PROTOCOL SOLUTIONS GROUP
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LeCroy SAS*Suite*™ User Manual

for Avalanche™, SAS*Tracer*™ and SAS*Trainer*™ Systems

User Manual Version 6.2

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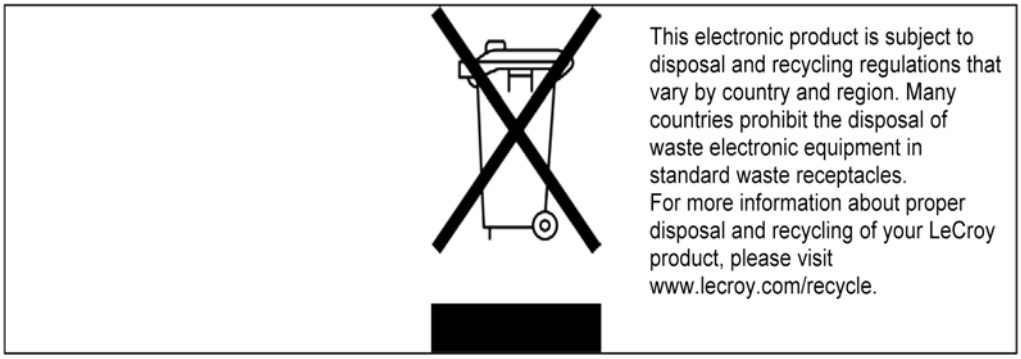

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Chapter 1: Overview

LeCroy's SAS*Suite* expert application software package provides a powerful and flexible means for recording, decoding and displaying communications traffic on SAS and SATA links. The SAS*Suite* application supports the following major products to assist engineers in designing, developing and validating SAS- and SATA-based products.

- The Avalanche Protocol Analyzer allows users to record and display all communications traffic on SAS or SATA links at data rates of 1.5, 3 and 6 Gb/s. As with all LeCroy analyzers, hardware-based pre-capture filtering is supported for efficient memory management. The system 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 Avalanche to test Serial ATA environments (1.5, 3 or 6 Gb/s).
- The SAS*Tracer* Protocol Analyzer allows users to record and display all communications traffic on SAS or SATA links at data rates of 1.5 and 3 Gb/s. Full SATA-II analysis support is included for users interested in using SAS*Tracer* to test Serial ATA environments (1.5 or 3 Gbps). An important option for the SAS*Tracer* Analyzer is the SAS*Tracker* Command Analyzer option. SAS*Tracker* monitors commands issued over SAS or SATA networks to track all commands, measure execution time, identify slow commands or commands that fail to complete, and optimize overall system performance.
- The SAS*Trainer* Exerciser is a traffic generation system that can initiate SAS or SATA traffic (emulating either an initiator or target device) for testing of SAS/SATA designs and products. The system 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.

These products, used either separately or in combination, provide fast, efficient and accurate debug, test and verification of Serial Attached SCSI semiconductors, devices and systems. They allows designers and validation engineers to quickly and easily transmit valid and invalid SAS or SATA traffic, selectively record the exchange and display the results using the SAS*Suite* expert analysis software. The SAS*Suite* software supports all LeCroy SAS and SATA products, allowing this all-in-one test platform to play an important role at every phase of the SAS product development process.

The Avalanche protocol analyzer uses LeCroy's newest and most advanced hardware platform, providing support for all SAS and SATA data rates up to 6 Gb/s.

The SAS*Tracer* and SAS*Trainer* systems operate on a common modular hardware design, based on the LeCroy CATC 10K chassis. The different product functions are supported by hardware modules which plug into the chassis, by LeCroy's unique BusEngine firmware cores, and by the SAS*Suite* Application Software.

The heart of the LeCroy SAS 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 and SATA traffic. It can intelligently monitor SAS and SATA frame headers and addresses, and start or stop recording based on user-defined events.

The modular LeCroy SAS products allow users to expand and upgrade systems as their needs change. Adding new modules, or adding new BusEngines to existing modules, can economically expand the system capabilities while maintaining a common software interface through the integrated SAS*Suite* Application Software.

For complete product information, please visit **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 www.t10.org.

Avalanche System

SAS*Tracer*/*Trainer* System

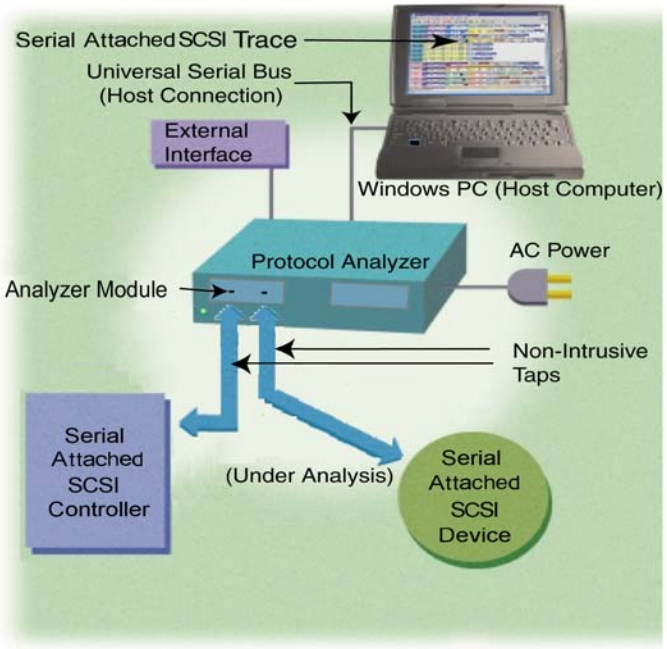
General Description

The LeCroy SAS analyzer systems are intended to operate while inserted in the data path between SAS or SATA initiators and targets, non-intrusively passing all data traffic while capturing and recording the traffic of interest to the user.

The analyzer, in turn, connects to a PC over a high-speed USB cable. The PC functions as the host controller for the analyzer. SAS*Suite* software on the PC controls and configures the products and retrieves and displays recorded data.

The SAS*Suite* 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 CATC 10K chassis supports up to two plug-in modules that can support tracing, traffic generation and/or command analysis. The common hardware design allows users to obtain muliple functions at economical prices, and to upgrade existing systems to new functions by adding the appropriate modules, BusEngines or software licenses.



The protocol 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, the analyzer 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.

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 SAS*Suite* 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.

Avalanche Features

- High-Performance Protocol Analyzer System
- Available with one, two or four analysis ports, each supporting 1.5 Gb/s, 3.0 Gb/s and 6.0 Gb/s data rates
- SAS and Serial ATA Recording at 1.5, 3.0 or 6.0 Gb/s
- Sophisticated Triggering
- Hardware Filtering
- DWORD Display
- External 4-lane MiniSAS Connectors
- Traffic Summaries
- Collapsible / Expandable Headers
- Automatic Decoding at Transport Layer; SCSI, ATA and Management Application Layers
- Field Upgradeable BusEngine Technology
- Dynamically Allocated Memory Pool (4 GB)
- 3 Year Hardware Warranty
- All-in-one platform transmits, records, and analyzes SAS 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 and data 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

SAS*Tracer*/*Trainer* Features

- Integrated Analyzer, Generator and Command Analyzer 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
- Command Analyzer tracks all commands issued in SAS matrix of up to 8 initiators and 128 targets
- 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 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 and data by removing non-essential primitives
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- Easily upgrade firmware to support new features
- Protect your investment with industry-leading warranty

LeCroy BusEngine

LeCroy’s BusEngine™ Technology is at the heart of the SAS Product Line. 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.

Connection to Host PC System

The Avalanche and the SAS*Tracer*/*Trainer* are USB 2.0 Certified Hi-Speed Devices. 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 analyzer products include 2.0 USB hubs. You might see the drivers for these generic hubs being installed upon the initial plug-in.

Chapter 2: Installation

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

System Components

- One stand-alone SAS/SATA Analyzer system
- One USB cable
- SAS*Suite* software program CD-ROM
- SATA(SAS) cables approriate to analyzer system and devices under test
- Breakout board

Note: Specific components included with the analyzer system vary based on model and configuration ordered.

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

Analyzer PC Requirements

The SAS Analyzer connects to a Host PC via USB line.

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

Analyzer Hardware Description

Avalanche System

The LeCroy Avalanche system is a compact package that provides ports on the front to connect to SAS or SATA initiators and targets, and rear connections including power and USB (to host PC). The front panel also contains arrays of indicator LEDs, both for the status of the four initiators and four targets, and also for the analyzer functions.

The SAS/SATA ports are "MiniSAS" connectors that can use either MiniSAS-to-MiniSAS cables or can use an "octopus" cable that breaks out the MiniSAS connector to individual device connectors. Up to four links are supported between targets and initiators.

Avalanche LED Descriptions

The Status and Speed LEDs indicate the status of each link, as follows:

- The STATUS LED is green when receiving a frame, red when errors are found, and mixed color (1/2 green, 1/2 red) during OOB. Otherwise, the LED is off.

- The SPEED LED is green for 6Gb/s traffic, mixed color (1/2 green, 1/2 yellow) for 3 Gb/s traffic, and yellow for 1.5 Gb/s traffic (or off if no traffic is detected on that link)

The System LEDs indicate the status of the protocol analyzer, as follows:

- The TRIG/ERR RIGHT LED is green if the system is triggered, red if either Link 1 or Link 2 have a system error; and off otherwise.
- The REC/UPLOAD RIGHT LED is red if either Link 1 or 2 is recording, green if either Link1 or Link 2 are uploading, and off otherwise.
- The TRIG/ERR LEFT LED is green if the system is triggered, red if either Link 3 or Link 4 have a system error, and off otherwise.
- The REC/UPLOAD LEFT LED is red if either Link 3 or Link 4 is recording, green if either Link 3 or Link 4 are uploading, and off otherwise.

Note: In the descriptions above, "Link 1" refers to the link between Initiator 1 (I1) and Target 1 (T1), "Link 2" refers to the link between I2 and T2, etc. The designation "Left" or "Right" is used since the Avalanche system includes dual BusEngines, one of which (right side) processes traffic from Link 1 and Link 2, while the other (left side) processes traffic from Link 3 and Link 4.

Avalanche Rear Panel Connectors

The rear panel of the Avalanche System provides the following connectors:

- POWER IN (to be supplied using the Adapter provided with the Avalanche System)
- USB (to provide a connection to the host PC system running the SAS*Suite* application software)
- DATA IN/OUT (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.)
- SYNC OUT and SYNC IN (provides the capability to link up to 8 Avalanche Systems together to form a single system supporting up to 32 time-synchronized links)
- EXT OUT and EXT IN (SMA connectors which provide signal connections to the Avalanche system from an external device, or to cause the Avalanche system to signal an external device)

SAS*Tracer*/*Trainer* System

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

SAS*Tracer* Analyzer Systems

Module Part # SS002MAA-X & SS003MAA-X

Module Part # SS004MAA-X

SAS*Tracer*/*Trainer* Analyzer LED Descriptions

When powered on, the SAS Analyzer activates the user-accessible controls and LEDs on the front and rear panels of the CATC 10K.

Front Panel (Internal single lane connector - SS002MAA & SS003MAA-X)

Front Panel (4 Port External connector - SS004MAA-X)

Front Panel LEDs (from left to right)

- **A** **PWR** (power) - Green indicator LED for CATC 10K. Lights when the unit power is switched on.
- **B** **Status** indicator - Red indicator LED for CATC 10K. Lights during initialization/power up of CATC 10K 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. Blinks during OOB or when only one of the two connected devices is transmitting.

Connectors on the SAS*Tracer* 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).

SAS*Tracer*/*Trainer* Rear Panel Description

From left to right, the CATC 10K rear panel contains the following components:

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 SAS*Suite* 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.

Setting Up the Analyzer

Step 1 Remove the analyzer from its shipping container.

Step 2 Connect the analyzer unit to a source of compatible AC power using the provided power cord (and, for Avalanche, the provided external power supply).

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 front of the Avalanche or on the rear of the CATC 10K).

Note: At power-on, the analyzer initializes itself in approximately ten seconds and performs an exhaustive self-diagnostic that lasts about five seconds. If the diagnostics fail, 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 SAS*Suite* CD). Step through the Windows hardware wizard. The wizard will see that the analyzer has an internal USB hub and will begin loading hub drivers. Afterwards, the wizard will automatically install the system 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 the following files

- For Avalanche systems, install **AvaInche.sys** and **CTCDragn.sys**
- For SAS*Tracer* systems, install **CATCupa.sys** and **SasTracer.sys**.

Connecting SAS/SATA Devices to the Analyzer

Depending on the model of your analyzer, you will have different SAS/SATA connectors on the front panel, as follows:

- Avalanche systems provide MiniSAS connectors.
- SAS*Tracer* systems provide either SATA-style connectors or Infiniband connectors, depending on the module installed in your SAS*Tracer*.

Avalanche Connectors

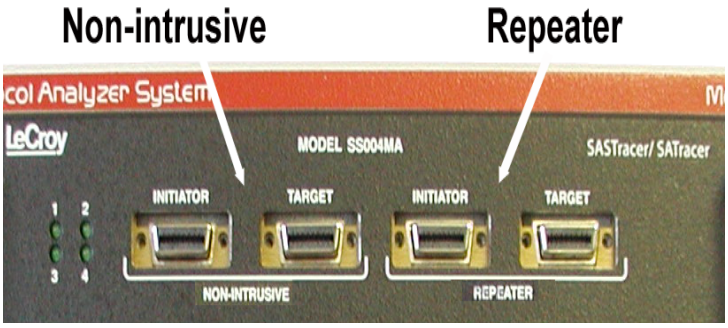
Avalanche systems provide MiniSAS connectors, each of which can be connected to up to four devices. Devices can be connected using either MiniSAS-to-MiniSAS cables, or using "octopus" cables, which provide connections from one MiniSAS connector to up to four SATA-style connectors.

SAS*Tracer* Connectors

Depending on the module installed in your SASTracer chassis, you will have either SATA-style connectors or Infiniband connectors..

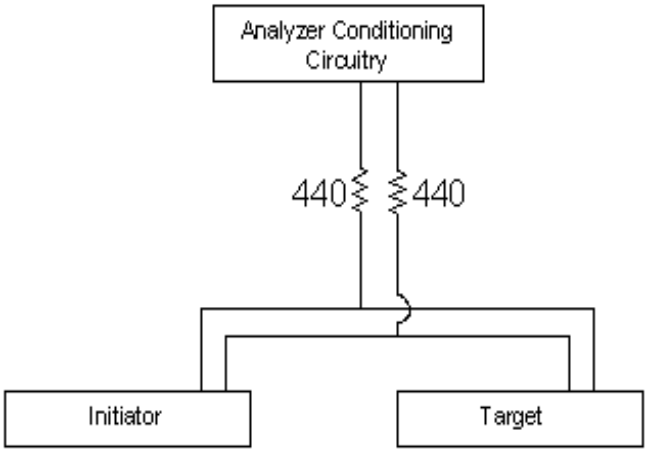
Model SS004MAA-X incorporates the SAS external "Infiniband style" connector which includes both a non-intrusive as well as a repeater style front-end. This allows users to selectively switch between these two probing techniques based on their specific application. Only one pair of connectors may be used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

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



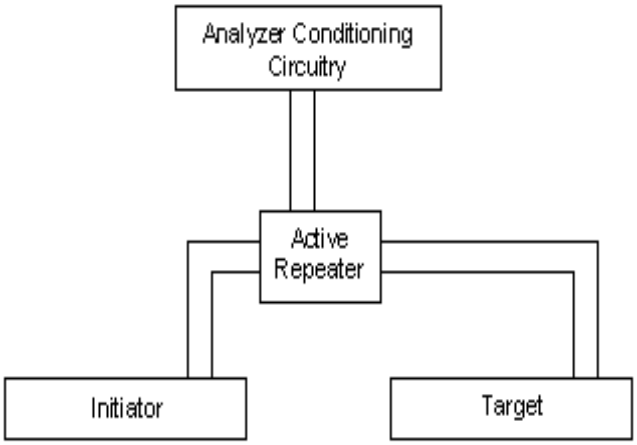
Non-intrusive Tap

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%).

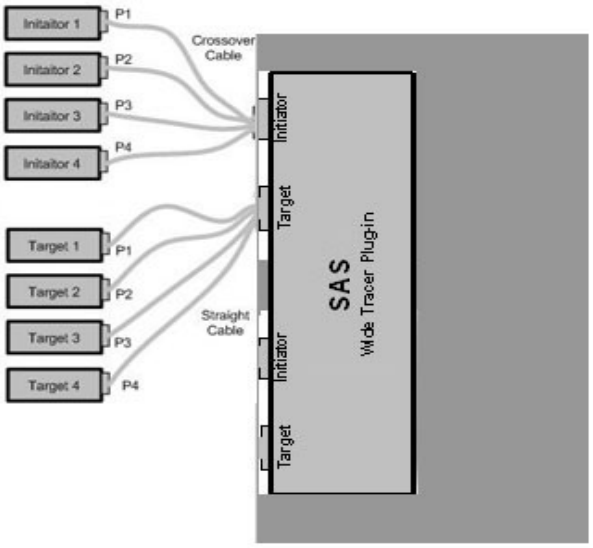


Repeater Tap

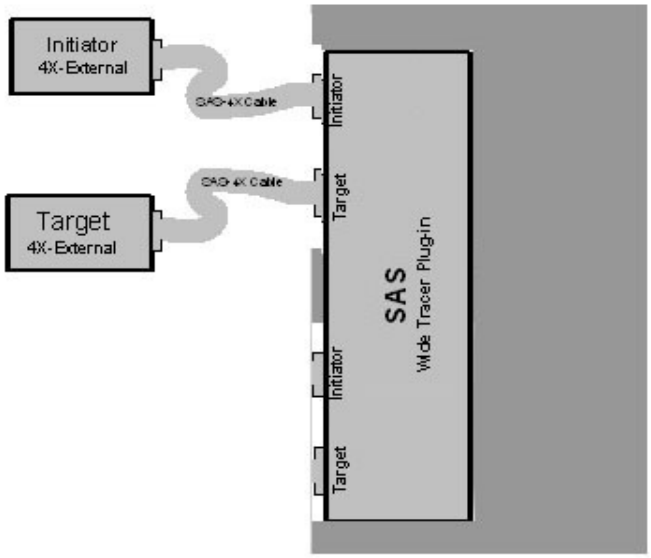
In repeater mode, the analyzer reproduces the exact patterns it receives on the inbound (RX) line. While the repeater does not re-time the signal—it does "clean-up" normal reflections that can occur over a full length cable when the analyzer is not in the line.



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.



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

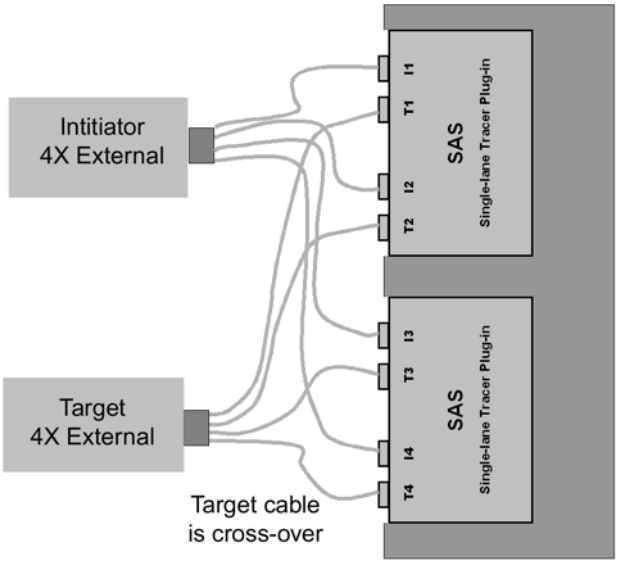


Note: When using new External Connector Module (SS004MAA) with standard 4X External InfiniBand style cables, there is no need to use "cross-over" cable. Both cables above are straight.

SAS*Tracer* Analyzer with Internal SATA Connectors (SS002MAA & SS003MAA)

When using the original single-lane "SATA-style" module (SS002MAA & SS003MAA) with devices that utilize single-lane SATA style connectors, the standard SATA-style single-lane connector cables must be used.

Test Setup With DUT Requiring External 4 Lane Connector



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

Installing the SAS*Suite* Software

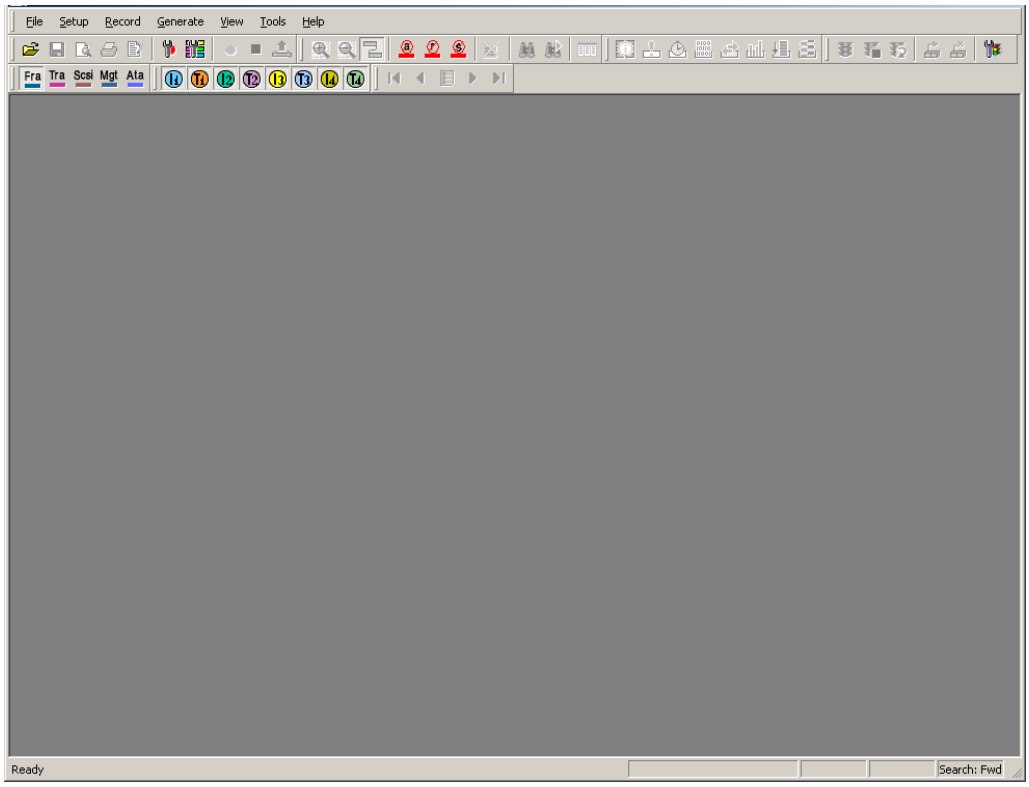
Once the SAS Analyzer has been recognized as a USB device, install the SAS*Suite* software on the Host PC.

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

The SAS*Suite* software will install on the PC hard disk.

Step 2 To start the application, launch the LeCroy SAS*Suite* program from the Start menu:
Start > Programs > LeCroy > LeCroy SASSuite.

The SAS*Suite* program opens.



Note: The software may be used with or without the analyzer. When used without an analyzer, the program functions as a viewer to view, analyze, and print recorded files.

Making a Recording on the SAS*Tracer* Analyzer

After installation, the software is configured to make a 16 or 32 MByte snapshot recording of your Serial Attached SCSI traffic (16 MByte for SAS*Tracer*, 32 MByte for Avalanche).

To make this recording, follow these steps:

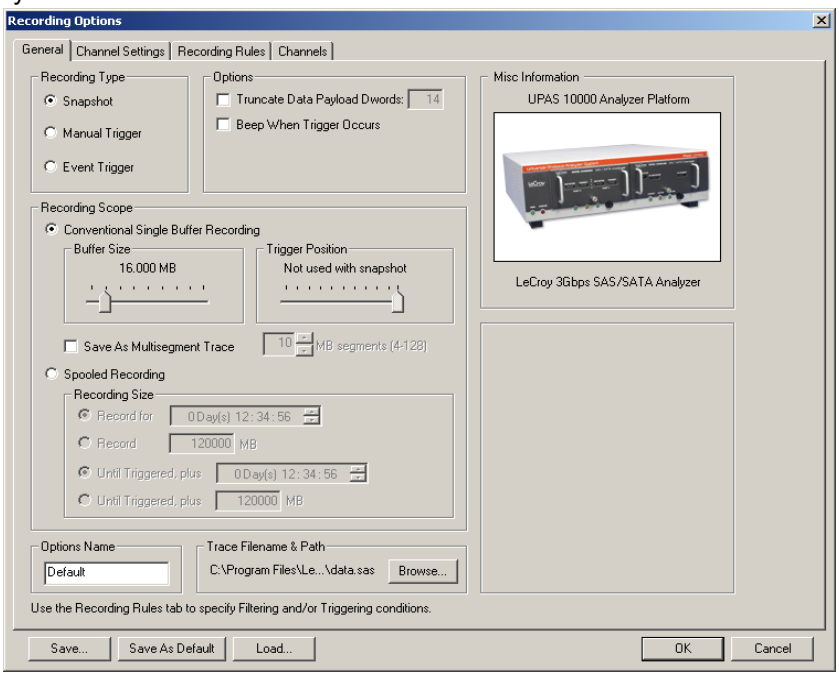
Step 1 Connect a cable to each of the two connectors on the analyzer module, then connect the other ends to the Serial Attached SCSI device under test and Serial Attached SCSI host system.

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 or 32 MBytes buffer size are displayed. For your first recording, you can leave these settings unchanged. The window displayed below is for the SAS*Tracer* system, the Avalanche window is

virtually identical except for the default buffer size and the image of the system.



Step 4 Click **OK** to close the Recording Options window.

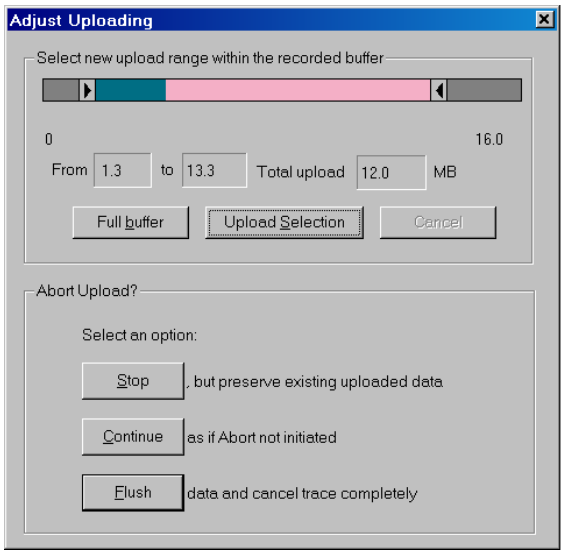
Step 5 Click  on the Tool Bar. After 16 (or 32) MBytes of traffic is recorded, the analyzer uploads the data and displays the Frames.

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

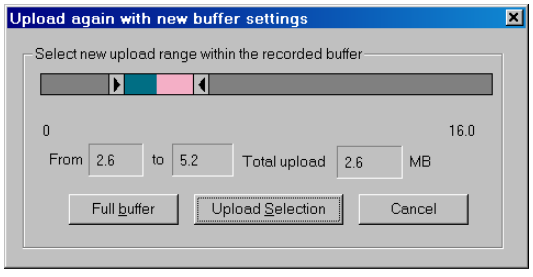
You can interrupt the upload process by pressing the Stop button. Pressing Stop will cause the following dialog box to open:



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

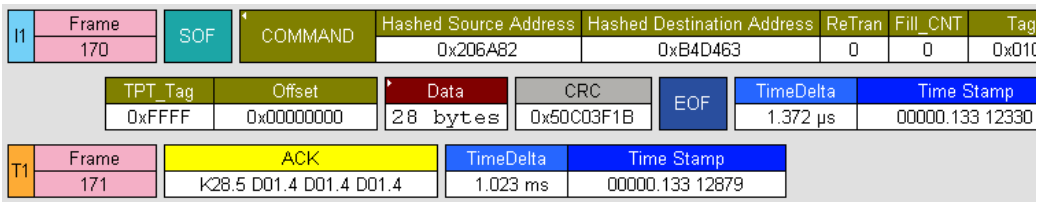
- **Select New Upload Range within the Recorded Buffer**
  - Slide Bar - Adjust arrows at either end of the slide bar to select the range of buffer you want uploaded. The color in the slide bar indicates pre- and post-trigger traffic.
  - **Full Buffer** - Uploads entire buffer to the PC.
  - **Upload 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 analyzer chassis; or the name you assign as the default filename.



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.

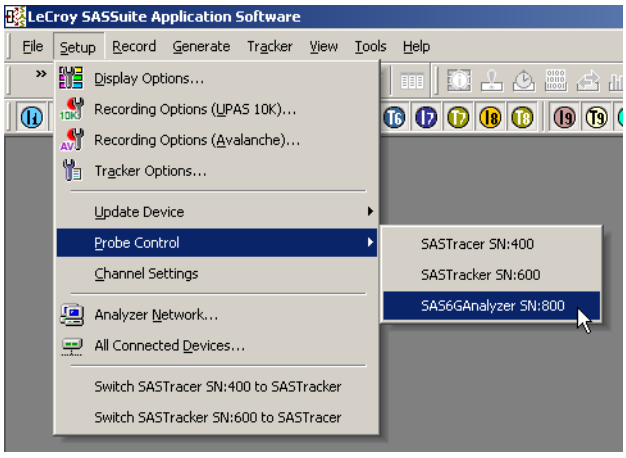
Probe Control Settings

LeCroy analyzers are designed to interface with the communications channel in a non-intrusive manner, to minimize any distruption of traffic or error conditions due to insertion of the analyzer. In some cases, the user may desire to adjust the probe settings to achieve a more optimum balance of complete data capture with minimal traffic disruption, and for that reason direct user access is provided to the probe control settings.

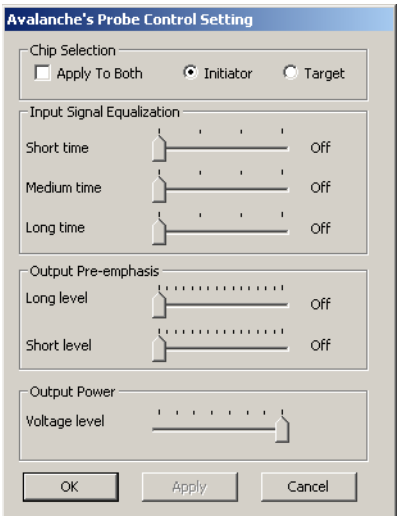
The probe control dialog provides several user adjustable settings for the probe performance, which vary depending on the model (Avalanche or SAS*Tracer*). Modification of these settings occur in real-time and do not require cycling the power or uploading new firmware.

Avalanche Systems

To access probe control setting for an Avalanche System, select Probe Control from the Setup menu.



Selecting this option bring up the following dialog window:

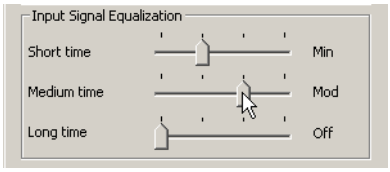


In the Avalanche System, the probes can be controlled separately for the initiator traffic and for the target traffic, and a selection whether to adjust initiator, target or both is provided at the top of the window. If separate adjustments are desired, first adjust one probe, click on Apply to apply the settings, then select the other probe and make adjustments there.

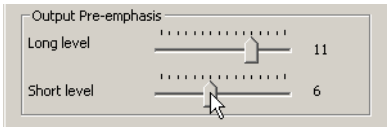
Allowed adjustments include applying input signal equalization, output pre-emphasis, and output power.

Input Signal Equalization

Input signal equalization can be adjusted within a matrix of three time values and four settings for each time value. These settings are named in relative terms: time values are "Short time, Medium time, and Long time"; and settings for each are "Off, Min(imum), Mod(erate), and Max(imum)". This matrix provides a range of different settings that covers the expected needs of any specific application. The default settings are "Off" for all values.



Output Pre-emphasis



Output pre-emphasis is controlled within a matrix of two time values and 15 settings within each time value. The time values are "Long level" and "Short level"; the settings for each are from "Off" (or 0) to "Max" (or 15). The default settings are "Off" for both values.

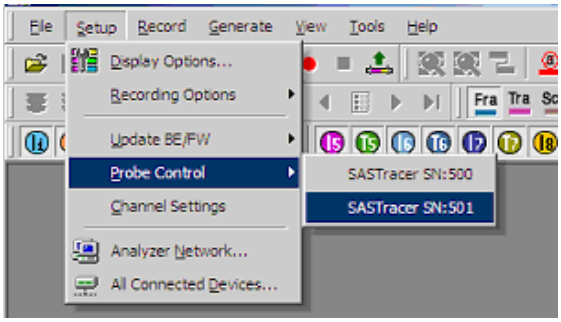
Output Power

The output power can be controlled in eight steps from 626 mV to a maximum of 1294 mV. The output power level will appear as soon as the slider bar is moved (although as with all probe settings, no changes are applied until the "Apply" or "OK" buttons are clicked). The default setting is the maximum value of 1294 mV.

SAS*Tracer* Systems

To access probe control settings for a SAS*Tracer* System, select **Probe Control** from the **Setup** menu.

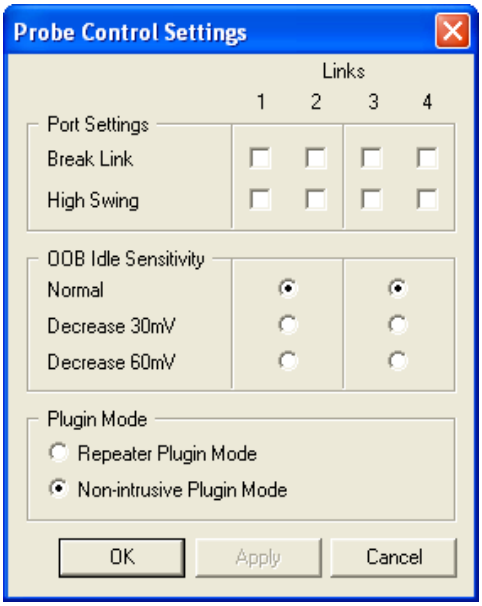
If there's more than one analyzer connected, the user will have an option to select Probe Control Settings for each device individually



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

The Plug-in Mode options provide an additional control for the SAS*Tracer* 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 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

Chapter 3: Software Overview

SAS*Suite* is an application that may be used with or without an analyzer unit. When used without an analyzer, the program functions as a viewer to view, analyze, and print captured traces (from Avalanche or SAS*Tracer* analyzers) or command log files (from the SAS*Tracker* option on the SAS*Tracer*).

Starting the SAS*Suite* Program

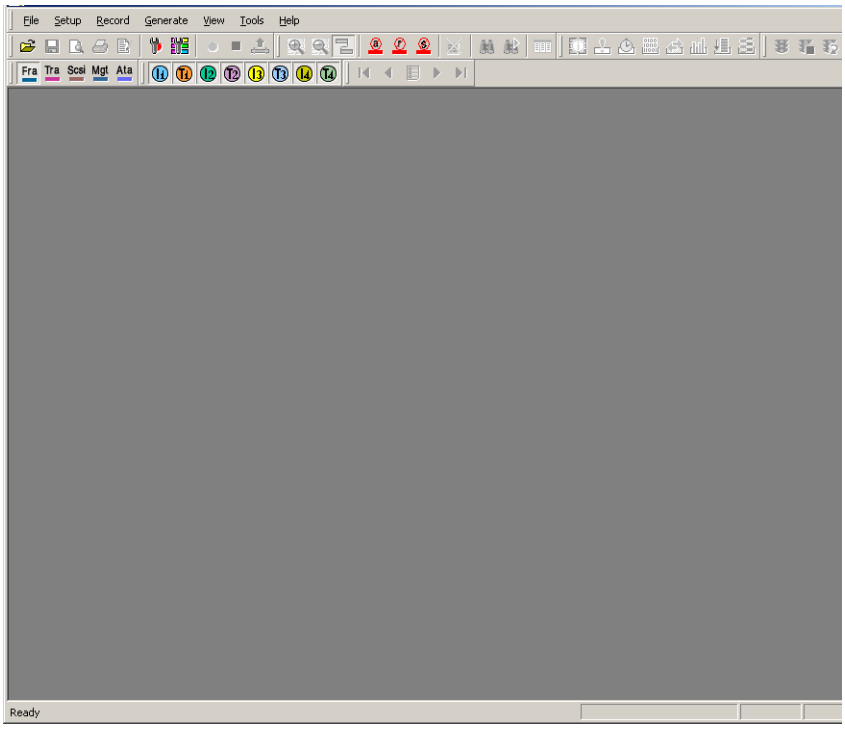
To start the SAS*Suite* program from the Start menu,

Step 1 Click **Start**.

Step 2 Select **Programs**.

Step 3 Select **LeCroy**.

Step 4 Click **LeCroy SASSuite**.



Opening Sample Traces

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

Opening "Older" Trace Files

If you have recently installed a newer version of SAS*Suite* and have existing data files recorded in older versions, when you try to open these files you may be prompted to update the files to the newer file format. In most cases, you simply need to click on the "Update file" button to update the file.

If you expect to need to use the older version of SAS*Suite* to open these files (perhaps on a different computer system), you can select to make a backup copy of the file which retains the older file format.

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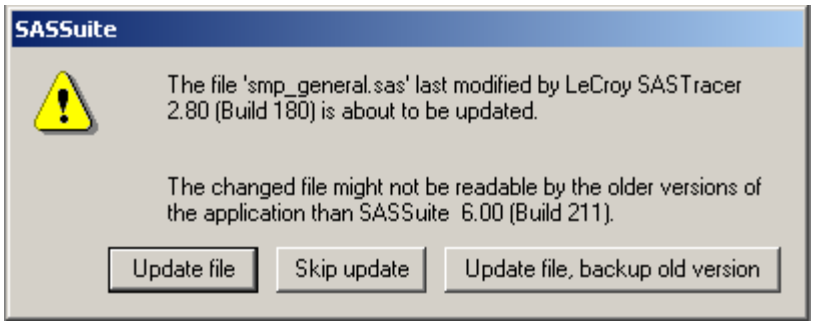
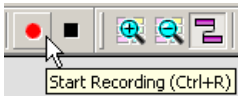


Tool Tips

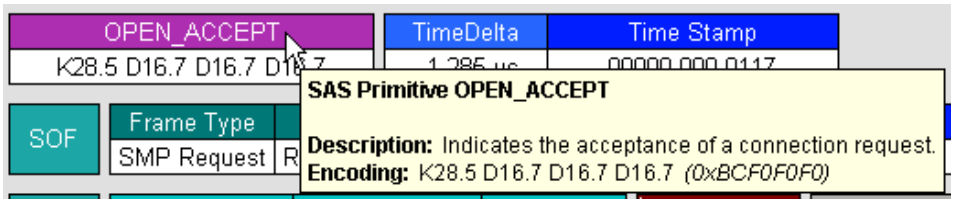
Throughout the application, Tool Tips provide useful information about buttons on the toolbar.

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



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.



The Menu Bar

While some of the analyzer's main display window options are familiar, many contain options specific to the analyzer program. Depending on the particular analyzer function in use, not all of the options shown here may be displayed.

Table 1: Main Display Pull-Down Menus

Menu	Function
File	
New GenFile	**Creates a new (and empty) traffic generation file. To add text, click the Edit as Text button on the toolbar.**
Open...	**Opens a trace file or traffic generation file.**
Close	**Closes the current trace or generation file.**
Save As...	**Saves all or a specified range of Frames from the current file with a specified name.**
Print...	**Prints part or all of the current trace or traffic generation file.**
Print Preview	**Produces an on-screen preview before printing.**
Print Setup...	**Sets up your current or new printer.**
Edit Comment...	**Opens a dialog for entering a brief comment about the trace.**
Export>>	**Packets to Text (Packet View Format) - Saves all or part of a trace to a text file. Useful for saving traces to floppy disk and for emailing.** **to Generator File Format ... - Creates a traffic generation file based on the open trace. This is a fast and easy way of creating a traffic generation file.** **Packets to EAS Format ... - 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.** **Transport to CSV Format ... - 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).**
Convert>>	**Convert .stg to .ssg - Converts SATA traffic generation files created by SATracer (.stg) to the SASTracer generation format (.ssg).**
Merge Trace Files	**Merges files which have been recorded as multitrace files (e.g., when using cascaded analyzers)**
Exit	**Exits the SAS*Suite* program.**

Menu	Function
Setup	
Display Options...	Opens a dialog for customizing trace colors, formats, and filters.
Recording Options (UPAS 10K)...	Configures the SAS*Tracer* 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.
Recording Options (Avalanche)...	Configures the Avalanche 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.
Update Device	Opens a dialog for updating the BusEngine and Firmware of the selected device.
Probe Control	Provides a dialog to adjust the probe settings of the selected device.
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 Add 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 Select 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.
Switch ... to...	Switches between SAS*Tracer* and SAS*Tracker* capabilities for systems with dual-function licenses.
Record	
Start	Causes the Analyzer to begin recording.
Stop	Causes the Analyzer to stop recording.
Recording Options (UPAS 10K)...	Configures the SAS*Tracer* 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.
Recording Options (Avalanche)...	Configures the Avalanche 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.
Generate	
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.

Menu	Function
Generation Options	Opens a dialog for configuring traffic generation. The dialog looks like the Recording Rules dialog (Setup > Recording Options > Recording Rules). See Generation Options in the Traffic Generation chapter.
Tracker	
Start Tracking	Initiates tracking of all commands issued and completed.
Stop Tracking	Stops command tracking.
Tracker Options	Opens a dislog box to allow the user to establish settings to control command tracking and set the timeout trigger.
Report	
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.
Run Verification Scripts	
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.
Search	
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.
View	

Menu	Function
Toolbars	Displays list of available Tool bars.
Analyzer Network 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.
Wrap	Wraps displayed Frames within the window.
Compact	Changes view mode to the compact view.
Link Layer	Displays Link Layer traffic in the trace.
Decoding Assignments	
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.
Hide	

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	
New Window	Switches display of the Tool bar on or off.
Cascade	Displays all open windows in an overlapping arrangement.
Tile Horizontal	Displays all open windows as a series of strips horizontally across the display.
Tile Vertical	Displays all open windows as a series of strips vertically down the display.
Arrange Icons	Arranges minimized windows at the bottom of the display.
Windows ...	Displays a list of open windows.

Help	
Help 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
About...	Displays version information about SAS*Suite*.

The Toolbar

The Tool Bar provides quick access to most of the SAS*Suite* software functions. You can learn the function of each button by pausing 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 (for SAS*Tracer*, or for Avalanche)

Setup Display Options

Start Recording

Stop Recording

Re-upload. This button appears in the toolbar if Stop has been 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.

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

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

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

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

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

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.

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 Management Application Layer (Management Transactions)

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

Decode & display ATA Application Layer Transactions

Decode & display SCSI Application Layer (SCSI Commands)

Hide Buttons

Hide Align and Notify Primitives

Hide Initiator Channel 1

Hide RRDY Primitives

Hide Target Channel 1

Hide SATA Sync Cont Primitives

Hide Raw Data

Hide Unassociated Traffic

Multisegment 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.

Show first multisegment file

Show next multisegment file

Show previous multisegment file

Show last multisegment file

Show multisegment index file

Traffic Generation Buttons

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

Start Traffic Generation. This button activates if a traffic generation file (.ssg) is open and an SATrainer is attached.

Connect link. Establishes a link between SA*Trainer* and the DUT. When a Connect is built into the traffic generation script, this button will give status on the connection (it will depress when a connect occurs and undepress when disconnected.)

Stop Traffic Generation. This button becomes active if a traffic generation is underway.

Disconnect link

Resume Traffic Generation.

Generation Options. Opens a dialog for configuring traffic generation.

Command Tracking Buttons

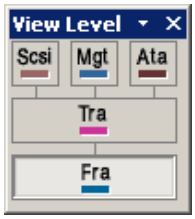
Start Tracking. Initiates tracking of all commands issued and completed.

Stop Tracking. Stops command tracking.

Tracker Options. Opens a dialog window to allow the user to establish settings for controlling command tracking, including setting a timeout trigger.

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.



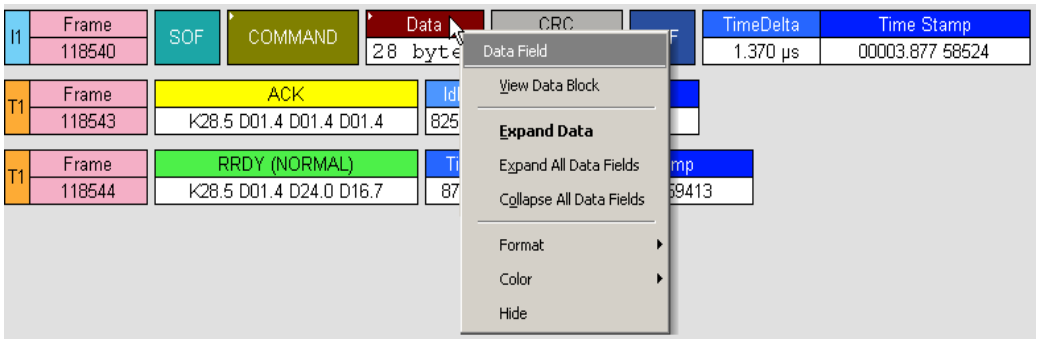
Pop-Up Menus

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.

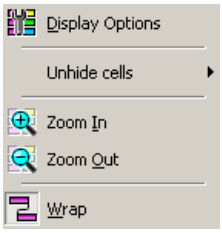
The menu is context-sensitive and changes depending on what field of the data file has been clicked.

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 recording 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.

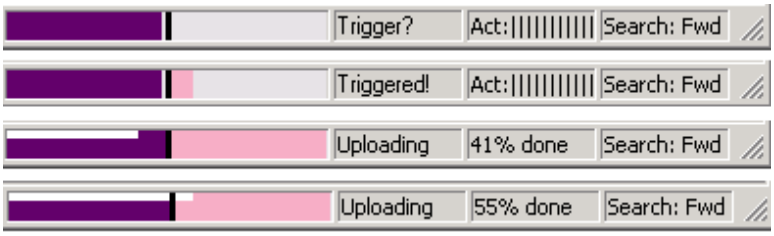


Status Bar

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 on an Avalanche or SAS*Tracer* Analyzer, 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 using a file named **data[sn].sas** where [sn] is the serial number of the analyzer chassis; or the name you assign as the default filename. 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).

Navigation Tools

You can zoom in and out, and wrap the recording 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

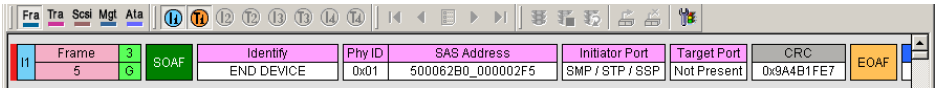
Decreases the size of the displayed elements, allowing more (but smaller) Frame fields per screen.

Click  on the Tool Bar.

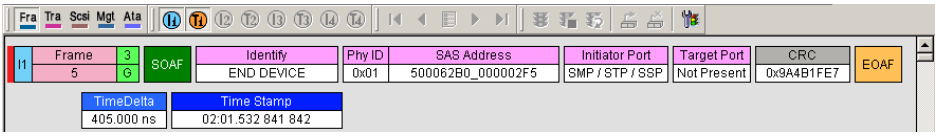
Wrap

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.



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



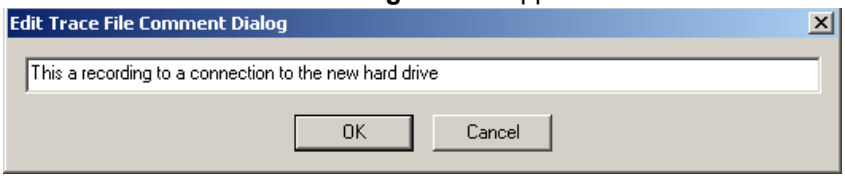
Trace with Wrap turned on. Entire Frame displays in window.

Adding Comments to the Recording

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

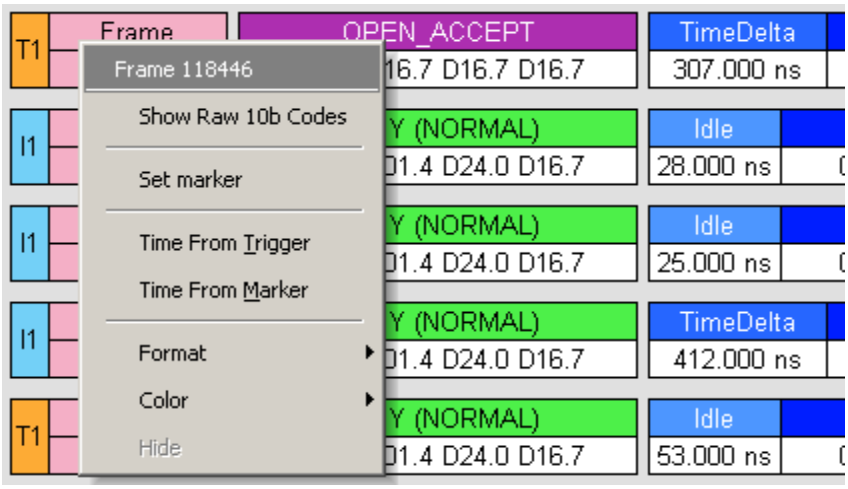
Set Marker

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.

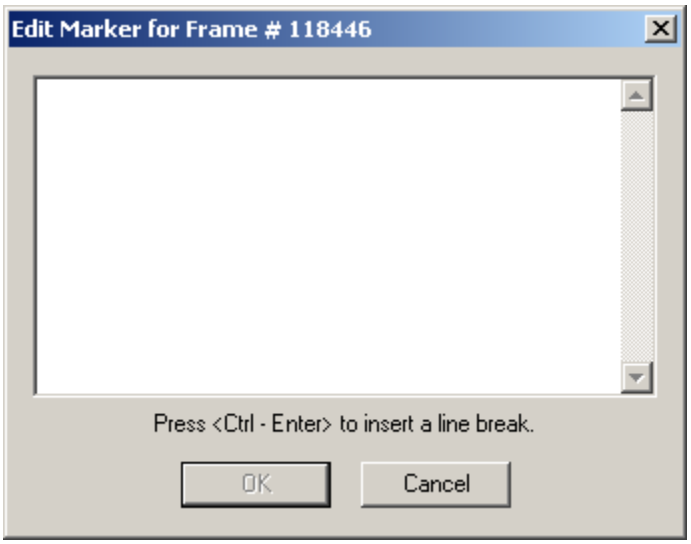
To set a marker on a Frame, perform the following steps:

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



Step 2 Select **Set Marker**.

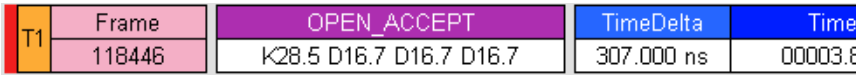
The **Edit Market for Frame #** comment window appears.



Step 3 Enter your comment.

Step 4 Click **OK**.

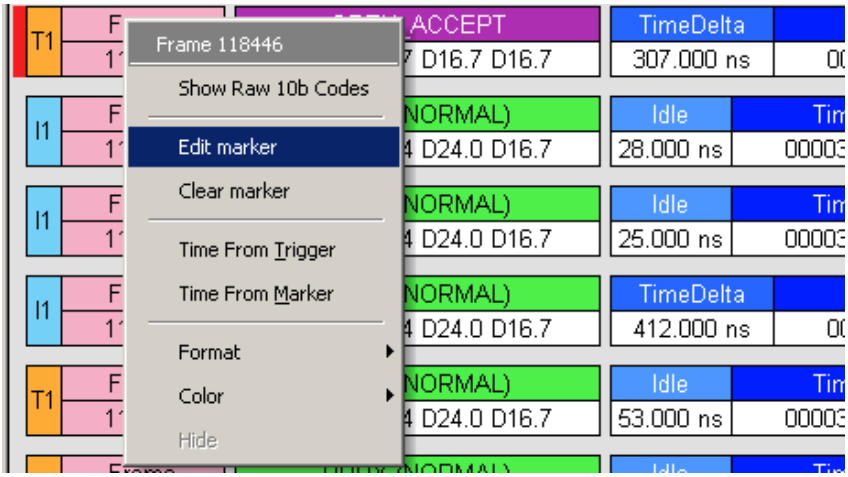
A marked Frame is indicated by a vertical red bar along the left edge of the Frame # block:



Edit or Clear Marker

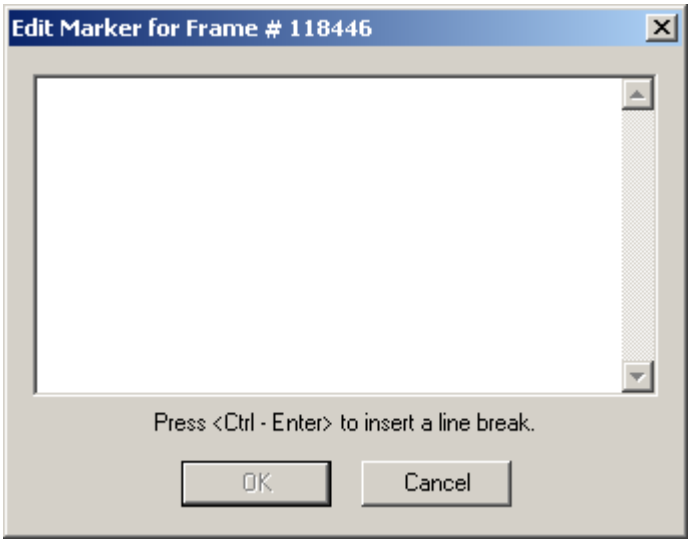
To clear or edit comments associated with a Frame marker,

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.

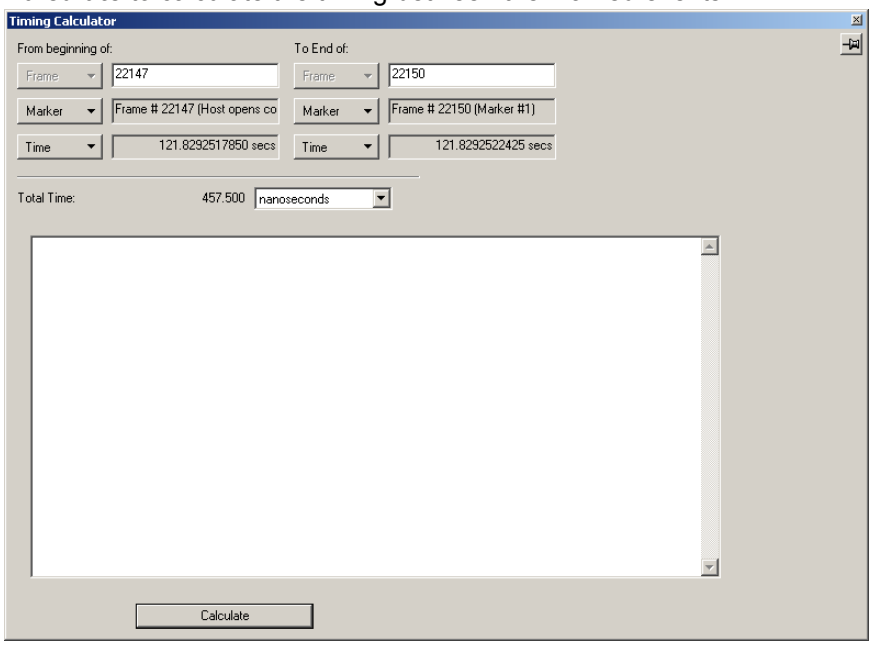
Step 4 Click **OK**.

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

The vertical red Marker bar disappears.

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.

Chapter 4: Avalanche Recording Options

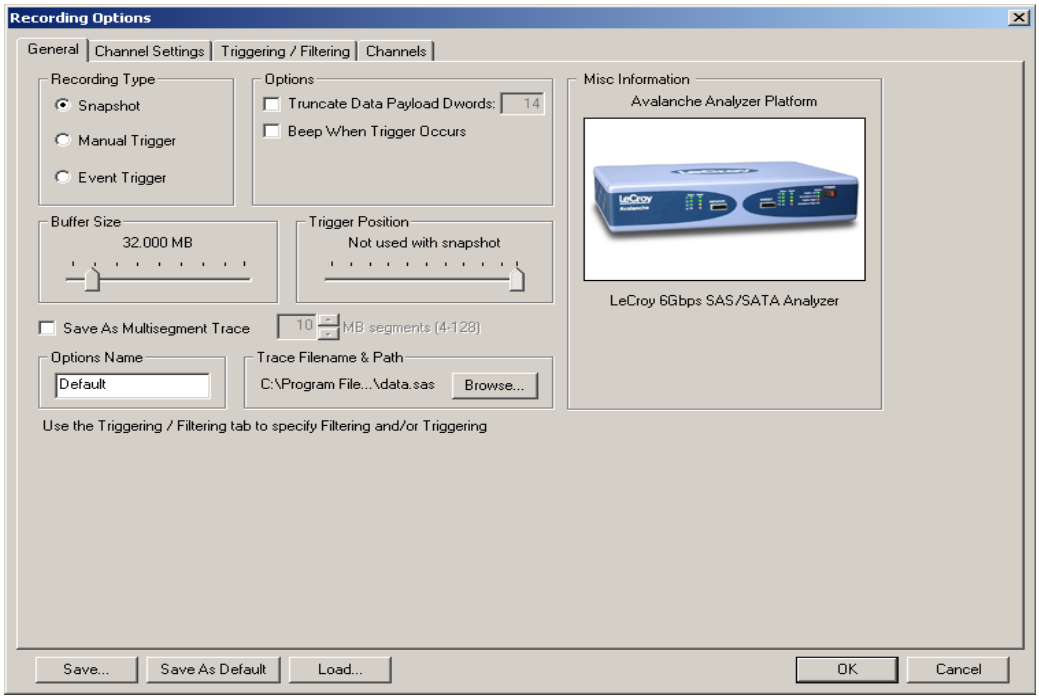
Recording options provide instructions for the analyzer hardware as to how a trace recording should be captured. Included in these instructions are items such as how to start or stop a recording, what information should be recorded, and trigger conditions that can be used to automatically record certain data events (or sequences of events) when they occur.

Since these instructions are specific to the hardware platform being used, there are differences in the way the recording options are set up for the Avalanche system vs. the SAS*Tracer* system. In order to present this information clearly, we have divided the information into two Chapters in this User Manual.

This Chapter covers recording options for the Avalanche systems only. For information on the SAS*Tracer* systems, see Chapter 5.

General Recording Options

From the **Setup** menu, select **Recording Options (Avalanche)...** . The following screen is displayed:



Options displayed on the General page include the following:

- Recording Type
- (Recording) Options
- Buffer Size

- Trigger Position
- Save As Multisegment Trace Option
- Options Name
- Trace Filename & Path
- Misc Information

Recording Type

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

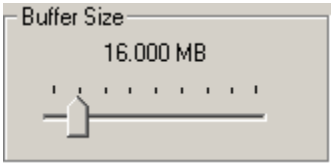
- **Snapshot**: A fixed-length recording. A Snapshot is a recording whose size is set via the "Buffer Size" box. Recording begins when the Start Recording button is clicked and ends when either the preselected buffer size is filled or the Stop Recording button is pressed.
- **Manual Trigger**: A recording 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 is ended by the user pressing the Trigger button on the front panel, although in some cases recording may not stop immediately. Once the Trigger button has been pressed, recording continues until the post-trigger buffer has been filled (see Trigger Position below) 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 option 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 limits the amount of space each frame requires to be stored in the buffer, thereby increasing the number of frames that can be recorded.
- **Beep When Trigger Occurs**: When this checkbox is selected, the computer connected to the Avalanche beeps three times to alert the user when a Trigger condition is first detected.

Buffer Size



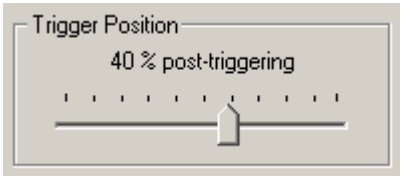
The Buffer Size slide bar adjusts the recording buffer size from 3.2 megabytes to 4096 MB. This option is used for setting the maximum memory to be used for a recording.

The option mentioned above for truncating data payloads, as well as filtering options which will be discussed later, determine what information from the raw data stream is actually recorded into trace memory. Also, although there are 4096 MB of physical memory in the Avalanche analyzer, there is additional information recorded with each frame, such as timestamps and other system parameters, so the efficiency of the

recording is at least 60% (ratio of actual SAS or SATA traffic to physical memory). Filtering and truncation will yield better efficiency. The actual 4096 MB of memory can only be reached when symmetric data is recorded on all four ports.

Note: The Buffer Size slider bar is not linear and affords more granularity in the smaller buffer sizes.

Trigger Position



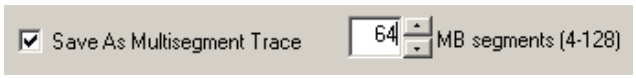
The Trigger Position slider bar allows the user to define the position of the trigger within the recorded traffic. Essentially, this is instructing the system when to stop recording. If the trigger position is set to the end of the recording, recording will stop immediately when the trigger occurs. If the trigger is set to the start of the recording, when the trigger occurs the system will continue to record until the buffer has filled again and then stop (before the new data overwrites the trigger). Any intermediate setting allows the user to see data both before and after the trigger occurred. 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 or the Stop Recording button in the GUI is pressed..

Save As Multi-segment 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 it 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 10 MB. Before attempting large recordings, it is recommended that you adjust this number to see what value best suits your needs. based on the capabilities of your host PC.

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 SAS*Suite*) 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

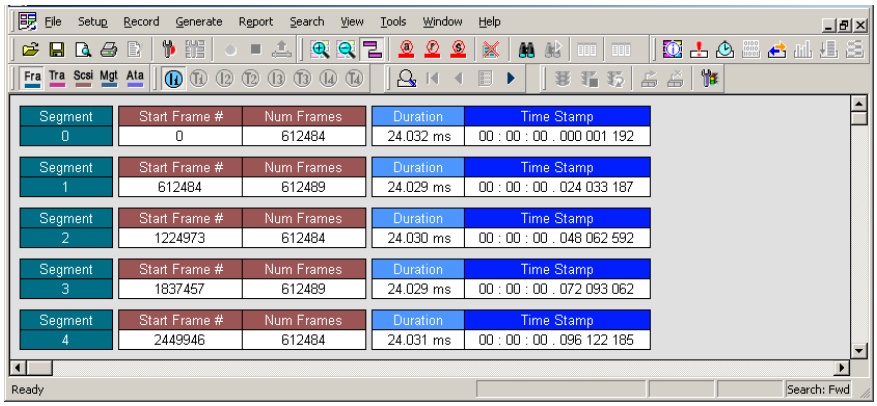
A 1010 MB recording using 10 MB segments and the default file names will create the following sub-directories and files. The example below uses the serial number 111:

- 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.



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.

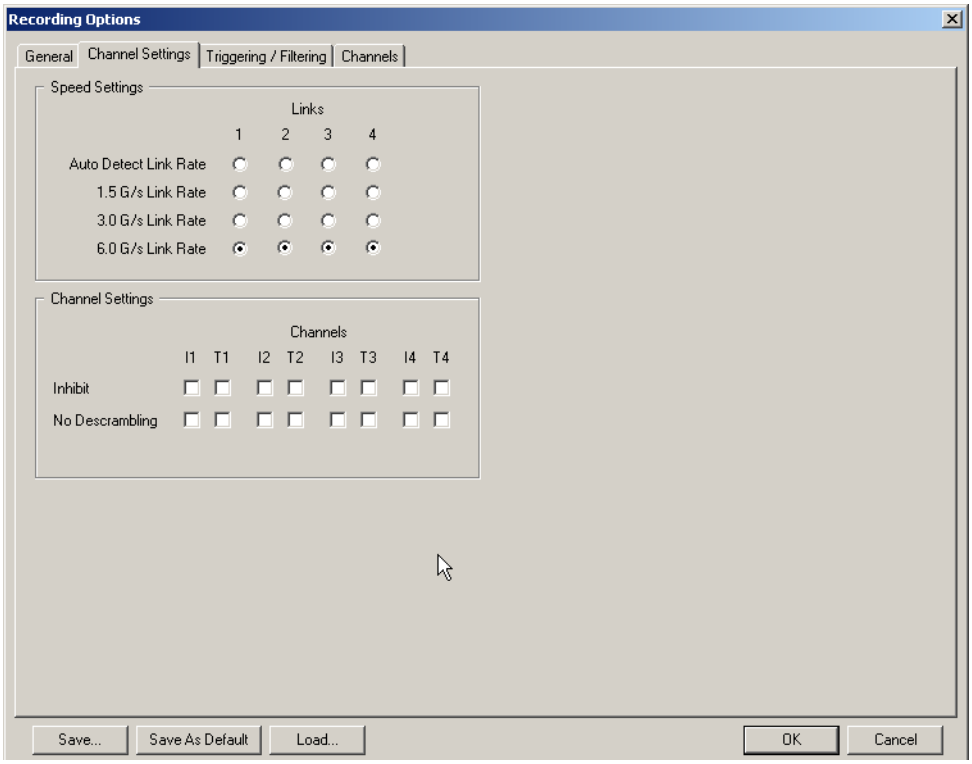
Multisegment Toolbar

When an index file is opened like the one shown above, the Multisegment 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.**

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 Avalanche systems are designed to support 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, 3G or 6G rate. However, if the negotiated link speed is higher or lower than the speed selected in this tab, analyzer 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 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)."

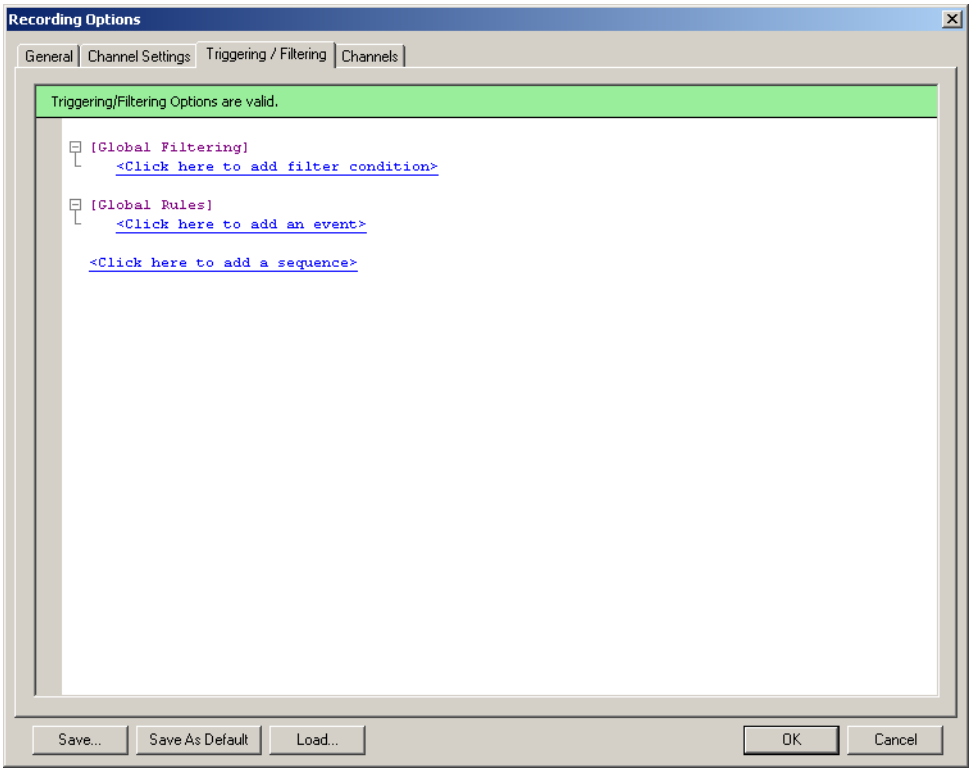
No Descrambling - Turns off the analyzer's descrambling from the selected channels. Select this option if your DUTs are not scrambling their traffic.

Triggering/Filtering

The Triggering/Filtering page allows the user to define triggers and filters that can be simple or quite complex.

The SAS*Suite* application provides a menu-driven interface for building triggers and filters. The interface prompts you for simple decisions and choices from drop-down menus. As you make your selections, the script takes shape automatically in the scenario window. The script is in the form of simple English sentences. You need not understand any formal scripting language.

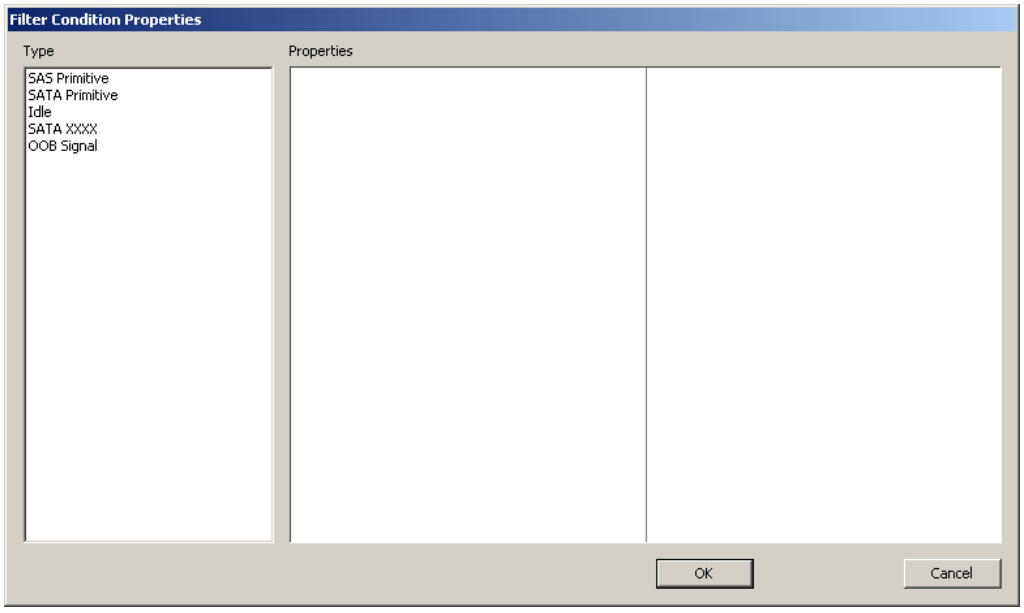
Selecting the Triggering/Filtering tab brings up the following screen:



Building Filters

The top section of the screen, labeled "Global Filtering", is used to build filters. Filters are definitions of commands or data types that may be present in the traffic, that the user does NOT want to include in the trace recording. For example, some of the traffic that takes place in a SAS or SATA link might be simple primitives, and for high-level routines these primitives simply occupy space in the trace without providing any useful information to the programmer. Alternatively, a busy link might include traffic between multiple devices, and if a problem is being experienced with one device, traffic from other devices simply fills up the analyzer buffer without providing useful information to the user. In such a case, data recording can be limited to traffic involving only specific devices, although this capability is accessed in the Channel Settings tab as noted earlier.

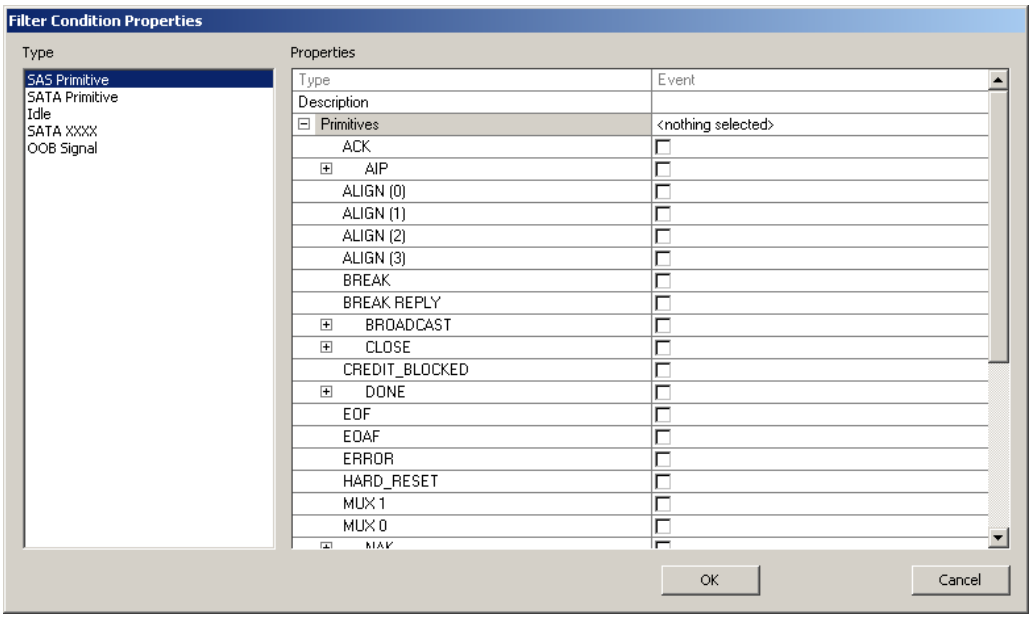
To begin to build a filter, simply click on the link which says "Click here to add filter condition". The following screen appears:



This screen displays five filter conditions which can be selected by the user. Selecting any one of these conditions brings up screens with additional information.

SAS Primitive

Selecting SAS Primitive allows the user to filter on one or more SAS Primitives from the data stream. Clicking this type brings up a detailed screen as follows:



The user may click on any specific primitive in order to exclude it from the recorded trace. Primitives are organized in a "nested" hierarchy, so for example the user may click on the AIP checkbox to exclude all AIP primitives, or may expand the selection by clicking on the "+" sign next to the AIP, which opens a list of specific AIP primitives and allows the user to specify only specific primitives such as the AIP (WAITING ON DEVICE).

Note: Clicking on a collapsed set of primitives selects (or deselects) all primitives in that set, and clicking on the "master" primitive selects (or deselects) all primitives in that set even if the list is open.

Note: In all screens with multiple checkboxes, a global select or global deselect option is provided by using CNTL-Click (holding down the CNTL key while left-clicking the checkbox). So the simplest method to exclude all SAS primitives is to open the SAS Primitives type, and then CNTL-Click on any checkbox to select the entire list.

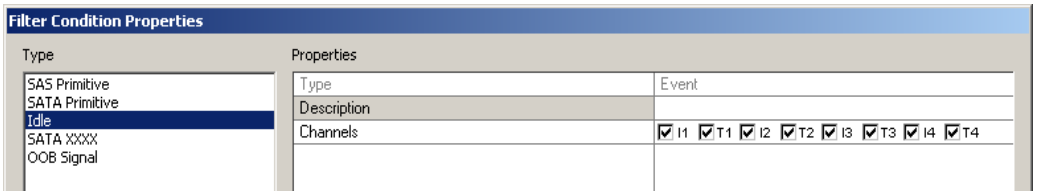
Note: If you wish to edit or delete an event or action while editing Global Filtering, Global Rules or Sequences, you can right-click on the event and you will be given the choice to edit or delete the event/action. You can also edit the event or action by double-clicking on the event or action.

SATA Primitives

Filtering on SATA primitives is exactly analogous to the SAS Primitives described above, with the exception that there is no nesting structure provided for the more limited set of available SATA primitives.

IDLE

Filtering on IDLE characters can be controlled by clicking on "Idle" under the Filter Conditions Type list. This brings up the following screen:



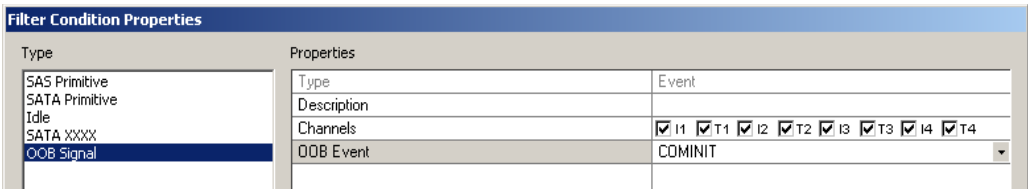
By default, once this condition is selected all IDLE characters are filtered on all channels. If the user wishes to change this default setting, individual channels can be deselected (or again, all channels can be deselected with one CNTL-Click on any checkbox).

SATA XXXX

Any SATA traffic which follows a SATA_CONT primitive is "filler" traffic to keep the link alive and active, until a valid SATA primitive (other than ALIGN) is sent to the receiver. This filler traffic is referred to as "SATA XXXX". In most cases this traffic is of no interest and can be filtered out of the recorded trace. Selecting this option brings up a screen very similar to the IDLE screen shown above, where the user can decide which channels to deselect.

OOB Signal

By selecting this option, the user can control the recording of OOB (Out of Band) traffic, which may not be of interest to some users. Clicking on this item brings up the following screen:



By default, OOB traffic (including COMINIT, COMWAKE and COMSAS) is recorded on all channels. Through changing the checkboxes on this screen, the user can exclude OOB traffic of certain types of specified channels from the recording.

Additional Filtering Capability

Note that under a broad definition of "filtering" (i.e., any user selections that prevent all data traffic from being recorded into the trace memory buffer), we have already described (in other sections) selections which can be made which result in filtering of various types.

For example, under the General screen, data payloads can be truncated after a specified number of Dwords to limit the amount of data which occupies trace memory.

Also, in the Channel Settings screen, individual channels can be selected to be recorded or not to be recorded, as the user wishes. This is also a type of filtering.

Global Rules And Sequences

In addition to the filtering functions described above, the Triggering/Filtering screen provides a means for developing logical sequences of actions based on events that occur. One example of this is to create conditions that generate a trigger.

Creating a trigger condition can range from an extremely simple exercise that requires only one condition to be met, to a complex series of multiple events with precise timing requirements all of which must be met before a trigger is issued. Why would so much sophistication be needed in developing a trigger? The answer lies in the type of problem being pursued by the user. For initial development, recordings may be made without triggers at all. Simply start the analyzer, run the test, and look at the traffic that resulted. As the system becomes more sophisticated, the user may need to add simple triggers to enable the analyzer to focus on the data of interest in the midst of continuous, unrelated traffic. Finally, when pursuing rare or intermittent bugs, the user may need to trigger on a complex series of events that occurs either shortly before or after the problem of interest.

The Avalanche system is well equipped to manage all these types of issues, providing novice users with a simple mechanism to generate simple results, and allowing engineers the flexibility to develop sophisticated state machines to extract critical data from heavily loaded communication channels.

The Avalanche system supports three independent state machines, which can be easily "programmed" using simple menu selections which result in clear and well-defined instructions which can be read "in simple English".

The first state machine supports only one state which is always active, and therefore is referred to as the "Global Rules".

The two remaining state machines allow for multiple states with branching between the various states, and allow for multiple conditions and/or multiple actions at any stage. These state machines are called "Sequence 0" and "Sequence 1".

Creating Avalanche sequences is easy, but it requires an understanding of the following terms: event, combined event, action, global rules, sequence, and state.

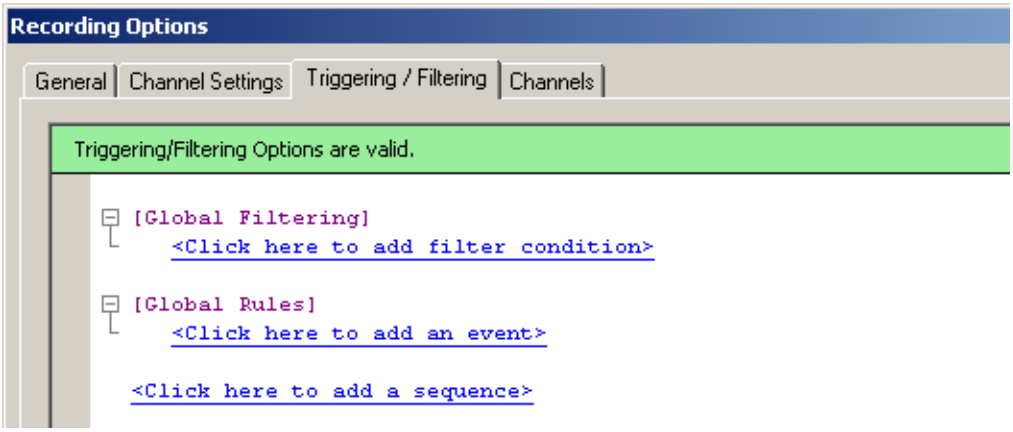
Term	Definition
Event	Condition that is detectable by Avalanche.
Combined Event	Logical OR association of events (for example, event A or event B).
Action	Avalanche response to an event or combined event.
Global Rules	A single defined Avalanche test state (always active).
Sequence	Single or multiple defined Avalanche test states. More flexible than the Global Rules, a sequence allows more powerful scenarios that include branching and looping between test states (the Global Rules can define only a single test state, so there is no branching).
State	"Behavior" of the Global Rules or a sequence at any point in time. In terms of Avalanche, behavior is "waiting" for a certain set of events and responding with a certain set of actions.

You can think of the Global Rules and each sequence as separate test routine or program operating simultaneously. Each operates independently and in parallel with the others. The purpose of each is to detect events and then respond with the appropriate action or set of actions. In essence, they allow you to operate up to three test states simultaneously within Avalanche.

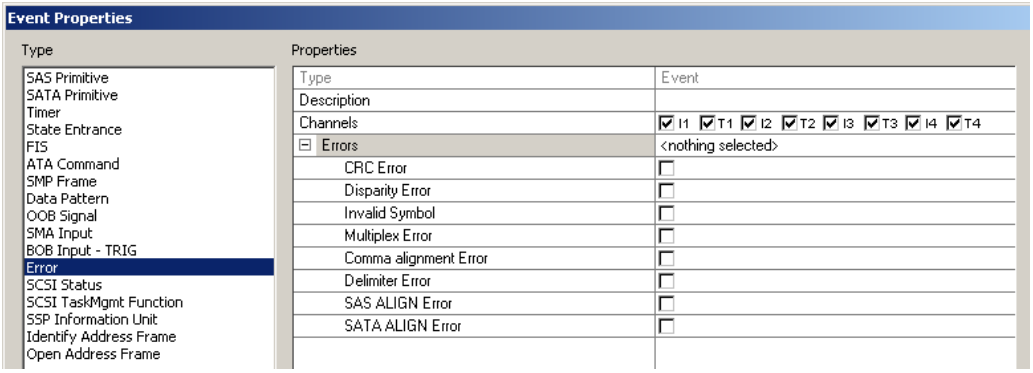
Building Global Rules

The best way to understand how to use Global Rules is to start with a simple example. Suppose we wanted to define a trigger that would be issued whenever a CRC error was detected on any channel.

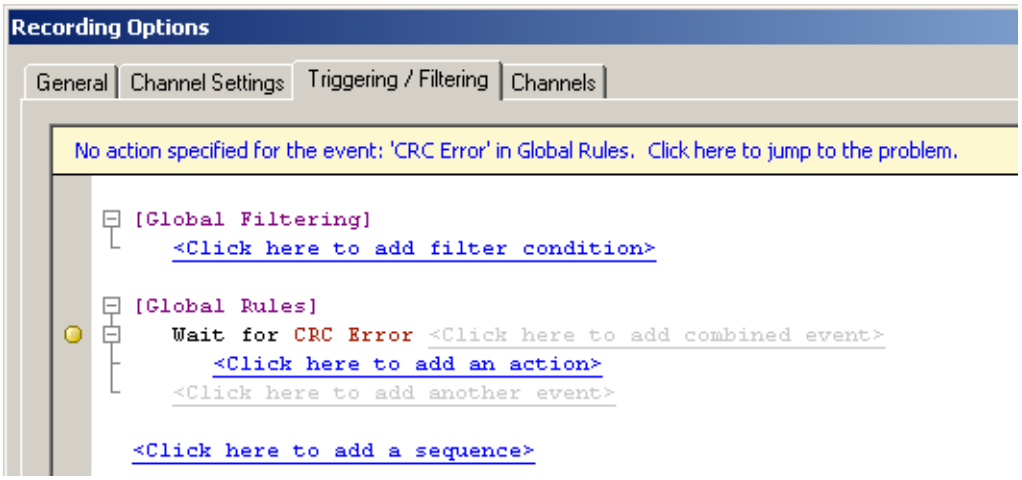
We would bring up the Triggering/Filtering screen (via the **Setup** menu, selecting **Recording Options (Avalanche)...**, then clicking the **Triggering/Filtering** tab), as follows:



Under Global Rules, click on the "<Click here to add an event>" link. A list of available events appears. Click on the Event Type "Error", and the following screen appears:

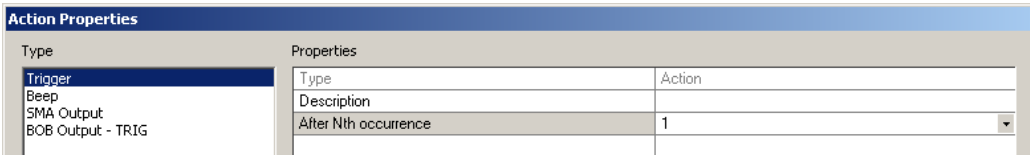


Click on the CRC Error checkbox, and then click on the OK button at the bottom of the screen. The Trigger/Filtering screen now shows:



Note that the Global Rules now has the event "Wait for CRC Error" listed, but since there is no corresponding action defined, the bar at the top has changed from green to yellow to indicate an incomplete command, and there is a yellow dot next to the incomplete command.

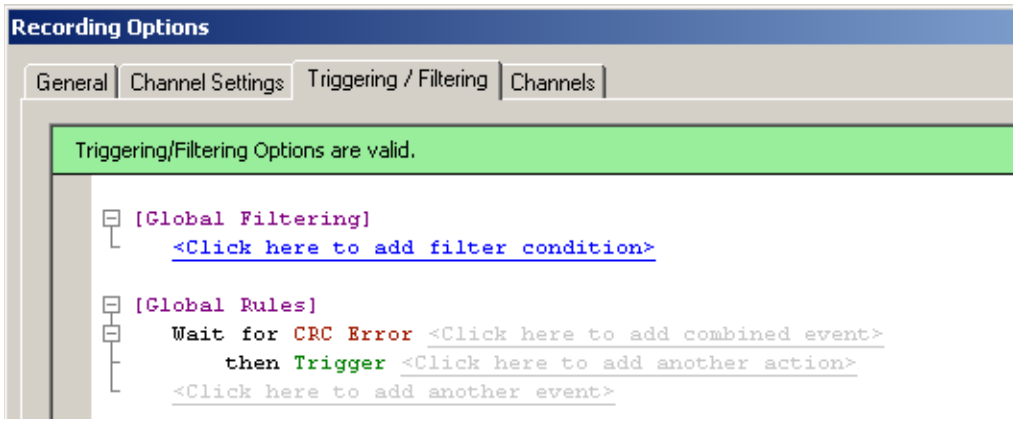
To complete the command, click on the link that says "<Click here to add an action>", and select "Trigger" from the list of available actions. The action screen now shows:



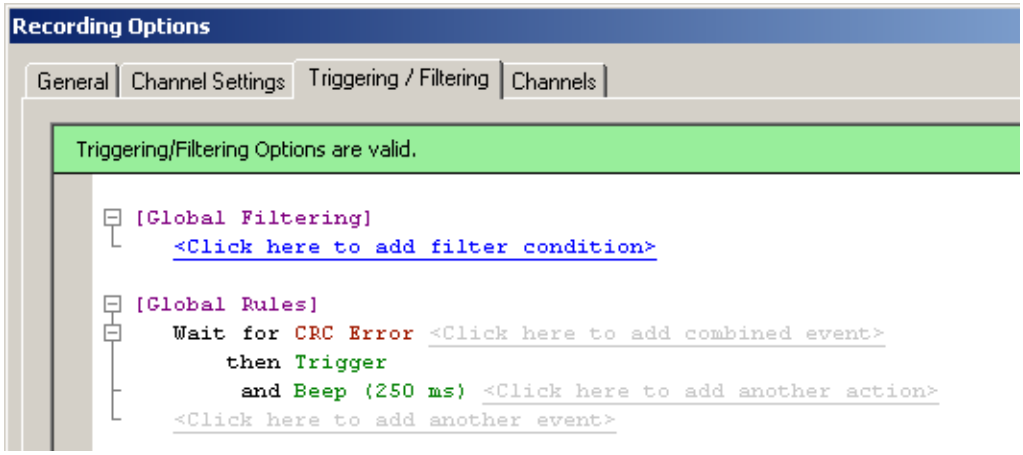
Note that you have the option to define a trigger to happen after "N" occurrences of the event (in this case, after N CRC Errors), but for now we will leave the value at the default setting of "1" and click the OK button.

Note: All actions have the parameter "After Nth occurrence" where N can be set to a number greater than or equal to one. If N is set to three, **this does NOT mean that the action will happen three times**. This means that the event which calls the action must occur three times before the action happens one time.

Our Global Rule now reads:



Finally, we decide to have the system beep so that we know that the CRC Error has occurred and the system has been triggered. So click on the link which reads "<Click here to add another action>", select "Beep" from the list of available actions, and click OK. The completed Global Rule now reads:

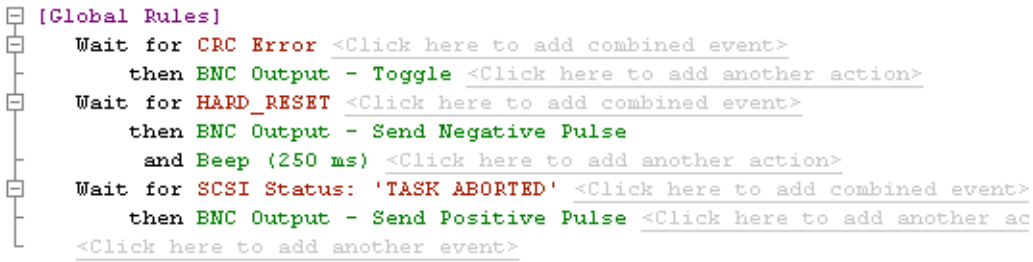


In this simple example, we have demonstrated how easy it is to add events and actions to sequences, including places where we want multiple events or actions to be included.

The available events and resulting actions that can take place are discussed in detail below.

Multiple Parallel Events

When multiple events are defined in Global Rules, the events are operating in parallel and will continue to remain active (even if they have occurred one or more times) until recording is stopped. In the example below, three different events have been defined which will all cause an action on the " EXT OUT" SMA output at the rear of the unit. In addition, one event (a SCSI HARD_RESET primitive) will alert the user with a beep. As long as recording continues, these events will continue to cause their defined outputs on the "EXT OUT" SMA output and/or beeper.



Building Sequences

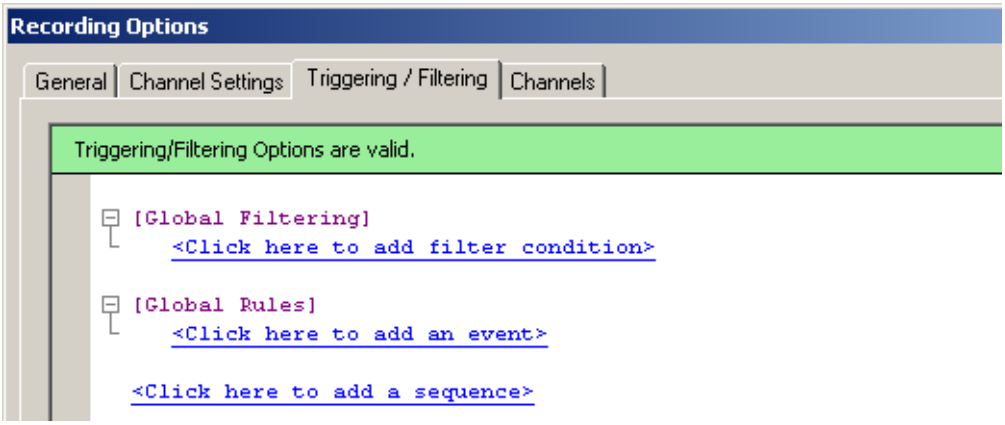
Sequences differ from Global Rules in that sequences may have multiple states defined, although only one state within a sequence is active at any given time. However, all events within that state are active and operating in parallel. This allows for branching and looping between states, where State 0 (which is always the starting state) can call another state depending on a specified sequence of events, and that state can in turn call a different state, or can call the original state.

Note: There is an upper limit of 256 states that can be defined within any one sequence.

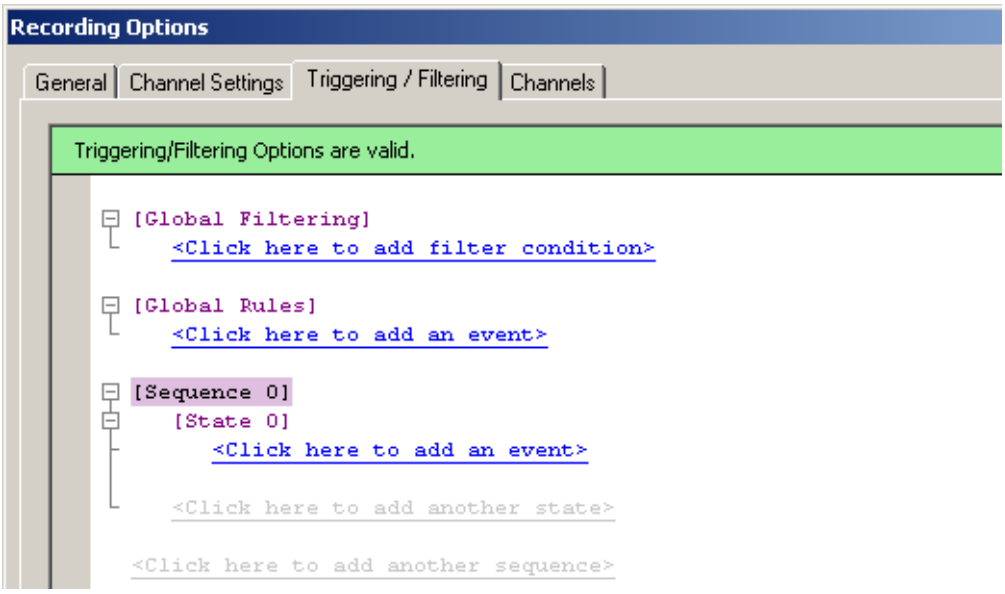
Note: Sequences allow a state to contain multiple conditions that result in branches to different other states. For example, if event A results in a branch to State 2, and event B results in a branch to State 3, then the sequence will branch to either State 2 or State 3, depending on which event occurs first.

As another simple example to explain how this works, suppose we want to create some type of handshake between an Avalanche unit and an external device. We want the Avalanche unit to look for a SCSI Check Condition, inform the external device when one is detected, and then allow the external device to complete some task before starting to watch for the next Check Condition.

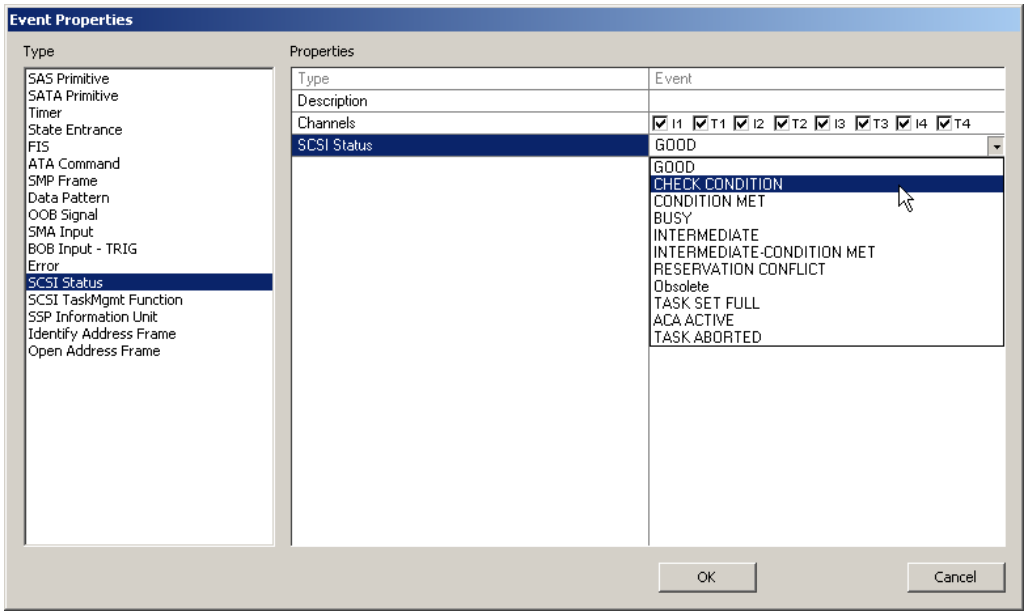
We can create this sequence as follows. First, open the Triggering /Filtering window by selecting **Recording Options (Avalanche)...** from the **Setup** menu, and then click the **Triggering/Filtering** tab. The screen shows the following:



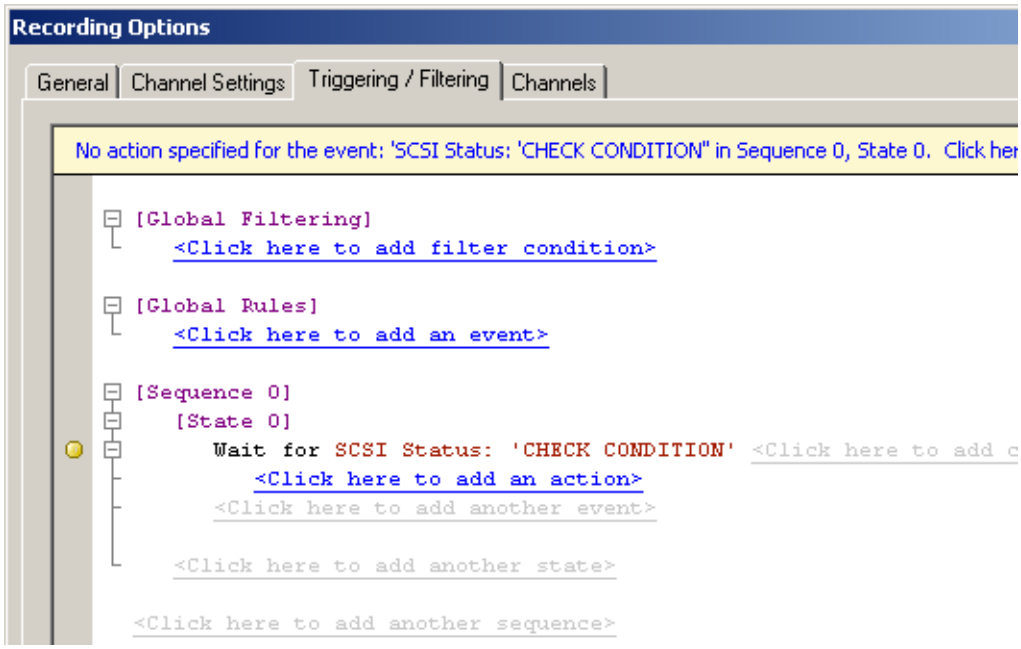
In this case, since we want to create a sequence that has multiple states, we will click on "<Click here to add a sequence>". The screen displays the following:



The new sequence has been added (Sequence 0) and a default starting state (State 0) has been created. To create the logic of the sequence, in the section under State 0 click on "<Click here to add an event>" and a list of possible events appears. In the event type list, we select "SCSI Status" and in the drop down list that appears, we select "Check Condition", as follows:

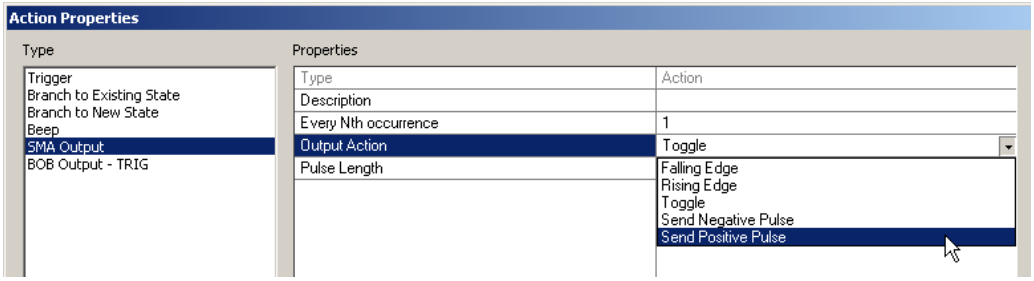


Click "OK", and the Sequence 0 we are building now looks as follows:

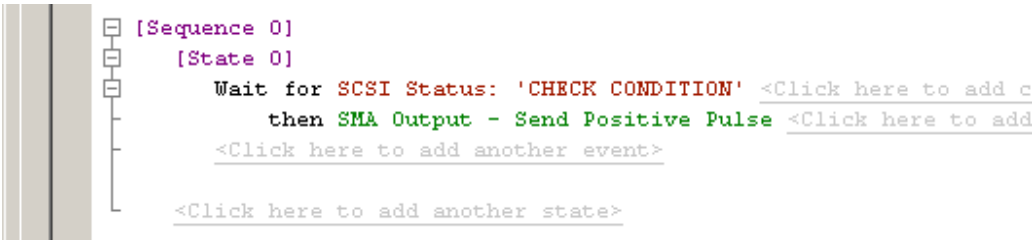


Note again that the existing of a event without an action to complete the state is flagged by the yellow bar along the top and the yellow dot to the left of the incomplete command.

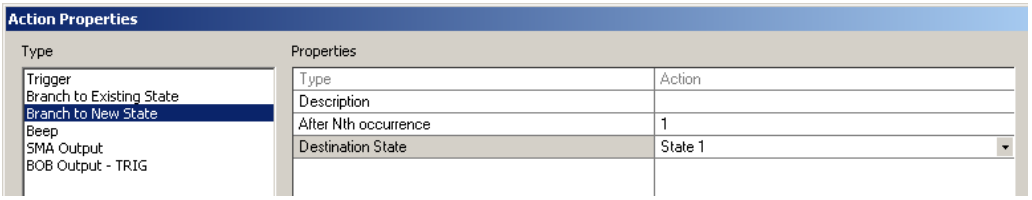
To complete State 0, we need to select an action, so click the link "<Click here to add an action>" and select "SMA Output", then in the drop-down list of outputs select "Send Positive Pulse", as follows:



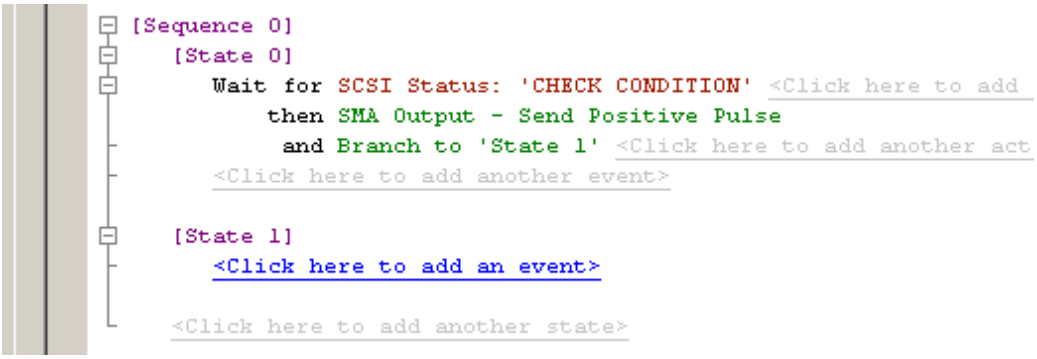
Click OK, and State 0 now reads as follows:



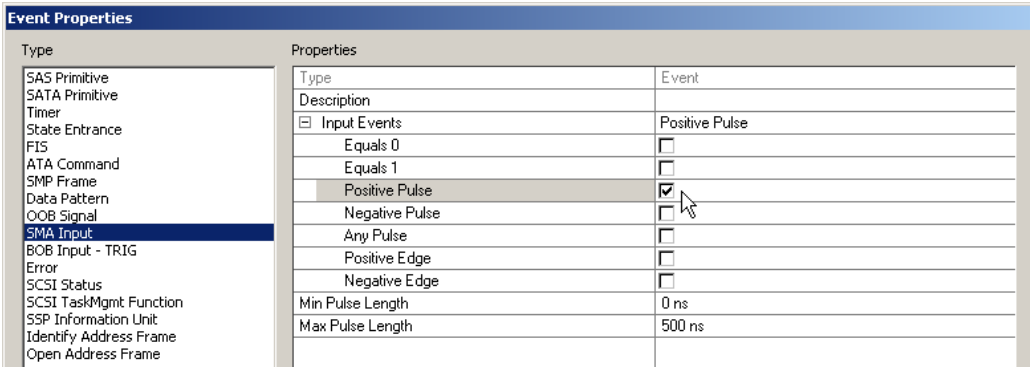
However, we don't want this action to just happen once, we now need the system to wait for a response from the external system when it is ready for the next Check Condition. So click on the link next to "Send Positive Pulse" that reads "<Click here to add another action>" and select "Branch to new state" from the list of actions. The screen now shows:



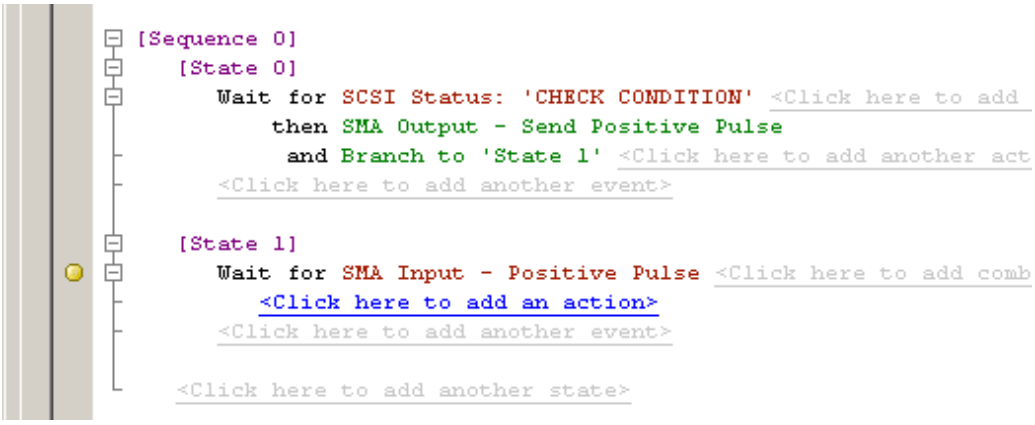
The default values provided of branching on the first occurrence and branching to State 1 are what we need, so click OK and the sequence we are building now looks as follows:



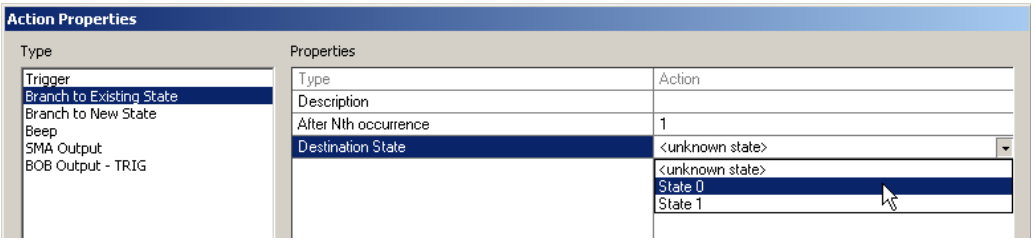
A new state, State 1, has automatically been added, and now we are ready to tell the State 1 what to do when the external device is ready to process another SCSI "Check Condition" status. So first click on "<Click here to add an event>" (under State 1), and select "SMA Input" and click on the checkbox next to "Positive Pulse", as follows:



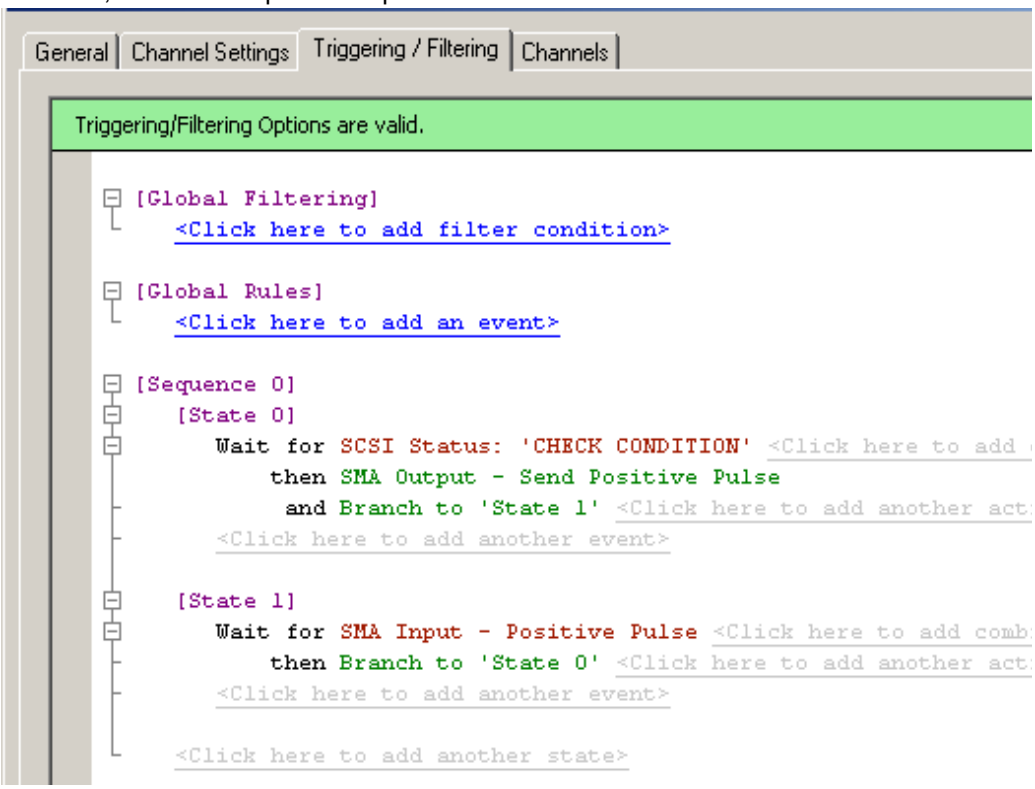
Click OK, and the sequence now reads:



To complete State 1, click on "<Click here to add an action>" and select "Branch to Existing State", and then select State 0 from the drop-down list of available states, as follows:



Click OK, and the completed sequence now reads as follows:



Note that the sequence we have created contains two defined states:

- State 0 is the starting state, which watches traffic passing through the analyzer to detect a SCSI Check Condition on any channel. Once the Check Condition is detected, the analyzer issues a positive pulse to an external device and branches to State 1.
- State 1 is a waiting state, which watches for a positive pulse to return from the external device before doing anything else. Once the external device signals that it is ready to process the next Check Condition, the external device sends a positive pulse to the analyzer, which causes it to return to State 0 and begin the process again.

Note: Only one state within this sequence is active at any time. The two states form a loop, first watching for the Check Condition and then waiting for a response from the external device. While in State 1, traffic will be recorded but any SCSI Check Condition that occurs will be ignored by the analyzer since State 0 is not active at that time. The sequence will continue to loop until some manual intervention is used to stop the analyzer from continuing to record (e.g., the Stop Recording button is clicked).

With this simple example, we have demonstrated how sequences can contain multiple states, and how branching and looping can occur between various states within a sequences.

Multiple Parallel Events within a State

If multiple events are defined within a state, all events are simultaneously active and operate in parallel as long as that state is active. Once a branch to another state occurs, all events in the first state cease to be active.

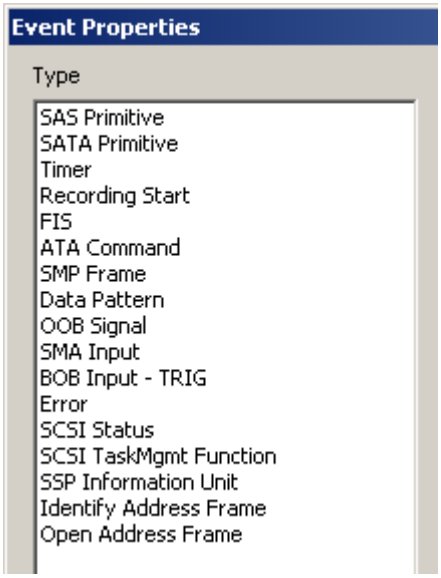
There is one exception to this rule due to a special event ("State Entrance") which is intended to provide a one-time action or set of actions that occur only when the state is initially entered. Among other applications, this can be useful for following which state the system is in at any given time (e.g., you can have the system beep when it enters a particular state).

Multiple Parallel Sequences

Again, note that within a given sequence only one state is active at any given time, but different sequences can be simultaneously active. There can be three simultaneously active processes, which are as follows:

- Global Rules (which has only one state)
- Sequence 0 (which can contain multiple states)
- Sequence 1 (which can contain multiple states)

Events

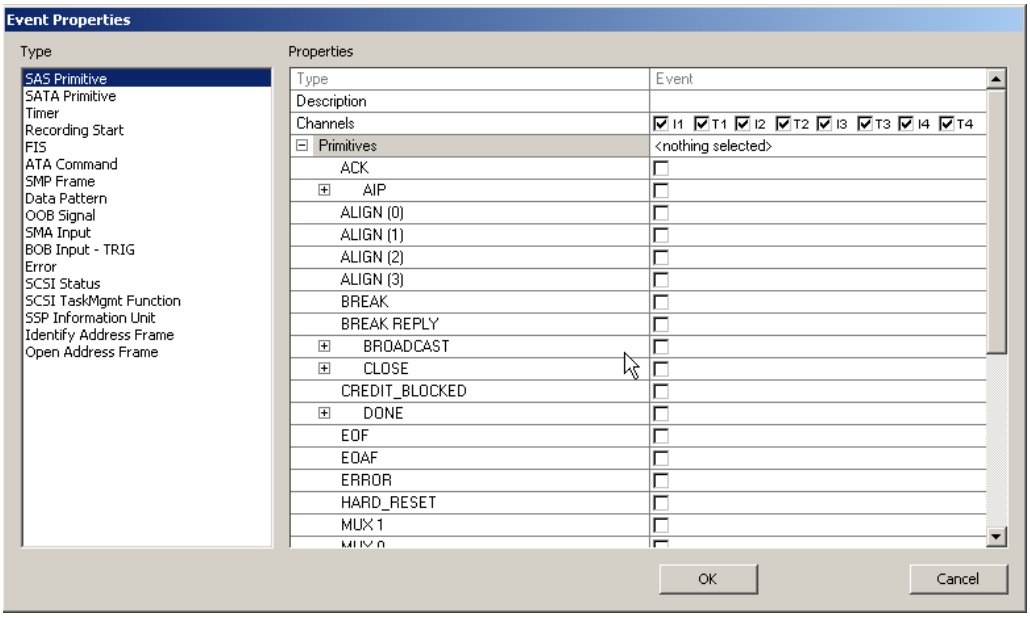


For either Global Rules or Sequences, there is a list of event types that you can choose from, which is presented to you each time you "Click here to add an event". With one exception (see below), the list of events is identical between Global Rules and Sequences.

The events are explained in more detail in this section.

SAS Primitive

The SAS Primitive event screen allows you to define one or more SAS primitives which must be detected in the traffic in order to generate an action. This screen selection is directly analogous to the SAS Primitive selection described in the Filtering section.



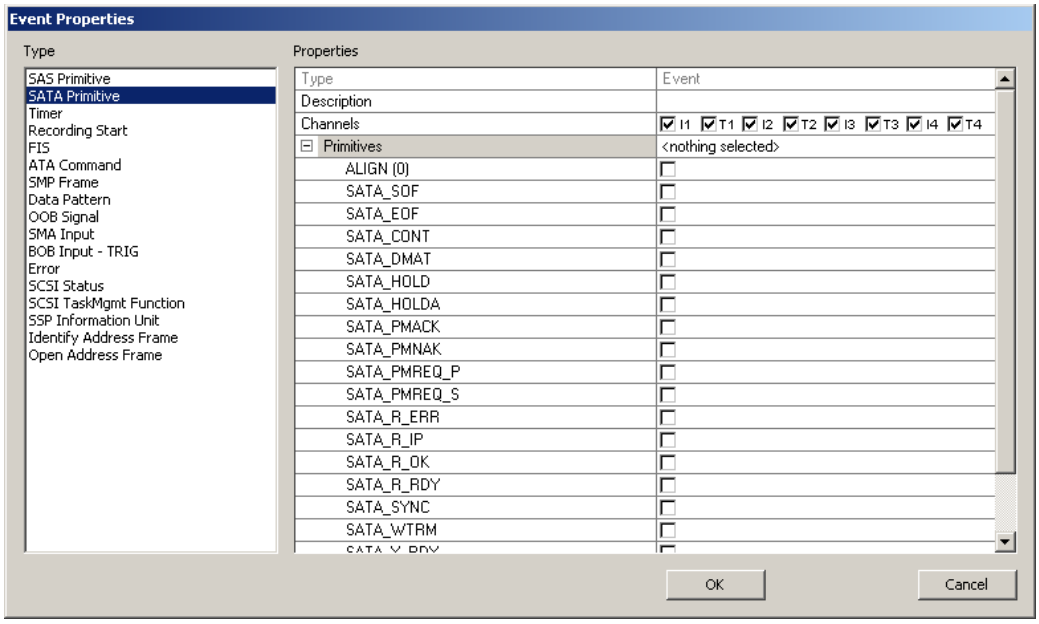
The detection of SAS Primitives can be limited to certain channels by selecting the appropriate channels across the top of the screen, By default, all channels are selected.

All SAS Primitives are listed using a nested hierarchical structure, in which groups of related primitives can be selected with a single checkbox, or the nested hierarchy can be expanded by clicking on the [+] symbols to select individual primitives within a group.

Note: As with other screens, a shortcut method of selecting or deselecting all channels or all primitives is provided by using CTRL-Click on any checkbox.

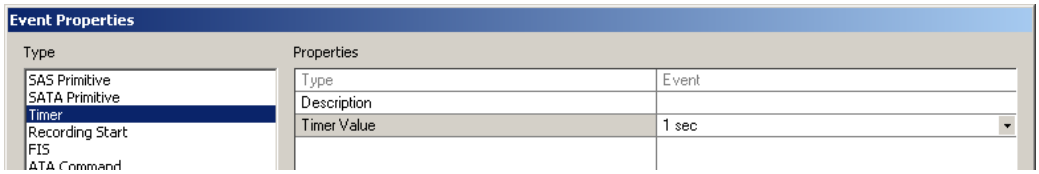
SATA Primitives

SATA Primitives can be selected in a similar manner, with the slight exception that the list of primitives does not use a nested hierarchical structure.

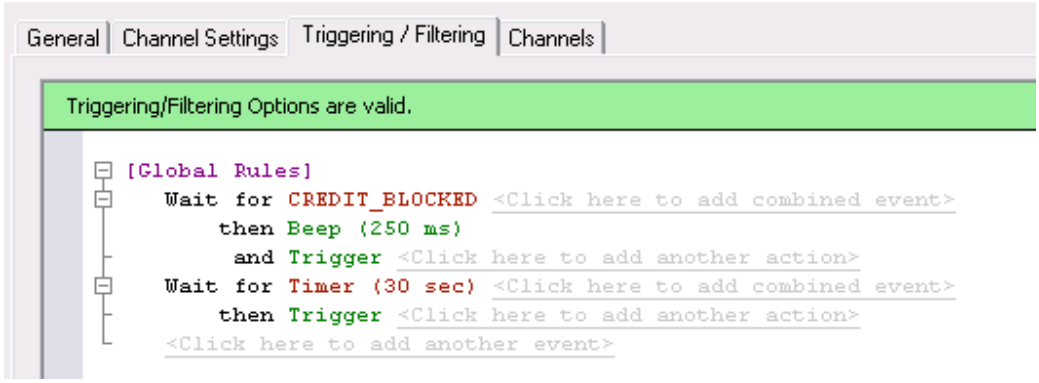


Timer

The timer event allows the user to insert a specified delay. The Timer event screen allows the user to select a delay between 50 ns and 50 years, by selecting an appropriate value from the dropdown menu.



An example of how the timer event might be used is shown below. In this example, the analyzer waits to detect a CREDIT_BLOCKED primitive, then beeps to alert the user and triggers the analyzer. If the condition is not detected within 30 secs, the analyzer will trigger to stop the test.

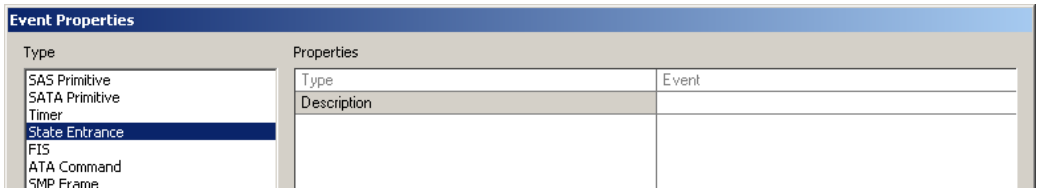


Recording Start/State Entrance

In the list of events for Global Rules, this event is listed as "Recording Start", since Global Rules have only one state and it begins at the start of recording. For sequences, this event is listed as "State Entrance".

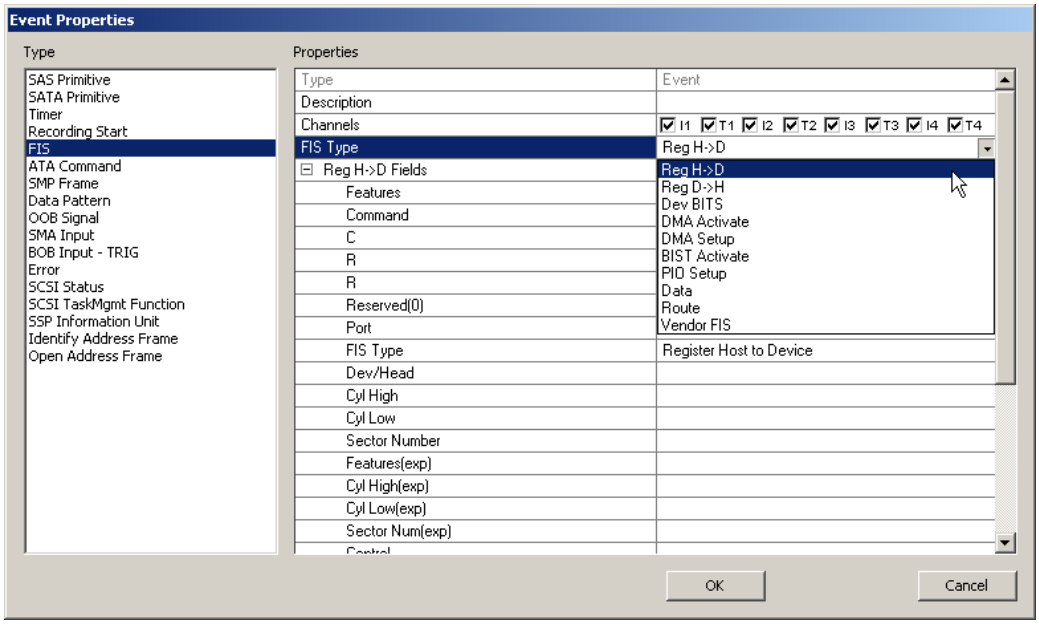
These events are used for special actions which the user only wants to occur once, when the state is first entered. Some examples have been given earlier where the user might want a beep as an alert when the system enters a specific state, but the concept is general and there may be an entire list of actions that the user wants to occur when a state is entered, but then not remain active while the system remains in that state.

The "Recording Start" and "State Entrance" events have no other parameters associated with the event.



FIS

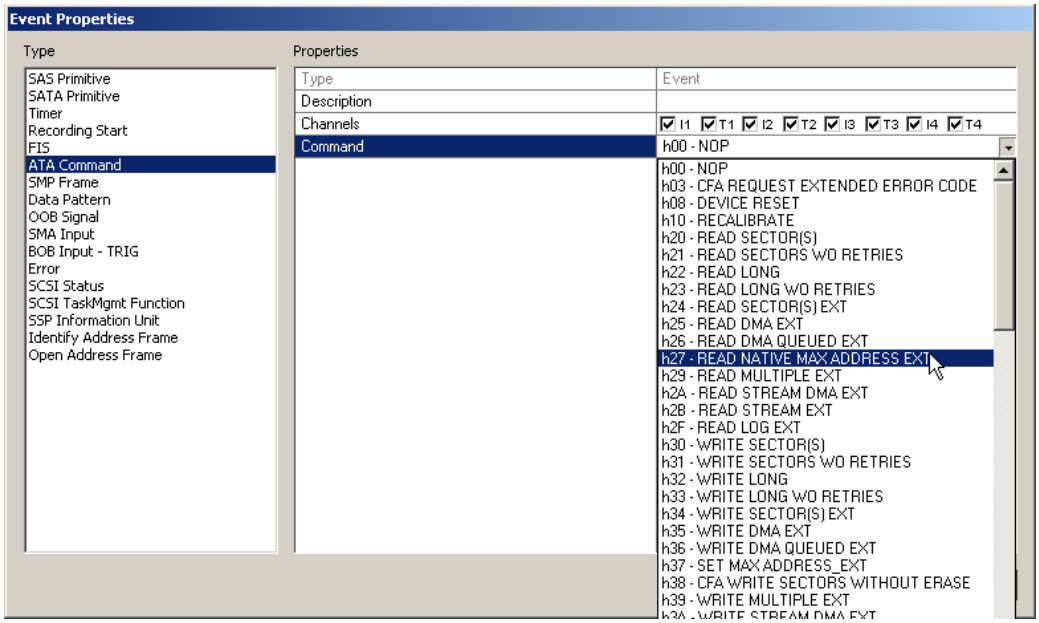
The FIS Event allows the user to specify virtually any parameter associated with any SATA FIS (Frame Information Structure). There are several types of FIS formats, and the drop-down list under "FIS Type" allows the user to select the FIS format of interest.



With the selection of the FIS Type, the fields associated with that FIS Type will appear as a list below the type, and the user may enter any value for any of the defined fields.

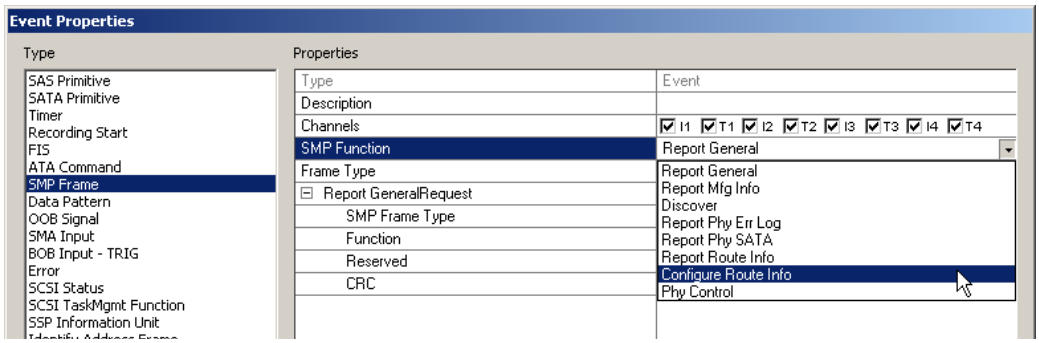
ATA Command

The ATA Command Event allows the user to specify any ATA command that might be present in the data stream. Selecting this event type provides a drop-down list of ATA Commands that can be selected.



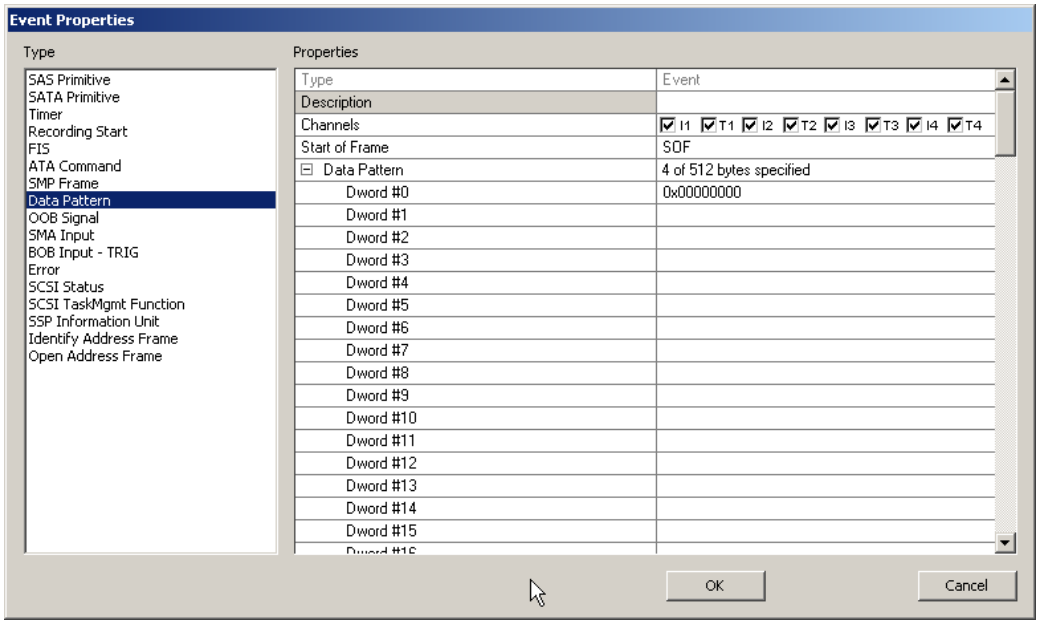
SMP Frame

The SMP Frame event allows the user to specify any SMP (Serial Management Protocol) Frame. As with other frame descriptors, drop-down menus are supplied where appropriate and the user may enter specific data values for appropriate fields in the frame structure.



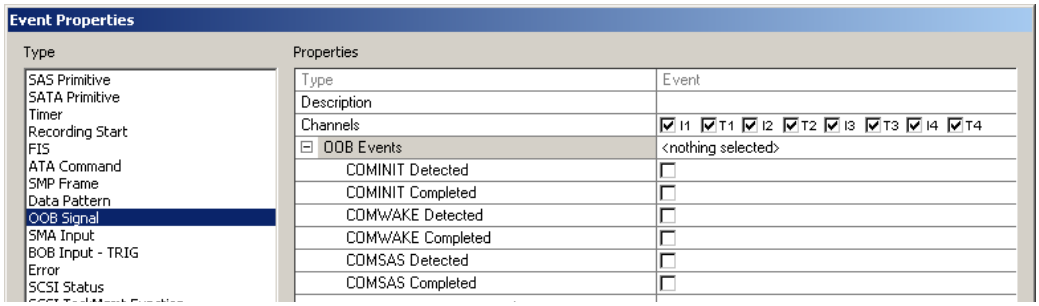
Data Pattern

The Data Pattern event allows the user a generic way of defining a match to any part of a frame, starting with the first Dwords that follow the SOF. This event will match values a specific distance into the frame (number of Dwords) with the value(s) provided by the user.



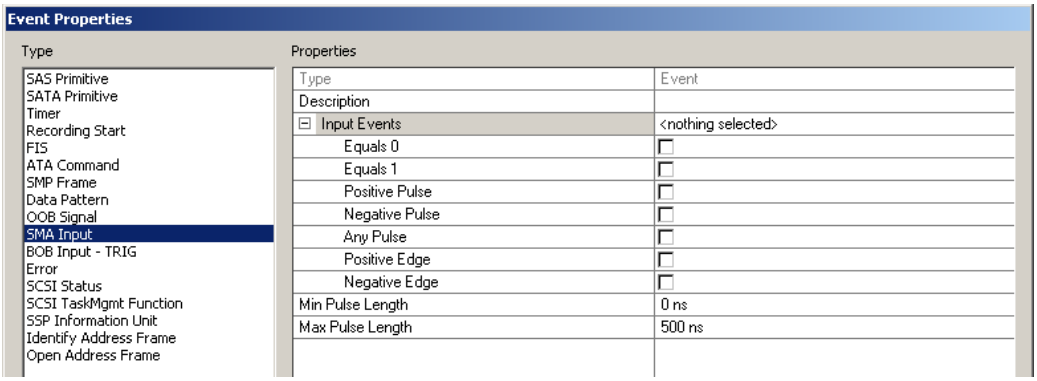
OOB Signal

The OOB Signal event allows the user to specify either the occurrence or the completion of the three OOB (out of band) commands, COMINIT, COMWAKE, and/or COMSAS.



SMA Input

The SMA Input event is used to detect triggers and other TTL transitions that occur on the "EXT IN" connector at the rear of the unit.



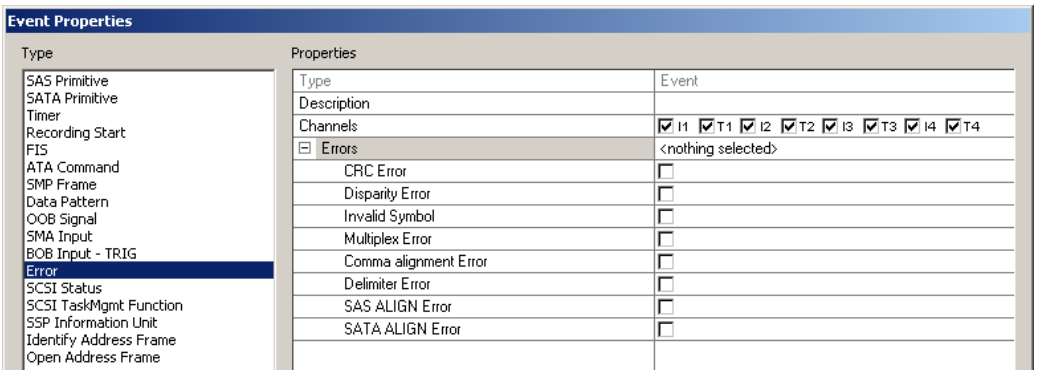
Note that the TTL transition that occurs can be of several different types, including remaining at a given value. In addition, there are minimum and maximum durations that can be selected for each type of transition, ranging from 0 to 1.5 usec for minimum pulse length, and from 0 to 25 usec for maximum pulse length.

BOB Input - TRIG

The BOB (Breakout Board) Input trigger events come from signals connected to the Breakout Board (which is in turn connected to the analyzer via the Data In/Out connector on the back of the unit). The BOB Input - TRIG events have identical parameters to the BNC Input event described above, with the additional parameter that since there are two separate triggers, an extra parameter (called "Trigger Source", with allowed values of "Input 0" and "Input 1") is provided.

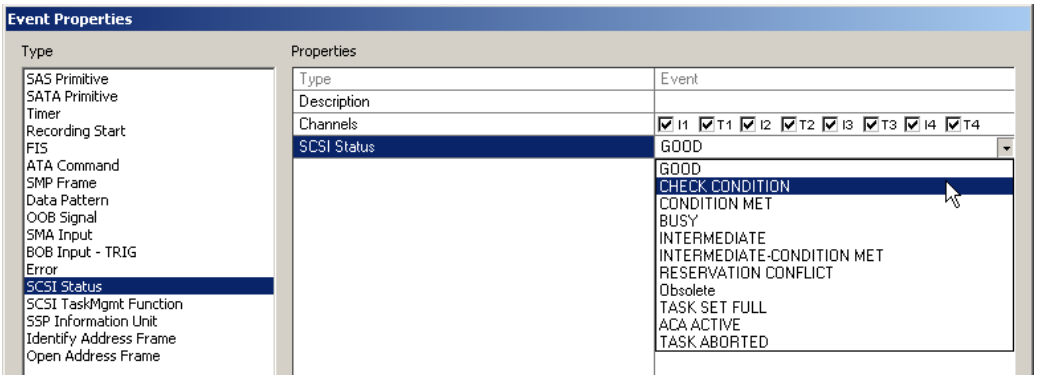
Error

The Error event is a series of errors that can be selected individually or in combination, as shown below:



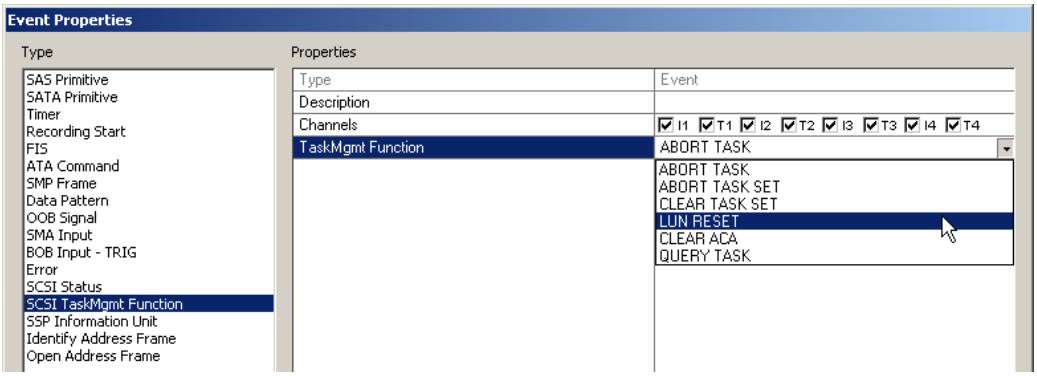
SCSI Status

The SCSI Status event allows the user to specify a number of high level SCSI conditions, shown in the drop-down list illustrated below:



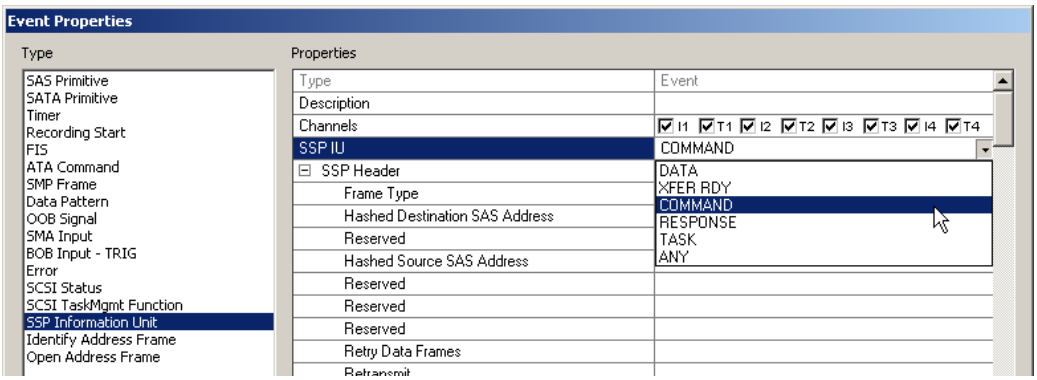
SCSI TaskMgmt Function

The SCSI TaskMgmt Function Event provides a series of SCSI task management functions which can be selected from a drop-down list, as shown below:



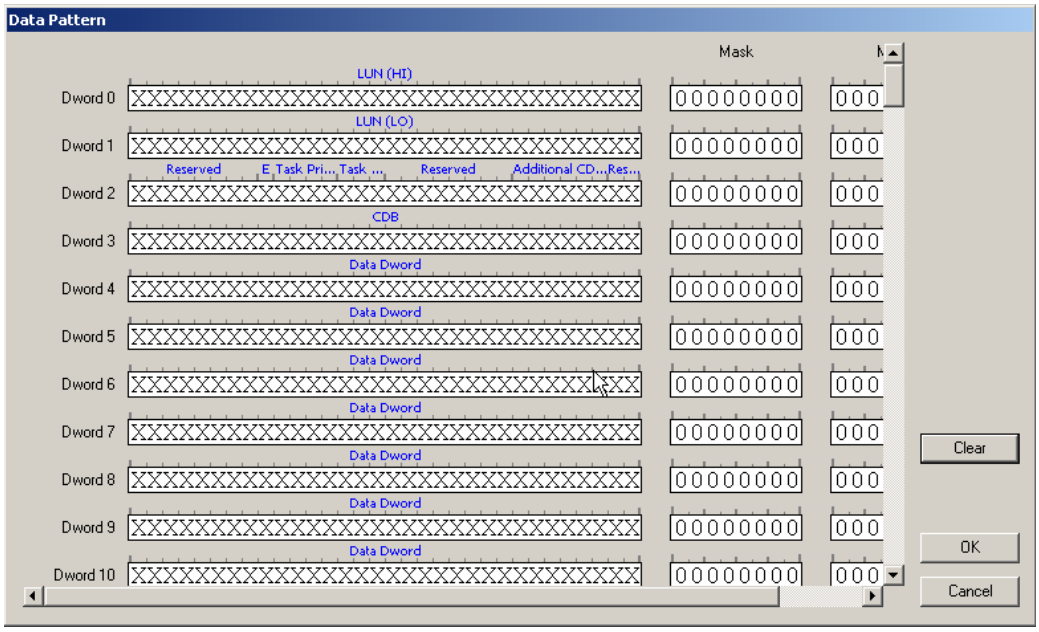
SSP Information Unit

The SSP Information Unit event provides a flexible and powerful way for defining virtually any type of SSP (Serial SCSI Protocol) event. Selecting the SSP Information Unit event provides a screen that includes a drop-down menu to select the type of SSP IU, as shown below:



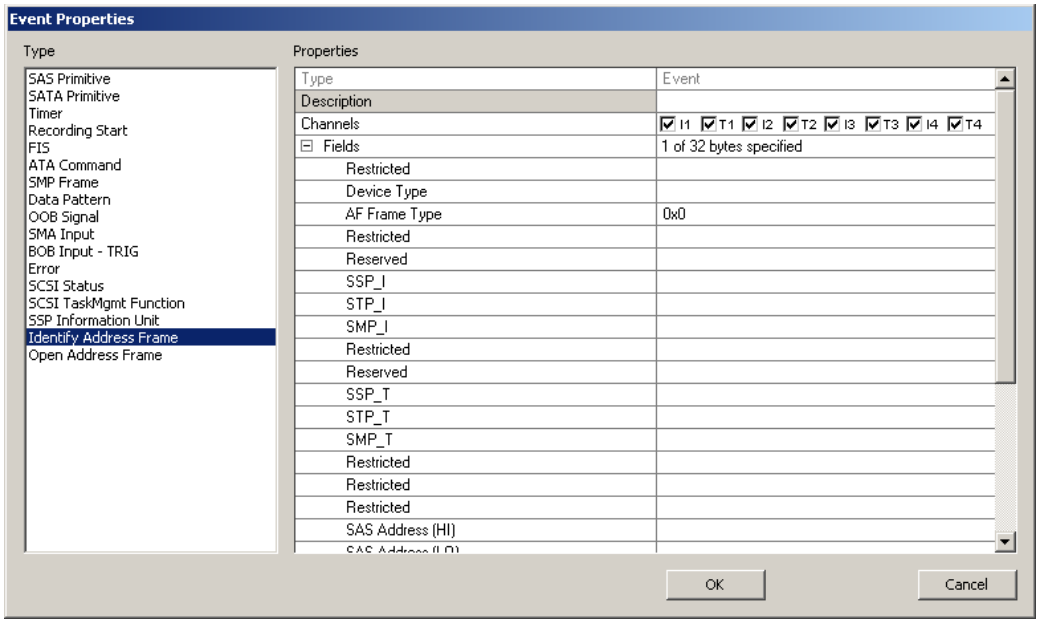
The screen also includes a complete list of fields in the SSP frame, allowing the user to specify values for specific fields. Scrolling down this list reveals the COMMAND Fields parameter, as follows:

Clicking on the gray box on the far right brings up a screen where individual bits can be mapped into specific command field Dwords, either as a bit pattern or as Mask or Match Fields (Hex).



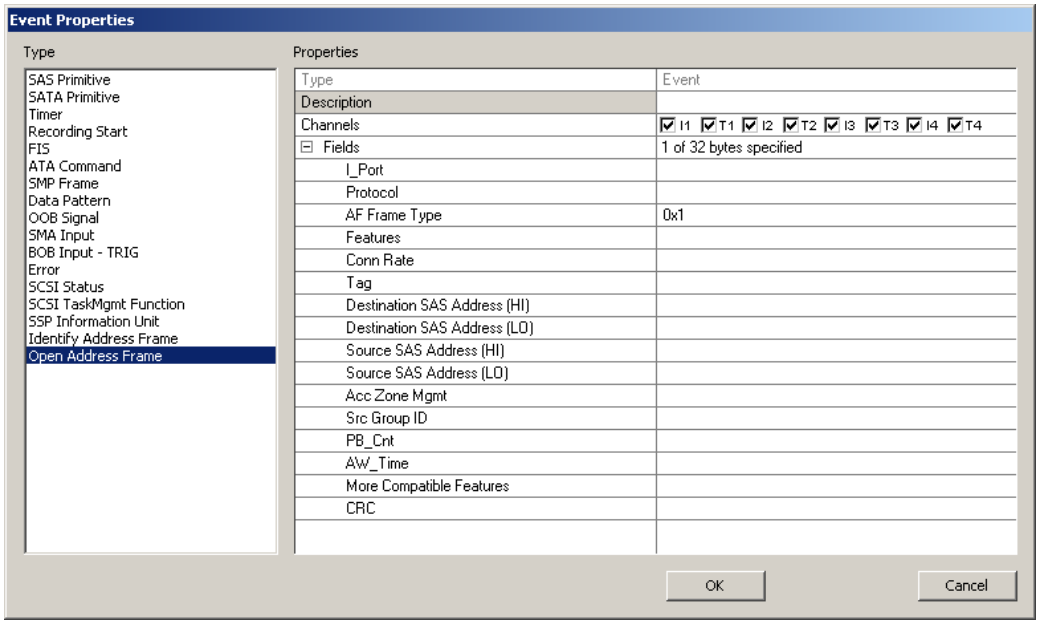
Identify Address Frame

The Identify Address Frame event provides a list of fields which can be edited to match with specific values provided by the user. Some fields (such as device type) reveal a drop-down list of defined selections for that field.

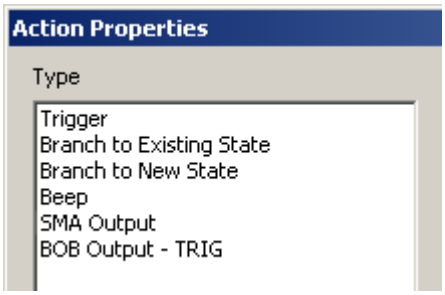


Open Address Frame

Similar to the Identify Address Frame event listed above, the Open Address Frame event provides a list of fields which can be edited by the user, with helpful drop-down menus for fields with defined selections (protocol and connection rate).



Actions

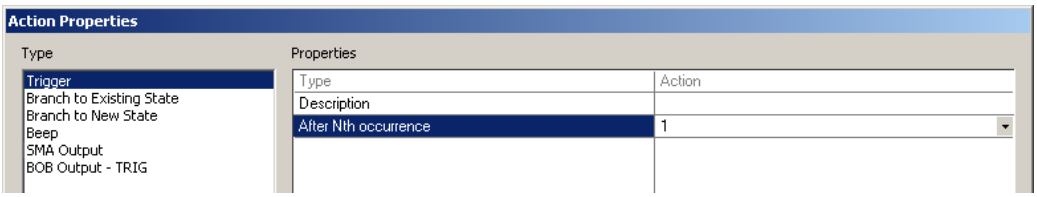


Once any event (or set of events) has been identified, the next step is to define an action (or a set of actions) that result from the event(s). There are several actions which can take place, as shown in the list to the left. (Note: The actions "Branch to Existing State" and "Branch to New State" are shown only when building a sequence, in which multiple states are allowed. If building Global Rules, these options are not shown, since Global Rules have only one state.

Trigger

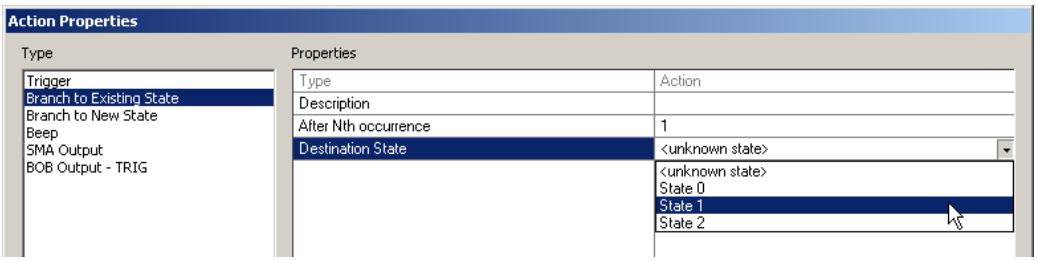
The Trigger action is the most common endpoint of the majority of scenarios. Triggers work in combination with other settings previously described to determine what data is actually captured and retained in analyzer memory. Triggers work, in effect, to stop recording, but depending on the settings for the trigger position, recording may not stop immediately when the trigger is issued.

The Trigger action has only one parameter, which is the number of time the action must be called before the trigger is issued. This allows the scenario to trigger, for example, on the 10th instance that the specific event occurred. The number of occurrences can be selected from a list of options provided in the drop-down menu.



Branch to Existing State

This action is shown only for sequences, not for Global Rules which can contain only one state. The Branch to Existing State action provides a means for branching and looping within a scenario between different predefined states.



The option of an "unknown state" is provided as a temporary means to include a branch to state which has not yet been defined, but if this option is selected the Triggering/ Filtering screen will identify this as an error in the script until the new state is defined and the user returns to and corrects this "dead end".

Also note that the option is provided, as with all actions, of the event needing to happen multiple times before the action actually occurs.

Branch to New State

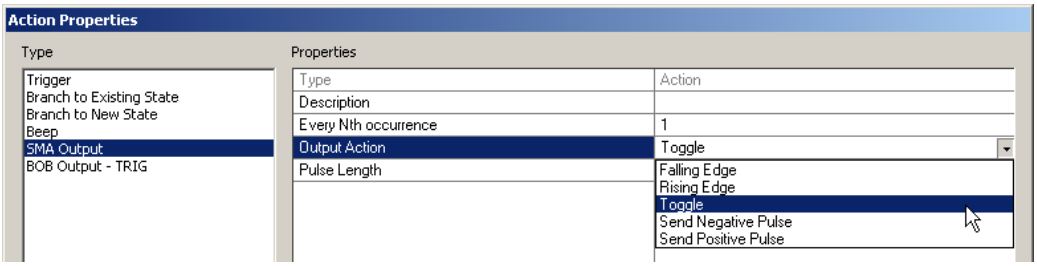
This option is shown only for sequences, not for Global Rules which can contain only one state. The Branch to New State action is similar to the Branch to Existing State action defined above, however this option automatically create a new (but empty) state in the scenario. If there are currently "n" states in the scenario, the new state will be "State N" (because states always start with State 0).

Beep

The Beep action produces an audible beep to alert the user to various events that have occurred. The beep can be specified as a duration of 250 ms or of 1 sec. Multiple beeps could be created in a sequence by branching to a new state which waits for a short time and then issues a second beep.

SMA Output

The SMA Output action produces a signal to an external device. The type and duration of the signal can be controlled by the parameters listed in the action, as follows:



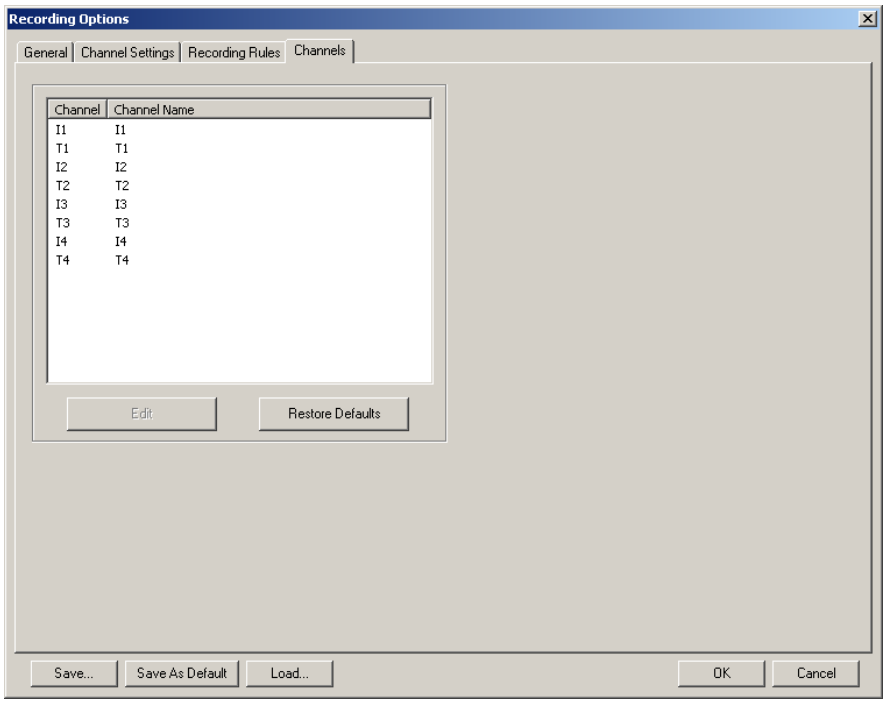
The signal created by the SMA Output action appears as a TTL level signal on the "EXT OUT" connector at the rear of the Avalanche unit.

BOB Output - TRIG

The BOB (Break Out Board) Output -TRIG action produces a TTL level signal on one of the two outputs on the breakout board (which is connected to the analyzer via the Data In/Out connector at the rear of the unit). The parameters associated with this action are identical to the BNC Output action described above, with the addition that since there are two outputs on the breakout board, there is an additional parameter of "Trigger Destination" with the allowed values of "Output 0" or Output 1".

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.



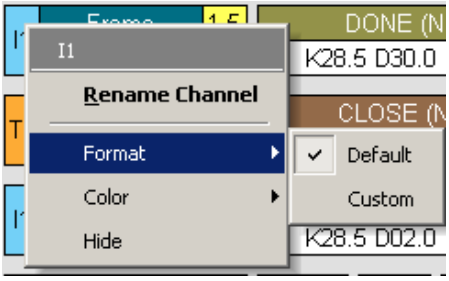
Note: You can also change channel names by clicking on the first cell of a trace (the channel cell) and selecting **Rename Channel** from the pop-up menu.

Where Custom Channel Names Appear

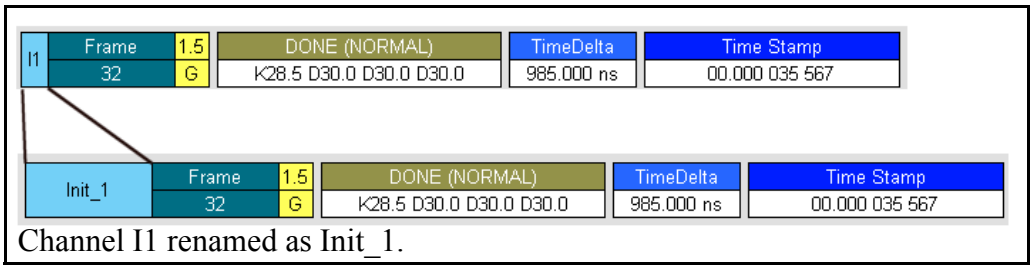
Custom channel names appear in three places:

- 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**.

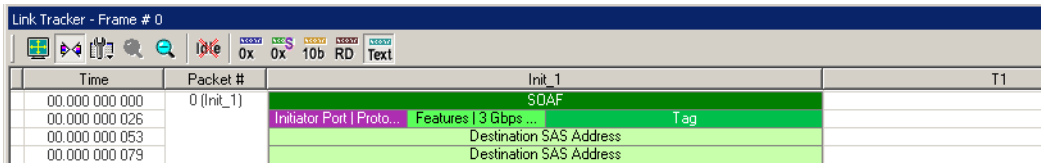


The custom names will then appear in the trace.



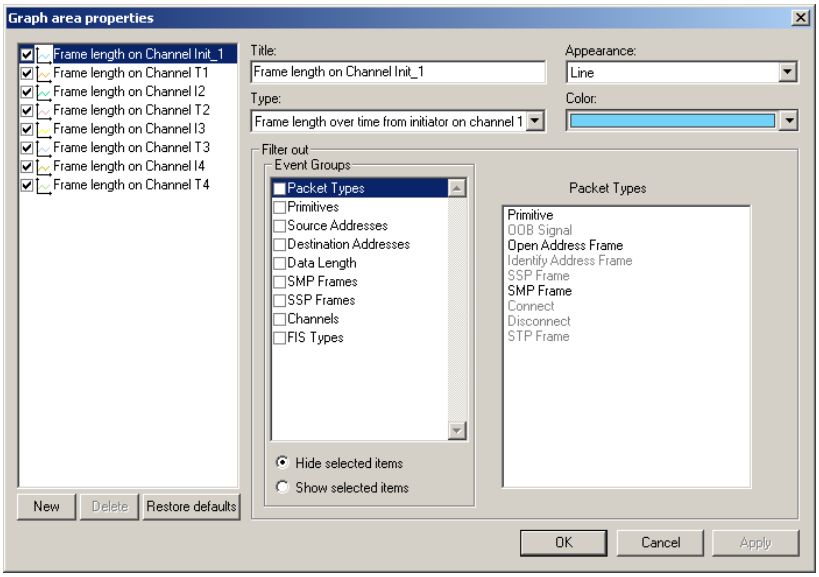
Channel I1 renamed as Init_1.

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.

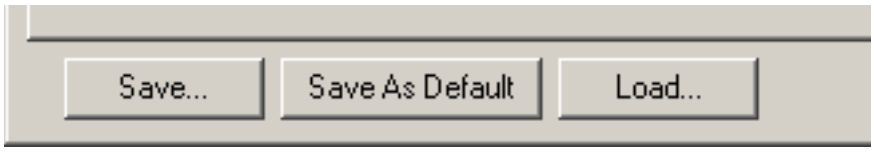
To open the properties dialog box for the Bus Usage window, right-click in the window, then choose **Properties** from the pop-up menu.



Saving and Loading Recording Options

Once defined, a set of recording options cam be saved as a file on disk for later use. Included in this file are all settings for all four screens that appear under the recording options selection, including General, Channel Settings, Filtering/Triggering, and Channels. Included in this information will be all filtering criteria, Global Rules, and any defined sequences.

To save a set of recording options, have the recording options window open (with any tabbed page showing), and click on **Save...** at the bottom of the screen.



Clicking on **Save...** will bring up a window allowing the user to name the file and navigate to any folder that he wishes to use to save the file.

To reload a saved recording options file, click on the **Load...** button and select the file.

If you would like to define a set of recording options as the default for the system, once the recording options are correctly defined click on the **Save As Default** button.

Chapter 5: SAS*Tracer* Recording Options

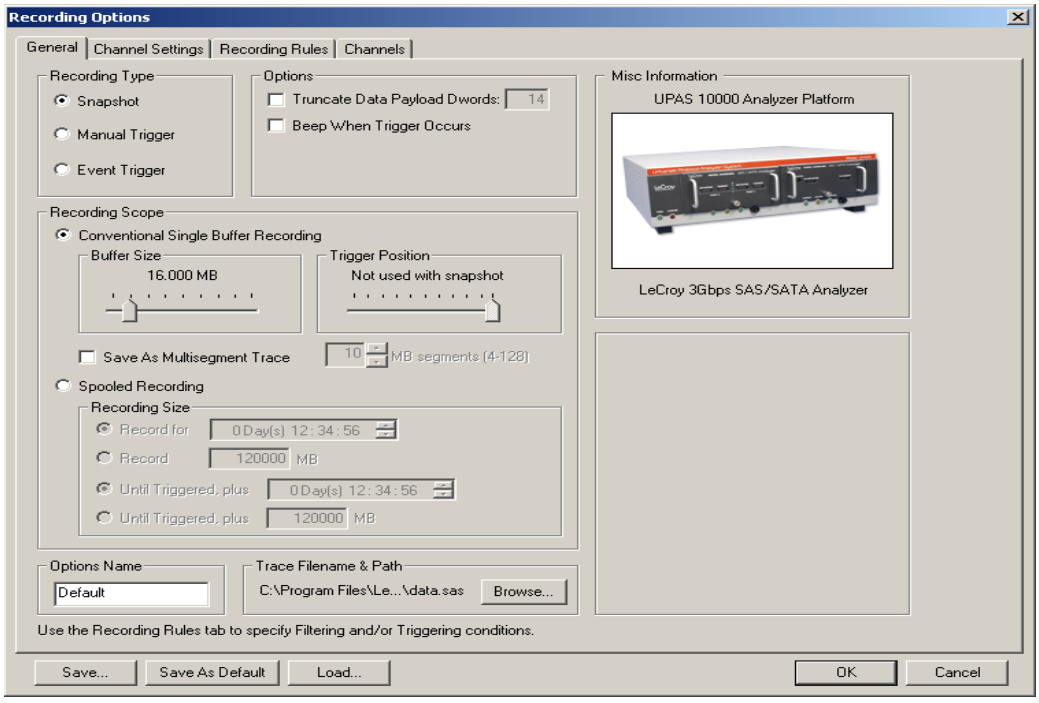
Recording options provide instructions for the analyzer hardware as to how a trace recording should be captured. Included in these instructions are items such as how to start or stop a recording, what information should be recorded, and trigger conditions that can be used to automatically record certain data events (or sequences of events) when they occur.

Since these instructions are specific to the hardware platform being used, there are differences in the way the recording options are set up for the Avalanche system vs. the SAS*Tracer* system. In order to present this information clearly, we have divided the information into two Chapters in this User Manual.

This Chapter covers recording options for the SAS*Tracer* systems only. For information on the Avalanche systems, see Chapter 4.

General Recording Options

From the **Setup** menu, select **Recording Options (UPAS 10K)...** . The following screen is displayed:



Options displayed on the General page include the following:

- Recording Type
- (Recording) Options
- Recording Scope, including Buffer Size and Trigger Position for conventional recordings, and recording parameters for spooled recordings

- Options Name
- Trace Filename & Path
- Misc Information

Recording Type

The **Recording Type** box presents three options that control how SAS*Suite* 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 preselected 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 is ended by the user pressing the Trigger button on the front panel, although in some cases recording may not stop immediately. Once the Trigger button has been pressed, recording continues until the post-trigger buffer has been filled (see Trigger Position below) 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 limits the amount of space each frame requires to be stored in the buffer, thereby increasing the number of frames that can be recorded.
- **Beep When Trigger Occurs**: When this checkbox is selected, the computer connected to the SAS*Suite* beeps three times to alert the user when a Trigger condition is first detected.

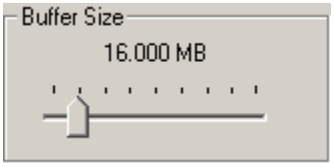
Recording Scope

Recording Scope presents two important options that affect the size or scope of the recording. These options are *Spooled* and *Conventional* recordings. The *Spooled* 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 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 maximum size of the analyzer buffer. 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. Once the recording is complete, the traffic is uploaded to the host PC.

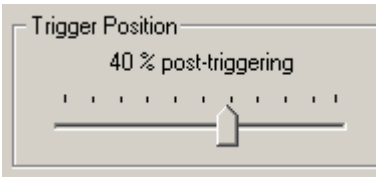
If you are planning to create a large recording or are planning to let the analyzer run over a several days, then select **Spooled Recording**. In a Spooled Recording, traffic is uploaded periodically to the host PC--thus freeing analyzer buffer and allowing the recording to continue.



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 maximum memory to be used for a Conventional recording.

The option mentioned above for truncating data payloads, as well as filtering options which will be discussed later, determine what information from the raw data stream is actually recorded into trace memory. Also, although there are 2048 MB of physical memory in the SAS*Tracer* analyzer, there is additional information recorded with each frame, such as timestamps and other system parameters, so the efficiency of the recording ranges from about 37% in the worst case to 75% in normal traffic and higher when packing is possible (ratio of physical memory to actual SAS or SATA traffic).

Note: The Buffer Size slider bar is not linear and affords more granularity in the smaller buffer sizes.



Trigger Position - The Trigger Position slider bar allows the user to define the position of the trigger within the recorded traffic. Essentially, this is instructing the system when to stop recording. If the trigger position is set to the end of the recording, recording will stop immediately when the trigger occurs. If the trigger is set to the start of the recording, when the trigger occurs the system will continue to record until the buffer has filled again and then stop (before the new data overwrites the trigger). Any intermediate setting allows the user to see data both before and after the trigger occurred. 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 10 MB. Before attempting large recordings, it is recommended that you adjust this number to see what value best suits your needs. based on the capabilities of your host PC.

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 SAS*Suite*) Thus, for example, if you had an analyzer with the serial number 111, the index file would be called *data111.smt*.

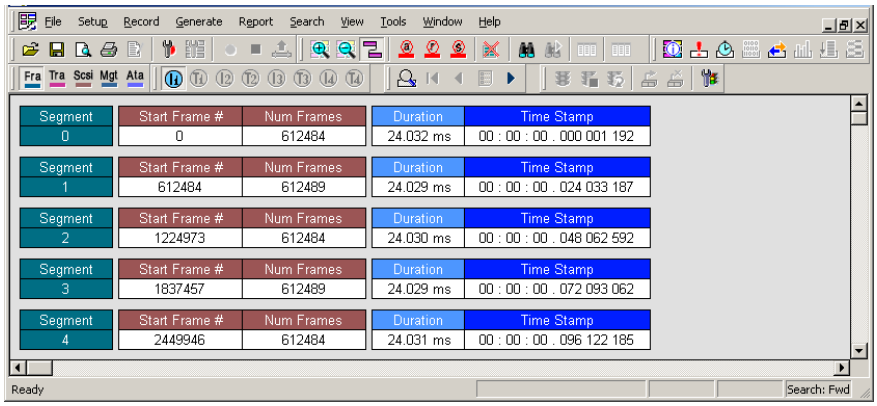
The index file and the segmented trace files are stored in a directory named after the index file. The directory is named *indexfilename_smt_files***.** For example, if the index file is named *data111.smt*, the directory will be named *data111_smt_files*. Below this directory additional, sequentially 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.



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.

Multisegment Toolbar

When an index file is opened like the one shown above, the Multisegment 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 the actual physical memory in the analyzer. However, an issue to be aware of with any spooled recording is that the actual spooling process is typically slow in comparison to the potential recording speed of the analyzer. So unless the recorded traffic is intermittent or heavily filtered, it is possible for data to be lost if the the spooling process does not keep pace with the recording process. This produces "gaps" in the resulting data, which are identified in the data file.

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.

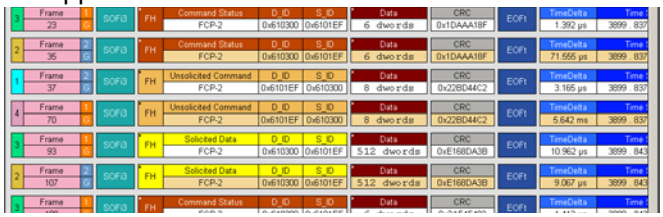
Record - Enter the amount of traffic (in MB) that you want the analyzer to record. Selecting this option will create a fixed length recording that begins as soon as you click the REC button on the menu bar.

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 **"Recording Rules" on page 82** 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.



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.

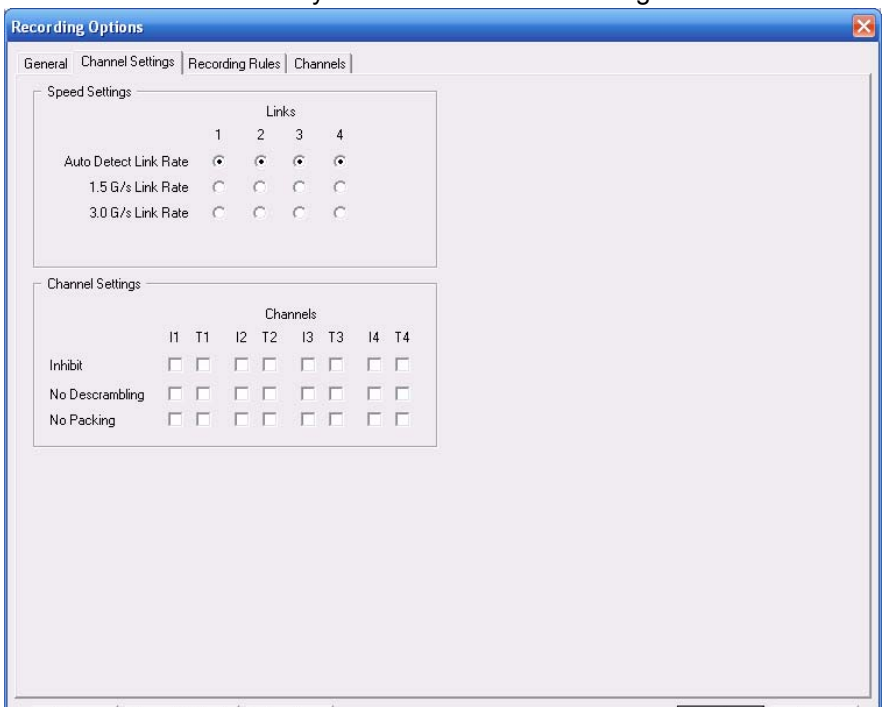
Hardware Buffer - shows you how full the analyzer buffer is and if the analyzer is currently dropping packets. In the example above, Hardware Buffer field shows that the buffer is full (shown by the thick green graph) and that the analyzer is currently dropping packets (shown by thin red line atop of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

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 SAS*Tracer* systems support 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, analyzer 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.

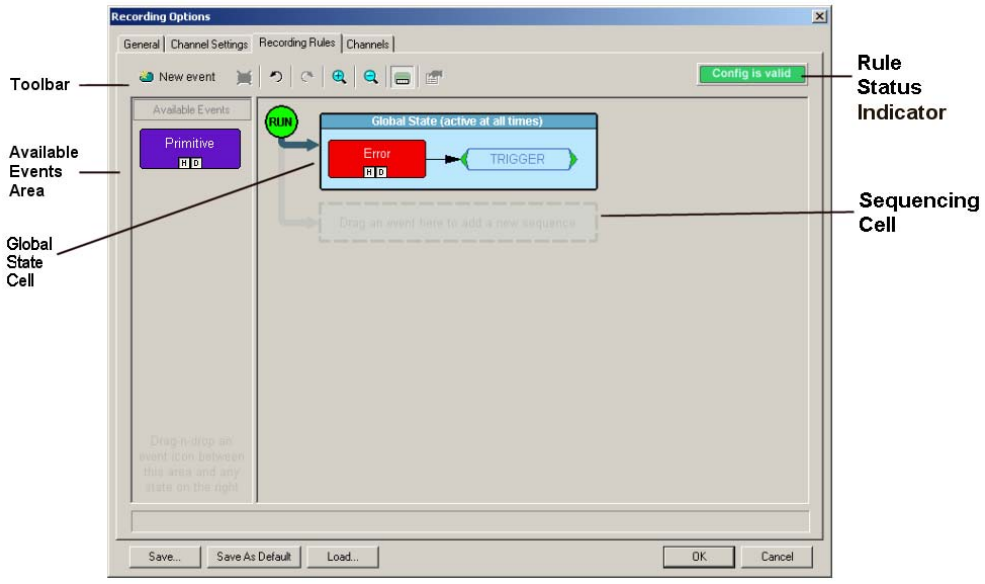
Inhibit - Inhibits recording of traffic from selected channels. For example, if you check the option for T1, it means "record all channels except for Target channel 1 (T1)."

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.

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.

Recording Rules Toolbar

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

	**New Event. Opens a menu of events. Selecting an event causes an event button to appear in the Available Events area.**
	**Delete Event. Deletes selected event button.**
	**Undo. Undoes last change made to Recording Rules page. The undo buffer has unlimited depth.**
	**Redo. Repeats changes undone by the Undo button.**
	**Zoom In. 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.**
	**Zoom Out. Makes the display appear smaller.**
	**Show/Hide channels. When pressed, this button tells the Recording Rules dialog to show the channel buttons on the Events icons. When unpressed, the channels are hidden.**
	**Show/Hide Properties Dialog. Shows or hides the Properties dialog of the selected State/Event/Action.**
	**Config is valid. 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 invalid."**
	**Config is invalid. 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.**

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.

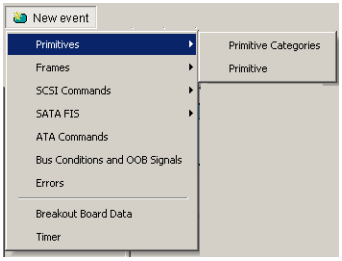
You can create simple or complex rules.

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.

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.

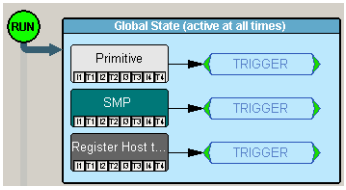
Assigning an action is a two-step process: first, move an Event button from the **Available Events** area on the left to one of the two cells in the center of the window. Then, right-click on the Event button and assign an action.

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** 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.

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

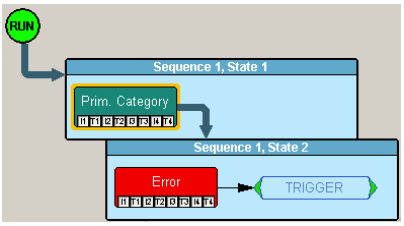
The Global State Cell - The Global State Cell tells the analyzer what events to look for throughout the entire recording. The cell is called a "Global State" because the conditions you define in the cell are always active. You can place several events in this cell. Doing so tells the analyzer to look 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 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.



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

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**.

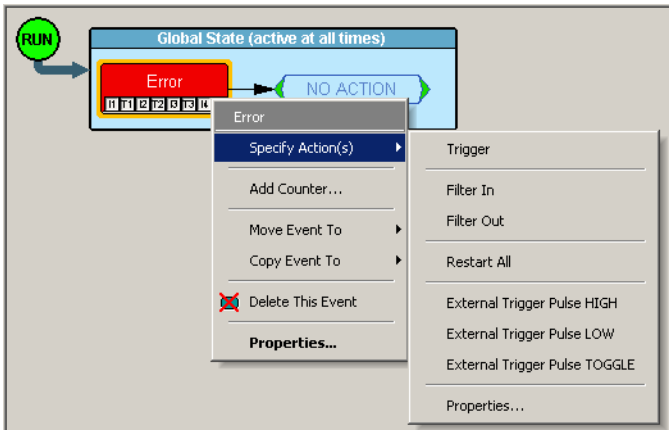
There are two ways to assign an action to an event button:

- **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.

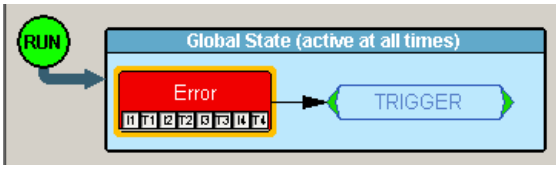
Assigning an Action from the Pop-up Menu

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:

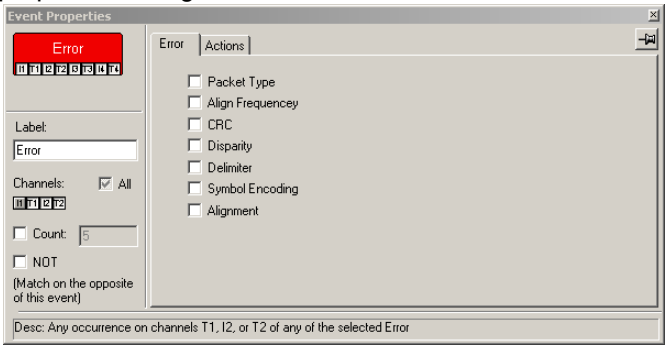


Step 2 Select **Specify Action** and then an action from the sub-menu. The menu closes and the action is assigned.



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 “Types of Properties Dialog Boxes” on page 90 for further details on Properties dialog boxes.

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.

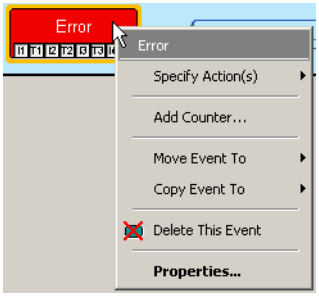
Event Pop-up Menu

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 CATC 10K. 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 CATC 10K. 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.

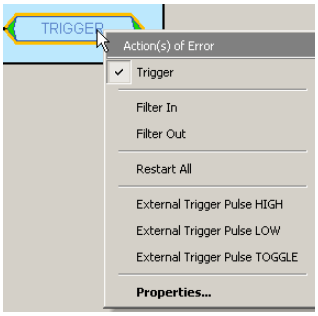
Action Pop-up Menu

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

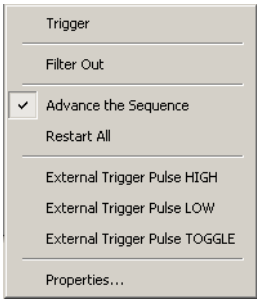
Trigger - Sets or clears Trigger action.

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.

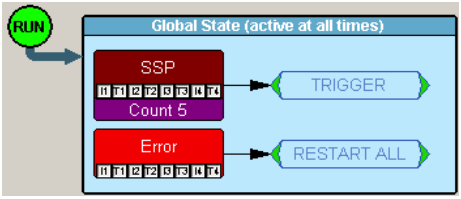


Global State Cell. Action menu for event in

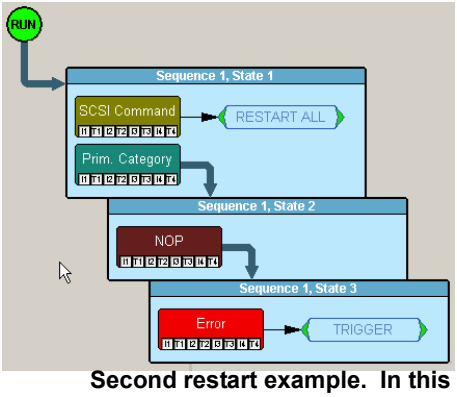


Actions menu for event in Sequence cell.

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, the analyzer will restart its search for a sequence of 5 SSP frames if an error is encountered.



Second restart example. In this configuration, the analyzer 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 CATC 10K. 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.

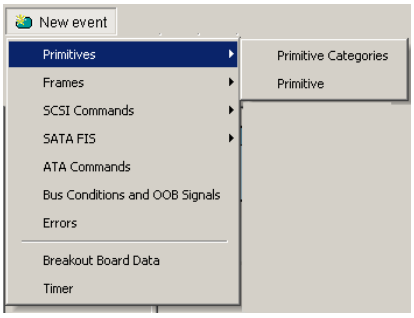
New Events Menu

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

Types of Properties Dialog Boxes



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

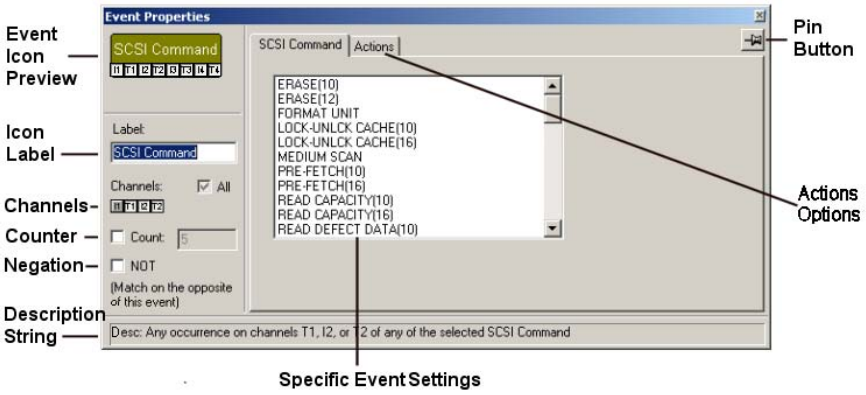
Properties dialog boxes can be opened by:

- 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.

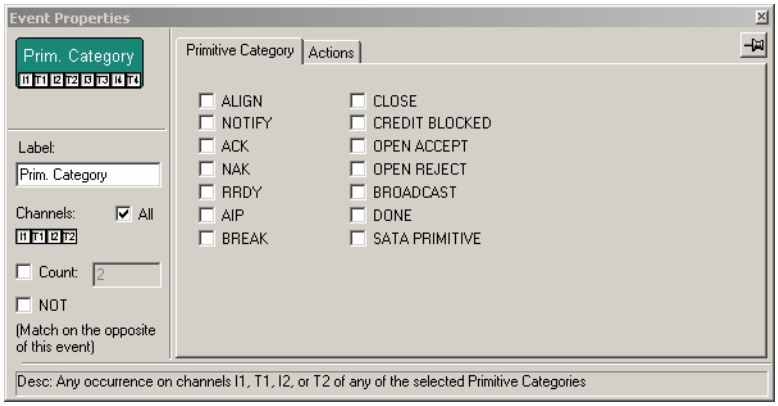
Description String - This area contains a textual description of the event.

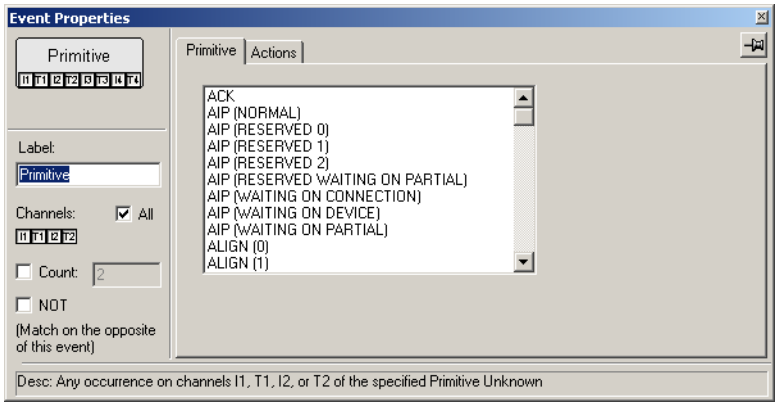
Specific Event Settings - The largest part of the Event Properties dialog box. By selecting one or more events from the list, you narrow the range of events for which the analyzer searches.

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

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

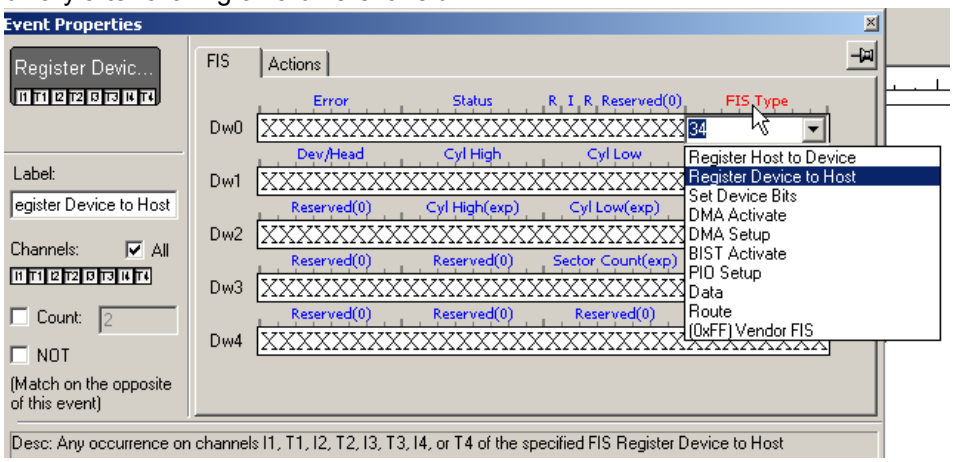
Checkboxes and **Lists** present options for you to select from. Selecting one or more option tells the analyzer which event(s) the analyzer should search for. Examples are shown below:



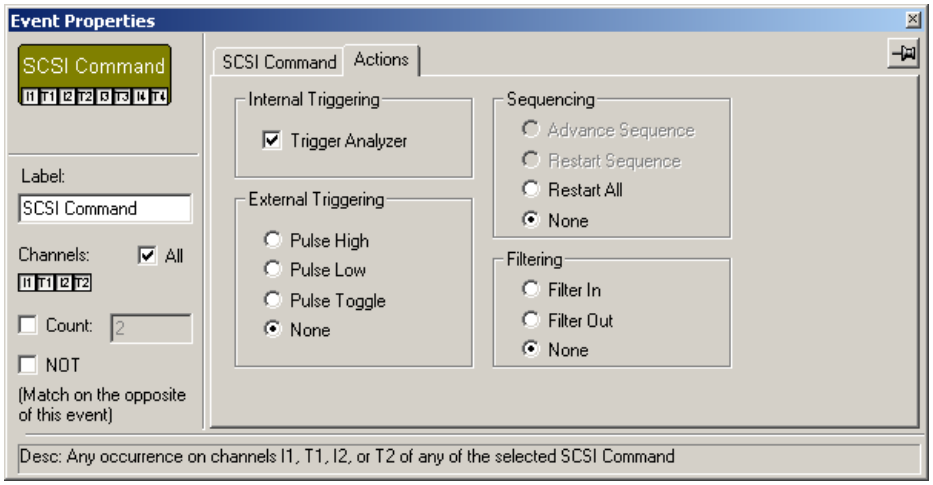


The **Pattern Editor**, on the other hand, presents a series of text boxes in which you can enter a data pattern (in 8 bit codes) that the analyzer can use as a trigger pattern search.

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.



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:

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

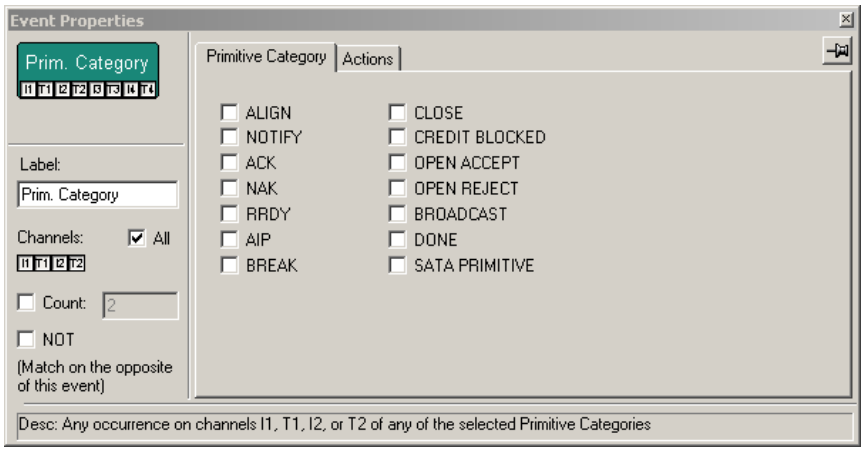
The descriptions below follow the order of events listed in the table above.

Primitives

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

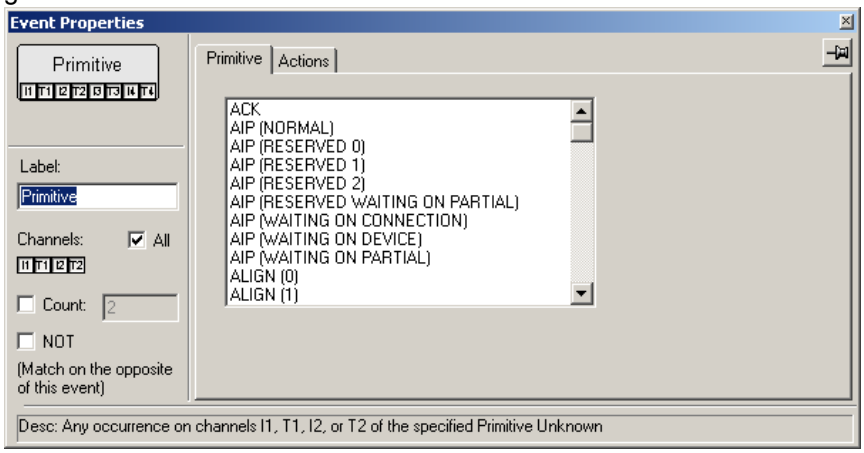
Primitive Categories Properties Dialog

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

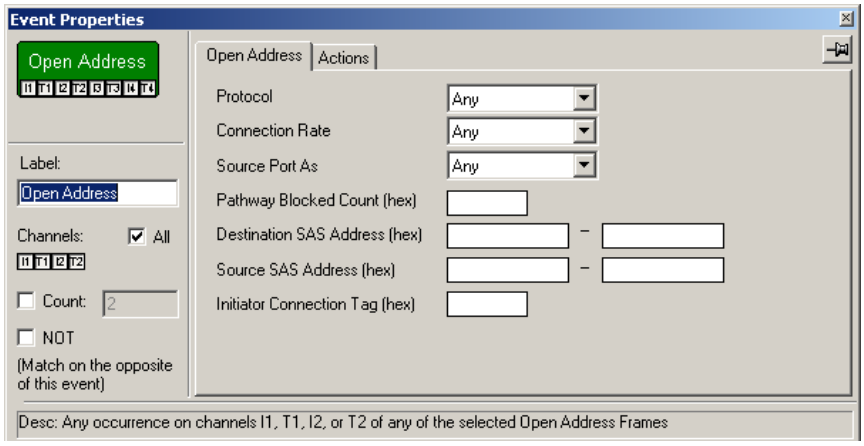
Pathway Blocked Count (hex):

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, Present, Not Present

STP Initiator: Any, Present, Not Present

SSP Target: Any, Present, Not Present

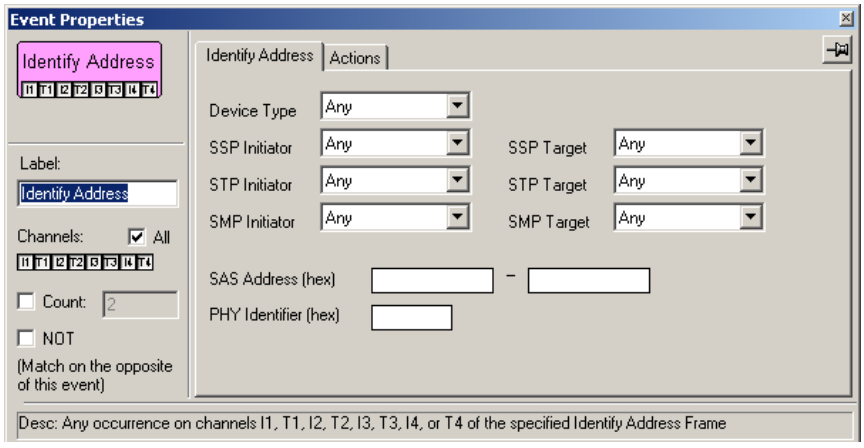
STP Target: Any, Present, Not Present

STP Target: Any, Present, Not Present

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

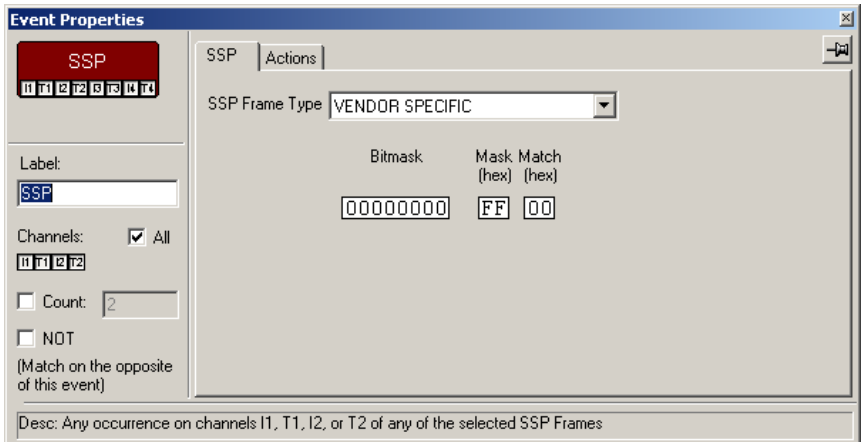
PHY Identifier (hex): Text box for entering PHY identifier.

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



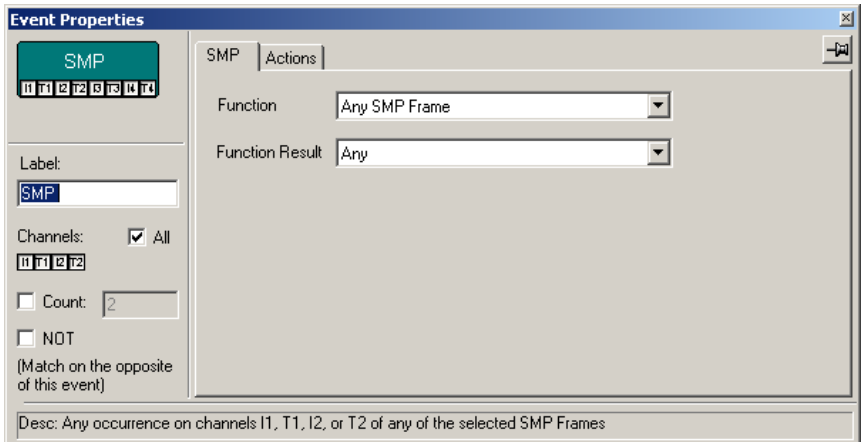
SSP Frames Properties Dialog

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 frame 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.



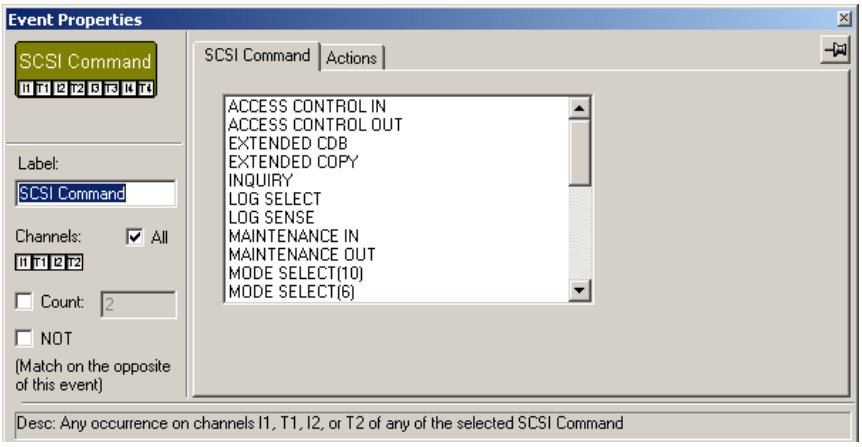
SCSI Commands

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

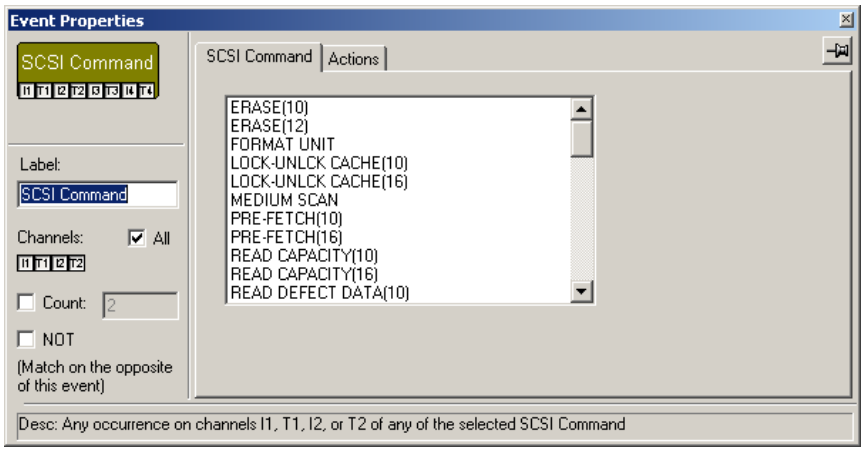
Lets you specify parameters for the selected SCSI Primary Command Set. To enter a parameter, select an item from the drop-down menu.

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



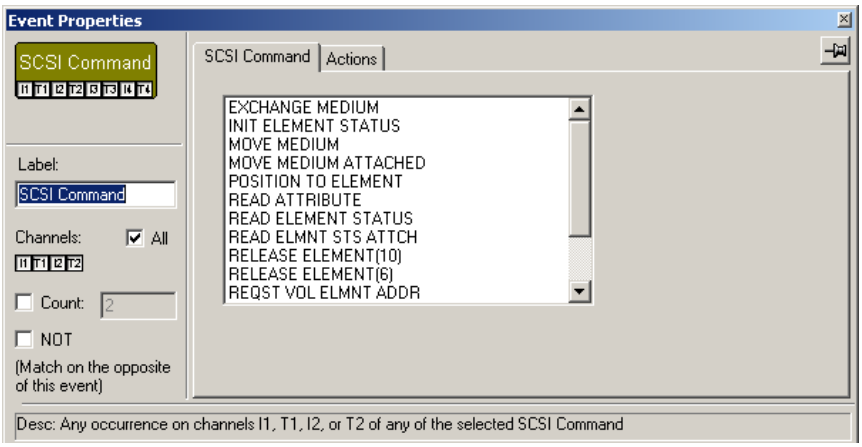
SCSI Block Command Set Properties Dialog

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



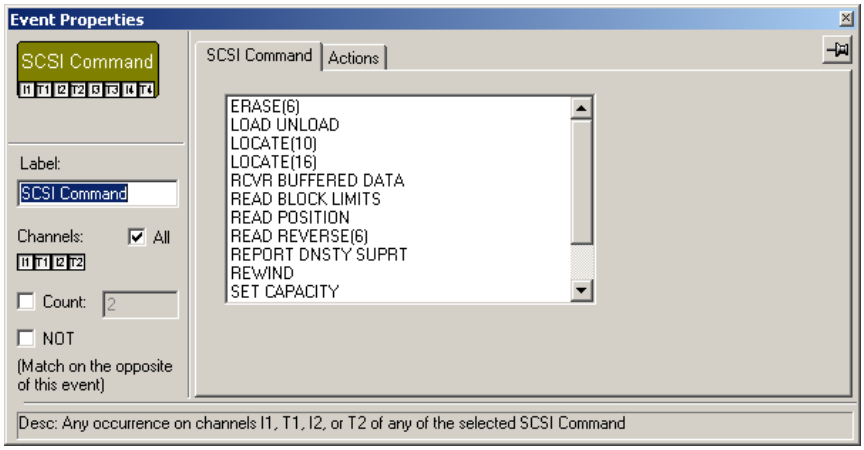
Media Changer Command Set Properties Dialog

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



Stream Command Set Properties Dialog

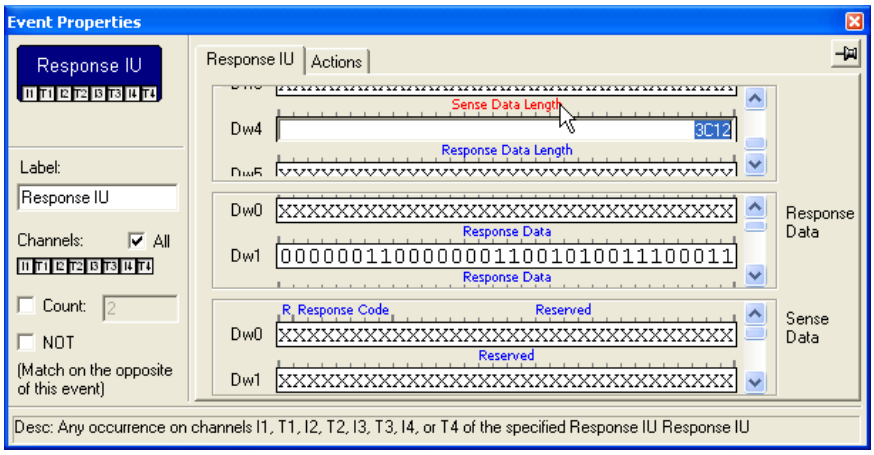
Presents options for triggering or filtering on various Stream Command sets. If NOT is checked, any unchecked command will generate an event match.



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

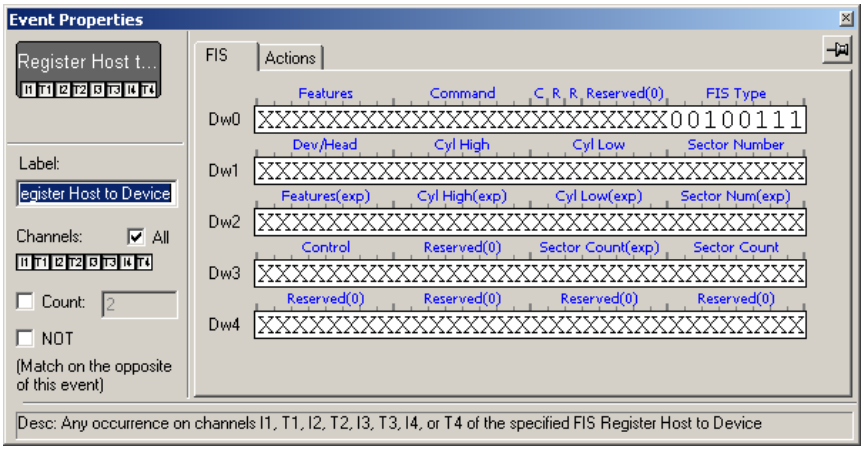
accessed using the scroll bars. Entering a data pattern tells the analyzer to wait for the specified pattern before triggering. Checking the NOT box selects the inverse match to the data pattern defined.



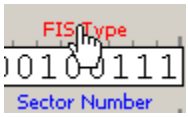
SATA FIS

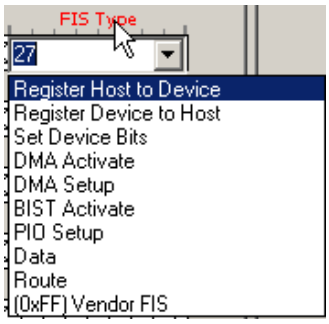
There are ten SATA FISs that can be selected from the New Events menu: Register Host to Device, Register Device to Host, Set Device Bits, DMA Setup, BIST Activate, PIO Setup, Data, Route, and Vend FIS: 0xFF.

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:

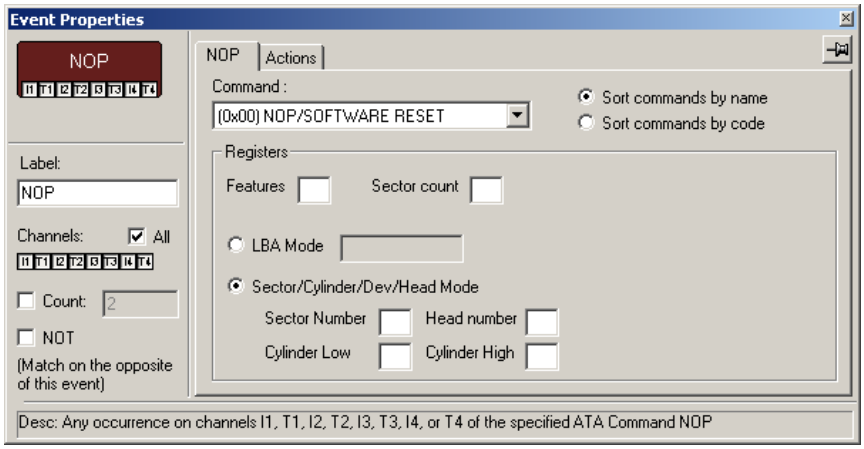
Commands - Presents a long list of ATA Commands. Selecting a command will cause the analyzer to search for the selected command.

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.

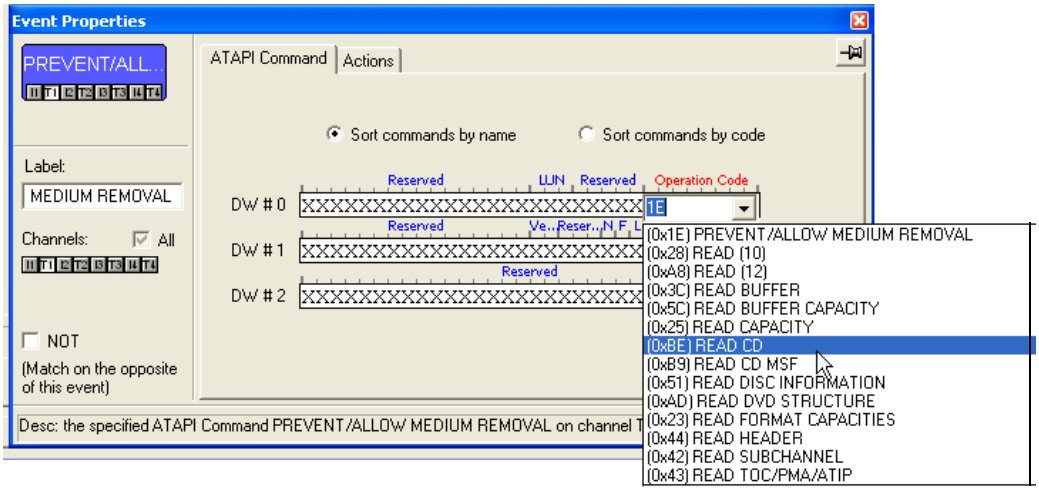
Sector/Cylinder/Dev/Head Mode - Select the radio button, then enter values into the text boxes.



If NOT is checked, any unchecked command 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.

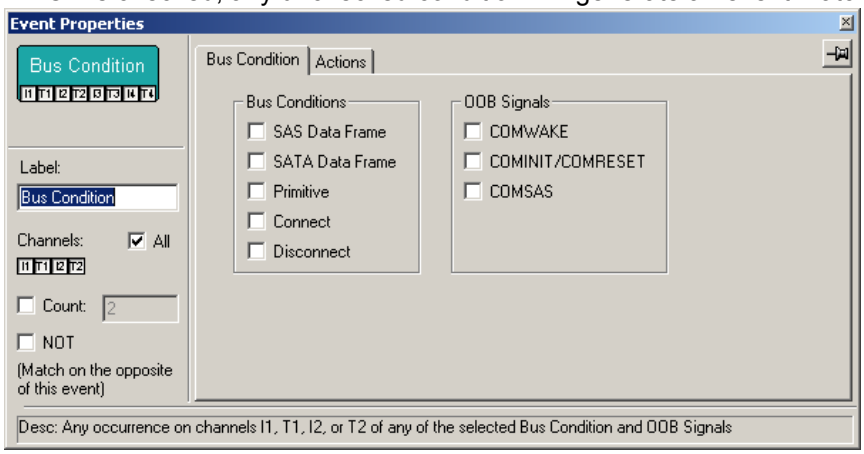
Bus Conditions and OOB Signals

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 condition will generate an event match.

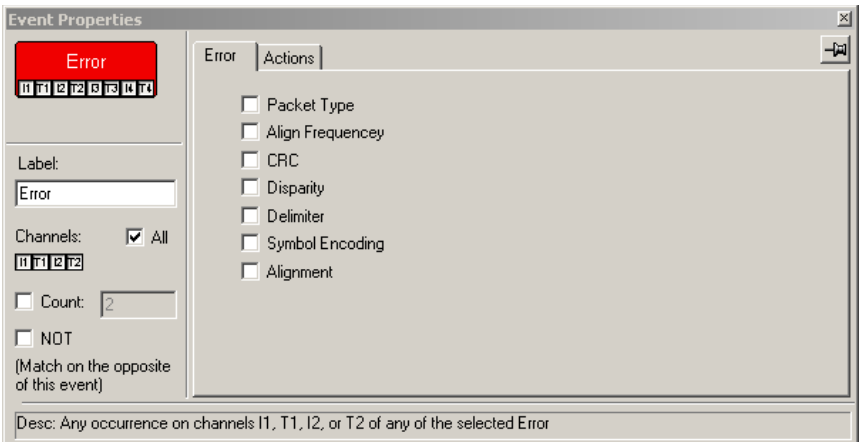


Errors

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 condition will generate an event match.

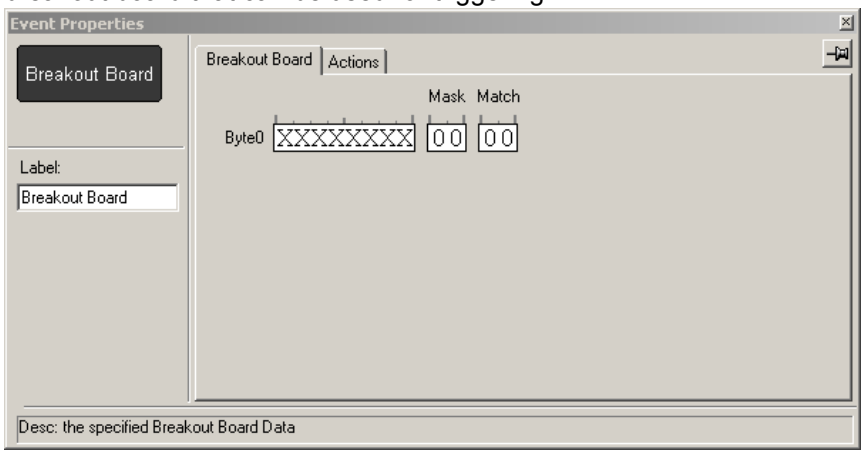


Breakout Board Data

Breakout board data are entered into a single dialog box.

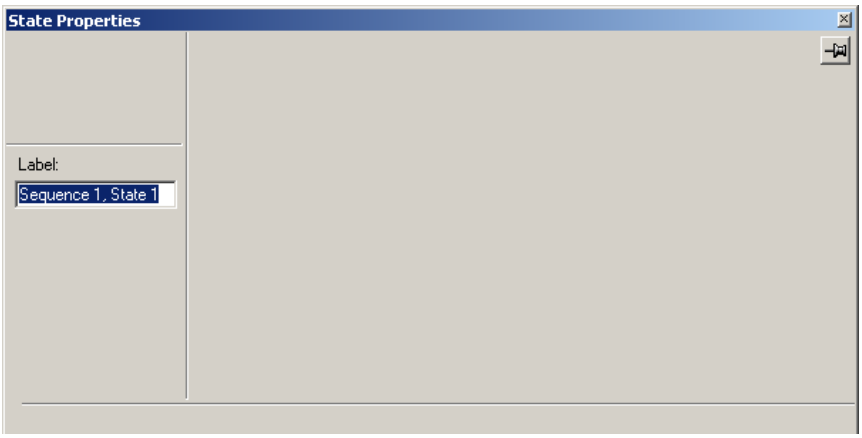
Breakout Board Data Properties Dialog

The Breakout Board Data properties dialog box lets you specify a bit pattern from a breakout board that can be used for triggering.



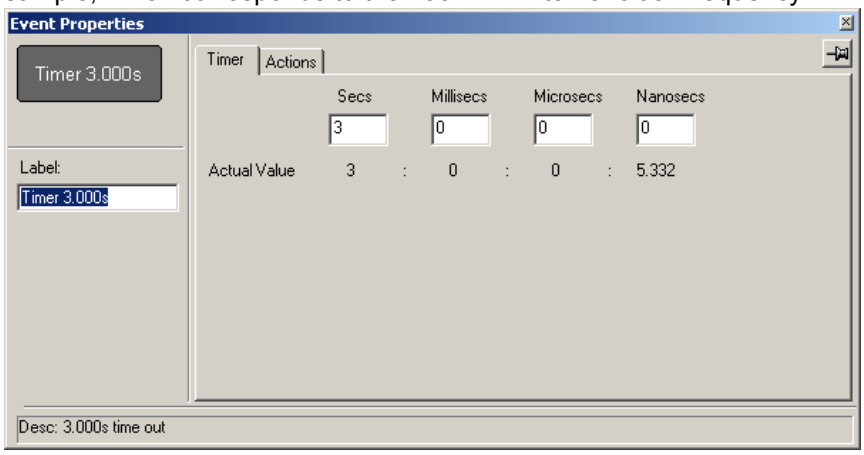
State Properties Dialog

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).



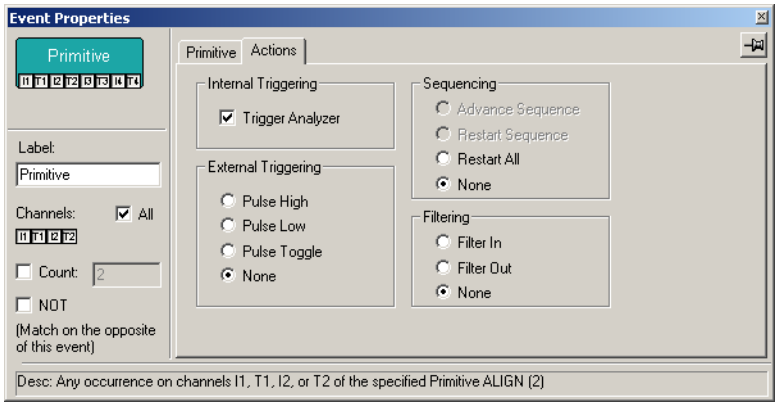
Timer Properties Dialog

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 133 MHz internal clock frequency.



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.



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.

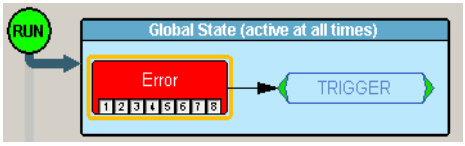
The assigned action will be represented by a button to the right of the Event button.

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.

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:

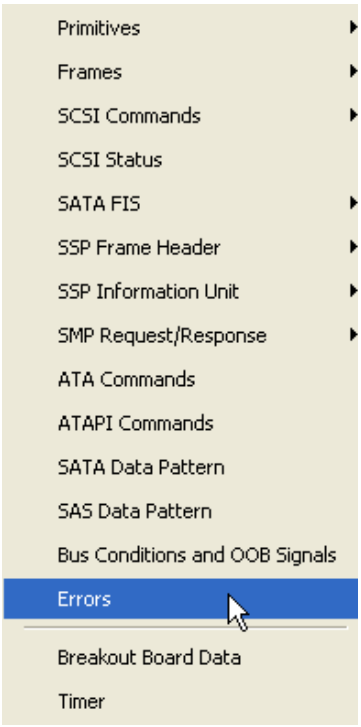
Step 1 Click the New Event button. An Events menu opens (shown right).

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.

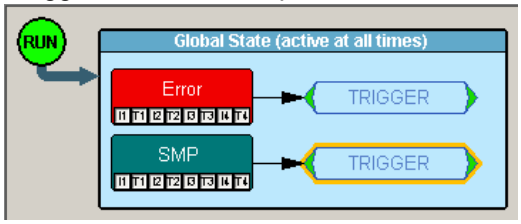
Step 5 Select **Trigger** from the menu. An arrow will project from the error button and point to a cell marked **Trigger**.



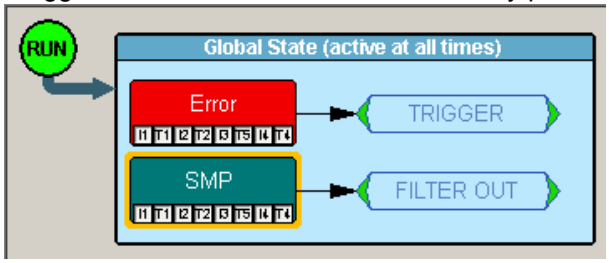
Creating Multiple Event Conditions in the Global State Cell

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".

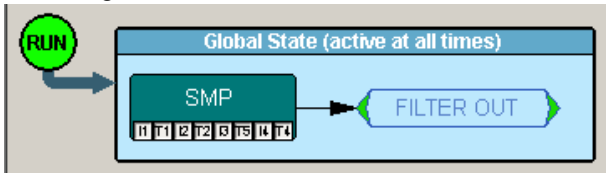


Creating an AND Condition - When multiple events are placed in the Global State cell and assigned *different* actions, an AND statement is created. The example below reads "Trigger if an error occurs AND filter out any primitives that occur."



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."

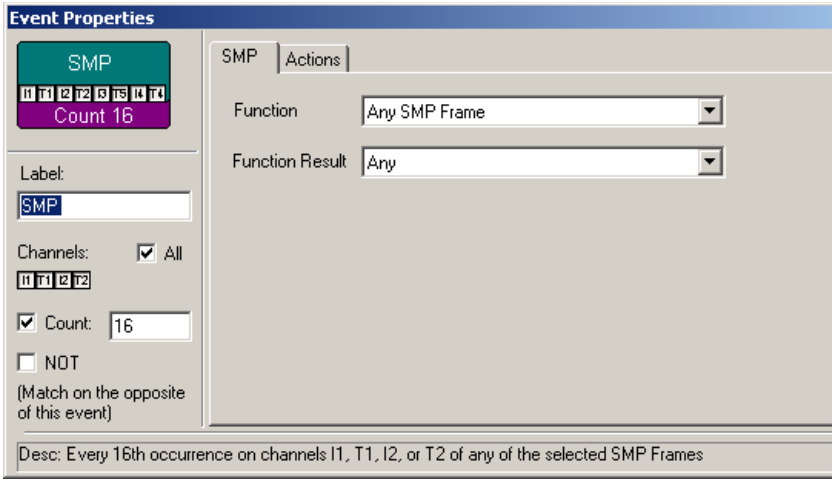
To use a counter, follow these steps:

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.

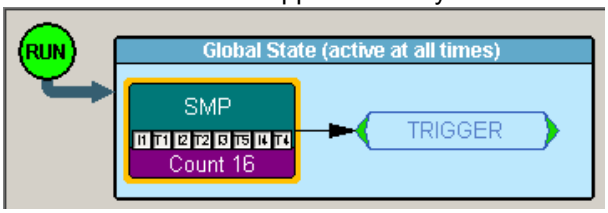
Step 3 Right-click the event and select **Add Counter**. A dialog box opens.



Step 4 In the text box to the right of the label Count enter a value.

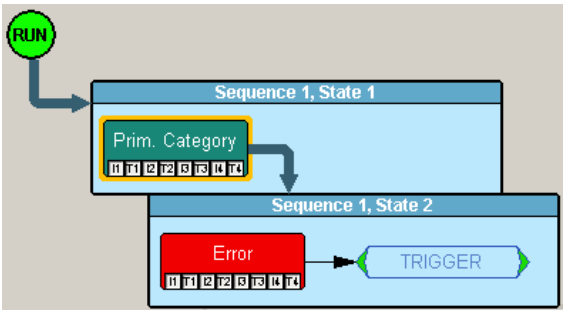
Step 5 Make sure the checkbox to the left of the label Count is checked.

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.



Creating Event Sequences

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



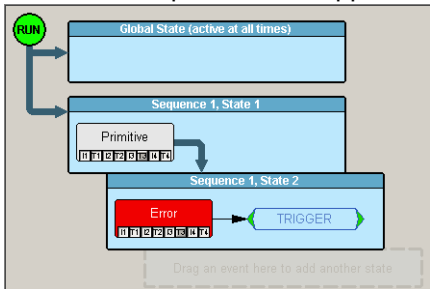
multi-event "if, then" condition: "If *x* followed by *y* followed by *z* occurs, trigger." Event sequences are created by dragging two or more buttons into the *Sequence cell.* The Sequence cell is a faintly marked cell just below the Global State cell. The Sequence cell contains the text *Drag an event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

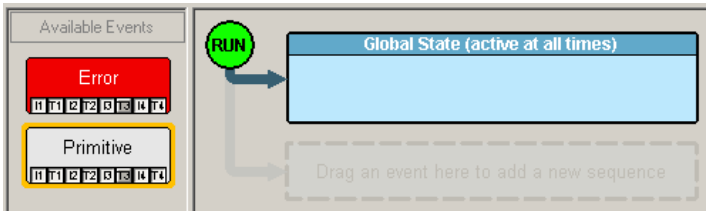
How to Create an Event Sequence

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.

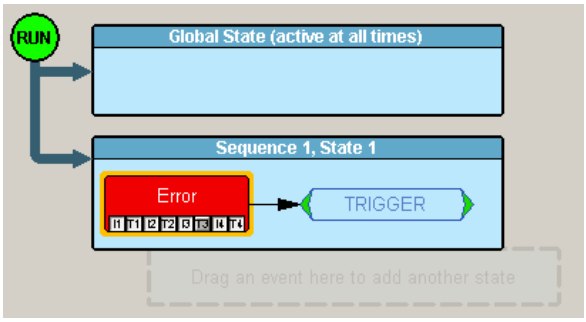
Step 1 Click the **New Event** button. The **New Event** menu opens.

Step 2 Select an event type from the menu, for example an error. A button appears in the **Available Events** area.

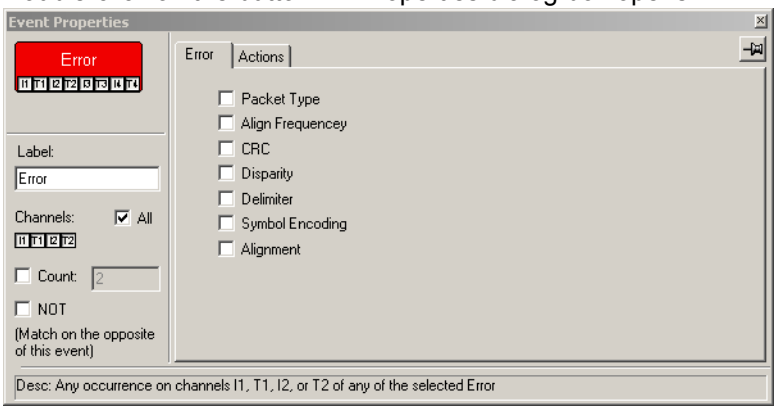
Step 3 Click the **New Event** button and select a second event type, for example a Primitive. At this point, you should see two buttons in the **Available Events** area.



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.

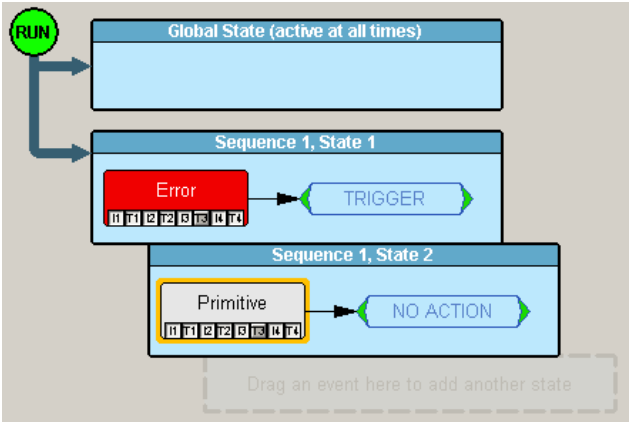


Step 6 Select desired options from the dialog box, for example an error sub-type. The options apply immediately.

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

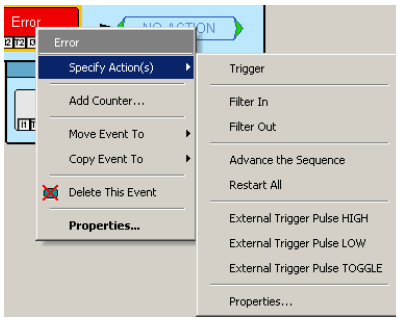


marked "Drag an event here to add a sequence."

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:



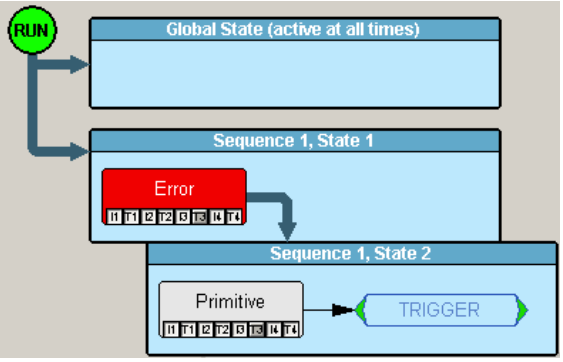
- **Advance the Sequence** - Draws an arrow that connects the selected event button to the event button below it. This option creates a sequence.
- **Restart the Sequence** - (Not visible in the menu above.) This option restarts the entire sequence. This option appears once you have linked two or more 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.

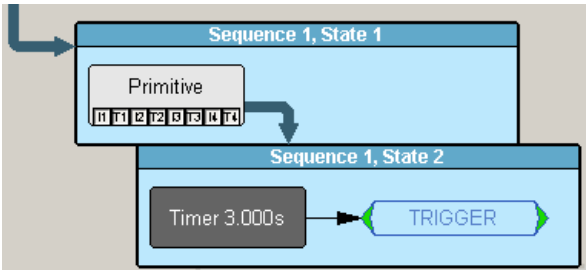
Step 13 Select **Trigger**. A cell will appear to the right of the second button saying "Trigger." Your sequence configuration is now complete and

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.

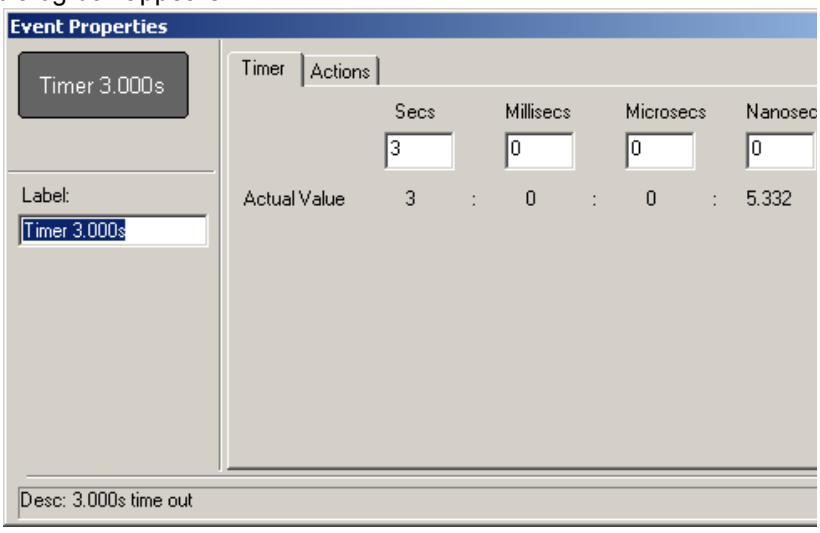
Step 9 Select **Advance the Sequence**. The menu closes and an arrow appears that connects this cell to the State cell below.

Step 10 Right-click on the Timer button. A pop-up menu appears.

Step 11 Select **Specify Action(s)**. A sub-menu opens.

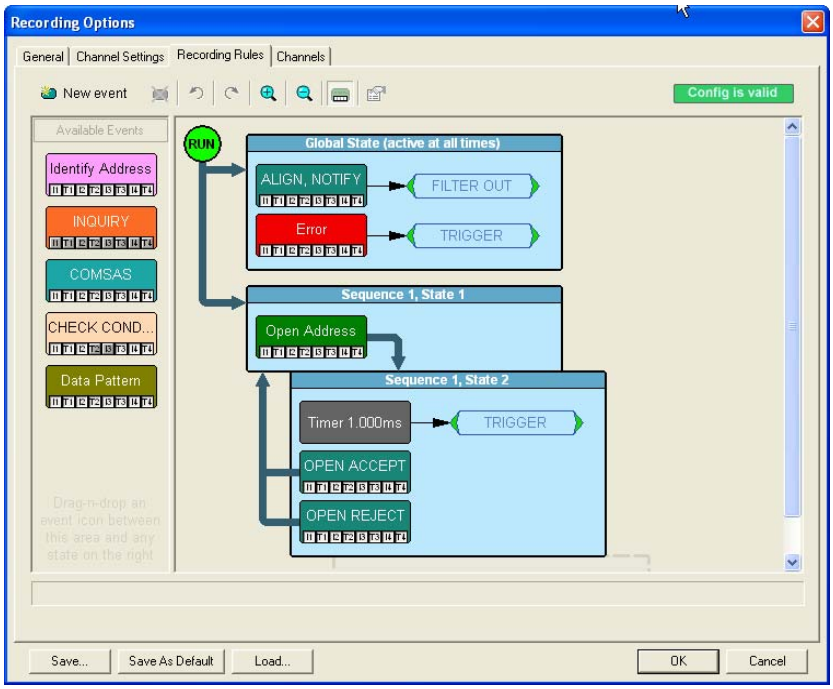
Step 12 Select **Trigger**. The menu closes and an arrow appears that connects the Timer button to a new cell to the right marked **Trigger**.

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.

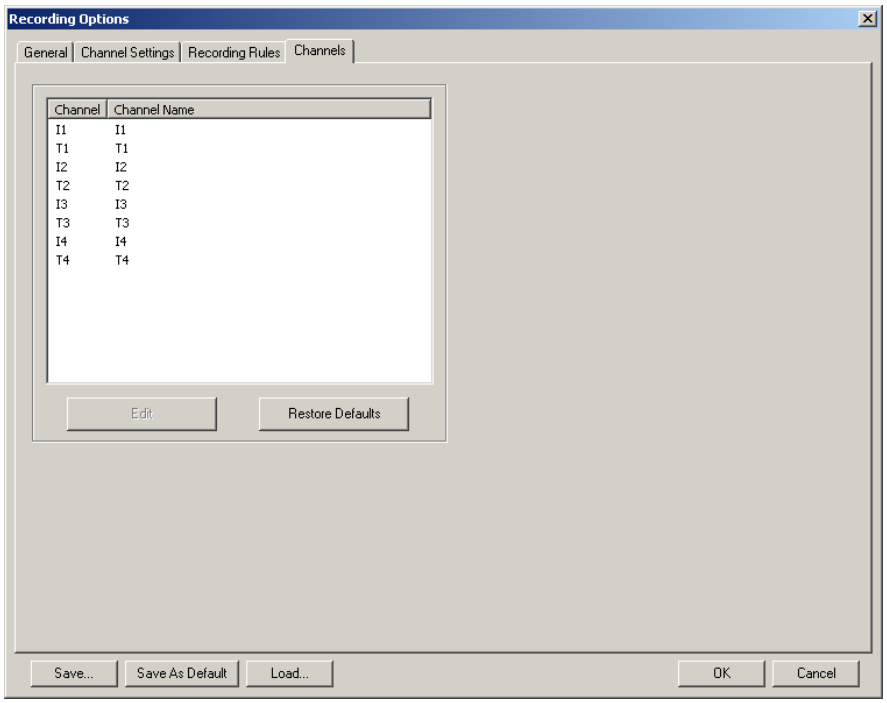


Sequential Events and Timers

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".

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.



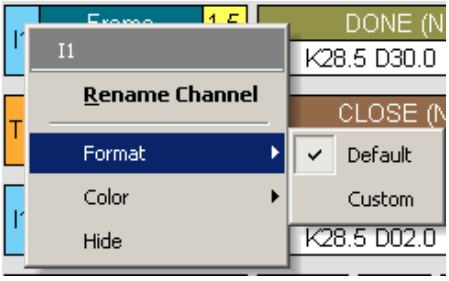
Note: You can also change channel names by clicking on the first cell of a trace (the channel cell) and selecting **Rename Channel** from the pop-up menu.

Where Custom Channel Names Appear

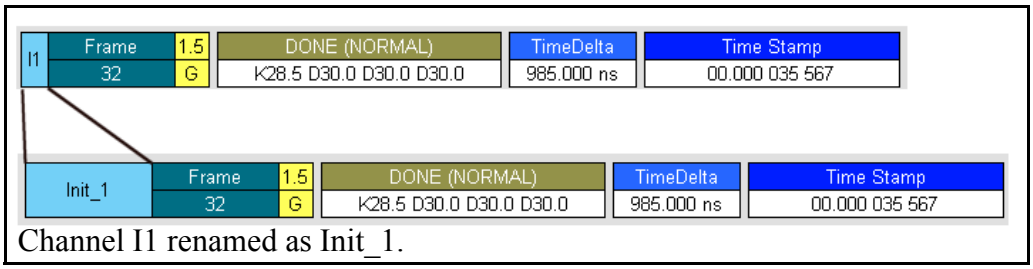
Custom channel names appear in three places:

- 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**.

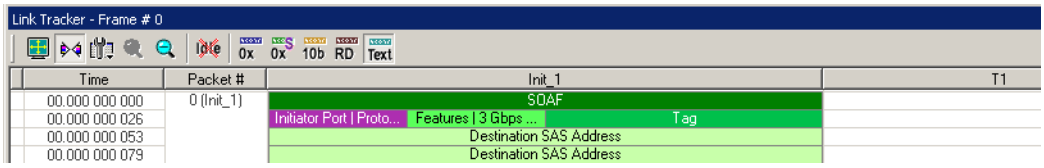


The custom names will then appear in the trace.



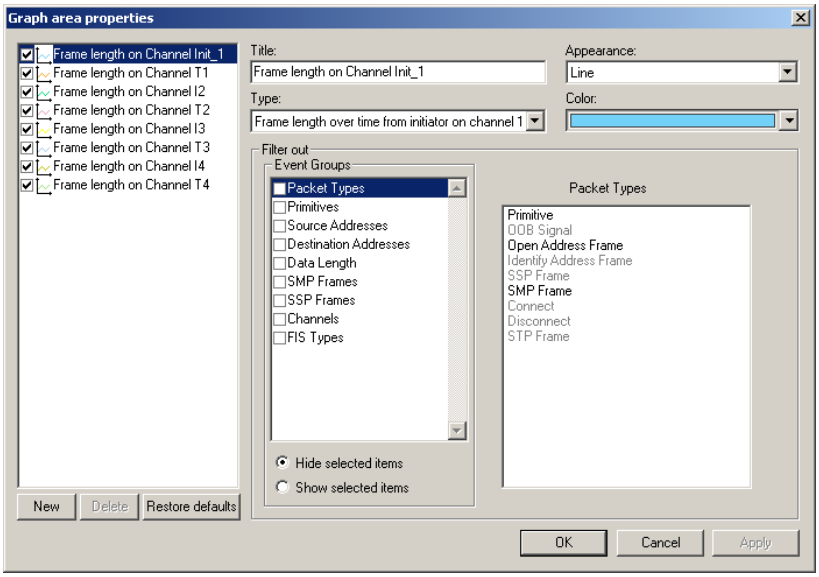
Channel I1 renamed as Init_1.

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.

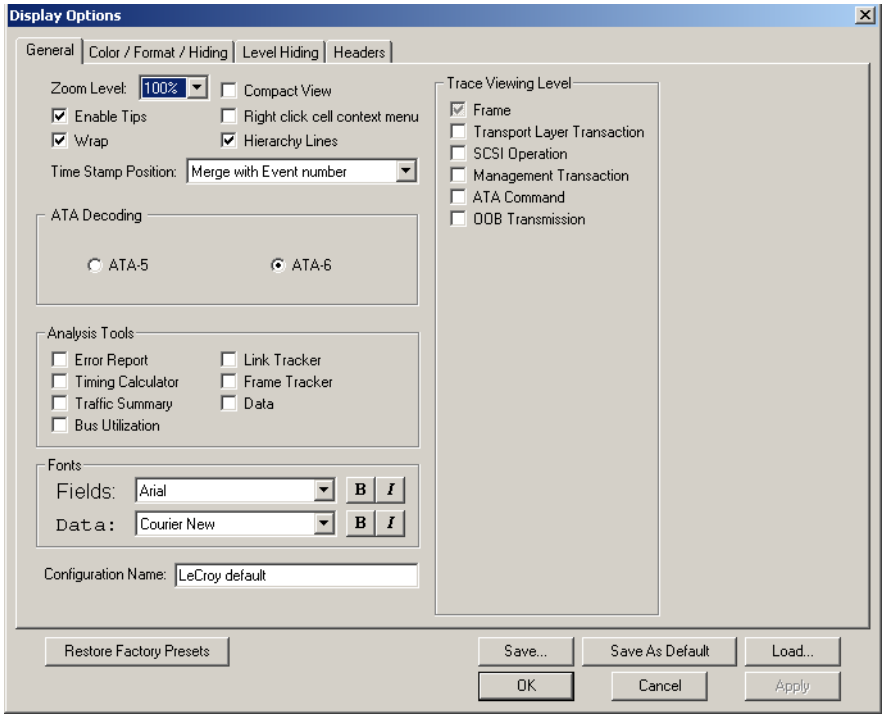
To open the properties dialog box for the Bus Usage window, right-click in the window, then choose **Properties** from the pop-up menu.



Chapter 6: Display Options

Use the **Display Options** menu to specify the way data file information is displayed.

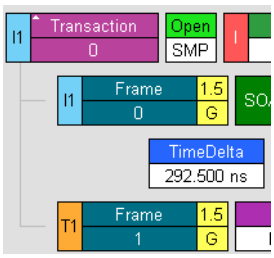
From the **Setup** menu, select **Display Options**.



General Display Options

Use the General Display Options to specify the basic appearance of a 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 at left) 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.

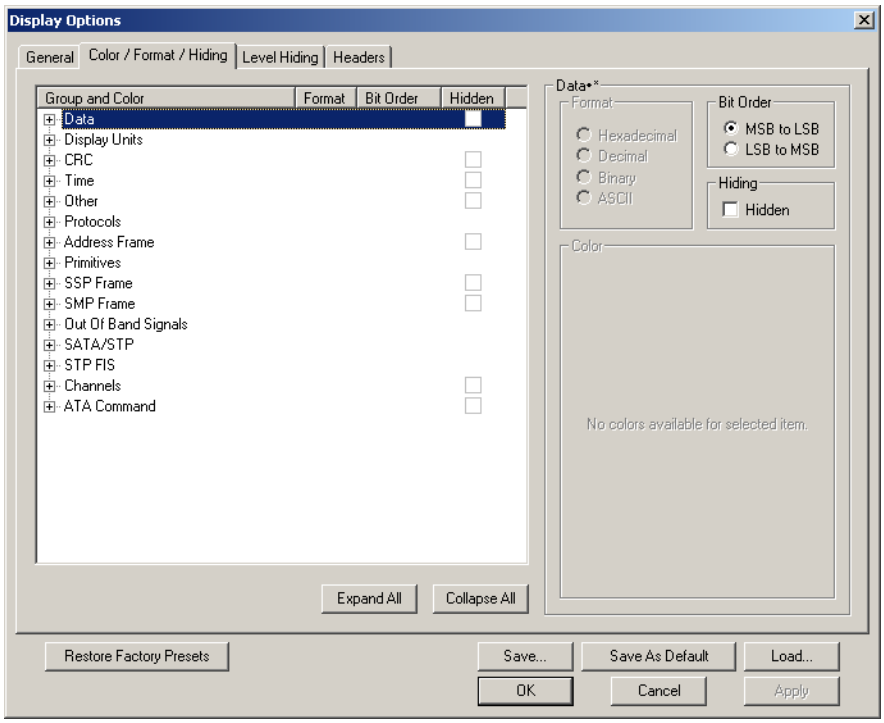
Step 2 Click **Save**...

Step 3 Specify a filename (***.opt**).

Step 4 Click **Save**.

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.

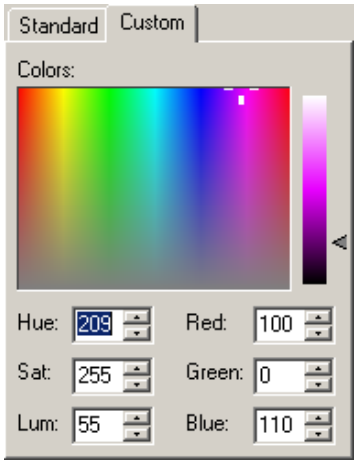
Setting Color Display Options

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.

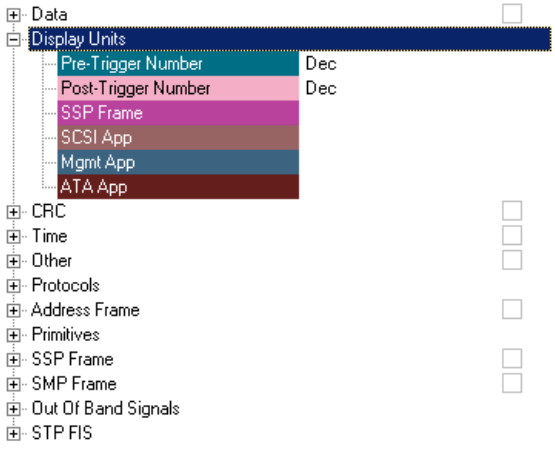
Use this window to customize the colors associated with each field in the trace. You can experiment with these options to achieve the color combination best suited to a particular graphic system.

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

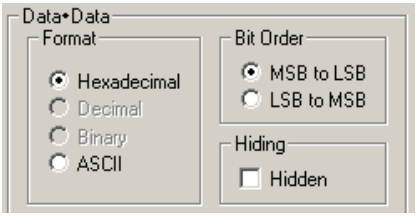


Changing Field Formats

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:



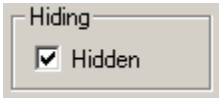
The following formats are available:



Note: Not every format is available for every item.

Hiding Display Options

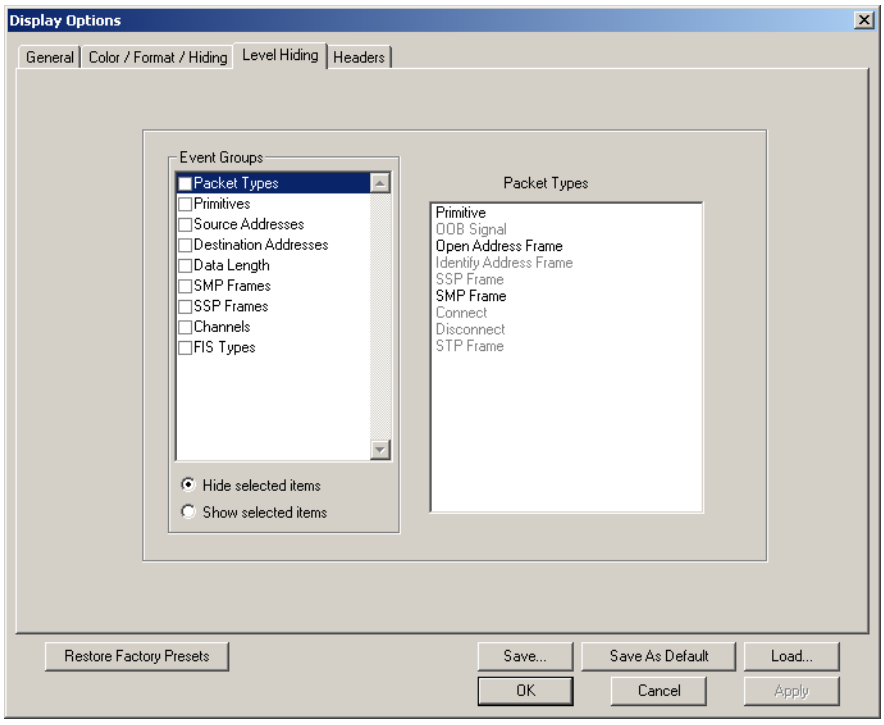
To hide one or more fields in the trace, select the appropriate item from the Group and color column, click the checkbox marked **Hidden**, and click the **Save** button.



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

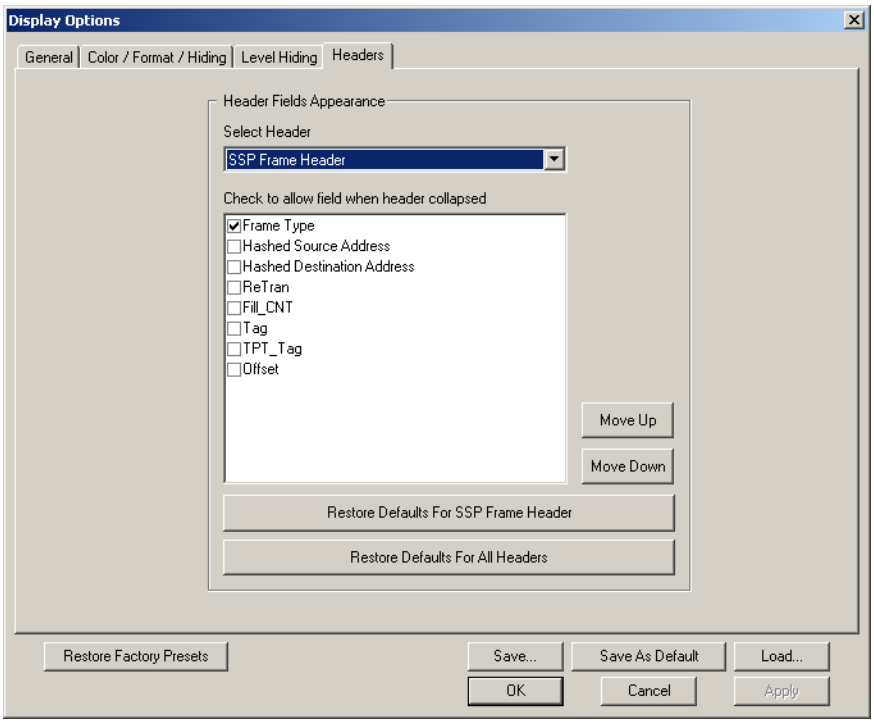
Level Hiding Options

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**.



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.

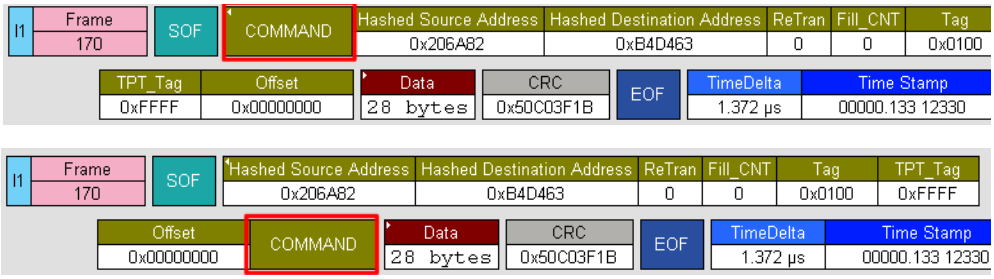
A list of header fields appears in the pane below marked **Check to allow field when header is collapsed**. Selecting fields in this pane causes the fields to appear in collapsed format within the trace.

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.



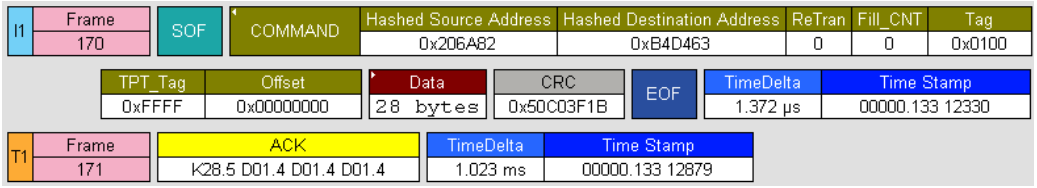
You can restore the default field order by clicking the **Restore Defaults** buttons.

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.

Chapter 7: Reading a Recording



Recording View Features

SAS*Suite* viewing software displays make extensive use of color and graphics to fully document the captured traffic. Frames (for Avalanche or SAS*Tracer* files) or commands (for SAS*Tracker* files) 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 Viewer that may be freely distributed.

Frame, Transport, SCSI, and Management Views

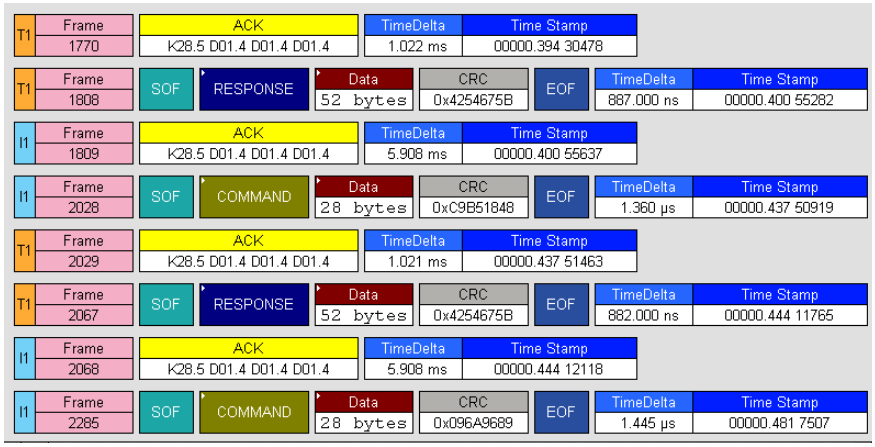
The default display mode for recorded traces is Frame view. The trace can also be viewed in Transport Layer (Tra), SCSI Application Layer, Management Application, ATA Application Layer and OOB (Out of Band) signaling views.

Changing Display Levels

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

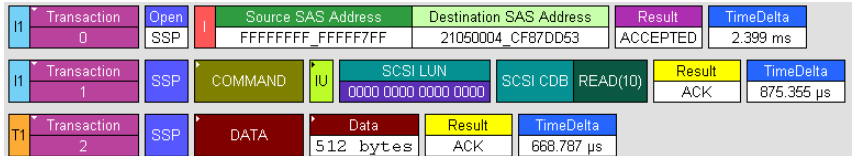
Frame Level

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



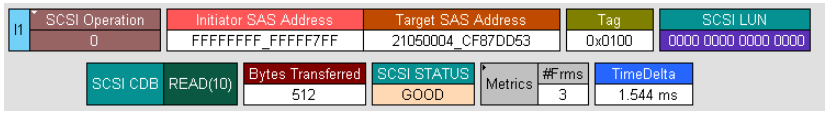
Transport Layer

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).



SCSI Application Layer

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



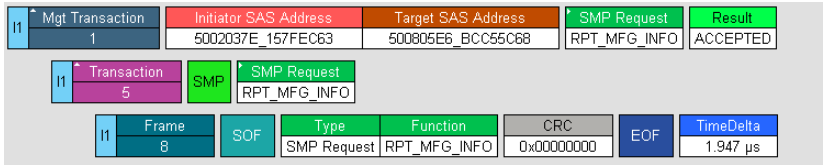
Management Application Layer

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

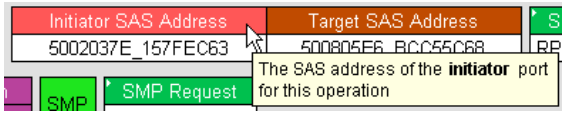
ATA Application Layer

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 triangle in the first cell. The following is an example of an expanded Management Level view showing its constituent Transport Layer Transactions and Frames:



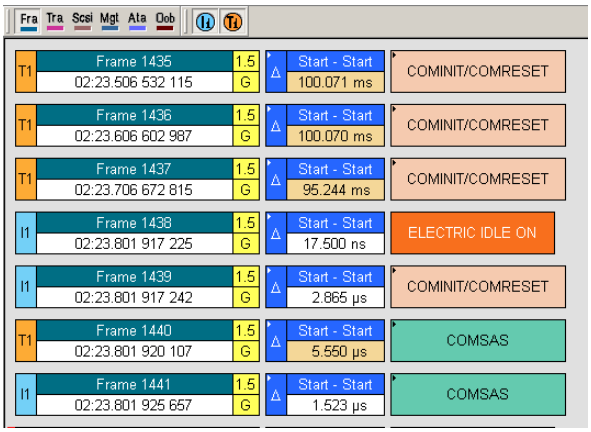
You can also get additional information on fields by holding your mouse over selected fields as shown in the following example:



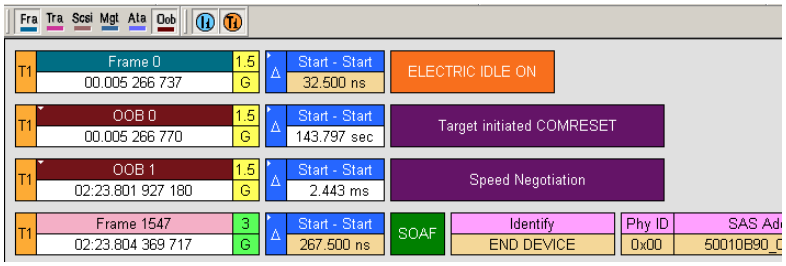
OOB (Out of Band) Signaling View

The OOB view combines OOB scenarios (establishing link, speed negotiation, etc.) into a simplified and integrated view. These scenarios typically occur at power on and after hardware resets as devices initialize and initiate communications.

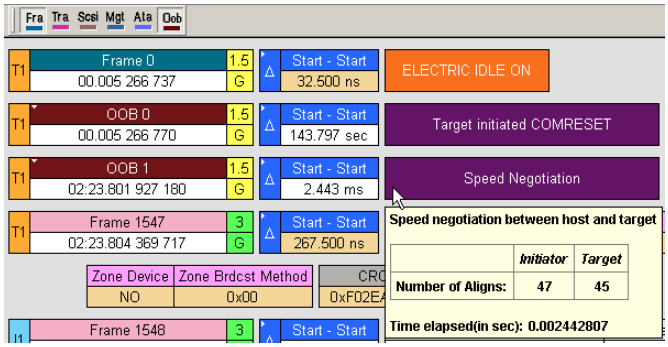
The trace view below shows the default trace display as a SAS target and SAS host attempt to initiate communication. The SAS target powers on first, and starts sending COMINIT repeatedly (in fact, in this example, over 1400 times). When the initiator powers on it also sends COMINIT and then both devices immediately respond with COMSAS to identify themselves as SAS devices. and then proceed to speed negotiation.



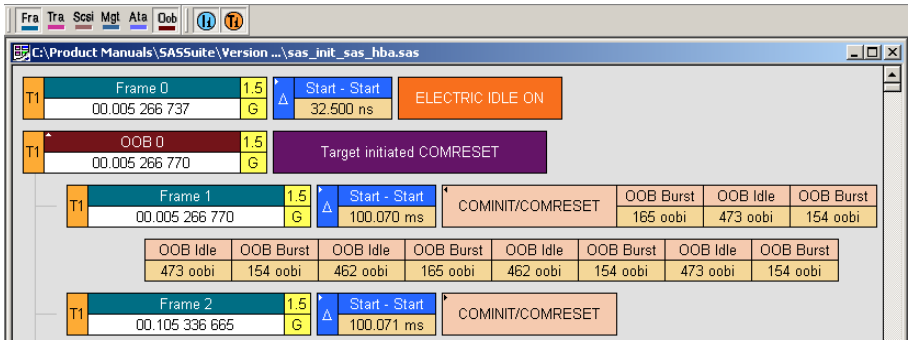
Clicking on the "OOB" button simplifies this long stream of OOB signals into a higher level summary, as follows:



As with other views, you can get additional information on the event by holding your mouse over selected fields or you can "open" any decode level to reveal the components by clicking the small triangle in the upper left corner of the cell.



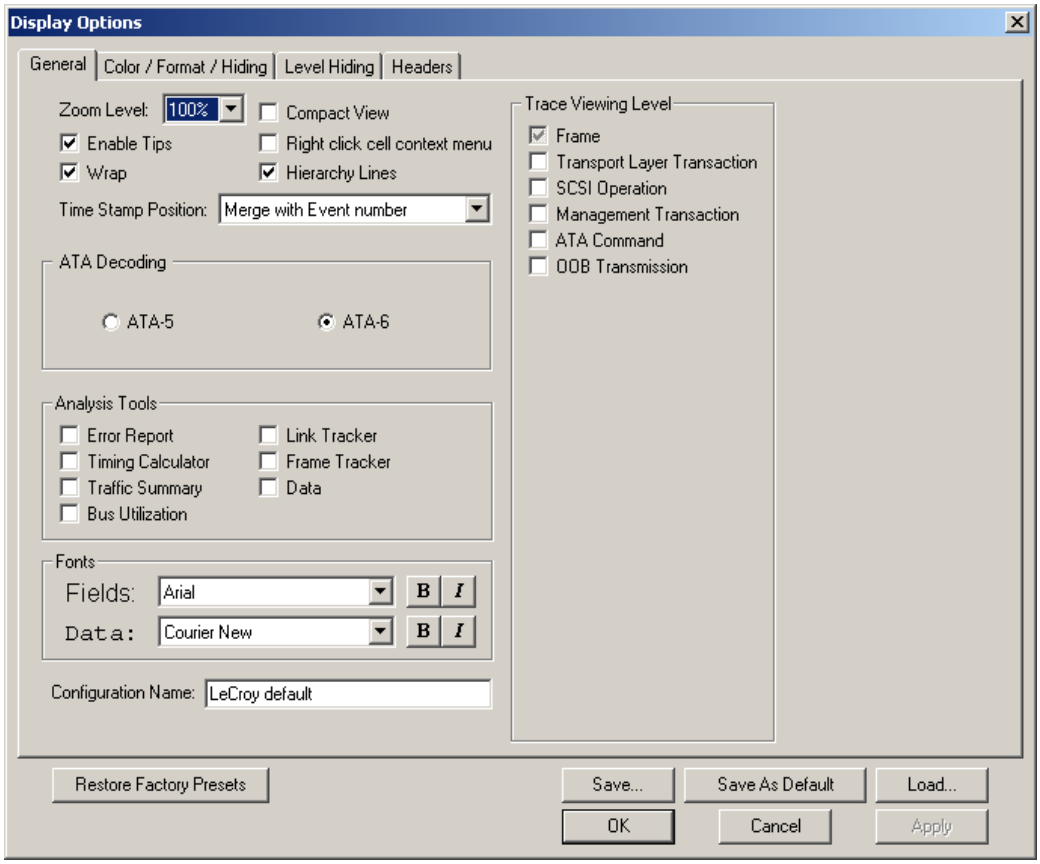
Opening the decode levels will first bring you to a list of all OOB signals, and further opening the COMINIT events will show the actual times of the traffic bursts that comprise the COMINIT, as shown below.



This example shows the power of the SAS*Suite* software in being able to summarize details at a very high level, while allowing the user to easily "drill down" into the details that comprise each displayed event to find more and more detail on events of interest.

Setting Heirarchical View Level Using the Display Options Window

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



STP Decoding

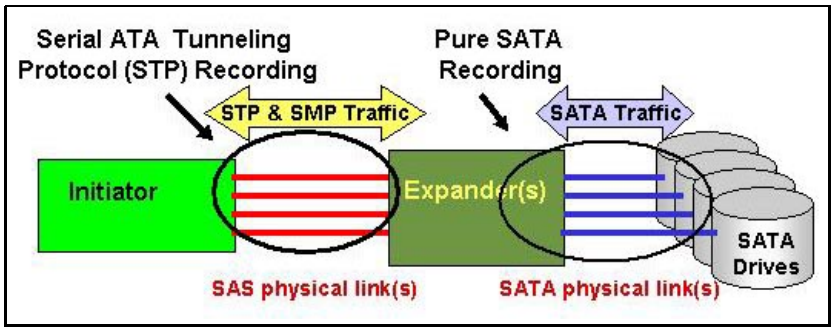
If STP traffic is present in a trace, you can see it by doing the following:

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. Also, note that some Expanders support SAS Zoning, if so this information will be available to view in the trace (see “SAS Zoning” on page 132).



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.

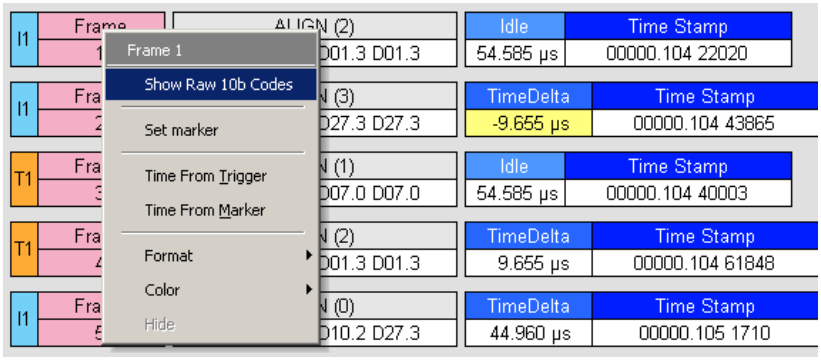
View Raw Bits

SAS*Suite* 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:

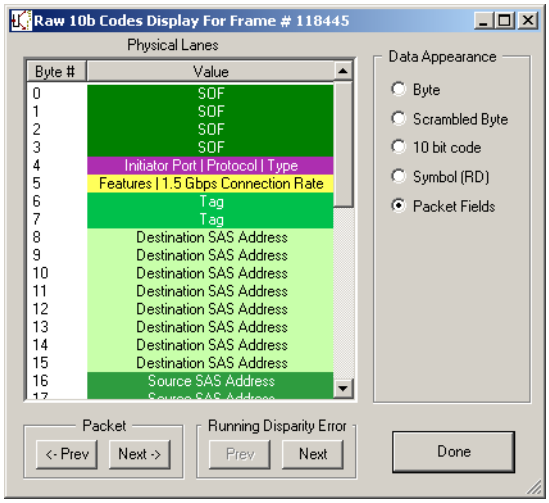
Step 1 Click on the first cell of a **Frame**.

Note: Raw Bits can be viewed only in Frames.



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 SAS*Suite* 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.

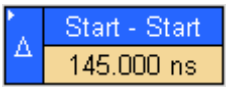
Running Disparity

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 raw bits view displays the running disparity of the 10bit code in the column following the raw bits.

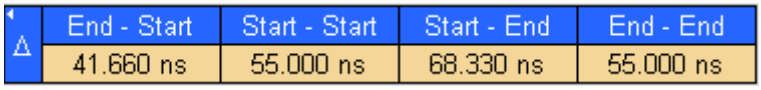
Note: For a more complete definition of Running Disparity, please refer to the Serial Attached SCSI Specification (available at www.t10.org)

Expanding and Collapsing Fields

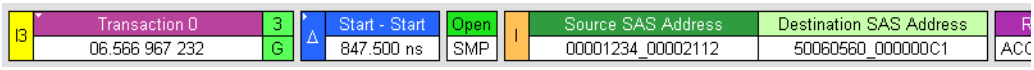
Many of the fields shown in each display may be expanded (to display additional detail) or collapsed (to reduce extraneous information) with a single click. Fields which allow expansion or collapse are indicated by a small solid white triangle located in the upper left corner of the field, as shown below:



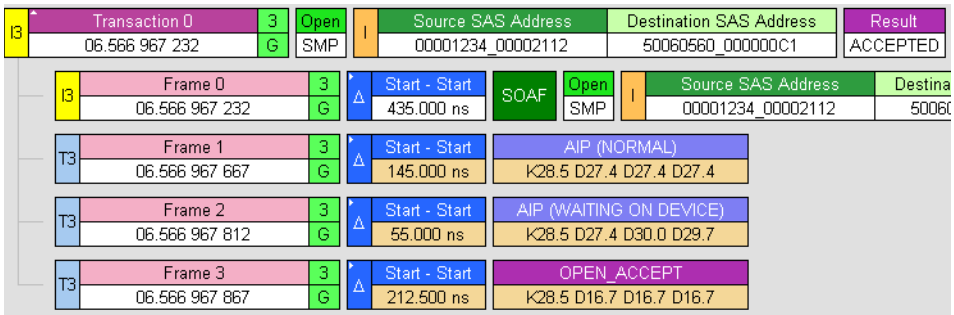
>>expands to>>



As an example, if the Transport Layer is selected, typically individual frames are collapsed into Transactions, as shown in the example below. If you wish to see further detail about any specific transaction, simply click the white triangle next to any Transaction number, and the Frames which compose that Transaction are displayed.



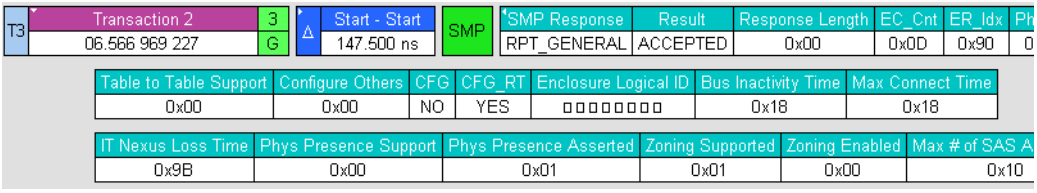
>>expands to>>



SAS Zoning

For Expanders that support zoning, the zoning information can be displayed by displaying the trace in the Transport mode, then expanding the SMP Response Field to provide details on the response. The fields ""Zoning Supported" and "Zoning Enabled" are among the detailed fields that are displayed. [Note: Currently SAS Zoning is decoded using SAS 2r05a.]

>>expands to>>



Expanding a Data Payload

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

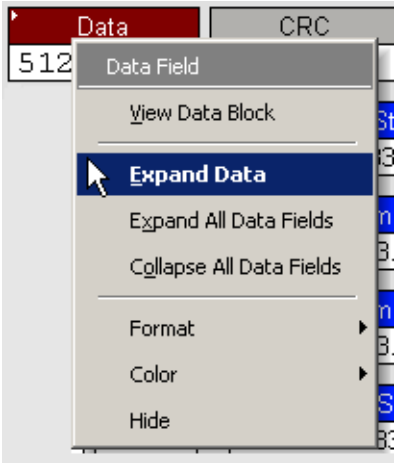
- Clicking the small triangular arrows on the left side of the data payload field
- Clicking and holding down the mouse button on the triangular button on the left side of a data payload field. This action will expand or collapse data fields for all Frames throughout the trace
- Double-clicking anywhere 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."

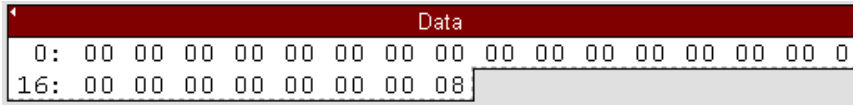
This section describes expanding or collapsing data payload by using the menu:

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.

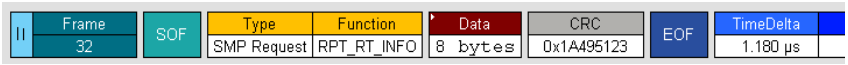
View Data Block Window

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, ASCI, 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,

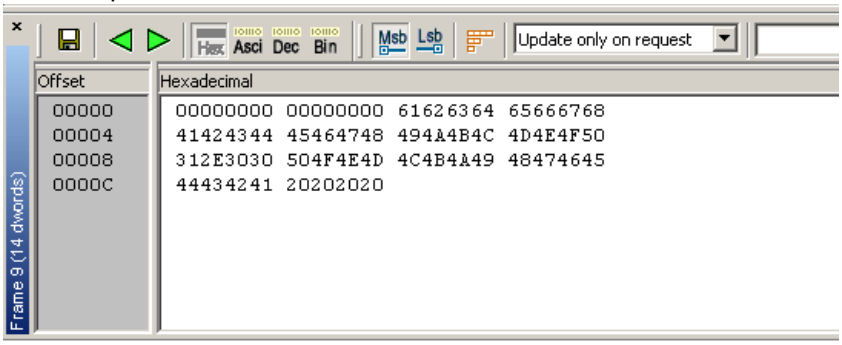
Step 1 Decode to the level of interest by pressing Fra or Tra .

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



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.



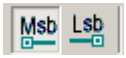
Description of View Data Block Window

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:

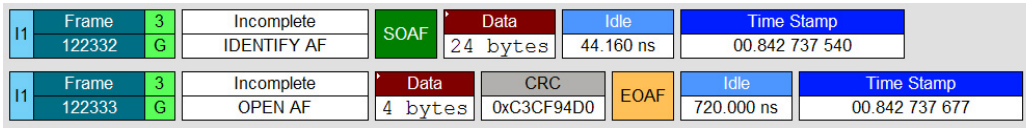
- **Update only on request** - Locks whatever data block currently is on display in the Data window unless overridden by a direct request. There are two ways to make a request -- by clicking on the buttons or by right-clicking in the trace on a data block and selecting View Data Block from the pop-up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

Incomplete Frames Handling and Display

If the analyzer 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:

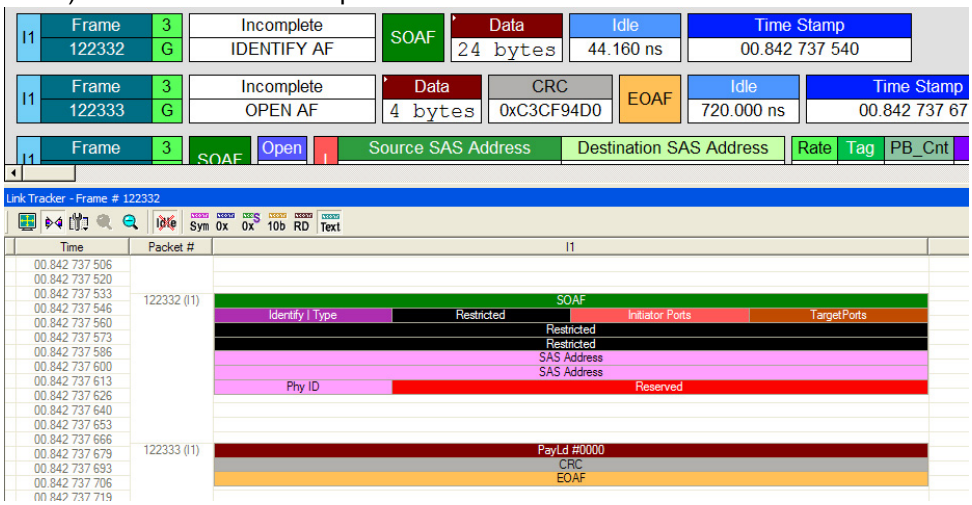


Incomplete Address frames

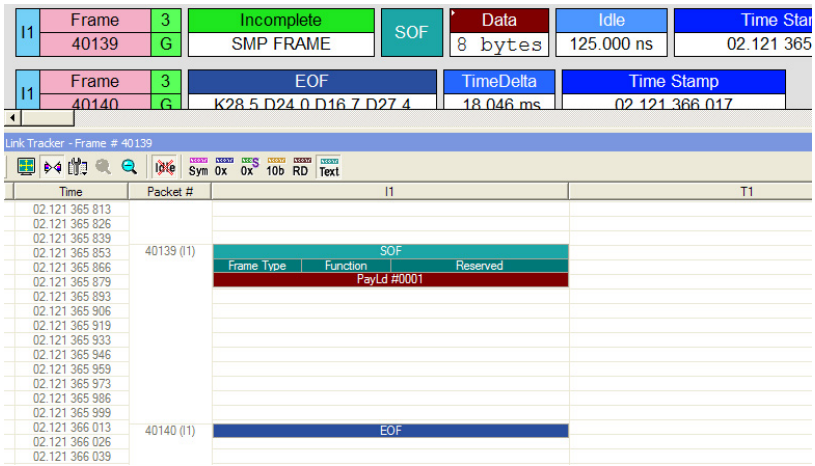
Incomplete SSP frame

Incomplete SATA frame

When incomplete frames are displayed, no field decoding takes place, 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:



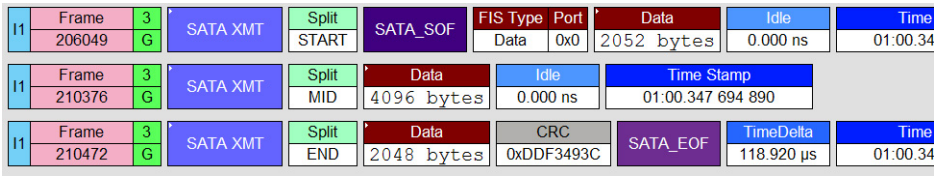
Link Tracker shows some decoded fields for incomplete Identify Address frame



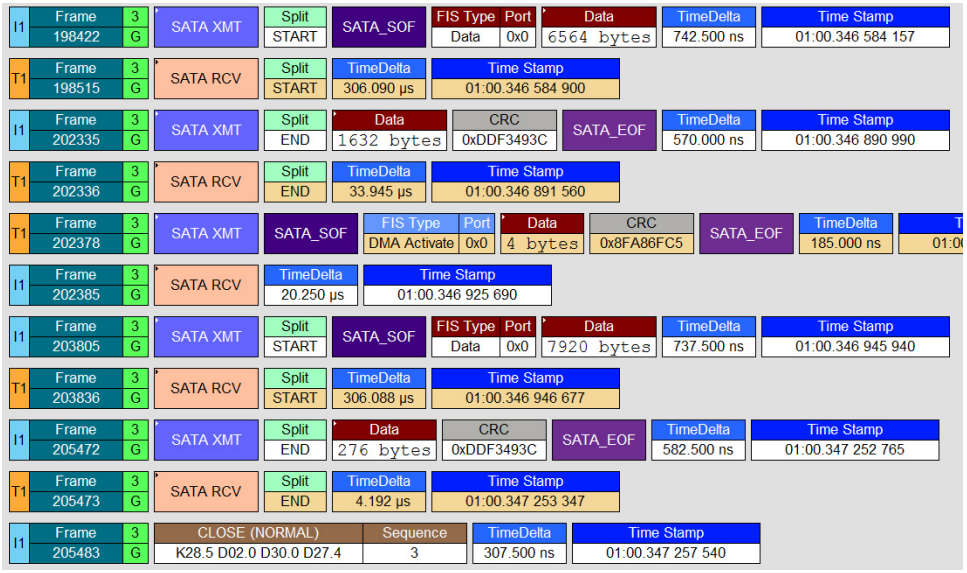
Link Tracker shows some decoded fields for incomplete SMP frame

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 the analyzer 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:

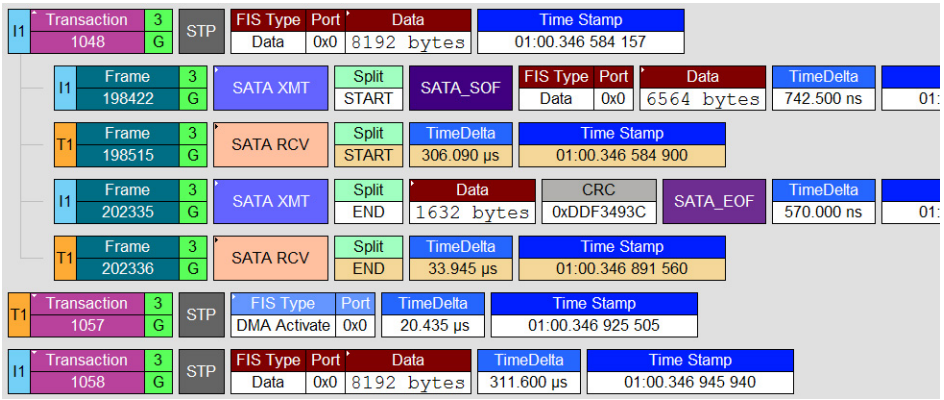


A frame transmitted by SATA initiator is split into three frames.



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:



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.

Compact View

Some traces contain field headers which repeat from line-to-line (frame-to-frame) even if the content of the fields are changing. The repeated display of the same header information can occupy space on the screen that would be more useful if presented in a tabular form.

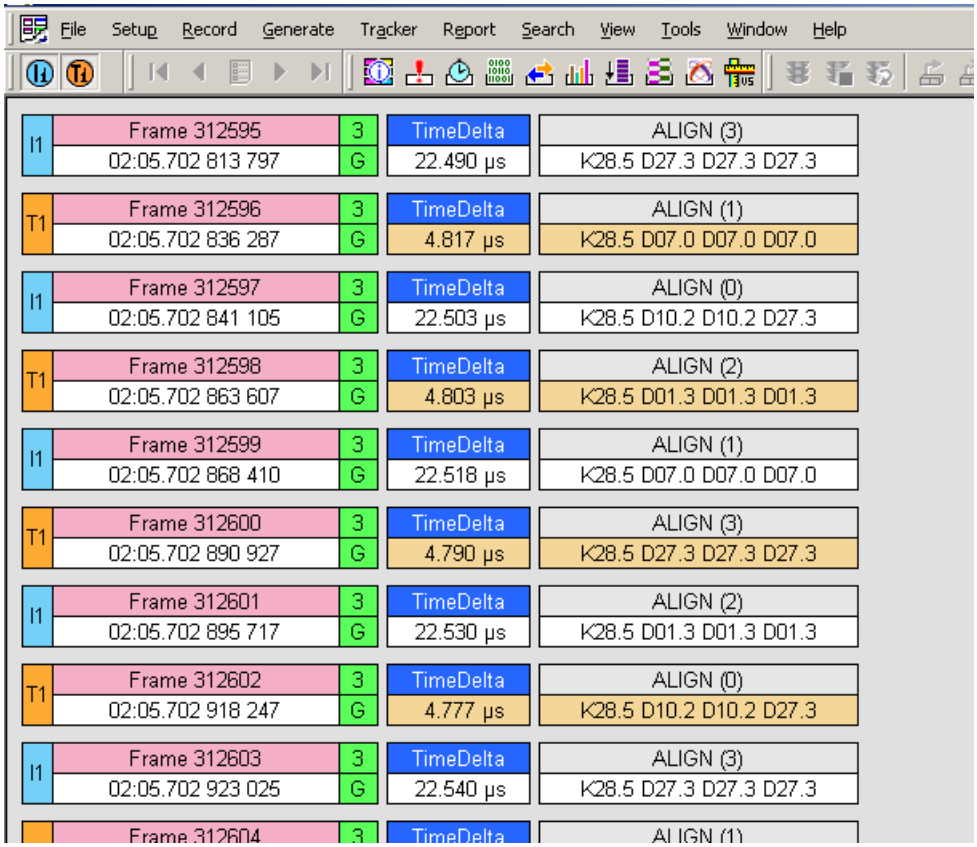
The compact view provides a means of condensing repeating header information into one line of headers, with the data arranged below in "spreadsheet" fashion. Compact view automatically condenses repeating headers, but when the next header that is different appears it will be shown as a new header.

Compact view can be selected in any of the following ways:

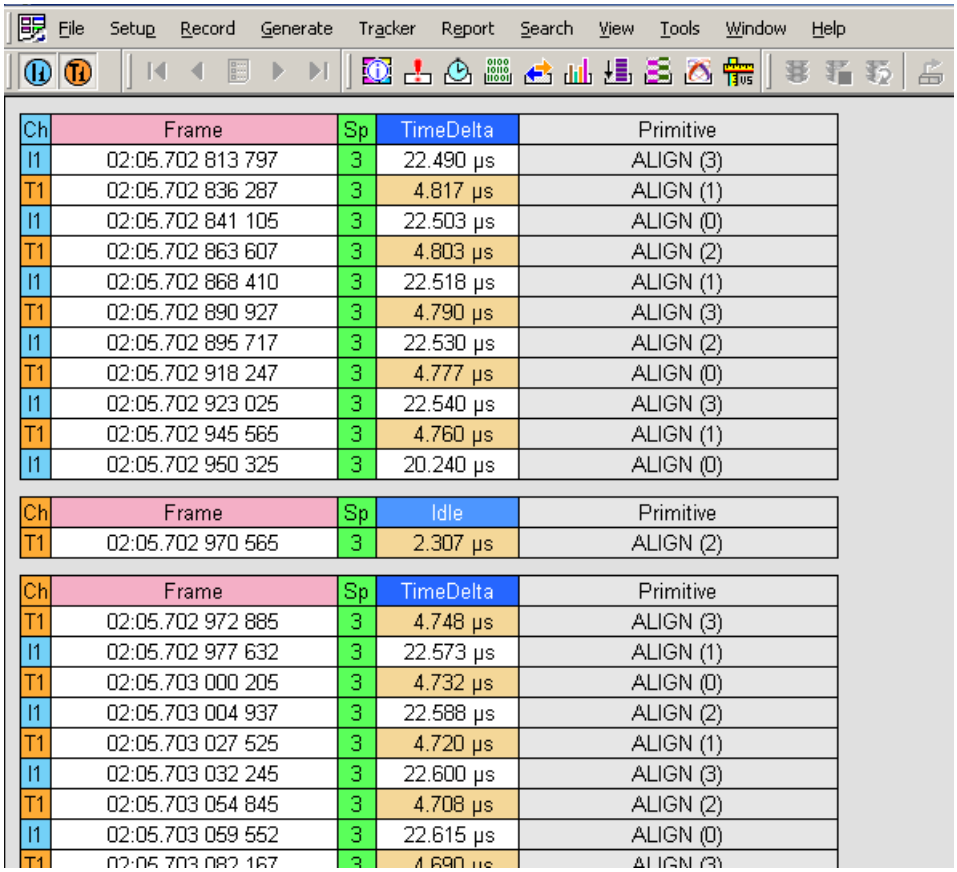
- From the **View** Menu, select **Compact**.
- Use the Ctrl-Q keyboard shortcut.
- With the mouse pointer positoned over the display area, right-click the mouse and select "Compact" for the menu that displays.

To change back, repeat either the menu selection or the keyboard shortcut.

The following screens illustrate the use of compact view mode. In the screen below (shown in normal view), the same header information repeats for each frame:



When View>Compact (or Ctrl-Q) is selected, the trace file is now shown as follows, which allow far more data to be displayed in the same screen:



Ch	Frame	Sp	TimeDelta	Primitive
I1	02:05.702 813 797	3	22.490 µs	ALIGN (3)
T1	02:05.702 836 287	3	4.817 µs	ALIGN (1)
I1	02:05.702 841 105	3	22.503 µs	ALIGN (0)
T1	02:05.702 863 607	3	4.803 µs	ALIGN (2)
I1	02:05.702 868 410	3	22.518 µs	ALIGN (1)
T1	02:05.702 890 927	3	4.790 µs	ALIGN (3)
I1	02:05.702 895 717	3	22.530 µs	ALIGN (2)
T1	02:05.702 918 247	3	4.777 µs	ALIGN (0)
I1	02:05.702 923 025	3	22.540 µs	ALIGN (3)
T1	02:05.702 945 565	3	4.760 µs	ALIGN (1)
I1	02:05.702 950 325	3	20.240 µs	ALIGN (0)

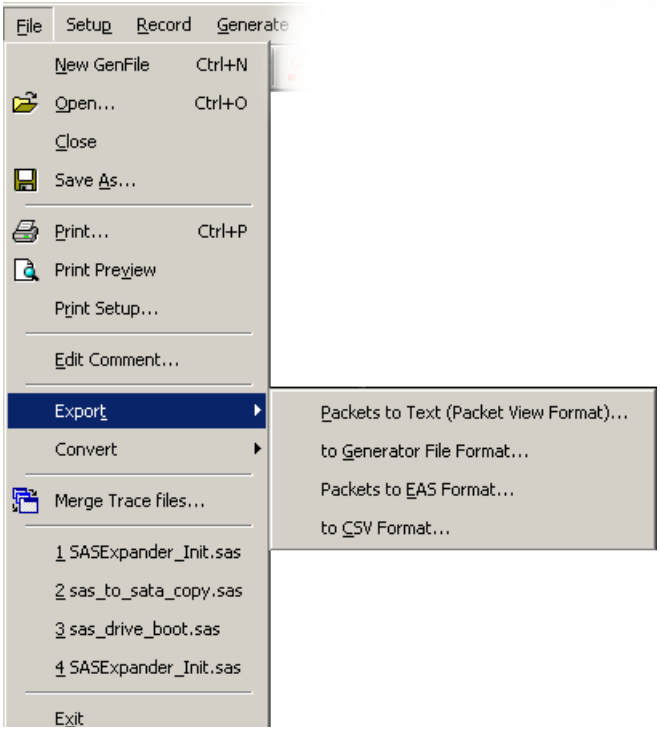
Ch	Frame	Sp	Idle	Primitive
T1	02:05.702 970 565	3	2.307 µs	ALIGN (2)

Ch	Frame	Sp	TimeDelta	Primitive
T1	02:05.702 972 885	3	4.748 µs	ALIGN (3)
I1	02:05.702 977 632	3	22.573 µs	ALIGN (1)
T1	02:05.703 000 205	3	4.732 µs	ALIGN (0)
I1	02:05.703 004 937	3	22.588 µs	ALIGN (2)
T1	02:05.703 027 525	3	4.720 µs	ALIGN (1)
I1	02:05.703 032 245	3	22.600 µs	ALIGN (3)
T1	02:05.703 054 845	3	4.708 µs	ALIGN (2)
I1	02:05.703 059 552	3	22.615 µs	ALIGN (0)
T1	02:05.703 082 167	3	4.690 µs	ALIGN (3)

Note that the occurance of just one frame in the display with a different header ("Idle" instead of "Time Delta") results in the header row being redisplayed.

Export Options

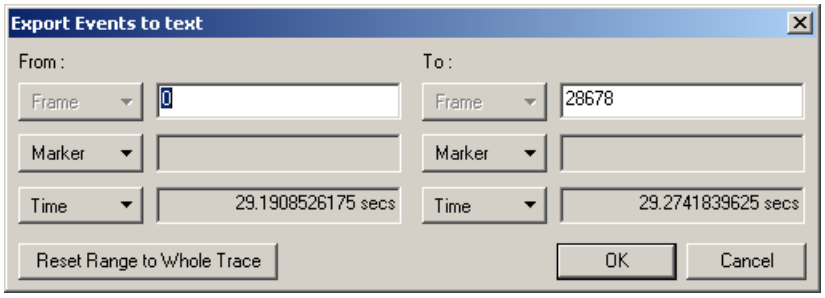
Trace data captured by Avalanche or SAS*Tracer* can be exported for other uses, including uses outside the system. These options are accessed through the **File** menu by selecting **Export**, as shown below.



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 SAS*Trainer* is the ability to use a trace captured by the SAS*Tracer* as the basis for traffic to be generated by the SAS*Trainer*. 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 186 for a discussion on how to use this feature with the SAS*Trainer*.

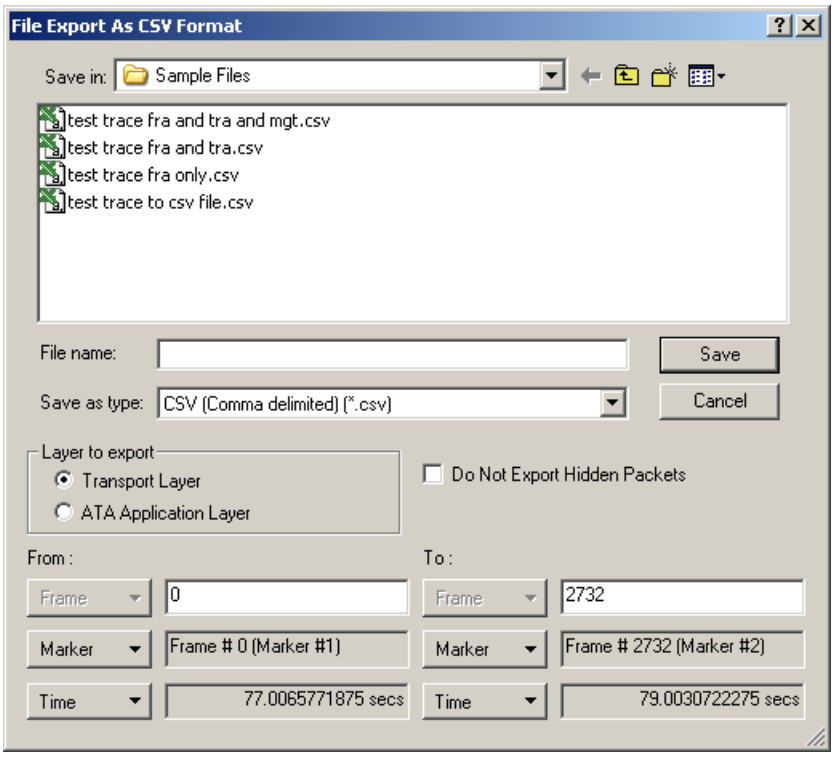
Packets to EAS Format

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" extention. 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 "Transport to CSV Format" option provides a means of generating a structured file from trace data captured by Avalanche or by SAS*Tracer*.

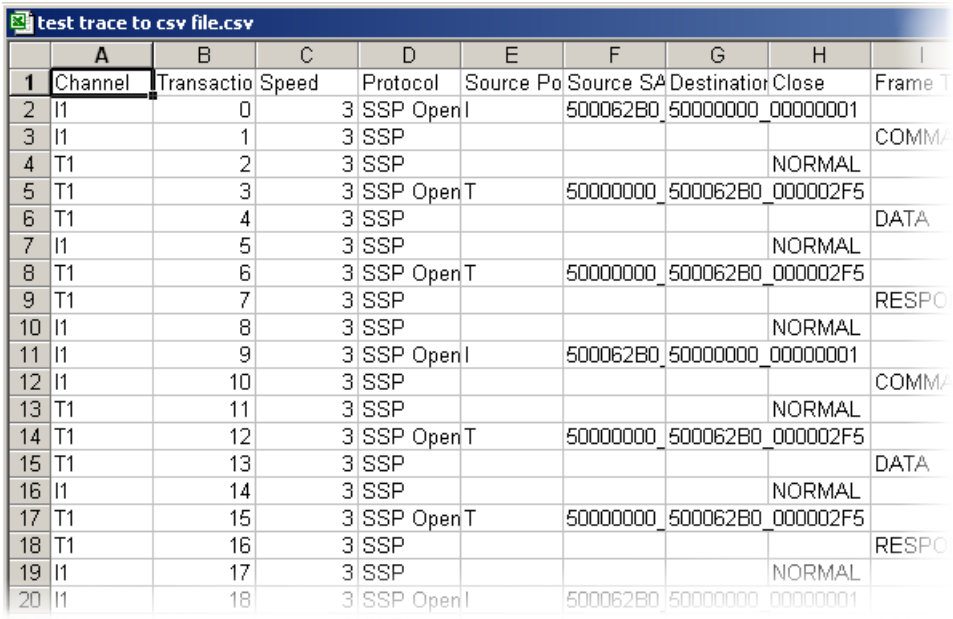
Selecting this option will bring up a screen allowing the user to specify the information from the current file to be exported and the destination file for the exported data.



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 below. Once opened, the file can be later saved as any supported Excel file type.



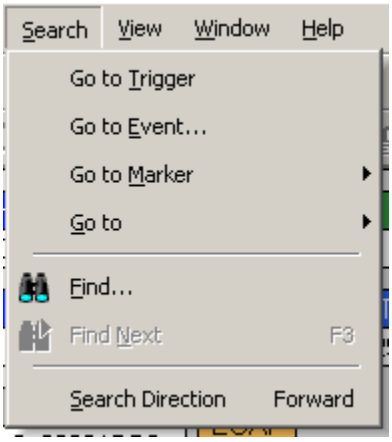
test trace to csv file.csv

	A	B	C	D	E	F	G	H	I
1	Channel	Transactio	Speed	Protocol	Source Po	Source SA	Destinatior	Close	Frame T
2	I1	0	3	SSP Open	I	500062B0	50000000	00000001	
3	I1	1	3	SSP					COMM
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					COMM
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	

Chapter 8: Searching Recordings

SAS*Suite* has several search commands that enable you to navigate a recording 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.



Go to Trigger

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

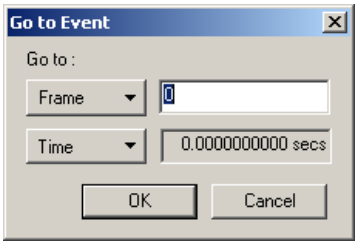
The Trace View is repositioned with the first Frame following the Trigger event (or the Frame that caused the Trigger) at the top of your screen.

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.

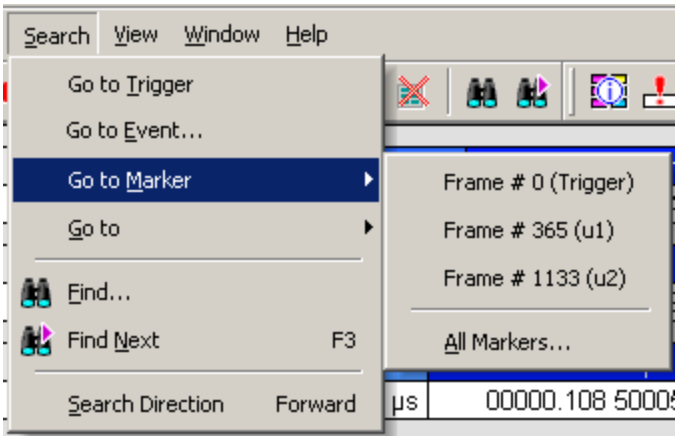
Step 3 Click **OK.**

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

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.

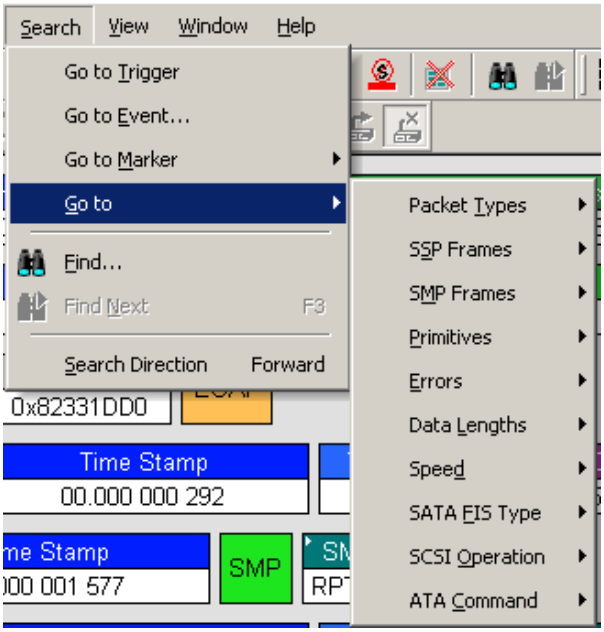
The Trace View is repositioned with the selected item at the top of your screen.

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 Recording**.

Go To

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



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

Find

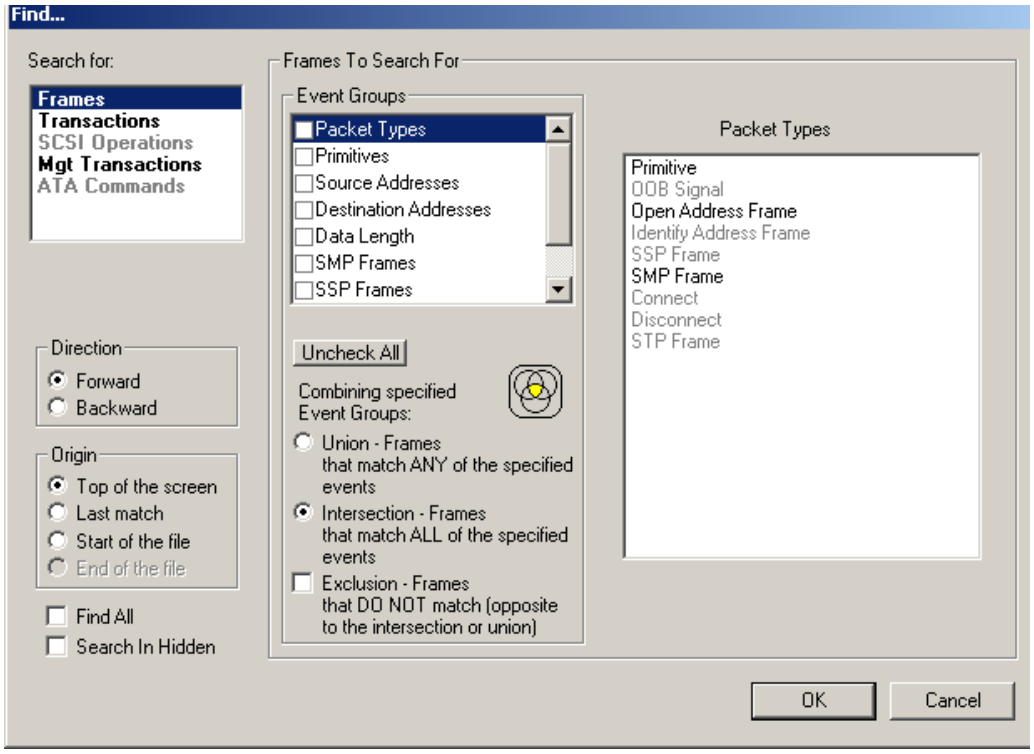
Find is a utility for conducting searches of one or more events within a recording. In SAS*Tracer* trace files, Find allows you to search different hierarchical levels within the trace - Frames, Transactions, SCSI Operations, and Mgt Transactions. To start find,

- 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.

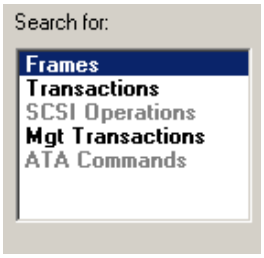
Right area -- Controls the specific events to be searched within the trace. The box in this right section displays events from the selected Event Group.

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.

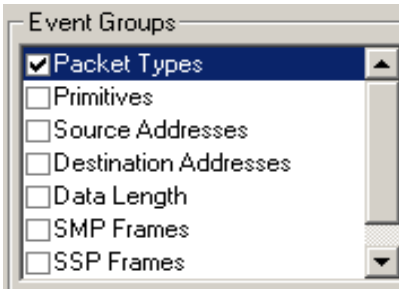
Complex Searches

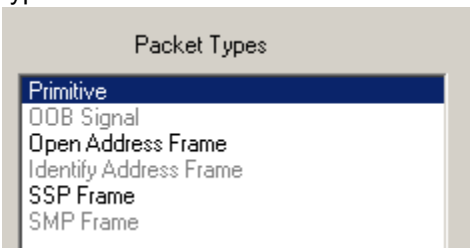
When conducting complex searches in the Find dialog box, you first push a decode button in the toolbar to enable *Frames, Transactions, SCSI Operations, or Management Transactions* in the **Search for**... box.



In this example, three of the five "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 frame 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*, *Intersection* or *Exclusion* 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 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,

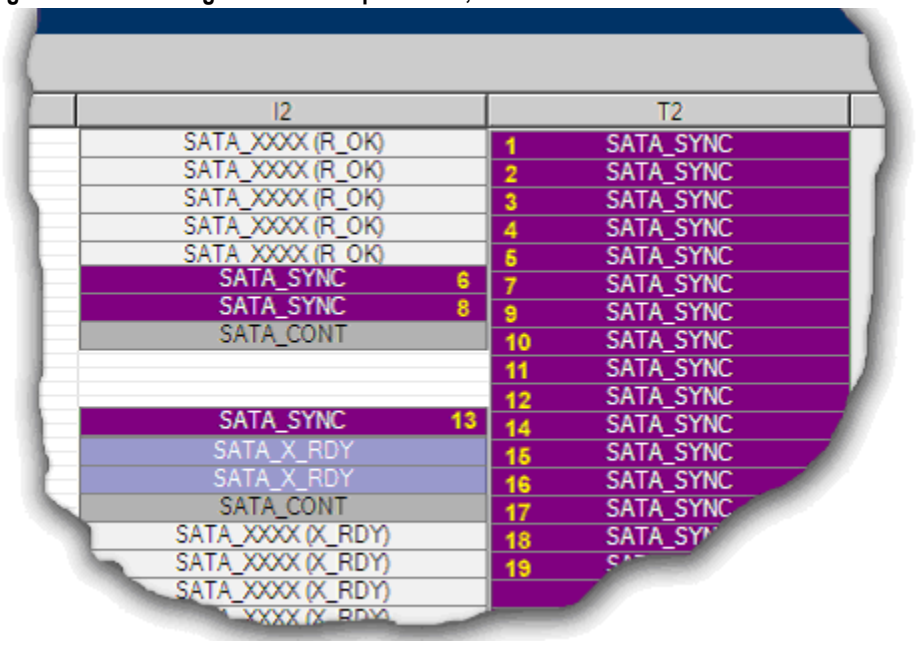
Select **Find Next (or F3)** under **Search** on the Menu Bar

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 occureds.

Figure 1: When using Find Next for primitives, the search order will be as shown



Chapter 9: External Interface for Trigger In /Out

With each Avalanche or SAS*Tracer* analyzer, LeCroy includes two mechanisms for low latency communications with general purpose test and measurement equipment:

- BNC (or SMA) External 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 for SAS*Tracer* in Chapter 11). The BNC/SMA 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.
- Breakout board - The breakout 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.

BNC/SMA External In / Out

The BNC/SMA External 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/SMA External In provides a similar mechanism allowing physical layer instruments to signal the analyzer to trigger at a specific moment.

Using the SMA Trigger Out on an Avalanche

Step 1 Attach the SMA EXT OUT connector to an appropriate Trigger In connector on a general purpose test instrument using the provided SMA cable or an SMA-to-BNC cable, as appropriate

Step 2 In the SAS*Suite* software, under **Recording Options (Avalanche)...**, select the **Triggering/Filtering** tab

Step 3 In either the Global Rules or Sequence section, click on the **<Click here to add an event>** link and select the event desired to initiate the external Trigger Out signal, then click OK

Step 4 Click on the **<Click here to add an action>** link and select the **SMA Output** action, then modify the parameters under **Output Action** and **Pulse Length** to be appropriate to the external instrument, then click OK

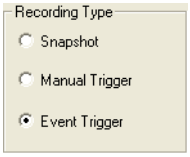
Step 5 If you wish the event to also be used to trigger the Avalanche analyzer, select the **<Click here to add another action>** link and select **Trigger**, then click OK

Step 6 Start the recording on the Avalanche analyzer.

Using the SMA Trigger In on an Avalanche

Step 1 Attach an appropriate Trigger Out connector on a general purpose test instrument to the SMA EXT IN connector using the provided SMA cable or an SMA-to-BNC cable, as appropriate.

Step 2 In the SAS*Suite* software, under **Recording Options (Avalanche)...,** select the **General Tab** and click the radio button **Event Trigger** under **Recording Type.**



Step 3 Select the **Triggering/Filtering** Tab. Under the Global Rules section (or in one of the Sequence sections), click on the **<Click here to add an event>** link

Step 4 Select **SMA Input**, adjust the parameters to match the signal expected from the external device, and click OK.

Step 5 Click on the **<Click here to add an action>** link, select **Trigger**, then click OK.

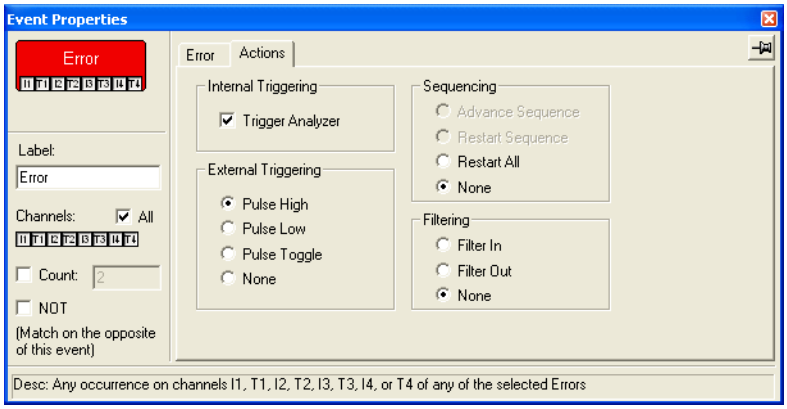
Step 6 Select **Start** from the **Record** menu.

Using the BNC Trigger Out on SAS*Tracer*

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 SAS*Suite* software, under **Recording Options (UPAS 10K)...**, 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 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

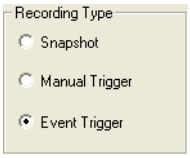
Step 5 Select **Trigger Analyzer** on the **Actions** Tab if you intend to record protocol level traffic simultaneously while using the BNC External Trigger Out signal

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 on a SAS*Tracer*

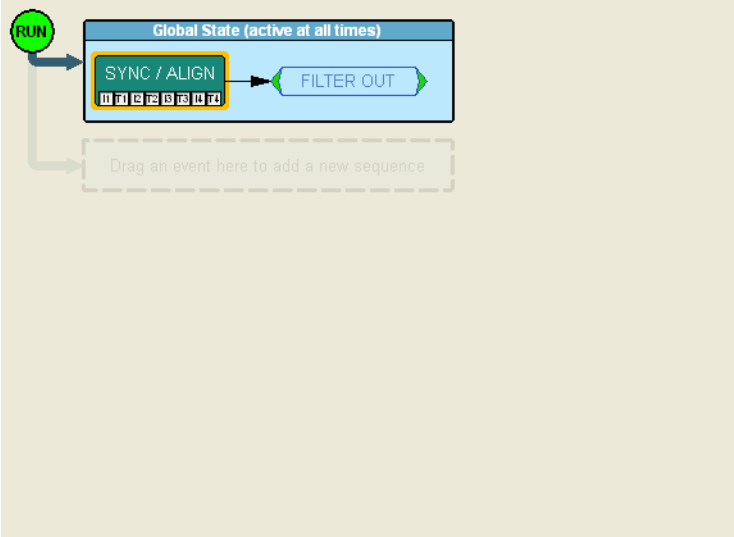
Step 1 Attach an appropriate BNC Trigger Out connector on a general purpose test instrument to the BNC Trigger In connector using the provided BNC cable.

Step 2 In the SAS*Suite* software, under Recording Options, select the **General Tab** and click the radio button **Event Trigger** under **Recording Type.**



Step 3 Select the **Recording Rules** Tab. Remove all triggering events from the Recording rules (Filtering options can be retained - see

Recording Rules screen image below)



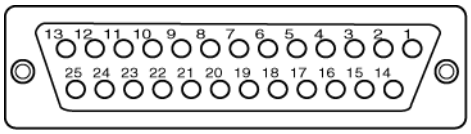
Step 4 Press **Record** > Start button to arm the analyzer. The analyzer will indicate it is waiting for a trigger. Any edge detected on the Trigger In signal will stop the recording and fill the buffer on the analyzer.

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.

Breakout 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 100Ω 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)

Pin-Outs for the Data In/Out Connector

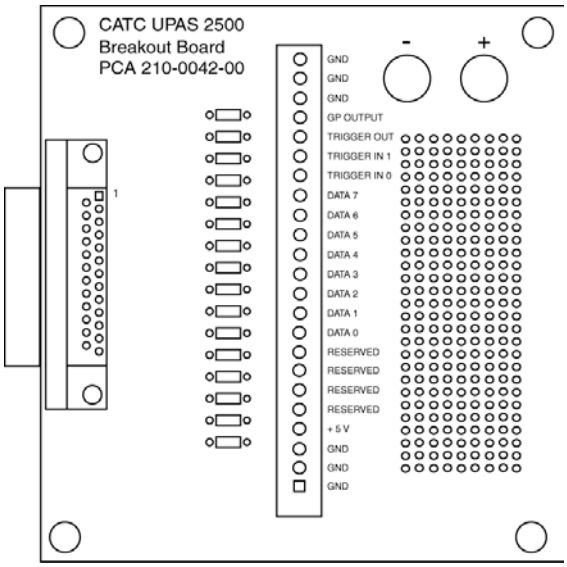
The following table lists the pin-out and signal descriptions for the **Data In/Out** connector on a cable that connects to the Breakout board.

Data In/Out Connector – Pin-Out

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

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

Configuring Input Signaling through the Breakout Board

Triggering an Avalanche System

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

Step 1 Select **Setup** > **Recording Options (Avalanche)....** and select the **Triggering/Filtering** tab.

Step 2 Under **Global Rules**, click on the **<Click here to add an event>** link

Step 3 Select **BOB Input - TRIG** from the Events menu. Specify the Trigger Source, Input Events and Pulse Length parameters to match the expected signal from the external device, then click OK

Step 4 Click on the **<Click here to add an action>** link and select **Trigger**, then click OK.

Step 5 Select **Start** from the **Record** menu

Triggering a SAS*Tracer* System

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.

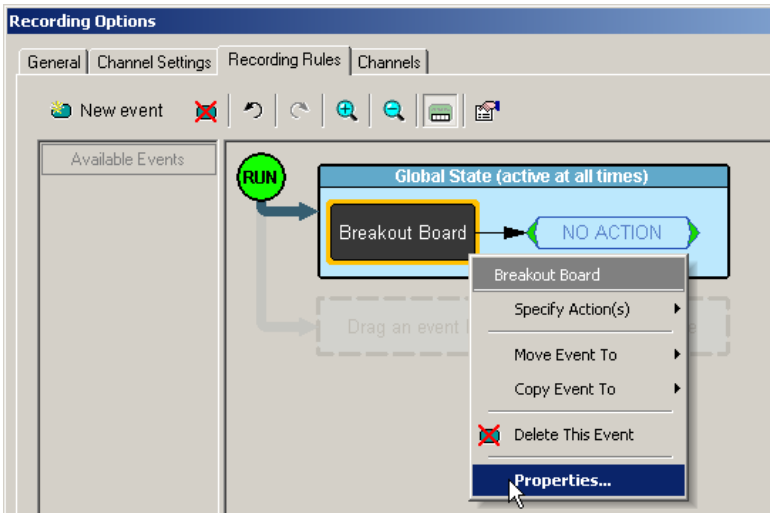
Step 2 Click the **New Events** button to open the New Events menu.

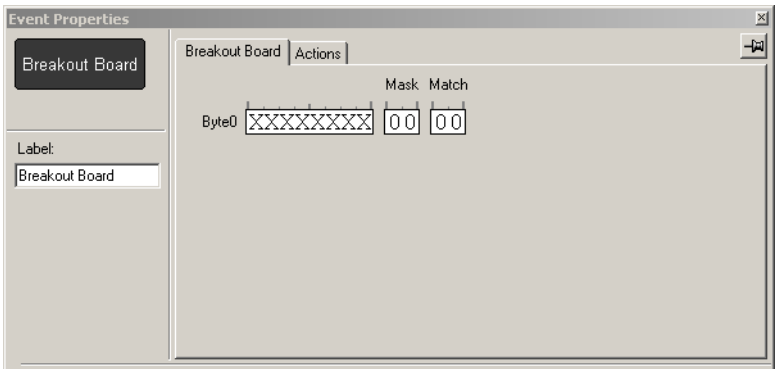
Step 3 Select **Breakout Board Data** from the New Events menu. This will cause a button to appear in the **Available Events** area. The button will be labeled **Breakout Board**.

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

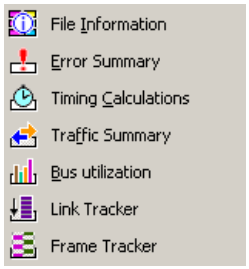
pattern, enter it in the box marked Byte0. Alternatively, you can enter a hex pattern and mask into the boxes marked Mask and Match. If no pattern is specified, the analyzer will trigger on ANY input signal.

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.

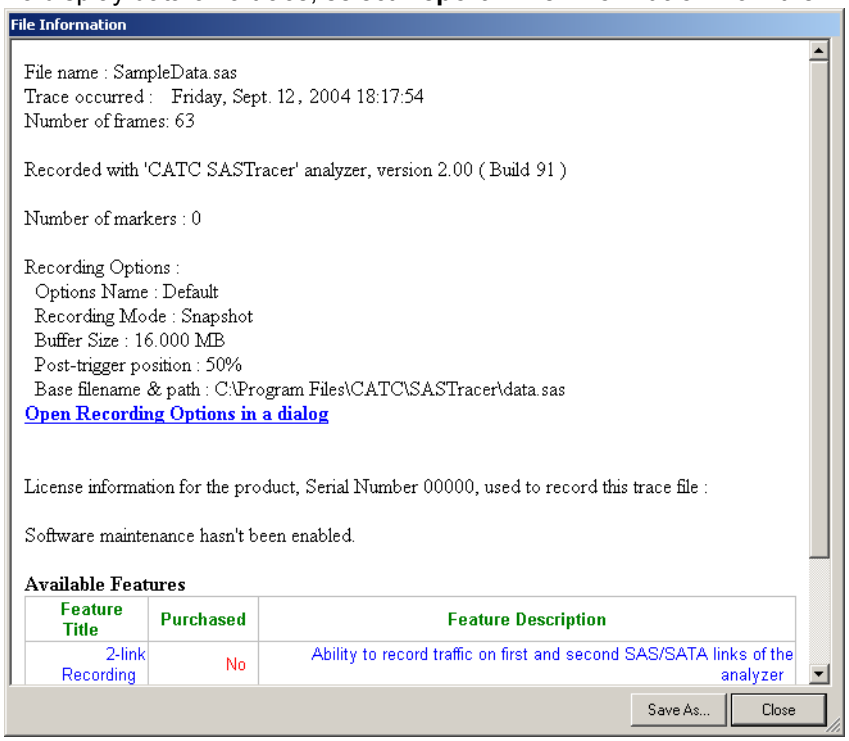
Chapter 10: Reports

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



File Information

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



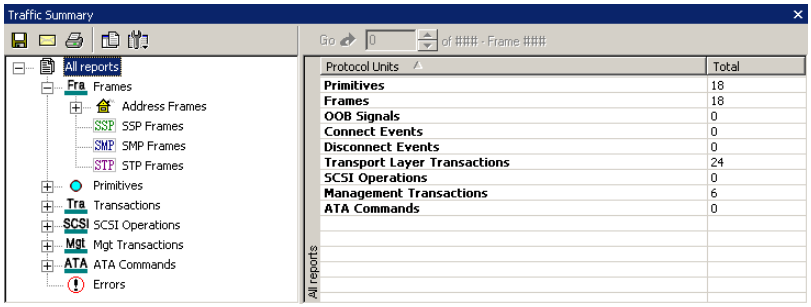
The File Information dialog opens and provides information about the recording such as when it was made and version of the Analyzer Firmware and BusEngine.

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 **Open Recording Options in a dialog**. Clicking this link causes the software to open the Recording Options dialog and automatically populate the dialog with the settings used to create the open trace.

Traffic Summary

The Traffic Summary displays a report of traffic in the data file and appears at the bottom of the SAS*Suite* main window. The left side contains a tree view where you can expand or collapse types of data you want displayed to the right of the Traffic Summary window. You can print, e-mail, save to disk, or display data in a two-column table by using the buttons in the Traffic Summary tool bar.

From the **Report** menu, select **Traffic Summary**.



Navigating

The Traffic Summary window also functions as a trace navigation tool. If you click one of the numbers in the right side of the window, the trace will jump to the first instance of your selection. Afterwards, click the up or down arrows at the top of the Traffic Summary window to navigate forward or backward through the display.

Buttons

Buttons at the top of the Traffic Summary window serve to format the display and export summarized data to email, file, or the printer:

The buttons have the following functions:

Save As - Saves Traffic Summary results into an HTML format

Email - Creates an email with a *.html file attachment of the graphs

Print

Displays results tabular text format

Displays drop-down menu with:

Grid Lines - Displays/Hides grid lines

Row Selection - Allows entire rows to be selected

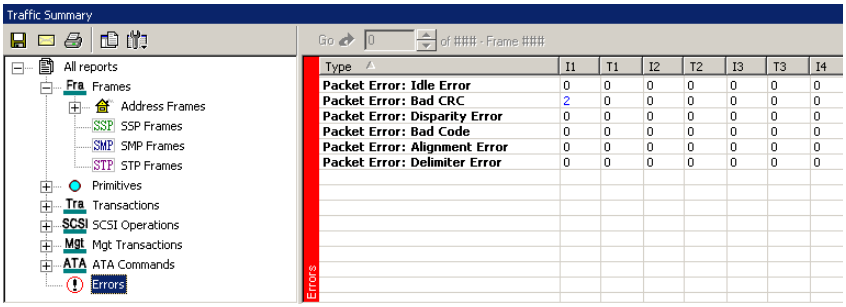
Tight Columns - Reformats column widths to match data

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.



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

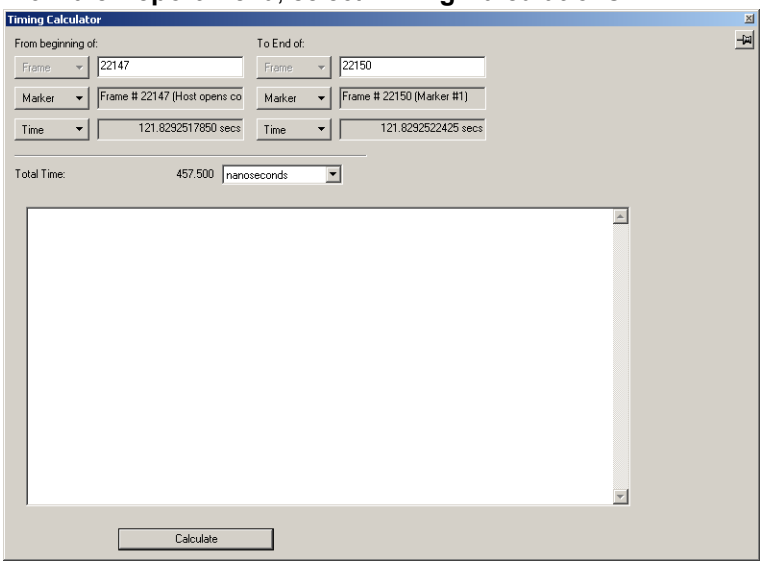
Step 3 Use the arrows to cycle though each occurrence of a particular error.

Timing Calculations

The timing calculation measures timing between any two specified frames or markers. The timing calculator feature is designed 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**.

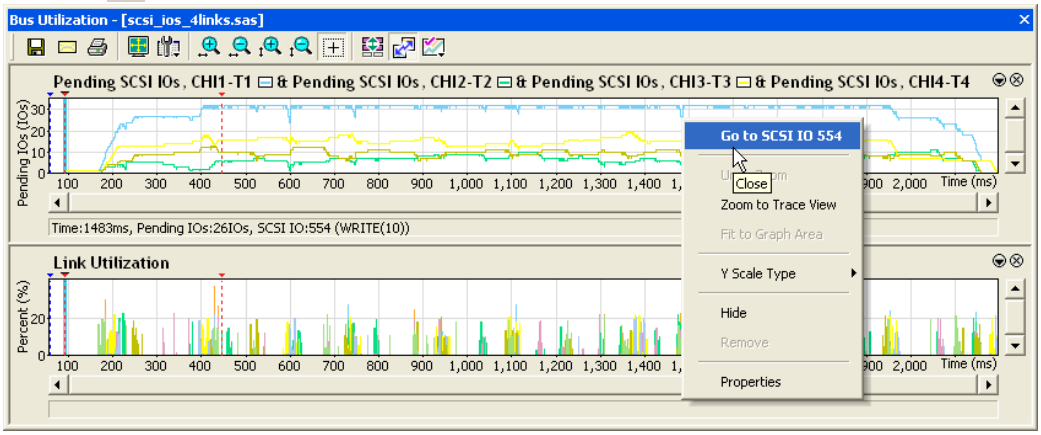


Step 2 Select the range, and click the **Calculate** button. The results will then display in the window.

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 162 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)

Email - Creates an email with a *.bmp file attachment of the graphs

Print

Full Screen

View Settings - opens a sub-menu with options for formatting the display. See "View Settings Menu" below

Horizontal zoom in

Horizontal zoom out

Vertical zoom in

Vertical zoom out

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.

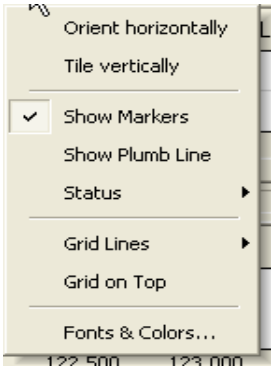
Select Range

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

Graph Areas - Presents a menu of graphs for various types of bus data

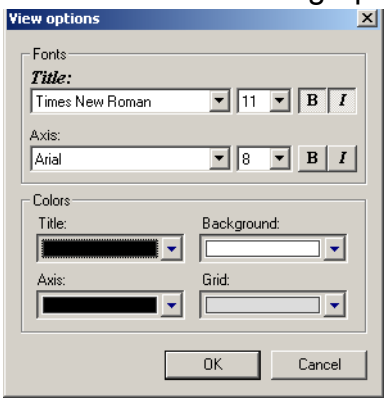
View Settings Menu

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:

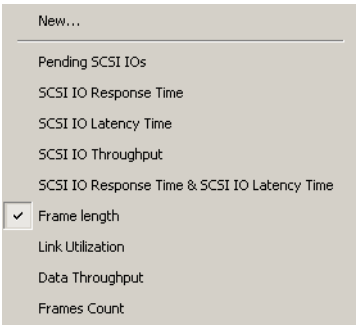


Graph Areas Menu

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.



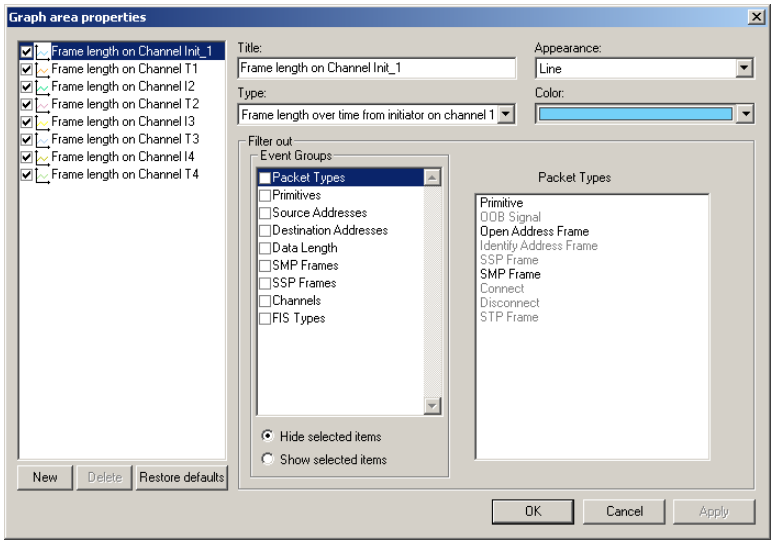
Step 2 Select a graph type from the menu. Repeat for additional graphs.

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.

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.

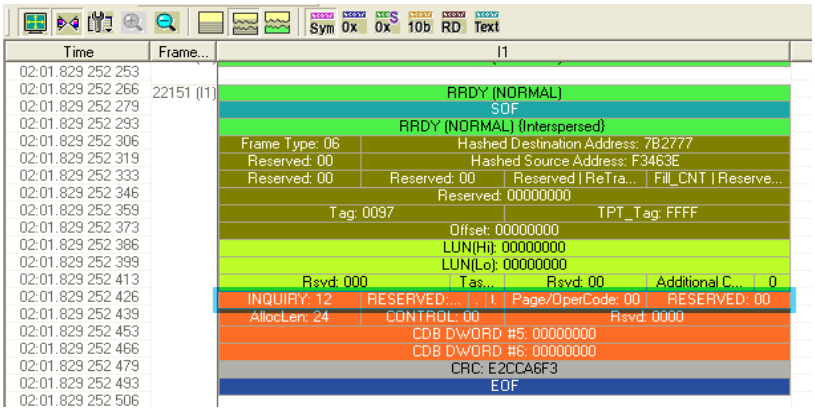
Each time slot in the vertical axis represents the minimum time required by a dword to traverse the bus.

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**		**Show Values**
	**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.**		**Show Scrambled Values**
	**View Options. Opens a menu with three options: Collapsible Idle Time, Tooltip Display, and Reset Column Widths. See View Options Menu below for descriptions.**		**Show 10b Codes**
	**Zoom In**		**Show Symbols**

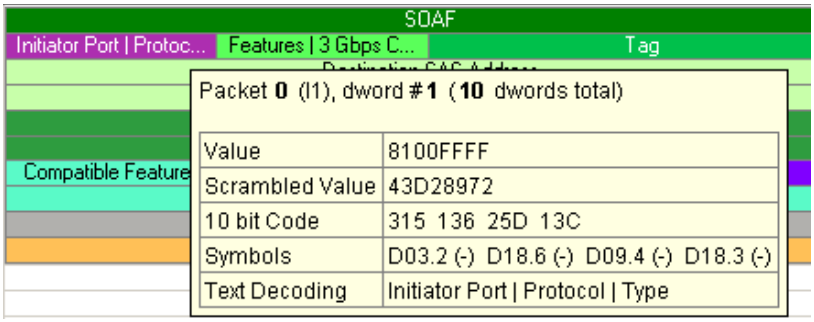
	Zoom Out		**Show text decoding of frame header fields**
	Collapse Idles		**Collapse Idles plus. Further condenses Link Tracker display to show only first 5 DWORDs of each frame.**

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:



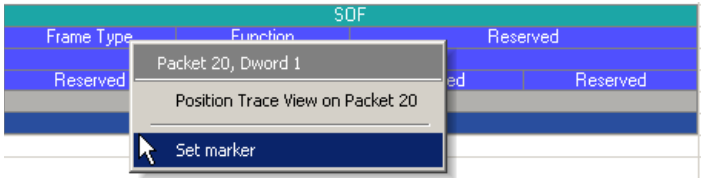
- **Reset Column Widths** - This option resets column widths to their defaults.

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

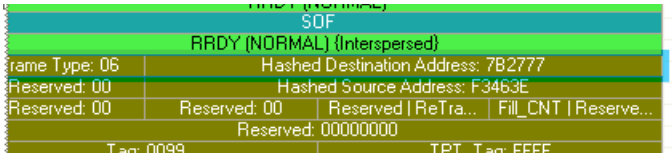
Markers can be set on any dword on any event within the Link Tracker window. To set a marker, right-click on an event, then select **Set Marker** from the pop-up menu. Once marked, events can be easily navigated to via the **Go to Marker** command in the **Search** menu.



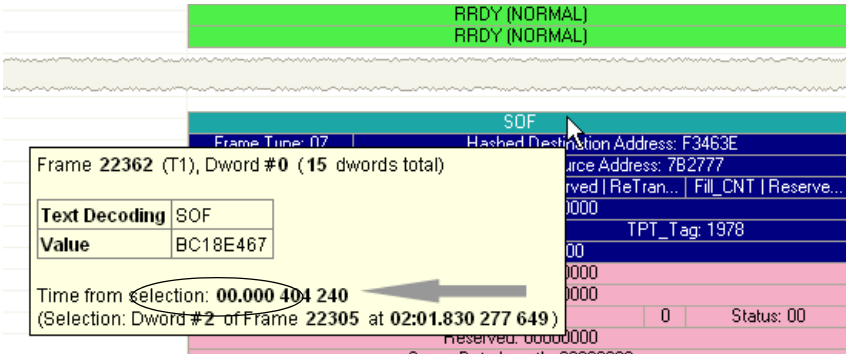
Calculating Time between Dwords

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

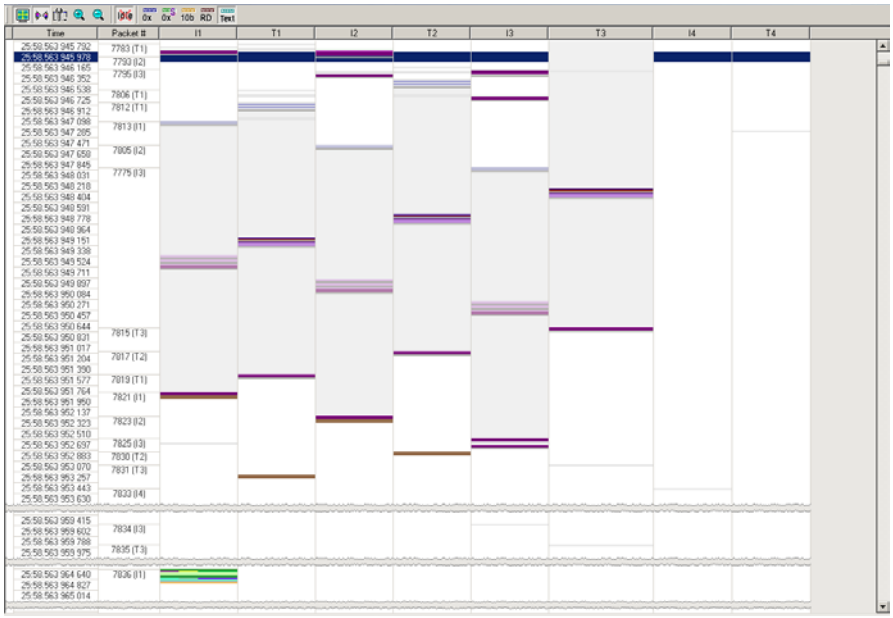
You can hide Aligns, Channels and other data from the Link Tracker window by clicking the Hide buttons on the toolbar in the Trace window or by selecting one or more of the various Hide options in the Display Options dialog box.

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

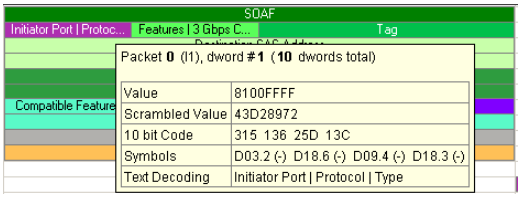
Click the View Options button to open a menu with options for formatting the display. Three options are presented:

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:



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.

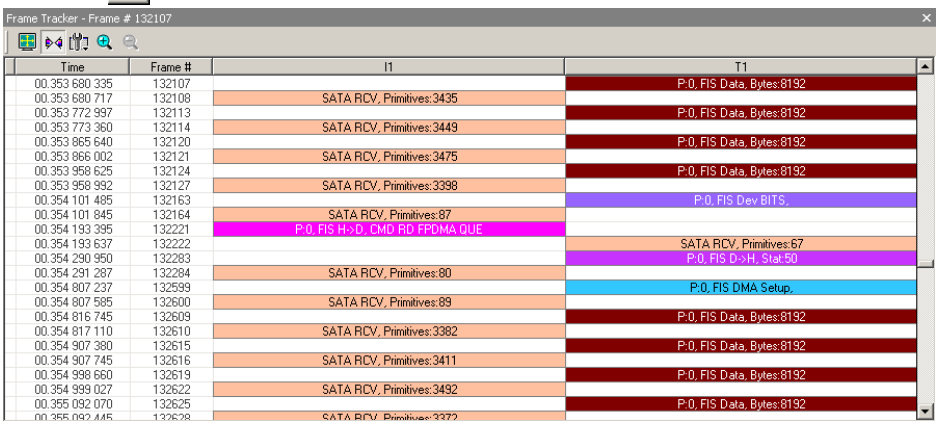
Frame Tracker Window

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:



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**

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

 **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**

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.

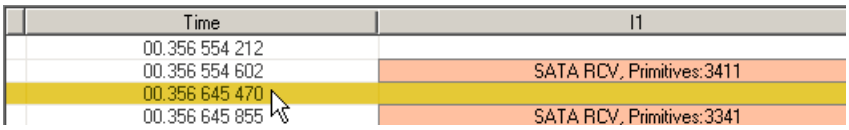
Docking and Undocking the Window

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.

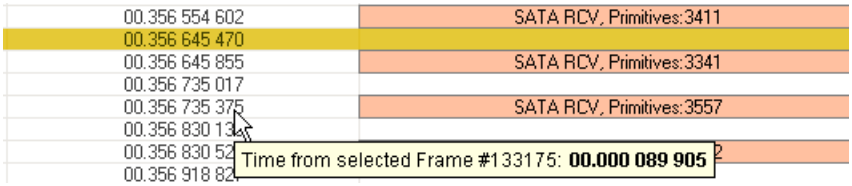
Calculating Time between Frames

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.

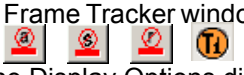
Step 1 Click on the time value for the first event.



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.



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.

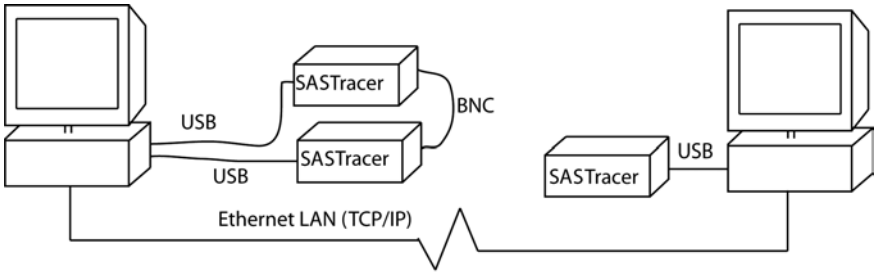
Searching

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.

Chapter 11: Networking



SAS*Suite* has networking and cascading functions that are described in this chapter.

- **Cascading** -- Allows mutliple 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 connectors on the back of the analyzers. These connections are used to send clocking information and recording commands are sent from one analyzer to another.
- **Networking** -- SAS*Suite* can support analyzers connected remotely over an IP LAN. Using the Network browse dialog, you can remotely control one or more analyzers.

Working with Multiple Analyzers

Multiple 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.

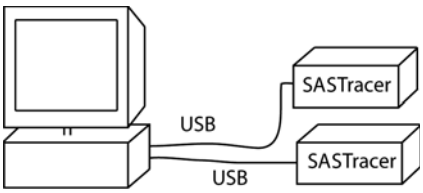
Cascaded - Two or more local analyzers linked together. One (or all) of the analyzers then connect via USB to a host PC.

The link 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.

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 SAS*Suite* application. The application provides you with a means of toggling back and forth between the different analyzers that are connected.



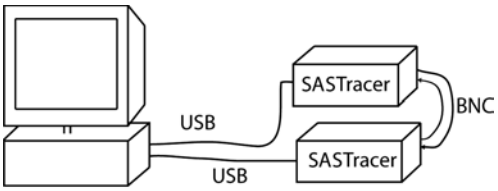
To set up multiple analyzers via USB, you attach USB cables between the analyzers and the host PC as shown in the illustration on the right. If you do not intend to group the analyzers together for synchronized multi-analyzer recordings, no further hardware setup is required. If you do intend to group the analyzers, then you will need to add connection 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 SAS*Suite* software will allow you to toggle between the analyzers but not run two copies of SAS*Suite* software on your screen simultaneously.

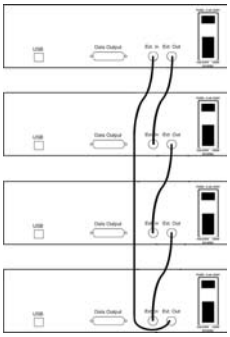
Setup for Cascaded Multiple Analyzer Use

Using Multiple SAS*Tracer* Analyzers

SAS*Tracer* Analyzers are connected in a cascade using the "EXT IN" and "EXT OUT" BNC connectors on the rear of the chassis. SAS*Tracer* supports up to four analyzers connected together in a cascade.



If you add a BNC connection between the analyzers shown, 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.



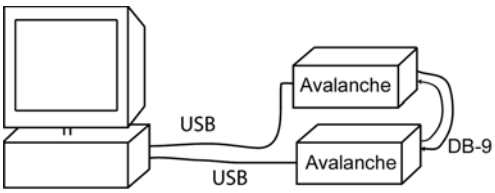
To set up a cascade, you connect a BNC cable between the External Output port on the back of one analyzer to the input port on the second. The first analyzer will serve as the controlling or master analyzer. It will transmit clocking information, Recording Option commands and other data to the other 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.

Note: For SAS*Tracer* Analyzers, the BNC cables must form a complete loop by connecting a BNC cable from the last analyzer's "EXT OUT" port to the first analyzer's "EXT IN" port.

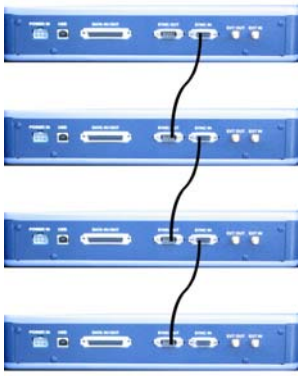
Using Multiple Avalanche Analyzers

Avalanche Analyzers are connected in a cascade using the "SYNC IN" and "SYNC OUT" DB-9 connectors on the rear of the chassis. Avalanche supports up to eight analyzers connected together in a cascade.

If you add a DB-9 male-to-female cable connection between the analyzers shown, 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 DB-9 cable between the SYNC OUT port on the back of one analyzer to the SYNC IN 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 more than two analyzers together, daisy-chain the remaining analyzers together using additional DB-9 male-to-female cables.

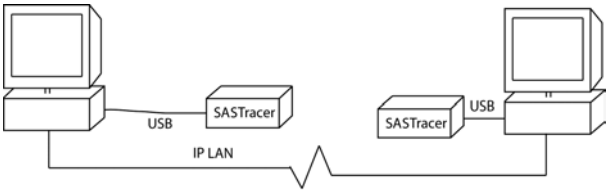


Note: For Avalanche Analyzers, the resulting connection is an open daisy chain. **Do NOT form a loop** by connecting an extra cable between the first and last analyzers.

Note: As of the date of this release, Avalanche and SAS*Tracer* Analyzers cannot be mixed together in a cascade.

Set Up for Remote Access over an IP LAN

Analyzers 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 SAS*Suite* 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 174.

Configuring the Connection

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

USB Connected Analyzers

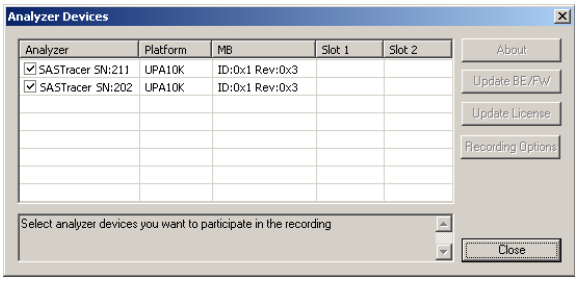
Configuration for two or more USB connected analyzers is minimal.

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

Step 1 Start the SAS*Tracer* analyzers and the SAS*Suite* 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 SAS*Suite* software on your screen will now control the selected analyzer.

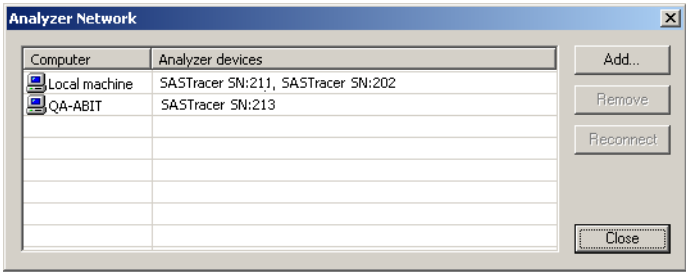
Note: You can update the Firmware, BusEngine and License from this dialog by checking an analyzer and then clicking the appropriate button on the right. You can also directly open and set Recording Options for any of the analyzers by checking one or more analyzers and then clicking the Recording Options 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 SAS*Suite* 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.



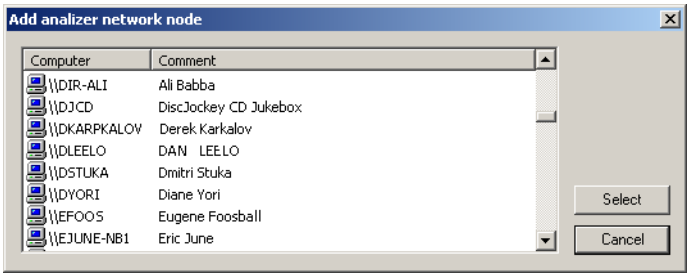
Step 2 Remove any host (other than the Local Machine) from the list by

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.

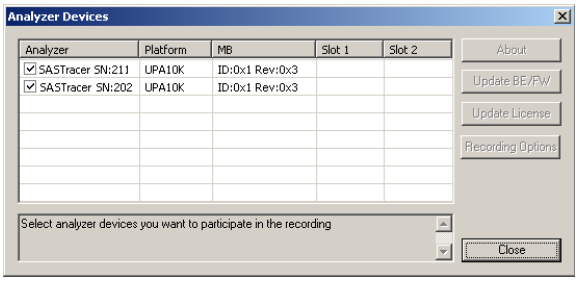


Step 4 Browse to the host that has an analyzer attached to it and double click on it.

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 SAS*Tracer* analyzers to work as a group (i.e., into a *cascade*), attach BNC cables as described in “Setup for Cascaded Multiple Analyzer Use” on page 174, then perform the following steps:

Step 1 Perform **Steps 1** and **2** as described above in “USB Connected Analyzers” on page 176.

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.

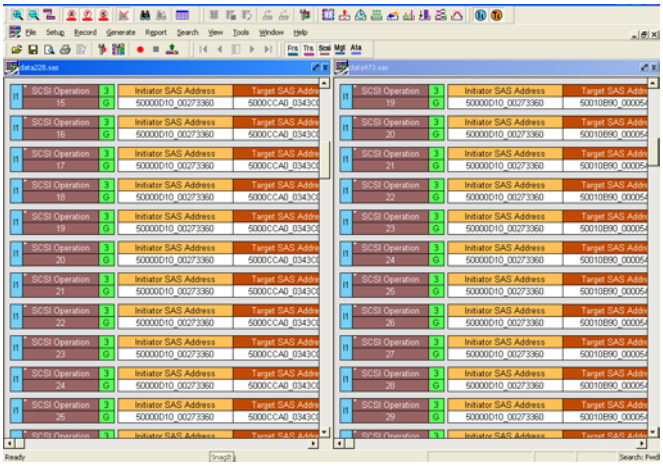
Step 3 Click **Close**.

The dialog closes and the analyzers are selected.

Step 4 Test the setup by recording some traffic.

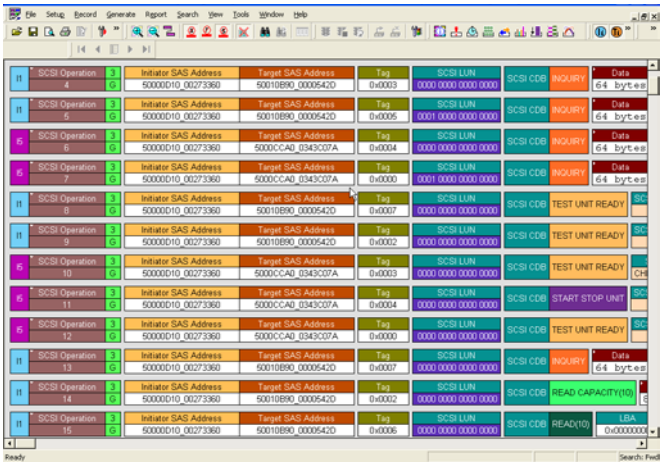
If the analyzers are not connected by the BNC cables, an error message will appear prompting you to correct the problem.

Step 5 The SAS*Suite* 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 179.



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.

Merging Traces

SAS*Suite* v2.5 and later supports merging multi-trace files (*.smtt) recorded on an Avalanche or SAS*Tracer* 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 174).

Note: Although this feature is intended for merging traces that have been recorded as multi-trace files, it can be used for merging regular trace files (that have a .sas or .sata file extension) as follows: Make sure the files you want to combine are in the same folder. Select **Open...** from the **File** menu. Choose all the files you want to combine by holding down the "Ctrl" button and clicking on each file, then click **Open**. This opens the files in a side-by-side display. Select **Merge Multi-trace...** from the **File** menu. You will get a message saying the file has not yet been saved, click **OK** and then provide a filename for the combined trace file. You will then get the dialog shown in Step 2 below, allowing you to merge the files.

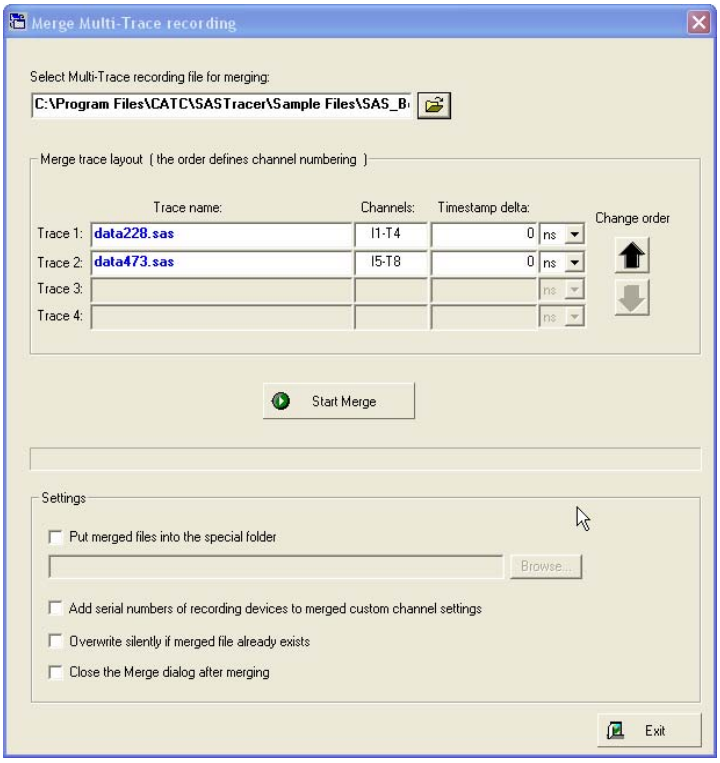
Merging Multi-Trace Files

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.

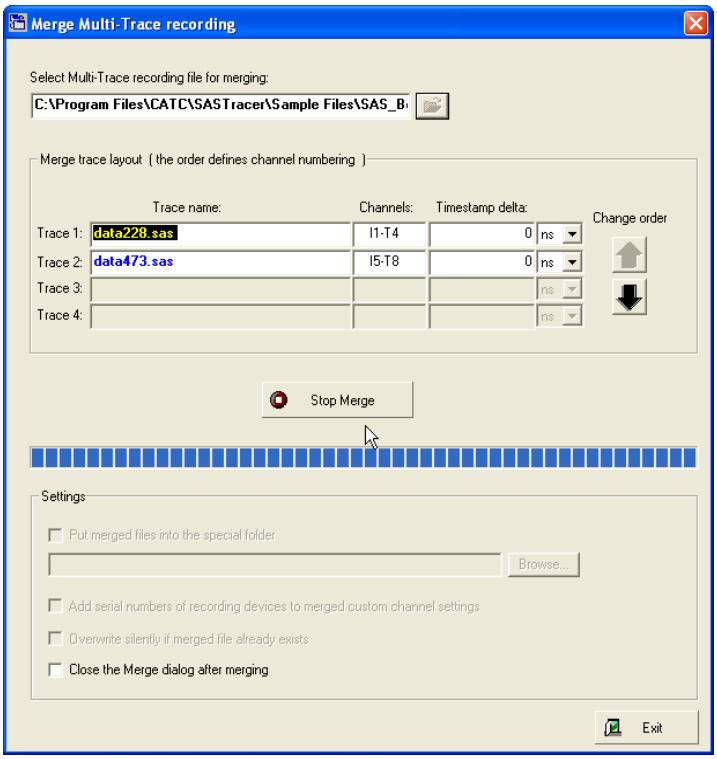


Note: The application recommends the channel layout for the merged files. For steps to change the channel layout; see Altering Channel Layout on page 182.

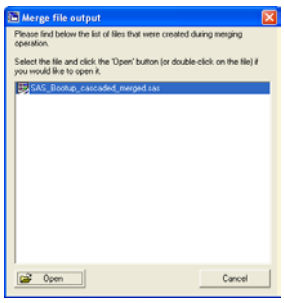
Alternatively, users may click the '*Select SAS Multitrace File for Merging*...' dialog to choose up to 4 different files to merge.

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.

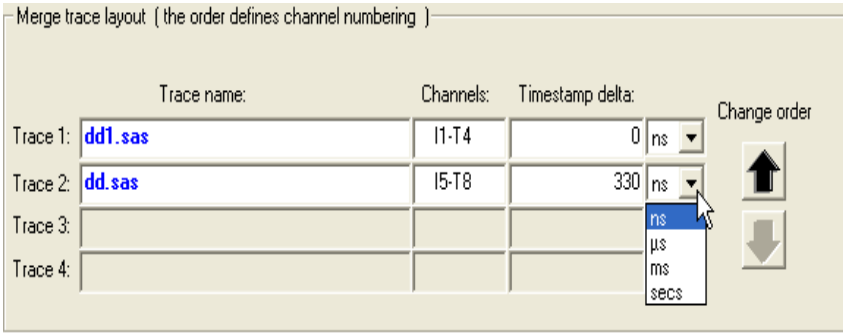
The merge feature will only display channels that actually contain valid SAS/SATA traffic. For example, a multi-trace file captured from 4 cascaded systems with real traffic in only the first channel (on each analyzer) will result in a display with traffic on channels: (I1 / T1), (I5 / T5), (I9 / T9), 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 1048 MB 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 179 except click the '*Select SAS Multitrace File for Merging*...' dialog and choose up to 4 different files to merge.

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.

Chapter 12: Traffic Generation with SAS*Trainer*

SAS*Trainer* is a traffic generator that can emulate a SAS initiator/target or SATA host/device. Traffic generation enables engineers to test designs under realistic conditions and to transmit known errors, allowing engineers to observe how devices handle faulty link conditions. Traffic generation is performed via the execution of text-based scripts. These scripts contain statements about the types of traffic to be generated.

SAS/SATA Exerciser Hardware

LeCroy SAS*Trainer* 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 2: SASTracer/Trainer 2 port Analyzer with Exerciser option installed

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 SAS*Tracer/Trainer* to the target-side port on the unit under test.

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 SAS*Tracer/Trainer* to the initiator-side port on the unit under test.

Generating Traffic

Generating traffic using SAS*Suite* is a two step process. First, a text-based Traffic Generator file must be created. This file can be created through a special conversion command in SAS*Suite* that converts a trace file captured by a SASTracer analyzer into a traffic generator file. Alternatively, you can edit an existing file or write your own.

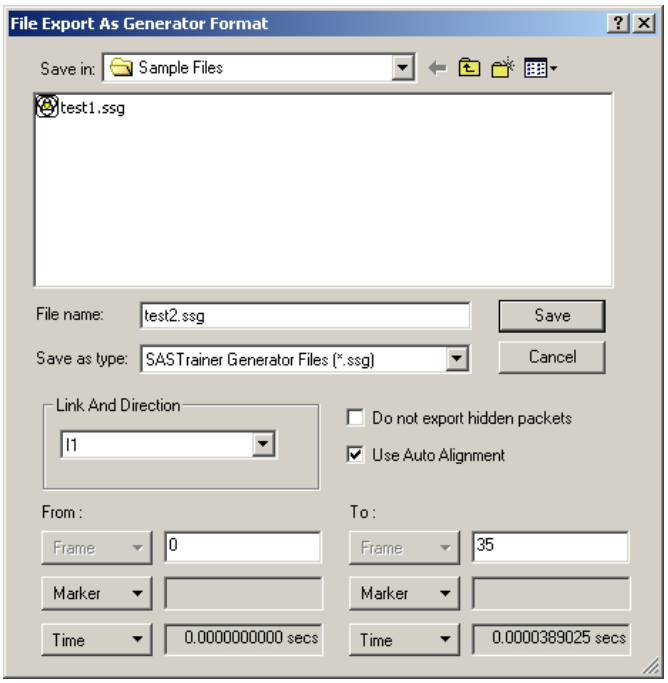
This text file is named with an **.ssg** extension. Once the file has been created, in can be opened and displayed in the SAS*Suite* application. You can invoke the SAS*Suite* application to transmit the traffic generation file by using the Traffic Signal button  .

Creating a Traffic Generation File with SAS*Suite*

The easiest way to create a Traffic Generation file is to convert an SAS*Tracer* trace file (***.sas**) into a *.**ssg** file. This is done with the **Export** function in SAS*Suite*.

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 **(.ssg).**



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 SAS*Suite* application.

Opening a Traffic Generation File

Once the Traffic Generation file **(*.ssg)** file has been created, you can then open it in the SAS*Suite* application.

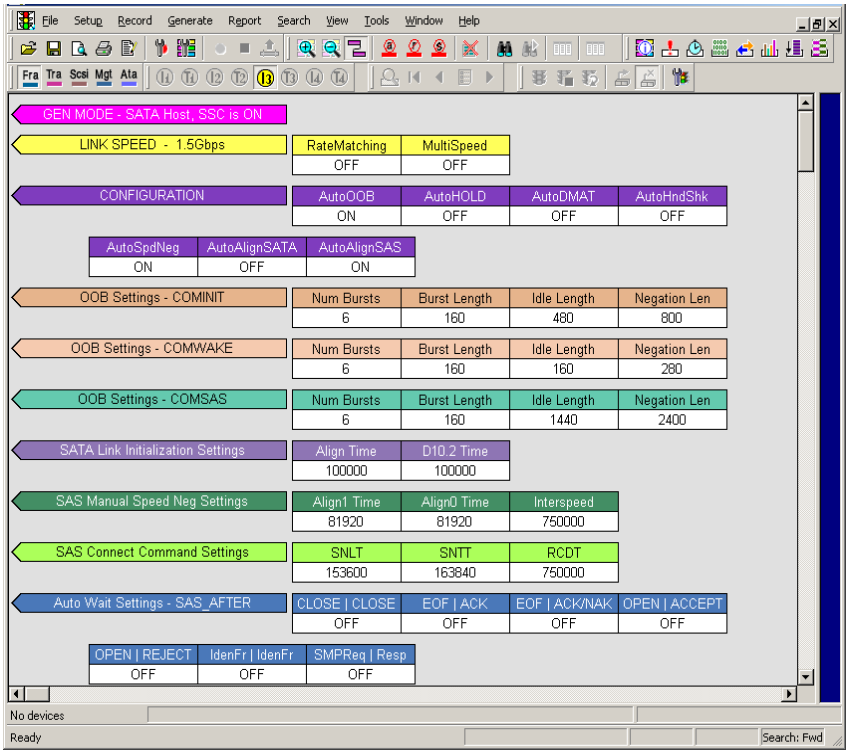
To open a Traffic Generation file,

Step 1 Select **Open** under **File** on the Menu Bar

OR

Click  on the Tool Bar.

Step 2 Select a Generator text file (***.ssg**) 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 .ssg 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.

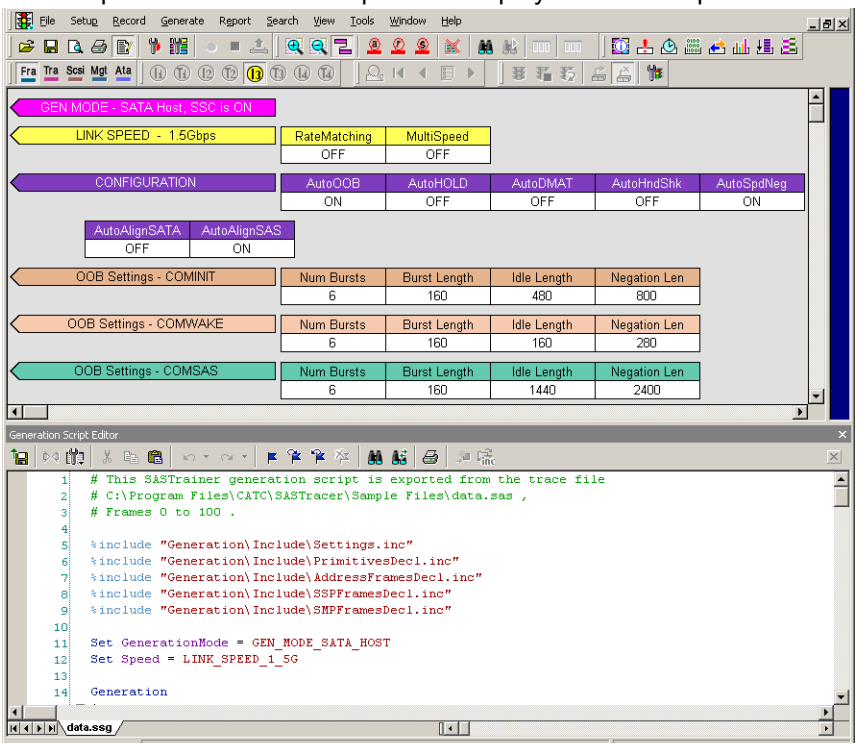
You can edit the traffic generation file to add, edit or remove frames.

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.

View Options. Opens a menu with three options: Enable Outlining, Toggle Outlining, and Line Numbers. See View Options Menu below for descriptions.

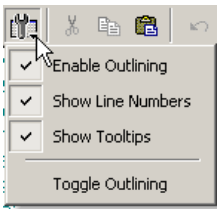
Go to next bookmark.

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

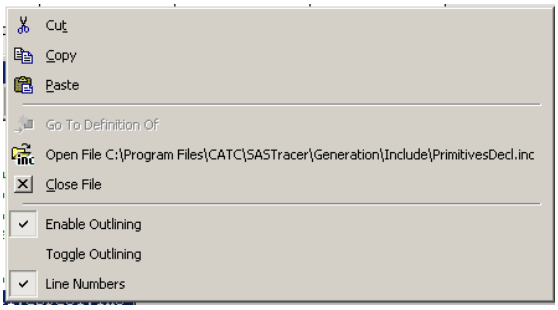
The View Options button has a menu with three options:



- **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.

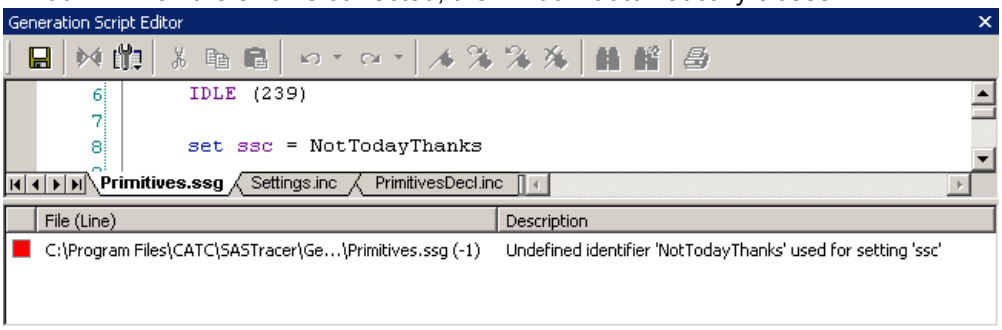
Enable Outlining, Toggle Outlining, and **Line Numbers** - Enables the three options described above under *View Options Menu.*

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.

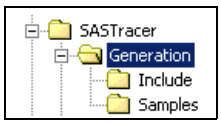
Error Log

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.



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\LeCroy\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.

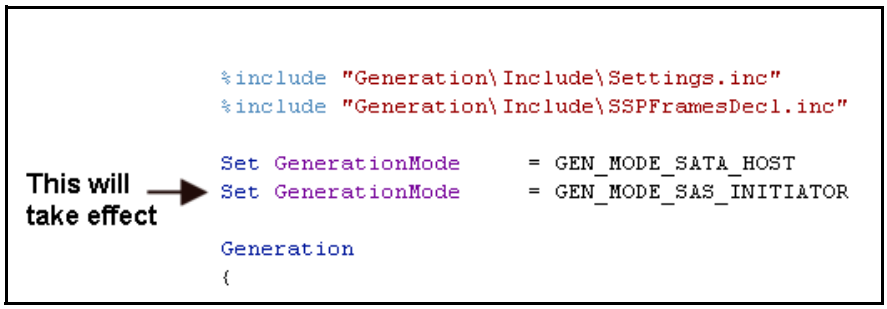
```
%include "Generation\Include\PrimitivesDecl.inc"
%include "Generation\Include\Settings.inc"

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



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:

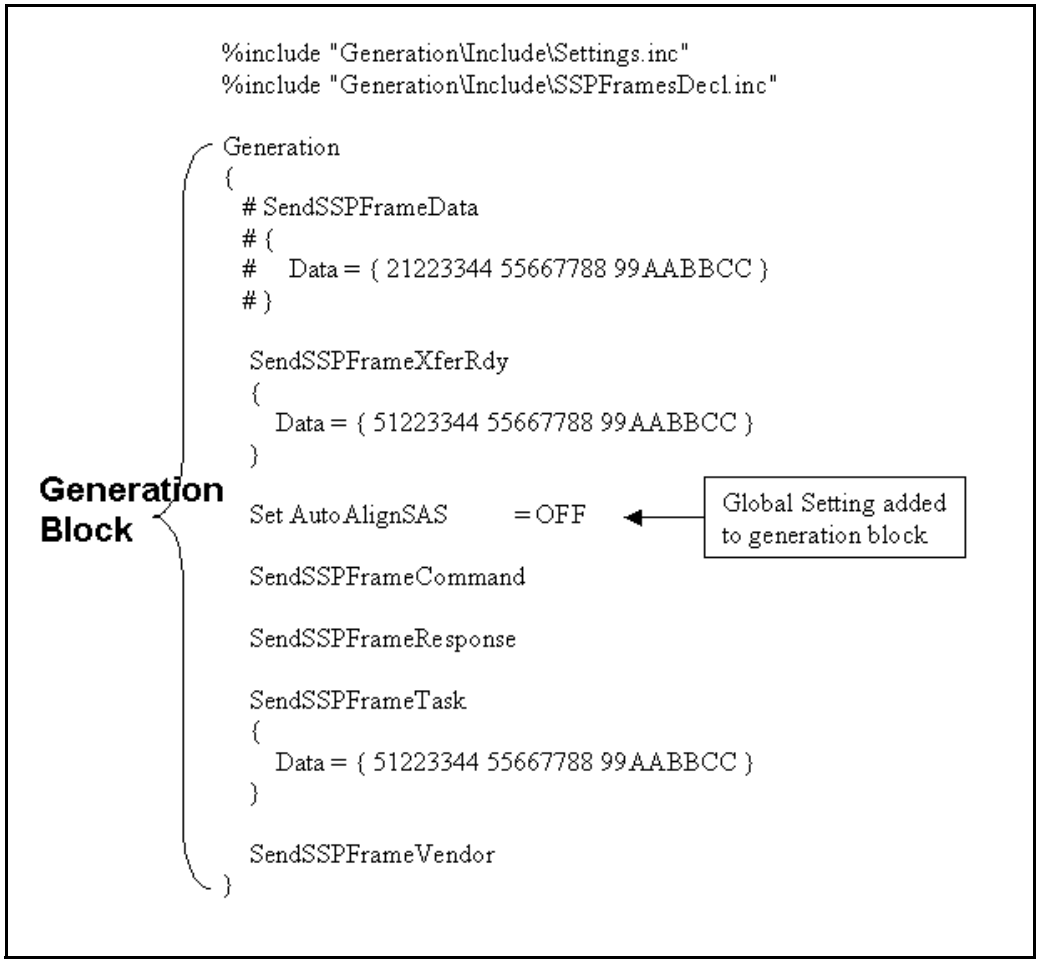
- AutoAlignSATA is assumed to be OFF
- AutoAlignSAS is assumed to be ON

For STP,

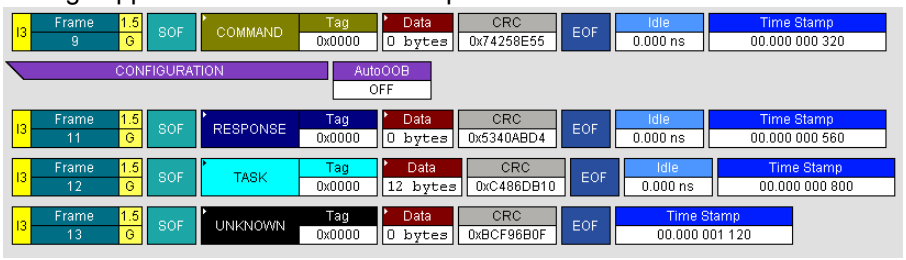
- AutoAlignSAS and AutoAlignSATA are assumed to be ON

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.



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.

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 SAS*Suite* unless told otherwise - If the CRC is not explicitly set in the traffic generation file, SAS*Suite* 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, SAS*Suite* 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.

Primitives Decl.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.

Address FramesDecl .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

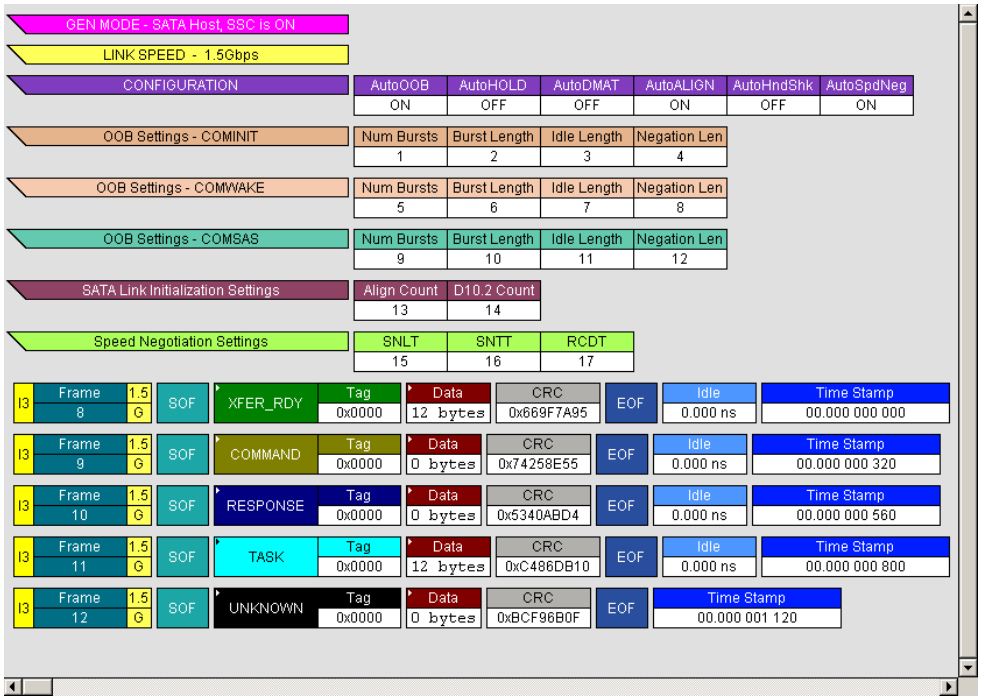
For examples of usage, see STPFrames.ssg in the Samples directory.

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
}
```



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.

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 SAS*Suite* 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  .

Chapter 13: SAS*Trainer* Generation Language

The SAS*Trainer* File Generation Language is an API that allows you to separate traffic into text commands. These commands are used construct primitives and frames that are sent to the host or the device.

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)

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 SAS*Trainer.*

EXAMPLES:

Const SOME_HEX_DATA = 0xAABBFFEE # defines hexadecimal constant

Const SOME_DEC_DATA = 12 # defines decimal constant

Const "SOME DEC DATA" = 64 # defines decimal constant

Const "Some Hex Data" = 0xCDCDBEBE

Predefined Constants

- TRUE
- FALSE
- ON
- OFF
- INFINITE

Data Patterns

Data patterns are streams of hexadecimal values. Using '["]' lets the user include constants or predefined data pattern in another pattern.

EXAMPLES:

DataPattern PATTERN_1 = AAAABBBB [SOME_HEX_DATA] EEEEFFFF 1210ABB1 AAAABBBB 1210ABB1 AAAABBBB 1210ABB1 AAAABBBB 1210ABB1 ["SOME DEC DATA"] 1210AB

DataPattern PATTERN_2 = 00000000 11111111 22222222 33333333 AAAABBBB 55556666 FEFEFEFE CDCDCDCD 9999BBBB 12343434 6767676B 56BBFF

DataPattern PATTERN_3 = [PATTERN_1] FFFFFFFF EEEEEEEE [SOME_HEX_DATA]

DataPattern SOME_PATTERN = BBBBBBBB DDDDDDDD

Primitives

Primitives can be defined using the following:

- Byte values ('k' indicates control symbol). The 10b codes are calculated based on the current running disparity
- Primitives are completely interchangeable with SymChains.

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)"
}
```

Generation Block

SAS*Trainer* 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)
}
```

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
 }
```

SAS*Trainer* Generation Commands

General Commands

IDLE (n)	Generator will insert n idle dwords into gen stream
CLEAR_CREDIT_AVAIL	This commands clears the credit established with the command WF_CREDIT_AVAIL. (See WF_CREDIT_AVAIL in following section on Wait Commands for explanation).

RD_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 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.
OOB Commands	
COMINIT	Generator will send COMINIT OOB signals using current COMINIT settings.
COMRESET	Generator will send COMRESET OOB signals using current COMRESET settings.
COMWAKE	Generator will send COMWAKE OOB signals using current COMWAKE settings.
COMSAS	Generator will send COMSAS OOB signals using current COMSAS settings.
SATA_ALIGN	Generator will go through SATA_ALIGN stage of SATA SpeedNeg process using current SATA_ALIGN settings.
SATA_D10_2	Generator will go through SATA_D10_2 stage of SATA SpeedNeg process using current SATA_D10_2 settings.
SPEED_NEG_RCDT	Generator will go through SPEED_NEG_RCDT stage of SAS SpeedNeg process using current SPEED_NEG_RCDT settings.
SPEED_NEG_ALIGN0	Generator will go through SPEED_NEG_ALIGN0 stage of SAS SpeedNeg process using current SPEED_NEG_ALIGN0 settings.

SPEED_NEG_ALIGN1	Generator will go through SPEED_NEG_ALIGN1 stage of SAS SpeedNeg process using current SPEED_NEG_ALIGN1 settings.

SATA Commands

Look at STP sample file for syntax.

- SEND_SATA_FRAME
- SendSATAFrame
- SATAData
- SATA_Data
- SATACRC
- SATA_CRC
- SATAXXXX
- SATA_XXXX

Primitive Commands

The following is a list of SAS and SATA primitives declared in "Primitives.Decl.inc" as Symbol Chains. If you want to use these primitives in your script you must also include "Primitives.Decl.inc" in your script.

- SOF
- EOF
- SOAF
- EOAF
- ALIGN (0)
- ALIGN (1)
- ALIGN (2)
- ALIGN (3)
- NOTIFY (ENABLE SPINUP)
- NOTIFY (RESERVED 0)
- NOTIFY (RESERVED 1)
- NOTIFY (RESERVED 2)
- ACK
- NAK (CRC ERROR)
- NAK (RESERVED 0)
- NAK (RESERVED 1
- NAK (RESERVED 2)
- CREDIT_BLOCKED
- RRDY (NORMAL)
- RRDY (RESERVED 0)
- RRDY (RESERVED 1)
- SATA_SOF
- SATA_EOF
- SATA_CONT

- SATA_DMAT
- SATA_HOLD
- SATA_HOLDA
- SATA_PMACK
- SATA_PMNAK
- SATA_PMREQ_P
- SATA_PMREQ_S
- SATA_R_ERR
- SATA_R_IP
- SATA_R_OK
- SATA_R_RDY
- SATA_SYNC
- SATA_WTRM
- SATA_X_RDY
- SATA_ERROR
- AIP (NORMAL)
- AIP (RESERVED 0)
- AIP (RESERVED 1)
- AIP (RESERVED 2)
- AIP (RESERVED 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	Timeout Credit Available When WF_TIMEOUT is requested in WAIT_FOR command the wait session will be released after timeout has elapsed. The Timeout value can be set two different ways: 1. Through the global WaitTimeout setting that can appear anywhere in generation. Default value is 1000 microseconds. Syntax: Set WaitTimeout = <value> (in microseconds) 2. Through local WaitTimeout value for this specific wait session. Syntax: WAIT_FOR (<number_of_microseconds>) { WF_TIMEOUT <other_wait_commands> } In this case wait for other commands will be released no later then after number_of_microseconds, but global WaitTimeout value remains unchanged for future use. See Generation\Include\WaitCommands.inc in your SASTracer program folder for the samples of syntax.
WF_SOF	primitive
WF_EOF	primitive
WF_SOAF	primitive
WF_EOAF	primitive
WF_ACK	primitive
WF_NAK_CRC_ERROR	primitive

WaitCommand Name	Description
WF_NAK_RESERVED_0	primitive
WF_NAK_RESERVED_1	primitive
WF_NAK_RESERVED_2	primitive
WF_CREDIT_AVAIL	Credit Available This function is based on a 10-bit counter whose value can range from -512 to +511 (twos-complement). This counter is cleared by sending or receiving an OPEN_ACCEPT primitive, or by execution of a CLEAR_CREDIT_AVAIL command in the script. This counter is incremented by receiving any SAS RRDY primitive and is decremented by sending SAS SOF. The wait_for command will wait for this counter to have a positive value between +1 and +511. This wait_for condition is intended to be used before sending a SAS frame within a connection. CIEAR_CREDIT_AVAIL clears this credit function.
WF_CREDIT_BLOCKED_RECEIVED	CreditBlocked Received This function is based on a flip-flop which is cleared by sending or receiving an OPEN_ACCEPT primitive. It is set by receiving a CREDIT_BLOCKED primitive. It is intended to be used in conjunction with wf_credit_avail to prevent script hangs in those cases where there is not going to be any more credit granted.
WF_CREDIT_BLOCKED	primitive

WaitCommand Name	Description
WF_RRDY_NORMAL	primitive
WF_RRDY_RESERVED_0	primitive
WF_RRDY_RESERVED_1	primitive
WF_BREAK	primitive
WF_CLOSE_CLEAR_AFFILIATION	primitive
WF_CLOSE_NORMAL	primitive
WF_CLOSE_RESERVED_0	primitive
WF_CLOSE_RESERVED_1	primitive
WF_DONE_ACK_NAK_TIMEOUT	primitive
WF_DONE_CREDIT_TIMEOUT	primitive
WF_DONE_NORMAL	primitive
WF_DONE_RESERVED_0	primitive
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

WaitCommand Name	Description
WF_AIP_RESERVED_2	primitive
WF_AIP_RESERVED_WAIT_ON_PART	primitive
WF_AIP_WAIT_ON_CONN	primitive
WF_AIP_WAIT_ON_DEVICE	primitive
WF_AIP_WAIT_ON_PARTIAL	primitive
WF_IDENTIFY_FRAME	Identify Address Frame
WF_OPEN_FRAME	Open Address Frame
WF_SMP_REQUEST	SMP Request Frame
WF_SMP_RESPONSE	SMP Response Frame
WF_REC_RESOURCES_OUTPUT_A	Advanced Wait Condition A This command causes generation to wait for Event "A" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_REC_RESOURCES_OUTPUT_B	Advanced Wait Condition B This command causes generation to wait for Event "B" to occur that you defined in the Generation Options dialog described at the end of this chapter.

WaitCommand Name	Description
WF_REC_RESOURCES_OUTPUT_C	Advanced Wait Condition C This command causes generation to wait for Event "C" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_REC_RESOURCES_OUTPUT_D	Advanced Wait Condition D This command causes generation to wait for Event "D" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_REC_RESOURCES_OUTPUT_E	Advanced Wait Condition E This command causes generation to wait for Event "E" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_REC_RESOURCES_OUTPUT_F	Advanced Wait Condition F This command causes generation to wait for Event "F" to occur that you defined in the Generation Options dialog described at the end of this chapter.
WF_COMRESET_COMINIT	COMRESET OOB Signals
WF_COMSAS	COMSAS OOB Signals
WF_COMWAKE	COMWAKE OOB Signals

WaitCommand Name	Description
WF_BLOCK1_MISC_RESERVED_0	reserved
WF_BLOCK1_MISC_RESERVED_1	reserved
WF_BLOCK1_MISC_RESERVED_2	reserved
WF_BLOCK1_MISC_RESERVED_3	reserved
WF_BLOCK1_MISC_RESERVED_4	reserved
WF_SATA_CONT	primitive
WF_SATA_DMAT	primitive
WF_SATA_EOF	primitive
WF_SATA_ERROR	primitive
WF_SATA_HOLD	primitive
WF_SATA_HOLDA	primitive
WF_SATA_PMACK	primitive
WF_SATA_PMNAK	primitive
WF_SATA_PMREQ_P	primitive
WF_SATA_PMREQ_S	primitive
WF_SATA_R_ERR	primitive
WF_SATA_R_IP	primitive
WF_SATA_R_OK	primitive
WF_SATA_R_RDY	primitive
WF_SATA_SOF	primitive
WF_SATA_SYNC	primitive
WF_SATA_WTRM	primitive
WF_SATA_X_RDY	primitive
WF_OPEN_ACCEPT	primitive

WaitCommand Name	Description
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
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

WaitCommand Name	Description
WF_NOTIFY_RESERVED_0	primitive
WF_NOTIFY_RESERVED_1	primitive
WF_NOTIFY_RESERVED_2	primitive
WF_BROADCAST_CHANGE	primitive
WF_BROADCAST_RESERVED_0	primitive
WF_BROADCAST_RESERVED_1	primitive
WF_BROADCAST_RESERVED_2	primitive
WF_BROADCAST_RESERVED_3	primitive
WF_BROADCAST_RESERVED_4	primitive
WF_BROADCAST_RESERVED_CHANGE_0	primitive
WF_BROADCAST_RESERVED_CHANGE_1	primitive
WF_BLOCK2_MISC_RESERVED_0	reserved
WF_BLOCK2_MISC_RESERVED_1	reserved

Wait Command Groups

Wait Command Group	Group Contents
WF_TIMEOUT	WF_TIMEOUT_BLOCK_ONE WF_TIMEOUT_BLOCK_TWO
WF_ALL_SOF	WF_SOF
	WF_SOAF
WF_ALL_EOF	WF_EOF
	WF_SOAF
WF_NAK	WF_NAK_CRC_ERROR
	WF_NAK_RESERVED_0
	WF_NAK_RESERVED_1
	WF_NAK_RESERVED_2
WF_RRDY	WF_RRDY_NORMAL
	WF_RRDY_RESERVED_0
	WF_RRDY_RESERVED_1
WF_CREDIT_OK	WF_CREDIT_AVAIL
	WF_CREDIT_BLOCKED_RECEIVED
WF_CLOSE	WF_CLOSE_CLEAR_AFFILIATION
	WF_CLOSE_NORMAL
	WF_CLOSE_RESERVED_0
	WF_CLOSE_RESERVED_1

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
WF_AIP	WF_AIP_NORMAL
	WF_AIP_RESERVED_0
	WF_AIP_RESERVED_1
	WF_AIP_RESERVED_2
	WF_AIP_RESERVED_WAIT_ON_PART
	WF_AIP_WAIT_ON_CONN
	WF_AIP_WAIT_ON_DEVICE
	WF_AIP_WAIT_ON_PARTIAL
WF_REC_RESOURCES	WF_REC_RESOURCES_OUTPUT_A
	WF_REC_RESOURCES_OUTPUT_B
	WF_REC_RESOURCES_OUTPUT_C
	WF_REC_RESOURCES_OUTPUT_D
	WF_REC_RESOURCES_OUTPUT_E
	WF_REC_RESOURCES_OUTPUT_F
WF_RCV_STATUS	WF_SATA_R_ERR
	WF_SATA_R_OK

Wait Command Group	Group Contents
WF_PM_REQ	WF_SATA_PMREQ_P
	WF_SATA_PMREQ_S
WF_PM_STATUS	WF_SATA_PMACK
	WF_SATA_PMNAK
WF_OPEN_REJECT	WF_OPEN_REJECT_BAD_DESTINATION
	WF_OPEN_REJECT_CONN_RATE_NOT_ SUPPORTED
	WF_OPEN_REJECT_NO_DESTINATION
	WF_OPEN_REJECT_PATHWAY_BLOCKED
	WF_OPEN_REJECT_PROTOCOL_NOT_ SUPPORTED
	WF_OPEN_REJECT_RETRY
	WF_OPEN_REJECT_STP_RESOURCES_ BUSY
	WF_OPEN_REJECT_WRONG_ DESTINATION
	WF_OPEN_REJECT_RESERVED_ ABANDON_0
	WF_OPEN_REJECT_RESERVED_ ABANDON_1

Wait Command Group	Group Contents
WF_OPEN_REJECT (continued...)	WF_OPEN_REJECT_RESERVED_ ABANDON_2
	WF_OPEN_REJECT_RESERVED_ ABANDON_3
	WF_OPEN_REJECT_RESERVED_ CONTINUE_0
	WF_OPEN_REJECT_RESERVED_ CONTINUE_1
	WF_OPEN_REJECT_RESERVED_ INITIALIZE_0
	WF_OPEN_REJECT_RESERVED_ INITIALIZE_1
	WF_OPEN_REJECT_RESERVED_STOP_0
	WF_OPEN_REJECT_RESERVED_STOP_1
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

Predefined Constants

Predefined Constant	Internal Value
GEN_MODE_ERROR	0
GEN_MODE_SATA_HOST	1
GEN_MODE_SATA_DEVICE	2
GEN_MODE_SAS_INITIATOR	3
GEN_MODE_SAS_TARGET	4
GEN_LINK_SPEED_1_5G	0
GEN_LINK_SPEED_3G	1
SCRAMBLING_MODE_NONE	0
SCRAMBLING_MODE_SAS	1
SCRAMBLING_MODE_SATA	2

Generation Settings

Setting	Default Value	Description
Global Settings		
GenerationMode	>>>>>	Generation Mode - must be defined or no generation will take place. Possible Values: GEN_MODE_SATA_HOST GEN_MODE_SATA_DEVICE GEN_MODE_SAS_INITIATOR GEN_MODE_SAS_TARGET Default Value: GEN_MODE_ERROR - undefined mode
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.
Output Disable	0	This very poorly named register bit forces the Trainer to output data. It is a little like the output_on script command except that its effect cannot be undone for the duration of the script. If this is turned on, none of the out-of-band commands will work, as the output enable is forced on.
AutoMode Settings		
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).
AutoSpeedNeg	0	When set, the generator will automatically go throughthe speed negotiation process, for the speed set in the PINTERFACEC_SERDES register for the Trainer.

Setting	Default Value	Description
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
COMINIT Settings		
COMINIT_NegLen	800	The number of bursts to send as part of this OOB type.Each Burst is followed by an Idle. The Burst-Idle pairs are repeated the requested number of times, and then followed by the Negation_length of Idle.
COMINIT_IdleLen	480	Burst time between each OOB idle in OOBIs.During the specified period, the generator will send ALIGN(0) at the specified speed.
COMINIT_BurstLen	160	Idle time between each OOB burst in OOBIs.During the specified period, the generator will keep the line at electric idle.
COMINIT_NumBursts	6	Negation time at the end of the OOB signal in OOBIs.During the specified period, the generator will keep the line at electric idle.
COMWAKE Settings		
COMWAKE_NegLen	280	The number of bursts to send as part of this OOB type.Each Burst is followed by an Idle. The Burst-Idle pairs are repeated the requested number of times, and then followed by the Negation_length of Idle.
COMWAKE_IdleLen	160	Burst time between each OOB idle in OOBIs.During the specified period, the generator will send ALIGN(0) at the specified speed.
COMWAKE_BurstLen	160	Idle time between each OOB burst in OOBIs.During the specified period, the generator will keep the line at electric idle.
COMWAKE_NumBursts	6	Negation time at the end of the OOB signal in OOBIs.During the specified period, the generator will keep the line at electric idle.

Setting	Default Value	Description
COMSAS Settings		
COMSAS_NegLen	2400	The number of bursts to send as part of this OOB type.Each Burst is followed by an Idle. The Burst-Idle pairs are repeated the requested number of times, and then followed by the Negation_length of Idle.
COMSAS_IdleLen	1440	Burst time between each OOB idle in OOBIs.During the specified period, the generator will send ALIGN(0) at the specified speed.
COMSAS_BurstLen	160	Idle time between each OOB burst in OOBIs.During the specified period, the generator will keep the line at electric idle.
COMSAS_NumBursts	6	Negation time at the end of the OOB signal in OOBIs.During the specified period, the generator will keep the line at electric idle.
SATA Link Init Settings		
OOB_SATA_D102_Time	100000	D10.2 time for SATA link synchronization in OOBIs.During the specified period, the generator will transmit D10.2 symbols.
OOB_SATA_Align_Time	100000	ALIGN(0) time for SATA link synchronization in OOBIs.During the specified period, the generator will transmit ALIGN(0) primitives.
SAS Speed Negotiation Settings		
OOB_SAS_Align1_Time	81920	ALIGN(1) time for SAS speed negotiation in OOBIs.During the specified period, the generator will transmit ALIGN(1) primitives.
OOB_SAS_Align0_Time	81920	ALIGN(0) time for SAS speed negotiation in OOBIs.During the specified period, the generator will transmit ALIGN(0) primitives.
OOB_SAS_Interspeed_Time	750000	Interspeed time for SAS speed negotiation in OOBIs.During the specified period, the generator will keep the line at electric idle.

Setting	Default Value	Description
SATA Speed Negotiation Settings		
OOB_SpeedNeg_RCDT	750000	Maximum time in OOBIs during the speed negotiation window for a transmitter to reply with ALIGN(1).
OOB_SpeedNeg_SNTT	163840	Time in OOBIs during which ALIGN(0) or ALIGN(1) is transmitted at each physical link rate during the speed negotiation sequence.
OOB_SpeedNeg_SNLT	153600	Time in OOBIs during which the transmitter shall transmit idle between rates during speed negotiation.
Speed Settings		
Speed	>>>>>	Link Speed Possible Values: LINK_SPEED_1_5G LINK_SPEED_3G Default Value: LINK_SPEED_1_5G
RateMatching	0	When set, the generator will automatically inserting the stream Align(0) primitive after every dword.

Setting	Default Value	Description
Scrambling Mode Settings		
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
Wait Timeout Settings		
WaitTimeout	1000	Sets global WaitTimeout value in microseconds
AUTO_WAIT_SAS_AFTER Settings		
AUTO_WAIT_SAS_AFTER_CLOSE_FOR_CLOSE	FALSE	When set, the generator will insert WAIT_FOR CLOSE command immediately after each CLOSE primitive.
AUTO_WAIT_SAS_AFTER_EOF_FOR_ACK	FALSE	When set, the generator will insert WAIT_FOR ACK command immediately after each EOF primitive.
AUTO_WAIT_SAS_AFTER_EOF_FOR_ACK_OR_NAK	FALSE	When set, the generator will insert WAIT_FOR ACK or NAK command immediately after each EOF primitive.
AUTO_WAIT_SAS_AFTER_OPEN_FOR_OPEN_ACCEPT	FALSE	When set, the generator will insert WAIT_FOR OPEN_ACCEPT command immediately after each Open Address Frame.
AUTO_WAIT_SAS_AFTER_OPEN_FOR_OPEN_REJECT	FALSE	When set, the generator will insert WAIT_FOR OPEN_REJECT command immediately after each Open Address Frame.
AUTO_WAIT_SAS_AFTER_IDENTIFY_FOR_IDENTIFY_FRAME	FALSE	When set, the generator will insert WAIT_FOR Identify Frame command immediately after each Identify Address Frame.
AUTO_WAIT_SAS_AFTER_SMP_REQ_FOR_RESP	FALSE	When set, the generator will insert WAIT_FOR SMP Response Frame command immediately after each SMP Request Frame.
AUTO_WAIT_SAS_BEFORE Settings		

Setting	Default Value	Description
AUTO_WAIT_SAS_BEFORE_CLOSE_FOR_CLOSE	FALSE	When set, the generator will insert WAIT_FOR CLOSE command right before each CLOSE primitive.
AUTO_WAIT_SAS_BEFORE_SOF_FOR_CREDIT	FALSE	When set, the generator will insert WAIT_FOR CREDIT command right before each SOF primitive.
AUTO_WAIT_SAS_BEFORE_IDENTIFY_FOR_IDENTIFY_FRAME	FALSE	When set, the generator will insert WAIT_FOR Identify Frame command right before each Identify Address Frame.
AUTO_WAIT_SAS_BEFORE_OPEN_ACCEPT_FOR_OPEN	FALSE	When set, the generator will insert WAIT_FOR Open Frame command right before each OPEN_ACCEPT primitive.
AUTO_WAIT_SAS_BEFORE_OPEN_REJECT_FOR_OPEN	FALSE	When set, the generator will insert WAIT_FOR Open Frame command right before each OPEN_REJECT primitive.
AUTO_WAIT_SAS_BEFORE_AIP_FOR_OPEN	FALSE	When set, the generator will insert WAIT_FOR Open Frame command right before each primitive of AIP group.
AUTO_WAIT_SAS_BEFORE_SMP_RESP_FOR_REQ	FALSE	When set, the generator will insert WAIT_FOR SMP Request Frame command right before each SMP Response Frame.
AUTO_WAIT_SATA_AFTER Settings		
AUTO_WAIT_SATA_AFTER_X_RDY_FOR_R_RDY	FALSE	When set, the generator will insert WAIT_FOR SATA_R_RDY command immediately after each case of SATA_CONT primitive following SATA_X_RDY primitive.
AUTO_WAIT_SATA_AFTER_WTRM_FOR_STATUS	FALSE	When set, the generator will insert WAIT_FOR SATA_R_ERR or SATA_R_OK command immediately after each case of SATA_CONT primitive following SATA_WTRM primitive.
AUTO_WAIT_SATA_AFTER_PMREQ_S_FOR_RESPONSE	FALSE	When set, the generator will insert WAIT_FOR SATA_PMACK or SATA_PMNAK command immediately after each case of SATA_CONT primitive following SATA_PMREQ_S primitive.

Setting	Default Value	Description
AUTO_WAIT_SATA_AFTER_PMREQ_P_FOR_RESPONSE	FALSE	When set, the generator will insert WAIT_FOR SATA_PMACK or SATA_PMNAK command immediately after each case of SATA_CONT primitive following SATA_PMREQ_P primitive.
AUTO_WAIT_SATA_AFTER_ SYNC_FOR_SYNC	FALSE	When set, the generator will insert WAIT_FOR SATA_SYNC command immediately after each case of SATA_CONT primitive following SATA_SYNC primitive.
AUTO_WAIT_SATA_BEFORE Settings		
AUTO_WAIT_SATA_BEFORE_ PMACK_FOR_PMREQ	FALSE	When set, the generator will insert WAIT_FOR SATA_PMREQ_S or SATA_PMREQ_P command right before each SATA_PMACK primitive.
AUTO_WAIT_SATA_BEFORE_ PMNAK_FOR_PMREQ	FALSE	When set, the generator will insert WAIT_FOR SATA_PMREQ_S or SATA_PMREQ_P command right before each SATA_PMNAK primitive.
AUTO_WAIT_SATA_BEFORE_ RERR_FOR_WTRM	FALSE	When set, the generator will insert WAIT_FOR SATA_R_ERR command right before each SATA_WTRM primitive.
AUTO_WAIT_SATA_BEFORE_ ROK_FOR_WTRM	FALSE	When set, the generator will insert WAIT_FOR SATA_R_OK command right before each SATA_WTRM primitive.
AUTO_WAIT_SATA_BEFORE_RIP_FOR_SOF	FALSE	When set, the generator will insert WAIT_FOR SATA_R_IP command right before each SATA_SOF primitive.
AUTO_WAIT_SATA_BEFORE_ R_RDY_FOR_X_RDY	FALSE	When set, the generator will insert WAIT_FOR SATA_X_RDY command right before each SATA_R_RDY primitive.

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:

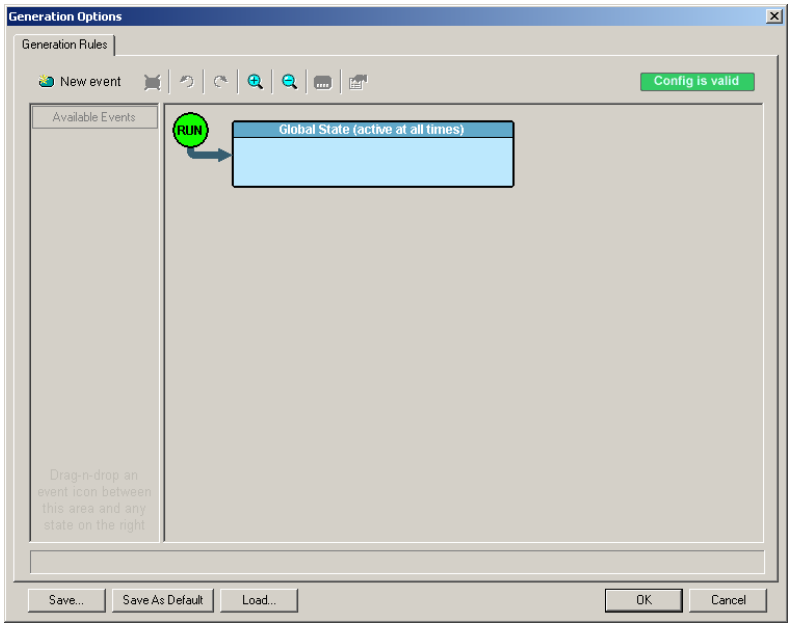
Wait_For {WF_REC_RESOURCES_OUTPUT_A}

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:

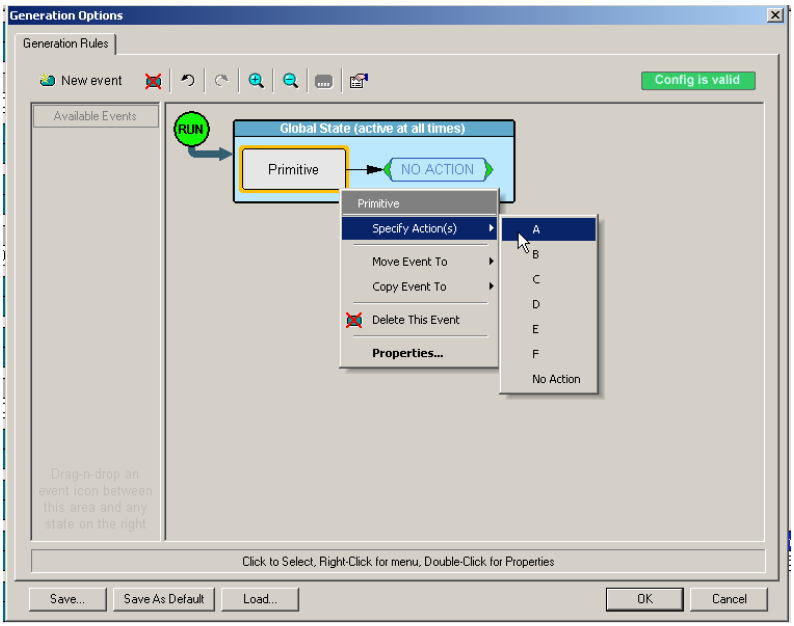
Step 1 Select **Generate** > **Generation Options** from the menu. The Generation Options dialog opens. The Generation Options dialog looks very similar to the Recording Rules dialog:



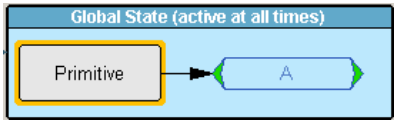
Step 2 Click the **New Events** button and select an event from the menu. The selected event should appear in the **Available Events** area along the left side of the dialog box.

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}

Chapter 14: SAS*Tracker* Systems

The SAS*Tracker* Command Analyzer option for SAS*Tracer* systems is designed to track commands in a SAS or SATA network that can involve up to 8 initiators and up to 128 targets. Within this matrix, SAS*Tracker* will track all commands issued and completed, included queue depths up to the full 16 bit depth provided for in the SAS specification.

Product Configurations

SAS*Tracker* capability is supported on the same hardware modules that support SAS*Tracer* systems (see “Analyzer Hardware Description” on page 7). Running the SATracer option uses a different BusEngine and cannot operate simultaneously with SAS*Tracer* on the same CATC 10K system. A simple menu selection converts back and forth between the two capabilities.

Theory of Operation

The SAS*Tracker* Command Analyzer option monitors traffic and identifies all new commands issued and command completions sent in an active SAS/SATA environment. Every command issued is tracked, and when any command exceeds a user-defined timeout (which can vary based on command type), the system triggers and provides a Command Log File of up to the last 8 million commands issued.

SAS*Tracker* monitors live traffic in a SAS or SATA network, and each time a command is issued SAS*Tracker* records information on that command and begins to track that command to determine when it is completed, how it is completed, and to trigger on any command that fails to complete within user-defined timeout periods.

The Command Log File generated by SAS*Tracker* will contain information about every command initiated and completed during the session. In addition, the Command Log File will contain "command fragments" of two types:

Incompletes: Command Start Events that were not completed during the recording session. These may include commands which exceeded the user-defined timeout, or simply commands that were issued near the end of the recording and did not have time to complete before recording was stopped.

Orphans: Command End Events that do not correspond to any issued command that is present in the recording. Called "orphans", these typically occur when recording is started during live traffic, resulting in command completions being observed for commands that were issued prior to the start of recording. Orphans also occur in recordings that "wrap", where the available memory space has been exceeded and the user has specified that the recording should continue until a trigger condition is encountered.

For command timeout purposes, the SAS*Tracker* Analyzer actively tracks all commands which have been issued, but for which no Command End Event has yet occurred. Once a Command End Event that terminates that command has occurred, the command is no

longer actively tracked, but the information on that command will still be present in the Command Log File (provided the Command Log File does not wrap and overwrite the data).

Note that Command End Events may not all be successful command completions. Events such as CHECK_CONDITION result in termination of a command in a way consistent with the SCSI protocol, and will result in the command being terminated without generating a timeout trigger condition.

When a trigger condition is reached (or when the desired recording size is reached when in "snapshot" mode), the recording will stop and the Command Log File will be available for viewing.

Note: Catastrophic events such as Bus Resets which result in all commands being terminated are not supported by SASTracker.

Installing the SAS*Tracker* Command Analyzer

The SAS*Tracker* Command Analyzer option is installed and connected to systems in exactly the same way as the SAS*Tracer* Protocol Analyzer (see “Installation” on page 7). Both systems reside in the traffic pathway on a SAS/SATA link.

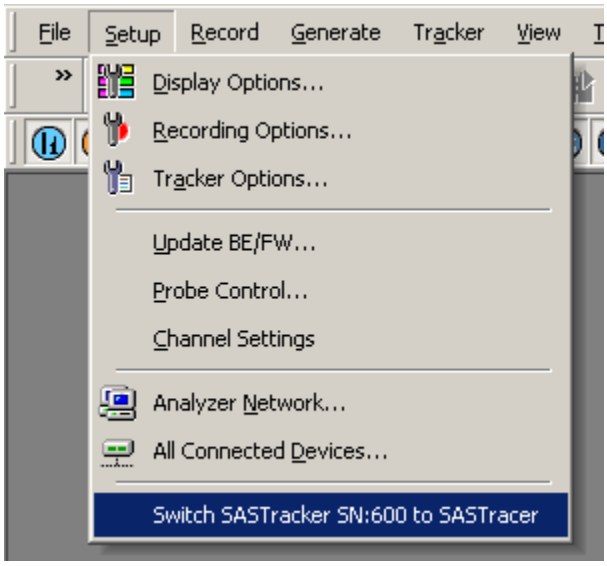
If not already installed, the SAS*Suite* software should be installed on the host PC as described in “Installing the SASSuite Software” on page 15.

Changing the BusEngine

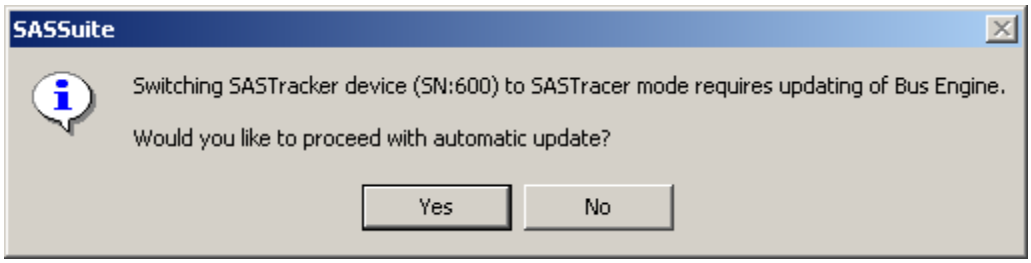
If the system is being operated as both a SAS*Tracer* Protocol Analyzer and a SAS*Tracker* Command Analyzer, the BusEngine will need to be changed each time the unit is converted between the two functions. As noted previously, the same hardware can support both functions, but the two functions cannot coexist at the same time. If both tracing and tracking are required simultaneously, two separate CATC 10K platforms must be used.

To check which BusEngine is currently loaded, select the **About...** option from the **Help** menu.

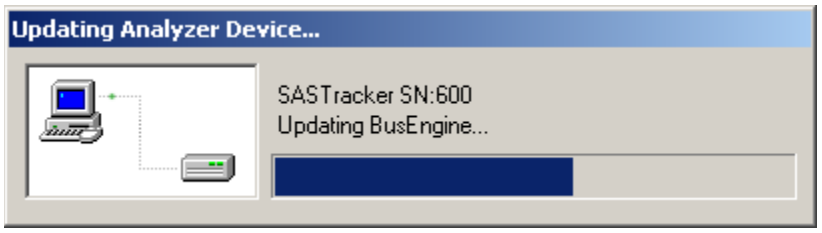
To switch from one BusEngine to the other, select the **Switch ... to ...** option under the **Setup** menu. This option will display whenever a SAS*Trainer* or SAS*Tracker* System is connected to the host PC. If multiple systems are connected, a selection will show for each connected analyzer. Make sure that the analyzer you wish to update is connected to the host PC and is turned on.



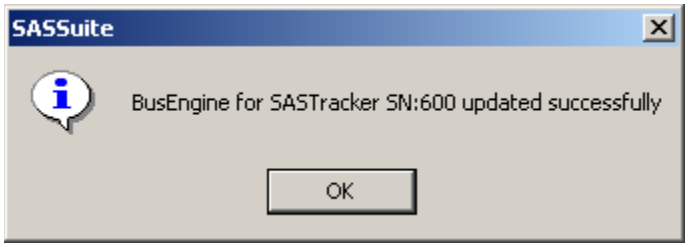
Once selected, a screen will appear asking you to confirm the choice. Select "Yes".



A progress bar will show the progress of the update.

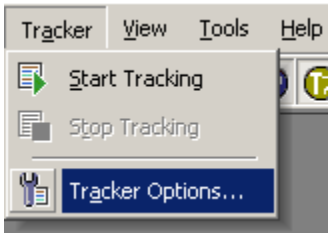


When the update completes, the analyzer will be restarted and a screen will appear confirming the update process. Click on "OK".

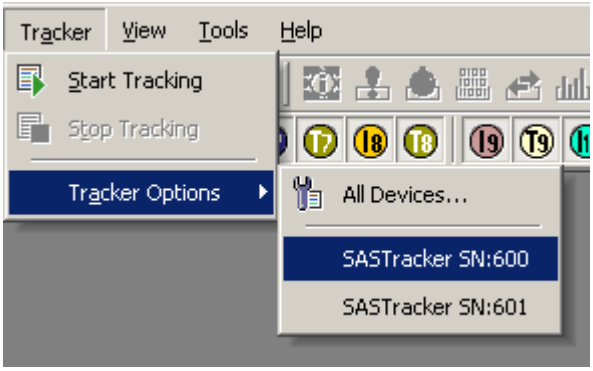


Preparing to Track a Command Sequence

Before starting to track commands with the SAS*Tracker* Command Analyzer, you should first set up the recording options by selecting **Tracker Options** under the **Tracker** menu (or under the **Setup** Menu--but do not use "Recording Options", that selection applies to SAS*Tracer* only).



Note: If you have more than one SAS*Tracker* System attached, you will see a submenu allowing you to choose whether to set the Tracker Options for all systems, or for a specific system only.



Note: In this and the following sections, the menu selections available in the Tracker menu are also available as icons in the Tracker Toolbar, as follows:

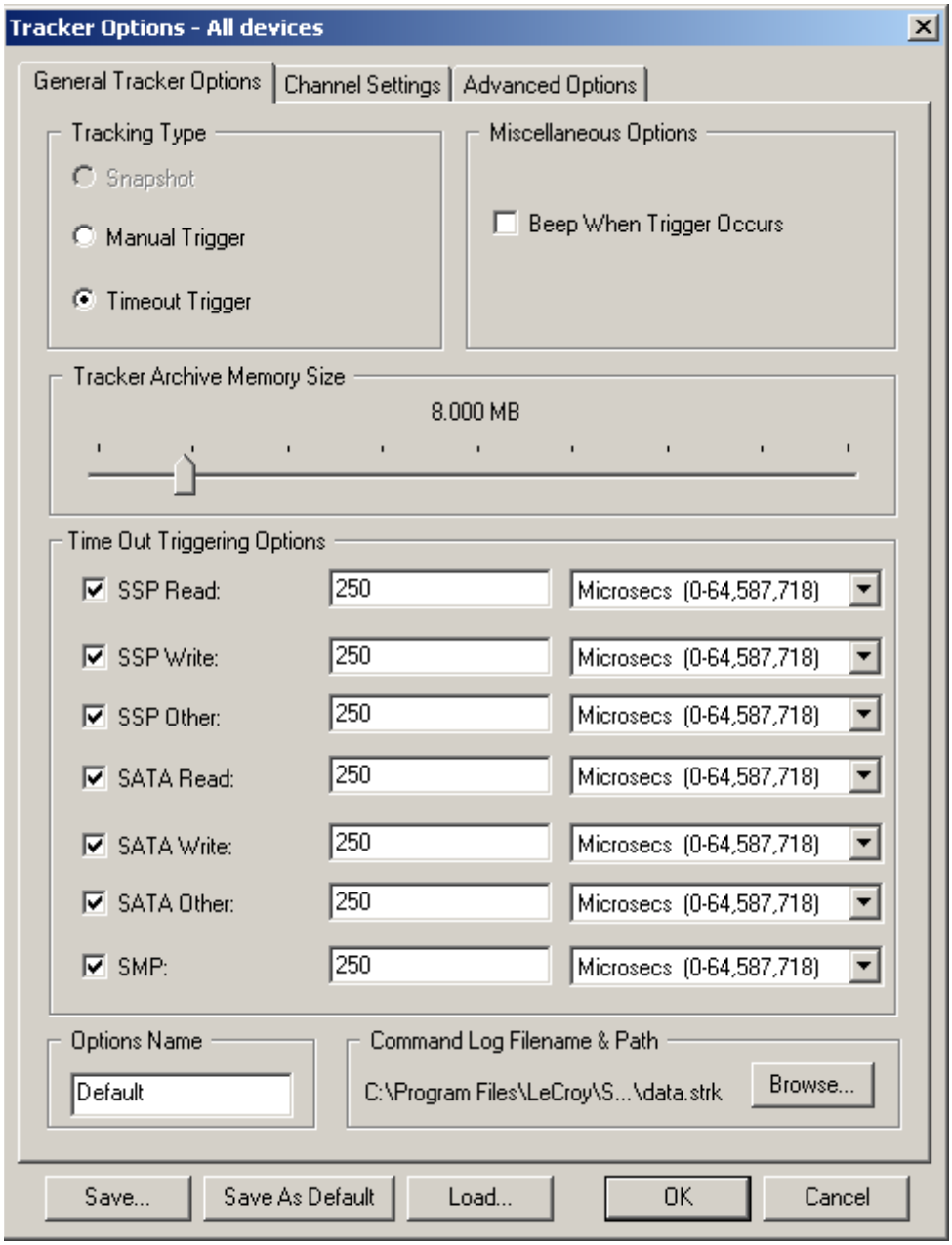
Tracker Buttons

Start Tracking

Tracker Options (if multiple SAS*Tracker* systems are connected, this button is used for "All Devices" by default).

Stop Tracking

Selecting the **Tracker Options** menu selection brings up the following screen:



Tracking Type

There are two types of tracking, differentiated by the way the recording is terminated, as listed below.

- **Manual Trigger:** In this mode, recording continues until **Stop Tracking** is selected in the **Tracker** menu. If the recording memory (defined in the Tracker Archive Memory Size selection) is exceeded, the recording wraps and recording continues, overwriting the oldest contents of the recording memory. The recording will continue to wrap (multiple times if necessary) until the manual trigger is pressed or recording is otherwise stopped.

- **Timeout Trigger:** In this mode, recording normally continues until one of the commands issued fails to complete within the user-defined Trigger Timeout period. In this mode, recording can also be stopped by using the **Stop Tracking** selection in the **Tracker** menu.

Misc. Options

Under **Miscellaneous Options**, there is an option for the SAS*Tracker* to provide a beep to alert the user when a trigger occurs.

Tracker Archive Memory Size

Under **Tracker Archive Memory Size**, the user may decide how large a recording file to generate by specifying the maximum file size in MB. The maximum value for this setting is roughly 1024 MB (1 GB). This setting affects when recording is terminated while using snapshot mode, and affects when recording wraps when using either trigger mode. Each 1MB of recording memory represents information on approximately 10,000 completed commands.

Time Out Triggering Options

Under **Time Out Triggering Options**, the user may specify the trigger timeout to use with each of seven command classes. This value in each class may vary from 0 to 32 seconds, and can be specified in integer units of seconds, milliseconds, microseconds or nanoseconds. Very small values are likely to result in almost immediate termination of the recording when Timeout Trigger mode is selected.

The seven command classes are as follows:

- SSP Read
- SSP Write
- SSP Other (any SSP command other than Read or Write)
- SATA Read
- SATA Write
- SATA Other (any SATA command other than Read or Write)
- SMP

Any of the seven command classes can be included as a trigger condition by selecting the checkbox to the left of the command class. Each selected command class is treated as a trigger condition such that any command timeout violation in any selected class will result in the system triggering.

For example, the user may specify that SSP Read commands that fail to complete within 100 microseconds are a trigger condition, but that SSP Write commands are allowed 1 second to complete. This allows the user to "fine tune" the trigger conditions to focus on specific command classes.

When the system triggers, tracking is stopped and the user is informed that a trigger has occurred.

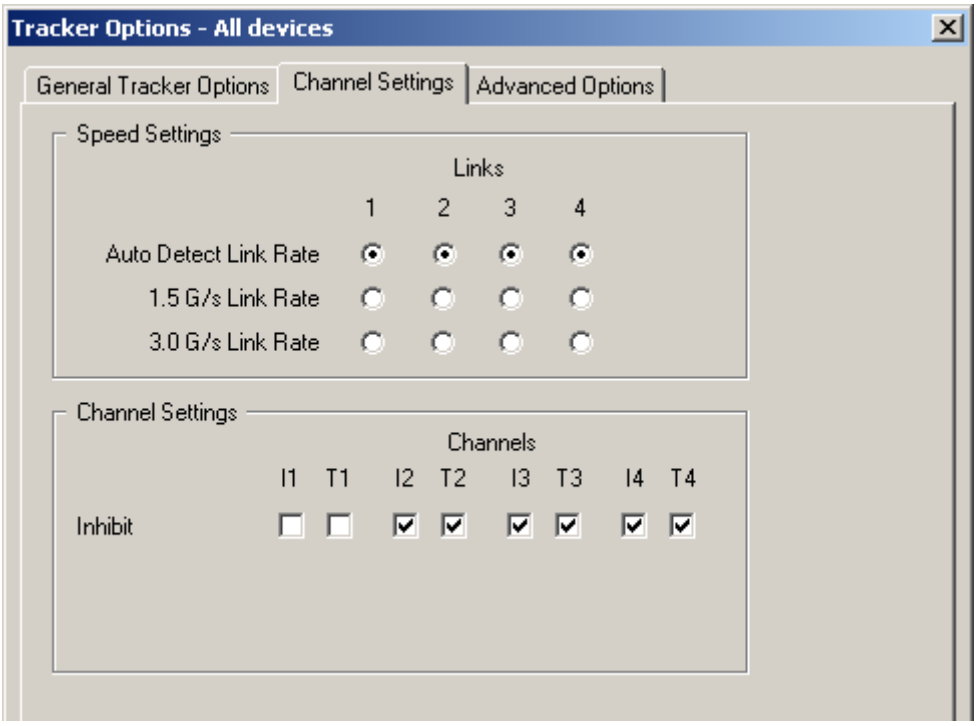
Command Log Filename

Under Command Log Filename & Path, the user can define the name of the file to be used for storing the recording when completed.

Saving Tracker Option Settings

When a specified set of Tracker Options has been established, the conditions may be saved by giving the options a name (under Options Name) and then choosing "Save..." or "Save as Default". A previously saved set of options can be reloaded by selecting the "Load..." button.

By selecting the "Channel Settings" tab, the following options are displayed:



Speed Settings

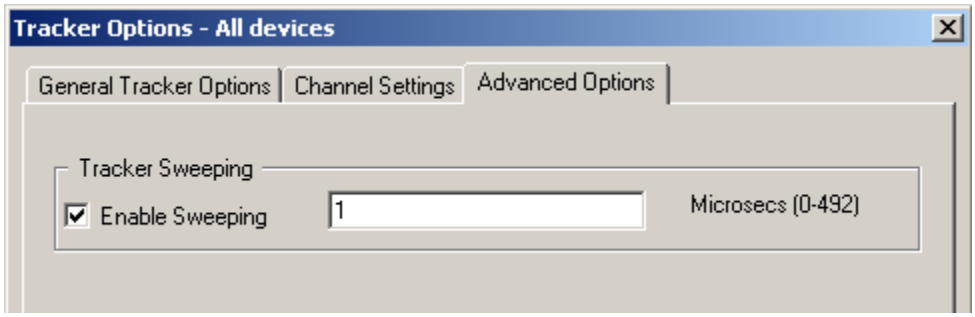
The SAS*Tracker* system supports Autodetect Link Rate which is designed to pass through the speed negotiation signaling allowing the initiator and device to determine the link speed using the method defined in the SAS specification. In general, this is the most convenient setting to use because it ensures 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, SAS*Tracker* will not decode the traffic properly. The user will know if devices are negotiating successfully by getting clean recordings.

Channel Settings

These options allow you to inhibit recording 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)."

By selecting the "Advanced Options" tab, the following screen is displayed:



Tracker Sweeping

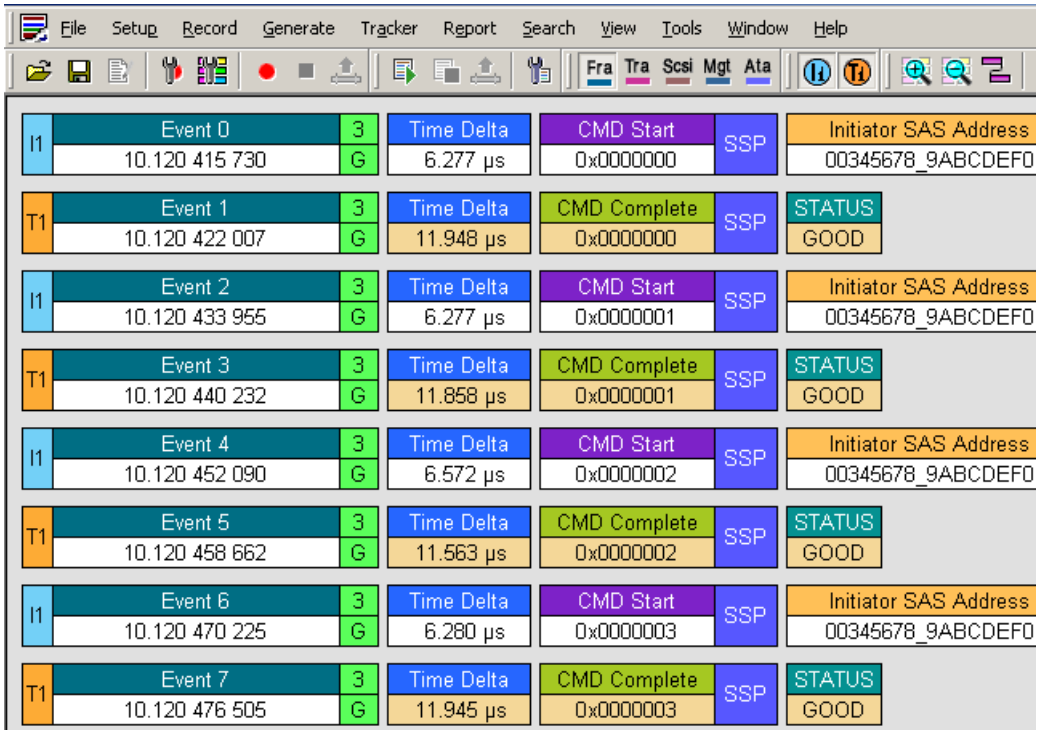
Under **Tracker Sweeping**, the user may select whether to enable sweeping and the sweeping interval. "Sweeping" refers to the rate at which SAS*Tracker* checks for incomplete commands which have exceeded the timeout trigger period. The SAS*Tracker* BusEngine divides available processing time between the tasks of (a) processing incoming commands and command terminations, and (b) monitoring for any commands that have exceeded the trigger timeout period. If the incoming traffic has a large number of very short commands with little data interspersed, or has a large number of complex command termination situations where multiple commands are ended with a single event, more time may be needed for command processing in order to keep up with the command flow. In such situations, the user can increase the interval of tracker sweeping to allow a larger portion of processing time to go towards command processing.

Note: If Tracker Sweeping is disabled but the Timeout Trigger mode is selected, the SAS*Tracker* system will still trigger when a Command End Event occurs that exceeds the defined Timeout Trigger value. However, in this situation the system will not be able to detect a timeout trigger due to commands that never receive a Command End Event (i.e., lost commands).

Viewing Command Log Files

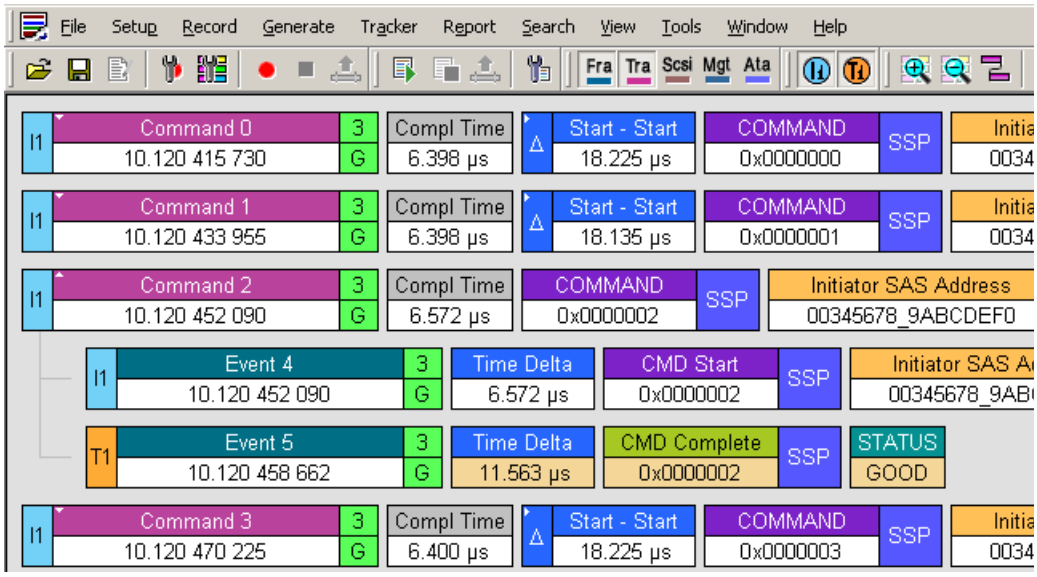
Command Log Files are displayed by SAS*Suite* in a format very similar to trace displays captured by SAS*Tracer* (discussed in “Reading a Recording” on page 125).

A typical SAS*Tracker* Command Log File is shown below.



In this file, we can see a simple set of events (commands and completions) taking place between one initiator and one target device. The value under the "CMD START" and "CMD COMPLETE" headings is the Command ID which is assigned by SAS*Tracker* (when the command is first issued) as a unique ID number for that particular command.

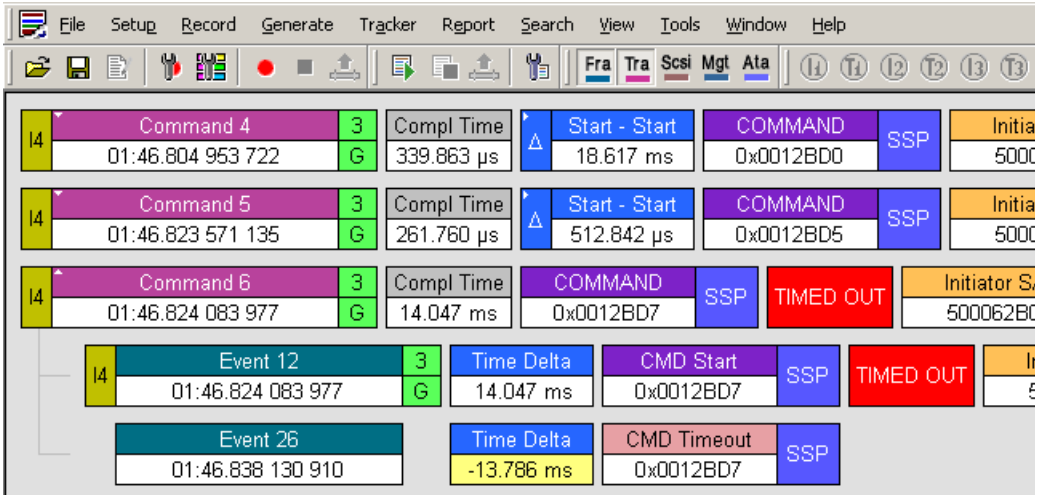
A more useful way to view this file (and many other SAS*Tracker* Command Log Files) is to select the transaction-oriented view by selecting **Transport Layer** under the **View** menu. The resulting view is as follows:



In this view, related events are grouped together as commands, and each command can be expanded to show the Command Start Event and Command End Event, as has been shown above in Command 2. To expand (or combine) commands, click on the small arrow in the upper left corner of the "Command XX" box.

When grouped as commands, the command completion time is shown for each command.

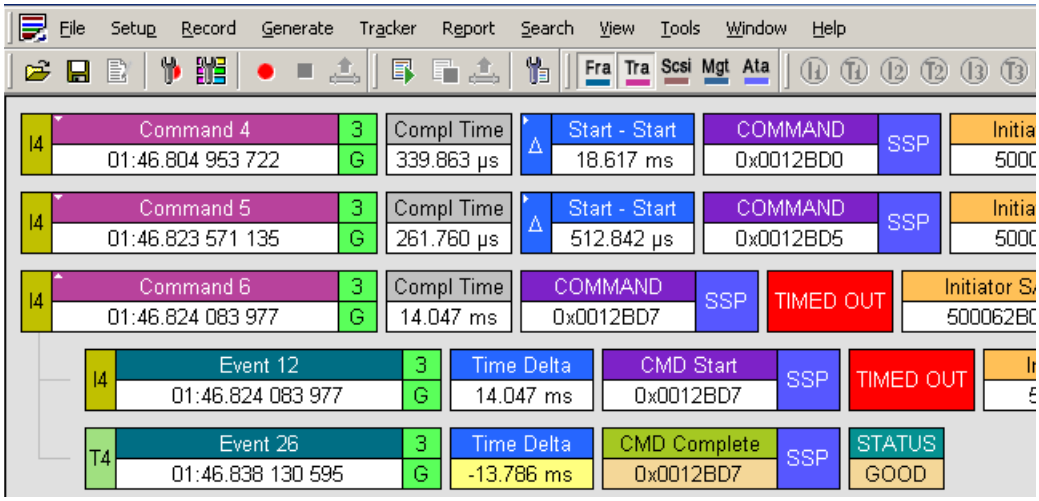
In this display, command fragments (see “Theory of Operation” on page 233) are shown as individual events that are not grouped into commands. However, if a command has caused the timeout trigger condition to be violated, that trigger event will be shown as a command in which the second "event" is a special trigger condition summary. This situation is illustrated in the following display:



A Command End Event is inserted by the SASTracker System when timeouts are detected and no Command End Event was recorded.

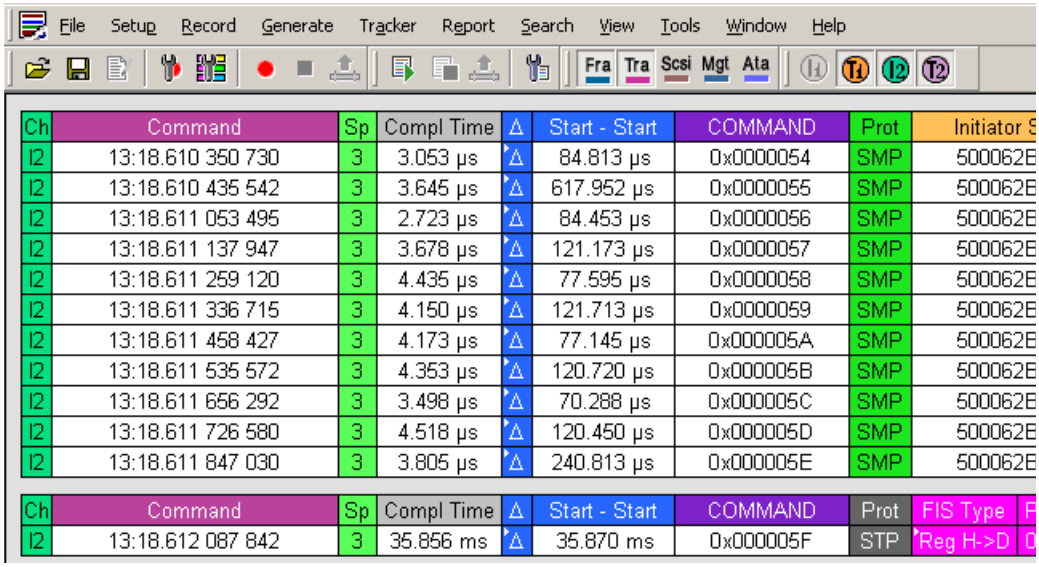
In this Command Log File, the command initiated in "Event 12" did not complete, and as a result the system has indicated this by flagging the event as "TIMED OUT". Expanding the transaction shows the result as "CMD TIMEOUT" to indicate that no command completion for this event was present in the Command Log File. A Command End Event is inserted by the SAS*Tracker* System to indicate that the trigger condition was violated.

A command may complete with an execution time longer than the trigger timeout period, but before the system has stopped recording. These late commands will have both a Command Start Event and a Command End Event, but the execution time still exceeds the trigger timeout. An example of this is shown in the display below:



This display shows that the Command End Event was recorded, but since the execution time exceeded the trigger timeout, the command was flagged as "TIMED OUT".

When viewing a large number of commands to determine a timeout violation, use of the Compact View is helpful. Select **Compact** from the **View** menu, or use the Ctrl-Q keyboard shortcut. The resulting display is shown below.



Ch	Command	Sp	Compl Time	Δ	Start - Start	COMMAND	Prot	Initiator
I2	13:18.610 350 730	3	3.053 µs	Δ	84.813 µs	0x0000054	SMP	500062E
I2	13:18.610 435 542	3	3.645 µs	Δ	617.952 µs	0x0000055	SMP	500062E
I2	13:18.611 053 495	3	2.723 µs	Δ	84.453 µs	0x0000056	SMP	500062E
I2	13:18.611 137 947	3	3.678 µs	Δ	121.173 µs	0x0000057	SMP	500062E
I2	13:18.611 259 120	3	4.435 µs	Δ	77.595 µs	0x0000058	SMP	500062E
I2	13:18.611 336 715	3	4.150 µs	Δ	121.713 µs	0x0000059	SMP	500062E
I2	13:18.611 458 427	3	4.173 µs	Δ	77.145 µs	0x000005A	SMP	500062E
I2	13:18.611 535 572	3	4.353 µs	Δ	120.720 µs	0x000005B	SMP	500062E
I2	13:18.611 656 292	3	3.498 µs	Δ	70.288 µs	0x000005C	SMP	500062E
I2	13:18.611 726 580	3	4.518 µs	Δ	120.450 µs	0x000005D	SMP	500062E
I2	13:18.611 847 030	3	3.805 µs	Δ	240.813 µs	0x000005E	SMP	500062E

Ch	Command	Sp	Compl Time	Δ	Start - Start	COMMAND	Prot	FIS Type
I2	13:18.612 087 842	3	35.856 ms	Δ	35.870 ms	0x000005F	STP	Reg H->D

Command Log File Reports

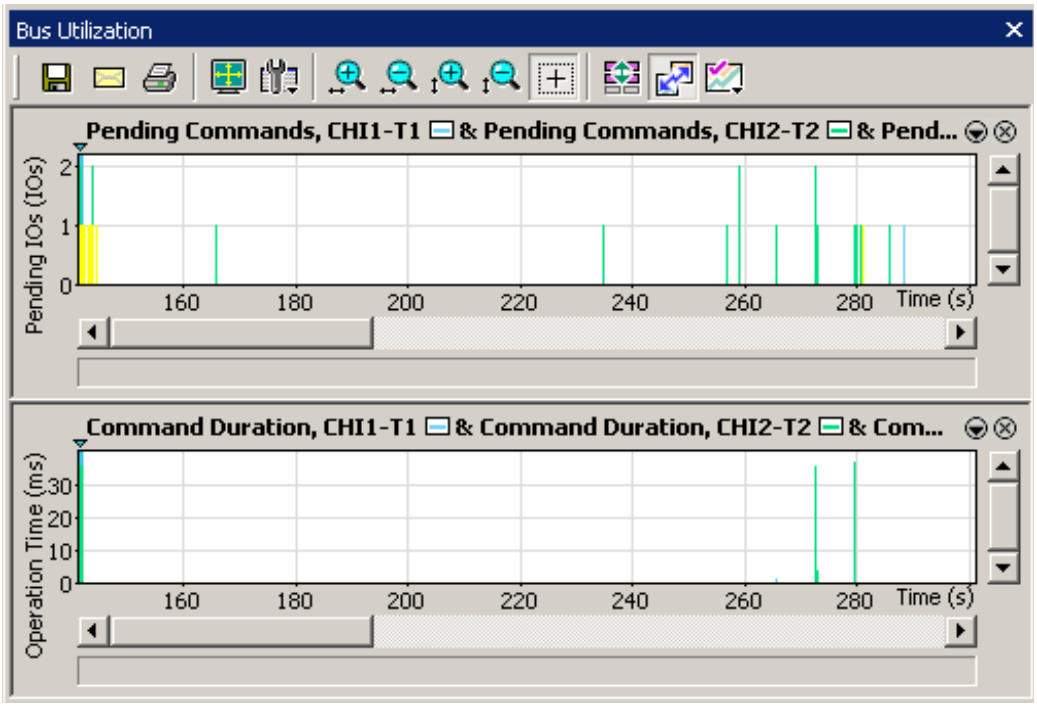
As with trace files collected with SAS*Tracer*, command log files generated by SAS*Tracker* have access to reporting capabilities within the SAS*Suite* program.

One of the more useful reports available for SAS*Tracker* Command Log Files is the "Bus Utilization" report, which in the case of SASTracker files will show the following:

- The number of **pending commands** at all times during the period that the Command Log File was recording. This display is useful to determine the outstanding commands that existed at any point in time, and to determine times at which the number of pending commands was larger than usual for the system.
- The **command duration** for all completed commands contained within the command log file, shown against the time they occurred within the recorded trace. This display highlights commands which were taking unusually long times to complete, and by having this data aligned with the pending command data mentioned above, the user can determine whether long command completion times are related to the number of pending commands, or due to some other effect.

To display the Bus Utilization report, select the **Bus Utilization** menu selection in the **Report** menu, or click the Bus Utilization button  in the Analysis toolbar.

The following graphs are displayed in the bottom half of the screen:

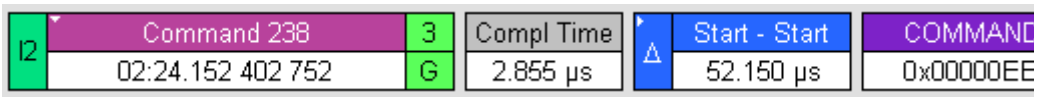


The graph display can be customized to focus on areas of particular interest using the tools provided in the icons at the top of the graph. By double-clicking at any point within the graph area, the Command Log File display in the top half of the screen will jump to that section of the file. For more information on manipulating this display, see “Bus Utilization” on page 160.

Exporting Command Log Files

As with trace files, Command Log Files from SAS*Tracker* can be exported for use by other data analysis programs (such as MicroSoft Excel). The data that is exported depends, to an extent, on the data displayed on the screen.

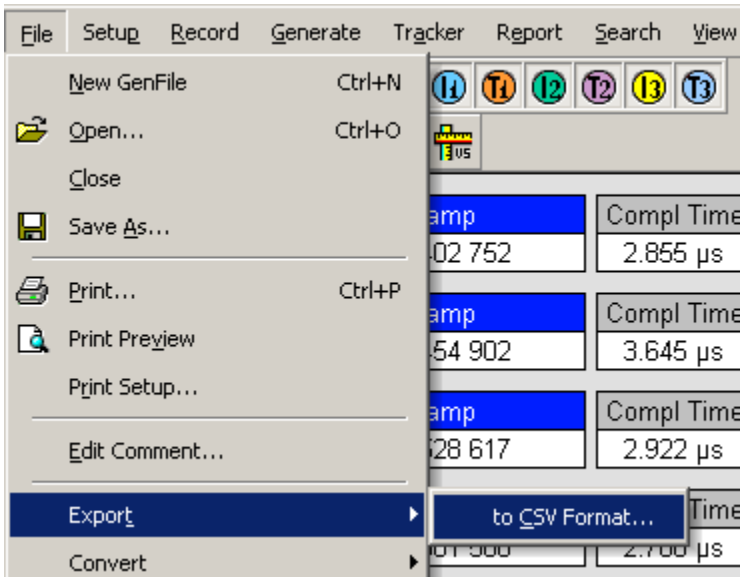
In the default SAS*Tracker* display, the timestamps for each event are combined (for convenience in reading the log file) with the command number, as shown below.



If timestamps are desired in the exported data file, the first step in exporting the data is to separate the timestamp into its own field. To do this, select **Display Options...** from the **Setup** Menu. Under the "General" tab, change the field marked "Time Stamp Position" to be "At the beginning", and click "OK". The display will now appear as follows:

In a similar fashion, the user can have some control over the data which is exported by expanding and/or contracting data files as described in “Expanding and Collapsing Fields” on page 132.

To export the Command Log File, select **Export.. to CSV Format...** in the **File** menu.

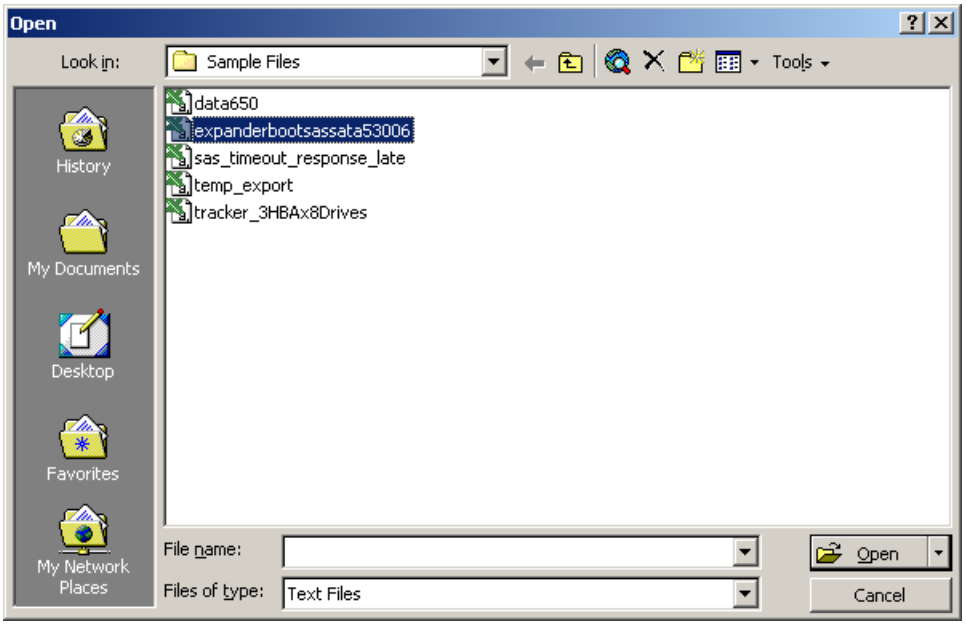


The next screen will allow you to specify a filename and location for the exported file, and also to limit the data exported to some portion of the file if only a portion is required.

Working with Exported Data Files

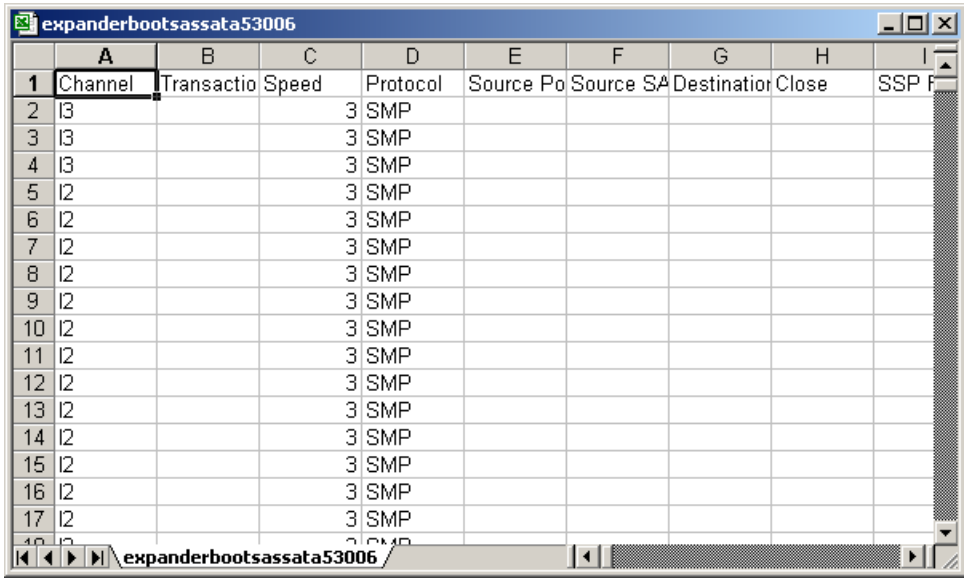
The file type which is exported from SAS*Suite* is a generic text data file (.csv) which can be imported into many applications. In this example, we will use Microsoft Excel, but the same procedure can be used with many database and spreadsheet applications.

Once the file has been saved, open Microsoft Excel. Select **Open..** from the **File** menu, which will bring up a screen allowing you to navigate to the folder in which you saved the file. (If you have forgotten where you saved the file, go back to the SAS*Suite* program and select **File... Export to CSV Format...** again and note which directory and folder contains the exported file.)



At the bottom of this screen, under "Files of Type:", select "Text Files". This will produce a display of all .csv files contained in the folder. Click on the correct file to highlight it, then click on **Open**.

When the file is opened, a large spreadsheet similar the following will appear:



This spreadsheet will have a large number of columns (most of which are blank). This format is used for all SAS*Suite* data exports, and many of the columns will not have application to SAS*Tracker* data files.

The first row of the spreadsheet contains the titles for each column. Remaining rows contain information on each completed command that was present in the exported data.

Since there are many blank columns (for data values which are not used in SAS*Tracker* Command Log Files), these columns can be deleted to simplify the spreadsheet. If a very large number of events has been exported, it may be difficult to be sure that no data exists anywhere in a column. In such cases, insert an extra row just below the column titles and enter a formula similar to "=1000 - COUNTBLANK(A3:A1002)", and copy this value across all columns. In this example (which assumes 1000 exported events), all blank columns will show "0" as the result of this function and may be deleted. Any column with data will show the number of cells that contain data in that column.

Some data is exported as text fields which represent numeric values. For example, the command completion time will be exported as fields such as "234.245 us" or "3.456 ms". In order to convert these text fields to values which can be sorted and otherwise manipulated, create a new column next to the "COMPL TIME" column and enter a formula such as the following into the first data row of the new column:

```
=IF(P2="","",IF(RIGHT(P2,2)="ms",1000*VALUE(LEFT(P2,LEN(P2)-3)),
                                                VALUE(LEFT(P2,LEN(P2)-3))))
```

This formula assumes that the original data value is in cell P2. The formula first checks to see if P2 contains any data (if not a blank value will be inserted--this is typically the case for command fragments such as incomplete commands or orphans). If data exists, the formula determines whether the units used are millisecs ("ms"), in which case it extracts the numeric value of the cell and multiplies it 1000. If the units are not ms, then the formula extracts the numeric value as microseconds. The result (for data that contains only millisec and microsec values), is a column with completion times all in microseconds.

Copy this formula down the length of the column, and all original text data is converted to numeric data expressed in microseconds.

> **Note:** If the data fields contain other units such as seconds or nanseconds, the formula will need to be modified to account for all units used.

The commands in the file can now be sorted in increasing or decreasing order of command completion time by selecting all rows containing data, then selecting **Sort** from the **Data** menu in Microsoft Excel. Choose the column which contains the numeric completion times, and select "Ascending" or "Descending".

Creating a Histogram using Microsoft Excel

Microsoft Excel and other database and spreadsheet programs often have sophisticated statistical functions useful for analyzing the data produced by SAS*Tracker.* For example, it may be useful to have a histogram of command completion times for a Command Log File, to show the range and the pattern of variation of the command completion times. A histogram is a chart which shows the frequency of occurance of values within a specified data range, and allows the user to easily see which completion times cluster around certain values, and which are unusual.

One way to create this chart is to begin by converting all command completion times into data values as described above. Once this column is created, some basic statistic values can be determined using Excel formulas, such as the following (in this example, the data is contained in column Q, rows 2 through 512):

- The number of valid datapoints can be determined by using the formula "=511 - COUNTBLANK(Q2:Q512)"
- The maximum value in the range of command completion times can be determined by the formula "=MAX(Q2:Q512)"
- The minimum value in the range of command completion times can be determined by the formula "=MIN(Q2:Q512)

Once the minimum and maximum values are known, the histogram can be prepared by deciding on the "buckets" to be used to collect the data.

An example is shown below. In this example, the measured command completion times varied from 1.645 microseconds to 36,852 microseconds. Data "buckets" were set up for the following ranges:

- Less than 2 us
- 2-3 us
- 3-5 us
- 5-10 us
- 10-100 us
- 100-1,000 us
- 1,000-10,000 us
- 10,000-50,000 us

These values were entered in cells Q519 through Q526.

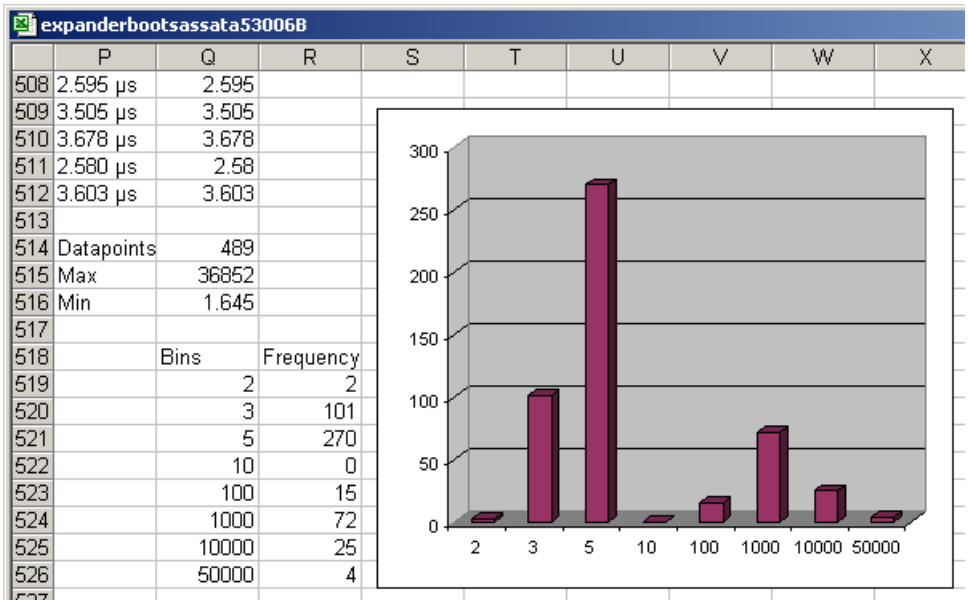
To create the histogram, first select all cells which will contain the data, in this case cells R519 through R526. Type in the following formula:

=FREQUENCY(Q2:Q512,Q519:Q526)

but instead of pressing ENTER to enter the formula, press CTRL+SHIFT+ENTER. This enters this formula into the entire array of cells you selected. The values shown are the number of datapoint that fall between each "bucket" value.

You can produce a graph of this data by using the Excel Chart Wizard. Select the cells containing the histogram data. Click on the Chart Wizard icon and follow the instructions. On the second step, click on the "Series" tab, then on the "Category (X) axis labels:" field, select the list of "buckets" in Q519 through Q526, and enter them as axis labels.

The result is the graph shown below:



This graph shows an interesting bimodal distribution in command completion times, with a large set of commands completing within less than 5 microsecond, and another set of commands requiring 1-20 milliseconds to complete. By sorting and analyzing this pattern, the user can more easily understand which commands are resulting in long completion times and causing performance degradation.

Chapter 15: Updates and Licensing

From time to time as modifications are made to the SAS*Suite* Analyzer Software, it may become necessary to update the SAS*Suite* software. You can obtain new software from the LeCroy website:

www.LeCroy.com

When you download new SAS*Suite* 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 SAS analyzers include downloads of new SAS*Suite* software releases that are made available during the 12 months after purchase. Following that time, software releases are included when the LeCroy Maintenance Agreement is purchased. Contact LeCroy for details.

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 SAS*Suite* 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 SASSuite…** from the **Help** menu.

The About SAS*Suite* window appears.

About SASSuite details revisions of the following software and hardware:

- SAS*Suite* Software Version, Build Number
- Firmware Version of Analyzer (if connected)
- BusEngine Version, Build Number (if connected)
- Unit Serial Number (if connected)

Note: When contacting LeCroy for technical support, please have available all the revisions reported in the **About SASSuite** window.

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**.

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 installer file from the website.

Step 3 Unzip the files into your choice of directory (if required).

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.

Automatic BusEngine and Firmware Updates

BusEngine and Firmware updates often need to be performed when you update the SAS*Suite* software. These updates can be performed automatically or manually. Both processes are described.

Updating the BusEngine

The BusEngine core is the heart of the LeCroy SAS 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 SAS*Suite* software is updated, the software may become incompatible with the BusEngine and Firmware. If a recording is attempted, SAS*Suite* displays an error message and then automatically begins an update process for the BusEngine and Firmware.

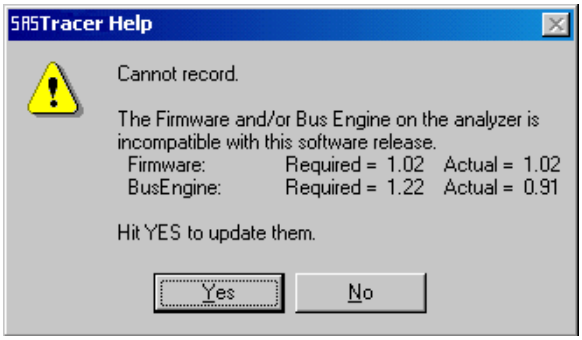
To perform an automatic BusEngine and Firmware update, follow these steps:

Step 1 If needed, update the SAS*Suite* software, following the steps outlined in "Software Updates."

Step 2 Turn on the Analyzer.

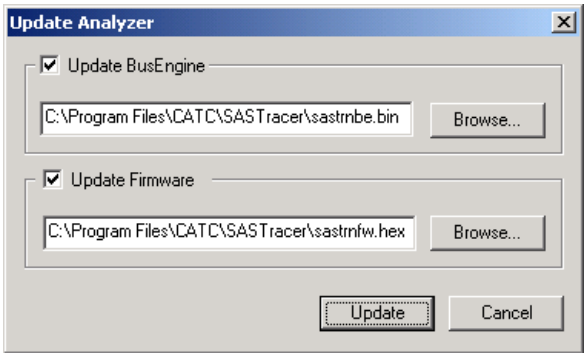
Step 3 Select **Start** > **Record** from the menu.

Because the BusEngine and/or the Firmware are incompatible with the current SAS*Suite* 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.

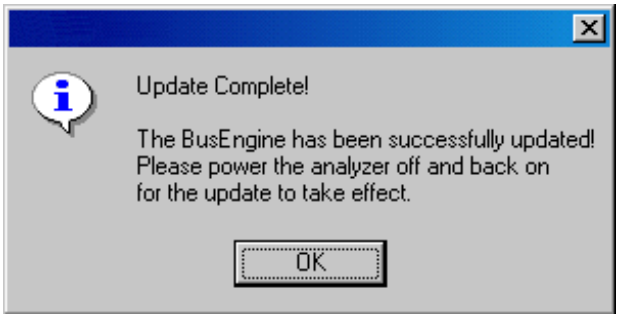


Step 5 Click **Update**.

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.

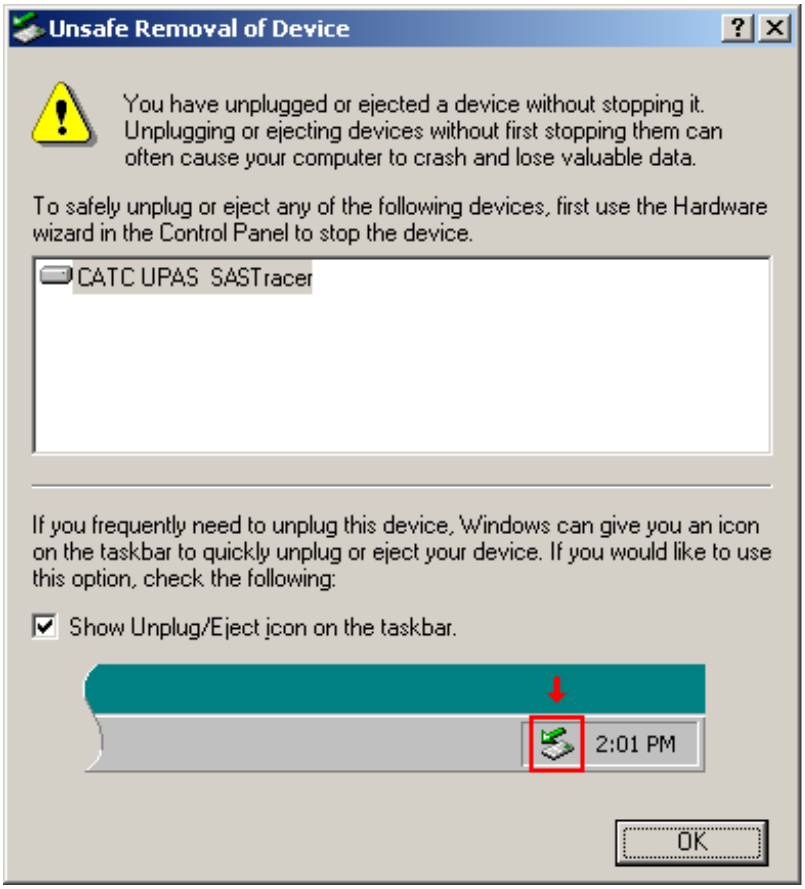
Note: Once you have started updating the BusEngine or Firmware, do not interrupt the update!

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 SAS*Suite* (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).

License Information

Licensing information for SAS*Suite* can be viewed by selecting Display License Information from the Help menu. The License window provides maintenance expiration for SAS*Suite*.

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…	http://www.lecroy.com/

Limited Hardware Warranty

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

What this Warranty Does Not Cover

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

Coverage During Warranty Period

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

How to Obtain Warranty Service

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

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

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

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

If LeCroy evaluates and determines there is "no trouble found" in any Product returned or that the returned Product is not eligible for warranty coverage, LeCroy will inform you of its determination. If you thereafter request LeCroy to repair the Product, such labor and service shall be performed under the terms and conditions of LeCroy's then current repair policy. If you chose not to have the Product repaired by LeCroy, you agree to pay LeCroy for the cost to return the Product to you and that LeCroy may require payment in advance of shipment.

General Provisions

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

LECROY DOES NOT ACCEPT LIABILITY BEYOND THE REMEDIES SET FORTH IN THIS LIMITED WARRANTY STATEMENT OR FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING, WITHOUT LIMITATION, ANY LIABILITY FOR THIRD PARTY CLAIMS AGAINST YOU FOR DAMAGES, PRODUCTS NOT

BEING AVAILABLE FOR USE, OR FOR LOST DATA OR SOFTWARE. LECROY'S LIABILITY TO YOU MAY NOT EXCEED THE AMOUNT YOU PAID FOR THE PRODUCT THAT IS THE SUBJECT OF A CLAIM. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE PRECEDING EXCLUSION OR LIMITATION MAY NOT APPLY TO YOU.

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

Appendix A: Specifications

Avalanche Systems

	Host Requirements	Windows 2000 or gretaer; Intel Pentium II processor or greater; USB port
	Recording Memory Size	4 GB for trace capture, timing and control information
	Power Requirements	100-250 VAC, 50-60 Hz (universal input), 480W max
	Back Panel Connectors	AC Power connection, External trigger connections (TRIG IN/OUT, SMA), USB type "B" host computer connection, Breakout Board Data Output Connection
	Manual Trigger Switch	Forces a trigger event when pressed
	Basic Trigger Events	Primitives, Bus Conditions, FISs, Errors, ATA Commands, SATA Commands, External Signals, Vendor FIS, Data Pattern SCSI Operations, SCSI Status, SSP IUs, SMP Request/Response
	Traffic Summary Reports	Errors, Primitives, FIS, Frames, Transactions, SCSI Operations, ATA Commands
	Bus Utilization Reports	Pending SCSI IOs, Pending ATA IOs, Response Time, Latency Time, Throughput, Frame Length, Link Utilization, Data Throughput, Frames Count
Connectors	Two (2) 4-port MiniSAS	One MiniSAS connector supports up to four initiators, the second connector supports up to four targets
Indicators	Initiator Status (1, 2, 3, 4)	Green when receiving frame, Mixed Green/Red during OOB, Red on error
	Initiator Speed (1, 2, 3, 4)	Green for 6 Gb/s, Mixed Green/Yellow for 3 Gb/s, Yellow for 1.5 Gb/s
	Target Status (1, 2, 3, 4)	Green when receiving frame, Mixed Green/Red during OOB, Red on error
	Target Speed (1, 2, 3, 4)	Green for 6 Gb/s, Mixed Green/Yellow for 3 Gb/s, FYellow for 1.5 Gb/s
	Trig/Err Right	Green when Channel 1 or 2 are triggered, Red on error
	Rec/Upload Right	Red when Channel 1 or 3 are recording, Green when uploading
	Trig/Err Left	Green when Channel 3 or 4 are triggered, Red on error
	Rec/Upload Left	Red when Channel 3 or 4 are recording, Green when uploading

Physical and Environmental

Dimensions (W x H x D)	29.4 x 6.7 x 23.7 cm (11.6 x 2.6 x 9.3 inches)
Net Weight (Chassis)	3.4 Kg (7.5 lbs)
Net Weight (Chassis + PS)	4.3 Kg (9.5 lbs)
Temperature: Operating	0C to 55C (32F to 131F)
Temperature: Non-operating	-20C to 80C (-4F to 176F)
Humidity: Operating	10% to 90% RH (non-condensing)

SAS*Tracer*/*Trainer* Systems

LeCroy SAS*Tracer*/*Trainer* analyzers are hardware modules that install into the CATC 10K platform. The following specifications describe a combined SAS 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) Single-wide Plug-in: 4.5 x 6.7 x 1.3 inches (11.3 x 17.0 x 3.2 cm) Double-wide Plug-in: 9.5 x 6.7 x 1.3 inches (24.1 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) Single-wide Plug-in: 1 lb 11.4 oz (.77 kg) Double-wide Plug-in: 3 lb 3 oz (1.45kg)

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
Operating Altitude:	Up to 6.560 feet (2,000 meters)

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)

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.

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

CATC 10K:	Illuminated when the analyzer is powered on.
Status (STATUS):	Illuminates for approximately 25 seconds during initialization/power up of the CATC 10K 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:	
Status (STATUS):	Illuminates when there is traffic on both the host and device sides. Blinks when there is traffic on one side only.

Basic SAS*Tracer* 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

SAS*Tracer* Traffic Summary Reports

Data Frames
Primitives
Connects/Disconnects
Errors
SCSI Commands
Read Response (min, max, avg.)
Write Response (min, max, avg.)

Miscellaneous Information

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

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

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

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

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

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