

CATC SATracer/Trainer™

Serial ATA Protocol Analyzer

User's Manual



For Software Version 3.1

Manual Version 3.1

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1. Overview

The CATC *SATracer/Trainer*[™] SATA protocol analyzer provides fast, efficient and accurate debug, test and verification of Serial ATA semiconductors, devices, and systems.

Effective Serial ATA analysis requires non-intrusive recording at both 1.5 and 3 Gbps line-rate with native support for spread spectrum clocked (SSC) signals. CATC's 4th Generation SATA analyzer utilizes production level transceiver silicon designed to be fully compatible with Serial ATA-II. It displays traffic using CATC's Expert Analysis Software to provide unsurpassed ease of use and understanding for Serial ATA communications.

1.1 Analyzer Hardware

SATracer is a hardware plug-in module that installs into the CATC Universal Protocol Analyzer System (UPAS 10000). The UPAS 10000 is CATC's highest bandwidth platform intelligently designed to support other technologies by plugging different protocol-specific modules into the chassis. Affordable plug-ins are available for Fibre Channel, PCI-Express and InfiniBand. The *SATracer* system can also be upgraded with software to support Serial Attached SCSI (SAS).

The heart of the UPAS platform is the revolutionary CATC BusEngine[™]. This state-of-the-art protocol processor core incorporates a real-time recording engine and configurable tools to effectively monitor Serial ATA traffic at full line rate. All BusEngine logic is fully field-upgradeable.

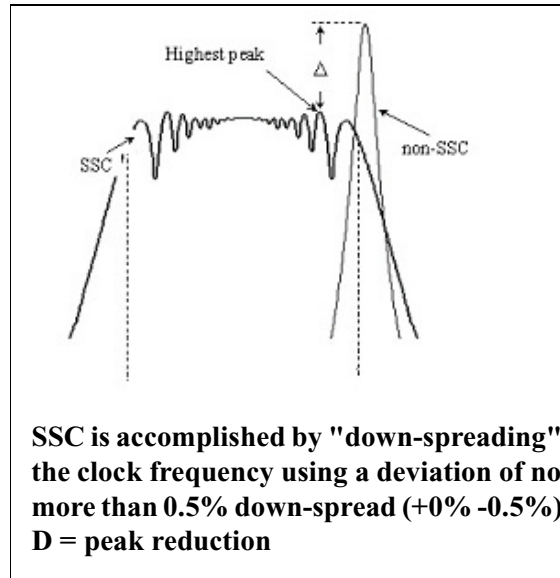
CATC's *SATracer* analyzer module plug-in utilizes production level transceiver silicon designed to be fully compatible with Serial ATA-II. It triggers and records the critical out-of-band (OOB) signaling, supports SSC and displays SATA-II negotiated link speeds. A Hi-Speed USB port is used to upload Serial ATA traffic to the host PC.

SATracer comes with trace viewer software that can be installed on PCs as a stand-alone viewer to view Serial ATA data recorded by other *SATracer* analyzers, thereby giving engineers a vehicle for sharing trace data and resolving problems encountered in the trace.

1.2 Spread Spectrum Clocking

SATracer version 1.4 and above can record traffic from Serial ATA devices that utilize spread spectrum clocked (SSC) signaling. SSC modulates the operating frequency of a circuit slightly to spread its radiated emissions over

a range of frequencies rather than just one tone. By distributing emissions for a given frequency, SSC transmissions help devices meet FCC requirements.



SSC transmission is optional on the transmitter (TX) side for both host and device. However, SSC is a mandatory capability for all Serial ATA receivers (RX). This requirement eliminates compatibility issues by ensuring that all devices can tolerate SSC signals when attached to a device that transmits SSC signaling.

Please refer to the *Serial ATA Specification* for details on the Serial ATA protocol. The Serial ATA specification is available from the Serial ATA at its web site <http://www.serialata.org>.

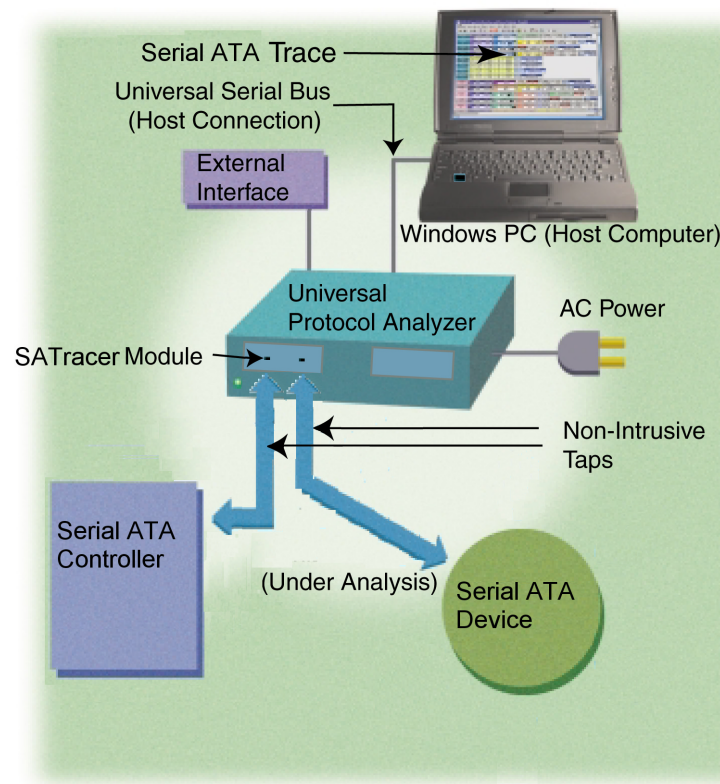


1.3 General Description

SATracer/Trainer is a plug-in module that installs into a chassis called the *Universal Protocol Analyzer System 10000 (UPAS 10K)*. The UPAS 10K, in turn, connects to a PC over a Hi-Speed USB cable. The PC functions as the host controller for the SATracer and UPAS. SATracer software on the PC controls and configures the analyzer and retrieves and displays trace data.

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

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



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

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

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

1.4 Features

SATracer Plug-in Module Hardware

- SATracer Analyzer records and analyzes GB Serial ATA traffic
- SATracer plug-in module designed for the CATC Universal Protocol Analyzer System (UPAS)
- Taps between host and device using standard connectors and cables
- Two GByte recording capacity to capture long time windows for analysis and problem solving
- Field-upgradeable firmware and recording engine with upgrades available for download direct from CATC
- External Breakout board for triggering from external signals or for triggering to external equipment

SATrainer Plug-in Module Hardware

- Integrated Analyzer and Generator system - all in one platform transmits, records, and analyzes Serial ATA protocol
- Serial ATA I compliant Host and Device Emulation serves as flexible platform for testing both host and devices
- Transmit Legal and illegal Serial ATA traffic - create framing and code errors
- Manual error injection for testing and debugging real-world fault handling
- Operates in both single-burst and continuous transmission modes for configuring generator for real-time or overnight stress testing
- Recreate problems reported in the field using only a sample CATC trace capture file - validate interoperability and compatibility with pre-production hardware that has limited availability

Software

- Industry-standard CATC Trace user interface
- Accurately time-stamped, easy visualization of bi-directional sequence between transmitter and receiver
- Turns an unintelligible stream of primitives into color-coded, clearly labeled protocol elements
- Collapsible and expandable headers with tool tip explanations make it easy to navigate and interpret sequence contents, headers, and commands

- Export any trace file to create test patterns for the Generator - quickly and easily assemble sequences of primitives to emulate a variety of real world traffic conditions
- Online help

Recording Options

- UPAS 10K systems record up to 2 GB of Serial ATA data, timing and control information. UPAS 2500H systems records up to 512 MB
- Three recording modes: snapshot, manual trigger, and event trigger
- Selectable recording buffer size and trigger position
- UPAS 10K systems record the full data rate of a single 1.5 or 3.0 Gbit/sec Serial ATA link. UPAS 2500H records 1.5 Gbit/sec
- Trigger on Serial ATA conditions like Bus Conditions, Primitives, FIS, Errors, and Data Patterns
- Trigger on a comprehensive list of error conditions like running disparity, or FIS errors
- UPAS 2500H can trigger on sequences of up to six events
- Programmable triggering based on bit-wise pattern matching of Serial ATA headers and data payloads

Display Options

- Extensive use of color and graphics within the trace
- The base level traffic unit is a *Sequence*, which is a CATC-defined term for a serial stream of primitives and data transmitted from a host to a device or *vice versa*.
- Sequence, FIS, and Command errors and protocol violations are highlighted in red
- Sequence color clearly indicates position before or after the trigger point
- Sequences can be marked with text annotations that become tool tips for future reference
- Tool tips with complete definitions of most fields
- Search, show or hide only the data of interest using Serial ATA-specific criteria
- Sequences, FISs, and Commands are accurately time-stamped (26.67 ns resolution)
- Measure time, throughput or total data payload between Sequence, FIS, and Command markers or relative to the trigger position

SATracer/Trainer BusEngine

CATC's BusEngine™ Technology is at the heart of the new SATracer/Trainer Analyzer. 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 CATC Website.

Power Cord Set

Cord Manufacturer and Models:

180-0005-00 Quail 5000.079 UL,CSA

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

180-0014-00 Quail 9650.098 ASTA

UPAS 10000 and 2500H Platforms

UPAS 10K and 2500H are USB 2.0 Certified Hi-Speed Devices. To upload traces from the UPAS/SATracer to an attached PC at Hi-Speed, the PC must have a USB 2.0 Certified Host Controller and be running Windows 2000 SP3 or Windows XP.

Note The UPAS 10K and 2500H products include 2.0 USB hubs. You might see the drivers for these generic hubs being installed upon the initial plug-in.

2. Installation

SATracer/Trainer is a factory-installed module that is sold as part of the Universal Protocol Analyzer System (UPAS).

This chapter describes how to set up SATracer/Trainer and create your first recording.

2.1 System Components/Packing List

- One stand-alone SATracer/Trainer Analyzer module
- One USB cable
- Two Serial ATA cables
- SATracer software program CD-ROM
- Breakout board
- DB-25 Cable
- User Manual

2.2 Analyzer PC Requirements

SATrainer/Tracer connects to a Host PC. The Host PC needs to meet the requirements outlined in the readme file on the Installation CD.

2.3 Analyzer LED Descriptions

The installed SATracer/Trainer analyzer module occupies the left slot on the CATC Universal Protocol Analyzer System (UPAS). When powered on, the SATracer activates the user-accessible controls and LEDs on the front and rear panels of the UPAS.

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

Figure 1: Front Panel of UPAS 2500H System with SATracer Module.



UPAS LEDs (from left to right)

- Green **PWR** (power) indicator LED for UPAS - lights when the unit power is switched on.
- Red **Status** indicator LED for UPAS - lights during initialization/power up of UPAS base unit. Blinks if a self-test fails.

The following LEDs and the **Manual Trigger** button on the UPAS enclosure under the left module slot function in conjunction with the SATracer module inserted above it.

- Green **REC** (recording) LED - lights when the unit is recording.
- Orange **TRG** (triggered) LED - lights when the unit triggers on an event.
- Green **UPLD** (Upload) - lights when unit is uploading data to PC.
- The **Manual Trigger** push-button - allows a manual Trace capture.

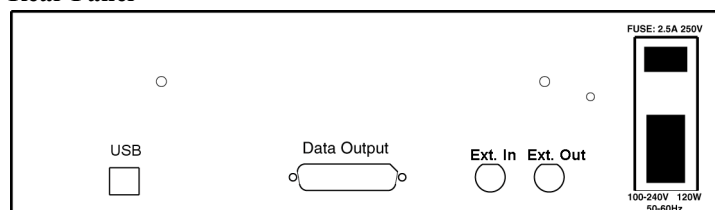
LEDs and Connectors on the SATracer Module

- Green **Status** LED (Illuminates when there is traffic on both the host and device side of the bus).
- Serial ATA Connectors (2).

2.4 Rear Panel Description

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

Figure 2: Rear Panel



USB type "B" host computer connector

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

RS-232 25 pin "Data Output" Connector

This connector links a 25 pin RS-232 cable to an external breakout board. The breakout board allows signals to be sent from the analyzer to an external device such as an oscilloscope or from an external device to the analyzer for

the purpose of triggering on an external input. You configure input/output signalling through the Recording Options dialog box. Breakout board use is described at the end of this chapter.

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

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

Wide range AC connector module

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

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

2.5 Setting Up the Analyzer

The following steps show the installation procedure for the SATracer on a UPAS 2500H system. The installation steps for the UPAS 10K are essentially the same.

Step 1 Remove the SATracer/Trainer/UPAS from its shipping container.

The SATracer/Trainer module will already be installed in the left slot. The right slot will have a memory module installed in order to run the BusEngine and Firmware.

Previous versions of SATracer have a blank face plate that covers the right slot bay, which should be left in place to facilitate proper airflow and venting.

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

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

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

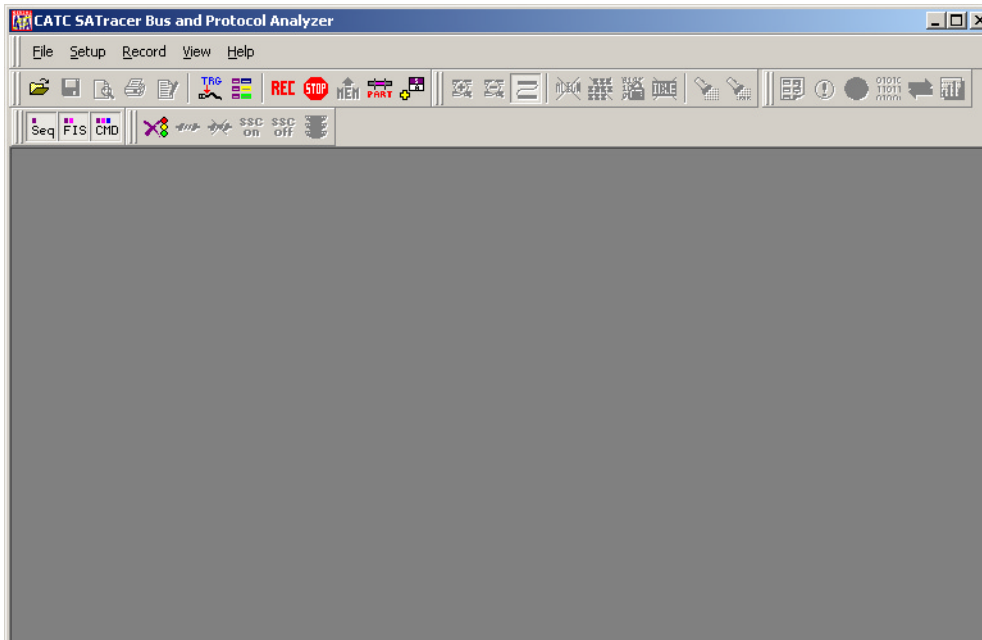
- Note:** At power-on, the analyzer initializes itself in approximately ten seconds and performs an exhaustive self-diagnostic that lasts about five seconds. The Status LED of the UPAS base unit turns red on power up/initialization. The LED remains on approximately 25 seconds while the analyzer performs self-diagnostic testing. If the diagnostics fail, the Status LED will blink red, indicating a hardware failure. If this occurs, call CATC 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 host 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 SATracer CD). Step through the Windows hardware wizard. The wizard will see that the UPAS has an internal USB hub and will begin loading hub drivers. Afterwards, the wizard will automatically install SATracer/Trainer as a USB device on the PC. When the wizard prompts you for driver information, point it to the CD which should be in your disk drive and install **catcupa.sys** and **SATracer.sys**.

2.6 Installing the SATracer/Trainer Software

Once SATracer has been recognized as a USB device, install the SATrainer/Tracer software on the Host PC.

- Step 1** On the PC, run **setup.exe** on the installation CD and follow the on-screen instructions.
- The SATrainer/Tracer software will install on the PC hard disk.
- Step 2** To start the application, launch the CATC SATracer program from the Start menu:
- Start > Programs > CATC > SATracer.**

The SATrainer/Tracer program opens.



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

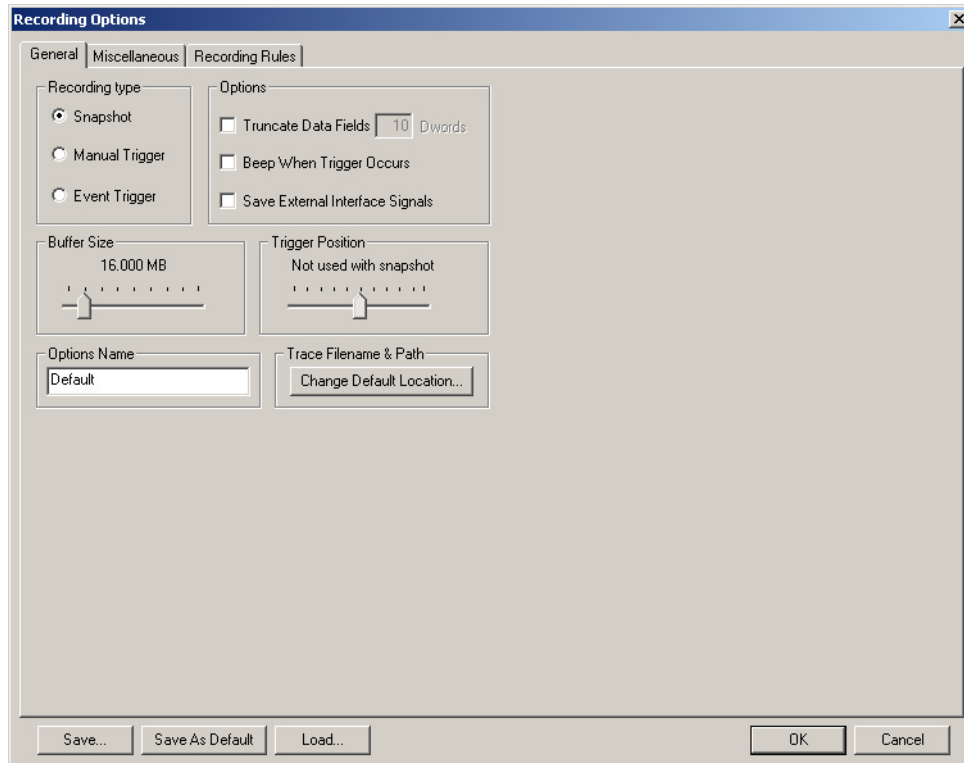
2.7 Making a Serial ATA Recording


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

To make this recording, follow these steps:


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

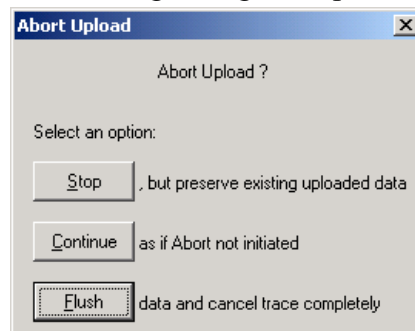
The following window displays the factory default settings such as “Snapshot” and 16 Mbytes buffer size are displayed. For your first recording, you can leave these settings unchanged.



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

Stopping a Recording

You can stop the recording process at any time by pressing . Afterwards, the following dialog box opens:



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

- **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.

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.sat** or the name you assign as the default filename.

FIS #	3	H	Register H->D	Port	C	Command	Control	Cyl Low	Cyl Low (exp)	Cyl High	Cyl High (exp)	Dev/Head
0	G		0x27	0x00	1	WRITE DMA W/O RETRIES	0x00	0xFF	0xE0	0x2E	0x0E	0xE0
Features	Features (exp)	Sector Count	Sector Count (exp)	Sector Number	Sector Num (exp)	Delta	Time Stamp					
0xDA	0xDA	0x08	0x00	0x26	0x2F	0.000 ns	0.083 25346					

FIS #	3	D	DMA Activate	Port	Delta	Time Stamp
1	G		0x39	0x00	2.587 μ s	0.083 25508

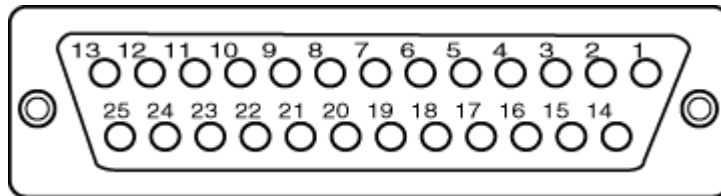
- Step 5** To save a current recording for future reference, select **Save As** from the **File** menu.
- Step 6** Give the recording a unique name and save it to the appropriate directory.

2.8 External Interface Breakout Board

With each analyzer, CATC includes an External Interface Breakout Board for accessing several potentially useful standard, LV TTL output and input signals. The breakout board also offers a simple way to connect logic analyzers or other tools to the SATracer/Trainer Analyzer unit. Six ground pins and one 5-volt pin are provided.

The Breakout Board connects via a cable to the **Data In/Out** connector located on the rear of the analyzer unit. Each signaling pin is isolated by a 100 Ω series resistor and a buffer inside the Analyzer unit.

Data In/Out Connector (on cable)



Pin-Outs for the Data In/Out Connector

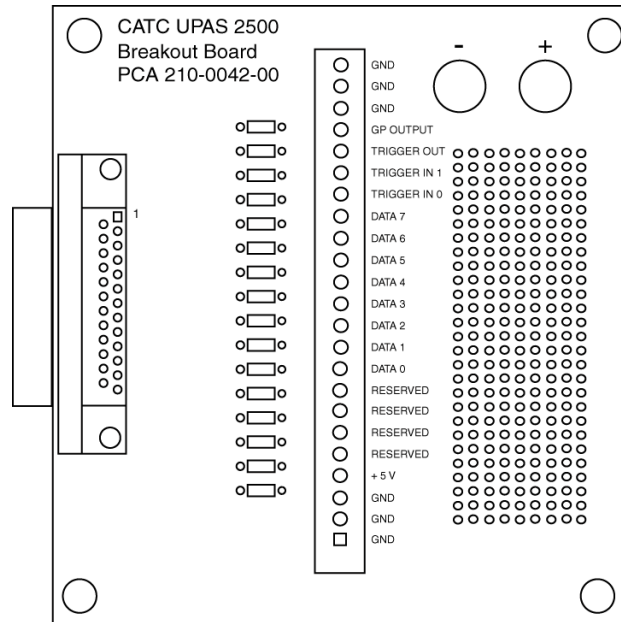
The following table lists the pin-out and signal descriptions for the **Data In/Out** connector on a cable that connects to the Breakout board.

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 the Analyzer for the Breakout Board

To configure the analyzer for the breakout board, see "External Input Signals" on page 89, "Setting External Output Options" on page 113, and "Specifying Pulse Signal Outputs" on page 114.

3. Updates

From time to time as modifications are made to the *SATracer/Trainer* Analyzer, it may become necessary to update the *SATracer/Trainer* software. You can obtain new software from the CATC website:

www.catc.com

When you download new *SATracer* software, firmware and BusEngine files are included as part of the software package. Occasionally, CATC 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: CATC analyzers come with a Three Year Investment Protection Agreement that entitles users to new software. Thereafter, to obtain new software the user will need to renew the CATC Maintenance Agreement. Contact CATC for details.

3.1 Software, Firmware, and BusEngine Versions

The **Readme.txt** file on the installation CD and on the installed directory on your hard drive. This file 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 *SATracer/Trainer* Analyzer has completed the self diagnostics and is connected to the PC, you can check the latest version of the software and BusEngine.

To check information about the current software, select **About SATracer...** from the **Help** menu.

The About *SATracer* window appears.

About SATracer details revisions of the following software and hardware:

- *SATracer/Trainer* Software Version
- *SATracer/Trainer* Firmware Version
- BusEngine Version
- Unit Serial Number

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



3.2 Software Updates

When a new software release is available, it is posted on the Support page of the CATC website at www.catc.com/support.html.

To update the software, follow these steps:

Step 1 Find the latest released software version on the CATC website under **Support**.

If you are running the latest version of the software, no further action is needed.

If you are **not** running the latest version, continue to Step 3.

Step 2 Download the Zip file from the website.

Step 3 Unzip the files into your choice of directory.

Step 4 Click **Start**, then **Run**, and browse to where you unzipped the files.

Step 5 Select the program named **Setup** and click **Open**.

Step 6 Click **OK** to run the Setup and begin the installation.

Step 7 Follow the on-screen instructions to complete the installation.

Step 8 Read the Readme file for important information on changes in the release.

3.3 Automatic BusEngine and Firmware Updates

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

Updating the BusEngine

The BusEngine core is the heart of the *SATracer/Trainer* Analyzer. Using FPGA technology, it incorporates both the high speed recording engine and the configurable building blocks that implement data/state/error detections, triggering, capture filtering, external signal monitoring, and event counting and sequencing. Both the BusEngine program and the Firmware that manages the internal microcontroller are fully field updateable.

Within a new software release, it may be necessary to update the Analyzer's BusEngine hardware for proper operation. The Readme file lets you know if this is necessary.

Updating the Firmware

Within a new software release, it may also be necessary to update the Analyzer's firmware for proper operation. The Readme file informs you if this is necessary.

Automatic Updates

When the *SATracer/Trainer* software is updated, the software may become incompatible with the BusEngine and Firmware. If a recording is attempted, *SATracer/Trainer* displays an error message and then automatically begins an update process for the BusEngine and Firmware.

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

- Step 1** If needed, update the *SATracer/Trainer* software, following the steps outlined in "Software Updates."
- Step 2** Turn on the *SATracer/Trainer* Analyzer.
- Step 3** From the **Record** menu, select **Start**.

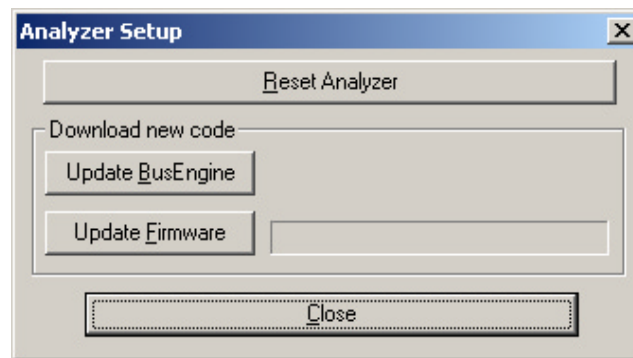
Because the BusEngine and/or the Firmware are incompatible with the current *SATracer/Trainer* software version, an error message

appears showing your current versions and indicating what versions you need to install.



Step 4 Click **Yes**.

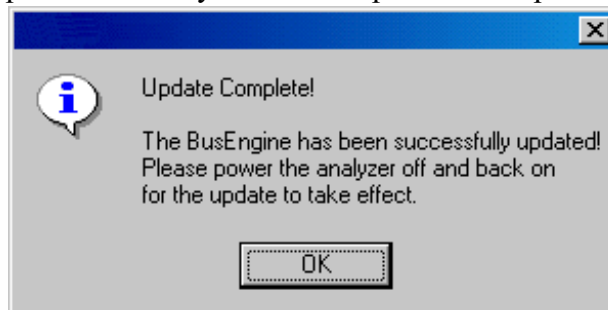
The **Analyzer Setup** window appears.



Step 5 Click **Update BusEngine** or **Update Firmware**.

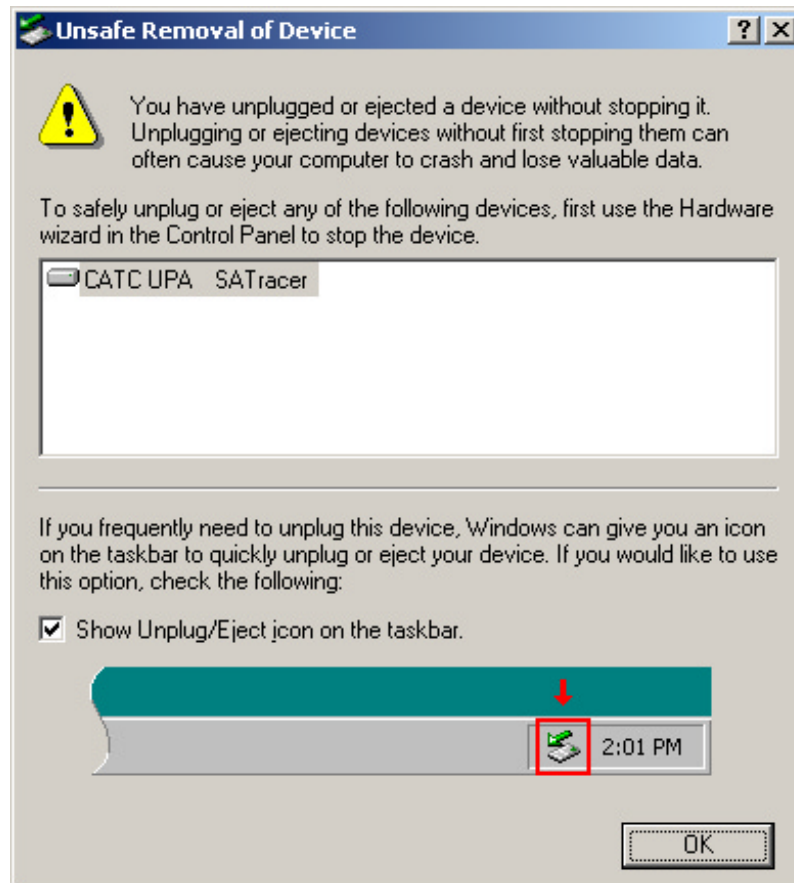
You can select only one item at this point. If both the BusEngine and the Firmware need to be updated, the update will complete for the first item and then return to the above window so the second update can be performed.

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 SATracer/Trainer (turn the unit off then back on).

If you are running Windows 2000, the Analyzer will automatically reboot, and the following message will appear:



Step 7 Click **OK**.

In this instance, you do not need to power cycle the Analyzer (turn off then back on).

3.4 Manual BusEngine and Firmware Updates

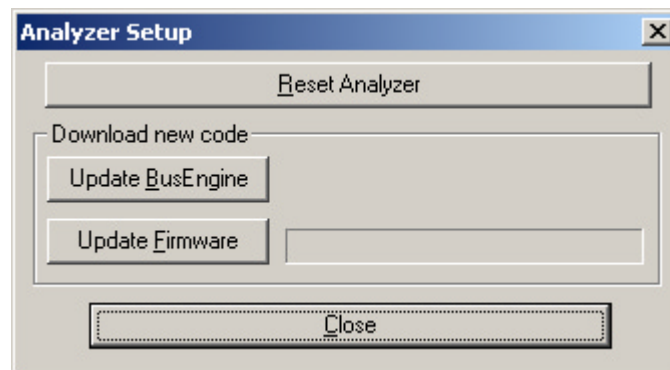
The BusEngine and Firmware can be manually updated. This section describes the procedure.

Updating the BusEngine

Within a new software release, it might be necessary to update the SATracer/Trainer Analyzer's BusEngine hardware for proper operation. The Readme file informs you if updating SATracer/Trainer is necessary. Normally, the BusEngine is updated automatically following a software update.

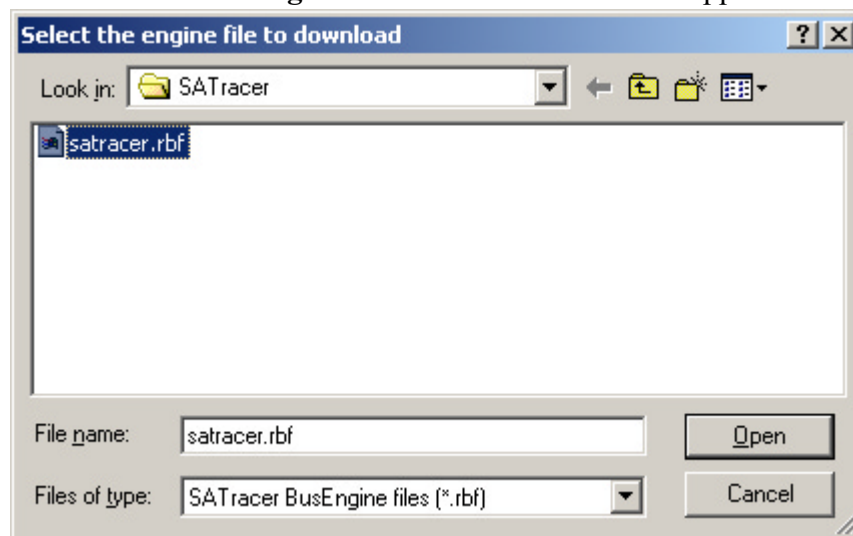
To manually update the BusEngine, follow these steps:

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



Step 2 In the **Analyzer Setup** window, click **Update BusEngine**.

The **Select engine file to download** window appears.



The program has already automatically searched for the correct file, and it is displayed in the **File name** field.

Note: The most current Primary BusEngine file (**SATracer.rbf**) was copied to your \CATC\SATracer directory when you installed the program.

Step 3 Click **Open**.

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

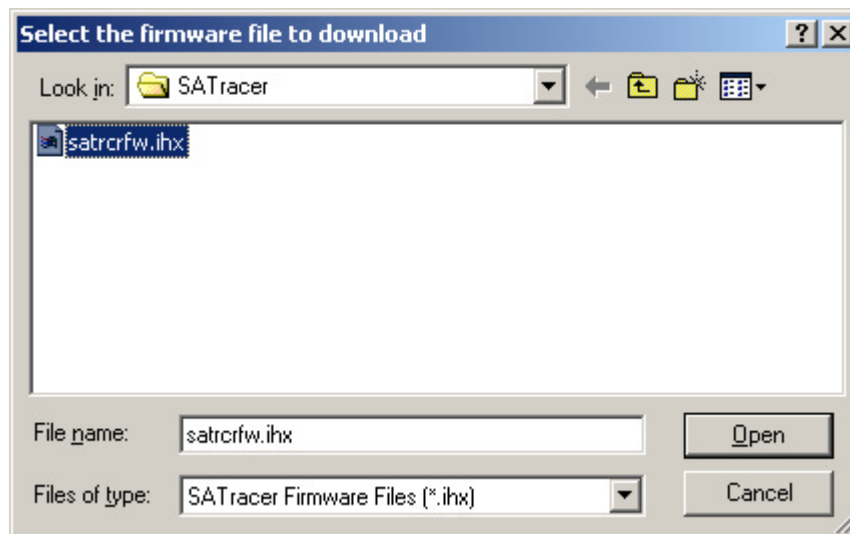
Updating the Firmware

Within a new software release, it may also be necessary to update the SATracer/Trainer Analyzer's firmware for proper operation. The Readme file informs you if this is necessary.

To update the firmware, follow these steps:

Step 1 Click **Update Firmware** on the **Analyzer Setup** screen.

The **Select the firmware file to download** window appears.



The program has already automatically searched for the correct file and displays it in the **File name** field.

Step 2 Click **Open**.

The SATracer/Trainer Analyzer updates the Firmware.

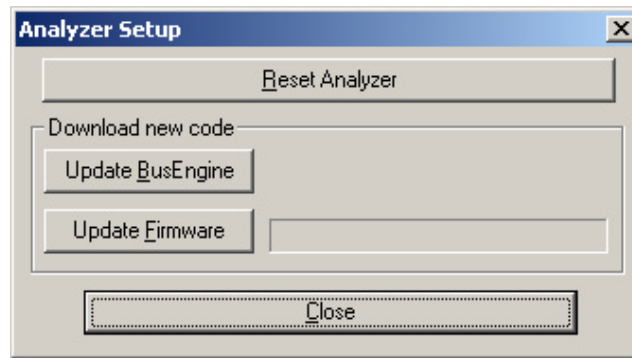
Step 3 Unplug the Serial ATA cable from the back of the

SATracer/Trainer Analyzer unit and then reinsert it so the new Firmware update can take effect.

Note: Once you have begun updating the Firmware, do not interrupt the update!

3.5 Resetting the Analyzer

The Analyzer Setup window contains a reset button at the top of the window. Its function is the equivalent of power cycling the Analyzer.



Once the **Reset Analyzer** button has been pressed, SATracer/Trainer takes about 25 seconds to reinitialize. During this time the UPAS Status LED is on, indicating that power-on diagnostics are being run. If there is a hardware failure, the Trigger LED will blink after initialization is complete. If this occurs, contact CATC for customer support.

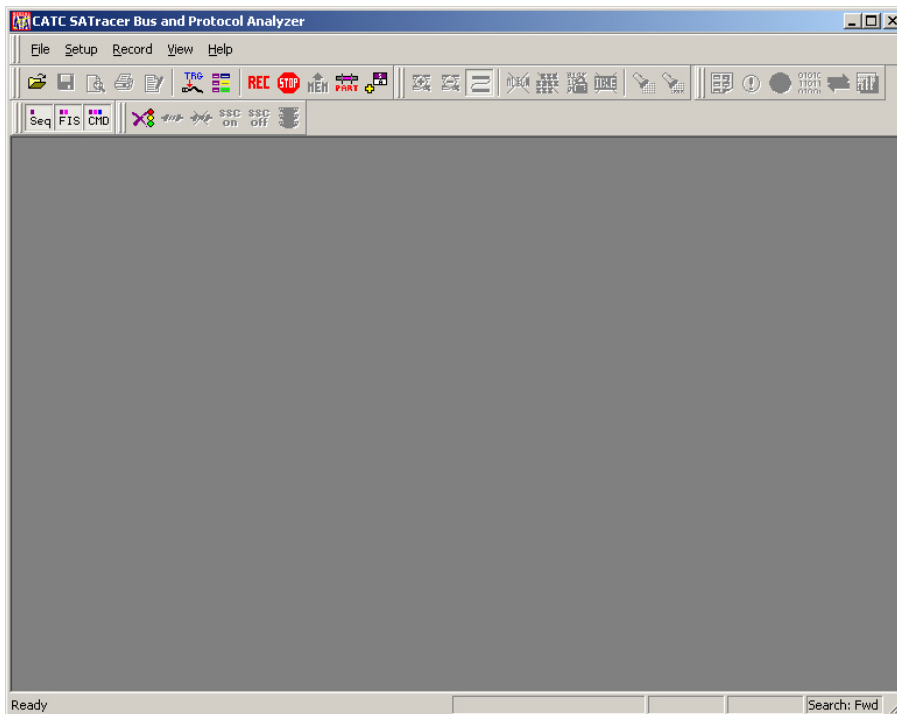
4. Software Overview

The *SATracer/Trainer* is an application that may be used with or without the *SATracer/Trainer* Analyzer unit. When used without an *SATracer/Trainer* Analyzer unit, the program functions in a Trace Viewer mode to view, analyze, and print captured protocol traffic from *SATracer/Trainer* Analyzers.

4.1 Starting the *SATracer/Trainer* Program

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

- Step 1 Click **Start**.
- Step 2 Select **Programs**.
- Step 3 Select **CATC**.
- Step 4 Click **CATC SATracer**.



4.2 Application Preferences ...

For those running *SATracer* on the UPAS 10K platform, you can skip this section. The *SATracer* software supports by default the UPAS 10K platform. If you are running *SATracer* software with a UPAS 2500H, the

analyzer software will detect by default the type of UPAS that is running (i.e., the 10K or the 2500H) and load the options associated with attached platform. If you run SATracer software in 2500H mode *without* the analyzer, you can configure the software for the 2500H by selecting:

Setup > Application Preferences ... then de-select the option **If no analyzer is connected, use UPAS 10K recording options.**

This option affects the Recording Options dialog box. See the Recording Options chapters for details.

4.3 Tool Tips

Throughout the application, Tool Tips provide useful information.

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



4.4 Pop-up Tool-Tips

Many fields within the Trace will display pop-up tool-tips when the mouse pointer is suspended over them. These tips provide added details about the field.

Register	C	Command	Control	Cyl Low	Cyl Low (exp)	Cyl High	Cyl High (exp)	Dew/Head
0x27	1	Contains the contents of the Command register of the Shadow Register Block.						
(exp)	Sector C							
87		0x00	0x00	0x78	0x71	0000	0000	00

4.5 The Menu bar

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

Note - The **Generate** menu is specific to SATrainer and is visible only when a File Generator file (*.stg) is open in the Trace view.

Table 1: Main Display Pull-Down Menus

Menu	Function
File	
Open...	Opens a file.
Close	Closes the current file.
Save <u>A</u> s...	Saves all or a specified range of Sequences from the current file with a specified name.
Print...	Prints part or all of the current traffic data file.
Print Preview	Produces an on-screen preview before printing.
Print Setup...	Sets up your current or new printer.
Edit Comment...	Creates or edits the Trace file comment field.
Export>>	<p><u>S</u>equences to Text (Sequence View Format) - Saves all or part of a Trace to a text file.</p> <p><u>D</u>ata - Allows transfer data to be exported as text or a binary file.</p> <p>8b/10b - Allows raw data to be saved to a spreadsheet/database format (.csv - Comma Separated Value)</p> <p>Sequences to <u>T</u>raffic Generator Text File (.stg)... - Creates an .stg file that allows SATrainer to generate traffic</p> <p>Comma Separated Value > New - Creates a new .csv file. The process takes two steps: 1) Select fields from the trace for inclusion in a .csv file - this step creates a template; 2) create the new .csv file.</p> <p style="padding-left: 40px;">> Open - Opens a template of previously selected fields and then exports the open trace file data to that template</p> <p>Commands to iPeak (.raw) - Exports data to a format compatible with Intel's iPeak performance-measuring software</p>
Exit	Exits the SATracer/Trainer program.
Setup	
<u>D</u> isplay Options...	Configuration dialog for setting color, formats, and filter options.
<u>R</u> ecording Options...	Configuration dialog for setting recording, triggering, & filtering options.
Application Preferences	Opens a dialog box for selecting the SATracer software interface that will be used and for setting how Commands will be sorted any time they appear in a menu or list. By default, the UPAS 10000 interface is selected. This interface differs from the UPAS 2500H interface in the types of pages present in the Recording Options dialogs.
<u>A</u> nalyzer...	Updates the BusEngine and Firmware.
Host Port (Transmit) > AC Coupled DC Coupled	Retransmits the signal through the analyzer to the host in AC or DC Coupled mode.
Device Port (Transmit) > AC Coupled DC Coupled	Retransmits the signal through the analyzer to the device in AC or DC Coupled mode.

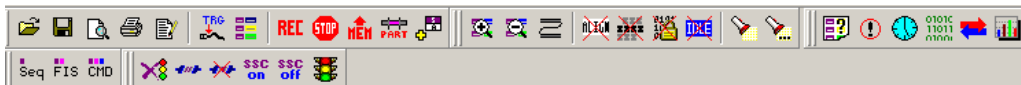
Menu	Function
Record	
<u>S</u> tart	Causes the Analyzer to begin recording Serial ATA activity.
Stop	Causes the Analyzer to stop recording.
Use Partial Uploading	Enables Partial Uploading, an option for uploading a portion of the analyzer's buffer to the PC. This option lets you set the size and location of the analyzer's buffer for uploading (for example, a few MB before and after the trigger event). This option is useful with large recordings where uploading can take several minutes. If disabled, the full recording will upload before it can be decoded and analyzed.
Generate (This menu appears when a traffic generation file is loaded.)	
<u>S</u> tart/ <u>S</u> top	Start/Stop File Generation for SATrainer.
<u>C</u> onnect	Connect Traffic Sequence.
<u>D</u> isconnect	Disconnect Traffic Sequence.
Report	
<u>F</u> ile Information	Displays information about the recording such as the number of sequences and triggering setup.
<u>E</u> rror Summary	Summarizes the errors throughout the recording. Allows for fast navigation to errors.
Timing <u>C</u> alculation	Calculates timing between two Sequences.
<u>T</u> raffic Summary	Summarizes the numbers and types of Sequences, Primitives, FIS types, Commands, and errors that occurred in the open Trace.
Bus Utilization	Displays graphs of various types of events that occurred in the open trace.
View <u>D</u> ata	Opens a window that displays data for the selected FIS or Command
Search	
Go to <u>T</u> rigger	Positions the display to show the Trigger event.
Go to <u>S</u> equence/FIS /Command ...	Positions the display to the indicated Sequence, FIS, or Command.
Go to <u>M</u> arker »	Positions the display to the selected marked Sequence.
Go to Time ...	Opens a "Go to" dialog box and repositions the display to the selected Time.
<u>G</u> o to »	Enables quick searching for specific events using a cascade of pop-up windows.
Find ...	Allows searches by multiple criteria.
Find <u>N</u> ext	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	
<u>T</u> ool Bars	Displays list of available Tool bars.
<u>S</u> tatus Bar	Switches display of the Status Bar on or off.
Zoom <u>I</u> n	Increases the size of the displayed elements.
Zoom <u>O</u> ut	Decreases the size of the displayed elements.
<u>E</u> xpand	Expands Data Payloads and Status Fields at the Sequence, FIS, Command, and all levels.

Menu	Function
<u>C</u> ollapse	Collapses Data Payloads and Status Fields at the Sequence, FIS, Command, and all levels.
H <u>i</u> de	Hides information from the display window.
<u>W</u> rap	Wraps displayed sequences within the window.


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








Help	
<u>H</u> elp Topics ...	Opens online help.
Update License...	Displays a window for updating the software license
Display License Information...	Displays information on the current software license.
<u>A</u> bout SATracer	Displays version information about SATracer/Trainer.

4.6 The Toolbar



The Tool Bar provides quick and convenient access to the most used SATracer/Trainer software functions. Tool Tips briefly describe the functionality of each icon and menu item as the mouse arrow is moved over the icon/item.

	Open file		Hide idle sequences
	Save As		Allows complex searches
	Preview		Find Next - repeats last Find or Go To operation
	Print...		File Information Report

	Edit ... Opens Notepad for editing traffic generation files (.stg).		Error Report
	Setup Record Options		Timing and Bus Usage Calculations
	Setup Display Options		Show Data - Opens the Data window and displays the data for a selected data field in a FIS or Command
	Start Recording		Traffic Summary
	Stop Recording		Bus Utilization
	Re-upload part or all of the trace from analyzer to PC. Requires that the Enable Partial Upload button be pushed first.		View Sequence Level
	Enable Partial Upload. Allows the user to re-upload part of the trace. See page 121 for details.		View FIS level
	Record with/without Syncs and Aligns		View ATA Command Level
	Zoom In		Analyzer Only Mode
	Zoom Out		Connect Trainer sequence
	Wrap		Disconnect Trainer sequence
	Show/Hide ALIGN primitives		Turn on SSC on the Generator.
	Shows/Hides data after Cont(XXXX)		Turn off SSC on the Generator
	Show Sequence level data scrambled or unscrambled		Start, stop, resume traffic generation

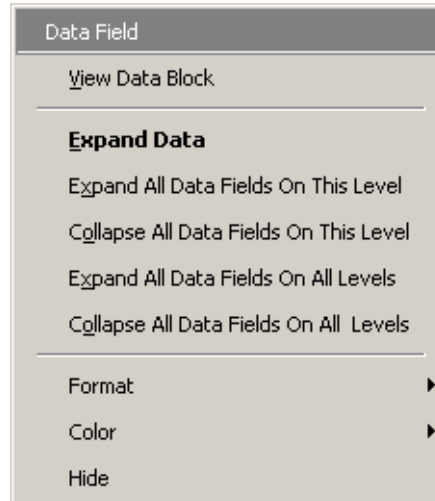
Note - These buttons  are specific to SATrainer.

4.7 Pop-Up Menus

Clicking the trace with the right or left mouse button displays a pop-up menu with options for formatting the display.

Left Mouse Button - If you click a cell in the trace with the left mouse button, a pop-up menu appears and displays options for modifying the contents or appearance of the selected cell. The menu is context-sensitive and varies depending on the selected cell.

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.
- **Collapse/Expand Data** - Collapses or expands data field. Summarizes the amount of data displayed in the cell.
- **Expand All Data Fields On This Level** - Expands any data fields that are currently collapsed at this level.
- **Collapse All Data Fields On This Level** - Collapses any data fields that are currently expanded on at this level.
- **Expand All Data Fields On All Levels** - Expands any data fields that are currently collapsed at all levels.
- **Collapse All Data Fields On All Levels** - Collapses any data fields that are currently expanded at all levels.

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

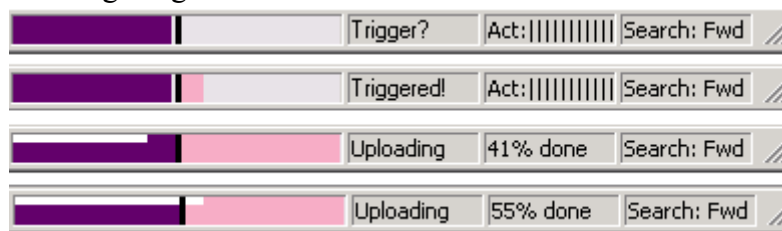


4.8 Status Bar

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

Recording Progress

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



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

- In the Progress Indicator, a black vertical line illustrates the location of the Trigger position you selected in Recording Options.
 - Pre-Trigger progress is displayed in the field to the left of the Trigger Position in the before-Trigger color specified in the Display Options.
 - 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 Position fills in the after-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 accordingly 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. When you activate the **Record** function, this segment flashes one of the following messages (depending on the selected Recording Options):

- Trigger?
- Triggered!
- Uploading

After recording stops, The following occurs:

- Flashing message changes to **Uploading data-x% done** (x% indicates the percentage completion of the data uploading process).
- Traffic data is copied to disk (overwriting any previous version of this file) using the default file name **data.sat**. 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 sequence following the Trigger (or the sequence 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 sequence 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.

Note If traffic is filtered out or if data is truncated, the trace may not have the data it needs to decode Transactions or Commands properly.

Search Status


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

4.9 Navigation Tools

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


Zoom In

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

Click  on the Tool Bar.


Zoom Out

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

Click  on the Tool Bar.

Wrap

Adjusts the Trace View so that sequences 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 sequence.

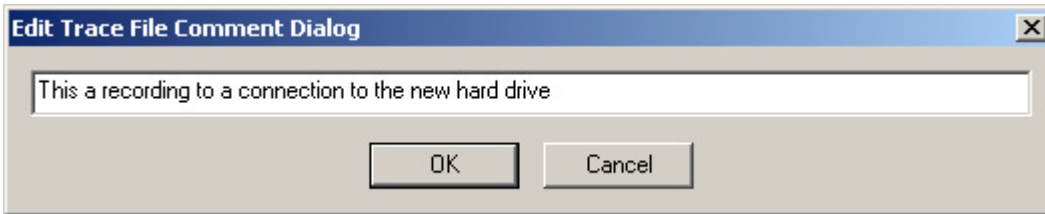
Click  on the Tool Bar.

4.10 Adding Comments to the Trace

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

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

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



Step 2 Create, view, or edit the comment.

Step 3 Click **OK**.

5. Recording Options - UPAS 10K

Note The following chapter describes how to configure Recording Options for *SATracers* based on the UPAS 10000 platform. If you are running an *SATracer* on a UPAS 2500H platform, see chapter six.

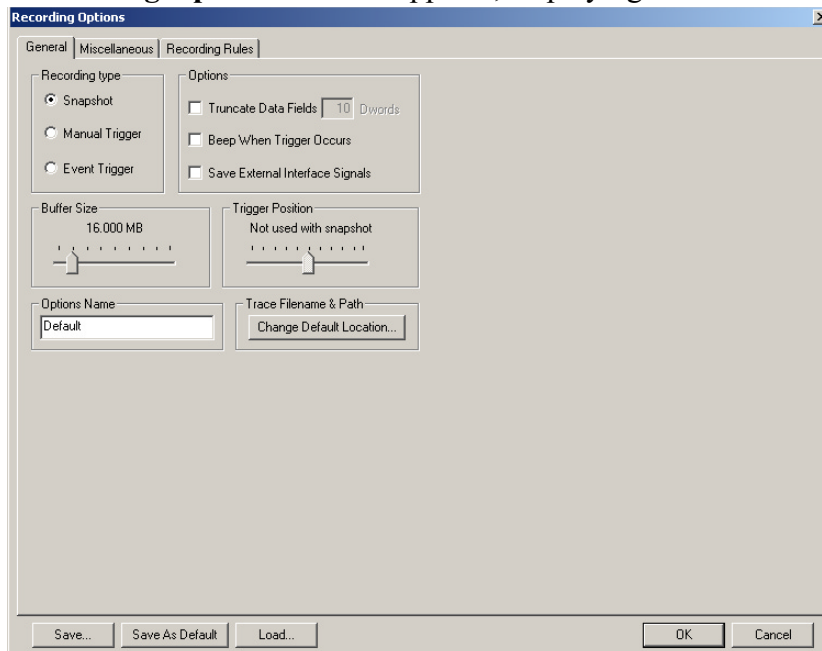
The **Recording Options** dialog box presents options for configuring a recording. The dialog box has three pages: General, Miscellaneous, and Recording Rules. The General page present general types of options that affect all recordings. The Miscellaneous page presents options for configuring the traffic speed that will be recorded. The Recording Rules page allows triggers and filters to be set on different events.

Note To configure the analyzer software to display the UPAS 10000 or the 2500H Recording Options, select **Setup > Application Preferences ...** from the menu and then select or de-select the option **If no analyzer is connected, use UPAS 10K recording options**, then click **OK**.

Opening the Recording Options Dialog

To open the **Recording Options** dialog, select **Setup > Recording Options** from the menu.

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







5.1 General Recording Options


The General Recording Options allow you to select or adjust the recording type, the buffer size, the amount of post-Trigger recording, and the Trace filename and path.

Recording Type

The **Recording Type** box gives three options that allow you to set how SATracer/Trainer begins and ends a recording. The options are *Snapshot*, *Manual Trigger*, and *Event Trigger*.

- **Snapshot:** Fixed-length recording whose size is determined by the "Buffer Size" box in the Recording Options dialog or by a manual click of the Stop button. Recording begins when the Start Recording button  is clicked and ends when either the selected buffer size is filled or the Stop Recording button  is pressed.
- **Manual Trigger:** Recording whose Trigger point is caused by pressing the Trigger button on the front panel.

Recording begins when you click  on the Tool Bar. Recording continues in a circular manner within the limits set by the buffer size. Recording ends when  is clicked on the Tool Bar or after post-Trigger memory has been filled following depression of the Trigger button on the front panel.

- **Event Trigger:** Recording whose Trigger is defined by a specific event or events. Recording begins when you click  on the Tool Bar.

Recording continues in a circular manner within the limits set by the buffer size until an event is detected that meets the Trigger conditions specified in the Triggering Options and the defined amount of data has been recorded after the Trigger event.

Options

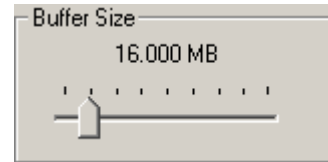
The options checkboxes appear on the upper right side of the General tab of the Recording Options window.

- **Truncate Data Fields:** Allows Data Payload Dwords to be truncated during a recording in order to preserve recording memory. The length of the truncated Data Payload Dword is specified in the box marked "Dwords."
- **Beep When Trigger Occurs:** When this checkbox is selected, the computer connected to the SATracer/Trainer beeps three times when a Trigger condition is first detected.

- **Save External Interface Signals:** Causes the analyzer to save signals from a Break-out board as fields in the trace.

Buffer Size

The Buffer Size box has a slide bar for adjusting the recording buffer size from 16 megabytes to 2 GB.



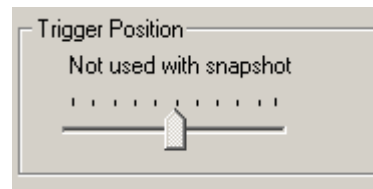
The Recording Type option determines how this buffer is used. Although there are 2 GB of physical memory in the Analyzer, the efficiency of the recording is about 75% or better.

You must have an equivalent amount of physical memory on the computer controlling the SATracer analyzer.

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

Trigger Position

The Trigger Position slide bar sets the amount of pre- and post-trigger recording. It also allows adjustment of the location of the trigger within the defined buffer. You can adjust the Triggering Position between 1 and 99% post-Trigger. **Trigger Position** is available only when **Manual Trigger** or **Event Trigger** is selected as **Recording type**.



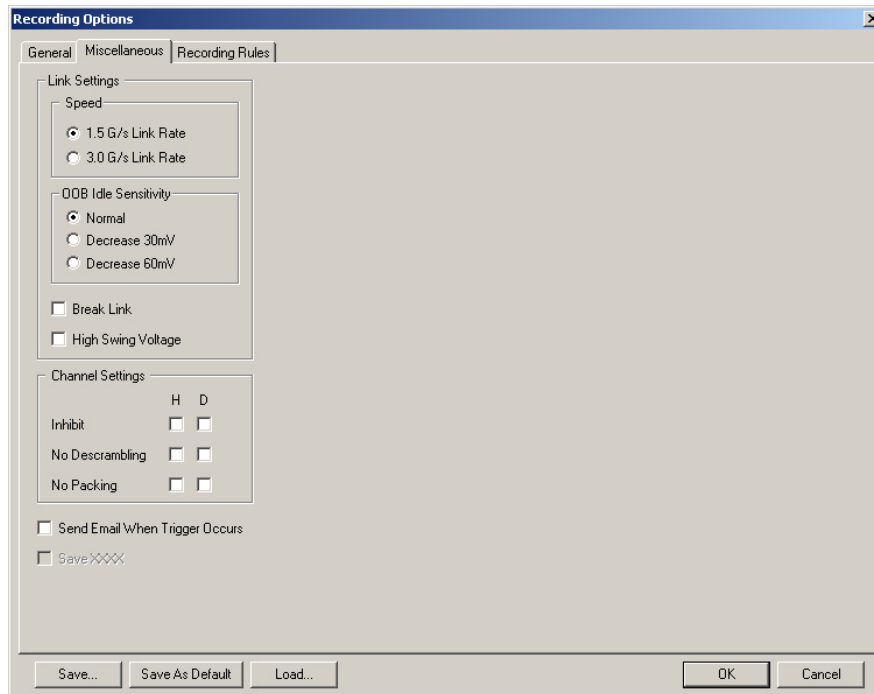
As an example, if the buffer size is set to 16MB, then for the following Trigger Position settings, the amount of pre- and post-Trigger data is

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

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

5.2 Miscellaneous

The Miscellaneous page controls speed settings, descrambling, packing and other options for each channel. It also allows recording to be inhibited on a per channel basis.



Link Speed - Set the link speed of the analyzer for the devices that are being recorded. If you do not set the correct link speed, errors will result in the trace.

This release requires the user to designate the recording speed for each link. The *SATracer* system 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 SATA specification. However, if the negotiated link speed is higher or lower than the speed selected in this tab, *SATracer* will not decode the traffic properly (there will be errors in the trace). If an initiator and target are successfully negotiating 3Gbps transmission rate, choose the 3Gbps Speed Selection in this tab. The user will know if devices are negotiating successfully by getting clean recordings.

OOB Idle Sensitivity - The **OOB Idle Sensitivity** selection sets the sensitivity level for the DUTs. The OOB spec for SAS and SATA are slightly different: the minimum burst amplitude for the OOB period in SAS is 240mV whereas in SATA it is 325mV.

High Swing Voltage - Sets the High Swing voltage. If using SATA devices, de-select the option to use low swing voltage.

Inhibit - Inhibits recording of traffic from selected channels. For example, if you check the option for **H**, it means "record the device channel only."

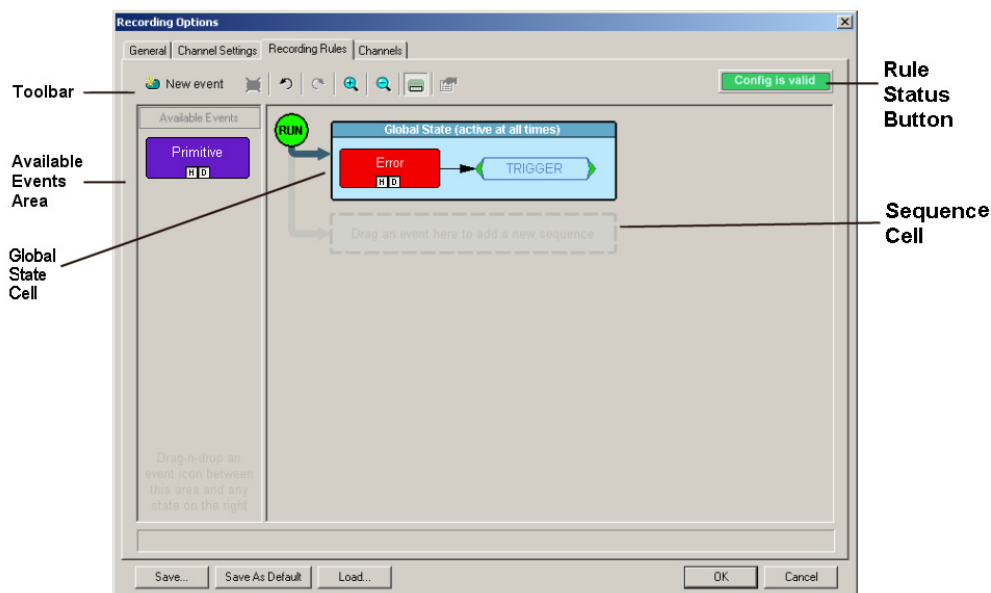
No Descrambling - Turns off the analyzer's descrambling from the selected channels. Select this option if your DUTs are not descrambling their traffic.

No Packing - Turns off primitive and idle packing from the selected channels. This option is intended for debug use only and should be used if so directed by CATC.

Send Email When Trigger Occurs - If checked, this option will open a dialog box prompting the user for an email address. Upon triggering, the user will be sent an email notification of the trigger event.

5.3 Recording Rules

The Recording Rules page is where triggers and filters are set. 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 Button** - A button that indicates if the rules the user has created are valid or invalid. When the rules are correct, the button will display the text **Config is valid**. When incorrect, the button will turn red and display the text **Config is Invalid**.
- **Pop Up Menus** (not shown) - Right-clicking on button or area in the Recording Rules page will access a context-sensitive pop-up menu containing most of the commands listed in the toolbar.

5.4 Recording Rules Toolbar

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

 New event	New Event. Creates a new event in the Available Events area. A set of cascaded menus will pop up.
	Delete Event. Deletes selected event.
	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 incorrect."

Config is invalid. This message displays when the current Recording Rules configuration exceeds hardware limitations. You can click the button to get the diagnostics message box to find the problem.

5.5 Recording Rules Page - How it Works

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

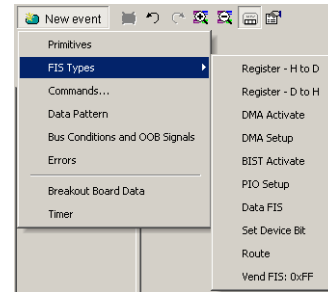
You can create simple or complex rules.

Creating a rule involves four steps:

- Step 1** Create Event buttons.
- Step 2** Select the Host and/or Device channels that the analyzer should record by clicking the small buttons marked **H** and **D** on each Event button.
- Step 3** Move the Event buttons to the Global State Cell or to the Sequence Cell.
- Step 4** Assign an action such as Trigger to the events buttons.

Creating Event Buttons

To create a rule, you start by creating one or more Event buttons. To create a new Event button, click the **New Event** button and then select an event from the resulting menu. A new Event button appears and is automatically parked in the Available Events area. The following steps show the process.

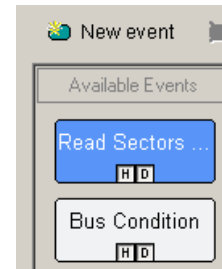


Step 1 Click the **New Event** button.

A menu of Events displays.

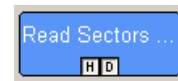
Step 2 Select an Event from the menu. The selected Event will appear in the **Available Events** area.

Step 3 To move the button to the Global State Cell, hold the left mouse button down and drag it.



Selecting a Channel on an Event Button

At the bottom of each event button are two small buttons marked **H** and **D** that represent Host and Device channels. Selecting a channel button defines which channels should be monitored for matching the specific trigger event. For example, if you depress the **H** button but not the **D** button it means "Look for the trigger event on only the Host channel."



Please note that deselecting a channel button does not stop the recording on that channel - it merely disables actions such as triggers from occurring. Thus, if you had set the analyzer to trigger on any error but had deselected channel **H**, the analyzer would record traffic on both channels but would ignore errors on channel **H**.

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

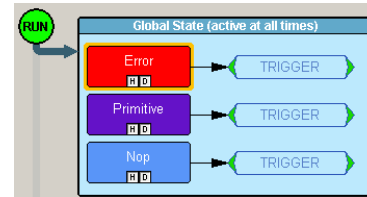
Dragging a Button to the Global State Cell

To activate an Event button, you need to drag the button to the Global State Cell or Sequence Cell.



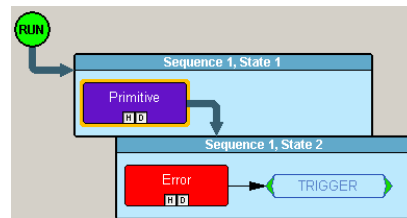
To activate an Event button, drag it to the Global State Cell.

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. For example, you could place three events in this cell and have each cause a trigger. Such a configuration would read "If x, y or z occurs, trigger."



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

Sequence Cell - 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." There can be up to 255 events linked together into a sequence.



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

Event sequences are created by assigning the action **Advance the sequence** to events in the chain. The last event is then assigned the action **Trigger**.

Assigning an Action

Once an Event button has been moved to the Sequence Cell or Global State Cell, an action such as Trigger can be assigned. 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.

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

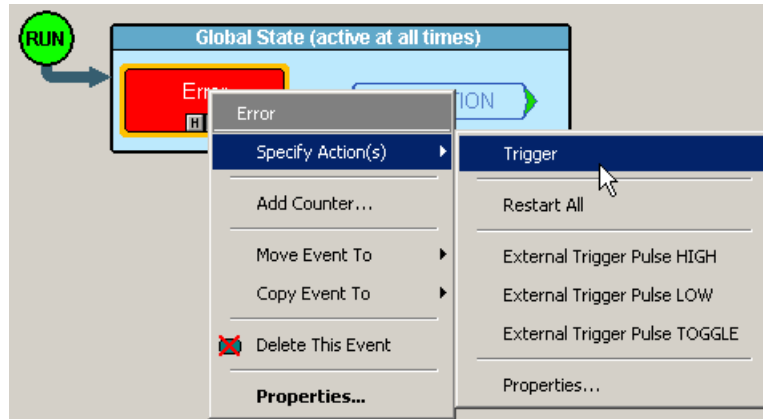
- **Right-click** on an event button and select Specify Action from the pop-up menu.
- **Double-click** on the event button and then select an action from the Properties dialog box.

Note If you do not assign an action to an event button, the analyzer will ignore the selected event.

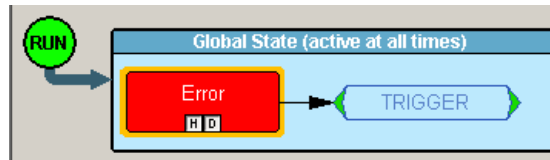
Assigning an Action from the Pop-up Menu

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:

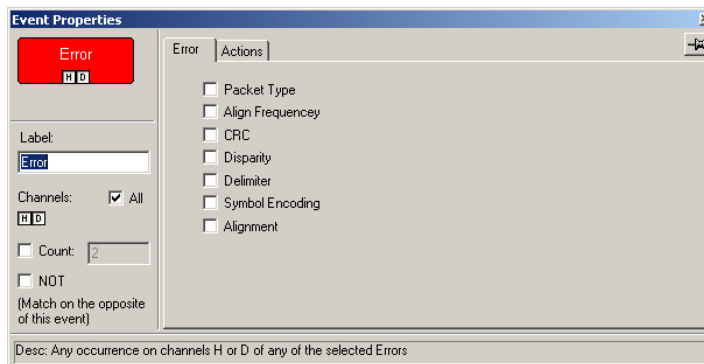


Step 2 Select **Specify Action** and then an action from the sub-menu. The menu closes and the action is assigned.

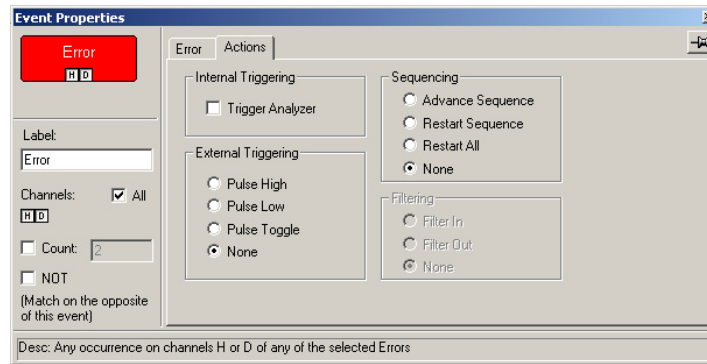


Assigning an Action via the Properties Dialog Box

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. The Actions page opens.



Step 3 Assign an action.

See Section 5.8 "Types of Properties Dialog Boxes" on page 52 for further details on Properties dialog boxes.

5.6 Types of Pop-up Menu

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

Global State Cell Pop-up Menu

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



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

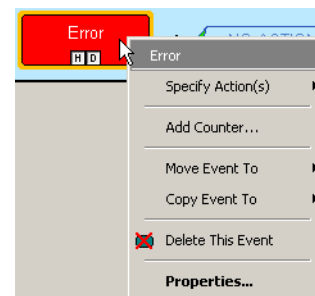
Properties - Brings up the State Properties dialog for the selected state.

Event Pop-up Menu

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

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

- **Trigger** - Triggers end of recording. Recording continues until post-trigger buffer is expended. Buffer settings are controlled by the Recording Options - General page.



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

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

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

Copy Event To - Copies selected event to a different position in the Recording Rules window.

Delete this Event - Deletes the selected Event. Alternatively, you can use the Delete button on the toolbar or keyboard to delete events.

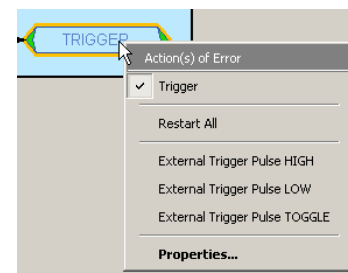
Properties - Opens a dialog box and lets you specify further sub-types (for example, types of errors) and additional conditions for the selected event.

Action Pop-up Menu

If you click on an Action button, you will get a pop-up menu with most or all of the following choices:

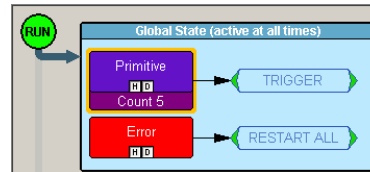
Trigger - Sets or clears Trigger action.

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



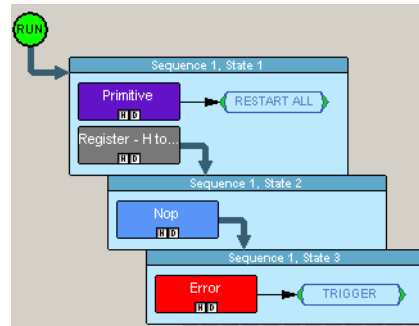
Filter Out - Sets or clears the Filter Out action. This option precludes the use of Filter In.

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 Primitives and then trigger. If, however, an Error occurs any time before the fifth Primitive has occurred, restart the count."



Restart example. In this configuration, SATracer will restart its search for a sequence of 5 primitives if an error is encountered.

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



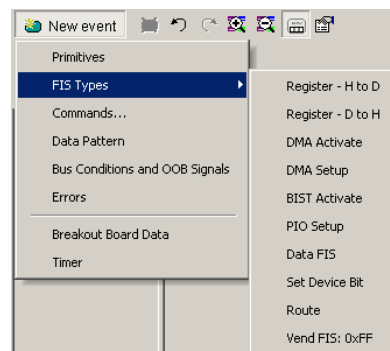
Second restart example. In this configuration, SATracer will restart its search for the above sequence of events if a Primitive is found.

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

5.7 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
- FIS Types
- Commands
- Data Pattern
- Bus Conditions and OOB Signals
- Errors
- Breakout Board Data
- Timer



5.8 Types of Properties Dialog Boxes

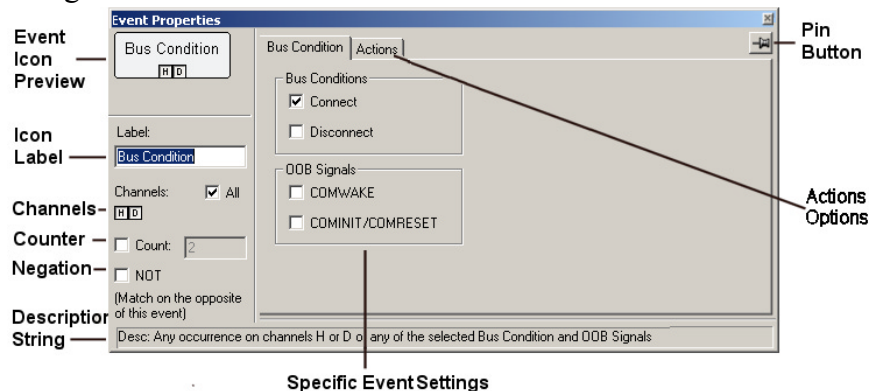
Each cell and button has a properties dialog box that allows refinement of the options being set. Properties dialog boxes can be opened by:

- 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 you what the button 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 you type 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 "10" is entered, the analyzer will count 10 instances of the selected event before it performs whatever action has been assigned. 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.

Pin Button - Allows you to "pin" the Properties dialog box to the application so that it stays on screen when other objects appear.

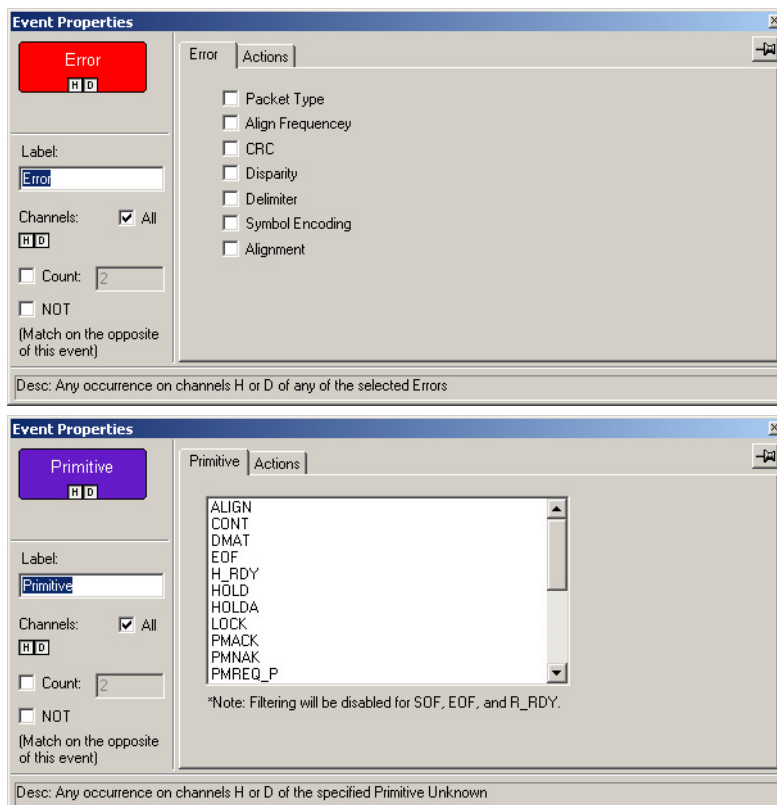
Description String - This area contains a textual description of the event.

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

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

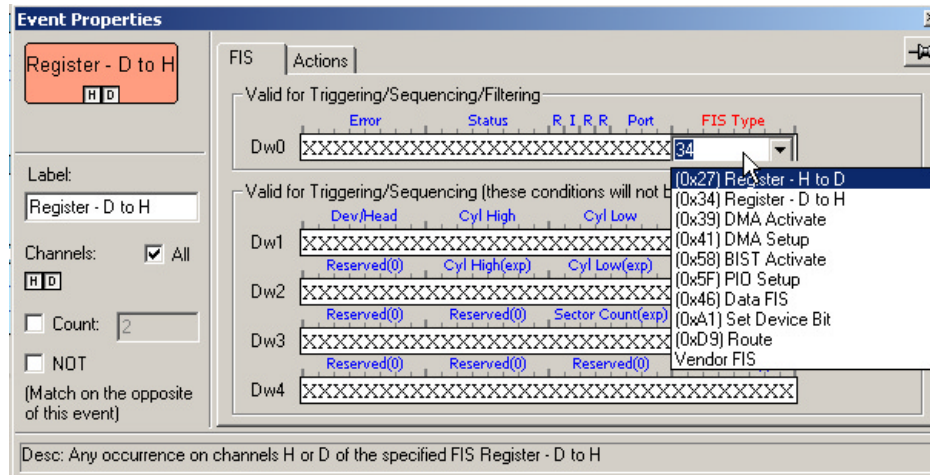
- **Checkboxes**
- **List**
- **Pattern Editor**

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

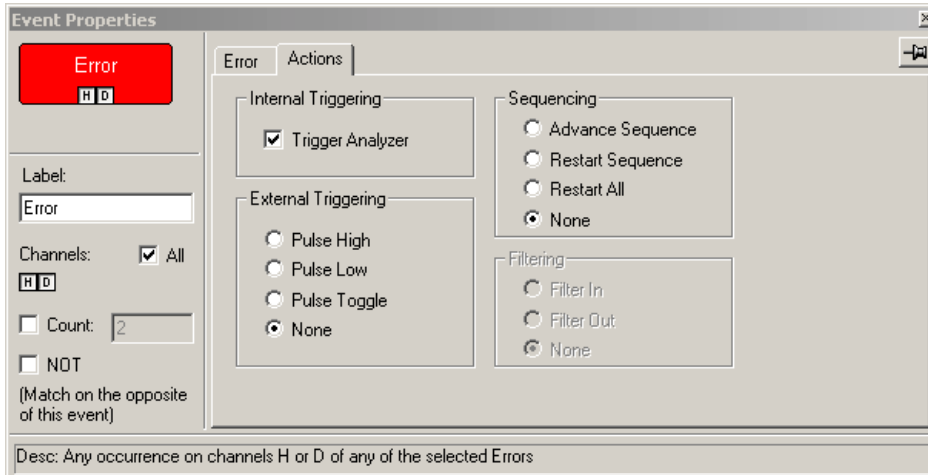


The **Pattern Editor**, on the other hand, presents a series of text boxes in which you can enter a data pattern that the analyzer should seek. Pattern Editors can be seen in any of the FIS Type properties dialogs and in the Data Pattern properties dialog.

The **Pattern Editor** has two components: the text boxes themselves, in which a binary pattern can be entered, and blue field headings. The blue field headings can be clicked to open either a decimal editor that will convert your decimal value into binary or a pull-down menu like the FIS Types menu shown below.



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

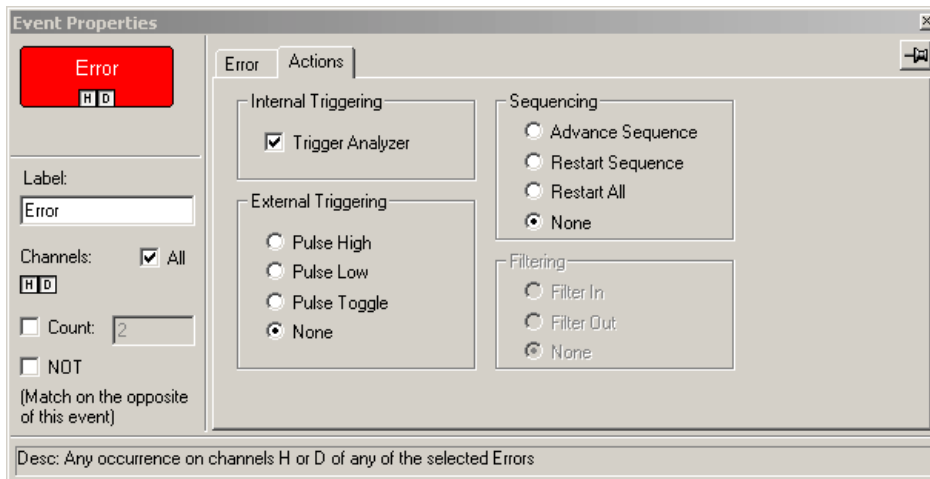
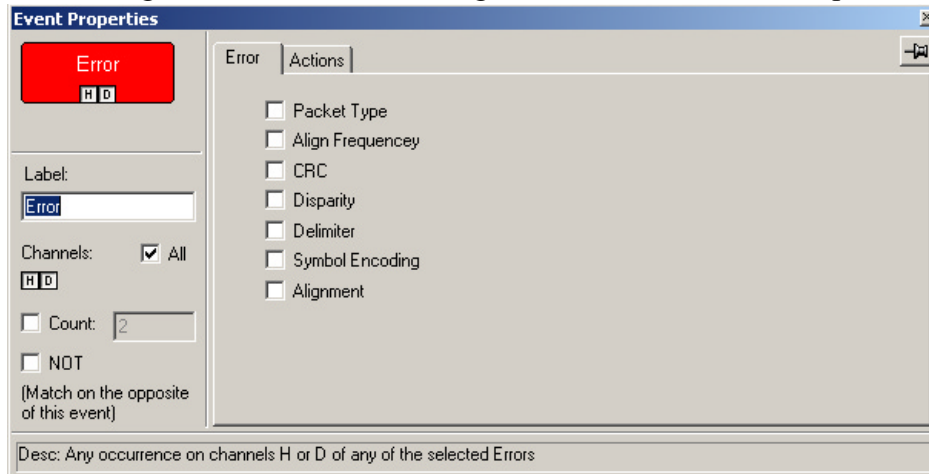


5.9 Event Properties Dialog Boxes - Descriptions

Each event button has a Properties dialog box opens with options for further specifying the type of event that the analyzer should look for. Selecting an option narrows the search pattern to the selected event.

To open a Properties dialog box for an event button, double click it.

Properties dialog boxes have two pages of options: one listing event sub-categories, and the other listing actions. Below is an example.

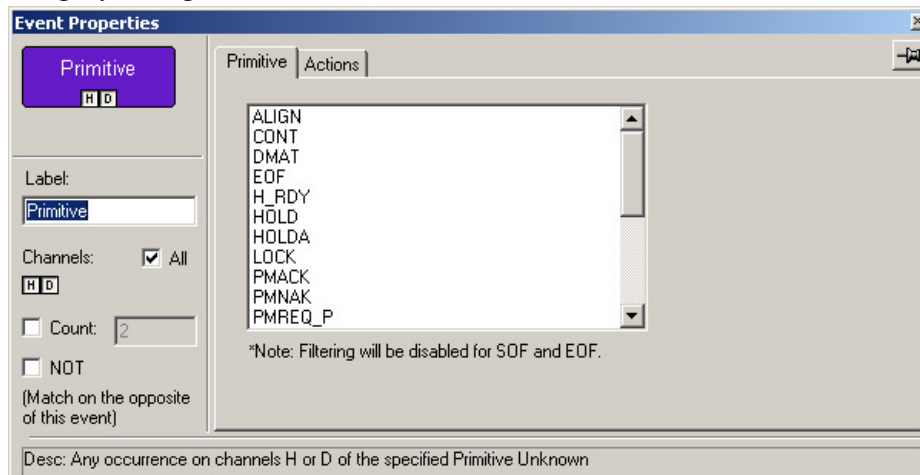


There are properties dialog boxes for each of the event categories listed in the New Events menu. Each dialog is described in this section.

Category	Event
Primitives	
FIS Types	Register H to D Register D to H DMA Activate DMA Setup BIST Activate PIO Setup Data FIS Set Device Bit Route Vend FIS: 0xFF
Commands	See Commands section below.
Data Patterns	
Bus Conditions and OOB Signals	
Errors	
Breakout Board Data	
Timer	

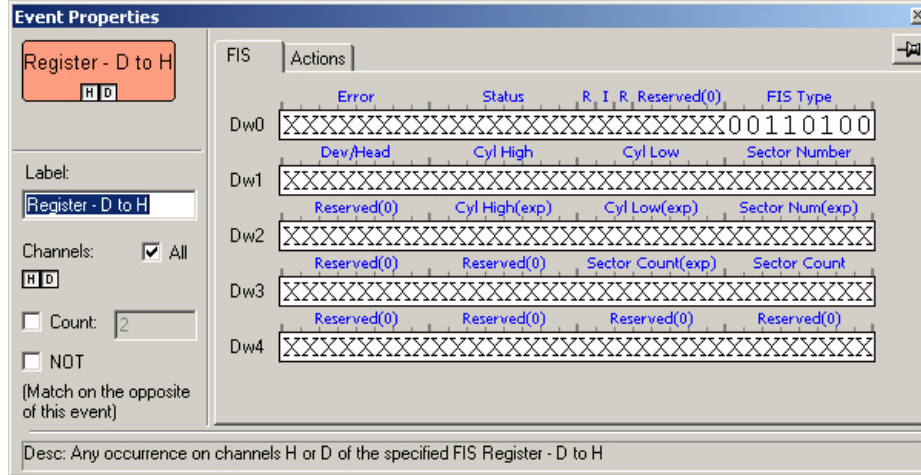
PRIMITIVES

The various types of Primitives are collectively listed in the **Primitives** properties dialog. Selecting a Primitive from the list narrows the analyzer's search to just the selected Primitive. Afterwards, a trigger or filter can then be set on the selection. If NOT is checked, any unchecked primitive category will generate an event match.

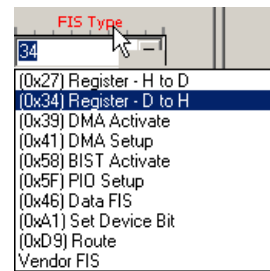


FIS TYPES

The **FIS Types** properties dialog presents options for triggering or filtering on several different FIS categories. An example (Register Device to Host) is show below. Each FIS Properties dialog box displays a pattern editor that allows you to set a bit pattern to be matched. If NOT is checked, any unchecked primitive category will generate an event match.



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.

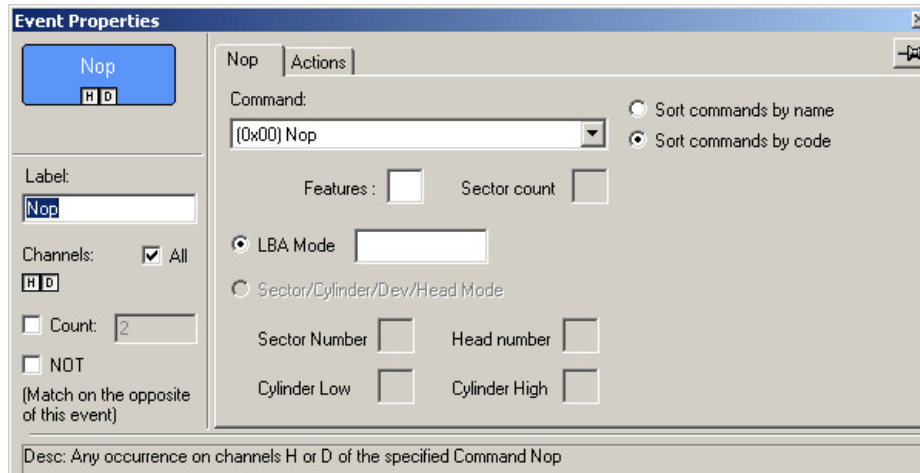


COMMANDS

The Commands Properties dialog box contains a long menu of commands and presents additional options that vary depending on which command has been selected.

Example of Commands Properties Dialog Box

Each of the Commands properties dialog boxes is organized similarly to the example shown below.



Command - Presents a menu of all of the Commands listed in the New Events menu.

Sort commands by name - Organizes the Command menu alphabetically by name.

Sort commands by code - Organizes the Command menu by code.

Features: - Features refers to the contents of the Features register. To trigger on Features, enter a value in the box. This option is context-sensitive and is not available for all Commands.

Sector Count - Sector Count refers to the contents of the Sector Count register. To trigger on Sector Count, enter a value in the box. This option is context-sensitive and is not available for all Commands.

LBA Mode - Select this option to activate LBA (Logical Block Address) addressing. Then enter an address into the text box. The term LBA defines the addressing of data on the device by the linear mapping of sectors.

Sector/Cylinder/Dev/Head Mode - Select this option to activate the following parameters:

Sector Number - Enter a value to trigger on the Sector Number register.

Head Number - Enter a value to trigger on the Head Number register.

Cylinder Low - Enter a value to trigger on the Cylinder Low register.

Cylinder High - Enter a value to trigger on the Cylinder High register.

Sector Number - Sector Count refers to the contents of the Sector Count register. To trigger on Sector Count, enter a value in the box. This option is context-sensitive and is not available for all Commands.

Commands

The following commands are listed in the **Commands** properties dialog:

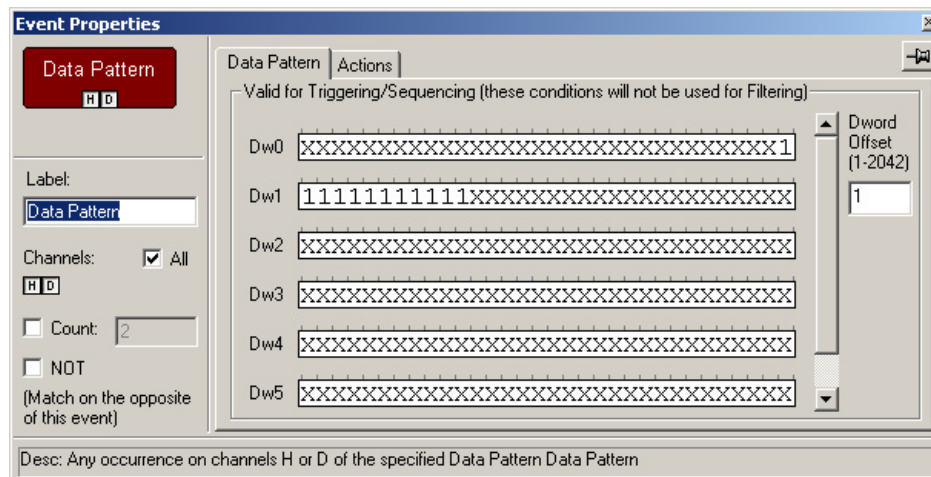
- Execute Device Diag
- Device Reset
- CFA Erase Sectors
- CFA Request Ext Error Code
- Check Power Mode
- Flush Cache
- Flush Cache Ext
- Get Media Status
- Idle
- Idle Immediate
- Initialize Device Params
- Media Eject
- Media Lock
- Media Unlock
- Nop
- Read Native Max address
- Read Native Max address Ext
- Read Verify Sectors
- Security Erase Prepare
- Security Freeze Lock
- Seek
- Set Features
- Set Max Address
- Set Max Address Ext
- Set Multiple Mode
- Sleep
- Smart
- Standby
- Standby Immediate
- CFA Translate Sector
- Identify Device
- Identify Packet Device
- Read Buffer
- Read Multiple
- Read Multiple Ext
- Read Sectors
- Read Sectors Ext

- CFA Write Multiple wout Erase
- CFA Write Sectors Wout Erase
- Download Microcode
- Security Disable Password
- Security Erase Unit
- Security Set Password
- Security Unlock
- Write Buffer
- Write Multiple
- Write Multiple Ext
- Write Sectors
- Write Sectors Ext
- Read DMA
- Read DMA Ext
- Write DMA
- Write DMA Ext
- Packet
- Service
- Read DMA Queued
- Read DMA Queued Ext
- Write DMA Queued
- Write DMA Queued Ext
- Read Stream SMA
- Read Stream PIO
- Read Log Ext
- Write Stream DMA
- Write Stream PIO
- Write Log Ext
- Read Verify Sectors Ext
- Configure Stream
- Device Configuration
- Check Media Card Type
- Smart Read Data
- Smart Read Log
- Smart Write Log
- Smart Enable Operations
- Smart Disable Operations
- Smart Return Status
- Smart Execute Off Line
- Smart Enable Disable Autosave
- Smart Save Attribute
- Device Config Freeze Lock
- Device Config Identify

- Device Config Restore
- Device Config Set
- Read SFO
- Write SFO
- SEP ATTN
- Read FPDMA Queued
- Write FPDMA Queued
- Recalibrate
- Format Track
- Identify Device DMA
- Read DMA Without Retries
- Write DMA Without Retries
- Read Sectors Without Retries
- Write Sectors Without Retries
- Read Long
- Read Long Without Retries
- Write Long
- Write Long Without Retries
- Write Verify
- Write Verify Without Retries
- Read Verify Without Retries

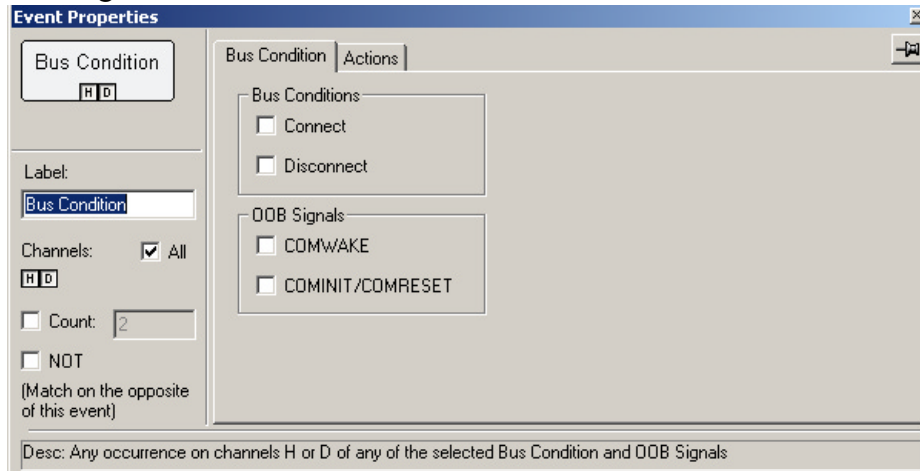
DATA PATTERN

The **Data Pattern** properties dialog allows you to set triggers or filters on a user-defined bit pattern.



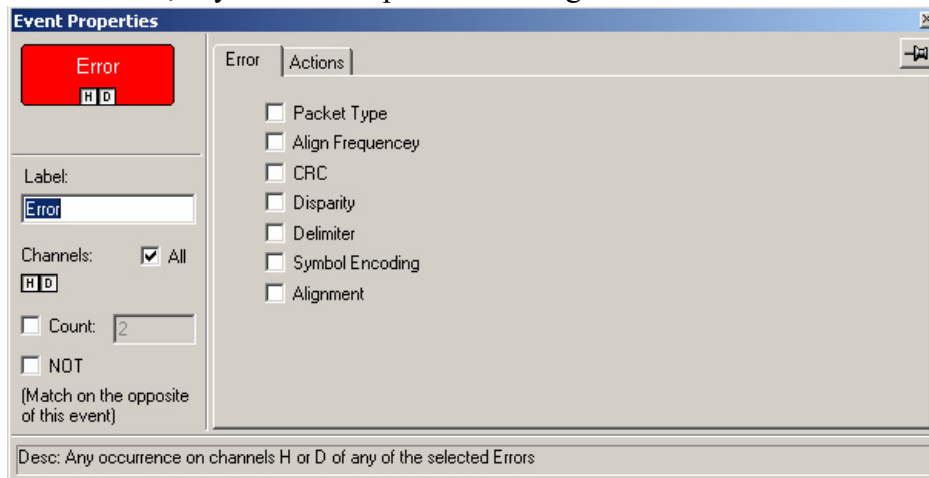
BUS CONDITIONS AND OOB SIGNALS

This properties dialog presents options for triggering or filtering on Bus Conditions and OOB Signals. To specify a bus condition or OOB signal, check the appropriate option. If NOT is checked, any unchecked primitive will generate an event match.



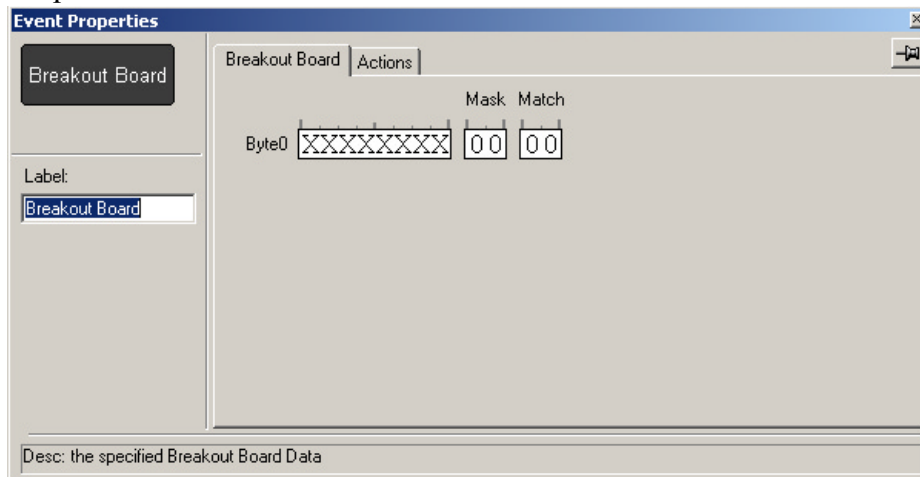
ERRORS

The **Errors** properties dialog presents options for triggering or filtering on Error types. To specify an error type, check the appropriate option. If NOT is checked, any unchecked primitive will generate an event match.



BREAKOUT BOARD DATA

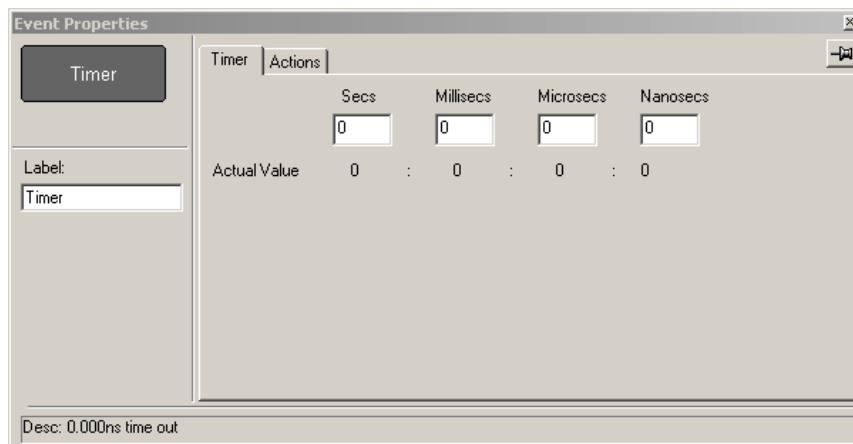
The **Breakout Board Data** properties dialog box lets you specify a bit pattern from a breakout board that can be used for triggering. If NOT is checked, an event match will be created for any pattern other than the one specified.



TIMER

The **Timer** properties dialog allows delays to be added to sequences. Timers let you create statements such as "Look for an error. When the error occurs, wait three seconds and then trigger."

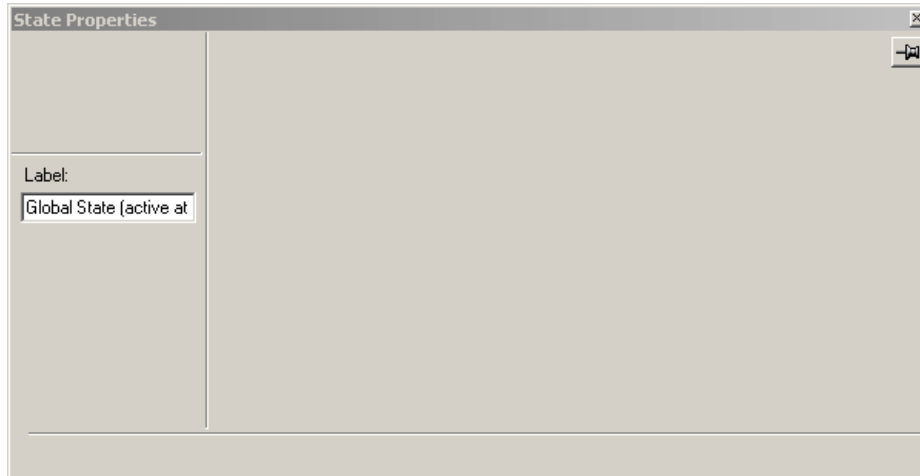
Timers values are seconds, milliseconds, microseconds, and nanoseconds. The set timer value appears at the bottom left corner of the dialog and reflects the hardware precision capabilities. The time is rounded up to the next 7.519 nanosecond sample, which corresponds to the 1.33 MHz internal clock frequency.



5.10 State Properties Dialog

Both the Global State and Sequence Cells have their own properties dialog boxes. Double-click on either of these cells (but not on an event button within them), to open the State Properties dialog.

The State properties dialog allows the caption.



5.11 Assigning Actions

Actions can be assigned to buttons two ways: by right-clicking an event button and selecting an action from the pop-up menu; and by double-click a 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.



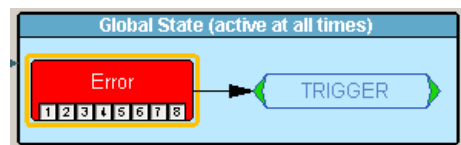
The following table shows the types of Actions you can select.

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

5.12 Setting Conditions: The Role of the Global State Cell

The Global State cell is the place for creating triggering and/or filtering conditions that are active at all times. You can think of these conditions as the *default conditions*. You use the

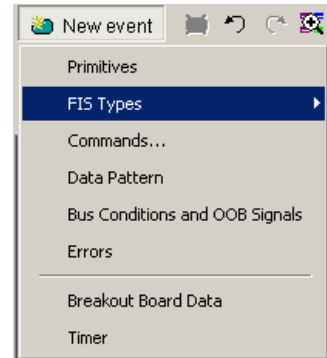
Global State cell to create simple condition such as "Trigger when you see an xxx error," or "filter out all xyz primitives."



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:

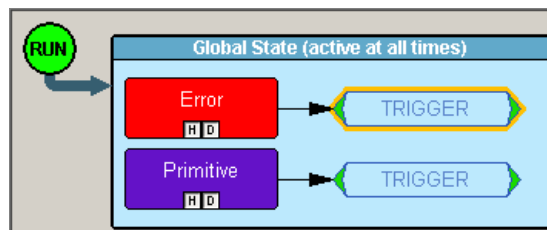
- Step 1 Click the New Event button. An Events menu opens (shown right).
- Step 2 Select an event from the menu. The event will appear as a button in the **Available Events** area on the left.
- Step 3 Drag the event button to the cell marked "Global State."
- Step 4 Right-click on the button (i.e., 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**.



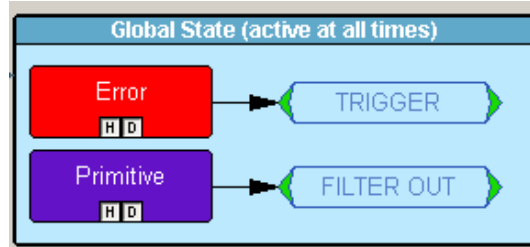
Creating Multiple Event Conditions in the Global State Cell

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".

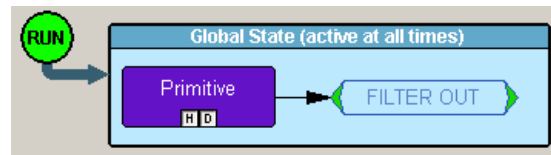


Creating an AND Condition - When multiple events are placed in the Global State cell and assigned *different* actions, an AND statement is created. The example below reads "Trigger if an error occurs AND filter out any primitives that occur."



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 and Filter Out

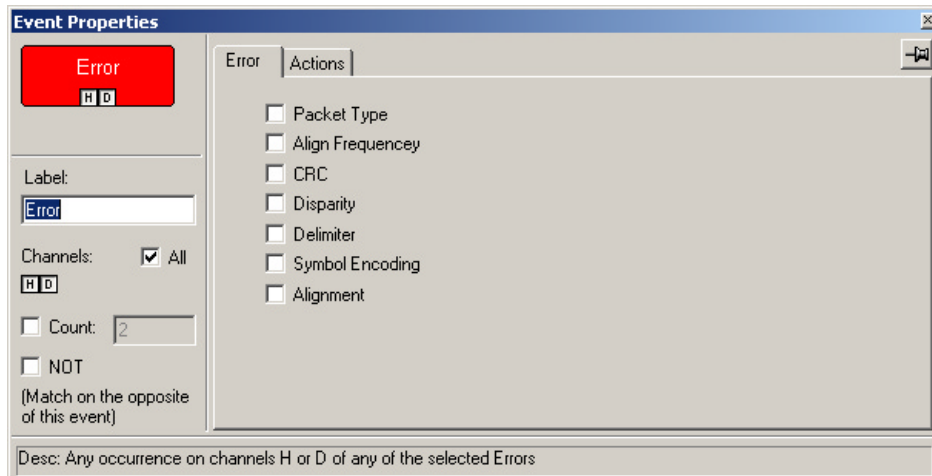
The options **Filter Out Everything** or **Filter In Everything** allow you to filter all traffic in or out of the trace. These options are intended for a future release to allow you to selectively exclude and include traffic from a recording.

Counting Events

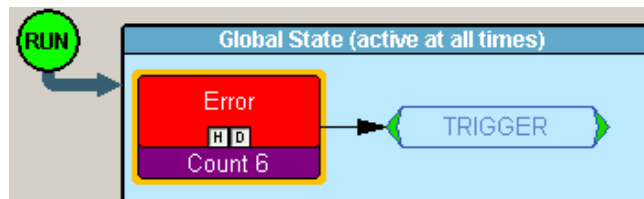
In addition to setting triggers and filters, you can also set *counters*. A counter is an action that allows you to set a trigger based on a count of events. For example, you could use a counter to "Trigger following the 16th occurrence of an error."

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** Double click on the event. The Properties dialog box opens for the selected event.

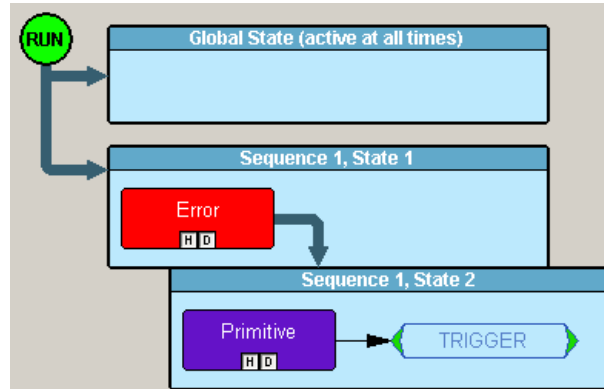


- Step 4** Check the box marked **Count**.
- Step 5** In the text box to the right of the label Count enter a value.
- Step 6** Click the X in the top right corner of the dialog box to close the dialog. A counter button should appear below your selected event.

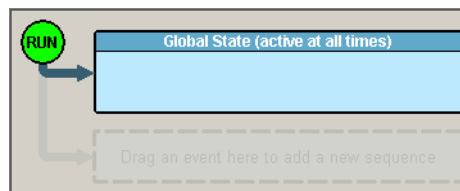


5.13 Creating Event Sequences

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*.

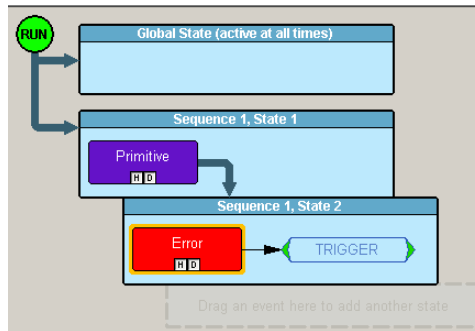


Note Event sequences can only be created in the Sequence cell. You cannot create a sequence in the Global State cell.

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 - *Sequence 1, State 1* and *Sequence 1, State 2*. The maximum number of states a sequence can support is 255.

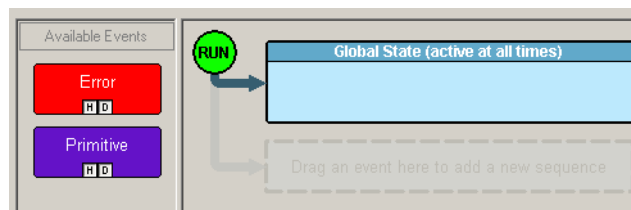


The foregoing example reads: "Trigger if you see a Primitive followed by an error."

How to Create an Event Sequence

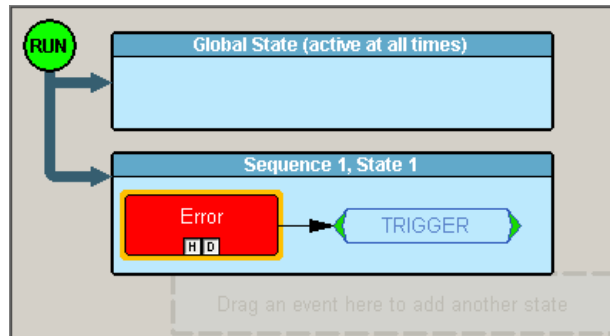
To create an event sequence, you drag event buttons to the Sequence cell, link them with the action **Advance the Sequence**, then apply a trigger or other action to the end of the chain. The following steps illustrate how to create an event sequence.

- 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.

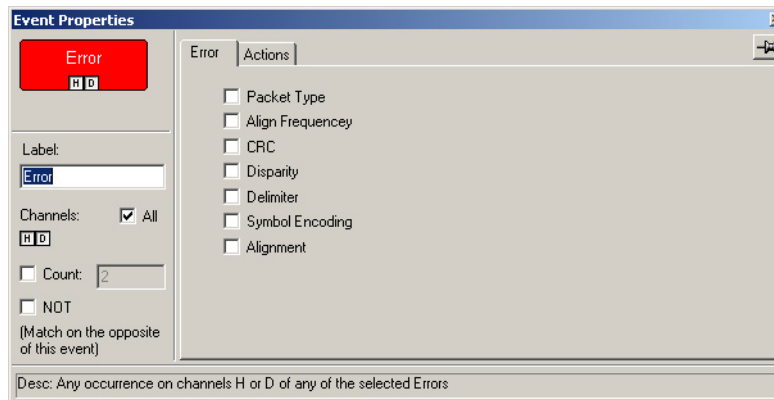


- Step 4 Drag the first button to the cell marked "Drag an event here to create a sequence." When you finish, notice how two new cells appear in

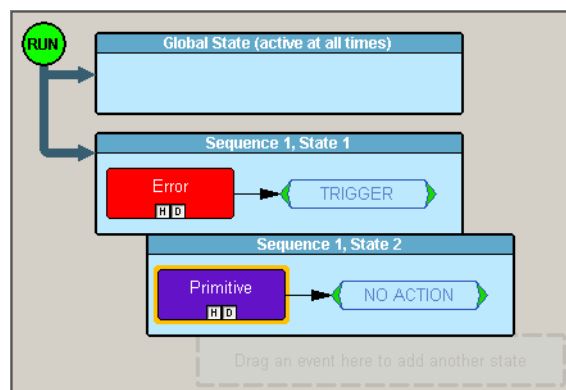
the window as shown below the cell where you placed your button.



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

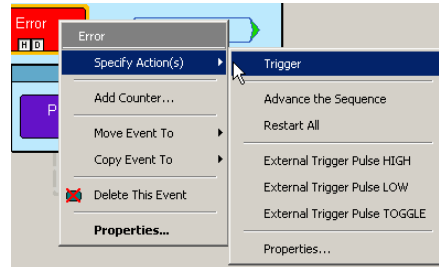


appears marked "Drag an event here to add a sequence."

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:



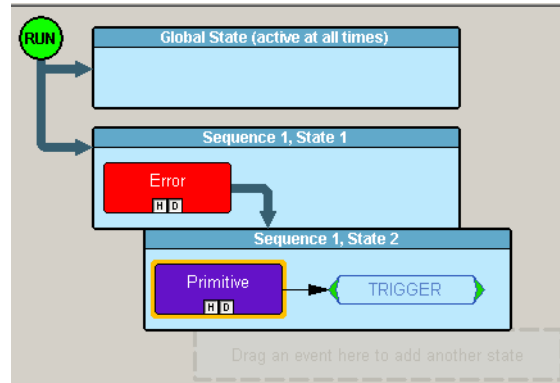
- **Advance the Sequence** - Draws an arrow that connects the selected event button to the event button below it. This option creates a sequence.
- **Restart the Sequence** - (Not visible in the menu above.) This option restarts the entire sequence. This option appears once you have linked two or more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

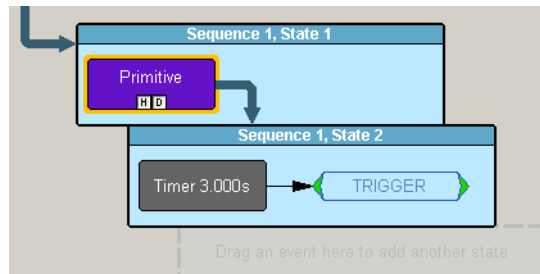
Step 13 Select **Trigger**. A cell will appear to the right of the second button saying "Trigger." Your sequence configuration is now complete and

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.

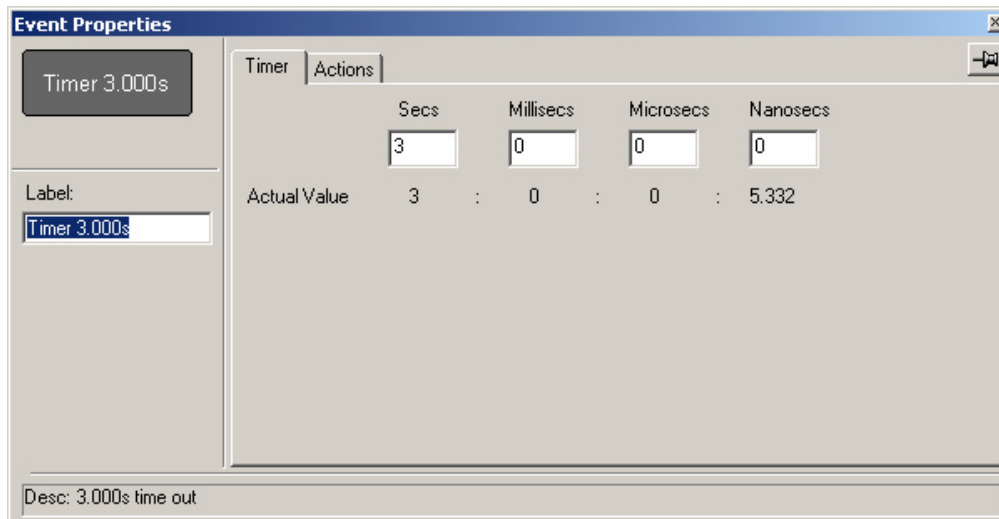


This example reads "Look for a Primitive. When you see one, wait three seconds then trigger."

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.



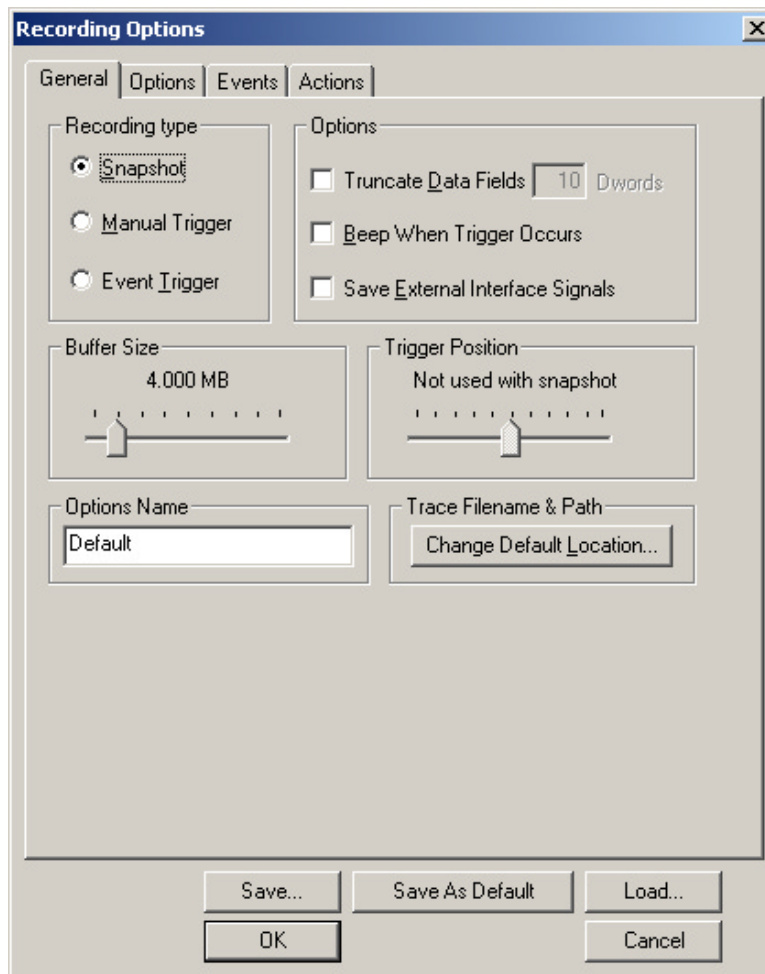
- Step 14** Enter a time value in the boxes.
- Step 15** Click the x to close the dialog box. The timer is now set.

6. Recording Options - UPAS 2500H

The following chapter describes how to configure Recording Options for SATracer based on the UPAS 2500H platform. These options will appear automatically if a UPAS 2500H is attached to your PC. If you are not running an UPAS 2500H, you can configure the analyzer software to display the UPAS 2500H Recording Options by selecting **Setup > Application Preferences ...** from the menu and then de-selecting the option **If no analyzer is connected, use UPAS 10K recording options**, then click **OK**. When you open the Recording Options dialog, it should look like the one below.

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

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






6.1 General Recording Options


The General Recording Options allow you to select or adjust the recording type, the buffer size, the amount of post-Trigger recording, and the Trace filename and path.

Recording Type

The **Recording Type** box gives three options that allow you to set how SATracer/Trainer begins and ends a recording. The options are *Snapshot*, *Manual Trigger*, and *Event Trigger*.

- **Snapshot:** Fixed-length recording whose size is determined by the "Buffer Size" box in the Recording Options dialog or by a manual click of the Stop button. Recording begins when  is clicked and ends when either the selected buffer size is filled or the  button is pressed.
- **Manual Trigger:** Recording whose Trigger point is caused by pressing the Trigger button on the front panel.

Recording begins when you click  on the Tool Bar. Recording continues in a circular manner within the limits set by the buffer size. Recording ends when  is clicked on the Tool Bar or after post-Trigger memory has been filled following depression of the Trigger button on the front panel.

- **Event Trigger:** Recording whose Trigger is defined by a specific event or events. Recording begins when you click  on the Tool Bar.

Recording continues in a circular manner within the limits set by the buffer size until an event is detected that meets the Trigger conditions specified in the Triggering Options and the defined amount of data has been recorded after the Trigger event.

Options

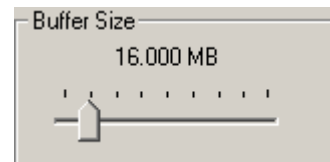
The options checkboxes appear on the upper right side of the General tab of the Recording Options window.

- **Truncate Data Fields:** Allows data fields to be truncated between 10 and 251 dwords during the recording in order to save Analyzer memory and allow recording of more packets. Enter a minimum data length value in the box marked Dwords. SATracer truncates the data to the stated value or slightly larger.

- **Beep When Trigger Occurs:** When this checkbox is selected, the computer connected to the SATracer/Trainer beeps three times when a Trigger condition is first detected.
- **Save External Interface Signals:** Allows external input signals from a breakout board to be recorded.

Buffer Size

The Buffer Size box has a slide bar for adjusting the recording buffer size from 0.4 megabytes to 512 MB.



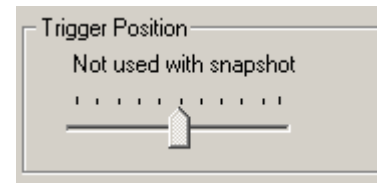
The Recording Type option determines how this buffer is used. Although there are 512 MB of physical memory in the Analyzer, the efficiency of the recording ranges from 2:1 to 4:1 ratios of physical memory to actual Serial ATA traffic. Shorter Serial ATA sequences yield a less efficient recording.

You must have an equivalent amount of physical memory on the computer controlling the SATracer analyzer.

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

Trigger Position

The Trigger Position slide bar sets the amount of pre- and post-trigger recording. It also allows adjustment of the location of the trigger within the defined buffer. You can adjust the Triggering Position between 1 and 99% post-Trigger. **Trigger Position** is available only when **Manual Trigger** or **Event Trigger** is selected as **Recording type**.

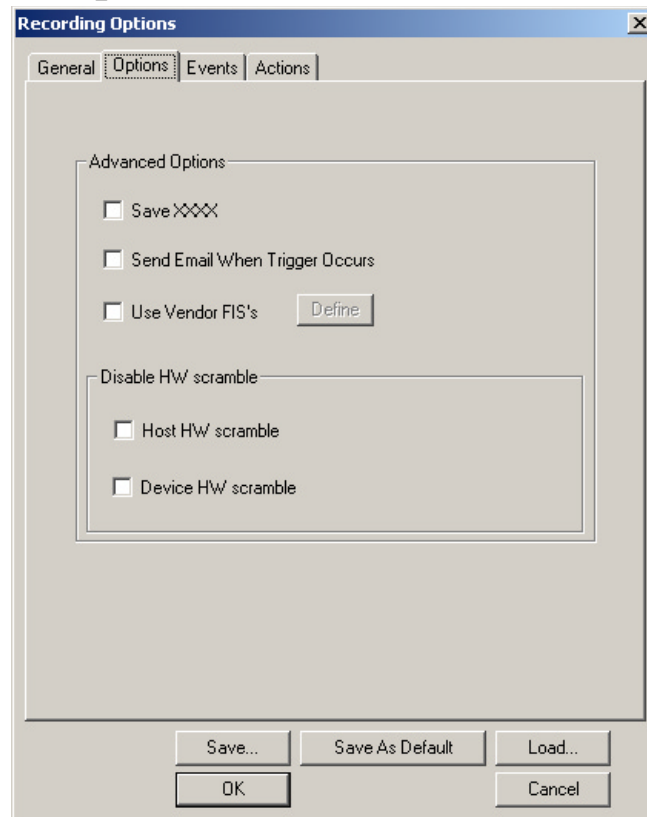


As an example, if the buffer size is set to 16MB, then for the following Trigger Position settings, the amount of pre- and post-Trigger data is

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

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

6.2 Advanced Options



- **Save XXXX:** SATracer's Advanced Recording Options includes the ability to save and display unformatted XXXX data (both in 10-bit or in hex format). The ability to save all traffic on the line including "idle" or "filler" data is often useful in early silicon validation.

Note this option will rapidly fill SATracer's recording memory and can not be used with filtering.

A significant portion of the constant transmission of Serial ATA flow control primitives will contain Idle Sequences. This "filler" data is represented by XXXX signals in the CATC Trace display. By default, SATracer does not record the actual XXXX traffic but discards this information to preserve recording memory. The CATC Trace substitutes a place holder for each of the XXXX values.

- **Send Email When Trigger Occurs:** Sends email via the host PC. The PC must have a fully qualified email address.
- **Use Vendor FISs:** Prevents SATracer hardware from reporting FIS type errors on vendor-specific FISs. When selected, opens a pattern editor that lets you enter data patterns in binary or hex for up to five Vendor FISs. After a pattern has been entered, the **Define** button will become active. The **Define** button lets you edit your FIS data patterns.
- **Disable HW scramble:**
 - HOST:** Allows you to disable the BusEngine host side descrambler module, so that the host can send unscrambled data. This option is useful for viewing traffic from early silicon designs that have not yet implemented the scrambling of Serial ATA data payloads or primitives.
 - DEVICE:** Allows you to disable the BusEngine device side descrambler module, so the device can send unscrambled data.

Options Name

Descriptive label of the current Recording Options settings. Options names are associated with files that have a **.rec** suffix.

The default option name is **default**. **Default** preserves the current recording options settings.

The purpose of the **Options Name** box is to give you a place to preserve different recording options that you use on a recurrent basis. For example, if you use two or three different recording options configurations, you can save these configurations and load them the next time they are needed.

Because options names are descriptive labels and not file names, you can enter in any text you desire into the box.

To create a new **Recording Options** name, follow these steps:

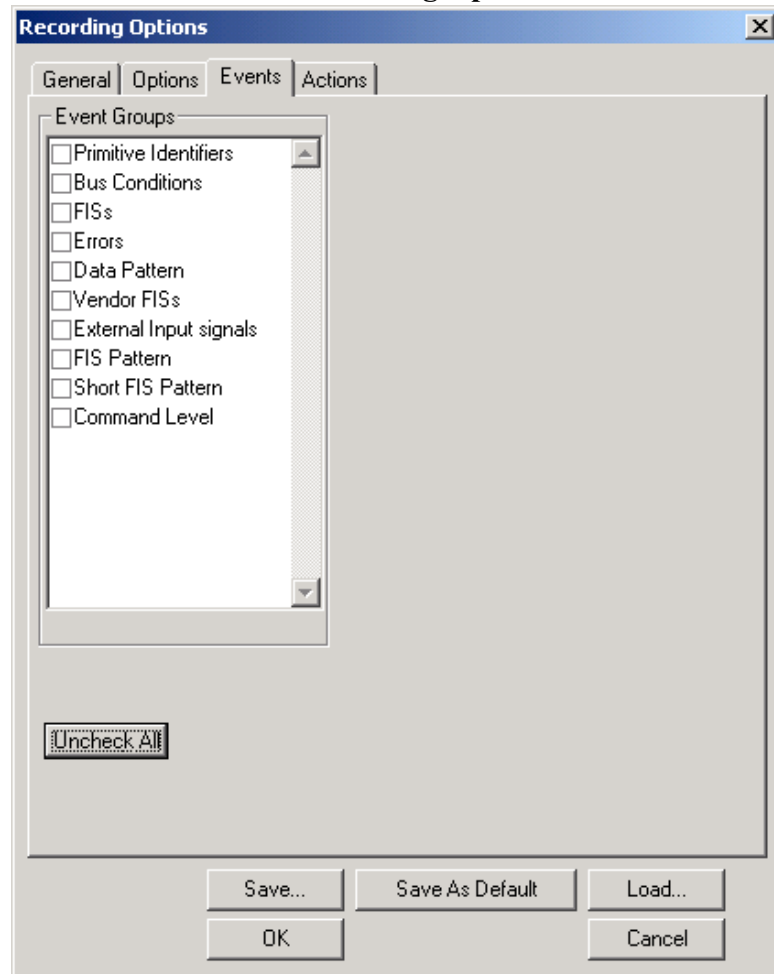
- Step 1** Enter a comment for the new file in the **Options name** field.
- Step 2** Click **Save...**
- Step 3** Specify a filename (***.rec**).
- Step 4** Click **Save**.

To load a **Recording Options** name, follow these steps:

- Step 1** Click **Load ...**
- Step 2** From the list of **.rec** files, select the one that represents your options name.

6.3 Events Recording Options

Click the **Events** tab on the **Recording Options** screen.

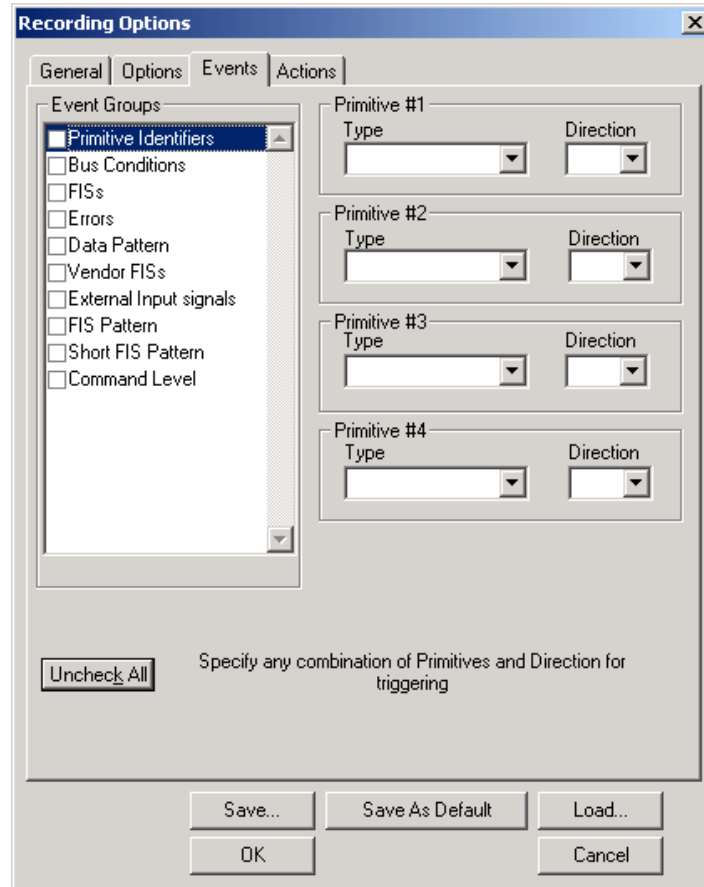


The event Triggering and Filtering options allow you to set specific parameters for each event group. When an event group is selected, a field appears that allows you to select specific conditions within the corresponding event group. As details are selected, other event group details may fade since there are limited hardware resources in the Analyzer. Information about the resources available is displayed below the event group details. When a detail is faded, it is inactive and cannot be selected. If an event group remains inactive, the current version of the application or BusEngine does not support it.

Primitive Identifiers

Select **Primitive Identifiers**.

Four pairs of menus display labeled "Primitive" and "Direction." You can select a Primitive from each menu. The Direction menus lets you optionally specify a direction for each selected Primitive. Your choices are: Host to Device, Device to Host, or Both. You can also leave the Direction unselected (which is the default condition).



The following chart shows the Primitives that appear in the Primitives menus and the actions that can be performed on them. (See Section 6.5, “Connecting Events to Actions” on page 105 for details on setting Actions.) As can be seen in the following chart, Primitives are not available for Filter In operations.

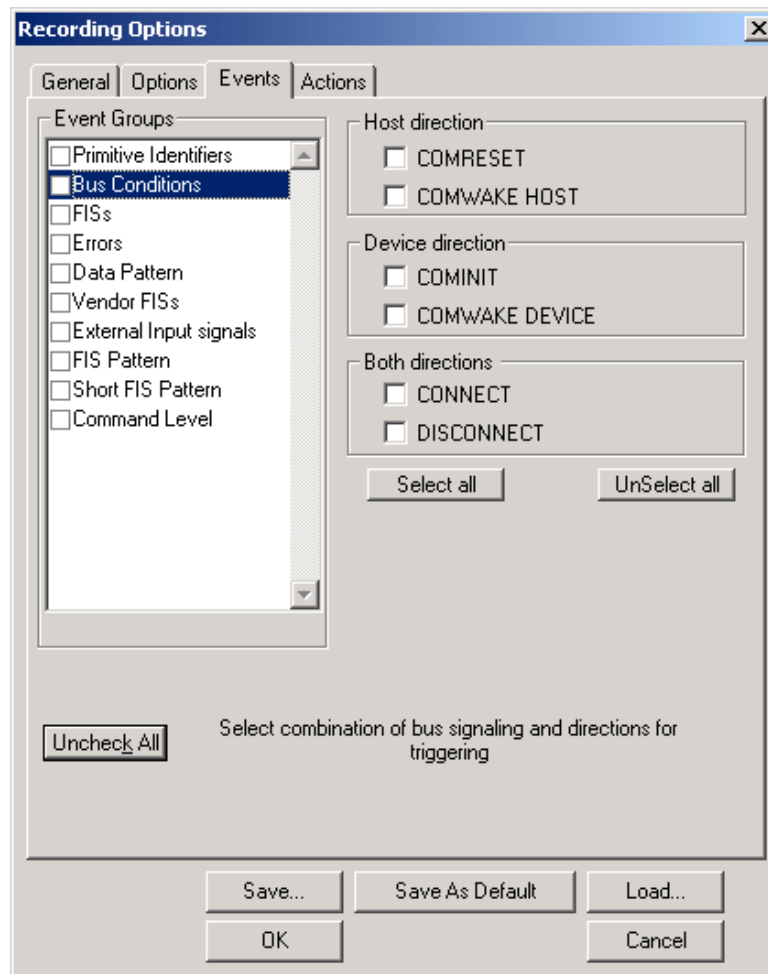
Primitive	Trigger	Filter Out	Filter In	Restart
Sync	X	X		X
X_RDY	X			X
WTRM	X	X		X
R_RDY	X			X
R_IP	X	X		X
R_OK	X	X		X
R_ERR	X	X		X
SOF	X			X
HOLD	X	X		X
HOLDA	X	X		X
DMAT	X	X		X
PMREQ_P	X			X
PMREQ_S	X			X
PMACK	X	X		X
PMNAK	X	X		X
EOF	X			X
ALIGN	X	X		X
CONT	X			X
RTX	X			X
H_RDY	X			X
B_OFF	X	X		X
R_NAK	X	X		X

Figure 3: Actions that SATracer can perform on Primitives.

Note As can be seen in the above chart, the Primitives X_RDY, R_RDY, SOF, PMREQ_S, PMREQ_P, EOF, CONT, RTX, H_RDY can not be filtered in or out.

Bus Conditions

Select **Bus Conditions**.

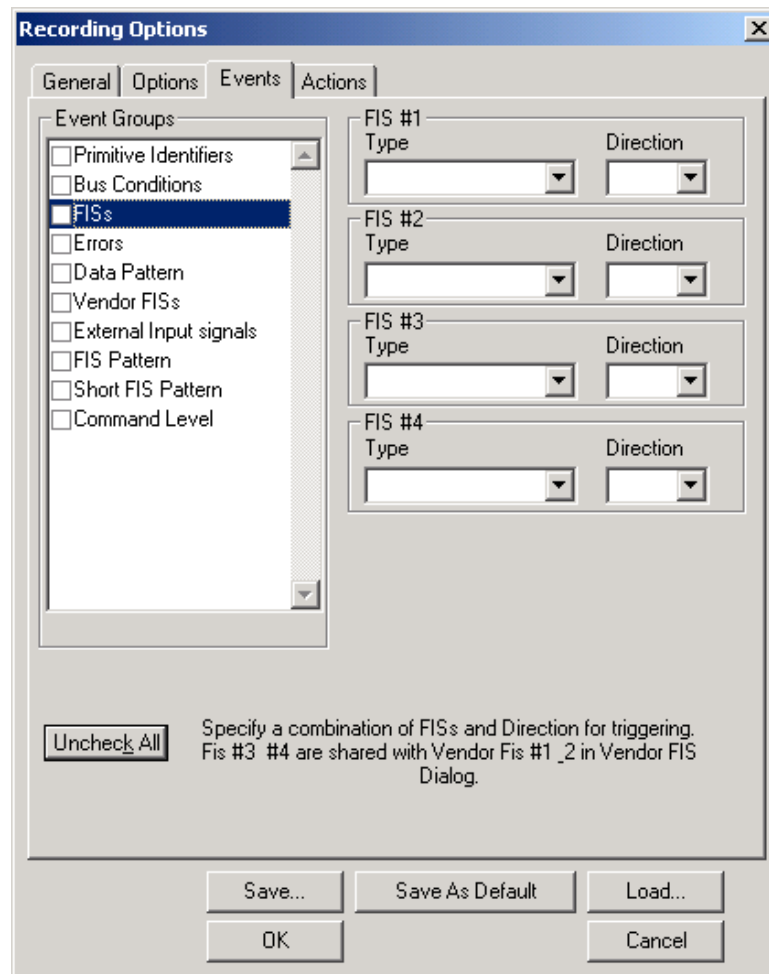


You can select up to six combinations of bus conditions in the checkboxes for triggering or filtering.

Note You can not filter in or out Bus Conditions.

Frame Information Structure (FIS)

Select FISs.



A FIS is the user payload of a frame, exclusive of the SOF, CRC, and EOF delimiters. The four sets of drop-down menu presents FIS and direction options. Specify any combination of options.

Note The selections you make here will impact on the number of Vendor FISs you can select. You can select a combined total of four FISs and Vendor FISs. If, for example, you select four FISs, then you will not be able to select any Vendor FISs.

Any Action can be set upon the selected FISs (Trigger, Filter In, Filter Out, or Restart).

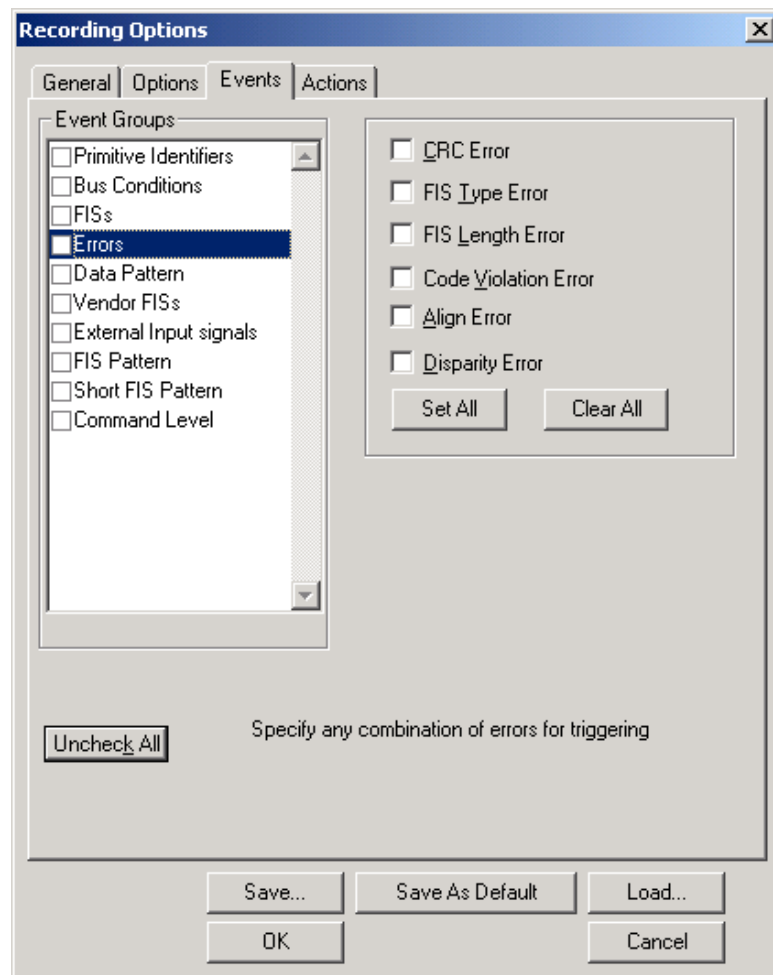
The FISs presented are:

- Register-H->D (Host to Device)

- Register-D->H (Device to Host)
- DMA Activate
- DMA Setup
- BIST Activate
- PIO Setup
- Data
- Set Device Bit

Errors

Select **Errors**.

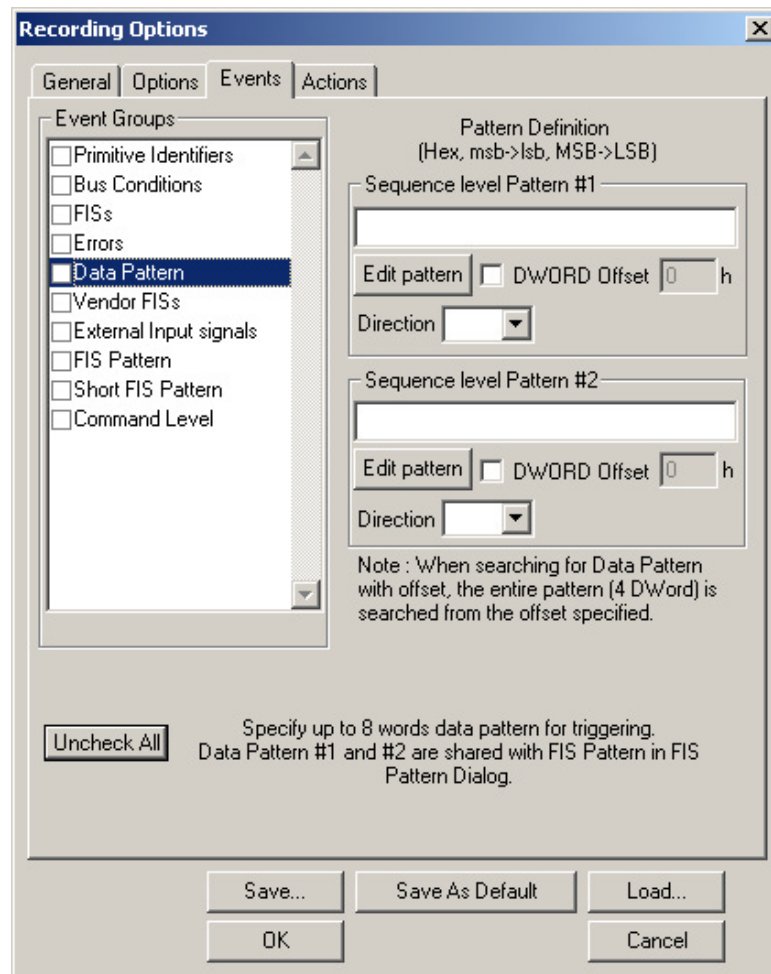


Specify any combination of errors for triggering. When you select multiple errors, only one Error button will appear in the Actions window.

Note You can not filter in or out Errors from the recording.

Data Pattern

Select **Data Pattern**.



In the box labeled **Sequence Pattern # 1**, enter a Data Pattern with a length of up to 16 bytes for triggering. This will cause the analyzer to trigger on the pattern *anywhere* within the payload.

To specify a second data pattern, enter text into the box labeled **Sequence Pattern # 2**.

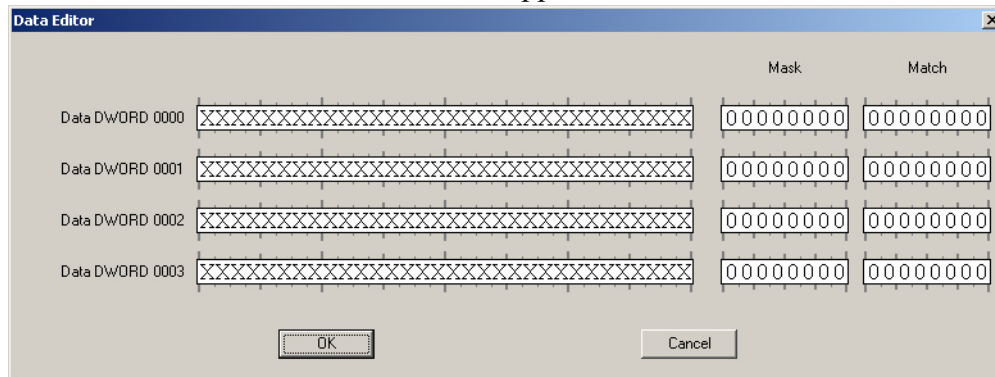
Edit Pattern - Allows the analyzer to trigger on a pattern within a specific dword. Click **Edit Pattern** to open a pattern editor that will allow you to enter the data pattern on a bit-by-bit basis and thereby keep track of the bits and bytes.

Dword Offset - This option lets you specify how many dwords should be offset (i.e. skipped) before pattern matching should begin. For example, "1" means "begin pattern matching on the second dword." Enter a value in hexadecimal.

To enter data bit-by-bit, follow the next procedure.

Step 1 Press the **Edit** button.

The **Data Editor** window appears.



Step 2 Click on the bits within each byte that you wish to edit, and make the appropriate changes. Alternatively, you can also enter hexadecimal values into the Mask and Match boxes.

Step 3 Click **OK** to close the dialog box.

SATracer can trigger on a data pattern match. There are two modes for this:

- Normal data pattern
- Data pattern with offset

Data pattern is always padded to WORD size (16 bits). For example, "123" will be padded to "0123," and "1" will be padded to "0001." The data pattern will always be searched as WORD aligned.

When triggering on a data pattern without the offset, the Serial ATA traffic is searched, and a trigger occurs when the data is found. The search resolution is (16-bit) WORD size. The search will look for the pattern as displayed in the sequence level.

Data pattern trigger with offset works with resolution of DWORDS. You need to enter the values and the offset in the exact position in order to trigger. For example, entering "1234" is actually "12340000," which is not the same as "00001234."

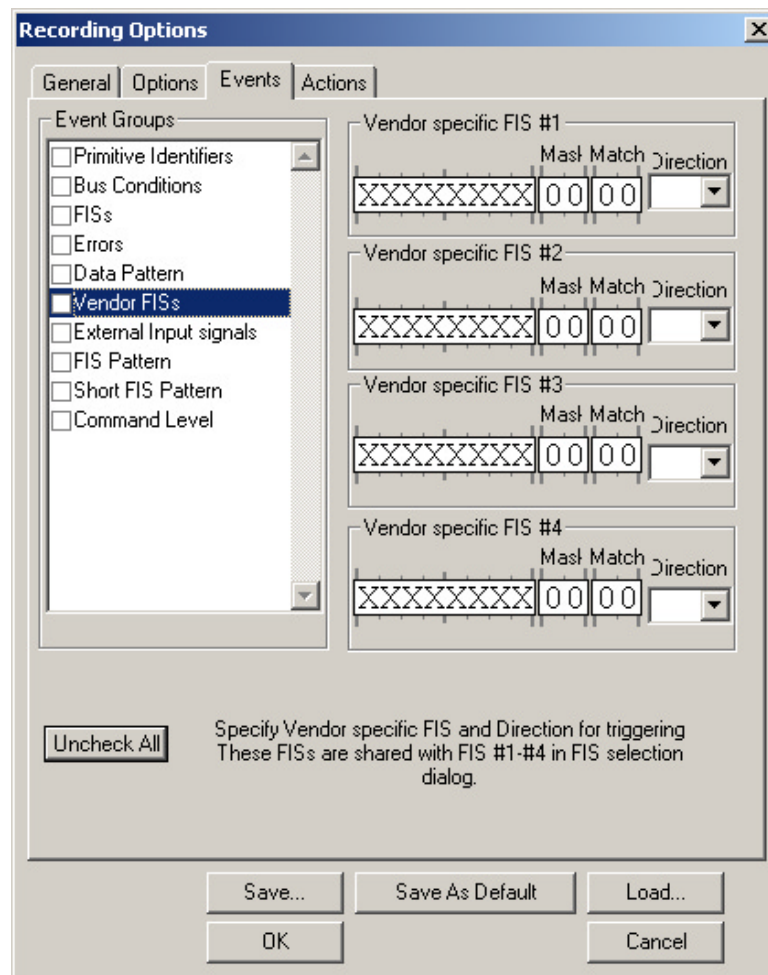
You can use the "X" to indicate "don't-care" in the value. For example, the data pattern "XXXX1234" is different if you use it with or without offset. If used without offset, then this is exactly the same as "1234." If used with offset, then this means that you wish to trigger on a DWORD where its lower WORD is "1234" and the upper DWORD is not defined.

When editing a Data pattern with the Edit Pattern button, you can edit every bit. You can edit the mask and match values, using either binary pattern or hexadecimal representation of the values you want. When setting the MASK value to 0xF(1111), a full match is required. When setting the MASK to 0x0(0000) it means that you do not need any match to trigger.

Note You can not Filter In or Filter Out Data patterns from the recording. Trigger and Restart are the only available Actions that can be performed.

Vendor FISs

Select Vendor FISs.



If you have not selected any FISs from the FIS options (described on page 84), you will be able to select up to four Vendor FISs. If you have selected FISs from the FIS options, a corresponding number of Vendor FIS

menus will be greyed out. For example, if you have selected two FISs from the FIS options, then two of the Vendor FIS menus will be greyed out. You can select no more than a combined total of four FISs and Vendor FISs.

Any action can be performed on the selected Vendor FISs (Trigger, Filter In, Filter Out, or Restart).

To specify a FIS, enter the bit values in the boxes marked with Xs or enter hex values in the Mask and Match boxes. Use the Direction drop-down menu to supply a direction.

External Input Signals

The analyzer can be configured to trigger on external input signals from a device such as an oscilloscope.

To trigger from an external source, you will need to connect the triggering device to the analyzer using a BNC or RS-232 cable.

Using a BNC Cable

If using a BNC cable, connect the triggering device to one end of the cable and the other end to the connector marked "Ext. In" on the back of the analyzer. You will not need to terminate the analyzer's input connector because all analyzer inputs are terminated with 50 ohms.

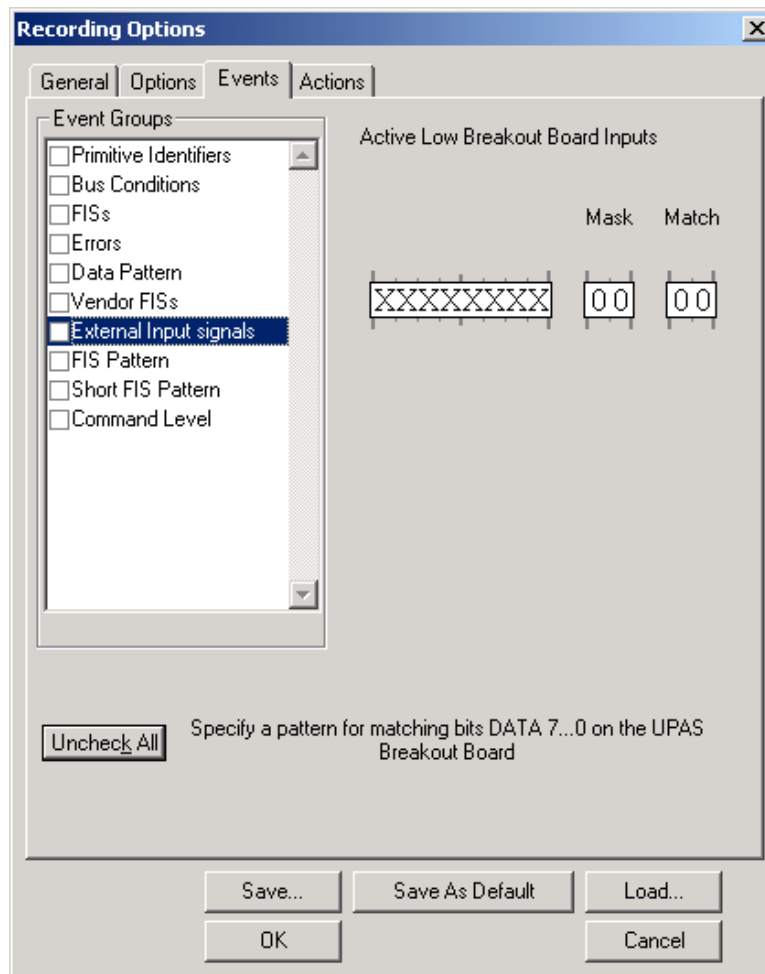
Using an RS-232 25 pin Cable

If using an RS-232 cable, you will also need to use a CATC breakout board and alligator cables. Connect alligator cables from the triggering device to one or more Data pins on a breakout board. Then connect a 25 pin RS-232 cable from the breakout board to the 25 pin connector on the back of the analyzer marked "DATA IN/OUT."

Once the analyzer is connected, you will need to configure the analyzer to trigger on external input signals.

Setting Recording Options

In the Events window of Recording Options, select **External Input Signals**.



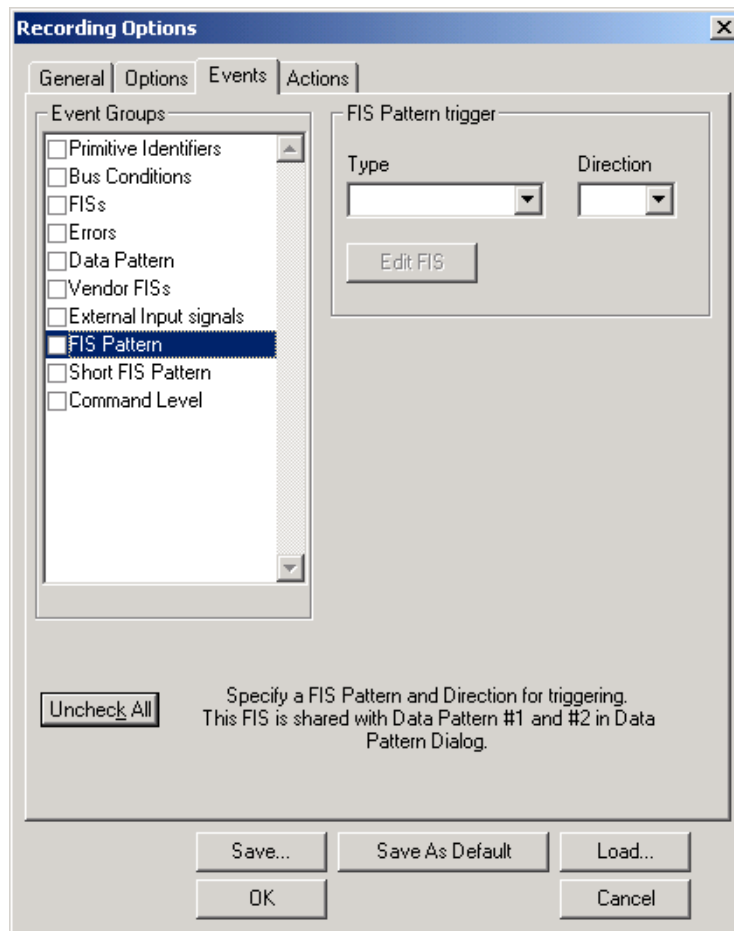
This option allows the analyzer to trigger on external input signals from an external device via a breakout board (for details on the breakout board, see Section 3.4, “External Interface Breakout Board” on page 13). To specify an External Input Signal, enter bit values in the boxes on the left marked with Xs or enter hex values in the Mask and Match boxes.

Note: If you want the external input signals to be recorded as fields in the trace, you must select the option **Save External Input Signals** under **Recording Options > General**.

Once the Recording Options have been set, the analyzer will be ready to record. Start the recording. The analyzer will then trigger when the external device generates a triggering signal.

FIS Pattern

Select **FIS Pattern**.



The FIS Pattern option lets you create triggers based on FIS type, direction, and patterns.

To specify a FIS type, make a selection from the pull-down menu labeled **Type**. Depending on the option you have selected, the **Direction** menu may become active and allow you to choose a direction.

To specify a FIS pattern,

- Step 1** Select a FIS type from the pull-down menu. The **Edit** button becomes active.
- Step 2** Click the **Edit** button. A Pattern editor opens that will look like the one shown below. Depending on the FIS type selected, the editor may look a little different than that shown below.
- Step 3** To specify a pattern, enter a bit value in one or more of the boxes. "X" represents a "Don't Care" value. As an alternative, values can

be added in hex in the box on the right.

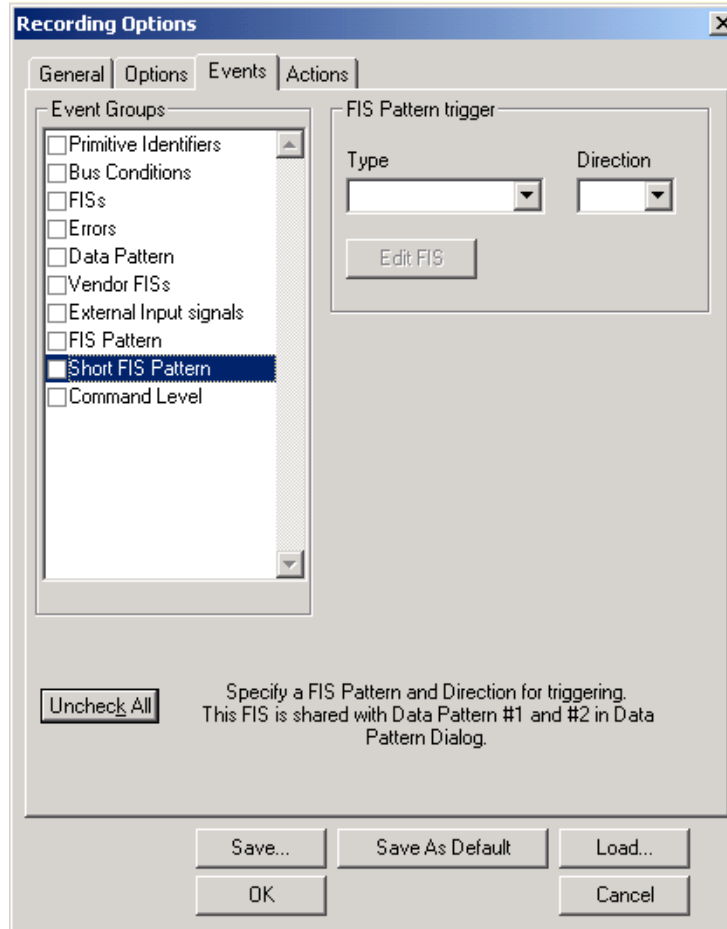
The screenshot shows a dialog box titled "FIS Pattern Dialog" with a close button (X) in the top right corner. The dialog contains several rows of input fields, each with a label and a corresponding hex value box. The fields are as follows:

Field Label	Hex Value
Features	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX00100111
Command	00000027
Cyl High	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Cyl Low	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Sector Number	00000000
Features(exp)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Cyl High(exp)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Cyl Low(exp)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Sector Num(exp)	00000000
Control	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Reserved(0)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Sector Count(exp)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Sector Count	00000000
Reserved(0)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Reserved(0)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Reserved(0)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Reserved(0)	00000000

At the bottom of the dialog, there are two buttons: "OK" and "Cancel".

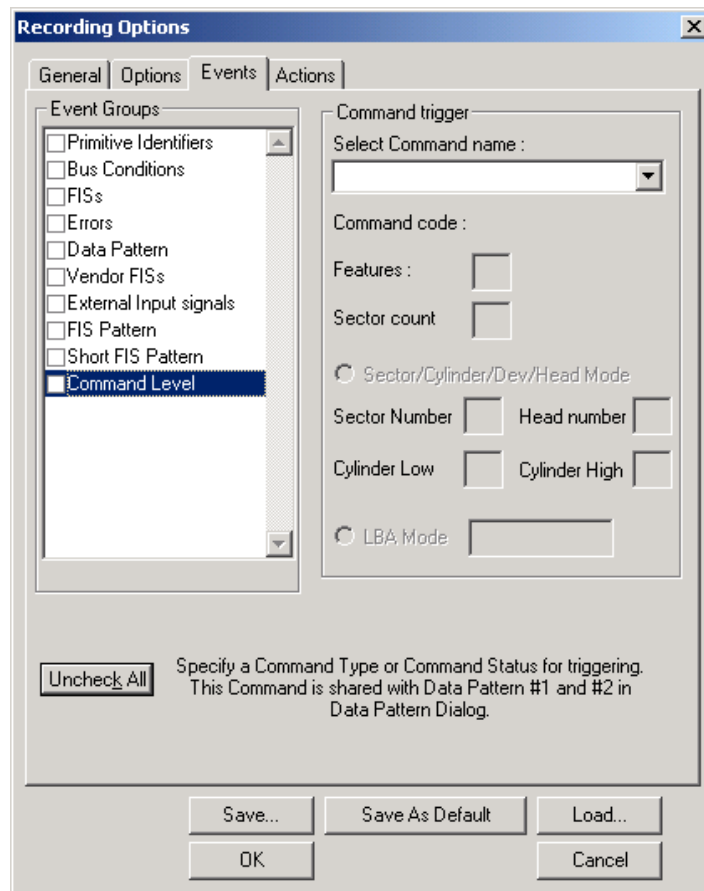
Short FIS Pattern

Short FIS allows the Data Pattern trigger and the FIS Pattern trigger to be active simultaneously. Specify a FIS pattern and direction for triggering. This FIS is shared with Data Pattern # 1 and Data Pattern # 2 in the Data Pattern dialog.



Command Level

Select **Command Level**.



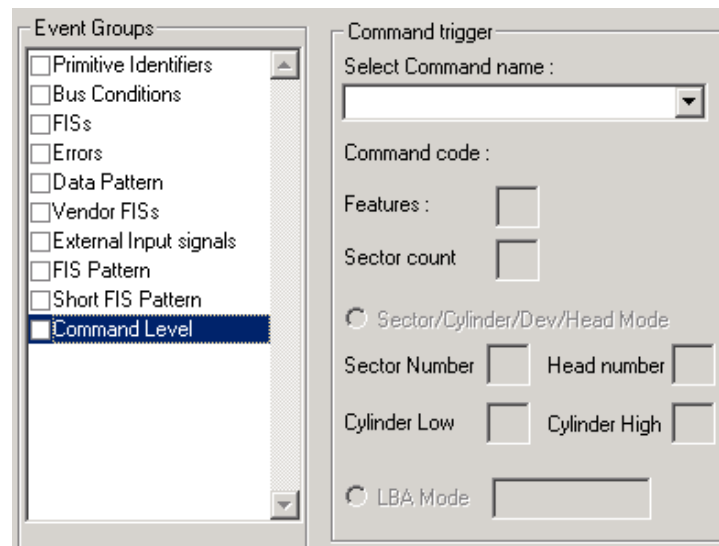
Select from the drop down menu one of the following options:

- Execute Device Diag
- Device Reset
- CFA Erase Sectors
- CFA Request Ext Error Code
- Check Power Mode
- Flush Cache
- Flush Cache Ext
- Get Media Status
- Idle
- Idle Immediate
- Initialize Device Params
- Media Eject
- Media Lock
- Media Unlock
- Nop

- Read Native Max address
- Read Native Max address Ext
- Read Verify Sectors
- Security Erase Prepare
- Security Freeze Lock
- Seek
- Set Features
- Set Max Address
- Set Max Address Ext
- Set Multiple Mode
- Sleep
- Smart
- Standby
- Standby Immediate
- CFA Translate Sector
- Identify Device
- Identify Packet Device
- Read Buffer
- Read Multiple
- Read Multiple Ext
- Read Sectors
- Read Sectors Ext
- CFA Write Multiple wout Erase
- CFA Write Sectors Wout Erase
- Download Microcode
- Security Disable Password
- Security Erase Unit
- Security Set Password
- Security Unlock
- Write Buffer
- Write Multiple
- Write Multiple Ext
- Write Sectors
- Write Sectors Ext
- Read DMA
- Read DMA Ext
- Write DMA
- Write DMA Ext
- Packet
- Service
- Read DMA Queued
- Read DMA Queued Ext
- Write DMA Queued

- Write DMA Queued Ext
- Read Stream SMA
- Read Stream PIO
- Read Log Ext
- Write Stream DMA
- Write Stream PIO
- Write Log Ext
- Read Verify Sectors Ext
- Configure Stream
- Device Configuration
- Check Media Card Type
- Smart Read Data
- Smart Read Log
- Smart Write Log
- Smart Enable Operations
- Smart Disable Operations
- Smart Return Status
- Smart Execute Off Line
- Smart Enable Disable Autosave
- Smart Save Attribute
- Device Config Freeze Lock
- Device Config Identify
- Device Config Restore
- Device Config Set
- Read SFO
- Write SFO
- SEP ATTN
- Read FPDMA Queued
- Write FPDMA Queued
- Recalibrate
- Format Track
- Identify Device DMA
- Read DMA Without Retries
- Write DMA Without Retries
- Read Sectors Without Retries
- Write Sectors Without Retries
- Read Long
- Read Long Without Retries
- Write Long
- Write Long Without Retries
- Write Verify
- Write Verify Without Retries
- Read Verify Without Retries

After selecting a Command, configure the appropriate parameters, then click **OK**. The parameters are explained below:



Command Code

Displays the code for the whatever Command was selected in the menu.

Features

Features refers to the contents of the Features register. To trigger on Features, enter a value in the box. This option is context-sensitive and is not available for all Commands.

Sector Count

Sector Count refers to the contents of the Sector Count register. To trigger on Sector Count, enter a value in the box. This option is context-sensitive and is not available for all Commands.

Sector/Cylinder/Dev/Head Mode

Select this option to activate the following parameters:

Sector Number - Enter a value to trigger on the Sector Number register.

Head Number - Enter a value to trigger on the Head Number register.

Cylinder Low - Enter a value to trigger on the Cylinder Low register.

Cylinder High - Enter a value to trigger on the Cylinder High register.

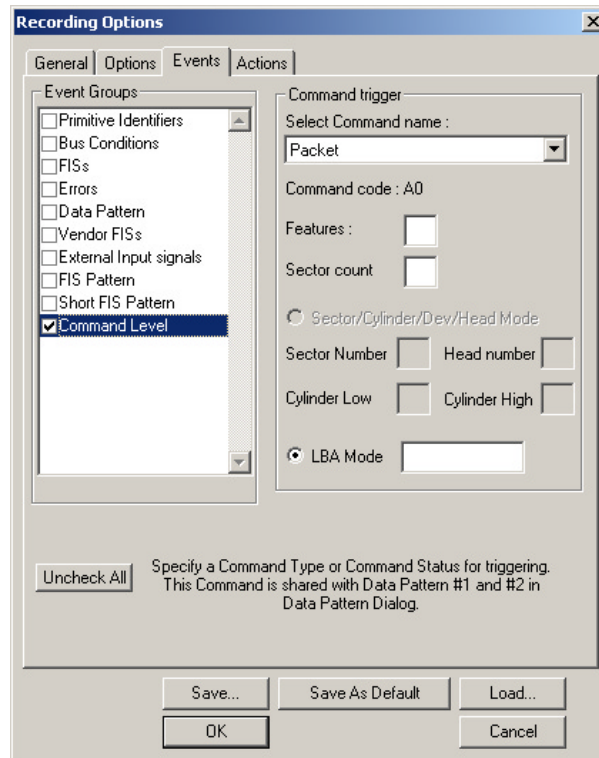
LBA Mode

Select this option to activate LBA (Logical Block Address) addressing. Then enter an address into the text box. The term LBA defines the addressing of data on the device by the linear mapping of sectors.

Triggering on ATAPI Commands

SATracer can now trigger on ATAPI 5/6 command packets. To trigger on ATAPI Commands, perform the following steps:

Step 1 From the Events page in the Recording Options dialog box, select **Command Level**.

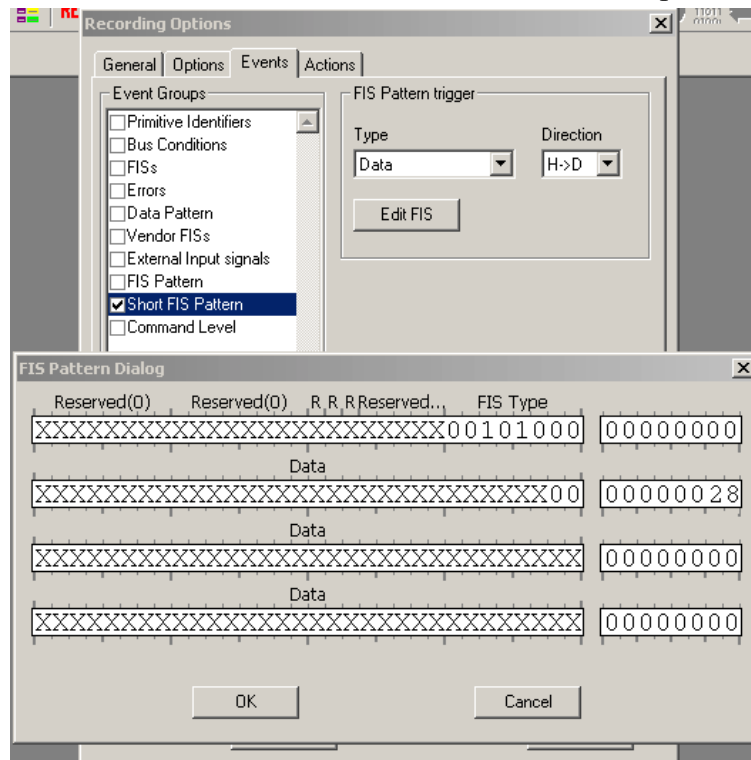


Step 2 From the drop-down menu marked **Select Command name**, select **Packet**.

Step 3 From the Events Group list on the left, select **Short FIS Pattern**.

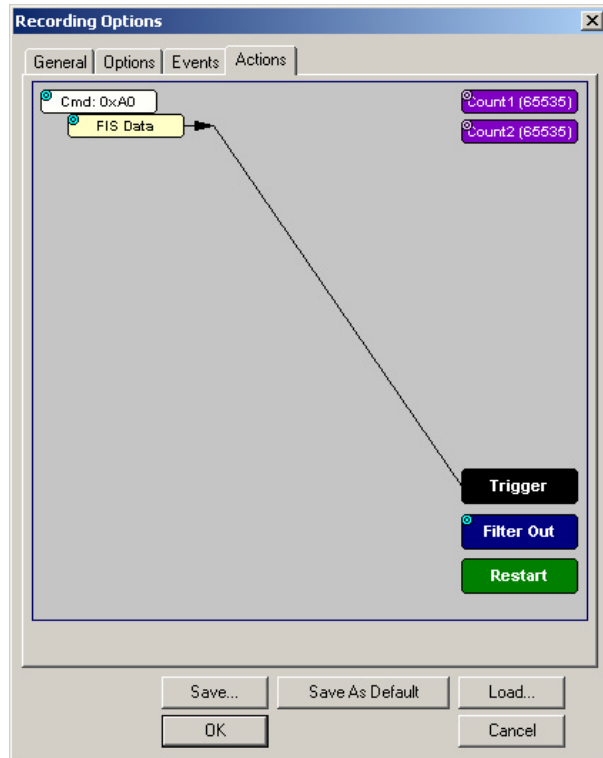
Step 4 From the Type menu, select **Data**.

Step 5 Click the Edit button. The Pattern Editor will open.



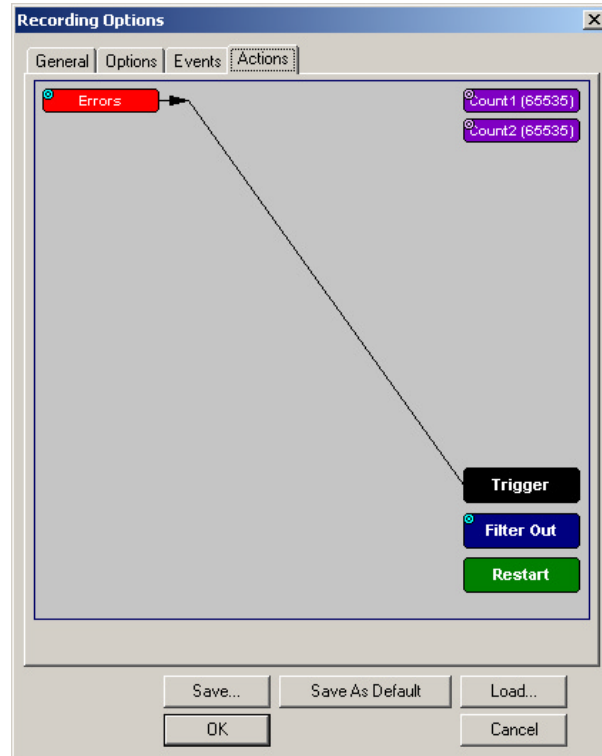
- Step 6** Enter a bit or hex pattern for the Command OpCode in the box(es) marked Data. In the example above, a 28 has been entered. 0x28 is the OpCode for a Read(10). Other examples: Inquiry = 0x12; Write(10) = 0x2A
- Step 7** Click the Actions tab at the top of the Recording Options dialog. You should see two buttons on the left side marked **Command** and **FIS Data Button**. These buttons will be connected by two arrows to the Trigger button.
- Step 8** Drag the Command button into the FIS Data Pattern button at the top of the dialog box. This action should cause the two buttons to sit immediately adjacent to one another as shown below. This configuration means "When a Command is followed by a FIS data pattern of xyz, trigger" - in other

words, "Trigger on the ATAPI xyz."



6.4 Recording Options - Actions

The **Actions** screen is used to configure the type of action that the analyzer will perform when key events are encountered in the trace. The Actions window is like a chalk board - it graphically displays events and actions as buttons, and lets you establish relationships between them.

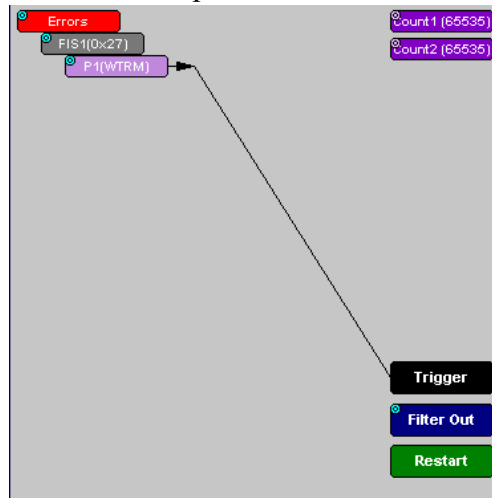


Simple or complex configurations can be created in the **Actions** window. Simple configurations involve a single event and action, as shown above. This example reads: "Trigger when the specified error occurs."

Complex configurations involve multiple events. Multiple events can be combined in different ways to create *event sequences* and *event counts*.

Event Sequences

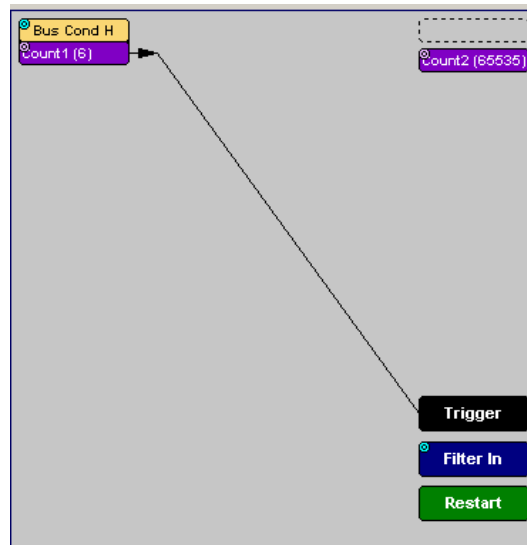
An *event sequence* is two or more events (up to six) that are strung in a series to a trigger button. The sequence below reads "Look for an error followed



by a FIS, and then by a WTRM Primitive Identifier. When you see this sequence, trigger." The events do not need to immediately follow each other - there can be intervening events.

Event Counts

An *event count* is an Event button connected to a Counter button. The Counter tells the analyzer to look for multiple instances of an event before triggering.

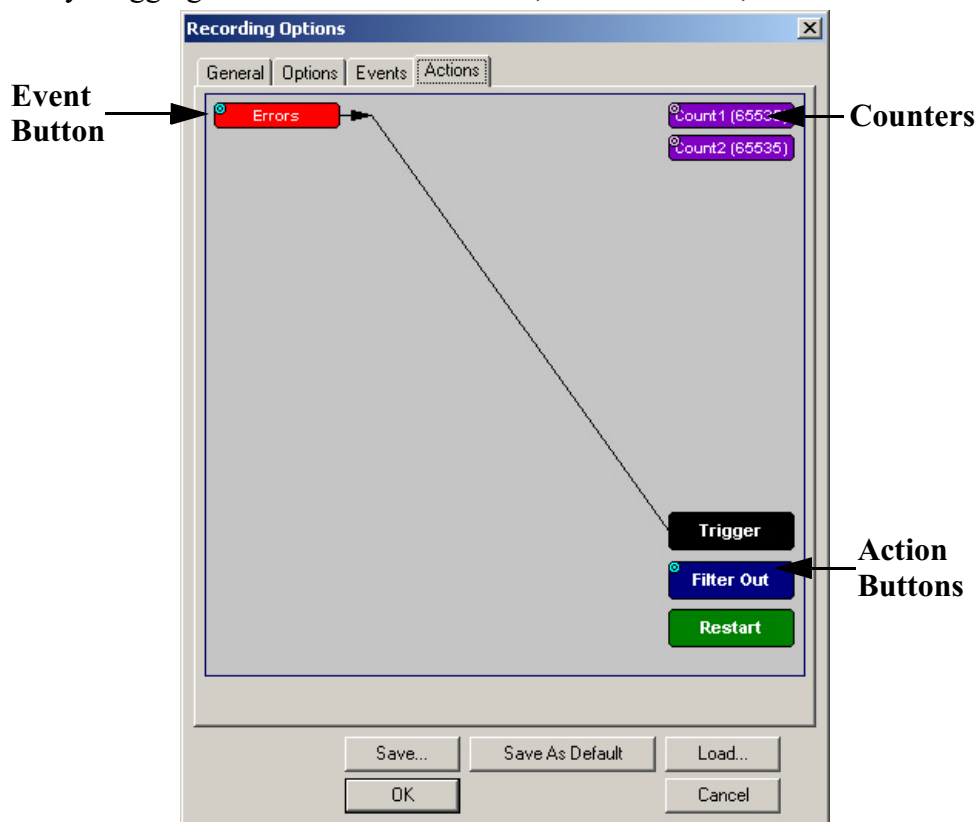


Event count are created by clicking on an Event button and then clicking on one of the counters on the right side of the window. Afterwards, the Counter button will reposition itself directly below the associated Event button. Together, the Event button and the Counter button will point to the Trigger button.

You set the counter to a particular value by clicking the blue dot in the corner of the button and enter a value. For details see Section 6.8, "Counting Events" on page 110.

Actions Window Layout

The Actions window displays three groups of buttons that can be connected by dragging the mouse: Event buttons, Action buttons, and Counters.



Event Buttons

Event buttons represent the events you selected in the Events window. These buttons are created automatically when you make your choices in the Events window. If no events are selected, no Event buttons will appear.

By default, Event buttons are connected to the Trigger button.

Action Buttons

Buttons marked **Trigger**, **Filter In/Out**, and **Restart** are Action buttons. These buttons determine the outcome of an event.

Trigger Button - When an Event button such as an Error is connected by a line to the Trigger button, the association tells the analyzer to trigger the end of the recording when the selected event occurs.

Filter In/Out Button - Tells the Analyzer to filter in or out events from the recording. Filtering Out excludes specified traffic. Filtering In lets you specify the types of traffic that should be included in the trace.

Filtering functions as a way of excluding unwanted traffic in order to preserve recording memory and thereby increase amount of desired traffic in your trace.

The polarity of this button is toggled from Filter In to Filter Out and vice versa by clicking the blue dot on the button and selecting a polarity from the pop-up menu.

Restart - This button is used to restart *Counts* and *Event Sequences*. See below for an explanation of Counts and Event Sequences.

Counter Buttons

Buttons marked **Count1** and **Count2** are counters. Counters are used to create triggers based on several occurrences of the same packet type. Counters let you create configurations such as "Trigger following the 6th FIS Length Error."

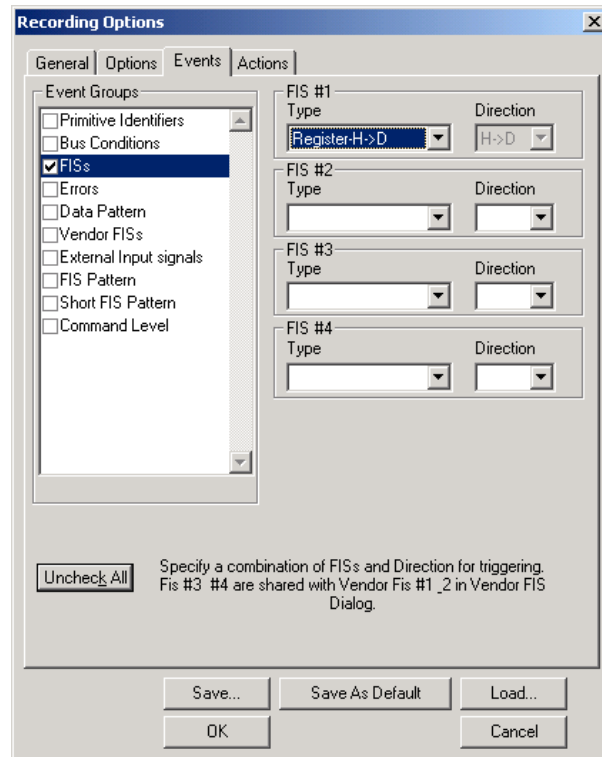
Counters only work with triggers. You cannot connect a counter to the Filter In/Out button or to the **Restart** button.

6.5 Connecting Events to Actions

Event buttons can be linked to Action buttons by clicking on an Event button and then clicking on an Action button. A line will join the newly associated buttons.

The following steps show how to connect Event and Action buttons:

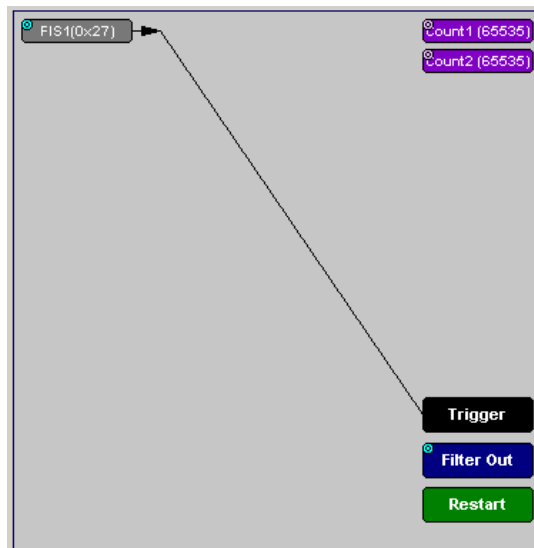
Step 1 Open the **Events** tab and select a single event.



Step 2 Click the **Actions** tab.

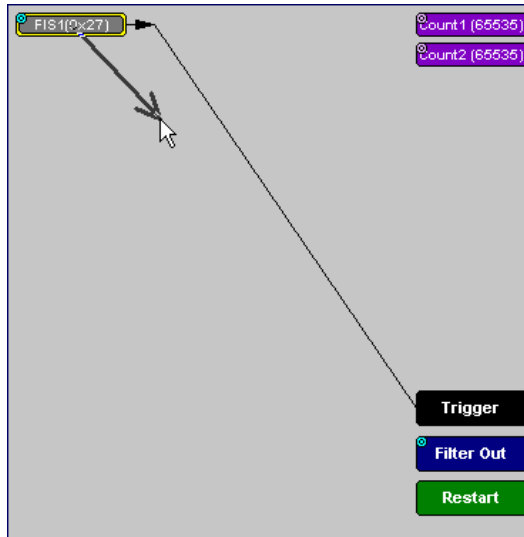
The Event you selected will display as a button on the left side of the Actions window. By default, this button will be connected to

the Trigger button. The configuration below reads "Trigger when a H->D FIS occurs."

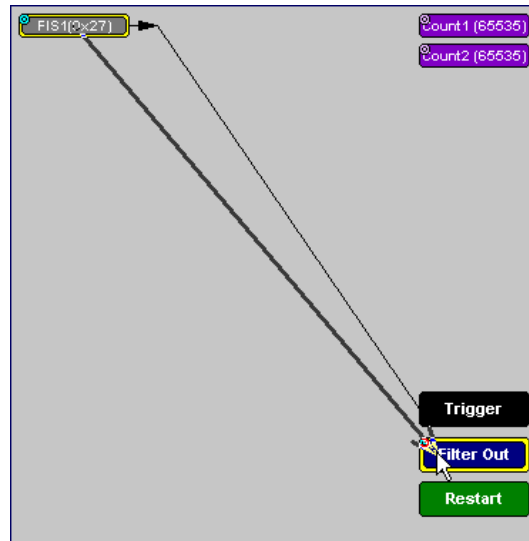


Step 3 Click on the Event button.

The elastic arrow appears.



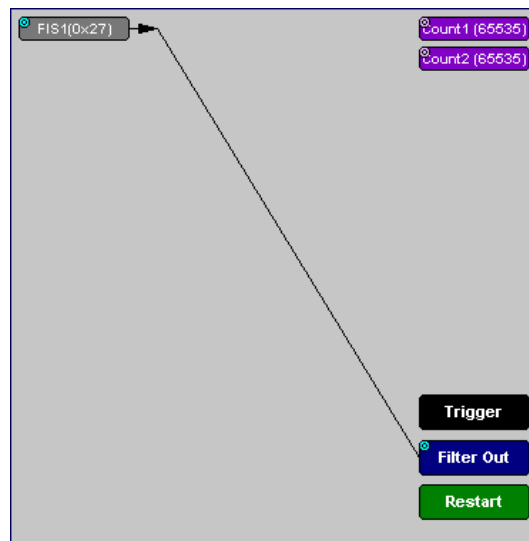
Step 4 Drag the arrow to the desired Action button.



Step 5 With the pointer over the desired Action button, click the left mouse button again.

The arrow is replaced with a black line, and the Event button is now connected to the Action button.

Note Not all events can be connected to the Filter or Restart buttons (for example, errors).

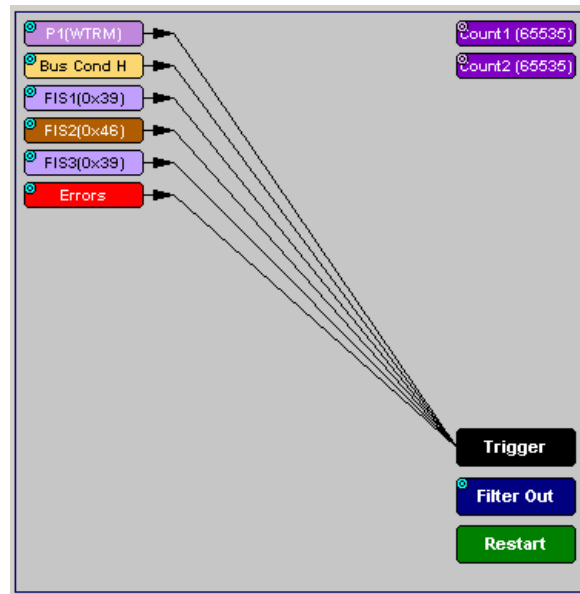


If an Event button is linked to a counter and then to a Trigger, it indicates that the analyzer should trigger following a count of several instances of the event. The number of times that the analyzer should count the event is determined by the number visible in the counter button. You set this number by clicking the blue dot in the counter and entering a value.

6.6 Triggering from an Event in a Set

When you select several events in the Events window, the Actions window displays the events as shown below. Each Event button will have its own connection to the Trigger button. In this configuration, the Analyzer will trigger a recording from any one of these events.

See the following example:



To trigger on an event in a set, follow these steps:

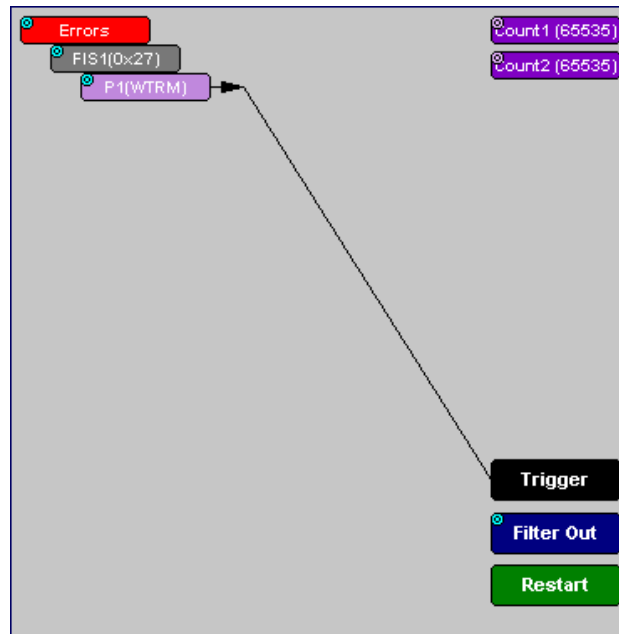
- Step 1 From the Events window, select two or more events.
- Step 2 Open the Actions window. The events will display as shown above.

6.7 Creating an Event Sequence

When multiple events are selected in the Events window, you create what is called an *event sequence*. An event sequence is the stringing together of events so that the analyzer triggers on the selected sequence in the specified order.

SATracer allows you to link up to six events together in a sequence, and up to two sequences in an action.

In the following example, the Analyzer is told to trigger when Errors then FIS1 then P1 events occur:



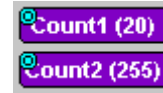
To create an event sequence, follow these steps:

- Step 1** From the Events window, select two or more events.
- Step 2** Click the Actions tab. The events you selected appear in the Actions window with separate lines connecting to the Trigger button.
- Step 3** To sequence the buttons, click an event button. An elastic arrow appears.
- Step 4** Point the arrow to another Event button. The Event buttons move next to each other in sequence, as shown in the example above.

6.8 Counting Events

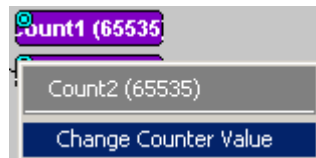
Counters count multiple occurrences of an event. When the analyzer is configured for counting, it searches for multiple occurrences of an event such as an error and triggers when the last event in the count occurs.

When a counter is in use in the Actions window, the counter button will be relocated below its associated Event button and then connected by a line to the Trigger button. The Counter will display a number that indicates the number of events that the Counter is set to look for.



The buttons marked **Count1** and **Count2** provide a way of triggering after a number of events have passed, such as "Trigger after the 20th error."

Counters have blue dots in their top left corner that provide access to pop-up menus. The menus provide the means of setting the counter value. The counter can be set between 1 and 65,535.



To connect an event to a counter, follow these steps:

Step 1 Click the **Event** tab and select an Event such as **Error**.

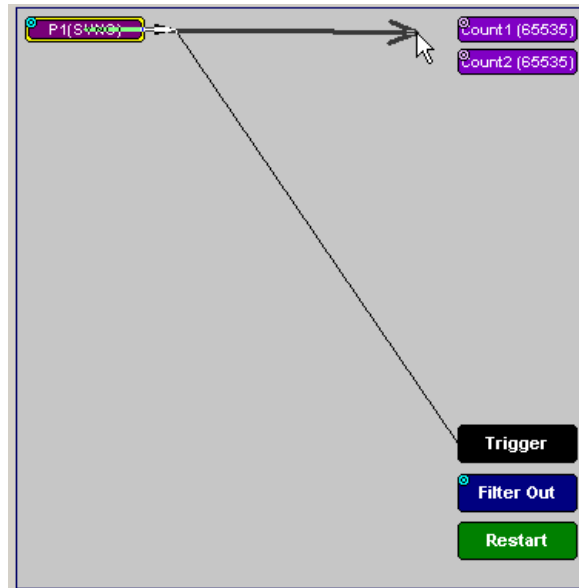
Selecting an event causes an Event button to automatically appear in the **Actions** tab.

Step 2 Click the **Actions** tab.

The tab displays an event button that is connected to the Trigger button on the right.

Step 3 Click the Event button.

An arrow appears that connects the Event button to your mouse pointer.



Step 4 Click one of the two counters.

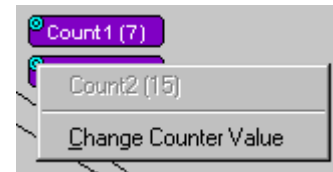
The event automatically connects to the Counter button and then connects to the Trigger button.

Step 5 Click the blue dot in top right corner of your selected counter.

A pop-up menu opens. This menu lets you configure the counter.

Step 6 Choose **Change Counter Value**.

Step 7 Set the counter to a value of your choice, and click **OK**.



6.9 Triggering External Output

The Actions window has options enabling the analyzer to send an output signal through a BNC cable or an RS-232 cable and breakout board to an external device such as an oscilloscope.

Cabling

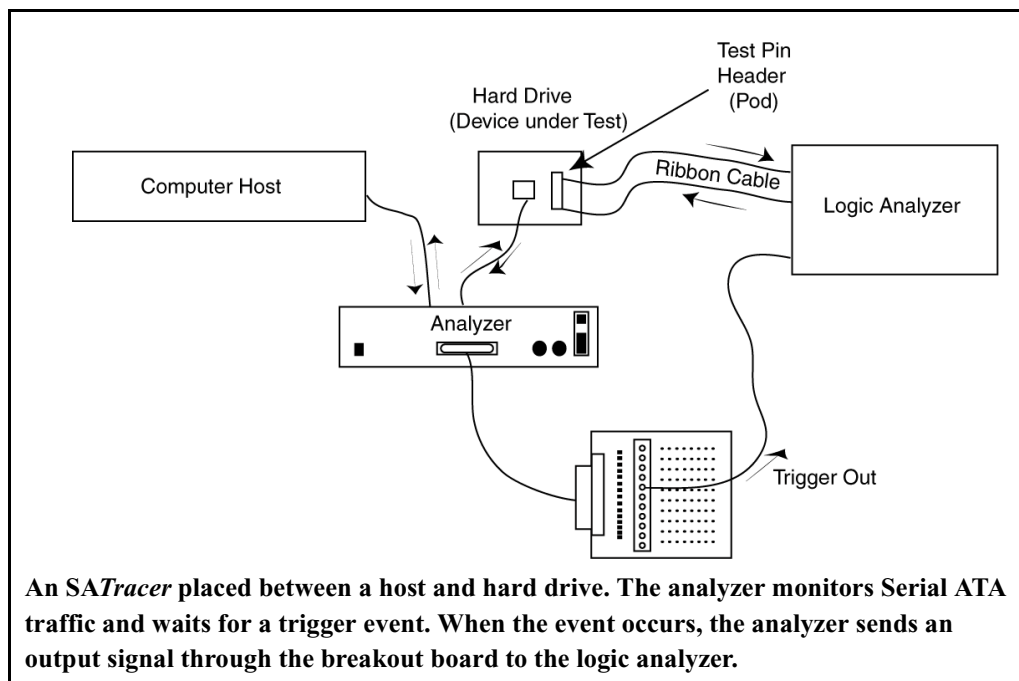
To set up the analyzer for signal output, you will first need to connect the analyzer to the external device using a BNC or RS-232 cable.

Using a BNC Cable

If using a BNC cable, connect the external device to one end of the cable and connect the other end of the cable to the output connector marked "Ext. 2" on the back of the analyzer.

Using an RS-232 25-pin Cable

If using an RS-232 cable, you will also need to use a CATC breakout board and alligator cables. Connect alligator cables from the external device to one or more Data pins on a breakout board. Then connect a 25-pin RS-232 cable from the breakout board to the 25-pin connector on the back of the analyzer marked "DATA IN/OUT."



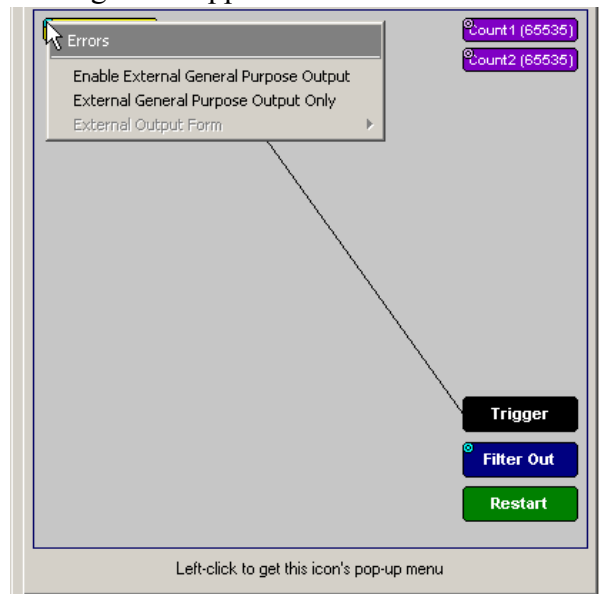
Once the analyzer is connected, you will need to configure the Recording Options so the analyzer will send an output signal.

Setting External Output Options

To configure the analyzer for signal output, follow these steps:

- Step 1** If it is not already open, open the Actions window in Recording Options. You should see Event buttons on the left side of the screen representing the events you selected in the Events window of Recording Options.
- Step 2** Click the blue dot on an event button representing the event you wish to cause an output signal. For example, if you want the analyzer to send an output signal when it see an error, to trigger an output signal based on an error, click on the blue dot in the Error button.

The following menu appears:



The menu offers three choices:

Enable External General Purpose Output - This option causes an output signal to be generated *AND* triggers the end of the recording. When selected, a small arrow appears on the event button, indicating that output signalling has been enabled. Also present is a line between the event button and the trigger button. This line indicates that the analyzer is set to trigger the end of its recording.

Enable External General Purpose Output Only - This option causes an output signal to be generated without triggering the end of the recording. When enabled, a small arrow on the event button indicates that the analyzer is configured to send an output signal. You will see that the no line between the selected event button to

the trigger button - this indicates that the analyzer will continue recording without triggering.

External Output Form - This option presents a menu with options for setting the form of the output signal. Your choices are:

- **Pulse Low** - Causes the Analyzer to transmit a 0.2-volt, 67-nanosecond signal.
- **Pulse High** - Causes the Analyzer to transmit a 3.2-volt, 67-nanosecond signal. This is the default format.
- **Toggle** - Causes the Analyzer to send a signal that toggles with each trigger event between a continuous 3.2-volt signal and a continuous 0.2-volt signal.

Step 3 Choose "Enable External General Purpose Output" or "Enable General Purpose Output." A small arrow will appear on the selected event button.

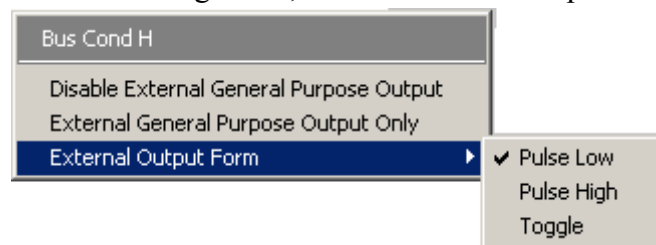
Specifying Pulse Signal Outputs

Once Output signalling has been enabled, you can configure the output signal to **Pulse Low**, **Pulse High**, or **Toggle**.

To configure the output signal, follow these steps:

Step 1 Click the blue dot on an event button that has a small arrow attached.

Step 2 In the resulting menu, choose External Output Form.



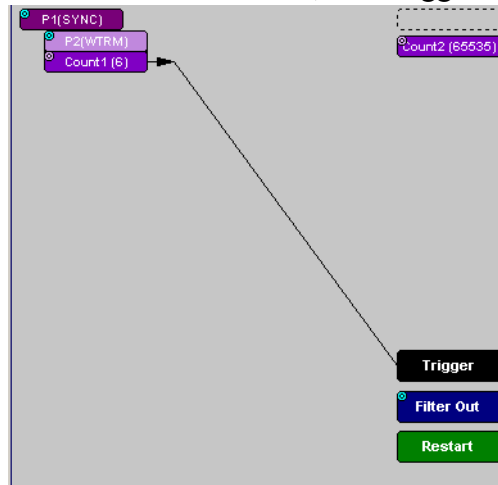
Step 3 Choose Pulse Low, Pulse High, or Toggle.

6.10 Setting Multiple Conditions with Counters

You can create multiple event conditions by linking a counter to multiple events or by linking two counters to two or more events.

Sequencing with Counters

When two or more Events are connected together and then to a counter, a condition is created such as the one shown below. This example reads: "When P1 occurs then P2 occurs 6 times, then trigger."

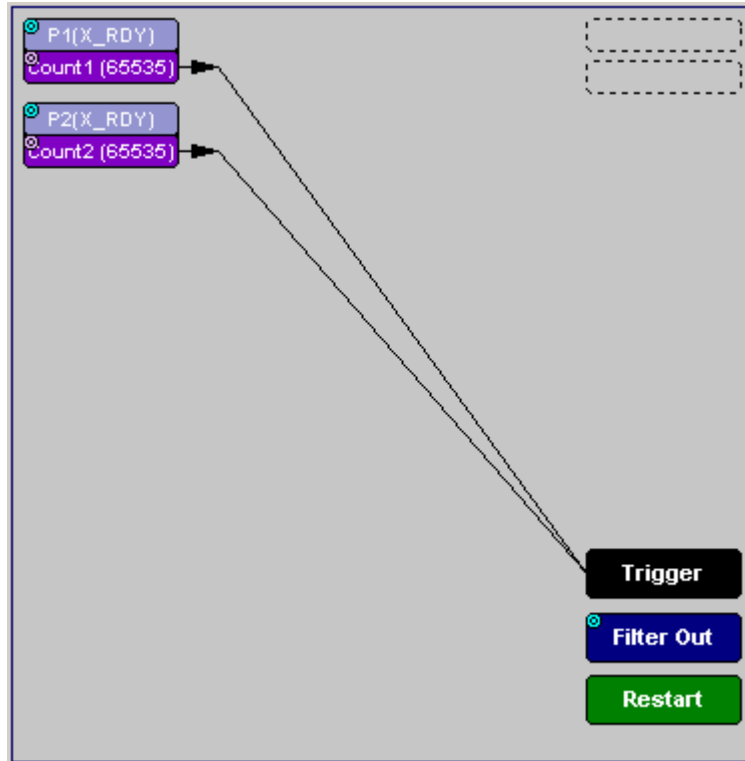


To link two or more Events to a counter,

- Step 1** Select two or more events in the Events window (Recording Options > Events).
- Step 2** Click the Actions tab.
- Step 3** Click one of the event buttons. An elastic arrow will appear on your mouse pointer.
- Step 4** Click one of the Counters. The Counter button will move directly under the Event button.
- Step 5** Click another Event button. An elastic arrow will appear on your mouse pointer.
- Step 6** Click the Counter button that is below the first Event button.

Linking Two Events to Two or More Counters

If an Event is linked to **Count1** and a second event is linked to **Count2**, it creates an "or" condition. The example below reads "Trigger when Count1 OR Count2 has reached their specified values."



6.11 Filtering Traffic

Filtering lets you exclude unwanted traffic so you can preserve recording memory and increase the amount of desired traffic in the trace. The blue dot in the upper left corner of the Filter button gives you a menu of the two filter options: **Filter In** and **Filter Out**.

What Happens to the Trace When You Filter Out Traffic

When traffic is filtered out at the FIS level, you will see a horizontal line appear in the trace where the item was removed. When traffic is filtered out at the Sequence level, SATracer shows where primitives were filtered and removed.

XXXX	SYNC	SYNC	SYNC	CONT	XXXX	SYNC	SYNC	SYNC	CONT	XXXX	Filter	Filter	Filter
293 ns	Filter	Filter	Filter	Filter	106 ns	Filter	Filter	Filter	Filter	1.360 μs	R_IP	R_IP	CONT
XXXX	Filter	XXXX	Filter	Filter	Idle	Time Stamp							
453 ns	SYNC	53 ns	SYNC	CONT	4.022 ms	00002.815317 014							

Filtering Idle Sequences

When there is an idle state on the Serial ATA bus (i.e., a bus with no FIS traffic), idle traffic remains. Idle traffic is represented in the trace as Idle Sequences that contain ALIGN primitives and XXXX cells. These Idle Sequences are largely irrelevant when debugging at the protocol level. SATracer can display the data patterns transmitted within idle traffic.

To remove Idle Sequences, follow these steps:

- Step 1** Open the Events tab in Recording Options.
- Step 2** Select **Primitive Identifiers**.
- Step 3** Select **Sync** from the first drop-down menu, and select **Align** from the next menu.
- Step 4** Select the Actions tab.
- Step 5** Connect both primitive objects to **Filter Out**.

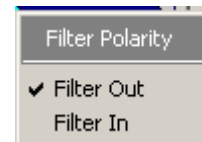
This will effectively remove Idle Sequences from a trace.

Setting the Filter to Filter In or Filter Out

To change the polarity of the filter, click the Blue dot in the corner of the Filter button. A pop-up menu appears with the following choices:

Filter In - Tells the analyzer to include *only* the selected event(s) in the trace.

Filter Out Tells the analyzer to exclude the selected event(s) from the trace.



Note: Some events, such as errors, cannot be filtered.

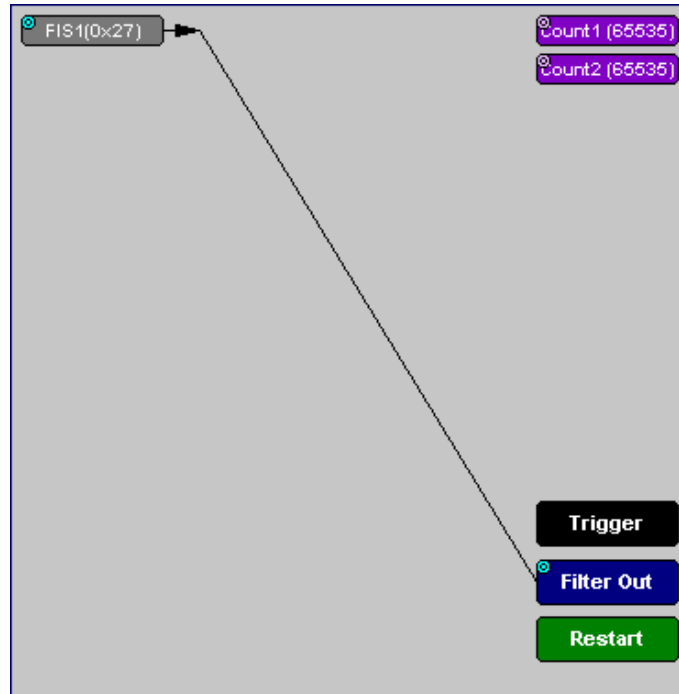
How to Use Filters

To filter an event in or out from a recording, follow these steps:

- Step 1** From the Events window, select one or more events.

- Step 2** Click the Actions tab to open the Actions window.
- Step 3** Click an Event button, then click the Filter In/Out button.

A line will connect the Event button to the Filter In/Out button.



- Step 4** Click the blue dot on the Filter In/Out button.

A pop-up menu will appear with choices for **Filter In** and **Filter Out**.

- Step 5** Select one of the two choices.

The polarity of the Filter In/Out button will change to your selection.

6.12 Restarting Sequences and Counters

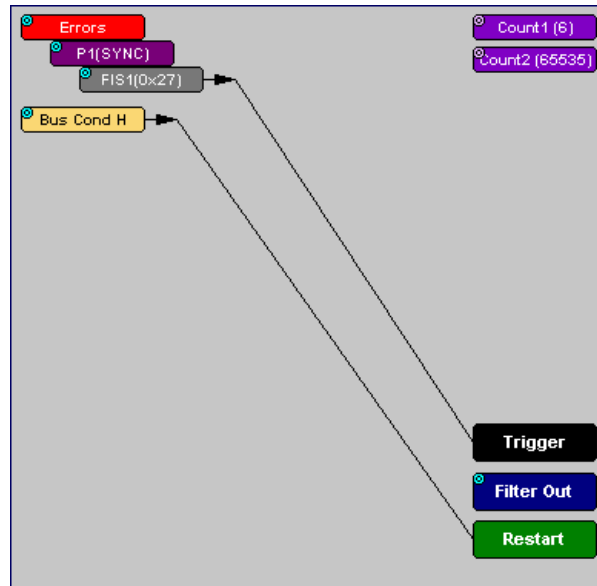
The Restart button is used to create conditional statements with sequences and counts.

When an event is linked to the Restart button, the Analyzer restarts any counting or sequencing it is performing if that event is found.



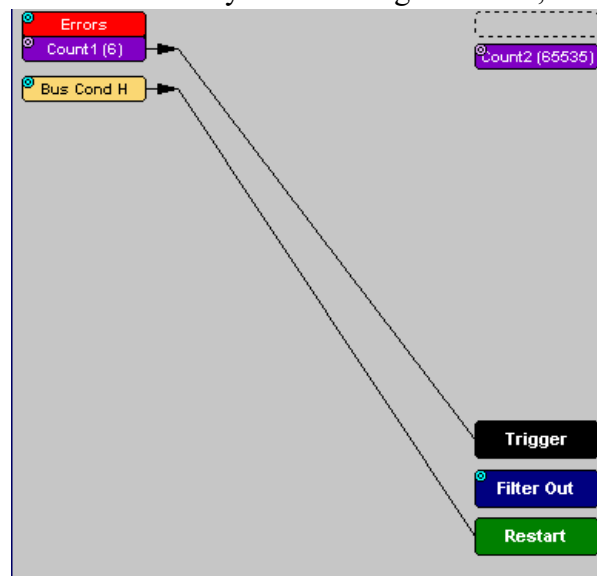
Restarting a Sequence

For example, in the illustration below the Analyzer is told: "Trigger following a sequence of an FIS Length Error, a Sync Primitive, and a Data FIS Pattern. However, if a Bus Condition occurs during the sequence, restart the search."



Restarting a Count

The Restart button can be used to restart counting. If a Event count has been defined, adding a link between another event and the Restart button tells the analyzer to restart the count any time the Restart event has been found. This is best explained with an example. In the screenshot below, the analyzer is configured to trigger following the sixth FIS Length Error, but if a Bus Condition event occurs anywhere during the count, restart the count.



6.13 Saving Recording Options

To complete your recording options settings, use the features at the bottom of the **Recording Options** screen. These features remain the same no matter which of the three recording options windows in which you are working.


- Click **Save** to save the currently specified recording options for use in future recording sessions. Any file name can be specified, though use of the **.rec** extension is recommended; if no extension is specified, **.rec** is added by default.
- Click **Load** to load a previously saved ***.rec** file, and restore a previous set of recording options.
- The **Save as Default** function is equivalent to the **Save** function, specifying the file name **default.rec**. Whenever you start up the Analyzer, it automatically loads the **default.rec** file if one exists.
- Click **OK** to apply any changes and close this window.
- Click **Cancel** to cancel any immediate changes you have made and exit the **Recording Options** menu.

6.14 Recording Bus Data

To start recording Serial ATA traffic once the appropriate Recording Options have been set, perform the following steps.

If you have created any event Triggers, be sure to select *Event Trigger* under the General tab in the Recording Options dialog box.

Step 1 From the **Record** menu, select **Start**.

Your recording session can continue until it has finished naturally or you might need to stop manually by clicking  on the Tool bar, depending on how you set the **Recording Options**.

Step 2 To manually stop recording, select **Stop** from the **Record** menu.

When the recording session is finished, the bus traffic is saved to the hard drive as a file named **data.sat** or whatever name you assign as the default filename.

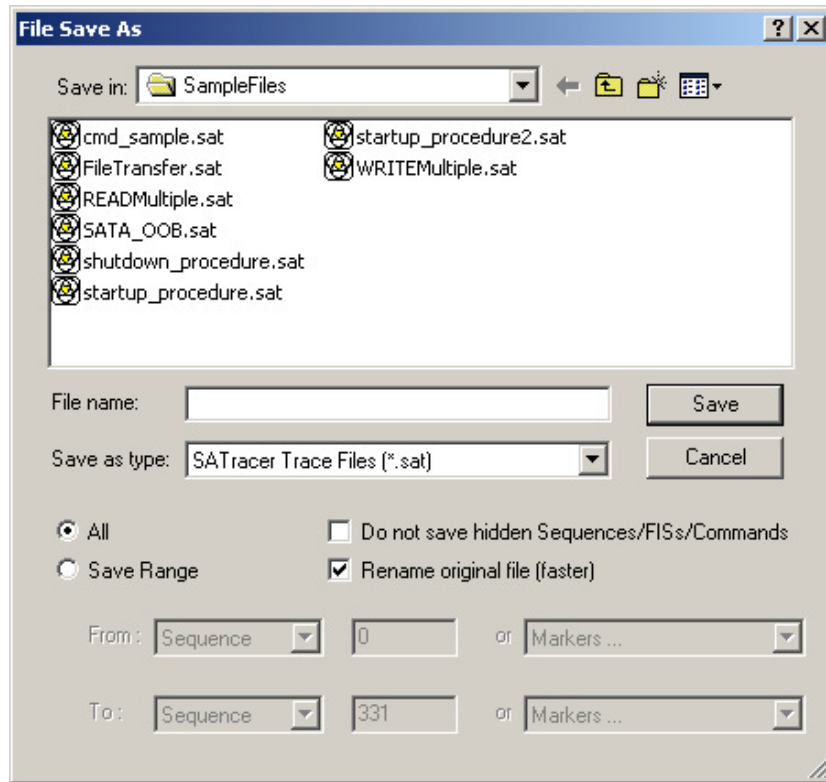
Step 3 To save a current recording for future reference, select **Save As** from the **File** menu.

Step 4 Give the recording a unique name and save it to the appropriate directory.

6.15 Saving a Trace

You can save all or part of a trace with the **Save As** command:

Step 1 Select **File > Save As**.



Step 2 Click the **Save Range** option.

Step 3 In the boxes marked From and To: Select Sequence, FIS, or Command from the drop-down menus. If FIS and/or Command are grayed out, you will need to close the Save As dialog box and decode these levels.

Step 4 Enter the range that you wish to save.

Step 5 Click **Save**.

6.16 The Partial Upload Utility

Partial Upload is a utility that allows you to upload a portion of a trace to the PC while leaving the original recording intact in the analyzer's buffer.


Partial Upload lets you target a portion of a trace, view that portion and, if need be, reload a new portion. The utility thus gives you an opportunity to review different parts of a recording as many times as needed until you have found the traffic that most interests you.

The Partial Upload utility presents a dialog box with a slide bar for specifying the starting and ending point of the buffer the user wishes to upload after a recording is made. This will allow the user to record the maximum buffer size, and upload a portion of it to see if it is what the user needs, or simply work on portions of it without the need to upload the entire buffer into memory.

If you execute a re-upload, the analyzer opens the Partial Upload dialog box again and lets you reselect the buffer you want transmitted to the PC. The process does not affect the trace in the analyzer's memory - hence you can edit and re-edit a trace as often as you like.

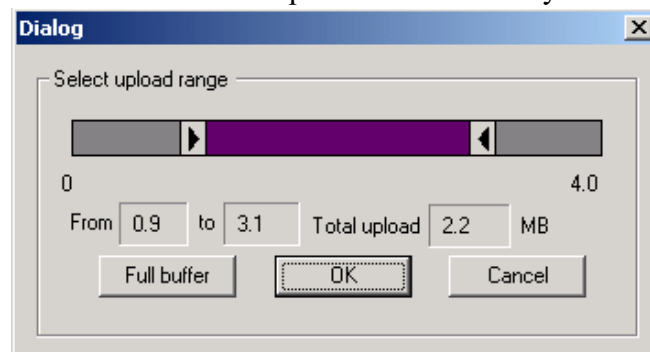
When to Run Partial Upload

This utility needs to be enabled before it can be run. You can enable it either before or after recording a trace.

You enable Partial Upload by pressing .


Enabling Partial Upload Before Recording

If you enable Partial Upload before recording a trace, a dialog box opens asks you to set the start and end points of the traffic you wish to upload.



Drag the slide bars or enter values into the boxes, then press **OK**.

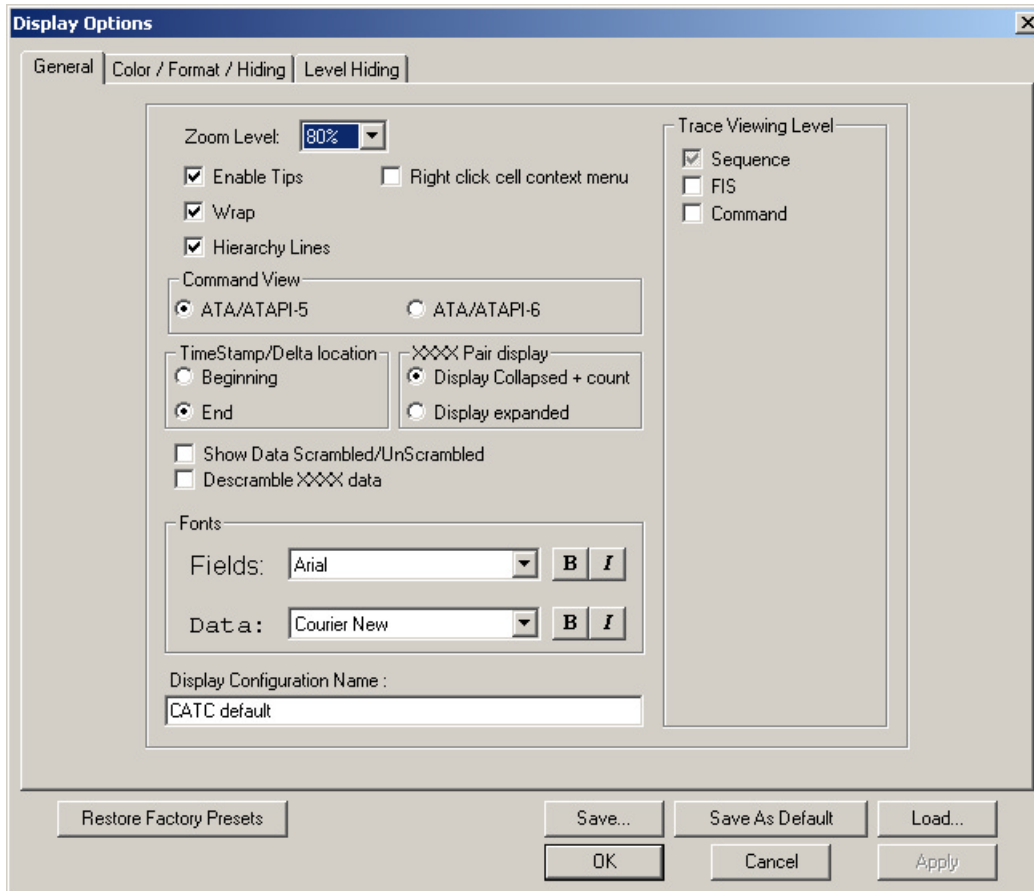
Once the recording is complete, only the selected range of traffic will upload and display.

You can repeat this process as often as you would like by pressing . When done, you can preserve the edited trace with the **File >Save As** command.

7. Display Options

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

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



7.1 General Display Options

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

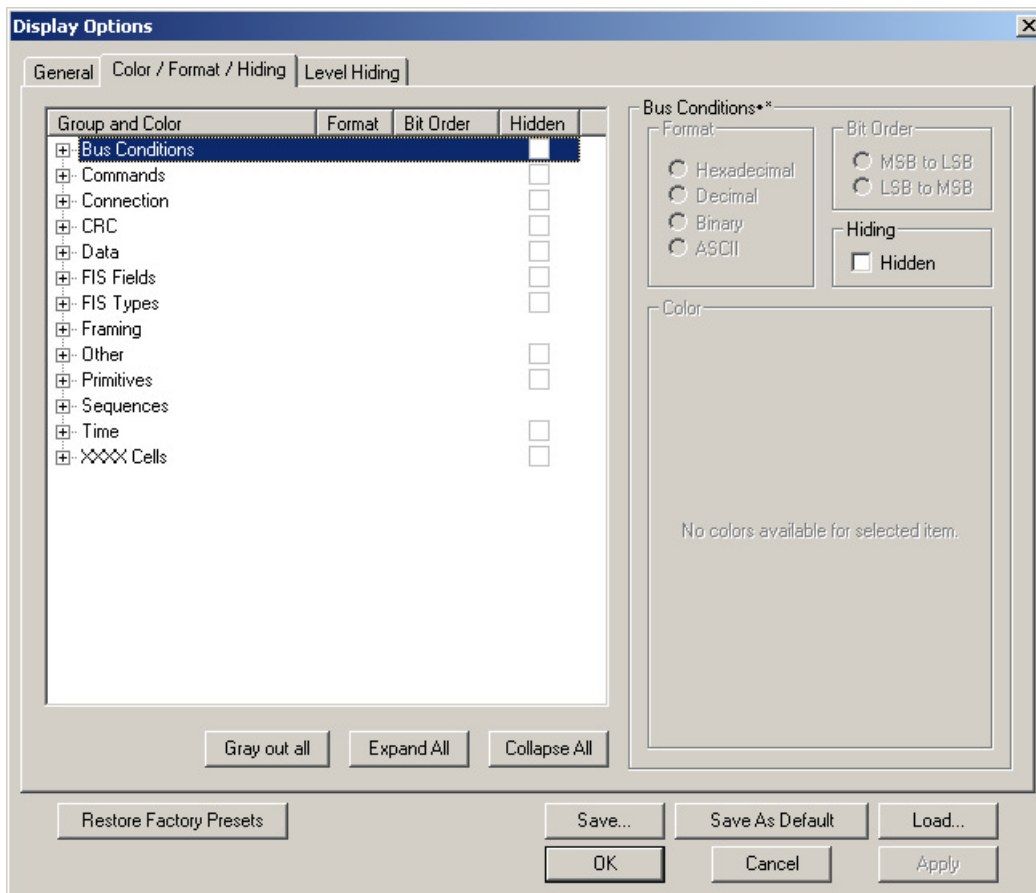
- **Zoom Level:** Adjustable in discrete increments from 10% to 200% percent.
- **Enable Tips:** Select to enable Tool Tips with explanation text to pop up when you position your cursor over various fields in the Trace View.
- **Wrap:** Causes packets to wrap within the window if their length exceeds the width of the window.
- **Hierarchy Lines:** Adds faint lines to the left side of the trace window connecting packets, FISs and Commands into an explicit hierarchical relationship.
- **Right click cell context menu:** Activates the right mouse button for opening cell context menus.
- **Trace Viewing Level:** Allows you to select the hierarchical level at which traffic is displayed.
- **Command View:** Presents options for viewing ATA Commands in ATA/ATAPI-5 or ATA/ATAPI-6 formats.
- **Time Stamp Location:** Presents options for displaying the Time Stamp at the beginning or end of a Sequence, FIS or Command.
- **XXXX Pair Display:** Presents options for displaying XXXX pairs in a collapsed format with a count, or expanded format.
- **Show RAW Data Scrambled/Unscrambled:** Select to show raw data in Scrambled or Unscrambled format.
- **Descramble XXXX data:** Shows XXXX data descrambled.
- **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**.

7.2 Setting Color, Formatting, and Hiding Options

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



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

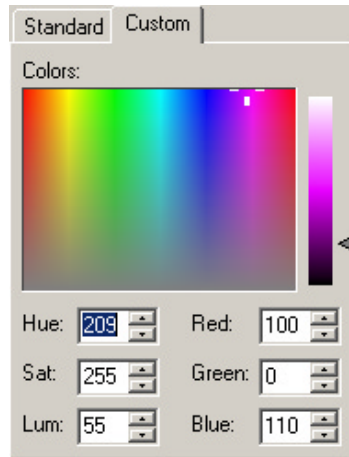
Setting Color Display Options

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

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

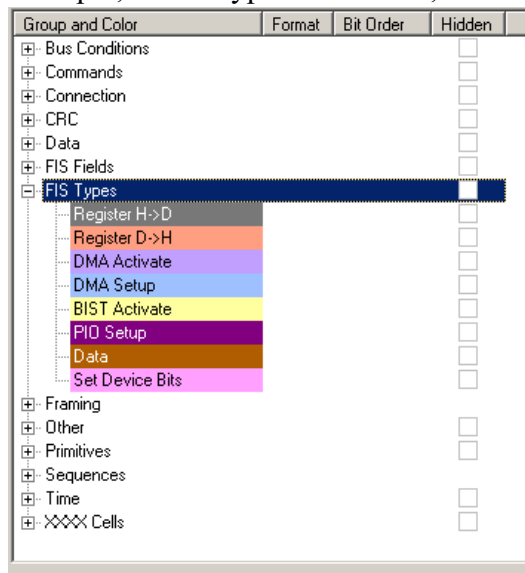
Use this window to customize the colors associated with each field in the trace. You can experiment with these options to achieve the color combination best suited to a particular graphic system.

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

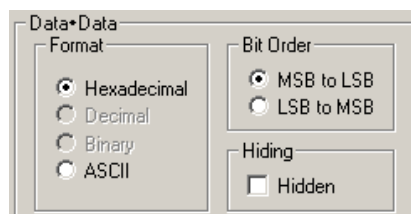


Changing Field Formats

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



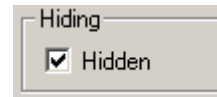
The following formats are available:



Note Not every format is available for every item.

Hiding Display Options

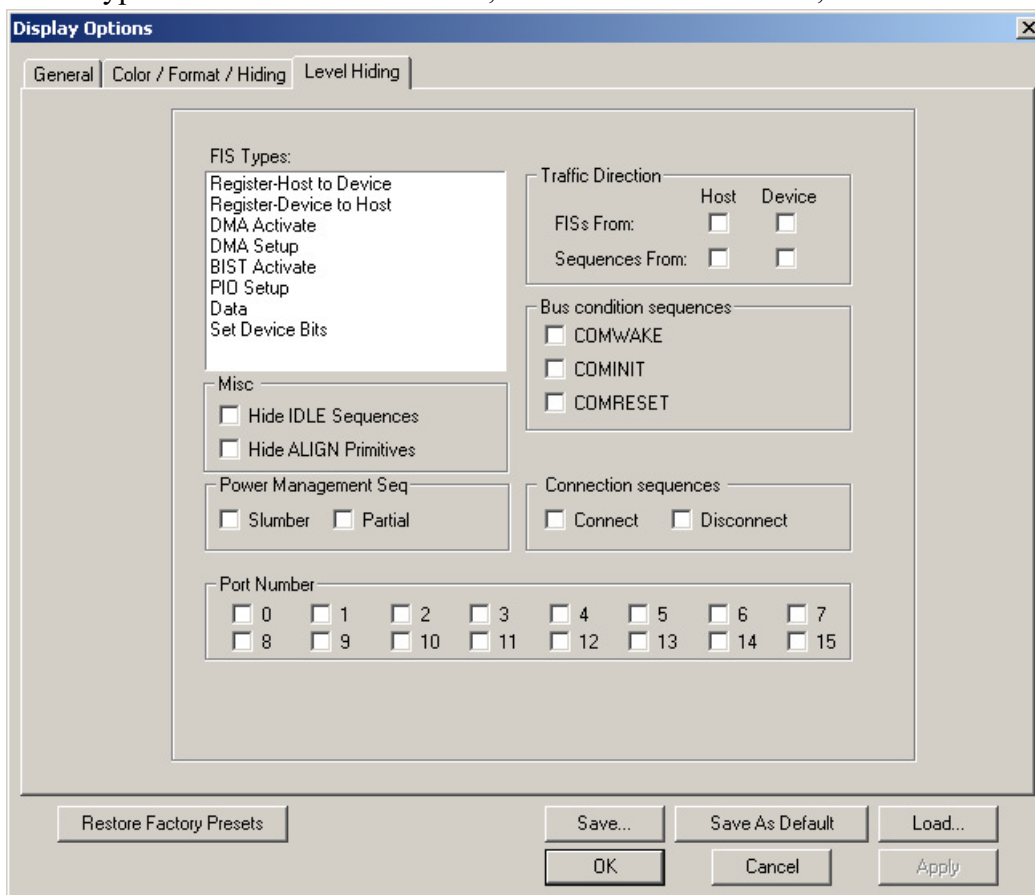
To hide one or more fields in the trace, select the appropriate item from the Group and color column, click the checkbox marked **Hidden**, and click the **Save** button.



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

7.3 Level Hiding Options

The Level Hiding tab allows you to hide FISs, Idle Sequences and other types of traffic. To hide traffic, select one or more items, then click **Save**.



Level Hiding Parameters

The Level Hiding window displays the following options:

FIS Types

Displays a list of FIS types. Selecting one or more FIS types causes the selected types to be hidden from the trace.

To select multiple items from the FIS Types list, press the Control button down on the keyboard and click the desired options. Use the same procedure to deselect the items. Hold down the control key, and click the items until all are deselected.

Traffic Direction

Hides traffic by its direction. You can select up to four directions.

Misc

Allows Idle or Align primitives to be hidden from the trace.

Bus condition sequences

Hides Out of Band signals.

Power Management Seq

Hides traffic for devices in Slumber mode or in Partial mode.

Partial Mode and *Slumber Mode* are Power Management states in which the PHY logic is powered, but is in a reduced power state. In both modes, signal lines on the interface are at a neutral logic state (common mode voltage). The exit latency from this state is no longer than 10 ms.

Port Number

Hides traffic to or from one or more ports.

7.4 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.

8. Reading a CATC Trace

FIS #	3	H	Register H->D	Port	C	Command	Control	Cyl Low	Cyl Low (exp)	Cyl High	Cyl High (exp)	Dew/Head
0	G		0x27	0x00	1	WRITE DMA W/O RETRIES	0x00	0xFF	0xE0	0x2E	0x0E	0xE0
Features	Features (exp)	Sector Count	Sector Count (exp)	Sector Number	Sector Num (exp)	Delta	Time Stamp					
0xDA	0xDA	0x08	0x00	0x26	0x2F	0.000 ns	0.083 25346					
FIS #	3	D	DMA Activate	Port	Delta	Time Stamp						
1	G		0x39	0x00	2.587 μ s	0.083 25508						

8.1 Trace View Features

SATracer/Trainer trace viewing software display makes extensive use of color and graphics to fully document the captured traffic. Sequences 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 sequence fields with detailed information about their contents.

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

8.2 Sequence, FIS, and Command Views

The default display mode is Sequence view. The Serial ATA trace can also be viewed in Frame Information Structure (FIS), and Command views.

What is a Sequence?

A Sequence is a CATC-defined term for a serial stream of primitives and data that is sent from a host to a device or *vice versa*.

Sequences usually begin at X_RDY (or PMREQ_S/PMREQ_P) and end at the next X_RDY (or PMREQ_S/PMREQ_P).

Filter out is not applicable to the following primitives: X_RDY, R_RDY, SOF, PMREQ_P, PMREQ_S, EOF, CONT.

Changing Display Levels

To switch between the Sequence, FIS, and Command views, click the respective buttons on the right hand side of the Tool Bar.



When you click the **Seq** button Sequence view appears as below:

The screenshot displays the Sequence view with two entries:

- Sequence # 0:** Shows signal states like X_RDY, R_RDY, CONT, and timing values such as 106.660 ns and 133.330 ns. It also includes a Data Payload section with CRC, EOF, and WTRM fields.
- Sequence # 1:** Shows similar signal states and timing information, with a Delta of 26.660 ns and a Time Stamp of 1.426 36523.

When you click the **FIS** button, the FIS view appears as below:

The FIS view shows the following data:

FIS #	Register H>D	Port	C	Command	Control	Cyl Low	Cyl Low (exp)	Cyl High	DewHead	Features	Features (exp)	Sector Count	Sector Count (exp)	Sector Number	Sector Num (exp)
0	0x27	0x00	1	IDENTIFY DEVICE	0x00	0x00	0x00	0x00	0x00	0xA0	0x00	0x3F	0x00	0x01	0x00

When you click the **CMD** button, the Command view appears as below:

The Command view shows the following data:

Command #	ATA Command	Port	ATA Protocol	Data	In	Out	Delta	Time Stamp
0	IDENTIFY DEVICE	0x00	PIO IN	128 Dwords	In		0.000 ns	1.426 00644
1	SMART ENABLE OPERATIONS	0x00	NON DATA		In	Out	55.056 ms	1.427 12881
2	SMART ENABLE DISABLE AUTOSAVE	0x00	NON DATA		In	Out	33.089 ms	1.482 0962

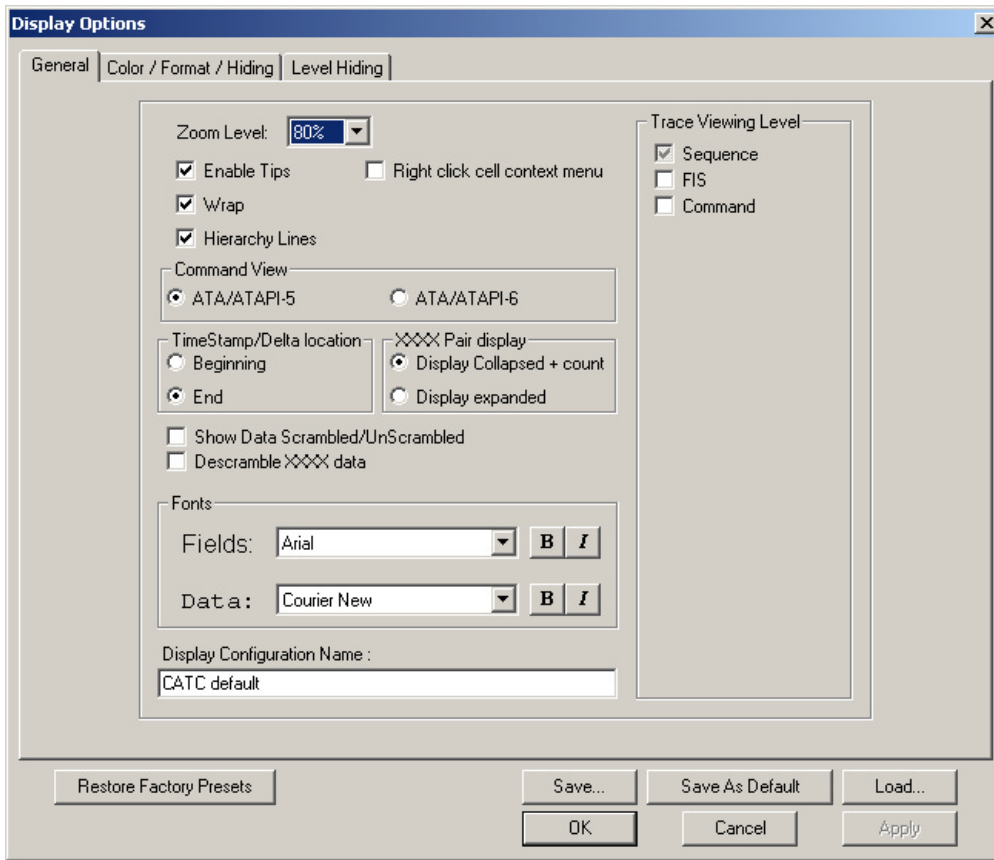
You can also expand the views by clicking the triangle in the Sequence, FIS, or Command views. The following is an example of an expanded Command view and its hierarchical relationship between Sequences and FIS:

The screenshot shows the Command view expanded to show the FIS view for Command # 0, which is further expanded to show the Sequence # 0 view. This illustrates the hierarchical relationship between these views.

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

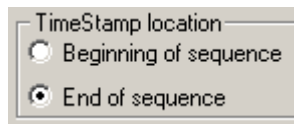
The screenshot shows a mouse cursor hovering over the FIS # field in the FIS view. A tooltip appears, displaying the text "FIS terminated successfully".

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



8.3 Timestamp Location

The timestamp in the trace appears either at the beginning or end of the CATC trace - depending on how you configure the *SATracer* Display Options. Select **Setup > Display Options > General** to set the timestamp location.



When set to **Beginning of sequence**, the Timestamp will display at the beginning of the trace as follows:

FIS #	1.5	H	Time Stamp	Delta	Register H->D	Port	C	Command	Control	Cyl Low
0	G		1.426 00644	0.000 ns	0x27	0x00	1	IDENTIFY DEVICE	0x00	0x00
Cyl High (exp)	DewHead	Features	Features (exp)	Sector Count	Sector Count (exp)	Sector Number				
0x00	0xA0	0x00	0x00	0x3F	0x00	0x01				

When set to **End of sequence**, the Timestamp will display at the end of the trace as follows:

FIS #	1.5	Register H>D	Port	C	Command	Control	Cyl Low	Cyl Low (exp)	Cyl High	Cyl High (exp)	DewHead	
0	G	0x27	0x00	1	IDENTIFY DEVICE	0x00	0x00	0x00	0x00	0x00	0xA0	
Features	Features (exp)	Sector Count	Sector Count (exp)	Sector Number	Sector Num (exp)	Delta	Time Stamp					
0x00	0x00	0x3F	0x00	0x01	0x00	0.000 ns	1.426 00644					

8.4 Delta Cells

Delta cells occur before Timestamp cells to show the difference in time between two Sequences, FISs, or Commands.

Delta	Time Stamp
54.913 ms	00001.427343 019

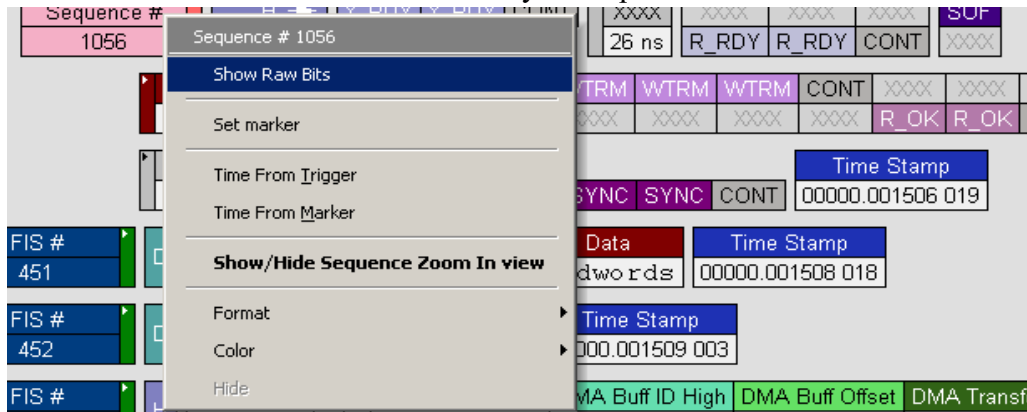
8.5 View Raw Bits

SATracer allows you to view low-level 8B/10B values for Serial ATA traffic. You can expand a specific sequence to view the raw bits by right clicking on the Sequence number and selecting Show Raw Bits.

To view Raw Bits, follow these steps:

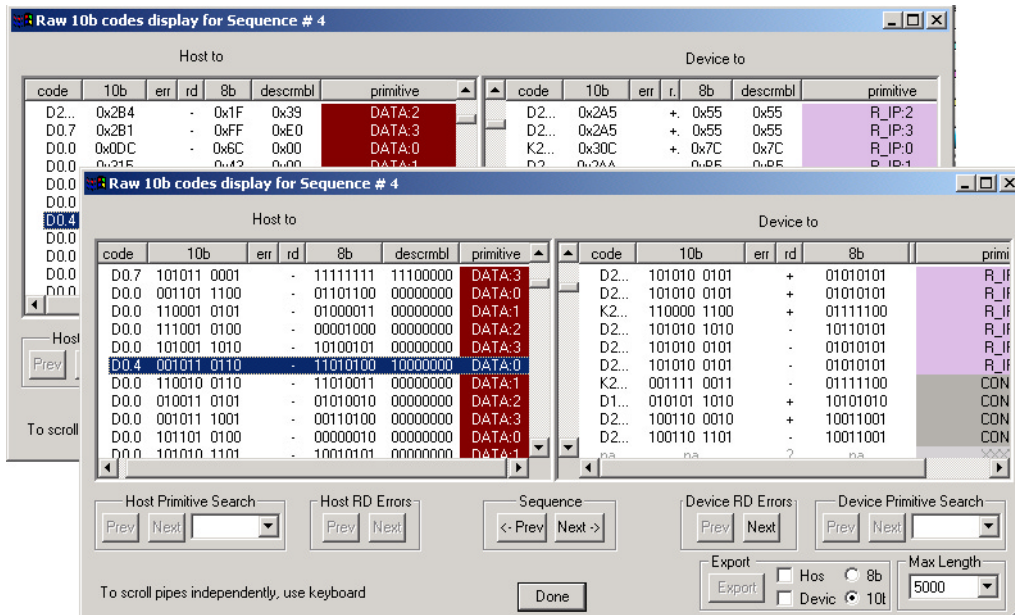
Step 1 Click on the first cell of a **Sequence**.

Note Raw Bits can be viewed only in Sequences.



Step 2 Select Show Raw Bits.

The data **8b** and **10b** field can be displayed in either binary or hexadecimal by clicking on the column header, as shown below.



Window Layout - The window displays packets as rows and physical lanes as columns.

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 **Sequence** buttons at the bottom of the window:

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

Running Disparity Error - If SATracer detects Running Disparity Errors it will display a red question mark symbol in the **err** column.

You can use the **Previous** and **Next** buttons to scroll the both sides of the display at the same time. You can use the keyboard to scroll each side separately. By default, the Rawbits view shows the first 5000 10b codes. You can use the drop-down list to view additional 10b values. Selecting the maximum length shows the full sequence.

The Raw Bits view includes search tools for navigating to Primitives within the Sequence. It will only show the primitives that occur in the sequence. Use the Search drop-down list to use this feature.

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

Running Disparity

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

Note: For a more complete definition of Running Disparity, please refer to the Serial ATA Specification Version 1.0.

Exporting 10b/8b Raw Bits

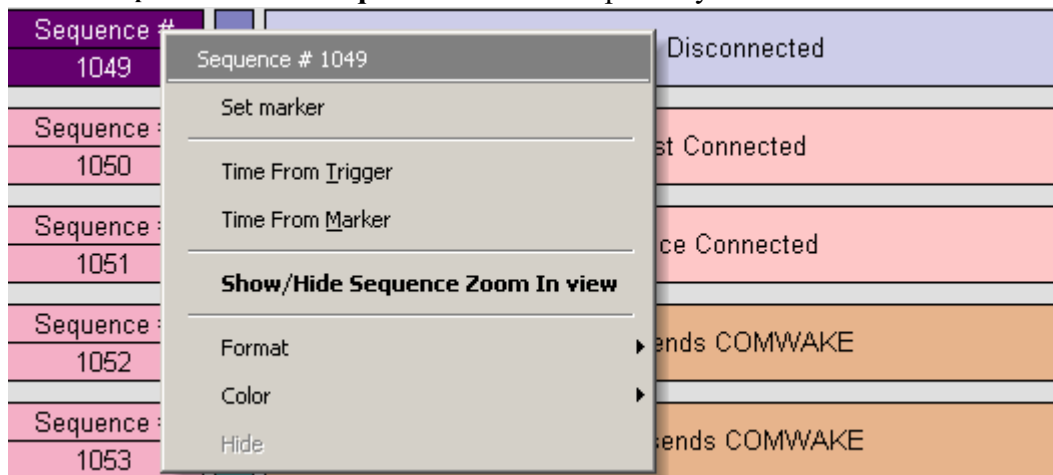
You can export 8b/10b raw bit codes to a file in a spreadsheet format. See Section 10.3, “Exporting 10b/8b Raw Bits” on page 171.

8.6 Set Marker

The **Set Marker** works in conjunction with the **Go to Marker** feature.

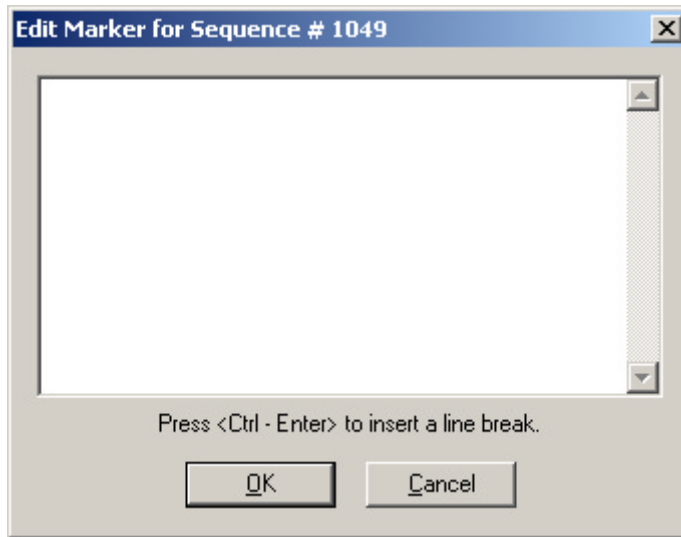
You can define a unique marker for each sequence by following these steps:

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



Step 2 Select Set Marker.

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



Step 3 Enter your comment.

Step 4 Click OK.

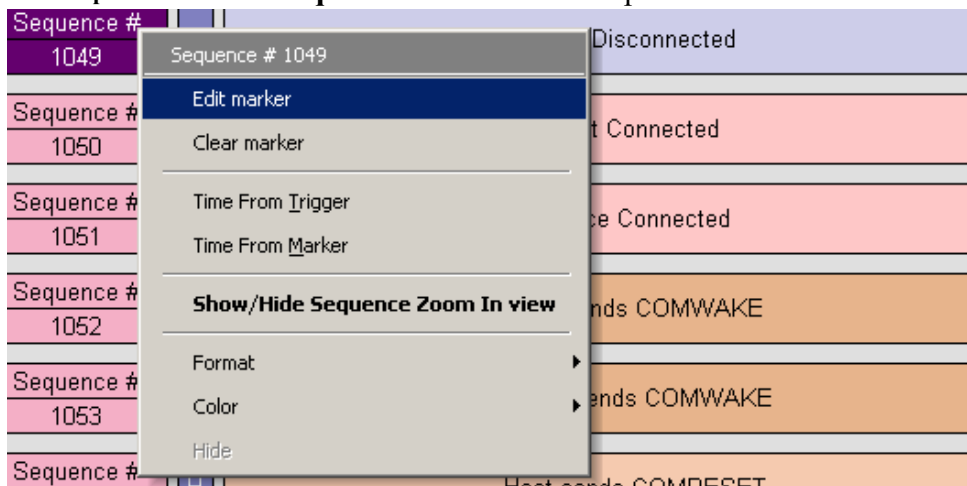
A marked sequence is indicated by a vertical red bar along the left edge of the sequence # block:



8.7 Edit or Clear Marker

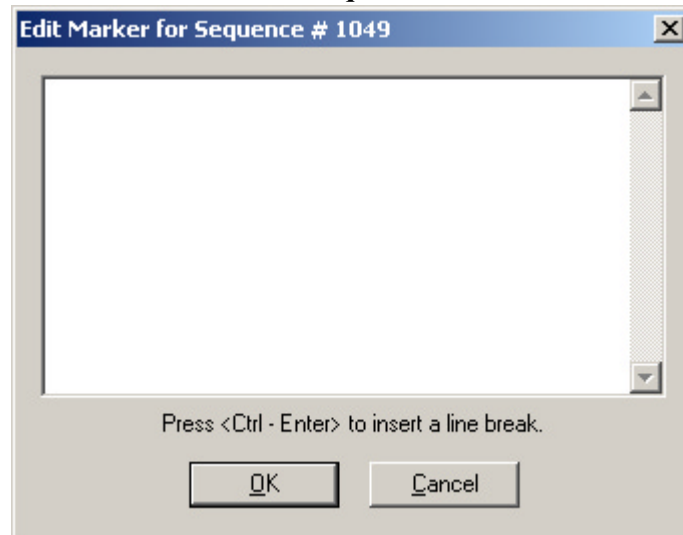
To clear or edit comments associated with a sequence marker,

Step 1 Click on Sequence # for the chosen packet.



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

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



Step 3 Edit the comment as desired.

Step 4 Click **OK**.

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

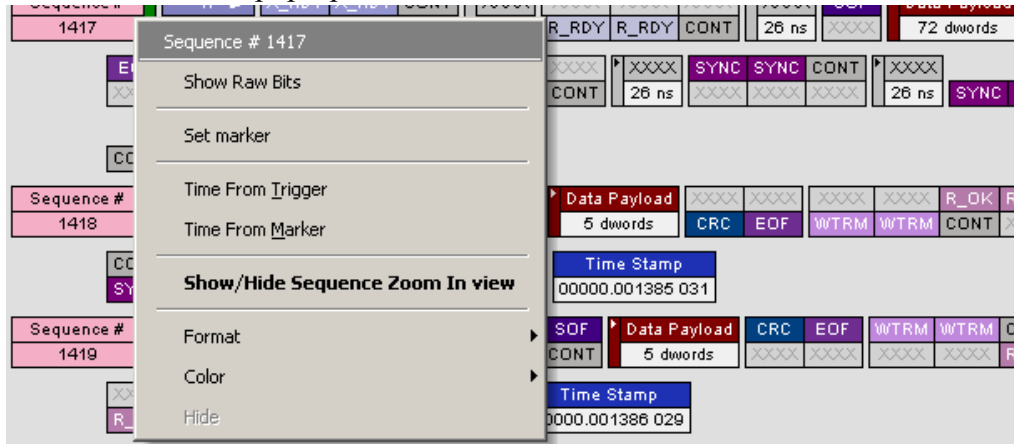
The vertical red Marker bar disappears.

8.8 Showing Sequences in Zoom View

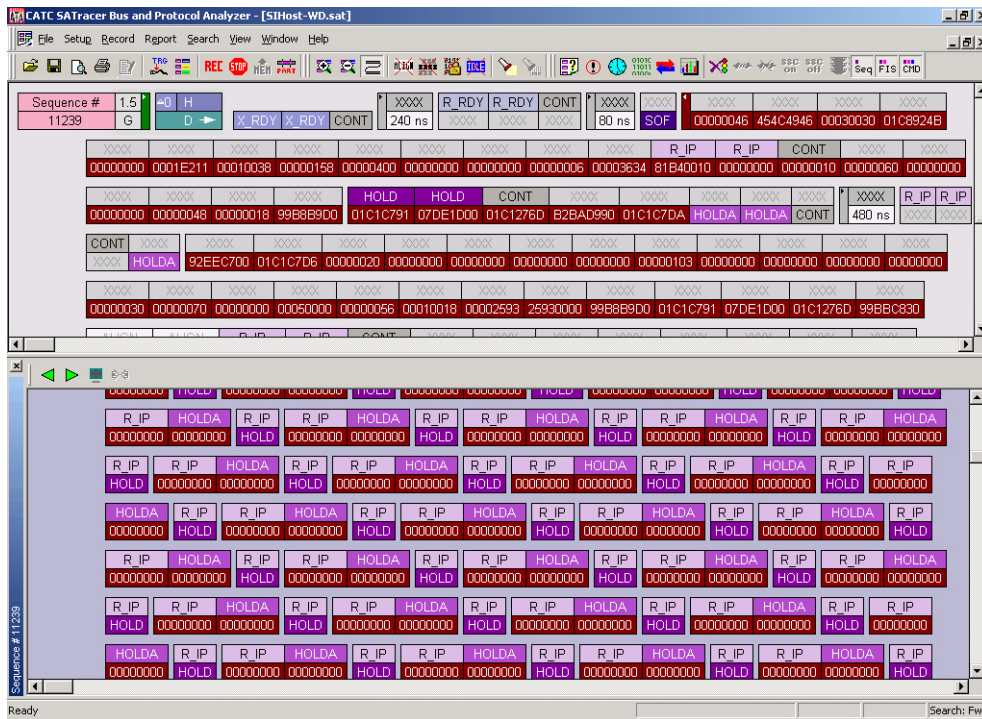
SATracer has a zoom feature that allows you to isolate a sequence in a trace and scroll through it line by line. This feature is needed for sequences with large payloads.

When scrolling through a trace that contains sequences with large payloads, it will scroll from one sequence to the next. In this case, you might scroll past parts of the sequence that are off the display window. To scroll through a sequence line by line, use the "Show Sequence in Zoom View" option.

Click the first cell of a Sequence and select **Show/Hide Sequence in Zoom View** from the pop-up menu.



A new window appears showing the isolated sequence:

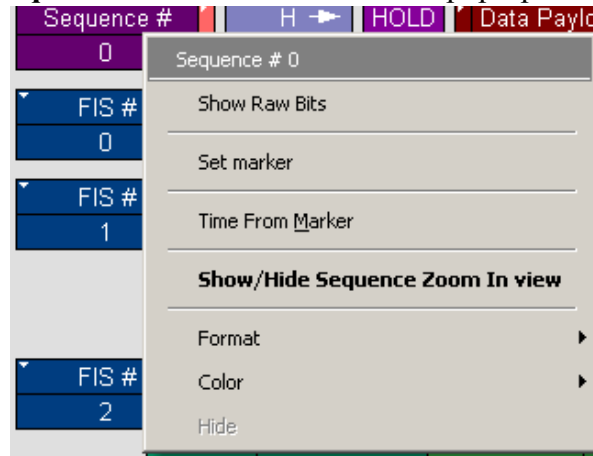


Step 6 If the Sequence is very long, use the scroll bar in the Zoom View window to scroll through the Sequence.

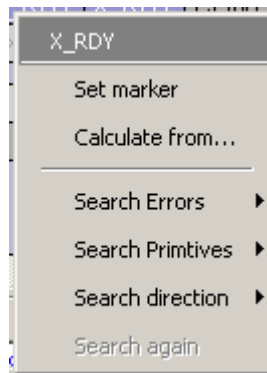
Timing Calculations in Zoom View

The Zoom View allows you mark primitives and calculate time differences between two primitives. You can mark points in the sequence for time calculation and set jumping points in that sequence. These markers are deleted when moving from one sequence to another.

- Step 1** Click on a Sequence in a Trace, and select **Show/Hide Sequence Zoom In View** from the pop-up menu.

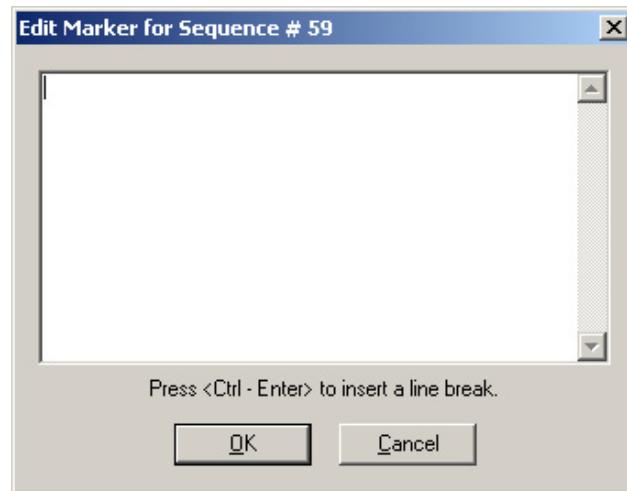


- Step 2** Click on a cell in the Zoom In view, and select Set Marker.

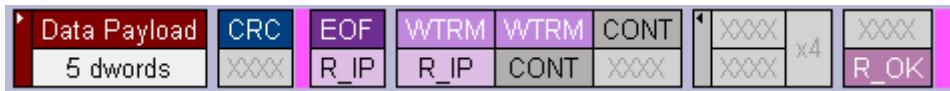


- Step 3** In the Edit Marker window, type the name of the new marker.

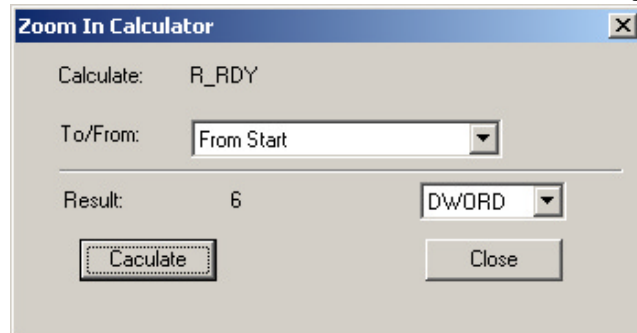
The marker will be displayed in the Zoom In view.



The markers appear in the trace as follows:



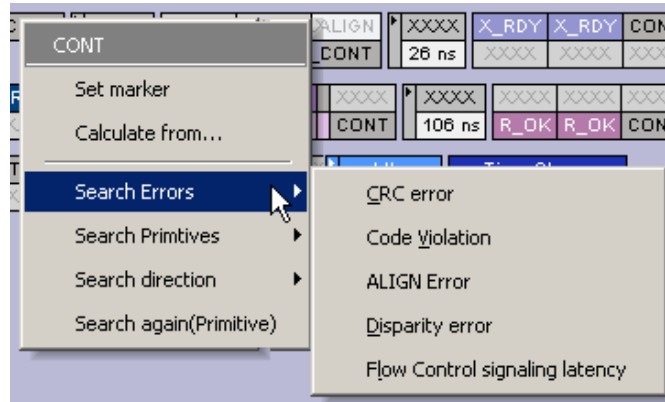
Step 4 Click on a cell, and select Calculate From in the pop-up menu.



Step 5 In the Zoom In Calculator, select the ending point and units, and click **Calculate**.

Search for Errors within Zoom-in View

Click in a field of interest to access a context-sensitive menu. The menu gives you options for searching for Errors and Primitives within the Zoom-in view.



The sequence must be fully expanded in the Zoom View to search within it. Collapsed cells can not be searched.

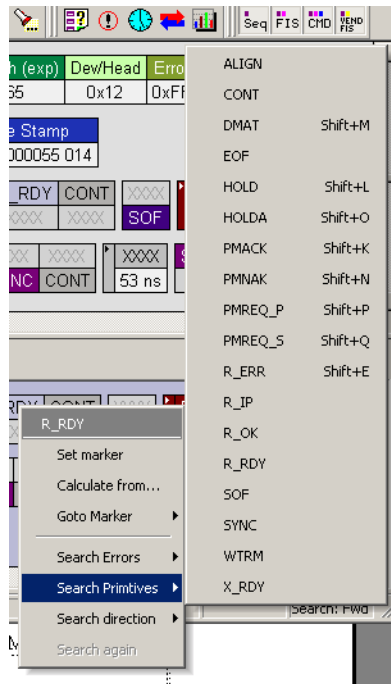
Errors that are marked in a sequence and that can be searched for are:

- CRC Error
- Code Violation
- ALIGN Error
- Running Disparity Error
- Flow Control Signaling Latency

You can see Errors marked with red cells in a trace, and the tool tip contains the error description.

Searching for Primitives within Zoom-in View

The right-click menu also allows you to search for Primitives within the Zoom-in view.



8.9 Expanding and Collapsing Data Fields

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

- Clicking the small triangular arrows on the left side of the data payload field
- Clicking and holding down the mouse button on the triangular button on the left side of a data payload field. This action will expand or collapse data fields for all Sequences/FISs/Commands 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.

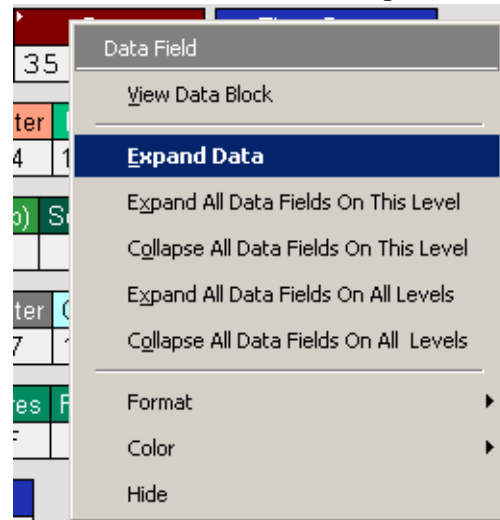
When you select "Expand Data," only the first 100 dwords are shown. To view all of the dwords, select "View Data Block."

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 in the Serial ATA trace expands to show more detailed description of the data:

Data			
0:	AAAAAAAA	BBBBBBBB	CCCCCCCC
4:	EEEEEEEE	FFFFFFFF	12345678
8:	00002ADD	00002ADE	00002ADF
12:	00002AE1	00002AE2	00002AE3
16:	00002AE5	00002AE6	00002AE7
20:	00002AE9	00002AEA	00002AEB
24:	00002AED	00002AEE	00002AEF
28:	00002AF1	00002AF2	00002AF3
32:	00002AF5	00002AF6	00002AF7

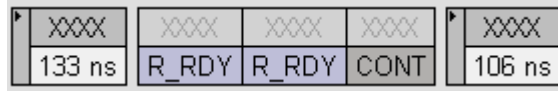
To collapse data, follow the same steps described above, and select **Collapse Data**.

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

Expanding and Collapsing XXXX Pairs

XXXX pairs can be displayed as collapsed and expanded, as shown in the following examples:

Collapsed view of XXXX pairs





Expanded view of XXXX pairs



8.10 View Data Block Window

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

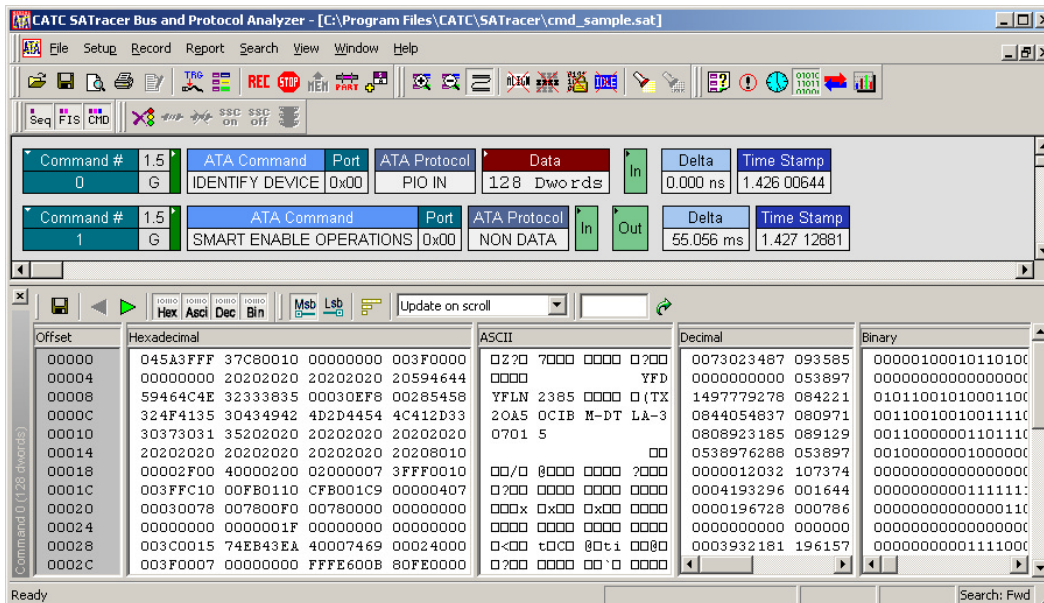
To access the View Data Block window,

- Step 1 Click  or  to decode to the FIS or Command level.
- Step 2 Locate a FIS or Command with a data field such as the one shown below:

Command #	1.5	ATA Command	Port	ATA Protocol	Data	In	Delta	Time Stamp
0	G	IDENTIFY DEVICE	0x00	PIO IN	128 Dwo rds		0.000 ns	1.426 00644

- 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 FIS or Command that has a data block and display that data block.



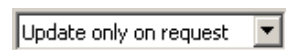
Data Format Display. Creates a column for the specified data format and then displays the currently selected data block in that format.




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 FIS or Command at the top of the trace window.

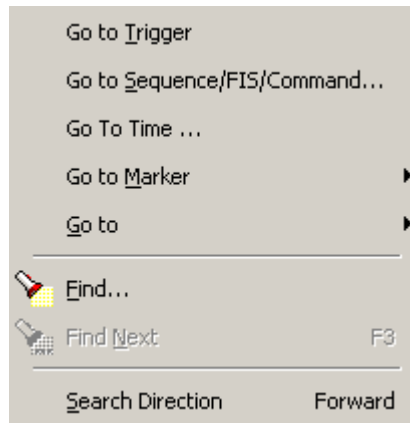


Scroll to Offset. Repositions the Data window to whatever offset you enter in the Offset box. You can enter an offset value in decimal or hexadecimal.

9. Searching Traces

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

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



9.1 Go to Trigger

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

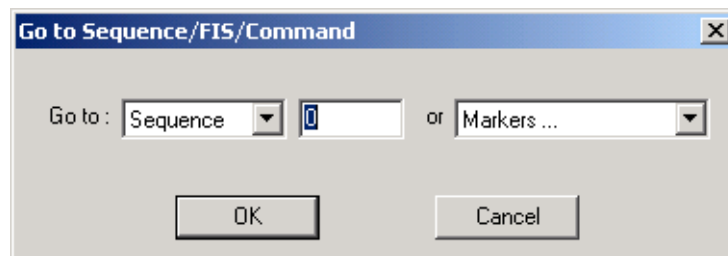
The Trace View is repositioned with the first sequence following the Trigger event (or the sequence that caused the Trigger) at the top of your screen.

9.2 Go to Sequence/FIS/Command

To display a specific sequence, follow these steps:

Step 1 From the **Search** menu, select **Go to Sequence/FIS/Command...**

The **Go to Sequence/FIS/Command** window appears.



Step 2 From the **Go To** pull-down menu, select Sequence or FIS.

Step 3 Enter the number of the sequence, FIS, or command you want to display.

or

From the pull-down menu on the right side of the window, select the trigger sequence or marker.

Step 4 Click **OK**.

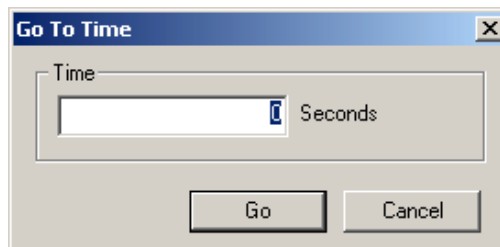
The trace view is repositioned with the selected item at the top of your screen.

9.3 Go To Time

To reposition the trace to a particular time event, use the **Go To Time** command.

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

The **Go To Time** window appears.



Step 2 In the box marked Time, enter a time value in seconds.

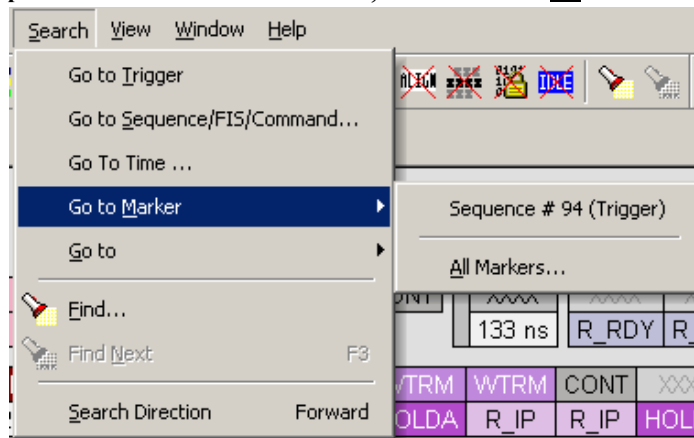
Step 3 Click **OK**.

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

9.4 Go to Marker

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

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



Step 2 Select the desired sequence, FIS, or Command from the displayed list.

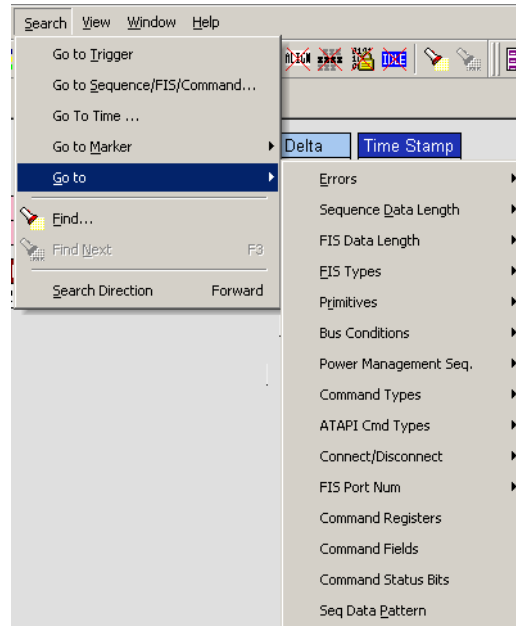
The Trace View is repositioned with the selected item at the top of your screen.

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 sequence are added or edited with the **Set Marker** feature. Please refer to **Set Marker in Reading a CATC Trace**.

9.5 Go To

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




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

9.6 Find

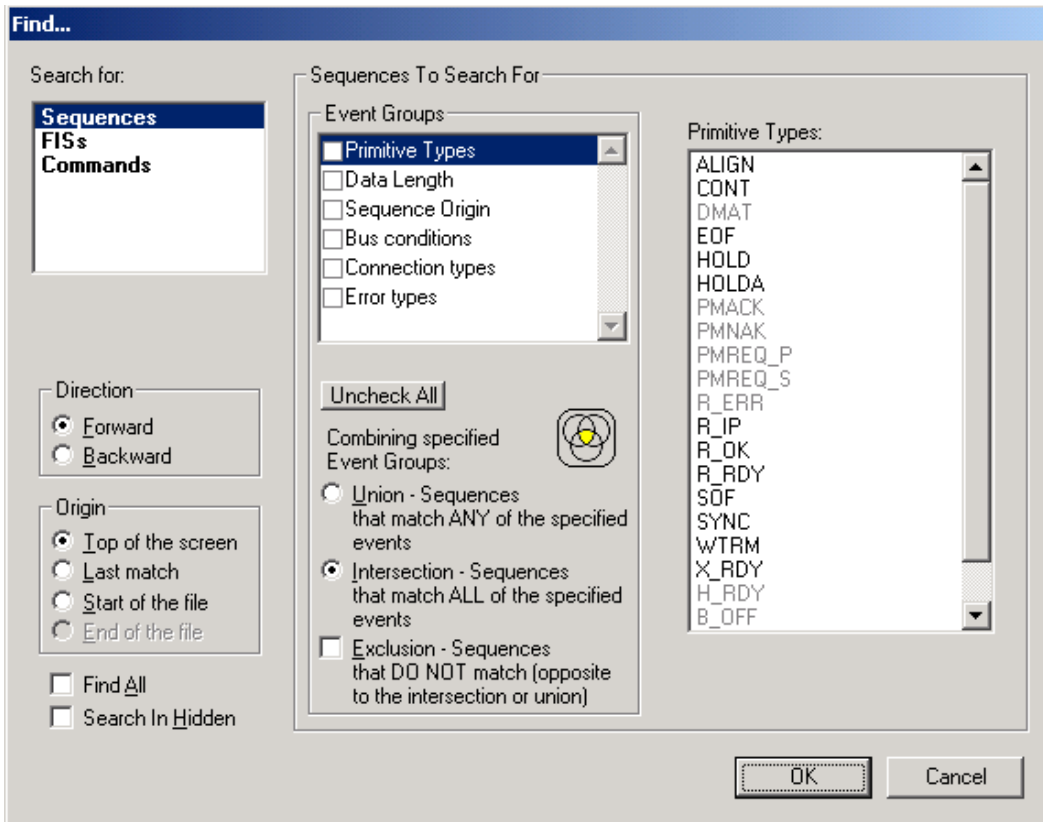
Find is a utility for conducting searches of one or more events within a trace. Find allows you to search different hierarchical levels within the trace - Sequences, FISs, and Commands. To start find,

- 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 **FISs** and **Commands** to be active, you will need to decode these levels in the trace.

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.

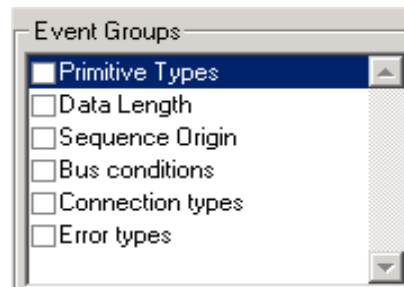
In the example shown above, Primitive Types is selected. The right side of the screen shows all of the Primitive Types that occurred in the displayed trace.

Complex Searches

When conducting complex searches in the Find dialog box, you first push a decode button in the toolbar to enable *Sequence*, *FIS*, or *Command* in the **Search for...** box.

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

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



Event Groups

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

Union, Intersection, and Exclusion

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

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

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

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

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

Using Find

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

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

Step 2 Select a search direction and origin.

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

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

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

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



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



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

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




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

Find Next

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

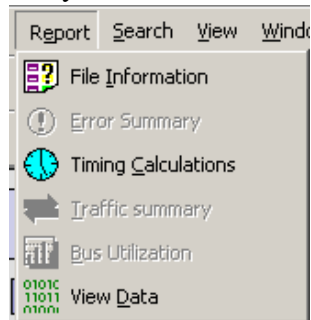
Select **Find Next** under **Search** on the Menu Bar

OR

Click  on the Tool Bar.

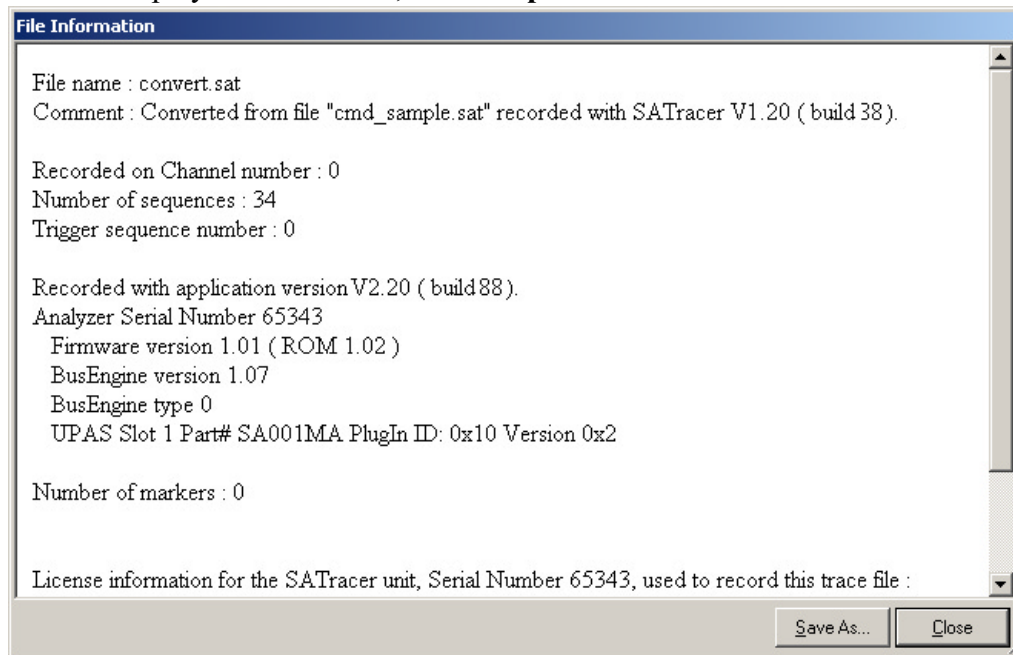
9. Reports

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



9.1 File Information

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



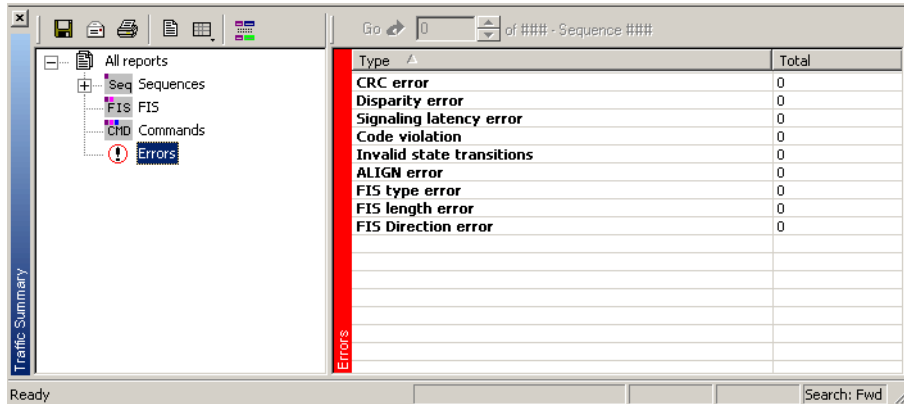
The File Information dialog opens and provides information about the recording such as when it was made, buffer settings, and version of the Analyzer Firmware and BusEngine.

9.2 Error Summary

The Error Summary details all errors analyzed throughout the recording.

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

The Traffic Summary window appears with Error information displayed.



The screenshot shows a window titled 'Traffic Summary' with a tree view on the left and a table on the right. The tree view includes 'All reports', 'Seq Sequences', 'FIS FIS', 'CMD Commands', and 'Errors'. The table has two columns: 'Type' and 'Total'. The table lists various error types with their respective counts, all of which are 0.

Type	Total
CRC error	0
Disparity error	0
Signaling latency error	0
Code violation	0
Invalid state transitions	0
ALIGN error	0
FIS type error	0
FIS length error	0
FIS Direction error	0

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

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

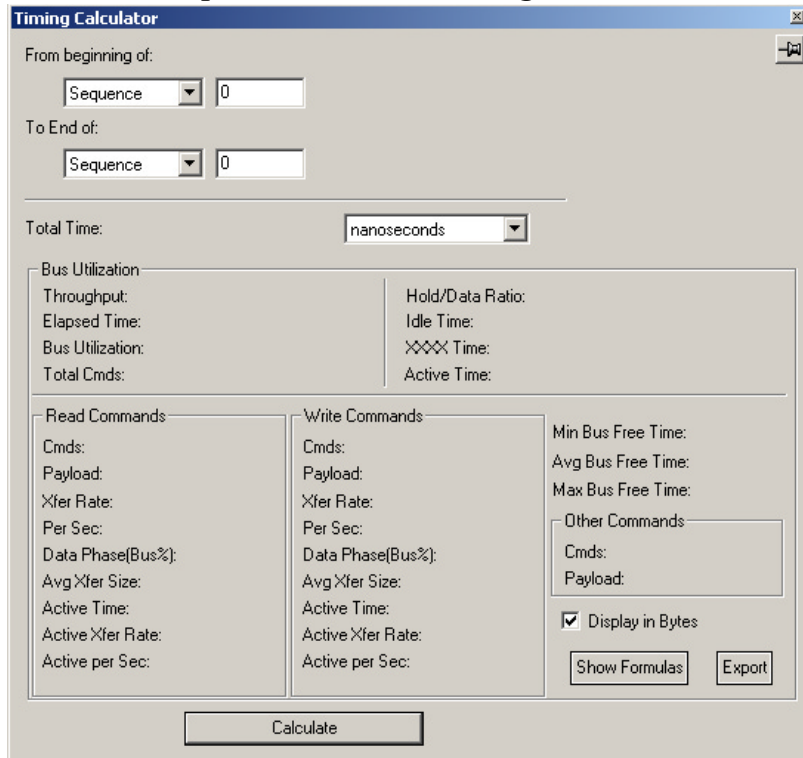
9.3 Timing Calculations

The Timing measures timing between any two specified sequences, FIS, or markers. The timing calculator feature is designed specifically for tracking bus utilization and I/O performance in current or previously captured trace files. By default the statistics will be calculated on a complete capture file or one bounded between markers or between any two commands, FIS, or sequences. You can export these statistics to a .txt file by using the **Export** function in the Timing Calculator screen. In addition to the number of commands, the timing calculator provides the following statistics:

- Transfer Rate per second
- Commands per second
- Transfer Size
- Transfer time
- Bus Idle Time
- Data vs. Overhead (%)
- Data vs. Hold Ratio

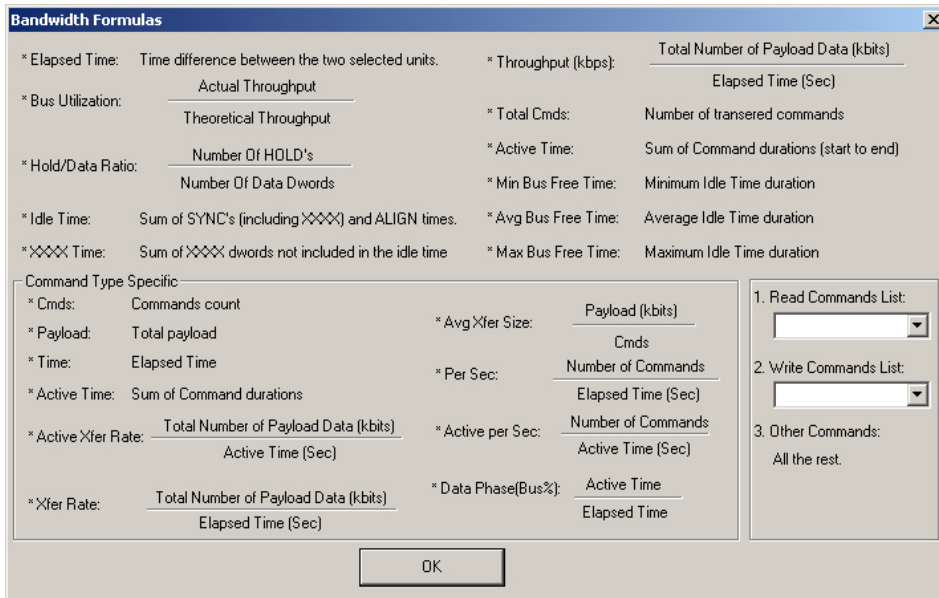
To run the Timing Calculator, perform the following steps:

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



Step 2 Select your calculation criteria from the drop-down list boxes, and click the **Calculate** button. The results will then display in the window.

Step 3 To see the formulas used to calculate the results, click **Show Formulas**. The following dialog box displays:



This dialog includes drop-down menus for **Read Commands** and **Write Commands**. These menus are informational only - meaning that they are provided so you can see what is meant by the labels "Read Commands" and "Write Commands" shown in the Timing Calculator dialog box.

To export Timing Calculator statistics to a text file,

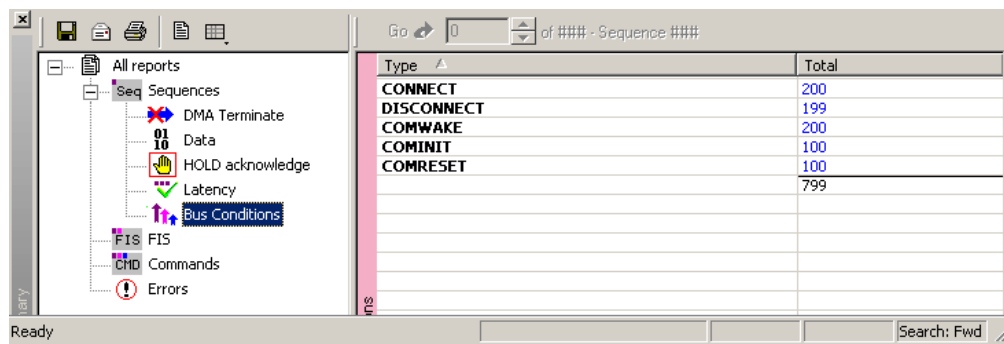
Step 1 Click the **Export** button. The Save As dialog appears.

Step 2 Choose a path and filename, and click **Save**.

9.4 Traffic Summary

The Traffic Summary displays a report of traffic in the SATracer and appears at the bottom of the SATracer 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**.

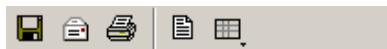


Navigating






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:




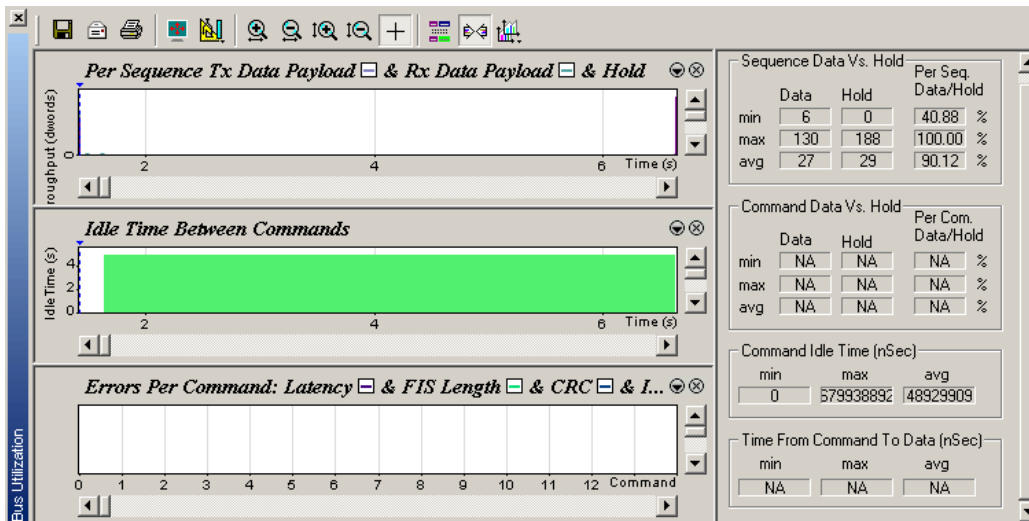
The buttons have the following functions:

-  Save As - Saves Traffic Summary results into an HTML format
-  Displays results tabular text format
-  Email - Creates an email with a *.html file attachment of the graphs
-  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
-  Print

9.5 Bus Utilization


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


To open the Bus Utilization window, select **Report > Bus Utilization** or click the button marked . A window opens similar to 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 164 for an explanation of the types of graphs listed in this menu.














- **Min/Max/Avg Area** - Displays the minimum, maximum, and average values for several parameters. Data is available **only** after you have displayed the relevant graph. After displaying a graph, the Min/Max/Avg information is calculated and is thereafter available to the user even if the graph is closed. The user can close this section by clicking  and deselecting *Statistics Accumulation* from the menu.

Bus Utilization Buttons


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



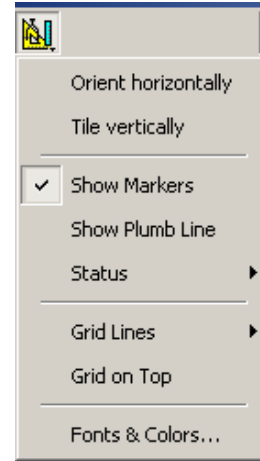
The buttons have the following functions:

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

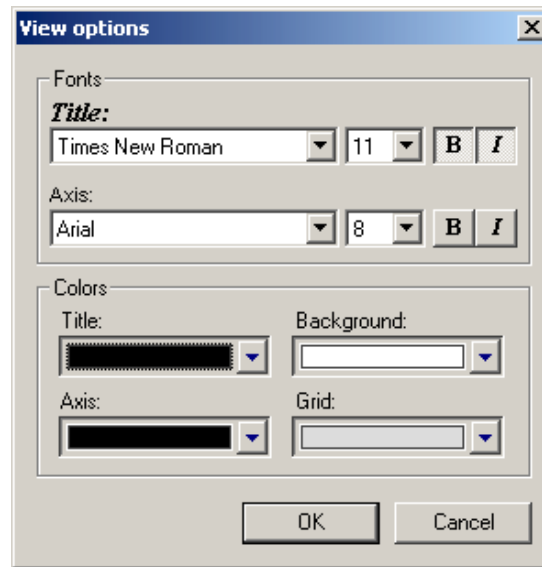
View Settings Menu

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

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




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

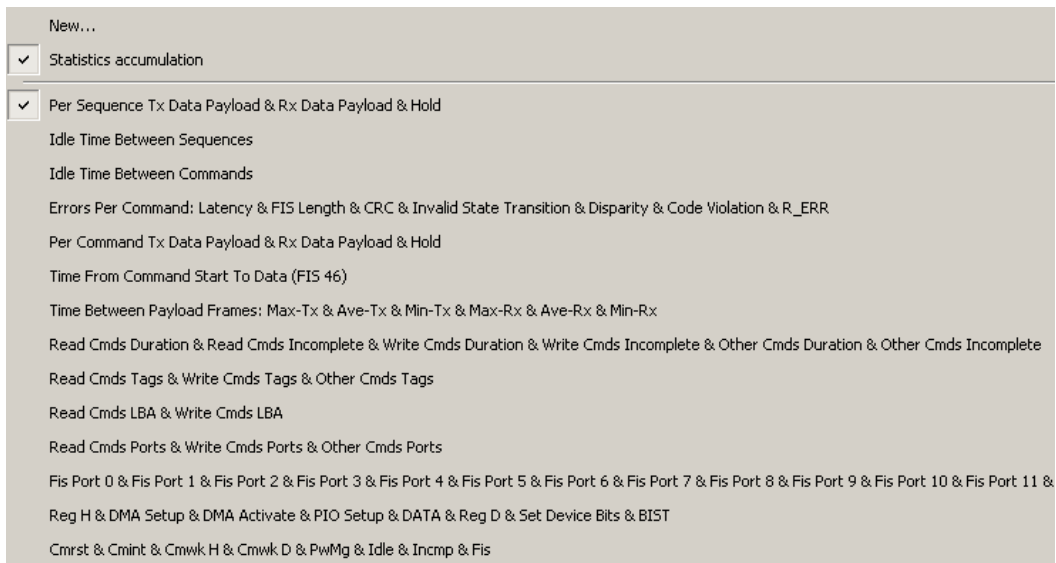


Graph Areas Menu

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

Step 1 Click the  button.

The Graph Areas menu opens.



Step 2 Select a graph type from the menu. Repeat for additional graphs. Menu options are explained in the following table.

The graph types listed in the menu are as follows:

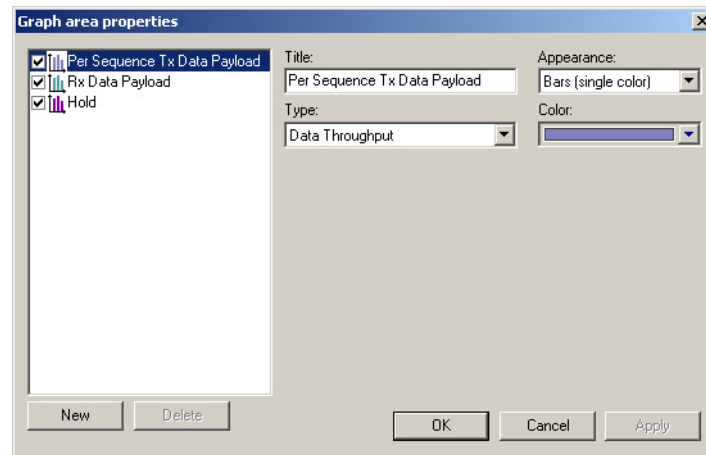
Command	Explanation
New ...	Allows you to create a custom graph.
Statistics accumulation	Allows you to display or hide the Min/Max/Avg Area on the right side of the Bus Utilization window.
Per Sequence Tx Data Payload & Rx Data Payload & Hold	Shows for each sequence the number of data dwords (Tx or Rx, each one in a different color) and the number of HOLD primitives.
Idle Time Between Sequences	Displays the time between sequences which contain only XXXX, SYNC, and ALIGN fields.
Idle Time Between Commands	Displays the time between the end of a Command and the start of the next one. Sequences and FISs that have failed to decode into the Command are counted as Idle time. This graph has Min/Max/Avg information.
Errors Per Command: Latency & FIS Length & CRC & Invalid State Transition & Disparity & Code Violation & R_ERR	Displays the number of errors that occurred in the Command. Each error has its own color and place in the graph.
Per Command Tx Data Payload & Rx Data Payload & Hold	Displays the data payload of a Command. Tx and Rx transfers are shown separately, and HOLD count is also shown per direction. HOLD and Payload counts are in dwords. Payload count does not include the first data dword. This graph has Min/Max/Avg information.
Time From Command Start to Data (FIS 46)	Displays the lapsed time between the start of a Command and the first data transfer. If the Command does not have any data FIS, the amount of time displayed equals the total time of the Command. This graph has Min/Max/Avg information.
Time Between Payload Frames: Max-Tx & Ave-Tx & Min-Tx & Max-Rx & Min-Rx	Displays the times between one data FIS and the next data FIS for Commands with multiple data FIS (46). This graph shows more than one value per Command. Min/Max/Avg values are calculated for each Command.
Read Cmds Duration & Read Cmds Incomplete & Write Cmds Duration & Write cmds Incomplete & Other cmds Duration & Other Cmds Incomplete	Displays how long this command takes to complete. Also flags incompletes. All split into the different command categories.

Command	Explanation
Read cmds tags & Write Cmds Tags & Other Cmds Tags	Command usage of tags based on time scale. All split into the different command categories. Supports 0-31 tags.
Read Cmds LBA & Write Cmds LBA	LBA usage per Read and Write commands. X axis is the time scale, LBA is the Y axis
Read cmds Ports & Write cmds Ports & Other cmds Ports	Port usage per commands. X axis is the time scale so port usage can be seen over time. All split into the different command categories.
FIS Port N	Same as the above but in FIS level.
Reg h & DMA Setup & DMA Activate & PIO Setup & DATA & reg D & Set Device Bits & BIST	FIS types usage over time. X axis is the time scale, Y axis is the FIS Type.
Comreset & Cominit & Comwake H & Comwake D & & pw mgmt 7 Idle incomp & FIS	Traffic summary over time. This shows the different types of bus states over time (OOB events, power management, idle, traffic). X axis is the time scale, Y axis is the bus state.

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 ...**

The following dialog box will open:

Step 3 From the **Title**, **Appearance**, and **Type** boxes, select the desired options.

10. Exporting Trace Data

SATracer has export commands that enable you to extract trace data to CSV, text and other file formats. This chapter describes the export process for creating CSV and iPek files.

Export commands are accessible through the menu: **File > Export**. The Export menu has five options:

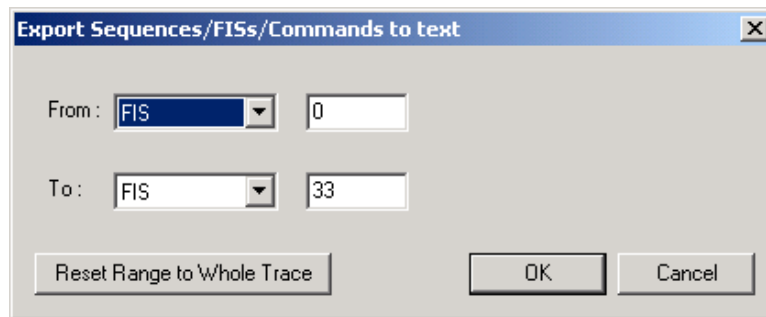
- Sequences to Text (Sequence View Format) ...
- Data ...
- 8b/10b
- Sequences to Traffic Generator Text File (.stg) ...
- Comma Separated Data
- Commands to iPeak (.raw)...

10.1 Exporting To Text Format

To export trace data to a text file,

Step 1 Select **File > Export > Sequences to Text (Sequence View Format) ...**

The following dialog box opens.



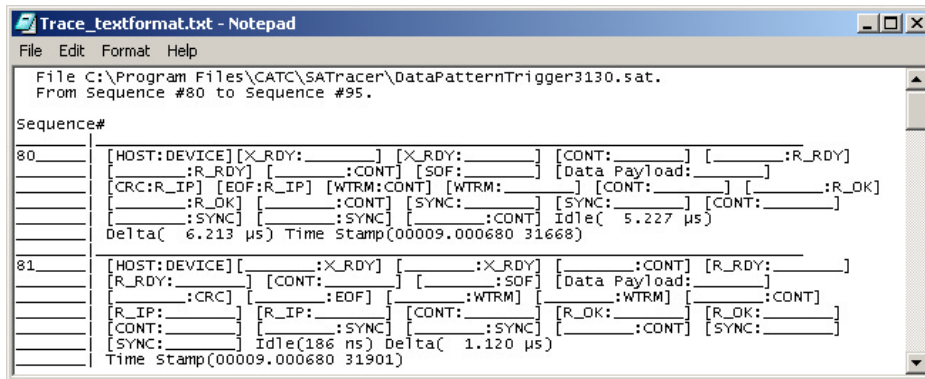
Step 2 Select the type and range of traffic to be searched from the From and To menus

Step 3 Click OK.

A **Save As** dialog box opens.

Step 4 Enter a name for the file and click **OK**.

The file is then saved. Exported text files look like this:



10.2 Exporting Data

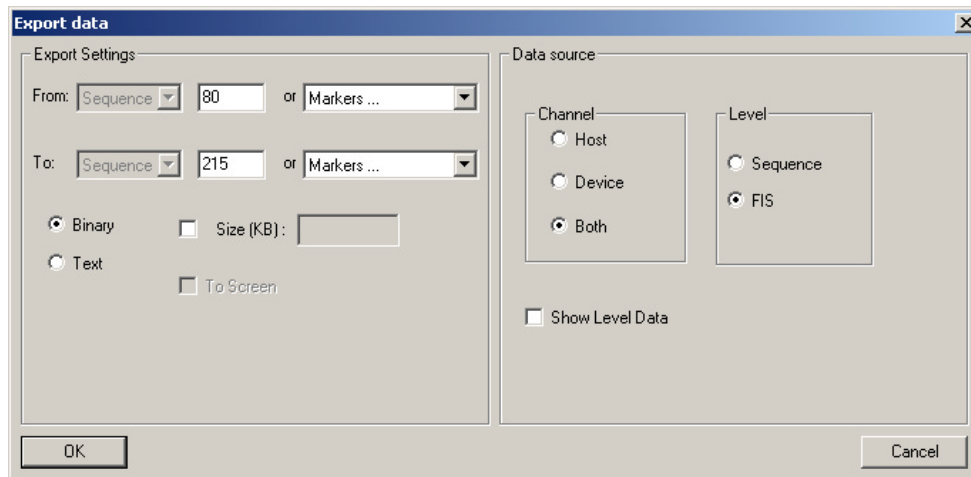
SATracer allows you to extract just the data from Sequences, FISs, and Commands. You are given three output choices: .txt, .dat, and On Screen.

The process is as follows:

To export trace data to a text file,

Step 1 Select **File > Export > Data ...**

The following dialog box opens.



Step 2 Select the type and range of traffic to be searched from the From and To menus

Step 3 Select the format for export. You have three choices:

Binary - Will extract the data into a binary format

Text - Will extract the data into a text format

On Screen - Extracts the data to a dialog box on your screen. To enable this option, select **Text**. The **On Screen** option will then become selectable.

Step 4 Select the remaining options:

Channel - Gives you a choice of saving the traffic from the Host, Device, or Both.

Level - Gives you a choice of the decode level: Sequence or FIS.

Show Level Data - Displays the decode level in the results.

Step 5 Click **OK**.

If you have selected **On Screen** a dialog box will open displaying the extracted data. If you have not selected this box, a **Save As** dialog box opens.

Step 6 Enter a name for the file and click **OK**.

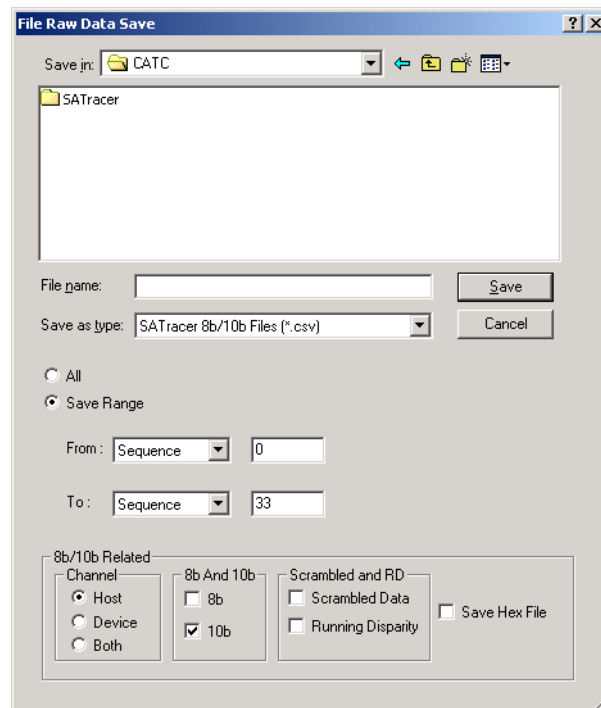
The file is then saved.

10.3 Exporting 10b/8b Raw Bits

You can export 8b/10b raw bit codes to a file in a spreadsheet format.

Step 1 To export raw bits, select **File > Export > 8b/10b**.

Step 2 In the following dialog, enter a path and filename.



Step 3 In the To and From fields choose Sequence or FIS, and specify a numeric range. Or specify Sequence # or Marker.

- Step 4** Choose a channel: Host, Device, or Both.
- Step 5** In the 8B/10B Related fields, select the appropriate checkboxes and click **Save**. See below for descriptions:
- **8Bit** - Includes 8-bit values in the export.
 - **10Bit** - Includes 10-bit values in the export.
 - **Scrambled Data** -Includes the 8-bit binary values in scrambled mode.
 - **Running Disparity** - Includes the RD values as a separate field within the export.
 - **Hex** - Saves hexadecimal values in the *.csv file.

Note If you export raw 10b or 8b values to a csv file and attempt to view the file in a spreadsheet such as Microsoft Excel, these applications will automatically strip off the leading zeros from each cell/value. Many of the 8b/10b codes will appear with missing zero characters. Change Excel's formatting options to pad cell values and correctly display leading zeros.

See CATC Application Note: Exporting 8b/10b Codes for further information: http://www.catc.com/products/support/sup_SATracer.html.

10.4 Exporting to a Traffic Generation Format

Traffic Generation files allow *SATrainer* to generate Serial ATA traffic. To create a Traffic Generation file, you create or open a trace that has the type of traffic you want to generate. This file will act as a blueprint for traffic generation. You then issue the command:

File > Export > Sequences to Traffic Generation Text File (.stg) ...

SATracer will then export the data it needs for traffic generation. See *Section 11.*, “*Traffic Generation with SATrainer*” on page 183.

10.5 Overview of Exporting to a .CSV Format

CATC's *SATracer* automatically generates over a dozen performance metrics for every trace including throughput and average bus free time. The metrics are measured *SATracer*'s Traffic Summary, Bus Utilization, and Timing Calculations dialogs. *SATracer* also has the ability, however, to extract a far wider range of statistics. Additional performance data can be extracted to a Comma Separated Value (.csv) format where it can be

analyzed and measured with a spreadsheet, database or other application. SATracer's **Export to Comma Separate Data** command lets you extract performance trace data. This section describes the process. In addition, this section describes a sample spreadsheet called *Performance Analysis.xls* that is included with the SATracer software. *Performance Analysis.xls* measures and graphs the .csv file's performance data. Advanced Excel users can develop their own template for graphing performance spreadsheet.

When performing custom analysis using the **Export to Comma Separated Data** feature, SATracer generates metrics by command type. It exports these metrics to a single .csv file for every occurrence of the specified command. This allow engineers to focus their analysis on the critical I/O commands like READ or READ_FPDMA_QUEUED. With all the key metrics for a given command in a single spreadsheet, it's easy to graph and display performance over time.

During the process of exporting trace data to CSV format, users define which commands to export; and the order in which fields should appear. These settings are stored in an Export Configuration file (.xpt) that is created as part of the Export process. The Export Configuration file can be reused in future for other traces.

Summary of the Export Process

Exporting trace file data to Excel is a five-step process:

- Step 1** Open a trace and select Commands and Attributes to be exported to a .csv file.
- Step 2** Save your Command/Attribute settings into a CATC export-format file (.xpt).
- Step 3** Export the selected Commands and Attributes from the trace in the format specified by the Export file into a .csv file.

At this point you are done.

If you would like to see your performance data graphed using a special Excel template created by CATC, continue to steps 4 and 5.

- Step 4** Start Microsoft Excel and then open the CATC template file *performance analysis.xls*.
- Step 5** Open your .csv file. The .csv file will be formatted and graphed automatically and will display performance metrics.

10.6 Exporting Trace Data to CSV Files

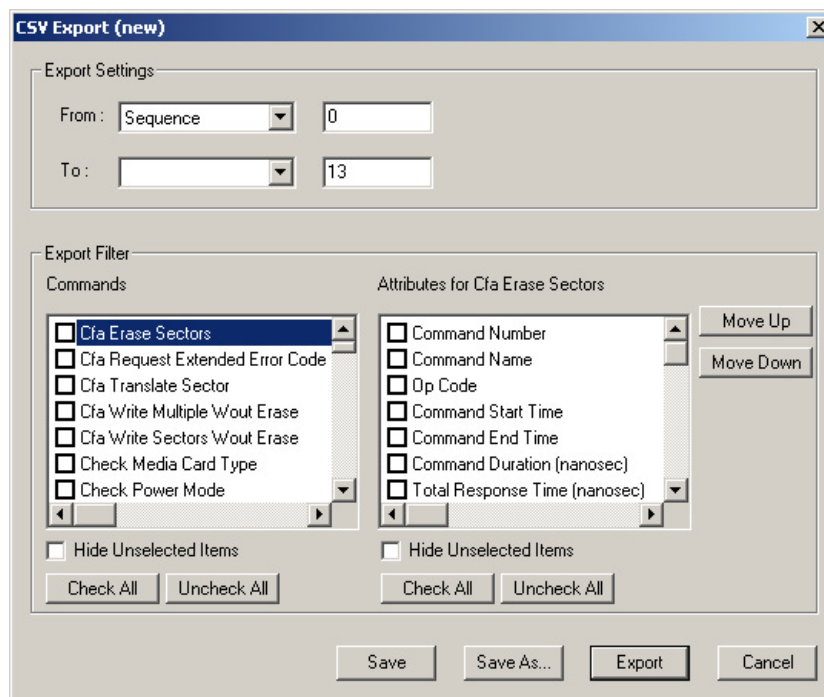
Export to **.csv** file comprises Steps 1, 2, and 3 from above. You start by identifying the traffic you want exported. Then you create an Export file (**.xpt**) which arranges the data in the format that you prefer. Lastly, you export the data.

Creating an Export File

In your first steps, you open a trace, select and organize Serial ATA Commands and Attributes into order you want them in the **.csv file**, and save the configuration as an Export file (**.xpt**). This Export file preserves your field selection and formatting.

Step 1 In *SATracer*, open a trace.

Step 2 From the SATracer menu, select **File > Export > Comma Separated Values > New**. The CSV Export dialog box opens. This dialog box lets you select and order the Commands and Attributes you want present in your **.csv** file:



Step 3 Select a range using the **From** and **To** boxes.

Step 4 Select one of the checkboxes in the Commands List.

Step 5 Select the attributes for your selected Command from the

checkboxes for the Attributes List on the right.

Note If you select all Commands and Attributes, the Export process described later will take a long time.

Step 6 If you wish to re-order the Commands and Attributes differently than they appear in the list, use the **Move Up** or **Move Down** button.

Step 7 Repeat Steps 3 - 5 to select additional commands.

Save Configuration Settings to .xpt File

To preserve your selections into an **.xpt** file, click the **Save As** button. Pressing **Save As** causes a directory to be created whose name is

trace file name + timestamp:

filename_yyyymmddhhmmss

where yyyy is the year, mmm is the month, dd is the day, hh is the hour, mm is the minutes, and ss is seconds.

Step 1 Click the **Save As ...** button. A Save As dialog box opens.

Step 2 Enter a file name and location and press Save. This **.xpt** file can be viewed with an ASCII text viewer such as Notepad.

Note: After you have created an **.xpt** file, you can re-open it in the future with the SATracer command **File > Export > Comma Separated Values > Open**.

Export Trace Data to .csv File

The **Export** button exports trace data according to the settings made in the open **xpt** file.

Step 1 Press the **Export** button. A browse dialog box opens.

Step 2 Select a folder where you want to export the file, and click **OK**. Two files will be created: a spreadsheet file (**.csv** file), and a data summary file (**.txt** file).

10.7 Using the CATC Performance Spreadsheet

CATC has created two Export Configuration files (**.xpt**) and an Excel spreadsheet template that are designed to work together. The Export Configuration files cause *SATracer* to extract key performance data from whatever trace is open into a **.csv** file. This **.csv** file is formatted in such a way that it easily plugs into a CATC Excel template called *performance*

analysis.xls. This Excel template has built-in macros and formulas that will allow you to view performance metrics within your **.csv** file. If you open the **.csv** file in this template, the performance data will be inserted into pivot tables and graphed.

Step 1 Open a trace in *SATracer*.

Step 2 Run the command **File > Export > File Separated Data > Open**.

Step 3 Navigate to the directory:
Program Files\CATC\SATracer\CSVExport

Step 4 Select either of the two **.xpt** files:

- **read write performance.xpt**
- **selectall.xpt**

Note CATC will add to these **.xpt** files in future software releases.

Step 5 Click **Export**. A browse window opens.

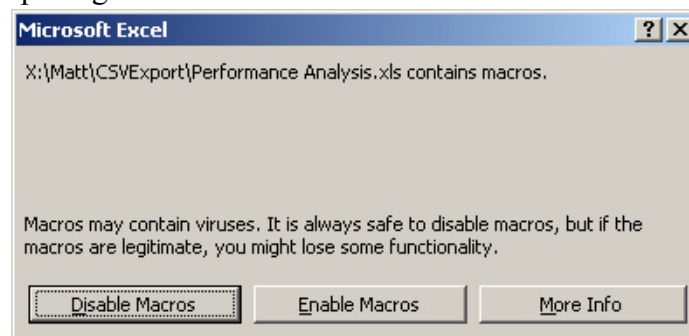
Step 6 Select a directory where you would like to export your data.

Step 7 Click **OK**. The dialog box closes. A **.csv** file is created and placed in a directory called *tracename_timestamp*.

Step 1 Open Microsoft Excel.

Step 2 Open **Performance Analysis.xls**. It resides in:
Program Files\CATC\SATracer\CSVExport

Step 3 A message will appear warning you that the file you are opening contains macros.



Note: If you do not first open the **performance analysis.xls** template file before opening your **.csv** file, the **.csv** file will open as an ordinary spreadsheet file and will not display any graphs.

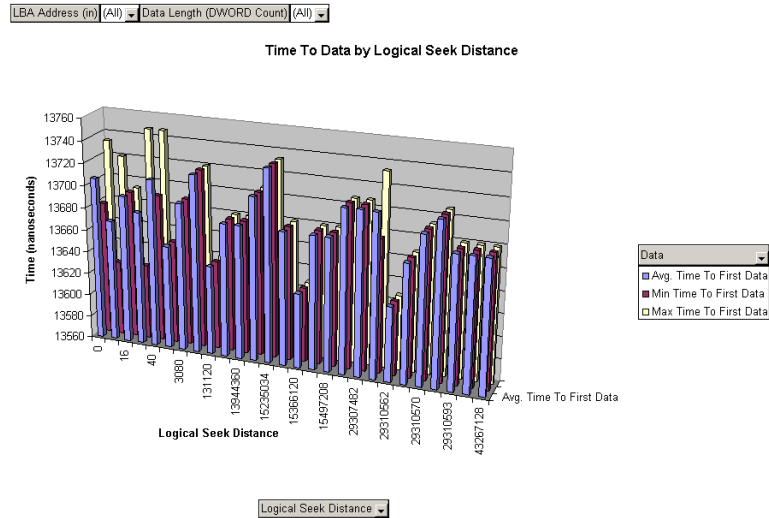
Step 4 Click **Enable Macros**. You must enable macros in order for the spreadsheet to work properly. After clicking **Enable**

Macros, a browse dialog box opens.

Open Your .csv Spreadsheet File

Step 1 In the browse dialog box, select the .csv file that you created above.

Step 2 Click **OK**. Excel then opens the file.



Excel will display ten tabs along the bottom of the application:

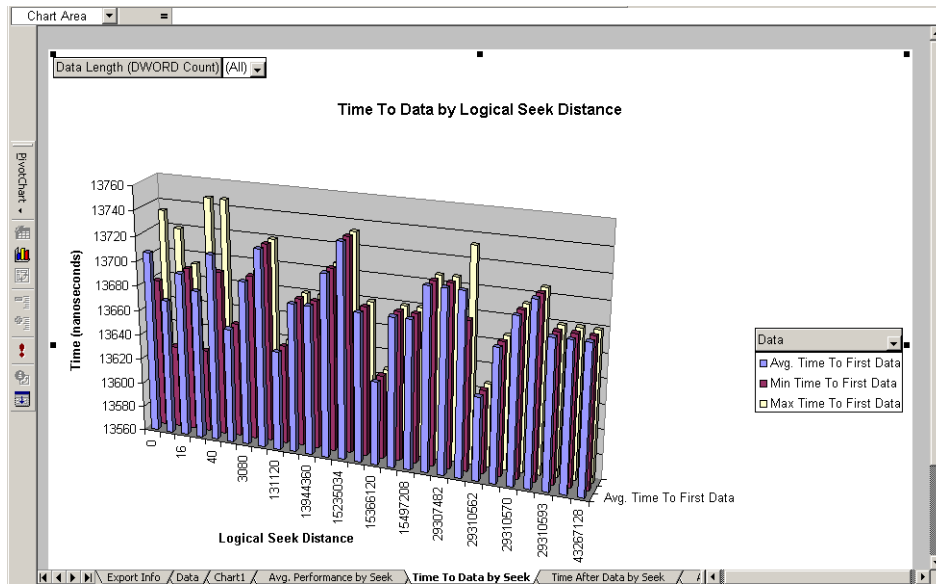
- Export Info - a brief summary of the file
- Data - the raw spreadsheet data
- Average Performance by Seek - graph
- Time to Data by Seek - graph
- Time after Data by Seek - graph
- Average Performance by Data Length - graph
- Performance by Command - graph
- Latency by Seek -graph
- SeekPivot - pivot table
- SizePivot - pivot table

Performance Analysis Spreadsheet Graphs

Graphical displays are primarily useful for identifying trends and anomalies. The graphs included in Performance Analysis.xls focus on charting Time against Transfer Size or Logical Address.

Time to Data Performance

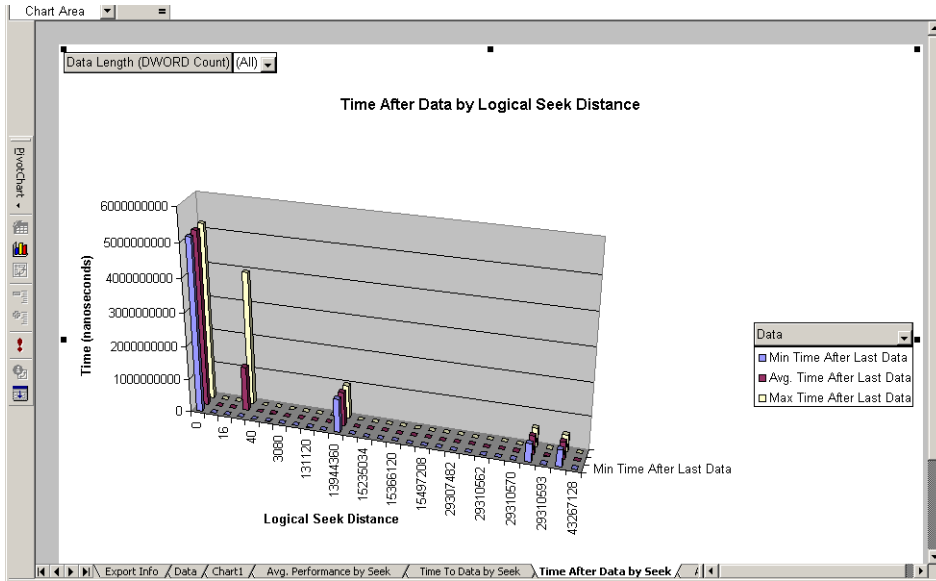
The graphic below shows Time to Data by Logical Seek Distance. It illustrates the elapsed time (in ns) between each WriteDMA command being issued to the device and the first Data FIS being returned. The x-Axis reflects logical seek distance between the last LBA accessed and next LBA.



The different bar colors represent Min, Max, and Average Time to Data. The example below includes only 19 commands so each point in the graph is unique. But in larger datasets the min/max/average are helpful in determining if it was a one-time anomaly or a persistent problem. The 20% spike in Time to Data (occurring at logical seek distance of 634723) is outside the range of "normal" command overhead. It is more likely an indication of fragmentation, a media (bad block) or firmware problem.

Time After Data Performance

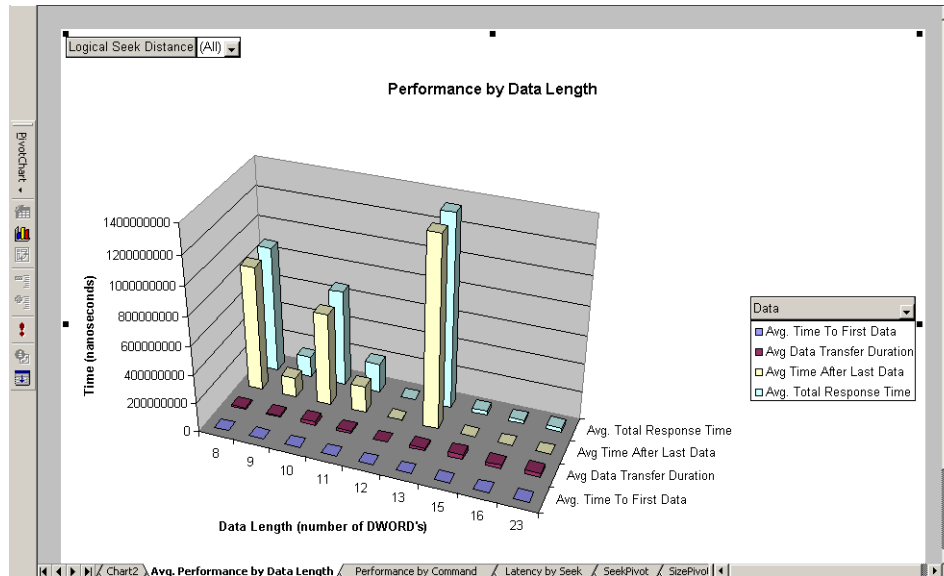
The graphic below shows Time After Data by Logical Seek Distance. This illustrates the elapsed time (in ns) between the last Data FIS being returned from a WriteDMA command and the next WriteDMA command being issued. In this example, the x-Axis also reflects Logical Seek Distance between the last LBA accessed and next LBA.



Time after Data values may increase slightly (higher latency) as the Logical Seek Distance increases. But the spikes in Time After Data measurements above could also reflect issues with excessive command overhead at the host or drive controller level. The Performance Analysis.xls spreadsheet references the actual command number where these spikes occurred making further investigation easy.

Average Performance by Data Length

The graphic below provides an average value for several different metrics that illustrate device performance. It provides a different view of the two metrics discussed above - oriented around payload size. Plus, it shows average transfer time and command completion times with respect to the Data Length (in Dwords).



Average Total Response Time (in ns) illustrates the elapsed time between starting and finishing the WriteDMA command using different payload sizes. Obviously, the average Data Transfer time is higher when the transaction contains a larger payload. The x-Axis reflects the data length. It's easy to see how transfers with larger data payloads (2048 Dwords) are more efficient than transfers with smaller data payloads (128 Dwords). This type of graph is most useful when measuring identical read/write patterns recorded on the same device with different revs of firmware.

10.8 Exporting Commands to iPeak Format

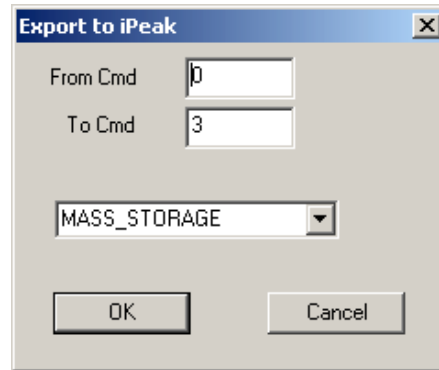
iPeak is an Intel application consisting of a suite of utilities for assessing drive performance and workload characteristics. iPeak uses a .raw file format.

To export Commands to iPeak format,

Step 1 Click  to decode to Command Level.

Step 2 Select **File > Export > Commands to iPeak File (.raw) ...**

The following dialog box opens.



Step 3 Select the range of commands to be exported from the From and To menus

Step 4 If you know the types of devices that created the traffic in the recording, select one of the following categories. You have five choices:

- Mass_Storage
- DISK
- CD_ROM
- DVD
- TAPE

Step 5 Click **OK**.

A **Save As** dialog box opens.

Step 6 Enter a name for the file and click **OK**.

The file is then saved with a .raw extension.

11. Traffic Generation with SATrainer

SATrainer is a traffic generator that can emulate a Serial ATA host or a 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.

SATrainer is supported only by the UPAS 2500H. It is not supported by the UPAS 10K.

SATrainer can generate a maximum of 5000 sequences, with a maximum sequence length of 50000 dwords.

11.1 SATrainer Hardware

CATC SATrainer requires both the Serial ATA Analyzer module that contains the Generator port, and the Serial ATA Generator module that plugs into the left slot of the UPAS. SATrainer is then enabled through a software license from CATC. When the Serial ATA Generator module is installed, the **About SATracer...** screen will display the text, "Slot B: Memory Module." You can access the **About SATracer...** screen from the Help menu.

Two SATrainer Models

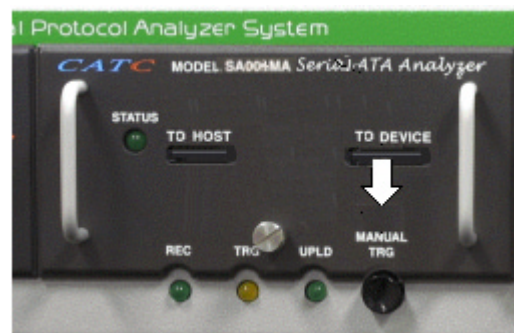
There are two models of SATrainer hardware:

SA003MA - Has three ports marked: *Host*, *Gen. Out*, and *Device*.

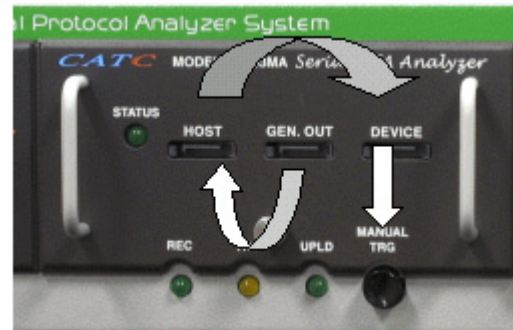
SA004MA - Has two port marked: *Host* and *Device*.

11.2 Setting Up SATrainer for Host Emulation

SA004MA - Connect the Serial ATA cable from the SATrainer **To Device** port to the Host port on the unit under test. This transmits the Traffic Generator stream from the **To Device** port on the SATracer/Trainer to the device-side port on the unit under test.



SA003MA - Connect the Serial ATA cable from the SATrainer **Gen. Out** port to the SATrainer **Host** port. Then connect the SATrainer **Device** port to the device-side port on the unit under test. This transmits the Traffic Generator stream out of the **Gen. Out** port, back in through the **Host** port, and finally out the **Device** port to the host-side port to the unit under test.



11.3 Setting Up SATrainer for Device Emulation

SA004MA - Connect the Serial ATA cable from the SATrainer **To Host** port to the host-side port on the unit under test. This transmits the Traffic Generator stream from the **To Host** port on the SATracer/Trainer to the host-side port on the unit under test.



SA003MA - Connect the Serial ATA cable from the SATrainer **Gen. Out** port to the SATrainer **Device** port. Then connect the **Device** port to the host-side port on the device under test. This transmits the Traffic Generator stream through the SATracer/Trainer module and back out using the host-side port to the unit under test.



11.4 Generating Traffic

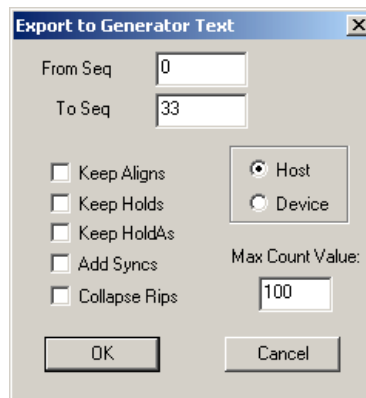
Generating traffic using the *SATracer/Trainer* is a two step process. First, text-based Traffic Generator file must be created. This file can be created through a special conversion command in *SATracer* that converts a trace file into a traffic generator file. Alternatively, you can edit an existing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

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

Creating a Traffic Generation File with *SATracer*

The easiest way to create a Traffic Generation file is to convert an *SATracer* trace file (*.sat) into a *.stg file. This is done with the **Export** function in *SATracer*.

Step 1 In *SATracer*, Select **File>Export>Sequences to Traffic Generator (.stg)**. The Export to Generator Text screen appears.



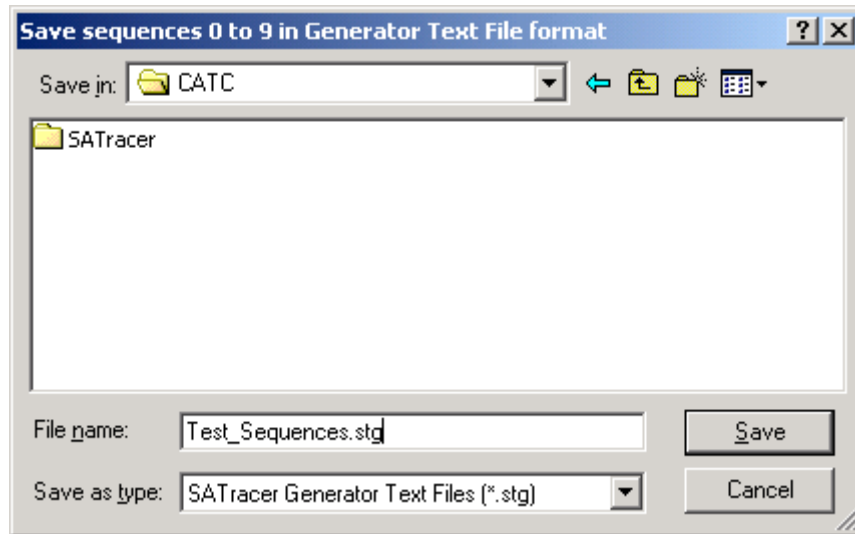
Step 2 Select **Host** or **Device**.

Step 3 If desired, enter a Max Count for Primitives or aligns. This setting provides you with a way to restrict the count subkey.

Step 4 If desired, select Keep Aligns, Keep Holds etc.

Step 5 Enter the sequence range in the text fields.

Step 6 Click **OK**. The Save dialog appears.



Step 7 Enter a path and filename for the Generator Text file and click **Save**.

A Generator file (*.stg) has now been created and can be read with the SATracer/Trainer application. A few lines of a File Generator file (shown in a text viewer) are illustrated below:

```

file_type=UPAS2500H
file_version=1
file_speed=GEN1

begin_config = HERE
auto_align = true
auto_align_hw = true
auto_oob = FALSE
traffic_dir = HOST
prev_rd = NEG
end_config = HERE

bus_condition=connect

xxxx = 0 count = 100
primitive_id = R_RDY count = 50
primitive_id = X_RDY count = 50

```


Opening a Traffic Generation File

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

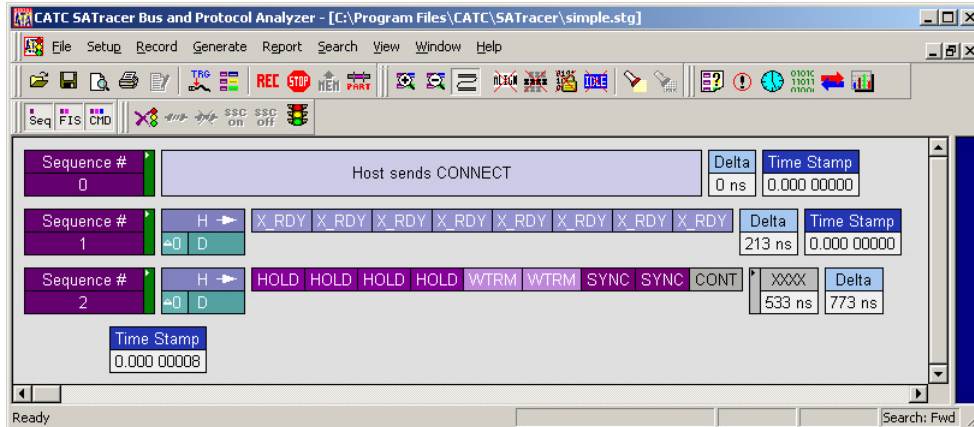
To open a Traffic Generation file,

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

OR



Click  on the Tool Bar.

- Step 2** Select a Generator text file (*.stg) 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:



Start the Recording

Once the **.stg** file has been loaded, begin the recording.


- Step 1** Click  to put the analyzer in Analyzer/Generator mode.
- Step 2** Click  to begin the recording.

Power On OOB Sequence

To bring a line into Idle, use the **Connect** command from the Tool Bar or Menu Bar. The Connect button is available as an alternative to embedding the Power on OOB sequence directly into the **.stg** file. It is typically used to bring the link up prior to transmitting a traffic pattern (**.stg** file).

Select **Connect** under **Generate** on the Menu Bar

Or


Click  on the Tool Bar.

Start Traffic Generation

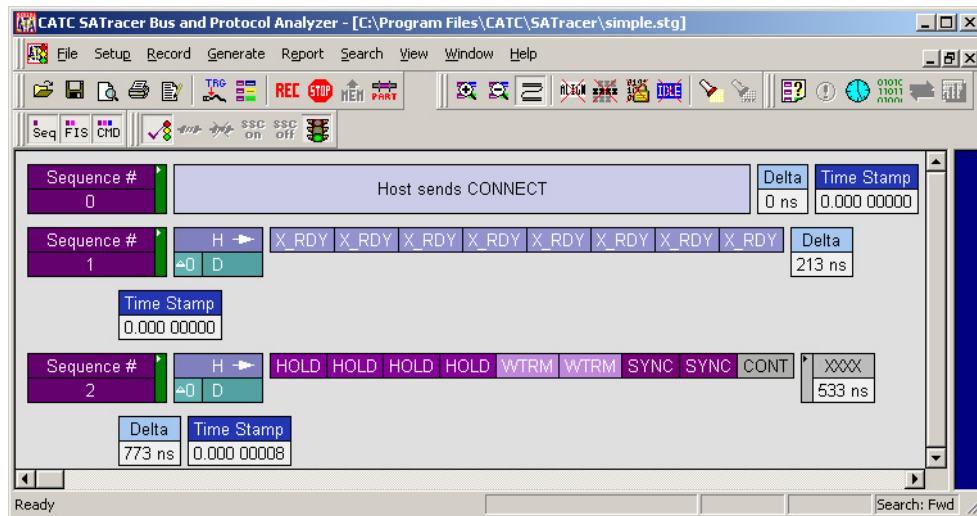
Once a connection has been established, start traffic generation.

From the **Generate** menu, select **Start Traffic**.

Or

Click  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 *SATrainer* reaches the end of the Generator file.

To manually stop traffic generation,

Select **Stop Traffic** under **Generate** on the Menu Bar

Or


Click  on the Tool Bar.

Power Off OOB Sequence

To disconnect a line, use the Disconnect command from the Tool Bar or Menu Bar. Disconnect is a power off sequence that will cause *SATrainer* to disable its transceiver.

Select **Disconnect** under **Generate** on the Menu Bar

Or

Click  on the Tool Bar.

Using the Spread Spectrum Clock (SSC)

When the SSC is on, *SATrainer* will use SSC when transmitting data. You can turn SSC off in order to test without enabling the SSC receiver or when your design does not support SSC. *SATracer/Trainer* automatically recognizes SSC on the Receive side of transmissions. The default setting is on.

Note: SSC On/Off is not currently supported.

When SSC On/Off becomes supported, you turn SSC on by performing the following steps:

Select **Generate>SSC On** from the Menu Bar.

Or

Click the  button.

To turn SSC off,

Select **Generate>SSC Off** from the Menu Bar.

Or

Click the  button.

11.5 SATrainer File Generation Language

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

Within the text file each definition consists of a set of assignments that look like: key=VALUE. White space is permitted around the equal sign. There are no restrictions about dividing definition to lines, and it is not necessary to define each new definition in a separate line, although it is recommended. The maximum number of characters in a line is 250. The characters '#' and ';' indicate end-of-line comments (i.e. the rest of the line is ignored). All keys and values are case-insensitive, but are shown with keys lower case and values upper case for clarity.

Each Primitive definition starts with one of the assignments: primitive=N (where N is a string representing a valid primitive identifier).

Subsequent assignments after a primitive's starting assignment define the values of particular fields associated with the primitive. If a field is not defined it is defaulted appropriately.

Values are assumed to be decimal unless they are prefixed with '0x' and then are interpreted as hexadecimal. Values within a block assignment are always assumed to be hexadecimal and should not be prefixed by '0x'.

Some level of syntax and bounds checking is done when the file is parsed for displaying, and then again upon downloading.

The following tables contain support keys for defining fields within a sequence:

File Control Keys

File Control Keys are session based instructions for setting up a stream. They can only be used at the beginning of a file. These keys determine the direction of the stream, whether it is going to the device or the host.

Table 2: File Control Keys

Key Code	Format	Description
file_type		This must be included at the beginning of the file to determine the hardware platform the file was created for. This key can only be used in the beginning of the file before the first sequence.
file_version	integer	This must be included after the " file_type =" key to determine the version of this file. Value is currently 1. This key can only be used in the beginning of the file before the first sequence.
file_speed		This must be included after the " file_version =" key to determine the speed of primitives to be generated. Only one " file_speed " is allowed per .stg file. This key can only be used in the beginning of the file before the first sequence.
stop		If you want to run only some first portion of the beginning of a .stg file, insert this statement where you want generation to halt. This saves having to edit a file into smaller files when testing a portion of traffic.

Configuration Control Keys

Configuration keys are localized commands that control the behavior of the Serial ATA traffic based on where you put these commands in the stream. These commands customize traffic behavior and how it transmits or handshakes.

Table 3: Configuration Control Keys

Key Code	Format	Description
Begin_config	HERE	Defines the beginning of the region in the file used to configure the generated traffic. Can appear either in the beginning of the file or during an idle time (after sync) on the bus.
Prev_rd	Pos/Neg	Defines the running disparity polarity before the traffic from this file. It is used to generate the 10b code for the first 8b code. This key can only be used in the beginning of the file before the first sequence.
Traffic_dir	Host/Device	Sets the direction of the generated traffic. This key can only be used in the beginning of the file before the first sequence.

Table 3: Configuration Control Keys

Key Code	Format	Description
auto_align	False/True	Defines if the software should generate ALIGN's automatically. Default is FALSE. Fields: <ul style="list-style-type: none"> • per_burst - Default is 2. • between_bursts - Default is 254. • offset_to_first_burst - Default is 0. This key can only be used in the beginning of the file before the first sequence.
auto_align_hw	True/False	When enabled, the SATrainer inserts a pair of Aligns every 254 dwords in idle time. Default is TRUE.
auto_oob	True/False	Responds to OOB sequence automatically. Default is TRUE. This key can be used either in the beginning of the file or during an idle time on the bus (after a SYNC SYNC CONT).
end_config	Here	Terminates the configuration region. This key can be used either in the beginning of the file or during an idle time on the bus (after a SYNC SYNC CONT).
Begin_oob	Here	This defines the beginning of the region defining OOB negotiation.
Com_reset_init	(value value value value)	Fields (in hex): <ul style="list-style-type: none"> • per_burst - number of aligns per burst. Default is 4. • Number_of_bursts - Default is 3. • Time_between_bursts - time in dwords (26.6ns) between bursts. Default is 320 ns. • Time_after_last - time in dwords (26.6ns). Default is 525 ns.
Com_wake	(value value value value)	Fields (in hex): <ul style="list-style-type: none"> • per_burst - number of aligns per burst. Default is 4. • Number_of_bursts - Default is 3. • Time_between_bursts - time in dwords (26.6ns) between bursts. Default is 160 ns. • Time_after_last - time in dwords (26.6ns). Default is 175 ns.
D102_align	(value value)	Fields: <ul style="list-style-type: none"> • Align_count - Number of Aligns to generate after d10.2 burst • D10.2_count - Number of d10.2 dwords to generate Used only when auto_OOB is off.
end_oob	Here	Terminates the OOB region.
Auto_handshake	TRUE FALSE	Allows hosts and devices to synchronize at the primitive level.

Bus Condition Keys

Bus Condition keys are used to selectively introduce bus condition signalling within the SATrainer traffic stream. This allows the user to transmit out-of-band signaling like **COM RESET** or **COMWAKE** programmatically anywhere in the traffic file.

Bus Condition keys are influenced by OOB Configuration and Control Configuration keys, which let the user define how the SATrainer will behave when it **receives** and **transmits** out-of-band signals from host or device.

Table 4: Bus Condition Keys

Key Code	Format	Description
Bus_condition	Comreset/cominit/comwake/connect/disconnect/oob_align/oob_d10.2	The different Bus conditions will behave according to the specs defaults, unless specified differently in the OOB configuration section. Connect is used together with auto_oob to bring the line up (full OOB sequence). After a disconnect, it is recommended to add an Idle block to specify how long the lines should remain in idle. The next command will be transmitted after this idle time, and if there is no other command the lines will stay disconnected. This key also controls the synchronization stage at the end of OOB . The trainer will transmit the align/d10.2 primitives based on the given count value.
Idle	integer	Idle time in ns count (+-13.3 ns) max is 666000 (< 666 micro sec).

Primitive Keys

Primitive Keys are the basic building blocks of all Serial ATA traffic.

Table 5: Primitive Keys

Key Code	Format	Description
primitive_id	string or 32 bits	Use this as the primitive to be sent. The key should be assigned to a valid primitive identifier string per the Serial ATA specification: ALIGN, CONT, DMAT, EOF, HOLD, HOLDA, PMACK, PMNAK, PMREQ_P, PM_REQ_S, R_ERR, R_IP, R_OK, R_RDY, SOF, SYNC, WTRM, X_RDY . Optionally, you can assign this key a raw 32 bit value. Fields: <ul style="list-style-type: none"> • count - number of primitives to transmit - Default is 1. Maximum count is 10000. • prd - sets the previous rd sign (used to generate the 10b code) (POS/NEG). • rd_error - forces an rd error (value == TRUE).
Data	32 bits	Fields: <ul style="list-style-type: none"> • prd - sets the previous rd sign (used to generate the 10b code) (POS/NEG). • rd_error - forces an rd error (value == TRUE). • control - using a 4 bits mask, sets one of the 8 bits code so that it will translate into a 10b control code.
auto_data	(value value value)	Fields: <ul style="list-style-type: none"> • initial_data - for incremental data. • count - number of dwords to add - default 1-step - step between each value.
Xxxx	32 bits or Auto	Generates garbage traffic (after CONT) on the bus. Field: count - number of dwords to add default 1 Max count is 10000. Example: xxxx=value cont=#
crc	32 bits or auto	This is the crc value for the previous data. <ul style="list-style-type: none"> • prd - sets the previous rd sign (used to generate the 10b code) (POS/NEG). • rd_error - forces an rd error (value == TRUE). • crc_error - force a crc error.
raw_data	40 bit values in hex (ff ff ff ff)	Raw data to be generated on the bus.
raw_data_10b	40 10-bit values in Hex (3ff 3ff 3ff 3ff)	Raw data to be generated on the bus.
marker	“string”	A description for the current sequence (once per sequence).

11.6 Configuration Behaviors

A configuration section starts with a **begin_config=here** and ends with **end_config=here**.

Session configuration

These settings are only accepted in the beginning of the file.

prev_rd	Sets the initial running disparity. This running disparity is used to generate the 10b code of the first transmitted primitive.
traffic_dir	Sets the direction of the generated traffic.
auto_align	If set, you can get the software to add Aligns into the generated stream (based on the parameters of this command).

Localized configuration

Note - Localized configuration is accepted only during idle time on the bus.

auto_oob	<p>When enabled, SATrainer will:</p> <ul style="list-style-type: none"> React automatically to OOB commands issued by the tested Device or Host. After the OOB sequence the generator will continue from the last place, though the context may be lost due to the unexpected OOB signaling. Wait for OOB responses before continuing the OOB flow. <p>When enabled, SATrainer will:</p> <ul style="list-style-type: none"> Ignore OOB commands issued by the tested Device or Host. Follow user commands while transmitting OOB flow.
Auto_align_hw	<p>When enabled, SATrainer will insert Aligns into stream (2 every 254 dwords)</p> <p>When enabled, SATrainer will:</p> <ul style="list-style-type: none"> If auto_handshake is set: only insert Aligns during Idle times, if necessary. If auto_handshake is unset: do nothing.
OOB Configuration	<p>A configuration section has to start with a begin_oob=here and ends with end_oob=here.</p> <p>OOB configuration is accepted only during idle time on the bus.</p> <p>The following keys let the user define attributes of the OOB commands. SATrainer will use these attributes when generating OOB commands. If no attributes are defined, SATrainer will use the default set from the specification.</p> <ul style="list-style-type: none"> com_reset_init - based on the traffic direction, this set the attributes of COMRESET (Host traffic) or COMINIT (Device traffic). com_wake - sets the attributes of COMWAKE.

Primitives Configuration

ALIGN	You either generate ALIGN primitives using the primitive_id key or use the auto_align key to so automatically. During Idle time on the bus if auto_alignw is set, the hardware will insert aligns into the generated stream (in 254 dwords intervals).
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OOB Configuration

COMRESET	When auto_oob is set, <i>SATrainer</i> will transmit the COMRESET and then wait until COMINIT is received. When auto_oob is unset, <i>SATrainer</i> will transmit the COMRESET and continue to the next command.
COMINIT	When auto_oob is set, <i>SATrainer</i> will wait for COMRESET before transmitting COMINIT and then wait until COMWAKE is received. When auto_oob is unset, <i>SATrainer</i> will transmit the COMINIT and continue to the next command.
COMWAKE	When auto_oob is set, <i>SATrainer</i> will transmit COMWAKE and then wait for until COMWAKE is received. When auto_oob is unset, <i>SATrainer</i> will transmit the COMWAKE and continue to the next command.
CONNECT	When auto_oob is set, <i>SATrainer</i> will transmit full OOB sequence until the line is Idle.
DISCONNECT	<i>SATrainer</i> will disconnect the line.
OOB_ALIGN	<i>SATrainer</i> will transmit a stream of ALIGN based on the given count in D10.02_align . If auto_oob is set, the stream will be stopped when line is synchronized and not based on count.
OOB_D102	<i>SATrainer</i> will transmit a stream of D10.2 based on the given count based on the given count in D10.02_align . If auto_oob is set, the stream will be stopped when ALIGNs will be received on the other line.

Idle Configuration

IDLE	Insert idle time in ns (-+13.3ns).
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Inserting Errors

crc error	Use the crc key to write a specific wrong crc value or use the crc_error = true attribute.
scrambling error	Insert raw data (raw_10b) in the data stream or reset the scrambler seed in the middle of the data.
align error	Insert aligns primitives in wrong places in the stream.
running disparity error	Use the raw_10b key to insert running disparity errors or set an rd error using the prd or rd_error sub keys.
code violation	Insert a wrong code using the data or raw_data keys.
protocol error	<ul style="list-style-type: none">• fis length - create a mismatch between fis type and length.• fis type - use an illegal type in the data stream.• fis direction - use a fis in the wrong direction.• invalid state transition - use any wrong primitive combination.

11.7 Generator File Structure

The following shows the general structure of a Generator file (.stg):

```

|file_type=UPAS2500H
|file_version=1
|file_speed=GEN1

begin_config = HERE
auto_align = FALSE
auto_align_hw = TRUE
auto_oob = FALSE
traffic_dir = HOST
prev_rd = NEG
end_config = HERE

start_loop=here

primitive_id = 0x5757b57c count = 2 ;X_RDY
primitive_id = 0x9999aa7c ;CONT
xxxx = 0x00000000 count = 13
primitive_id = 0x3737b57c ;SOF
data = 0x00ec8027
data = 0xa00000aa
data = 0x00000055
data = 0x00000100
data = 0x00000000
crc = 0x705d5f7c
primitive_id = 0xd5d5b57c ;EOF
primitive_id = 0x5858b57c count = 2 ;WTRM
primitive_id = 0x9999aa7c ;CONT
xxxx = 0x00000000 count = 100

end_loop=10

xxxx = 0x00000000 count = 20

start_loop = here

primitive_id = 0x5757b57c count = 2 ;X_RDY
primitive_id = 0x9999aa7c ;CONT
xxxx = 0x00000000
primitive_id = 0x3737b57c ;SOF
data = 0x00918027
data = 0xaf0000aa
data = 0x00000000
data = 0x0000ff3f
data = 0x00000000
crc = 0x80b68f01
primitive_id = 0xd5d5b57c ;EOF
primitive_id = 0x5858b57c count = 2 ;WTRM
primitive_id = 0x9999aa7c ;CONT
xxxx = 0x00000000 count = 20

end_loop=5

```

The diagram illustrates the structure of a Generator file (.stg) with three main sections:

- Primary Control Keys:** This section includes the file metadata: `|file_type=UPAS2500H`, `|file_version=1`, and `|file_speed=GEN1`.
- Configuration Control Keys:** This section includes the configuration parameters: `begin_config = HERE`, `auto_align = FALSE`, `auto_align_hw = TRUE`, `auto_oob = FALSE`, `traffic_dir = HOST`, `prev_rd = NEG`, and `end_config = HERE`.
- Primitive Keys:** This section contains two loops of primitive keys. The first loop starts with `start_loop=here` and ends with `end_loop=10`. The second loop starts with `start_loop = here` and ends with `end_loop=5`. Each loop contains a series of primitive keys with their respective IDs, counts, and control characters (e.g., `X_RDY`, `CONT`, `SOF`, `EOF`, `WTRM`), along with data and CRC values.

Appendix A: Specifications

SATracer/Trainer is a hardware module that installs into the Universal Protocol Analyzer System. The following specifications describe a combined *SATracer/Trainer/Universal Protocol Analyzer System*.

Package

Connectors: UPAS AC power connection
External trigger connection (TRIG IN/OUT, BNC)
PC connection (USB 2.0 Hi-Speed, type "B")
SATracer Plug-in Recording Channel

Power Requirements

90-254VAC, 47-63Hz (universal input), 120W maximum

Environmental Conditions

Operating Range: 0 to 55 °C (32 to 131 °F)
Storage Range: -20 to 80 °C (-4 to 176 °F)
Humidity: 10 to 90%, non-condensing

Switches

Power: On/off
Manual Trigger: When pressed, triggers the end of the recording

LEDs

UPAS: Illuminated when the analyzer is powered on.
Status (STATUS): Illuminates for approximately 25 seconds during initialization/power up of the UPAS base unit. If this LED blinks following initialization, this is an indication that initialization failed.
Recording (REC): Illuminated when the analyzer is actively recording traffic data
Triggered (TRG): Illuminated during power-on testing and when the analyzer has detected a valid trigger condition.
UPloading (UPLD): Illuminated when the analyzer is uploading its recording memory to the Host PC for displaying the CATC trace

SATracer Plug-in

Module:
Status (STATUS): Illuminates when there is traffic on both the host and device sides.

Probing Characteristics

Connection: Serial ATA Signal Cable receptacles
Standard cables (up to 1 meter in length)
Frequency: 1.5 gigahertz +/- 220 ppm

Recording Memory Size

512 M x 8-bit DRAM for traffic data capture, timing, state and other data.

Basic Trigger Events

Primitives:	SYNC, X_RDY, WTRM, ALIGN, R_RDY, R_IP, R_OK, R_ERR, SOF, HOLD, HOLDA, DMAT, PMREQ_P, PMREQ_S, PMACK, PMNAK, EOF, CONT
Bus Conditions:	COMRESET, COMINIT, COMWAKE HOST, COMWAKE DEVICE, CONNECT, DISCONNECT
FISs:	Register-Host to Device, REgister Device to Host, DMA Activate, DMA Setup, BIST Activate, PIO Setup, Data, Set Device Bit
Errors:	FIS Length Error, FIS Type Error, CRC Error, Disparity Error, Align Error, Code Violation Error

Commands Execute Device Diag, Device Reset, CFA Erase Sectors, CFA Request, Ext Error Code, Check Power Mode, Flush Cache, Flush Cache Ext, Get Media Status, Idle, Idle Immediate, Initialize Device Params, Media Eject, Media Lock, Media Unlock, Nop, Read Native Max address, Read Native Max address Ext, Read Verify Sectors, Security Erase Prepare, Security Freeze Lock, Seek, Set Features, Set Max Address, Set Max Address Ext, Set Multiple Mode, Sleep, Smart, Standby, Standby Immediate, CFA Translate Sector, Identify Device, Identify Packet Device, Read Buffer, Read Multiple, Read Multiple Ext, Read Sectors, Read Sectors Ext, CFA Write Multiple wout Erase, CFA Write Sectors Wout Erase, Download Microcode, Security Disable Password, Security Erase Unit, Security Set Password, Security Unlock, Write Buffer, Write Multiple, Write Multiple Ext, Write Sectors, Write Sectors Ext, Read DMA, Read DMA Ext, Write DMA, Write DMA Ext, Packet, Service, Read DMA Queued, Read DMA Queued Ext, Write DMA Queued, Write DMA Queued Ext, Read Stream SMA, Read Stream PIO, Read Log Ext, Write Stream DMA, Write Stream PIO, Write Log Ext, Read Verify Sectors Ext, Configure Stream, Device Configuration, Check Media Card Type, Smart Read Data, Smart Read Log, Smart Write Log, Smart Enable Operations, Smart Disable Operations, Smart Return Status, Smart Execute Off Line, Smart Enable Disable Autosave, Smart Save Attribute, Device Config Freeze Lock, Device Config Identify, Device Config Restore, Device Config Set, Read SFO, Write SFO, SEP ATTN, Read FPDMA Queued, Write FPDMA Queued, Recalibrate, Format Track, Identify Device DMA, Read DMA Without Retries, Write DMA Without Retries, Read Sectors Without Retries, Write Sectors Without Retries, Read Long, Read Long Without Retries, Write Long, Write Long Without Retries, Write Verify, Write Verify Without Retries, Read Verify Without Retries

How to Contact CATC

Type of Service	Contact
Call for technical support...	US and Canada: 1 (800) 909-2282
	Worldwide: 1 (408) 727-6600
Fax your questions...	Worldwide: 1 (408) 727-6622
Write a letter...	Computer Access Technology Corp. Customer Support 3385 Scott Blvd. Santa Clara, CA 95054
Send e-mail...	support@CATC.com
Visit CATC's web site...	http://www.CATC.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 Computer Access Technology Corporation ("CATC") or one of its authorized representatives, CATC 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.catc.com/support/register/>. The Warranty Period commences on the earlier of the date of delivery by CATC of a Product to a common carrier for shipment to you or to CATC'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 CATC, abuse, misuse, problems with electrical power, including power surges and outages, servicing not authorized by CATC, usage or operation not in accordance with Product instructions, failure to perform required preventive maintenance, software related problems (whether or not provided by CATC), problems caused by use of accessories, parts or components not supplied by CATC, Products that have been modified or altered by someone other than CATC, Products with missing or altered service tags or serial numbers, and Products for which CATC has not received payment in full.

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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 CATC Technical Support or its authorized representative.

CATC Technical Support can be reached at 800-909-7112 or via email at support@catc.com. You may also refer to CATC's website at <http://www.catc.com> for more information on how to contact an authorized representative in your region. If warranty service is required, CATC or its authorized representative will issue a Return Material Authorization Number. You must ship the Product back to CATC 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. CATC must receive the Product prior to expiration of the Warranty Period for the repair(s) to be covered. CATC or its authorized representative will thereafter ship the repaired or replacement Product to you freight prepaid by CATC 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. CATC does not accept liability for lost or damaged peripheral accessories, data or software.

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

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

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