figure 3.134: SAS: Assign SAS Address Alias

Assign a meaningful name to each SAS address in use and click **OK**. The assigned names replace the SAS address in the sample view, Search, filter, and Statistical report.

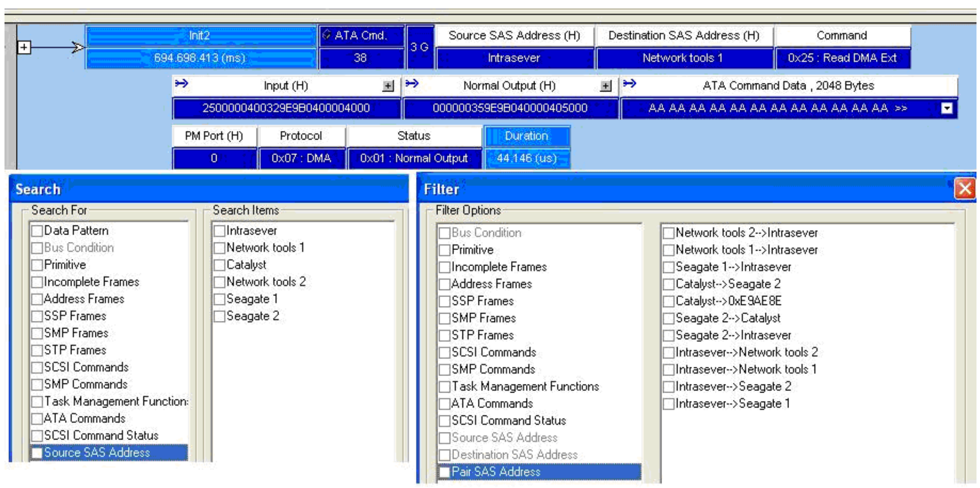


Figure 3.135: SAS: SAS Address Alias

If you elect to save the captured sample file, the assigned SAS address names are saved together with the result, so that when you open the sample file later, the assigned names are retained.

Set As Default

If you want to set these SAS address aliases for sample files that will be captured later, you can set them as default, and new samples will be opened by these default SAS address aliases.

3.16 TxRxVout & Preemphasis

The analyzer incorporates the ability to select TxRx Vout for the transmitter and receiver on each port. Using TxRx Vout can increase the output voltage swing above the nominal value, for test and characterization purposes. This feature is also useful to compensate for line loss when driving long cables.

To select TX Vout, select **Setup > TxRx Vout & Preemphasis** to display the Rx/Tx Settings dialog:

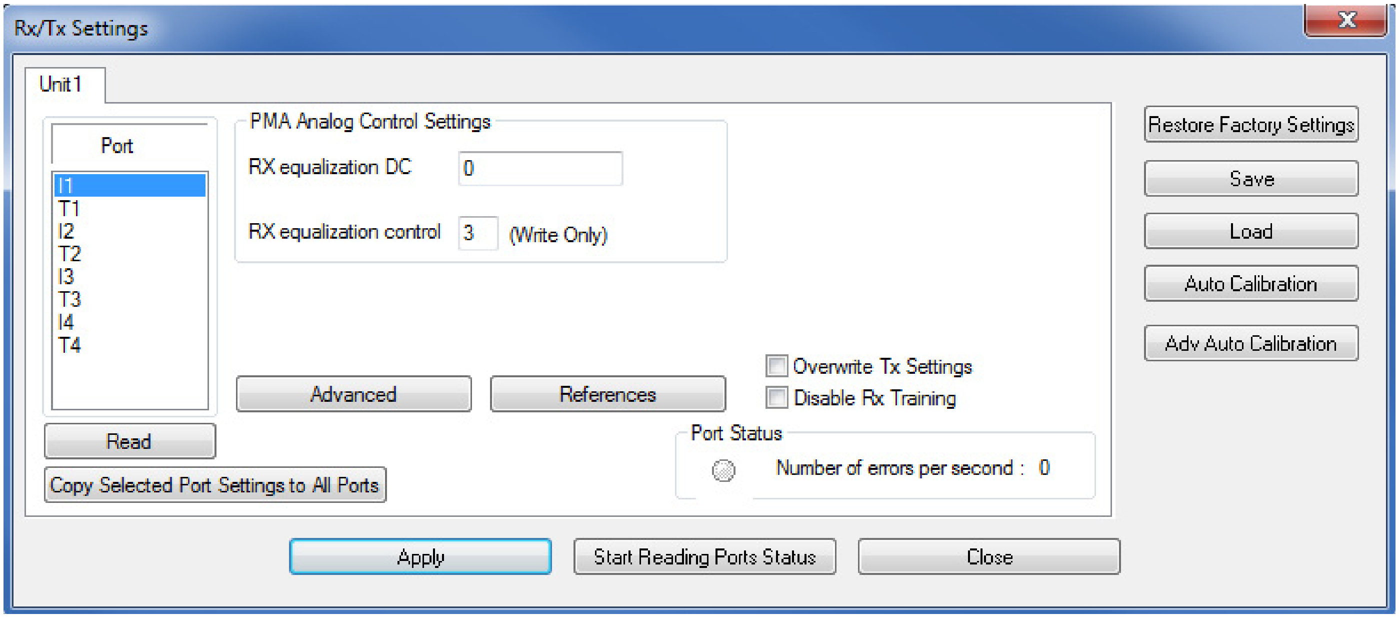


Figure 3.136: Choose Port for TxRx Vout

Port displays ports to select from.

Copy Selected Port Settings to All Ports implements selected port's setting into all other port settings.

PMA Analog Control Settings allows you to select values for RX equalization DC and RX equalization (Write Only)

Advanced displays the Advanced Probe Setting dialog (see Advanced Probe Setting on page 206).

References displays the References Probe Setting dialog (see References Probe Setting on page 206).

Overwrite Tx Settings check this box to overwrite the Tx settings.

Disable Rx Training check this box to use the manually entered settings.

Port Status displays number of errors per second.

Apply applies the selected settings.

Start Reading Port Status implements reading of number of errors displayed in Port Status.

Restore Factory Settings restores default values.

Save saves the new values as a ***.sng** file.

Load loads back the saved ***.sng** file.

Auto Calibration displays the Auto Probe Calibration dialog (see Auto Probe Calibration on page 209).

3.16.1 Advanced Probe Setting

The Advanced Probe Setting dialog allows you to set the TX Signals and DFE_Control (Decision Feedback Equalization) parameters.

You can set the TX Signals values for:

- VOD (Programmable Differential Voltage)
- Pre-emphasis Pre-tab
- Pre-emphasis first
- Pre-emphasis second

You can set the DFE_Control values for:

- DFE_Tap1
- DFE_Tap2
- DFE_Tap3
- DFE_Tap4
- DFE_Tap5
- reference voltage

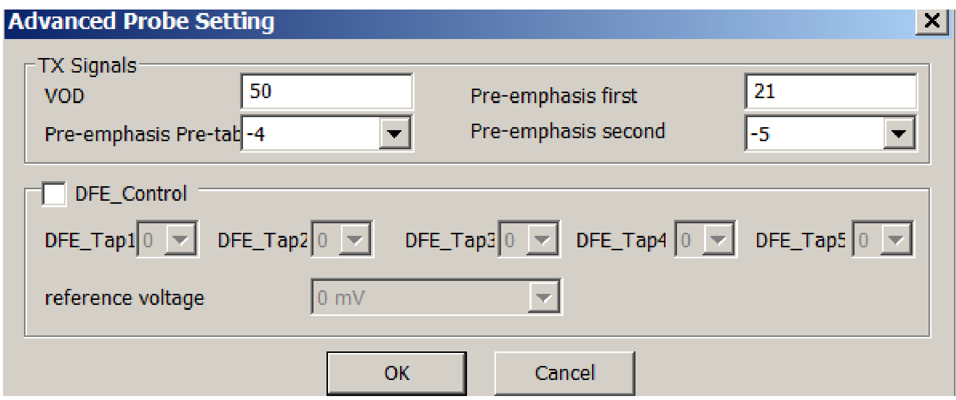


Figure 3.137: Advanced Probe Setting Dialog

3.16.2 References Probe Setting

The References Probe Setting dialog (see Figure 3.138 on page 207) allows you to set the three reference points defined by the SAS 3.0 specification (Reference 1, Reference 2 and NoEq), in cases when the default reference points do not result in a clean link.

These settings only need to be applied once for each analyzer as they are saved by the SAS/SATA Protocol Suite application on the host machine. Connecting to a different host machine requires reapplying the settings.

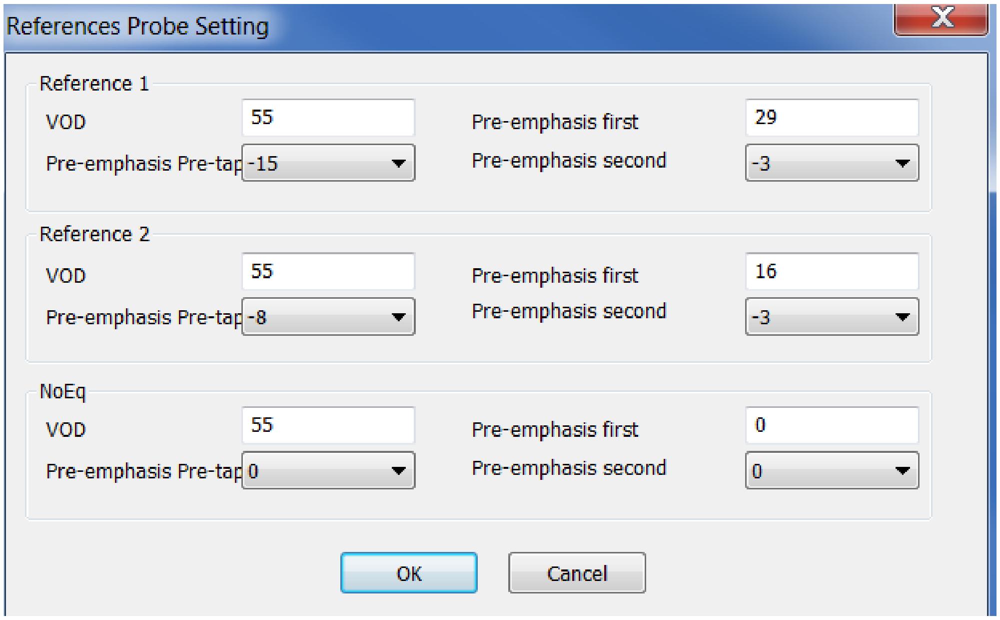


Figure 3.138: References Probe Setting Dialog

3.16.3 Manual Calibration of Tx Path from Jammer or Trainer

To manually calibrate perform the following steps:

1. Select **Setup > TxRx Vout & Preemphasis** to display the Rx/Tx Settings dialog (see Figure 3.139 on page 208).
2. Press the **Read** button to read the current values for all ports (values achieved through automatic Training when the link has come up), then press the **Advanced** button to see and tweak the values.
3. The typical set of values for the Initiator are shown in Figure 3.140 on page 208. If you see these values then no changes are required.

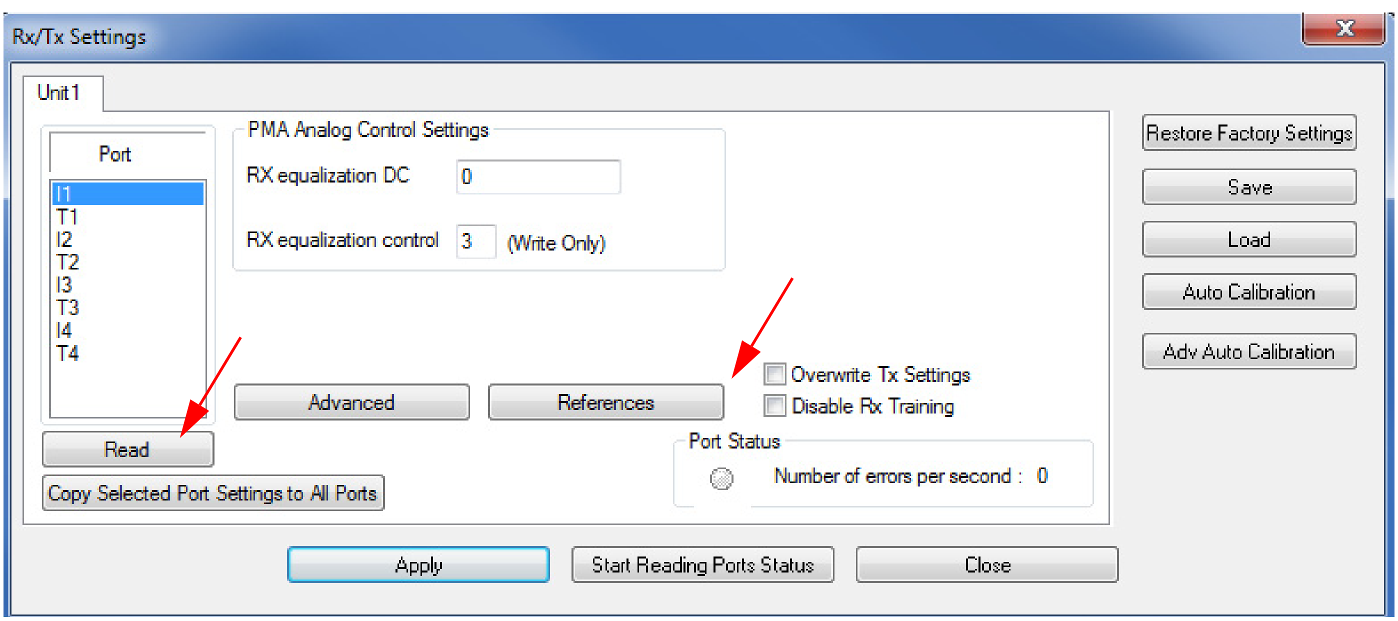


Figure 3.139: Rx/Tx Settings Dialog

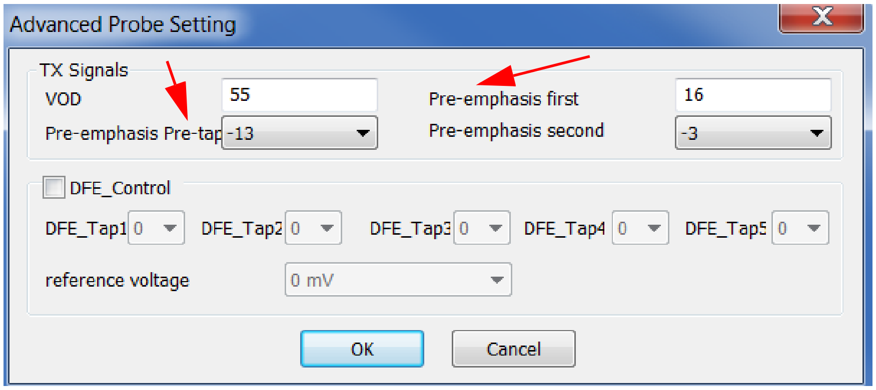


Figure 3.140: Advanced Probe Setting Dialog

4. To see the Target values, click **Cancel** on the Advanced Probe Setting dialog.
5. Select T1 on the Rx/Tx Setting dialog (see Figure 3.141 on page 208), and then click the **Advanced** button (no need to re-read the values).
6. Manipulate the "Pre-emphasis first" and "Pre-emphasis pre-tap" fields by making small changes to the values achieved by Training (see Figure 3.140). This is an iterative process to eliminate errors. After each value change, press **OK** to make the change in the software copy of the value, and then press **Apply** in the Rx/Tx Settings (see Figure 3.141 on page 208) dialog to write the new value to the Serdes.

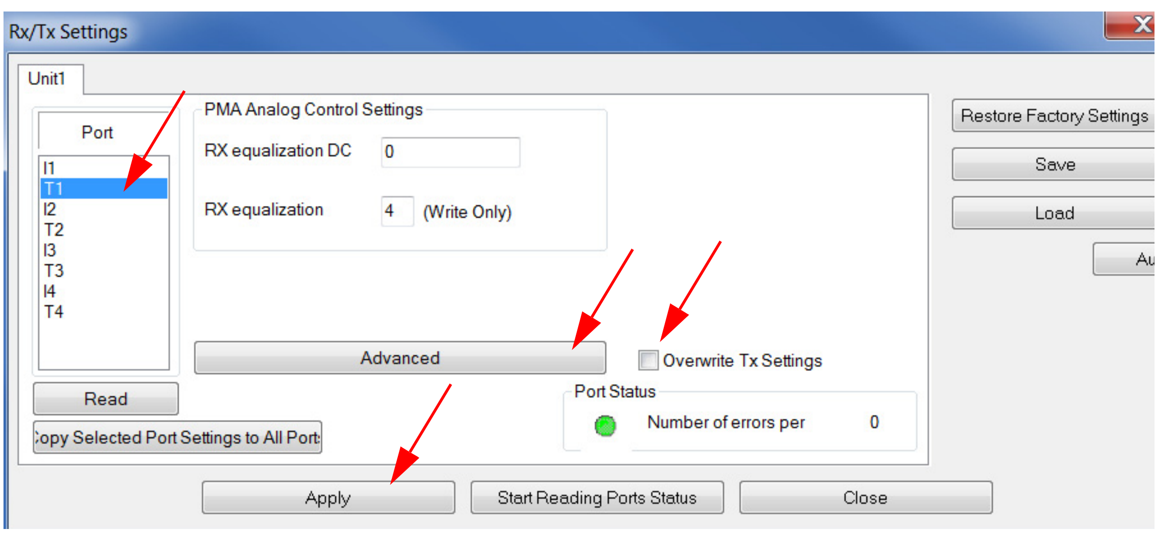


Figure 3.141: Rx/Tx Settings Dialog

Overwrite Tx Settings: Check this box (see Figure 3.141) to retain the optimal values reached through manual calibration every time the link goes through Training due to port reset, power cycle or disconnection.

3.16.4 Auto Probe Calibration

The Auto Probe Calibration dialog will attempt to optimize the receiver settings. The accuracy is controlled by the time interval spent on each setting. Note that this action might take a very long time depending on the values entered.

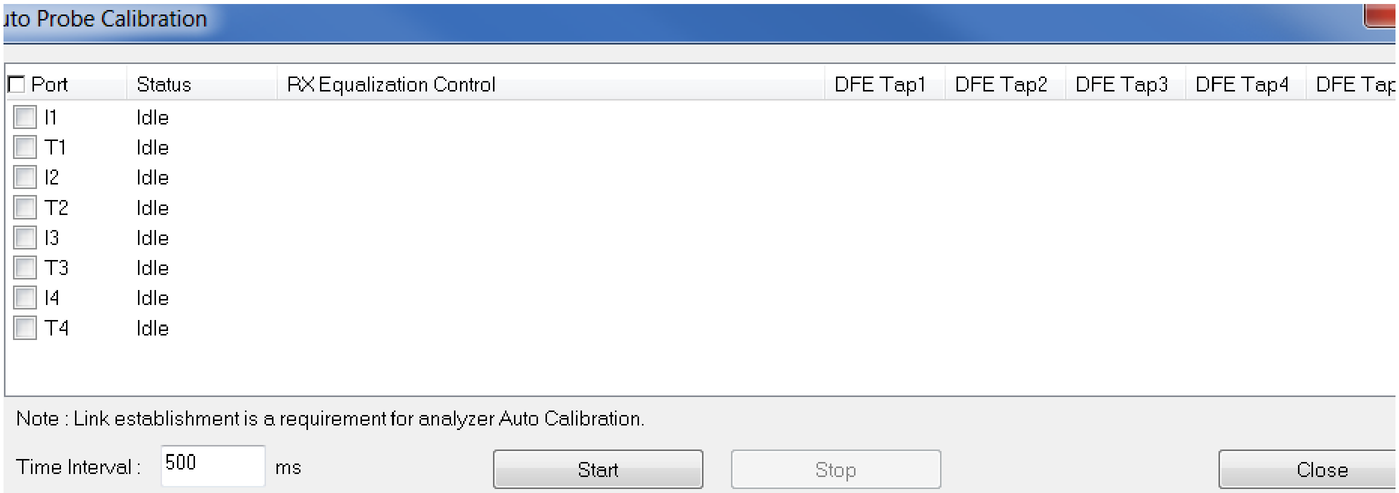


Figure 3.142: Auto Probe Calibration Dialog

3.17 Preferences

Preferences allows you to define template files for new Analyzer projects, to specify how sample files appear when opened, and to set ATAPI and SCSI Spec Assignments. Click **Setup** on the toolbar and choose **Preferences** to display the General tab (see Figure 3.143).

3.17.1 General Tab

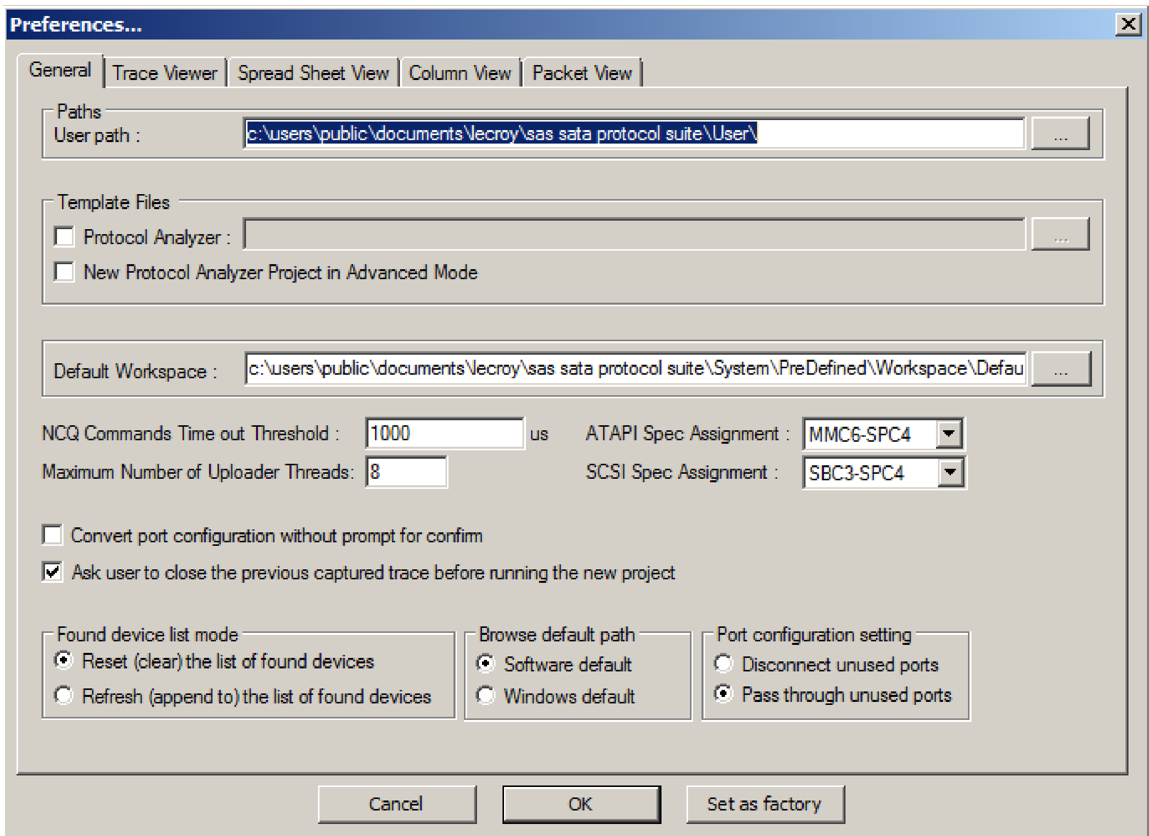


Figure 3.143: Preferences Dialog General Tab.

Paths

User Path specifies the “User” folder path, used by the software after launching the Open dialog.

Template Files

Protocol Analyzer: You can use a pre-saved analyzer and/or analyzer project file as a template. Whenever you make a new project file, the software uses the template to initialize the project file.

New Protocol Analyzer Project in Advanced Mode: When you use the New menu item to create a new project file, the software switches to Advanced mode automatically.

Other

Default Workspace specifies the default workspace file for opening a sample file. You can save any viewer configuration as a workspace and then specify it as the default workspace. The software always open a trace file based on the default workspace file.

NCQ Commands Time out Threshold: The software uses this setting in the statistical ATA command page for NCQ commands. If the time out exceeds this setting, the software reports an error.

Maximum Number of Uploader Threads: If Quick View is not enabled, during cascading, specifies the number of concurrent processes for uploading a sample file.

ATAPI spec assignment: Specifies the ATAPI default spec.

SCSI spec assignment (SAS only): Specifies the SCSI default spec.

Convert port configuration without prompt for confirm: If the current attached board does not support the project file port configuration, the software converts it to a supported port configuration without asking for confirmation. If this setting is unchecked, the software asks for confirmation

Ask user to close the previous captured sample before running the new project: When you start to run a new project, the software prompts you to close the current sample.

Found Device List Mode

Reset (clear) the list of found devices: Lists only the currently found devices.

Refresh (append to) the list of found devices: Adds new devices to the list of devices found previously.

Browse Default Path

Software default: After you select **File > Open**, the Open dialog shows the default user folder.

Windows default: After you select **File > Open**, the Open dialog shows the path selected when the Open dialog was last used.

Port Configuration Setting

These options pertain to Port Configurations that have unused ports (as marked by a dash in the Port Configuration table, eg AA--). This allows the user to control these ports, if unused by the analyzer platform, are to be disconnected or are to be used as pass through, meaning the traffic will simply pass through them (default setting). It is sometimes useful to force disconnect on unused ports, to cause all traffic to pass through the used ports. Select the desired option:

Disconnect unused ports

Pass through unused ports

3.17.2 Trace Viewer Tab

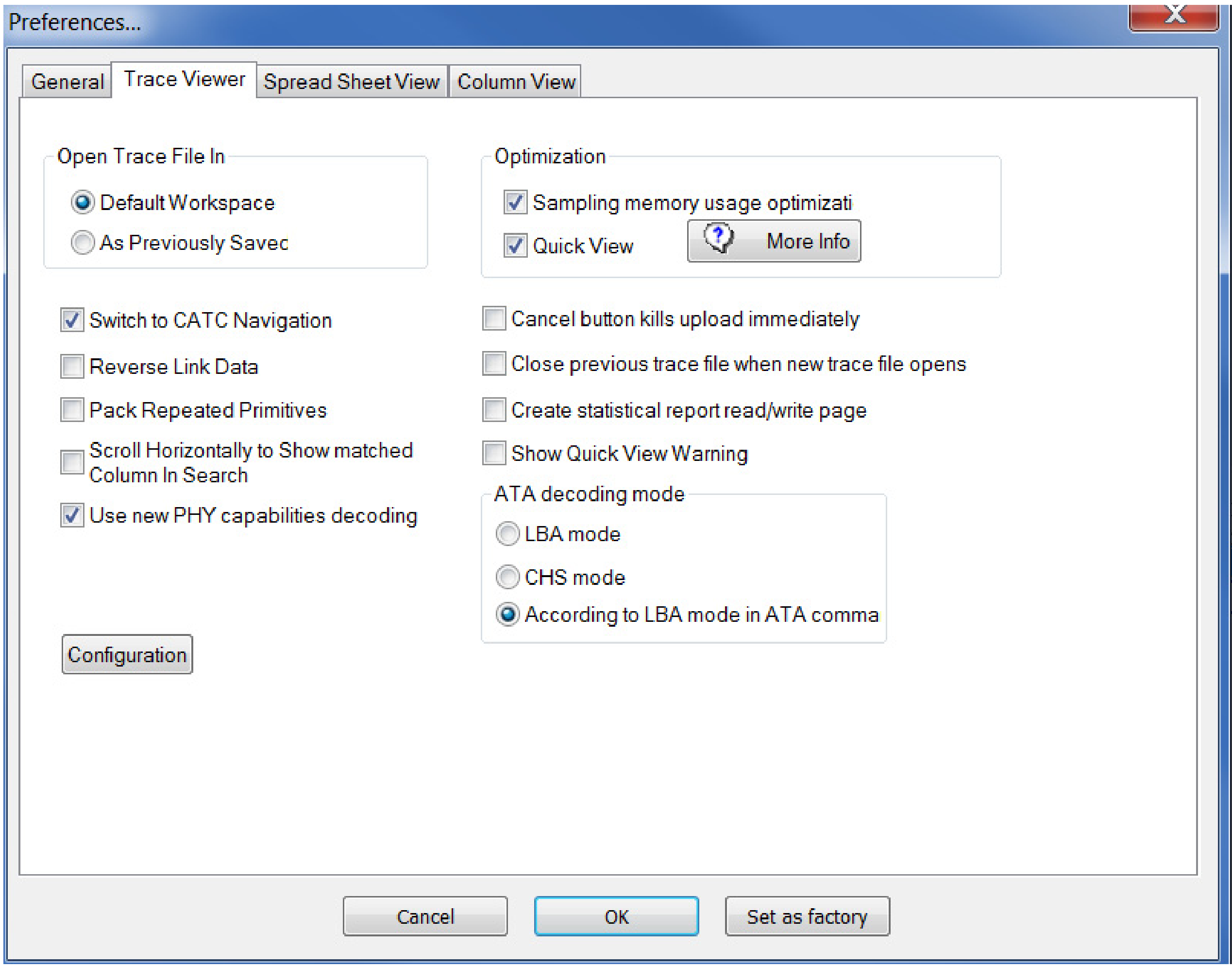


Figure 3.144: Preferences Dialog Trace Viewer Tab

Open Trace file In

Default Workspace: The software opens a **trace** file in view(s) based on the specified default workspace.

As previously saved: The software opens a trace file in view (views) based on the last saved configuration for the **trace** file.

Optimization

Sampling memory usage optimization: Enables memory cascading for two ports. The analyzer will use memory of another port if there is not data on another port. (see Sampling Memory Usage Optimization on page 217)

Quick View: Quick View allows full access to the whole trace more quickly, especially when using a Gigabit Ethernet connection. However, the trace is NOT written to the host machine's hard drive. To save the trace, you must manually click **Save**.

If you do not check Quick View, the trace loads more slowly but is automatically saved to the host machine's hard drive.

Other

Switch to CATC Navigation: Packet view will open in CATC mode.

Reverse Link Data: The software shows DWORDs of link data as reversed.

Pack Repeated Primitives: The software packs repeated primitives just after opening a sample file.

Pack Repeated Primitives: The software packs repeated primitives just after opening a sample file.

Scroll Horizontally to Show matched Column in Search: When unchecked makes columns stationary even during search.

Use new PHY capabilities decoding: Decodes PHY capability bits in reverse order per the latest specification.

Cancel button kills upload immediately: The software kills the uploading process if you press **Cancel**.

Close previous sample file when new sample file opens: When you want to open a new sample file, the software closes any open sample files.

Create statistical report read/write page: The software creates a Read/Write page in the statistical report. Enabling this setting displays the **Read/Write Stream DMA** command in the Read/Write page.

Show Quick View Warning: The Quick View Warning pops up when attempting to close a trace that has not yet been saved, and is only shown in Quick View "mode". This checkbox allows to turn off this popup.

LBA mode: Checking this box enables LBA mode for ATA decoding.

CHS mode: Checking this box enables CHS mode for ATA decoding.

According to LBA mode in ATA command: Checking this box enables decoding according to LBA mode in ATA command for ATA decoding.

Configuration: Clicking **Configuration** displays the Trace Viewer Configuration dialog (see Figure 3.145 on page 214).

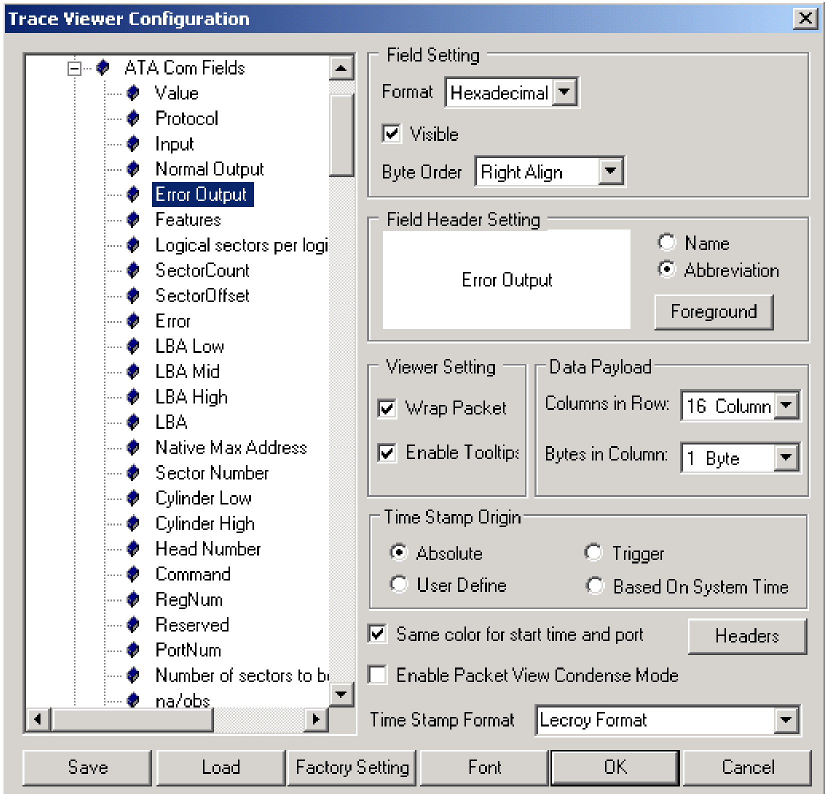


Figure 3.145: Preferences Dialog Trace Viewer Configuration Tab

Select a view in the left pane and set the trace viewer display options in the right pane.

3.17.3 Spread Sheet View Tab

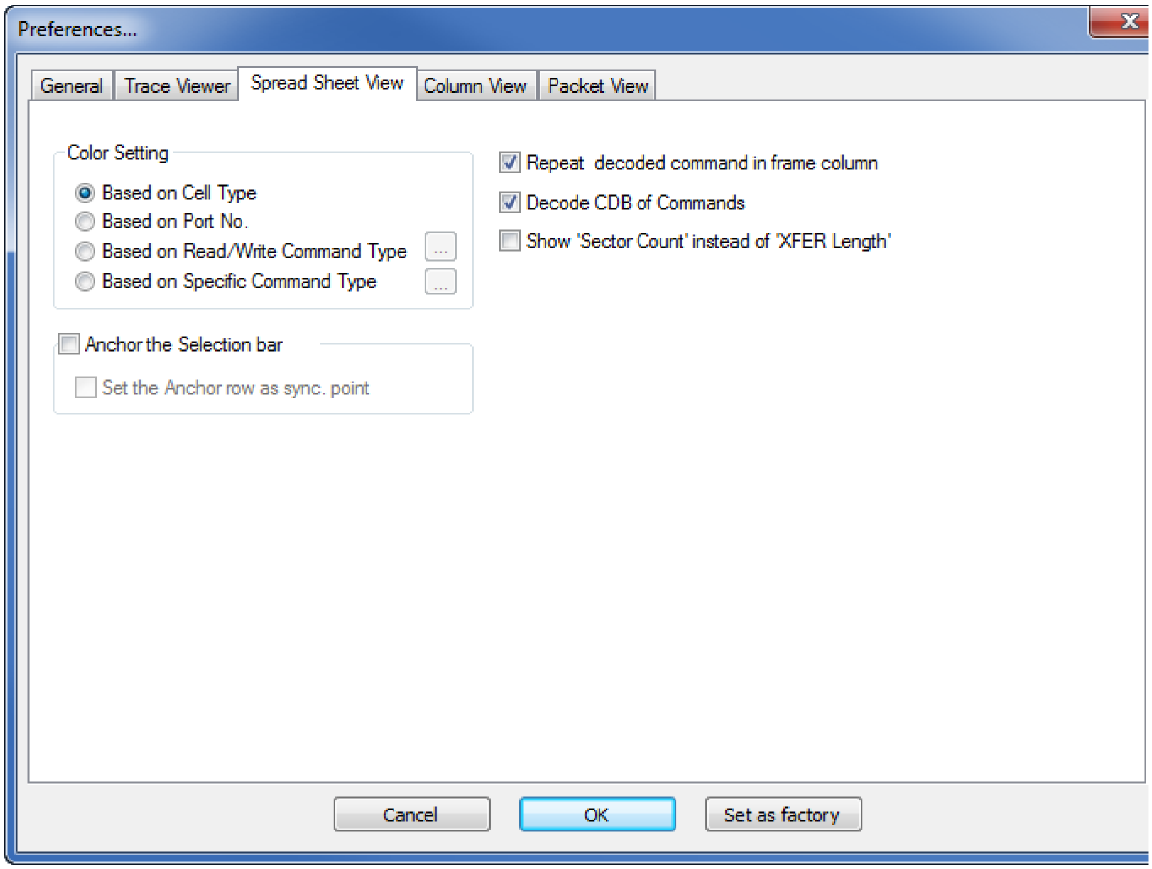


Figure 3.146: Preferences Dialog Spread Sheet View Tab

Color Setting

Based on Cell Type: Each column has its own color.

Based on Port No.: Data of each row are shown based on the specified color for its port. You can set the color of ports in the Viewer settings.

Based on Read/Write Command Type: You can specify a color for Read commands, another color for Write commands, and other color for other commands. The software shows each row based on the command type: Read, Write, or others.

Based on Specific Command Type: You can specify a color for each command. The software applies the setting on the Command column.

Anchor the Selection Bar

You can anchor the selection bar of the Spreadsheet View.

Set the Anchor row as sync. point: Other views synchronize based on the contents of the anchor row.Other

Repeat decoded command in frame column: The spreadsheet shows the name of the command in front of all frames in the Command column. Otherwise, it will show the name of the command only in front of the SSP command frame.

Decode CDB of Commands: The spreadsheet shows name of command in command column, otherwise shows CDB of command in command column.

Show 'Sector Count' instead of 'Xfer Length' (SATA only): Display sector count.

3.17.4 Column View Tab

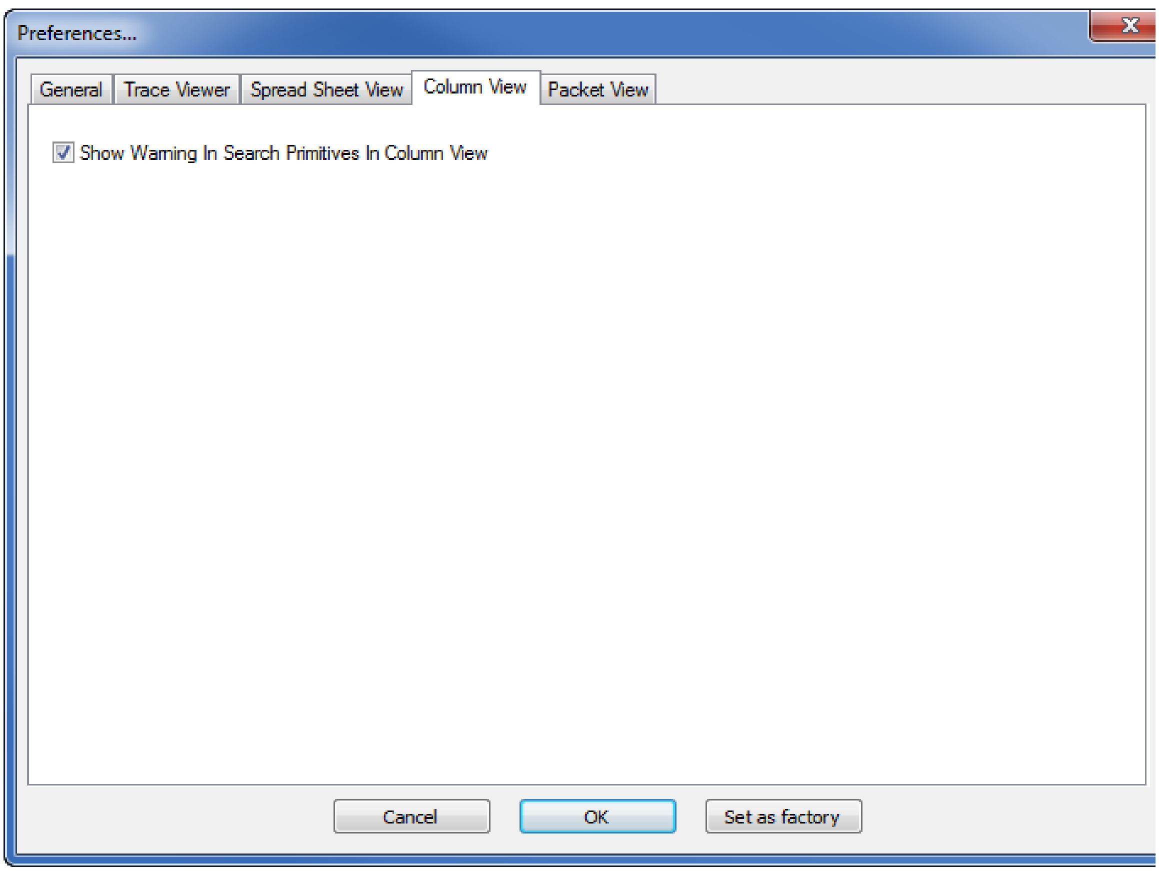


Figure 3.147: Preferences Dialog Column View Tab

Show Warning in Search Primitive In Column View: If searching in Column View takes a long time, the software asks if you want to continue search. Otherwise, the software continues searching with no pause.

3.17.5 Packet View Tab

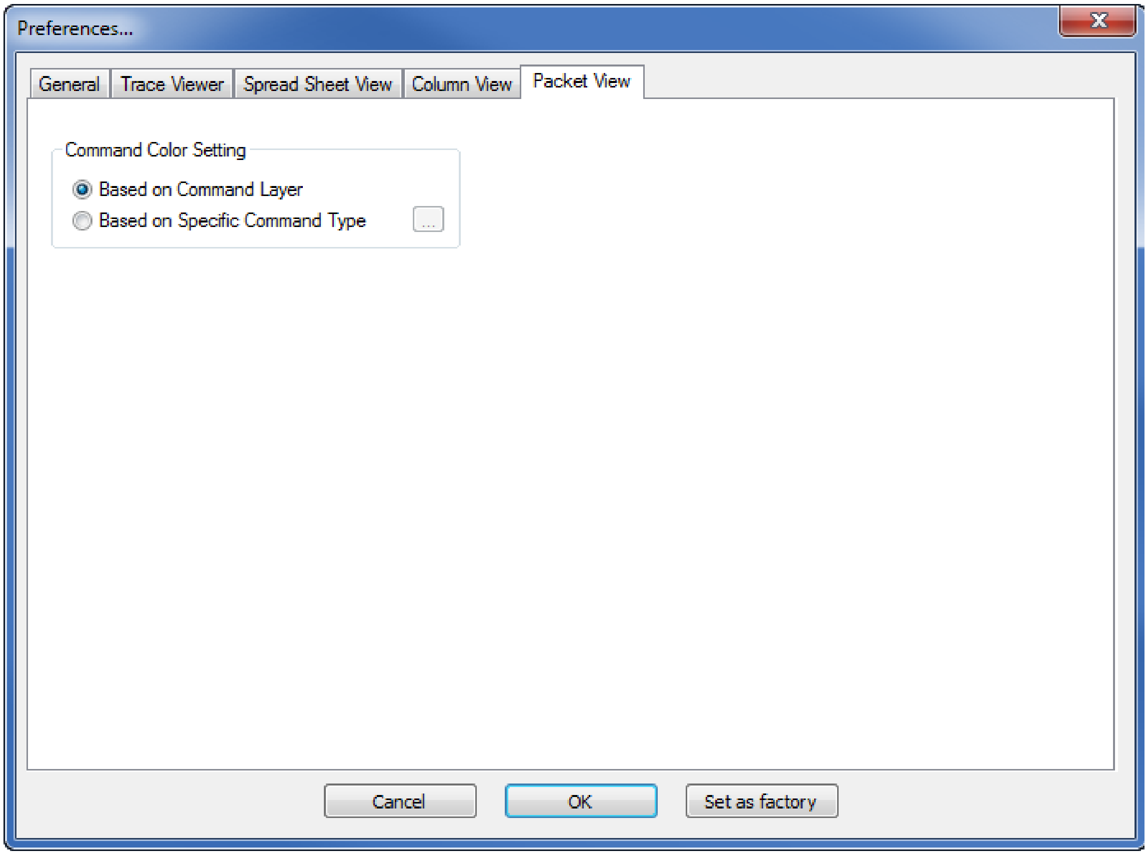


Figure 3.148: Preferences Dialog Packet View Tab

Based on Command Layer: You can specify a color for the Command Layer. The software shows each row based on the command layer.

Based on Specific Command Type: You can specify a color for each command. The software applies the setting on the Command column.

3.17.6 Sampling Memory Usage Optimization

The Preferences dialog has a Sampling Memory Usage Optimization option in the **Trace Viewer** tab. This Memory Assignment (MA) feature optimizes sampling memory utilization.

If the Sampling Memory Usage Optimization Option is Checked

The system tries to use empty space in all memory banks to prevent any memory bank from filling completely. Each physical link is not necessarily assigned to a specific memory bank. The system can capture more sample data than if the MA option is unchecked, and sample file size is closer to the user-defined Sampling Memory Size.

Memory Assignment efficiency varies with Port Configuration and Trigger Position:

- **FPGA**: The Memory Assignment feature works for a pair of ports connected to one FPGA, for example ports 1 and 2 (or ports 3 and 4). Memory Assignment does not work for two ports connected to different FPGAs, for example ports 1 and 3.

- **Triggering**: Memory Assignment only starts after the trigger point. During pre-trigger, each physical link is always assigned to a specific memory bank. Post-trigger, the system can try to use empty space in all memory banks, if you check the MA option. Therefore, Memory Assignment efficiency is maximum when Trigger Position is set to 0% (snap-shot trigger) and is minimum when Trigger Position is set to 99% or when there is no triggering (you stop recording manually).
- **MUX**: When MUX is enabled, each segment has four memory banks, limiting Memory Assignment somewhat.

Here are examples of different Port Configurations and Trigger Positions:

- **One port configuration (A - - -):** Sample size is user-specified sample size.
- **Two port configuration (AA - -)**: Ports 1 and 2 are on the same FPGA, so Memory Assignment has an effect. If you use snapshot triggering, the sample size is near specified size.
- **Two port configuration (AA - -):** If you use manual stop, Memory Assignment has no effect. Sample size depends on port traffic loads.
- **Two port configuration (AA - -)**: If trigger is set at 50%, and there is enough data to fill pre-trigger, Memory Assignment has an effect. Sample size is typically near specified size.
- **Two port configuration (AA - -)**: If trigger is set at 50%, but there is not enough data to fill pre-trigger, Memory Assignment has an effect. Sample size is typically more than half specified size, with size determined by the amount of data captured before trigger.

Note: Checking this option does not affect the sample. It only allows larger sample sizes.

Note: If traffic is balanced on ports, sample size is the same whether you check or uncheck the Sampling Memory Usage Optimization option.

Note: Memory Assignment depends on traffic load distribution at the time when the system tries to re-assign physical links to memory banks. Therefore, if you repeat a capture with the same Sampling Memory Size and Segment Number parameters, the resulting sample size may not be the same. However, if traffic load distribution is similar, sample size will be similar.

Note: The buffer status indicator shows buffer by FPGA, not by port.

If the Sampling Memory Usage Optimization Option is Not Checked

Each physical link (or logical link if MUX is enabled) is assigned to a specific memory space (memory bank), depending on the Sampling Memory Size and Segment Number parameters.

Important: If **any** physical link fills its memory bank, the recording process stops. Other memory banks will typically be less than full (and can be empty). The sample file might be smaller than the user-defined Sampling Memory Size. You might even think that the Analyzer malfunctioned.

3.18 Floating License

Note: License Manager is only available when in Cascading mode. For example, if one unit is licensed only for JJJJ and a second unit is licensed only for AAAA, cascading the two units and using the License Manager allows each unit to do JJAA.

To manage the license, select **Setup > Manage Setup Licenses**.

The Floating License dialog (see Figure 3.149 on page 219) displays the available functionality by Function, Total Ports, Assigned To ports, and Not Used. It also displays the Current License Configuration by License Type, Serial Number, Analyzer, Device Emulator, Host Emulator, and InFusion.

Note: Sierra M124 currently does not support Device Emulator, Host Emulator, and InFusion.

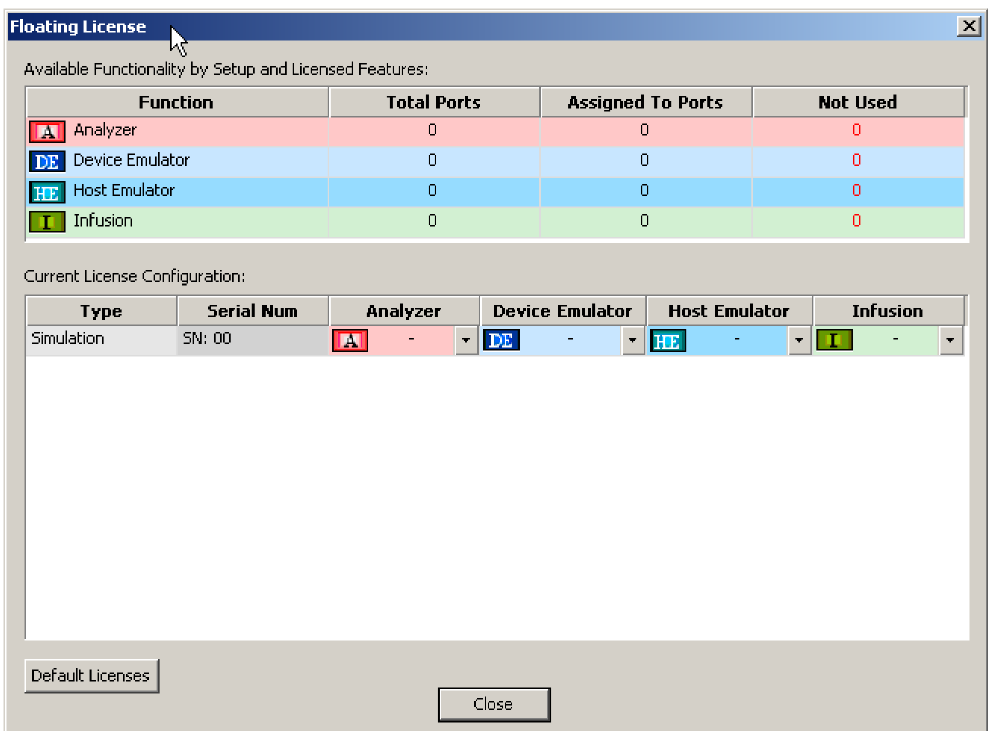


Figure 3.149: Floating Licence Dialog

3.19 External Trig Setting

To display the External Trig Setting dialog, select **Setup > External Trig Setting**. The External Trig Setting dialog displays the External Trig Out Setting and External Trig In Setting as High Active, Low Active, or Toggle.

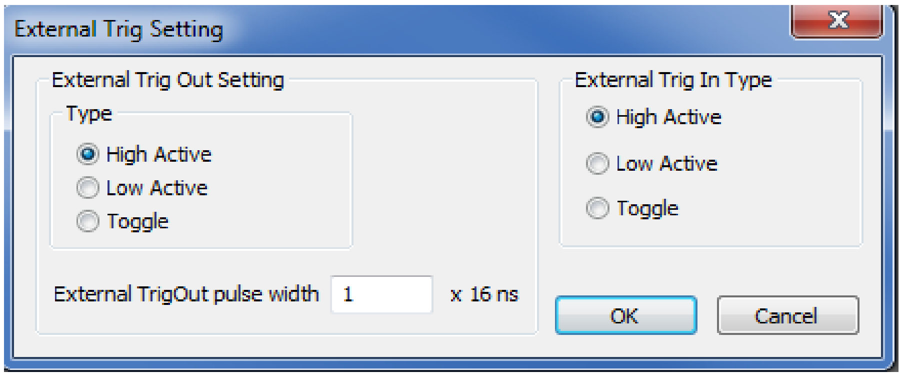


Figure 3.150: External Trigger Setting Dialog

To display the External Trig Setting dialog, select **Setup > External Trig Setting**.

External Trig Out Setting
The Analyzer can send a Low or High external signal anytime a trigger occurs. Select the External Trig Out Setting: High Active, Low Active, or Toggle from High to Low or Low to High once (3.3 V output).

Enter the External TrigOut pulse width.

Note: The External TrigOut pulse width field supports increments of 16 ns, starting from 64 ns and up to 1024 ns.

External Trig In Setting
An external Low or High input signal can cause triggering. Select the External Trig In Setting: High Active, Low Active, or Toggle from High to Low or Low to High once (3.3 V output).

Note: The nominal External Trigger voltage is 0.818 volts. Trigger In can work with 1 volt to 5 volts input voltage.

3.20 Update Device

The Update Device command allows you to update a Sierra M124 Analyzer or CATC-Sync expansion card whose current version is incorrect.

1. Click **Setup > Update Device** to display the Device Setup dialog.

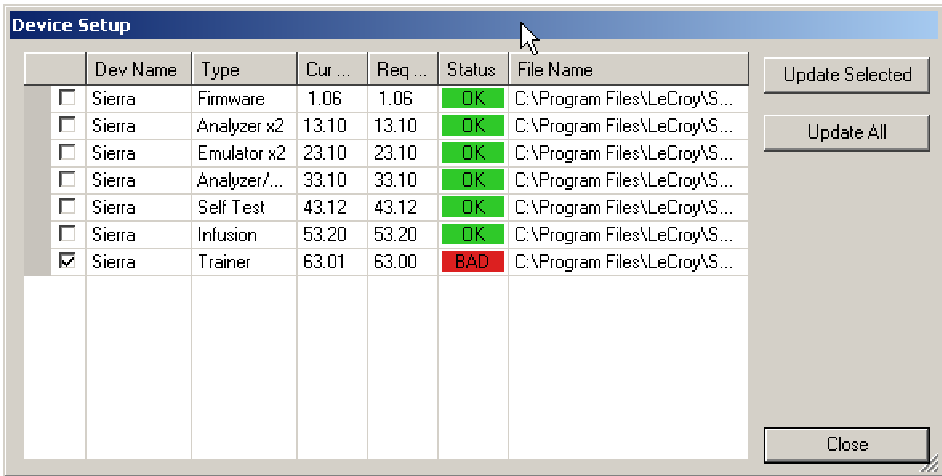


Figure 3.151: Device Setup Dialog with BAD Device Status

Devices whose version is correct have an OK status.
A device whose version is incorrect has a BAD status.

Note: You can click the ellipses (...) at the end of a file path and name to display an Open dialog, in which you can browse for files.

---

2. Click the checkbox to the left of a device with BAD status, then click **Update Selected** to begin the process that will make the Analyzer version correct (see figure on next page).

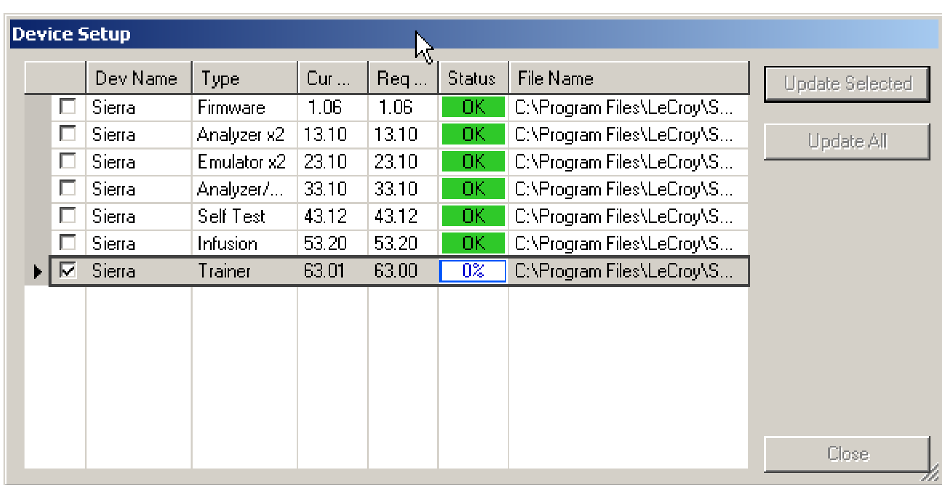


Figure 3.152: Device Setup Dialog Beginning to Update Status of a Device

After the update, the device must restart.

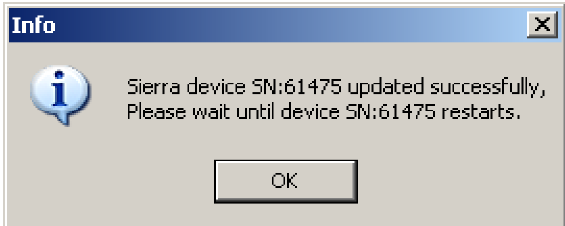


Figure 3.153: Info Dialog

Then the update is complete.

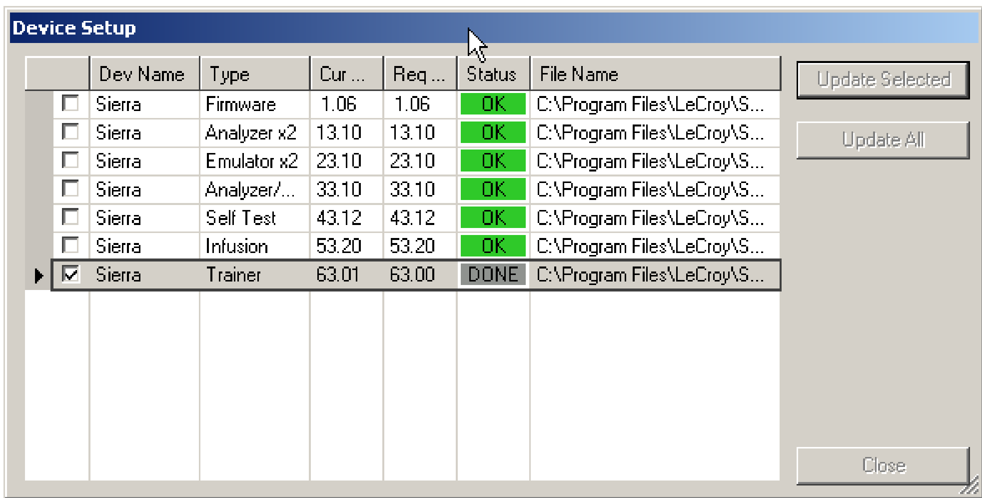


Figure 3.154: Device Setup Dialog with DONE Device Status

3.21 User-Defined Decoding

User-defined decoding allows you to create a definition file to interpret commands and frames that are not in the standard set recognized by the software.

Select **Setup > User Defined Decoding** to open the User Defined Decoding dialog.

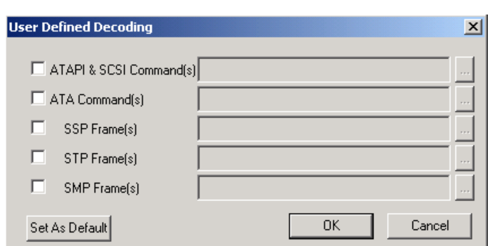


Figure 3.155: SAS: User Defined Decoding

SAS vs. SATA: SAS adds SCSI Commands, SSP Frames, and SMP Frames.

Check **ATA Commands** and/or **STP frames.** Click the ellipses next to a command type text box to display the **Open** dialog. Choose an appropriate script file and click **Open**.

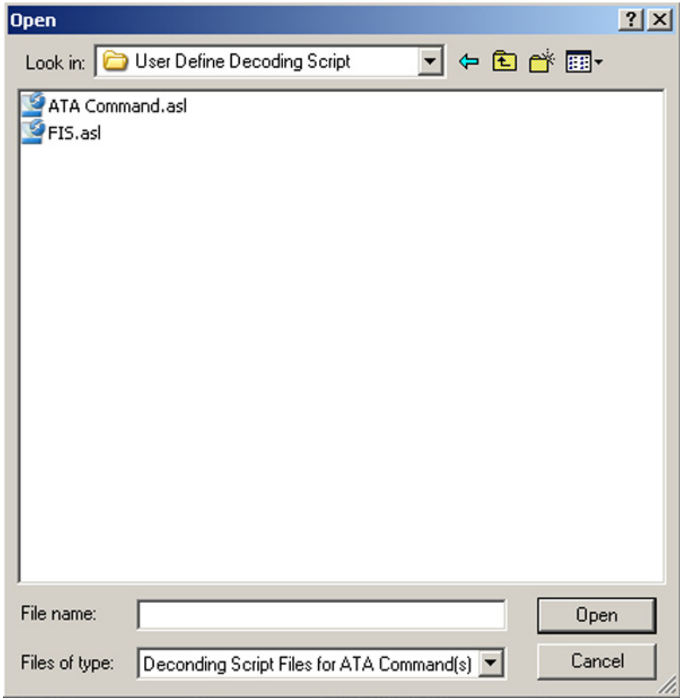


Figure 3.156: Choosing a Script File

3.22 Help Menu

3.22.1 Tell Teledyne LeCroy

Report a problem to Teledyne LeCroy Support via e-mail. This requires that an e-mail client be installed and configured on the host machine.

3.22.2 Help Topics

Displays online help. You can also select F1.

3.22.3 VSE Help Topics

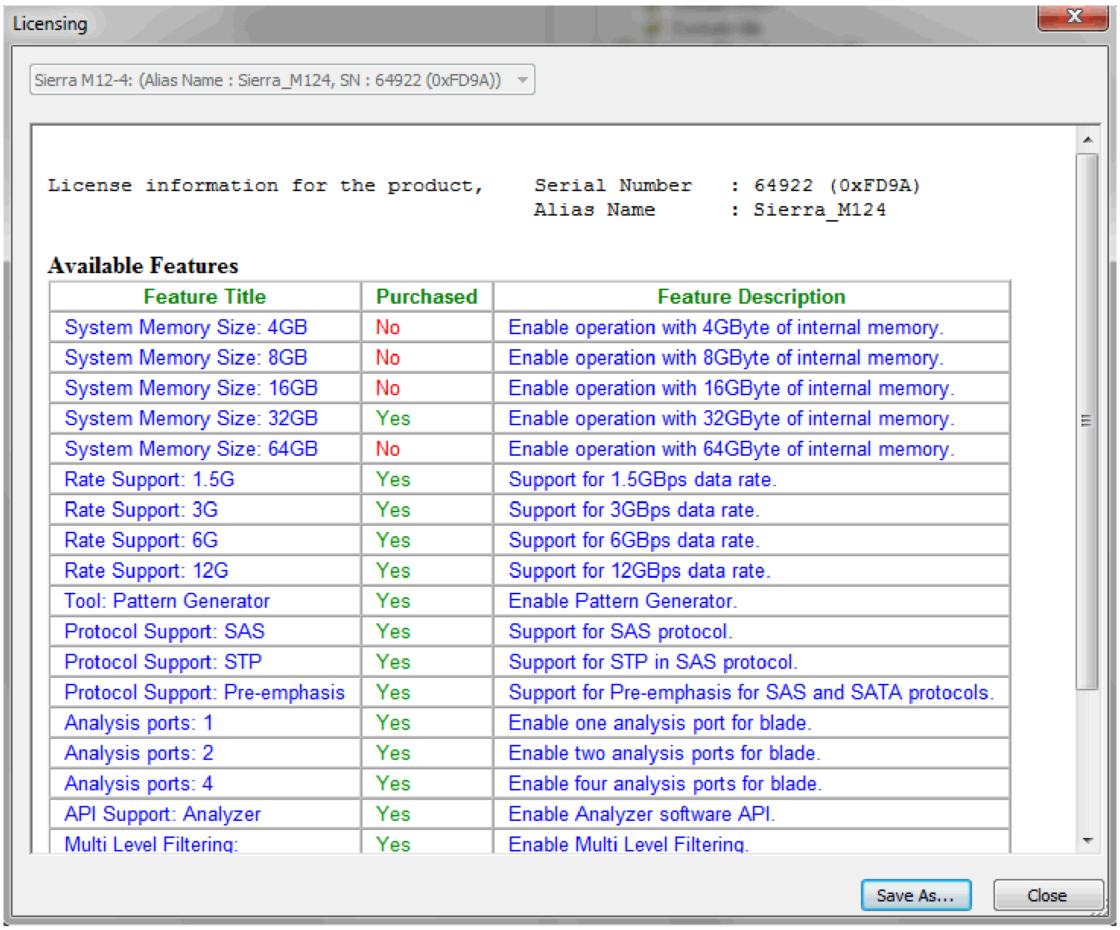
Displays VSE online help. You can also select F1.

3.22.4 Update License

A current license agreement with Teledyne LeCroy entitles the Analyzer owner to continued technical support and access to software updates as they are published on the Teledyne LeCroy website. When you obtain a license key, from the Help menu select Update License to display the Select License Key File dialog box. Enter the path and filename for the license key, or browse to the directory that contains the license key and select the *.lic file. Click Open.

3.22.5 Display License Information

Open a license information dialog to display a list of named features supported by the current software version (see Figure 3.157 on page 224). Named features that are not enabled on your system are indicated by No in the Purchased column. Whether or not named features are enabled depends on the license key stored in your analyzer. If you try to use a feature for which you do not yet have a license, the program displays the License Protection Message. To use the feature, you must purchase a license.



Feature Title	Purchased	Feature Description
System Memory Size: 4GB	No	Enable operation with 4GByte of internal memory.
System Memory Size: 8GB	No	Enable operation with 8GByte of internal memory.
System Memory Size: 16GB	No	Enable operation with 16GByte of internal memory.
System Memory Size: 32GB	Yes	Enable operation with 32GByte of internal memory.
System Memory Size: 64GB	No	Enable operation with 64GByte of internal memory.
Rate Support: 1.5G	Yes	Support for 1.5GBps data rate.
Rate Support: 3G	Yes	Support for 3GBps data rate.
Rate Support: 6G	Yes	Support for 6GBps data rate.
Rate Support: 12G	Yes	Support for 12GBps data rate.
Tool: Pattern Generator	Yes	Enable Pattern Generator.
Protocol Support: SAS	Yes	Support for SAS protocol.
Protocol Support: STP	Yes	Support for STP in SAS protocol.
Protocol Support: Pre-emphasis	Yes	Support for Pre-emphasis for SAS and SATA protocols.
Analysis ports: 1	Yes	Enable one analysis port for blade.
Analysis ports: 2	Yes	Enable two analysis ports for blade.
Analysis ports: 4	Yes	Enable four analysis ports for blade.
API Support: Analyzer	Yes	Enable Analyzer software API.
Multi Level Filtering:	Yes	Enable Multi Level Filtering.

Figure 3.157: Licensing Dialog

3.22.6 Check for Updates

Check whether a new software version is available. If so, you can download from the Teledyne LeCroy web site.
You can select to Check for updates at application startup.

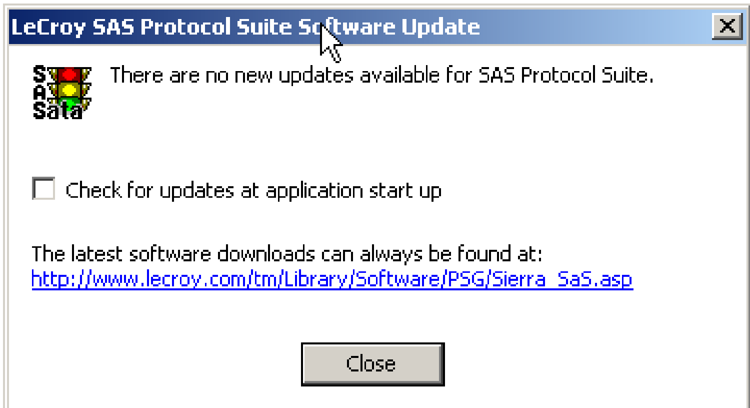


Figure 3.158: Check for Updates

3.22.7 About

Displays version information.

3.23 Find DUT

Saving device information allows you to import the specific device information into the Target/Device emulator.

The Find DUT utility obtains all vendor-specific information and detailed device parameters.

This feature only works in "SAS address" mode. It finds SAS addresses only and works up to one expander level.

Find device finds any devices that are attached to any port.

Select **Setup** on the main menu bar and choose **Find DUT** (see Figure 3.159 on page 226).

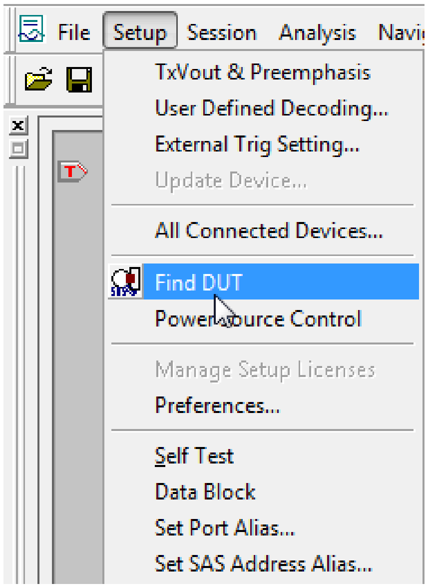


Figure 3.159: Find DUT

The Find DUT dialog displays.

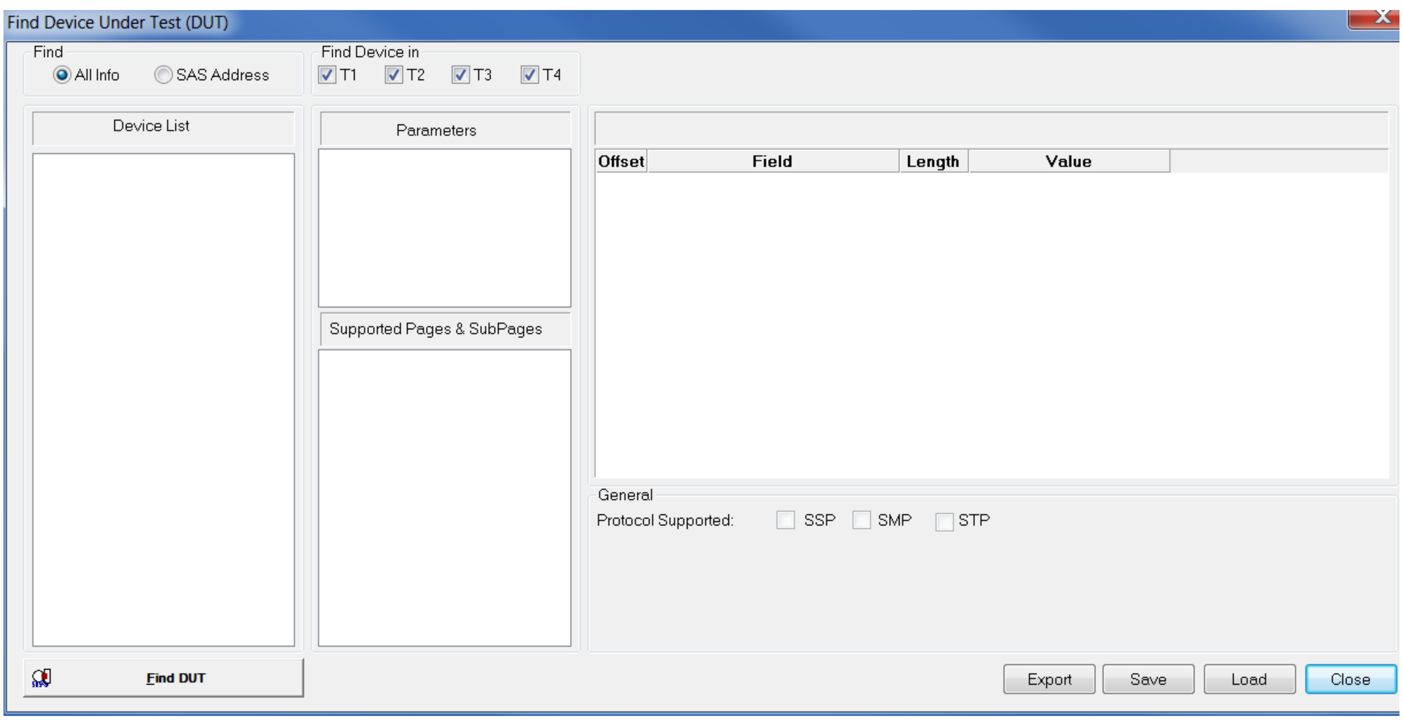


Figure 3.160: Find DUT Dialog

Click the **Find Device** button to search for connected devices. After a brief period, the dialog displays all device information.

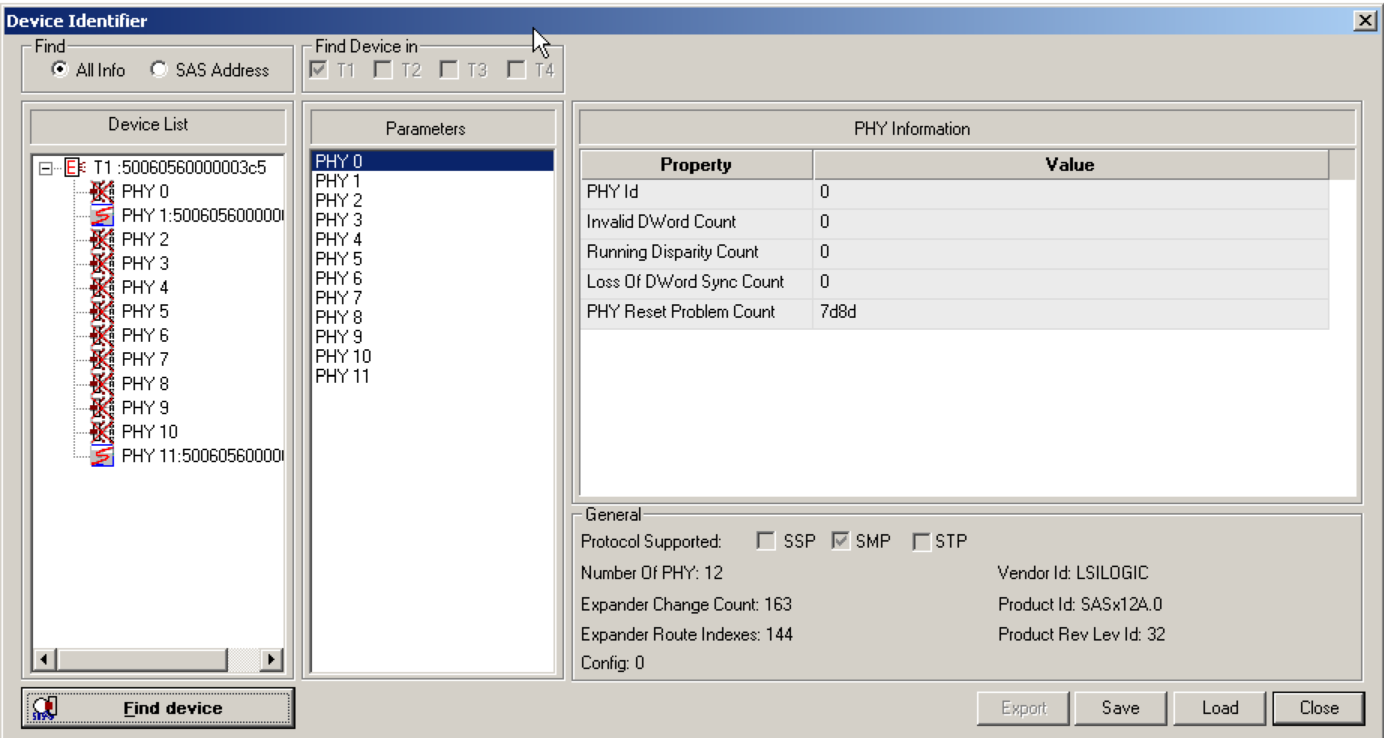


Figure 3.161: SAS: Identified Devices

Click a device in the Device List to display information about that device.

Aliasing

You can enter a 16-character alias name for a device. In the Device List, right-click the device name and enter an alias after the colon.

The alias name appears in the Device List.

Exporting

You can export a device specification to a text file. Click the **Export** button to open the Export dialog.

3.24 SAS Verification (SAS)

SAS Verification consists of a set of selectable tests to verify compliance with the SAS specification.

Note: Speed Negotiation and all other SAS tests are documented in the *SAS Verification Test Descriptions.pdf*. file in the installed documents directory.

Note: With the exception of the NACA test, the SAS Verification tests can be run at 12G.

To run a SAS Verification Test:

1. Select **Analysis** on the main toolbar and choose **SAS Verification** to open the SAS Verification dialog (see Figure 3.162 on page 228).

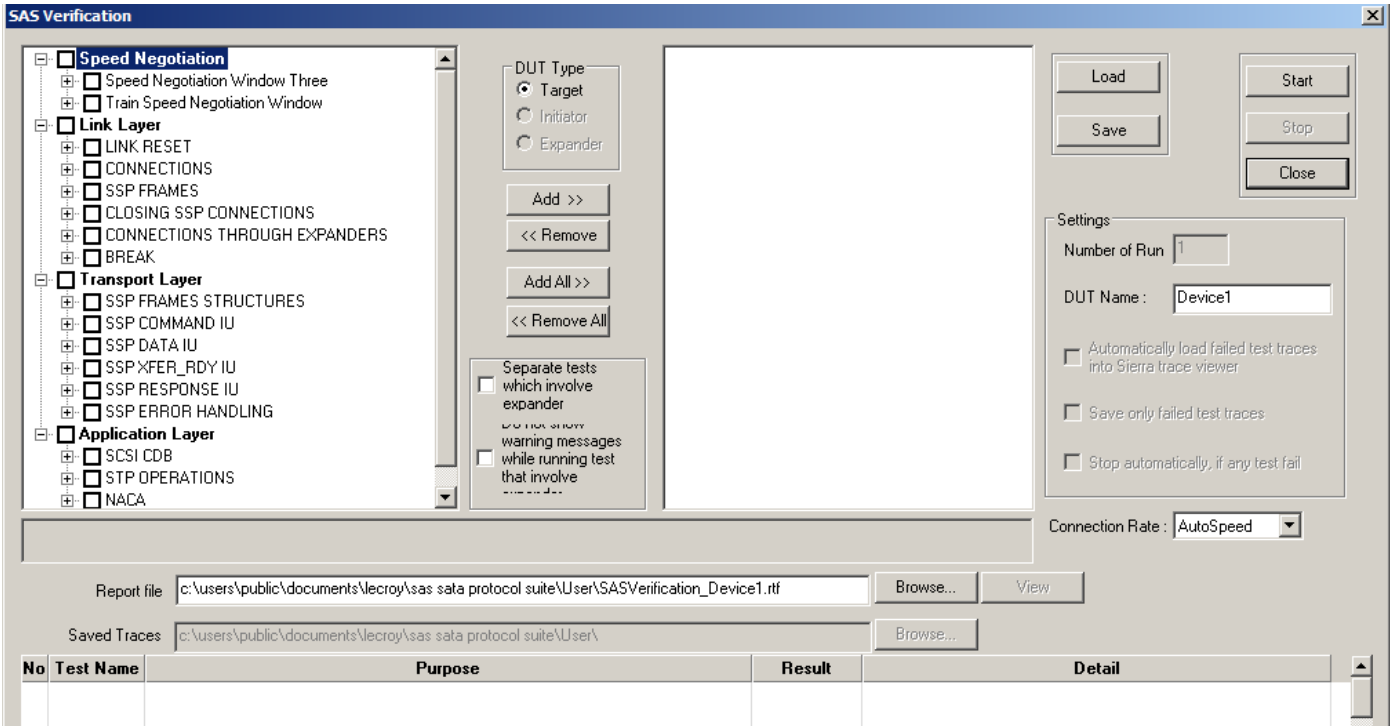


Figure 3.162: SAS Verification Dialog.

- **Speed Negotiation** has Speed Negotiation Window Three and Train Speed Negotiation Window.
- **Link Layer** has Link Reset, Connections, SSP Frames, Closing SSP Connections, Connections through Expanders, and Break.
- **Transport Layer** has SSP Frames Structures, Command IU, Data IU, XFER_RDY IU, Response IU, and Error Handling.
- **Application Layer** has SCSI CDB, STP Operations and NACA.

2. Choose the tests in the left pane of the dialog and click the **Add>>** button.
3. Enter a value for **DUT Type**: Target, Initiator, or Expander.
4. Enter a value for the **Number of Runs** to run a particular test more than once.
5. Enter the **DUT Name**.
6. Enter the **Connection Rate** as Autospeed or a value.
7. To view failed test traces in the sample viewer, check the **Automatically load failed test traces into Sierra trace viewer** check box.
8. To save the failed test traces only, check the **Save only failed test traces** check box.
9. Enter a path and file name for **Report file**, or use the default file name and path:

For Windows XP:

```
C:\Program Files\LeCroy\SAS SATA Protocol
Suite\User\SASVerification_Device1.rtf
```

For Windows 7:

```
C:\Users\Public\Documents\LeCroy\SAS SATA Protocol
Suite\User\SASVerification_Device1.rtf
```

10. Enter a path and file name for **Saved Traces**, or use the default folder:

For Windows XP:

```
C:\Program Files\LeCroy\SAS SATA Protocol Suite\User\
```

For Windows 7:

```
C:\Users\Public\Documents\LeCroy\SAS SATA Protocol Suite\User\
```

11. After you select tests, click **Start**.
12. The test runs and, after a brief period, displays the result.
13. To save the current compliance setup for later use, click the **Save** button to open the **Save As** dialog. Assign a meaningful name to the setup and save it as a ***.cst** compliance file.
14. To run a previously defined setup, click the **Load** button and choose a previously defined setup to run.

Note: For the NACA test, both ports of the SAS device must be connected to two Host Emulation ports, I1 and I2, using two SATA cables.

Note: When you are running SAS Verification, you cannot work with Trainer and Emulator while device is connected to D connector and HBA is connected to H connector.

Note: You must use a Power Expansion Card (ACC-EXP-004-x or ACC-EXP-005-X) for SAS Verification. See Using the Power Expansion Cards on page 21.

Note: Connecting to an HBA, while running in Emulation/Trainer mode, will impact test results.

Chapter 4

InFusion Overview

The LeCroy InFusion™ Error Injector and Traffic Modifier is an error injector and traffic modification tool that allows you to verify real-world fault handling for Serial Attached SCSI (SAS) and Serial ATA (SATA) systems. InFusion can sit unobtrusively in the data path on a live system to programmatically alter or corrupt traffic. InFusion is the ideal tool for stress-testing systems using actual workloads.

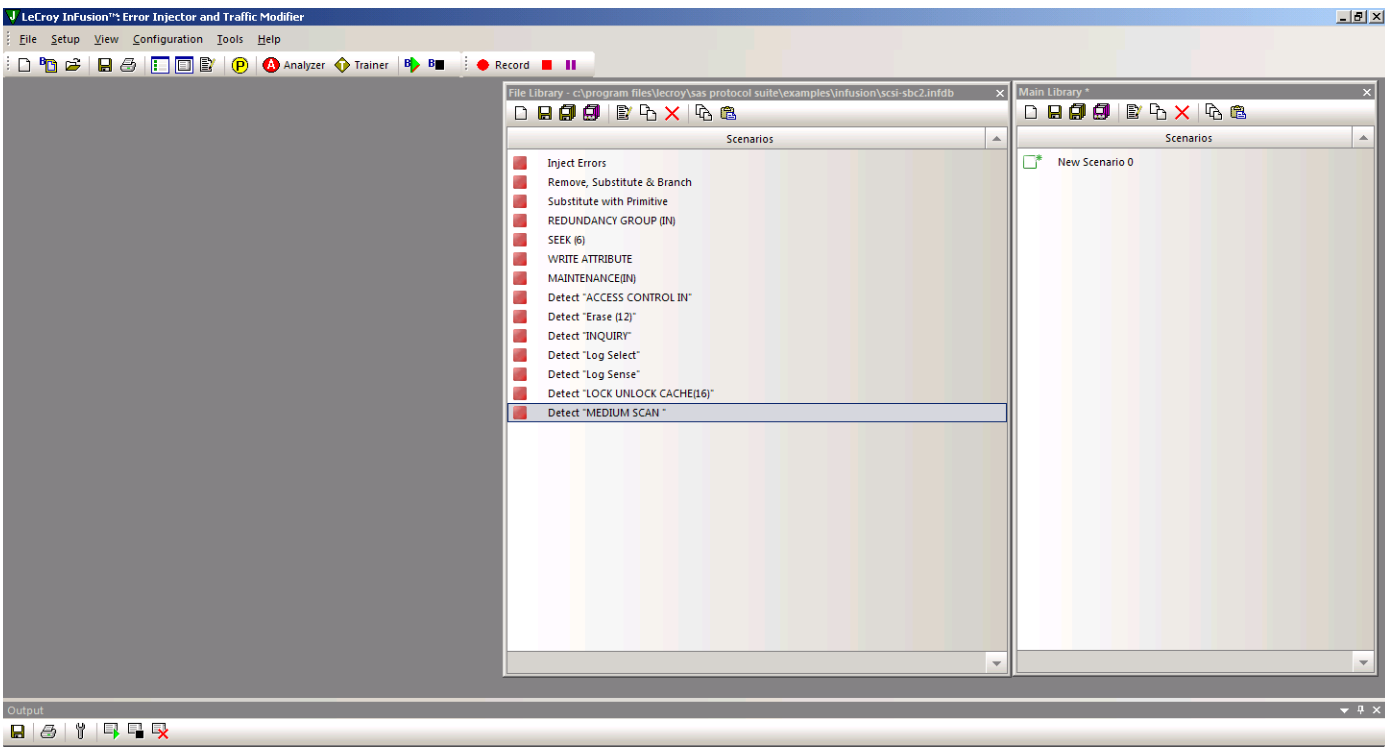


Figure 4.1: InFusion Windows.

InFusion supports SAS SSP, SMP, STP, and SATA-based protocols operating across a single SAS or SATA link up to 12 G. InFusion monitors traffic from both directions in real-time and relies on predefined rules to replace any bit, primitive, or parameter with one you specify. InFusion can change traffic when it detects a specific sequence or reaches a designated time interval, yet it requires no complicated scripts, programming, or simulation tools.

InFusion can monitor traffic in both directions and act on events occurring in either direction of the communications link. InFusion can modify traffic in only one direction within a given test scenario, but that direction can be either from the Initiator or from the Target.

InFusion is specifically designed to verify recovery characteristics within a subsystem. An easy pop-up menu interface allows you to create specific test scenarios in just minutes.

Once a InFusion session starts, the system automatically handles protocol handshaking between devices. InFusion transmits a faithful copy of the original data stream down to the CRC value which, if needed, it recalculates. InFusion allows test engineers to systematically verify error recovery in ways not possible with other test platforms.

An Infusion event can trigger an analyzer.

4.1 Key Features

The key features of InFusion are:

- **Error Injection**: Injects CRC, disparity, 8b/10b encoding, framing, and coding errors.
- **Break Link Recovery**: Programmatically breaks the connection to test link recovery.
- **Value Replacement**: Monitors the link for specific values, patterns, or primitives (as low as bit level) and replace with user-defined values. You can replace values on every occurrence, after a specified number of occurrences, or after a specified time interval.
- **Packet Drop**: Removes individual primitives, address frames, or data frames from the stream to verify retry behavior.
- **Primitive Manipulation**: Replaces handshaking and flow control primitives to help validate robustness of a design.
- **Traffic Monitoring:** Operates as a traffic monitor, collecting statistical data on user-specified parameters. In this mode, data passes unchanged in both directions.
- **Menu-Driven Interface:** Allows easy set-up of test scenarios.
- **API based on C++:** Allows development of custom test applications.
- **Scenario Batch Files:** Allows scenario scripts.

With respect to traffic modification, in the Link Layer you can modify primitives, CRC, scrambled traffic, and SSP, SMP, and STP connection events. You cannot modify clock skew management, OOB and power management, and signal integrity.

InFusion consists of a hardware device that connects to the line under test and a Windows-based software application used to create and download test scripts to the device. You also can use the software application to configure and control the device across an Ethernet link.

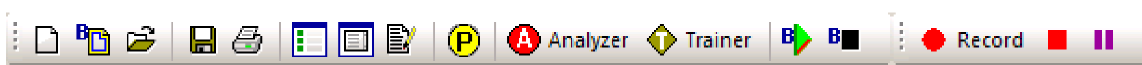
InFusion test scripts are called scenarios. Scenarios determine how the hardware device monitors and modifies line traffic. You must use the application to create and download scenarios.

For the InFusion connections, the device is connected between the SAS/SATA host and the PHY of the test target (DUT). Link training is not performed transparently because the FPGA cannot manipulate the required physical probe settings. Hence, training sequences and speed negotiation cannot be jammed. Another side effect is that pre-jam and post-jam recordings during these events are not the same.

4.2 Interface

4.2.1 Buttons

The InFusion interface has the following command buttons:



New Scenario: Begins the scenario creation process by listing Scenario Name, Direction for traffic changes, and Global Rules in the scenario window.

New Batch Script: Starts a scenario batch file in Batch Script window.

Open Library: Lists the InFusion Library Files (**.infdb**), which contain the available scenarios, in an Open dialog.

Save: Saves the current scenario in the UserData folder.

Print: Prints the current scenario.

Show Library: Displays/hides the Main Library window (on the right), which displays the available scenarios. You can create a new scenario, save a selected scenario, save the library, save a copy of the library, display the selected scenario, insert a copy of the selected item, or delete the selected scenario.

Show Output: Displays/hides the Output window (at the bottom), which displays InFusion output. Use the buttons to save output, print output, display options (automatically save the log file, with a path and size), start logging, stop logging, and clear the Output window.

Show Port Assignment: Displays/hides the current port assignment.

Port Configuration: Displays the port configuration dialog. See "Port Configuration for InFusion" on page 237.

Launch Analyzer: Returns to the Protocol Analyzer or Target/Host Emulator window.

Launch Trainer: Goes to the Trainer window.

Run Batch Script: Runs a scenario batch file.

Stop Batch Script: Stops a running scenario batch file.

Record: Starts recording on the current analyzer, using the current project.

Stop: Stops recording on the current analyzer.

Abort: Aborts recording.

4.2.2 Menus

The InFusion interface has the following menus:

File

(see command descriptions in the "Buttons" section above)

- New Scenario, Open Scenario (File Library or Main Library)
- Open an InFusion database (**.infdb** file)
- Launch Analyzer
- Launch Trainer
- New Batch Script, Save Batch Script As
- New Library, Close Library (File Library or Main Library), Save Library, Save Copy of Library As
- Open Log File
- Print Setup
- Recent Trace Files
- Recent Project Files
- Close

Setup

- External Trig Setting (see "Floating Licence Dialog" on page 219)
- Update Device (see "Update Device" on page 221)
- All Connected Devices
- Status Bar

View

- Views (Library, Output, Port Assignment, Customize - commands, Toolbars, Keyboard, Menu and Options)
- Smart Docking
- Toolbar
- Status Bar

Configuration

- Port Configuration (see "Port Configuration for InFusion" on page 237)
- Batch Script Setting (see "Scenario Batch Files" on page 281)

Tools

Browse UserData, System, or InFusion folder.

Help

Help Topics and About InFusion.

4.2.3 Main Library

You can **Show Main Library**.

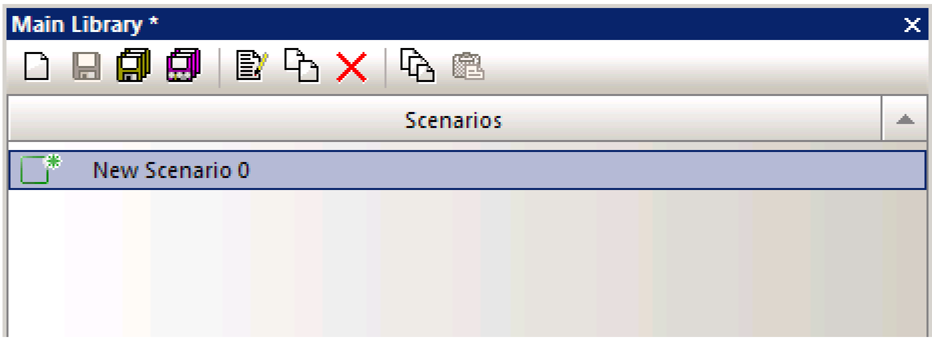


Figure 4.2: Main Library.

The Main Library has Scenarios.

Using the buttons from left to right, you can:

- Create a new scenario and save a scenario.
- Save a library and save a copy of a library.
- View/edit a scenario, insert copy of a scenario and delete scenario.
- Copy and paste.

4.2.4 File Library

You can display the File Library.

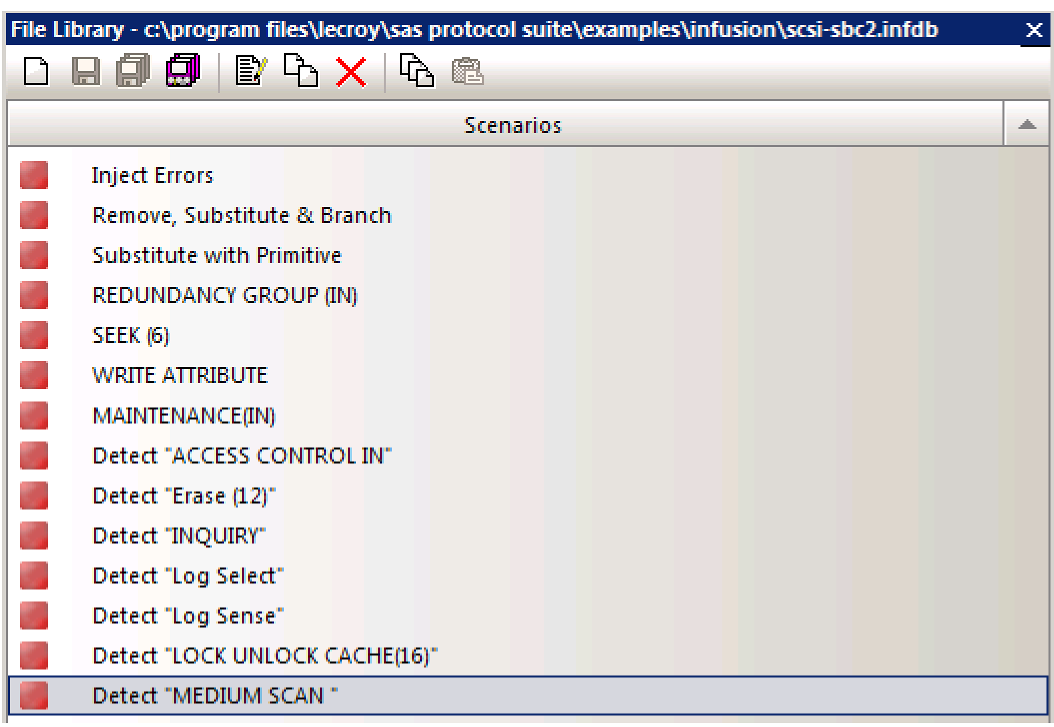


Figure 4.3: File Library.

A File Library has Scenarios currently available in the device.

Using the buttons from left to right, you can:

- New scenario.
- Save selected scenario.
- Save library.
- Save a copy of the library as.
- View/edit a selected item.
- Insert a copy.
- Delete a selected scenario.
- Copy
- Paste

4.2.5 Device Ports

If a device is connected, the software displays the Device Ports.

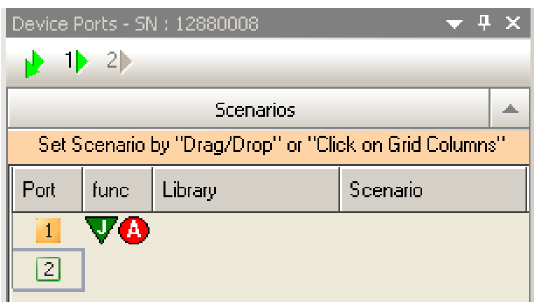


Figure 4.4: Device Ports.

Using the first row of icons, you can Run/Stop All Ports or Run/Stop individual ports.
The columns display the Port, Function/Configuration, Library, and Scenario.
You can Float, Dock, Auto-Hide, or Hide the window.

Note: A port row is grayed-out when that port has not been configured to be a Jammer in the Port Configuration dialog (see "Port Configuration for InFusion" on page 237).

Using the Device Ports Dialog

After you have finished Port Configuration (see "Port Configuration for InFusion" on page 237), you use the Device Ports dialog (see "Scenario Libraries" on page 242) to assign specific scenarios to ports, so that different scenarios can run on different ports.

To assign a scenario to a port, drag and drop the scenario from any library window to the port. The Device Ports dialog then displays the Library and Scenario on the row for that Port/Configuration.

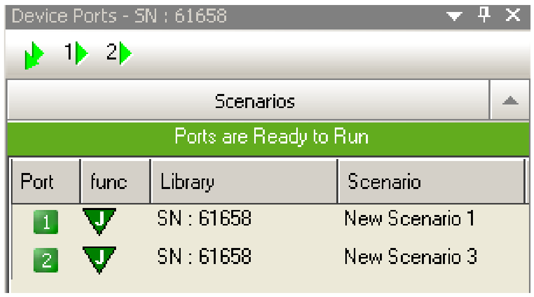


Figure 4.5: Device Ports Dialog.

Alternatively, assign the scenario using the Library and Scenario drop-down lists.

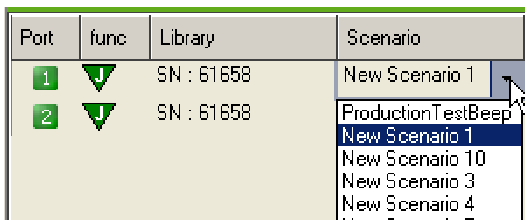


Figure 4.6: Scenario Drop-down List.

After you have assigned scenarios to ports, in the first row of icons, use the first green arrow icon to **Run/Stop All Ports**, or use the numbered green arrows to **Run/Stop an individual port**.

Note: A port row is grayed-out when that port is running a scenario.

4.3 Port Configuration for InFusion

The InFusion (Jammer) port configurations must match the Analyzer port configurations for the infusion-analyzer to work.

Select **Configuration > Port Configuration** to display the Select Port Configuration dialog (see Figure 4.7 on page 238).

To record traffic both before and after the InFusion modifies (jams) it, select **Analyzer/Jammer/Analyzer** on the port that you want to jam. In the following figure, there is a match on Port 0.

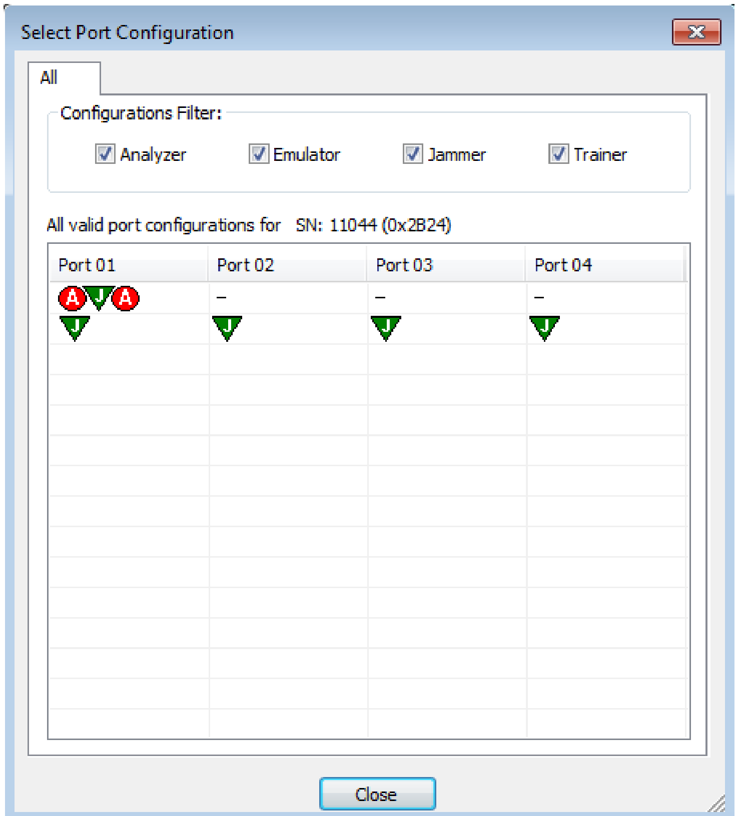


Figure 4.7: Ports Configuration Dialog with InFusion/Analyzer Port Match.

Note: You can select only one Jammer port at a time with this configuration.

To record traffic from two ports after the InFusion modifies (jams) them, select a combination of ports that have **Jammer/Analyzer** specified under them. The different configurations accommodate different possible user setups and requirements.

Note: To display the current Port Configuration, click **Show Analyzer** to go to the analyzer application, then click the green button in the lower right corner to display the Port Status window (see "Port Status" on page 195).

4.4 InFusion Scenarios

You can create and execute InFusion scenarios. A scenario is a test script that defines how InFusion monitors and modifies line traffic.

4.4.1 Scenarios Overview

The InFusion application provides a menu-driven interface for building scenarios. The interface prompts you for simple decisions and choices from drop-down menus. As you make your selections, the script takes shape automatically in the scenario window. The script is in the form of simple English sentences. You need not understand any formal scripting language (see Figure 4.8 on page 239).

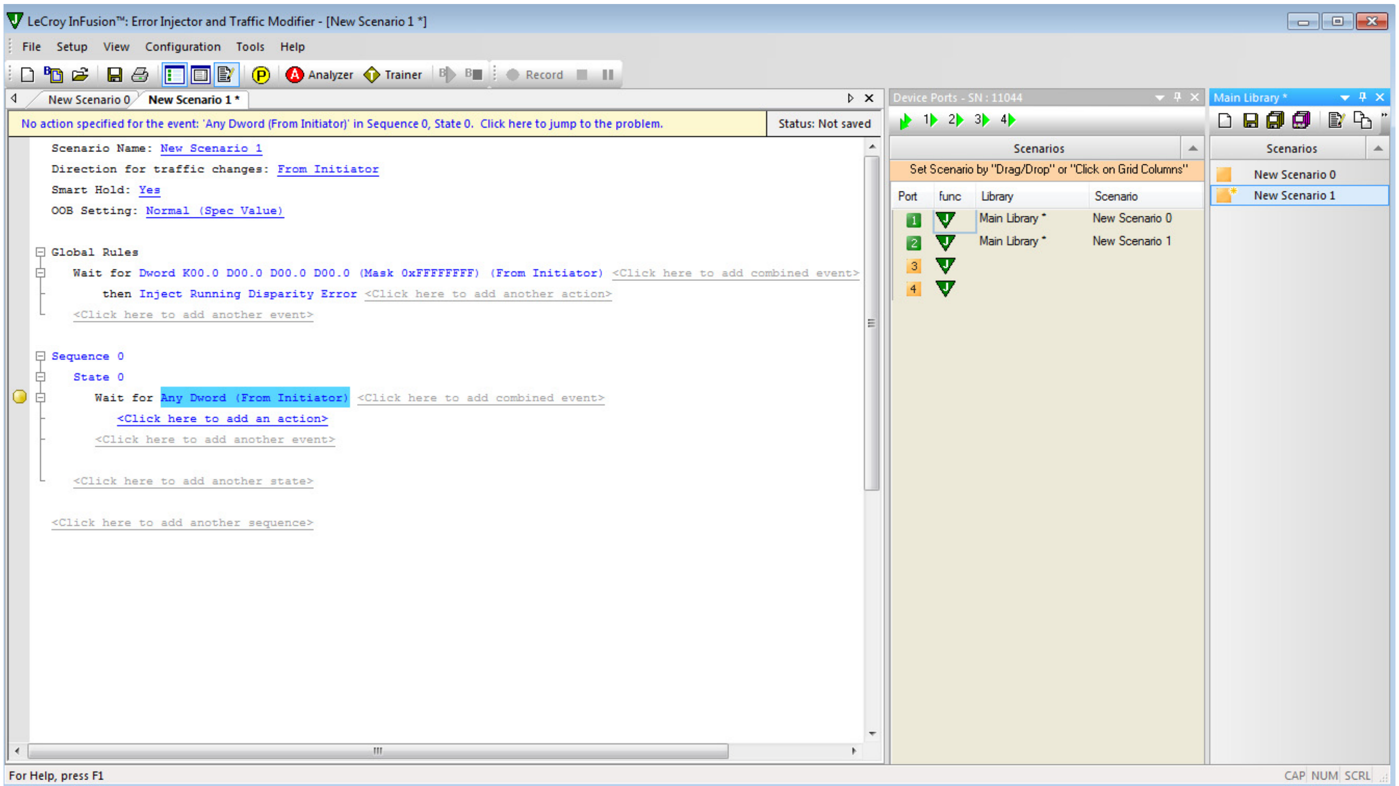


Figure 4.8: New Scenario in InFusion Window

InFusion Scenario Parameters

Timers

Timers allowed per state/sequence/scenario:

2 timers per state and 6 timers per scenario are allowed.

Events

Events allowed to be used per state/sequence/scenario:

For combined events, there is virtually no limit per state/sequence/scenario.

Actions

Actions allowed per state/sequence/scenario:

A maximum of 8 actions per state, 2048 actions per sequence (8*256 state), 4104 actions per scenario (2*2048 + 8 more in the Global Rules "state").

Monitors

Monitors allowed to be used per state/sequence/scenario:

InFusion can keep an account of 8/12 Monitor/Count events per scenario.

Random change of use of count and count randomly:

In Global Rules, if a Counter is used for Event counting, 2 extra actions are consumed. 2 more actions are required for "Every Nth occurrence" option.

In Sequences, If a Counter is used for Event counting, 3 extra actions are consumed. 3 more actions are required for "Every Nth occurrence" option.

Regarding limits on any of the above mentioned connections, i.e., x timers + y monitors are allowed per state where x+y=n:

There are a lot of big/small rules checked by the scenario compiler, but as a rule of thumb:

8 actions per state are available

12 counters globally are available, each assigned permanently to a certain job

6 available timers per scenario

12 programmable multi-purpose resources for DWORD comparison/substitution/capture are available. If a pattern detector uses 3 of these resources to trigger on a specific frame on the bus, only 9 more resources are available for other tasks. Frame/FIS type detectors are excluded from this rule, because they use their own dedicated resources.

8 primitive detectors are available

If you want to trigger on a pattern (Frame/FIS) and change/capture a dword(s) before the last offset of a detected pattern (e.g., changing the Frame Type of a SAS Frame with Data Offset == 11223344), you are limited to a maximum of 9 dword offset (i.e., if you trigger on the 20th payload of a Data FIS, you can change/capture the 12th dword onwards. 11th payload dword and preceding dwords are not accessible for change/capture)

You can not change a state based on back-to-back events. At 6G speed, there should be at least one dword between the triggering event of two consecutive states. At other speeds, back-to-back dword state transitions might rarely be missed, so best practice is to never assume back-to-back dword events.

As described later in this chapter, you can create any number of scenarios and store them in libraries on the PC hard drive. Scenario library files names are in the following format:

<*filename*>.infdb

Creating InFusion scenarios is easy, but it requires an understanding of the following terms defined in Table 4.1 on page 241.

TABLE 4.1: Key Scenario Terms

Term	Definition
Action	InFusion response to an event.
Event	Condition that is detectable by InFusion.
Combined Event	Logical OR association of events (for example, event A OR event B).
Global Rules	Portion of a scenario that can define a single InFusion test state. You can think of the Global Rules and each sequence as a separate test routine or program operating within the scenario. Each operates independently and in parallel with the others. The purpose of each is to detect events and then respond with the appropriate action or set of actions. In essence, you can operate up to three test states simultaneously within InFusion.
Sequence	Portion of a scenario that can define multiple InFusion test states. More flexible than the Global Rules, a sequence allows more powerful scenarios that include branching and looping between test states (Global Rules can define only a single test state, so there is no branching).
State	“Behavior” of the Global Rules or a sequence at any point in time. In terms of InFusion testing, behavior is “waiting” for a set of events and responding with a set of actions.

4.4.2 Global Rules

Global Rules are a portion of the scenario that can define only one test state. To create the Global Rules, you use the menu-driven interface to enter an event or combined event and the corresponding action or set of actions (the response of InFusion hardware to the event).

In the case of a combined event, the action is taken upon occurrence of any of the events stated for the event combination. It is a logical OR association, meaning any of the events can trigger the action.

After you enter the event or combined event, the interface prompts you for actions. An action might be, for example, injecting a particular primitive or error into the traffic stream. You can enter multiple actions, which take place simultaneously.

After defining the event and actions within the Global Rule area, you can save the scenario and download it to a InFusion device.

4.4.3 Sequences

The Global Rules are all you need for simple test scenarios. However, a scenario also can contain one or two sequences, which can define multiple states and allow branching between states. With a sequence, you also can do looping, which allows you to repeat a test state or to execute a test for a specified period of time.

As with Global Rules, the menu-driven interface guides you in building a sequence. Some of the prompts are different, however, because you now are encapsulating groups of events and actions as distinct states. Recall that a state is a combination of events and actions at a specific point in time. If the event or combined event defined by a state occurs, the corresponding action or set of actions follows.

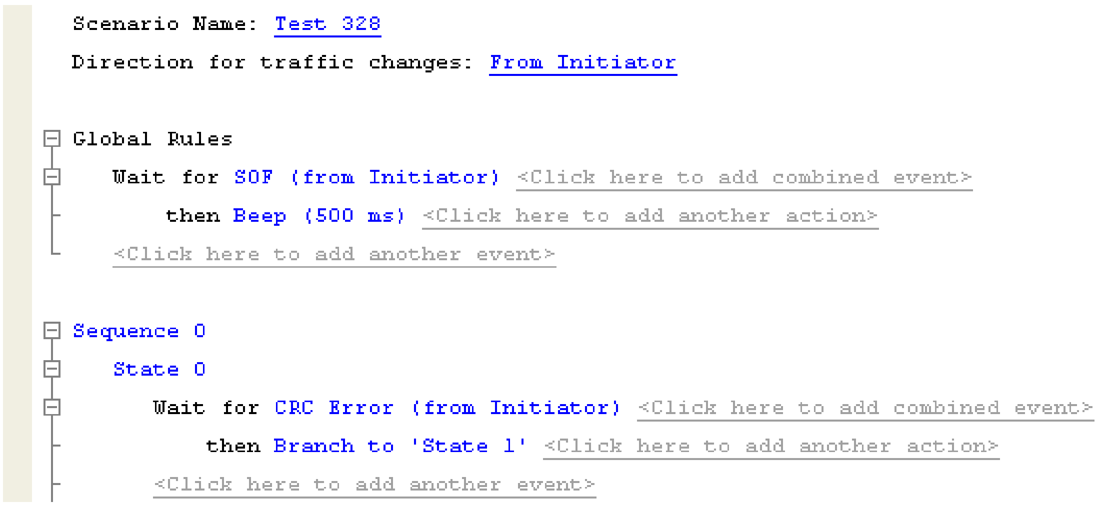


Figure 4.9: Global Rules and Sequence Areas of a Scenario

InFusion hardware provides the capacity to have up to two sequences co-existing in a scenario in addition to the Global Rules. Recall that both the Global Rules and any sequences are active at all times. Each is a separate “state machine,” having the behavior of a particular test state at any point in time. Because the Global Rules has the capacity for only one state, you can view it as a “degenerative state machine.”

4.5 Scenario Libraries

You can create any number of scenarios, which you then can archive on your PC hard drive. You also can download up to ten scenarios to each InFusion device for test execution. You can think of the libraries as windows that hold scenarios.

Recall that each library is a separate ***.infdb** file.

4.5.1 Main Library

When you launch the InFusion application, it opens a window called the Main Library. The main library is the default workspace for creating and storing new scenarios. The main library corresponds with the following file in the InFusion folder on the PC hard drive:

```
default.infdb
```

4.5.2 File Libraries

You can save the main library with a name other than default (while still using the **.infdb** file extension). The new file becomes a file library that is functionally equivalent to the main library with the following exception: It does not open by default in the Main Library window. You can navigate to other file libraries using the File Manager of the InFusion application.

In this manual, the main library and other **.infdb** file libraries are collectively called general libraries.

If you select **Open Library,** you see a window similar to the following:

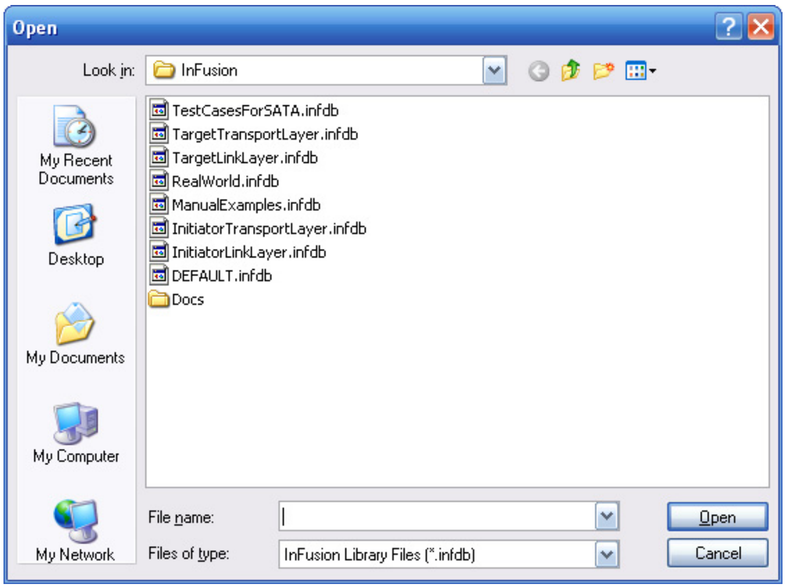


Figure 4.10: Open Library File List

By selecting the **TestCasesForSATA.infbd** file, you get an additional library window with predefined SATA test cases, similar to the following:

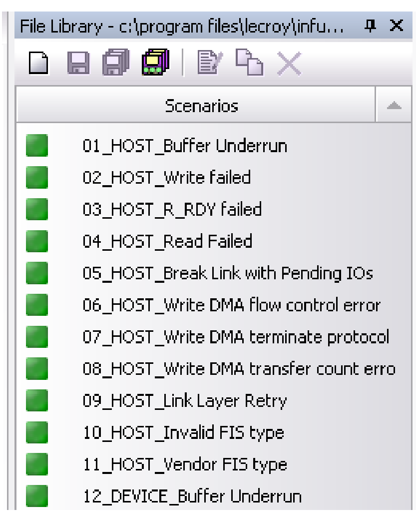


Figure 4.11: Test Cases for SATA Library

4.6 Scenario Properties

To begin the scenario creation process, you click the **New Scenario** button in a library window or on the InFusion application toolbar. As the first step in creating a scenario, the application prompts you for scenario name, a short description (optional), and the direction of traffic to which any traffic changes apply. Changes are, for example, injection or removal of data or a primitive.

You identify direction of traffic change, or modification, in terms of traffic origin. The application uses the following conventions:

- **From Initiator**: Change is made to traffic coming from test host (for example, CRC error is injected into traffic stream sent from initiator to target).
- **From Target**: Modification is made to traffic coming from the target (for example, CRC error is injected into traffic stream sent from target to initiator).

The following figure shows the first prompt in the scenario creation process.

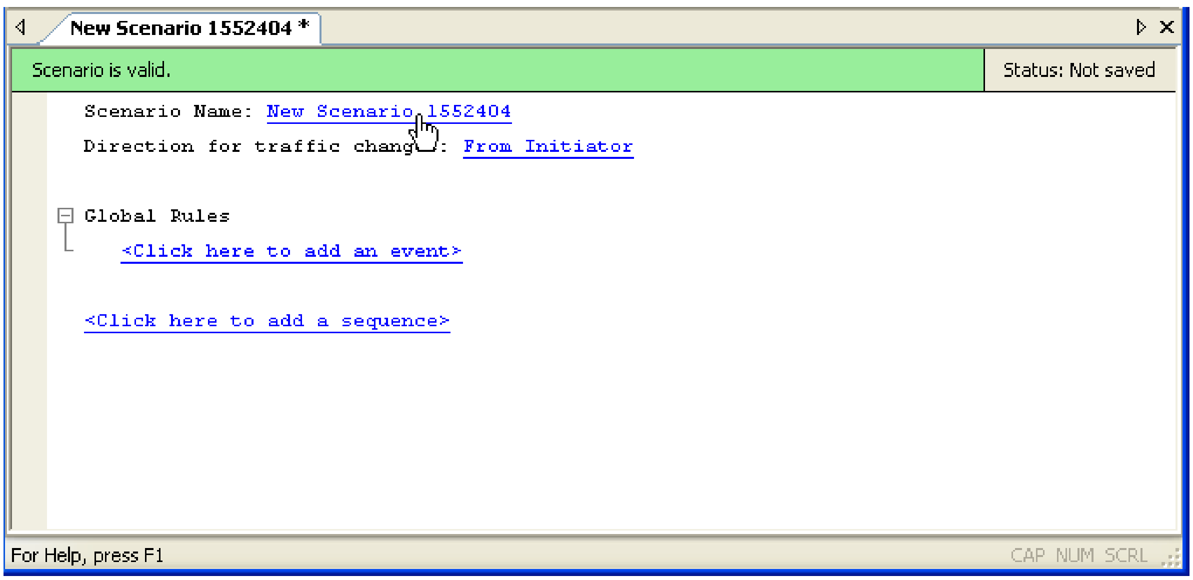


Figure 4.12: Entering Basic Scenario Information

To copy an event or action, right-click on the event or action and select **Copy**. Right-click **Click here to add another event** or **Click here to add an action** and then select **Paste**.

To copy a sequence or state, right-click on the sequence or state and select **Copy**. Right-click **Click here to add another sequence** or **Click here to add another state** and then select **Paste**.

You can also cut, delete, and edit a selected sequence, state, event, or action.

When you click the Scenario Name or the Direction For Traffic Changes, the Scenario Properties dialog box displays (see Figure 4.13 on page 245), allowing you to enter the scenario name, a short description, and direction of traffic change.

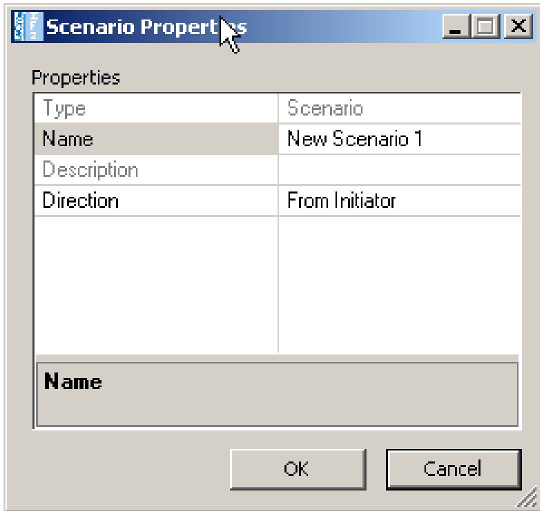


Figure 4.13: SAS Scenario Properties Dialog Box

In the Scenario Properties screen, the direction for traffic modification is defined on a global basis for the entire scenario. In other words, any scenario action that modifies line traffic only affects the traffic flowing in the direction established at the top of the scenario, in the Scenario Properties. Scenario events can be monitored in either direction, and therefore the parameters for events provide the ability to specify the intended direction for monitoring traffic for that event.

SATA Smart Hold Option

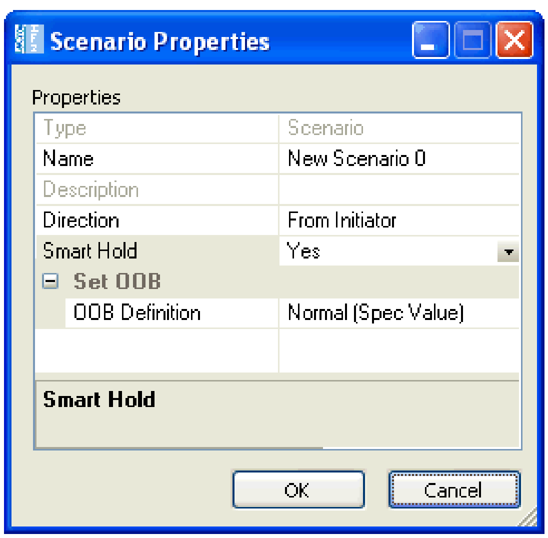


Figure 4.14: SATA Scenario Properties Dialog Box

SATA Scenario Properties have a Smart Hold option, which is on by default.

Each port monitors incoming data, which originated with the other device's receiver, as close as possible to where it enters the bus engine. If a port detects a HOLD primitive during a SATA frame, the port stops reading data from the FIFO and generates HOLDA. The HOLD propagates through the bus engine and eventually goes to the other device, where the HOLD causes the other device to send HOLDA. (The bus engine FIFOs must be deep enough to hold all the traffic that the other device sends while the HOLD propagates. The port drops all incoming HOLDA conditions, so HOLDAs are never put in the FIFOs or made visible to the sequencers.)

After this, the port that had been receiving the HOLD stops sending HOLDA and attempts to read data from the FIFO. The termination of HOLD propagates through the bus engine and then causes the other device to restart transmission, which puts data into the FIFO.

Note: If both sides send HOLD primitives that overlap, the receivers drop the HOLD conditions to avoid overflowing the FIFOs. If you turn off the Smart Hold option, the port does not send HOLDA when it detects a HOLD primitive during a SATA frame.

4.7 Scenario Events

A scenario is a script you create using simple mouse clicks and text entries. As you work, the script takes shape in the scenario area of the application display. You can think of the scenario area itself as consisting of two subareas: A Global Rules area at the top, where you create the Global Rules, and a Sequence area beneath the Global Rules, where you create any sequences. Whether you are creating Global Rules or a Sequence, the menu-driven interface prompts you to specify the event(s) for which you want to trigger actions (see Figure 4.15 on page 247).

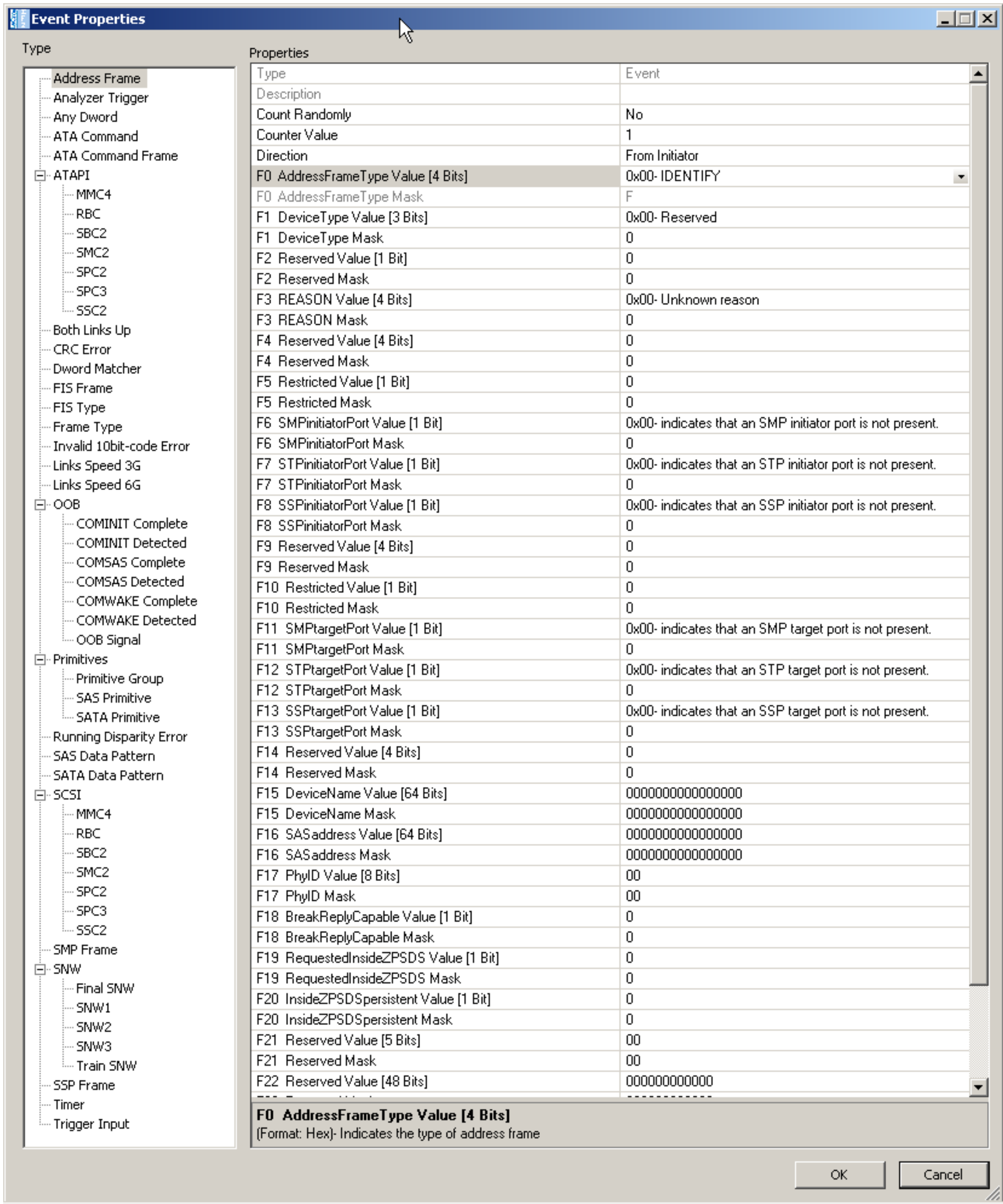


Figure 4.15: Event Properties Dialog.

While many events are line conditions, an event also can be a condition that occurs within a InFusion device (for example, detection of a trigger signal from another device). The following table lists supported events. Note that some events are applicable only in the context of creating sequences (those events appear on the drop-down list only if you are creating a sequence). Sequences can have multiple states, and they allow branching between states.

TABLE 4.2: Events

Event	Description
Address Frame	Occurrence of a specified address frame.

Event	Description
Analyzer Trigger	Trigger on Analyzer when its event matches. You can see the trigger on the Status Bar, but the Port Status dialog does not display any mark in the Trigger column. **Note**: This is different than the external trigger mechanism. You do not need an external trigger cable. **Note**: The Trigger on Analyzer feature functions when the trigger pattern is set to "Pattern/Infusion" and running a scenario which will trigger analyzer after a 5s timer. A message "Triggered, Post-Trig Capturing" displays on the Software Status bar. **Note**: When the analyzer triggers, it triggers on a packet before the actual trigger event occurs. The trace triggers more than 1us before the event actually occurs. The trigger is on the Initator side instead of the Target side as set in the scenario.
Any DWORD	Occurrence of any DWORD.
ATA Command	Occurrence of a particular ATA command.
ATA Command Frame	Occurrence of a particular ATA command frame.
[+] ATAPI	Occurrence of a particular ATAPI command from the list: MMC4, RBC, SBC2, SMC2, SPC2, SPC3, or SSC2.
Both Links Up	Occurrence of both line ports active (not idling).
CRC Error	Occurrence of a CRC error.
DWORD Matcher	Occurrence of a particular DWORD.
FIS Frame	Occurrence of a particular FIS frame.
FIS Type	Occurrence of a particular SATA FIS type.
Frame Type	Occurrence of a particular frame type.
Invalid 10bit-code Error	Occurrence of an invalid 10b code.
Links Speed 3G	Both lines operating at 3 Gbps.
Links Speed 6G	Both lines operating at 6 Gbps.
Links Speed 12G	Both lines operating at 12 Gbps.
OOB Signal	Occurrence of OOB signal.
[+] Primitives	Occurrence of Primitive Group, SAS Primitive, or SATA Primitive.
Running Disparity Error	Occurrence of Running Disparity (RD) error.
SAS Data Pattern	Occurrence of a particular data pattern in a SAS frame.
SATA Data Pattern	Occurrence of a particular data pattern in a SATA frame.
{+} SCSI	Occurrence of a particular SCSI command from the list: MMC4, RBC, SBC2, SMC2, SPC2, SPC3, or SSC2.
SMP Frame	Occurrence of a particular SMP frame.
SNW	Occurrence of Final SNW, SNW1, SNW2, SNW3, Train SNW
SSP Frame	Occurrence of a particular SSP frame.

Event	Description
Timer	Occurrence of a particular elapsed time (time period).
Training Sequence	Occurrence after training sequence.
Trigger Input	Occurrence of input trigger.

The following sections provide some additional details about three of the above events.

4.7.1 DWORD Matcher

DWORD Matcher is a DWORD pattern matcher that presents match and mask fields and a K-Code Mask field. K-Codes are control characters that are always used in the first byte of a four-byte primitive. Of the K-Code masks listed in the menu, D-D-D-D is used for data bytes, and K-D-D-D is used for all primitives.

When you create a DWORD match, keep the following in mind:

- The pattern can be inside or outside of frames (it does not matter if the pattern is inside a frame or not).
- Because the pattern can be inside or outside of frames, there is no offset.
- You can make user-defined primitives. (This is the reason this feature was created.)
- You can use any K/D pattern.

4.7.2 Address Frame

With Infusion, you must enter all values in reverse MSB, LSB order.

For example: a SAS Address in the viewer "5000C50056B8C829" should be entered like this in Infusion: "29C8B85600C50050".

4.7.3 SAS Data Pattern

When you create a SAS data pattern, keep the following in mind:

- The pattern must be defined inside a frame that starts with a SOF or SOAF.
- The pattern must be data only (no K-codes/primitives).
- The pattern must be defined at a specific offset in the frame.
- The pattern and mask must be specified in the same format as specified in the SAS standard:
  0x12345678 (hex)
  where “1” is the first digit on the cable and is the MSB as given in the SAS Standard.

For example, for an SMP Request:

```
Pattern: 0x40000000
Mask: 0xFF000000
Offset: 0
SOF Type: SOF
```

4.7.4 SATA Data Pattern

When you create a SATA data pattern, keep the following in mind:

- The pattern must be defined inside a frame that starts with a SATA_SOF.
- The pattern must be data only (no K-codes/primitives).
- The pattern must be defined at a specific offset in the frame.
- The pattern and mask must be specified in the same format as specified in the SATA Standard.

For example, for Register H -> D FIS:

```
Pattern: 0x00000027
Mask: 0x000000FF
Offset: 0
SOF Type: SATA_SOF
```

4.7.5 Analyzer Trigger

Trigger the Analyzer when the Scenario event matches. You can see the trigger on the Analyzer Status Bar.

The Analyzer Trigger feature functions when the Analyzer trigger pattern is set to Pattern/ Infusion and is running a scenario which activates the Trigger analyzer action. A message Triggered, Post-Trig Capturing displays on the Software Status bar.

This is different from the external trigger mechanism. You do not need an external trigger cable.

When the analyzer triggers, it triggers on a packet before the actual trigger event occurs. The trace triggers more than 1 µs before the event actually occurs. The trigger is on the Initator side instead of the Target side, as set in the scenario.

4.8 Scenario Actions

After you enter the set of events for a test state, the menu-driven interface prompts you for the corresponding action or set of actions. If you define multiple actions, the actions occur simultaneously (see Figure 4.16.)

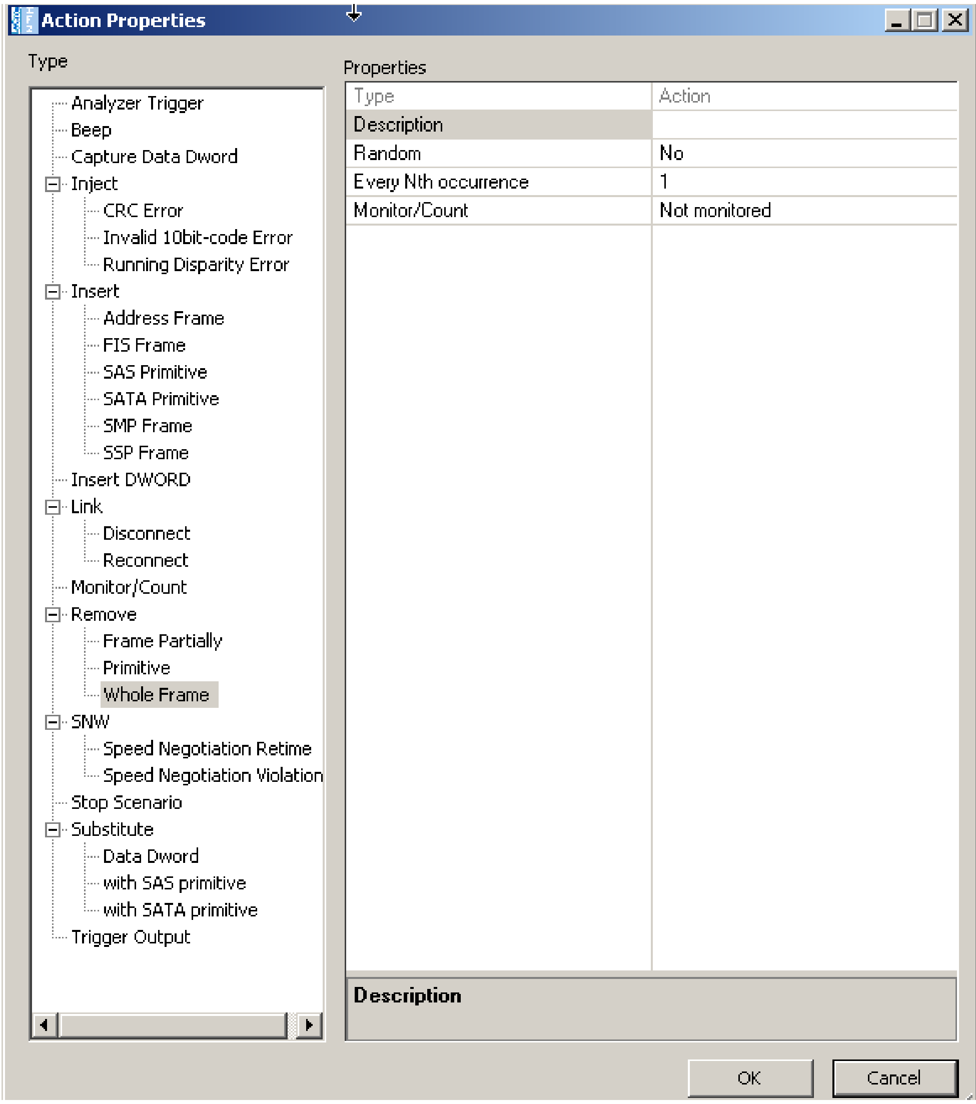


Figure 4.16: Action Properties Dialog

The following table lists supported actions. Note that some of these actions only apply to creating sequences.

TABLE 4.3: Test State Actions

Action		Description
Analyzer Trigger		The Jammer sends a trigger to the Analyzer.
Beep		Emits audible sound of duration selectable via drop-down list.
Capture Data DWORD		Captures a data DWORD into one of four registers.
Inject	CRC Error	Injects a CRC error into the line.
	Invalid 10bit-code Error	Injects invalid 10b code into the line.
	Running Disparity Error	Injects a Running Disparity (RD) error into traffic.
Insert	Address Frame FIS Frame SAS Primitive SATA Primitive SMP Frame SSP Frame	Inserts a frame or primitive.
Insert DWORD		Inserts DWORD.
Link	Disconnect	Puts both InFusion SAS ports at electrical idle immediately. This action is only in effect while the scenario is running, and the Jammer will reconnect the line when the scenario is stopped.
	Reconnect	Starts traffic pass-through immediately. This action restarts traffic after a previous disconnect command. Once traffic is passing through, the initiator and target resume OOB signaling.
Monitor/Count		Opens a window to count the number of events that occur during a session. A session is a time interval during which a scenario runs.
Remove	Frame Partially	Removes the targeted event from the traffic.In InFusion.
	Primitive	A Remove primitive action is implemented by replacing the primitive with an idle data DWORD.
	Whole Frame	A Remove frame action is implemented by replacing the start-of-frame and end-of-frame primitives with an idle data DWORD.
Restart	All Sequences[1]	Restart all sequences in the scenario.[1]
	Current Sequence[1]	Restart the sequence that contains this action definition. [1]

Action		Description
SNW	Speed Negotiation Retime	Set RCDT, SNTT, ALT/TLT, TX speed, TRAIN/ TRAIN_DONE pattern, and/or PHY Capability.
	Speed Negotiation Violation	Set Violation Type.
Stop Scenario		Stops all scenario activity.
Substitute	Data DWORD	Substitutes a data DWORD in the traffic.
	with SAS Primitive	Substitutes a SAS primitive in the traffic.
	with SATA Primitive	Substitutes a SATA primitive in the traffic.
Trigger Output		Sends a signal out the trigger port to the device downstream. The trigger point in the Analyzer that caused the analyzer trigger action will not be the selected event, it will be the selected event with some offset.

[1] Only shown in Action Properties dialog box when creating a sequence.

4.8.1 Available Resources

You can specify Events, Combined Events and Actions and additional Events. The application automatically checks for the maximum number of terms (Events/Actions). When you exceed the limit, an error is flagged, prompting you to jump to the place that caused the error.

The list of available resources is given below:

- External Trigger X 1
- Analyzer Trigger X 1
- Training Detector x 4 (only M12x)
- Primitive Detector (each has its own Embedded counter in M12x) X 8
- Pattern Detector (each has its own Embedded counter in M12x) X 8 (a total of 12 DWORD detectors are shared between all pattern detectors)
- Frame Type Detector X 24
- Counter X 12
- Timer X 8
- OOB X 1
- ComWakeDetected X 1
- ComWakeCompleted X 1
- ComInitDetected X 1
- ComInitCompleted X 1
- ComSasDetected X 1
- ComSasCompleted X 1
- Snw1 X 1
- Snw2 X 1
- Snw3 X 1
- SnwFinal X 1
- SnwTrain X 1

- DisparityError X 1
- 10B Error X 1
- CrcError X 1
- Both Links Up X 1
- Link Speed 3G X 1
- Link Speed 6G X 1
- Link Speed 12G X 1
- Primitive Substitute X 12
- Insert Frame1 (Up To 1024 Dword) X 1
- Insert Dword8 (Up To 16 Dword) X 8
- SNW Manipulation X 16
- Global Action Register X 8
- State per sequencer X 256
- Action Register per state X 8

Usage of Action Register:

- Each Counter in Global Rules = 2
- Each Counter in State = 3
- Each Timer in Global Rules = 2
- Each Timer in State = 3
- Other Actions = 1

4.8.2 Using Counters in Events and Actions

Many of the events and actions supported by InFusion also support counters that can control functions.

Within events, counters determine how many times the event must occur before the associated actions are triggered. Event counters typically have two properties:

- **Count Randomly**: Can be set to “Yes” or “No” (default value is “No”). If set to “Yes”, the event repeats a random number of times (between 1 and the value set in the property **Max Random Count**, which replaces the property **Counter Value** when “Yes” is selected), before the action is triggered.
- **Counter Value**: Number of repeats required when **Count Randomly** is set to “No”. The default value is 1.

Within actions, counters determine how many times the system calls the action before it acts. Action counters typically have two properties:

- **Random**: Can be set to “Yes” or “No” (default value is “No”). If set to “Yes”, the action triggers a number of occurrences before the action takes place. That number ranges randomly between 1 and the value set in the property **At least every Nth occurrence**, which replaces the property **Every Nth occurrence** when “Yes” is selected.
- **Every Nth occurrence**: Number of times the system calls the action before it acts.

Note that there is some overlap in the way these counters can be used. For example, in the simple case of a single event leading to a single action, it makes no difference whether you specify the event to require five repeats before triggering the action, or the action to require five occurrences before it acts.

However, in the case of combined events and/or actions, the separate counters provide flexibility in designing test cases. For example, consider the case where Event_1 OR Event_2 leads to Action. If Event_1 has a counter of 5, then the Action triggers either when Event_1 has repeated five times or when Event_2 happens the first time, whichever occurs first.

But if the event counters are set to 1 and the Action counter is set to 5, then the Action happens after five occurrences of EITHER Event_1 or Event_2.

4.8.3 Capturing a Data DWORD

InFusion provides the ability to capture individual data DWORDs and provides four different registers to store captured DWORDs (DWORD #0, #1, #2 and #3).

To capture a data DWORD, select **Capture Data DWORD** from the Action Properties screen, as shown below. Select the register to be used to store the DWORD from the drop-down menu under the **Capture Register** property.

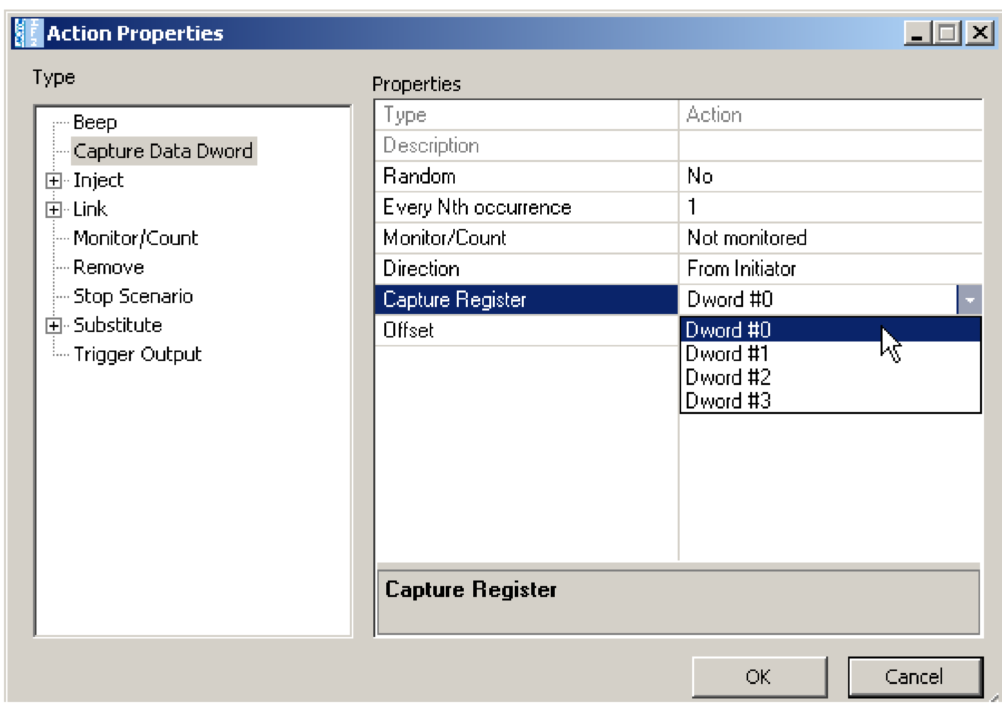


Figure 4.17: Capture Data DWORD Action

4.8.4 Using Captured Data DWORDs

Captured data DWORDs can be used in creating events for data that match the captured DWORD(s), or in creating actions to substitute the captured DWORD(s) into the data stream.

To create an event using the captured DWORD, in the Event Properties menu, select **SAS Data Pattern** (or **SATA Data Pattern**), and then select any of the 12 DWORDs (**DWORD 0 Type** through **DWORD 11 Type**). The drop-down menu (see Figure 4.18 on page 256) provides the choice of a custom DWORD or any of the four captured DWORDs. If you select a captured DWORD, the **Value** field beneath this selection is hidden (the **Value** field is only used for specifying custom DWORDs). Note that choice of a mask and an offset are still available when using captured DWORDs.

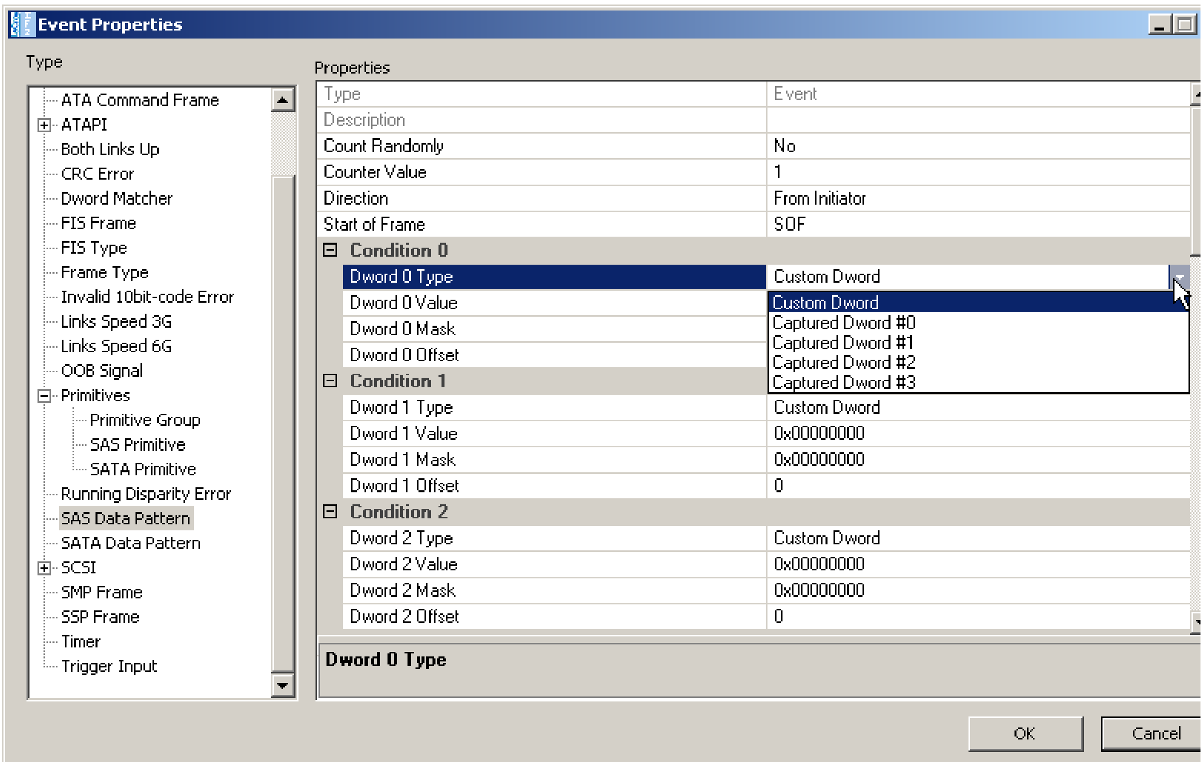


Figure 4.18: Using a Captured DWORD in a SAS Data Pattern

Captured data DWORDs may also be used in the **Substitute Data DWORD** test state action. From the Action Properties screen, choose **Substitute Data DWORD** and then select the **Substitute for** property. A drop-down menu is provided (see below) that allows the choice of a custom DWORD or any of the four captured DWORD registers.

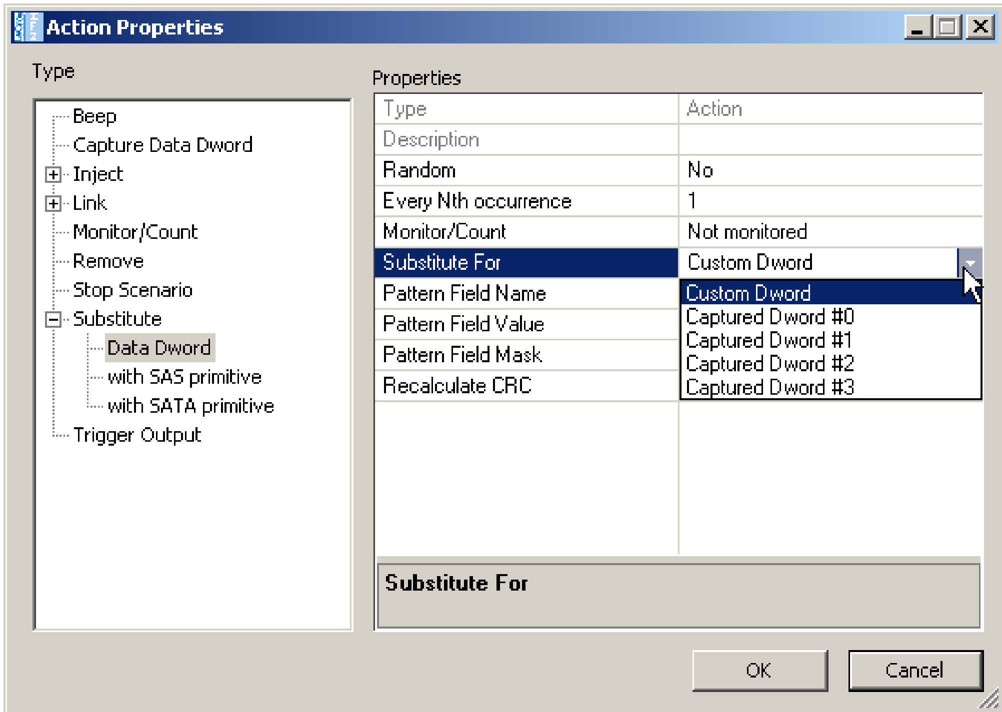


Figure 4.19: Using a Captured Data DWORD in Substitute DWORD Test Action

4.8.5 Summary of Scenario Creation

The suggested process of creating and executing a scenario is as follows:

1. Create a scenario in the main library.
2. Save all scenarios in the main library to a InFusion device or a device of your choice.
3. Select the scenario in the main library that you want to run on the device.
4. To run the scenario, click the **Start Scenario** button from the Main Library toolbar. The device starts to monitor/modify traffic.

Note: Step 1 is described in detail for each example in following sections. Steps 2 to 5 are described in detail at the end of this chapter.

4.9 Creating Global Rules

This section gives examples for creating the Global Rules area of a scenario. Recall that the Global Rules area defines a single test state. The Global Rules do not have the capacity for multiple states, so that area of a scenario cannot change state.

In terms of InFusion testing, a state defines test "behavior." In this context, behavior is "waiting" for an event and responding with an action or set of actions that happen simultaneously.

Keep in mind that a test state you implement with the Global Rules operates in parallel with the active test state of each sequence in the scenario.

In effect, InFusion lets you do up to three line tests at the same time. You can do one test with the Global Rules and a separate test with each sequence you create. You can have up to two sequences in a scenario.

The following table summarizes the Global Rules examples that follow.

TABLE 4.4: Global Rules Examples

Example	Description
1	Creating a single event and action (removes a primitive).
2	Creating a single event and action (replaces a primitive).
3	Creating a combined event (a logical OR association of multiple events) and an action.
4	Creating multiple triggers and actions.
5	Creating multiple actions on a single event.
6	Using timers.

4.9.1 Example 1: Creating a Single Event and Action that Removes a Primitive

In this example, the Global Rules area of the scenario waits for each RRDY Normal primitive from the initiator and removes it.

1. Click the **New Scenario** button in the main library or one of the device libraries.
2. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change (see Figure 4.13 on page 245).
3. In the Global Rules area, click the prompt to **add an event**.

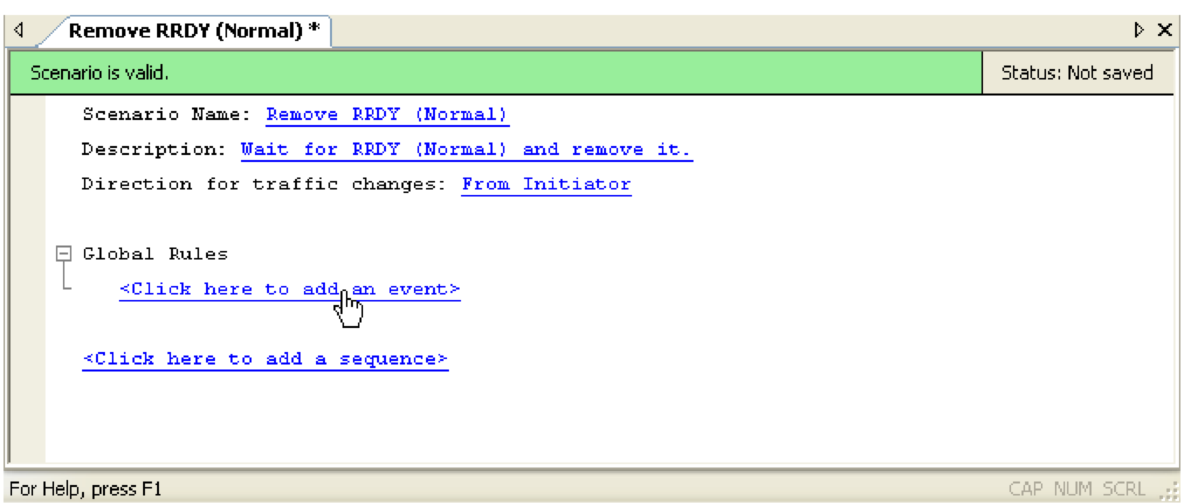


Figure 4.20: Example 1: Adding an Event

The Event Properties dialog box appears (see Figure 4.15 on page 247).

4. In the Type column of the Event Properties dialog, choose **Primitive > SAS Primitive**.
5. In the Type column in the middle of the dialog box, click **Description** if you want to add a description of the event.
6. Click **Direction** to choose the direction of traffic to monitor for the selected event (the default is **From Initiator**, which is what you want for this example).
7. Still in the middle column of the Event Properties dialog box, click **Primitive** to display a drop-down menu that lets you choose the type of primitive for which you want to wait in this scenario. In this example, it is **RRDY (Normal)**.

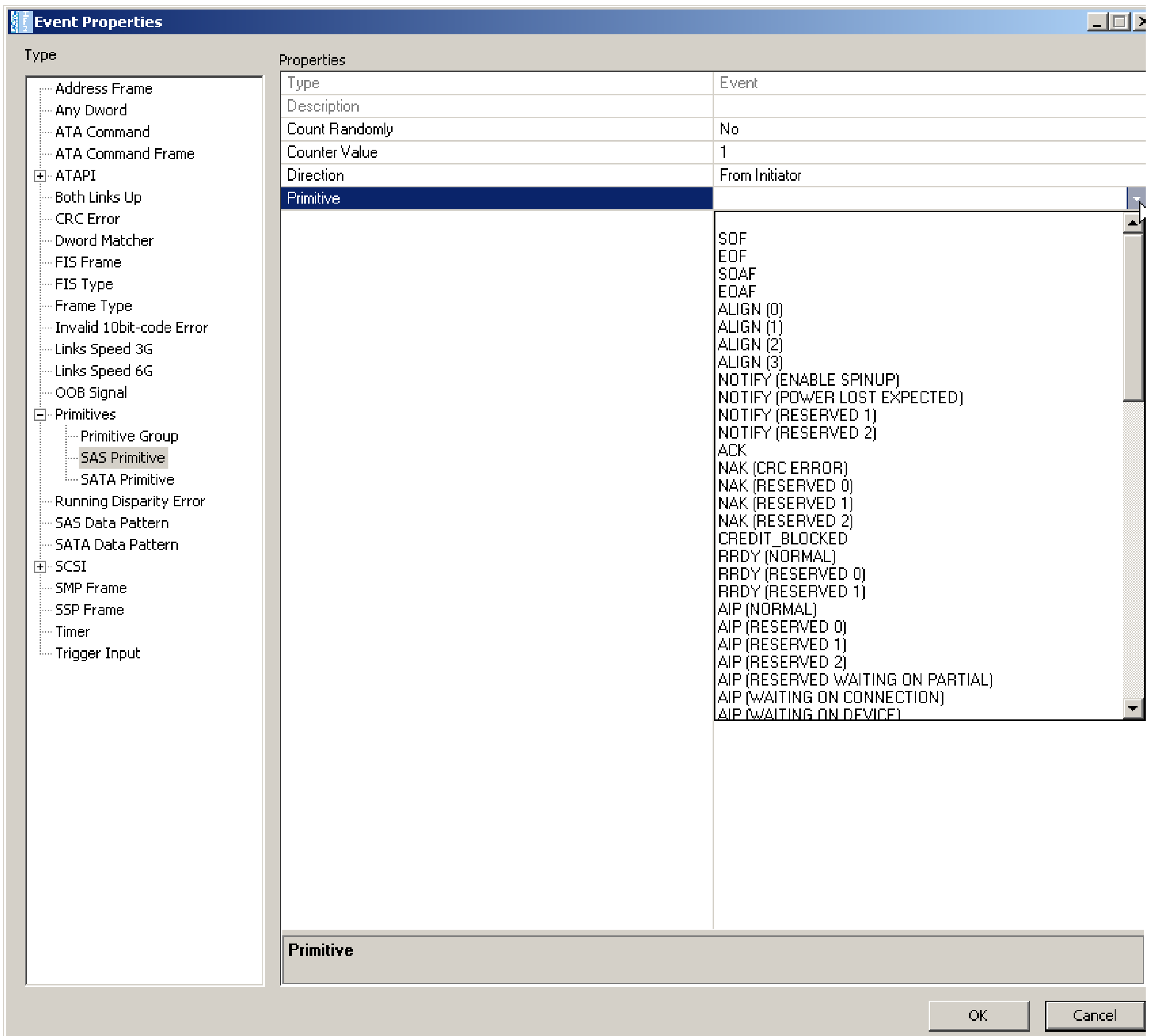


Figure 4.21: Example 1: Event Drop-Down List

8. Click **OK** to close the Event Properties dialog box.

9. In the Global Rules area, click the prompt to **add an action**.

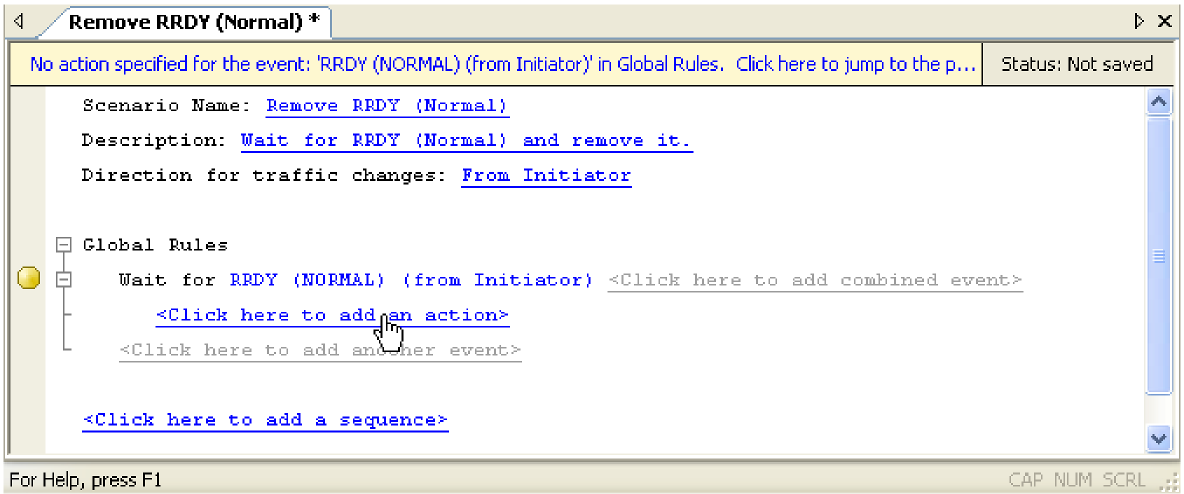


Figure 4.22: Example 1: Entering an Action

The Action Properties dialog box appears (see Figure 4.16 on page 251).

10. In the Type column on the left, choose the action that you want to occur when an RRDY is detected. In this example, it is the **Remove Primitive** action. Select Random **Yes** or **No**, **N** for Every Nth occurrence, and Monitor/Count as **Monitored** or **Not Monitored.**
11. Click **OK** to close the Action Properties dialog box.

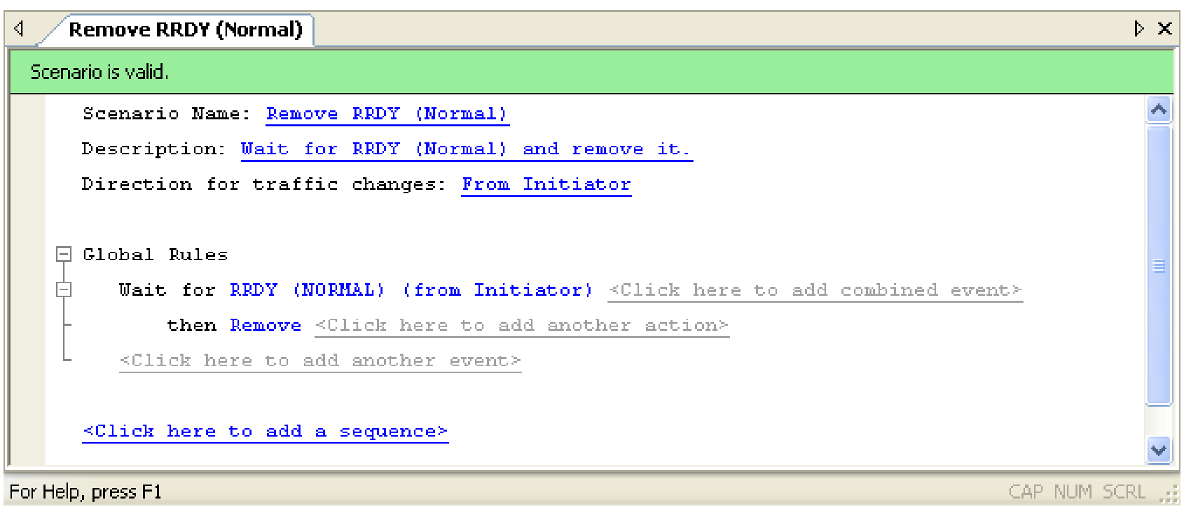


Figure 4.23: Example1: Complete Scenario

12. In the File menu, select **Save Scenario** to save the scenario.

4.9.2 Example 2: Wait for a Primitive and Replace It with an Error

In this example, the Global Rules portion of the scenario waits for each RRDY Normal primitive and replaces it with an ERROR primitive.

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. In the Global Rules area, click the prompt to **add an event** to display the Event Properties dialog box.
3. As you did in the previous example, choose **RRDY (Normal)** as the type of primitive to monitor.
4. In the Global Rules area, click the prompt to **add an action** to display the Action Properties dialog box.
5. In the Type column on the left, choose **Substitute > with SAS Primitive** as the action that you want when an RRDY (Normal) occurs.
6. In the middle column of the dialog box, click **Description** if you want to add a description of the action.
7. Still in the middle column of the Event Properties dialog box, click **Primitive** to display a drop-down menu that lets you choose the type of primitive for which to substitute for RRDY (Normal) (see Figure 4.21 on page 259). Choose **ERROR**.
8. Click **OK** to close the Action Properties dialog box.
9. In the File menu, select **Save Scenario** to save the scenario.

In this example, you set the substitution action to happen at every occurrence of an RRDY (Normal) (as shown in the figure, the action is set for every occurrence). However, you can set an action to happen at other multiples of event occurrence (for example 5, 25, 1000 and so on). You also can set the action to happen at random, within a specified number of event occurrences.

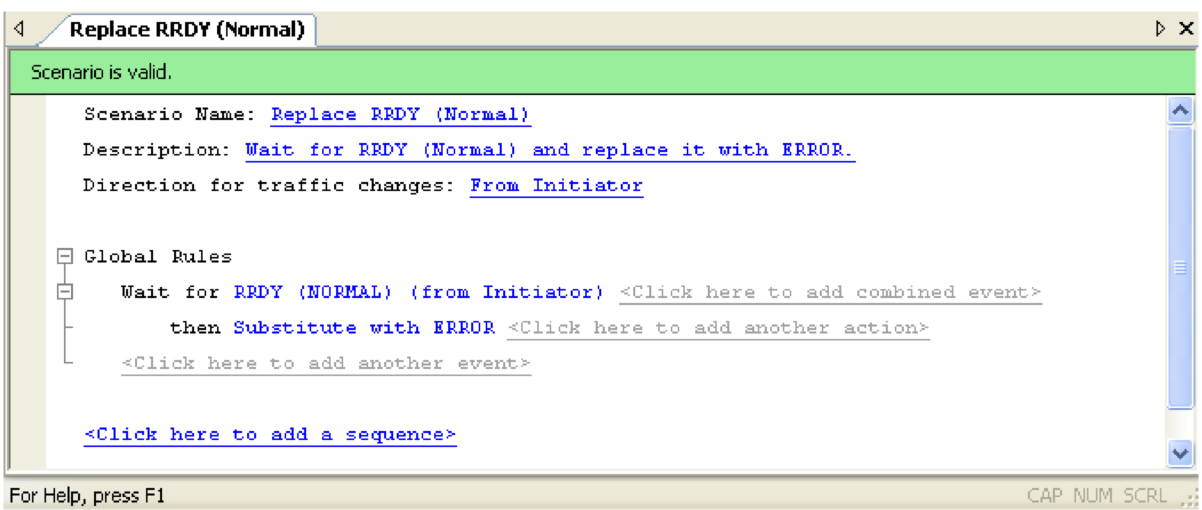


Figure 4.24: Example 2: Complete Scenario

4.9.3 Example 3: Creating OR Conditions

In this example, the Global Rules area of the scenario waits for either of two types of RRDY primitive and replaces them with an ERROR primitive.

This example includes a combined event (a logical OR association of two or more single events). Here, the combined event consists of any occurrence of RRDY (Normal) or RRDY (Reserved 0).

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. In the Global Rules area, click the prompt to **add an event** to display the Event Properties dialog box.
3. As you did in example 1 of this chapter, choose **RRDY (Normal)** as the first primitive that you want to monitor.
4. Click the **add combined event** prompt to add a second event.

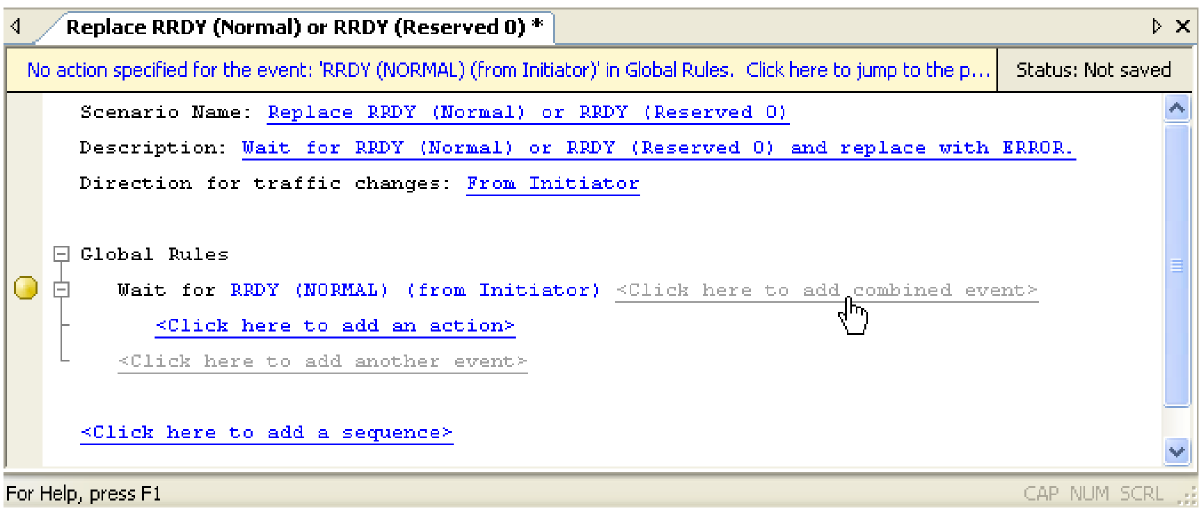


Figure 4.25: Example 3: Entering the Second Event

The Event Properties dialog box appears.

5. Choose **RRDY (Reserved 0)** as the second primitive that you want to monitor.
6. Click **OK** to close the Event Properties dialog box.
7. In the Global Rules area, click the prompt to **add an action** to display the Action Properties dialog box.
8. In the Type list on the left, choose **Substitute SAS Primitive** as the action that you want when either RRDY Reserved 0 or RRDY Normal occurs.
9. Click **OK** to close the Action Properties dialog box.

10. In the File menu, select **Save Scenario** to save the scenario.

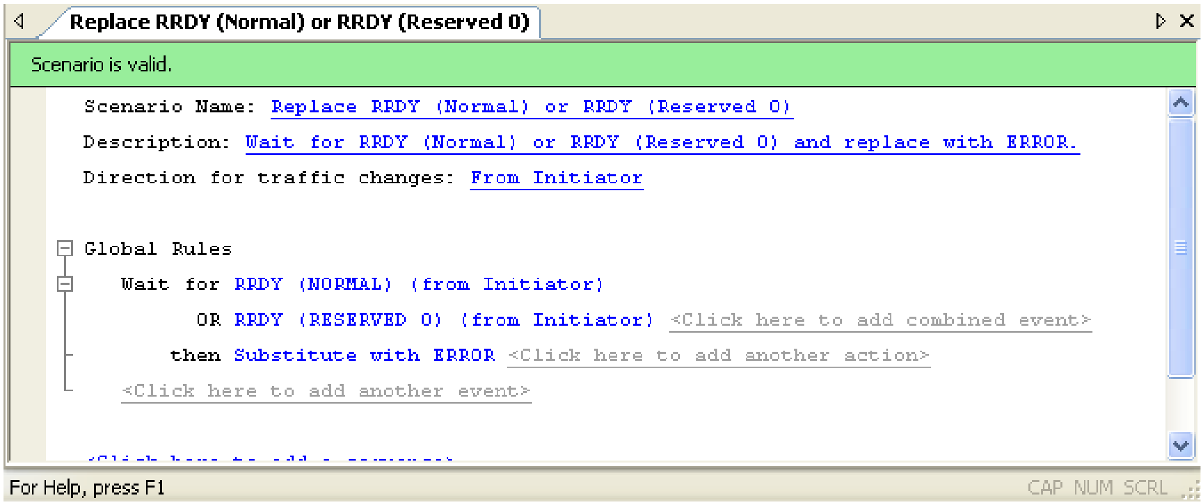


Figure 4.26: Example 3: Complete Scenario

4.9.4 Example 4: Multiple Triggers and Actions

In this example, the Global Rules area of the scenario waits for two events, each of which triggers a different action.

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. As you did in example 2, choose **RRDY (Normal)** as the first event to monitor, and substitute with the SAS primitive **ERROR** as action.
3. In the Global Rules area, click the prompt to **add the next event** (keep in mind this is not a combined event).

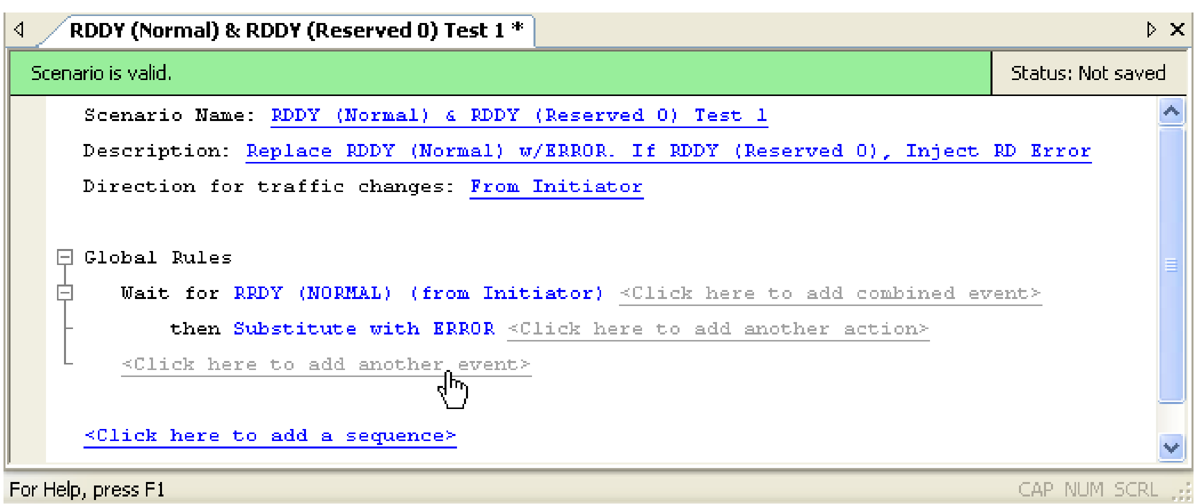


Figure 4.27: Example 4: Entering Second Event

The Event Properties dialog box appears.

In this example, there is a parallel set of events, but each event is associated with its own action. In a combined event, there is a parallel set of events sharing the same action.

4. Using the drop-down menu, choose **RRDY (Reserved 0)** as the second event to monitor.
5. Click **OK** to close the Event Properties dialog box.
6. In the Global Rules area, click the prompt to **add an action** to be triggered by the RRDY (Reserved 0).

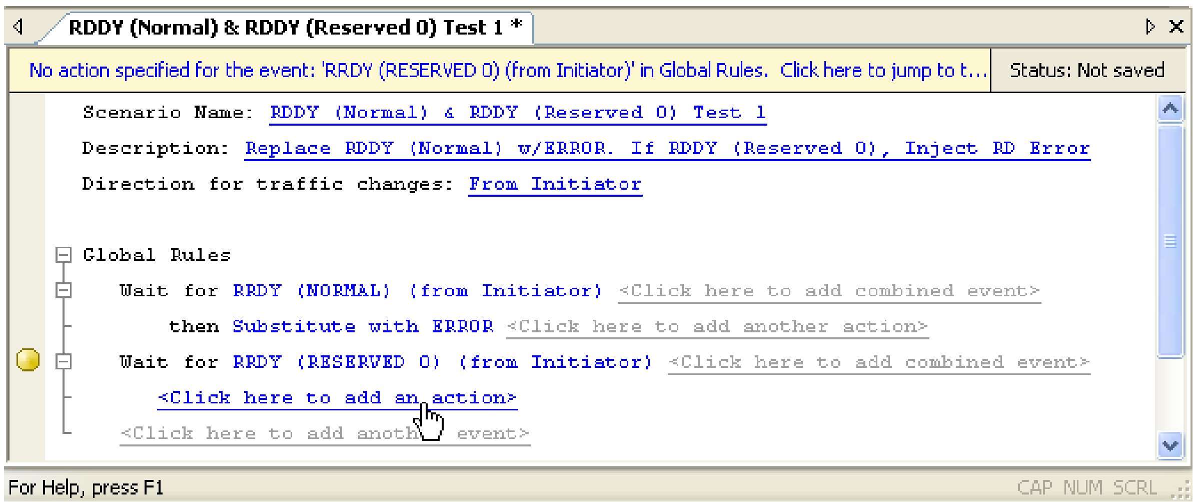


Figure 4.28: Example 4: Entering Second Action

The Action Properties dialog box appears.

7. Use it to choose **Inject RD Error** as the action triggered by RRDY (Reserved 0).
8. Click **OK** to close the Action Properties dialog box.

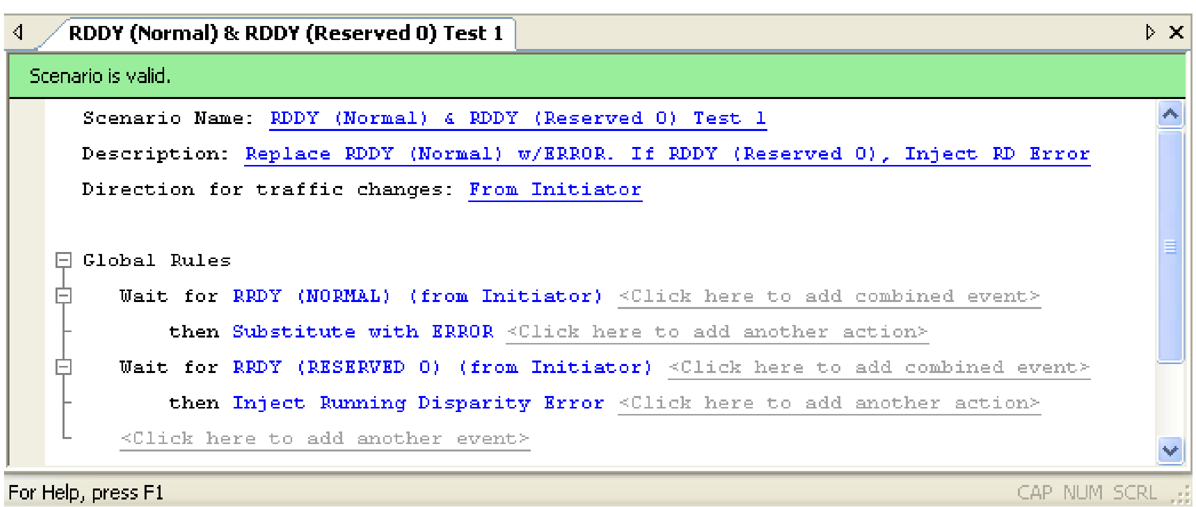


Figure 4.29: Example 4: Complete Scenario

9. In the File menu, select **Save Scenario** to save the scenario.

4.9.5 Example 5: Multiple Actions on a Single Event

In this example, an event triggers a set of actions. The actions occur at the same time. The device waits for an ACK from the initiator. When it occurs, the device beeps, injects an RD error, and increments a counter monitoring for that event (ACK from initiator).

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. As in previous examples, configure the first event and its response in the Global Rules area. Choose **ACK** primitive as the event and **Beep** as the action. From the Action Properties drop-down menu, enter **500 ms** as the duration of the beep.
3. Click the **add another action** prompt to add a second action.

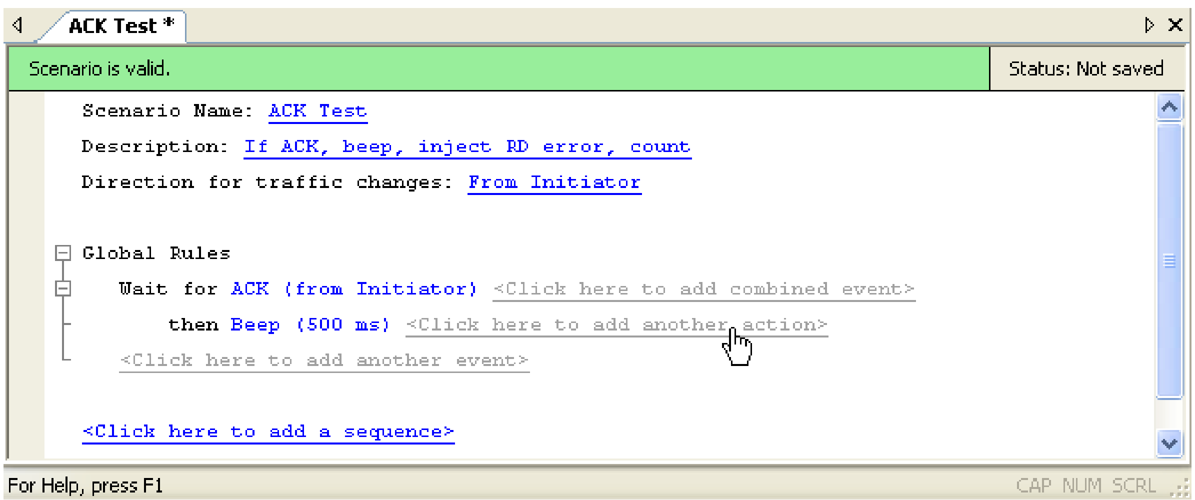


Figure 4.30: Example 5: Entering the Second Action

The Action Properties dialog box appears.

4. Choose **Inject RD Error** as the second action.
5. Click the **add another action** prompt to add a third action.
6. The Action Properties dialog box appears.
7. Choose **Monitor/Count** as the third action.

8. Click **OK** to close the Action Properties dialog box.

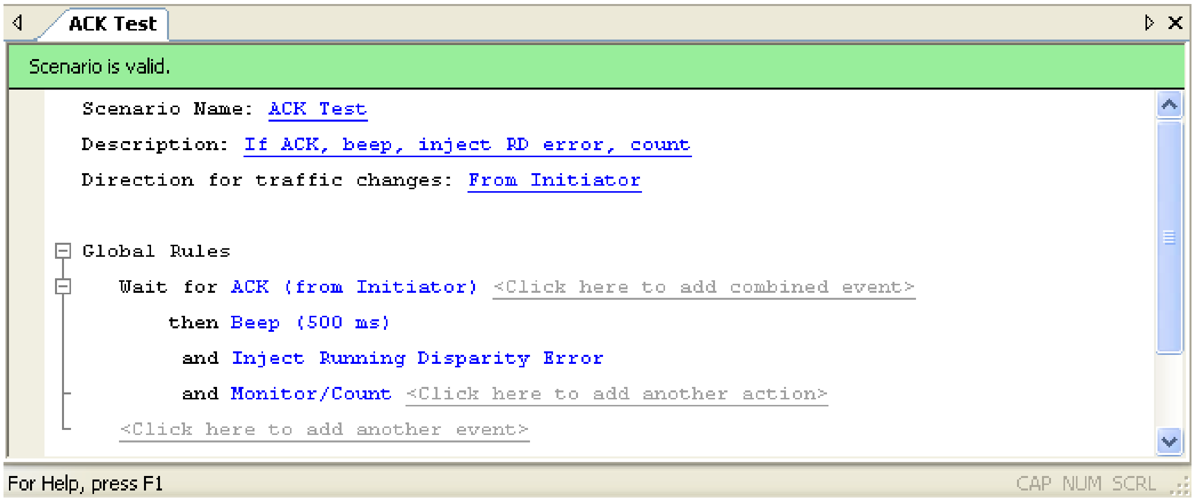


Figure 4.31: Example 5: Complete Scenario

9. In the File menu, select **Save Scenario** to save the scenario.

This example sets the counter to increment at each occurrence of an ACK (every 1 ACK).

4.9.6 Example 6: Using Timers

In this example, the Global Rules portion of the scenario waits for an ACK primitive from the initiator. Each time the device detects an ACK, it injects an RD Error into the traffic stream. This state continues for a random period of time, not to exceed 1.790 seconds. After the time period has elapsed (timer times out), the scenario stops.

Although this example sets the timer for a random period, you also can set the timer for known values (2 ms., 5 mins., 1 hr., and so on).

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. As in previous examples, configure the first event and its response in the Global Rules area. Choose **ACK** primitive as the event and **Inject RD Error** as the action.

3. Click the prompt to **add another event** (keep in mind this is not a combined event).

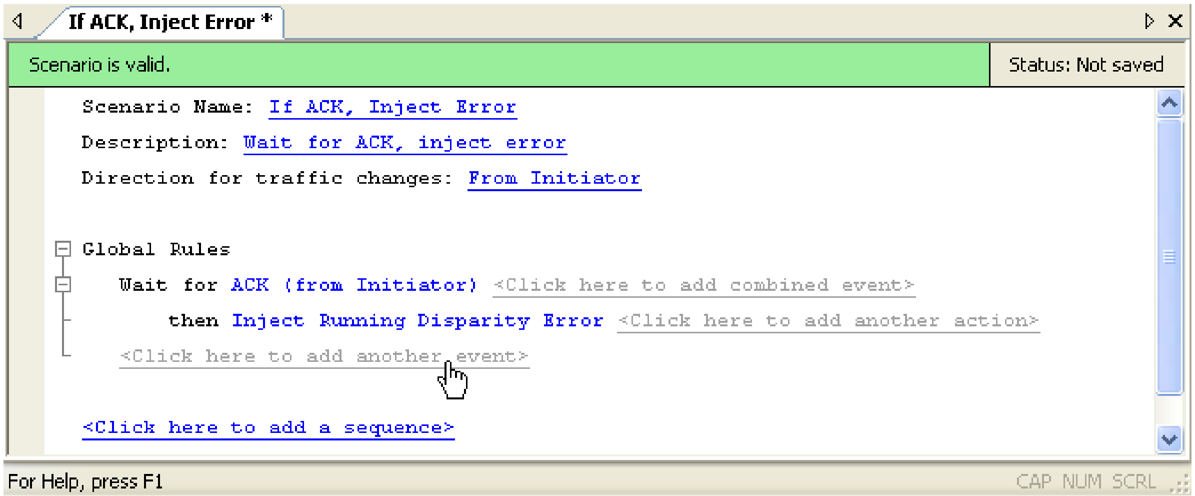


Figure 4.32: Example 6: Entering the Second Event

The Event Properties dialog box appears.

4. In the Type column on the left, choose **Timer**. Set the timer for random timing with a maximum time limit of 1.790 seconds.
5. Click **OK** to close the Event Properties dialog box.
6. Click the prompt to **add an action** to correspond with the second event.

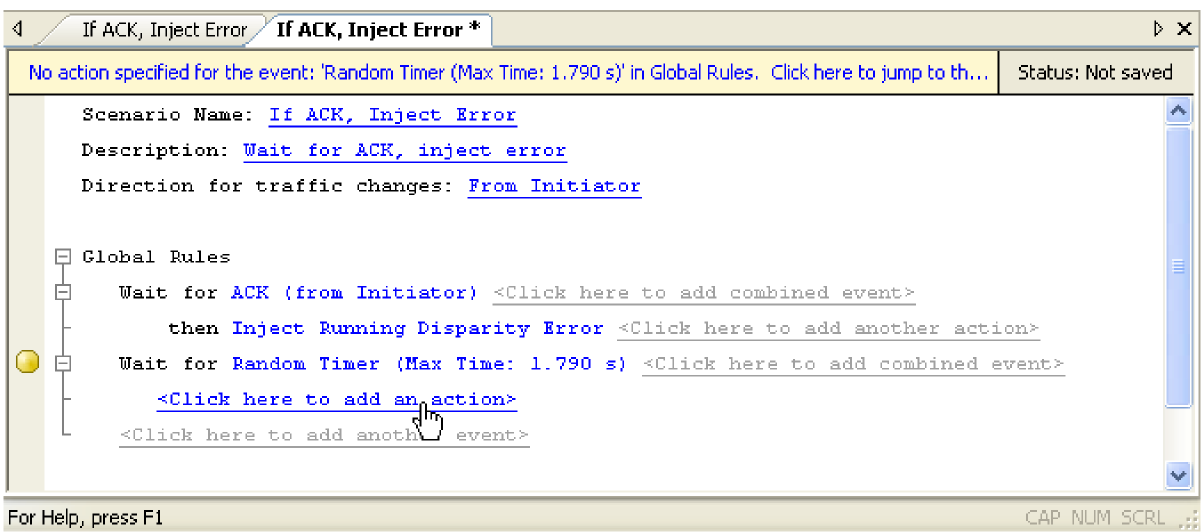


Figure 4.33: Example 6: Entering Second Action

The Action Properties dialog box appears.

7. In the Type list on the left, choose **Stop Scenario** as the action that you want after the timer has expired.

8. Click **OK** to close the Action Properties dialog box.

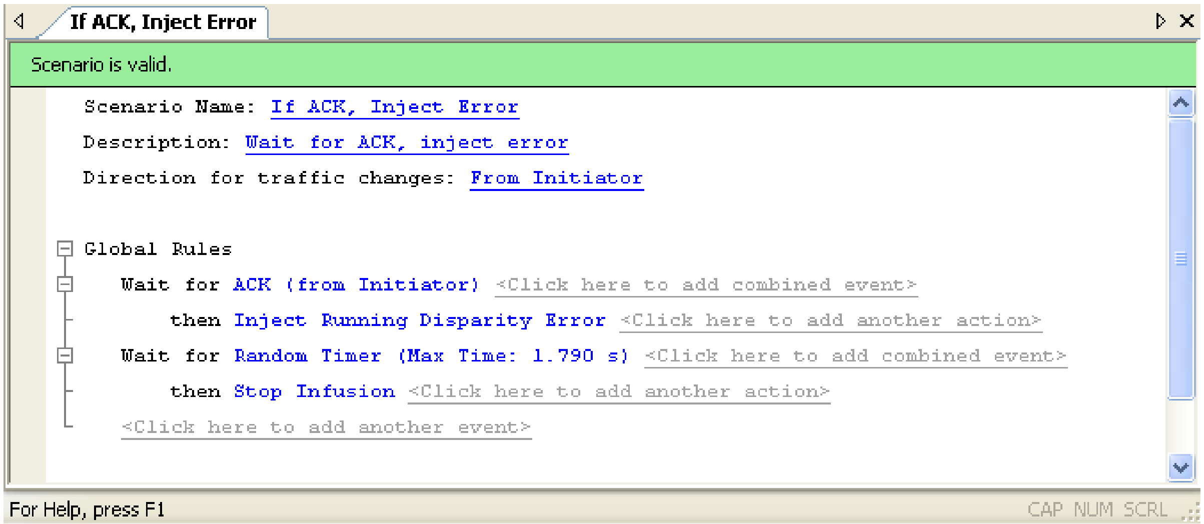


Figure 4.34: Example 6: Complete Scenario

9. In the File menu, select **Save Scenario** to save the scenario.

4.10 Creating a Sequence

This section gives several examples for creating sequences. Recall that a sequence can have multiple states, but only one state is active at any time. In other words, at any point in time, a sequence “waits” for one event (or combined event) and responds with the corresponding action or set of actions when the event occurs.

A sequence is more powerful than Global Rules, because you can create branching or looping test logic with a sequence.You can include up to two sequences in a scenario, but each is completely independent of the other. There is no branching or other interaction between the two, except through the Restart All Sequences action.

You must follow some simple rules when creating sequences:

TABLE 4.5: Sequence Rules

You can use only two branch actions per state. When you specify actions for a state, you can only use two instances of **Branch to an Existing State** or **Branch to a New State**. If you try to use more than two, a red error message appears in the status area of the application that says “Too Many Actions.”
You can use only one restart sequence action per state. When you specify actions for a state, you can only use one instance of **Restart Current Sequence** or **Restart All Sequences**. If you try to use more than one, a red error message appears in the status area of the application that says “Too Many Actions.”
You can use a maximum of 255 states per sequence. If you try to use more than 255 states, a red error message appears in the status area of the application.

The following table summarizes the examples that follow.

TABLE 4.6: Sequence Examples

Example	Description
7	**Creating two sequences and Global Rules**: This scenario has two objectives that you implement with Global Rules and two sequences. 1) You use Global Rules to replace any of three types of primitives. 2) You use two sequences to detect the order in which a type of frame is received from initiator and target.
8	**Creating a sequence with many states #1**: The objective of this scenario is to detect an incorrect order of primitives and to cause the device to beep when it happens. You implement this scenario with a single five-state sequence.
9	**Creating a sequence with many states #2**: This scenario is an enhancement of example 8. In this scenario, the objective is to detect an incorrect order of primitives, fix it, and cause the device to beep when this happens. As with example 8, you implement this scenario with a single five-state sequence.

4.10.1 Example 7: Creating Two Sequences and Global Rules

In this example, Global Rules substitute an Align (0) primitive for each of the following received from the initiator: Align (1), Align (2), and Align (3). As a separate test operation, two sequences determine the order in which each Identify Address frame is received from initiator and target.

The following tables summarize the logic implemented by each of the sequences.

TABLE 4.7: Example 7: Logic of Sequence 0

State	Description
State 0	If Address Frame is detected from initiator, go to State 1; otherwise, continue to check incoming frames (do not change state).
State 1	If next Address Frame detected is from target, beep 1 second.

TABLE 4.8: Example 7: Logic of Sequence 1

State	Description
State 0	If Address Frame is detected from target, go to State 1; otherwise, continue to check incoming frames (do not change state).
State 1	If next Address Frame detected is from initiator, beep 2 seconds.

There is no interaction between the two sequences. Each of them operates independently (and is independent of the Global Rules). However, the two sequences complement each other with their logic. In this sense, they both combine to implement a test objective.

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. As in previous examples, create the Global Rules area.
3. Click the prompt to **add a sequence**. Prompts for the sequence appear beneath the Global Rules area. You create a sequence one state at a time. The application numbers states consecutively from 0 up (1, 2, 3, and so on).

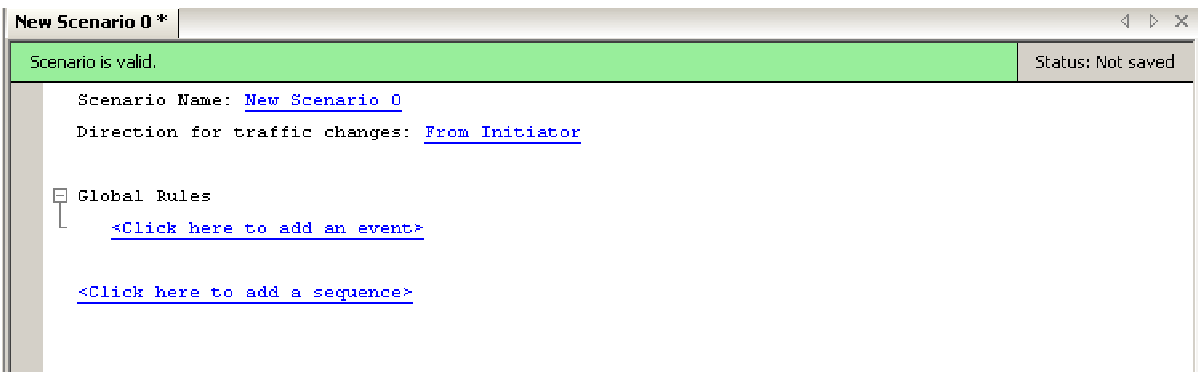


Figure 4.35: Example 7: Adding a Sequence

By default, the name of the first sequence in a scenario is Sequence 0. The name of the first state is State 0. To change the name of a sequence or state, or to associate a description with it, click the name of the sequence or state. A dialog box appears that allows you to enter that information.

Note: The description does not appear on screen, but you can bring it up by clicking the name of the sequence or state.

4. In the State 0 area, click the prompt to **add an event**.

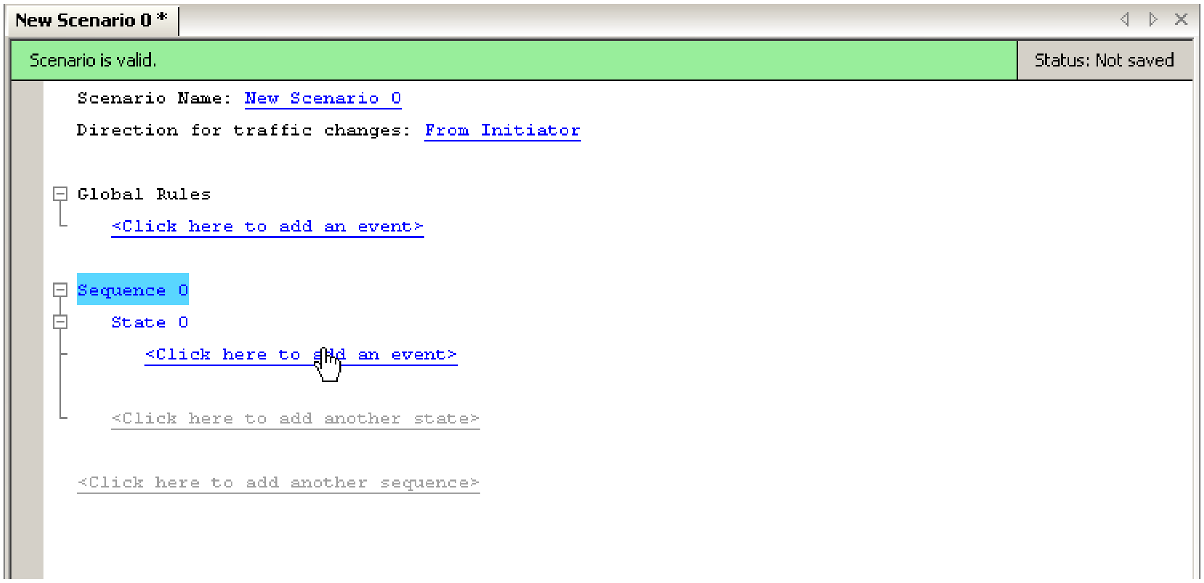


Figure 4.36: Example 7: Adding an Event for the First State

The Event Properties dialog box appears.

5. In the Event Properties dialog box, select **Address Frame** as the event.
6. Click **OK** to close the Event Properties dialog box.

7. In the State 0 area, click the prompt to **add an action**.

Figure 4.37: Example 7: Adding an Action for the First State

The Action Properties dialog box appears

8. For the action, select **Branch to > New State**.
9. Click the **OK** button to close the Action Properties dialog box.
10. This saves the action and automatically creates an area for State 1 in the scenario.
11. In the State 1 area, click the prompt to **add an event**. The Event Properties dialog box appears.
12. Choose the **Address Frame** event. In the Direction column, select **From Target** (you want State 1 to trigger on an Identify Address frame received from the target).
13. Click **OK** to close the Event Properties dialog box.

14. Click the prompt to **add an action** for State 1.

Figure 4.38: Example 7: Adding an Action to the Second State

The Action Properties dialog box appears.

15. In this example, you enter the action **Beep**, and you set the duration of the beep for 1 second.
16. Click **OK** to close the Action Properties dialog box.

17. You are finished creating the first sequence. Click the **add another sequence** prompt to create an area in the scenario for the second sequence (Sequence 1).

Figure 4.39: Example 7: Adding a Second Sequence

18. Create two states in the second sequence with the characteristics shown in the following table.

TABLE 4.9: Example 7: States for Second Sequence

State	Event	Action
0	Address Frame from Target	Branch to State 1
1	Address Frame from Initiator	Beep for 2 seconds.

19. In the File menu, select **Save Scenario** to save the scenario.

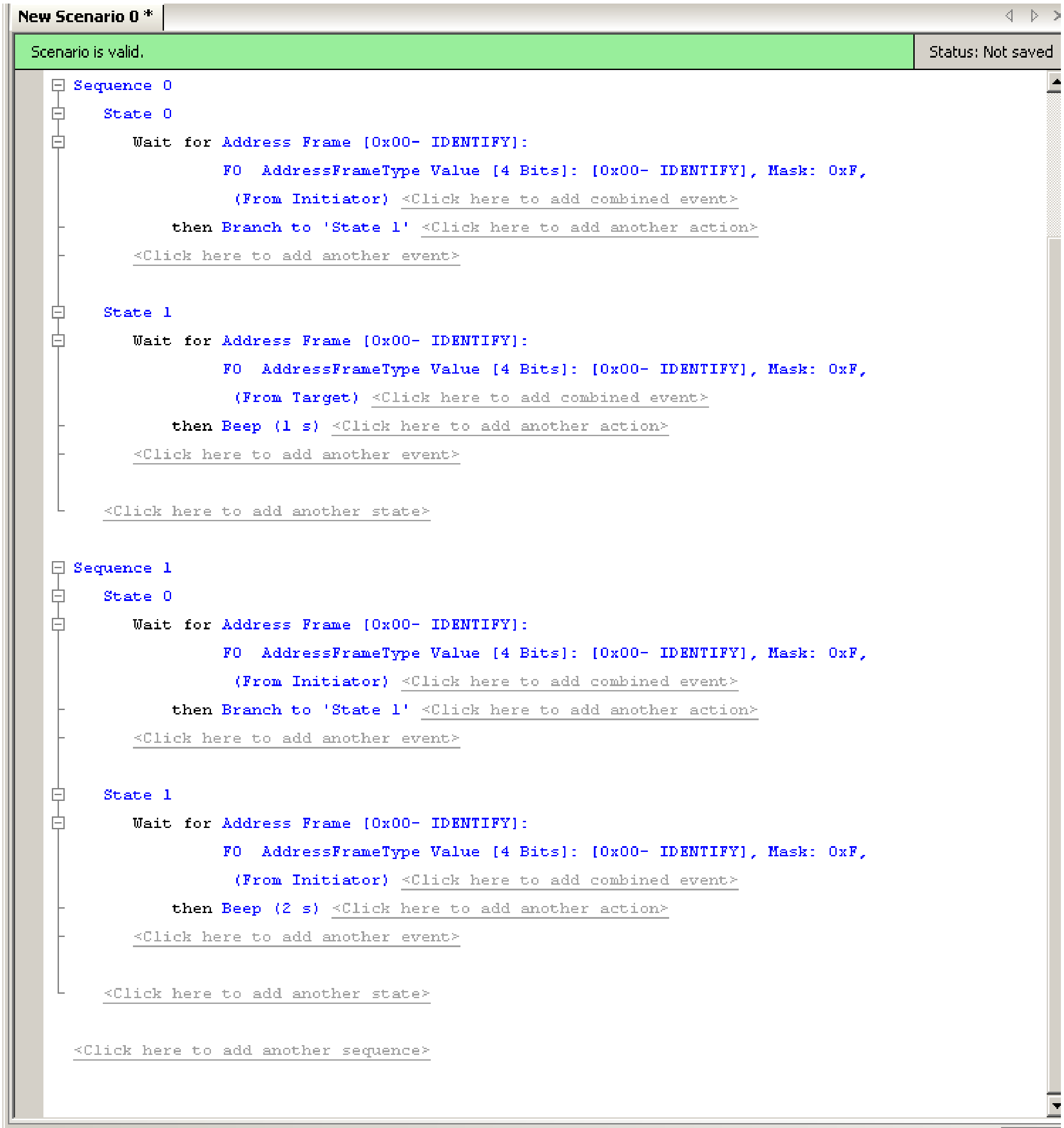


Figure 4.40: Example 7: Sequence Area of Scenario

4.10.2 Example 8: Creating a Sequence With Many States #1

In this example, a five-state sequence detects if a group of primitives is received out-of-order from the initiator. The expected order is: Align (0), Align (1), Align (2), Align (3). If this scenario detects any other order of these primitives, it causes the device to beep and the scenario to restart.

This example is designed to give you an idea of the powerful logic that you can implement with sequences.

Note that the states in this sequence have been renamed (do not have their default names). The following table summarizes the sequence logic.

TABLE 4.10: Example 8: Logic of Sequence 0

State	Description
Wait for Align (0)	When an Align (0) is received, go to Wait for Align (1).
Wait for Align (1)	If an Align (1) is received next, go to Wait for Align (2); otherwise, go to Indicate Error.
Wait for Align (2)	If an Align (2) is received next, go to Wait for Align (3); otherwise, go to Indicate Error.
Wait for Align (3)	If an Align (3) is received next, restart test; otherwise go to Indicate Error.
Indicate Error	Indicate error and restart test.

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. As in previous examples, create the five states for this sequence.

3. In the File menu, select **Save Scenario** to save the scenario.

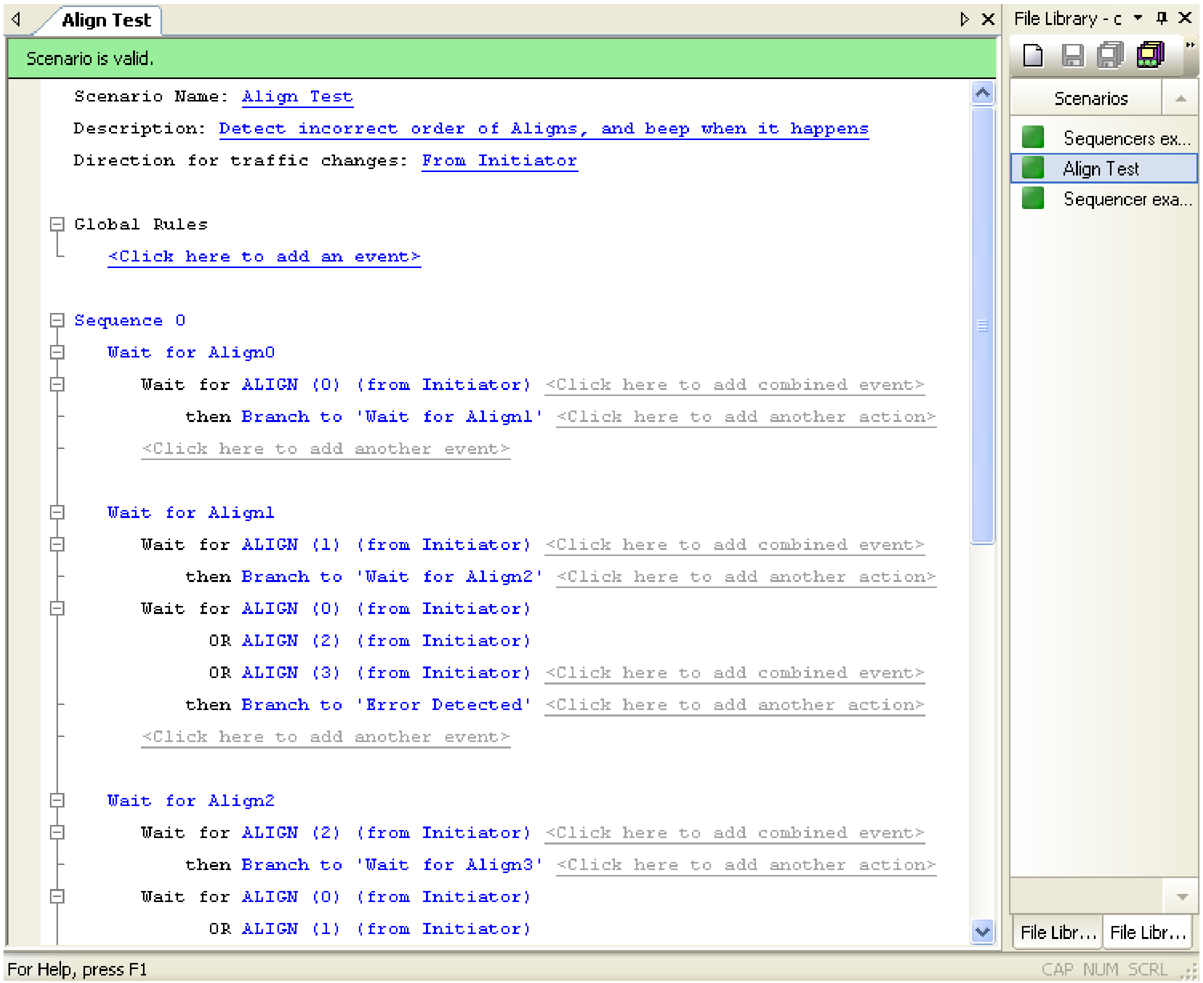


Figure 4.41: Example 8: Top Half of Scenario

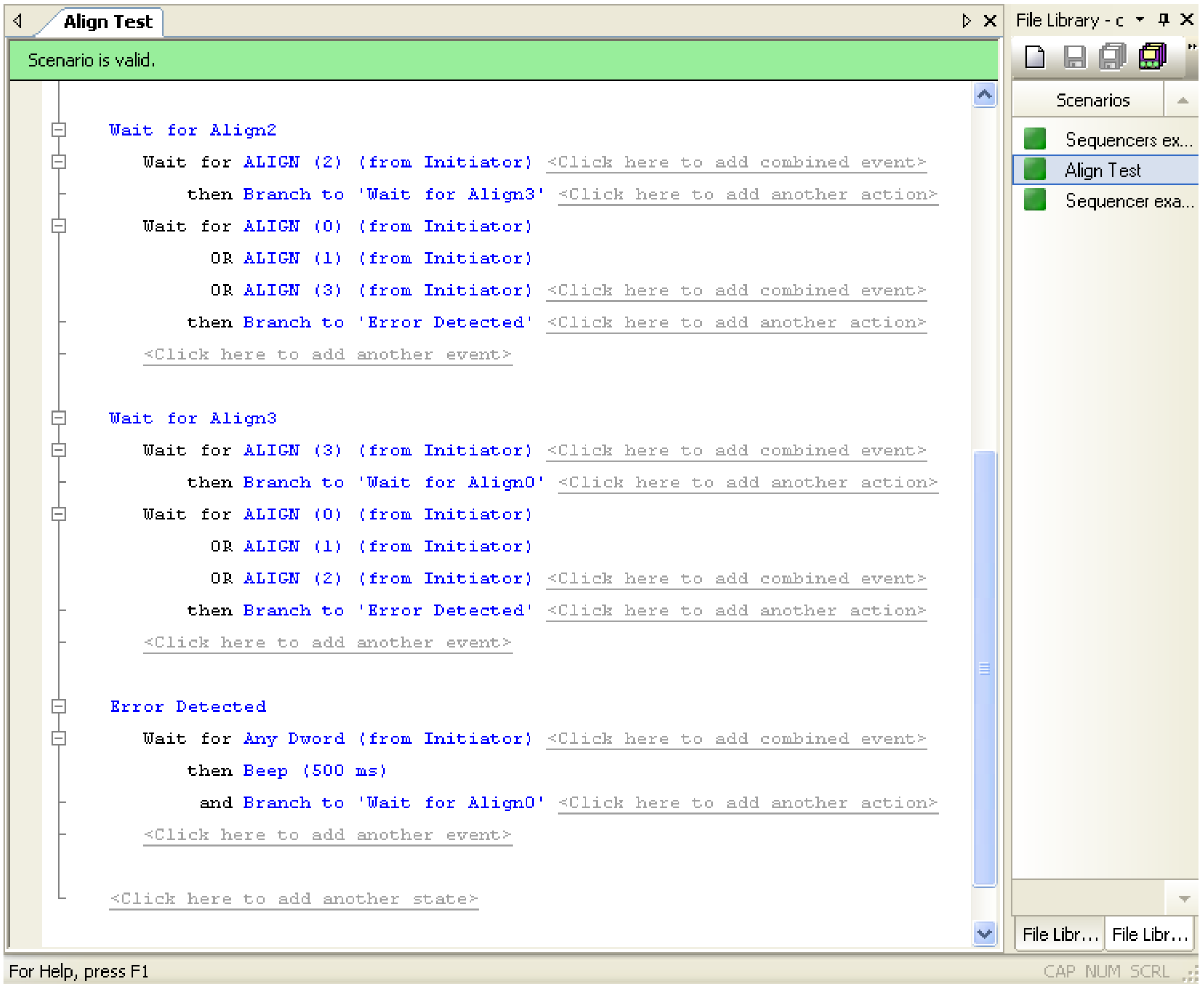


Figure 4.42: Example 8: Bottom Half of Scenario

4.10.3 Example 9: Creating a Sequence With Many States #2

In this example, a five-state sequence not only detects if a group of primitives is received out-of-order, but it fixes any incorrect order. The logic is similar to that of example 8 with a few small changes. The following table summarizes each state.

TABLE 4.11: Example 9: Logic of Sequence 0

State	Description
Wait for Align (0)	When an Align (0) is received, go to Wait for Align (1).
Wait for Align (1)	If an Align (1) is received next, go to Wait for Align (2); otherwise, replace primitive with Align (1) and go to Indicate Error.
Wait for Align (2)	If an Align (2) is received next, go to Wait for Align (3); otherwise, replace primitive with Align (2) and go to Indicate Error.
Wait for Align (3)	If an Align (3) is received next, restart test; otherwise, replace primitive with Align (3) and go to Indicate Error.
Indicate Error	Indicate error and restart test.

1. Click the **New Scenario** button in the main library or one of the device libraries. In the Scenario Properties dialog, enter the scenario name, description, and direction of traffic change.
2. As in previous examples, create the five states for this sequence.

3. In the File menu, select **Save Scenario** to save the scenario.

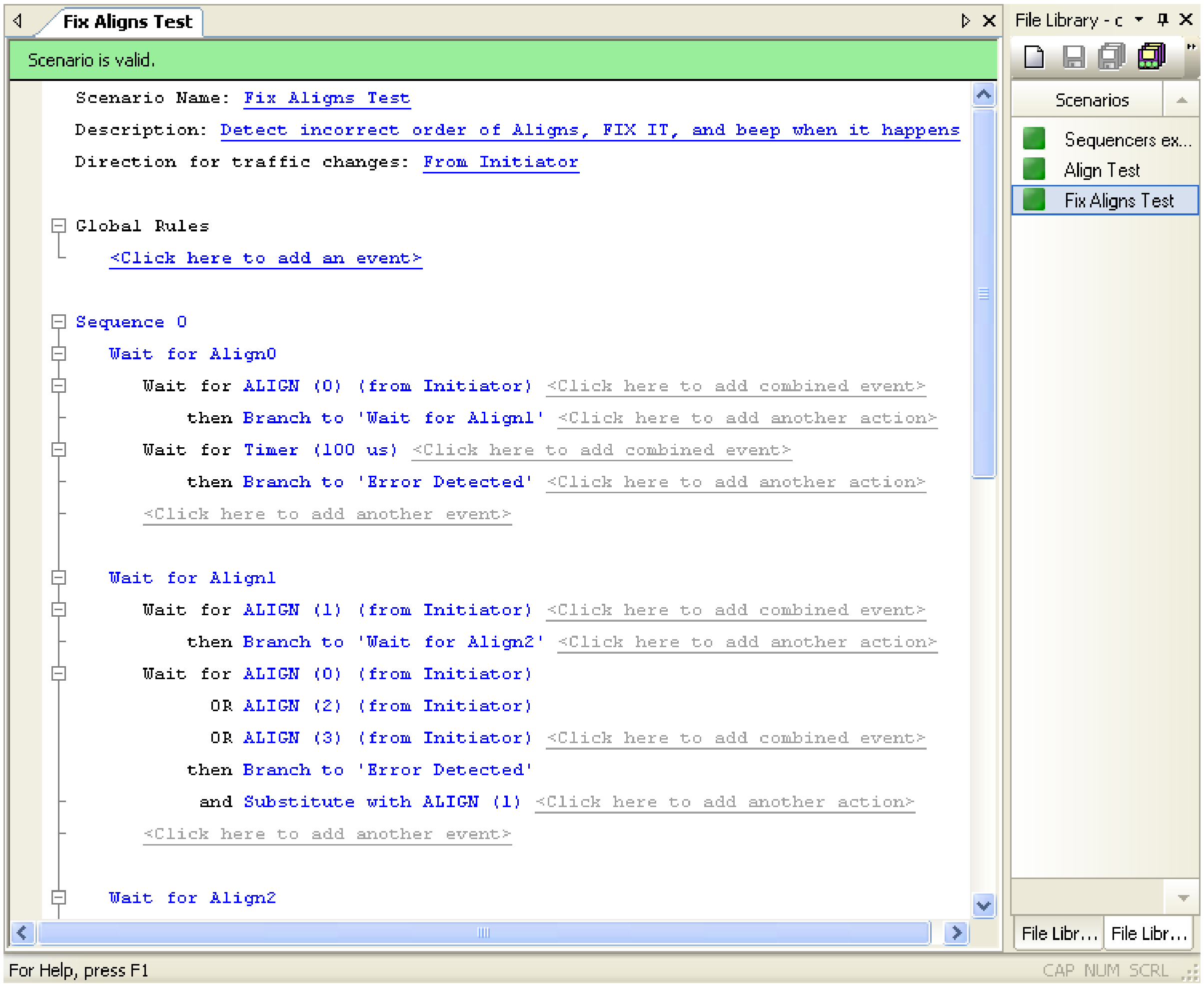


Figure 4.43: Example 9: Top Half of Scenario

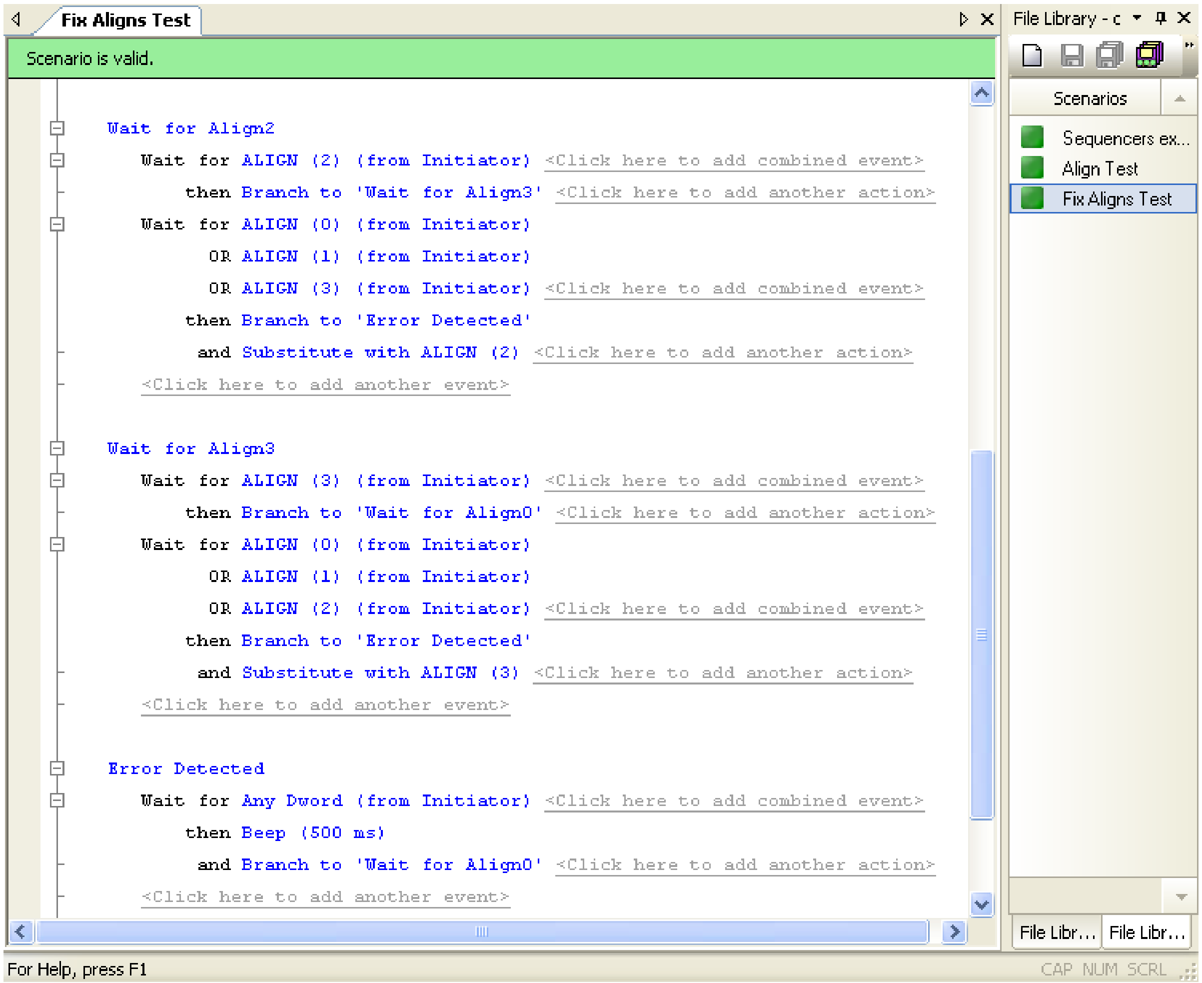


Figure 4.44: Example 9: Bottom Half of Scenario

4.11 Running Scenarios

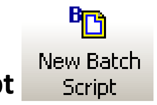
If you use a general library as a scenario archive, then the process of executing a scenario is as follows:

1. Select the scenario to run by clicking it.
2. To run the scenario, click the **Run Scenario** button on the Device Library toolbar (second button from the right). The InFusion device then begins its session.

4.12 Scenario Batch Files

You can write a script with commands to run a sequence of executable scenarios automatically. A Scenario Batch file is a text file with a list of commands to run in sequence when you execute the file. A batch script can manage scenarios and their assigned ports and hardware in sequence, using conditions. The system checks for accuracy of inputs and commands.

Note: Before you run a Scenario Batch file that requests scenarios, you must download the scenarios to the Scenarios box.

To start a batch script, click the **New Batch Script**  button or select **File > New Batch Script**.

4.12.1 Script Workspace

In the Script Workspace, add a command and make a batch file.

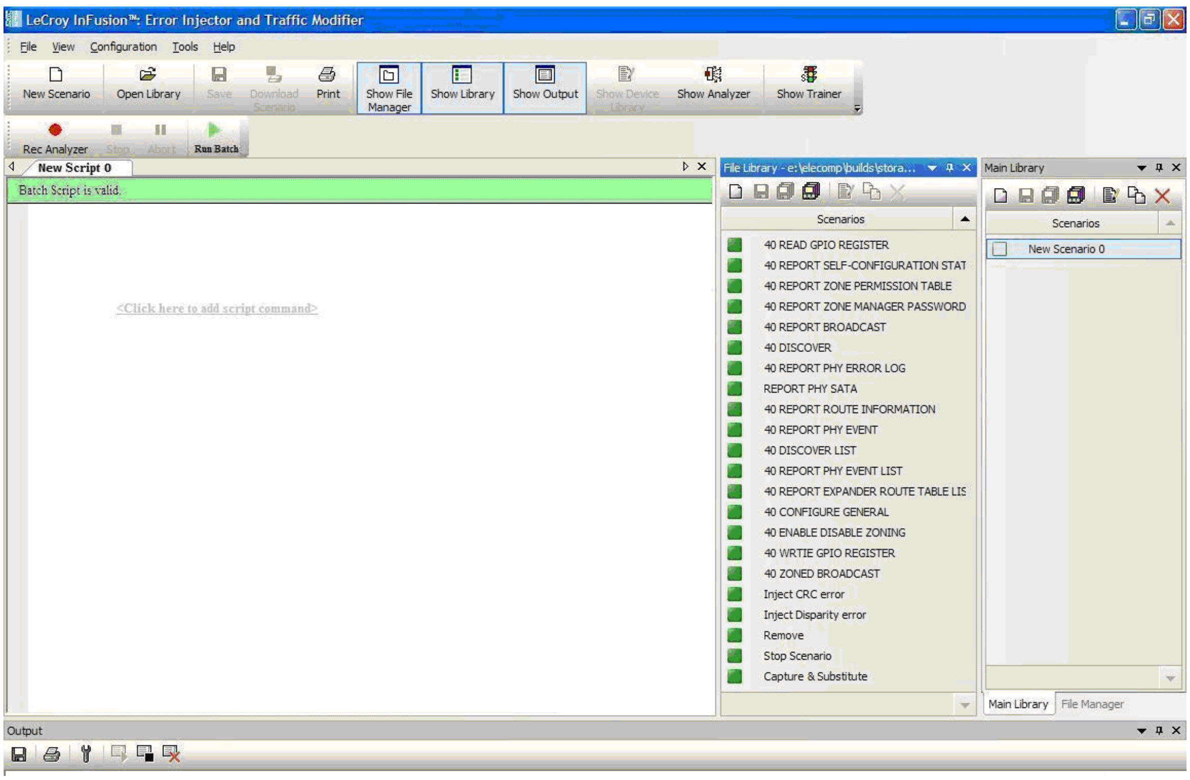


Figure 4.45: Script Workspace

In this dialog, you can enter a script command by clicking **Click here to add script command**.

3. First, click **Click here to add script command** to open the Command Properties dialog (see Figure 4.46 on page 283).

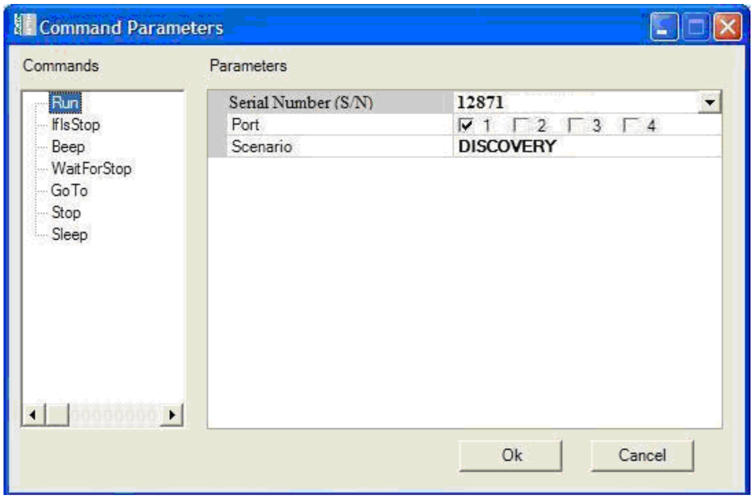


Figure 4.46: Command Parameters Dialog

The Command Parameters Dialog contains the list of available commands and their parameters from which to build scenarios and connected hardware and available ports.

4. Select appropriate parameters for the command and click **OK** to display the script in the Script Workspace.

Note: You can select ports from the port list, depending on number of ports licensed.

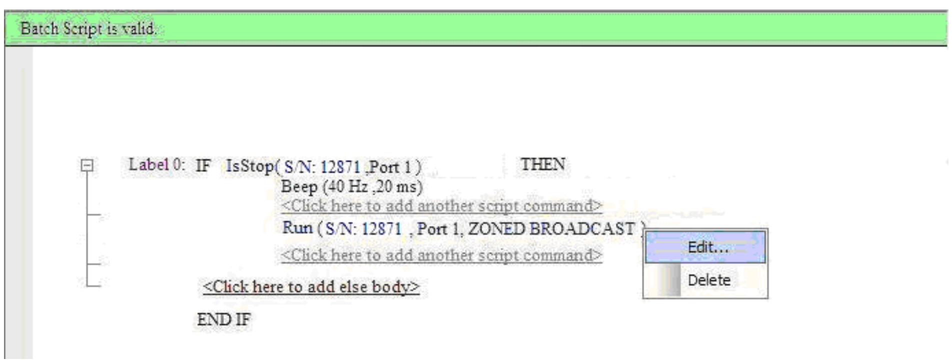
Note: The hardware Serial Number can already exist or not. If the Serial Number exists, the Serial Number (for example, S/N: 12871) is shown. In Offline and Simulation mode, you can enter a Serial Number. In Online mode, you can only enter an existing Serial Number.

5. To add another command, click **Click here to add another script command.**

To copy a script command, right-click on the command and select **Copy**. Right-click **Click here to add another script command** and then select **Paste**.

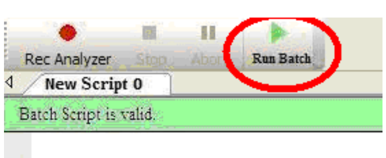
You can also cut, delete, and edit a selected script command.

6. To edit batch commands, click the command, or right-click the command and select **Edit** from popup menu.



7. **To delete a command**, right-click and select **Delete** from popup menu, or select command and press **Delete** key on keyboard.

After finishing, if everything is correct, push the **Run Batch** button to execute scenario and save result in the log file.



Note: Before you run a Scenario Batch file that requests scenarios, you must download the scenarios to the Scenarios box.

4.12.2 Error Checking

The Script Workspace shows errors by red color. The program reports all errors in the log file.

If you use a script from other InFusion hardware, it may cause an error, for example, mismatch in hardware Mac addresses, or scenarios that are not already in current hardware.

4.12.3 Log

Results of executable batch commands are saved automatically into a log file with user-specified name. The status of executable commands is shown in log area.

4.12.4 Statements

Statements can be conditional statements or non-conditional statements.

IfIsStopped

Shows whether a scenario is already stopped or not.

Format

```
IfIsStopped (Serial Number, Target Port)
```

Parameters

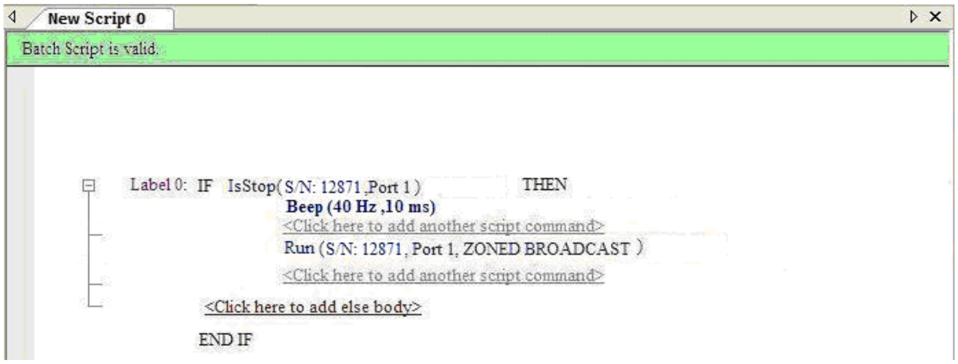
- **Serial Number**: Serial number of hardware
- **Target Port**: Port number in port map

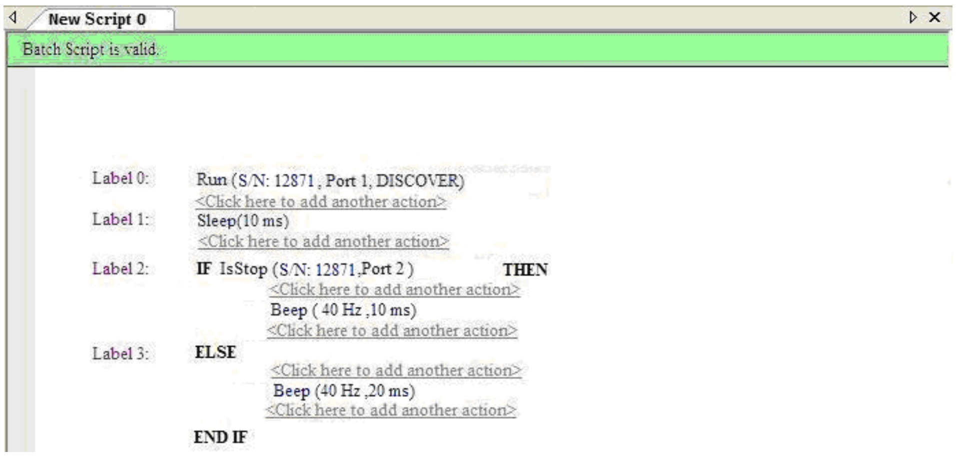
Example

```
IfIsStopped(ox01267, 1) Then
  {
  Beep (750, 300)
  Run (ox01267," Detect AddressFrame Open", 5)
  }
```

The value of second parameter is 5 and shows check stopping mode of combination of port number 1 and port number 3.

After filling parameters from the Command Parameters Dialog, the program makes the IF-ELSE structure in the Script workspace. The ELSE statement is optional. To add an ELSE body, click **Click here to add else body**.





Goto Label

Goes to specified label. Labels can be assigned to each script line.

Format

```
Goto Label3
```

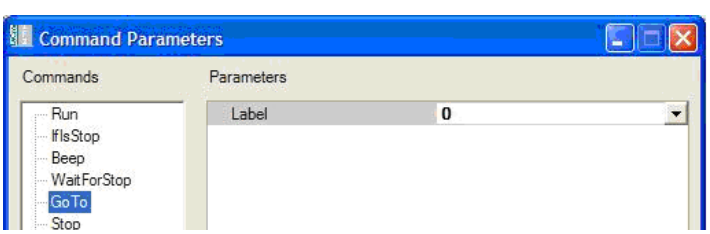
Parameters

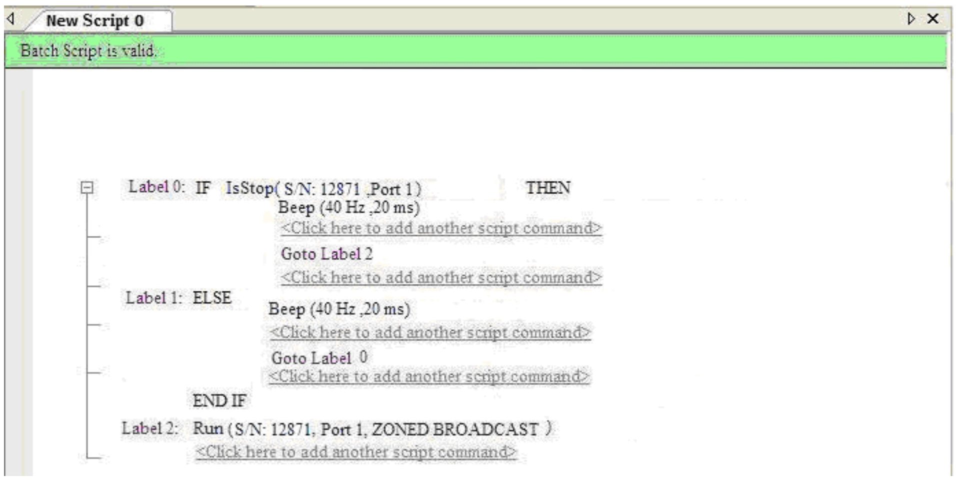
none

Example

```
Label3: WaitForStop(0x83456, 2, 100))
Run (ox01267," Inject CRC000", 4)
Goto Label7
```

Note: You can use a **Label** and a **Goto Label** to make loops. First make the label, then make Goto Label. The Command Parameters window shows only enabled Labels. Labels are disabled by default and are in gray color. To enable them, click them to make purple color.





Run

Runs the scenario on hardware on specified ports. If you call this command for the first time and the scenario was not assigned to the hardware and ports before, the scenario is assigned to specified hardware and ports and then scenario runs on the hardware.

Format

```
Run(Serial Number, Scenario Name, Target Port)
```

Parameters

- **Serial Number**: Serial number of hardware
- **Scenario Name**: Name of scenario
- **Target Port**: Port number in port map

Example

```
Run (ox841200," Substitute address frame", 4)
Beep(800, 400)
Run (ox841200," CRC Inject _ Play CD", 8)
WaitForStop(0x63463, 1, 150)
Run (ox841200," Remove Send Cue Sheet", 2)
Goto Label6
Run (S/N: 12871, Port 1, DISCOVER)
```

Note: If the selected ports are busy, scenario cannot run, and the command will be skipped. The result will be written in Log area.

Stop

Stops running scenario by hardware and port name.

Format

```
Stop (Serial Number, Target Port)
```

Parameters

- **Serial Number**: Serial number of hardware
- **Target Port**: Port number in port map

Example

```
Run (ox00820,"Inject CRC000", 2)
Beep(700, 500)
Stop (ox00820, 2)
Goto Label3
...
Label3 : Run(ox005007,"Detect DATA", 8)
Sleep(40)
```

WaitForStop

Used to wait for occurrence of specified condition.

Format

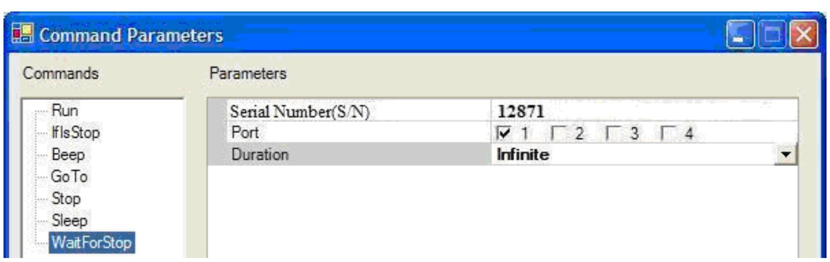
```
WaitForStop(SerialNumber, Target Port, Duration)
```

Parameters

- **Serial Number**: Serial number of hardware
- **Target Port**: Port number in port map
- **Duration**: Integer or random duration in milliseconds. In the Command Parameters Window, WaitForStop duration has three options:
- **Infinite**: Wait until **Stop** command.
- **Random**: Stop after a random time.
- **Finite time**: Stop after specified time in milliseconds.

Example

```
Run (ox001267,"Detect AddressFrame Open", 2)
WaitForStop (0x348790, 2, Forever)
Run (ox005007,"Detect DATA", 4)
WaitForStop(ox005007, 4, 100)
Stop (ox001267, 2
```



Sleep

Used to sleep for a few seconds.

Format

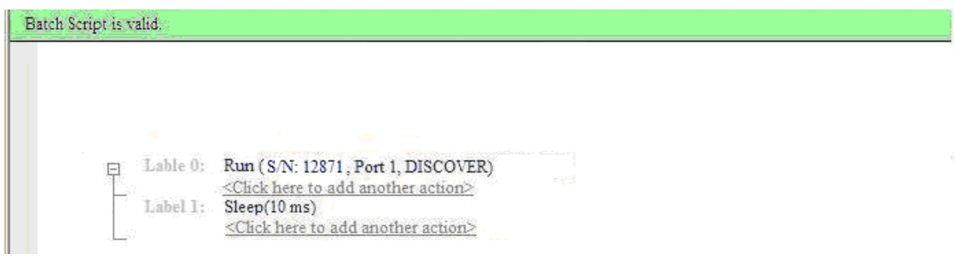
```
Sleep(Duration)
```

Parameters

- **Duration**: Integer or random duration in milliseconds

Example

```
Sleep(100)
```



Beep

If specified condition is satisfied, the system beep for specified duration.

Format

```
Beep (Duration, Frequency)
```

Parameters

- **Duration**: Integer or random duration in milliseconds
- **Frequency**: Frequency in hertz

Example

```
IfIsStopped(0x83456, 4)) then
  {
  Beep (2, 20)
  Run (0x83456,"Identify_Disparity error", 8)
  }
```

Chapter 5

Sierra Trainer Traffic Generation

The Sierra Trainer is a traffic generator that can emulate a SAS initiator/target or SATA host/device. Traffic generation enables engineers to test designs under realistic conditions and to transmit known errors, allowing engineers to observe how devices handle faulty link conditions.

Traffic generation is performed via the execution of text-based scripts. These traffic generation files (***.ssg**) contain statements about the types of traffic to be generated. These script files can be edited with either a simple text editor such as Notepad or with the Script Editor utility provided by the application.

To open the Traffic Generation window, click the **Launch Trainer Icon** 

in the SAS/SATA Protocol Suite window:

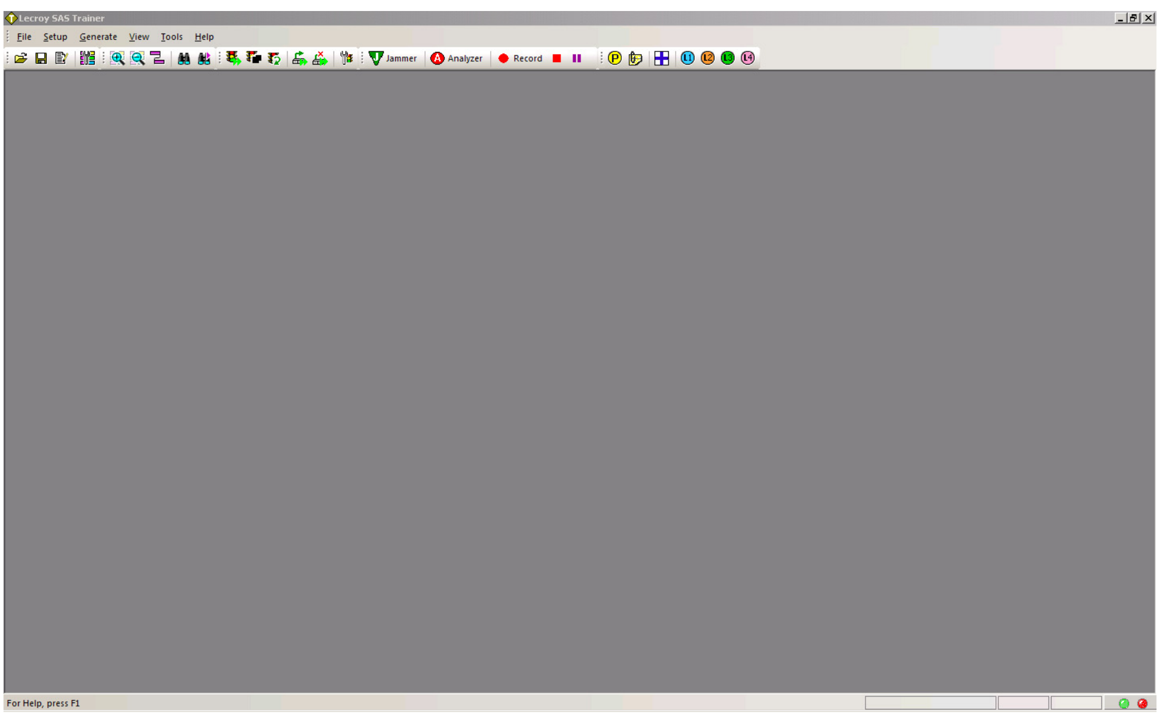


Figure 5.1: SAS: Sierra Trainer Window

SATA: Replaces the SAS icon with the SATA icon for Show Analyzer Frame.

Note: Trainer has Power On and Power Off commands to control External Power Expansion Card.

5.1 Sierra Trainer Menus

The Sierra Trainer menus are:

5.1.1 File Menu

New GenFile: Starts a new Generation File.

Open: Opens a file.

Close: Closes the current window.

Launch Analyzer: Displays Analyzer Window.

Launch Analyzer: Displays Jammer (Infusion) Window.

Save As: Saves the current file with a new name.

Print: Prints part or all of the current traffic data file.

Print Preview: Produces an on-screen preview before printing.

Print Setup: Sets the options for the current or new printer.

Edit Comment: Allows you to enter a comment in a dialog.

Export: Saves trace as text file in Packet View Format.

Convert: Converts an SATrainer Generation File (**.stg** file) to a Generation File (**.ssg** file).

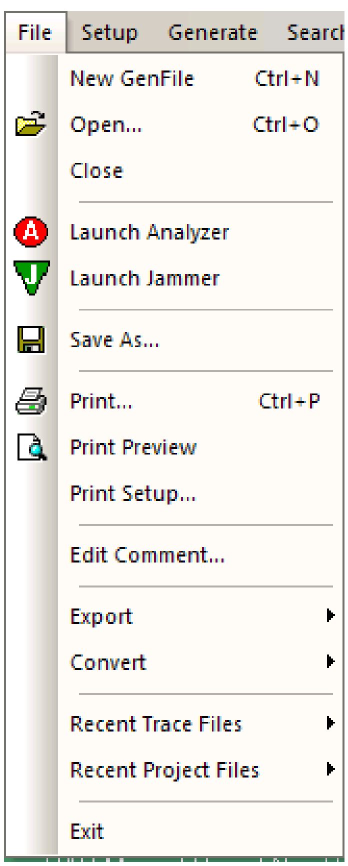


Figure 5.2: Trainer File Menu

5.1.2 Setup Menu

- **Update Sierra Device:** See “Update Device” on page 221.
- **Port Configuration**:

You can select different combinations of Trainer with Analyzer and Jammer. When running two different applications on the ports, you must set the same port configuration in both of them. See “Ports Configuration” on page 98. The following describes possible configurations:

  - **Analyzer and Trainer on same port**: You can generate initiator/target traffic and also capture the traffic generated.
  - **Analyzer and Trainer on same port, and Analyzer and Trainer on another port**: You can generate initiator/target traffic and also capture the traffic generated on two ports.
  - **Trainer on one port, Analyzer on another port, and Analyzer on a third port**: Trainer is run on a port generating initiator/target traffic and two port Analyzers run on two other ports capturing the traffic of those ports.
  - **Trainer on two ports, and Analyzer on two ports**: Two Trainers run on two ports generating initiator/target traffic and two Analyzers run on two other ports capturing the traffic of those ports.
  - **Trainer and Jammer on same port**: You can generate initiator/target traffic and also inject errors on the traffic between initiator and target on the port.

Note: See “Multi-Port Trainer Script Assignments to Links” on page 310.

Display Options: Selects what information to display. See “Display Options” on page 378.

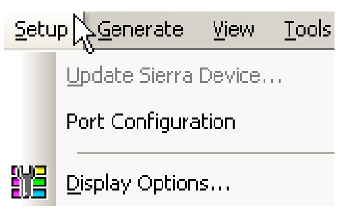


Figure 5.3: Trainer Setup Menu

5.1.3 Generate Menu

Start Generation: Causes the Generator to begin generation.

Stop Generation: Causes the Generator to stop generation.

Resume Generation: Causes the Generator to resume generation after a stop.

Connect Link: Automatically bring the linkup to the Host, Device, Initiator, or Target connected to the Trainer.

Disconnect Link: Disconnect link.

Connect Parameters: Set the “Identify” frame parameter settings to keep the link connected. See “Connection Parameters” on page 383.

Generation Options: Setup the Generation Rules. See “Auto Speed Negotiation” on page 365.

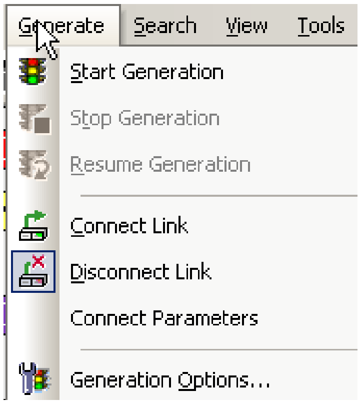


Figure 5.4: Trainer Generate Menu

5.1.4 Search Menu

Go to Event: Opens a dialog that allows you to go to a frame and time.

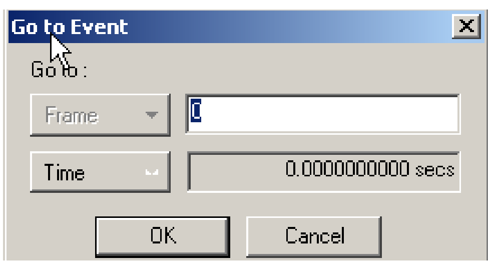


Figure 5.5: Go to Event Dialog

Go to Marker: Positions the display to the selected marked packet.

Go to: Packet Types, SSP Frames, SMP Frames, Primitives, Errors, Data Lengths, Speed, SATA FIS Type, SATA FIS Port, or Hash Address (Source or Destination). See Figure 5.6 on page 295.

Find: Displays the Find dialog. See “Find” on page 374.

Find Next: Applies the previous **Find** parameters to the next search.

Search Direction: Toggles the search forward or backwards. The current direction is indicated in the menu.

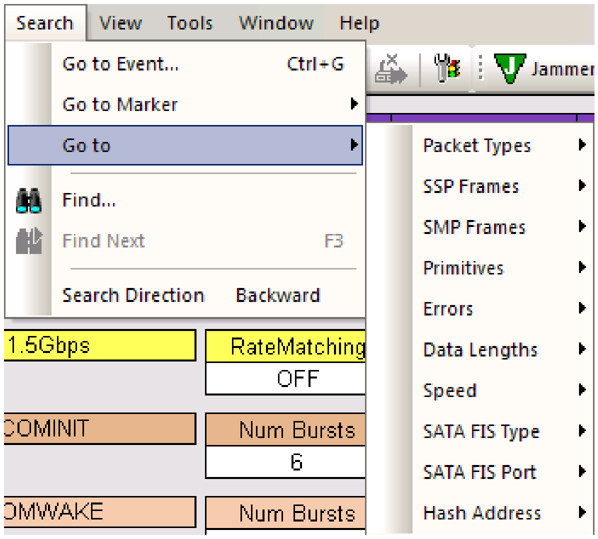


Figure 5.6: Trainer Search Menu

5.1.5 View Menu

See Figure 5.7.

Zoom In: Increases the size of the displayed elements.

Zoom Out: Decreases the size of the displayed elements.

Toolbars: Displays list of available toolbars: Standard, Frequently Used, Generator, Analyzer, Ports, or Customize. See “Resetting the Toolbar” on page 384.

Status Bar: Toggles the Sierra Trainer Status Bar, at the bottom of the window, which shows help messages and the search direction. The right most segment displays the current search direction: Fwd (forward) or Bwd (backward). Change the search direction from the Search menu or double-click the Search Status segment.

Wrap: Wraps displayed packets within the window.

Compact: Displays each row on one line only, with no wrapping.

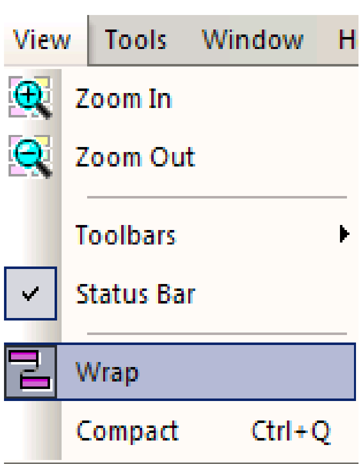


Figure 5.7: Trainer View Menu

5.1.6 Tools Menu

Hash Address Utility: Opens a dialog that allows you to enter an eight-byte SAS Address to display a Hashed Address.

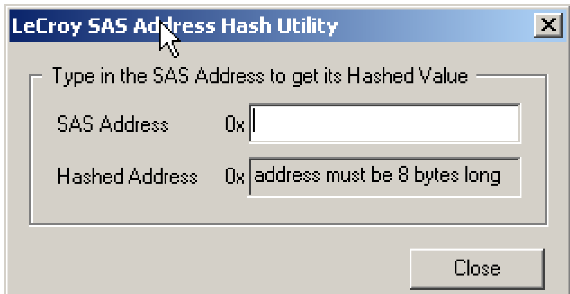


Figure 5.8: Address Hash Utility Dialog

5.1.7 Window Menu

Cascade: Displays all open windows in an overlapping arrangement.

Tile Horizontal: Displays all open windows in a above-below arrangement.

Tile Vertical: Displays all open windows in a side-by-side arrangement.

Arrange Icons: Arranges minimized windows at the bottom of the display.

Windows: Displays a list of open windows.

5.1.8 Help Menu

Help Topics: Displays online help. You can also select F1.

Check for Updates: Check whether a new software version is available. If so, you can download from the Teledyne LeCroy web site. You can select to Check for updates at application startup.

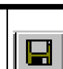
About: Displays version information.

5.2 Sierra Trainer Main Toolbar

The Sierra Trainer toolbar contains the following buttons:

Figure 5.9: Sierra Trainer Toolbar

The buttons have the following functions:

	Open Document.		Save As. Opens a dialog in which you can save your edits in the appropriate file type.
	Edit as Text. Edit the text file for the document.		Setup Display Options. Opens the Display Options window.

	Zoom In.		Zoom Out.
	Wrap.		Find.
	Find Next.		Start All Generation.
	Stop All Generation.		Resume All Generation.
	Connect All Link.		Disconnect All Link.
	Setup Generation Options. Opens the Generation Options window.	Jammer	Launch Jammer (Infusion).
Analyzer	Launch Analyzer.	Record	Start Recording.
	Stop Recording.		Abort Recording.
	Show Port Configuration Dialog. (See “Ports Configuration” on page 98.)		Show Script Assignment Dialog. (See section below.)
	Tile Windows	L1 L2 L3 L4	Assign Active Script/ Remove Assigned Script for Link 1, 2, 3, or 4 See “Multi-Port Trainer Script Assignments to Links” on page 310.

5.3 Setting Up for Generating Initiator Traffic

Connect the SAS cable from the **Target** port of the Sierra Analyzer to the Target port on the unit under test. This transmits the Traffic Generator stream from the **Target** port to the target-side port on the unit under test.

5.4 Setting Up for Generating Target Traffic

Connect the SAS cable from the **Initiator** port of the Sierra Analyzer to the Initiator-side port on the unit under test. This transmits the Traffic Generator stream from the **Initiator** port to the initiator-side port on the unit under test.

5.5 Creating a Traffic Generation File

Generating traffic is a two-step process.

First, create a text-based Sierra Trainer Traffic Generator file. This text file has an **.ssg** extension. You can create this file by creating a new generator file or editing an existing file.

Note: .ssg files created in other applications run in the Sierra Trainer.

After the file has been created, it can be opened and displayed in the application. You can invoke the application to transmit the traffic generation file by using the **Start Generation** button .

Note: For details about traffic generation files, see “Sierra Trainer Generation Language” on page 312.

5.5.1 Creating a New Generator File

You can create a new Sierra Trainer Traffic Generator **.ssg** file.

To create an **.ssg** file:

1. In the Sierra Trainer window, select **File > New GenFile** to display the Global Settings of a new **.ssg** file in a trace view.

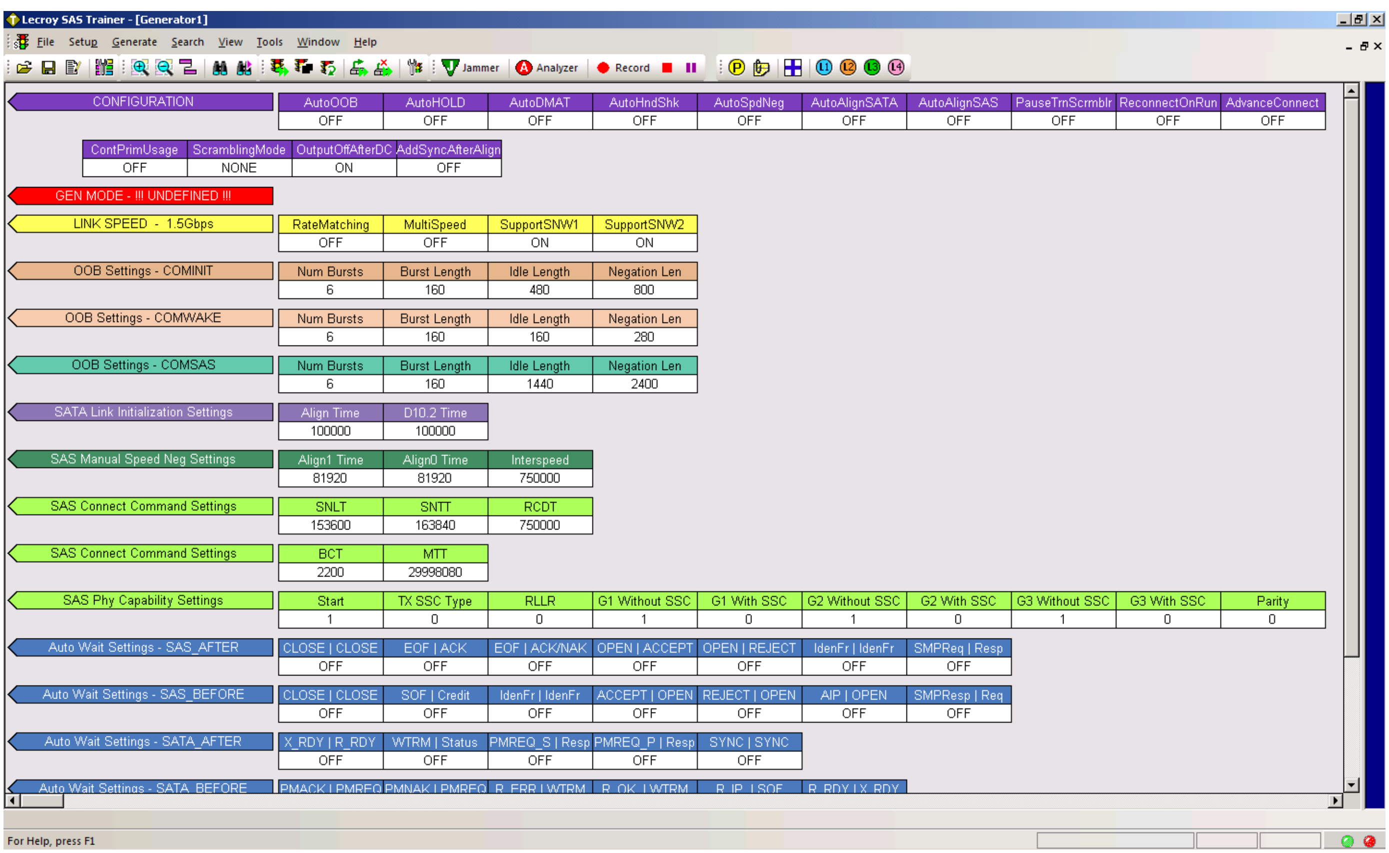


Figure 5.10: New GenFile

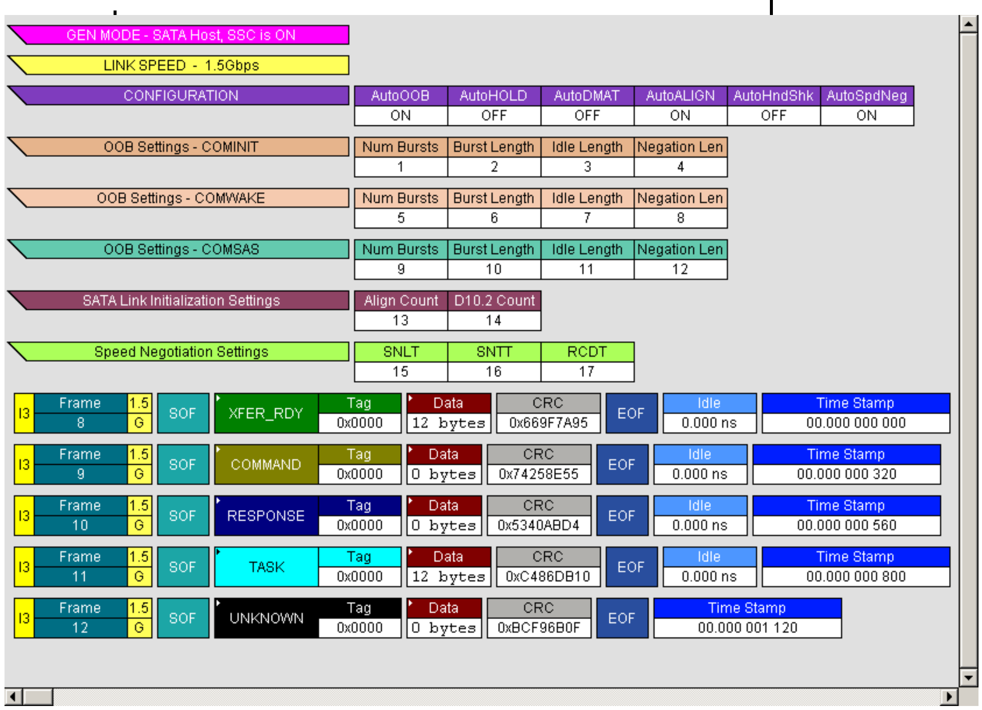
2. Click the **Edit as Text** button to enter Generation Block or Change Settings instructions in the Generation Script Editor. See "Starting the Script Editor" on page 306.

5.5.2 Editing an Example Generation File

The easiest way to generate traffic is to start with one of the example generation files and edit the settings to see how the script file behaves. As you make and save changes, the trace view of the generation file is automatically updated.

The following screenshots show an example file as it appears in the script editor and trace window.

```
Generation
{
    # SendSSPFrameData
    # {
    #      Data = { 21223344 55667788 99AABBCC }
    # }

     SendSSPFrameXferRdy
     {
         Data = { 51223344 55667788 99AABBCC }
     }

     SendSSPFrameCommand

     SendSSPFrameResponse

     SendSSPFrameTask
     {
         Data = { 51223344 55667788 99AABBCC }
     }

     SendSSPFrameVendor
}
```



In the screenshot, global settings make up the eight bars at the top of the window. Below that are five frames. If you look at the script itself, there are six frame commands, five active and one commented out.

The following sections describe how to open and edit traffic generation files.

5.5.3 Converting a SATrainer Traffic Generation File

If you have old 2500-based SATrainer Generator **.stg** files, you can convert them to Sierra Trainer Traffic Generator **.ssg** files using the legacy **Convert** function.

To convert an **.stg** file into an **.ssg** file:

1. In the Sierra Trainer window, select **File > Convert > Convert .stg to .ssg** to display an Open dialog.
2. Use Files of Type **SATrainer Generator Files (.stg).**
3. Select an SATrainer Generator ***.stg** file.
4. Click **Open**. The application creates a Sierra Trainer Traffic Generator file (***.ssg**).

5.5.4 Opening a Traffic Generation File

After the Traffic Generator file (***.ssg)** file has been created, you can open it in the application.

To open a Traffic Generator file:

1. Select **File > Open** on the Menu Bar, or click  on the Toolbar, to display an Open dialog.
2. Select a Generator text file (***.ssg**) and click **Open** to display the file (see Figure 5.11 on page 301). (The install directory contains example files.)

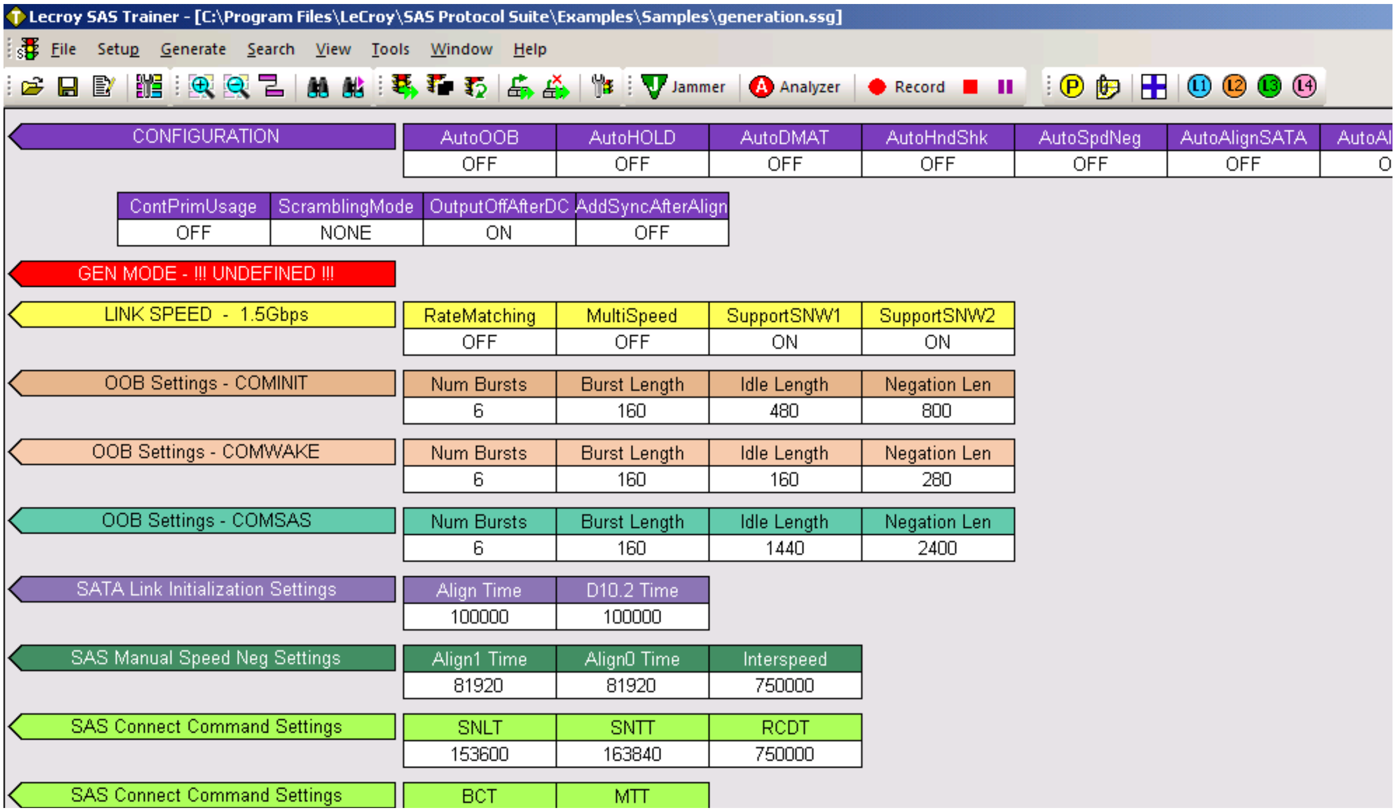


Figure 5.11: Sierra Trainer Generator File

5.5.5 Layout

The **.ssg** file has several colored bars that represent global settings. The bars show the current configuration of the generation file. Example settings are:

- Configuration
- GenMode (SAS or SATA, SSC On or Off)
- Link speed (1.5 Gbps, 3.0 Gbps, 6.0 Gbps or 12.0 Gbps)
- Type of device (Initiator or Device)
- COMINIT
- COMWAKE
- Scrambling Mode

As changes are made and saved to the traffic generation file, the bars immediately update. The traffic pattern to generate appears below the bars as a series of frames. You can edit the traffic generation file to add, edit or remove frames.

5.6 Overview of Generation and Global Settings Files

Example **.ssg** files and **Include** files are in two directories called **\Samples** and **\Include** that are typically installed in: **C:\Users\Public\Documents\LeCroy\SAS SATA Protocol Suite\Generation\Samples.**

5.6.1 Traffic Generation (*.ssg) Files

The **.ssg** traffic generation files are text files consisting of **include** statements, a generation block, and optionally global statements.

The generation block is the code responsible for the actual traffic generation. It is marked by the tag **Generation**. The composition and format of the generation block is described later.

```
%include "Generation\Include\Settings.inc"

Generation
{

}
```

The **include** statements provide links to the **Include** files, which provide the definitions for primitives, frames, and settings that hold for most or all of the generation session (global settings).

The definitions for SAS and SATA traffic are contained in Teledyne LeCroy-provided **Include** files: Settings.inc, PrimitivesDecl.inc, AddressFramesDecl.inc, SSPFrames.inc, SMPFrames.inc, and SSPFrames.inc.

5.6.2 Settings.inc File

The **Settings.inc** file contains global statements about the link, the type of device being emulated, and other conditions that are to exist throughout part or all of the traffic generation. This file must be included in the traffic generation file.

There are fifteen groups of settings in this file:

- AutoMode
- COMINIT/COMRESET OOB Signal
- COMWAKE OOB Signal
- COMSAS OOB Signal
- Generation Commands
- Link Speed
- SATA Link Initialization
- SAS Speed Negotiation
- SATA Speed Negotiation
- Autowait:
  - SAS After
  - SAS Before
  - SATA After
  - SATA Before
- Wait Command Timeout
- Scrambling Mode

Details about each group of settings are described in the **Traffic Generation Language** section.

Editing Settings.inc

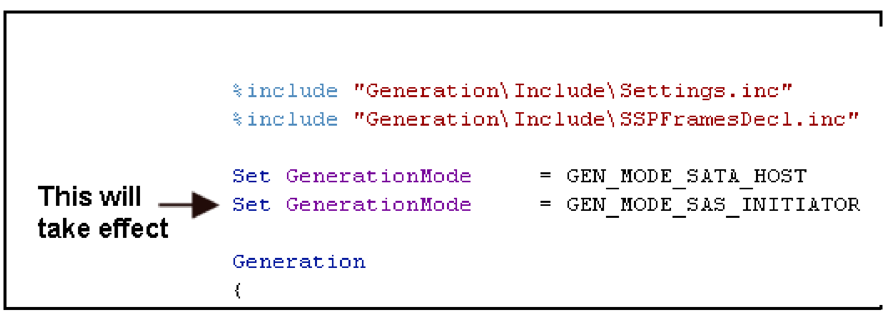
Text in the **Settings.inc** file can be edited directly or copied into the beginning of the traffic generation file and edited there.

```
%include "Generation\Include\PrimitivesDecl.inc"
%include "Generation\Include\Settings.inc"

Set GenerationMode = GEN_MODE_SATA_HOST

Generation
{

}
```

When editing global settings, keep in mind the following rule: The last line encountered before the generation block takes precedence. Thus, if the following two lines about the device emulation were added just above the generation block, the second would take effect:

set GenerationMode = GEN_MODE_SATA_HOST

set GenerationMode = GEN_MODE_SAS_INITIATOR



The Global Setting “AutoAlign”

AutoAlign is a global setting that may be on or off depending on the type of device you are emulating. There is an AutoAlign setting for SAS and one for SATA, for example, “set AutoAlignSAS = ON” and “set AutoAlignSATA=OFF.”

- SAS: Sends AutoAligns every 2048 DWORDs.
- SATA: Sends AutoAligns every 256 DWORDs.

If you plan to set and reset AutoAlign in the middle of traffic generation, you need to know what the defaults are for AutoAlign. The defaults are as follows:

For SATA host/device emulation,:

- AutoAlignSATA is assumed to be ON.
- AutoAlignSAS is assumed to be OFF.

For SAS emulation, the assumptions are opposite:

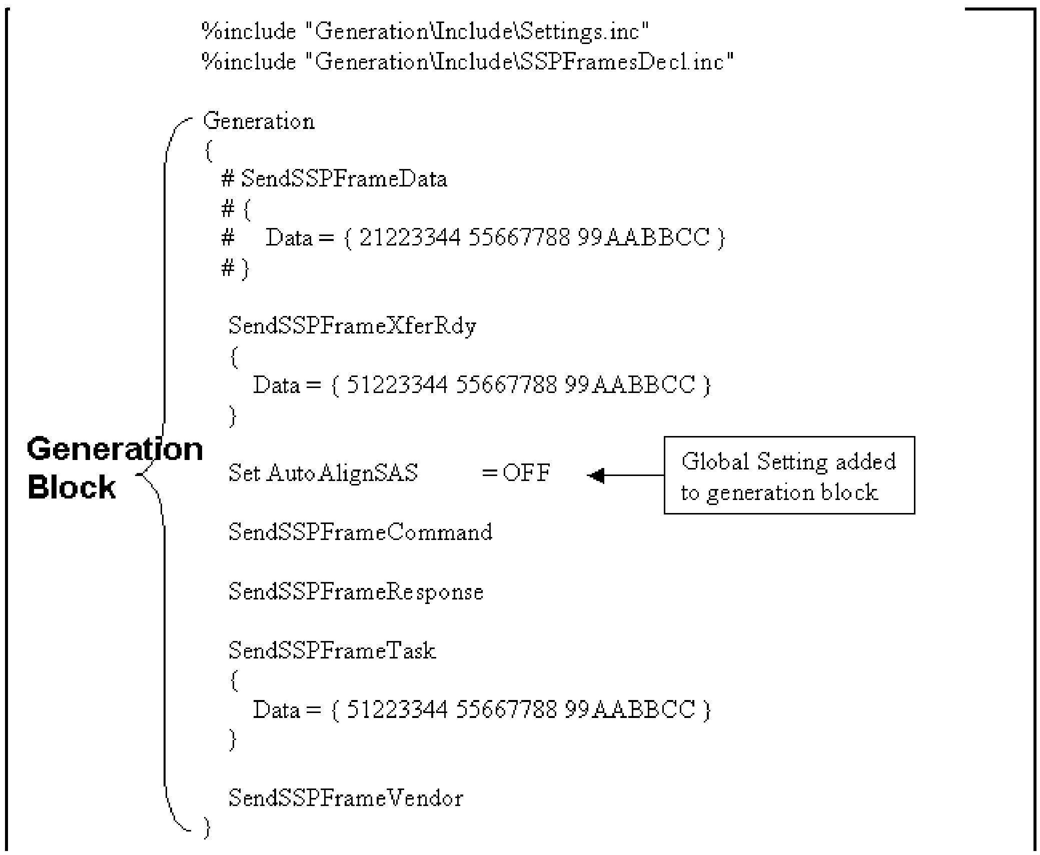
- AutoAlignSATA is assumed to be OFF.
- AutoAlignSAS is assumed to be ON.

For STP:

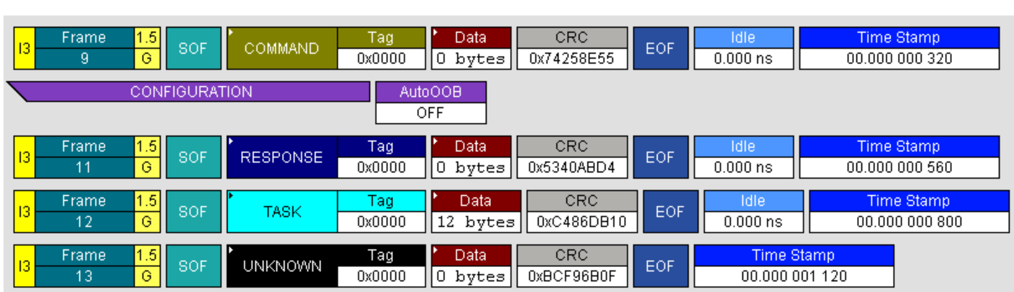
- AutoAlignSAS and AutoAlignSATA are assumed to be ON.

Placing Global Settings in the Generation Block

Some global settings such as AutoAlign = On/Off can be set and reset in the generation block. For example, you might want to set SASAutoAlign = ON prior to traffic generation, and then change to OFF halfway through the generation session.



When placed within the generation block and then viewed in the trace window, global settings appear as colored bars interspersed amidst the traffic.



While most global settings can be set in the generation block, three will be ignored if placed within the generation block:
set Link Speed =
set GenerationMode =
set SSC =

These commands should be configured either in the **Setting.inc** file or at the beginning of the traffic generation file as a global statement.

5.7 Primitive and Frame Definitions

Five other **Include** files are provided that define the most of the known templates for Primitives and Frames. The five are:

- PrimitivesDecl.inc
- AddressFramesDecl.inc
- SSPFramesDecl.inc
- SMPFramesDecl.inc
- STPFramesDecl.inc

Each of the Frame templates defines header and field structure.

The default value for all Frame fields is zero.

5.7.1 Special Conditions for Frames

There are three conditions about Frames that need to be kept in mind when configuring Frame generation:

1. Frame delimiters need to agree - At the present time, when defining a Frame, make sure that the Frame Prologue and Frame Epilogue agree. Do not mix types. For example, do not mix a SAS Start of Frame (SOF) with a SAS End of Address Frame (EOAF).

A SAS SOF should be matched to a SAS EOF. A SAS SOAF should be matched to a SAS EOAF. If generating SATA traffic, a SATA_SOF should be matched to a SATA_EOF.

At the present time, if you mix different types of prologues and epilogues for any given Frame, the Frame is ignored.

2. Data Length Fields can be fixed-length or variable - By default, data frames are of a fixed length. If you want to generate variable length frames, place an asterisk in the Data definition field in the **SSPFramesDecl.inc** file:
Data : *

```
############ DATA ##############
Data                        : *     # Variable length field, can be assigned to an array of DWORDs
```

If you replace the asterisk with a value, then the field becomes fixed length.

3. CRC Calculations are calculated unless told otherwise - If the CRC is not explicitly set in the traffic generation file, the application assumes that you want it and calculates and displays it in front of the generated frames.

If you provide a CRC value, the application uses that value, even if it is incorrect. This gives you the option of configuring the generator to create errors.

If the generation file was created through the Export command (File > Export > To Generator File Format ...), the CRC is calculated but commented out. If the source trace has a bad CRC, the CRC is exported into the generation file and is not commented out.

5.7.2 Primitives Decl.inc File

The **PrimitivesDecl**.inc file defines Primitives. The file consists of declarations (left) and the corresponding byte streams (right).

```
Primitive SOAF                                    = kBC 18 1E 81
Primitive EOAF                                    = kBC 18 67 9F

Primitive "ALIGN (0)"                             = kBC 4A 4A 7B
Primitive "ALIGN (1)"                             = kBC 07 07 07
Primitive "ALIGN (2)"                             = kBC 61 61 61
Primitive "ALIGN (3)"                             = kBC 7B 7B 7B
```

To generate Primitives, copy relevant portions of text on the left (not the bytes shown right) from this file into the generator block section of the **.ssg** file.

5.7.3 Address FramesDecl.inc File

The **AddressFramesDecl**.inc file defines Address frames.

5.7.4 SSPFrames.inc File

The **SSPFrames.inc** file defines SSP frames.

5.7.5 SMPFrames.inc File

The **SMPFrames.inc** file defines SMP frames.

5.7.6 STPFrames.inc File

The **STPFrames.inc** file defines STP frames.

5.8 Starting the Script Editor

To edit an **.ssg** file, use the Script Editor. The Script Edit editing tool displays the **.ssg** file and its supporting **Include** files. The Script Editor utility has several aids to simplify the process of writing and editing scripts: tool-tips, drop-down menus, and colored fields. The Script Editor example below shows several commented lines followed by some instructions. The Script Editor has three areas: toolbar (top), script window, and file tabs (at the bottom of the window). If errors occur, a log opens at the bottom of the window.

Note: If more than one port of Trainer is licensed, you can assign scripts to one or more ports. See “Multi-Port Trainer Script Assignments to Links” on page 310.

To launch the Script Editor, click the **Script Editor**  button on the toolbar or right-click in the trace window and choose **Edit as Text**.

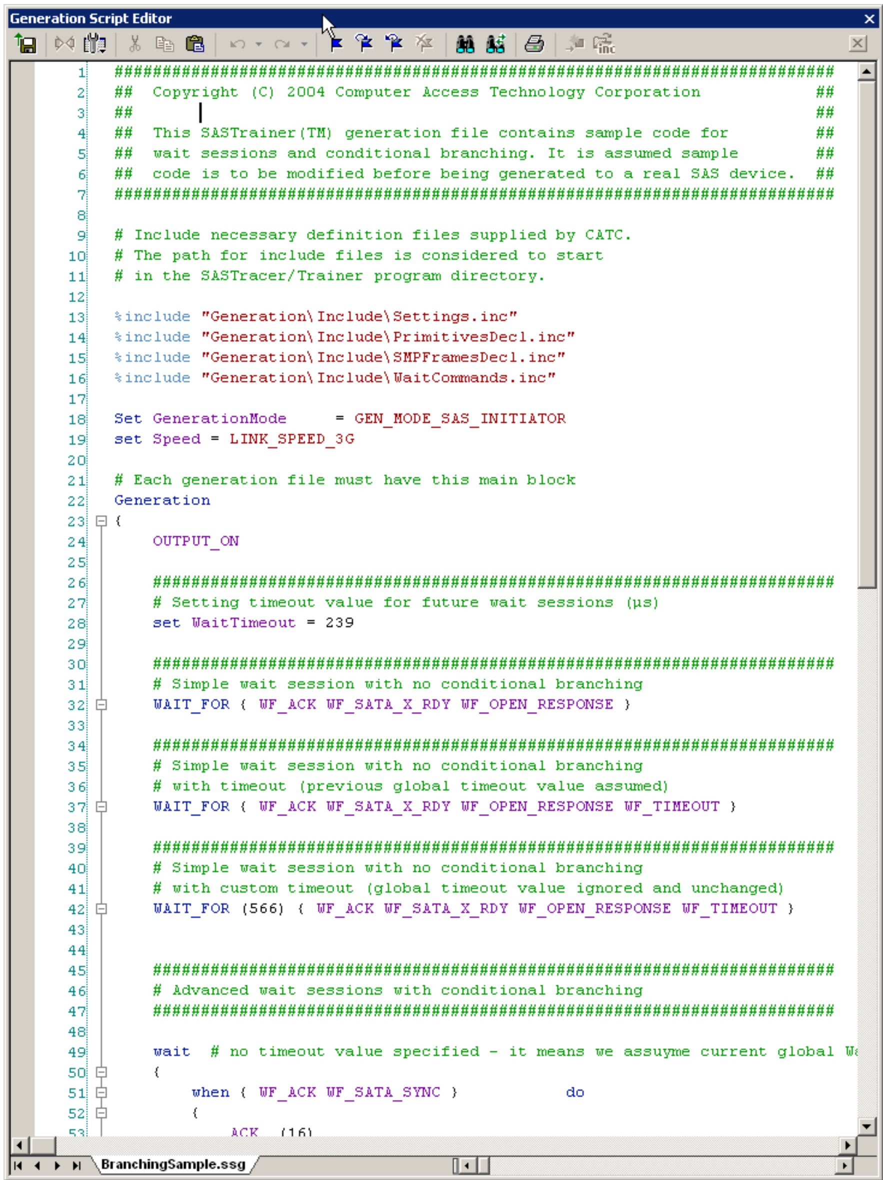


Figure 5.12: Script Editor

5.8.1 Script Editor Toolbar

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

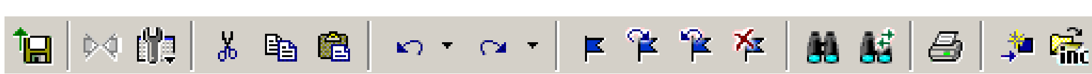


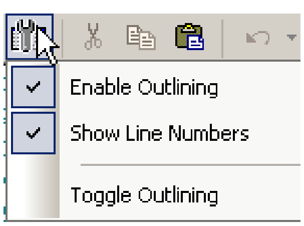
Figure 5.13: Script Editor Toolbar

The buttons have the following functions:

	Save. Saves your edits and immediately updates the setting bars and Frames shown in the trace window.		Add/Remove bookmark. Allows markers to be set or removed to aid in navigation.
	View Options. Opens a menu with three options: Enable Outlining, Toggle Outlining, and Show Line Numbers. See **View Options Menu** below.		Go to next bookmark.
	Cut.		Go to previous bookmark.
	Copy.		Clear all bookmarks.
	Paste.		Find.
	Undo.		Find and Replace.
	Redo.		Go to Trace View
	Print.		Go to Definition of Selected Keyword.
			Open File under Cursor. Opens the file pointed to with the mouse in the script. This command works with **Include** statements.

View Options Menu

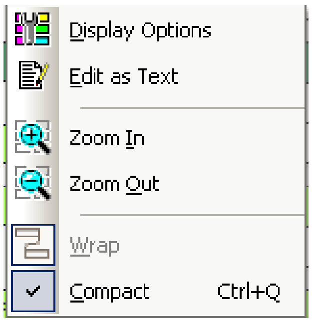
The View Options button displays a menu with the following options:



- **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.
- **Toggle Outlining**: Switches between collapsed and expanded states.

Pop-up Menu

Left-click anywhere in the script window to open a pop-up menu with the following options:



- **Display Options**: Selects what information to display. See "Display Options" on page 378.
- **Edit as Text**: Opens the Script Editor.
- **Zoom In**: Increases the size of the displayed elements
- **Zoom Out**: Decreases the size of the displayed elements
- **Wrap**: Wraps displayed packets within the window.
- **Compact**: Displays each row on one line only, with no wrapping

File Tabs

At the bottom of the window is a tab that shows the name of the **.ssg** file. If your **.ssg** file has an Include statement in it, the supporting Include files automatically open when the **.ssg** file is first opened. Tabs for the opened Include files appear at the bottom of this window.

Figure 5.14: File Tab

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.

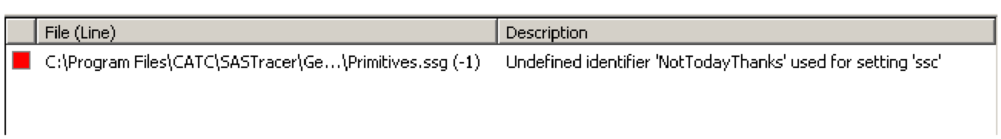


Figure 5.15: Log

Tooltips

The Script Editor window includes extensive tooltips for each keyword. To see a tooltip, hold the mouse pointer over a keyword.

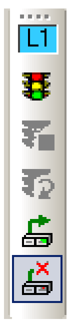
5.9 Multi-Port Trainer Script Assignments to Links

If more than one port of Trainer is licensed, after you open a generator file (**.ssg**) or create a new generator file (“Creating a Traffic Generation File” on page 297), you can assign the script to one or more ports.

Click the  Port Configuration button to open the Set Port Configuration dialog (see “Ports Configuration” on page 98). Select a port configuration. For example, Trainer may be on Port1 and Port 2 or Port3 and Port4.

After you select port configuration, the Assign Active Script/Remove Assigned Script for Link 1, 2, 3, or 4 buttons have colors. For example, for Trainer on Ports 1 and 2, the buttons are .

After you open or create a script in the Trainer window, click the L1 or L2 button to assign the script to Port 1 or Port 2. A display appears to the left of the script in the Trainer window:



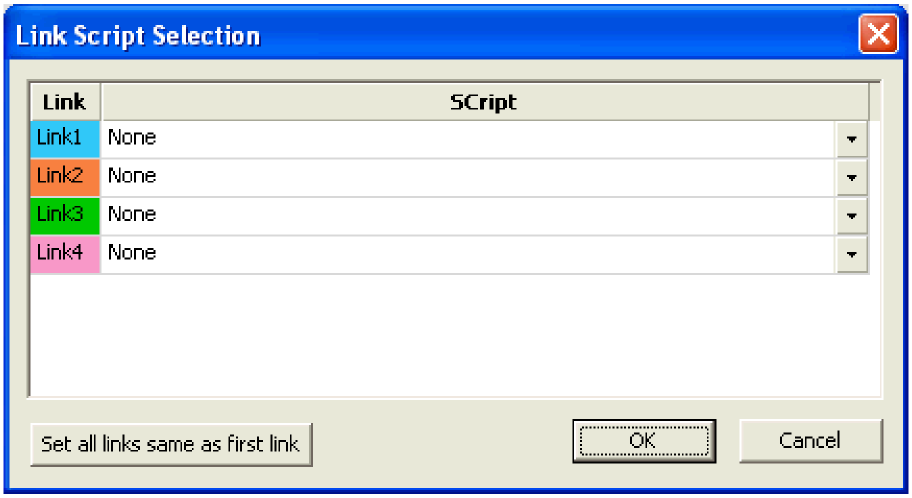
That link now has link-specific Start, Stop, Resume, Connect, and Disconnect buttons. (See the previous page for the button descriptions.)
Use the link-specific buttons to control each link separately.

You can click the L1 or L2 button again to remove the script from the link.

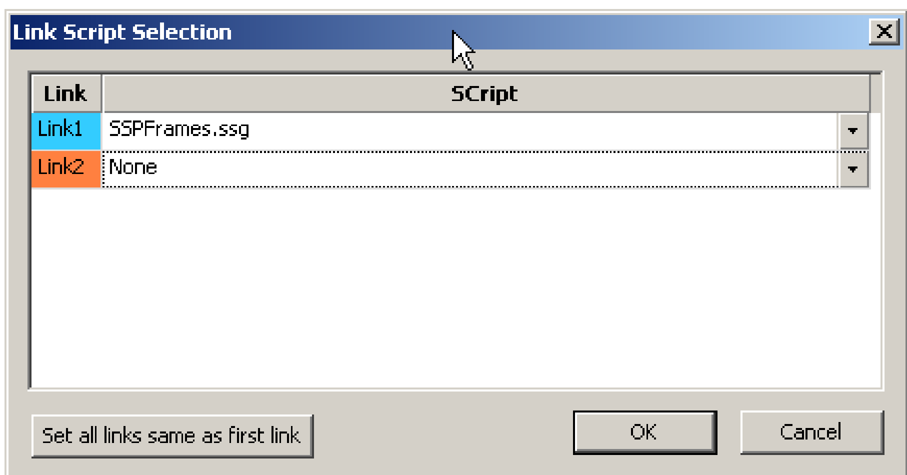
After you select port configuration, the Trainer toolbar changes to display the Generation buttons Start All Generation, Stop All Generation, Resume All Generation,
Connect All Link, and Disconnect All Link:

Use these buttons to control all links.

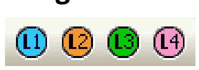
You can click  to open the Link Script Selection script assignment dialog (see the following two figures).



For any available Link, you can select any open script from the Script drop-down list.



After you select an open script, you can assign or remove a link for that script by clicking **Assign Active Script/Remove Assigned Script for Link.**



5.10 Generating Traffic

After the **.ssg** file has been opened onscreen, recording and traffic generation can begin at any time.

1. (optional) Click  to begin the recording.
2. If the script does not have a connect block built into it, connect the exerciser to the DUT by clicking the **Connect Link** button  . Clicking this button causes the generator to invoke the various settings in your script (for example, the global settings) and then establish a connection.

3. Click the **Start Generation** button on the Toolbar.

While generating traffic, a bar appears on the right of the trace view, indicating that traffic generation is taking place. (The green light on the Traffic signal button also blinks during traffic generation).

5.10.1 Stop Traffic Generation

Normally, traffic generation stops automatically when the application reaches the end of the Generator file.

To manually stop traffic generation, click the **Stop Generation** button .

5.10.2 Resume Traffic Generation

If traffic generation is stopped prior to the end of the script, it can be resumed.

To resume traffic generation, click the **Resume Generation** button .

5.11 Sierra Trainer Generation Language

The Sierra Trainer File Generation Language is an API that allows you to separate traffic into text commands. These commands are used construct primitives and frames that are sent to the host or the device.

5.11.1 File Structure

Traffic Generation files (***.ssg**) should have the following structure:

Declarations

- Global generation settings
- Constants
- Data patterns
- Chain of symbols (primitives, raw data)
- Packet templates

Note: Some declared objects could be used in further declarations as long as they are previously declared. No forward declarations are allowed at this time.

Generation Blocks

- List of generation instructions

Note: It is possible to create many generation blocks, but currently only a block with the name 'Generation' executes. (Calls of some blocks from another blocks are not currently allowed.)

5.11.2 Language

Comments

#' is the Comment symbol. The line remainder after this symbol is ignored.

/*' '*/' is a Comment Block. All the text between '/' '*' and '*' '/' is ignored.

/*
This is an example of a block of comments.
*/

Includes

The directive **%include "FileName.inc"** includes the file **FileName.inc**. This lets you add common definitions and templates into new scripts.

The language parser makes sure the same file is not included more than once.

Example:

```
%include "SomeInc.inc"
# This directive actually includes file 'SomeInc_1.inc'.
```

%inline is the same as **%include**, but without the Language parser check.

Settings

The **Set "Constant Name" = Value** statement sets different constants/modes using the following value types:

- Predefined constants (TRUE, FALSE, ON, OFF, INFINITE)
- Numbers

Examples:

```
Set AutoAlignSATA=ON
Set WaitTimeOut=239
```

Constants

Only unsigned integers can be defined as constants. Some constants are predefined in Sierra Trainer.

Examples:

```
Const SOME_HEX_DATA = 0xAABBFFEE #defines hexadecimal constant
Const SOME_DEC_DATA = 12     # defines decimal constant
Const "SOME DEC DATA" = 64     # defines decimal constant
Const "Some Hex Data" = 0xCDCDBEBE
```

Predefined Constants

- TRUE
- FALSE
- ON
- OFF
- INFINITE

Data Patterns

Data patterns are streams of hexadecimal values. Using '[""]' lets the user include constants or predefined data pattern in another pattern.

Examples:

```
DataPattern PATTERN_1 = AAAABBBB [SOME_HEX_DATA] EEEEFFFF   1210ABB1
AAAABBBB 1210ABB1 AAAABBBB 1210ABB1 AAAABBBB 1210ABB1 ["SOME DEC
DATA"] 1210AB
DataPattern PATTERN_2 = 00000000 11111111 22222222 33333333 AAAABBBB
55556666 FEFEFEFE CDCDCDCD 9999BBBB 12343434 6767676B 56BBFF
DataPattern PATTERN_3 = [PATTERN_1] FFFFFFFF EEEEEEEE [SOME_HEX_DATA]
DataPattern SOME_PATTERN = BBBBBBBB DDDDDDDD
```

Primitives

Primitives can be defined using the following:

- Byte values ('k' indicates control symbol). The 10b codes are calculated based on the current running disparity
- Primitives are completely interchangeable with SymChains.

Declaring Raw Data Definitions

Primitive primitive_name = byte_data …   byte_data # (byte_data is Decimal, Hex, 10b, K type or D type format)

SynChain raw_data_name = byte_data …   byte_data # (byte_data is Decimal, Hex, 10b, K type or D type format)

RawData { param_data …   param_data } #(param_data is byte_data, primitive or variables)

Example:

```
Primitive "CHAIN (ONE)"  = kBC 1E 1E 1E kBC 1A 0F
SymChain ChainTwo = k28.5 D12.3 D10.2 D11.6
SymChain ChainThree = k28.3 3EA 25 k18 IFA
Primitive SOF = kBC 18 E4 67
Primitive EOF = kBC 18 F0 9B
SymChain raw_data_1 = K28.1 D23.3 D11.4 D14.6
SymChain raw_data_2 = 345 160 023 K15.3 K28.1 D23.3 D11.4 D14.6 # some
RD errors will occur
raw_data_1 ( 1000 ) # send defined above pattern raw_data_1 1000 times
raw_data_2 (  10 )  # send defined above pattern raw_data_2   10 times
raw_data_2 ( 195 )  # send defined above pattern raw_data_2  195 times

RawData { 217 2E1 351 362 }# send RawData pattern - some RD errors
will occur
RawData { K28.1 D23.3 D11.4 D14.6 }    # send RawData pattern
```

Sending OpenAddressFrame Using Standard Frame Templates	Sending the Same OpenAddressFrame Using Raw Data Mechanism
SendOpenAddressFrameSTP {	Set ScramblingMode =
SourceAddress = { 500805EF FFFF0041 }	SCRAMBLING_MODE_SAS
DestinationAddress = { 500062B0 00000030	RawData {
}	K28.5 D24.0 D30.0 D01.4
ArbitrationWaitTime = 0x1	21 08 00 01
AccessZoneManagement= 0x0	50 00 62 B0
SourceZoneGroup = 0x0	00 00 00 30
ConnectionRate = 0x8	50 08 05 EF
Features = 0x0	FF FF 00 41
InitiatorConnectionTag = 0x1	00 00 00 01
InitiatorPort = 0x0	00 00 00 00
MoreCompatibleFeatures = 0x0	05 0F 19 E0
PathwayBlockedCount = 0x0	K28.5 D24.0 D07.3 D31.4 }
# CRC = 0x050F19E0 # good crc }	* CRC is inserted manually

```
# RawData with variables embedded
RawData {
K28.5 D24.0 D30.0 D01.4
@variableName1
50 00 62 B0
00 00 00 30
50 08 05 EF
$C
00 00 00 01
00 00 00 00
SendCRC
K28.5 D24.0 D07.3 D31.4 }
}
```

When there are variable values in RawData, you must include SendCRC command instead of last dword. Otherwise, wrong CRC value will be sent. The constraints are:

- Variables are not allowed on First and LAST DWORD (instead of start/end frames).
- SendCRC is only supported on last DWORD before end of frame.

- ❑ Raw 10 bits codes. This definition might cause running disparity errors.

Example:

```
Primitive "CHAIN (TWO)" = 305 2D4 1E4 362
```

- ❑ Mixed bytes and 10b codes. This definition might cause running disparity errors.

Example:

```
Primitive "CHAIN (TWO)" = 305 2D4 1E4 362 ["CHAIN (ONE)"]
```

Packets/ Frames

Using the “Frame” or “Packet” keyword, you can define a frame of traffic to use in the generation stream. Declarations of prolog and epilog may be mixed with field declarations.

```
Frame "name" : "parent name"
{
Field Definition 0: "Field Name : Field Length = Default Value"
…
Field Definition n: "Field Name : Field Length = Default Value"
Primitive Definition 0: "Primitive name, offset, count"
…
Primitive Definition m: "Primitive name, offset, count"
Prolog = "primitive name"
Epilog = "primitive name"
}
```

Field Definition

- ❑ Field length is in bits. '*' means that the length is variable and is set based on the assigned value.
- ❑ Field starting offset is calculated from frame start based on the length of the previous fields.

Examples:

```
Field32     : 32 = 0xAABBFFEE
FrameType   : 8  = 12
HashedDest  : 24 = HEX_DATA
Reserved1   : 8  = 0xDA
Field16     : 16 = 0xAAAA
Reserved2   : 8  = 0xAD
CRC         : 32
```

Data field Definition

- **Data = { pattern }**: Pattern is assigned to Data.
- **Data = count, value**: A pattern of “count” times “value” is assigned to Data.
- **Data = count, start value, step**: A pattern of values starting with “start value” with steps of “step” and a length of “count” is assigned to Data.

Primitive definition. Primitives are inserted into the frame payload. Primitive definitions are inherited by descended frame templates.

- Assigning '*' clears all previous settings (maybe from parent frame template).
- Offset specifies the DWORD offset where this primitive is inserted in the Frame.
- Count specifies how many times to repeat the primitive.

Examples:

```
Primitive : *
Primitive : SOF, 48   # where 48 = offset
Primitive : "CLOSE (NORMAL)", 36, 5   # where 5 = repeat
```

Prolog and Epilog define Primitive chains to be used at the beginning and end of the frame.

Examples:

```
Prolog = SOF # For this frame primitive 'SOF' is a Prolog.
Epilog = EOF # For this frame primitive 'EOF' is an Epilog.
```

Frames can be derived from other Frames, therefore inheriting the layout of the parent Frame. In this case, the user may:

- Change Prolog and Epilog.
- Change default field values.
- Add new fields.

Frame Examples

```
Frame  Some_Frame
{
    Field32     : 32 = 0xAABBFFEE
    FrameType   : 8  = 12
    HashedDest  : 24 = HEX_DATA
    Reserved1   : 8  = 0xDA
    Field16     : 16 = 0xAAAA
    Reserved2   : 8  = 0xAD
    Data        :  * = PATTERN_1
    CRC         : 32

    Primitive : *
    Primitive : SOF, 48
    Primitive : SOF, 96
    Primitive : "CLOSE (NORMAL)", 36, 5

    Prolog = SOF
    Epilog = EOF
}
Frame Some_Frame_1 : Some_Frame
{
    Field32 = "Some Hex Data"
    Data    = { 11111111 22222222 33333333 44444444 55555555 }
    Opcode    : 128, 8, 0x2A
    LBA       : 64

    Primitive : *
    Primitive : "CLOSE (NORMAL)", 24, 48
```

```
    Prolog = "CHAIN (ONE)"
    Epilog = "CHAIN (ONE)"
}
```

5.11.3 Generation Block

Sierra Trainer generates the stream that is defined in this block.

```
Generation
{
Chain Definition (Repeat = N, Idle = M)
Chain Definition (N, M)
Chain Definition
Frame Definition
Frame Definition (RunningDisp = ON/OFF)
Frame Definition
{
Field Definition
Data Definition
} (Repeat = N, Idle = M, RunningDisp = ON/OFF)
```

5.11.4 Definitions

Chain Definition:

- Without any parameters, the chain is sent once.
- With “Repeat” and “Idle” parameters, the chain is sent N times and then nothing is sent (idle) M times. “Repeat” and “Idle” are optional.

Frame Definition

- Without any parameters, send the frame based in default values.
- With “RunningDisp” ON, send the frames based on default values and insert a running disparity error.
- With parameters overriding or adding to a template frame, with or without injection of an overriding or adding to a template frame, with or without injection of running disparity error.

Field Variable Declarations

You can declare a variable (var_name) as a frame of type (frame_type):

```
$var_name = frame_type
```

Note: Frame variables can be declared/re-declared and used many times.

Changing Frame Fields

You can change some fields in a frame variable.

```
Change var_name { field_name = value }
```

Preprocessor Integer Arithmetic

You can declare DWORD variables, make arithmetic operations, and use them in field and parameters assignments.

Note: Arithmetic expressions are allowed only in numeric variable assignments.

Examples:

Legal Operations

```
x = 2
y = ( z = 12 ) + ( SOME_DEC_DATA + 36 ) / 8
z = 0x1 << 5
s = "Some Hex Data" # constant may be used in operations


x++
y--
z += ( x + y )
x = ( ( y & 0xFF ) >> 5 ) / 12

SOF ( Repeat = x, Idle = y )



X
{
Field16 =  0xEEEE   # Example of the data payload assignment which
usesbothintegervariables,constants,hexliteralsanddatapatterns
Data    =  { y y y y 7a7a7a7a "Some Hex Data" "Some Hex Data" 8b8b8b8b
z z z z [PATTERN_3] }
}
( Repeat = 10, Idle = y )  # uses integer variable for parameter/
setting.

Illegal operations

x = y + 2
SOF ( Repeat = (x+y)*7 )
# - illegal, use z = (x+y)*7  SOF ( Repeat = z ) instead
```

Loops

Loops can be used in two modes:

1. Using an integer number, loop a specified number of loops. This number has to be smaller than 64,000.

2. Using the word “infinite”, loops for ever.

```
Loops ( loop_count/Infinite )
{
 send instructions
 assignments
 change values
 send instructions
```

```
}
```

Example:

```
LOOP( 50 )
{
        "CHAIN (ONE)"
        "CHAIN (TWO)"
        Some_Frame
        $Y = Some_Frame { Data = 256, 0xFEFEFEFE }
        Y
        Change Y { Field32 = x }
        Y
        Y
}
```

5.11.5 Connecting the Trainer

Three methods are available for connecting the trainer:

- Use the **Connect** command to connect and perform transmitter training.
- Use the new commands to handle the transmitter training manually (see Manual Transmitter Training Commands and Descriptions below).
- Use the Send_Train_TX_Window command to send transmitter training automatically and use other commands for speed negotiation.

The SATA scripts should be run in SAS mode.

Manual Transmitter Training Commands and Descriptions

Send_TTIU (32'b DATA/Variable, Idle count, Repeat number)

This instruction is mainly for sending a specific TTIU with variable number of Idles. 32 bit TTIU value can be specified either by directly specifying the 32 bit data or by specifying a variable. When the variable name is recognized, the trainer reads the data in the specified variable and considers it as the TTIU value. The Idle count defines the number of idles to be transmitted after the 32 bit TTIU and the repeat number defines the number of times the same TTIU is to be transmitted.

Example:

```
Var32 @ttiu =0x00006000
Generation {
Send_ttiu (0x00006000, 0x36, 0xA)     //ttiu with specific data
Send_ttiu (@ttiu, 0x36, 0xA)          //TTIU with variable
}
```

Wait_For_TTIU(DATA/Change TTIU , MASK

This instruction waits for a specific TTIU. During the execution of this instruction, the previously transmitted TTIU is transmitted. The user can trigger a wait for a specific TTIU or change the TTIU, or a part of TTIU, by specifying the 32 bit mask value.

The default mask value is set to all ones. The application waits for all 32 bits to match the received TTIU. Changing the mask value provides the flexibility to wait for some specific bits in the TTIU. Giving the Change_TTIU command with mask value waits for any change in the specified Bits in the Received TTIU compared to the previously received TTIU.

Example:

```
Generation
{
Wait_for_ttiu  (change_ttiu , 0x00004000) //waiting for change in tx_init
                                            bit of TTIU
Send_ttiu ((0x00006000, 0x36, 0xA)
Wait_for_ttiu (0x0000A000 , 0X00008000)  //waiting for train comp bit to
                                           go high
}
```

LRT: Last received TTIU

This instruction is for accessing the last received TTIU. The user can access the received TTIU and reuse it as required.

Example:

```
{
@ttiu_mask=0x0006000
@ttiu=LRT
@ttiu_temp=@ttiu and @ttiu_mask
If(ttiu_temp=0006000)
{
Send_ttiu(0x0006000)
}

}
```

Training_ERROR_COUNT

This instruction is for accessing the error count of the received Dwords. This gives flexibility to the user to change the remote tx parameters to get the optimal link with minimal errors.

Example:

```
Var32 @error_count
Generation
{
Send_ttiu ((0x00006000, 0x36, 0xA)
Wait_ttiu (change_ttiu , 0x00004000)
@error_count= Training_ERROR_COUNT;
If(@error_count<2)
{
Send_ttiu ((0x0000A000, 0x36, 0xA)

 }
}
```

Reset_Training_ERROR_COUNT

During manual Tx_Training resetting error _count can be done using this command.

Example：

```
Var32 @error_count
Generation
{
Send_ttiu ((0x00006000, 0x36, 0xA)
Wait_ttiu (change_ttiu , 0x00004000)
@error_count= Training_ERROR_COUNT;
If(@error_count<2)
{
Send_ttiu ((0x0000A000, 0x36, 0xA)
Rest_Training_Error_count
 }
}
```

Change_Local_tx_parameter(16'b data/variable)

This instruction is to change the Local tx parameters. It takes either 16 bit data or 16 bit variable which represents the control word of the TTIU. When this command is given, the 32 bit data or 16 bit variable value is written to the constant variable memory location (address location is 511)

Example：

```
var32 @received_control
var32 @Status
var32 @ control=0x00100000
var32 @temp
Generation
{
 Send_ttiu ((0x00006000, 0x36, 0xA)
 Wait_ttiu (change_ttiu , 0x00004000)
 Change_Local_tx_parameter (0x0400)  //requesting to change the tx
                                       parameters to reference_1
@received_control=LRT
@temp=@received_control & 0x1111000 //0x11110000 is the mask data so that
                                     the variable contains only the
                                     controlwordofthereceivedttiu.

Change_Local_tx_parameter(@temp)//variable as input

@status= Local_ Tx_status_word
@temp=@status | @control
Send_ttiu(@temp,0x36,0xA)
}
```

Where “0x0400” is the control word of TTIU.

Local_ Tx_status_word

This instruction is for getting the status of the local tx parameters for the previous requested tx parameter change. This is a 32 bit word in which the LSB 16-bit contains the status word and MSB 16 bits are ZEROS.

Set OOB_SpeedNeg_TX_TAT:Tx_training_analysis_time

This setting defines the time for Link analysis i.e., the time for counting errors in the received dwords. At the end of this period, the trainer requests for new attached tx_phy change depending on the error count in Auto Tx_training mode. This is a global setting.

SendRAWTTIU(Pattern_marker 32bits of BMC encoded TTIU)

This command is for transmitting a Raw_TTIU. i.e BMC encoded 32 bits TTIU can be specified here. The user has the flexibility to specify the pattern marker.

Example:

```
Generation
{
Send_raw_ttiu( ffffc0000 FF C00F FC00 FF C00F FC00 FF C00F FC00 FF C00F
FC00 FF C1F0 7C00 FF C00F FC00 FF C00F FC00 FF C00F FC00}
Idle(54)
}
```

Where “ffffc0000” is the pattern marker.

Send_TTIU/SendTTIU (32'b DATA/Variable, Idle count, Repeat number)

This instruction is mainly for sending a specific TTIU with variable number of idles .32 bit TTIU value can be specified either by directly specifying the 32 bit data or by specifying a variable.(when the variable name is given trainer reads the data in the specific variable and considers it as TTIU value).Idle count defines the number of idles to be transmitted after the 32 bit TTIU and repeat number defines the number of times the same TTIU to be transmitted.

Example:

```
Var32 @ttiu =0x00006000

Generation {

Send_ttiu (0x00006000, 0x36, 0xA)      //ttiu with specific data

Send_ttiu (@ttiu, 0x36, 0xA)           //TTIU with variable

}
```

Wait_For_TTIU/WaitforTTIU(DATA/Change TTIU , MASK)

This instruction waits for specific TTIU. During this instruction previous transmitted TTIU will be transmitted. User can trigger wait for specific TTIU, Change in TTIU or part of TTIU by specifying 32'bit mask value.

Default mask value is set to all ones. i.e waits for all 32'bits to match with the received TTIU. Changing the mask value gives the flexibility to wait for some specific bits in the TTIU. Giving Change_TTIU with mask value waits for any change in the specified Bits in the Received TTIU compared to the previous received ttiu.

Example:

```
Generation
{
Wait_for_ttiu  (change_ttiu , 0x00004000)          //waiting for change in tx_init bit of TTIU
Send_ttiu ((0x00006000, 0x36, 0xA)
Wait_for_ttiu (0x0000A000 , 0X00008000)       //waiting for train comp bit to go high
}
```

LRT: Last received TTIU:

This instruction is for having access to the last received TTIU. User can have access to the received ttiu and reuse it as required. Example for using this command in the script is as follows:

```
{
@ttiu_mask=0x0006000
@ttiu=LRT
@ttiu_temp=@ttiu and @ttiu_mask
If(ttiu_temp=0006000)
{
Send_ttiu(0x0006000)
}


}
```

Training_ERROR_COUNT

This instruction is for having access to the error count of the received Dwords. This will give flexibility to user to decide on changing remote tx parameters to get the optimal link with minimal errors.

Example:

```
Var32 @error_count

Generation

{

       Send_ttiu ((0x00006000, 0x36, 0xA)

      Wait_ttiu (change_ttiu , 0x00004000)

      @error_count= Training_ERROR_COUNT;

     If(@error_count<2)

    {

       Send_ttiu ((0x0000A000, 0x36, 0xA)


    }

}
```

Reset_Training_ERROR_COUNT / ResetTrainingErrorCount

During manual tx_trainig resetting error _count can be done using this command.

```
Ex: Var32 @error_count

Generation

{

       Send_ttiu ((0x00006000, 0x36, 0xA)

      Wait_ttiu (change_ttiu , 0x00004000)

      @error_count= Training_ERROR_COUNT;

     If(@error_count<2)

    {

       Send_ttiu ((0x0000A000, 0x36, 0xA)

     Rest_Training_Error_count

    }

}
```

Change_Local_tx_parameter / changelocaltxparameter (16'b data/variable)

This instruction is to change the Local tx parameters. It takes either 16 bit data which represents the control word of the TTIU or 16'b variable that represents control word of the TTIU.

when this command is given ,32 bit data or variable value will be written in to a constant variable memory location (address location is 511)

Example:

```
 var32 @received_control

var32 @Status

var32 @ control=0x00100000

var32 @temp

Generation

{

       Send_ttiu ((0x00006000, 0x36, 0xA)

     Wait_ttiu (change_ttiu , 0x00004000)

 Change_Local_tx_parameter (0x0400)  //requesting to change the tx parameters to
reference_1

            @received_control=LRT

       @temp=@received_control & 0x1111000 //0x11110000 is the mask data so that the
variable contains only the control                                               word of the received ttiu.

      Change_Local_tx_parameter(@temp)//variable as input

     @status= Local_ Tx_status_word

     @temp=@status | @control

     Send_ttiu(@temp,0x36,0xA)

}
```

Local_ Tx_status_word

This instruction is for getting the status of the local tx parameters for the previous requested tx parameter change. This is a 32 bit word in which LSB 16-bit contains status word and MSB 16bits are ZEROS.

Set OOB_SpeedNeg_TX_TAT:Tx_training_analysis_time

This setting defines the time for Link analysis i.e time for counting errors in the received dwords after this time trainer request for new attached tx_ph y change depending on the error count in Auto Tx_training mode . This is a global setting.

Send_RAW_TTIU / SendRawTTIU(Pattern_marker 320bits of BMC encoded TTIU ,IDLE count, Repeat count)

This command is for transmitting a Raw_ttiu. i.e BMC encoded 320 bits ttiu can be specified here.User is given a flexibility to specify the pattern marker.

```
Generation
{
    sendrawttiu(3ff 3ff 000 000
              3ff 000 3ff 000
              3ff 000 3ff 000
              3ff 000 3ff 000
              3ff 000 3ff 000
              3e0 3ff 01f 000
              3ff 000 3ff 000
              3ff 000 3ff 000
              3ff 000 3ff 000
             ,0x3a ,0x10 )
  }
```

For TRAINING_ERROR_COUNT, Change_local_tx_parameter, Tx_status_word

commands hardware creates separate variables with pre defined address. When user specifies this command, software should compile the commands in to variable commands with specific pre defined variable address

Other Tx-training related Commands

1. LINK_SPEED_12G	: Sets speed to 12G.
2. Set OOB_SpeedNeg_Phy_g4 WithoutSSC	: Sets the G4 without SSC bit of phy capability window.
3. Set OOB_SpeedNeg_Phy_g4 WithSSC	: Sets the G4 with SSC bit of phy capability window.
4. SEND_TRAIN_TX_WINDOW	: Starts sending tx training window.
5. Set OOB_SpeedNeg_MTTT	: Sets the maximum tx training time for Tx-training window.

Set Auto_TxUpdate:

This setting is for manual Tx training. When Auto_TxUpdate is set to true, the Local tx parameters will be updated automatically depending on the received control word and as result the Tx_status_word is updated accordingly. When set to FALSE, Tx parameters is controlled by the script.

TRAINING_ERROR_COUNT, Change_local_tx_parameter, Tx_status_word

This command instructs the hardware to create separate variables with pre-defined addresses. When the user specifies this command, the software compiles the commands into variable commands with specific pre-defined variable addresses.

5.11.6 Trainer Script Enhancements

The Trainer script language can already produce SAS/SATA Primitive Sequences and Frames.

The Trainer script enhancements described in this section allow generation of Commands and Application Layer sequences (as in the Exerciser), by processing received frames, making complex decisions, and generating the contents of frame in run-time, for both RX and TX. Variables can keep the run-time state of the bus. Low-level commands can manipulate variables and use variables to create patterns.

Trainer language can perform SATA compliance tests with fast SSD devices and provide a SSD performance test tool with limited output data patterns. Trainer has sequential/ random LBA command generation and full NCQ support.

Trainer can be programmed to act as SAS Initiator, SAS Target, SATA Host, or SATA Device.

SAS Initiator

As an Initiator, Trainer can send commands in all protocols (SSP/STP/SMP) and interact with its peer to complete the command in normal conditions and some popular error conditions. Limitations are:

- Uses only one command at a time.
- Does not save Read data or reuse bulk read data for next commands.
- Sends only limited Write data patterns.
- Has tight flow control, due to limited RX frame processing.

SAS Target

As a Target, Trainer can receive commands in all protocols (SSP/STP/SMP) and respond to them in normal conditions or some popular error conditions. Limitations are:

- Uses only one command at a time. Command queuing is not supported.
- Does not save incoming write data. Sends back data for all LBAs or generates counter/random data. Cannot be used as a real formatted partition.
- Has tight flow control, due to limited RX frame processing.

SATA Host

As a Host, Trainer can send commands and complete them in normal or some popular error conditions. SATA Host can issue NCQ commands, necessary for SATA compliance tests on SSD devices. Limitations are:

- Does not save Read data or reuse bulk read data for next commands.
- Sends only limited Write data patterns.

SATA Device

As a Device, Trainer can receive commands and respond to them in normal or some popular error conditions. Limitations are:

- Uses only one command at a time. Command queuing is not supported.
- Does not save incoming write data. Sends back data for all LBAs or generates counter/random data. Cannot be used as a real formatted partition. To use the Trainer as a SATA Device in real configurations, only tools like IO-METER (that can work with un-partitioned and un-formatted drives) can be used.

Variable Definition

Variable definition is like definitions in programming languages. You can define up to 512 DWORD (32-bit) variables. There is no constraint on variable names, except you cannot use keywords. Variable scopes are general and you should define them in the script header before the generation block.

The syntax of variable definition is:

```
VAR32 @VariableName1, @VariableName2, ...
VAR64 @VariableName
```

VAR64 holds field values greater than 32 bits, such as SASAddress.

Note: Variable names should start with @.

Assigning Variable Values

You can set variable values in different ways:

Constant value:

```
@varName1 = 1234
```

Other variable value:

```
@varName1 = @varName2
```

Result of expression on other variables:

```
@varName1 = @varName1 + @varName2
```

Fields of last received frame:

```
@varName1 = (SSPFrame)LRF::FrameType,
```

where LRF is Last Received Frame

Note: Specifying packet type (SSPFrame) before LRF causes last received frame to be this packet type, and field start-bit position is calculated according to the packet-type definition.

Part of last received frame:

```
@varName1 = LRF[stratBitOffset:endBitOffset],
where offsets are bit based
```

Example:

```
SendSSPFrameCommand_Initiator
    {Data = LRF[startBitOffset:endBitOffset] )
Tag = 0x101}
```

The constraints are 1) Length bigger than 64 bit is not supported and 2) Offsets (StartBitOffset and EndBitOffset) should be in same DWORD, except for length bigger than 32.

Random values:

```
@varName1 = Random
```

Expression on Variables

Mathematical expressions, such as sum, subtract, and shift:

```
@varName1 + @varName2
@varName1 - @ varName2
@varName1 & @varName2
@varName1 | @varName2
@varName1  <<  2
```

Logical expressions, such as compare, equal, not, and, and or:

```
@varName1  >  @varName2
@varName1 < @ varName2
@varName1 ==  @varName2
@varName1 != @ varName2
 (logical expression1) &&  (logical expression2)
(logical expression1) || (logical expression2)
```

Complex expressions (combination of different operators) with prioritizing supported:

```
(@varName1 + @varName2) > @varName3
```

If/While in Logical Expressions

Like programming languages, scripts allow conditional statements.
The **if/while** syntaxes are:

```
If (expression)then
{
        ….
}
else
{
       ….
}
```

```
While(@VarName)
{
     …….
}
```

Example for if, then else:

```
@HT_RxFISType = LRF[0:7]
#LRF_SATA_FIS_TYPE_START_BIT:LRF_SATA_FIS_TYPE_END_BIT
if  (@HT_RxFISType == SATA_FIS_TYPE_DMA_ACTIVATE)   then  {…}
 else { if (@HT_RxFISType == SATA_FIS_TYPE_DATA) then  {…}
           else { if (@HT_RxFISType == SATA_FIS_TYPE_RD2H)  then  {…}
} }
```

Example for while:

```
while (@NCQ_Temp0)   {
      @NCQ_Temp1= @NCQ_Temp1 >> 1
      If (@NCQ_Temp1 != 0) then { … }
      @NCQ_Temp0 = @NCQ_Temp1 & 0x00000001     }
```

Note: In this release, **while** condition is limited to simple variable values only. Combining operators is not allowed in **while** expressions. You should move such expressions inside **while** block.

Note: Nested **while** and **if** are supported.

Wait/When/Do in Logical Expressions

The **wait/when/do** syntaxes are:

```
wait (time)
{when
{exp}do
{
      ….
}
elsewhen
{
{exp}do
{
      ….
}
on_timeout
{
      ….
}}
```

Example:

```
wait  { #no timeout use global WaitTimeout value default 1000 useconds
(1 ms)
    when  {WF_OPEN_ACCEPT}   do   { … }
    elsewhen  {WF_OPEN_REJECT}   do   { … }
    on_timeout  { … }     }
```

Example:

```
wait_for (100000)  { WF_OPEN_ACCEPT  WF_TIMEOUT}  { … } # (100 ms)
```

Note: Nested wait should not exceed 2 deep. Use a procedure call to extend wait logic sequence. Wait + Wait_For ok.

Using Variable Values in Creating Patterns on Bus

In creating patterns to send on bus, trainer script allows using variables. In these cases, because the created pattern is dynamic, it is not possible to do scrambling and calculating in software code. These tasks are done in the hardware engine. To activate, set “Auto scramble mode” in “on” state.

The following examples show uses of variables in creating patterns.

Use variable for field value:

```
SendOpenAddressFrameSSP
{
InitiatorPort = 0x1
    InitiatorConnectionTag = @variableName1
…...
}
```

The constraints are:

- Field Length bigger than 64 bit is not supported.
- Field StartBitOffset and EndBitOffset should be in same DWORD, except for length bigger than 32.

Use LRF directly for field value:

```
SendSSPFrameCommand_Initiator
{
    Data = LRF[startBitOffset:endBitOffset]
    Tag  = 0x101
}
```

The constraints are:

- Length bigger than 64 bit is not supported.
- Offsets (StartBitOffset and EndBitOffset) should be in same DWORD, except for length bigger than 32.

```
SendSSPFrameCommand
 {
#Data = {00112233 @variableName1 @variableName2 44556677}
 }


RawData {
 K28.5  D24.0  D30.0  D01.4
              @variableName1
              50     00     62     B0
              00     00     00     30
              50     08     05     EF
```

```
                  $C
                  00     00     00     01
                  00     00     00     00
                  SendCRC
                  K28.5  D24.0  D07.3  D31.4 }
}
```

When there are variable values in RawData, you must include **SendCRC** command instead of last DWORD. Otherwise, wrong CRC value will be sent.

The constraints are:

- Variables are not allowed on First and LAST DWORD (instead of start/end frames).
- **SendCRC** is only supported on last DWORD before end of frame.

```
SendSATAFrame
{
  SATA_SOF
  SATA_DATA ( 0x11223344 )
  SATA_DATA (@variableName1)
  SATA_DATA ( 0x55667788 )
  #SATA_CRC ( 0x99AACCBB ) # good crc - can be changed to bad
  SATA_EOF
}
```

If **SATA_CRC** command is not included, trainer engine computes and inserts correct CRC in pattern.

Timer

Trainer script syntax allows using some timers. You can start a timer anywhere. The timer current value is loadable on variable to be used in expressions and conditions on this expression. There are four timers, named A, B, C, and D.

Starting timer (setting timer value to zero) syntax is:

```
CLEAR_TIMER_A
CLEAR_TIMER_B
CLEAR_TIMER_C
CLEAR_TIMER_D
```

Loading timer current value in variables:

```
@varName1 =TIMER_A
@varName1 =TIMER_B
@varName1 =TIMER_C
@varName1 =TIMER_D
```

Example:

```
CLEAR_TIMER_A
While(@Counter < MaxPeriodCount) {
   … @Counter = TIMER_A … }
```

PATTERN Counter

Trainer script syntax allows you to use counters on a number of defined events in generation settings.

Syntax for loading counters in variables is:

```
@varName1 = COUNT_REC_RESOURCE_OUTPUT_A
@varName1 = COUNT_REC_RESOURCE_OUTPUT_B
@varName1 = COUNT_REC_RESOURCE_OUTPUT_C
@varName1 = COUNT_REC_RESOURCE_OUTPUT_D
@varName1 = COUNT_REC_RESOURCE_OUTPUT_E
@varName1 = COUNT_REC_RESOURCE_OUTPUT_F
```

Syntax for clearing (resetting) counters is:

```
CLEAR_REC_RESOURCE_OUTPUT_A
CLEAR_REC_RESOURCE_OUTPUT_B
CLEAR_REC_RESOURCE_OUTPUT_C
CLEAR_REC_RESOURCE_OUTPUT_D
CLEAR_REC_RESOURCE_OUTPUT_E
CLEAR_REC_RESOURCE_OUTPUT_F
```

Example:

```
CLEAR_REC_RESOURCE_OUTPUT_A
While(@Counter < MaxPrimitiveCount) {
      … @Counter = COUNT_REC_RESOURCE_OUTPUT_A … }
```

Procedure Definition

Procedures allow creating simple syntaxes for complex reusable parts in scripts. You can write such code once as a procedure and use everywhere required.

Procedure definition syntax is:

```
procedure procedureName
{
...
}
```

Calling procedure syntax is:

```
Call procedureName
```

5.11.7 Sierra Trainer Generation Commands

General Commands

IDLE (n)	Generator will insert n idle DWORDs into the generation stream.
CLEAR_CREDIT_AVAIL	This commands clears the credit established with the command WF_CREDIT_AVAIL. (See WF_CREDIT_AVAIL in following section on Wait Commands for explanation).
RD_ERROR	Generator will insert one idle DWORD into the generation stream, which will intentionally break RD sequence creating RD error.
CONNECT	Generator will go through connection sequence using current GenFile settings (gen mode, speed, and so on). Generation will not resume until connection is established.
DISCONNECT	Generator will break existing connection to DUT.
PAUSE	Generator will come to a break and the user will be able to resume generation by pressing Resume button on Generation toolbar. Generator shall transmit idle DWORDs while in the Pause.
OUTPUT_ON	Takes the Trainer out of Electric Idle state. If it is already out of Electric Idle, this is a NOP.
OOB Commands	
COMINIT	Generator will send COMINIT OOB signals using current COMINIT settings.
COMRESET	Generator will send COMRESET OOB signals using current COMRESET settings.
COMWAKE	Generator will send COMWAKE OOB signals using current COMWAKE settings.
COMSAS	Generator will send COMSAS OOB signals using current COMSAS settings.
SATA_ALIGN	Generator will go through SATA_ALIGN stage of SATA SpeedNeg process using current SATA_ALIGN settings.
SATA_D10_2	Generator will go through SATA_D10_2 stage of SATA SpeedNeg process using current SATA_D10_2 settings.
SPEED_NEG_RCDT	Generator will go through SPEED_NEG_RCDT stage of SAS SpeedNeg process using current SPEED_NEG_RCDT settings.
SPEED_NEG_ALIGN0	Generator will go through SPEED_NEG_ALIGN0 stage of SAS SpeedNeg process using current SPEED_NEG_ALIGN0 settings.

SPEED_NEG_ALIGN1	Generator will go through SPEED_NEG_ALIGN1 stage of SAS SpeedNeg process using current SPEED_NEG_ALIGN1 settings.
Set Speed = LINK_SPEED_1_5G	Generator will change speed to 1.5G (if MultiSpeed is enabled). This setting is not applied when Advanced Connect is set.
Set Speed = LINK_SPEED_3G	Generator will change speed to 3G (if MultiSpeed is enabled). This settings is not applied when Advanced Connect is set.
Set Speed = LINK_SPEED_6G	Generator will change speed to 6G (if MultiSpeed is enabled). This setting is not applied when Advanced Connect is set.
Set Speed = LINK_SPEED_12G	Generator will change speed to 12G (if MultiSpeed is enabled). This setting is not applied when Advanced Connect is set.
DevSlp	Makes the device sleep signal high. Trainer doesn’t go to Electric idle mode automatically after Devslp command. We can force trainer to go to DC Idle mode using the “disconnect “ command after Devslp command. This command works when Generation mode is GEN_MODE_SAS_INITIATOR or GEN_MODE_SATA_HOST
Exit_DevSlp	Makes Device sleep signal low (comes out of device sleep mode). This command works when Generation mode is GEN_MODE_SAS_INITIATOR or GEN_MODE_SATA_HOST
SEND_TRAIN_RX_WINDOW	(This Command is used in Train Windows). This command works exactly same as "Send_Train_TrainDone."
SEND_TRAIN_TX_WINDOW xxxxxx	(This Command is used in Train Windows).
Send_Phy_Capability	Generator will send PHY Capability Bits. (this command is used in SNW3).
Send_Train_TrainDone	Generator will send Train/Train Done Patterns. (This Command is used in Train Windows).
Delay (#)	Generator will wait until # ns before executing next command.

Power_Expansion_On(n)	Switch on power expansion card. The Default value is POWER_SOURCE_5V | POWER_SOURCE_12V. The power source can be combination of POWER_SOURCE_1_2V, POWER_SOURCE_1_5V, POWER_SOURCE_3_3V, POWER_SOURCE_5V, POWER_SOURCE_12V
Power_Expansion_Off(n)	Switch off power expansion card. The Default value is POWER_SOURCE_5V | POWER_SOURCE_12V.The power source can be combination of POWER_SOURCE_1_2V , POWER_SOURCE_1_5V , POWER_SOURCE_3_3V, POWER_SOURCE_5V, POWER_SOURCE_12V
Exit (ExitCode)	Call this command in any branch of the Trainer program to stop execution. After exit, the Port Status dialog displays the exit code. **Note:** The Trainer GUI has LED indicators: Green is for pass. Red is for fail. No color is for unknown or for user to review.
set_trainer_interconnect_signal_1 or settrainerinterconnectsignal_1	Set these signals to allow other ports to wait on them using WF_TRAINER_INTERCONNECT_SIGNAL_1
set_trainer_interconnect_signal_2 or settrainerinterconnectsignal_2	Set these signals to allow other ports to wait on them using WF_TRAINER_INTERCONNECT_SIGNAL_2
set_trainer_interconnect_signal_3 or settrainerinterconnectsignal_3	Set these signals to allow other ports to wait on them using WF_TRAINER_INTERCONNECT_SIGNAL_3
set_trainer_interconnect_signal_4 or settrainerinterconnectsignal_4	Set these signals to allow other ports to wait on them using WF_TRAINER_INTERCONNECT_SIGNAL_4
SET_EXTERNAL_TRIGGER	Call this command to set External Trigger Out Settings and External Trigger In Type to High Active, Low Active, Toggle and set External TrigOut pulse width.
SET_ANALYZER_TRIGGER	Call this command to set Analyzer Trigger.

Set OOB_SpeedNeg_TX_TAT:Tx_training_analysis_time	This setting defines the time for Link analysis i.e., the time for counting errors in the received dwords. At the end of this period, the trainer requests for new attached tx_phy change depending on the error count in Auto Tx_training mode. This is a global setting.
Set Auto_TxUpdate	This setting is for manual Tx training. When Auto_TxUpdate is set to true, Local tx parameters will be updated automatically depending on the received Control word and Tx_status_word will be updated accordingly. When set to FALSE,Tx parameters has to be controlled by script.

Send_TTIU (32 bit DATA/Variable, Idle count, Repeat number)	This instruction is mainly for sending a specific TTIU with variable number of Idles. 32 bit TTIU value can be specified either by directly specifying the 32 bit data or by specifying a variable. When the variable name is recognized, the trainer reads the data in the specified variable and considers it as the TTIU value. The Idle count defines the number of idles to be transmitted after the 32 bit TTIU and the repeat number defines the number of times the same TTIU is to be transmitted.
	
	Example:
	`Var32 @ttiu =0x00006000`
	`Generation {`
	`Send_ttiu (0x00006000, 0x36, 0xA)    // ttiu with specific data`
	`Send_ttiu (@ttiu, 0x36, 0xA)         // TTIU with variable`
	`}`

LRT: Last received TTIU	This instruction is for accessing the last received TTIU. The user can access the received TTIU and reuse it as required.
	
	Example:
	`{`
	`@ttiu_mask=0x0006000`
	`@ttiu=LRT`
	`@ttiu_temp=@ttiu and @ttiu_mask`
	`If(ttiu_temp=0006000)`
	`{`
	`Send_ttiu(0x0006000)`
	`}`
	
	`}`

Training_ERROR_COUNT	This instruction is for accessing the error count of the received Dwords. This gives flexibility to the user to change the remote tx parameters to get the optimal link with minimal errors.
	
	Example:
	Var32 @error_count
	Generation
	{
	Send_ttiu ((0x00006000, 0x36, 0xA)
	Wait_ttiu (change_ttiu , 0x00004000)
	@error_count= Training_ERROR_COUNT;
	If(@error_count<2)
	{
	Send_ttiu ((0x0000A000, 0x36, 0xA)
	
	}
	}

Reset_Training_ERROR_COUNT	During manual Tx_Training resetting error _count can be done using this command.
	
	Example:
	`Var32 @error_count`
	`Generation`
	`{`
	`Send_ttiu ((0x00006000, 0x36, 0xA)`
	`Wait_ttiu (change_ttiu , 0x00004000)`
	`@error_count= Training_ERROR_COUNT;`
	`If(@error_count<2)`
	`{`
	`Send_ttiu ((0x0000A000, 0x36, 0xA)`
	`Rest_Training_Error_count`
	` }`
	`}`

Change_Local_tx_parameter (16 bit data/variable)	This instruction is to change the Local tx parameters. It takes either 16 bit data or 16 bit variable which represents the control word of the TTIU. When this command is given, the 32 bit data or 16 bit variable value is written to the constant variable memory location (address location is 511)
	
	Example:
	`var32 @received_control`
	`var32 @Status`
	`var32 @ control=0x00100000`
	`var32 @temp`
	`Generation`
	`{`
	` Send_ttiu ((0x00006000, 0x36, 0xA)`
	` Wait_ttiu (change_ttiu , 0x00004000)`
	` Change_Local_tx_parameter (0x0400)  // requesting to change the tx parameters to reference_1`
	`@received_control=LRT`
	`@temp=@received_control & 0x1111000 // 0x11110000 is the mask data so that the variable contains only the control word of the received ttiu.`
	
	`Change_Local_tx_parameter(@temp)// variable as input`
	
	`@status= Local_ Tx_status_word`
	`@temp=@status | @control`
	`Send_ttiu(@temp,0x36,0xA)`
	`}`
	
	Where “0x0400” is the control word of TTIU.

Local_ Tx_status_word	This instruction is for getting the status of the local tx parameters for the previous requested tx parameter change. This is a 32 bit word in which the LSB 16-bit contains the status word and MSB 16 bits are ZEROS.

Send_RAW_TTIU(Pattern_marker 32 bits of BMC encoded TTIU)	This command is for transmitting a Raw_TTIU. i.e BMC encoded 32 bits TTIU can be specified here. The user has the flexibility to specify the pattern marker.
	
	Example:
	`Generation`
	`{`
	`Send_raw_ttiu( ffffc0000 FF C00F FC00 FF C00F FC00 FF C00F FC00 FF C00F FC00 FF C1F0 7C00 FF C00F FC00 FF C00F FC00 FF C00F FC00}`
	`Idle(54)`
	`}`
	
	Where “ffffc0000” is the pattern marker.

TRAINING_ERROR_COUNT, Change_local_tx_parameter, Tx_status_word	This command instructs the hardware to create separate variables with pre-defined addresses. When the user specifies this command, the software compiles the commands into variable commands with specific pre-defined variable addresses.

SATA Commands

Look at STP sample file for syntax.

- SEND_SATA_FRAME
- SendSATAFrame
- SATAData
- SATA_Data
- SATACRC
- SATA_CRC
- SATAXXXX
- SATA_XXXX

Primitive Commands

The following is a list of SAS and SATA primitives declared in **Primitives.Decl.inc** as Symbol Chains. If you want to use these primitives in your script, you must also include **Primitives.Decl.inc** in your script.

- SOF
- EOF
- SOAF
- EOAF
- ALIGN (0)

- ALIGN (1)
- ALIGN (2)
- ALIGN (3)
- NOTIFY (ENABLE SPINUP)
- NOTIFY (RESERVED 0)
- NOTIFY (RESERVED 1)
- NOTIFY (RESERVED 2)
- ACK
- NAK (CRC ERROR)
- NAK (RESERVED 0)
- NAK (RESERVED 1
- NAK (RESERVED 2)
- CREDIT_BLOCKED
- RRDY (NORMAL)
- RRDY (RESERVED 0)
- RRDY (RESERVED 1)
- SATA_SOF
- SATA_EOF
- SATA_CONT
- SATA_DMAT
- SATA_HOLD
- SATA_HOLDA
- SATA_PMACK
- SATA_PMNAK
- SATA_PMREQ_P
- SATA_PMREQ_S
- SATA_R_ERR
- SATA_R_IP
- SATA_R_OK
- SATA_R_RDY
- SATA_SYNC
- SATA_WTRM
- SATA_X_RDY
- SATA_ERROR
- AIP (NORMAL)
- AIP (RESERVED 0)
- AIP (RESERVED 1)
- AIP (RESERVED 2)
- AIP (RESERVED 3)
- AIP (WAITING ON CONNECTION)
- AIP (WAITING ON DEVICE)
- AIP (WAITING ON PARTIAL)
- BREAK
- BROADCAST (CHANGE)
- BROADCAST (RESERVED 0)
- BROADCAST (RESERVED 1)
- BROADCAST (RESERVED 2)

- BROADCAST (RESERVED 3)
- BROADCAST (RESERVED 4)
- BROADCAST (RESERVED CHANGE 0)
- BROADCAST (RESERVED CHANGE 1)
- CLOSE (CLEAR AFFILIATION)
- CLOSE (NORMAL)
- CLOSE (RESERVED 0)
- CLOSE (RESERVED 1)
- ERROR
- HARD_RESET
- OPEN_ACCEPT
- OPEN_REJECT (BAD DESTINATION)
- OPEN_REJECT (CONNECTION RATE NOT SUPPORTED)
- OPEN_REJECT (NO DESTINATION)
- OPEN_REJECT (PATHWAY BLOCKED)
- OPEN_REJECT (PROTOCOL NOT SUPPORTED)
- OPEN_REJECT (RESERVED ABANDON 0)
- OPEN_REJECT (RESERVED ABANDON 1)
- OPEN_REJECT (RESERVED ABANDON 2)
- OPEN_REJECT (RESERVED ABANDON 3)
- OPEN_REJECT (RESERVED CONTINUE 0)
- OPEN_REJECT (RESERVED CONTINUE 1)
- OPEN_REJECT (RESERVED INITIALIZE 0)
- OPEN_REJECT (RESERVED INITIALIZE 1)
- OPEN_REJECT (RESERVED STOP 0)
- OPEN_REJECT (RESERVED STOP 1)
- OPEN_REJECT (RETRY)
- OPEN_REJECT (STP RESOURCES BUSY)
- OPEN_REJECT (WRONG DESTINATION)
- DONE (ACK/NAK TIMEOUT)
- DONE (CREDIT TIMEOUT)
- DONE (NORMAL)
- DONE (RESERVED 0)
- DONE (RESERVED 1)
- DONE (RESERVED TIMEOUT 0)
- DONE (RESERVED TIMEOUT 1)

SAS-Specific Script-Defined Constants

The following is a list of SAS-specific constants declared in **AddressFramesDecl.inc** as Symbol Chains. If you want to use these commands in your script, you must also include **AddressFramesDecl.inc** in your script.

- SAS_AF_DT_NO_DEVICE_ATTACHED
- SAS_AF_DT_END_DEVICE
- SAS_AF_DT_EDGE_EXPANDER_DEVICE
- SAS_AF_DT_FANOUT_EXPANDER_DEVICE
- SAS_AF_FT_IDENTIFY
- SAS_AF_FT_OPEN

- SAS_AF_PROTOCOL_SMP
- SAS_AF_PROTOCOL_SSP
- SAS_AF_PROTOCOL_STP
- SAS_AF_PROTOCOL_UNKNOWN
- SAS_AF_RATE_1_5_GBPS
- SAS_AF_RATE_3_GBPS
- SAS_AF_RATE_6_GBPS
- SAS_AF_RATE_12_GBPS
- SMP_FRAME_TYPE_REQUEST
- SMP_FRAME_TYPE_RESPONSE
- SMP_REPORT_GENERAL
- SMP_REPORT_MANUFACTURER_INFO
- SMP_DISCOVER
- SMP_REPORT_PHY_ERROR_LOG
- SMP_REPORT_PHY_SATA
- SMP_REPORT_ROUTE_INFO
- SMP_CONFIGURE_ROUTE_INFO
- SMP_PHY_CONTROL
- SSP_FRAME_TYPE_DATA
- SSP_FRAME_TYPE_XFER_RDY
- SSP_FRAME_TYPE_COMMAND
- SSP_FRAME_TYPE_RESPONSE
- SSP_FRAME_TYPE_TASK
- SSP_FRAME_TYPE_VENDOR
- MUX (LOGICAL 0)
- MUX (LOGICAL 1)
- BREAK_REPLY
- TRAIN
- TRAIN_DONE
- PS_ACK
- PS_NAK
- PS_REQ_PARTIAL
- PS_REQ_SLUMBER

Primitive Category

- **ALIGN**: 0, 1, 2, or 3
- **NOTIFY**: ENABLE SPINUP, RESERVED 0, RESERVED 1, or RESERVED 2
- ACK
- **NAK**: CRC ERROR, RESERVED 0, RESERVED 1, or RESERVED 2
- **RRDY**: NORMAL, RESERVED 0, RESERVED 1
- **AIP**: NORMAL, RESERVED 0, RESERVED 1, RESERVED 2, RESERVED 3, WAITING ON CONNECTION, WAITING ON DEVICE, or WAITING ON PARTIAL
- BREAK
- **CLOSE**: CLEAR AFFILIATION, NORMAL, RESERVED 0, RESERVED 1
- CREDIT BLOCKED
- OPEN ACCEPT
- **OPEN REJECT**: BAD DESTINATION, CONNECTION RATE NOT SUPPORTED, NO DESTINATION, PATHWAY BLOCKED, PROTOCOL NOT SUPPORTED, RESERVED ABAN-

DON 0, RESERVED ABANDON 1, RESERVED ABANDON 2, RESERVED ABANDON 3, RESERVED CONTINUE 0, RESERVED CONTINUE 1, RESERVED INITIALIZE 0, RESERVED INITIALIZE 1, RESERVED STOP 0, RESERVED STOP 1, RETRY, STP RESOURCES BUSY, or WRONG DESTINATION

- **BROADCAST**: CHANGE, RESERVED 0, RESERVED 1, RESERVED 2, RESERVED 3, RESERVED 4, RESERVED CHANGE 0, or RESERVED CHANGE 1
- **DONE**: ACK/NAK TIMEOUT, CREDIT TIMEOUT, NORMAL, RESERVED 0, RESERVED 1, RESERVED TIMEOUT 0, or RESERVED TIMEOUT 1
- SATA FLOW CTRL PRIMITIVE
- SATA IDLE PRIMITIVE
- **SAS PS PRIMITIVE**: PS_REQ_PARTIAL, PS_REQ_SLUMBER, PS_ACK, or PS_NAK

Wait Commands

Syntax:

```
WAIT_FOR { <command1> <command2> ... <group1> <group2> ... }
```

Wait Command Name	Description
WF_TIMEOUT	Timeout Credit Available When WF_TIMEOUT is requested in WAIT_FOR command, the wait session will be released after timeout has elapsed. The Timeout value can be set two different ways: 1. Through the global WaitTimeout setting that can appear anywhere in generation. Default value is 1000 microseconds. Syntax: Set WaitTimeout = <value> (in microseconds) 2. Through local WaitTimeout value for this specific wait session. Syntax: WAIT_FOR (<number_of_microseconds>) {WF_TIMEOUT <other_wait_commands>} In this case wait for other commands will be released no later then after number_of_microseconds, but global WaitTimeout value remains unchanged for future use. See **Generation\Include\WaitCommands.inc** in the program folder for the samples of syntax.
WF_SOF	primitive
WF_EOF	primitive
WF_SOAF	primitive
WF_EOAF	primitive

Wait Command Name	Description
WF_ACK	primitive
WF_NAK_CRC_ERROR	primitive
WF_NAK_RESERVED_0	primitive
WF_NAK_RESERVED_1	primitive
WF_NAK_RESERVED_2	primitive
WF_CREDIT_AVAIL	Credit Available This function is based on a 10-bit counter whose value can range from -512 to +511 (twos-complement). This counter is cleared by sending or receiving an OPEN_ACCEPT primitive, or by execution of a CLEAR_CREDIT_AVAIL command in the script. This counter is incremented by receiving any SAS RRDY primitive and is decremented by sending SAS SOF. The wait_for command will wait for this counter to have a positive value between +1 and +511. This wait_for condition is intended to be used before sending a SAS frame within a connection. ClEAR_CREDIT_AVAIL clears this credit function.
WF_CREDIT_BLOCKED_RECEIVED	CreditBlocked Received This function is based on a flip-flop which is cleared by sending or receiving an OPEN_ACCEPT primitive. It is set by receiving a CREDIT_BLOCKED primitive. It is intended to be used in conjunction with wf_credit_avail to prevent script hangs in those cases where there is not going to be any more credit granted.
WF_CREDIT_BLOCKED	primitive
WF_RRDY_NORMAL	primitive
WF_RRDY_RESERVED_0	primitive
WF_RRDY_RESERVED_1	primitive
WF_BREAK	primitive
WF_CLOSE_CLEAR_AFFILIATION	primitive
WF_CLOSE_NORMAL	primitive
WF_CLOSE_RESERVED_0	primitive
WF_CLOSE_RESERVED_1	primitive
WF_DONE_ACK_NAK_TIMEOUT	primitive
WF_DONE_CREDIT_TIMEOUT	primitive
WF_DONE_NORMAL	primitive
WF_DONE_RESERVED_0	primitive

Wait Command Name	Description
WF_DONE_RESERVED_1	primitive
WF_DONE_RESERVED_TIMEOUT_0	primitive
WF_DONE_RESERVED_TIMEOUT_1	primitive
WF_ERROR	primitive
WF_HARD_RESET	primitive
WF_AIP_NORMAL	primitive
WF_AIP_RESERVED_0	primitive
WF_AIP_RESERVED_1	primitive
WF_AIP_RESERVED_2	primitive
WF_AIP_RESERVED_WAIT_ON_PART	primitive
WF_AIP_WAIT_ON_CONN	primitive
WF_AIP_WAIT_ON_DEVICE	primitive
WF_AIP_WAIT_ON_PARTIAL	primitive
WF_IDENTIFY_FRAME	Identify Address Frame
WF_OPEN_FRAME	Open Address Frame
WF_SMP_REQUEST	SMP Request Frame
WF_SMP_RESPONSE	SMP Response Frame
WF_REC_RESOURCES_OUTPUT_A	Advanced Wait Condition A This command causes generation to wait for Event "A" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_REC_RESOURCES_OUTPUT_B	Advanced Wait Condition B This command causes generation to wait for Event "B" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_REC_RESOURCES_OUTPUT_C	Advanced Wait Condition C This command causes generation to wait for Event "C" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_REC_RESOURCES_OUTPUT_D	Advanced Wait Condition D This command causes generation to wait for Event "D" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_REC_RESOURCES_OUTPUT_E	Advanced Wait Condition E This command causes generation to wait for Event "E" to occur that you defined in the Generation Options dialog described at the end of this chapter.

Wait Command Name	Description
WF_REC_RESOURCES_OUTPUT_F	Advanced Wait Condition F This command causes generation to wait for Event "F" to occur that you defined in the Generation Options dialog described at the end of this chapter.
wf_trainer_interconnect_signal_1	Events used to signal from one port to another.
wf_trainer_interconnect_signal_2	Events used to signal from one port to another.
wf_trainer_interconnect_signal_3	Events used to signal from one port to another.
wf_trainer_interconnect_signal_4	Events used to signal from one port to another.
WF_COMRESET_COMINIT	COMRESET OOB Signals
WF_COMSAS	COMSAS OOB Signals
WF_COMWAKE	COMWAKE OOB Signals
WF_BLOCK1_MISC_RESERVED_0	reserved
WF_BLOCK1_MISC_RESERVED_1	reserved
WF_BLOCK1_MISC_RESERVED_2	reserved
WF_BLOCK1_MISC_RESERVED_3	reserved
WF_BLOCK1_MISC_RESERVED_4	reserved
WF_SATA_CONT	primitive
WF_SATA_DMAT	primitive
WF_SATA_EOF	primitive
WF_SATA_ERROR	primitive
WF_SATA_HOLD	primitive
WF_SATA_HOLDA	primitive
WF_SATA_PMACK	primitive
WF_SATA_PMNAK	primitive
WF_SATA_PMREQ_P	primitive
WF_SATA_PMREQ_S	primitive
WF_SATA_R_ERR	primitive
WF_SATA_R_IP	primitive
WF_SATA_R_OK	primitive
WF_SATA_R_RDY	primitive
WF_SATA_SOF	primitive
WF_SATA_SYNC	primitive
WF_SATA_WTRM	primitive
WF_SATA_X_RDY	primitive
WF_OPEN_ACCEPT	primitive
WF_OPEN_REJECT_BAD_DESTINATION	primitive
WF_OPEN_REJECT_CONN_RATE_NOT_SUPPORTED	primitive
WF_OPEN_REJECT_NO_DESTINATION	primitive
WF_OPEN_REJECT_PATHWAY_BLOCKED	primitive

Wait Command Name	Description
WF_OPEN_REJECT_PROTOCOL_NOT_SUPPORTED	primitive
WF_OPEN_REJECT_RETRY	primitive
WF_OPEN_REJECT_STP_RESOURCES_BUSY	primitive
WF_OPEN_REJECT_WRONG_DESTINATION	primitive
WF_OPEN_REJECT_RESERVED_ABANDON_0	primitive
WF_OPEN_REJECT_RESERVED_ABANDON_1	primitive
WF_OPEN_REJECT_RESERVED_ABANDON_2	primitive
WF_OPEN_REJECT_RESERVED_ABANDON_3	primitive
WF_OPEN_REJECT_RESERVED_CONTINUE_0	primitive
WF_OPEN_REJECT_RESERVED_CONTINUE_1	primitive
WF_OPEN_REJECT_RESERVED_INITIALIZE_0	primitive
WF_OPEN_REJECT_RESERVED_INITIALIZE_1	primitive
WF_OPEN_REJECT_RESERVED_STOP_0	primitive
WF_OPEN_REJECT_RESERVED_STOP_1	primitive
WF_ALIGN_0	primitive
WF_ALIGN_1	primitive
WF_ALIGN_2	primitive
WF_ALIGN_3	primitive
WF_NOTIFY_ENABLE_SPINUP	primitive
WF_NOTIFY_RESERVED_0	primitive
WF_NOTIFY_RESERVED_1	primitive
WF_NOTIFY_RESERVED_2	primitive
WF_BROADCAST_CHANGE	primitive
WF_BROADCAST_RESERVED_0	primitive
WF_BROADCAST_RESERVED_1	primitive
WF_BROADCAST_RESERVED_2	primitive
WF_BROADCAST_RESERVED_3	primitive
WF_BROADCAST_RESERVED_4	primitive
WF_BROADCAST_RESERVED_CHANGE_0	primitive
WF_BROADCAST_RESERVED_CHANGE_1	primitive
WF_BLOCK2_MISC_RESERVED_0	reserved
WF_BLOCK2_MISC_RESERVED_1	reserved
WF_TRAIN	primitive
WF_TRAIN_DONE	primitive
WF_BREAK_REPLY	primitive
WF_MUX_LOGICAL_0	primitive
WF_MUX_LOGICAL_1	primitive
WF_PS_REQ_PARTIAL	primitive
WF_PS_REQ_SLUMBER	primitive

Wait Command Name	Description
WF_PS_ACK	primitive
WF_PS_NAK	primitive
WF_EXTERNAL_TRIGGER	This command causes generation to wait for an External Trigger
WF_ANALYZER_TRIGGER	This command causes generation to wait for an Analyzer Trigger
WF_TTIU(DATA/Change TTIU , MASK)	This instruction waits for specific TTIU. During this instruction the previously transmitted TTIU is transmitted. The user can trigger wait for specific TTIU or change the TTIU or part of TTIU by specifying the 32'bit mask value. The default mask value is set to all ones, i.e waits for all 32'bits to match with the received TTIU. Changing the mask value gives the flexibility to wait for some specific bits in the TTIU. Giving Change_TTIU with mask value waits for any change in the specified Bits in the Received TTIU compared to the previously received ttiu.

Wait Command Groups

Wait Command Group	Group Contents
WF_TIMEOUT	WF_TIMEOUT_BLOCK_ONE
	WF_TIMEOUT_BLOCK_TWO
WF_ALL_SOF	WF_SOF
	WF_SOAF
WF_ALL_EOF	WF_EOF
	WF_SOAF
WF_NAK	WF_NAK_CRC_ERROR
	WF_NAK_RESERVED_0
	WF_NAK_RESERVED_1
	WF_NAK_RESERVED_2
WF_RRDY	WF_RRDY_NORMAL
	WF_RRDY_RESERVED_0
	WF_RRDY_RESERVED_1
WF_CREDIT_OK	WF_CREDIT_AVAIL
	WF_CREDIT_BLOCKED_RECEIVED
WF_CLOSE	WF_CLOSE_CLEAR_AFFILIATION
	WF_CLOSE_NORMAL
	WF_CLOSE_RESERVED_0
	WF_CLOSE_RESERVED_1
WF_DONE	WF_DONE_ACK_NAK_TIMEOUT
	WF_DONE_CREDIT_TIMEOUT
	WF_DONE_NORMAL
	WF_DONE_RESERVED_0
	WF_DONE_RESERVED_1
	WF_DONE_RESERVED_TIMEOUT_0
	WF_DONE_RESERVED_TIMEOUT_1

Wait Command Group	Group Contents
WF_AIP	WF_AIP_NORMAL
	WF_AIP_RESERVED_0
	WF_AIP_RESERVED_1
	WF_AIP_RESERVED_2
	WF_AIP_RESERVED_WAIT_ON_PART
	WF_AIP_WAIT_ON_CONN
	WF_AIP_WAIT_ON_DEVICE
	WF_AIP_WAIT_ON_PARTIAL
WF_REC_RESOURCES	WF_REC_RESOURCES_OUTPUT_A
	WF_REC_RESOURCES_OUTPUT_B
	WF_REC_RESOURCES_OUTPUT_C
	WF_REC_RESOURCES_OUTPUT_D
	WF_REC_RESOURCES_OUTPUT_E
	WF_REC_RESOURCES_OUTPUT_F
WF_RCV_STATUS	WF_SATA_R_ERR
	WF_SATA_R_OK
WF_PM_REQ	WF_SATA_PMREQ_P
	WF_SATA_PMREQ_S
WF_PM_STATUS	WF_SATA_PMACK
	WF_SATA_PMNAK
WF_OPEN_REJECT	WF_OPEN_REJECT_BAD_DESTINATION
	WF_OPEN_REJECT_CONN_RATE_NOT_SUPPORTED
	WF_OPEN_REJECT_NO_DESTINATION
	WF_OPEN_REJECT_PATHWAY_BLOCKED
	WF_OPEN_REJECT_PROTOCOL_NOT_SUPPORTED
	WF_OPEN_REJECT_RETRY
	WF_OPEN_REJECT_STP_RESOURCES_BUSY
	WF_OPEN_REJECT_WRONG_DESTINATION
	WF_OPEN_REJECT_RESERVED_ABANDON_0
	WF_OPEN_REJECT_RESERVED_ABANDON_1
WF_OPEN_REJECT (continued...)	WF_OPEN_REJECT_RESERVED_ABANDON_2
	WF_OPEN_REJECT_RESERVED_ABANDON_3
	WF_OPEN_REJECT_RESERVED_CONTINUE_0
	WF_OPEN_REJECT_RESERVED_CONTINUE_1
	WF_OPEN_REJECT_RESERVED_INITIALIZE_0
	WF_OPEN_REJECT_RESERVED_INITIALIZE_1
	WF_OPEN_REJECT_RESERVED_STOP_0
	WF_OPEN_REJECT_RESERVED_STOP_1

Wait Command Group	Group Contents
WF_OPEN_RESPONSE	WF_OPEN_ACCEPT
	WF_OPEN_REJECT
WF_ALIGN	WF_ALIGN_0
	WF_ALIGN_1
	WF_ALIGN_2
	WF_ALIGN_3
WF_NOTIFY	WF_NOTIFY_ENABLE_SPINUP
	WF_NOTIFY_RESERVED_0
	WF_NOTIFY_RESERVED_1
	WF_NOTIFY_RESERVED_2
WF_BROADCAST	WF_BROADCAST_CHANGE
	WF_BROADCAST_RESERVED_0
	WF_BROADCAST_RESERVED_1
	WF_BROADCAST_RESERVED_2
	WF_BROADCAST_RESERVED_3
	WF_BROADCAST_RESERVED_4
	WF_BROADCAST_RESERVED_CHANGE_0
	WF_BROADCAST_RESERVED_CHANGE_1
WF_SAS_PS_REQ	WF_PS_REQ_PARTIAL
	WF_PS_REQ_SLUMBER
WF_SAS_PS_STATUS	WF_PS_ACK
	WF_PS_ACK

Predefined Constants

Predefined Constant	Internal Value
GEN_MODE_ERROR	0
GEN_MODE_SATA_HOST	1
GEN_MODE_SATA_DEVICE	2
GEN_MODE_SAS_INITIATOR	3
GEN_MODE_SAS_TARGET	4
GEN_LINK_SPEED_1_5G	00
GEN_LINK_SPEED_3G	01
GEN_LINK_SPEED_6G	10
SCRAMBLING_MODE_NONE	0
SCRAMBLING_MODE_SAS	1
SCRAMBLING_MODE_SATA	2

Generation Settings

Setting	Default Value	Description
Global Settings		
GenerationMode	>>>>>	Generation Mode - must be defined or no generation will take place. Possible Values: GEN_MODE_SATA_HOST GEN_MODE_SATA_DEVICE GEN_MODE_SAS_INITIATOR GEN_MODE_SAS_TARGET Default Value: GEN_MODE_ERROR - undefined mode
SSCEnable	0	Spread Spectrum Clocking (SSC) In SATA software, turns SSC on or off. Can only be set outside Generation block. In SAS software, when you turn on SSC, Trainer PHY can turn on SSC on the PHY. In the SAS protocol, during speed negotiation, when both sides of a link agree to turn on their SSC, SSC will turn on, with the SSC Type and SSC Amplitude parameters.
SSCType		Specifies SSC type as midspread.
SSCAmplitude		Specifies SSC Amplitude. Possible values are: SSC_AMP_500 SSC_AMP_1000 SSC_AMP_1500 SSC_AMP_2000 SSC_AMP_2500 SSC_AMP_3000
MultiSpeedMode	0	When set, the change of speed within Generation block is allowed with following syntax: set Speed = LINK_SPEED_1_5G / LINK_SPEED_3G / LINK_SPEED_6G
Output Disable	0	This very poorly named register bit forces the Trainer to output data. It is a little like the output_on script command except that its effect cannot be undone for the duration of the script. If this is turned on, none of the out-of-band commands will work, as the output enable is forced on.
SupportSNW1	1	When set, in “Connect command” SNW1 will be tried in Speed Negotiation phase Can only be set outside Generation block.
SupportSNW2	1	When set, in “Connect command” SNW2 will be tried in Speed Negotiation phase. Can only be set outside Generation block.

Setting	Default Value	Description
PauseTrnScrmblr.	0	When set, the generator pauses the Idle scrambler of Train/TrainDone pattern.
ReconnectOnRun	0	When “AdvanceConnect” and “ReconnectOnRun” are set, the “Connect” command forces the Trainer to disconnect the physical link before executing the “Connect” command. When “AdvanceConnect” is not set, this setting does not affect the Trainer.
AdvanceConnect	0	When set, the Trainer uses the “PHY Capability” and “SupportSNW” settings, instead of the “Set Speed” settings, for executing the “Connect” command.
OutputOffAfterDC	On Off	If set to On, Trainer puts DC Idle on line when it detects sync lost on the link.

Setting	Default Value	Description
AutoMode Settings		
AutoOOBMode	On	When set, the generator will go through the stages of bringing up the link automatically, including waiting for and responding to the device or host it is connected to.
AutoHoldMode	0	When set, the generator will respond automatically to Hold requests. Not supported for version 1.1 (reserved).
AutoDMAT	0	When set, the generator will respond automatically to DMAT requests. Not supported for version 1.1 (reserved).
AutoSpeedNeg	On	When set, the generator will automatically go throughthe speed negotiation process, for the speed set in the PINTERFACEC_SERDES register for the Trainer.
AutoAlignSATA	0	When set, the generator will automatically inserting the stream 2 Align(0) primitives every 254 DWORDs, as specified in the SATA spec.
AutoAlignSAS	On	When set, the generator will automatically inserting the stream Align primitives every 2048 DWORDs, as specified in the SAS spec.Two Align modes can be turned on simultaneously, to support STP
COMINIT Settings		
COMINIT_NegLen	800	The number of bursts to send as part of this OOB type.Each Burst is followed by an Idle. The Burst-Idle pairs are repeated the requested number of times, and then followed by the Negation_length of Idle.
COMINIT_IdleLen	480	Burst time between each OOB idle in OOBIs.During the specified period, the generator will send ALIGN(0) at the specified speed.
COMINIT_BurstLen	160	Idle time between each OOB burst in OOBIs.During the specified period, the generator will keep the line at electric idle.
COMINIT_NumBursts	6	Negation time at the end of the OOB signal in OOBIs.During the specified period, the generator will keep the line at electric idle.

Setting	Default Value	Description
COMWAKE Settings		
COMWAKE_NegLen	280	The number of bursts to send as part of this OOB type.Each Burst is followed by an Idle. The Burst-Idle pairs are repeated the requested number of times, and then followed by the Negation_length of Idle.
COMWAKE_IdleLen	160	Burst time between each OOB idle in OOBIs.During the specified period, the generator will send ALIGN(0) at the specified speed.
COMWAKE_BurstLen	160	Idle time between each OOB burst in OOBIs.During the specified period, the generator will keep the line at electric idle.
COMWAKE_NumBursts	6	Negation time at the end of the OOB signal in OOBIs.During the specified period, the generator will keep the line at electric idle.
COMSAS Settings		
COMSAS_NegLen	2400	The number of bursts to send as part of this OOB type.Each Burst is followed by an Idle. The Burst-Idle pairs are repeated the requested number of times, and then followed by the Negation_length of Idle.
COMSAS_IdleLen	1440	Burst time between each OOB idle in OOBIs.During the specified period, the generator will send ALIGN(0) at the specified speed.
COMSAS_BurstLen	160	Idle time between each OOB burst in OOBIs.During the specified period, the generator will keep the line at electric idle.
COMSAS_NumBursts	6	Negation time at the end of the OOB signal in OOBIs.During the specified period, the generator will keep the line at electric idle.
SATA Link Init Settings		
OOB_SATA_D102_Time	100000	D10.2 time for SATA link synchronization in OOBIs.During the specified period, the generator will transmit D10.2 symbols.
OOB_SATA_Align_Time	100000	ALIGN(0) time for SATA link synchronization in OOBIs.During the specified period, the generator will transmit ALIGN(0) primitives.

Setting	Default Value	Description
SAS Speed Negotiation Settings		
OOB_SAS_Align1_Time	81920	ALIGN(1) time for SAS speed negotiation in OOBIs.During the specified period, the generator will transmit ALIGN(1) primitives.
OOB_SAS_Align0_Time	81920	ALIGN(0) time for SAS speed negotiation in OOBIs.During the specified period, the generator will transmit ALIGN(0) primitives.
OOB_SAS_Interspeed_Time	750000	Interspeed time for SAS speed negotiation in OOBIs.During the specified period, the generator will keep the line at electric idle.
OOB_SpeedNeg_MTT.	29998080 OOBI	The maximum time in OOBI during which training phase of speed negotiation should be completed in Train-SNW.
OOB_SpeedNeg_SNTT.	2200 OOBI	The time in OOBI during which generator transmits phy capability bits in SNW-3. In Automatic connection This value is also used for the time during which generator sends Align0 and Align1 in SNW1 and SNW2.
OOB_SpeedNeg_BCT.	2200 OOBI	The time in OOBI during which generator transmits COMWAKE or D.C. idle during SNW-3.
OOB_SpeedNeg_MTTT	750000000 OOBI	The maximum time for transmitter training to complete during Train_Tx-SNW.
OOB_SpeedNeg_COEF_Setting.	Normal	The initial coefficient setting values to be transmitted in the Tx-training TTIU. The value can be one of these values :Normal, Reference-1, Reference-2, No-equalization.

Setting	Default Value	Description
Phy Capabilities Settings		
OOB_SpeedNeg_Phy_start		The START bit shall be set to one. The phy's receiver shall use this bit to establish the timing for the subsequent bits.
OOB_SpeedNeg_ Phy_txSSCtype		A TX SSC TYPE bit set to one indicates that the phy's transmitter uses center-spreading SSC when SSC is enabled. A TX SSC TYPE bit set to zero indicates that the phy's transmitter uses down-spreading SSC when SSC is enabled or that the phy does not support SSC.
OOB_SpeedNeg_Phy_RLLR		The REQUESTED LOGICAL LINK RATE field indicates if the phy supports multiplexing and, if so, the logical link rate that the phy is requesting.
OOB_SpeedNeg_ Phy_g1WithoutSSC		A G1 WITHOUT SSC bit set to one indicates that the phy supports G1 (i.e., 1.5 Gbps) without SSC. A G1 WITHOUT SSC bit set to zero indicates that the phy does not support G1 without SSC.
OOB_SpeedNeg_ Phy_g1WithSSC		A G1 WITH SSC bit set to one indicates that the phy supports G1 (i.e., 1.5 Gbps) with SSC. A G1 WITH SSC bit set to zero indicates that the phy does not support G1 with SSC.
OOB_SpeedNeg_ Phy_g2WithoutSSC		A G2 WITHOUT SSC bit set to one indicates that the phy supports G2 (i.e., 3 Gbps) without SSC. A G2 WITHOUT SSC bit set to zero indicates that the phy does not support G2 without SSC.
OOB_SpeedNeg_ Phy_g2WithSSC		A G2 WITH SSC bit set to one indicates that the phy supports G2 (i.e., 3 Gbps) with SSC. A G2 WITH SSC bit set to zero indicates that the phy does not support G2 with SSC.
OOB_SpeedNeg_ Phy_g3WithoutSSC		A G3 WITHOUT SSC bit set to one indicates that the phy supports G3 (i.e., 6 Gbps) without SSC. A G3 WITHOUT SSC bit set to zero indicates that the phy does not support G3 without SSC.
OOB_SpeedNeg_ Phy_g3WithSSC		A G3 WITH SSC bit set to one indicates that the phy supports G3 (i.e., 6 Gbps) with SSC. A G3 WITH SSC bit set to zero indicates that the phy does not support G3 with SSC.
OOB_SpeedNeg_ Phy_g4WithoutSSC		A G4 WITHOUT SSC bit set to one indicates that the phy supports G4 (12 Gbps) without SSC. A G4 WITHOUT SSC bit set to zero indicates that the phy does not support G4 without SSC.

Setting	Default Value	Description
OOB_SpeedNeg_ Phy_g4WithSSC		A G4 WITH SSC bit set to one indicates that the phy supports G4 (12 Gbps) with SSC. A G4 WITH SSC bit set to zero indicates that the phy does not support G4 with SSC.
OOB_SpeedNeg_Phy_Parity		The PARITY bit provides for error detection of all the SNW-3 phy capabilities bits. The PARITY bit shall be set to one or zero such that the total number of SNW-3 phy capabilities bits that are set to one is even, including the START bit and the PARITY bit.

Setting	Default Value	Description
SATA Speed Negotiation Settings		
OOB_SpeedNeg_RCDT	750000	Maximum time in OOBIs during the speed negotiation window for a transmitter to reply with ALIGN(1).
OOB_SpeedNeg_SNTT	163840	Time in OOBIs during which ALIGN(0) or ALIGN(1) is transmitted at each physical link rate during the speed negotiation sequence.
OOB_SpeedNeg_SNLT	153600	Time in OOBIs during which the transmitter shall transmit idle between rates during speed negotiation.
Speed Settings		
Speed	>>>>>	Link Speed Possible Values: LINK_SPEED_1_5G LINK_SPEED_3G LINK_SPEED_6G Default Value: LINK_SPEED_1_5G
RateMatching	0	Possible values: 0 (disabled) and 1 (enabled). When RateMatching is enabled, the software programs every other dword as Align(0) primitive, cutting the throughput in half. It is not recommended to use SendInc and SendBulk when you are employing RateMatching, since the automatically generated data will not get rate matched.
Scrambling Mode Settings		
Scrambling	>>>>>	Raw Data Scrambling Mode - Only those raw DWORDs will be scrambled that contain only data bytes (no 10-bit symbols or 'K' bytes. Scrambling is reset by changing ScramblingMode or by any valid SAS or SATA frame. When **Scrambling** is on, scrambling is done by Trainer engine. It automatically detects scrambling type (SAS or SATA) by start frame primitive. When **Scrambling** is off, data is sent without any scrambling. Possible Values: SCRAMBLING_MODE_NONE SCRAMBLING_MODE_SAS SCRAMBLING_MODE_SATA SCRAMBLING_MODE_AUTO Default Value: SCRAMBLING_MODE_AUTO

Setting	Default Value	Description
Wait Timeout Settings		
WaitTimeout	1000	Sets global WaitTimeout value in microseconds
AUTO_WAIT_SAS_AFTER Settings		
AUTO_WAIT_SAS_AFTER_ CLOSE_FOR_CLOSE	FALSE	When set, the generator will insert WAIT_FOR CLOSE command immediately after each CLOSE primitive.
AUTO_WAIT_SAS_AFTER_ EOF_FOR_ACK	FALSE	When set, the generator will insert WAIT_FOR ACK command immediately after each EOF primitive.
AUTO_WAIT_SAS_AFTER_ EOF_FOR_ACK_OR_NAK	FALSE	When set, the generator will insert WAIT_FOR ACK or NAK command immediately after each EOF primitive.
AUTO_WAIT_SAS_AFTER_ OPEN_FOR_OPEN_ACCEPT	FALSE	When set, the generator will insert WAIT_FOR OPEN_ACCEPT command immediately after each Open Address Frame.
AUTO_WAIT_SAS_AFTER_ OPEN_FOR_OPEN_REJECT	FALSE	When set, the generator will insert WAIT_FOR OPEN_REJECT command immediately after each Open Address Frame.
AUTO_WAIT_SAS_AFTER_ IDENTIFY_FOR_IDENTIFY_ FRAME	FALSE	When set, the generator will insert WAIT_FOR Identify Frame command immediately after each Identify Address Frame.
AUTO_WAIT_SAS_AFTER_ SMP_REQ_FOR_RESP	FALSE	When set, the generator will insert WAIT_FOR SMP Response Frame command immediately after each SMP Request Frame.
AUTO_WAIT_SAS_BEFORE Settings		
AUTO_WAIT_SAS_BEFORE_ CLOSE_FOR_CLOSE	FALSE	When set, the generator will insert WAIT_FOR CLOSE command right before each CLOSE primitive.
AUTO_WAIT_SAS_BEFORE_ SOF_FOR_CREDIT	FALSE	When set, the generator will insert WAIT_FOR CREDIT command right before each SOF primitive.
AUTO_WAIT_SAS_BEFORE_ IDENTIFY_FOR_IDENTIFY_ FRAME	FALSE	When set, the generator will insert WAIT_FOR Identify Frame command right before each Identify Address Frame.
AUTO_WAIT_SAS_BEFORE_ OPEN_ACCEPT_FOR_OPEN	FALSE	When set, the generator will insert WAIT_FOR Open Frame command right before each OPEN_ACCEPT primitive.
AUTO_WAIT_SAS_BEFORE_ OPEN_REJECT_FOR_OPEN	FALSE	When set, the generator will insert WAIT_FOR Open Frame command right before each OPEN_REJECT primitive.
AUTO_WAIT_SAS_BEFORE_ AIP_FOR_OPEN	FALSE	When set, the generator will insert WAIT_FOR Open Frame command right before each primitive of AIP group.
AUTO_WAIT_SAS_BEFORE_ SMP_RESP_FOR_REQ	FALSE	When set, the generator will insert WAIT_FOR SMP Request Frame command right before each SMP Response Frame.

Setting	Default Value	Description
AUTO_WAIT_SATA_AFTER Settings		
AUTO_WAIT_SATA_AFTER_X_RDY_FOR_R_RDY	FALSE	When set, the generator will insert WAIT_FOR SATA_R_RDY command immediately after each case of SATA_CONT primitive following SATA_X_RDY primitive.
AUTO_WAIT_SATA_AFTER_WTRM_FOR_STATUS	FALSE	When set, the generator will insert WAIT_FOR SATA_R_ERR or SATA_R_OK command immediately after each case of SATA_CONT primitive following SATA_WTRM primitive.
AUTO_WAIT_SATA_AFTER_PMREQ_S_FOR_RESPONSE	FALSE	When set, the generator will insert WAIT_FOR SATA_PMACK or SATA_PMNAK command immediately after each case of SATA_CONT primitive following SATA_PMREQ_S primitive.
AUTO_WAIT_SATA_AFTER_PMREQ_P_FOR_RESPONSE	FALSE	When set, the generator will insert WAIT_FOR SATA_PMACK or SATA_PMNAK command immediately after each case of SATA_CONT primitive following SATA_PMREQ_P primitive.
AUTO_WAIT_SATA_AFTER_SYNC_FOR_SYNC	FALSE	When set, the generator will insert WAIT_FOR SATA_SYNC command immediately after each case of SATA_CONT primitive following SATA_SYNC primitive.
AUTO_WAIT_SATA_BEFORE Settings		
AUTO_WAIT_SATA_BEFORE_PMACK_FOR_PMREQ	FALSE	When set, the generator will insert WAIT_FOR SATA_PMREQ_S or SATA_PMREQ_P command right before each SATA_PMACK primitive.
AUTO_WAIT_SATA_BEFORE_PMNAK_FOR_PMREQ	FALSE	When set, the generator will insert WAIT_FOR SATA_PMREQ_S or SATA_PMREQ_P command right before each SATA_PMNAK primitive.
AUTO_WAIT_SATA_BEFORE_RERR_FOR_WTRM	FALSE	When set, the generator will insert WAIT_FOR SATA_R_ERR command right before each SATA_WTRM primitive.
AUTO_WAIT_SATA_BEFORE_ROK_FOR_WTRM	FALSE	When set, the generator will insert WAIT_FOR SATA_R_OK command right before each SATA_WTRM primitive.
AUTO_WAIT_SATA_BEFORE_RIP_FOR_SOF	FALSE	When set, the generator will insert WAIT_FOR SATA_R_IP command right before each SATA_SOF primitive.
AUTO_WAIT_SATA_BEFORE_R_RDY_FOR_X_RDY	FALSE	When set, the generator will insert WAIT_FOR SATA_X_RDY command right before each SATA_R_RDY primitive.

5.11.8 Auto Speed Negotiation

The commands SATA_D10.2, SATA_ALIGN, SPEED_NEG_ALIGN0 and SPEED_NEG_ALIGN1 operate differently based on the state of the Auto Speed negotiation (Asng) control bit (which is set or cleared by configuration memory blocks in the stream) and by the current SAS/SATA, Init/Targ state of the Trainer Engine. The table below illustrates different actions done by Trainer Engine executing SATA_D10.2, SATA_ALIGN, SPEED_NEG_ALIGN0 and SPEED_NEG_ALIGN1 commands based on Asng and Trainer Engine setup.SS

Command	AutoSpeedNeg	Actions
SATA_D10.2	0	Send D10.2 dwords until the count is exhausted, then move on to the next block in stream. The count is specified by the SPEED_NEG_PARAMETER control block.
	1	Send D10.2 dwords until the count is exhausted or an ALIGN_0 is detected (whichever comes first), then move on to the next block in the stream.
SATA_ALIGN	0	Send Align_0 primitives until the count is exhausted, then move on to the next block in the stream. The count is specified by the SPEED_NEG_PARAMETER control block.
	1	Send Align_0 primitives until the count is exhausted or an Align_0 is detected (whichever comes first), then move on to the next block in the stream.
SPEED_NEG_ALIGN0	0	Send Align_0 primitives until the count is exhausted, then move on to the next block in the stream.
	1	Send Align primitives until the count is exhausted, then move on to the next block in the stream. Start with Align_0, and switch to Align_1 if an Align_0 is detected.
SPEED_NEG_ALIGN1	0	Send Align_1 primitives until the count is exhausted.
	1	Do nothing at all.

5.11.9 Generation Options

Use the Generation Rules to set triggers and filters.

To display the Generation Options dialog, select **Generate > Generation Options** or click the **Setup Generation Options**  button.

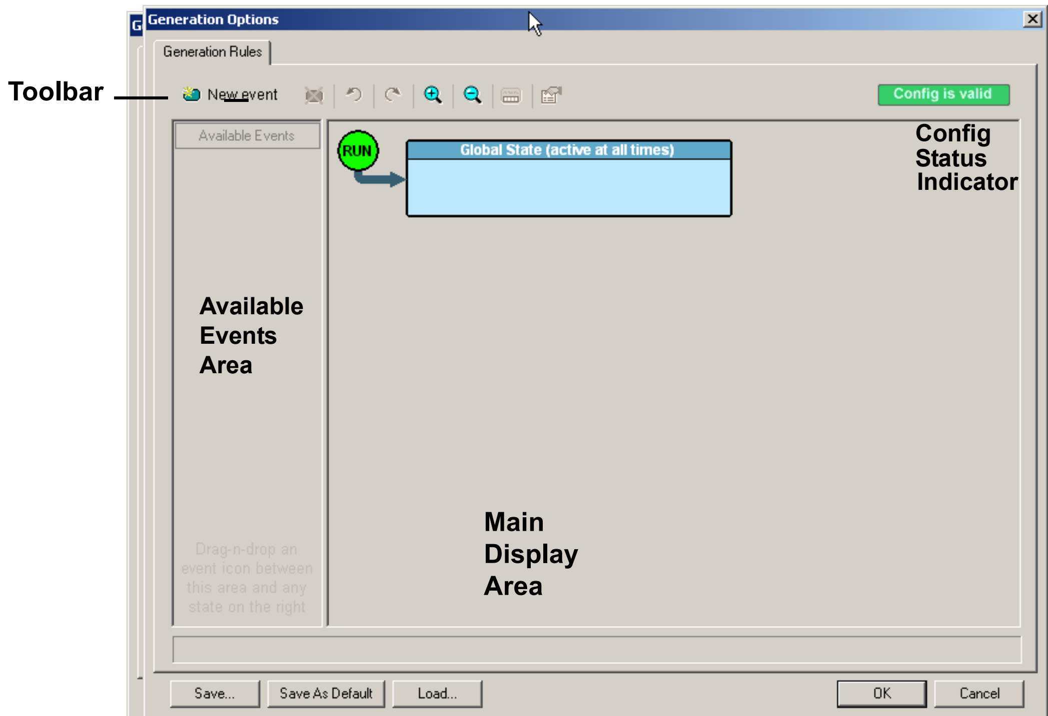


Figure 5.16: Generation Options Window

The page has the following areas:

- **Toolbar:** Contains buttons that control the Generation Rules page.
- **Available Events Area:** Area where you can park Event buttons that you intend to use in the Main Display area.
- **Main Display Area:** Area where you configure trigger and filter rules. You configure rules by dragging Event buttons from the Available Events area and then assigning actions to those buttons.
- **Config Status Indicator:** A button that indicates if the rule is valid or invalid. If a trigger or filter rule is configured correctly, the button is green and indicates Config is Valid. If a rule is not configured correctly, the button is red and indicates Config is Invalid.

Pop-Up Menus: When you right-click a button or area in the Generation Rules page, a context-sensitive pop-up menu appears that lets you do operations that relate to that button or area.

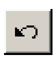
Properties Dialogs: When you click the Show/Hide Properties Dialog button for an event, action, or state, a dialog allows you to perform the same operations as in the pop-up menus.

5.11.10 Generation Rules Toolbar

The Generation Rules toolbar buttons control the Generation Rules page.

Figure 5.17: Generation Rules Toolbar

TABLE 5.12: Recording Rules Buttons

	New Event. Creates a new event in the Available Events area.		Zoom Out. Makes the display appear smaller.
	Delete Event. Deletes the selected event.		Show/Hide Channels. Shows or hides the channel icon on the Event button.
	Undo. Undoes the change made to Recording Rules page. The Undo buffer has unlimited size.		Show/Hide Properties Dialog. Shows or hides the properties dialog of the selected event, action, or state.
	Redo. Restores changes done to the Recording Rules page.		This display appears when the current Recording Rules configuration can be executed by the hardware.
	Zoom In. Enlarges the display (see note). There are five zoom levels. The default level is the middle one.		This display appears when the current Recording Rules configuration cannot be executed by the hardware.

Note: If you have a wheel on the mouse, you can zoom by holding down the CTRL key and rolling the mouse wheel.

5.11.11 Generation Rules Page: How It Works

You can think of the Generation Rules page as a workspace for creating rules (rules that determine how the analyzer generates traces). Rules are combinations of events and actions.

An event and the action or actions associated with it form a rule state.

Briefly, creating a rule involves the following steps:

1. Creating Event buttons in the Available Events area.
2. Drag-and-drop of Event buttons to the appropriate areas (cells) in the Main Display area.
3. Assigning an action or actions to each Event button.

5.11.12 Creating Event Buttons

To create a rule, first create one or more Event buttons. As you create Event buttons, they appear in the Available Events area. You then can drag-and-drop them into the Main Display area.

To create event buttons:

1. Click the **New Event** button at the left side of the toolbar to display the New Event pop-up menu.

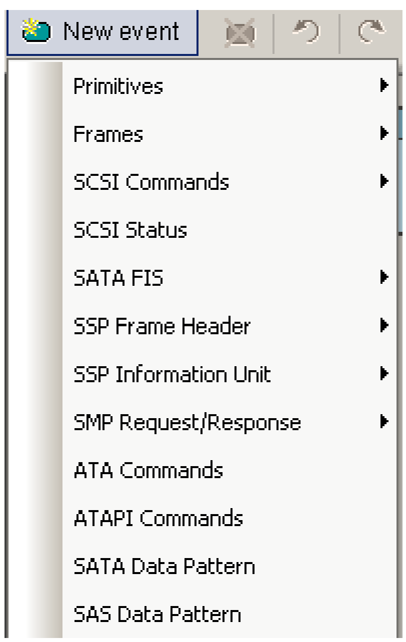


Figure 5.18: New Event Menu

2. Select an event, such as Primitive. The event appears in the Available Events area.

Figure 5.19: Available Events Area

5.11.13 Dragging a Button to the Main Display Area

After you create an Event button in the Available Events area, you can drag the button to the Main Display area and drop it in the appropriate cell (a cell is a grayed-out rectangle with a dashed line around it). You can think of each cell as a target for drag-and-drop of an Event button.

To drag-and-drop the Event button:

1. Place the mouse cursor on the Event button in the Available Events area. Click the left mouse button.
2. Drag the button to the cell. When the button is in the cell, a dashed highlight line appears around the cell. Drop the button in the cell (release the left mouse button). The Event button appears in the cell.

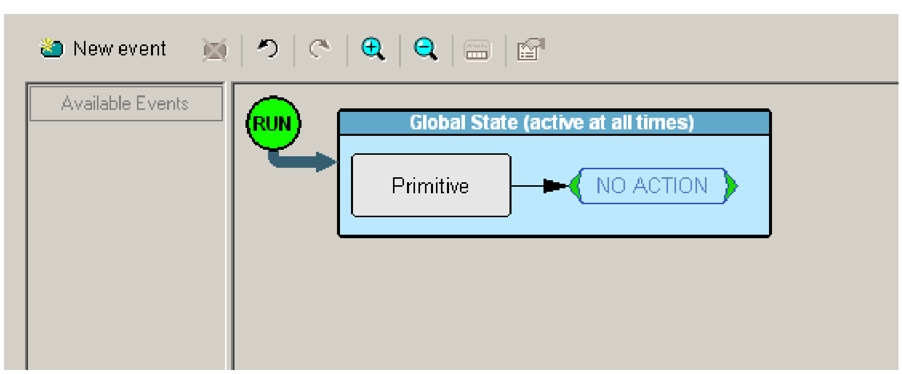


Figure 5.20: Event in Main Display

The default label for the first cell is Global State, which is active at all times.

5.11.14 Assigning an Action

After you have dropped the Event button in a cell in the Main Display area, you can assign an action to the event.

Note: If you do not assign an action to an Event button, the Generator ignores the event.

To assign an action to an Event button:

1. Right-click the **Event** button to display a pop-up menu.

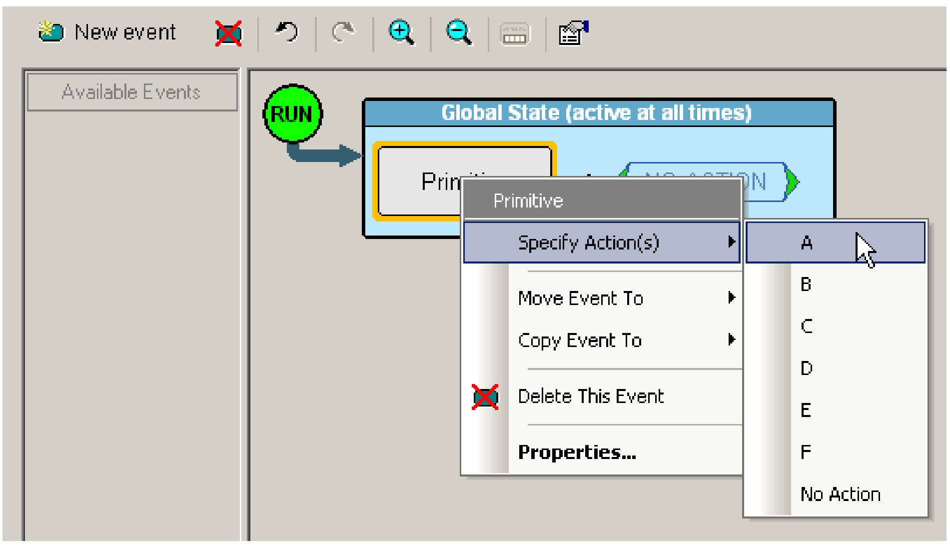


Figure 5.21: Action Menu

2. Select **Specify Action**, and then choose an action from the submenu. The menu closes, and the action is assigned.

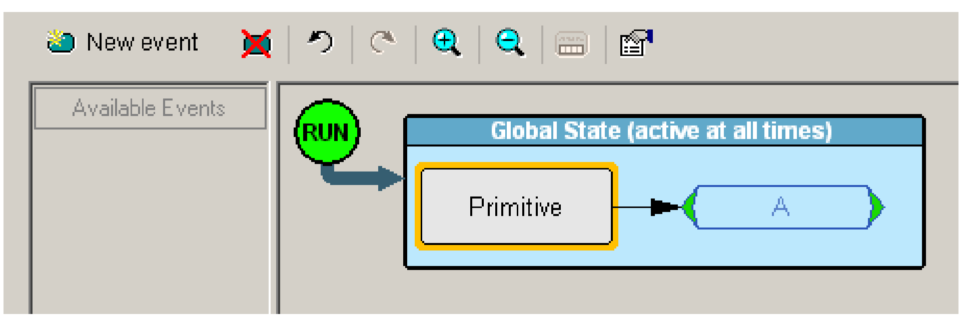


Figure 5.22: Action in Main Display

Note: You can also set actions within the Properties dialog for each event. Double-click the Event button to open the Properties dialog, then select the Actions tab and set your actions.

5.11.15 Generation Rules Pop-Up Menus

The Generation Rules window has context-sensitive pop-up menus that are associated with the following types of object: cells, events, and actions.

Cell Pop-up Menu

If you right-click a cell in the Main Display area that has an Event button contained in it, the Cell pop-up menu appears. The Cell pop-up menu has the following options.

- **New Event**: Displays the same menu that you get when you click the New Event button on the toolbar.
- **Properties**: Displays the Properties dialog for the selected cell.

Action Pop-up Menu

If you click an Action button in the Main Display area, the Action pop-up menu appears with the options **A** through **F** and **No Action**.

Event Pop-up Menu

If you click an Event button in the Main Display area, the Event pop-up menu appears. The Event pop-up menu has the following options:

- **Specify Action(s)**: Opens the Actions submenu, allowing you to assign an action to the event. Options on this submenu are the same as those on the Action pop-up, described previously.
- **Move Event to:** Moves the selected event to a different position in the Recording Rules window.
- **Copy Event to:** Copies the selected event to a different position in the Recording Rules window.
- **Delete This Event:** Deletes the selected Event. Alternatively, you can use the Delete button on the toolbar or keyboard to delete events.
- **Properties**: Displays the Event Properties dialog for the selected event.

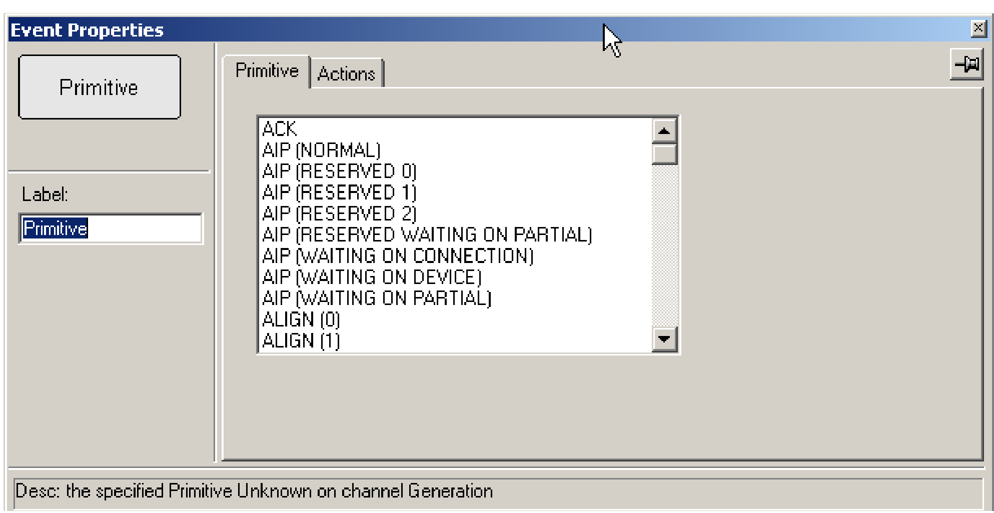


Figure 5.23: Event Properties

The dialog lists the Properties and their Values.

5.11.16 Events and Event Properties

Generation rules are associations between events and actions. These associations determine how trace recording occurs. The supported events are:

- **Primitives**: Primitive Categories or Primitive
- **Frames**: Open Address Frames, Identify Address Frames, Zone Broadcast Address Frames, SSP Frames, or SMP Frames
- SCSI Commands
- SCSI Status
- **SATA FIS**: Register Host to Device, Register Device to Host, Set Device Bits, DMA Activate, DMA Setup, BIST Activate, PIO Setup, Data, Route, or Vend FIS
- **SSP Frame Header**: DATA, XFER_RDY, COMMAND, RESPONSE, TASK, VENDOR, or RESERVED
- **SSP Information Unit**: Command IU, Task IU, XFER_RDY IU, or Response IU
- **SMP Request/Response**: RPT_GENERAL, RPT_MFG_INFO, DISCOVER, RPT_-PHY_ERR_LOG, RPT_PHY_SATA, RPT_RT_INFO, CONFIG_RT_INFO, PHY_CON-TROL, PHY_TEST_FUNCTION, CONFIG_PHY_ZONE, CONFIG_ZONE_PERM, RPT_ZONE_PERM, or RPT_ZONE_RT_TBL
- ATA Commands
- ATAPI Commands
- SATA Data Pattern
- SAS Data Pattern
- Transmitter Trainer IU Pattern

Data Pattern Mask and Match

If you select Data Pattern as the Event, you can set Data Pattern event properties in the Event Properties dialog.

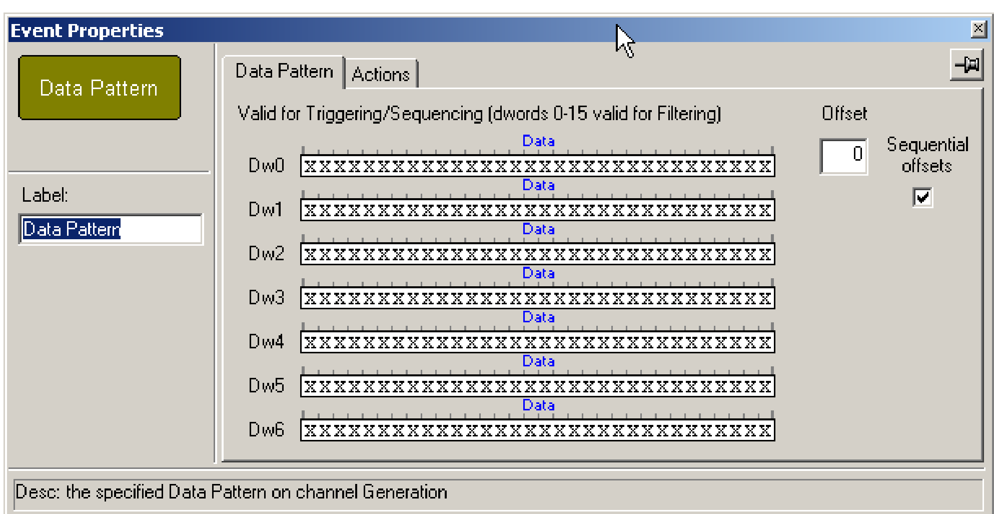


Figure 5.24: Event Properties for Data Pattern Event

In the Data Pattern dialog, you can set the DWORD. You can set the **Offset** by entering an integer. Optionally click the **Sequential Offsets** checkbox.

5.11.17 Setting Complex “Wait For” Conditions

The Generation Options dialog lets you define complex “Wait For” events and assign a letter value (“A” through “F”) to the definition, so that you can refer to the definition by letter instead of by textual name.

After a letter value has been assigned to an event, the letter is referred to in your generation script using the following command syntax:

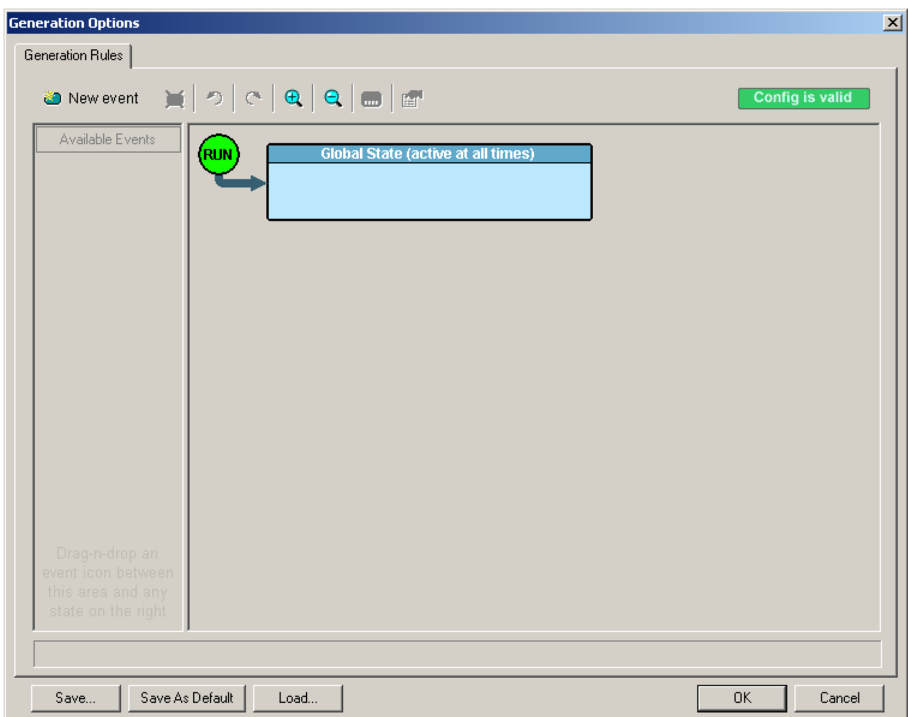
```
Wait_For {WF_REC_RESOURCES_OUTPUT_A}
```

where “A,” in this case, is the defined condition.

Setting Conditions with the Generation Options Dialog

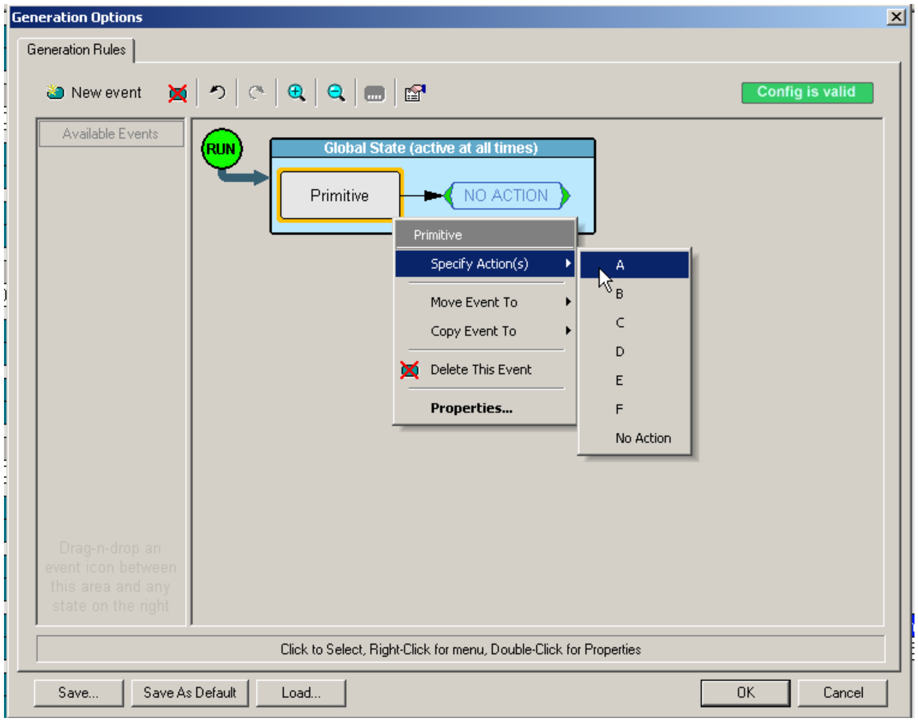
To set a complex condition, open the Generation Options dialog:

1. Select **Generate** > **Generation Options** from the menu to open the Generation Options dialog.

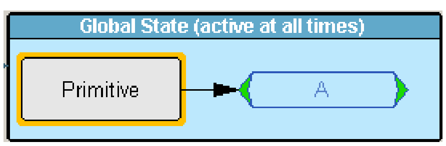


2. Click the **New Events** button and select an event from the menu. The selected event should appear in the **Available Events** area along the left side of the dialog box.
3. Drag the new event button to the **Global State** cell.

4. Right-click the new event button and select **Specify Action(s)**. A menu appears showing the letters A through F and the option "No action."



5. Select a letter from the menu. The menu closes. The event button should now point to a neighboring button that has the letter value you assigned.



6. After the condition has been defined, you can then add the **Wait For** command line (with whatever letter you assigned) to your script. For example:

```
Wait_For {WF_REC_RESOURCES_OUTPUT_A}
```

5.11.18 Find

Find allows searches on an open trace using one or more criteria. You can search by packet, transactions, split transaction, transfer, packet type, and fields within packets.

To run **Find**, select **Search > Find** or by click  on the toolbar.

Searches can combine criteria using the options **Intersection** and **Union**.
Intersection creates AND statements such as "Find all packets with *x* and *y*."
Union creates OR statements such as "Find all packets with *x* OR *y*."

You can also perform searches in which packets or events are excluded from a trace, using the **Exclusion** option.

To perform a search:

1. Select **Find...** under **Search** on the Menu Bar.
   OR
   Click  in the Toolbar.
   You see the User-Defined Find Events screen:

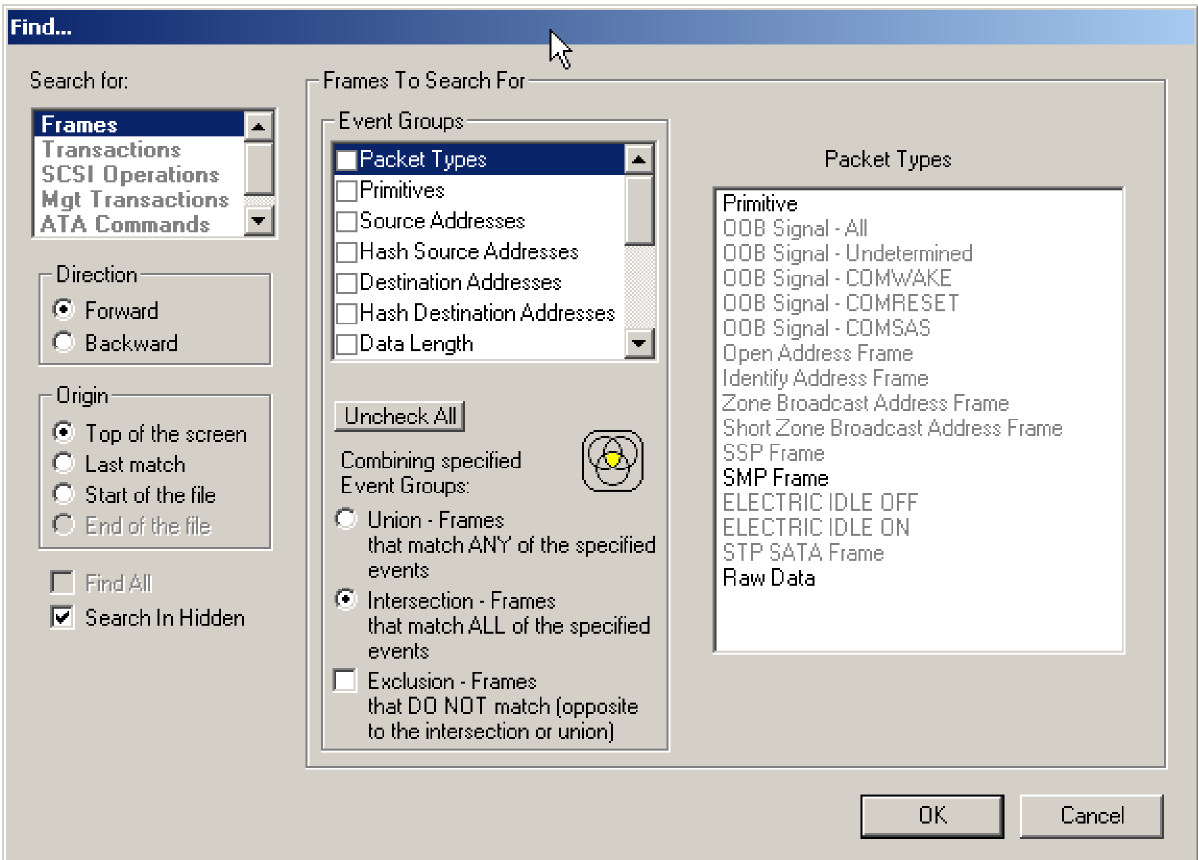
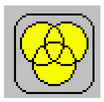


Figure 5.25: Find Dialog

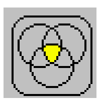
2. Select **Frames, Transactions**, **SCSI Operations**, **Management Transactions, ATA Commands**, or **OOBs** from the top left list box to list that type of event in the Events Group box.
3. Select one or more events from the **Events Group** box:
   - ❑ Packet Types (Header, PHY, Event, Transaction)
   - ❑ Primitives
   - ❑ Source Addresses
   - ❑ Hash Source Addresses
   - ❑ Destination Addresses
   - ❑ Hash Destination Addresses
   - ❑ Data Length
   - ❑ SMP Frames

- SSP Frames
- Errors
- FIS Types
- FIS Port Number
- Channel
- Data Pattern
- Completion Time

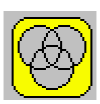
4. Select one of the following options:
   - **Union:** Find all packets matching ANY of the specified events.



   - **Intersection:** Find packets matching ALL of the specified events.



   - **Exclusion:** Exclude packets matching any of the specified events.
     Exclusion works with the other two options:
     Select Union *AND* Exclusion
     (=Exclude packets with ANY of the following fields) or
     Intersection *AND* Exclusion
     (=Exclude packets with ALL of the following fields.)



5. Optionally set the search **Direction** and **Origin**.
6. Optionally check to **Search in Hidden** or **Find All.**
7. Click **OK**.

After the search finishes, the program displays the packets meeting the search criteria.

5.11.19 Data Pattern Mask and Match

If you select Data Pattern as the Event Group in the Find dialog, you can set the Bitmask, Mask, and Match for each bit (see Figure 5.26 on page 377).

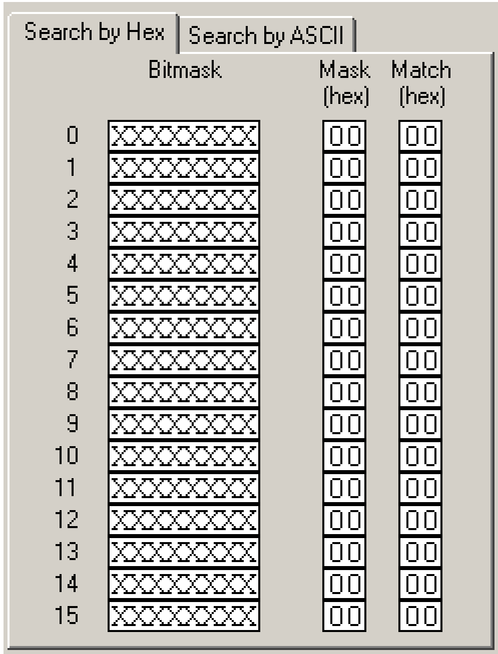


Figure 5.26: Data Pattern

Bitmask and Match always correlate. When you set Bitmask or Match. the other changes to maintain their correlation.

Note: If you set Bitmask/Match before setting Mask, the Mask changes to the default mask. You must change to the Mask that you want.

Note: If you set an appropriate Mask before setting Bitmask/Match, the Mask does not change automatically to a default mask if you change Bitmask/Match.

5.11.20 Find Next

To apply the previous **Find** parameters to the next search:

- ❑ Select **Find Next** under **Search** on the Menu Bar.

OR

- ❑ Click  on the Toolbar.

5.11.21 Search Direction

Toggles the search forward or backwards. The current direction is indicated in the menu.

5.12 Display Options

You can select what information to display using the Display Options window.

To open the Display Options window:

- ❑ Select **Display Options** under Setup on the Menu Bar.

OR

- ❑ Click  on the Toolbar.

You can select Color/Format/Hiding, Level Hiding, and Headers display options. The following sections describe these display options.

Restore Factory Presets sets all Display Options values to the installed values.

5.12.1 Color/Format/Hiding Display Options

To modify the colors, formats, and hiding options, select the **Color/Format/Hiding** tab.

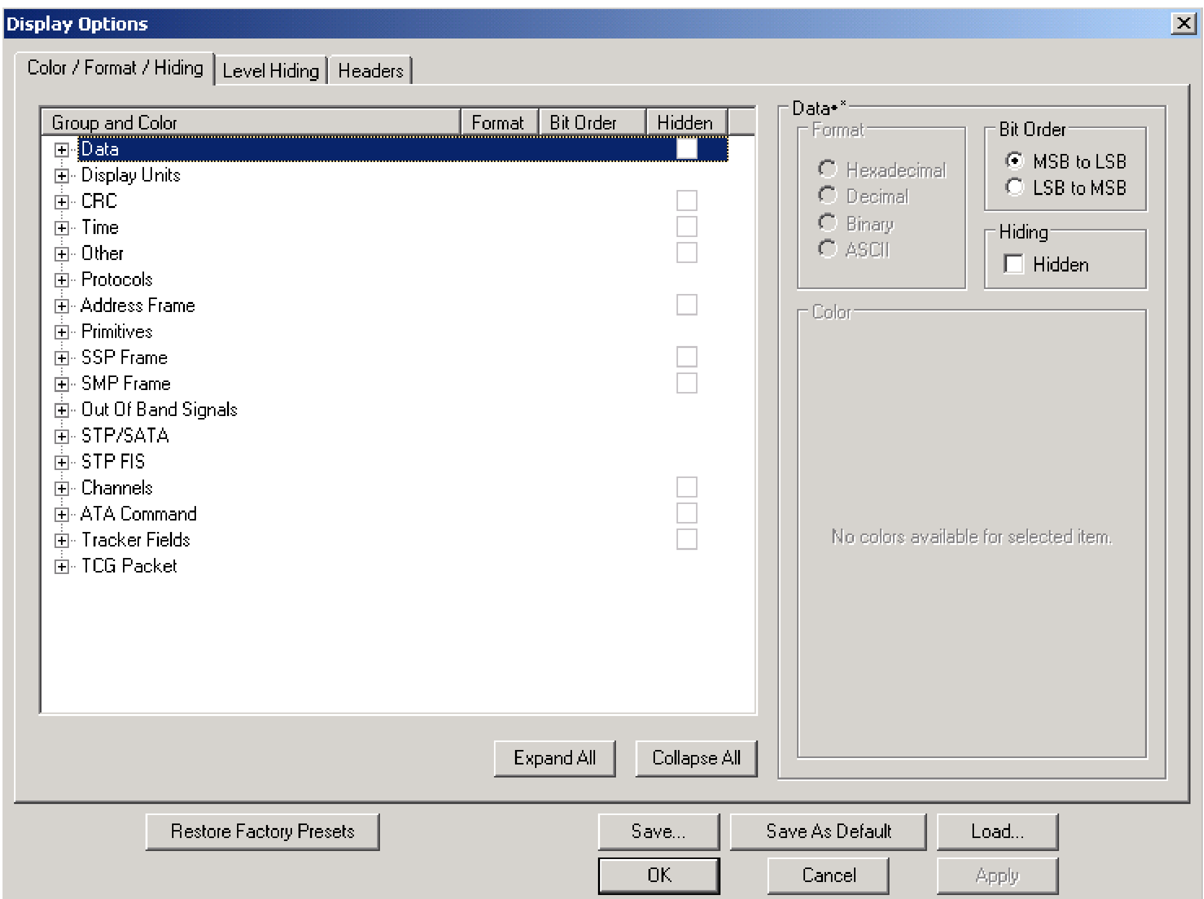


Figure 5.27: Display Options Dialog - Color, Format, Hiding Tab

Color Display Options

The program uses a default set of colors for each type of data in each group of data. The colors and color combinations are appropriate for most graphic systems. You can alter any color.

To specify a color for an information type, in the Color/Format/Hiding tab, select a row (such as Data) in the Group and Color column and expand it.

Select a data type (such as Data Length) in the Group, then select a color in the Color section, using Standard or Custom colors. Use a bright color for each important field.

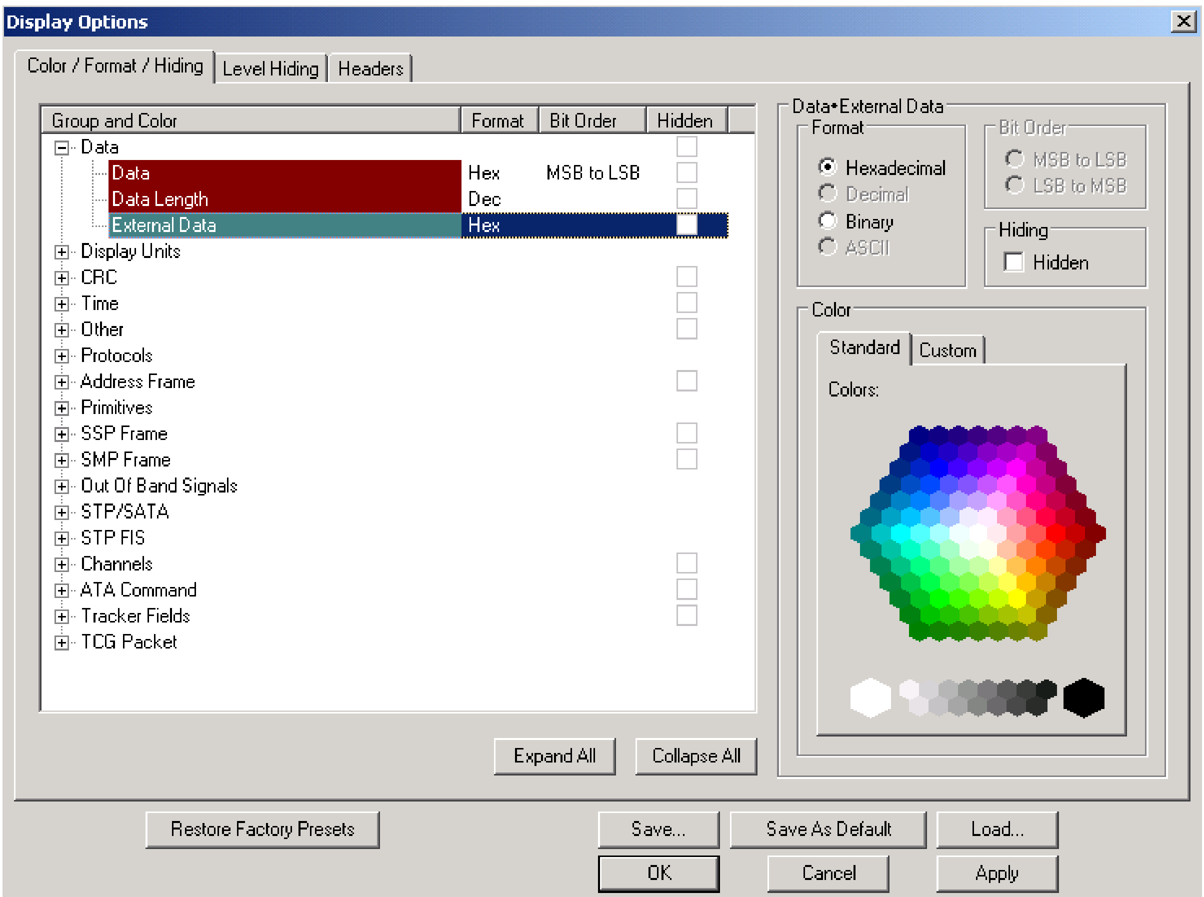


Figure 5.28: Display Options Dialog - Color

To customize colors, use the Custom tab.

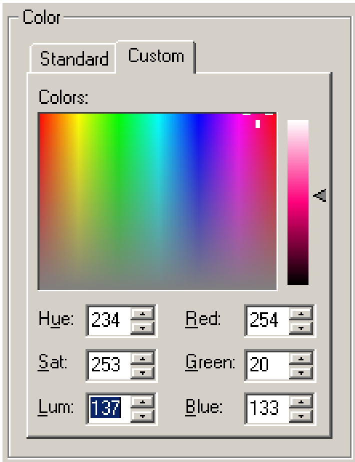


Figure 5.29: Custom Colors

Note: You cannot change the color of an Invalid Data (packet error) field. It is permanently set to red.

Formats Display Options

For each type of data in each group of data, the program has a default data format. Examples of number data formats are Binary, Decimal, and Hexadecimal. An example of a text data format is ASCII.

To specify a data format for an information type, in the Color/Format/Hiding tab, select a row (such as Data) in the Group and Color column and expand it.

Select a data type in the Group.

Select a format in the Format section. The following formats are available:

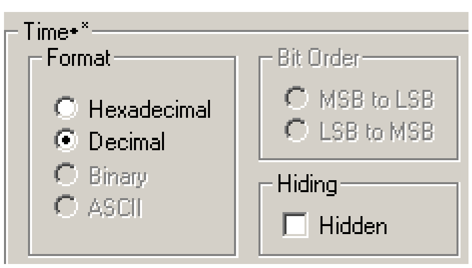


Figure 5.30: Formats

If available, select **Bit Order** in the Format section. The options are MSB to LSB or LSB to MSB.

Hiding Display Options

By default, no data is hidden. You can hide any group of data and any type of data.

To hide one or more fields, select the Group and Data type in the Group and Color column, then click the **Hidden** checkbox in the display or the **Hidden** checkbox in the Hiding section of the Format section.

Level Hiding Options

By default, nothing is hidden. You can hide:

- Packet Types
- Primitives
- Source Addresses
- Destination Addresses
- Data Length
- SMP Frames
- SSP Frames
- Channels
- FIS Types
- FIS Ports
- Gen Global Settings

Select the **Level Hiding** tab, then select the data types to hide.

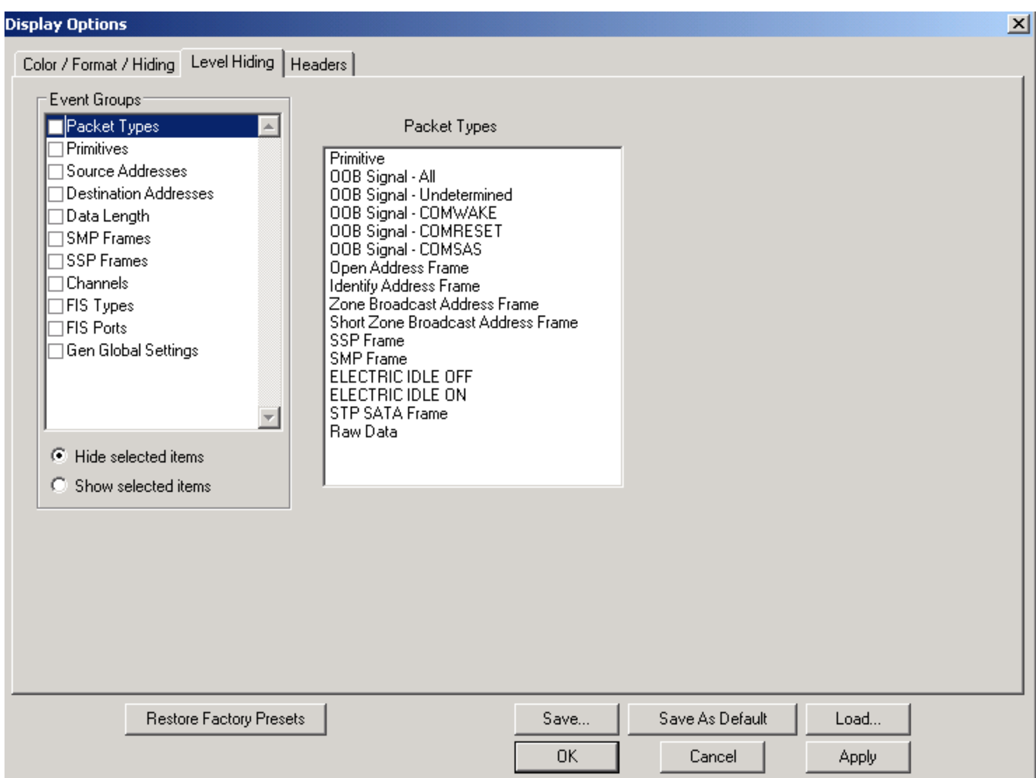


Figure 5.31: Level Hiding Tab

You can select to **Hide selected items** or **Show selected items**.

Headers Options

You can choose the appearance of header fields. Select the **Header** tab, then select the header.

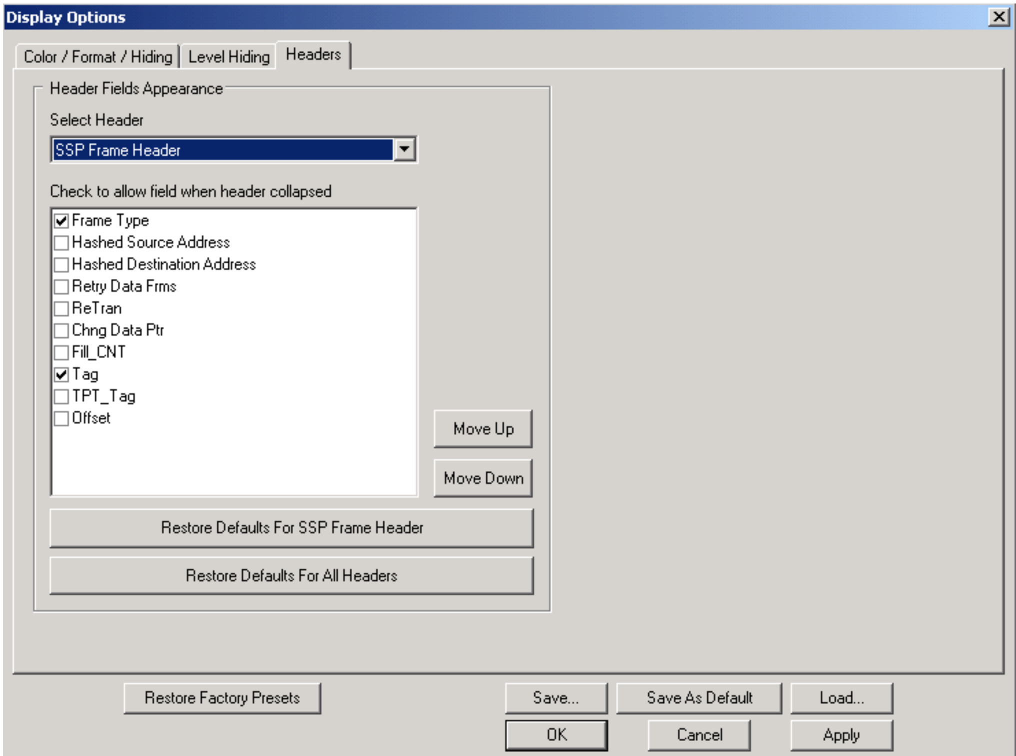


Figure 5.32: Level Hiding Tab

Available headers are:

- SSP Frame Header
- SMP Report General (Request or Response)
- SMP Report Mfg Info (Request or Response)
- SMP Discover (Request or Response)
- SMP Report Phy Error Log (Request or Response)
- SMP Report Route Info (Request or Response)
- SMP Configure Route Info (Request or Response)
- SMP Phy Control (Request or Response)
- SMP Phy Test Function (Request or Response)
- SMP Configure Phy Zone (Request or Response)
- SMP Configure Zone Permission (Request or Response)
- SMP Report Zone Permission (Request or Response)
- SMP Report Zone Routing Table (Request or Response)
- STP Register Host to Device FIS
- STP Register Device to Host FIS
- STP Register Device Bits Device to Host FIS
- STP DMA Activate Device to Host FIS
- STP DMA Setup FIS
- STP BIST Activate FIS

- STP PIO Setup Device to Host FIS
- STP Data FIS
- STP Frame Summary Header
- SATA Frame Summary Header
- SAS Delta Time

Check boxes to allow a field when the selected header is collapsed. Example header fields are:

- Frame Type
- Function
- Result
- Offset
- FIS Type

You can move items up and down.

You can select to **Restore Defaults** for the selected header or all headers.

Saving Display Options

You can save a set of Display Options values, make a set the default settings, or use a saved set of values with the commands at the bottom of the **Display Options** window:

- To save the current Display Options values in an options file for use in future sessions, click **Save**. Enter a file name without a file name extension. The program adds the **.opt** extension. (The file must have an **.opt** file name extension.)
- To load a previously saved **.opt** file, click **Load** and select a file name.
- To save the current Display Options values in the **default.opt** options file for use as the default display options, click **Save as Default**. (Do not delete the **default.opt** file.)
- To apply the current Display Options values, click **Apply**. The Display Options window remains open.
- To apply the current Display Options values and close the Display Options window, click **OK**.
- To cancel unsaved changes to display values and exit the Display Options window, click **Cancel**.

5.12.2 Connection Parameters

To display the Connection Parameters dialog (see Figure 5.33 on page 384), select **Generate > Connect Parameters**.

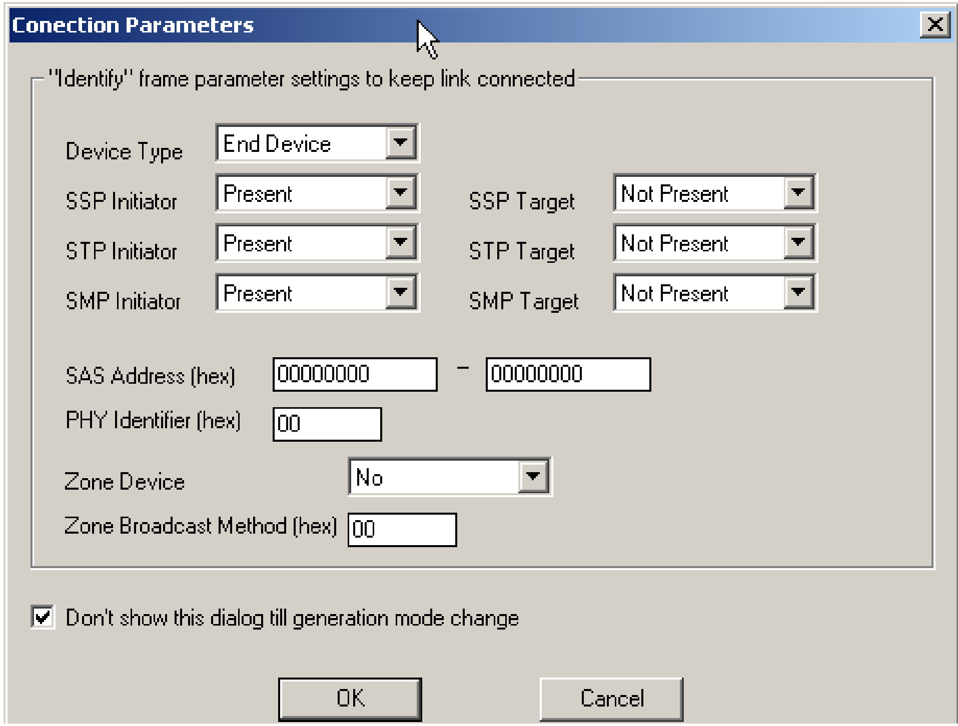


Figure 5.33: Connection Parameters Dialog

You can set the “Identify” frame parameter settings to keep the link connected:

- **Device Type**: End Device, Edge Expander, or Fanout Expander
- **SSP Initiator**: Present or Not Present
- **STP Initiator**: Present or Not Present
- **SMP Initiator**: Present or Not Present
- **SSP Target**: Present or Not Present
- **STP Target**: Present or Not Present
- **SMP Target**: Present or Not Present
- **SAS Address (hex)**: eight digits - eight digits
- **PHY Identifier (hex)**: two digits
- **Zone Device**: Yes or No
- Zone Broadcast Method (hex): two digits

You can select to not show the dialog until there is a generation mode change.

5.12.3 Resetting the Toolbar

The Analyzer Toolbar has the following:

- **Launch Jammer**: Switches to InFusion frame.
- **Launch Analyzer** : Switches to Analyzer frame.
- **Start Recording**: Start Analyzer without switching to Analyzer frame.
- **Stop Recording**: Stop Analyzer without switching to Analyzer frame.
- **Abort Recording**: Abort Analyzer without switching to Analyzer frame.

The Generator Toolbar has the following:

- **Start Generation**
- **Stop Generation**
- **Resume Generation**
- **Connect Link**
- **Disconnect Link**
- **Generation Options**

From time to time (such as following a software upgrade), it is possible for the buttons on the toolbar to not match their intended function. You can reset the toolbar by performing the following steps:

1. Select **View > Toolbars** from the menu bar.
2. Select **Customize** from the submenu to display the Customize dialog box.

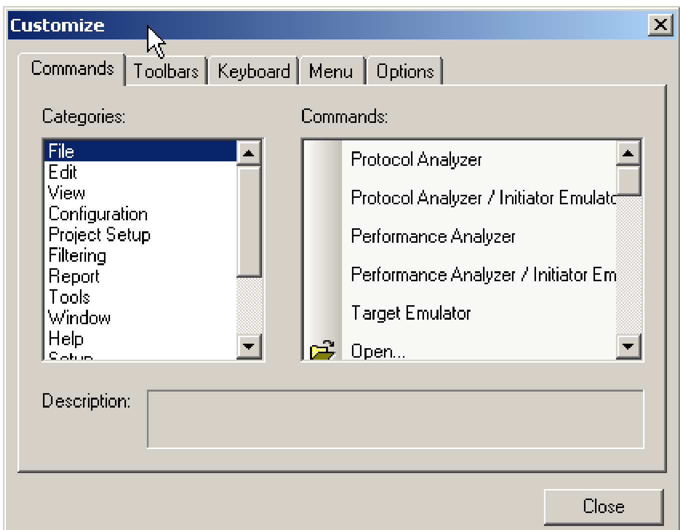


Figure 5.34: Customize Commands

3. Select the **Toolbars** tab to display the Toolbars page of the Customize dialog box.

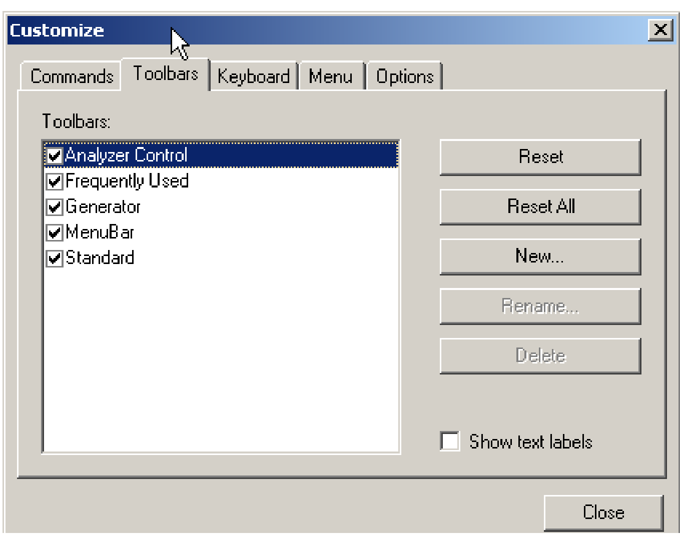


Figure 5.35: Customize Toolbars

4. Click the **Reset All** button.

Appendix A

Creating a Pattern Generator File

You may use any text editor or word processor to create a pattern generator file (*.spg) using the following conventions:

Note: If you have purchased a licence you can enable the pattern generator (see "Ports Configuration" on page 98.)

6.1 Key words

ALIGN, CONT, DMAT, EOF, HOLD, HOLDA, PMACK, PMNAK, PMREQ_P, PMREQ_S, R_ERR, R_IP, R_OK, R_RDY, SOF, SYNC, WTRM, X_RDY, XXXX, LOOP, Enable, Disable, Host, Device, Scramble, Role, END_OF_FILE.

6.2 Comment format

```
/*Comment text*/
```

6.3 Primitive definition format

To add an ALIGN primitive, use ALIGN or 27.3 10.2 10.2 K28.5

To add a CONT primitive, use CONT or 25.4 25.4 10.5 K28.3

6.4 Loop definition format

You may write a defined pattern into memory repeatedly by enabling a loop.

Loop definition allows either "Enable" or Disable". To enable looping use: Loop=Enable

6.5 Scramble definition format

Scramble definition allows either "Enable" or Disable". To enable scramble use: Scramble=Enable

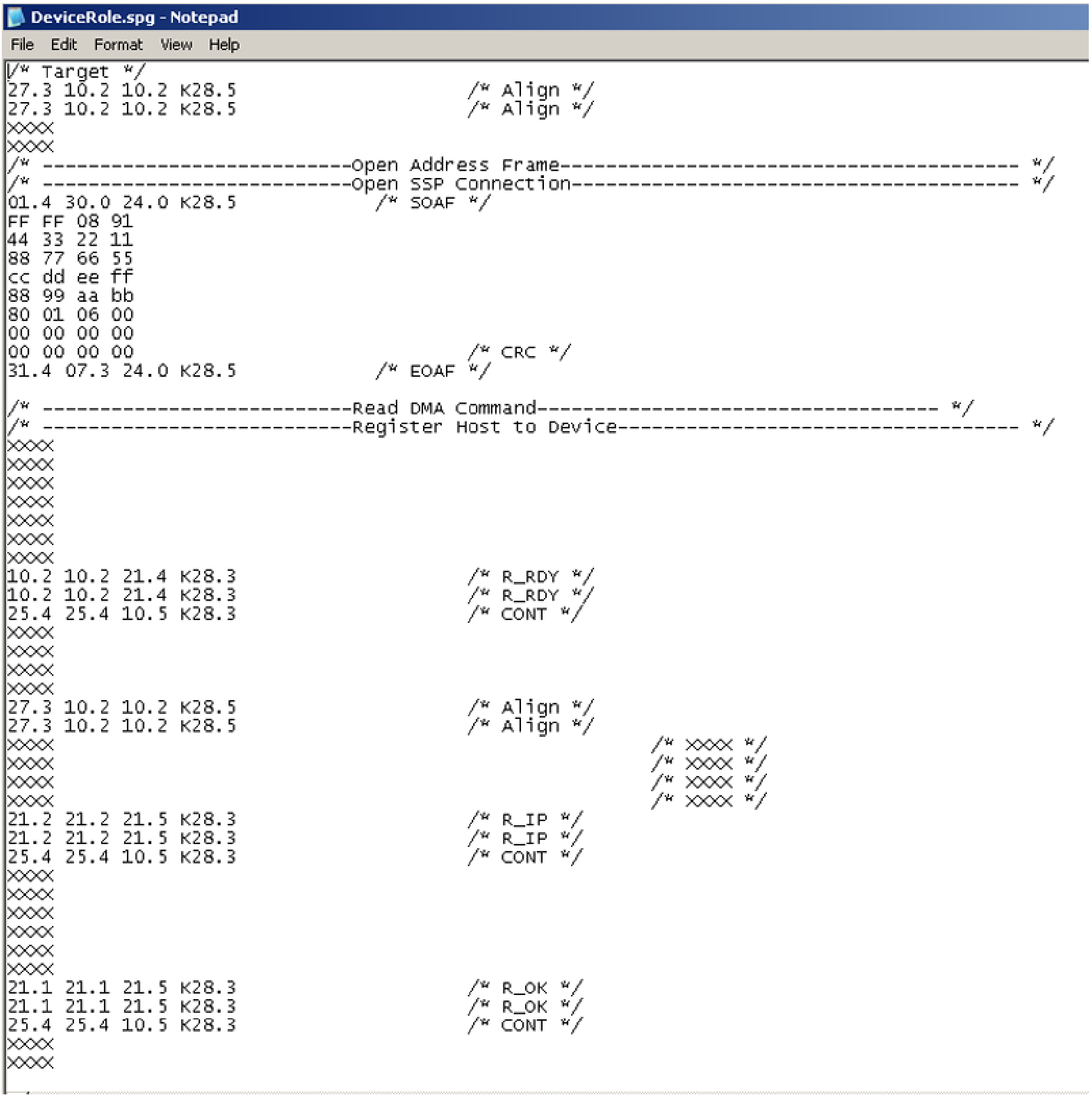
6.6 Role definition format

To specify SATA hardware role: Role=Host or Role=Device

6.7 END_OF_FILE definition

A pattern generator file must include END_OF_FILE as the last statement in the file.

Figure A-1 illustrates a typical Pattern Generator file.



```
DeviceRole.spg - Notepad
File Edit Format View Help
/* Target */
27.3 10.2 10.2 K28.5                /* Align */
27.3 10.2 10.2 K28.5                /* Align */
XXXX
XXXX
/* ---------------------------Open Address Frame---------------------------------------- */
/* ---------------------------Open SSP Connection--------------------------------------- */
01.4 30.0 24.0 K28.5        /* SOAF */
FF FF 08 91
44 33 22 11
88 77 66 55
cc dd ee ff
88 99 aa bb
80 01 06 00
00 00 00 00
00 00 00 00                         /* CRC */
31.4 07.3 24.0 K28.5        /* EOAF */

/* ---------------------------Read DMA Command---------------------------------- */
/* ---------------------------Register Host to Device----------------------------------- */
XXXX
XXXX
XXXX
XXXX
XXXX
XXXX
XXXX
10.2 10.2 21.4 K28.3                /* R_RDY */
10.2 10.2 21.4 K28.3                /* R_RDY */
25.4 25.4 10.5 K28.3                /* CONT */
XXXX
XXXX
XXXX
XXXX
27.3 10.2 10.2 K28.5                /* Align */
27.3 10.2 10.2 K28.5                /* Align */
XXXX                                                /* XXXX */
XXXX                                                /* XXXX */
XXXX                                                /* XXXX */
XXXX                                                /* XXXX */
21.2 21.2 21.5 K28.3                /* R_IP */
21.2 21.2 21.5 K28.3                /* R_IP */
25.4 25.4 10.5 K28.3                /* CONT */
XXXX
XXXX
XXXX
XXXX
XXXX
XXXX
21.1 21.1 21.5 K28.3                /* R_OK */
21.1 21.1 21.5 K28.3                /* R_OK */
25.4 25.4 10.5 K28.3                /* CONT */
XXXX
XXXX
```

Figure A.1: Sample Pattern Generator File *spg

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:
温度: 5摄氏度到40摄氏度
湿度: 5% - 95%最大相对湿度 (无冷凝)
高度: 最高2000米

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 homogenous materials used for this part is above the limit requirement specified in SJ/T11363-2006.						

EFUP (Environmental Friendly Use Period) Use Conditions:

Temperature	5C to 40C
Humidity	5% to 95% max RH (non-condensing)
Altitude	Up to 2000 meters

7.1 WAN Operation

WAN connected operation is supported. Contact factory for details of operation. Refer "How to Contact Teledyne LeCroy" on page 391 for contact information.

Appendix C

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/
Tell Teledyne LeCroy	Report a problem to Teledyne LeCroy Support via e-mail by selecting **Help>Tell Teledyne LeCroy** from the application toolbar. This requires that an e-mail client be installed and configured on the host machine.	

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