

# CATC SAS*Tracer*/Trainer<sup>TM</sup>

## Serial Attached SCSI Protocol Analyzer and Exerciser User's Manual

Manual Version 2.6



**For Software Version 2.6**

Spring 2006

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# 1. Overview

LeCroy's SASTracer/Trainer™ is an integrated protocol analyzer and exerciser platform that provides fast, efficient and accurate debug, test and verification of Serial Attached SCSI semiconductors, devices and systems. It allows designers and validation engineers to quickly and easily transmit valid and invalid 1.5 or 3 Gbps SAS or SATA traffic, selectively record the exchange and display the results using the CATC Trace™ expert analysis software. SASTrainer offers both initiator and target side emulation modes, allowing this all-in-one test platform to play an important role at every phase of the SAS product development process.

The SASTracer and SASTrainer software operate on the CATC SAS/SATA Analyzer and Exerciser platforms. SASTracer is the software that runs the SAS/SATA Analyzer plug-in module. This plug-in module installs into the CATC 10K platform. SASTrainer is traffic generation software that runs the SAS/SATA Exerciser platform. They can be used selectively for analysis only, traffic generation only, or perform both analysis and traffic generation at the same time. The SASTracer/Trainer can transmit a single link of 1.5 or 3 Gbps traffic while providing 1 or 2 recording channels. A “4-wide” recording option is also available to support wide link analysis tasks.

The heart of the CATC platform is the revolutionary LeCroy BusEngine™. This state-of-the-art, field-upgradeable, technology core incorporates a real-time non-intrusive recording engine and configurable tools to trigger and filter SAS traffic. It can intelligently monitor SAS frame headers and addresses; or start recording when event counters exceed specified thresholds.

The SAS/SATA Analyzer and Exerciser plug-in modules utilize standard Serial ATA cables and can be programmed to transmit valid and invalid SAS or SATA traffic. It can send specific IO operations or customized data payloads. The exerciser can “play-back” any previously recorded trace as a stimulus file and also offers a text-based API for creating scripts from the ground up.

As with all LeCroy analyzers, hardware based pre-capture filtering is supported for efficient memory management. It provides full decoding of STP traffic moving between SAS Expanders and SAS initiators. Full SATA-II analysis support is included for users interested in using SASTracer to test Serial ATA environments (1.5 or 3 Gbps).

For complete product information, please visit [www.LeCroy.com](http://www.LeCroy.com).

Please refer to the *Serial Attached Specification* for details on the Serial Attached SCSI protocol. The Serial Attached SCSI specification is available at the web site <http://www.t10.org>.

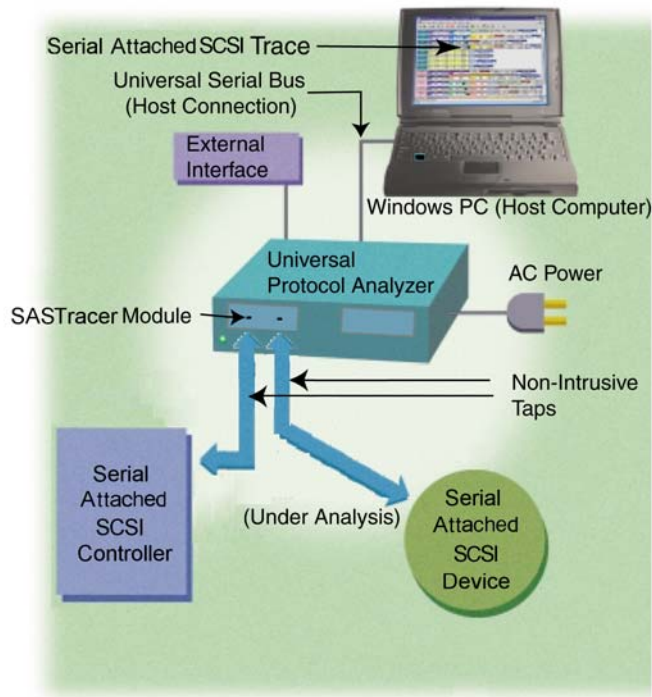


## 1.1 General Description

SAS/SATA Analyzer is a plug-in module that installs into a chassis called the CATC 10K platform. The UPAS 10K, in turn, connects to a PC over a Hi-Speed USB cable. The PC functions as the host controller for the SAS/SATA Analyzer and UPAS. SASTracer software on the PC controls and configures the analyzer and retrieves and displays trace data.

Recorded data is presented as a "trace" in the trace viewer as rows of color-coded graphics. Users can then search this trace for errors and other events using advanced search utilities, and then hide from the display all but only the most interesting and relevant data.

The SASTracer/Trainer trace viewing software runs on any personal computer using the Windows 98SE, Window 2000, Windows ME, or Windows XP operating systems and equipped with a functional USB interface.



The *SASTracer/Trainer* analyzer is capable of on-the-fly detection of and triggering on such events as Primitives, Bus Conditions, SSP and SMP Frames, Data Patterns, and Errors. Whether recording manually or with a specified trigger condition, *SASTracer/Trainer* continuously records the link data in a wrap-around fashion until manually stopped or until the Trigger Event is detected and a specified post-Trigger amount of link data is recorded.

Upon detection of a triggering event, the analyzer continues to record data up to a point specified by the user. Real-time detection of events can be individually enabled or disabled to allow triggering on events as they happen. This includes predefined exception or error conditions and a user-defined set of trigger events.

The *SASTracer/Trainer* software provides powerful search functions that enable investigation and highlighting of specific events. In addition to immediate analysis, you can print any part of the data. Use the **Save As** feature to save the data on disk for later viewing. The program also provides a variety of timing information and data analysis reports.

## 1.2 Features

- Integrated Analyzer and Generator System
- Available with One, Two or Four 1.5 or 3.0 Gbps SAS analysis ports
- SAS and Serial ATA Recording at 1.5 or 3.0 Gbps
- Sophisticated Triggering
- Hardware Filtering
- DWORD Display
- Internal Single-lane or External 4-lane Connector Option
- Exerciser offers Initiator and Target Emulation
- Exerciser automatically responds to incoming OOB
- Traffic Summaries
- Collapsible / Expandable Headers
- Automatic Decoding at Transport Layer; SCSI, ATA and Management Application Layers
- Field Upgradeable BusEngine Technology
- Dynamically Allocated Memory Pool (2 GB)
- 3 Year Hardware Warranty
- All-in-one platform transmits, records, and analyzes SAS and SATA protocols
- Monitor, trigger and record up to 4 Serial Attached SCSI links simultaneously
- Isolate areas of interest with real-time hardware triggering
- Extend capture window by removing non-essential primitives
- Chronologically display all DWORDs on all channels synchronized to a common clock
- Flexible platform for testing host and end-device behavior
- Automatically bring SAS device under test through power up / reset and speed negotiation sequence
- Statistical reports provide high level abstraction of events, operations, errors and throughput for each I\_T\_L Nexus
- Easy “drill-down” on field structures for individual Frames, Commands and Tasks
- View high-level Serial Attached SCSI protocol events
- Easily upgrade firmware to support new features
- Protect your investment with industry-leading warranty

### *SASTracer/Trainer BusEngine*

LeCroy's BusEngine™ Technology is at the heart of *SASTracer/Trainer*. The revolutionary BusEngine core uses FPGA technology and incorporates both the real-time recording engine and the configurable building blocks that implement data/state/error detection, triggering, external signal monitoring, and event counting and sequencing. Like the flash-memory-based firmware that controls its operation, all BusEngine logic is fully field upgradeable, using configuration files that can be downloaded from the LeCroy Website.

### *Power Cord Set*

Cord Manufacturer and Models:

180-0005-00 Quail 5000.079 UL,CSA

180-0013-00 Quail 8500.098 VDE, KEMA, CEBERC, NEMDO, DEMDO, SETI, OVE, SEV

180-0014-00 Quail 9650.098 ASTA

### *SAS/SATA Analyzer and Exerciser on the UPAS 10000 Platform*

UPAS 10000 is a USB 2.0 Certified Hi-Speed Device. To upload traces from the analyzer to an attached PC at Hi-Speed, the PC must have a USB 2.0 Certified Host Controller and be running Windows 2000 SP3 or Windows XP.

**Note** The UPAS 10000 products includes 2.0 USB hubs. You might see the drivers for these generic hubs being installed upon the initial plug-in.



## 2. Installation

SAS/SATA Analyzer is a factory-installed module that is sold as part of the CATC 10K based modular analysis platform.

This chapter describes how to set up SAS/SATA Analyzer and create your first recording.

### 2.1 System Components

- One stand-alone SAS/SATA Analyzer module
- One USB cable
- SASTracer software program CD-ROM
- SATA(SAS) Cables
- Break-out board

**Note:** Specific components included with the SASTracer/Trainer system vary based on model and configuration ordered.

### 2.2 Analyzer PC Requirements

The SAS/SATA Analyzer and UPAS connect to a Host PC via USB line.

Please consult the readme file on the installation CD for the latest PC requirements.

### 2.3 Analyzer Hardware Description

LeCroy's SAS/SATA Analyzer System is based on the CATC 10K chassis. Plug-in modules for SAS/SATA are available with either the Internal SATA style cable connector (**SS002MAA-X** & **SS003MAA-X**) or the new plug-in with External "Infiniband style" connectors (**SS004MAA-X**) below.

**Figure 1: LeCroy Analyzer Systems**



**Module Part # SS002MAA-X & SS003MAA-X**



**Module Part # SS004MAA-X**

## 2.4 Analyzer LED Descriptions

When powered on, the SAS/SATA Analyzer activates the user-accessible controls and LEDs on the front and rear panels of the UPAS.

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

**Figure 2: Front Panel (Internal single lane connector - SS002MAA & SS003MAA-X)**



**Figure 3: Front Panel (4 Port External connector - SS004MAA-X)**



### Front Panel LEDs (from left to right)

- A PWR** (power) - Green indicator LED for UPAS. Lights when the unit power is switched on.
- B Status** indicator - Red indicator LED for UPAS. Lights during initialization/power up of UPAS base unit. Blinks if a self-test fails.
- C REC** (recording) - Green LED. Lights when the unit is recording.
- D TRG** (triggered) - Orange LED. Lights when the unit triggers on an event.
- E UPLD** (Upload) - Green LED. Lights when trace is being uploaded from the analyzer to the PC.
- F Manual Trigger** - Push-button. Allows a manual Trace capture.
- G 1 - 4** (Link Channels 1 - 4) - Green LEDs. Lights when a connection is established on the corresponding link.



## Connectors on the SAS/SATA Analyzer Module

- Plug-in Modules SS002MAA-X & SS003MAA-X use single-lane Serial ATA Connectors (4).
- Plug-in Module SS004MAA-X use 4 port Infiniband style connectors (1).

## 2.5 Rear Panel Description

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

Figure 4: Rear Panel



### *USB type "B" host computer connector*

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

### *RS-232 25 pin "Data Output" Connector*

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

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

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

*Wide range AC connector module*

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

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

## 2.6 Setting Up the Analyzer

**Step 1** Remove the analyzer from its shipping container.

The SAS/SATA Analyzer module will already be installed in the left slot of the UPAS. The right slot may have a second analyzer or a SAS/SATA Exerciser.

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

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

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

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

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

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

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

**Step 6** Follow Windows on-screen Plug-and-Play instructions for the automatic installation of the analyzer as a USB device on the Host

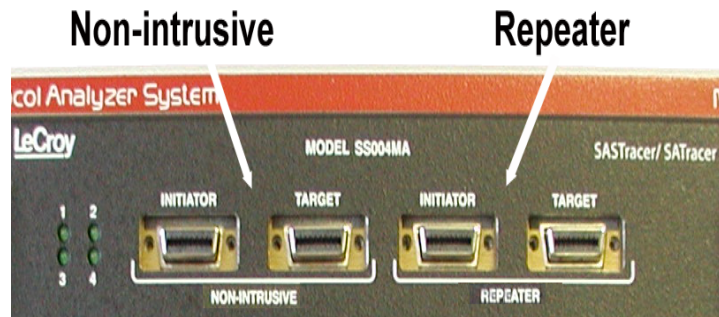
PC (the required USB files are included on the SASTracer CD). Step through the Windows hardware wizard. The wizard will see that the UPAS has an internal USB hub and will begin loading hub drivers. Afterwards, the wizard will automatically install SASTracer/Trainer as a USB device on the PC. When the wizard prompts you for driver information, point it to the CD which should be in your disk drive and install **catcupa.sys** and **SASTracer.sys**.

## 2.7 Connecting Devices to the Analyzer

Model SS004MAA-X incorporates the SAS external "Infiniband style" connector which includes both a non-intrusive as well as a repeater style front-end. This allows users to selectively switch between these two probing techniques based on their specific application. Only one pair of connectors may be used at a time.

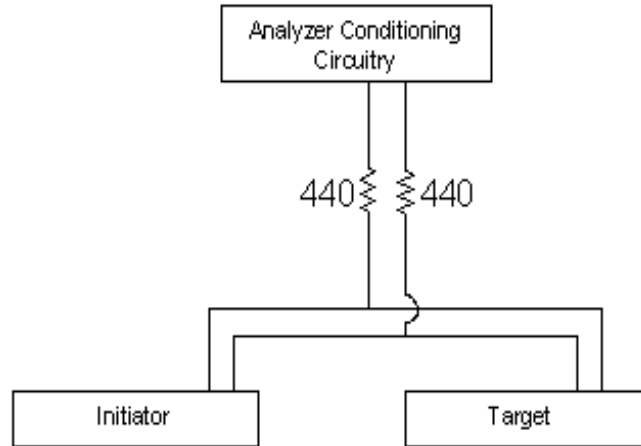
**Note:** User's with model SS004MAA-X must switch between "repeater" and "non-intrusive" using the SASTracer software. Go to **Setup > Probe Control** to enable "**repeater**" or "**non-intrusive**" mode.

Figure 5: Plug-in Module SS004MAA-X offers two types of probing



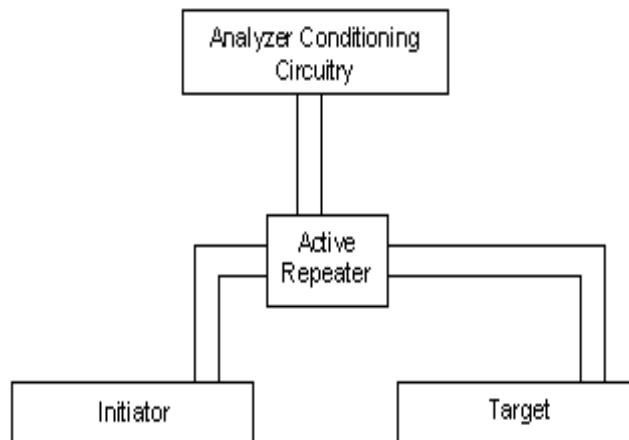
### *Non-intrusive Tap*

Also known as passive tapping, this approach silently samples the signal without re-driving the differential lines (high value resistors contribute to reduction in amplitude ~ 15%).

**Figure 6: Non-intrusive tap diagram**

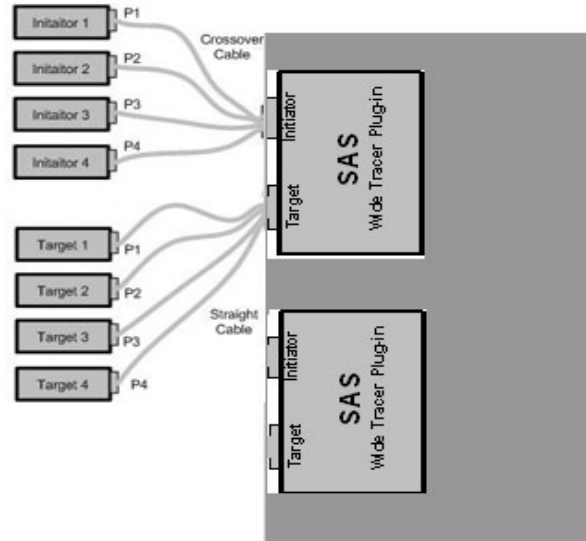
### *Repeater Tap*

In repeater mode, the analyzer reproduces the exact patterns it receives on the inbound (RX) line. While the repeater does not re-time the signal - it does "clean-up" normal reflections that can occur over a full length cable when the analyzer is not in the line.

**Figure 7: Repeater tap diagram**

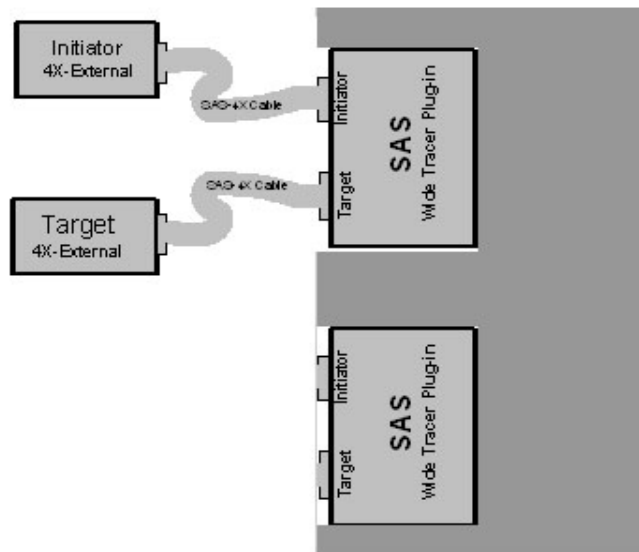
When using the External Connector Module (SS004MAA) to probe between devices that utilize single lane SATA connectors, the special octopus cable must be used. The SATA side of the octopus cables would be attached to the devices under test (see Figure 8).

**Figure 8: Test Setup With DUT Requiring Single Lane SATA Connectors**



**Note:** The initiator side must be a "cross-over" cable.

**Figure 9: Test Setup With DUT Requiring External 4 Lane Connector**

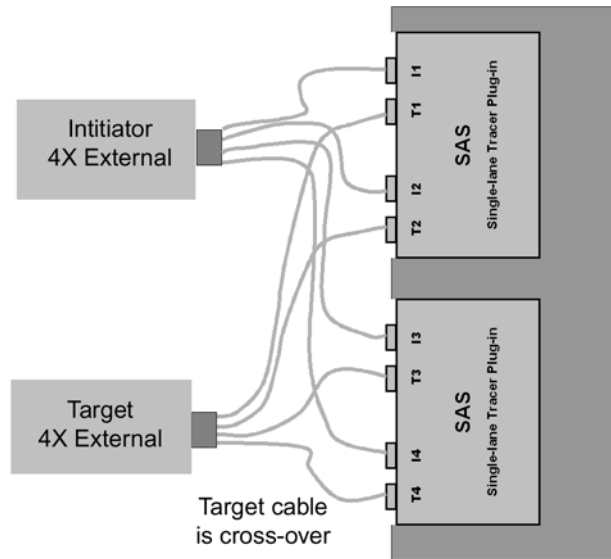


**Note:** When using new External Connector Module (SS004MAA) with standard 4X External InfiniBand style cables, there is no need to use "cross-over" cable. Both cables above are straight.

### *LeCroy Analyzer with Internal SATA Connectors (SS002MAA & SS003MAA)*

When using original single-lane "SATA-style" module (SS002MAA & SS003MAA) with devices that utilize single-lane SATA style connectors, the special octopus cable must be used. The SATA connector side of the octopus cables would be attached to the analyzer (see Figure 10).

**Figure 10: Test Setup With DUT Requiring External 4 Lane Connector**



**Note:** The target side must be a "cross-over" cable.

## 2.8 Installing the SASTracer/Trainer Software

Once SAS/SATA Analyzer has been recognized as a USB device, install the SASTracer software on the Host PC.

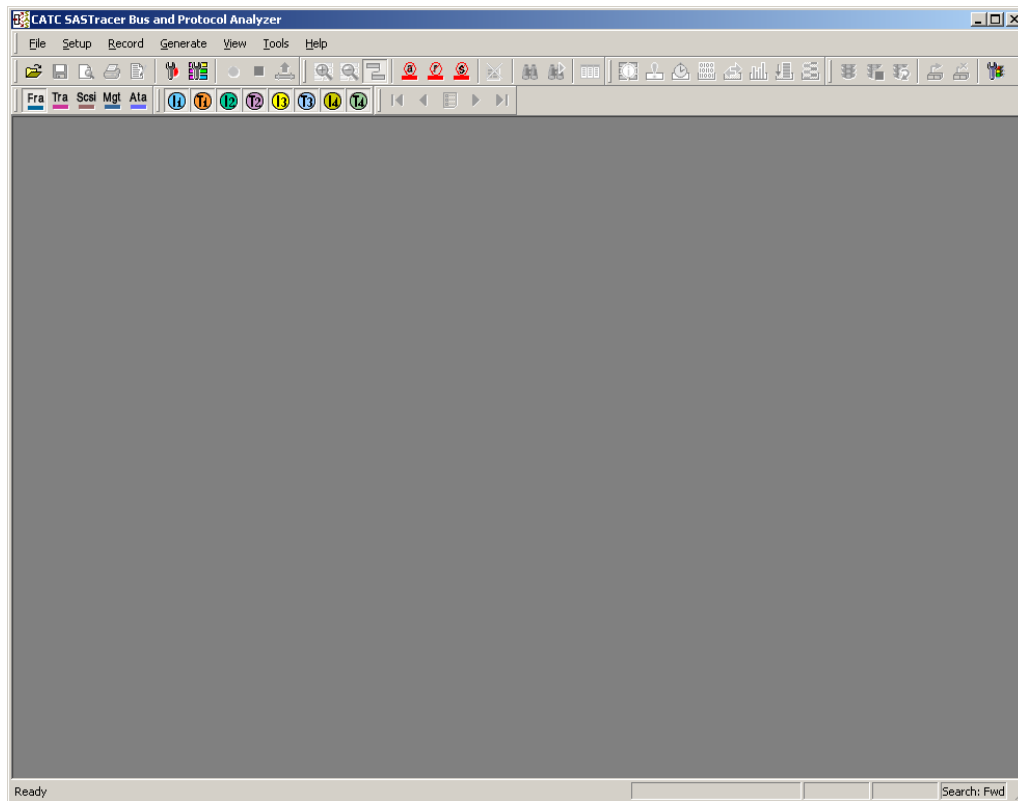
**Step 1** On the PC, run **setup** on the installation CD and follow the on-screen instructions.

The SASTracer software will install on the PC hard disk.

**Step 2** To start the application, launch the LeCroy SASTracer program from the Start menu:

**Start > Programs > LeCroy > SASTracer.**

The SASTracer program opens.



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

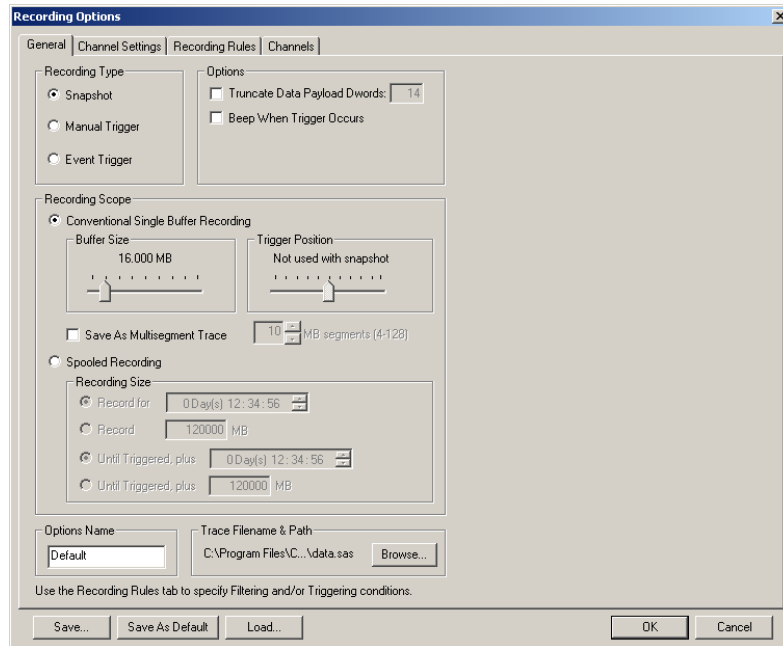
## 2.9 Making a Recording


After installation, the software is configured to make a four-Mbyte snapshot recording of your Serial Attached SCSI traffic.

To make this recording, follow these steps:


- Step 1** Connect a cable to each of the two connectors on the SASTracer/Trainer module, then connect the other ends to the Serial Attached SCSI device under test and Serial Attached SCSI host system.
- Step 2** From the **Setup** menu, select **Recording Options**.
- Step 3** Select the **General** tab.

The following window displays the factory default settings such as “Snapshot” and 16 Mbytes buffer size are displayed. For your first recording, you can leave these settings unchanged.




**Step 4** Click  on the Tool Bar. After 16 Mbyte of traffic is recorded, the SASTracer/Trainer Analyzer uploads the data and displays the Frames.

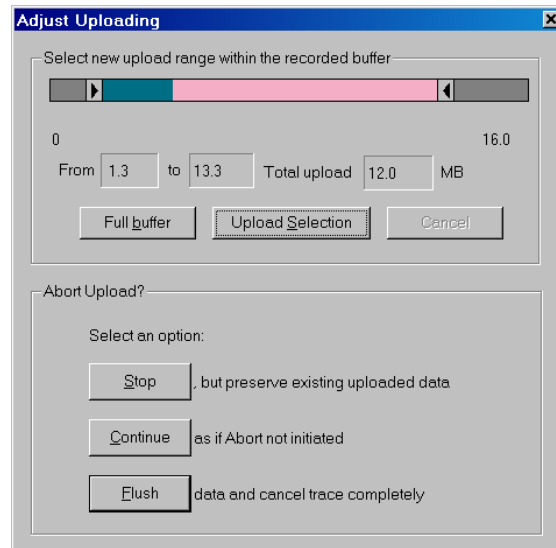
### Stopping a Recording

You can stop the recording process at any time by pressing . Afterwards, the trace will automatically upload from the analyzer to the PC.




## Interrupting the Upload Process

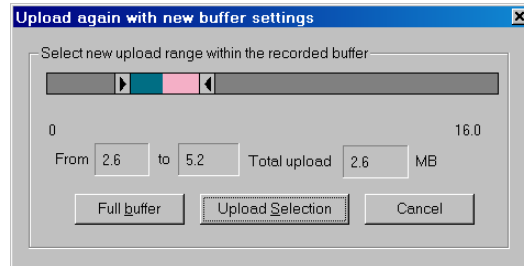
You can interrupt the upload process by pressing the Stop  button. Pressing Stop will cause the following dialog box to open:



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

- **Select New Upload Range within the Recorded Buffer**
  - **Slide Bar** - Adjust arrows at either end of the slide bar to select the range of buffer you want uploaded. The color in the slide bar indicates pre- and post-trigger traffic.
  - **Full Buffer** - Uploads entire buffer to the PC.
  - **Upload Selection** - Uploads whatever range you have selected via the slide bar.
- **Abort Upload?**
  - **Stop** - Stops the recording and then displays the trace on screen.
  - **Continue** - Resumes the recording.
  - **Flush** - Cancels the recording without saving or displaying the trace.

Once you have interrupted an upload, a new button will appear on the toolbar: . This button ("Re-upload") opens a dialog box with a slide bar for re-selecting the range of the trace that you would like to upload.



### Saving the Trace

When the recording session is finished, the bus traffic is uploaded to the PC and is automatically saved to the hard drive as a file named **data[sn].sas** where [sn] is the serial number of the 10K chassis; or the name you assign as the default filename.

I1	Frame	SOF	COMMAND	Hashed Source Address	Hashed Destination Address	ReTran	Fill_CNT	
	170			0x206A82	0xB4D463	0	0	
		TPT_Tag	Offset	Data	CRC	EOF	TimeDelta	Time St
		0xFFFF	0x00000000	28 bytes	0x50C03F1B		1.372 µs	00000.133
T1	Frame	ACK		TimeDelta	Time Stamp			
	171	K28.5 D01.4 D01.4 D01.4		1.023 ms	00000.133 12879			

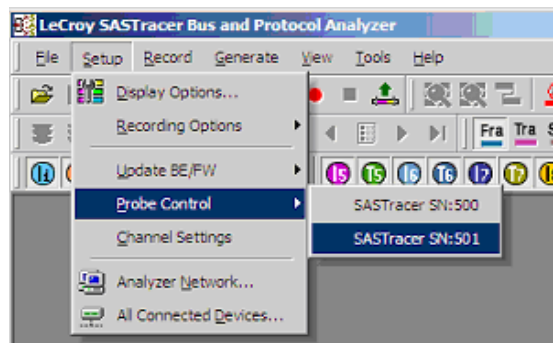
**Step 1** To save a current recording for future reference, select **Save As** from the **File** menu.

**Step 2** Give the recording a unique name and save it to the appropriate directory.

## 2.10 Probe Control Settings

The probe control dialog provides several user adjustable settings for the probe performance. Modification of these settings occur in real-time and do not require cycling the power or uploading new firmware.

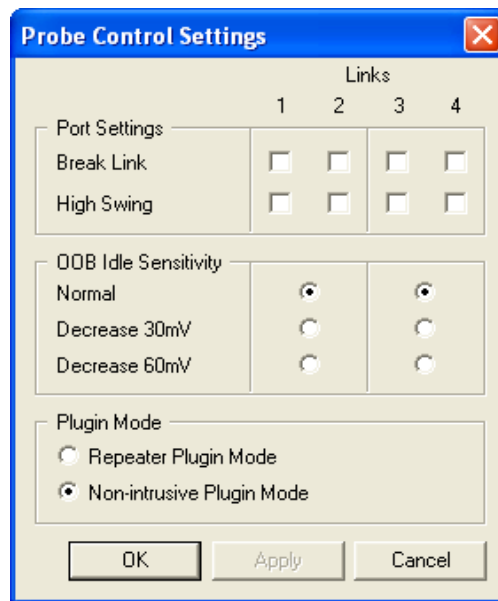
If there's more than one analyzer connected, the user will have an option to select Probe Control Settings for each device individually



The Port Settings and OOB Idle Sensitivity are only available when the SAS/SATA analyzer system is operating in Repeater mode.

The Plug-in Mode options provide an additional control for the External Connector Module (SS004MAA) only. These controls will be disabled when attached to the Internal SATA-style module (SS002MAA) because this module operates in Repeater mode only.

**Break Link** - Checking this box for a specific channel takes the link to electrical idle. It has the same effect as manually detaching a single connector from the device to "break the link". Unchecking the Break Link box for a specific channel brings the link up. It has the same effect as attaching a connector to a powered-on device.



**High Swing** - Alters the repeaters differential output swing to accommodate for PCB / connector loss. By default, the repeater uses "Normal" swing. "High" swing may be required when tapping between long backplanes or extended cable distances:

- Normal Swing: 440 mV min and 660 mV max (peak to peak)
- High Swing: 800 mV min and 1200 mV max (peak to peak)

**OOB Idle Sensitivity** - Alters the repeaters OOB detection behavior to accommodate for marginal OOB signal amplitude in SAS/SATA devices under test. The OOB idle sensitivity offers an adjustable threshold for detecting an inbound OOB sequence. If two PHYs fail to complete OOB,

users may find lowering the OOB idle sensitivity provides a mechanism for establishing the link even when the OOB signals from the DUT are marginal.

- Normal - 100mV to 200mV
- Decrease 30mV
- Decrease 60mV

## 3. Software Overview

The *SASTracer/Trainer* is an application that may be used with or without the analyzer unit. When used without an analyzer, the program functions as a trace viewer to view, analyze, and print captured protocol traffic from other *SASTracer* analyzers.

### 3.1 Starting the *SASTracer/Trainer* Program

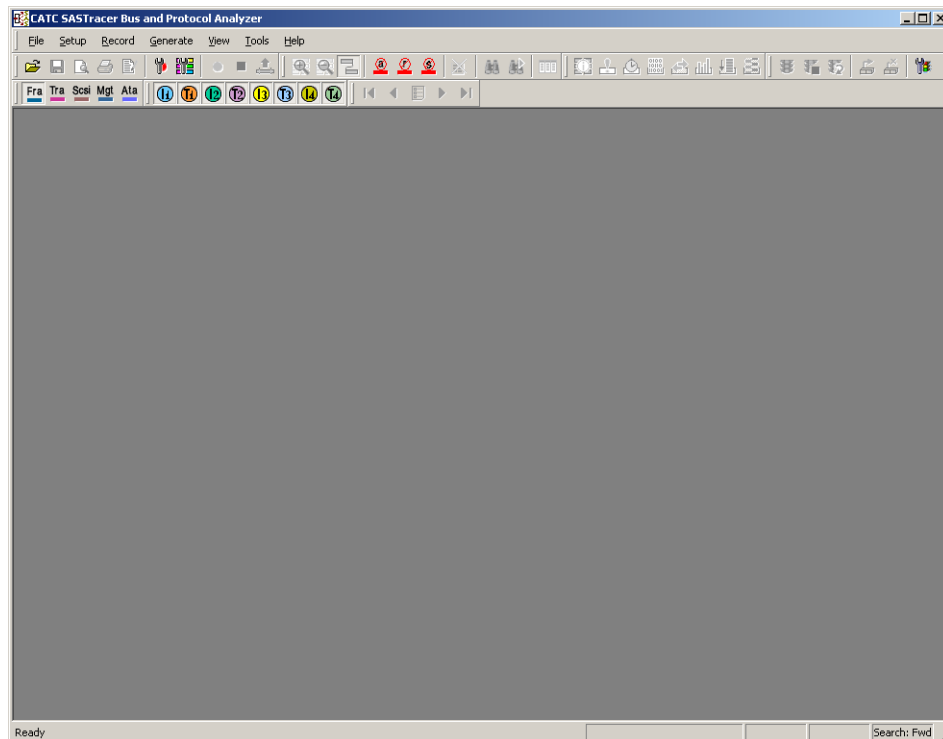
To start the *SASTracer/Trainer* Program from the Start menu,

**Step 1** Click **Start**.

**Step 2** Select **Programs**.

**Step 3** Select **LeCroy**.

**Step 4** Click **CATC SASTracer**.



### 3.2 Opening Sample Traces

A good way to gain familiarity with *SASTracer* is to open some of the provided sample files and explore the menus, pop-up menus, and reports.

### 3.3 Opening "Older" Trace Files

Beginning in the SASTracer 1.10 release, a conversion feature was added that affects trace files created with earlier software versions. When an older trace is opened, the user will be prompted to convert the file.

The conversion process represents a minor change in trace format to better accommodate SATA/STP traffic.

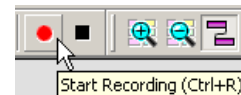
In the prior release, STP/SATA frames were shown as a single frame. In the 1.10 release, they are shown as two frames - one for the SATA Transmit channel and another for the Receive channel. At the Transport level, these two frames are combined into one FIS transaction.

Because of this change, the new software release has to convert all of the "old" traces into the new format. When you open a trace recorded with 1.01, the software will offer to convert to the common name "convert.sas" and then open it afterwards. The original trace will stay intact, though, and still can be opened by 1.01 software."

### 3.4 Tool Tips

Throughout the application, Tool Tips provide useful information about buttons on the toolbar.

To display a Tool Tip, position the mouse pointer over an item of interest such as part of the trace or a button.



### 3.5 Trace Tool-Tips

Many fields within the Trace will display tool-tips when the mouse pointer is suspended over them. These tips may provide a simple legend for the cell or may give substantial added details about the field.

OPEN_ACCEPT	TimeDelta	Time Stamp
K28.5 D16.7 D16.7 D16.7	1.285 us	00000.000.0117

SOF	Frame Type	
	SMP Request	R

<b>SAS Primitive OPEN_ACCEPT</b> <b>Description:</b> Indicates the acceptance of a connection request. <b>Encoding:</b> K28.5 D16.7 D16.7 D16.7 (0xBCF0F0F0)
--

### 3.6 The Menu bar

While some of the analyzer's main display window options are familiar, many contain options specific to the analyzer program.

**Table 1: Main Display Pull-Down Menus**

Menu	Function
<b><u>F</u>ile</b>	
<u>N</u> ew GenFile	Creates a new (and empty) traffic generation file. To add text, click the <b>Edit as Text</b> button on the toolbar.
<u>O</u> pen...	Opens a trace file or traffic generation file.
<u>C</u> lose	Closes the current trace or generation file.
Save <u>A</u> s...	Saves all or a specified range of Frames from the current file with a specified name.
<u>P</u> rint...	Prints part or all of the current trace or traffic generation file.
Print <u>P</u> review	Produces an on-screen preview before printing.
<u>P</u> rint Setup...	Sets up your current or new printer.
<u>E</u> dit Comment...	Opens a dialog for entering a brief comment about the trace.
Export>>	<p><b>Packets to Text (Packet View Format)</b> - Saves all or part of a trace to a text file. Useful for saving traces to floppy disk and for emailing.</p> <p><b>to Generator File Format ...</b> - Creates a traffic generation file based on the open trace. This is a fast and easy way of creating a traffic generation file.</p> <p><b>Packets to EAS Format ...</b> - Creates an EAS file based on the open trace. Running this command opens a dialog prompting you for a file name, path, and a range of Frames to be exported.</p> <p><b>Transport to CSV Format ...</b> - Creates a structured .csv file from all or part of the trace data. This file may be imported into external databases or spreadsheet programs (e.g., Microsoft Excel).</p>
Convert>>	<b>Convert .stg to .ssg</b> - Converts SATA traffic generation files created by SASTracer (.stg) to the SASTracer generation format (.ssg).
<u>E</u> xit	Exits the SASTracer/Trainer program.
<b><u>S</u>etup</b>	
<u>D</u> isplay Options...	Opens a dialog for customizing trace colors, formats, and filters.
<u>R</u> ecording Options...	Configures the analyzer's recording behavior. Opens a dialog for selecting event triggers and filters, and for setting the size of the recording buffer and other recording options.
<u>U</u> ppdate BE/FW...	Opens a dialog for updating the BusEngine and Firmware.
Channel Settings	Allows renaming of the channels - ie the establishment of aliases for each channel.
Analyzer Network ...	Opens a dialog box for browsing to local and networked analyzers. Within the dialog, click <b>Add</b> to browse. The dialog lists PCs that are on the LAN. If a PC has an analyzer attached to it, and if DCOM permissions have been set on the selected PC, clicking <b>Select</b> establishes a connection.
All Connected Devices ...	Opens a dialog box with a list of analyzers connected to the host PC. Lets you select an analyzer and update the BusEngine, Firmware, and licensing information.
<b><u>R</u>ecord</b>	
<u>S</u> tart	Causes the Analyzer to begin recording.
<u>S</u> top	Causes the Analyzer to stop recording.

Menu	Function
<b>Generate</b>	
Start Generation	Starts traffic generation. This command requires that a traffic generation file (.ssg) be open.
Stop Generation	Stops traffic generation.
Resume Generation	Resumes traffic generation if generation has been stopped.
Connect Link	Establishes a link between SAS/SATA Exerciser and the DUT.
Disconnect Link	Breaks the link between SAS/SATA Exerciser and the DUT.
Generation Options	Opens a dialog for configuring traffic generation. The dialog looks like the Recording Rules dialog (Setup > Recording Options > Recording Rules). See <b>Generation Options</b> in the Traffic Generation chapter.
<b>Report</b>	
File Information	Displays information about the recording such as the number of Frames and triggering setup.
Error Summary	Summarizes the errors throughout the recording. Allows for fast navigation to errors.
Timing Calculations	Calculates timing between two Frames.
Traffic Summary	Summarizes the numbers and types of Primitives, Frames, SCSI Operations, and errors that occurred in the open Trace.
Bus Utilization	Displays graphs of various types of events that occurred in the open trace.
Link Tracker »	Opens a window for displaying a detailed chronological view of Bus activity on a Primitive-by-Primitive basis.
Frame Tracker	Opens a window for displaying a detailed chronological view of traffic on a Frame-by-Frame basis.
<b>Search</b>	
Go to Trigger	Positions the display to show the Trigger event.
Go to Event...	Positions the display to the indicated Packet, Frame, Primitive etc. The menu is context-sensitive and depends on the decode level that you are currently displaying.
Go to Marker »	Positions the display to the selected marked Frame.
Go to »	Enables quick searching for specific events using a cascade of pop-up windows.
Find ...	Allows searches by multiple criteria.
Find Next	Looks for the next instance of an event specified with Goto or Find.
Search Direction	Allows the search direction to be changed from forward to backwards or backwards to forward.
<b>View</b>	
Toolbars	Displays list of available Tool bars.
Analyzer Chat Bar	Opens a dialog that allows users to conduct chat sessions over an IP LAN. In order to send and receive electronic text messages, each user must be working with a PC that is on an IP LAN and also attached to an analyzer. .
Status Bar	Switches display of the Status Bar on or off.
Zoom In	Increases the size of the displayed elements.
Zoom Out	Decreases the size of the displayed elements.



<b>Menu</b>	<b>Function</b>
<u>W</u> rap	Wraps displayed Frames within the window.
Link Layer	Displays Link Layer traffic in the trace.
Transport Layer	Decodes and displays Transport Layer transactions.
SCSI Application Layer	Decodes and displays SCSI Application layer transactions.
Management Application Layer	Decodes and displays Management Application layer transactions.
ATA Application Layer	Decodes and displays ATA Application layer transactions.

### **Tools**

Hash Address Utility	Opens a dialog for calculating a Hash address from the SAS address. Enter an 8 byte value into the lower box to see its Hash value.
----------------------	---

### **Window**

<u>N</u> ew Window	Switches display of the Tool bar on or off.
Cascade	Displays all open windows in an overlapping arrangement.
<u>T</u> ile	Displays all open windows as a series of strips across the display.
<u>A</u> rrange Icons	Arranges minimized windows at the bottom of the display.
Windows ...	Displays a list of open windows.

### **Help**

<u>H</u> elp Topics ...	Opens online help.
Update License ...	Opens a dialog box for entering license key information for the analyzer.
Display License Information ...	Opens a dialog box with information about the current status of the analyzer's license
<u>A</u> bout SASTracer	Displays version information about SASTracer/Trainer.

## 3.7 The Toolbar



The Tool Bar provides quick access to most of the *SASTracer/Trainer* software functions. You can learn the function of each button by passing the mouse pointer over them. Descriptions of the buttons appear on the status bar at the bottom of the window and as tooltips above each button.



Open file



Save As



Preview



Print...



Edit as text - opens a text editor for editing traffic generation files.



Setup Record Options



Setup Display Options



Start Recording



Stop Recording



Re-upload. This button appears in the toolbar if Stop is pressed during an upload. Causes analyzer to re-upload trace from analyzer buffer to the PC. Gives options for selecting which part of the trace you want uploaded.



Zoom In



Zoom Out



Wrap



Find - Opens a dialog for conducting complex searches



Find Next - repeats last Find or Go To operation



Trace Panes. Allows multiple traces to be locked together and scrolled in tandem. This option only works with .mlt traces created by multi-analyzer cascades in a single recording session.

### Reports Buttons



File Information Report. Opens a summary of the trace file including when it was made, the Recording Options used to create the file, and data on the analyzer that recorded the trace.



Error Report. Opens the Traffic Summary window and displays a summary of errors in the trace.



Timing and Bus Usage Calculations. Opens a calculator for measuring timing between Frames.



Show Data Block. Opens a dialog for navigating to data blocks within Frames and Transactions. Once a data block is located, the window can display the data in a variety of formats.



Traffic Summary. Opens a window displaying a table summary of traffic recorded in the trace.



Bus Utilization. Presents a graphical summary of traffic in the trace.



Show Link Tracker. Opens window with detailed chronological view of traffic on a Primitive-by-Primitive basis.



Show Frame Tracker. Opens window with detailed chronological view of traffic on a Frame-by-Frame basis.

### Decode Buttons



Decode & display Link Layer (Frames & Primitives)



Decode & display Transport Layer (SSP, SMP, & STP)



Decode & display SCSI Application Layer (SCSI Commands)



Decode & display Management Application Layer (Management Transactions)



Decode & display ATA Application Layer Transactions

### Hide Buttons



Hide Align and Notify Primitives



Hide RRDY Primitives



Hide SATA Sync Cont Primitives



Hide Unassociated traffic



Hide Initiator Channel 1



Hide Target Channel 1

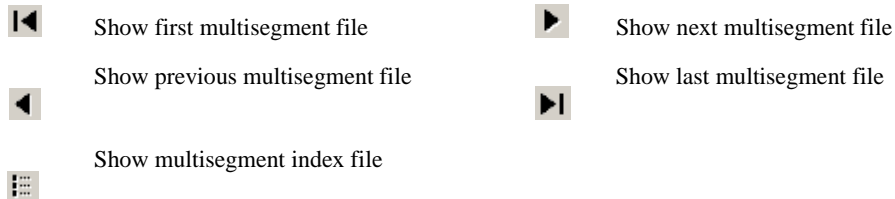
### Multi-segment Trace File Buttons

These buttons become active if a multi-segmented trace file has been opened. Multi-segment traces are traces that have been recorded as a series of small segments rather than as a single, large recording. Multi-segmenting was developed to make it easier to work with large recordings where navigation can sometimes be difficult.

Multi-segmenting is enabled in the General page of the Recording Options dialog.

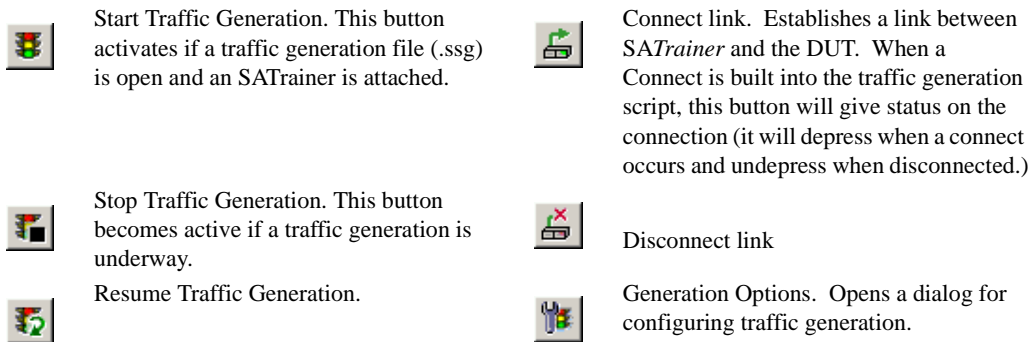
Multi-segmenting produces two kinds of files: segments and an index file that summarizes the recording and keeps tabs of the various segments.

The buttons below allow multi-segmented traces to be navigated.



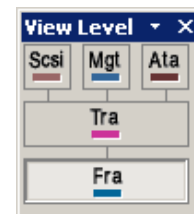
### Traffic Generation Buttons

These buttons become active if a traffic generation file (.ssg) is open.



## 3.8 Floating the Decode Toolbar

You can float any of the toolbars by dragging them from their current location at the top of the screen. If you float the decode toolbar, it will arrange the decode buttons so they reflect their hierarchical order.



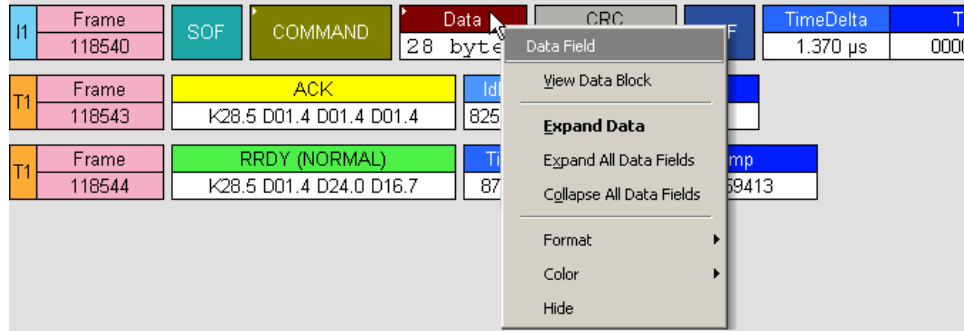
## 3.9 Pop-Up Menus

Pop-up menus within the trace provide options for formatting the trace.

**Left Mouse Button** - Opens a menu for expanding fields, viewing data fields, and formatting the trace.

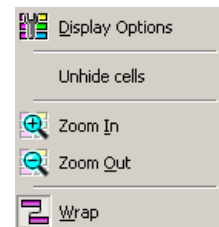
The menu is context-sensitive and changes depending on what part of the trace has been clicked.

A menu similar to the following appears:



- **Data Field** - Indicates the type of field that you selected. This field is context-sensitive.
- **View Data Block** - Allows raw data to be viewed from a data cell.
- **Expand Data/Collapse Data** - Expands or collapses data field. Summarizes the amount of data displayed in the cell.
- **Expand All Data Fields** - Expands any data fields that are currently collapsed.
- **Collapse All Data Fields** - Collapses any data fields that are currently expanded.
- **Format** - Presents options for changing the numerical formatting of the data fields throughout the trace.
- **Color** - Presents options for changing the color of the data fields throughout the trace.
- **Hide** - Hides data fields throughout the trace. To re-display hidden fields, right-click anywhere in the trace and select **Unhide Cells** and then one of the options from the sub-menu.

**Right Mouse Button** - If you click a cell in the trace with the right mouse button, a pop-up menu appears and shows the options for zooming in or out, wrapping the display, and other formatting options.

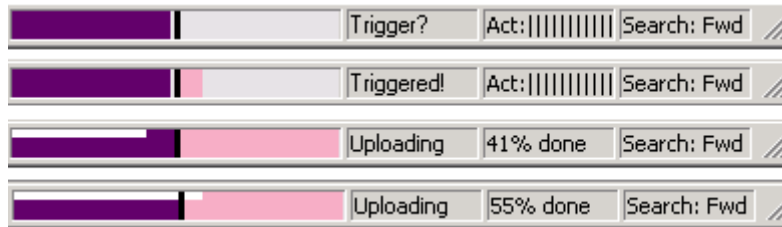


### 3.10 Status Bar

The Status Bar is located at the bottom of the main display window. Depending on the current activity, the bar can be divided into as many as four segments.

## Recording Progress

When you begin recording, the left-most segment of the Status Bar displays a recording Progress Indicator:



As recording progresses, the Progress Indicator changes to reflect the recording progress graphically:

- In the Progress Indicator, a black vertical line illustrates the location of the Trigger position you selected in Recording Options.
  - Pre-Trigger progress is displayed in the field to the left of the Trigger Position.
  - When the Trigger position is reached, the progress indicator wiggles as it waits for the Trigger.
  - After the Trigger occurs, the field to the right of the Trigger fills in the post-Trigger color specified in the Display Options.
  - When recording is complete, the upper half of the progress indicator fills in white, indicating the progress of the data upload to the host computer.

You should be aware of two exceptional conditions:

- If a Trigger event occurs during the before-Trigger recording, the before-Trigger color changes to the after-Trigger color to indicate that not all the expected data was recorded pre-Trigger.
- When you click **Stop** before or after a Trigger event, the Progress Bar adjusts to begin uploading the most recently recorded data.
- If you wish to abort an upload that is in progress, click the **Stop** button again.

The Progress Bar fills with color in proportion to the specified size and actual rate at which the hardware is writing and reading the recording memory. However, the progress indicator is normalized to fill the space within the Status Bar.

## Recording Status

During recording, the current recording status is displayed in the next segment of the status bar. (Refer to previous screenshot for examples.)

When recording is begun, one of the following messages flashes (depending on the selected Recording Options):

- Trigger?
- Triggered!
- Uploading

After recording stops, The following occurs:

- Flashing message changes to **Uploading data–x% done (x%** indicates the percentage completion of the data uploading process).
- Traffic data is copied to disk (overwriting any previous version of this file) using the default file name **data.sas**. You can also create a file name of your choice by specifying one in the Recording Options window.

To abort the upload process, press the **Stop** button.

You are asked if you want to keep or discard the partially uploaded data.

When the data is saved, the Recorded Data file appears in the main display window, and the Recording Status window is cleared.

- If the recording resulted from a Trigger event, the first Frame following the Trigger (or the Frame that caused the Trigger) is initially positioned second from the top of the display.
- If the recording did not result from a Trigger event, the display begins with the first Frame in the traffic file.

## Recording Activity

During recording, the fourth segment from the left of the Status Bar displays Recording activity as a series of vertical bars.

The more vertical bars that are displayed, the greater the amount of activity being recorded. If there are no vertical bars, there is no recorded activity.

During uploading, the percent of the completed upload is displayed.

## Search Status


The rightmost segment displays the current search direction: **Fwd** (forward) or **Bwd** (backward).

## 3.11 Navigation Tools

You can zoom in and out, and wrap the trace to fit within the screen by using the following buttons:


### Zoom In

Increases the size of the displayed elements, allowing fewer (but larger) Frame fields per screen.

Click  on the Tool Bar.


### Zoom Out

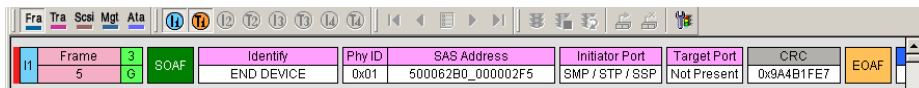
Decreases the size of the displayed elements, allowing more (but smaller) Frame fields per screen.

Click  on the Tool Bar.

### Wrap

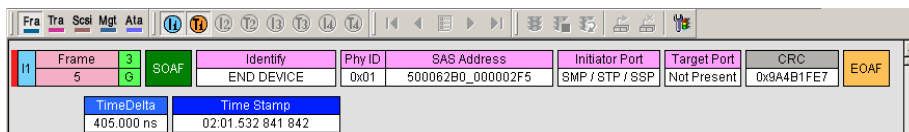
Adjusts the Trace View so that Frames fit onto the next line if they are longer than the size of the window. Without Wrap, you can use the horizontal scroll bar to see the hidden part of a Frame.

Click  on the Tool Bar.



Frame	SOAF	Identify	Phy ID	SAS Address	Initiator Port	Target Port	CRC	EOAF
5		END DEVICE	0x01	500062B0_000002F5	SMP / STP / SSP	Not Present	0x9A4B1FE7	

**Trace with Wrap turned off.** In this example, the Time Stamp extends off the right edge of the screen.



Frame	SOAF	Identify	Phy ID	SAS Address	Initiator Port	Target Port	CRC	EOAF	
5		END DEVICE	0x01	500062B0_000002F5	SMP / STP / SSP	Not Present	0x9A4B1FE7		
TimeDelta		Time Stamp							
405.000 ns		02:01.532 841 842							

**Trace with Wrap turned on.** Entire Frame displays in window.

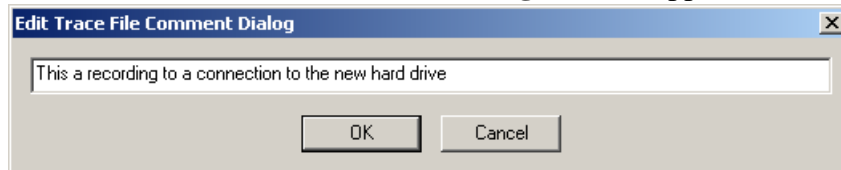


## 3.12 Adding Comments to the Trace

You can create, view, or edit the 100-character comment field associated with each Trace file.

**Step 1** From the **File** menu, select **Edit Comment**.

The **Edit Trace Comment Dialog** window appears.



**Step 2** Create, view, or edit the comment.

**Step 3** Click **OK**.

## 3.13 Set Marker

The **Set Marker** feature allows Frames to be marked so they can be navigate back to events of interest. Markers also provide you with a way of tagging events so you can perform timing calculations between them.

The **Set Marker** command works in conjunction with the **Go to Marker** feature. Once you have marked a Frame, you can navigate back to it by selecting **Search > Go to Marker**, and then selecting the marker of interest from the list.

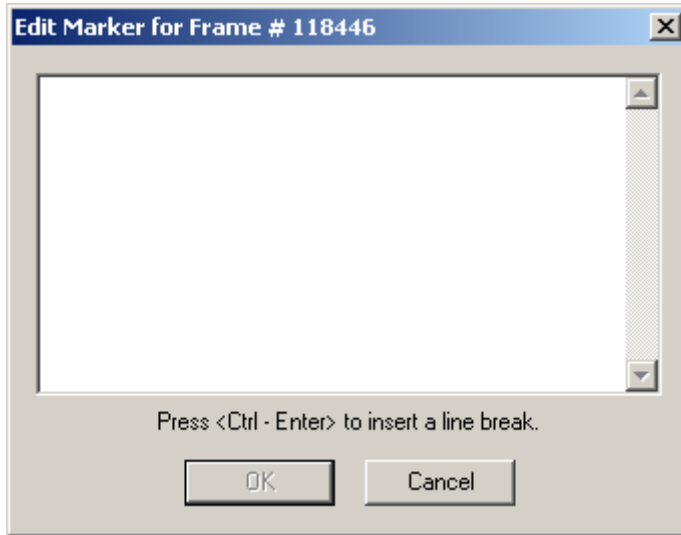
To set a marker on a Frame, perform the following steps:

**Step 1** Click on **Frame #** for the Frame you wish to mark.

Frame #	Frame	TimeDelta	Time Stamp
T1	OPEN_ACCEPT		
	16.7 D16.7 D16.7	307.000 ns	00003.862 597
I1	Y (NORMAL)	Idle	Time Stamp
	D1.4 D24.0 D16.7	28.000 ns	00003.862 59838
I1	Y (NORMAL)	Idle	Time Stamp
	D1.4 D24.0 D16.7	25.000 ns	00003.862 59860
I1	Y (NORMAL)	TimeDelta	Time Stamp
	D1.4 D24.0 D16.7	412.000 ns	00003.862 598
T1	Y (NORMAL)	Idle	Time Stamp
	D1.4 D24.0 D16.7	53.000 ns	00003.862 60046

**Step 2 Select Set Marker.**

The **Edit Market for Frame #** comment window appears.



**Step 3 Enter your comment.**

**Step 4 Click OK.**

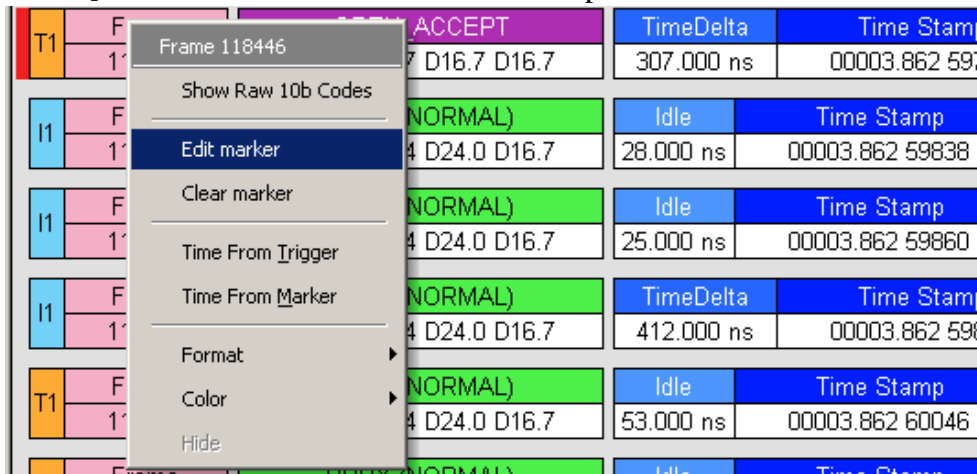
A marked Frame is indicated by a vertical red bar along the left edge of the Frame # block:

T1	Frame	OPEN_ACCEPT	TimeDelta	Time Stamp
	118446	K28.5 D16.7 D16.7 D16.7	307.000 ns	00003.862 59715

### 3.14 Edit or Clear Marker

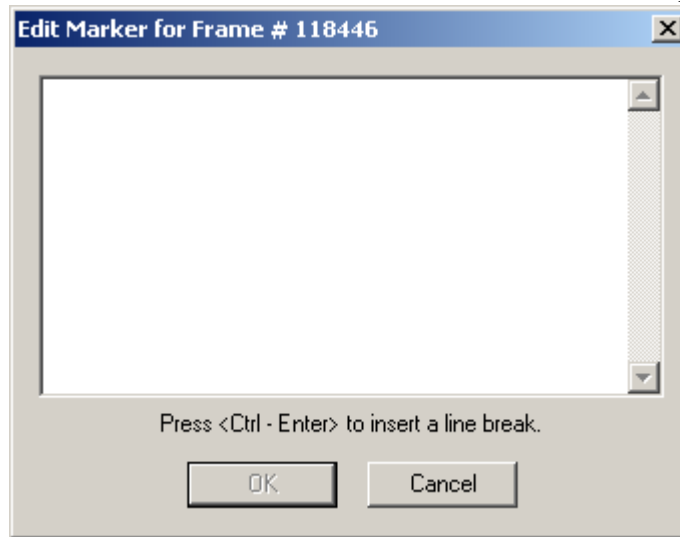
To clear or edit comments associated with a Frame marker,

**Step 1 Click on Frame # for the chosen packet.**



**Step 2** To edit the marker comment, select **Edit Marker**.

The **Edit Marker for Frame #** comment window appears.



**Step 3** Edit the comment as desired.

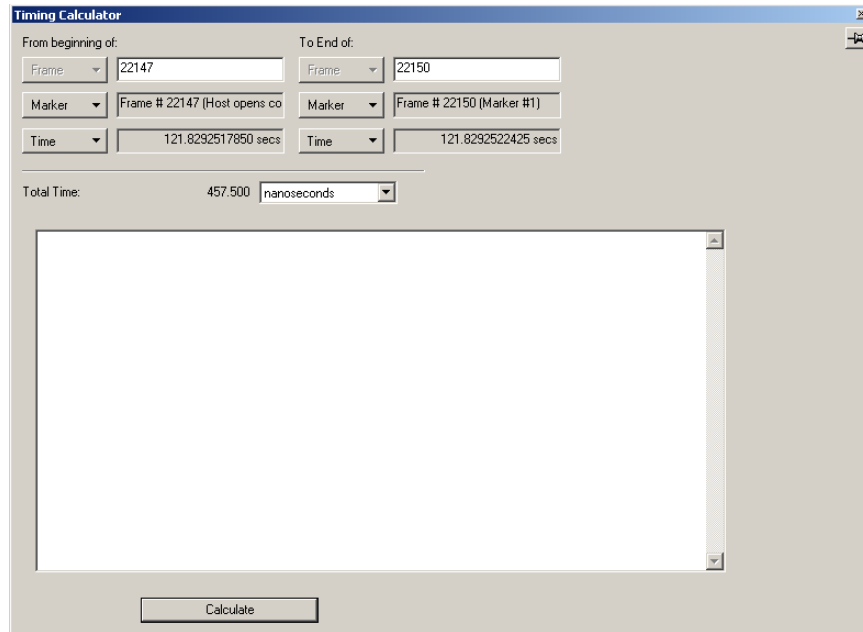
**Step 4** Click **OK**.

**Step 5** To clear a marker, click **Clear marker**.

The vertical red Marker bar disappears.

## 3.15 Timing Calculations on Markers

Markers can be used as reference points to calculate timing between events. To perform a timing calculation, select **Reports > Timing Calculations**, and then click the **Markers** buttons to select the markers you want to use for the calculation. Afterwards, click **Calculate** to calculate the timing between the marked events.

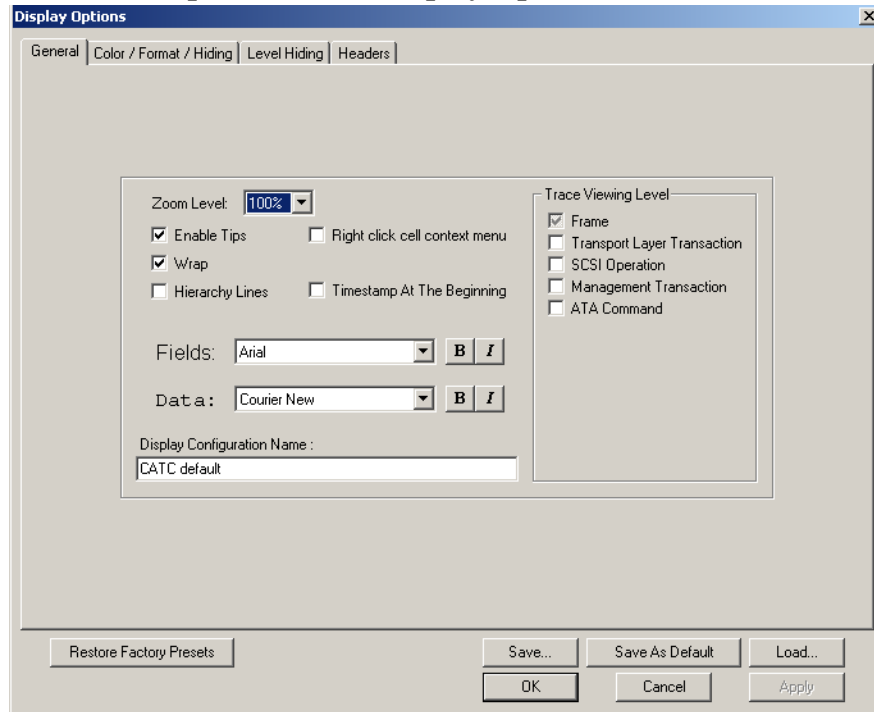


You can also calculate timing between markers by clicking the left mouse button on the first cell of a Frame in the trace window and selecting **Time from Marker** from the pop-up menu. The Timing Calculations dialog will open and prompt you to select a marker. Upon selecting a marker from the list, the calculation will be performed.

## 4. Display Options

Use the **Display Options** menu to specify the way CATC Trace information is displayed.

From the **Setup** menu, select **Display Options**.

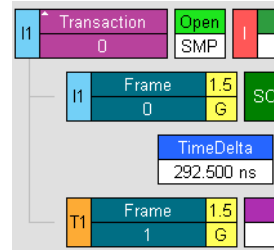


### 4.1 General Display Options

Use the General Display Options to specify the basic appearance of a Trace view.

- **Zoom Level:** Adjustable in discrete increments from 10% to 200% percent.
- **Enable Tips:** Select to enable Tool Tips with explanation text to pop up when you position your cursor over various fields in the Trace View.
- **Wrap:** Causes packets to wrap within the window if their length exceeds the width of the window.

- **Hierarchy Lines:** Adds faint lines (shown right) to the left side of the trace showing the hierarchical relationship of the Frames, Transactions etc within the trace. When this option is enabled, the lines display any time you cascade higher level decodes.
- **Right click cell context menu:** Activates the right mouse button for opening cell context menus.
- **Timestamp At The Beginning:** Moves the timestamp from the end of the Frame to near the beginning.
- **Trace Viewing Level:** Allows you to select the hierarchical level at which traffic is displayed.
- **Display Configuration Name:** Comment field associated with the \*.opt file containing the current Display Options values. You can also create and store your unique Display Options for future use.

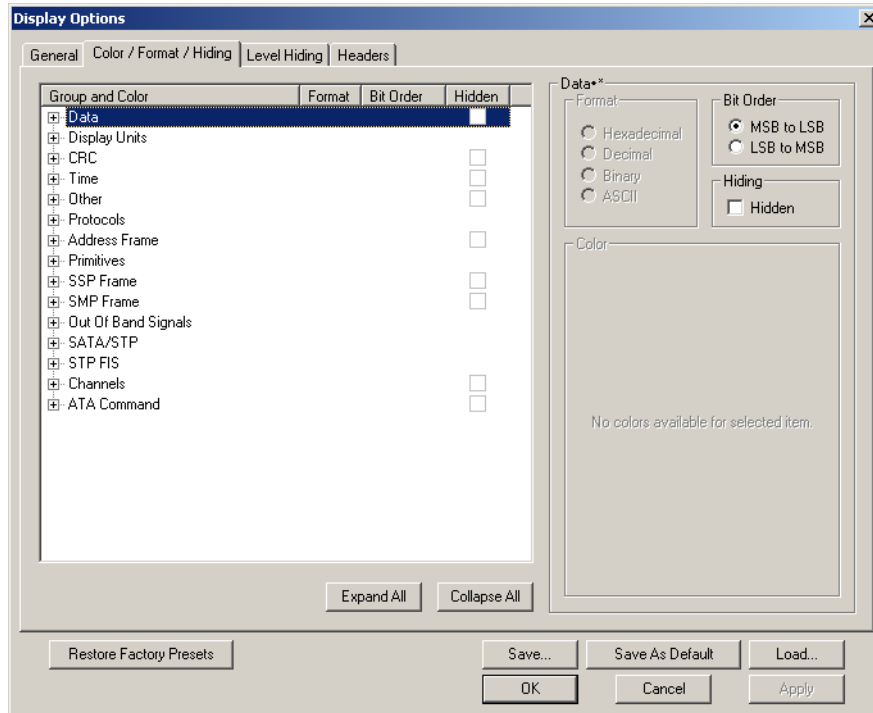


To create a new Display Options file, follow these steps:

- Step 1 Enter a comment for the new file in the **Display Configuration Name** field.
- Step 2 Click **Save...**
- Step 3 Specify a filename (\*.opt).
- Step 4 Click **Save**.

## 4.2 Setting Color, Formatting, and Hiding Options

Click the **Color/Format/Hiding** tab on the Display Options screen.



Use this window to customize the colors and formats associated with each field in the Trace view. You can also use this window to hide fields within the trace.

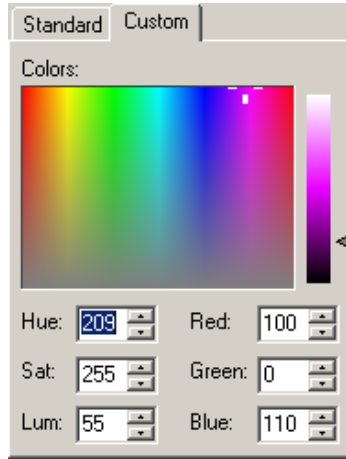
### Setting Color Display Options

To change the colors of elements in the trace, select an item in the Group and Color column and use the color pallet screen on the right to make the desired changes.

**Note** The color of an Invalid Data (packet error) field cannot be changed; it is permanently set to red.

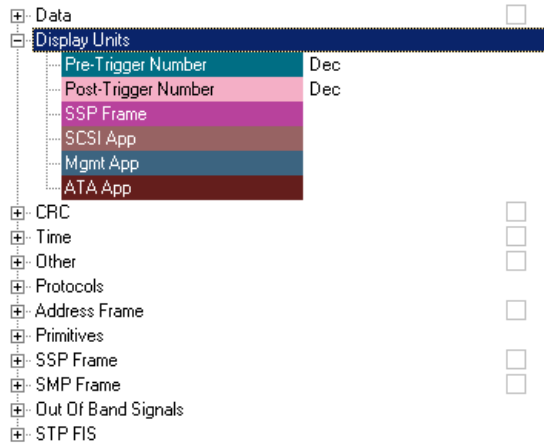
Use this window to customize the colors associated with each field in the trace. You can experiment with these options to achieve the color combination best suited to a particular graphic system.

You can also customize the colors by using the options in the Custom tab.

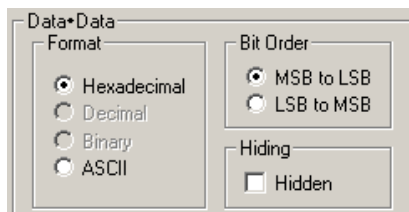


### Changing Field Formats

To change field formats, select an item under the Group and Color column. This action will enable the formats radio buttons on the right. The format types change with respect to the item selected under the Group and Color column. For example, if Display Units is selected, the following displays:



The following formats are available:

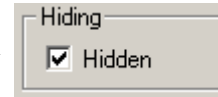


**Note** Not every format is available for every item.



## Hiding Display Options

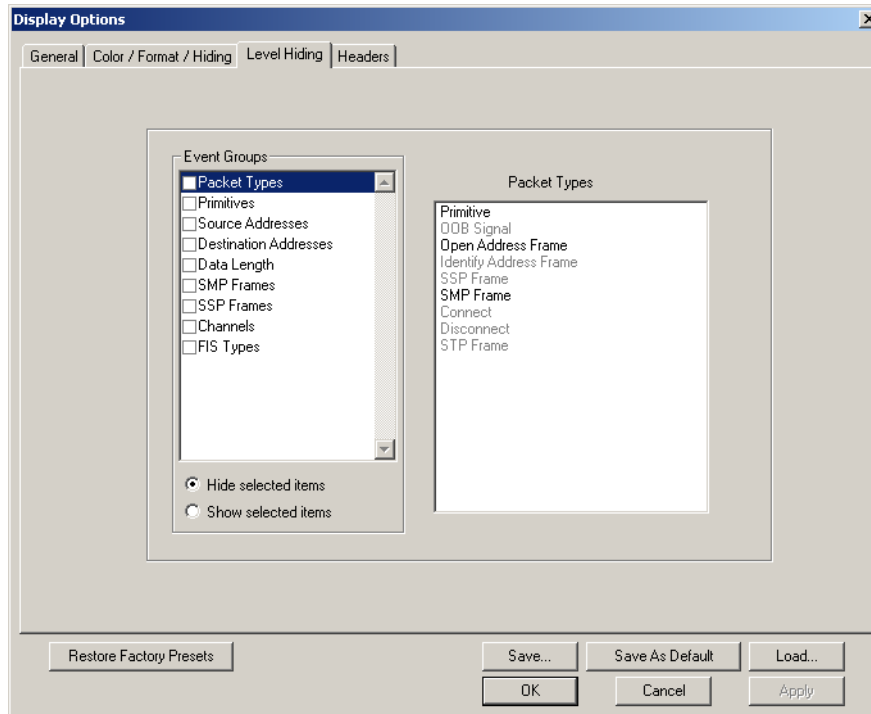
To hide one or more fields in the trace, select the appropriate item from the Group and color column, click the checkbox marked **Hidden**, and click the **Save** button.



You can also hide Frames from a trace by selecting the desired options from the checkboxes.

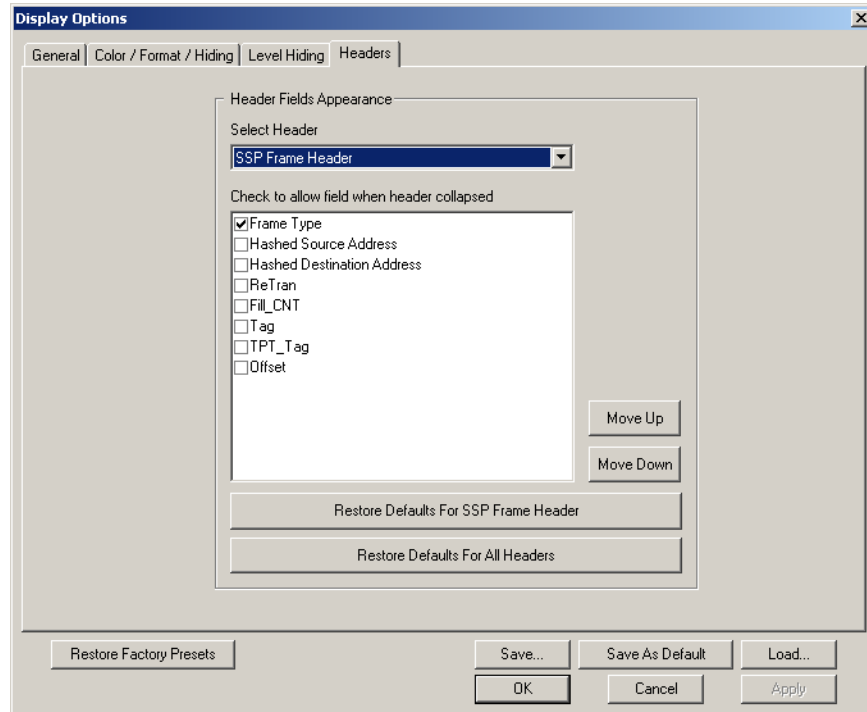
## 4.3 Level Hiding Options

The Level Hiding tab allows you to hide various types of traffic. To hide traffic, select one or more items from the Events Group list and from the list on the right, then click **OK**.



## 4.4 Display Options - Headers

The Headers tab lets you show header fields in either collapsed or expanded state. The Headers tab also lets you change the order of the header fields.



To change Header format,

**Step 1** Select a header type from the **Select Header** drop-down menu.

A list of header fields appears in the pane below marked **Check to allow field when header is collapsed**. Selecting fields in this pane causes the fields to appear in collapsed format within the trace.

**Step 2** Select header fields from the pane marked **Check to allow field when header is collapsed**.

**Step 3** If you want to move the selected field within the header, click the **Move Up** or **Move Down** buttons.

**Step 4** Click **OK** to apply the changes.

For example, below is a Frame where the Command field has been moved from the beginning of the Header field to the end.

11	Frame	SOF	COMMAND	Hashed Source Address	Hashed Destination Address	ReTran	Fill_CNT	Tag
	170			0x206A82	0xB4D463	0	0	0x0100
		TPT_Tag	Offset	Data	CRC	EOF	TimeDelta	Time Stamp
		0xFFFF	0x00000000	28 bytes	0x50C03F1B		1.372 $\mu$ s	00000.133 12330

11	Frame	SOF	Hashed Source Address	Hashed Destination Address	ReTran	Fill_CNT	Tag	TPT_Tag
	170		0x206A82	0xB4D463	0	0	0x0100	0xFFFF
		Offset	COMMAND	Data	CRC	EOF	TimeDelta	Time Stamp
		0x00000000		28 bytes	0x50C03F1B		1.372 $\mu$ s	00000.133 12330

You can restore the default field order by clicking the **Restore Defaults** buttons.

## 4.5 Saving Display Options

To complete your display options settings, use the features at the bottom of the **Display Options** window. These features remain the same no matter which of the four **Display Options** windows you are working in.

- Click **Save** to save the currently specified display options for use in future sessions. Any file name can be specified, but you must use the **.opt** extension. If no extension is specified, **.opt** is added by default.
- Click **Load** to load a previously saved **\*.opt** file, thus restoring a previous set of display options.
- The **Save as Default** function is equivalent to the **Save** function, specifying the file name **default.opt**. Whenever you start up the Analyzer, it automatically loads the **default.opt** file if one exists.
- Click **OK** to apply any changes you have made to **Display Options** and close this dialog box.
- Click **Cancel** to cancel any immediate changes you have made and exit the **Display Options** menu.
- Click **Apply** to apply your changes while keeping the **Display Options** window open.

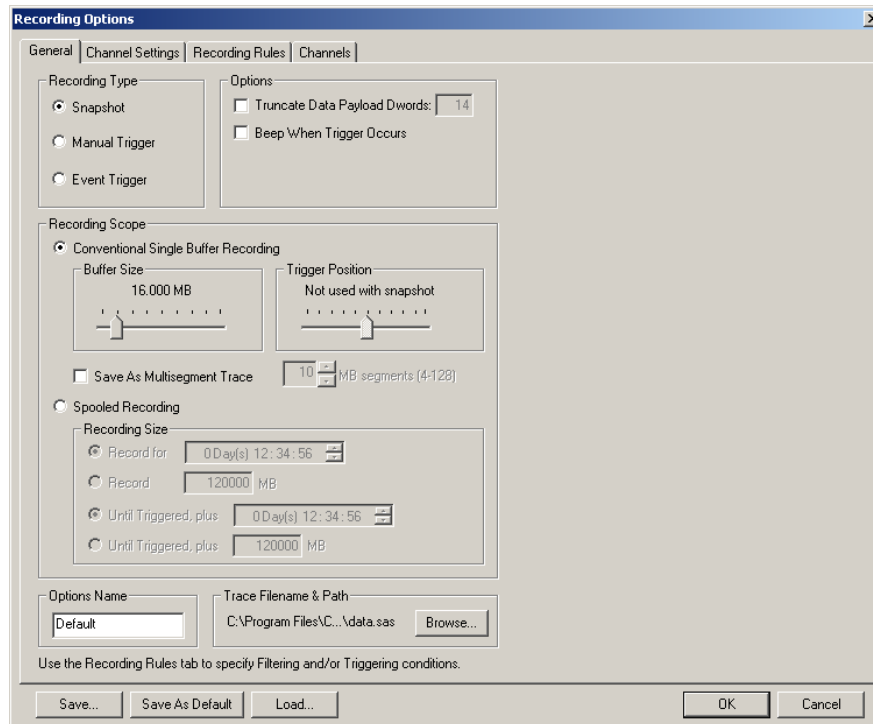


## 5. Recording Options

The **Recording Options** dialog box presents options for configuring a recording. The dialog box has two pages of options: General and Speed Selection. The General page present general types of options that affect all recordings. The Speed Selection page presents options for configuring the traffic speed that will be recorded.

From the **Setup** menu, select **Recording Options**.

**Recording Options** window appears, displaying the **General** tab.





## 5.1 General Recording Options



The General page presents options for setting the buffer size, recording type, and the Trace filename and path.


Two sets of Recording Type options are presented: *Recording Scope* and *Recording Type*.

### Recording Type

The **Recording Type** box presents three options that control how SASTracer/Trainer begins and ends a recording. The options are *Snapshot*, *Manual Trigger*, and *Event Trigger*.

- **Snapshot:** A Fixed-length recording. A Snapshot is a recording whose size is set via the "Buffer Size" box. Recording begins when the Start Recording button  is clicked and ends when either the selected buffer size is filled or the Stop Recording button  is pressed.
- **Manual Trigger:** A recording whose ending is triggered by pressing the Trigger button on the front panel.

Recording begins when the Record button  is pressed on the Tool Bar. Recording continues in a circular manner within the limits set by the buffer size. Recording ends following depression of the Trigger button on the front panel. Once the Trigger button has been pressed, recording continues until the post-trigger buffer has been filled or the Stop button  is clicked on the Tool Bar.

- **Event Trigger:** A recording whose ending is triggered by user-defined events. Recording begins when the Record button  is clicked on the Tool Bar. Recording continues in a circular manner within the limits set by the buffer size until a trigger event is detected and the defined amount of data has been recorded after the Trigger event.

### Options

The options checkboxes appear on the upper right side of the General tab of the Recording Options window.

- **Truncate Data Payload Dwords:** Allows data payloads to be truncated to whatever length is specified in the box. Truncating the payload preserves recording buffer, thereby increasing the amount of traffic that can be recorded.

- **Beep When Trigger Occurs:** When this checkbox is selected, the computer connected to the SASTracer/Trainer beeps three times when a Trigger condition is first detected.

### Recording Scope

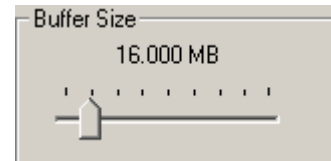
Recording Scope presents two important options that affect the size or scope of the recording. These options are *Spoiled* and *Conventional* recordings. The *Spoiled* option enables very large recordings - for example, several hours. The *Conventional* option is used for smaller recordings - for example, several minutes.

### Conventional Single Buffer Recording

In a Conventional recording, the entire trace is recorded and stored in the analyzer buffer before it is uploaded to the host PC. Recordings are thus limited in size to the size of the analyzer buffer - or 2 GB. If you are planning to create a moderate-sized recording, this is a good option to select. You set the buffer size and the trigger position, then begin the recording. The analyzer's buffer fills, then the traffic is uploaded to the host PC.

If you are planning to create a large recording or are planning to let the analyzer run over a several days, then select **Spoiled Recording**. In a Spoiled Recording, traffic is uploaded periodically to the host PC - thus freeing analyzer buffer and allowing the recording to continue.

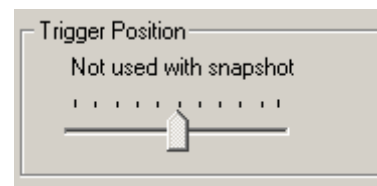
**Buffer Size** - The Buffer Size slide bar adjusts the recording buffer size from 1.6 megabytes to 2048 MB. This option is used for setting the memory for a Conventional recording.



The **Recording Type** option determines how this buffer is used. Although there are 2048 MB of physical memory in the Analyzer, the efficiency of the recording ranges from 2:1 to 4:1 ratios of physical memory to actual SAS or SATA traffic. Shorter Frames yield a less efficient recording. The non-traffic portion of physical memory is utilized for control and timing information.

**Note** The scale is not linear and affords more granularity in the smaller buffer sizes.

**Trigger Position** - The Trigger Position slide bar sets the amount of pre- and post-trigger recording in a Conventional recording. It also allows adjustment of the location of the trigger within the defined buffer. You can adjust the Triggering



Position between 1 and 99% post-Trigger. **Trigger Position** is available only when **Manual Trigger** or **Event Trigger** is selected as **Recording type**.

As an example, if the buffer size is set to 16MB, then for the following Trigger Position settings, the amount of pre- and post-Trigger data is

- 95% post-triggering: 0.8MB pre-trigger, 15.2MB post-trigger
- 75% post-triggering: 4MB pre-trigger, 12MB post-trigger
- 50% post-triggering: 8MB pre-trigger, 8MB post-trigger
- 25% post-triggering: 12MB pre-trigger, 4MB post-trigger
- 5% post-triggering: 15.2MB pre-trigger, 0.8MB post-trigger

**Note** When a Trigger occurs, recording continues until the post-Trigger amount of the buffer is filled.

**Note** The buffer is limited to 1 GB when in trainer mode/configuration.

#### *Save As Multisegment Trace*

This option causes the analyzer to segment the

trace into multiple files and create an index file called *data.mlt* that summarizes the starting and finishing frame for each segment.

This option is useful for very large recordings and for host PCs with limited memory. In the latter case, multi-segmenting gives a PC with limited memory a way to open recordings that would otherwise be too large to open.

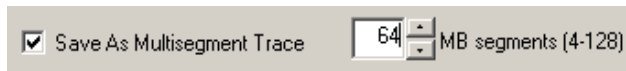
The only downside to multi-segmenting is that limits the scope of reports such as Traffic Summary, Bus Utilization, and Error Summary to each of the segments. You will not be able to perform summary statistics on the full recording.

The default value for this option is 64 MB. Before attempting large recordings, it is recommended that you play with this number to see what value best suits your needs.

To create a multisegmented trace,

**Step 1** Check the box marked **Save As Multisegmented Trace**.

**Step 2** Set the file size for each segment in the box marked **MB Segments**.





## File Structure for Segmented Files

Multisegmenting produces an index file and subordinate trace files. The default name of the index file is *dataXYZ.smt*, where XYZ is the last three digits of the analyzer's serial number. (You can see the unit's serial number by selecting Help > About SASTracer.) Thus, for example, if you had an analyzer with the serial number 111, the index file would be called *data111.smt*.

The index file and the segmented trace files are stored in a directory named after the index file. The directory is named *indexfilename\_smt\_files*. For example, if the index file is named *data111.smt*, the directory will be named *data111\_smt\_files*. Below this directory additional, sequentially numbered sub-directories (up to 100,000) that house the segmented trace files. These sub-directories bear simple numerical names: 00000 - 00999. Each of these subdirectories can hold up to 100 sequentially-numbered segment files. Collectively, the entire directory structure can hold up to 10 million files.

### Example

A 1010 MB recording using 10 MB segments and the default file names will create the following sub-directories and files. The example below uses the serial number 111:

- data111.smt This is the index file.
- data111\_smt\_files\00000\segment\_00000.sas
- data111\_smt\_files\00000\segment\_00001.sas
- ...
- data111\_smt\_files\00000\segment\_00099.sas
- data111\_smt\_files\00001\segment\_00100.sas
- data111\_smt\_files\00001\segment\_00101.sas

The index file looks something like a trace file but contains packet-like entities that summarize each 10 MB segment.

The screenshot shows the CATC SASTracer Bus and Protocol Analyzer interface. The main window displays a table with the following data:






Segment	Start Frame #	Num Frames	Duration	Time Stamp
0	0	612484	24.032 ms	00 : 00 : 00 . 000 001 192
1	612484	612489	24.029 ms	00 : 00 : 00 . 024 033 187
2	1224973	612484	24.030 ms	00 : 00 : 00 . 048 062 592
3	1837467	612489	24.029 ms	00 : 00 : 00 . 072 093 062
4	2449946	612484	24.031 ms	00 : 00 : 00 . 096 122 185

When uploading is complete, the index file will be opened. Each "packet" in this file corresponds to one of the numbered segments. Double clicking on the packet will open the corresponding segment file.

### Multisegement Toolbar



When an index file is opened like the one shown above, the Multisegement Toolbar will display. This toolbar lets you navigate the index file.

	Open first segment in multisegment trace.
	Open previous segment in multisegment trace.
	Open index file. This button becomes active if a multisegment trace file is open.
	Open next segment in multisegment trace.
	Open last segment in multisegment trace.

### Spooled Recording

In a Spooled recording, uploading commences when the recording is begun. As traffic is uploaded from the analyzer to the host PC, the analyzer memory is freed - creating space for recording additional traffic. Recording can thus continue for long periods of time, and create file lengths well in excess of 2 GBs.

### Recording Size

With Spooled Recordings, you are given the option of setting the recording length based on time or on the recording size.

**Record for** - Enter the duration of the recording in days, hours, minutes, and seconds.

**Record** - Enter the amount of traffic (in MB) that you want the analyzer to record. Selecting this option will create a fixed length recording that begins as soon as you click the REC button on the menu bar.

**Until Triggered, plus** - Enter the amount of traffic (in time) that you want the analyzer to record following an event trigger. Recording time units are days, hours, minutes, and seconds.

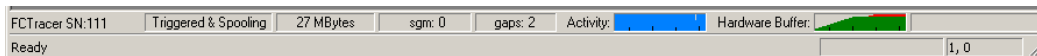
**Until Triggered, plus** - Enter the amount of traffic (in MB) that you want the analyzer to record following an event trigger. You select event triggers in the Recording Rules page -- see **Section 5.3, "Recording Rules"** on **page 53** for details.

### Spooled Recordings - Performance Issues

During a spooled recording if the analyzer buffer fills faster than the trace can be uploaded to the host PC, the analyzer will briefly suspend recording until some of the buffer is free. When recording is suspended, gaps will appear in the trace. These gaps will appear as entries in the trace.

Frame	Time	Source	Destination	Protocol	Command	D_ID	S_ID	Data	CRC	EOI	TimeDelta	Temp
23	35	SOFS	FH	FCP-2	0x610300	0x6101EF	0	dword	0x10AAA1BF	EOI	1.302 µs	3899.837
2	35	SOFS	FH	Command Status	0x610300	0x6101EF	0	dword	0x10AAA1BF	EOI	71.555 µs	3899.837
1	37	SOFS	FH	FCP-2	0x610300	0x6101EF	0	dword	0x10AAA1BF	EOI	3.195 µs	3899.837
4	70	SOFS	FH	Unsolicited Command	0x610300	0x6101EF	0	dword	0x228D44C2	EOI	5.642 ms	3899.837
3	93	SOFS	FH	FCP-2	0x610300	0x6101EF	0	dword	0x10AAA1BF	EOI	10.502 µs	3899.843
2	107	SOFS	FH	FCP-2	0x610300	0x6101EF	0	dword	0x10AAA1BF	EOI	9.067 µs	3899.843

During the recording, you can see if gaps are likely to happen by reading the status bar at the bottom of the screen.



The Status bar has two fields that you can use to determine if gaps are occurring or are about to occur.

**gaps** - Shows how many gaps have occurred. In the example above, two gaps have occurred.

**Hardware Buffer** - shows you how full the analyzer buffer is and if the analyzer is currently dropping packets. In the example above, Hardware Buffer field shows that the buffer is full (shown by the thick green graph) and that the analyzer is currently dropping packets (shown by thin red line atop of the green graph.)

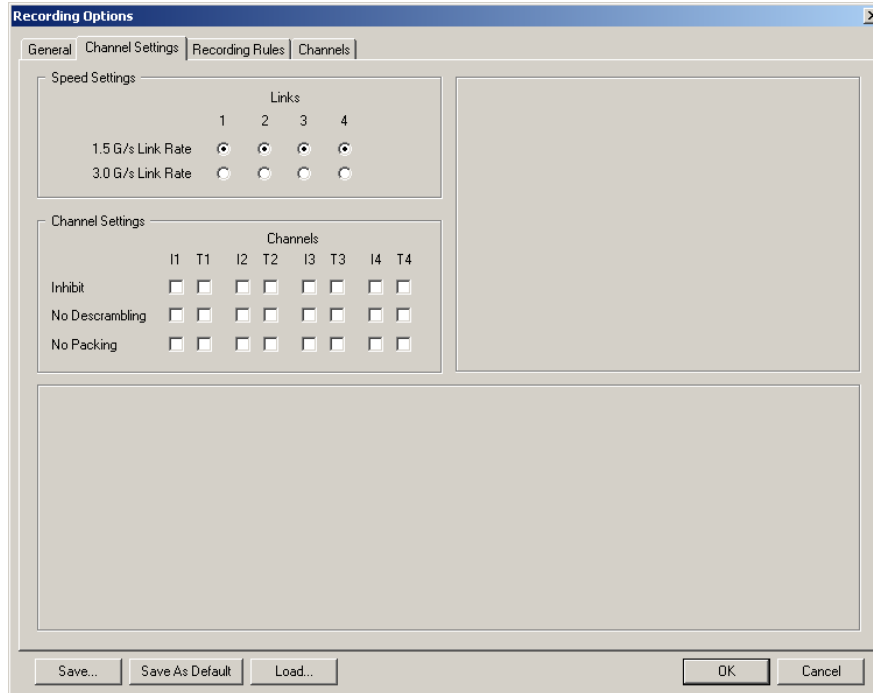
### Preventing Gaps

Gaps can be caused by a number of factors - the number of channels being recorded, the absence of filtering, the performance of the host PC (for example, is it using USB 2.0 to upload traffic?), and the amount of traffic produced by the devices under test.

There are several ways to prevent gaps. You will need to experiment with your setup to determine what works best for you. You might try filtering out primitives, turning on data truncation (for example to 10 Dwords) and filtering out LISMs. If you want to record primitives, it is recommended that you enable primitive packing.

## 5.2 Channel Settings

The Channel Settings page lets you to set speed, descrambling, and packing options for each channel. It also lets you inhibit channel recording.



### Speed Settings

The SASTracer system supports Autodetect Link Rate which is designed to pass through the speed negotiation signaling allowing the initiator and device to determine the link speed using the method defined in the SAS specification. In general, this is the most convenient setting to use because it ensures the traffic will get recorded at the negotiated rate. Alternatively, users may force the analyzer to record at the 1.5G or 3G rate. However, if the negotiated link speed is higher or lower than the speed selected in this tab, SASTracer will not decode the traffic properly (there will be errors in the trace). The user will know if devices are negotiating successfully by getting clean recordings.

### Channel Settings

These options allow you to inhibit recording and turn off scrambling and packing on a channel by channel basis.

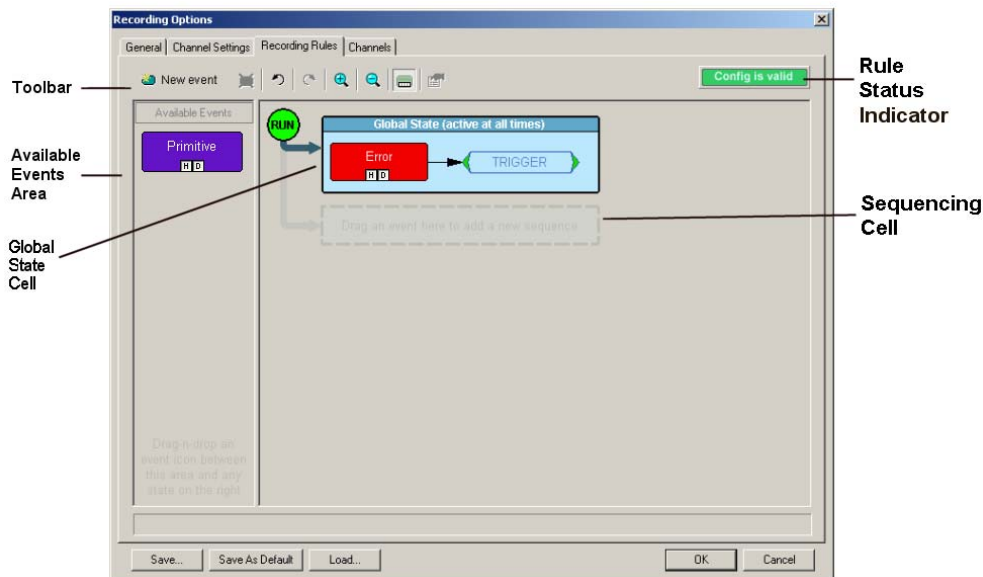
**Inhibit** - Inhibits recording of traffic from selected channels. For example, if you check the option for T1, it means "record all channels except for Target channel 1 (T1)."

**No Descrambling** - Turns off the analyzer's descrambling from the selected channels. Select this option if your DUTs are not scrambling their traffic.

**No Packing** - Turns off primitive and idle packing from the selected channels.

## 5.3 Recording Rules

The Recording Rules page lets you set triggers and filters. The page divides into following areas:



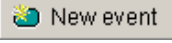







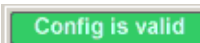

- **Toolbar** - Contains buttons that control the Recording Rules page.
- **Available Events area** -- Part of the screen where you can park buttons that you intend to use in the Global State Cell.
- **Global State Cell** -- Part of the screen where you create trigger and filter conditions. You create conditions by dragging event buttons from the Available Events Area into the Global State Cell and then assign actions to the event buttons.
- **Sequence Cell** -- The inactive cell marked by the faint text *Drag an event here to add a new sequence*. Once an event button is placed in this cell, the cell becomes active. The Sequence Cell is used to create *event sequences* - chains of events leading to an action: *If x followed by y followed by z occurs, trigger*. Event Sequences are created by assigning the action *Advance the Sequence* to the links in the chain and trigger (or some other action) to the final event.
- **Rule Status Indicator** - An indicator that shows the validity status of the current set of recording rules. When the rules are correct, the

indicator will display the text **Config is valid**. When incorrect, the indicator will turn red and display the text **Config is Invalid**.

- **Pop Up Menus** (not shown) - Right-clicking on button or area in the Recording Rules page will access a context-sensitive pop-up menu containing most of the commands listed in the toolbar.

## 5.4 Recording Rules Toolbar

The Recording Rules toolbar exposes functionality for controlling the Recording Rules page.

	<b>New Event.</b> Opens a menu of events. Selecting an event causes an event button to appear in the Available Events area.
	<b>Delete Event.</b> Deletes selected event button.
	<b>Undo.</b> Undoes last change made to Recording Rules page. The undo buffer has unlimited depth.
	<b>Redo.</b> Repeats changes undone by the Undo button.
	<b>Zoom In.</b> Enlarges the display. There are five zoom levels. The default level is the middle one. If you have a wheel mouse, you can also zoom by holding down the Control key and then operating the mouse wheel.
	<b>Zoom Out.</b> Makes the display appear smaller.
	<b>Show/Hide channels.</b> When pressed, this button tells the Recording Rules dialog to show the channel buttons on the Events icons. When unpressed, the channels are hidden.
	<b>Show/Hide Properties Dialog.</b> Shows or hides the Properties dialog of the selected State/Event/Action.
	<b>Config is valid.</b> This message displays when the current Recording Rules configuration is valid and can be executed by the hardware. This message gets updated every time the Recording Rules configuration changes. When the configuration is incorrect, the message is replaced by "Config is incorrect."
	<b>Config is invalid.</b> This message displays when the current Recording Rules configuration exceeds hardware limitations. You can click the indicator to get the diagnostics message box to find the problem.

## 5.5 Recording Rules Page - How it Works

The Recording Rules page can be thought of as a chalk board where you create a graphical model of the events and actions. In essence, you are creating a visual representation of the rules that the analyzer should follow during a recording.

You can create simple or complex rules.

Creating a rule involves three steps:

- Step 1** Select one or more events.
- Step 2** Select the channels that the analyzer should record.
- Step 3** Assign an actions to the events.

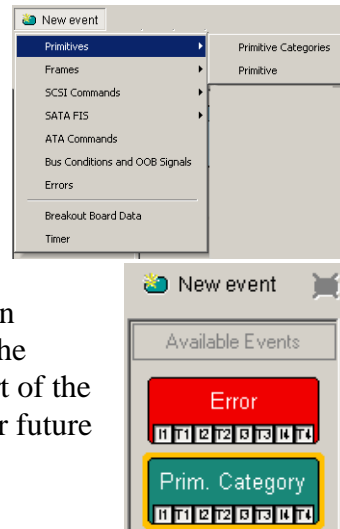
### Selecting Events

Events are selected from the New Event menu:

- Step 1** Click the **New Event** button.

A menu of Events and Event categories displays.

- Step 2** Select an Event from the menu. Once a selection has been made, an Event button appears in the **Available Events** area. The **Available Events** area is an inactive part of the window where buttons can be parked for future use.



### Selecting a Channel on an Event Button

At the bottom of each event button are small buttons that represent analyzer channels. Selecting a channel button tells the analyzer which channels to monitor for trigger and filter events.

Note that deselecting a channel button does not stop the recording on that channel - it merely disables actions such as triggers on the channel. Thus, if you had set the analyzer to trigger on an error but had deselected channel T1, the analyzer would record traffic on all channels (including T1) but would ignore any error that occurred on channel T1.



To turn off recording for individual channels, use Inhibit Recording option in the Recording Options > Channel Settings page. This option will prevent traffic from being recorded into the trace.

## 5.6 Assigning an Action

Assigning an action tells the analyzer what to do when it has found the targeted event. If you do not assign an action, the analyzer will look for the event but do nothing once the event has been encountered.

Assigning an action is a two-step process: first, move an Event button from the **Available Events** area on the left to one of the two cells in the center of the window. Then, right-click on the Event button and assign an action.

### Dragging a Button to the Global State Cell or Sequence Cell

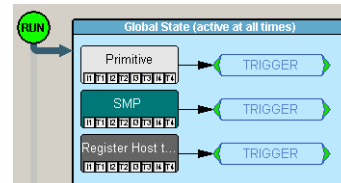
The center of the Recording Rules window is where rules are defined. To create a rule, you must drag an Event button from the **Available Events**



To activate an Event button, drag it to the Global State Cell.

area on the left to one of the two cells in the center of the Recording Rules window. The cells in the center control the duration of the rule: rules created with the Global State Cell are always enabled, while rules created in the Sequence cell are conditionally enabled.

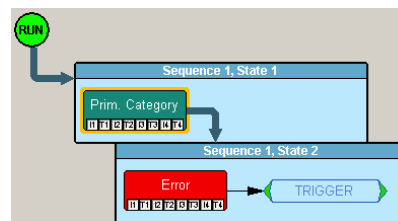
**The Global State Cell** - The Global State Cell tells the analyzer what events to look for throughout the entire recording. The cell is called a "Global State" because the conditions you define in the cell are always active. You can place several events in this cell. Doing so tells the analyzer to look for all of the events all of the time. For example, you could place three events in this cell and have each cause a trigger. Such a configuration would read "If any of the events occur, trigger."



This configuration reads "trigger if any of these events occur."

**Sequence Cell** - Sequence cells are marked with the faint text **Drag to add a new sequence**.

The Sequence Cell is used to create *event sequences*. An event sequence is a chain of events leading to some action. For example, "If x is followed by y and then by z, trigger." Events linked in a chain are



An event sequence. This reads "If a primitive is followed by an error, then trigger."



looked at sequentially. Thus, at any given time, the analyzer is often only be looking for a single event out of the several that might be in the Sequence cell.

There can be up to 255 events linked together into a sequence. Only one sequence can be created.

When two or more events have been moved into a Sequence cell, they can be linked into a sequence by assigning the action **Advance the sequence** to events in the chain. The last event in a sequence is then usually assigned the action **Trigger**.

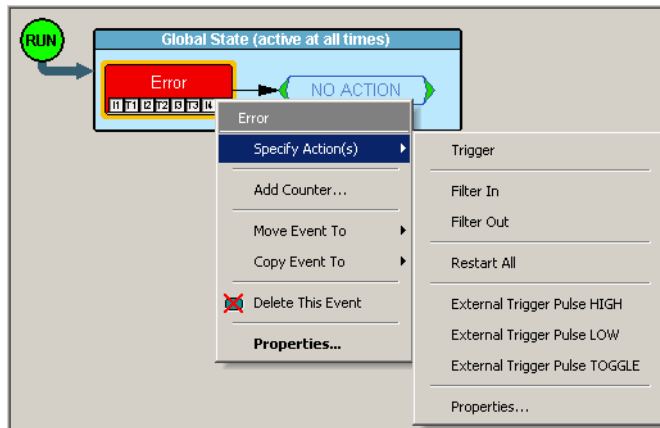
There are two ways to assign an action to an event button:

- **Right-click** on an event button and select Specify Action from the pop-up menu.
- **Double-click** on the event button and then select an action from the Properties dialog box.

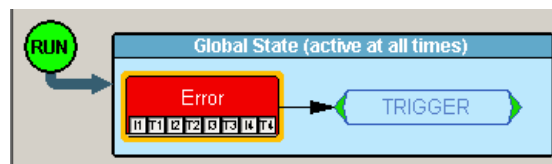
#### *Assigning an Action from the Pop-up Menu*

To assign an action to an event button via the pop-up menu,

**Step 1** Right-click on the button. A pop-up menu appears:

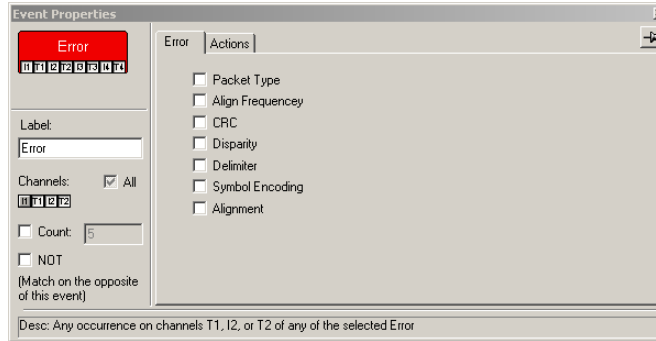


**Step 2** Select **Specify Action** and then an action from the sub-menu. The menu closes and the action is assigned.



### Assigning an Action via the Properties Dialog Box

- Step 1** You can also assign actions to event buttons via the Properties dialog box. Double-click on an event button to open the properties dialog box.



- Step 2** Select the Actions tab.

- Step 3** Assign an action.

See See Section 5.9 "Types of Properties Dialog Boxes" on page 61 for further details on Properties dialog boxes.

## 5.7 Types of Pop-up Menus

The pop-up menu are context-sensitive and will display different options depending on the object you have clicked.

### Global State Cell and Sequence Cell Pop-up Menus

If you click on the Global State Cell or Sequence Cell (but not one of the buttons inside them), you will get the following pop-up menu:



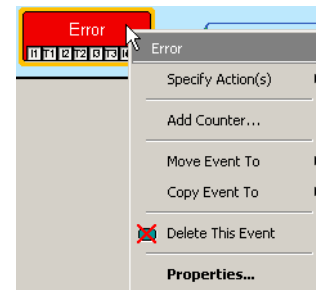
**New Event** - Brings up a menu of Event types. This is the same menu that appears when you click the New Event button on the toolbar.

**Properties** - Brings up the State Properties dialog for the selected state.

### Event Pop-up Menu

If you click on an Event button, you will get the following pop-up menu:

**Specify Action(s)** - opens a sub-menu with the following options:



- **Trigger** - Triggers end of recording. Recording continues until post-trigger buffer is expended. Buffer settings are controlled by the Recording Options - General page.
- **Filter Out** - Excludes selected traffic from recording. Filtering preserves recording memory, thereby extending recording sessions and excluding events of little interest.
- **Advance the Sequence** - Appears only in Sequence Cells and is used to create event sequences. Tells the analyzer to look for the next event in the sequence.
- **Filter In** - Includes selected traffic in recording.
- **External Trigger Pulse HIGH** - Sends an output signal with a Pulse High format through the output ports on the back of the UPAS. Pulse High is the default format. Pulse High causes the analyzer to transmit a 5 volt, 40 nanosecond signal.
- **External Trigger Pulse LOW** - Sends an output signal with a Pulse Low format through the output ports on the back of the UPAS. Pulse Low causes the analyzer to transmit a 0 volt, 40 nanosecond signal.
- **External Trigger Pulse TOGGLE** - This format causes the analyzer to transmit a signal that will toggle with each trigger event between a continuous 5 volt signal and a continuous 0 volt signal.

**Add Counter** - Displays the Event Properties dialog with the Counter selected and ready to accept the count value. The menu item is not shown if the counter is not applicable to the selected event. If the counter is already specified this menu item is replaced with **Don't Use Counter** and **Change Counter Value**.

**Move Event To** - Moves selected event to a different position in the Recording Rules window.

**Copy Event To** - Copies 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** - Opens a dialog box and lets you specify further sub-types (for example, types of errors) and additional conditions for the selected event.

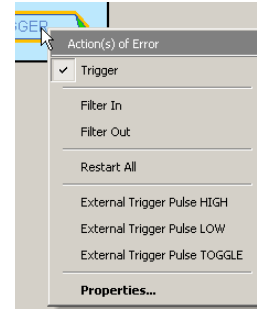
### Action Pop-up Menu

If you click on an Action button, you will get the following pop-up menu:

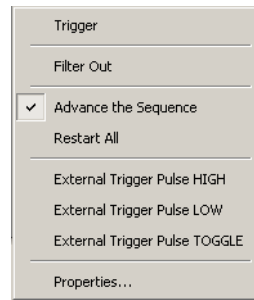
**Trigger** - Sets or clears Trigger action.

**Filter In** - Sets or clears Filter In action. This option precludes the use of Filter Out.

**Filter Out** - Sets or clears the Filter Out action. This option precludes the use of Filter In.

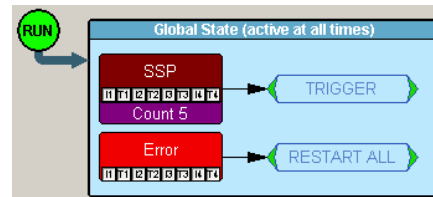


**Global State Cell.  
Action menu for event in**

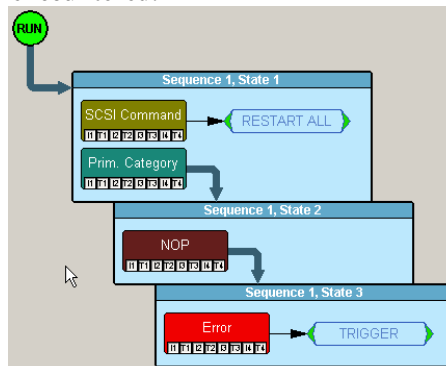


**Actions menu for event in  
Sequence cell.**

**Restart All** - Restarts any sequences or counts you may have set on other buttons. The example on the right illustrates how the Restart All action works. This example reads "Look for a sequence of five SSP Frames and then trigger. If, however, an Error occurs any time before the fifth SSP frame has occurred, restart the count".



**Restart example.** In this configuration, SASTracer will restart its search for a sequence of 5 SSP frames if an error is encountered.



**Second restart example.** In this configuration, SASTracer will restart its search for the above sequence of events if a SCSI command is found.

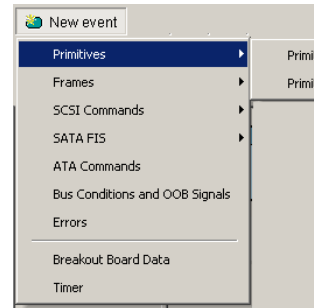
**External Trigger Pulse HIGH, Pulse LOW, Pulse TOGGLE** - Causes the event send an external signal out through the External Out port on the back of the UPAS. The shape of the signal (Pulse HIGH, Pulse LOW or Pulse TOGGLE) must be the same for all events sending out such signal. This means that if you change the output signal for one event, it will automatically change the signal for all other events sending output signals.

**Properties** - Displays the Action Properties dialog for the selected state.

## 5.8 New Events Menu

To add new Event buttons to the Available Events area, click the **New Events** button. A menu opens with the following categories:

- Primitives
- Frames
- SCSI Commands
- SATA FIS
- SSP Frame Header
- SSP Information Unit
- ATA Commands
- ATAPI Commands
- SATA Data Pattern
- SAS Data Pattern
- Bus Conditions and OOB Signals
- Errors
- Breakout Board Data
- Timer




## 5.9 Types of Properties Dialog Boxes

Each cell and button has a properties dialog box that allows refinement of the options being set.

Properties dialog boxes can be opened by:

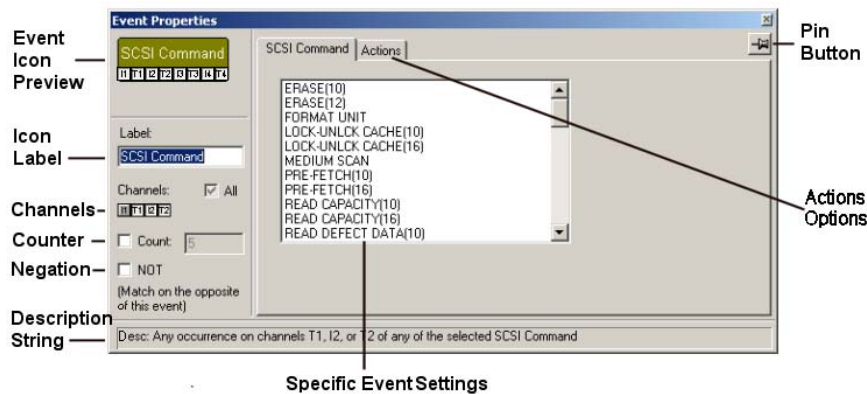
- Double-clicking a button or cell.

- Right-clicking a button and selecting **Properties** from the pop-up menu.
- Clicking the Properties button  on the toolbar.

Properties dialog boxes exist for all items in the Recording Rules page: the event buttons, action buttons, Global State cell and Sequence cells.

### Properties Dialog Box - General Features

Properties Dialog boxes share several features: an Icon preview, a Label Icon, Channel Settings, Negation, Counter, a Pin button, and a Descriptive String.



**Icon Preview** - The Icon Preview shows what the button currently looks like. If you make changes to the Channel settings or the Icon Label, these changes will immediately display in the Preview.

**Icon Label** - A text box for labeling the button. Whatever is typed here will appear on the button.

**Channels** - These controls allow you to select the channel(s) that the analyzer should search when it is looking for the event.

**Counter** - A counter tells the analyzer to search for  $x$  instances of the selected event. For example, if you enter "10," the analyzer will count 10 instances of the selected event before it performs whatever action you assign. There are only two counts available in the hardware so if you try to assign more than two, you will get a warning.

**Note** Counters can not be applied to events with Filter Actions. The maximum counter value is 65,535.

**Negation** - Tells the hardware to match the opposite of the event. For example, if you select NOT for Errors Event, the match will occur on Error types that are not checked. If you select NOT for a SCSI command, the match will occur on any FCP\_CMND except for the selected one, and also on the selected one if the additional parameters do not match.

**Pin Button** - Allows you to "pin" the Properties dialog box to the application so that it does not go away when another object appears such as an event, state or action.

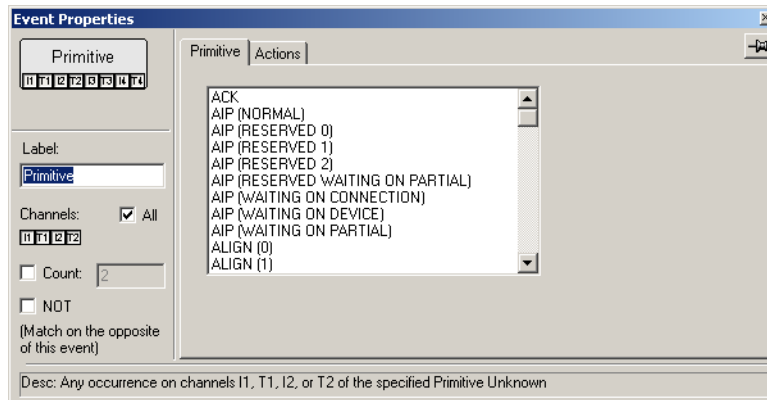
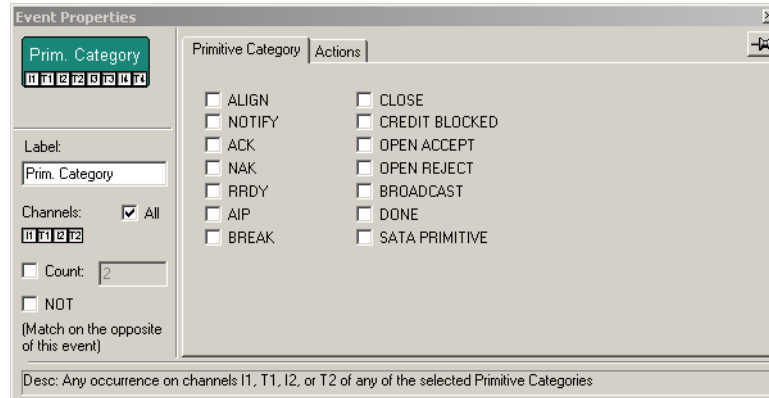
**Description String** - This area contains a textual description of the event.

**Specific Event Settings** - The largest part of the Event Properties dialog box. By selecting one or more events from the list, you narrow the range of events that the analyzer searches for.

The options presented in this area vary depending on the selected event. There are three basic formats:

- **Checkboxes**
- **List**
- **Pattern Editor**

**Checkboxes** and **Lists** present options for you to select from. Selecting one or more option tells the analyzer which event(s) the analyzer should search for. Examples are shown below:

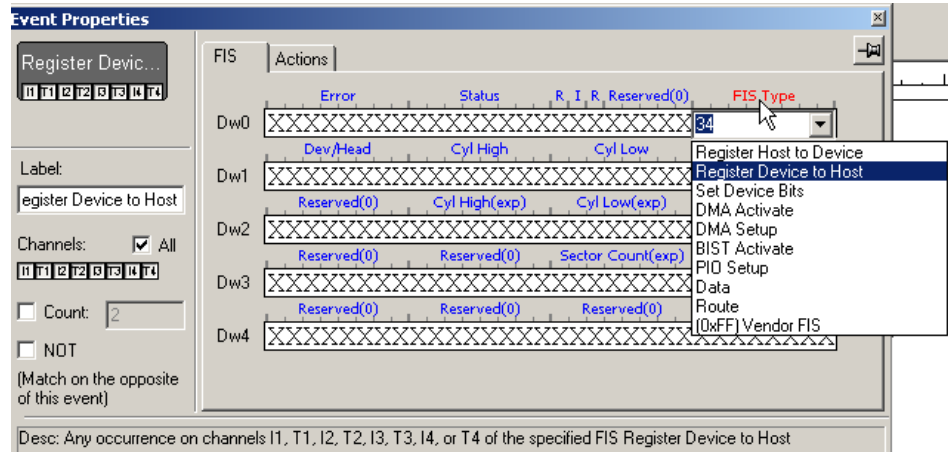


The **Pattern Editor**, on the other hand, presents a series of text boxes in which you can enter a data pattern (in 8Bit codes) that the analyzer can use as trigger pattern search for.

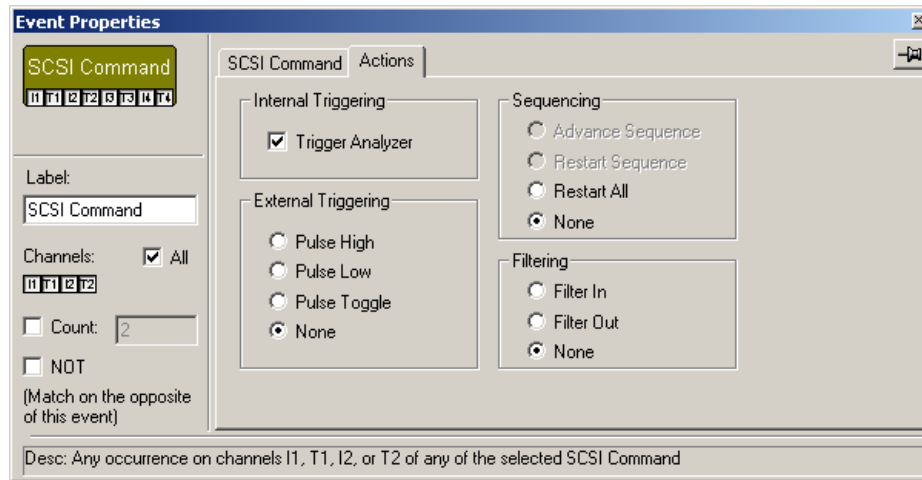
The **Pattern Editor** has two components: the text boxes themselves, in which a pattern can be entered, and pull-down menus. Pull-down menus are available for some fields. By clicking on any field header, users will either



be presented with a drop down menu (below) or they can enter values in decimal or hex and the string will be converted to binary after clicking on a different field.



**Actions Tab** - The Actions tab opens a page of options for setting triggers and other actions on the selected events.



## 5.10 Event Properties Dialog Boxes - Descriptions

Each Event button has a different Properties dialog box and each Properties dialog box has a different set of options.

This section describes the Event Properties dialog boxes and their options.

To see a menu of events, click the **New Events** button. The events are:

<b>Category</b>	<b>Event</b>
<b>Primitives</b>	Primitive Categories Primitives
<b>Frames</b>	Open Address Frames Identify Address Frames SSP Frames SMP Frames
<b>SCSI Commands</b>	SCSI Primary Command set SCSI Block Command set SCSI Media Changer Command set SCSI Stream Command set
<b>SATA FIS</b>	Register Host to Device Register Device to Host Set Device Bits DMA Activate DMA Setup BIST Activate PID Setup DataRoute Vend FIS: 0xFF
<b>ATA Commands</b>	All ATA commands
<b>ATAPI Commands</b>	All ATAPI 6/7 commands
<b>SSP Header Fields</b>	Command Data Response Task Vendor Reserved
<b>SSP Information Units</b>	Command Data Response Task
<b>SMP Request/Response</b>	SMP Request SMP Response
<b>Errors</b>	
<b>Breakout Board Data</b>	
<b>Timer</b>	
<b>Bus Conditions and OOB Signals</b>	

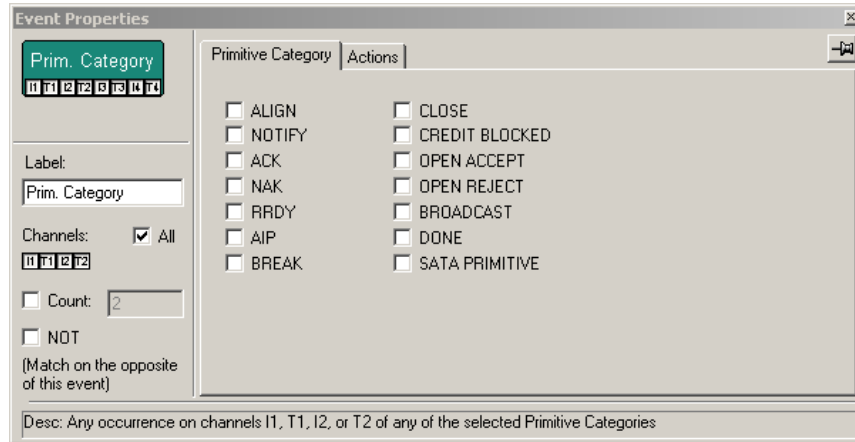
The descriptions below follow the order of events listed in the table above.

## PRIMITIVES

There are two types of primitive events: Primitive Categories and Primitives.

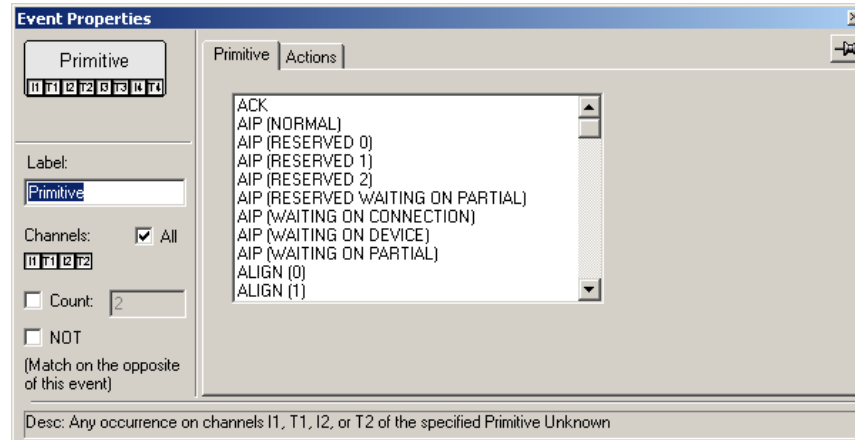
### Primitive Categories Properties Dialog

Presents options for triggering or filtering on various Primitive categories. If NOT is checked, any unchecked primitive category will generate an event match.



### Primitives Properties Dialog

Presents a menu of Primitive types. If NOT is checked, any unchecked primitive will generate an event match.



## FRAMES

There are four Frame types in the menu: Open Address Frames, Identify Address Frames, SSP Frames, and SMP Frames.

## Open Address Frames Properties Dialog

Presents options for triggering and filtering on Open Address Frames. Within the page are the following menus and text boxes:

**Protocol:** Any, SSP, SMP, STP

**Connection Rate:** Any, 1.5 Gbps, 3.0 Gbps

**Source Port As:** Any, Initiator, Target

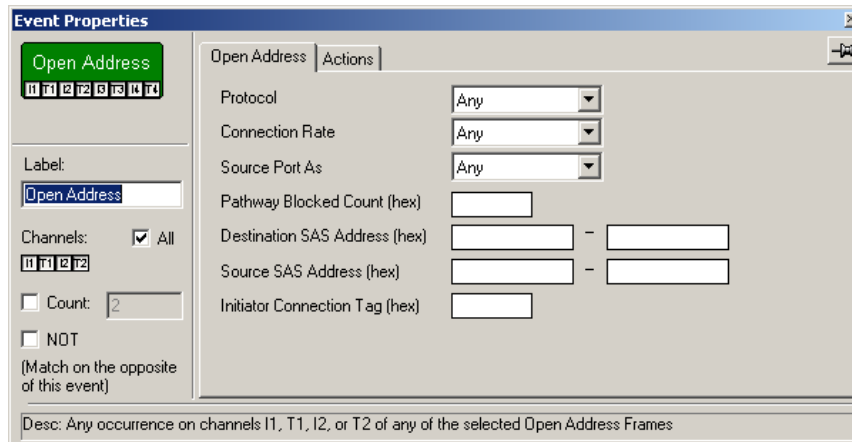
**Pathway Blocked Count (hex):**

**Destination SAS Address (hex):**

**Source SAS Address (hex):**

**Initiator Connection Tag (hex):**

If NOT is checked, any unchecked Frame will generate an event match.



## Identify Frames Properties Dialog

Presents options for triggering and filtering on Open Address Frames. Within the page are the following menus and text boxes:

**Device Type:** Any, End Type, Edge Expander, Fanout Expander

**SSP Initiator:** Any, Present, Not Present

**STP Initiator:** Any, Initiator, Target

**STP Initiator:** Any, Initiator, Target

**SSP Target:** Any, Present, Not Present

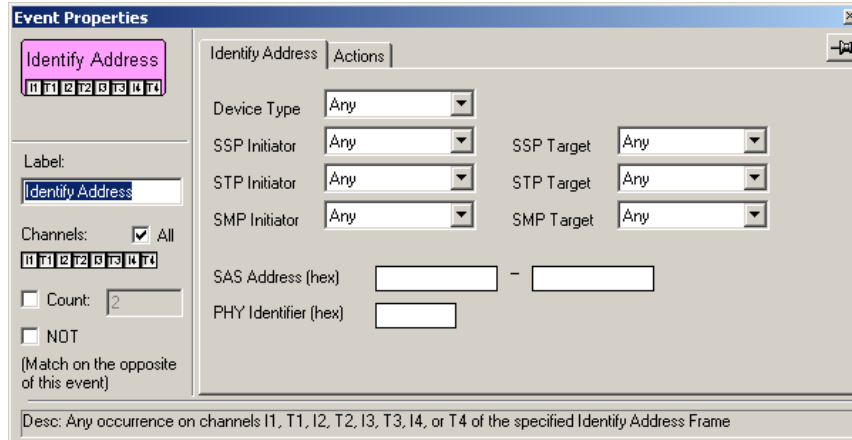
**STP Target:** Any, Initiator, Target

**STP Target:** Any, Initiator, Target

**SAS Address (hex):** Text box for entering an address.

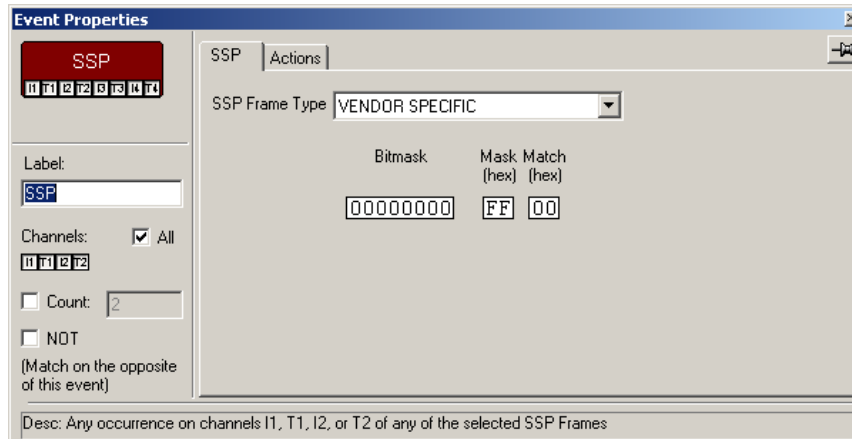
**PHY Identifier (hex):** Text box for entering PHY identifier.

If NOT is checked, any unchecked Frame will generate an event match.



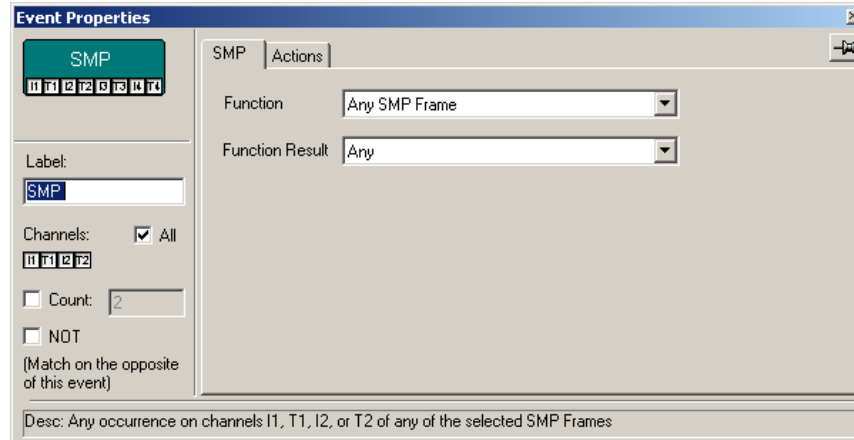
### SSP Frames Properties Dialog

Presents options for triggering or filtering on SSP Frames. To specify an SSP Frame type, select an item from the drop-down menu. If desired, you can further define the event by specifying a data pattern in the data fields. To enter a value in binary format, use the box marked Bitmask. To enter a value in hexadecimal format, use the boxes marked Mask (hex) and Match (hex). If NOT is checked, any unchecked primitive will generate an event match.



## SMP Frames Properties Dialog

Presents menus for triggering or filtering on SMP functions. Two menus are presented: Function and Function Result. The Function Result menu is context-sensitive and depends on the menu item selected in the Function menu. If NOT is checked, any unchecked Frame will generate an event match.



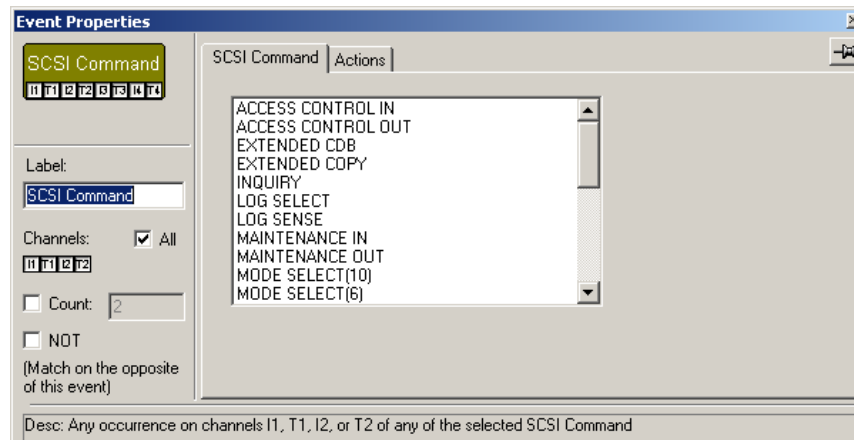
## SCSI COMMANDS

There are four SCSI Commands in the menu: SCSI Primary Command Set, SCSI Block Command Set, SCSI Media Changer Command Set, SCSI Stream Command Set.

### SCSI Primary Command Set Properties Dialog

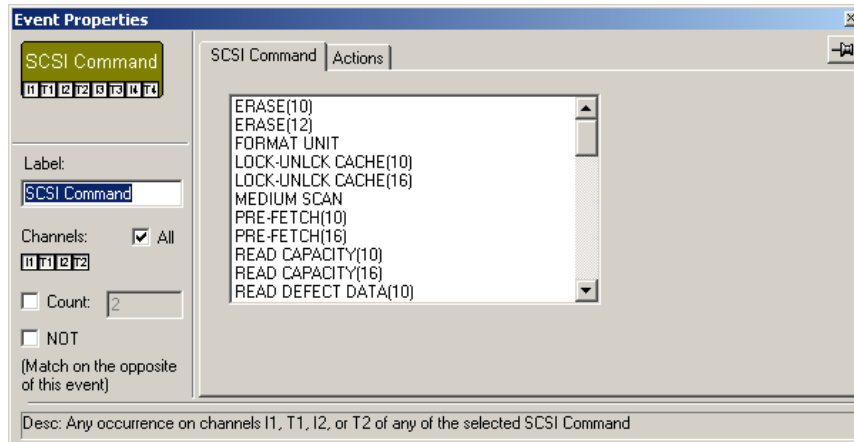
Lets you specify parameters for the selected SCSI Primary Command Set. To enter a parameter, select an item from the drop-down menu.

If NOT is checked, any unchecked SCSCI Command Set will generate an event match.



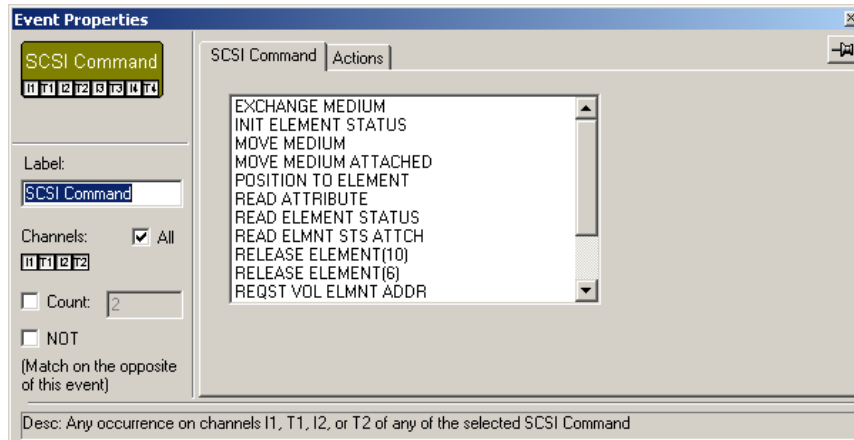
### SCSI Block Command Set Properties Dialog

Presents options for triggering or filtering on various SCSI Block Command sets. If NOT is checked, any unchecked primitive will generate an event match.



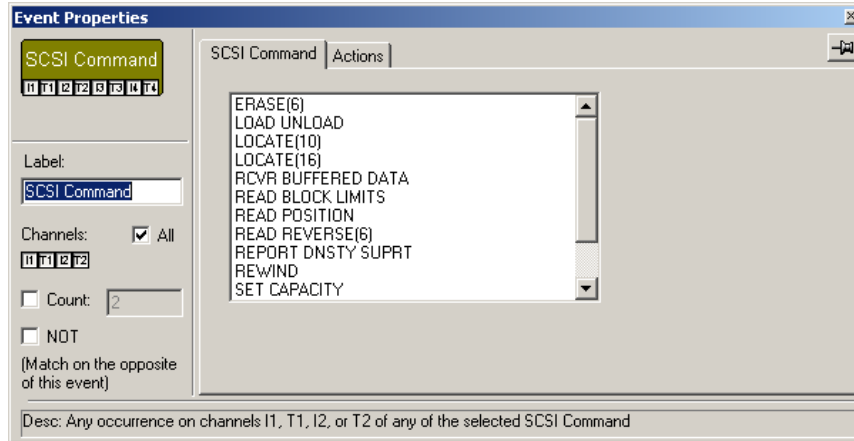
### Media Changer Command Set Properties Dialog

Presents options for triggering or filtering on various Media Changer Command Sets. If NOT is checked, any unchecked primitive will generate an event match.



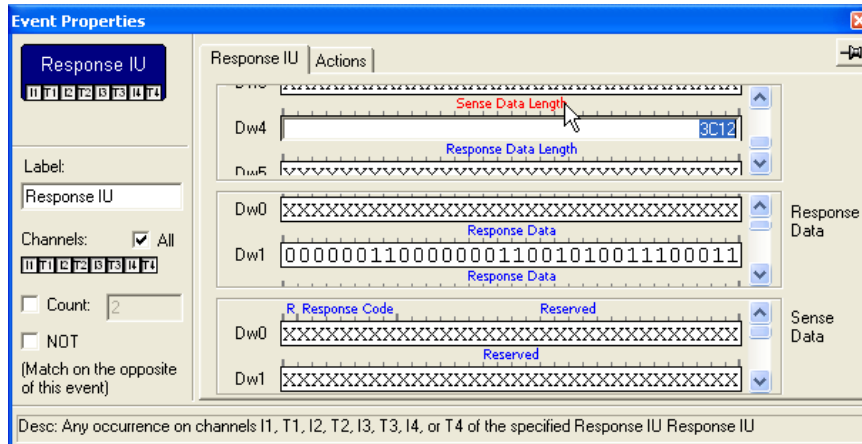
## Stream Command Set Properties Dialog

Presents options for triggering or filtering on various Stream Command sets. If NOT is checked, any unchecked primitive will generate an event match.



## SSP Information Unit: Response IU

The SSP Information Unit Events provide a bit-level pattern editor for selecting both SSP header fields and payload parameters including SCSI sense key and additional sense code patterns. Sense data length and related fields within the Response IU can be accessed using the scroll bars. Entering a data pattern tells the analyzer to wait for the specified pattern before triggering.

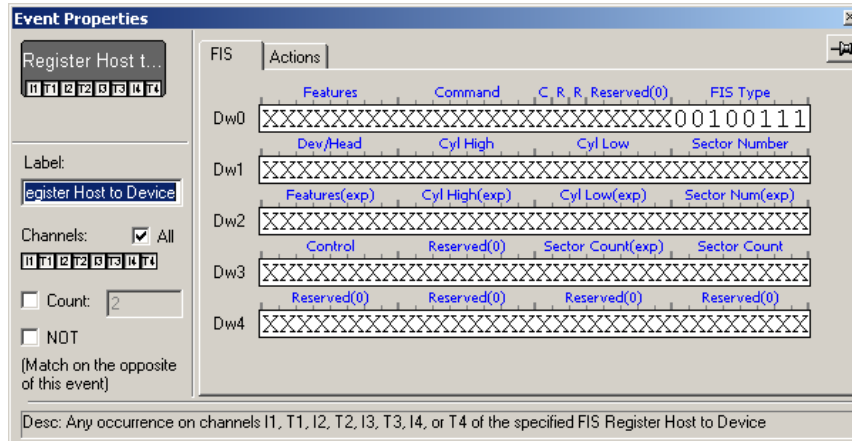


## SATA FIS

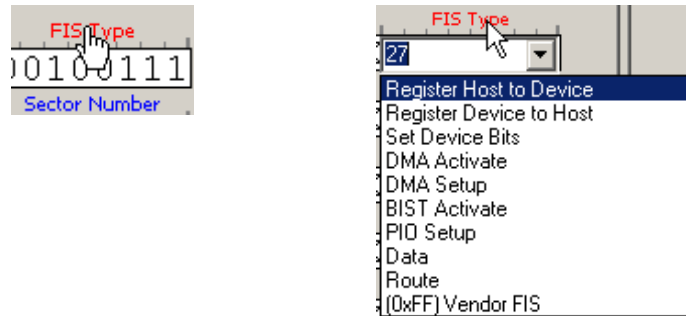
There are ten SATA FISs that can be selected from the New Events menu: Register Host to Device, Register Device to Host, Set Device Bits, DMA Setup, BIST Activate, PIO Setup, Data, Route, and Vend FIS: 0xFF.



The Properties dialogs for these FISs are similar to one another. They display data fields for entering data patterns on a bit-by-bit basis. Entering a data pattern tells the analyzer to search for the specified pattern. If NOT is checked, any pattern other than the one specified will generate an event match. The Properties dialog below is for **Register Host to Device**.



Note that some of the data fields have drop-down menus. To see which fields have menus, position your mouse pointer over the blue field headings. If the pointer changes into a hand, then the heading will present a menu if it is clicked.



## ATA COMMANDS

ATA Commands are presented in a single dialog box.

### ATA Commands Properties Dialog

Presents several options:

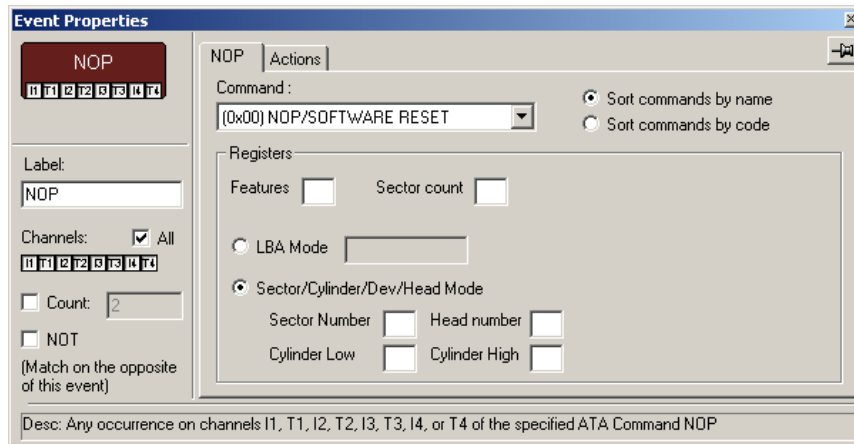
**Commands** - Presents a long list of ATA Commands. Selecting a command will cause the analyzer to search for the selected command.

**Features** - A text box for entering a value.

**Sector Count** - A text box for entering a Sector Count value.

**LBA Mode** - Select the radio button, then enter a value.

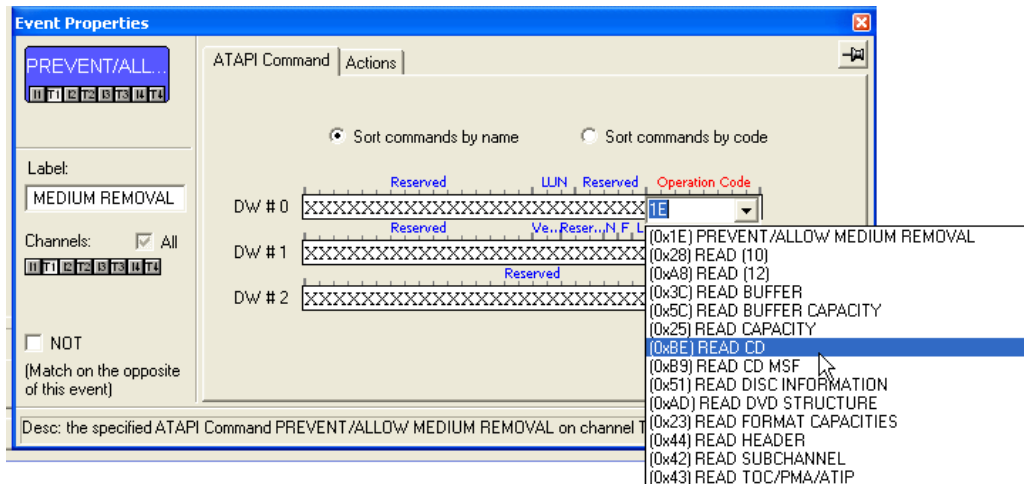
**Sector/Cylinder/Dev/Head Mode** - Select the radio button, then enter values into the text boxes.



If NOT is checked, any unchecked primitive will generate an event match.

## ATAPI COMMANDS

Individual ATAPI 6/7 commands can be selected as a trigger event. Resource limitations restrict ATAPI triggering to a single channel and to a single ATAPI event.



### ATAPI Command Properties Dialog

To specify ATAPI commands as the recording event, select the command using the Operation Code or Command name. Additional ATAPI parameters can be specified by entering bit-level pattern in binary or decimal including LUN, transfer length and LBA.

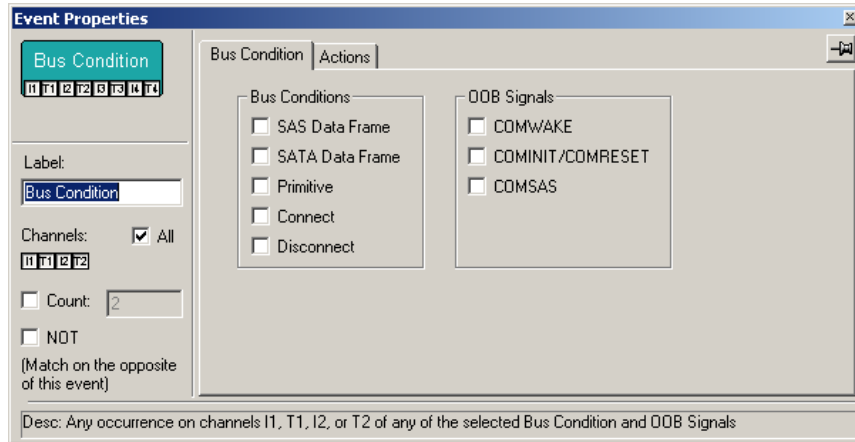
## BUS CONDITIONS AND OOB SIGNALS

Bus Conditions and Out of Band Signals are presented in a single dialog box.

### Bus Conditions and OOB Signals

Select from the check boxes to specify the type of Bus Condition or OOB Signal that you want the analyzer to search for.

If NOT is checked, any unchecked primitive will generate an event match.

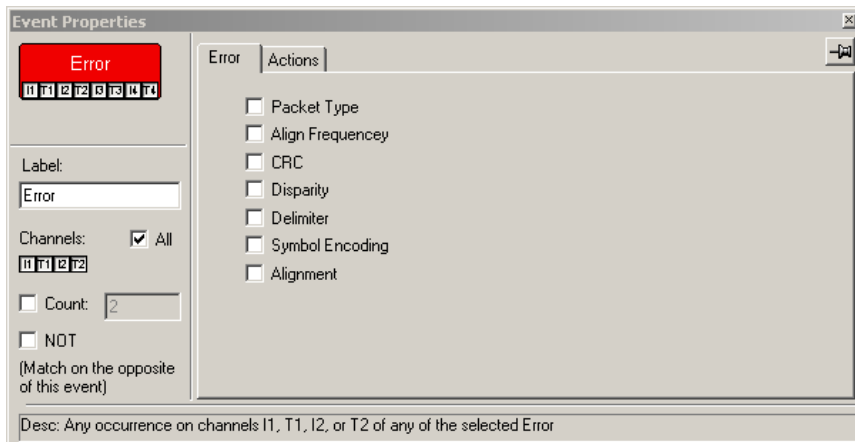


## ERRORS

Errors are presented in a single dialog box.

### Errors Properties Dialog

Select from the checkboxes to specify the type(s) of errors you want the analyzer to search for. If NOT is checked, any unchecked primitive will generate an event match.

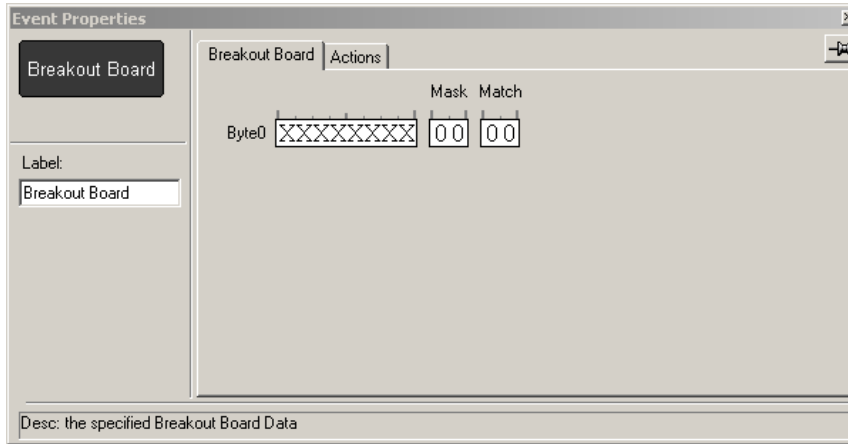


## BREAKOUT BOARD DATA

Breakout board data are entered into a single dialog box.

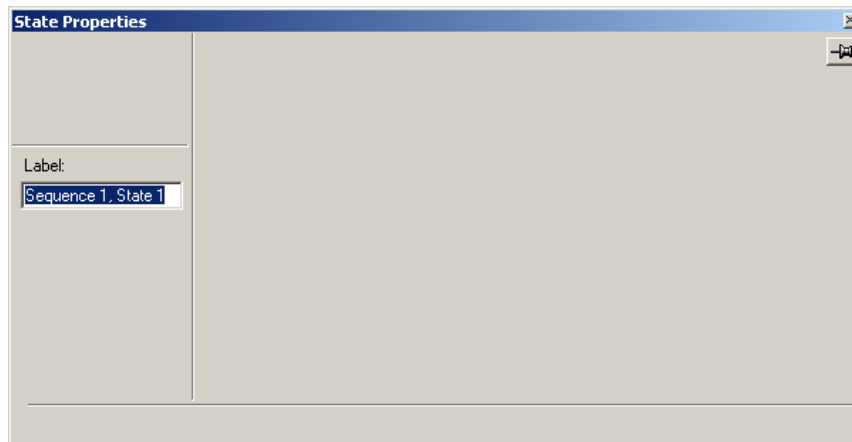
### Breakout Board Data Properties Dialog

The Breakout Board Data properties dialog box lets you specify a bit pattern from a breakout board that can be used for triggering. If NOT is checked, an event match will be created for any pattern other than the one specified.



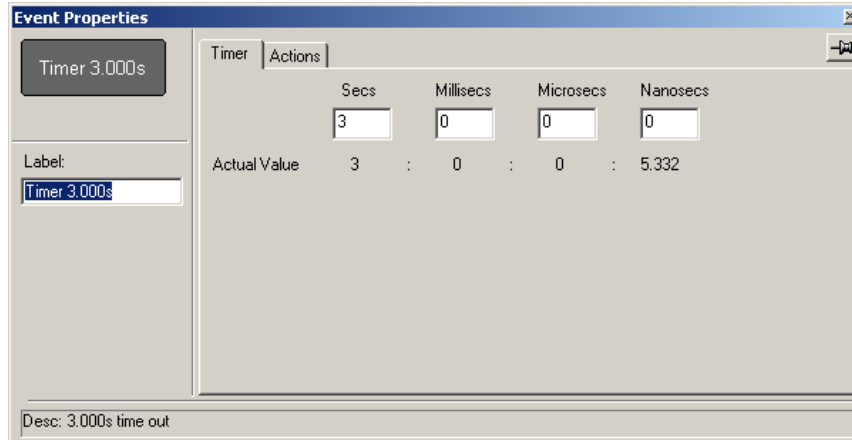
## 5.11 State Properties Dialog

The State Properties dialog allows you to specify the Global state's caption. To access this dialog box, click in the Global State Cell (but not on an Event button).



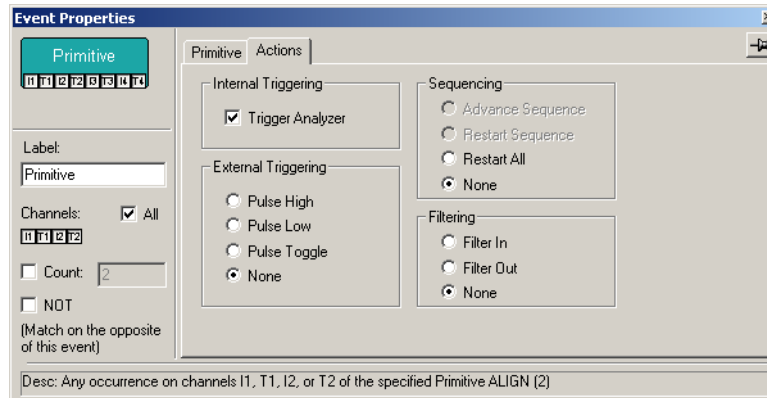
## Timer Properties Dialog

Specify the value for the timer in seconds, milliseconds, microseconds, and nanoseconds. The actual timer value is shown below the edit controls and reflects the hardware precision capabilities. The time is rounded up to the next 7.519 nanosecond sample, which corresponds to the 1.33 MHz internal clock frequency.



## 5.12 Actions Tab in the Properties Dialog

The Actions tab at the top of Event Properties dialog boxes lets you set the type of action that the analyzer will perform once an event has been found.



## 5.13 Assigning Actions

As shown above, you can double-click an Event or Action button to open the Properties dialog box, and then select the Actions tab. You can then select an action from one of the options.

The assigned action will be represented by a button to the right of the Event button.



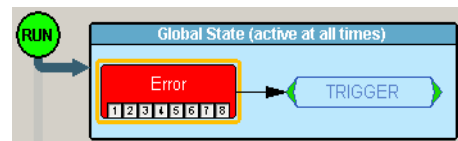
You can also assign an action by right-clicking on an Event or Action button and selecting an action from the pop-up menu.

The following table shows the types of Actions you can select.

Action	Comment
TRIGGER	Triggers the end of the recording. The end point of the recording is determined by the buffer settings in the Recording Options General page.
FILTER OUT	Filters traffic in or out of the recording - thereby conserving recording buffer space.  Can not be assigned to the events with Counters.
FILTER IN	
RESTART ALL	Reinitializes counters.

## 5.14 Setting Conditions: The Role of the Global State Cell

The Global State cell is the arena in which you create triggering and/or filtering conditions. The cell is called the *Global State* cell because the conditions you create are active at all

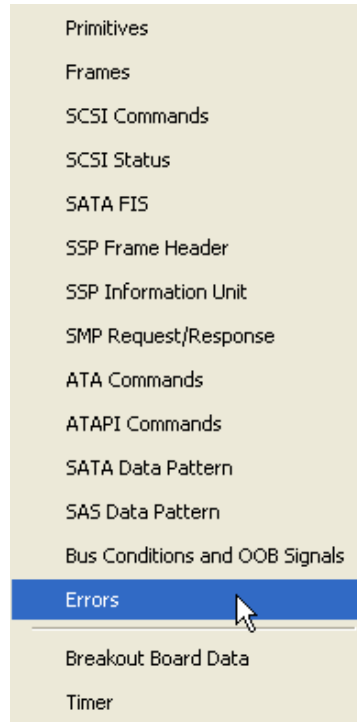


times. You can think of these conditions as the *default conditions*. You use the Global State cell to create simple condition such as "Trigger when you see an xxx error," or "filter out all xyz primitives."

### Example - Creating a Simple Event Trigger

To create a simple condition that is active at all times, place an event button in the **Global State** cell:

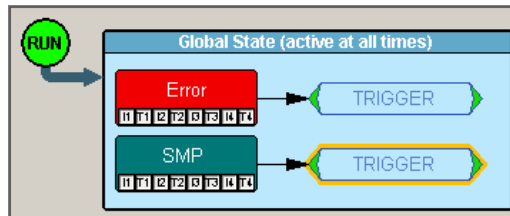
- Step 1** Click the New Event button. An Events menu opens (shown right).
- Step 2** Select an event from the menu. The event will appear as a button in the **Available Events** area on the left.
- Step 3** Drag the event button to the cell marked "Global State."
- Step 4** Right-click on the button (i.e., not the Global State cell). A pop-up menu appears.
- Step 5** Select **Trigger** from the menu. An arrow will project from the error button and point to a cell marked **Trigger**.



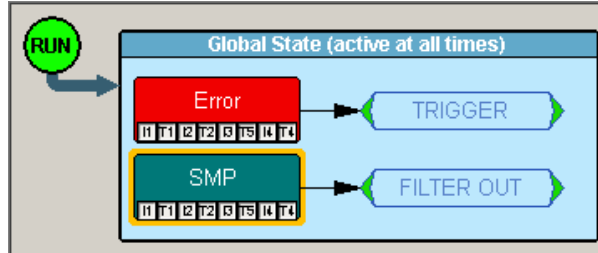
### Creating Multiple Event Conditions in the Global State Cell

When multiple buttons are placed in the Global Cell, it creates an "AND" condition or an "OR" condition depending on the actions selected.

**Creating an OR Condition** - When two or more buttons in the Global State cell are assigned the *same* action, the analyzer will search for all of the events and perform the action on which ever event it sees first. The example below illustrates. It reads "Trigger if an error or a primitive occurs".

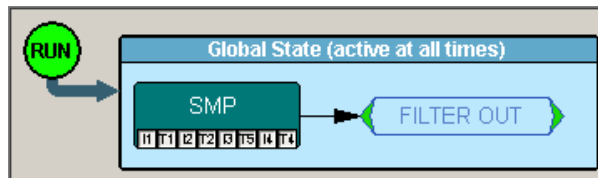


**Creating an AND Condition** - When multiple events are placed in the Global State cell and assigned *different* actions, an AND statement is created. The example below reads "Trigger if an error occurs AND filter out any primitives that occur."



### Filter In and Filter Out

A filter causes the analyzer to filter in or out specified events from the recording. If events are filtered out of the recording, they are excluded and not simply hidden from the trace. The purpose of filtering is to preserve recording memory so you can conduct longer recording sessions and exclude events that do not interest you.



To Filter In or Out traffic,

- Step 1 Click the **New Event** button. The **New Event** menu opens.
- Step 2 Select an event from the menu.
- Step 3 Drag the event into the Global State cell.
- Step 4 Right-click on the button. A pop-up menu opens.
- Step 5 Select **Specify Action(s)**
- Step 6 Select Filter Out (for example).

The analyzer is now configured to filter out the selected event.

### Filter In or Out Everything

The options **Filter Out Everything** or **Filter In Everything** allow you to filter all traffic in or out of the trace. These options are intended for a future release to allow you to selectively exclude and include traffic from a recording.

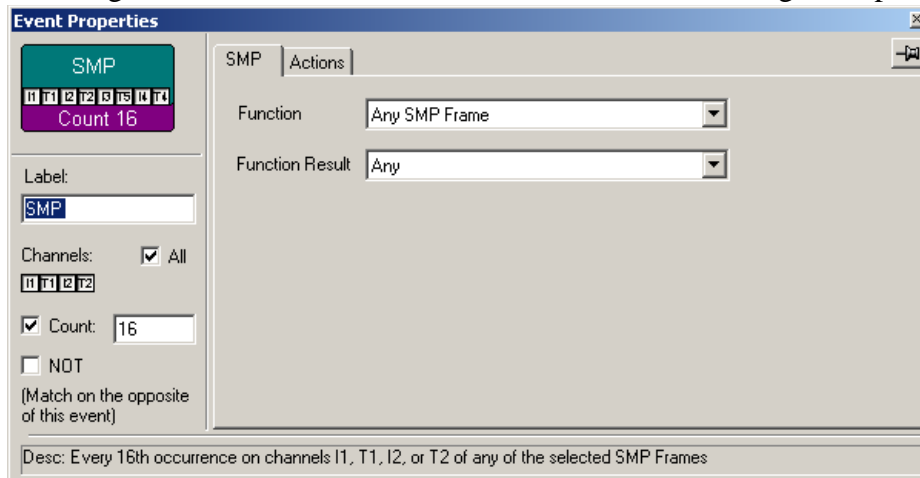


## Counting Events

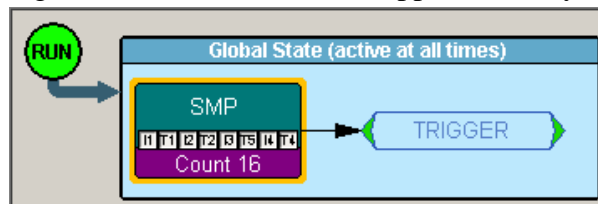
In addition to setting triggers and filters, you can also set *counters*. A counter is an action that allows you to set a trigger based on a count of events. For example, you could use a counter to "Trigger following the 16th occurrence of an error."

To use a counter, follow these steps:

- Step 1** Select an event from the **Select Event** menu and drag it to the Global State Cell in the center of the dialog box.
- Step 2** Click the small channel buttons on the selected Event button to select the channels for the actions.
- Step 3** Right-click the event and select **Add Counter**. A dialog box opens.

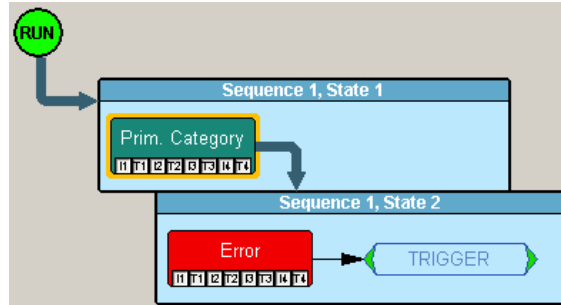


- Step 4** In the text box to the right of the label Count enter a value.
- Step 5** Make sure the checkbox to the left of the label Count is checked.
- Step 6** Click the X in the top right corner of the dialog box to close the dialog. A counter button should appear below your selected event.

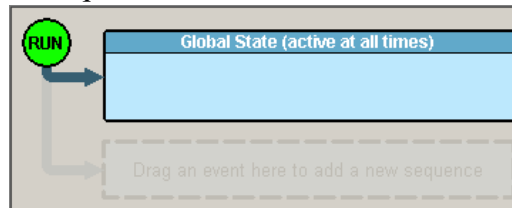


## 5.15 Creating Event Sequences

*Event sequences* are chains of events leading to some action. A sequence is is



a multi-event "if, then" condition: "If  $x$  followed by  $y$  followed by  $z$  occurs, trigger." Event sequences are created by dragging two or more buttons into the *Sequence cell*. The Sequence cell is a faintly marked cell just below the Global State cell. The Sequence cell contains the text *Drag an event here to add a new sequence*.

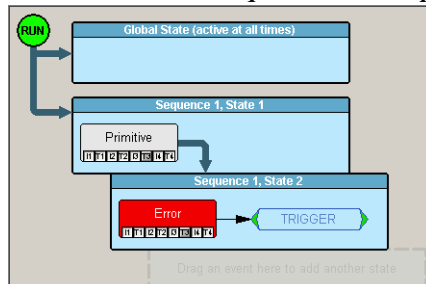


**Note** Event sequences can only be created in the Sequence cell. You cannot create a sequence in the Global State cell.

### States

Sequences are made up of cells called *States*. A state is a stage within a sequence that specifies what events the analyzer should look for and what actions to apply when the event occurs.

In the example below, the Sequence is composed of two states. The maximum number of states a sequence can support is 255.

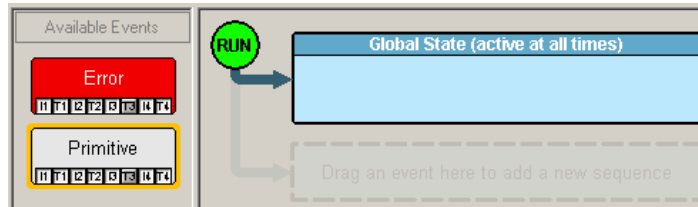


The foregoing example reads: "Trigger if you see a Primitive followed by an error."

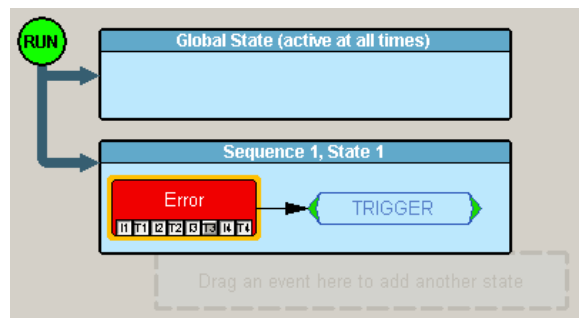
### How to Create an Event Sequence

To create an event sequence, you drag event buttons to the Sequence cell, link them with the action **Advance the Sequence**, then apply a trigger or other action to the end of the chain. The following steps illustrate how to create an event sequence.

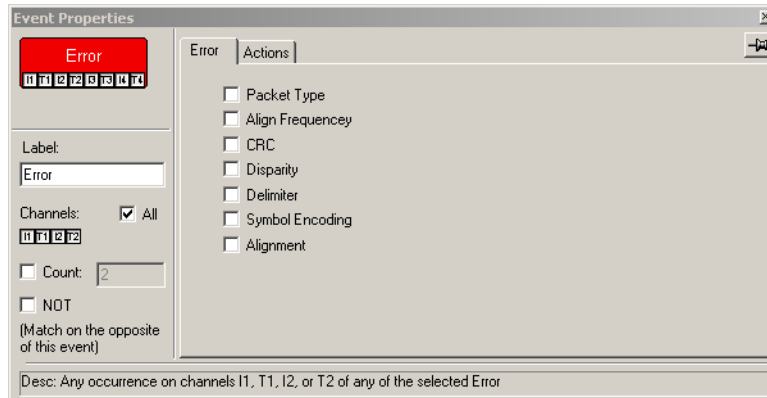
- Step 1** Click the **New Event** button. The **New Event** menu opens.
- Step 2** Select an event type from the menu, for example an error. A button appears in the **Available Events** area.
- Step 3** Click the **New Event** button and select a second event type, for example a Primitive. At this point, you should see two buttons in the **Available Events** area.



- Step 4** Drag the first button to the cell marked "Drag an event here to create a sequence." When you finish, notice how two new cells appear in the window as shown below the cell where you placed your button.



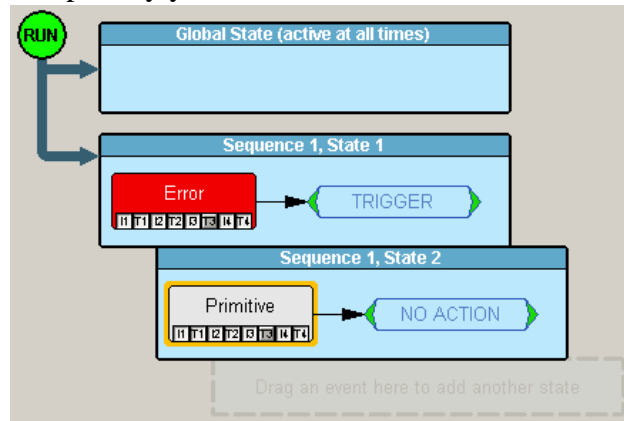
**Step 5** Double-click on the button. A Properties dialog box opens.



**Step 6** Select desired options from the dialog box, for example an error sub-type. The options apply immediately.

**Step 7** Close the Properties dialog box by clicking the X in the top right corner. The Properties dialog box closes.

**Step 8** Drag the second event button to the cell immediately below the cell occupied by your first event button. Note that an additional cell

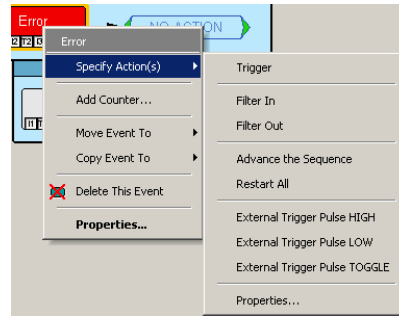


appears marked "Drag an event here to add a sequence."

**Step 9** Right-click on the first event button. A pop-up menu appears.

**Note** Be sure to click on the button itself and not the cell. If you click the cell, you will get a different menu with fewer options.

**Step 10** Select **Specify Actions**. Notice how this menu differs slightly from the menu shown earlier in this chapter. You will see three options for advancing or restarting a sequence:

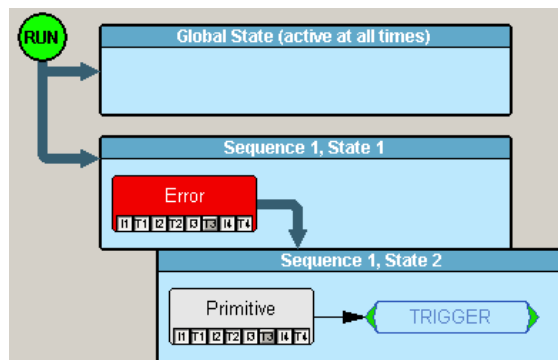


- **Advance the Sequence** - Draws an arrow that connects the selected event button to the event button below it. This option creates a sequence.
- **Restart the Sequence** - (Not visible in the menu above.) This option restarts the entire sequence. This option appears once you have linked two or more buttons in a sequence. This option draws an arrow upward from the selected event button to the beginning of the sequence.
- **Restart All** - Restart all sequences and counts. This option creates an arrow pointing a cell marked "Restart All."

**Step 11** Select **Advance the Sequence**. An arrow will appear that connects the first button to the second.

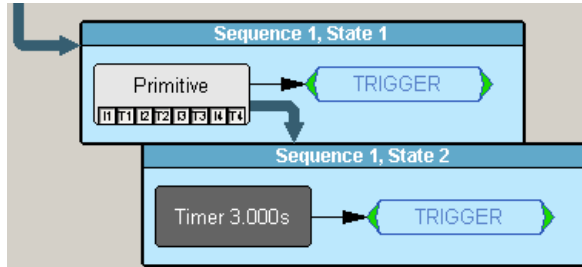
**Step 12** Right-click the second button and select **Specify Actions**. A sub-menu appears.

**Step 13** Select **Trigger**. A cell will appear to the right of the second button saying "Trigger." Your sequence configuration is now complete and should look like this:



## Using a Timer

Timers let you set a time-delay for a trigger or other action. The following example illustrates how timers work.



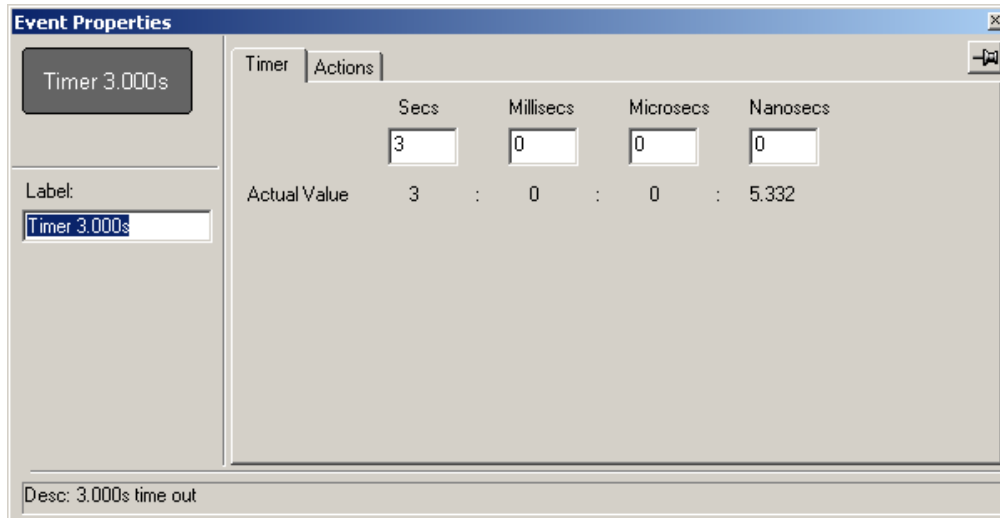
This example reads "Look for a Primitive. When you see one, wait three seconds then trigger."

To create the example shown above, perform the following steps:

- Step 1 Click the **New Event** button to open the Event menu.
- Step 2 Select an event such as Primitive from the menu. An event button appears in the **Available Events** area.
- Step 3 Drag the event button into a Sequence cell marked "*Drag an event here to add another state.*" Once the button is added, the cell turns blue and acquires a title like "Sequence 1, State 1." Below the cell, a new cell appears marked "*Drag an event here to add another state.*"
- Step 4 Click the **New Events** button. The Events menu opens.
- Step 5 Select **Timer**. A Timer button appears in the **Available Events** list.
- Step 6 Drag the Timer Button to the cell marked "*Drag an event here to add another state.*" The cell turns blue and acquires a title like "Sequence 1, State 2."
- Step 7 To link the two events into a sequence, right-click on the first event (in our example, the Primitive event button). Be sure to click on the event button and not on the cell. A pop-up menu appears.
- Step 8 Select **Specify Action(s)**. A sub-menu opens.
- Step 9 Select **Advance the Sequence**. The menu closes and an arrow appears that connects this cell to the State cell below.
- Step 10 Right-click on the Timer button. A pop-up menu appears.
- Step 11 Select **Specify Action(s)**. A sub-menu opens.
- Step 12 Select **Trigger**. The menu closes and an arrow appears that connects

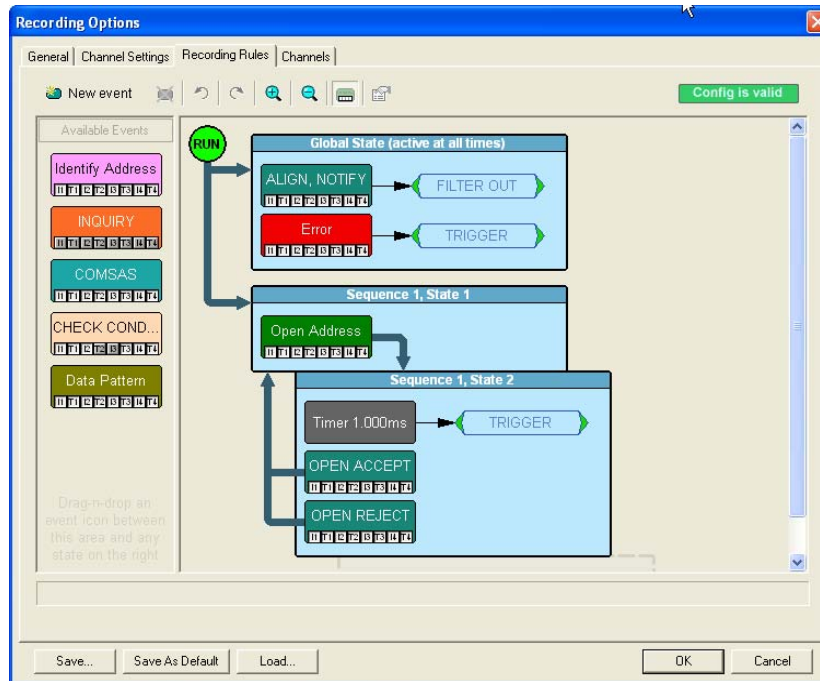
the Timer button to a new cell to the right marked **Trigger**.

- Step 13** To set the duration of the Timer, double-click on the Timer button. A dialog box appears.



- Step 14** Enter a time value in the boxes.

- Step 15** Click the **x** to close the dialog box. The timer is now set.



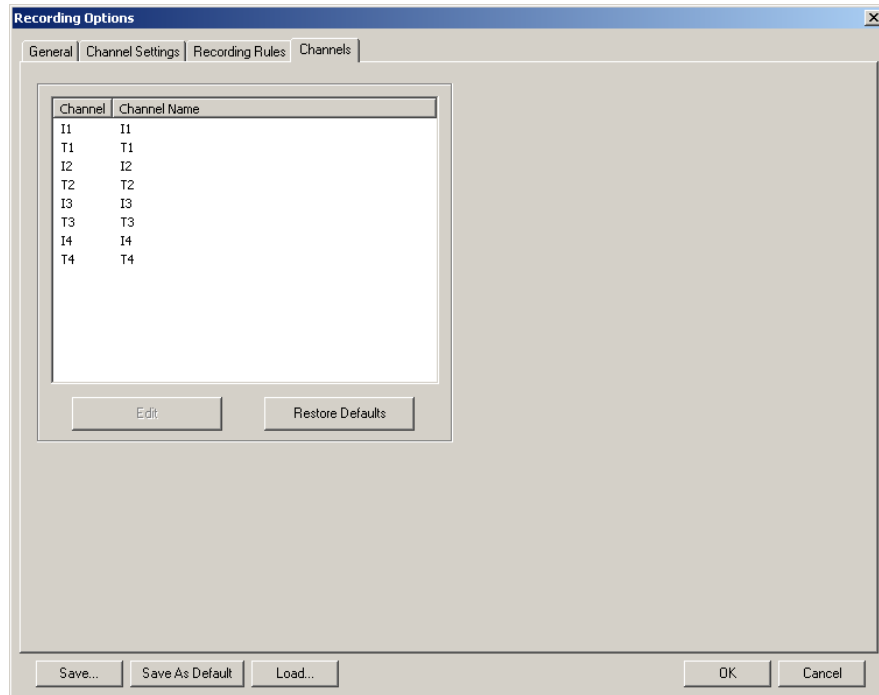
### *Sequential Events and Timers*

The recording option above shows an example of using a Loop and Timer to trigger on Open Timeout violation. This reads "Wait for an OPEN ADDRESS on I1; If OPEN ACCEPT or an OPEN REJECT occurs on T1 within 1ms, restart the loop; ELSE IF 1 ms elapses (without detecting an OPEN ACCEPT or an OPEN REJECT on T1) then trigger the analyzer".



## 5.16 Recording Options - Channels

The Channels page allows the channel names to be customized. To change a channel name, select the channel, then click the edit button and enter the new text, then click **OK**. Once the options are set, the analyzer will update the open trace and all future traces with the new channel names.



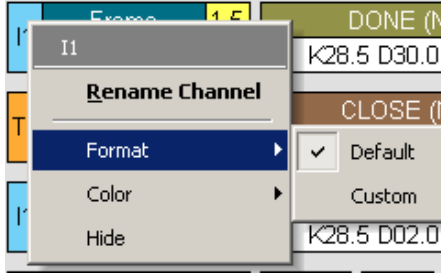
**Note** You can also change channel names by clicking on the first cell of a trace (the channel cell) and selecting **Rename Channel** from the pop-up menu.

### Where Custom Channel Names Appear

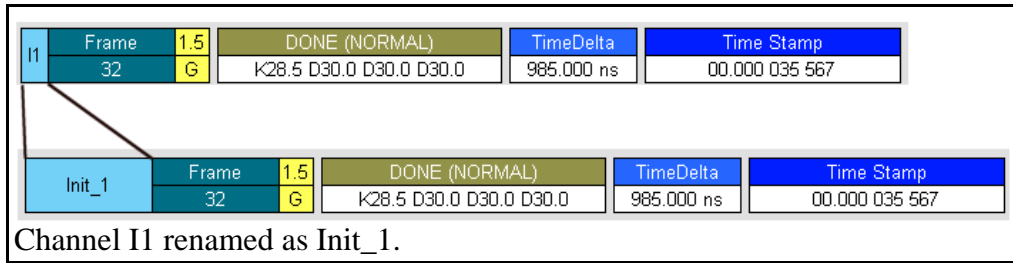
Custom channel names appear in three places:

- The trace itself
- Link Tracker window
- Bus Usage window

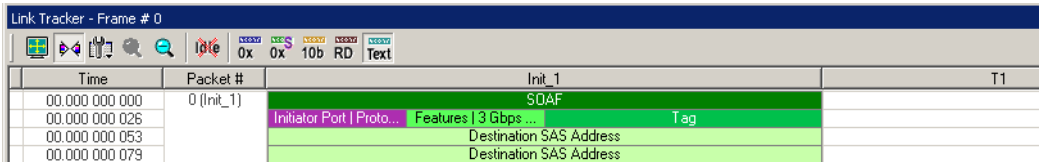
**Custom Channel Names in the Trace** - Custom channel names do not appear right away in the trace: the original names continue to display. To see the custom channel names, click in the first cell of the trace (the channel cell) and select **Format** from the pop-up menu, then select **Custom**.



The custom names will then appear in the trace.

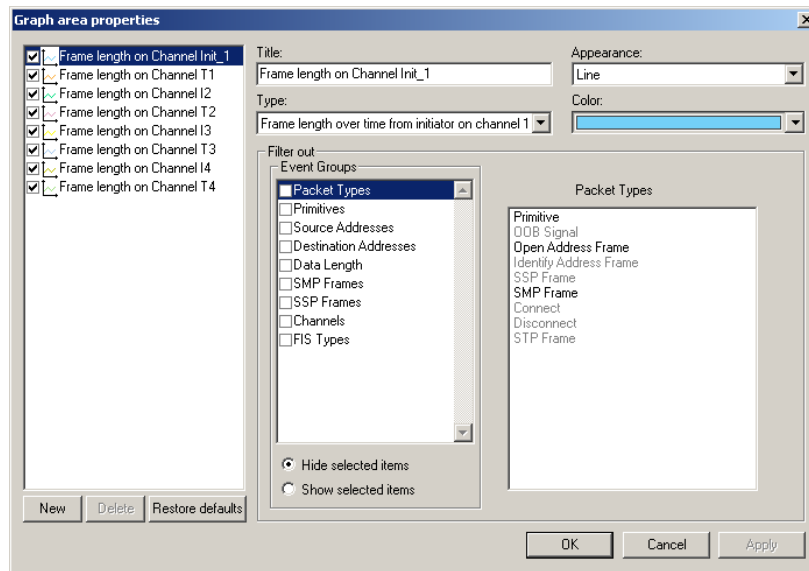


**Custom Channel Names in the Link Tracker Window** - The Link Tracker window will automatically show custom channel names as soon as they have been customized.



**Custom Channel Names in the Bus Usage Window** - Custom Channel names automatically appear in the Bus Usage window as soon as they have been customized. The easiest way to see this is to open the Bus Usage window and then to open the Properties dialog for the window. It will list the custom channel names.

To open the properties dialog box for the Bus Usage window, right-click in the window, then choose **Properties** from the pop-up menu.





## 6. Reading a CATC Trace

I1	Frame	SOF	COMMAND	Hashed Source Address	Hashed Destination Address	ReTran	Fill_CNT	Tag
	170			0x206A82	0xB4D463	0	0	0x0100
TPT_Tag		Offset		Data	CRC	EOF	TimeDelta	Time Stamp
0xFFFF		0x00000000		28 bytes	0x50C03F1B		1.372 µs	00000.133 12330
T1	Frame	ACK			TimeDelta	Time Stamp		
	171	K28.5 D01.4 D01.4 D01.4			1.023 ms	00000.133 12879		

### 6.1 Trace View Features

SASTracer/Trainer trace viewing software display makes extensive use of color and graphics to fully document the captured traffic. Frames are shown on separate time-stamped rows, with their individual fields both labeled and color coded. Data fields can be collapsed to occupy minimal space in the display (which can in turn be zoomed in and out to optimize screen utilization). Pop-up Tool Tips annotate Frame fields with detailed information about their contents.

The display software can operate independent of the hardware and so can function as a stand-alone Trace Viewer that may be freely distributed.

### 6.2 Frame, Transport, SCSI, and Management Views

The default display mode is Frame view. The trace can also be viewed in Transport Layer (Tra), SCSI Application Layer, Management Application, ATA Application Layer views.

#### *Changing Display Levels*

To switch between the Frame, Transaction, SCSI, Management, and ATA application views, click the respective buttons on the Tool Bar.



### Frame Layer

Frame Level view is the default decode level. Frame Level view displays traffic as shown below:

T1	Frame 1770	ACK	K28.5 D01.4 D01.4 D01.4		TimeDelta	Time Stamp		
					1.022 ms	00000.394 30478		
T1	Frame 1808	SOF	RESPONSE	Data 52 bytes	CRC 0x4254675B	EOF	TimeDelta 887.000 ns	Time Stamp 00000.400 55282
I1	Frame 1809	ACK	K28.5 D01.4 D01.4 D01.4		TimeDelta 5.908 ms	Time Stamp 00000.400 55637		
I1	Frame 2028	SOF	COMMAND	Data 28 bytes	CRC 0xC9B51848	EOF	TimeDelta 1.360 µs	Time Stamp 00000.437 50919
T1	Frame 2029	ACK	K28.5 D01.4 D01.4 D01.4		TimeDelta 1.021 ms	Time Stamp 00000.437 51463		
T1	Frame 2067	SOF	RESPONSE	Data 52 bytes	CRC 0x4254675B	EOF	TimeDelta 882.000 ns	Time Stamp 00000.444 11765
I1	Frame 2068	ACK	K28.5 D01.4 D01.4 D01.4		TimeDelta 5.908 ms	Time Stamp 00000.444 12118		
I1	Frame 2285	SOF	COMMAND	Data 28 bytes	CRC 0x096A9689	EOF	TimeDelta 1.445 µs	Time Stamp 00000.481 7507

### Transport Layer

When you click the **Tra** button, the Transport Layer traffic is decoded and presented as shown below. To see Transport Layer transactions, you may need to scroll through the trace or use the **Find** command (under Search).

I1	Transaction 0	Open SSP	Source SAS Address FFFFFFFF_FFFF7FF	Destination SAS Address 21050004_CF87DD53	Result ACCEPTED	TimeDelta 2.399 ms	
I1	Transaction 1	SSP	COMMAND IU	SCSI LUN 0000 0000 0000 0000	SCSI CDB READ(10)	Result ACK	TimeDelta 875.355 µs
T1	Transaction 2	SSP	DATA	Data 512 bytes	Result ACK	TimeDelta 668.787 µs	

### SCSI Application Layer

When you click the **SCSI** button, SCSI Application Level traffic is decoded and presented as shown below:

I1	SCSI Operation 0	Initiator SAS Address FFFFFFFF_FFFF7FF	Target SAS Address 21050004_CF87DD53	Tag 0x0100	SCSI LUN 0000 0000 0000 0000
	SCSI CDB READ(10)	Bytes Transferred 512	SCSI STATUS GOOD	Metrics #Fms 3	TimeDelta 1.544 ms

### Management Application Layer

When you click the **Mgt** button, Management Application Layer traffic is decoded and presented as shown below:

I1	Mgt Transaction 0	Initiator SAS Address 5002037E_157FE063	Target SAS Address 500805E6_BCC55C68	SMP Request RPT_GENERAL	Result ACCEPTED	TimeDelta 2.640 µs
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### ATA Application Layer

When you click the **ATA** button, ATA Application Layer traffic is decoded and presented.

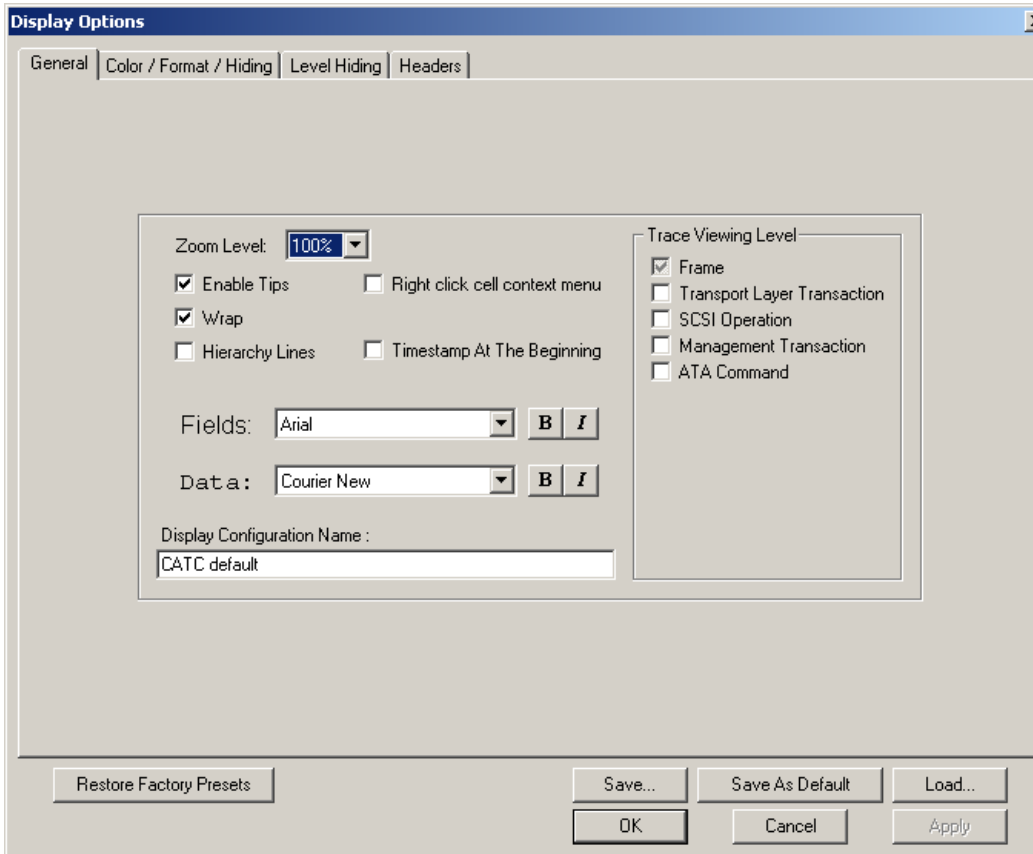
You can "open" any of these decode levels to reveal the components by clicking the small triangular in the first cell. The following is an example of an expanded Management Level view showing its constituent Transport Layer Transactions and Frames:

11	Mgt Transaction	Initiator SAS Address	Target SAS Address	SMP Request	Result		
1		5002037E_157FEC63	500805E6_BCC55C68	RPT_MFG_INFO	ACCEPTED		
11	Transaction	SMP	SMP Request				
5			RPT_MFG_INFO				
11	Frame	SOF	Type	Function	CRC	EOF	TimeDelta
8			SMP Request	RPT_MFG_INFO	0x00000000		1.947 μs

You can also get additional information on fields by holding your mouse over selected fields as shown in the following example:

Initiator SAS Address	Target SAS Address	
5002037E_157FEC63	500805E6_BCC55C68	
SMP	SMP Request	The SAS address of the initiator port for this operation

You can also set the hierarchical view by selecting checkboxes in the Trace Viewing Level Options in the **Display Options** window.



## 6.3 STP Decoding

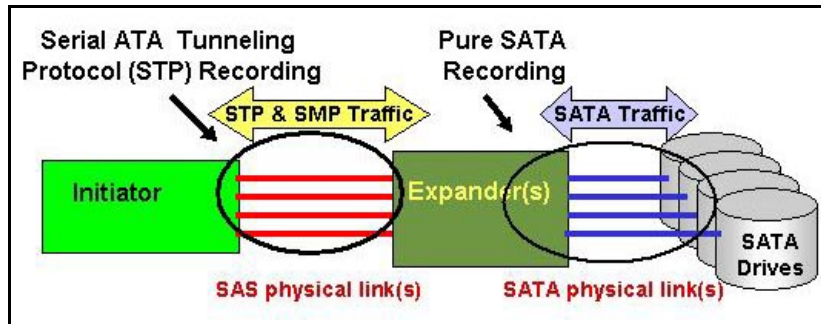
If STP traffic is present in a trace, you can see it by doing the following:

- Step 1** Click the **Tra** button to display Transport Layer protocols.
- Step 2** Select **Search > Go To > Frame Types > STP Frame**. The trace will reposition itself so that the next STP frame appears at the top of the Trace window.



### STP and SATA Traffic Over Hosts and Expanders

Traffic passing through an Expander may be STP on one side and SATA on the other side.



Traces of such setups will show different types of traffic depending on which link(s) were being recorded.

**STP Link Traffic** - Traffic on the STP side will have STP transactions but with SATA traffic embedded within it.

**SATA Traffic** - Traffic on the SATA side will be purely SATA and have no STP transactions.

## 6.4 View Raw Bits

SASTracer allows you to view low-level 8B/10B values for Serial Attached SCSI traffic. You can expand a specific Frame to view the raw bits by right clicking on the Frame number and selecting **Show Raw Bits**.

To view Raw Bits, follow these steps:

- Step 1** Click on the first cell of a **Frame**.

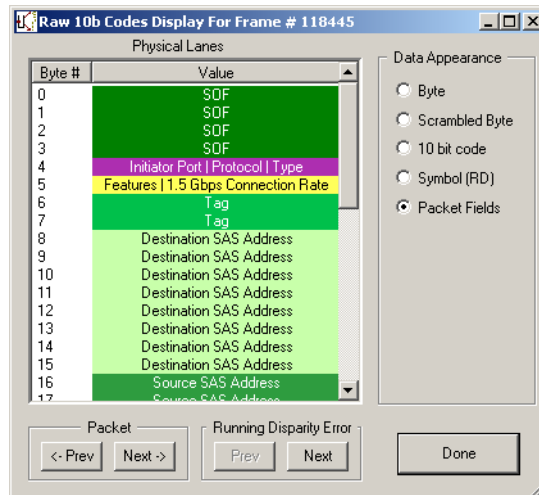


**Note** Raw Bits can be viewed only in Frames.

Frame	ALIGN (2)	Idle	Time Stamp
I1	Frame 1	D01.3 D01.3	54.585 $\mu$ s 00000.104 22020
I1	Frame 2	D27.3 D27.3	TimeDelta -9.655 $\mu$ s Time Stamp 00000.104 43865
T1	Frame 3	D07.0 D07.0	Idle Time Stamp 54.585 $\mu$ s 00000.104 40003
T1	Frame 4	D01.3 D01.3	TimeDelta 9.655 $\mu$ s Time Stamp 00000.104 61848
I1	Frame 5	D10.2 D27.3	TimeDelta 44.960 $\mu$ s Time Stamp 00000.105 1710

**Step 2** Select **Show Raw 10b Codes**.

The data **8b** and **10b** field can be displayed in several formats, as shown below.



**Data Appearance** - To change the format of the data, select from following options:

- **8b** - Click the column heading to show hexadecimal values.
- **10b** - Click the column heading to show hexadecimal values.

**Navigation** - To move to the previous or next packet in the trace, click one of the two buttons at the bottom of the window:

- **Prev** - Displays data for the previous Frame in the trace.
- **Next** - Moves to the next Frame in the trace.

**Running Disparity Error** - If SASTracer detects Running Disparity Errors it will display in red and have exclamation marks before and after the value.

The 8-bit codes change to 10-bit codes before they get transmitted.

### Running Disparity

Running Disparity is a binary parameter with either the value negative (-) or the value positive (+). After receiving any encoded character, the receiver shall determine whether the encoded character is valid using the running disparity parameter as a checksum. The receiver will then calculate a new value that is either the opposite of the previous character or neutral. The ability to view changes in Running Disparity polarity is an important part of the debug process. The CATC raw bits view displays the running disparity of the 10bit code in the column following the raw bits.

Note: For a more complete definition of Running Disparity, please refer to the Serial Attached SCSI Specification.

## 6.5 Expanding and Collapsing Data Fields

You can expand a Data Payload field to view it in greater detail or collapse it when you want a more compact view. *SASTracer/Trainer* allows you to expand and collapse the data payload information in four ways:

- Clicking the small triangular arrows on the left side of the data payload field
- Clicking and holding down the mouse button on the triangular button on the left side of a data payload field. This action will expand or collapse data fields for all Frames throughout the trace
- Double-clicking anywhere in the payload field
- Clicking in the data payload field and selecting **Expand/Collapse Data** in the pull-down menu.

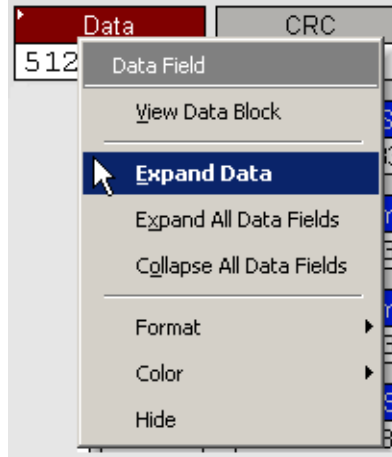
When you select "Expand Data," only the first 100 dwords are shown. To view all of the dwords, select "View Data Block."

This section describes expanding or collapsing data payload by using the menu:

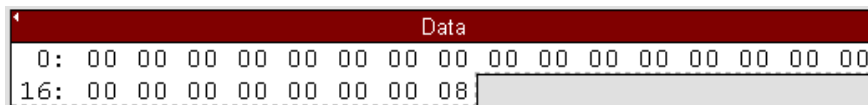
**Step 1** In the Serial ATA trace, click in a Data Payload box.



**Step 2** In the Data Field menu, select **Expand Data**.



The Data Payload box expands to show more detailed description of the data:



To collapse data, follow the same steps described above, and select **Collapse Data**.

You can also expand or collapse all data payload fields within a trace by using the above menu.

## 6.6 View Data Block Window

The View Data Block command opens a dialog box that lets you display and navigate the data within Frames and Transport Layer transactions. This dialog box gives you several format choices for the data: binary, hexadecimal, ASCII, and decimal. It also gives you the ability to navigate through data fields within different Frames and Transport Layer transactions.

To access the View Data Block window,

**Step 1** Decode to the level of interest by pressing **Fra** or **Tra**.

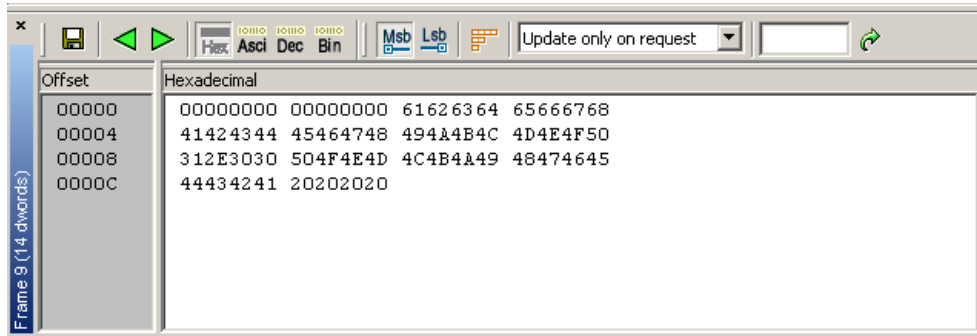
**Step 2** Locate a Frame or Transport Layer transaction with a data field such as the one shown below:

II	Frame	SOF	Type	Function	Data	CRC	EOF	TimeDelta	Time Stamp
	32		SMP Request	RPT_RT_INFO	8 bytes	0x1A495123		1.180 $\mu$ s	00000.000 14541

**Step 3** Click in the **Data** field to open a pop-up menu.

**Step 4** Choose **View Data Block** from the menu. The View Data Block


window opens.



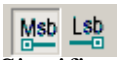
### Description of View Data Block Window


The View Data Block window (henceforth called the **View window**) displays the raw data for the selected Data field. Data is displayed in up to four formats, a column per format. The window has several options for navigating through Data blocks.

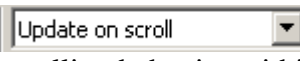
 **Save.** Saves the currently displayed data block into a text file.

 **Previous and Next.** These buttons cause the View window to jump to the next Frame that has a data block and display that data block.

 **Data Format Display.** Creates a column for the specified data format and then displays the currently selected data block in that format.

 **MSB/LSB Format.** Begins the data string with the Most Significant Bit (MSB) or Least Significant Bit (LSB).

 **Format Line.** Opens a dialog box for setting DWORD length. The default is 4 dwords.

 **Synchronize Options.** Configures the mouse's scrolling behavior within the View window.

The menu presents three scrolling options:

- **Update only on request** - Locks whatever data block currently is on display in the Data window unless overridden by a direct request. There are two ways to make a request -- by clicking on the buttons or by right-clicking in the trace on a data block and selecting View Data Block from the pop-up menu.
- **Update on click** - Repositions the Data window to whatever data block you click on in the trace window.

- **Update on scroll** - Synchronizes trace scrolling with the Data window. As you scroll the trace, the Data window will reposition to show the data block for the Frame at the top of the trace window.



**Scroll to Offset.** Repositions the Data window to whatever offset you enter in the Offset box. You can enter an offset value in decimal or hexadecimal.

## 6.7 Incomplete Frames Handling and Display

If SASTracer captures a frame that was not transmitted properly according to the protocol, it records the frame as an Incomplete Frame. This includes SSP, SMP, Address or STP(SATA) frames without Start Of Frame and/or End Of Frame, or frames with shorter payload that is dictated by the protocol.

The Incomplete frames are marked specifically in the Trace View. Here are some examples of Incomplete Frames display:

T1	Frame	3	Incomplete	SOAF	Data	Idle	Time Stamp	
	122332	G	IDENTIFY AF		24 bytes	44.160 ns	00.842 737 540	
T1	Frame	3	Incomplete	Data	CRC	EOAF	Idle	Time Stamp
	122333	G	OPEN AF	4 bytes	0xC3CF94D0		720.000 ns	00.842 737 677

### Incomplete Address frames

T1	Frame	3	Packet Error	Incomplete	SOAF	Idle	Time Stamp
	393352	G	Delimiter	SSP FRAME		0.000 ns	05.878 729 615

### Incomplete SSP frame

ime	3	Packet Error	SATA XMT	Incomplete	SATA_SOF	Data	TimeDelta	Time Stamp
559	G	10b Code		SATA FRAME		1028 bytes	104.160 μs	01:00.348 182

### Incomplete SATA frame

When Incomplete frames are displayed, no field decoding is done, only the raw payload recorded for the incomplete frame is presented. However, in the Link Tracker some field decoding can be performed, if possible (part of the frame header is received intact). Here are some examples:

11	Frame 122332	3	Incomplete	SOAF	Data	Idle	Time Stamp
		G	IDENTIFY AF		24 bytes	44.160 ns	00.842 737 540
11	Frame 122333	3	Incomplete		Data	CRC	Idle
		G	OPEN AF		4 bytes	0xC3CF94D0	EOAF
						720.000 ns	00.842 737 67

**Link Tracker shows some decoded fields for incomplete Identify Address frame**

11	Frame 40139	3	Incomplete	SOF	Data	Idle	Time Stamp
		G	SMP FRAME		8 bytes	125.000 ns	02.121 365
11	Frame 40140	3			EOF	TimeDelta	Time Stamp
		G			K28.5.D24.0.D16.7.D27.4	18.046 ms	02.121 366.017

**Link Tracker shows some decoded fields for incomplete SMP frame**

**Split Frames**

Some frames - mostly STP (SATA) - can take a very long time on the bus. For SATA frames it happens when Host and target go into long Hold periods while writing or reading the data. In this case it is not viable for SASTracer to record the whole traffic sequence as one frame, and the Split Frame approach is used. The long frame is broken into a sequence of smaller frames, which are marked as Starting frame, zero or more Middle frames and an Ending frame. This is highlighted in the Trace View like this:

I1	Frame	3	SATA XMT	Split	SATA_SOF	FIS Type	Port	Data	Idle	Time
	206049	G		START		Data	0x0	2052 bytes	0.000 ns	01:00.34
I1	Frame	3	SATA XMT	Split	Data				Time Stamp	
	210376	G		MID	4096 bytes				01:00.347 694 890	
I1	Frame	3	SATA XMT	Split	Data			CRC	SATA_EOF	TimeDelta
	210472	G		END	2048 bytes			0xDDF3493C		118.920 µs
										Time
										01:00.34

**A frame transmitted by SATA initiator is split into three frames.**

I1	Frame	3	SATA XMT	Split	SATA_SOF	FIS Type	Port	Data	TimeDelta	Time Stamp
	198422	G		START		Data	0x0	6564 bytes	742.500 ns	01:00.346 584 157
T1	Frame	3	SATA RCV	Split	TimeDelta	Time Stamp				
	198515	G		START	306.090 µs	01:00.346 584 900				
I1	Frame	3	SATA XMT	Split	Data			CRC	SATA_EOF	TimeDelta
	202335	G		END	1632 bytes			0xDDF3493C		570.000 ns
T1	Frame	3	SATA RCV	Split	TimeDelta	Time Stamp				
	202336	G		END	33.945 µs	01:00.346 891 560				
T1	Frame	3	SATA XMT	SATA_SOF	FIS Type	Port	Data	CRC	SATA_EOF	TimeDelta
	202378	G			DMA Activate	0x0	4 bytes	0x8FA86FC5		185.000 ns
I1	Frame	3	SATA RCV	TimeDelta	Time Stamp					
	202385	G			20.250 µs	01:00.346 925 690				
I1	Frame	3	SATA XMT	Split	SATA_SOF	FIS Type	Port	Data	TimeDelta	Time Stamp
	203805	G		START		Data	0x0	7920 bytes	737.500 ns	01:00.346 945 940
T1	Frame	3	SATA RCV	Split	TimeDelta	Time Stamp				
	203836	G		START	306.088 µs	01:00.346 946 677				
I1	Frame	3	SATA XMT	Split	Data			CRC	SATA_EOF	TimeDelta
	205472	G		END	276 bytes			0xDDF3493C		582.500 ns
T1	Frame	3	SATA RCV	Split	TimeDelta	Time Stamp				
	205473	G		END	4.192 µs	01:00.347 253 347				
I1	Frame	3	CLOSE (NORMAL)	Sequence	TimeDelta	Time Stamp				
	205483	G		K28.5 D02.0 D30.0 D27.4	3	307.500 ns				01:00.347 257 540

**SATA frames both on Transmitter and Receiver sides are split**

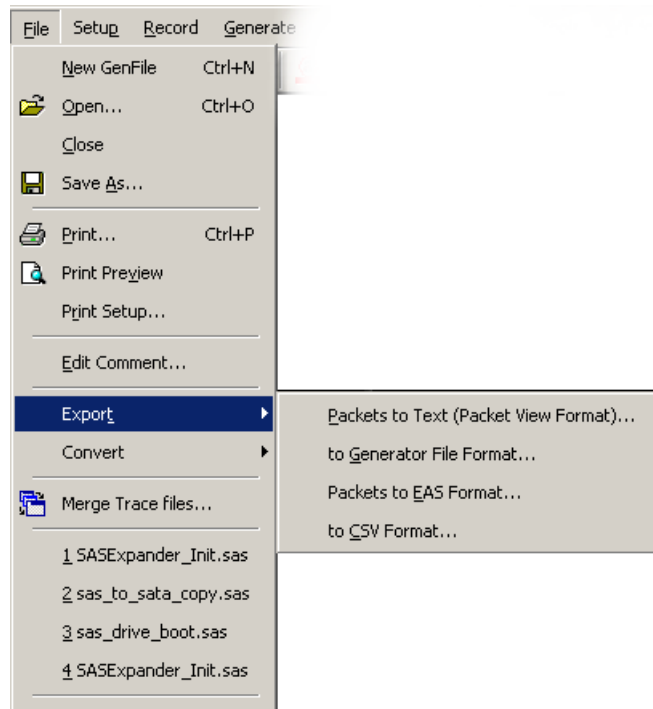
The frames that are split get assembled together at the Transport level of decoding/display. For example:

I1	Transaction	3	STP	FIS Type	Port	Data	Time Stamp			
	1048	G		Data	0x0	8192 bytes	01:00.346 584 157			
I1	Frame	3	SATA XMT	Split	SATA_SOF	FIS Type	Port	Data	TimeDelta	Time Stamp
	198422	G		START		Data	0x0	6564 bytes	742.500 ns	01:00.346 584 157
T1	Frame	3	SATA RCV	Split	TimeDelta	Time Stamp				
	198515	G		START	306.090 µs	01:00.346 584 900				
I1	Frame	3	SATA XMT	Split	Data			CRC	SATA_EOF	TimeDelta
	202335	G		END	1632 bytes			0xDDF3493C		570.000 ns
T1	Frame	3	SATA RCV	Split	TimeDelta	Time Stamp				
	202336	G		END	33.945 µs	01:00.346 891 560				
T1	Transaction	3	STP	FIS Type	Port	TimeDelta	Time Stamp			
	1057	G		DMA Activate	0x0	20.435 µs	01:00.346 925 505			
I1	Transaction	3	STP	FIS Type	Port	Data	TimeDelta	Time Stamp		
	1058	G		Data	0x0	8192 bytes	311.600 µs	01:00.346 945 940		

**In the example above, although SATA frames both on Transmitter and Receiver sides are split, they are assembled together in the Transport Layer transaction. The payload, that was split into 6564 and 1632 bytes is assembled together in one 8192 bytes buffer.**

## 6.8 Export Options

Trace data captured by *SASTracer* can be exported for other uses, including uses outside the system. These options are accessed through the **File** menu by selecting **Export**, as shown below.

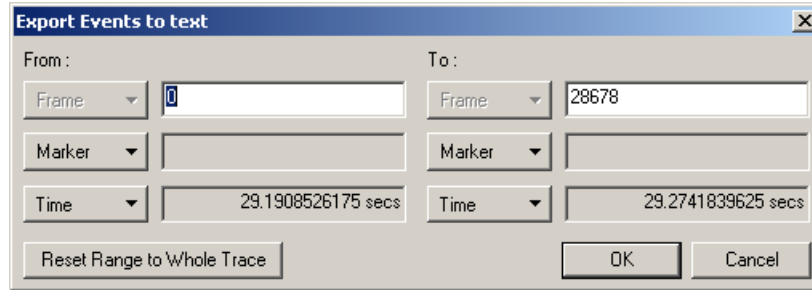


There are four export options supported. The data fields which will be present in the exported files are determined by the current screen view. Please select the appropriate data fields before exporting the data to ensure that the correct information is present in the exported file.



### Packets to Text (Packet View Format)

This option is used to create a text version of the trace (e.g., for use when emailing a trace section). Selecting this option brings up a screen to allow you to define the range of events that you want to include in the text file. The range can be defined by frame number, by markers, or by time.



Define the range of events (by frames, markers or time) that you would like in the exported file and click "OK". A screen will appear for you to provide a filename for the exported file, and allow you to navigate to the folder where you wish to store the file. The exported file will have a ".txt" extension.

### Export to Generator File Format

A feature of the *SASTrainer* is the ability to use a trace captured by the *SASTracer* as the basis for traffic to be generated by the *SASTrainer*. In order to use this feature, the captured trace must first be exported by using the "Export to Generator File Format" command. See *Generating Traffic* on page 156 for a discussion on how to use this feature with the *SASTrainer*.

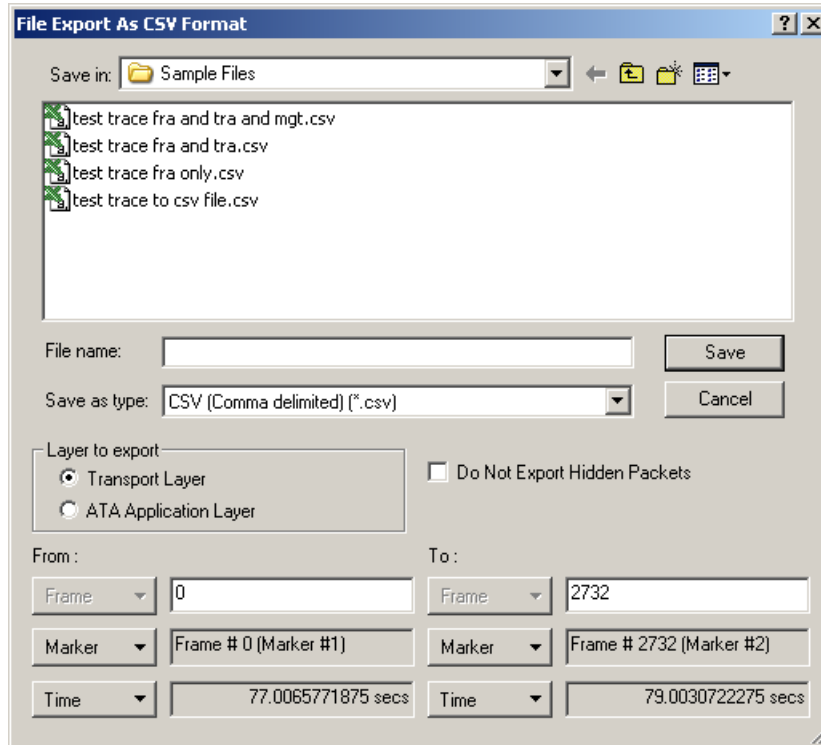
### Packets to EAS Format

This option creates EAS files based on the open trace. Selecting this option will bring up a screen allowing you to name the files and navigate to the folder that you would like to store the files. There are three files created, one file with a ".ecs" extension and two files (one for each channel) with a ".eas" extension. The ".eas" files will have "\_000\_ch1" and "\_000\_ch2" appended to the file name you provided.

### Export to CSV Format

Many users might wish to have the trace data exported into a formatted file (e.g., for import into databases or spreadsheet programs such as Microsoft Excel). The "Export to CSV Format" option provides a means of generating a structured file from trace data captured by *SASTracer*.

Selecting this option will bring up a screen allowing the user to specify the information from the current file to be exported and the destination file for the exported data.



Select the destination folder and enter the destination filename for the exported data. Select the layer to export (either Transport or ATA Application Layer). Indicate whether you would like hidden packets to be included in the exported file or just displayed packets. Define the range of events (by frames, markers or time) that you would like in the exported file and click "Save".

The exported file will have a ".csv" extension. The first line (or record) in the .csv file will be a header indicating the name of each variable included in the file. Each following line (or record) will contain only data.

If opening the exported file from within Microsoft Excel, in the Open File window under "Files of Type:" select "Text Files (....; \*.csv)". When the file is opened, a spreadsheet is shown with a large number of columns (each column representing one data type) and a number of rows on the trace which was selected for export. A typical spreadsheet is shown on the next page. Once opened, the file can be later saved as any supported Excel file type.

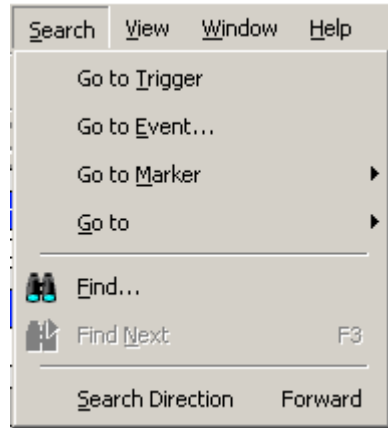
test trace to csv file.csv									
	A	B	C	D	E	F	G	H	I
1	Channel	Transactio	Speed	Protocol	Source Po	Source SA	Destination	Close	Frame T
2	I1	0	3	SSP Open I		500062B0	50000000	00000001	
3	I1	1	3	SSP					COMMA
4	T1	2	3	SSP				NORMAL	
5	T1	3	3	SSP Open T		50000000	500062B0	000002F5	
6	T1	4	3	SSP					DATA
7	I1	5	3	SSP				NORMAL	
8	T1	6	3	SSP Open T		50000000	500062B0	000002F5	
9	T1	7	3	SSP					RESPO
10	I1	8	3	SSP				NORMAL	
11	I1	9	3	SSP Open I		500062B0	50000000	00000001	
12	I1	10	3	SSP					COMMA
13	T1	11	3	SSP				NORMAL	
14	T1	12	3	SSP Open T		50000000	500062B0	000002F5	
15	T1	13	3	SSP					DATA
16	I1	14	3	SSP				NORMAL	
17	T1	15	3	SSP Open T		50000000	500062B0	000002F5	
18	T1	16	3	SSP					RESPO
19	I1	17	3	SSP				NORMAL	
20	I1	18	3	SSP Open I		500062B0	50000000	00000001	



## 7. Searching Traces

SASTracer has several search commands that enable you to navigate a trace in search of key events such as errors and triggers. These commands are launched from the Search menu.

To view the search options, click **Search** in the Menu bar.



### 7.1 Go to Trigger

To display a Trigger Event, select **Go to Trigger** from the **Search** menu.

The Trace View is repositioned with the first Frame following the Trigger event (or the Frame that caused the Trigger) at the top of your screen.

### 7.2 Go to Event ...

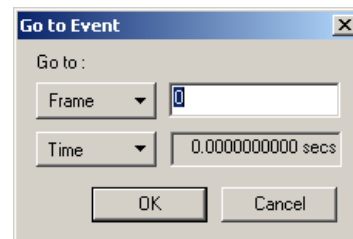
To display a specific Frame or higher decode level, follow these steps:

**Step 1** From the **Search** menu, select **Go to Event ...**

The **Go to Event** window appears.

**Step 2** From the **Go To** pull-down menus, select Frame, Time, or Markers (if present).

If you select Frame, a menu of decode levels will appear. Select the decode level of interest (if it does not appear, you may have to press a decode button on the toolbar). Then enter an event number in the text box to the right.



If you select Time, a text box will appear prompting you to enter a time value.

If you select Marker, a list of Markers in the trace will appear. Select a Marker from the list.

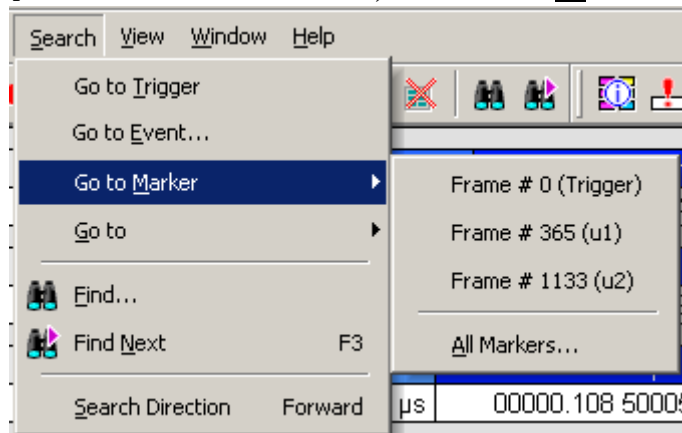
**Step 3** Click **OK**.

The trace view is repositioned with the selected item at the top of your screen.

## 7.3 Go to Marker

To instruct the Analyzer to display a marked Frame, follow these steps:

**Step 1** From the **Search** menu, select **Go to Marker**.



**Step 2** Select the desired Frame from the displayed list.

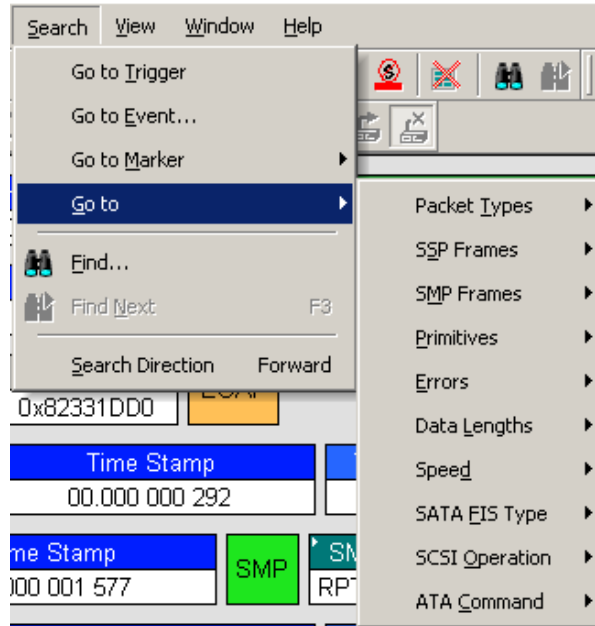
The Trace View is repositioned with the selected item at the top of your screen.

Selecting **Search > Go to Marker > All Markers** will cause a dialog box to open with a list of all markers in the trace. The dialog box offers options for editing, deleting, and copying markers.

**Note** The **Go to Marker** feature functions in conjunction with the **Set Marker** feature. The comments within the parentheses following each marked Frame are added or edited with the **Set Marker** feature. Please refer to **Set Marker in Reading a CATC Trace**.

## 7.4 Go To

The **Go To** feature takes you directly to an event in a Trace by allowing you to search by a specific criteria. Only the items present in a trace will be displayed in the **Go to** menu. If an item is not present in a trace, it is greyed out in the menu.




To apply the previous **Find** parameters to the next search, select **Find Next** from the **Search** menu.

## 7.5 Find

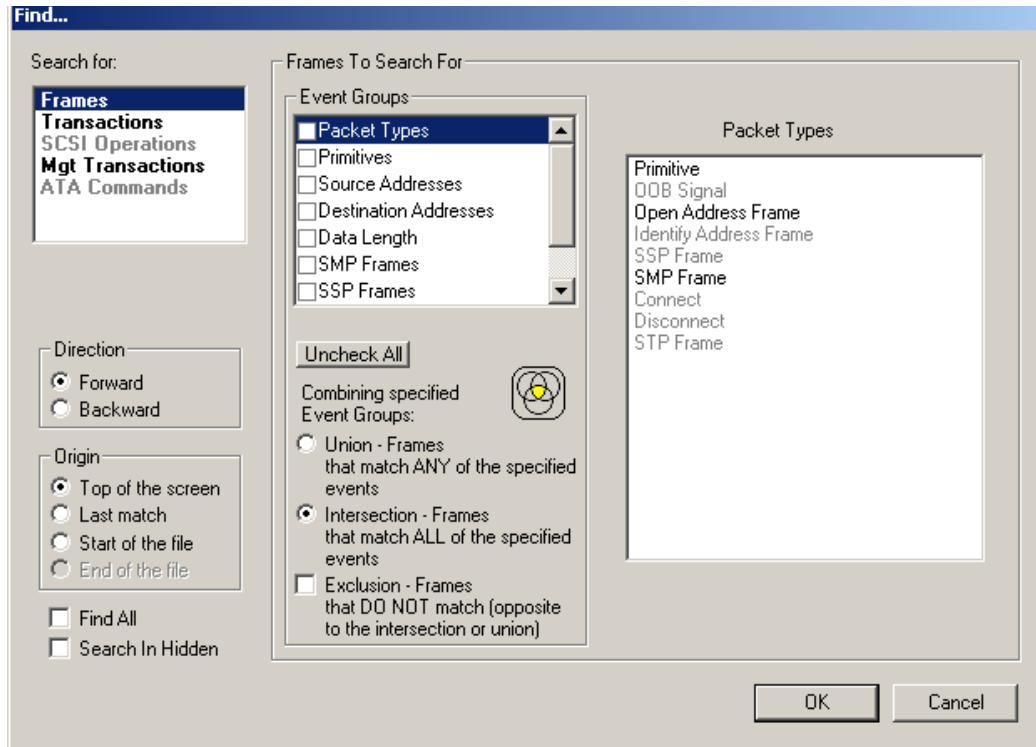
**Find** is a utility for conducting searches of one or more events within a trace. Find allows you to search different hierarchical levels within the trace - Frames, Transactions, SCSI Operations, and Mgt Transactions. To start find,

- Select **Find...** under **Search** on the Menu Bar

OR

Click  in the Tool Bar.

You see the **User-Defined Find Events** screen:



The **Find** window divides into three areas:

**Left area** -- Display options for setting the search level, direction and origin. The top left box is context-sensitive. In order for the **Transactions**, **SCSI Operations**, and **Management Transactions** to be active, you will need to decode these levels in the trace.

The left area includes two options at the bottom:

- **Find All** - Finds all specified events and extracts the results to a new window.
- **Search in Hidden** - Searches for specified events in all of the trace - including in traffic currently hidden from the display via the Hide buttons.

**Center area** -- Controls the event groups to be searched. The selection you make will display further choices on the right side of the Find window. At the bottom are three options called Union, Intersection, and Exclusion that are used with multi-criteria searches. These options are explained below.

**Right area** -- Controls the specific events to be searched within the trace. The box in this right section displays events from the selected Event Group.

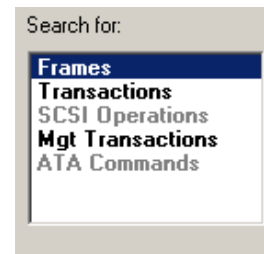


The right area is context sensitive - the Event Group selected in the Center Area determines what types of events display on the right. For example, if "Primitive Type" is selected, the right area will display a list of Primitive types. Bold entries indicate items that actually occurred in the trace.

In the example shown above, Primitive Types is selected. The right side of the screen shows all of the Primitive Types that occurred in the displayed trace.

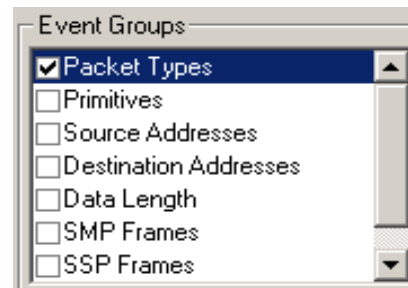
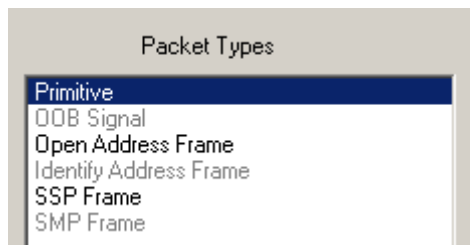
### Complex Searches

When conducting complex searches in the Find dialog box, you first push a decode button in the toolbar to enable *Frames*, *Transactions*, *SCSI Operations*, or *Management Transactions* in the **Search for...** box.



In this example, all of the Search for choices are enabled, and Frames is selected. The Event Groups box in the Find dialog contains available choices based on the selection.

After you have selected a choice in the Event Groups, the box on the right of the Find window will present choices based on your selection. In the following example, the box displays the primitive types that are available in the trace:



### Event Groups

Event Groups are categories of events that can occur in a trace. Clicking on an Event Group will display a list of Event types on the right side of the Find window that occur within each Event Group.

### Union, Intersection, and Exclusion

If multiple events are selected, use the options *Union* or *Intersection* to conduct the search.

**Union** is used to search for any selected event: "Find x or y." Union lets you tell the Analyzer to search the trace for any of any of the selected items.

**Intersection** is used to search for all selected events: "Find x and y." Intersection lets you tell the Analyzer to search the trace for any packet having all of the selected events.

**Exclusion** is used to exclude selected traffic from the trace. Exclusion is used with Union and Intersection --i.e., you select Exclusion with Union or Intersection.

- **Exclusion + Union** -- Exclude packets with any of the specified events.
- **Exclusion + Intersection** -- Exclude packets with all of the specified events.

### Using Find

**Step 1** Select the display level to be searched from the **Search For** box on the left side of the window.

For example, to search through Commands, select Commands. The display level affects options presented in the Events Group box.

**Step 2** Select a search direction and origin.

**Step 3** Select one or more events from the **Events Group** box.

Your choices will affect options displayed on the right side of the dialog.

**Step 4** If you have selected two or more criteria, then select either:

- **Union:** Find all packets that match ANY of the specified events.



- **Intersection:** Find all packets that match ALL of the specified events.



If you want to selected events from the trace, then select:

- **Exclusion:** Exclude all packets that match any of the specified events.




**Step 5** Click **OK**. The search then occurs, and the results display.

### Find Next

To apply the previous **Find** parameters to the next search,

Select **Find Next (or F3)** under **Search** on the Menu Bar

OR

Click  on the Tool Bar.

When Link Tracker is open and **Find Next** is used, the software repositions the LinkTracker (and other views) on the next frame containing the same primitive. For example, when using Find Next to search for SATA\_SYNC primitives - the display will select the next primitive in time starting from the specified origin (top of the screen, beginning of the file, last match), regardless of which frame and which recording channel it occurred.

**Figure 11: When using Find Next for primitives, the search order will be as shown**

I2		T2	
SATA_XXXX (R_OK)		1	SATA_SYNC
SATA_XXXX (R_OK)		2	SATA_SYNC
SATA_XXXX (R_OK)		3	SATA_SYNC
SATA_XXXX (R_OK)		4	SATA_SYNC
SATA_XXXX (R_OK)		5	SATA_SYNC
SATA_SYNC	6	7	SATA_SYNC
SATA_SYNC	8	9	SATA_SYNC
SATA_CONT		10	SATA_SYNC
		11	SATA_SYNC
		12	SATA_SYNC
SATA_SYNC	13	14	SATA_SYNC
SATA_X_RDY		15	SATA_SYNC
SATA_X_RDY		16	SATA_SYNC
SATA_CONT		17	SATA_SYNC
SATA_XXXX (X_RDY)		18	SATA_SYNC
SATA_XXXX (X_RDY)		19	SATA_SYNC
SATA_XXXX (X_RDY)			
SATA_XXXX (X_RDY)			



## 8. External Interface for Trigger In /Out

With each 10K analyzer, LeCroy includes two mechanisms for low latency communications with general purpose test and measurement equipment:

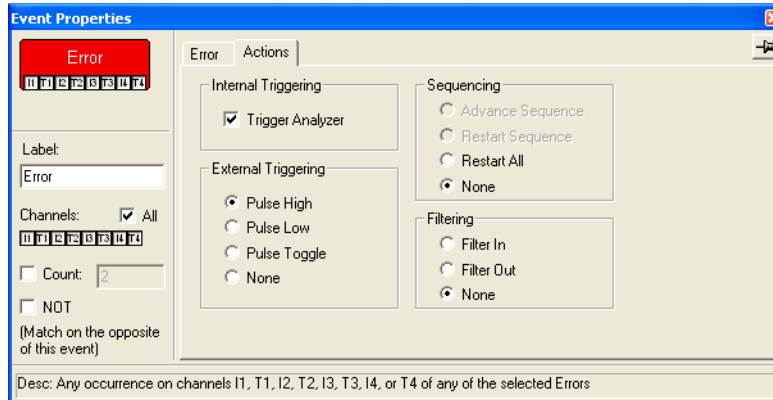
- BNC Trigger in / out - This connection can be used to send clocking information and recording commands from one analyzer to another (see “Setup for Cascaded Multiple Analyzer Use” on page 144.) The BNC interface can also be used for transmitting and receiving trigger in / out signals from general purpose instruments such as a LeCroy Oscilloscope or an InFusion Error Injection system.
- Break out board - The break-out board utilizes a LV TTL level signal which can provide a simple trigger in/out interface to the analyzer. It can also be used to configure the analyzer to trigger on a specific bit pattern received on the break out board data pins.

### 8.1 BNC External Trigger In / Out

The BNC External Trigger Out capability allows users to specify protocol level events as Trigger Out signals to external instruments. This provides a mechanism for SAS or SATA link layer errors detected on the analyzer to trigger an attached oscilloscope. The BNC Trigger In provides a similar mechanism allowing physical layer instruments to signal the analyzer to start capture at a specific instant.

#### Using the BNC Trigger Out

- Step 1** Attach the BNC Trigger Out connector to an appropriate BNC Trigger In connector on a general purpose test instrument using the provided BNC cable
- Step 2** In the SASTracer software, under **Recording Options**, select the **Recording Rules Tab**
- Step 3** Select the **New Event** button and specify the protocol level event desired to initiate the external Trigger Out signal



**Step 4** Under the **Actions** Tab, Select the type of **External Trigger** signal suitable for the external instrument. The 10K chassis support three external trigger-out signal types:

- Pulse High
- Pulse Low
- Pulse Toggle

**Note:** In each case, the BNC signal transmits an LV TTL level signal

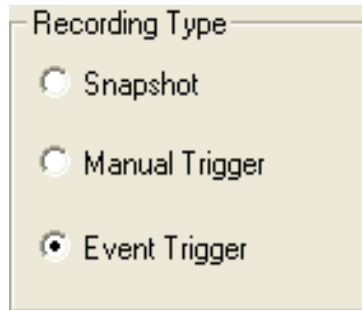
**Step 5** Select **Trigger Analyzer** on the **Actions** Tab if you intend to record protocol level traffic simultaneously while using the BNC External Trigger Out signal

**Step 6** Press the **Record** button to arm the analyzer. Trigger indicator on the analyzer faceplate will indicate when the trigger condition has been detected by the analyzer system.

### Using the BNC Trigger In

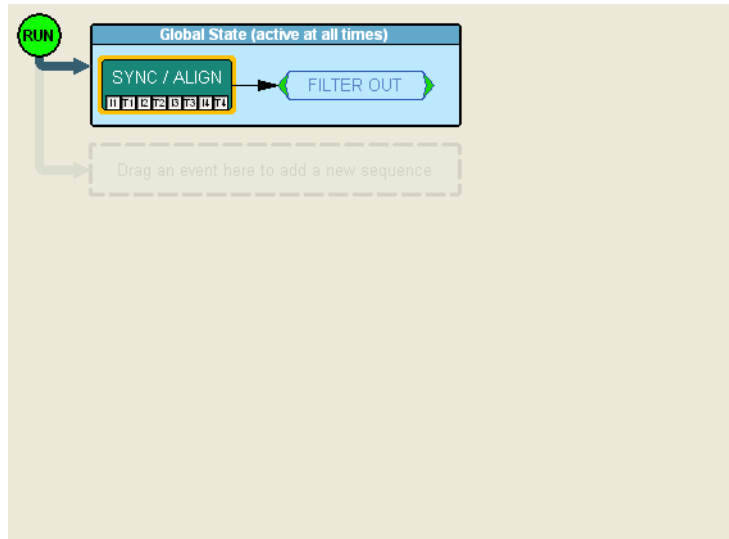
**Step 1** Attach an appropriate BNC Trigger Out connector on a general purpose test instrument to the BNC Trigger In connector using the provided BNC cable.

- Step 1** In the SASTracer software, under **Recording Options**, select the **General Tab** and click the radio button **Event Trigger** under



### Recording Type

- Step 2** Select the **Recording Rules** Tab. Remove all triggering events from the Recording rules (Filtering options can be retained - see Recording Rules screen image below)



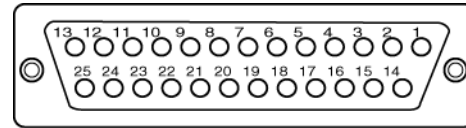
- Step 3** Press **Record > Start** button to arm the analyzer. The analyzer will indicate it is waiting for trigger. Any edge detected on the Trigger In signal will stop the recording and fill the buffer on the analyzer.

**Note:** Voltage required on the edge condition is 0 to .8V low, 2.0V to 3.3V high. 40nS is the approximate detection threshold for the BNC Trigger In feature.

**Note:** There is also a trigger indicator on the analyzer front panel that will indicate when the trigger condition has been detected by the analyzer.

## 8.2 Break Out Board Trigger In / Out

The Breakout Board connects via a 25 pin serial interface cable to the **Data In/Out** connector located on the rear of the analyzer unit. Each signaling pin is isolated by a 100 $\Omega$  series resistor and a buffer inside the Analyzer unit. Six ground pins and one 5-volt pin are provided.



**Data In/Out Connector (on cable)**

## 8.3 Pin-Outs for the Data In/Out Connector

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

### Data In/Out Connector – Pin-Out

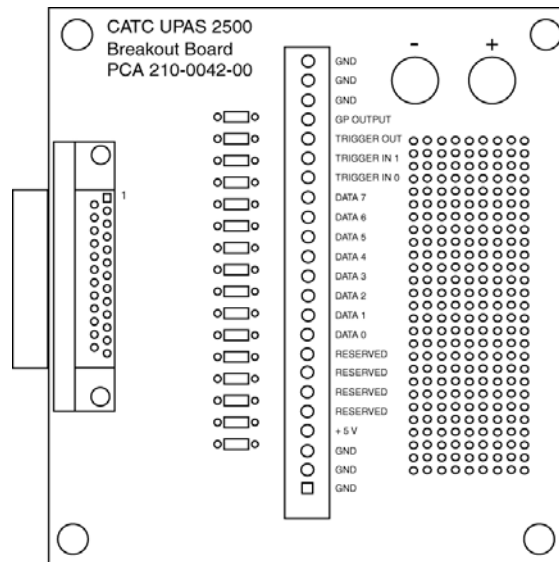
Pin	Signal Name	Signal Description
1	RSV	Reserved
2	GND	Ground
3	GP OUT	General Purpose Output
4	TRG IN 1	Trigger In 1
5	GND	Ground
6	DATA 6	Data 6
7	DATA 4	Data 4
8	DATA 3	Data 3
9	DATA 1	Data 1
10	GND	Ground
11	RSV	Reserved
12	RSV	Reserved
13	+5V	+5 Volts, 250 mA DC Source
14	RSV	Reserved
15	GND	Ground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



Pin	Signal Name	Signal Description
24	RSV	Reserved
25	RSV	Reserved

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

### External Interface Breakout Board



### Prototype Rework Area

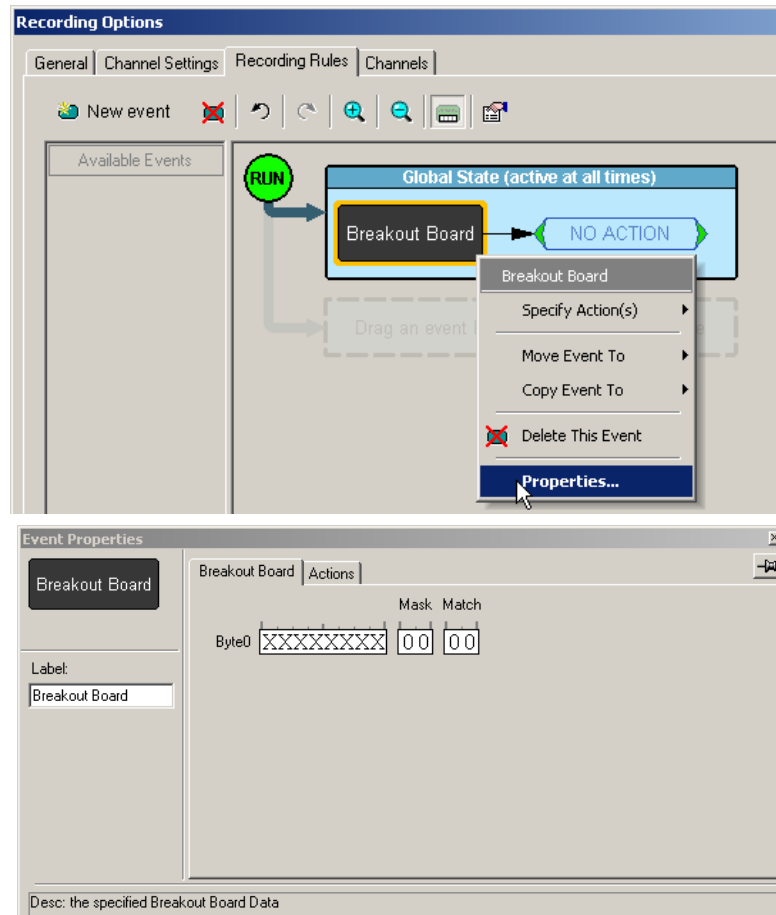
The Breakout Board contains a prototype rework area for making custom circuits for rapid development. The area consists of plated-through holes, 20 columns wide by 27 rows long. The top row of holes is connected to GND and the bottom row is connected to +5V. The remaining holes are not connected. Use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

## 8.4 Configuring Input Signaling through the Breakout Board

To configure the analyzer to trigger on an input signal from the breakout board, perform the following steps:

**Step 1** Select **Setup > Recording Rules** to open the Recording Options dialog. The Recording Rules page will display.

- Step 2** Click the **New Events** button to open the New Events menu.
- Step 3** Select **Breakout Board Data** from the New Events menu. This will cause a button to appear in the **Available Events** area. The button will be labeled **Breakout Board**.
- Step 4** Drag the new button to the **Global State Cell** or to the cell faintly marked **Drag an event here to add another state**. The **Global State Cell** allows you to set conditions that are globally true (i.e., always enabled). The cell marked **Drag an event here to add another state** is used to create event sequences - i.e., chains of events leading to a trigger or other action. For further explanation, see “Assigning an Action” on page 42.
- Step 5** Right-click on the Breakout Board button to open a pop-up menu.
- Step 6** Select **Properties** from the pop-up menu. The Properties dialog opens.



- Step 7** If you want to configure the analyzer to trigger on a specific bit pattern, enter it in the box marked Byte0. Alternatively, you can

enter a hex pattern and mask into the boxes marked Mask and Match. If no pattern is specified, the analyzer will trigger on ANY input signal.

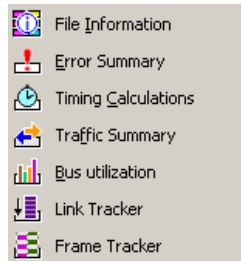
**Step 8** Click the tab marked **Actions**.

**Step 9** In the Internal Triggering section, select **Trigger Analyzer**. The analyzer is now configured to trigger on an input signal.



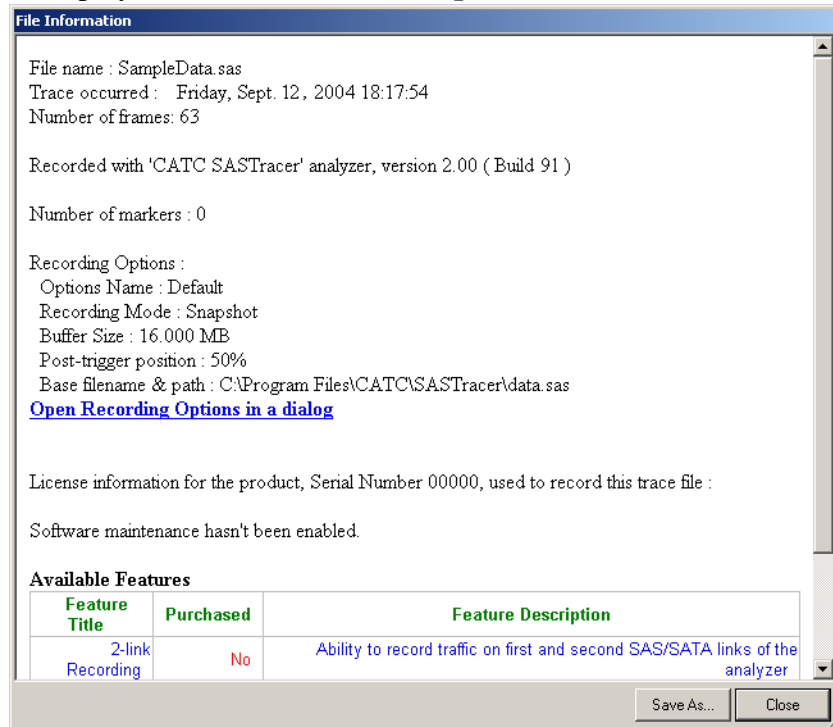
## 9. Reports

The Report menu provides several reports to assist you in analyzing traffic recorded by the Analyzer.



### 9.1 File Information

To display data on a trace, select **Report > File Information** from the menu.








The File Information dialog opens and provides information about the recording such as when it was made and version of the Analyzer Firmware and BusEngine.

Perhaps the most useful information listed in the dialog is the Recording Option settings used to create the open trace. These settings are shown in the above screenshot. Also shown in the screenshot is a hypertext link to the Recording Option settings themselves. The link is marked with the text



The buttons have the following functions:

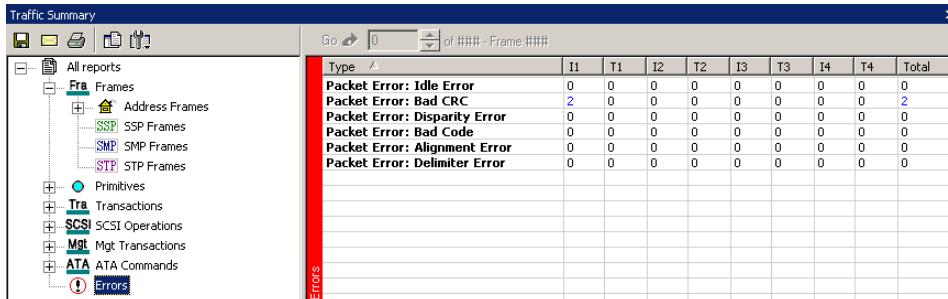
- |   |  |   |  |
|---|--|---|--|
|  | Save As - Saves Traffic Summary results into an HTML format          |  | Displays results tabular text format   |
|  | Email - Creates an email with a *.html file attachment of the graphs |  | Displays drop-down menu with:<br><b>Grid Lines</b> - Displays/Hides grid lines<br><b>Row Selection</b> - Allows entire rows to be selected<br><b>Tight Columns</b> - Reformats column widths to match data |
|  | Print  |   |  |

## 9.3 Error Summary

The Error Summary button opens the Traffic Summary window and displays a list of errors analyzed throughout the recording.

**Step 1** From the **Report** menu, select **Error Summary**.

The Traffic Summary window appears with Error information displayed.



Type	I1	T1	I2	T2	I3	T3	I4	T4	Total
Packet Error: Idle Error	0	0	0	0	0	0	0	0	0
Packet Error: Bad CRC	2	0	0	0	0	0	0	0	2
Packet Error: Disparity Error	0	0	0	0	0	0	0	0	0
Packet Error: Bad Code	0	0	0	0	0	0	0	0	0
Packet Error: Alignment Error	0	0	0	0	0	0	0	0	0
Packet Error: Delimiter Error	0	0	0	0	0	0	0	0	0

**Step 2** Navigate to an error within the recording by clicking the number of the Frame containing the error.

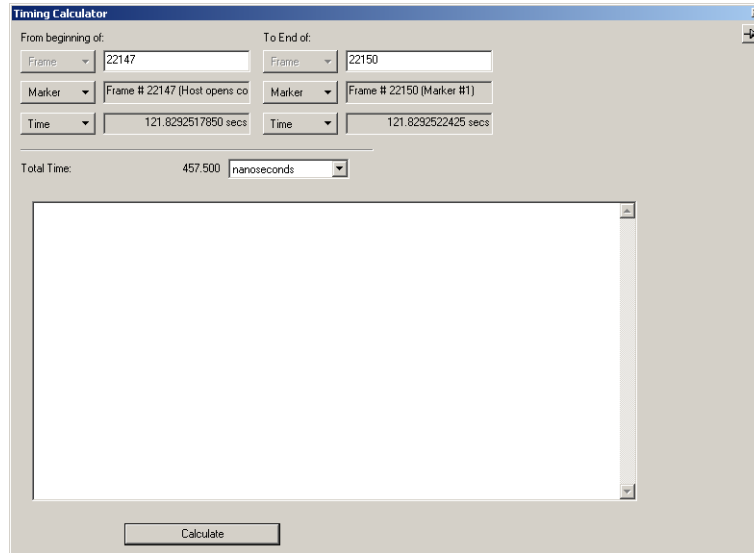
**Step 3** Use the arrows to cycle through each occurrence of a particular error.

## 9.4 Timing Calculations

The Timing measures timing between any two specified Frames or markers. The timing calculator feature is designed specifically for tracking bus utilization and I/O performance in current or previously captured trace files. By default the statistics will be calculated on a complete capture file or one bounded between markers or between any two Frames.

To run the Timing Calculator, perform the following steps:


**Step 1** From the **Report** menu, select **Timing Calculations**.

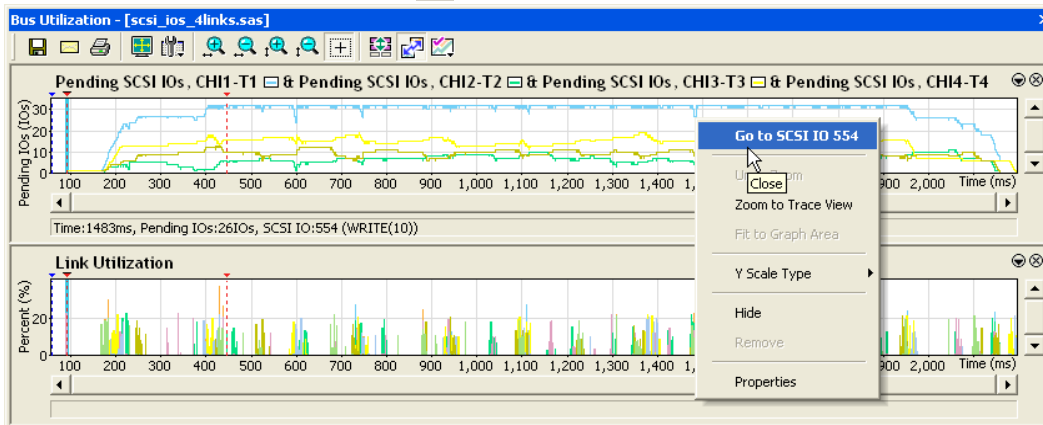


**Step 2** Select the range, and click the **Calculate** button. The results will then display in the window.

## 9.5 Bus Utilization

The **Bus Utilization** window displays information on bandwidth use.



To open the Bus Utilization window, select **Report > Bus Utilization** or click the button marked . A window opens like the one shown below:



### Window Layout

The Bus Utilization window divides into two areas:
















- **Graph Area** - Displays graphs. Initially, no graphs will be displayed. To display one or more graphs, click  and make a selection from the menu. See “Graph Areas Menu” on page 131 for an explanation of the types of graphs listed in this menu.
- **Min/Max/Avg Area** - Displays the minimum, maximum, and average values for several parameters. Data is available **only** after you have displayed the relevant graph. After displaying a graph, the Min/Max/Avg information is calculated and is thereafter available to the user even if the graph is closed. The user can close this section by clicking  and deselecting *Statistics Accumulation* from the menu.

### Bus Utilization Buttons


The Bus Utilization window has a row of buttons for changing the format of the displayed data and for exporting data:



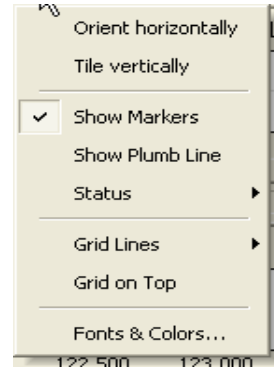
The buttons have the following functions:

	Save As - Saves the graphs as a bitmap file (*.bmp)		Vertical zoom in
	Email - Creates an email with a *.bmp file attachment of the graphs		Vertical zoom out
	Print		Click and Drag zoom - Click diagonally to select and zoom in on part of the graph. The initial direction you begin dragging the cursor determines whether the horizontal or vertical axis is magnified.
	Full Screen		Select Range
	View Settings - opens a sub-menu with options for formatting the display. See “View Settings Menu” below		Sync and Graph areas - If two or more graphs are displayed, this button will synchronize the graphs to one another. Once synchronized, the positioning slider of one graph will move the other graphs
	Horizontal zoom in		Graph Areas - Presents a menu of graphs for various types of bus data
	Horizontal zoom out		

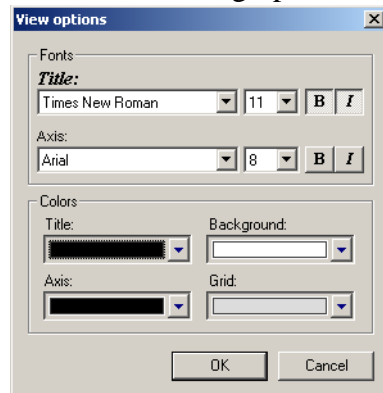
### View Settings Menu

Clicking the View settings button  causes a menu to open with options for formatting the display.

- **Orient Horizontally** - changes the orientation of bus usage to horizontal. After selecting this option, the menu will say "Orient Vertically."
- **Tile Vertically** - tiles the two graphs vertically (i.e., side by side).
- **Show Markers** - Places "tick" marks along the x axis of each graph.
- **Show Plumb Line** - Displays a vertical line that connects your cursor to the horizontal axis. As the mouse is moved, the status bar will show the packet and time frame to which the cursor is pointing.
- **Status** - Opens a sub-menu with the following options:
  - Bar - Displays a status bar at bottom of graph.
  - Tooltip - Causes a tooltip to appear if you position your mouse pointer over part of the graph and leave it there for a couple of seconds.
  - None - Turns off tooltips and the status bar.
- **Grid Lines** - Opens a sub-menu with the following options:
  - Both - Displays both X and Y axis gridlines
  - X Axis - Displays X axis gridlines
  - Y Axis - Display Y axis gridlines
  - None - Turns off gridlines
- **Grid on Top** - Moves the grid lines above the graph.




- **Fonts and Colors** - Opens a dialog box for setting the colors and fonts used in the graphs:

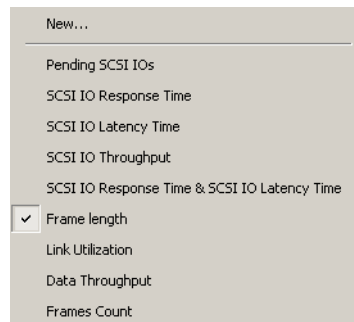


### Graph Areas Menu

The Graph Areas menu allows you to view different information in the Bus Utilization window.

- Step 1** Click the  button.

The Graph Areas menu opens.



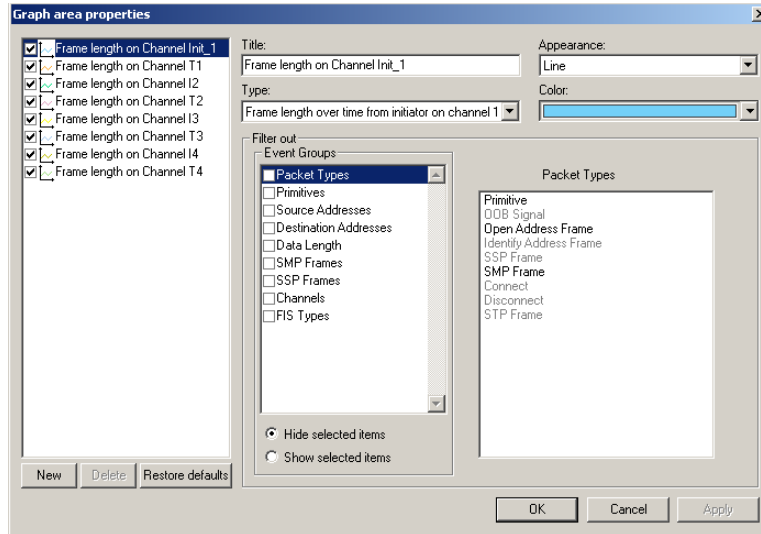
- Step 2** Select a graph type from the menu. Repeat for additional graphs.

**Note** Some graphs will only be available after decoding the logical SCSI or ATA layer operations.

### Modifying the Appearance of Graphs

To modify a Bus Usage graph, follow these steps below.

- Step 1** With a graph displaying in the Graphs Area, right-click anywhere in the graph and choose **Properties** from the pop-up menu. The following dialog box opens.




- Step 2** Select an a data type from the box on the left, then edit the **Title**, **Appearance**, **Type**, or **Color** boxes as appropriate.

- Step 3** Click **OK** to apply the changes.

### Creating a New Graph

To create a new graph,

- Step 1** Click .
- Step 2** From the menu, select **New ...**
- Step 3** From the **Title**, **Appearance**, and **Type** boxes, select the desired options.

## 9.6 Link Tracker Window


The **Link Tracker** window displays a detailed chronological view of events. Events are shown on a primitive-by-primitive basis within columns within the window, each column represents a single upstream or downstream channel. Time is presented as rows. Idle time is shown by empty rows in the window. Idles can be collapsed into gray strips running across the window.

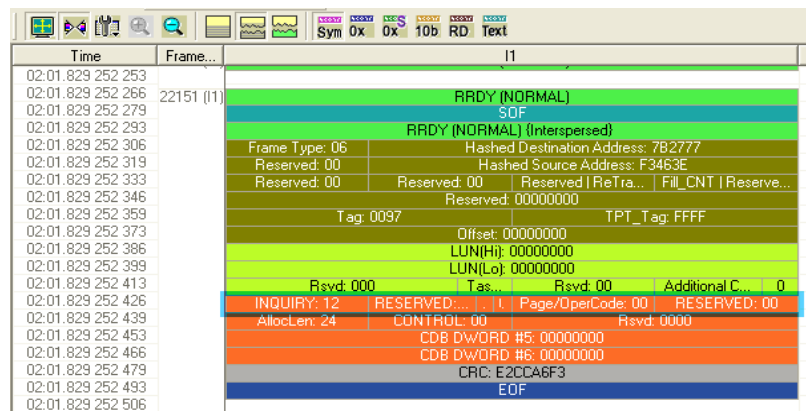
Each time slot in the vertical axis represents the minimum time required by a dword to traverse the bus.

The time slots are not fixed in size: they vary depending on how zoomed out the display is. When the Link Tracker is fully zoomed in, time slots for 1.5 G traffic measure 26.66 ns and time slots for 3.0 G traffic measure 13.33 ns.

When the Link Tracker window is fully zoomed out, the grid lines disappear and the scale changes to 1 dword equaling a line measuring one pixel in height.

### Opening the Link Tracker Window

To open the Link Tracker window, select **Report > Link Tracker** or click the button marked . A window opens like the one shown below:



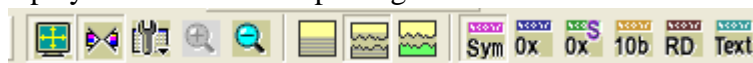
### Window Layout

The Link Tracker window divides into two areas:

- **Toolbar** - Presents buttons for changing data format.
- **Main Display Area** - Displays traffic chronologically as it occurred in the recording. The window divides into columns: the first column shows time and traffic is shown on a channel by channel basis in the columns on the right.

### Link Tracker Buttons

The Link Tracker window has a row of buttons for changing the format of the displayed data and for exporting data:



The buttons have the following functions:



Full Screen



Synchronize Trace View.  
Synchronizes the Trace View and Link Tracker windows so that a move in one window repositions the other. Because of the differences in scale and logic between the Link Tracker and Trace view windows, scrolling produces different effects depending on which window is being scrolled. Scrolling in the trace window causes the Link Tracker window to rapidly jump from event to event. Long periods of idle time are skipped. Scrolling in the Link Tracker window, in contrast, causes small moves in the trace window. Scrolling in the Link Tracker window causes the trace window to pause until the start of a packet is displayed. At that point, the trace window repositions itself. While scrolling through idle periods or the contents of a packet, the trace window will not move.



View Options. Opens a menu with three options: Collapsible Idle Time, Tooltip Display, and Reset Column Widths. See **View Options Menu** below for descriptions.



Zoom In



Zoom Out



Collapse Idles



Show Values



Show Scrambled Values



Show 10b Codes



Show Symbols



Show text decoding of frame header fields



Collapse Idles plus. Further condenses Link Tracker display to show only first 5 DWORDs of each frame.

### *View Options Menu*

Clicking the View Options button  causes a menu to open with options for formatting the display.

- **Collapsible Idle Time** - Opens a dialog box for setting the Idle time value. By setting a value, you tell the analyzer when to collapse Idle times and display them as grayed out strips within the Link Tracker

window. For example, if you had set the Idle time to value  $x$  then any time an Idle time exceeded  $x$  it would be displayed as a gray strip across the Link Tracker window.

- **Tooltip Display** - Opens a menu with options for adding content to tooltips. Tooltips will display when you position the mouse pointer over an item in the Link Tracker window. The options are:
  - Tooltip Display Values
  - Tooltip Display Scrambled Values
  - Tooltip Displays 10 bit Codes
  - Tooltip Displays Symbols
  - Tooltips Displays Text Decoding

The following screenshot shows a tooltip in which all five options have been enabled:

Packet 0 (11), dword #1 (10 dwords total)	
Value	8100FFFF
Scrambled Value	43D28972
10 bit Code	315 136 25D 13C
Symbols	D03.2 (-) D18.6 (-) D09.4 (-) D18.3 (-)
Text Decoding	Initiator Port   Protocol   Type

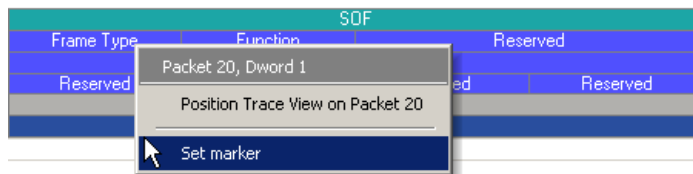
- **Reset Column Widths** - This option resets column widths to their defaults.

### *Docking and Undocking the Window*

You can undock the Link Tracker window by double-clicking on the blue title bar along the left side of the window. Once undocked, the window can be dragged anywhere in the application. To redock, double-click again on the title bar.

### *Setting Markers*

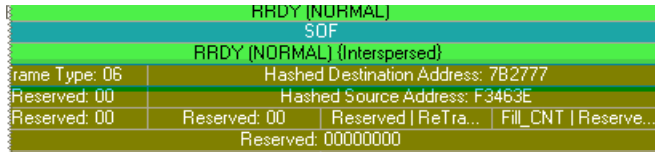
Markers can be set on any dword on any event within the Link Tracker window. To set a marker, right-click on an event, then select **Set Marker** from the pop-up menu. Once marked, events can be easily navigated to via the **Go to Marker** command in the **Search** menu.



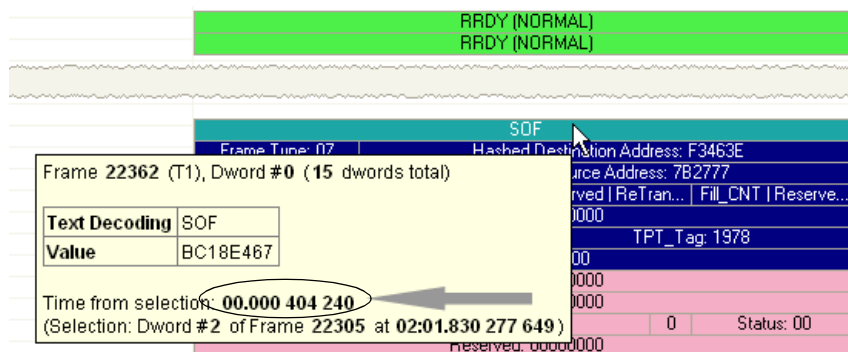
### Calculating Time between Dwords

You can calculate time between dwords by clicking on a specific cell and then positioning your mouse pointer over a second cell. A tooltip will display the time delta between the two cells.

**Step 1** Click on the cell for the first event to select it.




**Step 2** Scroll down through the trace to the second event and position the mouse pointer over the event. A tooltip will appear showing the time interval between the first and second events.




### More about Cell Selection

When searching for a frame or primitive within Link Tracker, the found cell will become the selected cell. When a cell is selected, it will remain selected even if it's off the screen. Keyboard actions in LinkTracker (scrolling, arrow key, etc...) will not affect the selection. Once a cell is selected, it can only be deselected by switching the selection to another cell.

### Searching

When the Trace view and Link Tracker windows are synchronized, the Find and Go To options in the Search menu will apply to the Link Tracker window. The Trace and Link Tracker windows can be synchronized by selecting the Synchronize button .

### Hiding Traffic

You can hide Aligns, Channels and other data from the Link Tracker window by clicking the Hide buttons on the toolbar in the Trace window  or by selecting one or more of the various Hide options in the Display Options dialog box.

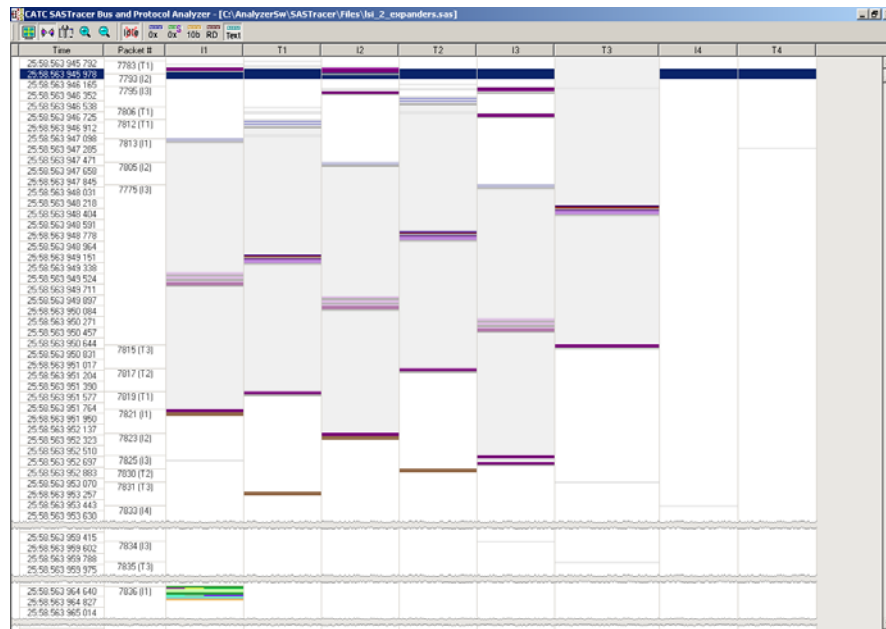


### Zooming In and Out

Zooming out can give you a quick, high-level view of a trace. A fully zoomed out trace will only show columns and colored lines. Using the colors you can see what types of traffic running through the trace - for example, brown represents data, and dark green is a Start of Frame.

Further information can be obtained on any point of interest in the trace by positioning your mouse pointer over it. Tool tips provide detailed description of events.

Note that when fully zoomed out, the smallest graphical unit is the dword, represented by a single line. Zooming out makes the trace appear smaller and increases the time scale in the first column.



### Collapsing Idle Time, Enabling Tooltips, and Resetting Column Widths

Click the View Options button  to open a menu with options for formatting the display. Three options are presented:

**Collapsible Idle Time** - Opens a dialog box for setting the Idle time thresholds. Setting a value tells the analyzer when to collapse Idle times and display them as grayed out strips within the Link Tracker window.



**Tooltip Display** - Opens a menu with options for adding content to tooltips. Tooltips will display when you position the mouse pointer over an item in the Link Tracker window. The options are:

- Tooltip Display Values

- Tooltip Display Scrambled Values
- Tooltip Displays 10 bit Codes
- Tooltip Displays Symbols
- Tooltips Displays Text Decoding

The following screenshot shows a tooltip in which all five options have been enabled:

SOAF		
Initiator Port   Protocol	Features   3 Gbps C...	Tag
Packet 0 (1), dword #1 (10 dwords total)		
Value	8100FFFF	
Scrambled Value	43D28972	
10 bit Code	315 136 25D 13C	
Symbols	D03.2 (-) D18.6 (-) D09.4 (-) D18.3 (-)	
Text Decoding	Initiator Port   Protocol   Type	

**Reset Column Widths** - This option resets column widths to their defaults and enables columns to resize themselves automatically any time the application window is resized.


Normally, columns will automatically resize themselves if the application window is made larger or smaller. However, if you manually resize any columns in the Link Tracker window, column widths become static. Thereafter, if you resize the application window, the Link Tracker columns will not adjust automatically. **Reset Column Widths** re-enables this automatic resizing capability.

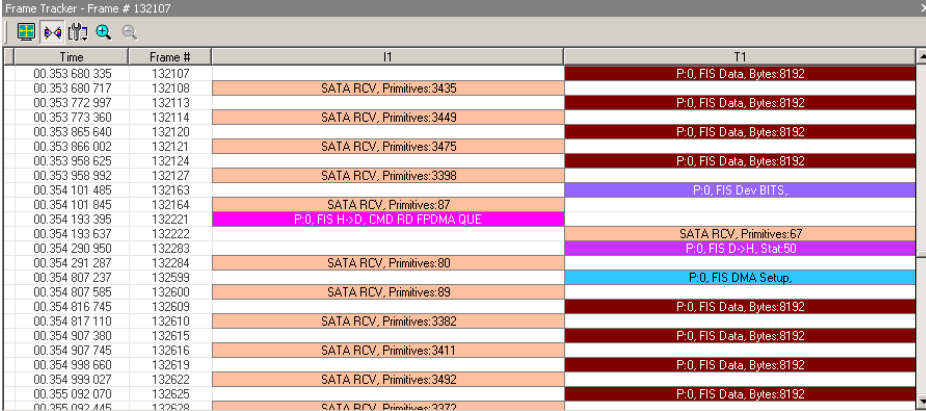
## 9.7 Frame Tracker Window

The **Frame Tracker** window displays a detailed chronological view of traffic on a Frame-by-Frame basis. Events are shown within columns within the window, each column representing a channel. Time is presented as rows. Idle time is shown by empty rows in the window.

Each time slot in the vertical axis represents the elapsed time required by the Frame to traverse the bus.

### Opening the Frame Tracker Window

To open the Frame Tracker window, select **Report > Frame Tracker** or click the button marked . A window opens like the one shown below:



Time	Frame #	I1	T1
00.353 680 335	132107		P.0, FIS Data, Bytes:8192
00.353 680 717	132108	SATA RCV, Primitives:3435	
00.353 772 997	132113		P.0, FIS Data, Bytes:8192
00.353 773 360	132114	SATA RCV, Primitives:3449	
00.353 865 640	132120		P.0, FIS Data, Bytes:8192
00.353 865 002	132121	SATA RCV, Primitives:3475	
00.353 958 625	132124		P.0, FIS Data, Bytes:8192
00.353 958 992	132127	SATA RCV, Primitives:3398	
00.354 101 485	132163		P.0, FIS Dev BITS
00.354 101 845	132164	SATA RCV, Primitives:87	
00.354 193 395	132221	P.0, FIS H->D, CMD RD FPDMA QUE	
00.354 193 637	132222		SATA RCV, Primitives:67
00.354 290 950	132283		P.0, FIS D->H, Stat:50
00.354 291 287	132284	SATA RCV, Primitives:80	
00.354 807 237	132599		P.0, FIS DMA Setup
00.354 807 595	132600	SATA RCV, Primitives:89	
00.354 816 745	132609		P.0, FIS Data, Bytes:8192
00.354 817 110	132610	SATA RCV, Primitives:3382	
00.354 907 380	132615		P.0, FIS Data, Bytes:8192
00.354 907 745	132616	SATA RCV, Primitives:3411	
00.354 998 660	132619		P.0, FIS Data, Bytes:8192
00.354 999 027	132622	SATA RCV, Primitives:3492	
00.355 092 070	132625		P.0, FIS Data, Bytes:8192
00.355 092 445	132628	SATA RCV, Primitives:3372	

### Window Layout

The Frame Tracker window divides into two areas:

- **Toolbar** - Presents buttons for changing data format.
- **Main Display Area** - Displays traffic chronologically as it occurred in the recording. The window divides into columns: the first column shows time and traffic is shown on a channel by channel basis in the columns on the right.

### Frame Tracker Buttons

The Frame Tracker window has a row of buttons for changing the format of the displayed data and for exporting data:



The buttons have the following functions:



Full Screen



Zoom In



Synchronize Trace View.  
Synchronizes the Trace View and Frame Tracker windows so that a move in one window repositions the other.



Zoom Out



View Options. Opens a menu with three options: Collapsible Idle Time, Tooltip Display, and Reset Column Widths. See **View Options Menu** below for descriptions.

### View Options Menu

Clicking the View Options button  causes a menu to open with options for formatting the display.

- **Time Format**- Opens a menu with options for setting the time format. There are two options:
  - Seconds
  - Clocks
- **Reset Column Widths** - This option resets column widths to their defaults.

Normally, columns will automatically resize themselves if the application window is made larger or smaller. However, if you manually resize any columns in the Frame Tracker window, column widths become static. Thereafter, if you resize the application window, the Frame Tracker columns will not adjust automatically. **Reset Column Widths** re-enables this automatic resizing capability.

### Docking and Undocking the Window

You can undock the Frame Tracker window by double-clicking on the blue title bar along the left side of the window. Once undocked, the window can be dragged anywhere in the application. To redock, double-click again on the title bar.

### Calculating Time between Frames

You can calculate time between cells within Frame Tracker by clicking on an event and then positioning your mouse pointer over a second event and reading the ensuing tooltip.

**Step 1** Click on the time value for the first event.

Time	I1
00.356 554 212	
00.356 554 602	SATA RCV, Primitives:3411
00.356 645 470	
00.356 645 855	SATA RCV, Primitives:3341

**Step 2** Scroll down through the trace to the second event and position the mouse pointer above its time value. A tooltip will appear showing the time interval between the first and second events.

00.356 554 602	SATA RCV, Primitives:3411
00.356 645 470	
00.356 645 855	SATA RCV, Primitives:3341
00.356 735 017	
00.356 735 375	SATA RCV, Primitives:3557
00.356 830 134	
00.356 830 524	
00.356 918 824	

Time from selected Frame #1 33175: **00.000 089 905**


### *Hiding Traffic*

You can hide Aligns, Channels and other data from the Frame Tracker window by clicking the Hide buttons on the toolbar in the Trace window



or by selecting one or more of the various Hide options in the Display Options dialog box.

### *Searching*

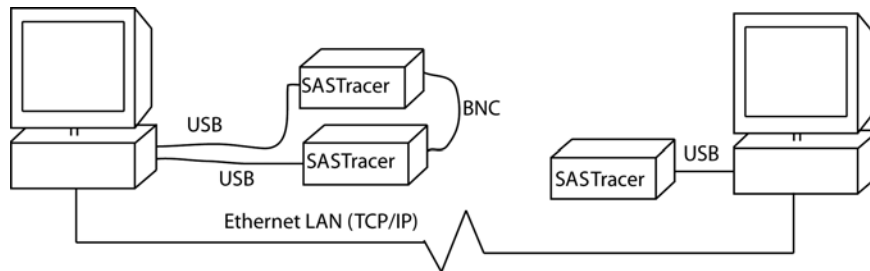
When the Trace view and Frame Tracker windows are synchronized, the Find and Go To options in the Search menu will apply to the Frame Tracker window. The Trace and Frame Tracker windows can be synchronized by selecting the Synchronize button. 

### *Zooming In and Out*

Zooming out provides a high-level view of a trace. This allows users to display more events on screen. Cell coloring can be used to distinguish between different types of traffic on the bus.



## 10. Networking SASTracer



SASTracer has networking and cascading functions that are described in this chapter.

- **Cascading** -- Allows two to four analyzers be linked (or "*cascaded*") together into a single, synchronized, logical unit in order to increase the number of ports that can be monitored. To enable synchronized multi-analyzer recording, the analyzers are connected together via their BNC connectors on the back of the analyzers. This connection is used to send clocking information and recording commands are sent from one analyzer to another.
- **Networking** -- SASTracer can be run remotely over an IP LAN. Using the Network browse dialog, you can remotely control one or more analyzers.

### 10.1 Working with Multiple Analyzers

Multiple SASTracer analyzers can be set up in three ways:

**Directly Connected by USB** - Two or more analyzers can be connected to a single host PC via USB. In this setup, no additional cables are used (as they are in a Cascaded setup) and the analyzers function as non-cascaded, standalone units. Users toggle back and forth between the units.

**Cascaded** - Two or more local analyzers linked by BNC. One (or all) of the analyzers then connect via USB to a host PC.

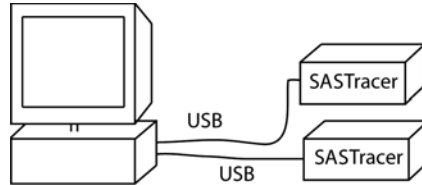
The BNC cable functions to transmit clocking and control information between the analyzers, thereby allowing the analyzers to function as a *cascade* - i.e., a single, logical analyzer. Cascading analyzers allows them to perform synchronized, multi-analyzer recordings.

**Connected Remotely over an IP Network** - A PC connected to analyzers across an IP network.

## 10.2 Hardware Setup for Direct USB Connections

Connecting multiple analyzers to a single PC by USB gives you the convenience of being able to control multiple analyzers from a single *SASTracer* application. The application provides you with a means of toggling back and forth between the analyzers.

To set up multiple analyzers via USB, you attach USB cables between the analyzers and the host PC as shown in the illustration on the right. If you do not intend to group the analyzers together for synchronized multi-analyzer recordings, no further hardware setup is required. If you do intend to group the analyzers, then you will need to add BNC cables as described in the section below under "Setup for Multiple Analyzer Use." Once the analyzers are connected and started, you can browse to the analyzers via the command **Setup > Analyzer Network ...**



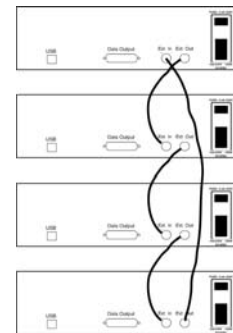
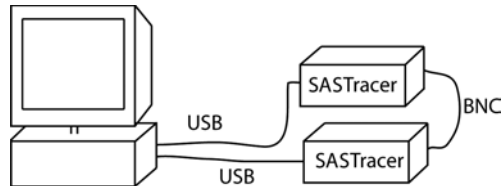
**Note** The *SASTracer* software will allow you to toggle between the analyzers but not run two copies of *SASTracer* software on your screen simultaneously.

## 10.3 Setup for Cascaded Multiple Analyzer Use

If you add a BNC connection between the analyzers shown above, you create a *cascade* which allows the analyzers to function together as a logical unit.

Cascading increases the numbers of ports that can be simultaneously recorded.

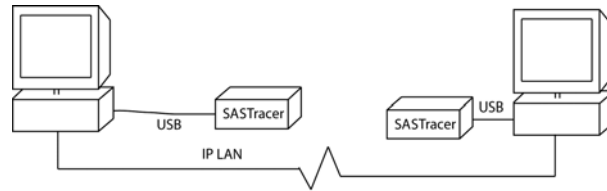
To set up a cascade, you connect a BNC cable between the External Output port on the back of one analyzer to the input port on the second. The first analyzer will serve as the controlling or master analyzer. It will transmit clocking information, Recording Option commands and other data to the other analyzers. If you plan to group three or four analyzers together, daisy-chain the remaining analyzers together, and then loop the output of the last analyzer to the input of the first analyzer as shown in the figure on the right.





## 10.4 Set Up for Remote Access over an IP LAN

SASTracers can be run remotely over an IP network. In an IP network, the analyzers connect their respective hosts via USB and the hosts, in turn, connect to each other via IP.



Setup involves installing SASTracer software on each analyzer host, then enabling IP LAN connectivity between the hosts.

When the remote analyzer is powered on, you connect remotely control the analyzer via its host. Your connection will be **Local host => Remote host => Analyzer**.

Use the command **Setup > Analyzer Network** to browse to the remote host.

You can cascade IP-connected analyzers by adding BNC connections between the analyzers as described above in “Setup for Cascaded Multiple Analyzer Use” on page 144.

## 10.5 Configuring the Connection

Once you have completed the physical setup, you are ready to configure the analyzer connection.

### USB-Connected Analyzers

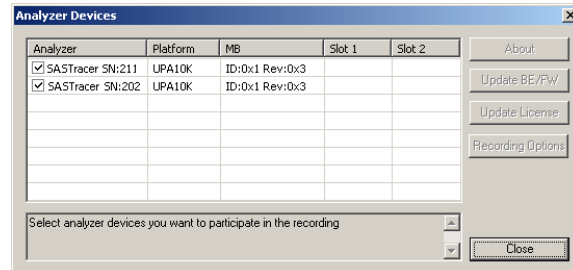
Configuration for two or more USB connected analyzers is minimal.

In the following example, two analyzers are linked via USB to a host PC. You connect to one of the two analyzers.

**Step 1** Start the SASTracer analyzers and the SASTracer software.

**Step 2** From the menu, select **Setup > All Connected Devices**.

The **Analyzer Network** dialog box opens. To select an analyzer, check the relevant checkbox on the left.



**Step 3** Click **Close**.

The dialog box closes and the analyzer is selected. The *SASTracer* software on your screen will now control the selected analyzer.

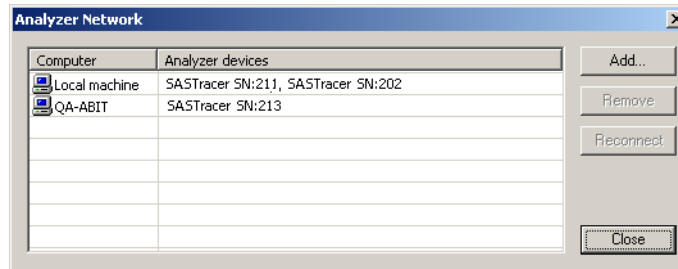
**Note** You can update the Firmware, BusEngine and License from this dialog by checking an analyzer and then clicking the appropriate button on the right. You can also directly open and set Recording Options for any of the analyzers by checking one or more analyzers and then clicking the Recording Options button. The Recording Options dialog will open. The settings you create will apply to all selected analyzers.

**Remote Analyzers Over an IP Network**

To configure *SASTracer* to remotely control an analyzer over an IP LAN, you will need to use the Analyzer Network dialog to browse to the host controlling the analyzer and add both the host and its PC to the dialog.

**Step 1** From the menu, select **Setup > Analyzer Network**.

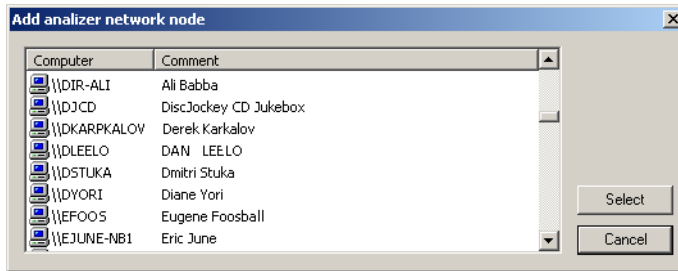
The Analyzer Network dialog box opens. This dialog lists host PCs and their analyzers. The listed devices are either currently connected or were connected at some point previously.

**Step 2** Remove any host (other than the Local Machine) from the list by selecting the host and then clicking **Remove**.

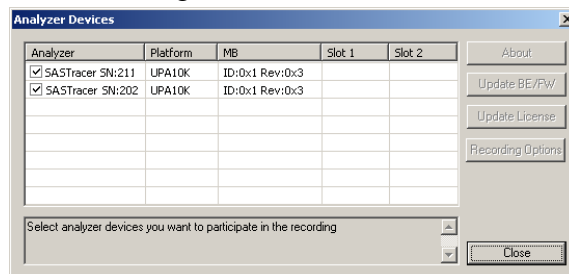
You should keep in the list only the host(s) that you are planning to immediately use.

**Step 3** To add a host and analyzer to the list, click **Add**.

A browse dialog box opens.



- Step 4** Browse to the host that has an analyzer attached to it and double click on it.
- Step 5** The host will be added to the Analyzer Network dialog.
- Step 6** Click **Close** to close the dialog box.
- Step 7** Select **Setup > All Connected Devices ...** to open the Analyzer Devices dialog box.



- Step 8** Uncheck all boxes except for the one for the remote analyzer that you wish to connect to.
- Step 9** Click **Close** to close the dialog box and establish a connection to the selected analyzer.

### Recording Multi-Trace Files

To configure analyzers to work as a group (i.e., into a *cascade*), attach BNC cables as described “Setup for Cascaded Multiple Analyzer Use” on page 144, then perform the following steps:

- Step 1** Perform **Steps 1 and 2** as described above in “USB-Connected Analyzers” on page 145.

The Analyzer Devices dialog box will open.

- Step 2** In the Analyzer Devices dialog box, verify that the checkboxes are checked for the cascaded analyzers.

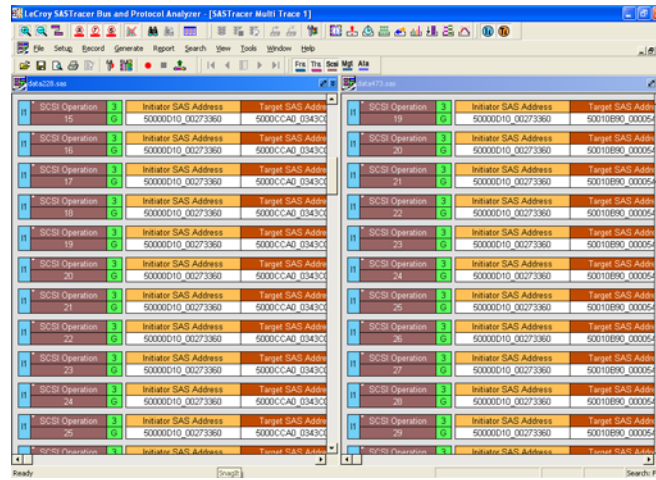
- Step 3** Click **Close**.

The dialog closes and the analyzers are selected.

**Step 4** Test the setup by recording some traffic.

If the analyzers are not connected by the BNC cables, an error message will appear prompting you to correct the problem.

**Step 5** The SASTracer software will display traffic from each analyzer in adjacent windows. The windows are synchronized together and can be scrolled in tandem.



**Multi-Trace file before merge - two synchronized trace files**

Traffic from each analyzer can also be merged together into a single unified display (as shown below). See Merging Multi-Trace Files on page 149.



**Multi-Trace file after merge - one unified trace file**

The merged view includes the Link Tracker display providing time correlated analysis of DWORD level data structures.

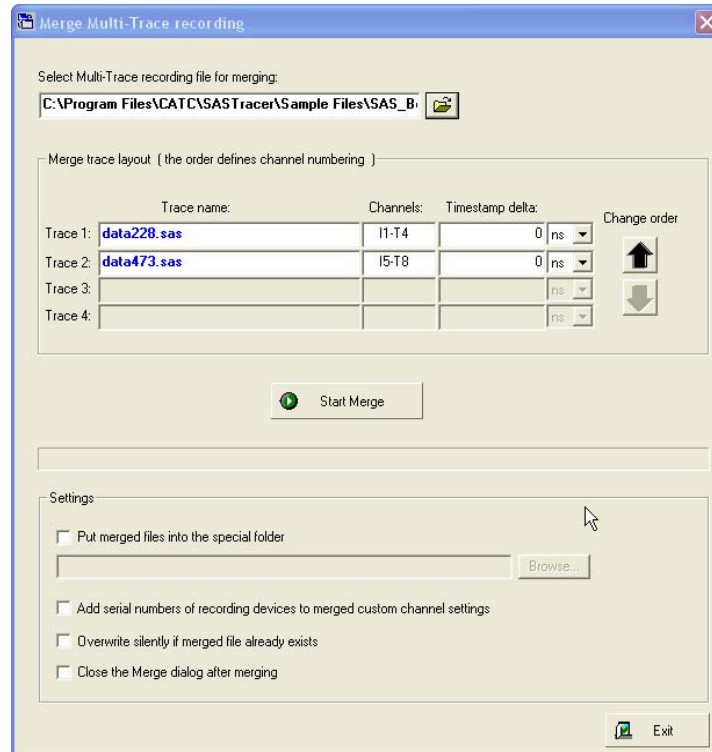
## 10.6 Merging Traces

SASTracer v2.5 and later supports merging multi-trace files (\*.smtt) into a single trace display containing up to 16 bidirectional links of traffic. The merge feature is ideal for analyzing 4 lane traffic moving both upstream and downstream through a SAS expander device. It's primarily intended for use when cascading multiple analyzers together. The BNC interface is used to synchronize the timing information across multiple systems (for configuration information, see Setup for Cascaded Multiple Analyzer Use on page 144).

### Merging Multi-Trace Files

Merged files can be created either by selecting Merge Multitrace files... with a .smtt file open or by selecting the .smtt file from the *Select SAS Multitrace File for Merging...* dialog:

- Step 1** Select **'Merge Trace files...'** item in 'File' menu
- Step 2** If an .smtt file is open, the 'Merge Multi-Trace recording' dialog will open and automatically populate the Merge Trace Layout list with the individual segments of the currently open *.SMTT* file.

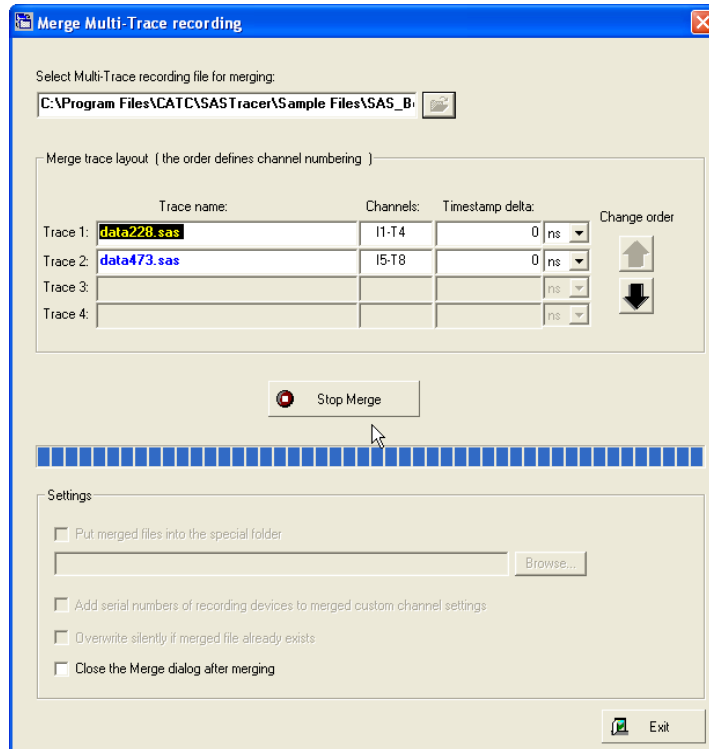


**Note** The application recommends the channel layout for the merged files. For steps to change the channel layout; see Altering Channel Layout on page 152.

Alternatively, users may click the '*Select SAS Multitrace File for Merging...*' dialog to choose up to 4 different files to merge.

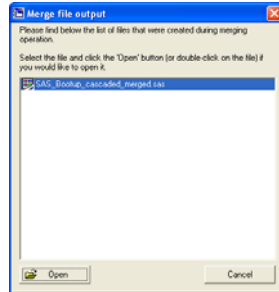
**Step 3** Click the **Start Merge** button to begin merging the selected files

All open trace files will be closed before merging begins. The time required to complete the merge process is dependent on system performance. The merging process can be stopped before merging is complete either by clicking the button '**Stop Merge**' or by exiting the dialog. During the merge process, the Merge dialog will display:



**Step 4** When the merging process completes, the **Merge File Output**

dialog will invite users to open the resulting merged file:



**Note** If the total recording has more than 32,000,000 frames or events, then the merged file will be truncated and a new one will be started from that point. The merge operation will produce as many files as necessary to complete the full merge.

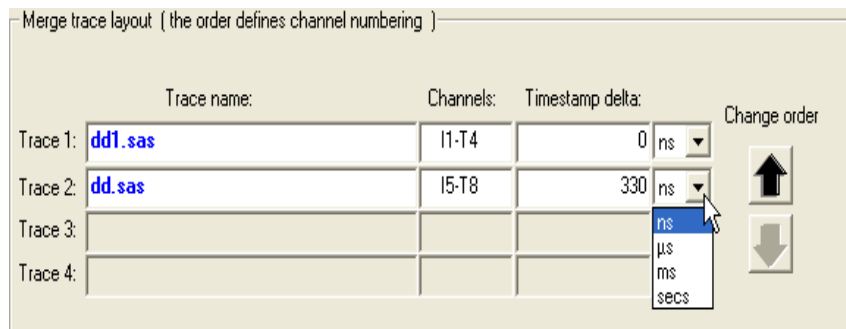
The merge feature will only display channels that actually contain valid SAS/SATA traffic. For example, a multi-trace file captured from 4 cascaded systems with real traffic in only the first channel (on each analyzer) will result in a display with traffic on channels: (I1 / T1), (I5 / T5), (I9 / T9), and (I13 / T13).

#### *Adjusting Timestamps Between Merged Trace Files*

When using more than one analyzer in cascaded configuration, the segments are automatically synchronized by timestamp. It is possible to adjust timestamps between different segments. This allows users to customize the display (post-capture) to accommodate for latency that may occur on one of the links in the system under test.

**Step 1** Select the **Timestamp Delta** field

**Step 2** Enter the amount of the delta to add to the trace file



- Step 3** Select the time increment using the pop-up menu (ns, us, ms, sec)
- Step 4** Press **Start Merge** button.
- Step 5** The designated time interval will be added to the first timestamp in a selected trace.

It's best to rename the merged trace using **Save as...** after altering the time delta in case the timing is changed unintentionally, the user can revert back to the original and repeat the process.

### *Altering Channel Layout*

When a multi-trace file is selected for merge, the application recommends the channel layout of the merged file. The 'Merge Multitrace Recording' dialog allows customization of the display order. For example, some users may prefer to keep the initiator traffic on links 1-4 with downstream traffic on links 5-8.

- Step 1** Within the Merge Multitrace Recording' dialog, select the trace file name that you wish to reposition to a different set of channels.
- Step 2** Use the arrow key to move up or down in the Trace Order display
- Step 3** Repeat to reposition other trace files in the display if needed
- Step 4** Press the start merge button

**Note** The time required to complete the merge process is dependent on system performance. At least 1048MB RAM and SCSI or SAS based storage devices are recommended when merging large files.

### *Merge dialog settings*

- **Put merged files into the special folder**

If checked, this setting instructs the application to put resulting merged files into the specified folder. If it is not set resulting files will be saved in the folder where the merged multi-trace file is located.

- **Add serial numbers of recording devices to merged custom channel settings.**

If checked, this option instructs the application to add the serial numbers from the analyzers in front of the custom channel settings (different from the default ones). If it is not checked, the channel settings are copied without changes.

- **Overwrite silently if merged file already exists**



If checked, this option instructs the application not to prompt user in case if a file having the same name as a resulting merged file already exists and overwrite it silently. If it is not checked, the application will prompt user before overwriting it.

- **Close the merge dialog after merging**

If checked, this option instructs the application to close the merge dialog after merging is complete. If it is not checked, the merge dialog will remain open.

### *Manually merging two or more regular trace files*

Merging trace files is primarily designed for use with multi-analyzer cascaded recordings. However, the merge feature can also be used to combine regular trace files (\*.sas) or multi-segmented files (\*.smt). To manually merge up to 4 trace files follow steps in “Merging Multi-Trace Files” on page 149 except click the '*Select SAS Multitrace File for Merging...*' dialog and choose up to 4 different files to merge.

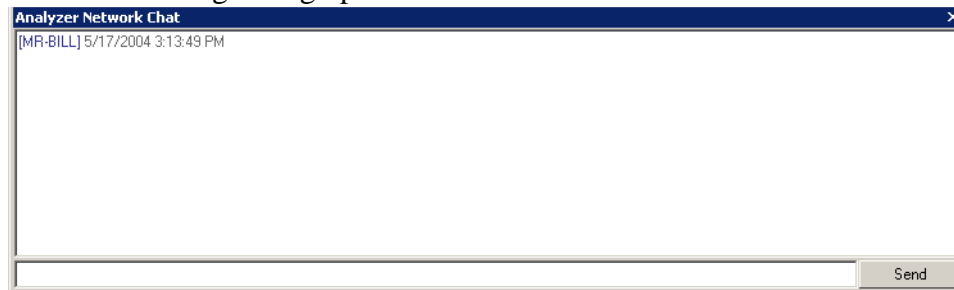
## 10.7 Network Chat

**Analyzer Network Chat** is a utility that allows users to conduct chat sessions over an IP LAN.

In order to send and receive electronic text messages, each user must be working with a PC that is attached to an analyzer. And each PC must, in turn, be connected to an IP LAN.

To start a chat session,

**Step 1** Select **View > Analyzer Network Chat Bar** from the menu. The following dialog opens.



**Step 2** Click in the cell at the bottom of the window and type some text.

**Step 3** Click **Send**. The sent text will appear in the top of the window next to your prompt.



## 11. Traffic Generation with SASTrainer

SASTrainer 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 scripts contain statements about the types of traffic to be generated.

### 11.1 SAS/SATA Exerciser Hardware

LeCroy SASTrainer requires both the SAS Analyzer module and the SAS Exerciser module that plugs into the right slot of the CATC 10K chassis. Installing the SASTracer Exerciser module will require that you remove ports 3&4 (if equipped with a 4 port analyzer) or the blank face plate (if equipped with a 2 port analyzer).

Figure 12: SASTracer/Trainer 2 port Analyzer with Exerciser option installed



### 11.2 Setting Up SAS/SATA Exerciser for Initiator Emulation

Connect the SAS cable from the SAS/SATA Exerciser **To Target** port to the Target port on the unit under test. This



transmits the Traffic Generator stream from the **To Target** port on the SASTracer/Trainer to the target-side port on the unit under test.


### 11.3 Setting Up SAS/SATA Exerciser for Target Emulation

Connect the SAS cable from the SAS/SATA Exerciser **To Initiator** port to the Initiator-side port on the unit under test. This transmits the Traffic Generator stream from the **To Initiator** port on the SASTracer/Trainer to the initiator-side port on the unit under test.



### 11.4 Generating Traffic

Generating traffic using the SASTracer/Trainer is a two step process. First, text-based Traffic Generator file must be created. This file can be created through a special conversion command in SASTracer that converts a trace file into a traffic generator file. Alternatively, you can edit an existing file or write your own.

This text file is named with an **.ssg** extension. Once the file has been created, it can be opened and displayed in the SASTracer application. You can invoke the SASTracer application to transmit the traffic generation file by using the Traffic Signal button .

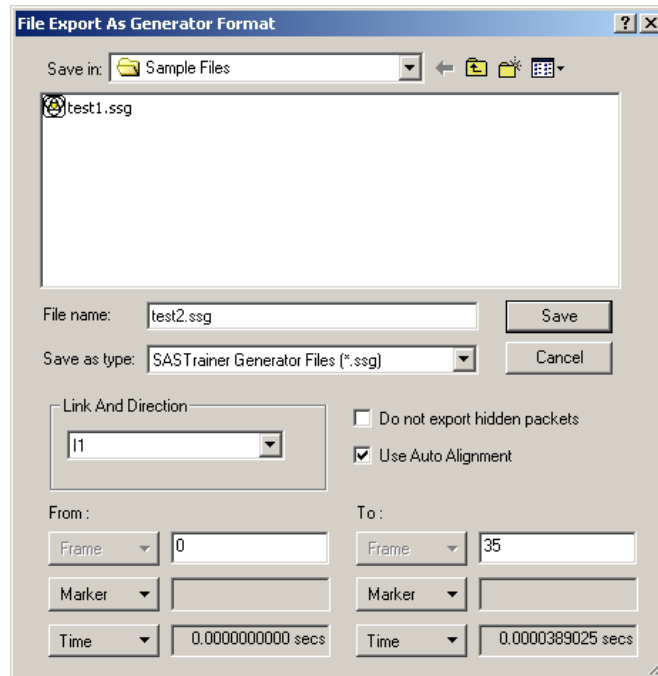
#### Creating a Traffic Generation File with SASTracer

The easiest way to create a Traffic Generation file is to convert an SASTracer trace file (\*.sas) into a \*.ssg file. This is done with the **Export** function in SASTracer.

**Step 1** Open a trace file.

**Step 2** From the menu, select **File>Export>to Generator File Format**

(.ssg). The Export to Generator Text screen appears.



There are several options:

**File Name** - Enter a user-defined file name.

**Save As Type** - There is but one option: **SASTrainer Generator Files (.ssg)**.

**Link and Direction** - Select the source and direction of the traffic you are going to export into a traffic generation file. You can only export a single uni-directional link (for example, I1).

**Do not export hidden packets** - If selected, will only export traffic that is currently displayed onscreen. Traffic hidden via the various hide buttons will not be exported into the traffic generation file.

**Use Auto Alignment** - If selected, exports Auto Aligns to the traffic generation file.

**From** - (Optional) Enter the range of traffic (in Frames, Markers, or Time) to be exported. The default is to export all traffic in the open trace.

**Step 3** Select the desired options, the click **Save**.

A Generator file (\*.ssg) has now been created and can be read with the SASTracer/Trainer application.


## 11.5 Opening a Traffic Generation File

Once the Traffic Generation file (\*.sbg) file has been created, you can then open it in the SASTracer application.

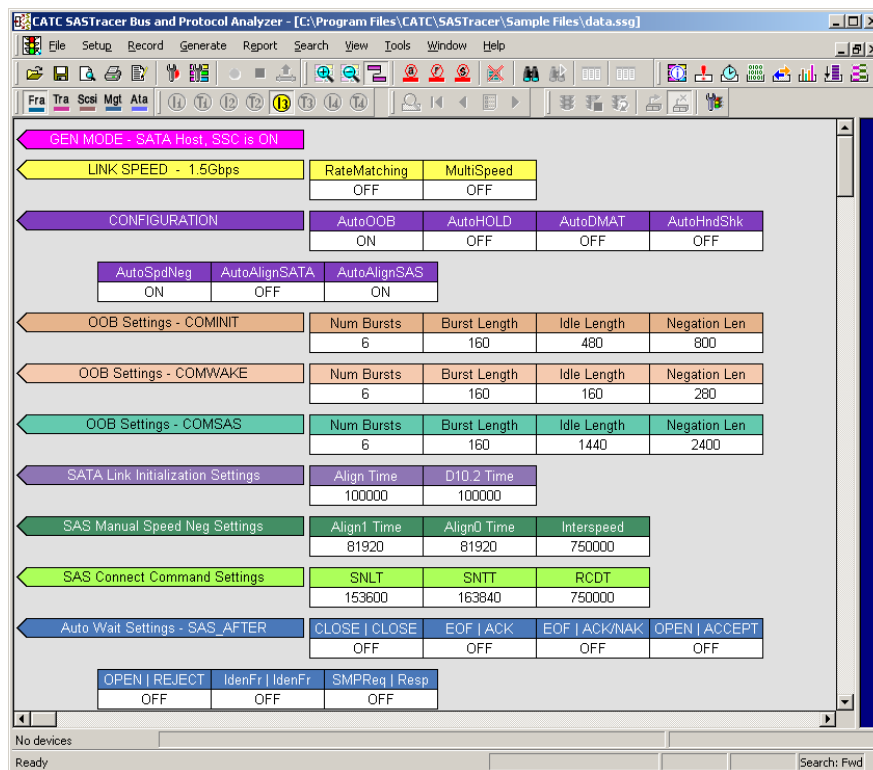
To open a Traffic Generation file,

**Step 1** Select **Open** under **File** on the Menu Bar

OR

Click  on the Tool Bar.

**Step 2** Select a Generator text file (\*.sbg) and click **Open**. If needed, navigate to the install directory. For samples, see the install directory. The Generator file appears in a Trace view, shown below:



### Layout


The .sbg file will show several colored bars across the screen that represent global settings. The bars serve to show how the generation file is currently configured. These settings include the link speed (1.5 Gbps vs. 3.0 Gbps), the type of device (for example, SAS Initiator or SATA Device), COMINIT, COMWAKE and some other settings. As changes are made and saved to the traffic generation file, the bars will immediately update.

The actual traffic pattern that is about to be generated appears below the bars as a series of Frames. In the generation file shown in the above screenshot, the first generation Frame is a Start of Address Frame labeled as Frame 8.

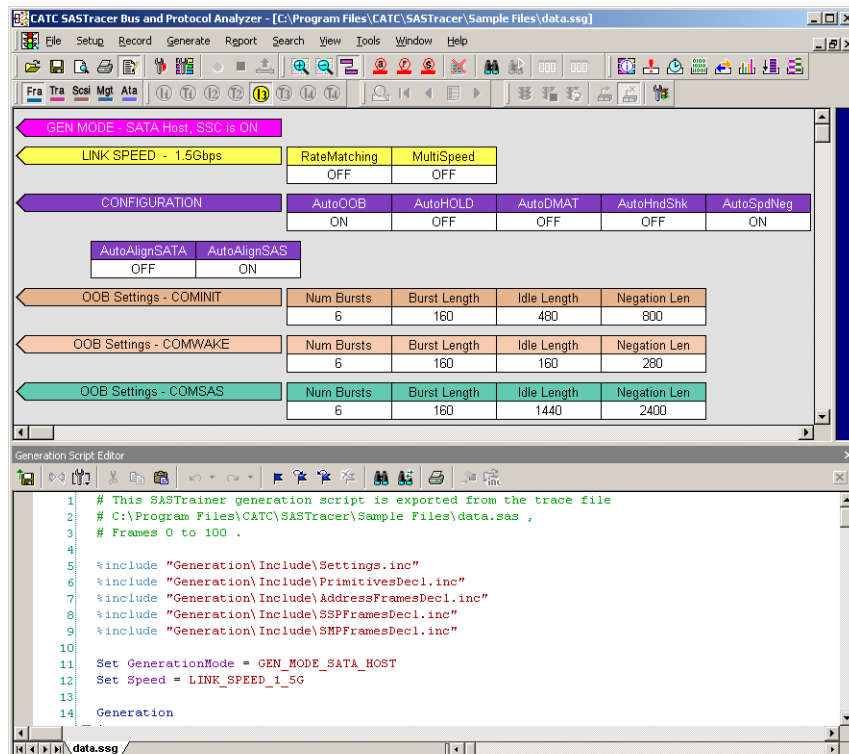
You can edit the traffic generation file to add, edit or remove frames.

## 11.6 Starting the Script Editor

To edit an .ssg file, use the Script Editor. The Script Edit is an editing tool that will display the .ssg file and its supporting Include files.

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**.

The Script Editor window will open and display in the lower portion of the trace window.



















The Script Editor divides into three areas: the toolbar, the script window, and the file tabs at the bottom of the window. If errors occur, a log will open at the bottom of the window.

## Toolbar

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



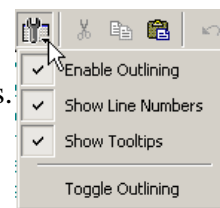
The buttons have the following functions:

	Save. Saves your edits and immediately updates the setting bars and Frames shown in the trace window.		Go to next bookmark.
	View Options. Opens a menu with three options: Enable Outlining, Toggle Outlining, and Line Numbers. See <b>View Options Menu</b> below for descriptions.		Go to previous bookmark.
	Cut.		Clear all bookmarks.
	Copy.		Find.
	Paste.		Find and Replace.
	Undo.		Print.
	Redo.		Go to Definition.
	Add/Remove bookmark. Allows markers to be set or removed to aid in navigation.		Open File Under Cursor. Opens whatever file has been pointed to with the mouse in the script. This command works with Include statements.

### View Options Menu

The View Options button has a menu with three options:

- **Enable Outlining** - Adds an expandable/collapsible tree structure to the left side of the Script Editor showing the hierarchical relationship of the script lines.
- **Show Line Numbers** - Adds line numbers to the left side of the Script Editor window.
- **Show Tooltips** - Displays tooltips in the editor window.
- **Toggle Outlining** - Toggles the outline tree between collapsed and expanded states.





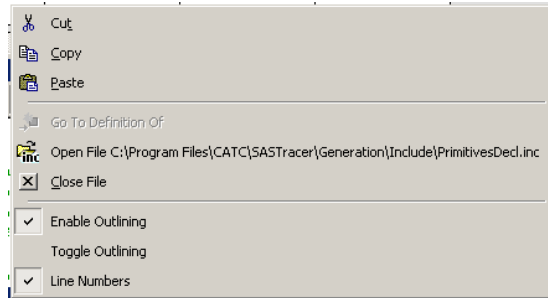
### Pop-up Menu

Right click anywhere in the script window to open a pop-up menu with the following options:

**Cut** - Cuts selected text.

**Copy** - Copies selected text.

**Paste** - Pastes selected text.



**Go to Definition of** - Repositions the script window to whatever definition has been selected.

**Open File** - Opens whatever file has been pointed to with the mouse in the script. This command works with Include statements - for example, "%include "Generation\Include\PrimitivesDecl.inc".

**Close File** - Closes whatever script file is currently being displayed.

**Enable Outlining, Toggle Outlining, and Line Numbers** - Enables the three options described above under *View Options Menu*.

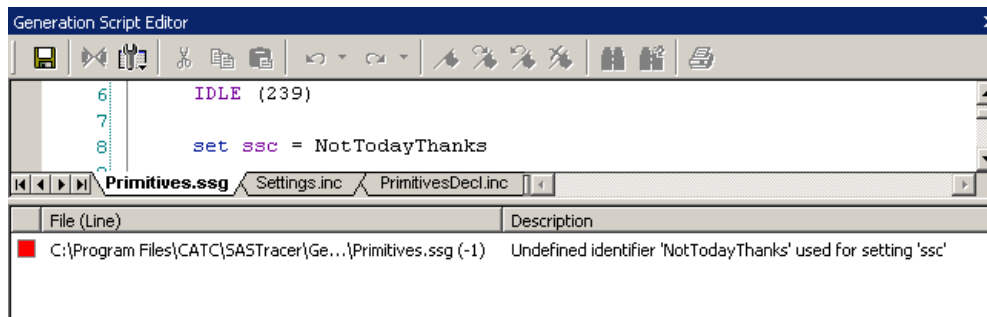
### File Tabs

At the bottom of the window are a series of tabs that allow the .ssg file and its supporting Include files to be opened and edited. The Include files open automatically when the software first reads the script.



### Error Log

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



## 11.7 Overview of Generation & Global Settings Files

Sample .ssg files and Include files reside in two directories called \Samples and \Include that are typically installed in:  
C:\Program Files\CATC\SASTracer\Generation.



### 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, in turn, provide the definitions for primitives, frames, and "global settings" - i.e., settings that hold for most or all of the generation session.

The definitions for SAS and SATA traffic are contained in five LeCroy-provided Include files: Settings.inc, PrimitivesDecl.inc, AddressFramesDecl.inc, SSPFrames.inc, SMPFrames.inc and SSPFrames.inc.

### 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 following chapter **Traffic Generation Language**.

#### *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. Many users opt for this latter approach.

```
%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
```

```
        %include "Generation\Include\Settings.inc"
        %include "Generation\Include\SSPframesDecl.inc"

        Set GenerationMode      = GEN_MODE_SATA_HOST
        Set GenerationMode      = GEN_MODE_SAS_INITIATOR

        Generation
        {
```

**This will take effect** →

### *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, then you need to know what the defaults are for AutoAlign. The defaults are as follows:

For SATA host/device emulation, then

- AutoAlignSATA is assumed to be ON
- AutoAlignSAS is assumed to be OFF.

For SAS emulation, then 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, a user might want to set SASAutoAlign = ON prior to traffic generation and then have it change to OFF half way through the generation session.

```

#include "Generation\Include\Settings.inc"
#include "Generation\Include\SSPFramesDecl.inc"

Generation
{
  # SendSSPFrameData
  # {
  #   Data = { 21223344 55667788 99AABBCC }
  # }

  SendSSPFrameXferRdy
  {
    Data = { 51223344 55667788 99AABBCC }
  }

  Set AutoAlignSAS = OFF ← Global Setting added
                           to generation block

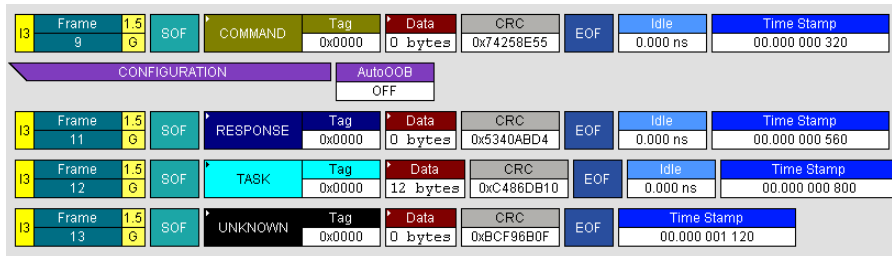
  SendSSPFrameCommand

  SendSSPFrameResponse

  SendSSPFrameTask
  {
    Data = { 51223344 55667788 99AABBCC }
  }

  SendSSPFrameVendor
}
    
```

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.

## 11.8 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.

### 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 will be 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, then place an asterisk in the Data definition field in the SSPFramesDecl.inc file:

**Data : \***

```

39|
40| ##### DATA #####
41| Data : * # Variable length field, can be assigned to an array of DWORDs
42|
43|

```

If you replace the asterisk with a value, then the field becomes fixed length.

**3. CRC Calculations will be calculated by SASTrainer unless told otherwise** - If the CRC is not explicitly set in the traffic generation file, SASTrainer will assume that you want it and will calculate and display it in front of the generated Frames.

If the user provides a CRC value, SASTrainer will use that value even if it is incorrect. This gives the user the option of configuring the generator to create errors.

If the generation file was created through the Export command (i.e., 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.

### PrimitivesDecl.inc

The PrimitivesDecl.inc file defines Primitives. The file consists of a declarations (left) and the corresponding byte stream (right).

```

6| Primitive SOAF = kBC 18 1E 81
7| Primitive EOAF = kBC 18 67 9F
8|
9| Primitive "ALIGN (0)" = kBC 4A 4A 7B
10| Primitive "ALIGN (1)" = kBC 07 07 07
11| Primitive "ALIGN (2)" = kBC 61 61 61
12| Primitive "ALIGN (3)" = kBC 7B 7B 7B

```

To generate Primitives, copy relevant portions of text on the left (i.e., not the bytes shown right) from this file into the generator block section of the .ssg file.

For examples of usage, see primitives.ssg in the Samples directory.

### AddressFramesDecl.inc

The AddressFramesDecl.inc file defines Address Frames.

For examples of usage, see AddressFrames.ssg in the Samples directory.

**SSPframes.inc**

The SSPframes.inc file defines SSP Frames.

For examples of usage, see SSPframes.ssg in the Samples directory.

**SMPframes.inc**

The SMPframes.inc file defines SMP frames

For examples of usage, see SMPframes.ssg in the Samples directory.

**STPframes.inc**

The STPframes.inc file defines STP frames

For examples of usage, see STPframes.ssg in the Samples directory.

## 11.9 Working with Generation Files

The easiest way to generate traffic is to start with one of the sample 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 shows the sample file SSPFrames.ssg as it appears in the script editor and trace window.

```

#include "Generation\Include\SSPFramesDecl.inc"
Generation
{
  # SendSSPFrameData
  # {
  #   Data = { 21223344 55667788 99AABBCC }
  # }

  SendSSPFrameXferRdy
  {
    Data = { 51223344 55667788 99AABBCC }
  }

  SendSSPFrameCommand

  SendSSPFrameResponse

  SendSSPFrameTask
  {
    Data = { 51223344 55667788 99AABBCC }
  }

  SendSSPFrameVendor
}
    
```


The screenshot displays the SASTracer/Trainer Analyzer interface. At the top, there are several configuration bars: 'GEN MODE - SATA Host, SSC is ON', 'LINK SPEED - 1.5Gbps', and 'CONFIGURATION'. Below these are tables for OOB Settings (COMINIT, COMWAKE, COMSAS) and SATA Link Initialization Settings. The bottom section shows a frame trace with five frames:


Frame	Rate	Symbol	Type	Tag	Data	CRC	EOF	Idle	Time Stamp
8	1.5 G	G	XFER_RDY	0x0000	12 bytes	0x669F7A95	EOF	0.000 ns	00.000 000 000
9	1.5 G	G	COMMAND	0x0000	0 bytes	0x74258E55	EOF	0.000 ns	00.000 000 320
10	1.5 G	G	RESPONSE	0x0000	0 bytes	0x5340ABD4	EOF	0.000 ns	00.000 000 560
11	1.5 G	G	TASK	0x0000	12 bytes	0xC486DB10	EOF	0.000 ns	00.000 000 800
12	1.5 G	G	UNKNOWN	0x0000	0 bytes	0xBCF96B0F	EOF	0.000 ns	00.000 001 120

In the lower 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, you will see that there are six frame commands, five active and one commented out.

## 11.10 Generating Traffic

Once the `.ssg` file has been opened onscreen, recording and traffic generation can begin at any time.

**Step 1** Click  to begin the recording.

**Step 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 will cause the generator to invoke the various settings in your script (for example, the global settings) and then establish a connection.

**Step 3** Click the Start Generation button  on the Tool Bar.

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).

### Stop Traffic Generation

Normally, traffic generation stops automatically when *SASTrainer* reaches the end of the Generator file.

To manually stop traffic generation, Click the Stop Generation button .

### 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 Stop Generation button .

## 12. SASTrainer Generation Language

The SASTrainer 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.

### 12.1 File Structure

Traffic Generation files (\*.ssg) should have the following structure:

#### Declarations

- Global generation settings
- Constants
- Data patterns
- Chain of symbols (primitives, raw data, etc)
- 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 at current time only a block with the name 'Generation' will be executed. (Calls of some blocks from another blocks are not currently allowed)

### 12.2 Language

#### Comments:

'#' - Comment symbol. The line remainder after this symbol will be ignored.

/\* \*/ - Comment Block. All the text between '/' '\*' and '\*' '/' is ignored.

/\*

This is an example of a block of comments.

\*/

**Includes:**

`%include "FileName.inc"` - This directive includes the file "FileName.inc". This lets the user add common definitions and templates into new scripts.

Language parser makes sure the same file is not included more than once.

*Example:*

```
%include "SomeInc.inc" # This directive will actually include file  
'SomeInc_1.inc'
```

`%inline` - The same as `%include`, but without the Language parser check.

**Settings**

Using the "Set "Constant Name" = Value" statement, users can set different constants/modes using the following value types:

- Predefined constants (TRUE/FALSE/ON/OFF/INFINITE/etc)
- Numbers

*Examples:*

```
Set AutoAlignSATA=ON
```

```
Set WaitTimeOut=239
```

**Constants**

Only unsigned integers can be defined as constants. Some constants are predefined in SASTrainer

*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.

*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
```

- 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, user can define a frame of traffic to be used 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 will be 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 will be 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 used as a Prolog.

Epilog = EOF # For this frame primitive 'EOF' is used as a 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)"
}

```

## 12.3 Generation Block

SASTrainer will generate 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)
}

```

## 12.4 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

The user 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
uses both integer variables, constants, hex literals and data patterns
    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 64K.
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
}
```

## 12.5 SASTrainer Generation Commands

### General Commands

CLEAR_CREDIT_AVAIL	This commands clears the credit established with the command <b>WF_CREDIT_AVAIL</b> . (See WF_CREDIT_AVAIL in following section on Wait Commands for explanation).
RD_POS	Generator will insert one idle dword into gen stream, which will bring current RD to positive level
RD_NEG	Generator will insert one idle dword into gen stream, which will bring current RD to negative level
RD_ERROR	Generator will insert one idle dword into gen stream, which will bring intentionally break RD sequence creating RD error
CONNECT	Generator will go through connection sequence using current GenFile settings (gen mode, speed e.t.c.) 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.
<b>OOB Commands</b>	
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.

### SATA Commands

Look at STP sample file for syntax.

- SEND\_SATA\_FRAME
- SendSATAFrame
- SATAData
- SATA\_Data
- SATA\_CRC
- SATA\_CRC
- SATA\_CXX
- SATA\_CXX

**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 WAITING ON PARTIAL)
- 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
- 
- 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
  
- 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



## Wait Commands

Syntax:        WAIT\_FOR { <command1> <command2> ... <group1> <group2> ... }

WaitCommand Name	Description
WF_TIMEOUT	<p><b>Timeout Credit Available</b></p> <p>When WF_TIMEOUT is requested in WAIT_FOR command the wait session will be released after timeout has elapsed.</p> <p>The Timeout value can be set two different ways:</p> <ol style="list-style-type: none"> <li>1. Through the global Wait-Timeout setting that can appear anywhere in generation. Default value is 1000 microseconds. Syntax: Set WaitTimeout = &lt;value&gt; (in microseconds)</li> <li>2. Through local WaitTimeout value for this specific wait session. Syntax: WAIT_FOR ( &lt;number_of_microseconds &gt; ) { WF_TIMEOUT &lt;other_wait_commands&gt; }</li> </ol> <p>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.</p> <p>See Generation\Include\WaitCommands.inc in your SASTracer program folder for the samples of syntax.</p>
WF_SOF	primitive
WF_EOF	primitive
WF_SOAF	primitive
WF_EOAF	primitive
WF_ACK	primitive
WF_NAK_CRC_ERROR	primitive
WF_NAK_RESERVED_0	primitive
WF_NAK_RESERVED_1	primitive

WaitCommand Name	Description
WF_NAK_RESERVED_2	primitive
WF_CREDIT_AVAIL	<p><b>Credit Available</b></p> <p>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.</p> <p>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.</p> <p><b>CLEAR_CREDIT_AVAIL</b> clears this credit function.</p>
WF_CREDIT_BLOCKED_RECEIVED	<p><b>CreditBlocked Received</b></p> <p>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.</p>
WF_CREDIT_BLOCKED	primitive
WF_RRDY_NORMAL	primitive
WF_RRDY_RESERVED_0	primitive
WF_RRDY_RESERVED_1	primitive

<b>WaitCommand Name</b>	<b>Description</b>
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
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

WaitCommand Name	Description
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	<p>Advanced Wait Condition A</p> <p>This command causes generation to wait for Event "A" to occur that you defined in the <b>Generation Options</b> dialog described at the end of this chapter.</p>
WF_REC_RESOURCES_OUTPUT_B	<p>Advanced Wait Condition B</p> <p>This command causes generation to wait for Event "B" to occur that you defined in the <b>Generation Options</b> dialog described at the end of this chapter.</p>
WF_REC_RESOURCES_OUTPUT_C	<p>Advanced Wait Condition C</p> <p>This command causes generation to wait for Event "C" to occur that you defined in the <b>Generation Options</b> dialog described at the end of this chapter.</p>

WaitCommand Name	Description
WF_REC_RESOURCES_OUTPUT_D	<p><b>Advanced Wait Condition D</b></p> <p>This command causes generation to wait for Event "D" to occur that you defined in the <b>Generation Options</b> dialog described at the end of this chapter.</p>
WF_REC_RESOURCES_OUTPUT_E	<p><b>Advanced Wait Condition E</b></p> <p>This command causes generation to wait for Event "E" to occur that you defined in the <b>Generation Options</b> dialog described at the end of this chapter.</p>
WF_REC_RESOURCES_OUTPUT_F	<p><b>Advanced Wait Condition F</b></p> <p>This command causes generation to wait for Event "F" to occur that you defined in the <b>Generation Options</b> dialog described at the end of this chapter.</p>
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

<b>WaitCommand Name</b>	<b>Description</b>
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
WF_OPEN_REJECT_PROTOCOL_NOT_SUPPORTED	primitive
WF_OPEN_REJECT_RETRY	primitive

<b>WaitCommand Name</b>	<b>Description</b>
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

WaitCommand Name	Description
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

### Wait Command Groups

Wait Command Group	Group Contents
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



Wait Command Group	Group Contents
WF_RRDY	WF_RRDY_ NORMAL
	WF_RRDY_ RESERVED_0
	WF_RRDY_ RESERVED_1
WF_CREDIT_OK	WF_CREDIT_ AVAIL
	WF_CREDIT_BLO CKED_RECEIVED
WF_CLOSE	WF_CLOSE_CLEA R_AFFILIATION
	WF_CLOSE_ NORMAL
	WF_CLOSE_ RESERVED_0
	WF_CLOSE_ RESERVED_1

Wait Command Group	Group Contents
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

Wait Command Group	Group Contents
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

Wait Command Group	Group Contents
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_RESERVED_ABANDON_2

<b>Wait Command Group</b>	<b>Group Contents</b>
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

Wait Command Group	Group Contents
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

**Generation Settings**

**Table 2: Generation Settings**

Setting	Default Value	Description
<b>Global Settings</b>		
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

**Table 2: Generation Settings**

<b>Setting</b>	<b>Default Value</b>	<b>Description</b>
SSC	0	Spread Spectrum Clocking mode for SATA. Can only be set outside Generation block.
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.
<b>AutoMode Settings</b>		
AutoOOBMode	0	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).
AutoHandshake	0	When set, the generator will respond automatically to TBD commands. Not supported for version 1.1 (reserved).



**Table 2: Generation Settings**

<b>Setting</b>	<b>Default Value</b>	<b>Description</b>
AutoSpeedNeg	0	When set, the generator will automatically go through the 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	0	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
<b>COMINIT Settings</b>		
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.

**Table 2: Generation Settings**

<b>Setting</b>	<b>Default Value</b>	<b>Description</b>
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.
<b>COMWAKE Settings</b>		
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.

**Table 2: Generation Settings**

<b>Setting</b>	<b>Default Value</b>	<b>Description</b>
<b>COMSAS Settings</b>		
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.
<b>SATA Link Init Settings</b>		
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.

**Table 2: Generation Settings**

<b>Setting</b>	<b>Default Value</b>	<b>Description</b>
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.
<b>SAS Speed Negotiation Settings</b>		
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.

**Table 2: Generation Settings**

<b>Setting</b>	<b>Default Value</b>	<b>Description</b>
<b>SATA Speed Negotiation Settings</b>		
OOB_SpeedNeg_RCDDT	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.
<b>Speed Settings</b>		
Speed	>>>>>	Link Speed Possible Values: LINK_SPEED_1_5G LINK_SPEED_3G Default Value: LINK_SPEED_1_5G
RateMatching	0	When set, the generator will automatically inserting the stream Align(0) primitive after every dword.

**Table 2: Generation Settings**

<b>Setting</b>	<b>Default Value</b>	<b>Description</b>
<b>Scrambling Mode Settings</b>		
ScramblingMode	>>>>>	Raw Data Scrambling Mode - Only those raw dwords will be scrambled that contain only data bytes (no 10bit symbols or 'K' bytes. Scrambling is reset by changing ScramblingMode or by any valid SAS or SATA frame. Possible Values: SCRAMBLING_MODE_NONE SCRAMBLING_MODE_SAS SCRAMBLING_MODE_SATA Default Value: SCRAMBLING_MODE_NONE
<b>Wait Timeout Settings</b>		
WaitTimeout	1000	Sets global WaitTimeout value in microseconds
<b>AUTO_WAIT_SAS_AFTER Settings</b>		
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.

**Table 2: Generation Settings**

<b>Setting</b>	<b>Default Value</b>	<b>Description</b>
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.
<b>AUTO_WAIT_SAS_BEFORE Settings</b>		
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.

**Table 2: Generation Settings**

<b>Setting</b>	<b>Default Value</b>	<b>Description</b>
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.
<b>AUTO_WAIT_SATA_AFTER Settings</b>		
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.



**Table 2: Generation Settings**

<b>Setting</b>	<b>Default Value</b>	<b>Description</b>
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.
<b>AUTO_WAIT_SATA_BEFORE Settings</b>		
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.

**Table 2: Generation Settings**

<b>Setting</b>	<b>Default Value</b>	<b>Description</b>
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_RRDY_FOR_X_RDY	FALSE	When set, the generator will insert WAIT_FOR SATA_X_RDY command right before each SATA_R_RDY primitive.

## 12.6 Setting Complex "Wait For" Conditions

The Generation Options dialog lets users 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.

Once a letter value has been assigned to an event, the letter is referred to in your generation script using the following command syntax:

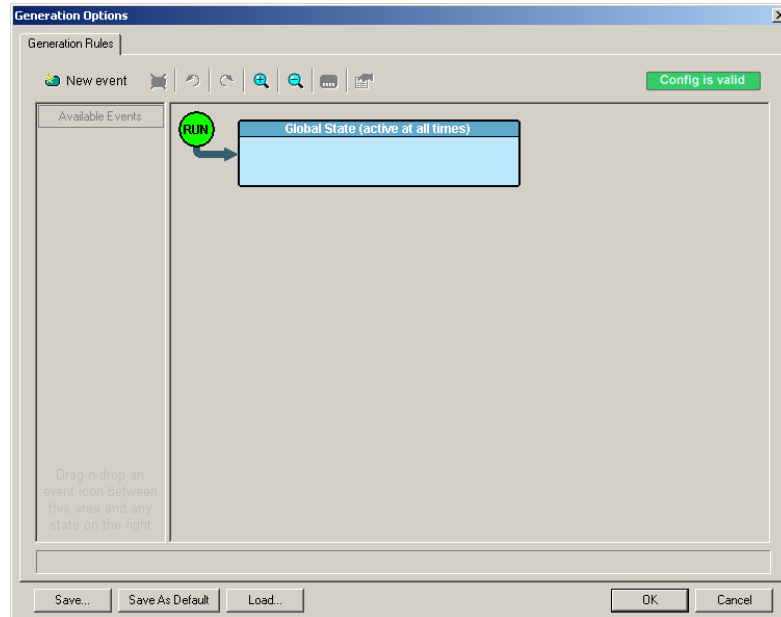
**Wait\_For {WF\_REC\_RESOURCES\_OUTPUT\_A}**

where "A," in this case, is the defined condition.

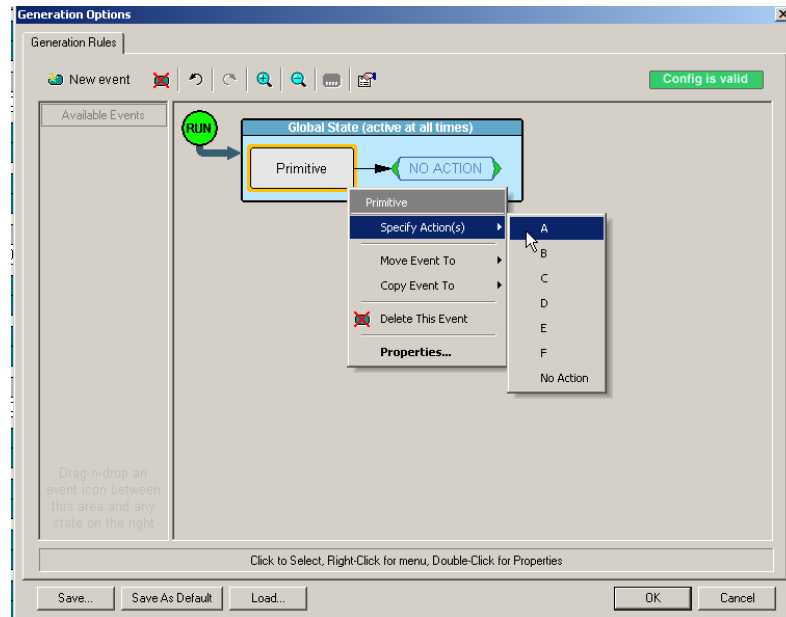
## Setting Conditions with the Generation Options Dialog

To set a complex condition, open the Generation Options dialog:

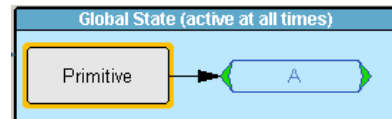
- Step 1** Select **Generate > Generation Options** from the menu. The Generation Options dialog opens. The Generation Options dialog looks very similar to the Recording Rules dialog:



- Step 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.
- Step 3** Drag the new event button to the **Global State** cell.
- Step 4** Right-click on the new event button and select **Specify Action(s)**. A menu appears showing the letters A through F and the option "No action."



- Step 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.



- Step 6** Once 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}`

## 13. Updates and Licensing

From time to time as modifications are made to the *SASTracer/Trainer* Analyzer, it may become necessary to update the *SASTracer/Trainer* software. You can obtain new software from the LeCroy website:

**www.LeCroy.com**

When you download new *SASTracer* software, firmware and BusEngine files are included as part of the software package. Occasionally, LeCroy will update these files. The new files will install automatically following installation of the new analyzer software. If you prefer, however, you can manually update firmware and BusEngine. This chapter describes both automatic and manual updates.

**Note:** LeCroy analyzers come with a Three Year Investment Protection Agreement that entitles users to new software. Thereafter, to obtain new software the user will need to renew the LeCroy Maintenance Agreement. Contact LeCroy for details.

### 13.1 Software, Firmware, and BusEngine Versions

The **Readme.txt** file on the installation CD and on the installed directory on your hard drive gives last-minute updates about the current release. Included with each release are the most recent downloadable images of the Firmware and the BusEngine.

Once the *SASTracer/Trainer* Analyzer has completed the self diagnostics and is connected to the PC, you can check the latest version of the software and BusEngine.

To check information about the current software, select **About SASTracer...** from the **Help** menu.

The About *SASTracer* window appears.

**About SASTracer** details revisions of the following software and hardware:

- *SASTracer/Trainer* Software Version, Build Number
- *SASTracer/Trainer* Firmware Version
- BusEngine Version, Build Number
- Unit Serial Number



**Note:** When contacting LeCroy for technical support, please have available all the revisions reported in the **About SASTracer** window.

## 13.2 Software Updates

When a new software release is available, it is posted on the Support page of the LeCroy website at [www.Lecroy.com/support.html](http://www.Lecroy.com/support.html).

To update the software, follow these steps:

**Step 1** Find the latest released software version on the LeCroy website under **Support**.

If you are running the latest version of the software, no further action is needed.

If you are **not** running the latest version, continue to Step 3.

**Step 2** Download the Zip file from the website.

**Step 3** Unzip the files into your choice of directory.

**Step 4** Click **Start**, then **Run**, and browse to where you unzipped the files.

**Step 5** Select the program named **Setup** and click **Open**.

**Step 6** Click **OK** to run the Setup and begin the installation.

**Step 7** Follow the on-screen instructions to complete the installation.

**Step 8** Read the Readme file for important information on changes in the release.

## 13.3 Automatic BusEngine and Firmware Updates

BusEngine and Firmware updates often need to be performed when you update the *SASTracer/Trainer* software. These updates can be performed automatically or manually. Both processes are described.

### Updating the BusEngine

The BusEngine core is the heart of the *SASTracer/Trainer* Analyzer. Using FPGA technology, it incorporates both the high speed recording engine and the configurable building blocks that implement data/state/error detections, triggering, capture filtering, external signal monitoring, and event counting and sequencing. Both the BusEngine program and the Firmware that manages the internal microcontroller are fully field updateable.

Within a new software release, it may be necessary to update the Analyzer's BusEngine hardware for proper operation. The Readme file lets you know if this is necessary.

### Updating the Firmware

Within a new software release, it may also be necessary to update the Analyzer's firmware for proper operation. The Readme file informs you if this is necessary.

### Automatic Updates

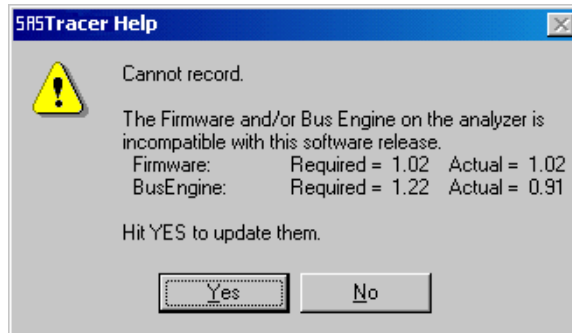
When the *SASTracer/Trainer* software is updated, the software may become incompatible with the BusEngine and Firmware. If a recording is attempted, *SASTracer/Trainer* displays an error message and then automatically begins an update process for the BusEngine and Firmware.

To perform an automatic BusEngine and Firmware update, follow these steps:

- Step 1** If needed, update the *SASTracer/Trainer* software, following the steps outlined in "Software Updates."
- Step 2** Turn on the *SASTracer/Trainer* Analyzer.
- Step 3** Select **Start > Record** from the menu.

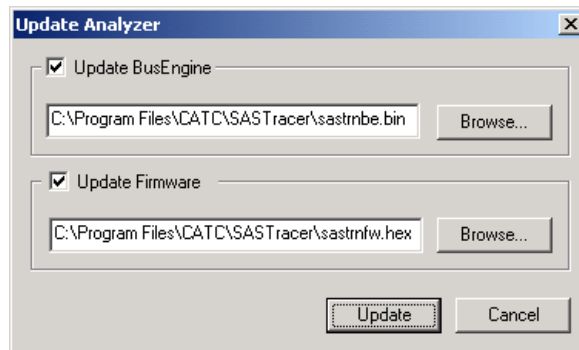
Because the BusEngine and/or the Firmware are incompatible with the current *SASTracer/Trainer* software version, an error message

appears showing your current versions and indicating what versions you need to install.



**Step 4** Click **Yes**.

The **Analyzer Setup** window appears.

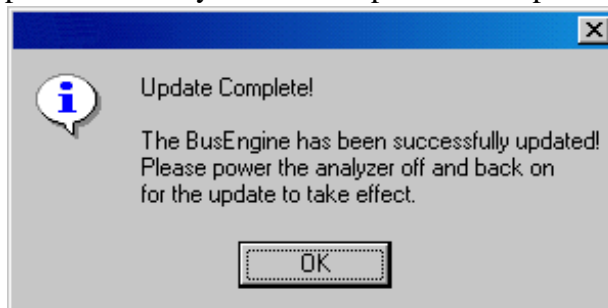


**Step 5** Click **Update**.

You can select only one item at this point. If both the BusEngine and the Firmware need to be updated, the update will complete for the first item and then return to the above window so the second update can be performed.

**Note:** Once you have started updating the BusEngine or Firmware, do not interrupt the update!

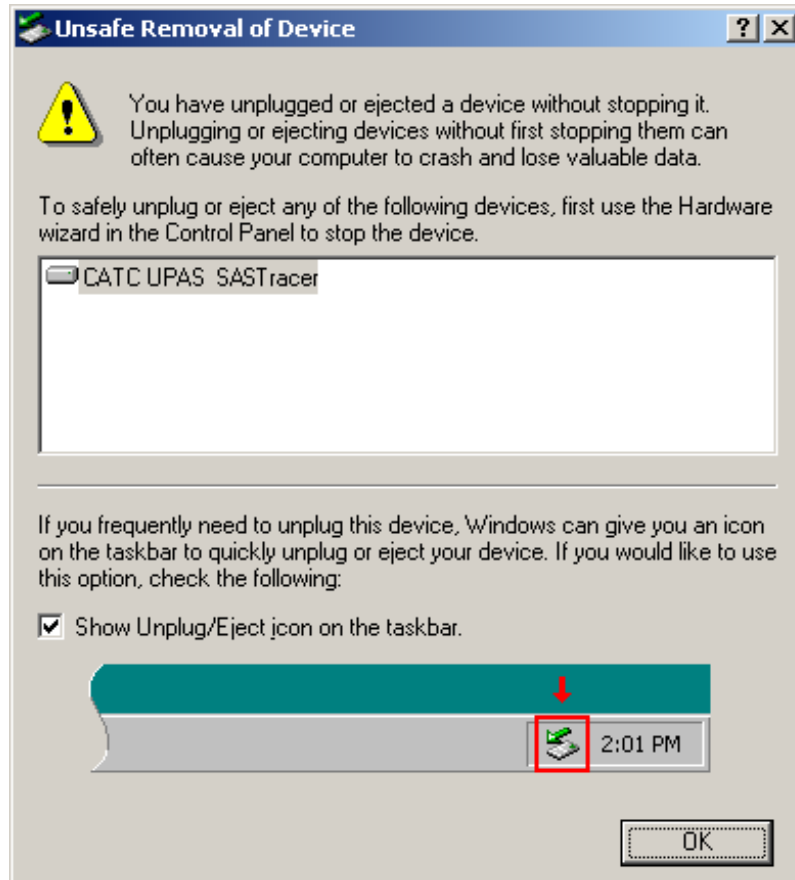
When the second update has finished, the following message appears and tells you that the update is complete.





**Step 6** To complete the update, power cycle the *SASTracer/Trainer* (turn the unit off then back on).

If you are running Windows 2000, the Analyzer will automatically reboot, and the following message will appear:



**Step 7** Click **OK**.

In this instance, you do not need to power cycle the Analyzer (turn off then back on).

## 13.4 License Information

Licensing information for *SASTracer* can be viewed by selecting Display License Information from the Help menu. The License window provides maintenance expiration for *SASTracer*.

## 13.5 Updating the Software License

A current License agreement with LeCroy entitles the analyzer owner to continued technical support and access to software updates as they are published on the LeCroy website.

If your license expires, a License Key must be obtained by LeCroy (refer to the contact information at the back of this manual.)

Once the License Key is obtained, follow these steps to install it:

- Step 1** From the **Help** menu, select **Update License**. The Update License dialog appears.
- Step 2** Enter the path and filename for the License key or use the Browse button to navigate to the directory that contains the License Key.
- Step 3** Select the \*.lic file, and then click **Update Device**.

## Limited Hardware Warranty

### How to Contact LeCroy

Type of Service	Contact
Call for technical support...	US and Canada: 1 (800) 909-2282 Worldwide: 1 (408) 653-1260
Fax your questions...	Worldwide: 1 (408) 727-6622
Write a letter...	LeCroy Protocol Solutions Group Customer Support 3385 Scott Blvd. Santa Clara, CA 95054 USA
Send e-mail...	support@CATC.com
Visit LeCroy's web site...	<a href="http://www.lecroy.com/">http://www.lecroy.com/</a>

## Limited Hardware Warranty

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



### What this Warranty Does Not Cover

This warranty does not cover damage due to external causes including accident, damage during shipment after delivery to a common carrier by LeCroy, abuse, misuse, problems with electrical power, including power surges and outages, servicing not authorized by LeCroy, usage or operation not in accordance with Product instructions, failure to perform required preventive maintenance, software related problems (whether or not provided by LeCroy), problems caused by use of accessories, parts or components not supplied by LeCroy, Products that have been

modified or altered by someone other than LeCroy, Products with missing or altered service tags or serial numbers, and Products for which LeCroy has not received payment in full.

### **Coverage During Warranty Period**

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

### **How to Obtain Warranty Service**

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

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

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

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

If LeCroy evaluates and determines there is "no trouble found" in any Product returned or that the returned Product is not eligible for warranty coverage, LeCroy will inform you of its determination. If you thereafter request LeCroy to repair the Product, such labor and service shall be performed under the terms and conditions of LeCroy's then current repair policy. If you chose not to have the Product repaired by LeCroy, you agree to pay LeCroy for the cost to return the Product to you and that LeCroy may require payment in advance of shipment.

### **General Provisions**

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

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

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



## Appendix A: Specifications

SASTracer/Trainer is a hardware module that installs into the CATC 10K analyzer / exerciser platform. The following specifications describe a combined SASTracer/Trainer 10K based system.

### Package

Dimensions: CATC 10K: 12.2 x 12.2 x 3.5 inches  
(31.1 x 31.1 x 8.9 cm)  
SASTracer Plug-in: 4.5 x 6.7 x 1.3 inches  
(11.3 x 17.0 x 3.2 cm)  
SASTrainer Plug-in: 4.5 x 6.7 x 1.3 inches  
(11.3 x 17.0 x 3.2 cm)

Rear Connectors: CATC 10K:  
AC power connection  
External trigger connection (TRIG IN/OUT, BNC)  
PC connection (USB 2.0 Hi-Speed, type "B")  
Break-out board (type "D")

Weight: CATC 10K: 9.5 lbs (4.3 kg)  
SASTracer Plug-in: 1 lb 11.4 oz (.77 kg)  
SASTracer doublewide Plugin in 3 lb 3 oz (1.45kg)  
SASTrainer Plug-in: 1 lb 11.4 oz (.77 kg)

### Power Requirements

90-254VAC, 47-63Hz (universal input), 120W maximum

### Environmental Conditions

Operating Range: 0 to 40 °C (32 to 104 °F)  
Storage Range: -20 to 80 °C (-4 to 176 °F)  
Humidity: 10 to 90%, non-condensing

### Probing Characteristics (model SS002MAA & SS003MAA)

Connector Type: One Port Model - Single Pair of Internal Connectors  
(Initiator and Target; Serial ATA Standard)  
Two Port Model - Dual Pair of Internal Connectors  
(Initiator and Target; Serial ATA Standard)  
Four Port Model - Single Pair of Internal Connectors  
(Initiator and Target; Serial ATA Standard)

SASTrainer Connection Type: Single Initiator and Target connectors  
(for transmission only)

*Probing Characteristics (model SS004MAA)*

Connector Type: 2 pairs SAS External 4 lane Connector:

Non-intrusive tap - samples the signal without re-driving the differential lines (high value resistors contribute to reduction in amplitude ~ 15%).

Repeater tap - re-drives the signal at either SAS (high swing) or SATA (low swing) voltages; does not re-time the signal.

SASTrainer Connection Type: Single Initiator and Target connectors (for transmission only)

*Recording Memory Size*

2 GBytes for trace capture, timing and control information.

*Host PC Requirements*

Operating System: Windows 98SE, Windows 2000, Windows ME or Windows XP

*Switches*

Power: On/off  
Manual Trigger: When pressed, triggers the end of the recording

*LEDs*

UPAS: Illuminated when the analyzer is powered on.  
Status (STATUS): Illuminates for approximately 25 seconds during initialization/power up of the UPAS base unit. If this LED blinks following initialization, this is an indication that initialization failed.  
Recording (REC): Illuminated when the analyzer is actively recording traffic data  
Triggered (TRG): Illuminated during power-on testing and when the analyzer has detected a valid trigger condition.  
UPloading (UPLD): Illuminated when the analyzer is uploading its recording memory to the Host PC for displaying the CATC trace

*SASTracer Plug-in*

Module: SASTracer Plug-in  
Status (STATUS): Illuminates when there is traffic on both the host and device sides. Blinks when there is traffic on one side only.



*Basic Trigger Events*

Frames: SSP Command, Data, Response, Task, X\_RDY and Vendor Unique, SMP Request, Response, Report, Discover and Configure;

Primitives: ACK, CREDIT\_BLOCKED, DONE (ACK/NAK TIMEOUT), NAK, RRDY, SOF, AIP, BREAK, BROADCAST, CLOSE, OPEN\_ACCEPT, OPEN\_REJECT, and more task management functions

Errors: Invalid 10b codes, CRC Errors, Running Disparity Errors, Time-outs, Alignment errors, Code Violation

SCSI Operations: Pending SCSI I/Os, SCSI I/O Response, SCSI I/O Latency, SCSI I/O Throughput, Frame Length, Data Throughput, Link Utilization (%), Frame Count

*Traffic Summary Reports*

Data Frames  
Primitives  
Connects/Disconnects  
Errors  
SCSI Commands  
Read Response (min, max, avg.)  
Write Response (min, max, avg.)

