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LeCroy USB*Tracer/Trainer*™

USB 2.0 Design & Verification System

User Manual

Manual Version 2.20

For Software Version 2.20

3 March 2006

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Part number: 730-0020-00

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1. Overview

The LeCroy USB*Tracer*™ USB 2.0 Design & Verification System is the latest in LeCroy's broad portfolio of analysis tools. As a fifth generation product, it builds upon solid knowledge of the needs of the USB development and test communities. The result is a USB bus & protocol Analyzer with unprecedented functionality, unparalleled flexibility, and uncompromising user friendliness. The USB*Tracer* interfaces with standard USB cables and connections to capture and display all speeds of USB bus traffic.

1.1 General Description

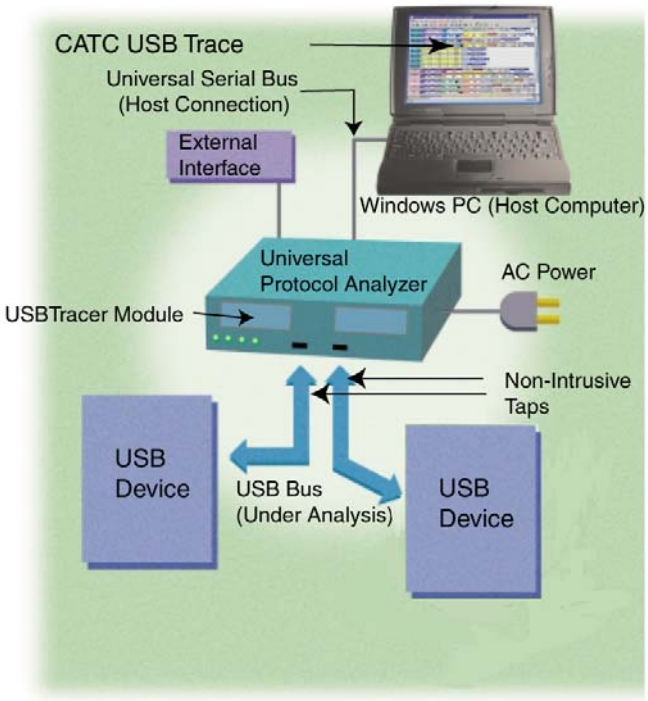
USB*Tracer*™ is a hardware module that installs into the LeCroy Universal Protocol Analyzer System. Once installed, USB*Tracer* can be easily configured and controlled by a portable or desktop PC connected via its USB port. USB*Tracer* provides customers with the familiar "CATC Trace" user interface that is the *de facto* industry standard for documenting the performance of high-speed serial protocols.

USB*Tracer* is a non-intrusive testing tool for the USB protocol providing traffic capture and analysis. Hardware triggering allows real-time events to be captured. Hardware filtering allows the different types of packets to be filtered in or out of the recording. Filtering allows users to focus recordings on events of interest and to preserve recording memory so that the recording time can be extended.

Recorded data is displayed in colored graphics in a trace viewer application. This application has advanced search and viewing capabilities that allow you to quickly locate specific data, errors and other desired conditions, thereby focussing the user's attention on events of interest.

USB*Tracer* functions with any personal computer using the Microsoft® Windows® 98SE, 2000, ME, or XP operating system and equipped with a functional USB interface.

The Analyzer is a plug-in module that is installed into a LeCroy Universal Protocol Analyzer System (UPAS). Together, the Analyzer and UPAS are controlled from a personal computer USB port across a USB connection.



USB*Tracer* provides on-the-fly detection of and triggering on such events as Tokens and Errors. Whether recording manually or with a specified trigger condition, USB*Tracer* 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 unit can also be triggered by an externally supplied signal. An external DB-25 connector provides a path for externally supplied data or timing data to be recorded along with traffic.

This DB-25 connector also provides a path for USB*Tracer* to transmit externally the software trigger signal or a user-defined event for purposes of probing and use by other circuitry.

The USB*Tracer* 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.

Please refer to the *Universal Serial Bus Specification, version 2.0* for details on the protocol. The USB specification is available from the USB Implementers Forum (USB-IF) at:

USB Implementers Forum
1730 SW Skyline Blvd.
Suite 203
Portland, OR 97221

Tel: +1/503.296.9892
Fax: +1/503.297.1090
Web: http://www.usb.org/

1.2 Features

General

- Fully compliant with USB specification revision 2.0.
- Flexible design - reconfigurable hardware for future enhancements.
- Convenient modular system architecture with field upgradeable firmware and recording engine.
- Supports all USB speeds (480 Mb/s, 12Mb/s and 1.5 Mb/s).
- On the UPAS 2500H platform, Hi-Speed recording and generation requires an optional, separately priced key. See your LeCroy representative for more information.
- Dual recording channels aid in the development of multiple speed functions upstream and downstream of speed-matching hub or transaction translator.
- User friendly "CATC Trace" interface that displays bus traffic using color and graphics.
- Trace Viewer available as free non-recording, view-only software.
- Online and context-sensitive help.
- Power-on self-diagnostics.
- Three year warranty and hot-line customer support.

- Can be used in conjunction with the LeCroy USB*Trainer* USB Traffic Generator hardware module to create a fully customizable USB test platform.

Physical Components

- Hardware module for the LeCroy Universal Protocol Analyzer System.
- Operated by any desktop or portable Microsoft Windows 98, 98SE, 2000, ME, or XP computer with USB capability.
- Convenient Plug-and-Play USB installation.
- High impedance tap inserts non-intrusively in any branch of a USB system.
- 512 MB of physical data recording memory.
- Two all speed recording channels, which include Low, Full, or Hi-Speed.
- Full-Speed USB connection to desktop or portable host PC. Hi-Speed on UPAS 2500H platform.
- Internal wide-range AC power supply.
- Break-out board (included) - used to interface to external test equipment.

Recording Options

- Versatile triggering - bit-wise value and mask data patterns up to sixteen bytes wide for Setup transactions and data packets.
- Triggering on new High-speed PIDs and split transaction special tokens (ERR, SPLIT, PING, NYET, DATA2, and MDATA).
- CATC Trace displays and enumerates High-speed Micro Frames.
- Three forms of triggering: Snapshot, Manual and Event.
- Transaction sequencer allows triggering on a token qualified by a data pattern and /or specific handshake or alternately transactions can be filtered (i.e., NAK’d transactions).
- Advanced triggering with event counting and sequencing.
- Dedicated trigger for recording input and output used to interface to external test equipment.
- Triggering on multiple error conditions - PID bad, bit stuffing bad, CRC bad, end-of-packet bad, babble, loss of activity, frame length violation, time-out or turn-around violation, data toggle violation, Token, Bus Conditions, Data Length, excessive empty frames.
- Real-time traffic capture filtering and data packet truncation variable up to 256 bytes.
- Adjustable buffer size from 0.4 MB to 512 MB.

Display Options

- Utilizes "CATC Trace" graphical display of bus packets, transactions, split transactions and transfers.
- Numerous packets and transactions can be grouped under a single transfer while quickly decoding all essential information.
- Decoding of split transactions up and down stream of a transaction translator is accomplished with a special hierarchical view.
- Variety of reports provided to summarize key statistics and conditions of interest with the ability to jump to the selected item in the trace display.
- Flexible input signaling can be recorded with the CATC Trace.
- Trace Viewer is backward compatible with Advisor™, Chief™, Inspector™, and Detective™ trace files.
- User-friendly trigger position indicated by different colors of pre- and post-trigger packet color.
- Markers can be set to assist with navigation and time calculations.
- Hide start-of-frame (SOF) packets as well as any packet or transaction.
- Search for a specific PID.
- Detects & alerts the user to every potential bus error, protocol violation, & combinations thereof.
- High resolution, accurate time stamping of bus packets, timing measurement and analysis functions.
- Extensive search and packet hiding capabilities.
- Comprehensive device class decoding plus user defined protocol decoding.

Traffic Generation

- Traffic generation capability available as an add-on module for the Universal Protocol Analyzer System called USB*Trainer*™.

Hi-Speed Slow Clock

The ability to Trace and Generate Hi-Speed traffic at fractional (slow) clock rate is available on both USBTracer platforms (2500 and 2500H), and can be purchased via a License Key. Contact LeCroy for more information.

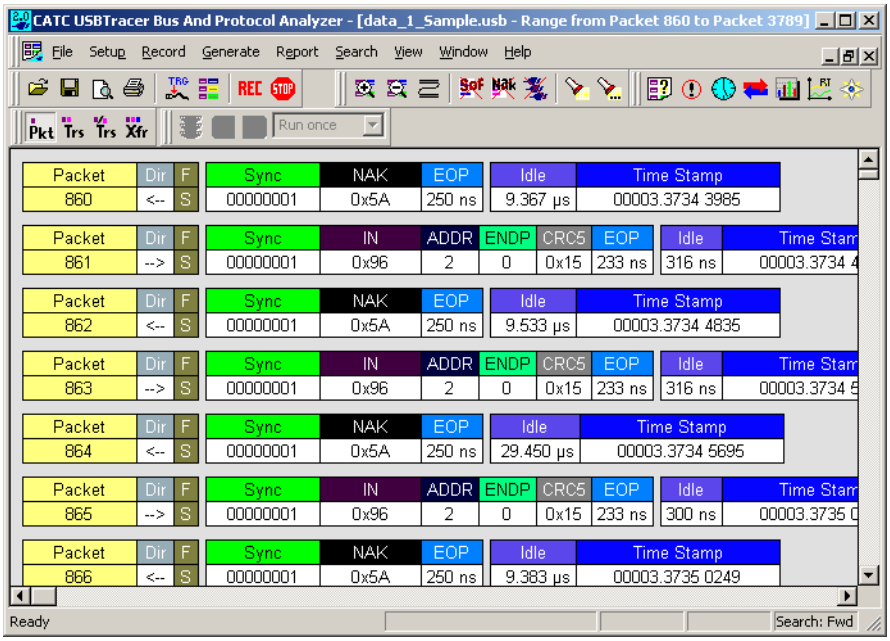
1.3 Graphical Bus Traffic Display

The USB*Tracer* transaction displays use color and graphics to show the captured transactions in an immediate, understandable and useful format.

Packets are shown on separate rows, with their individual fields both labeled and color-coded. Packets are also numbered (sequentially, as recorded), time-stamped. Protocol errors are automatically detected and visibly highlighted in red.

The display is customizable, allowing the user to control the color scheme and the formatting of field contents. A hide feature allows users to enable the suppression of SOF packets and user defined packets or fields that might be uninteresting in a given context. Display formats can be named and saved for later use. Pop-up "tool-tips" annotate packet fields with even more detailed information about their contents.

The display software operates independently of the hardware, allowing it to function as a stand-alone "trace viewer" that is freely distributed.



1.4 Accurate Time Management

USB*Tracer* uses internal counter/timer circuitry to enable a reliable, accurate (16.67 ns resolution) time stamping of recorded bus traffic. This timing information is displayed in the trace and in measurement and analysis functions. Any number of markers can be added by the user to denote specific packets, and further timing measurements can be made from one marker to another or from marker to trigger. All time fields are presented as a time stamp, idle time, bit time or in a new time delta in either decimal or hexadecimal format.

An essential feature of time management is that idle traffic does not consume the analyzer memory. Because of this unique technology, accurate timing calculations can be made while still preserving valuable recording memory for important bus traffic.

1.5 Comprehensive Error Detection and Analysis

USB*Tracer* detects and alerts the user to every potential bus error, protocol violation and/or combination thereof. The analyzer contains circuitry in the BusEngine™ to perform real-time triggering on multiple error conditions, such as PID bad, bit stuffing bad, header or data CRC bad, end-of-packet bad, babble, loss of activity, frame length violation, time-out or turn-around violation and data toggle violation. The analyzer program highlights all the hardware detected errors and further examines the trace file for additional protocol errors, including wrong packet length, data payload violation, and packet termination not on a byte boundary.

1.6 Real-Time Event Triggering and Capture Filtering

No attribute of a bus and protocol analyzer is more important than its capacity for extracting useful information from a crowded stream of bus traffic. The ability to accurately identify and selectively record transactions of interest is the trait most valuable to the user. USB*Tracer* offers a unique approach to this challenge. By using a set of "recording resources", over a dozen configureable hardware building blocks, each can be optimized to perform a particular activity appropriate to the task. A recording resource can independently await an initialization signal, monitor its external environment (external signals, other resources) in search of a particular event and take a subsequent action (triggering, inclusive or exclusive filtering, counting, etc.). Under control of the user interface, these resources can be selected, configured and combined to search for complex trigger conditions and selectively capture the associated transactions.

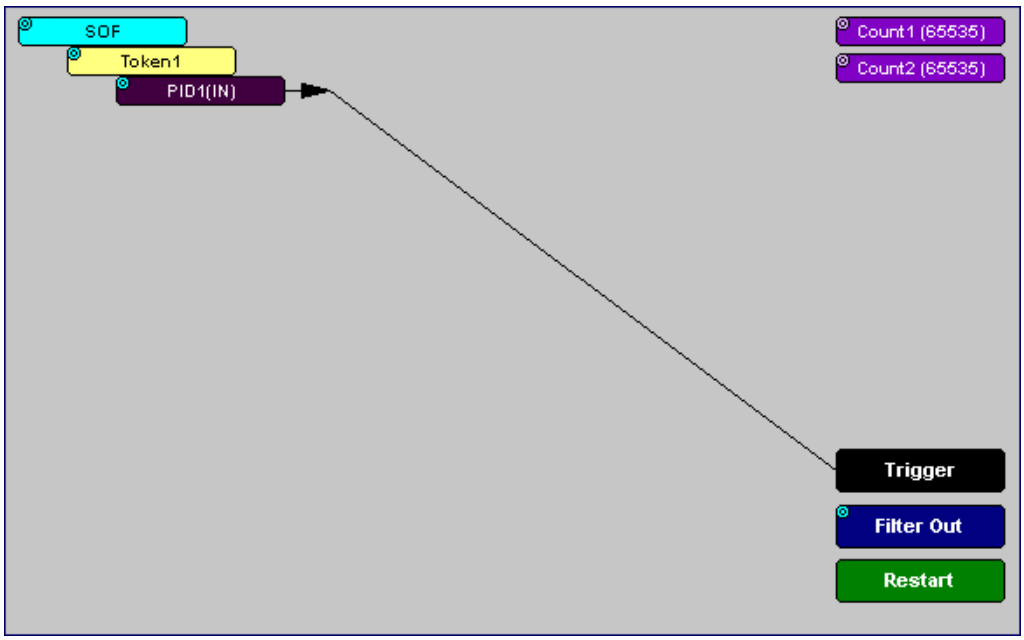
Thus, as well as triggering on basic events, such as specific bus conditions, packet identifiers (PID), etc. (see the Specifications section for a complete list), USB*Tracer* can easily manage the most challenging requirements. For example: "trigger on the fifth occurrence of a SETUP Token device number nine", or "trigger on a SET INTERFACE request, following a specified eight-byte bulk data pattern match from this scanner, and do not capture any start-of-frame (SOF) packets."

The user can set the size of the recording memory, specify the pre- and post-trigger capture ratio, and truncate large data packets up to 256 bytes.

1.7 Advanced Event Counting & Sequencing

The count and sequence options define rules for data recording sessions. These options provide the ability to configure and control the order of events that have been selected for triggering or filtering. There are two counters and a restart option that causes the sequencing to start again.

By utilizing this feature, designers can specify a specific sequence of up to seven events that must occur before the analyzer triggers and finishes capturing data. This allows designers to pinpoint certain types of events for recording. Without this feature, designers must scroll through potentially megabytes of recorded data to locate a specific sequence or occurrence of a sequence that can take hours to locate before being able to begin analyzing the data of interest.



1.8 BusEngine Technology

The LeCroy BusEngine Technology is at the heart of the new USB*Tracer* Analyzer. The BusEngine core uses state-of-the-art Electrically Programmable Logic Device (EPLD) technology and incorporates both the real-time recording engine and the configurable building blocks that implement data/state/error detection, triggering, capture filtering, external signal monitoring, and event counting & sequencing. Like the flash-memory-based firmware that controls its operation, all BusEngine logic is fully field upgradeable, using configuration files.

1.9 Specifications

USBT*racer* is a hardware module that installs into the Universal Protocol Analyzer System. The following specifications describe a combined USBT*racer/*Universal Protocol Analyzer System.

Package

UPAS	12.2 x 12.2 x 3.5 inches (31.1 x 31.1 x 8.9 cm)
USB*Tracer* Plug-in	4.5 x 6.7 x 1.3 inches (11.3 x 17.0 x 3.2 cm)

Connectors

UPAS	AC power connection External trigger connection Host connection (USB, type "B")

Weight

UPAS	7.5 lb. (3.4 kg)
USB*Tracer* Plug-in	1.0 lb. (0.5 kg)

Power Requirements

90-254VAC, 47-63Hz (universal input), 100W 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

Probing Characteristics

Connection	High Speed USB Connectors Standard cables

Switches

Power	On/off
Manual Trigger	When pressed forces a trigger event

Indicators (LEDs)

UPAS

Power (PWR):	Illuminated when the analyzer is powered on.
Status (STATUS):	Illuminated solid during self test, blinking during failure, off when the analyzer is functioning properly.
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.

Recording Memory Size

512 M x 8-bit DRAM for traffic data capture, timing, state and other data.

Host Compatibility

Works with any PC equipped with a functioning USB port and running the Microsoft Windows 98SE, ME, 2000, or XP operating system.

Required Setup

Microsoft Internet Explorer, Version 5 or newer.

Hardware

Processor: For optimum performance, use processors of the Intel Pentium III/Pentium 4 family, AMD Athlon/Duron family, or other compatible processors with clock speed of 500mHz or higher (Processors of the Intel Pentium II/Celeron family or AMD K6 family with clock speed of 300mHz is a minimum).

Memory: For the best performance, it is recommended to have physical RAM twice the size of the recording buffer setup - 512MB or more (minimum of 128MB of RAM).

Hard Disk: At least 20MB of free hard disk space is required for the installation. Additional disk space is needed for storing the recorded data in files during the recordings process (can be as much as 500MB when recording a full buffer size).

Display: Resolution of 1024 x 768 with at least 16-bit color is recommended (resolution of 800 × 600 with 16-bit color is a minimum).

Connectivity: A USB interface is required to connect to the USBTracer analyzer. This is not a requirement if the application is going to be used only as a viewer.

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

USBTracers on the UPAS 2500H Platform

UPAS 2500H USBTracer is a USB 2.0 Certified Hi-Speed Device. To upload at Hi-Speed, you must have a USB 2.0 Certified Host Controller and be running Microsoft Windows 2000 SP3 or Windows XP.

The UPAS 2500H ships in one of two configurations: Classic and Hi-Speed. The Classic version can trace and generate traffic at Low and Full Speeds. The Hi-Speed version can trace and generate traffic at All speeds: Low, Full, and Hi.

The Classic model may be upgraded to a Hi-Speed model by the purchase of a License Key from LeCroy. Contact your LeCroy representative for more information.

Note: The UPAS 2500 and UPAS 2500H products include internal 1.1 and 2.0 Hubs. You might see the drivers for these generic hubs being installed upon the initial plug-in.

2. Quick Installation

USBT*racer*™ is factory-installed hardware module that is sold as part of the LeCroy Universal Protocol Analyzer System.

The Universal Protocol Analyzer System (UPAS) together with the USB*Tracer* module and associated software are easily installed on most Microsoft® Windows®-based personal computer systems. You can begin making USB recordings after following these initial steps. However, if you are new to protocol analyzers, or are unsure about what to do after reading the Quick Installation instructions, or if your analyzer does not work after you follow these instructions, read through the subsequent sections in this manual.

Step 1 Connect the AC power cable to the rear of the Analyzer.

Step 2 Connect the USB port on the back of the Analyzer to the PC using the LONG (6-foot/2-meter) USB cable.

Step 3 Insert the CD.

Step 4 Turn on the power switch on the rear of the Analyzer.

Step 5 Click **Next** when you see the window of "Add New Hardware Wizard."

Step 6 Follow the on-screen Plug-and-Play instructions.

Step 7 Click **Finish** when you see the message that says "Windows has finished installing the software that your new hardware requires" and the file "Tracer.inf" has been installed in your PC.

Step 8 Run the program a:\setup and follow the on-screen instructions.

Step 9 Select **About USBTracer...** from the Help menu.

If you can see all of the information listed below, you can record a trace:

- USBTracer Software Version
- USBTracer Firmware Version
- BusEngine™ Version
- Unit Serial Number

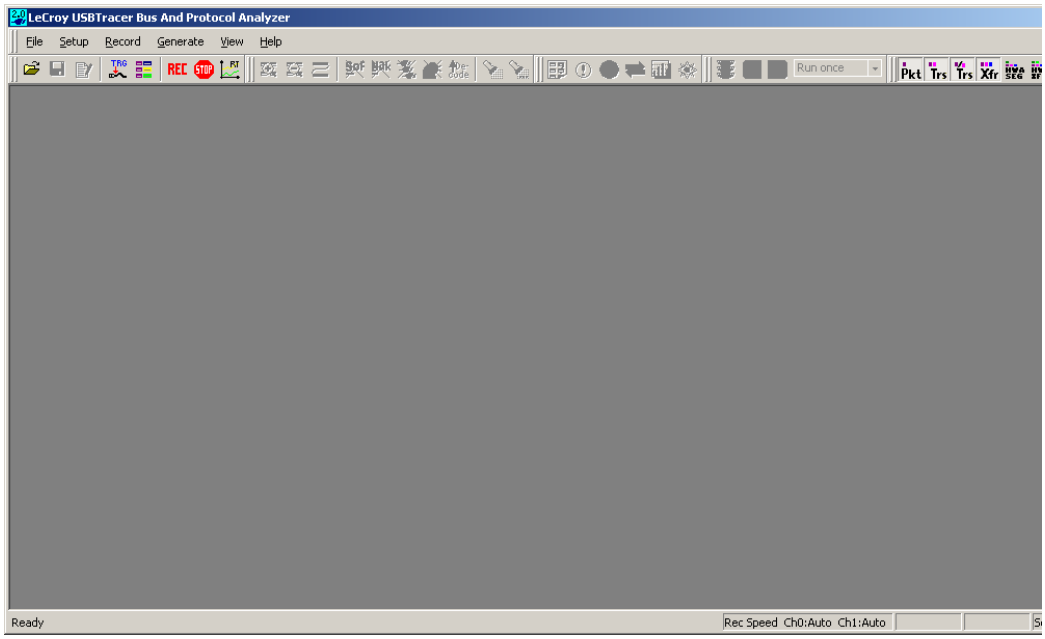
2.1 Installing the Software and Starting the Program

Step 1 Insert the USBTracer CD into the CD-ROM drive on the host PC and follow the on-screen instructions to install the USB*Tracer* application.

Step 2 To start the application, launch the **LeCroy USB*Tracer*** program from the **Start Menu:**

Start > Programs > LeCroy > LeCroy USB*Tracer*

The USBTracer main window opens:



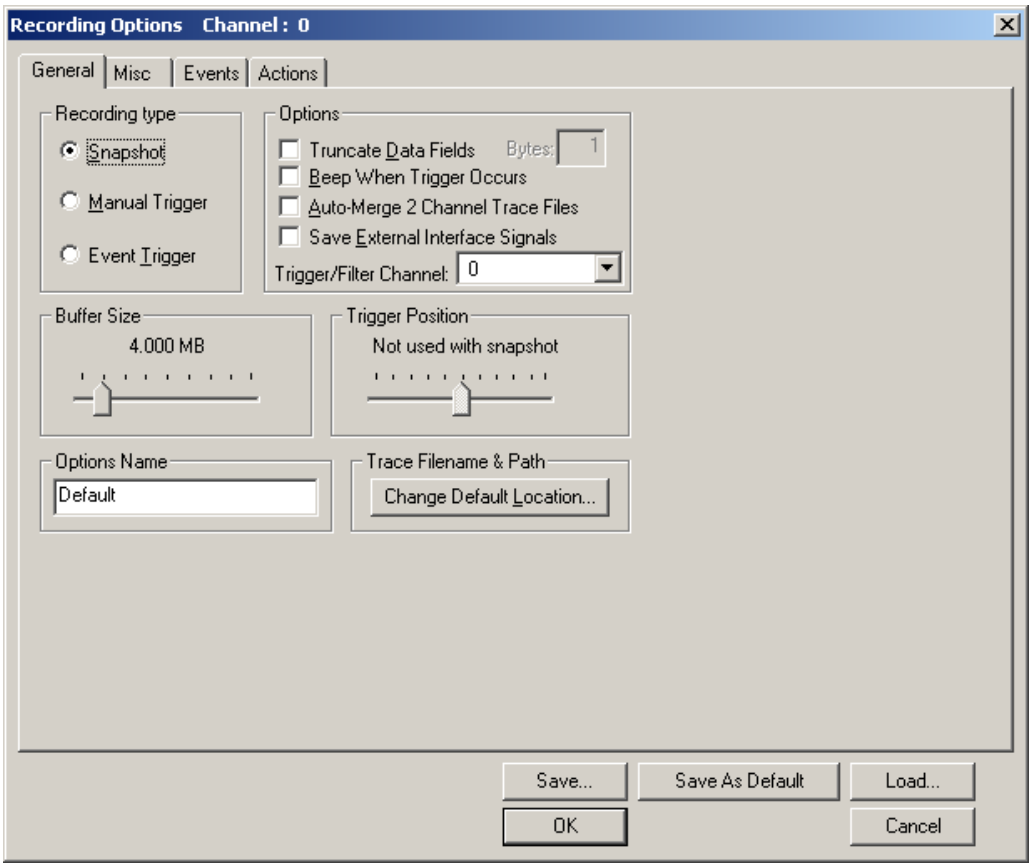
2.2 Your First USB Recording

After installing and launching the software, you can test USB*Tracer* by performing the following steps:

Step 1 Connect a USB cable to each of the two connectors on the USB*Tracer* module, then connect the other ends to the USB device under test and USB host system.

Step 2 Select **Recording Options** under **Setup** on the Menu Bar.

Step 3 Select the **General** tab to display the following dialog box showing factory default settings such as Snapshot and 4 Mbytes buffer size. For the first recording, you can leave these settings unchanged.



Step 4 Click **OK** to activate the recording options you selected.

Step 5 Turn on the USB devices that are to be tested and cause them to generate USB traffic.

Step 6 Click REC on the Tool Bar.

USBTracer starts to record the USB traffic immediately. After 4 Mbytes of traffic are recorded, the analyzer uploads the data and displays the packets in the trace window.

Step 7 To terminate recording before the snapshot automatically completes, click STOP on the Tool Bar.

When the recording session is finished, the traffic is uploaded from the Analyzer to the hard drive on your PC as a file named **data.usb** or the name you assigned as the default filename. While the file is

being uploaded, you should see a brown progress bar at the bottom of the screen. When the bar disappears, it indicates that the data has been uploaded to disk.

Step 8 To save a current recording for future reference, select **Save As** under **File** on the Menu Bar.

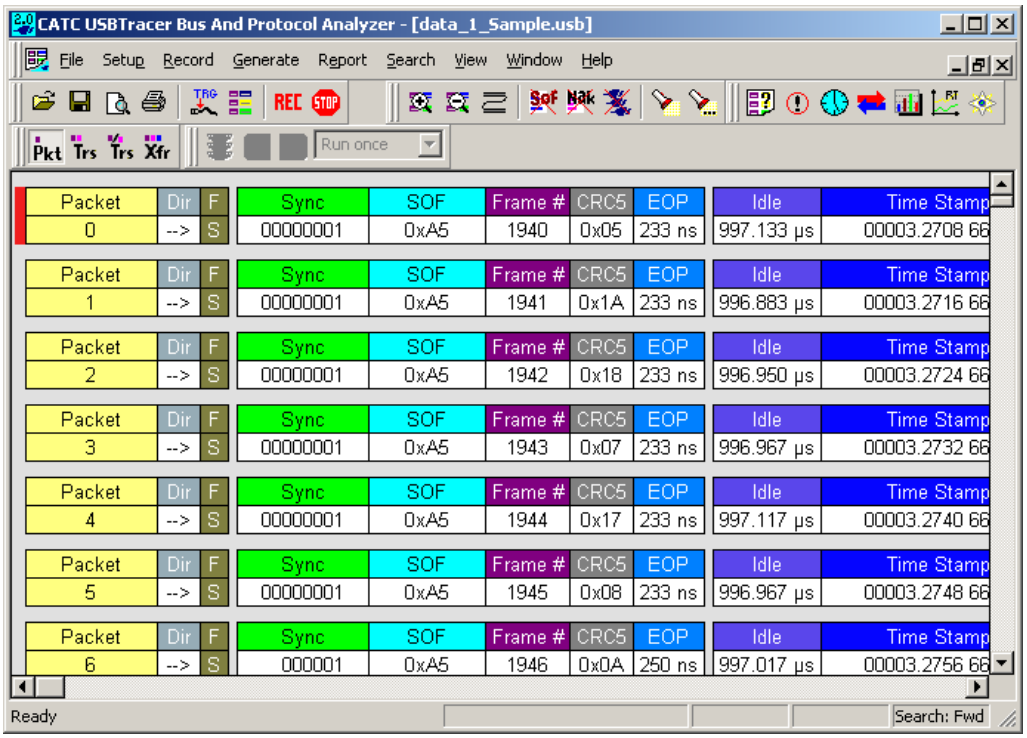
OR

Click on the Tool Bar to display the standard **Save As** screen.

Step 9 Give the recording a unique name and save it to the appropriate directory.

Capturing Your First Trace

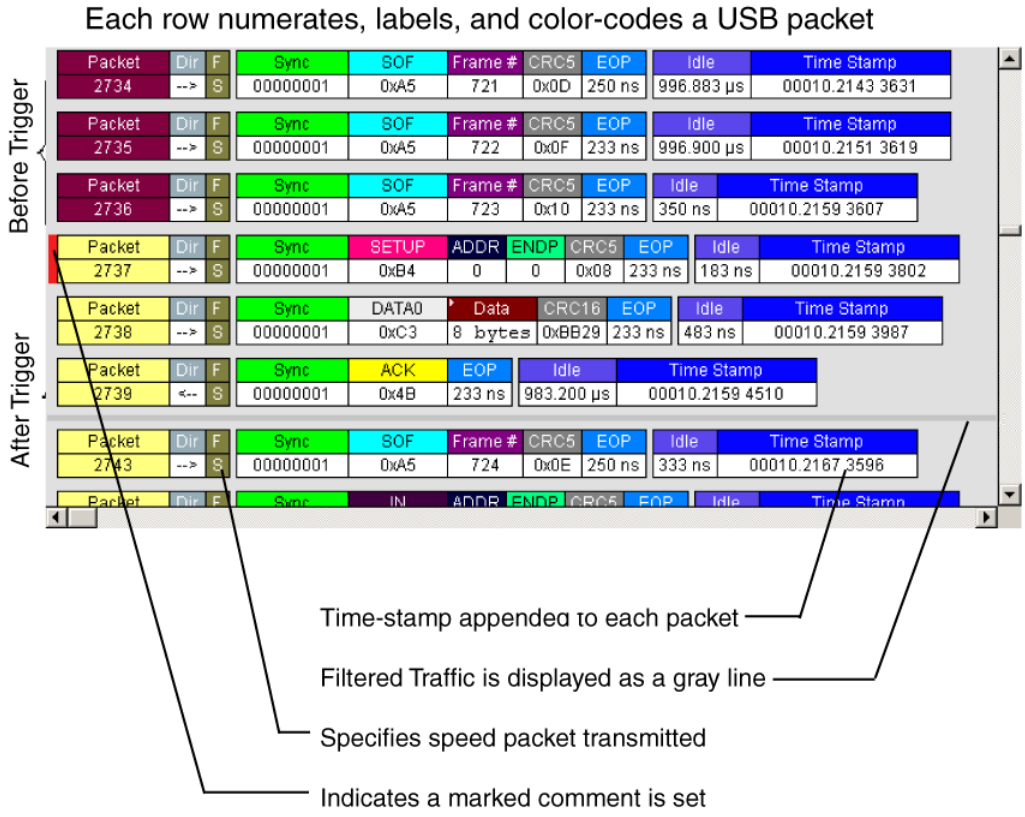
After a moment, the recording terminates and the results display:



Trace View Features

- The USB*Tracer* packet view display makes extensive use of color and graphics to fully document the captured traffic.
- Packets are shown on separate rows, with their individual fields both labeled and color coded.
- Packets are numbered (sequentially, as recorded), time-stamped (with a resolution of 16.67 ns), and highlighted to show the transmitted speed (low-speed, full-speed or high-speed).
- Display formats can be named and saved for later use.
- Pop-up Tool Tips annotate packet fields with detailed information about their contents
- 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).

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



3. Detailed Installation

3.1 System Components/Packing List

- One stand-alone USB*Tracer*™ Analyzer module
- Five USB cables
- USB*Tracer* software program installation diskettes
- Product documentation

3.2 The Installed USB*Tracer* Unit

USBT*racer* is a module that inserts into the left slot on the LeCroy Universal Protocol Analyzer System (UPAS). Once installed, the USB*Tracer* Analyzer activates the user-accessible controls and LEDs on the front and rear panels of the UPAS.

Figure 1 Front Panel

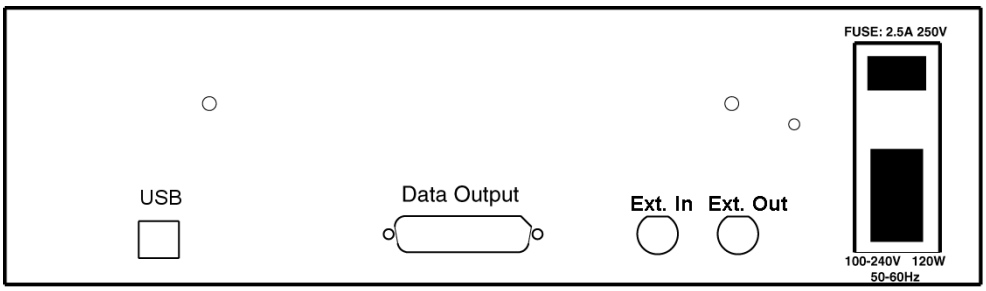


Figure 2 Rear Panel

LED and Button Descriptions

The following section describes the LEDs, buttons, and connectors on the module and UPAS.

LEDs on the Far Left Side of the UPAS

- Green **PWR** (Power) indicator LED for UPAS: Lights when the unit power is switched on.
- Red **Status** indicator LED for UPAS: Lights during boot up.

LEDs and Button on the UPAS under the Left Module Slot

The LEDs and button on the UPAS enclosure under the left module slot function in conjunction with the USB*Tracer* 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.
- **Manual Trigger** push-button: Allows a manual Trace capture.

LEDs and Button on the UPAS under the Right Module Slot

The LEDs and button under the right module slot are reserved for LeCroy generator modules such as the USB*Trainer* USB Traffic Generator (described in Chapter 11: **Traffic Generation with USBTrainer** on page 151):

- Green **HS**: Illuminates when Hi-Speed is being generated.
- Orange **Classic:** Illuminates when Full or Low Speed is being generated. Classic also illuminates during power-on testing and is turned off at the end of the power on cycle. If the LED blinks at the end of this cycle, the hardware is faulty.
- Green **Intelliframe**: Illuminates when Intelliframe traffic is being generated using Intelliframe mode, an intelligent adaptive traffic mode. If off, the generation is in Bitstream mode. See the section on "Traffic Generation Modes: Bitstream versus Intelliframe" in Chapter 11 for more information.
- **Start/Stop*:*** Push-button allows manual Trace capture.
- 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.

- Two **External Ports** marked Ext. 1 and Ext. 2.
- **USB** type B host computer connector
- **Data In/Out** DB-25 (25-pin) external interface connector

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

3.3 USB*Tracer* System Setup

USBTracer is a module that inserts into the Universal Protocol Analyzer System. The UPAS, in turn, is connected and controlled by a desktop or laptop PC via a USB connection.

To set up the system hardware:

- Insert the USB*Tracer* module into the UPAS.
- Connect the Analyzer to an AC power source.
- Connect to the analyzing PC via USB.
- Connect USB cable to the device under test.

3.4 AC Power Source

Step 1 Connect the Analyzer box 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 2 Use the power switch located on the rear panel to turn the analyzer unit on and off.

Note At power-on, the analyzer initializes itself in approximately 25 seconds and performs an exhaustive self-diagnostic that lasts about 45 seconds. The Status LED illuminates during the power-on testing and turns off when testing is finished. If the diagnostics fail, the Status LED blinks, indicating a hardware failure. If this occurs, call LeCroy Customer Support for assistance.

3.5 External Interface Breakout Board

The External Interface Breakout Board is an accessory that allows convenient access to several potentially useful standard, LV TTL output and input signals. It also offers a simple way to connect logic analyzers or other tools to the USB*Tracer* Analyzer unit. Six ground pins and one 5-volt pin are provided.

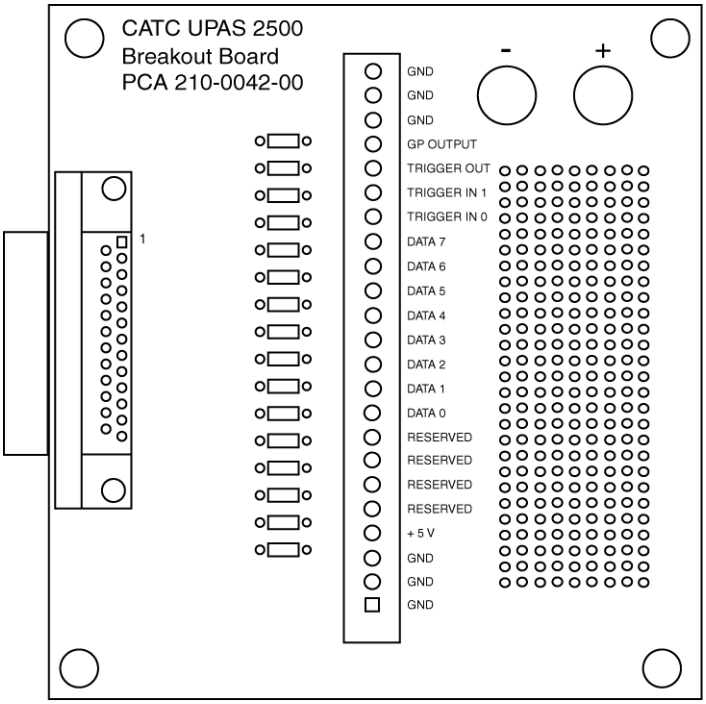


Figure 3 External Interface Breakout Board

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

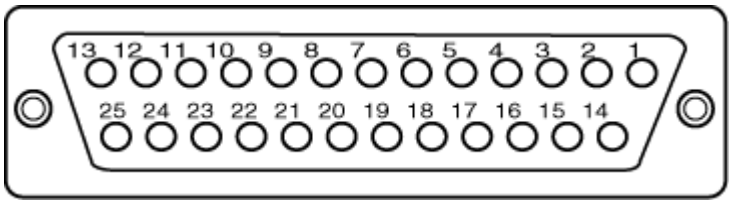


Figure 4 Data In/Out Connector (on cable)

Pin-Outs for the Data In/Out Connector

Table 11 lists the pin-out and signal descriptions for the **Data In/Out** connector on a cable that connects to the Breakout board.

Table 1 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

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.

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.

3.6 PC Connection

Use the **LONGEST (6-foot/2-meter)** of the five USB cables provided to connect the host computer to the USBTracer Analyzer box.

3.7 Analyzer PC Requirements

Please refer to the **Readme.txt** file on the installation CD for PC and operating system requirements.

3.8 Setting Up the Analyzer

Step 1 Connect the provided AC power cord to the rear of the UPAS and to a 100-volt to 240-volt, 50 Hz to 60 Hz, 100 W power outlet.

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 2 Turn on the power switch on the rear of the analyzer.

Note At power-on, the analyzer initializes itself in approximately ten seconds and performs an exhaustive self-diagnostic that lasts about five seconds. The Trigger LED illuminates during the power-on testing and turns off when testing is finished. If the diagnostics fail, the trigger LED blinks continuously, indicating a hardware failure. If this occurs, call LeCroy Customer Support for assistance.

Step 3 Connect the USB cable between the USB port on the back of the analyzer and a USB port on the analyzing PC.

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

3.9 Installing the Analyzer Software on the PC

Once USBTra*cer* has been recognized as a USB device, install the USB*Tracer* software on the PC administering the analyzer:

Step 1 Insert the USBTracer CD into the CD ROM drive of the PC that will administer the Analyzer.

Step 2 Follow Microsoft® Windows® on-screen Plug-and-Play instructions for the automatic installation of the USBTracer Analyzer as a USB device on your analyzing PC (the required USB files are included on the USBTracer CD.

Step 3 Select **Install Software** from the installation CD and follow the on-screen installation instructions.

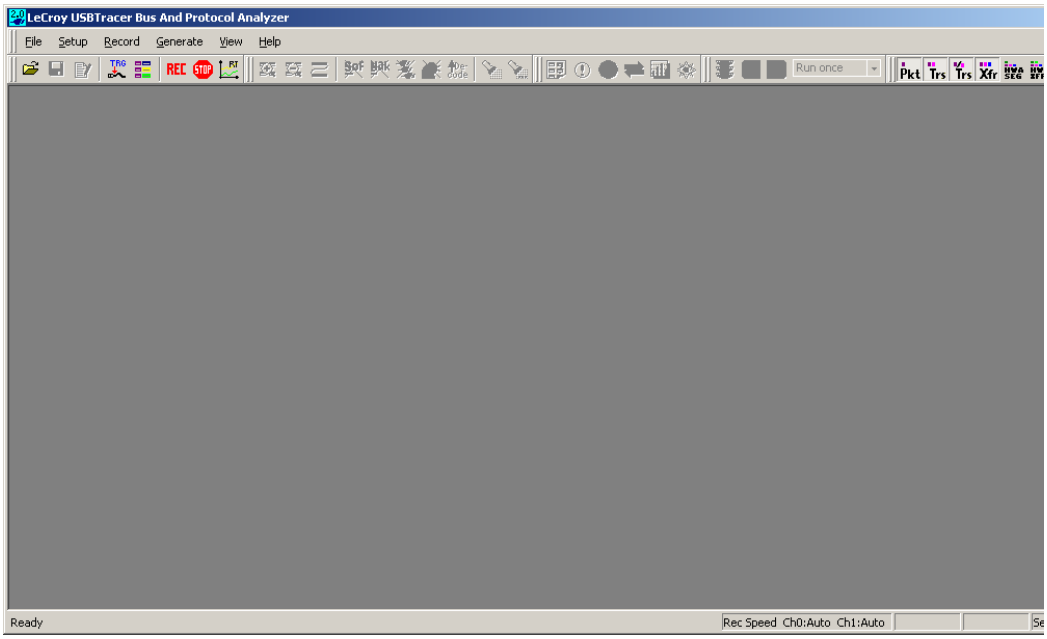
The USB*Tracer* application installs on the PC hard disk.

Step 4 To start the application, launch the **LeCroy USB*Tracer*** program from the **Start Menu:**
Start > Programs > LeCroy > LeCroy USBTracer.

The USBTracer program opens.

3.10 USB*Tracer* Program Startup

You can start the USB*Tracer* program from the Desktop or from the installed directory. The program always begins with its main screen active:



The software may be used with or without USB*Tracer*. When used without USB*Tracer*, the program functions in a Trace Viewer mode to view, analyze, and print captured protocol traffic.

When the program is used with the USB*Tracer* Protocol Analyzer attached to the computer, you can set trigger conditions, record, monitor and analyze the activity of your USB bus.

3.11 Making a Recording

After installation, the software is configured to make a Snapshot recording of USB traffic.

See Section 2.2 "Your First USB Recording" on page 14 to make your first recording of this traffic.

4. Updates

From time to time as modifications are made to the USB*Tracer*™ Analyzer, it is necessary to update the USB*Tracer* for optimal performance. Updates can be performed two ways: either automatically or manually. This chapter describes both procedures.

4.1 Software, Firmware, and BusEngine Revisions

The **Readme.txt** file on the first installation disk and in the installed directory 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 Analyzer has completed the self diagnostics and is connected to the PC, you can check the latest revision of the software and BusEngine by selecting **About USB*Tracer*…** from the **Help** menu.

About USB*Tracer* details revisions of the following software and hardware:

- USB*Tracer* Software Version
- USB*Tracer* Firmware Version
- BusEngine Version
- Unit Serial Number

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

4.2 Software Updates

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

To update the software:

Step 1 In the **About USB*Tracer*** screen, verify which version of USB*Tracer* Software you are currently running.

Step 2 Find the latest released software version on the LeCroy website under **Support**.

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

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

Step 3 Download the Zip files from the website.

Step 4 Unzip the files into your choice of directory.

Step 5 Click **Start**, then **Run**, and browse to where you unzipped the files.

Step 6 Select the program named **Setup** and click **Open**.

Step 7 Click **OK** to run the Setup and begin the installation.

Step 8 Follow the on-screen instructions to complete the installation.

Step 9 Read the Readme file for important information on changes in the release.

4.3 BusEngine and Firmware Updates

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

Updating the BusEngine

The BusEngine core is the heart of the USB*Tracer* Analyzer. Using state-of-the-art Electronically Programmable Logic Device (EPLD) 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 upgradeable.

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 USB*Tracer* software is upgraded, the software may become incompatible with the BusEngine and Firmware. If a recording is attempted, USB*Tracer* displays an error message and then automatically begins an update process for the BusEngine and Firmware.

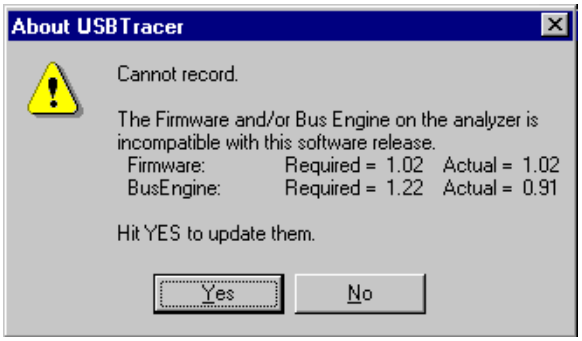
To perform an automatic BusEngine and Firmware update, follow these steps:

Step 1 If needed, update the USB*Tracer* software using the steps outlined in "Software Updates" described above.

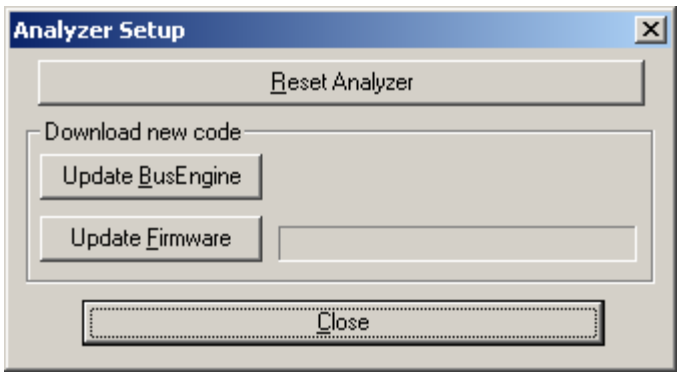
Step 1 Turn on the Analyzer.

Step 2 On the Tool Bar, click the REC button.

Since the BusEngine and/or the Firmware are incompatible with the current USB*Tracer* software version, an error message appears displaying your current versions and indicating what versions you need to install.



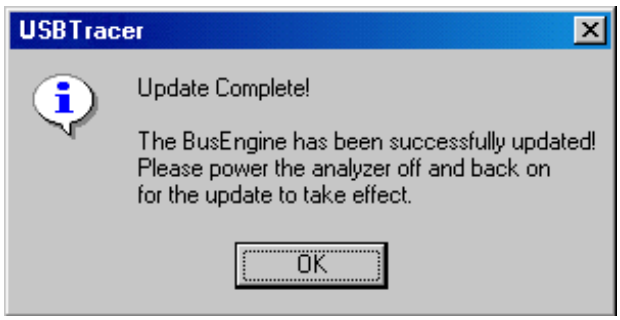
Step 3 Click **Yes** to close the window closes and open the Analyzer Setup window.



Step 4 Click **Update BusEngine** or **Update Firmware**.

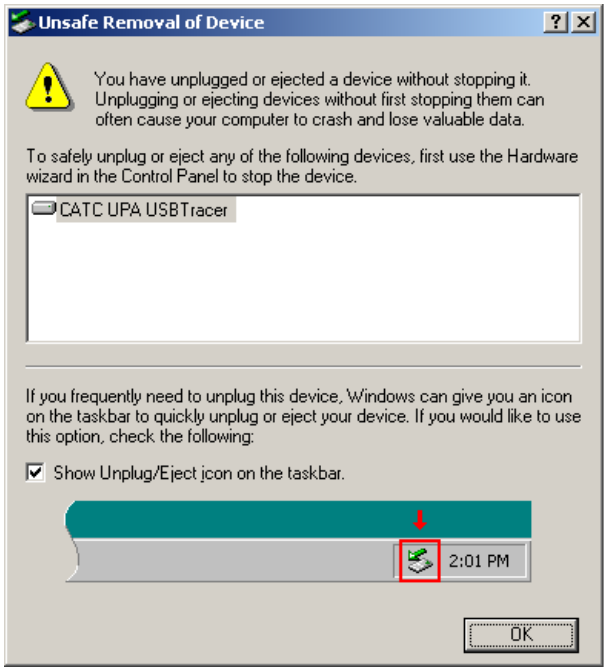
You can select only one item at this point. If both the BusEngine and the Firmware need to be updated, the update completes for the first item and then returns to the above screen so the second update can be performed.

If you are running Microsoft® Windows® 98, you get the following message when the second update is completed:



Step 5 Power cycle USB*Tracer* to complete the update.

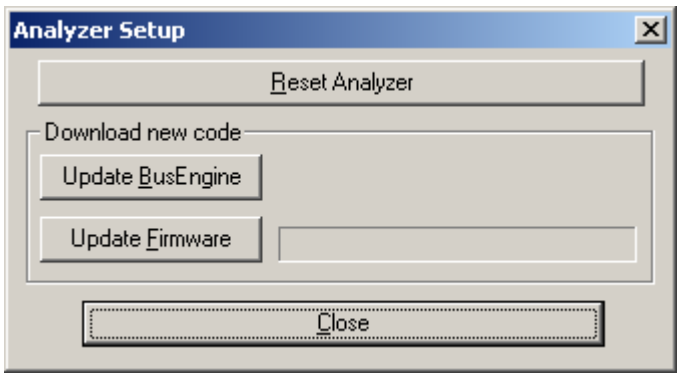
If you are running Windows 2000, the analyzer automatically reboots and displays the following message. When this message appears, click **OK**. **You do not need to power cycle the analyzer**.



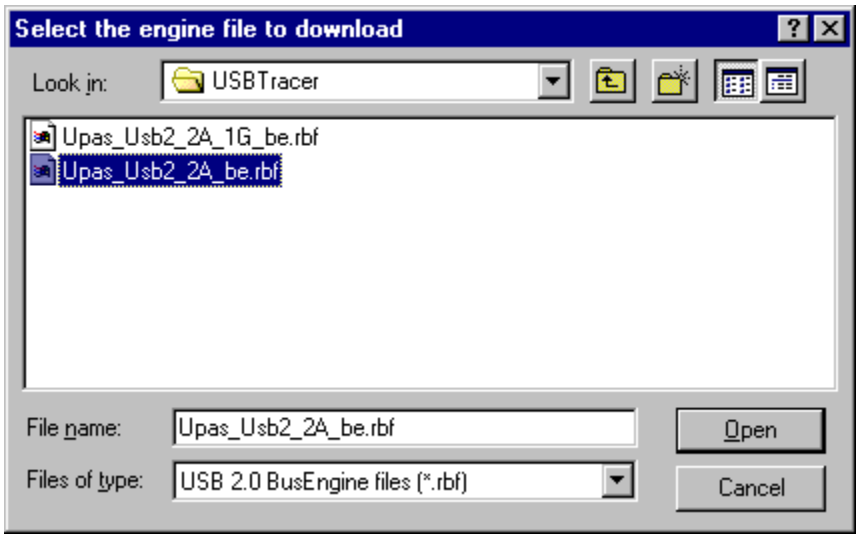
Manual Updates to BusEngine and Firmware

You can manually update the USB*Tracer* Firmware and/or BusEngine™ by performing the following steps:

Step 1 Select **Analyzer** under **Setup** on the Menu Bar to display the **Analyzer Setup** screen:



Step 2 To update the BusEngine, click **Update BusEngine** on the **Analyzer Setup** screen to display the **Select the engine file to download** window:



The program displays the correct file (**Upas_Usb2_2A_be.rbf**) in the **File name** field. This file is used to update the analyzer alone (i.e., without a Traffic Generator). The other file (**Upas_Usb2_2A_1G_be.rbf**) should be selected if you upgrading a UPAS system with both an analyzer and Traffic Generator.

If you have purchased device emulation, then the needed BusEngine file is **Upas_usb2_1A_1G-be.rbf**.

Note The most current Primary BusEngine file was copied to your **\LeCroy\USB*Tracer*** directory when you installed the program.

Step 3 Click **Open**.

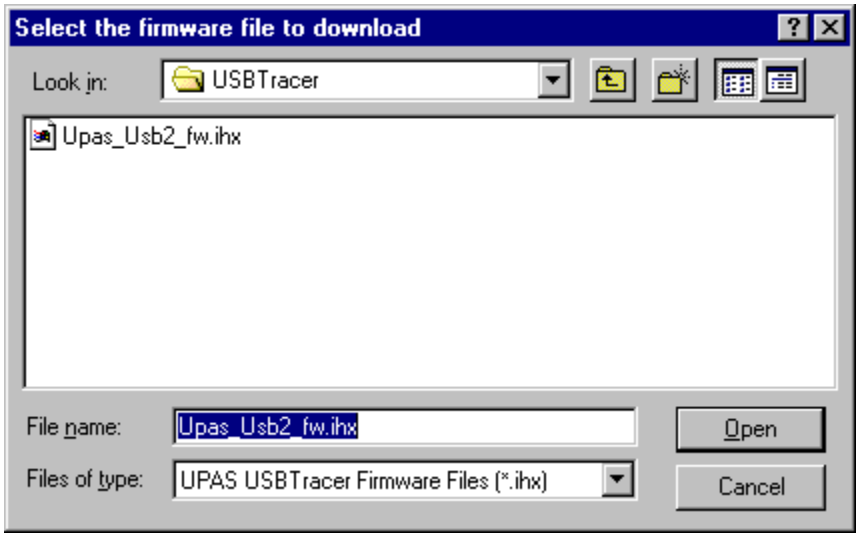
Step 4 Power cycle the analyzer.

Re-initialization takes a couple of minutes.

Manually Updating the Firmware

To update the firmware:

Step 1 Click **Update Firmware** on the **Analyzer Setup** screen to display the **Select firmware file** window:



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

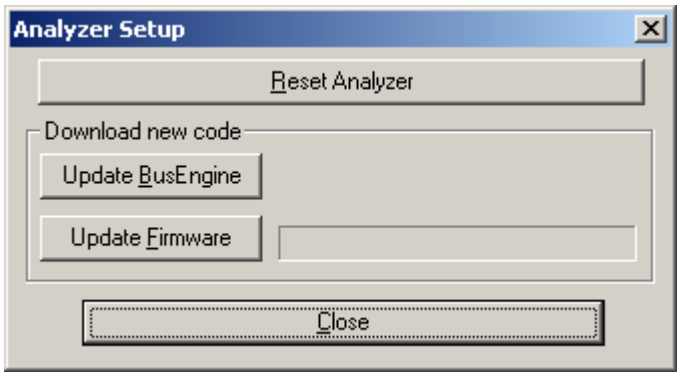
Step 2 Click **Open**.

The Analyzer updates the Firmware.

Step 3 Unplug the USB cable from the back of the Analyzer box and then reinsert it so the new Firmware update can take effect.

4.4 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.



5. Software Overview

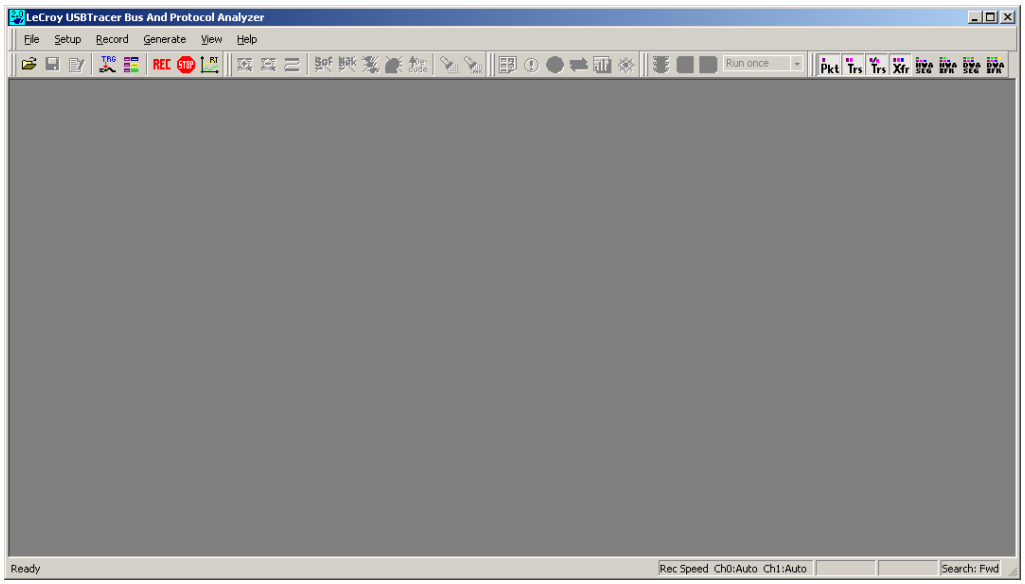
The USB*Tracer*™ Trace Viewer is an application that may be used with or without the Analyzer box. When used without an Analyzer box, the program functions in a Trace Viewer mode to view, analyze, and print captured protocol traffic from USB*Tracer* Analyzers. The software also allows you to view trace files created by the LeCroy Chief™, Advisor™, Detective™, and Inspector™. Opening a file created with either of these Analyzers displays a screen asking if you want to convert the old file to the new format under the name **convert.usb**.

When the program is used with the USB*Tracer* Analyzer attached to the computer, you can monitor and analyze the activity of your USB branch from either of the USB ports on the front of the Analyzer.

5.1 Starting the USB*Tracer* Program

To start the USB*Tracer* Program:

Step 1 Select **Start** > **Programs** > **LeCroy** > **LeCroy USBTracer**.



5.2 Tooltips

Tooltips provide useful information about cells in the trace and buttons in the application. To display a tooltip, position the mouse pointer over an item.

5.3 The Main Display Windows

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

Menu	Function
File	
New .utg file.	Creates a new, empty traffic generation file. Available only if a trace file (**.usb**) is open. To edit a **.utg** file, click the **Edit as Text** button in the toolbar.
Open	Opens a file.
Close	Closes the current file.
Save As	Saves all or a range of packets from the current file.
Print	Prints part or all of the current traffic data file.
Print Preview	Produces an on-screen preview before printing.
Print Setup	Sets the options for the current or new printer.
Edit as Text	Opens the Script Editor. Available only when a traffic generation file (.utg) is open.
Edit Comment	Creates or edits the Trace file comment field.
Check Syntax of .utg file	Reads open **.utg** file and checks syntax for errors. Available only when a traffic generation file (**.utg**) is open.
Export>>	Saves all or part of a trace to a text file or generator file.
Packets to Text (Packet View Format)	Saves trace as text file in Packet View Format.
Packets to .CSV (Comma Separated Values for Excel, etc.) Format)	Saves trace as a comma-separated-values text file for use with Microsoft® Excel.
Packets to Host Traffic Generator Text File (.utg)	Saves trace as script file that can be used by a Generator to generate a trace.
Packets to Device Emulation Traffic Generation Text File (.utg)	Exports packets to Device Emulation files. This option does not export transactions.
Data	Exports Transfer data as text or binary file.
Merge Trace Files	Merges two simultaneously recorded files into a single file. (This command does not work if the files were recorded at different times).
Import	Import data from **.vcd** file
Compare Endpoint Data	Allows you to select two endpoints of different directions with the same address and verify that the data OUT/IN is identical to the data IN/OUT from the other endpoint. Used when running echo-types of tests for data integrity. Available only when a trace file (**.usb**) is open.
Exit	Exits the USB*Tracer* program.

Menu	Function
Setup	
Display Options	Provides display options such as color, formats, and filters.
Recording Options	Provides setup options for recording, triggering events and filtering.
Setup Analyzer	Allows you to update the BusEngine™ and Firmware.
Record	
Start	Causes the Analyzer to begin recording USB activity.
Stop	Causes the Analyzer to stop recording.
Upload Again	Allows you to upload a different portion of the captured trace if the previous upload was only partially uploaded.
Generate	
Start	Starts traffic generation. Once traffic generation has begun, the Start command becomes Stop and lets you stop traffic generation.
IntelliFrame Generation Mode	Sets the mode of generation to IntelliFrame. Use before Start.
Bitstream Generation Mode	Sets the mode of generation to bitstream. Use before Start.
Repeat Mode	Allows you to repeat once, a specified number of times, or an infinite number of times using the Generation Repeat Mode window.
Report	
File Information	Displays information about the recording such as the number of packets and triggering setup.
Error Summary	Summarizes the errors throughout the recording. Allows for fast navigation to packet with errors.
Timing Calculations	Calculates timing between two packets and bus utilization.
Traffic Summary	Summarizes the numbers and types of errors, packets, transactions, split transactions, and transfers that occurred in the open trace.
Bus Utilization	Displays graphs of packet length, bus usage, and bus usage by device.
Search	
Go to Trigger	Positions the display to show the first packet that follows the trigger event.
Go to Packet/ Transaction/Transfer	Positions the display to the packet/transaction/transfer number selected in the Go to Packet/Transaction/Transfer menu.
Go to Marker »	Positions the display to the selected marked packet.
Go to »	Positions the display to the selected event, condition, value, or type.
Find	Allows complex searches on multiple criteria.
Find Next	Repeats the previous Find operation.
Search Direction	Allows the search direction to be changed from Forward to Backward or vice versa.

Menu	Function
View	
Toolbars	Displays list of available toolbars.
Status Bar	Switches display of the Status Bar on or off.
Real-time Statistics	Allows you to view traffic statistics as they occur.
Zoom In	Increases the size of the displayed elements.
Zoom Out	Decreases the size of the displayed elements.
Wrap	Wraps displayed packets within the window.
Hide SOF's	Hides Start of Frames.
Hide NAK's	Hides NAK'ed Transactions.
Hide Devices	Hides packets belonging to specified devices by address and endpoint.
Hide Chirps	Hide the Chirp-K and Chirp-J Bus conditions. These are recorded only in USB*Tracer*.
Apply Decoding Scripts	Decoding scripts set the values of the display and recording options for optimum views of trace information from specific vendors or classes of data. This menu option allows you to select the vendor or class of data for the request recipients and endpoints listed in the Request Recipients and Endpoints menu. You can keep the settings across recordings.
Packet Level	Displays Packets.
Transaction Level	Displays Transactions.
Split Transaction Level	Displays Split Transactions.
Transfer Level	Displays Transfers.
Refresh Decoding	Force the software to re-decode transactions and transfers. Useful if you have applied a decoding mapping which helps fully decode a sequence of transfers, as is the case with Mass Storage decoding.
Window	
New Window	Switches display of the Tool Bar on or off.
Cascade	Displays all open windows in an overlapping arrangement.
Tile Horizontal	Displays all open windows in a above-below arrangement.
Tile Vertical	Displays all open windows in a side-by-side arrangement.
Arrange Icons	Arranges minimized windows at the bottom of the display.
Windows ...	Displays a list of open windows.
Help	
Help	Displays online help. You can also select F1.
Help Topics	Displays online help.
Update License	Opens a dialog box for updating your LeCroy license.
Display License Information	Displays information related to licensing.
About USB USBTracer	Displays version information about USB USB*Tracer*.

5.4 View Options

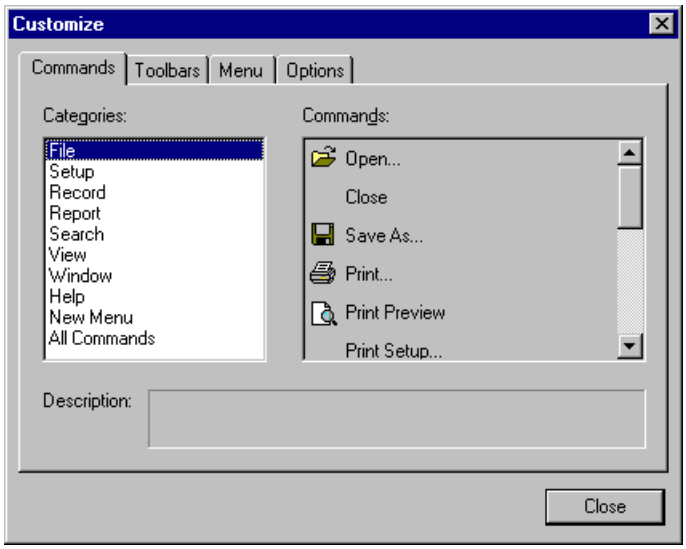
You can hide, display or reset toolbars by selecting **View > Tool bars** from the menu bar.

Resetting the Toolbar

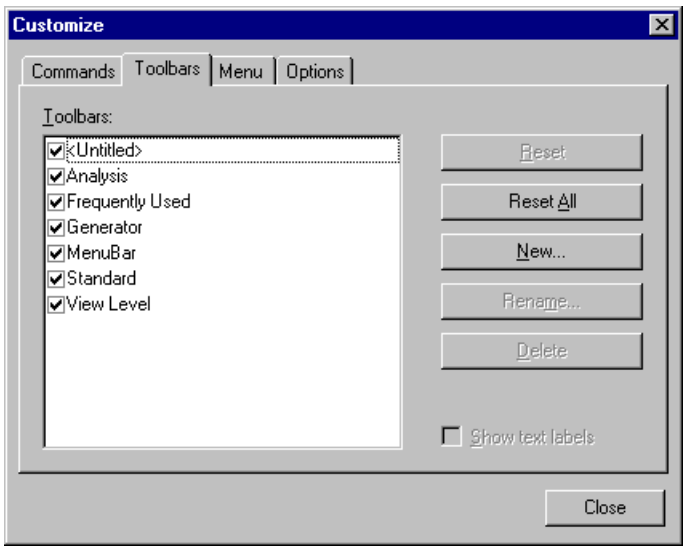
From time to time (such as following a software upgrade), it is possible for the buttons on the toolbar to not match their intended function. You can reset the toolbar by performing the following steps:

Step 1 Select **View > Tool bars** from the menu bar.

Step 2 Select **Customize** from the submenu to display the Customize dialog box.



Step 3 Select the **Toolbars** tab to display the Toolbars page of the Customize dialog box.



Step 4 Click the **Reset All** button.

The toolbar resets to the factory defaults.

Tool Bar

The Tool Bar provides quick and convenient access to the most popular USB*Tracer* program 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		Find Next
	Save As		File Information Report
	Preview		Error Report
	Edit as Text		Timing and Bus Usage Calculations
	Print…		Traffic Summary
	Setup Record Options		Bus Utilization

Setup Display Options

Start Recording

Stop Recording

Display Realtime Statistics.

Zoom In

Zoom Out

Wrap

Hide SOFs

Hide NAK'ed transactions.

Hide Devices

Hide Chirps

Assign High Level Decodes.

Find

Open the Navigator bar

Display Packets

Display Transactions

Display Split Transactions

Display Transfers

Display Host Wire Adapter Segments

Display Host Wire Adapter Transfers

Display Device Wire Adapter Segments

Display Device Wire Adapter Transfer

Start or Stop Traffic Generation (available if you have the USB*Trainer* modul)e.

Bitstream and Intelliframe modes

Repeat Upload

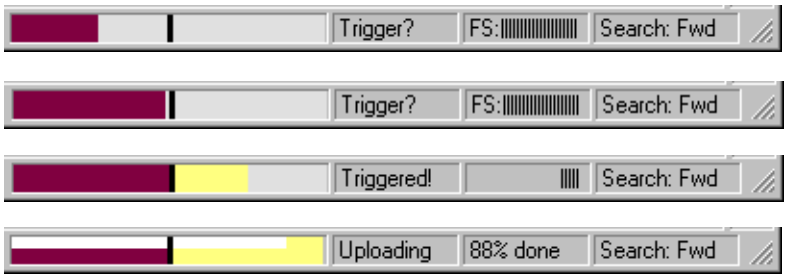
Repeat Mode. This button becomes active when a traffic generation file (*.utg) is open.

5.5 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.

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 flashing message changes to **Uploading data–*x*% done** (x% indicates the percentage completion of the data uploading process).
- The traffic data is copied to disk (overwriting any previous version of this file) using the default file name **data.usb**. If two channels of traffic are recorded, USB*Tracer* creates two files:**data_0.usb** and **data_1.usb**. You can also create a file name of your choice by specifying one in the Recording Options dialog box.

To abort the upload process:

- Press **Esc** on your keyboard

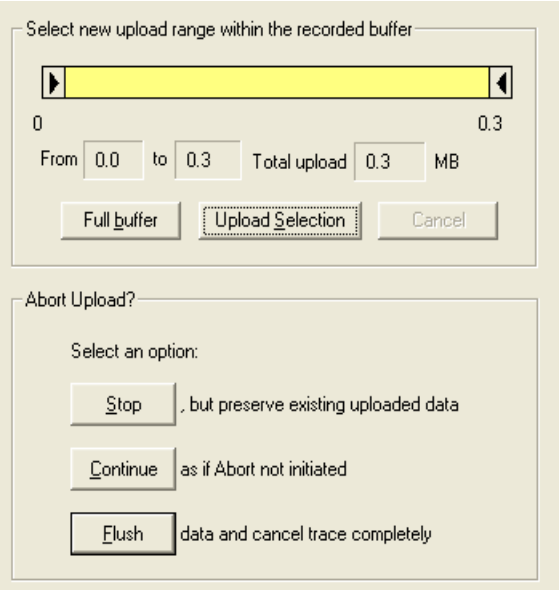
  OR

- Again click in the Tool Bar.

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

Note: While uploading is in progress, clicking the stop button again brings up a dialog opens a dialog that allows you to do a partial upload, flush the current file, keep what has uploaded at this point, and to continue uploading.

The Partial Upload button is enabled when you have partially uploaded data. When you click **Partial Upload**, a dialog box appears that gives you options on what portion of data you want to upload again.



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 packet following the Trigger (or the packet 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 packet 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 packets are filtered from the recording or data are truncated, the recording activity is reduced.

Search Status

The rightmost segment displays the current search direction: **Fwd** (forward) or **Bwd** (backward). Change the search direction from the Search Menu or double-click in the Search Status segment.

5.6 Navigation Tools

You can zoom in and out, and wrap packets/transactions/transfers to fit within the screen using the following buttons:

Zoom In

Zoom In increases the size of the displayed elements, allowing fewer (but larger) packet fields per screen.

- Click on the Tool Bar.

Zoom Out

Zoom Out decreases the size of the displayed elements, allowing more (but smaller) packet fields per screen.

- Click on the Tool Bar.

Wrap

Select **Wrap** to adjust the Trace View so that packets fit onto one line. If a packet is longer than the size of the window, the horizontal scroll bar can be used to see the hidden part of the packet.

- Click on the Tool Bar or select **Wrap** under **View** on the Menu Bar.

5.7 USB*Tracer* Analyzer Keyboard Shortcuts

Several frequently-used operations are bound to keyboard shortcuts.

Table 1: Keyboard Shortcuts

Operation	**Key Combination**
Trace Navigation	
Find Next	F3
Search Backwards	Ctrl+B
Search Forwards	Ctrl+F
Jump to First Packet	Ctrl+Home
Jump to Last Packet	Ctrl+End
Go to Any Error	Shift+E
Go to Channel 0	Ctrl+Shift+0
Go to Channel 1	Ctrl+Shift+1
PID	
Go to ACK	Shift+A
Go to DATA0	Shift+0
Go to DATA1	Shift+1
Go to DATA2	Shift+2
Go to DATAx	Shift+D
Go to IN	Shift+I
Go to MDATA	Shift+M
Go to NAK	Shift+N
Go to NYET	Shift+Y
Go to OUT	Shift+O
Go to PING	Shift+G
Go to PRE/ERR	Shift+P
Go to SETUP	Shift+S
Go to SOF	Shift+F
Go to SPLIT	Shift+X
Go to STALL	Shift+L

Bus Conditions	
Go to Reset	Shift+T
Go to Resume	Shift+6
Go to SE0	Shift+Z
Go to SE1	Shift+7
Go to Keep-Alive	Shift+5
Go to Suspend	Shift+U
Go to Chirp	Shift+C
Go to Full Speed J	Shift+J
Go to Full Speed K	Shift+K
OTG	
Go to SRP	Ctrl+Q
Go to HNP	Shift+H
Go to VBus Voltage Change	Shift+V
Go to OTG Host A	Ctrl+Shift+A
Go to OTG Host B	Ctrl+Shift+B
Misc.	
Marker Menu	Ctrl+M
Open File	Ctrl+O
Print…	Ctrl+P
Record	Ctrl+R
Stop Recording	Ctrl+T
Open Display Options dialog	Ctrl+Shift+D
Open Recording Options dialog	Ctrl+Shift+R
Hide SOFs	Ctrl+Shift+S
Hide NAKs	Ctrl+Shift+N
Hide Chirps	Ctrl+Shift+C
Apply Decoding Scripts	Ctrl+Shift+Y

6. Recording Options

Use **Recording Options** to create and change various features that control the way information is recorded by the USB*Tracer* Analyzer.

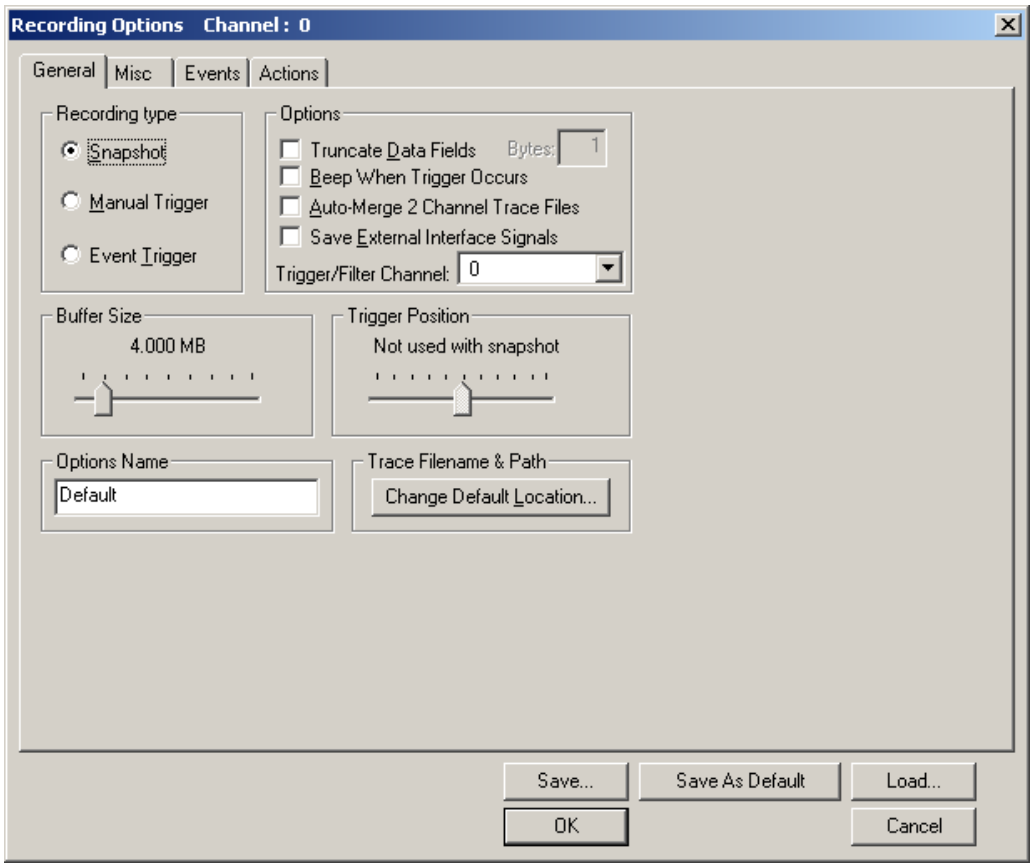
To open the **Recording Options** dialog box:

- Select **Recording Options** under **Setup** on the Menu Bar.

  OR

- Click on the Tool Bar.

You see the **Recording Options** dialog box:



The **Recording Options** window always opens with the **General** tab showing.

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 presents three options that allow you to set how USB*Tracer*™ begins and ends a recording. The options are: *Snapshot, Manual Trigger,* and *Event Trigger.*

Snapshot

A Snapshot is a fixed-length recording. The size of this recording is set by the Buffer Size box. Recording begins when REC is clicked and ends when either the selected buffer size is filled or the STOP button is pressed.

Manual Trigger

A Manual Trigger is a recording whose trigger point is caused by pressing the trigger button on the front panel.

Recording begins when you click REC on the Tool Bar. Recording continues in a circular manner within the limits set by the buffer size.

Recording ends when STOP 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 begins when you click REC 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

- **Truncate Data Fields:** Allows data fields to be truncated during recording in order to save Analyzer memory and allow recording of more packets. Enter a minimum data length value in the Bytes box. USB*Tracer* truncates the data to the stated value or slightly larger.

Note Truncation of data may cause incorrect transaction or transfer decoding.

- **Beep When Trigger Occurs:** The computer connected to the USB*Tracer* beeps three times when a Trigger condition is first detected.
- **Auto-Merge 2 Channel Trace Files**: Causes USB*Tracer* to merge traffic of the two recording channels into a file called data_merged.usb (or whatever name you wish to give it). USB*Tracer* also makes two other files during this recording: **data_0.usb** and **data_1.usb** (or whatever names you choose to give them). If unchecked, USB*Tracer* creates only two files: one for Classic-Speed traffic and another for Hi-Speed traffic.
- **Save External Interface Signals:** Causes USB*Tracer* to save signals from a Break-out board (pins *Data7 - Data0*) as fields in the trace.
- **Trigger/Filter Channel:** Presents a choice of Channel 0 or Channel 1. The selected choice tells USB*Tracer* what channel it should use to perform its triggers/filters. If you want to set triggers/filters on *both* channels, then you must select a channel, assign trigger/filter events and actions, then select the other channel and assign trigger filter events and actions to it. In other words, you must set your events and actions *twice* - once for each channel. The channel you are currently applying the triggers/filters to is shown in the Dialog Title Bar.

Buffer Size

You can adjust the size of the recording buffer from 0.4 megabytes to 512 megabytes.

The **Recording type** option determines how this buffer is used. Although there are 512 megabytes of physical memory in the Analyzer, the efficiency of the recording is about a 2:1 ratio of physical memory to actual USB traffic. Shorter USB packets yield a slightly less efficient recording. The non-traffic portion of physical memory is utilized for control and timing information.

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

Trigger Position

You can adjust the amount of recording to be done post-Trigger or select where you want the Trigger located within the defined buffer. You can adjust the Triggering Position between 1 and 99% post-Trigger. **Trigger Position** is available only when **Manual Trigger** or **Event Trigger** is selected as **Recording type**.

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

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

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

Options Name

The **Options Name** is a 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 like into the box. Your labels can be very descriptive such as "Trigger on High Speed traffic when CRC errors occur."

To create a new Recording Options name:

Step 1 Enter a comment for the new file in the **Options Name** field.

Step 2 Click **Save** to display the **Save As** window.

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

Step 4 Click **Save.**

To load a Recording Options name:

Step 1 Click **Load** to display the **Open** window.

Step 2 From the list of **.rec** files, select the one that represents your Options Name.

The options settings for that name then display.

Trace File Name & Path

Trace File Name & Path opens a **Save As** dialog box for saving your trace file. The default recording file name is **data.usb** for Low, Full, and High Speed recordings. If you are recording on both channels, then USB*Tracer* creates two files: **data_0.usb** for Channel 0, and **data_1.usb** for Channel 1.

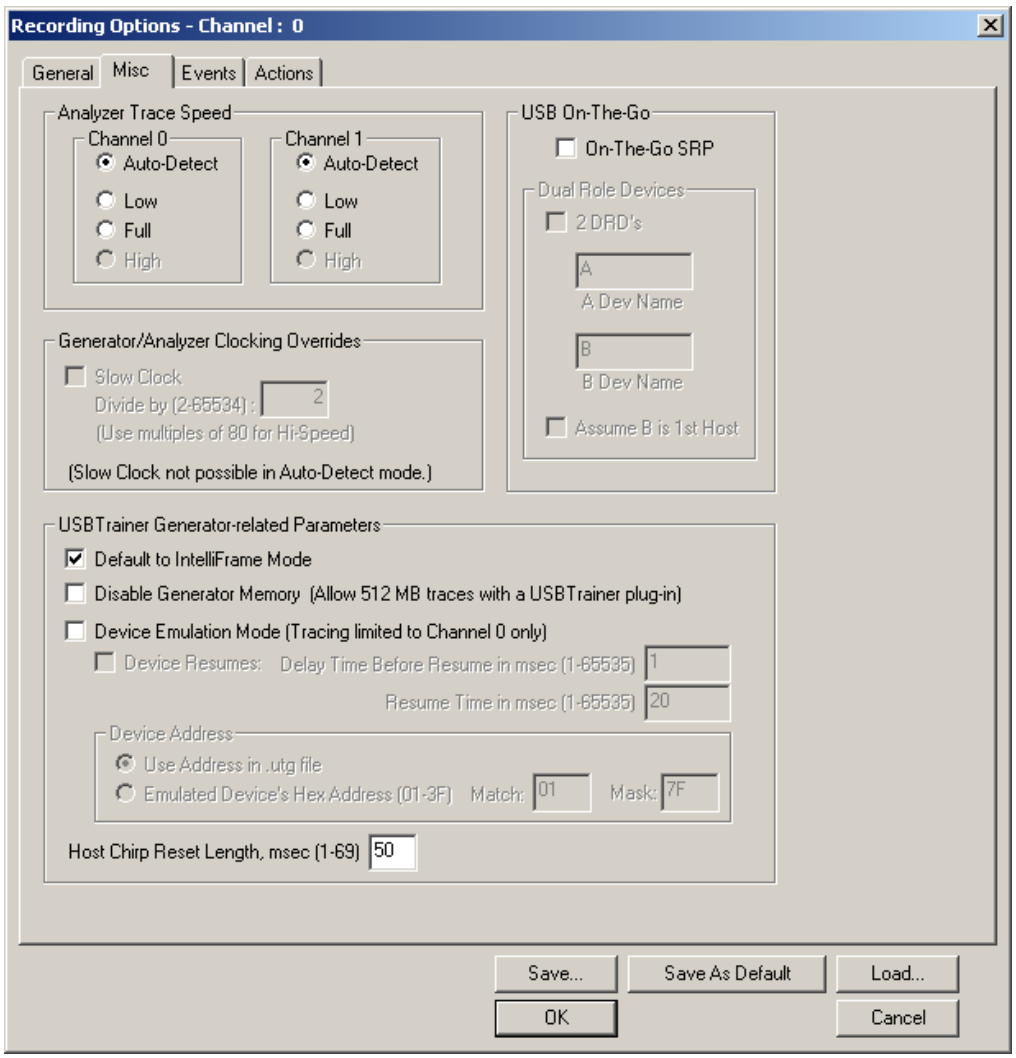
- Click **Trace File Name & Path.**

You see a **Save As…** window in which to enter the recording file name ***.usb** for all subsequent recordings.

6.2 Recording Options - Misc

The **Misc** page presents options for setting:

- Analyzer speed
- Device emulation
- OTG
- Clocking Overrides
- Traffic Generation



Analyzer Speed

This option sets the speed of the traffic recorded by the analyzer. Normally, the default setting "Auto-detect" is used. This setting tells the analyzer to discover what speed traffic is running and to label packets accordingly. If you are having problems with your recordings, you might try setting the traffic speed to one of the fixed values -- Low, Full, and Hi speed. These settings are used when you want to manually set the traffic speed.

In some rare cases, auto-detection circuitry causes Full Speed devices to fail to enumerate on plug-in. Changing the analyzer speed to Full Speed can sometimes solve this problem.

Setting the speed to one of the fixed values is sometimes useful for debugging purposes. For example, if a device that is producing numerous errors at a particular speed, you may wish to set the recording to that speed in order to ensure that the analyzer does not misread the error packets and label them the wrong speed. While it is unlikely that the analyzer will mislabel packets in this way, manually setting the recording speed guarantees that the analyzer always records packets at the correct speed.

You can set the speed for one or both channels.

Notes on Hi Speed Recordings

Erroneous chirp blocks can be recorded on an idle bus when the Device has its FS terminations on while the Host has HS terminations connected. This causes a small differential voltage (a.k.a "tiny-J") on the USB bus that causes false Chirp detection.

This condition occurs during speed negotiation:

- On a HS bus, the condition is momentary just before the device chirps.
- On a CS bus, the condition occurs both before and after the device chirp (until the end of Reset). The user is discouraged from using "Speed=HIGH" to record signals on a classic speed bus.
- The analyzer stops recording anything for 2.5 milliseconds following a FS_K state (which is at least 2 microseconds long). This is to avoid presenting "garbage" which is a by-product of the high-speed probe settling down.

Generator/Analyzer Clocking Overrides

Generator/Analyzer Clocking Overrides allows changes to be made to the analyzer/generator clocking. Select **Slow Clock**, then enter a value in the box on the right. The value that is entered tells the analyzer how much to divide the base clock by. For example, entering a 4 causes Full Speed traffic to be generated at a 3-megabit rate as opposed to the standard 12-megabit rate.

USB On-The-Go

USB On-The-Go option sets analyzer to record the USB On-The-Go traffic. This protocol lets you run two devices, specify one of them as the host, one of them as the device, and to assign each device a name.

USBTrainer Generator-related Parameters

Default to IntelliFrame Mode sets IntelliFrame default to "ON."

In IntelliFrame mode, the generator can wait for Device responses to complete before it continues generating more host packets. For example, after issuing an IN, the generator looks for the DATAx packet issued by the device to finish, and then issues an ACK. This way, the data length can vary and does not need to be pre-calculated. Also, using the "idle=TO_EOF" statement allows the generator to calculate where the end of the frame occurs, so that a subsequent "frame=AUTO" statement creates a Start of Frame at the correct time. Moreover, the Generator can be made to retry transactions that are NAKed automatically, and to use the PING protocol where appropriate. Retries can be made to occur within the same frame or in the next frame. For further information on the flexible behavior that can be instituted during the generation, see the syntax descriptions for the generation files. An additional advantage of the IntelliFrame mode is that it creates an image in the Generator’s memory that is MUCH smaller than that of the Bitstream mode, so it downloads much faster.

Disable Generator Memory [allow 512 MB traces with a USBTrainer plug-in] allows you to specify 512 MB traces on systems with a USBTrainer plug-in.

Device Emulation Mode [tracing limited to Channel 0 only]: Allows changes to the Resume time and the device address.

Device Resumes: If checked, the Device is responsible for issuing the Resume signal after waiting the specified amount of time following a suspend. If the Device Resumes option is not selected, the device waits indefinitely for the Host to resume signalling.

Delay Time: The time (in milliseconds) to wait after suspend before initiating a Resume.

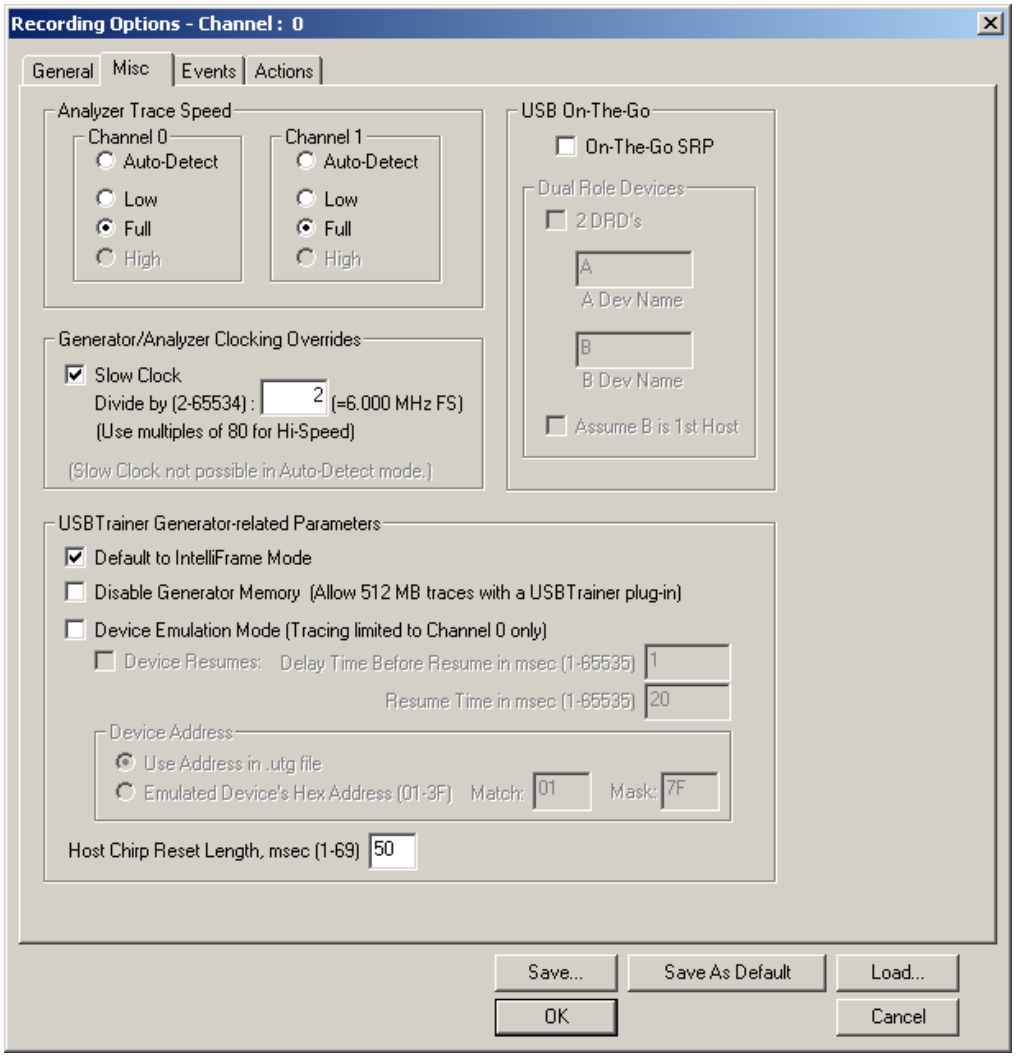
Resume Time: The Resume Time (in milliseconds) is used to configure how long a device should issue a Resume (K) signal once the delay time has occurred. Be careful to make this shorter than what the host does once it recognizes the Resume signal as a Remote Wakeup.

If the **Device Resumes** option is not selected, the device waits indefinitely for the Host to resume signalling.

- **Use Address in .utg file**: Causes the analyzer to use whatever Device address has been specified in the.utg file.
- **Emulate Device's Hex Address**: Allows the user to specify a different address than the one specified in the .**utg** file. This option is useful in cases where the host does not use the same address each time.
- **Chirp Reset Length:** Allows the Reset Length for Chirps to be edited. The default is 50 milliseconds. (Host generation only).

6.3 Slow Clock Selection

You can use the slow clock selection to slow down the base clock during generation. This also changes the Analyzer's clock base to match.



Step 1 In the **Misc** tab, make sure you are out of Auto-Detect mode.

Step 2 Select the **Slow Clock** checkbox.

Step 3 In the **Divide By** field, enter a value.

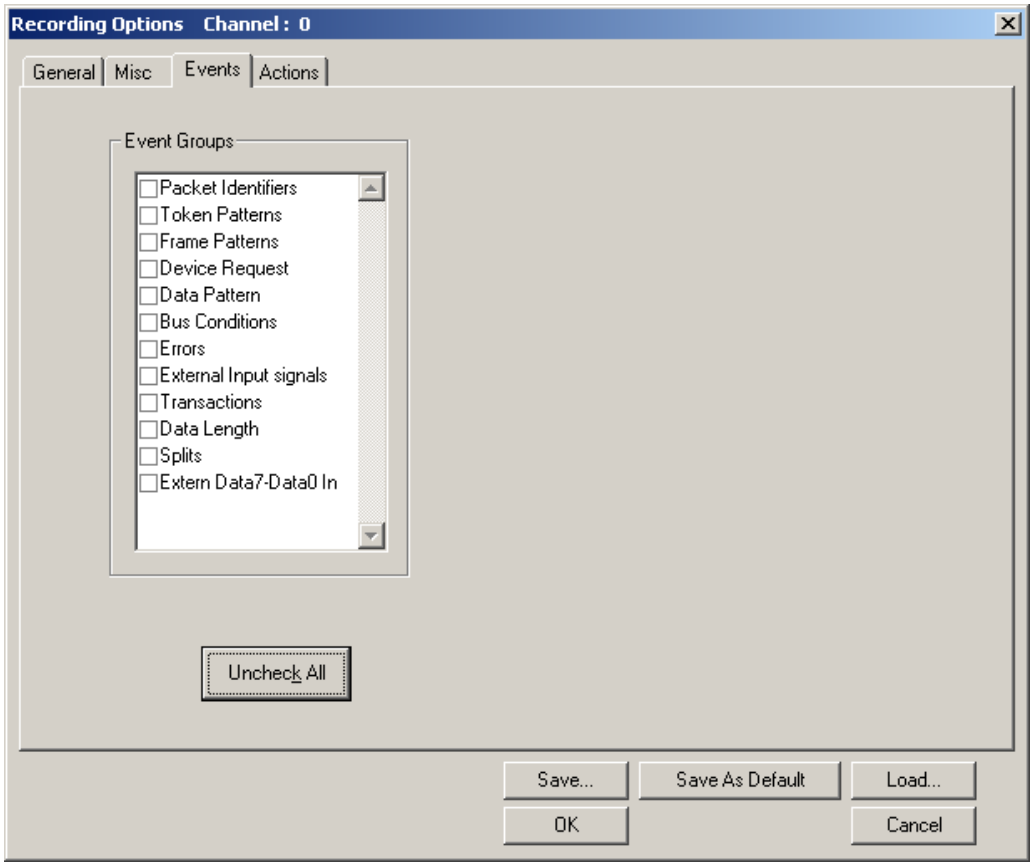
Step 4 Click **OK**.

Using this feature for Hi-Speed requires a License Key from LeCroy. Contact your LeCroy representative.

6.4 Events Recording Options

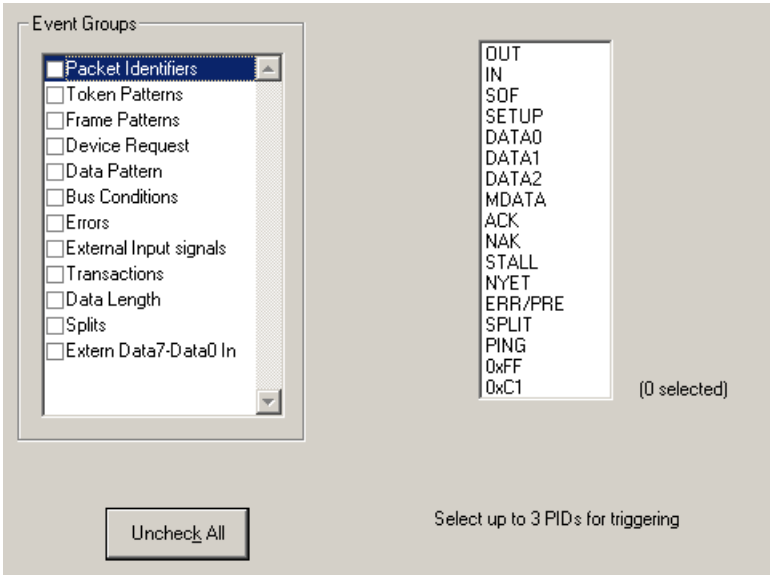
The Event triggering and filtering options allow you to set specific parameters for each Event Group. When an Event Group is selected, a field appears that allows you to select specific conditions within the corresponding Event Group. As details are selected, other Event Group details may become "grayed out" because of limited hardware resources in the Analyzer. Information about the resources available is displayed below the Event Group details. When a detail is grayed out, 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.

Click the **Events** tab on the **Recording Options** screen to display the **Event Groups** dialog box:



Packet Identifiers

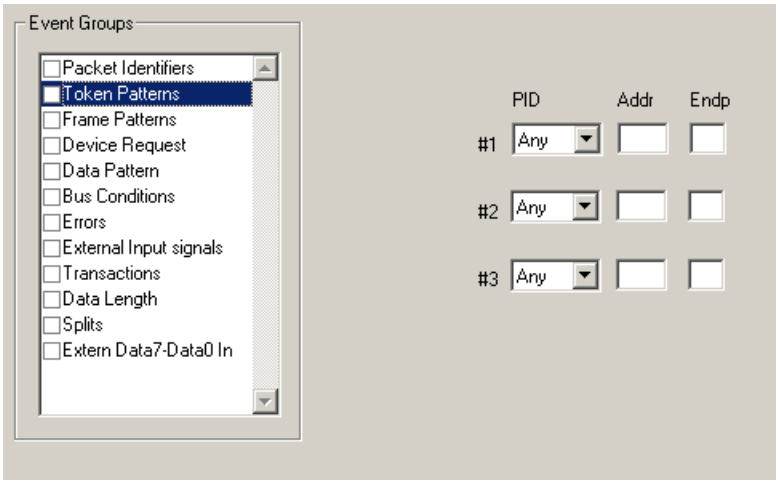
Select **Packet Identifiers** under **Event Groups.** You see the **Packet Identifiers** window:



The Packet Identifier (PID) field lists the available packet types. Select up to three packet types to use as a Recording Trigger.

Token Patterns

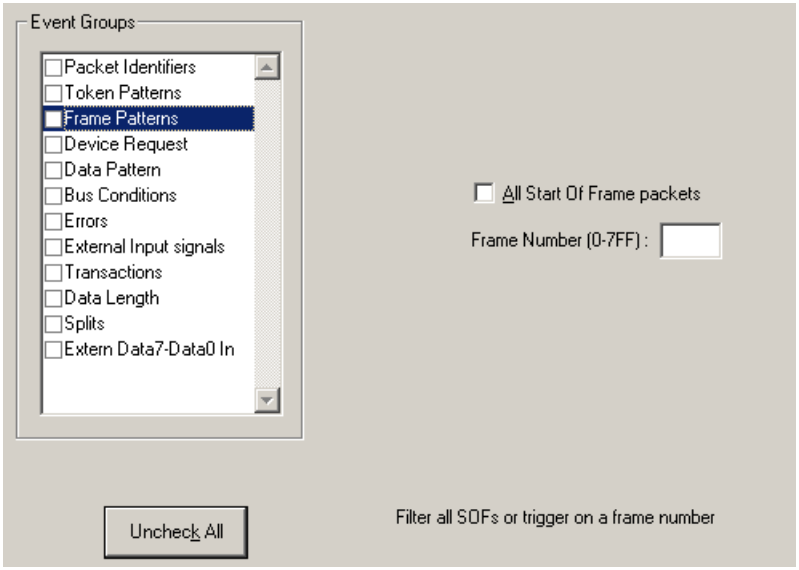
Select **Token Patterns** under **Event Groups.** You see the **Token Patterns** window:



Specify up to three combinations of Address/Endpoint with any of the token PIDs. They can be triggered on or filtered in/out.

Frame Patterns

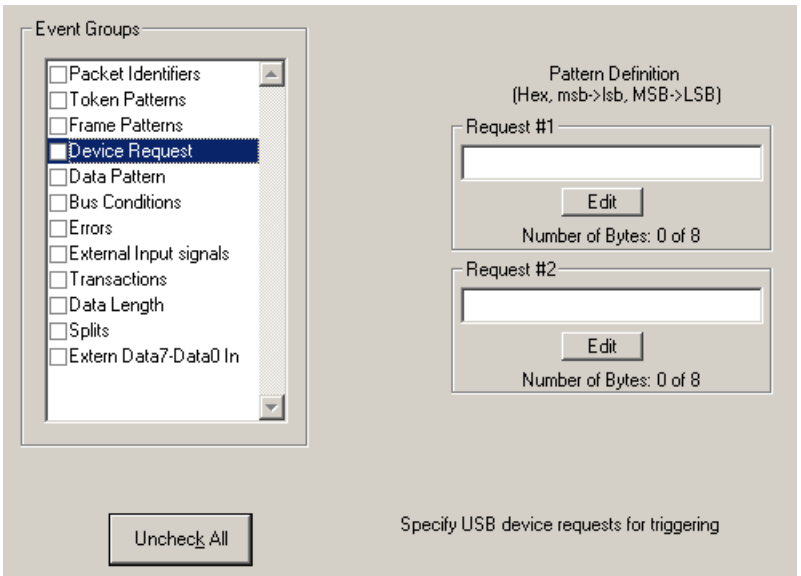
Select **Frame Patterns** under **Event Groups.** You see the **Frame Patterns** window:



Identify frame patterns you want either to filter out of a Trace View or to use as a Trigger. You can select either **All Start of Frame packets** (SOF) to be filtered out or specify the **Frame Number** of a frame to trigger on.

Device Requests

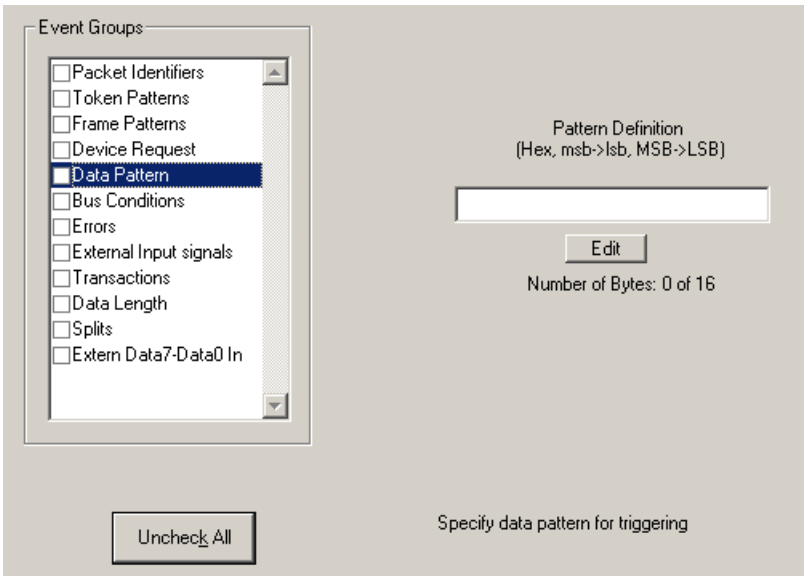
Select **Device Requests** under **Event Groups.** You see the **Device Requests** window:



You can select one or two Device Requests for triggering or filtering.

Data Pattern

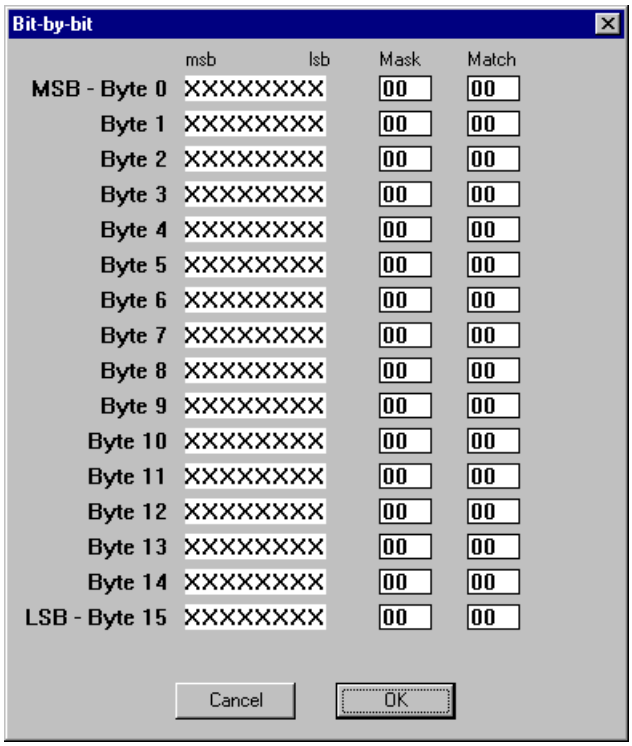
Select **Data Pattern** under **Event Groups.** You see the **Data Pattern** window:



Enter a Data Pattern to be triggered upon or click **Edit** to open a pattern editor and enter data on a bit-by-bit basis.

Step 1 Press the **Edit** button.

You see a **Bit-by-Bit** window:

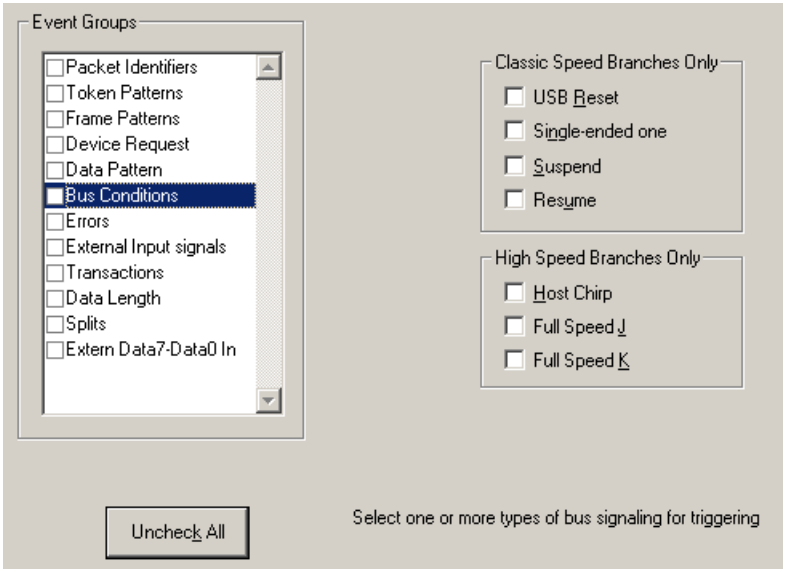


Step 2 Click your mouse on the bits within each byte that you wish to edit and enter in the appropriate text.

The Mask and Match fields change to reflect your changes.

Bus Conditions

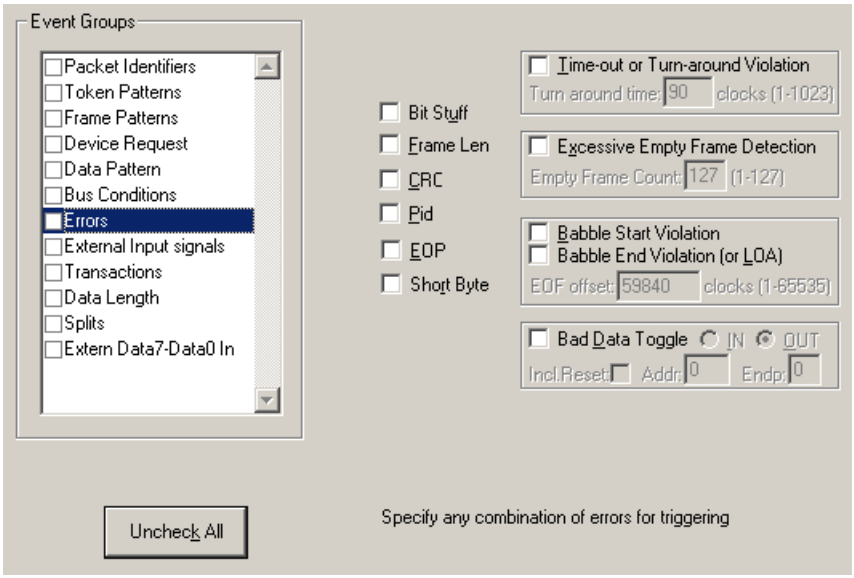
Select **Bus Conditions** under **Event Groups.** You see the **Bus Conditions** window:



Use any combination of the listed errors as a Trigger.

Errors

Select **Errors** under **Event Groups.** You see the **Errors** window:

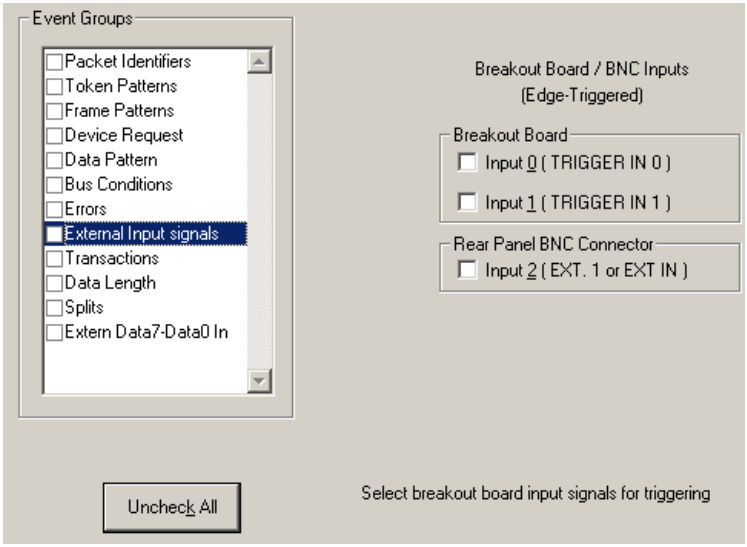


Use any combination of the listed errors as a Trigger.

- **Bit Stuffing, Frame-Length, CRC, Pid, EOP, Short Byte checkboxes**: Select one or more of these errors to set these as the basis for triggering or filtering. A Short Byte is a condition where EOP begins on a non-byte boundary.
- **Time-out Violation** - Select this checkbox and then enter in the Turn-around time in the text box. This value tells the analyzer how much time should elapse before triggering/filtering. Clocks are 60 MHz (with a resolution of 16.66 ns).
- **Excessive Empty Frame Detection** - Select this option and enter the empty frame count in the text box. This value tells the analyzer how many frames should elapse before triggering/filtering.
- **Babble Start Violation** - Select this checkbox to trigger or filter whenever the start of a packet occurs too late in a Frame.
- **Babble End Violation (or LOA)** - Select this to trigger/filter when the end of a packet occurs too late in a Frame. Enter a value in the **EOF offset** box from 1 to 65,535 clocks to indicate the size of the offset from start of previous SOF.
- **Bad Data Toggle** - Select this checkbox to trigger or filter whenever a Data0, Data1, Data2 toggle violation occurs.
  - Select **IN** or **OUT** if you only want triggering/filtering to occur only on IN or OUT transactions.
  - Check **Incl Reset** if you want the first toggle value after a reset to be considered "good" regardless of the value prior to that reset. If Unchecked, the toggle state is assumed to be preserved through the reset.
  - Select **Addr** and/or **Endp** to select Token Addresses and/or Endpoints.

External Input Signals

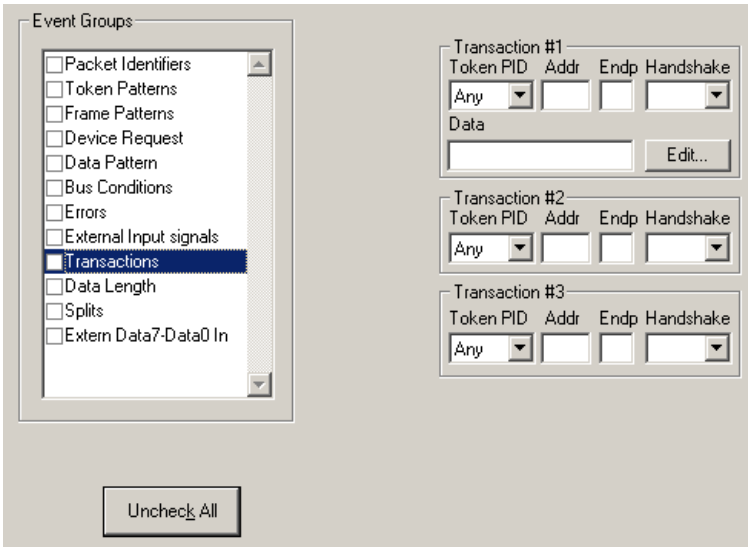
Select **External Input Signals** under **Event Groups.** You see the **External Input Signals** window:



This window has three checkboxes: **Input 0 (TRIG IN 0)**, **Input 1 (TRIGGER IN 1)**, and **Input 2 (Ext. 1 or Ext. IN)**. Use any combination of the inputs as a Trigger.

Transactions

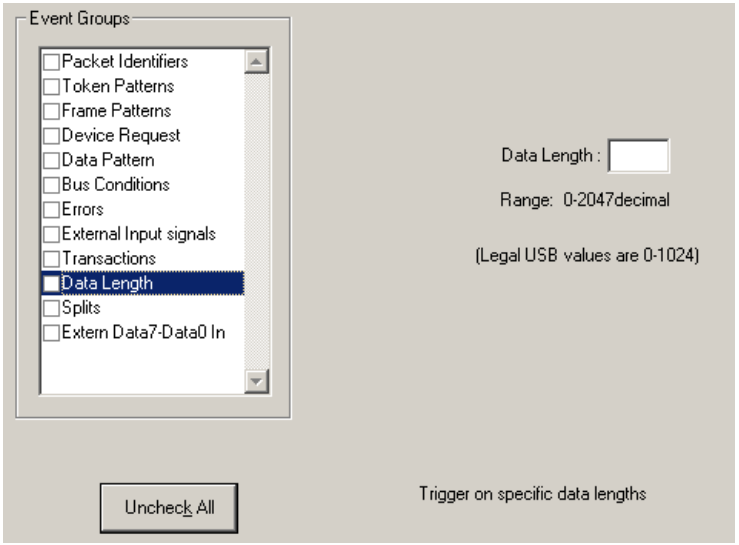
Select **Transactions** under **Event Groups.** You see the **Transactions** window:



Use any combination of the listed errors as a Trigger.

Data Length

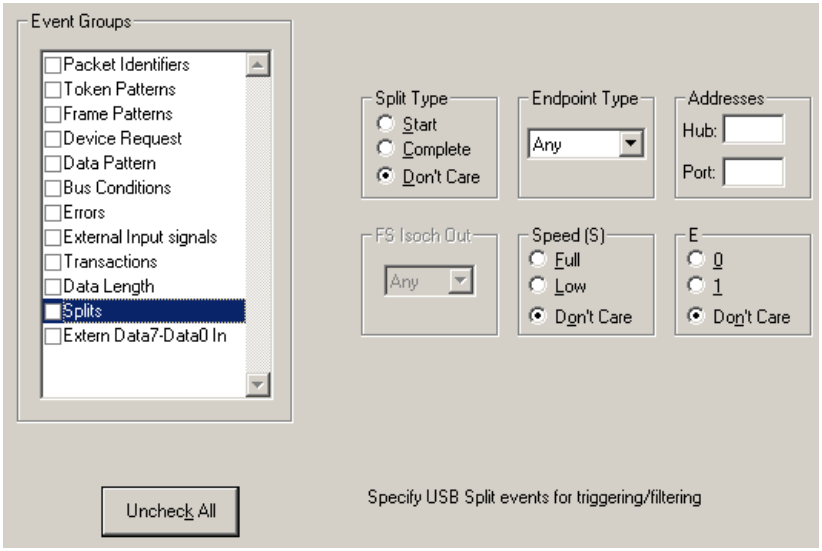
Select **Data Length** under **Event Groups**. You see the **Data Length** window:



To trigger on data length, enter a value between 0 and 1024 in the box marked **Data Length**.

Splits

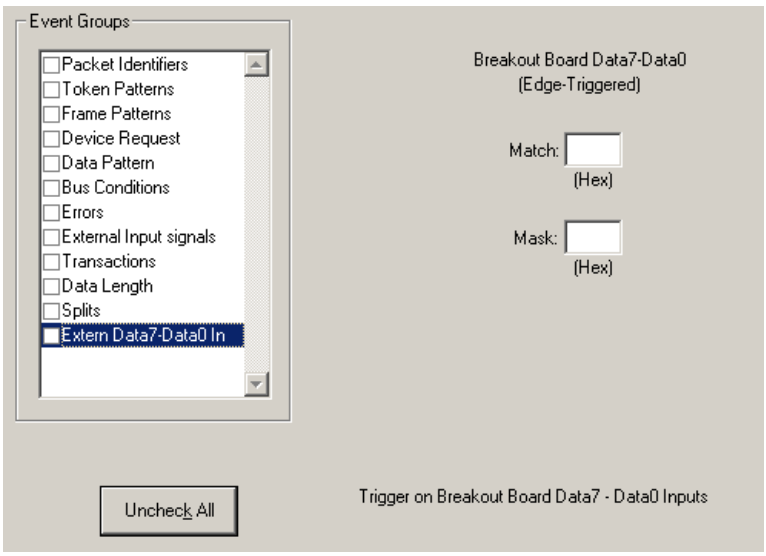
Select **Splits** under **Event Groups**. You see the following window.



To trigger on splits, select a split type, and endpoint type, and an address. You can also select FS Isoch Out when you select the Isoch endpoint type.

Extern Data7 - Data0 In

Select **Extern Data7 - Data0 In** under **Event Groups**.



To trigger on Extern Data 7 - Data0 In, enter values in the Match and Mask fields.

6.5 Actions Recording Options

The **Actions** screen serves as a means of setting **Triggers, Filters (In or Out),** and **Counts** for the events selected in the Events window.

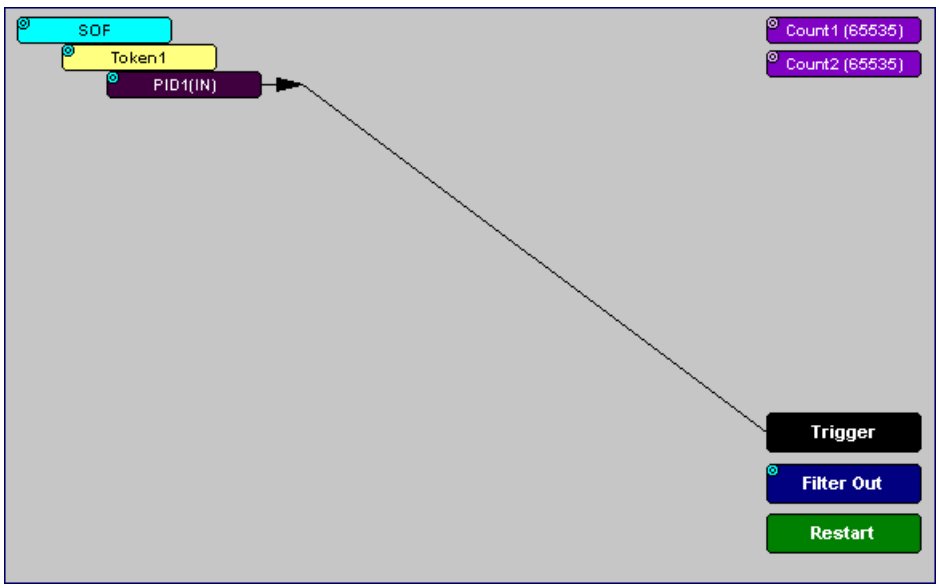
Actions Window Layout

The Actions window divides into three sections: left, center, and right.

The left section displays buttons for the events selected in the **Events** window. Events buttons tell USB*Tracer* what it should look for during a recording. The number of Event buttons displayed depends on the number of Events selected in the Events window. If no Events were selected, no Event buttons are displayed.

The right side of the window displays a pair of counters called **Count1** and **Count2**. Counters provide a way for setting triggers based on a passage of a certain number of events. When an event is linked to a counter, the counter appears below the event on the left side of the screen.

The right section displays three Action buttons: **Trigger**, **Filter Out**, and **Restart**. Action buttons controls USB*Tracer*'s response to Event conditions. For example, if an Error button is linked to a Trigger button, the Action button tells USB*Tracer* to trigger when the error condition occurs.



The lines that join the different buttons indicate the links between Actions and Events.

6.6 Connecting Events to Actions

To create or edit links between Event buttons, Counters, and Action buttons, you click an Event button and then click a Counter or Action. By clicking an Event, an arrow connects the Event button to the cursor. When you click a Counter or Action button, the arrow becomes anchored to the selected button.

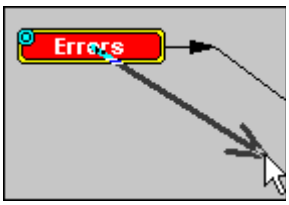
To make an association:

Step 1 Select one or more Events from the Events window.

Step 2 Open the Actions window.

Step 3 Click the left mouse button on an Event button such as **Errors**.

The elastic arrow appears.



Step 4 Point your mouse at the desired Action button.

The elastic arrow moves with your mouse pointer.

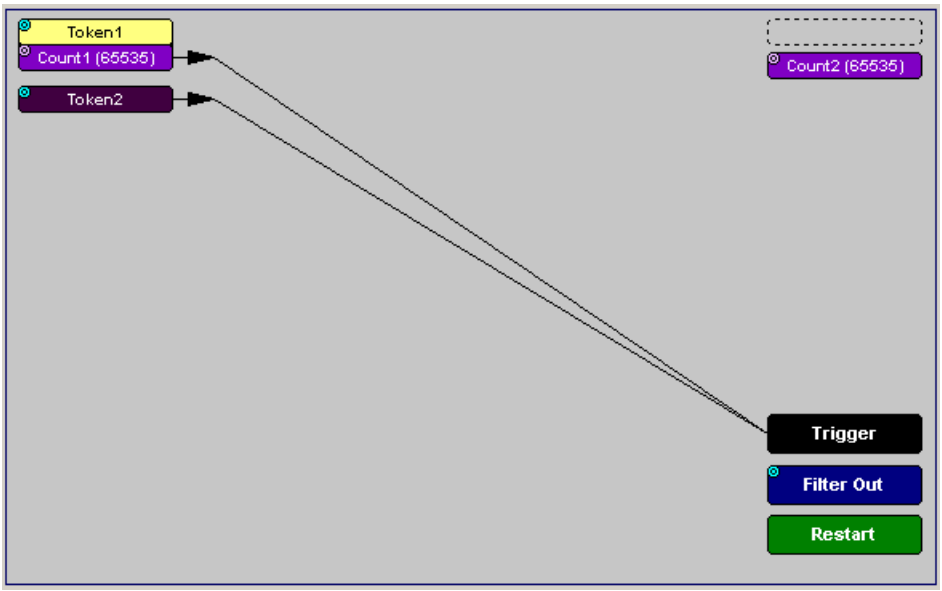
Step 5 With the pointer over an Actions button, click again the left mouse button again.

The arrow is anchored to the Action button. replaced with a black line connecting the Event button to the Action button.

6.7 Connecting Counters to Events

The right side of the Actions window contains two Counter buttons marked **Count1** and **Count2**. These counters provide a way of triggering after a number of events have passed, such as "Trigger after the 20th IN packet."

When an event is linked to a counter, the counter appears under that event on the left side of the Actions window. 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,

Step 1 Open the Event window and select an Event.

An Event button appears in the Actions window.

Step 2 Open the Actions window.

The window displays an Event button that is connected to the Trigger button on the right via a line.

Step 3 Click the Event button.

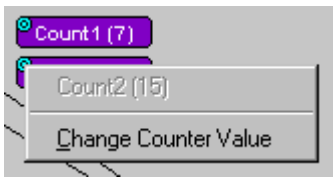
An arrow connects the Event button to the mouse pointer.

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 left corner of your selected counter.

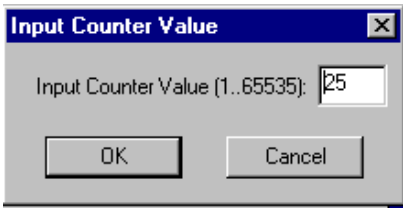
A pop-up menu opens to allow you to configure the counter.



Step 6 Choose **Change Counter Value** to open the Input Counter Value dialog box.

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

The Input Counter Value dialog box closes, and the Counter button displays your selection.

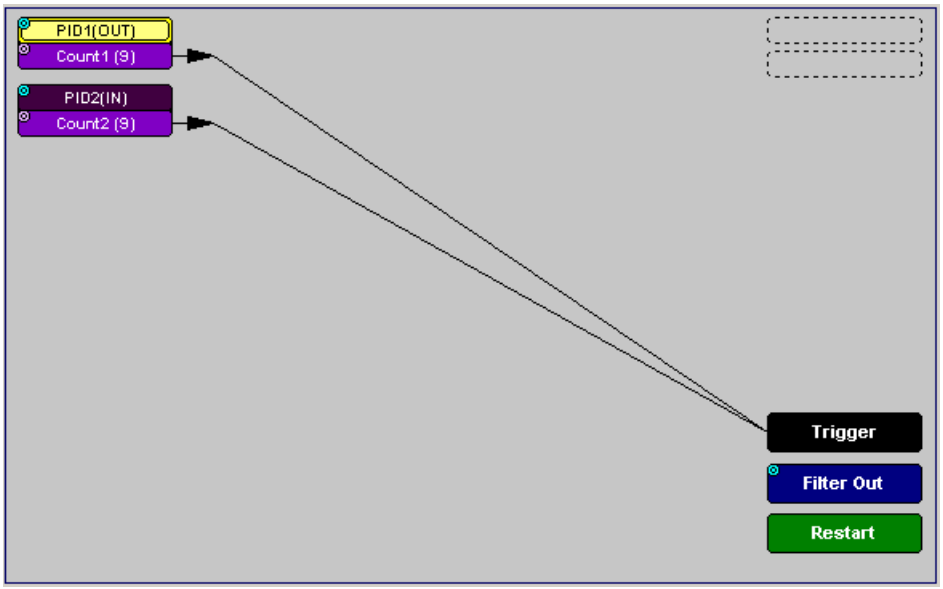


Setting Multiple Conditions with Counters

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

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" statement. This statement reads "Trigger when Count1 OR Count2 has reached their specified values."

This example reads "Trigger when Count1 has counted 9 Out packets or Count2 has counted 9 In packets."



6.8 Using Action Buttons

The right section of the Actions window displays three Action buttons labeled **Trigger**, **Filter Out/In**, and **Res**tart.

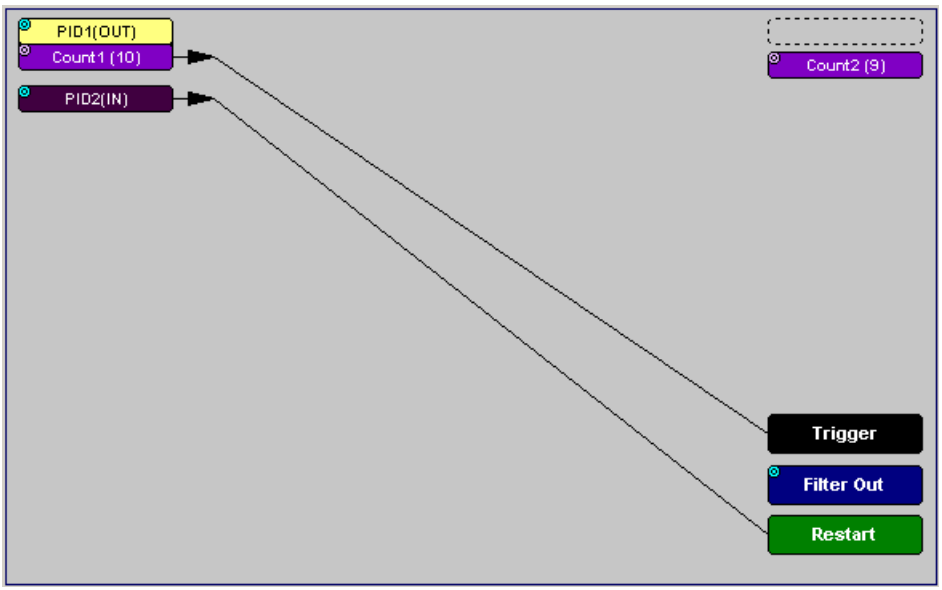
Trigger

The **Trigger** button enables event triggering.

Restart

Restart causes counters to restart counting when a certain event occurs. When Restart is used, the screen has at least two links: one between an Event and the Restart button, and a second between an Event, Counter and an Action button.

The screenshot below gives an example. The screen below reads "Look for IN and Out packets. When 10 OUT packets, trigger. However, if an IN packet occurs during the count, restart the count."



Filter Out/In

The **Filter In/Out** button causes events to be filtered in or out of the recording. **Filter Out/In** toggles between:

- **Filter In** records ONLY those packets related to the specified event.
- **Filter Out** records all packets EXCEPT those related to the specified event.

Note Only events from the Token, Frame Event, Device Request, and Transaction Groups can be used to filter a recording.

To filter in or out Token, Frame Event, Device Request, and/or Transaction Group events from a recording:

Step 1 Click the blue dot on **Filter Out**. (Note: the button may say **Filter In** depending on the last action specified.)

You see the **Filter Polarity** menu:

Use this menu to toggle the selection between **Filter Out** and **Filter In**.

Step 2 Select **Filter In**.

The button changes to read Filter In.

6.9 Other Actions: External Output Signals

Most Event buttons can be configured to trigger external output signals.

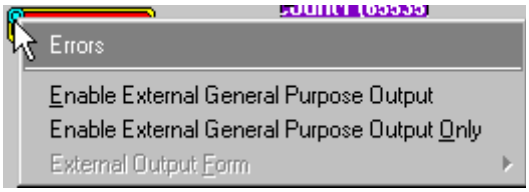
If a blue dot is present in the Event button, it means that a menu is present with three options for configuring external output signalling:

- Enable External Trigger Output
- Enable External Trigger Output only
- External Trigger Form

If you choose to enable External Output signalling, a small blue arrow projects from the Event button. This arrow is a reminder that External Signals have been set.

To enable or disable external trigger output:

Step 1 Click the blue dot on an Event button.



A menu similar to this one opens. Your menu may say "Disable" instead of "Enable."

Step 2 Select **Enable External Trigger Output** (or **Disable External Trigger Output** if that is the choice presented.)

If you have chosen **Enable External Trigger Output**, a small arrow appears on the right side of the button. This arrow indicates that a condition has been set for creating an external output signal. Choosing **Disable External Trigger** causes the arrow to disappear.

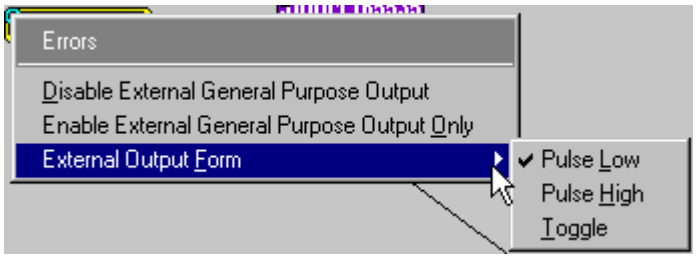
Enabling High Pulse, Low Pulse or Pulse Toggle Signal Outputs

If you chose External Trigger Output in the previous steps, then an additional choice appears in the Blue Dot Menu called **Enable External Trigger**. This option lets you control the output signal.

Step 1 Click the blue dot on an event button that has a small arrow attached to it like the one shown above.

A Blue Dot Menu opens. **External Trigger Form** should be an option. If it is not, choose **Enable External Trigger** and then reopen the menu.

Step 2 Choose **External Trigger Form** to display a menu with **Pulse Low**, **Pulse High**, and **Toggle**.



Step 3 Choose an option not currently selected.

The menu closes.

Step 4 Reopen the menu.

Note that your new selection is now checked.

6.10 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 screens you are working in.

- 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** is recommended; if no extension is specified, **.rec** is added by default.
- Click **Load** to load a previously saved ***.rec** file, thus restoring 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 dialog box.
- Click **Cancel** to cancel any immediate changes you have made and exit the Recording Options menu.

6.11 Recording Bus Data

To start recording USB traffic once the appropriate Recording Options have been set perform the following steps. Note: If you have inserted any event triggers, be sure to select *Event Trigger* under the General tab in the Recording Options dialog box.

Step 1 Select **Start** under **Record** on the Menu Bar

OR

Click on the Tool Bar.

Your recording session can continue until it has finished naturally,

or you may need to stop manually by clicking on the Tool Bar, depending on how you set the Recording Options.

To manually stop recording:

Step 2 Select **Stop** under **Record** on the Menu Bar

OR

Click on the Tool Bar.

Click again during the uploading to upload only a portion of the recorded memory.

Note The manual Stop Recording feature is primarily of use when recording low-speed traffic, which can take a long time to fill the recording buffer.

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

To save a current recording for future reference:

Step 3 Select **Save As** under **File** on the Menu Bar.

OR

Click on the Tool Bar.

You see the standard **Save As** screen.

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

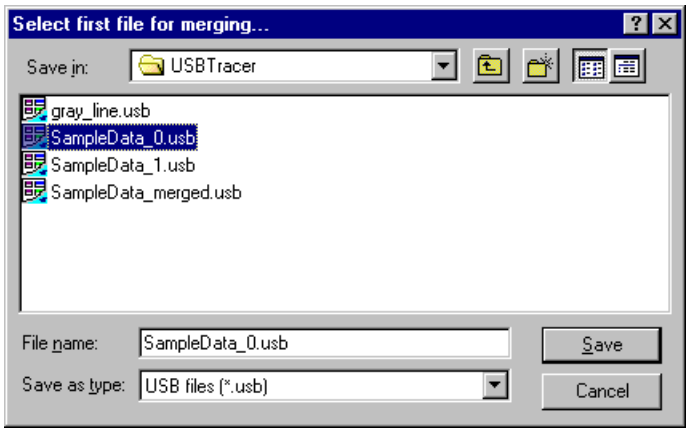
6.12 Merging Trace Files

It is possible to merge a Classic-Speed trace file with a Hi-Speed trace file using the Merge Trace File command under the File menu. This option only works with files that were created simultaneously through a single recording session. If the files were recorded during separate recording sessions, USB*Tracer* generates an error message and prevents the merge from completing.

Note USB*Tracer* is capable of merging High Speed and Classic Speeds traffic into a single merged file if the **Auto-Merge 2 Channel Trace Files** option is checked in the Recording Options dialog box. See page 51 for details.

To merge two trace files:

Step 1 Select **File > Merge Trace Files** to display a dialog box asking for the first source file.



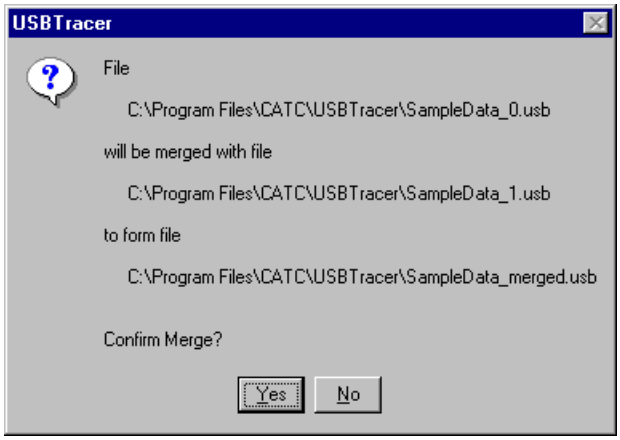
Note The **Merge Trace Files** command can be run with or without a trace file open on the screen. The merge process ignores the open file.

Step 2 Select the first trace file to be merged, then click **Save**.

Note It does not matter which of the two trace files is first selected so long as both were recorded in the same session.

Step 3 Select the second trace file to be merged, then click **Save**.

Confirm your choices.



Step 4 Click **Yes**.

The two files are merged into the new file data_merged.usb.

Note If you attempt to merge two files that were recorded in separate recording sessions, the following error message appears:

7. Display Options

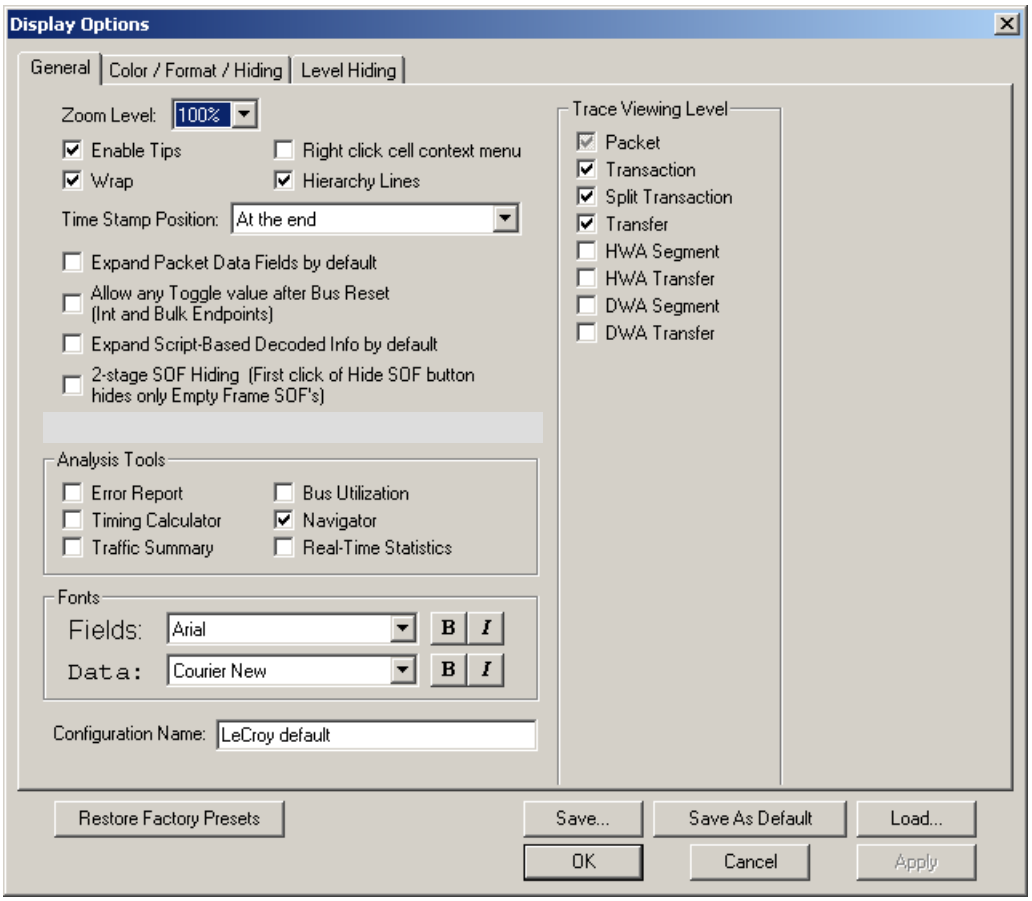
You can select what information to display in Trace Views using the **Display Options** window.

To open the **Display Options** window:

- Select **Display Options** under **Setup** on the Menu Bar.

  OR

- Click on the Tool Bar.:



You can select General, Color/Format/Hiding, and Level Hiding display options. The following sections describe these display options.

7.1 General Display Options

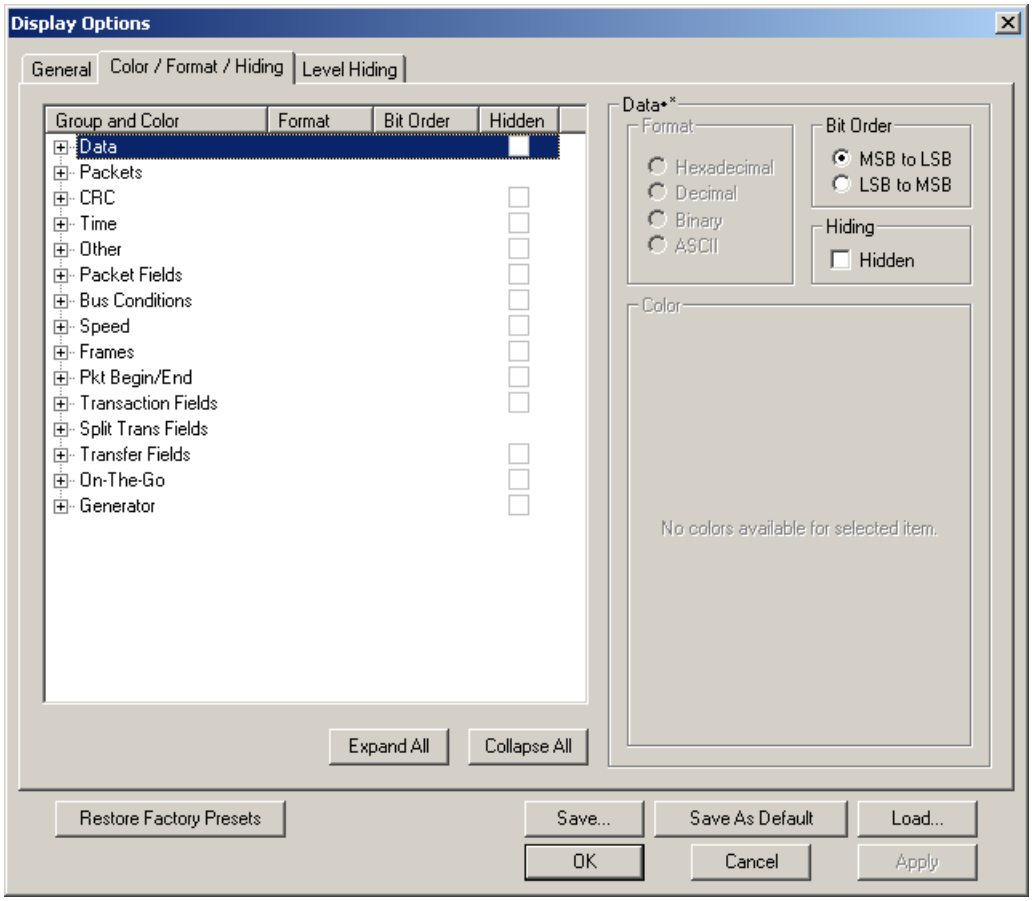
You specify the main Trace View information types and settings using General Display Options (see figure on previous page):

- **Zoom Level**: Zooms out from 100% (default) to 10% or zooms in from 100% to 200%.
- **Enable Tips**: Pops up text when you position the cursor over a field.
- **Wrap**: Wraps lines of traffic information instead of truncating lines at the right edge of the display.
- **Right click cell context menu**: By default, clicking the left mouse button on a field heading displays a context-sensitive pop-up menu providing commands about the field and clicking the right mouse button pops up a menu with display options. After selecting this option, clicking the right mouse button on a field heading displays the context-sensitive pop-up menu and clicking the left mouse button does nothing.
- **Hierarchy Lines**: Displays lines on the left side of Trace View showing the hierarchy from Packets to Transactions to Split Transactions to Transfers if you show higher-level decodes.
- **Timestamp Position**: Aligns the Timestamp field "At the beginning" (in a column on the left side of the Trace View), "At the end" (in a column on the left side of the Trace View), or "Merge with Packet/TRanmsaction/Translation". Selecting this option allows easier comparison with previous or following timestamps.
- **Expand Packet Data Fields by default**: Displays packet data fields in expanded mode. If this option is not selected, packet data fields display in collapsed mode, and you can expand them manually.
- **Allow any Toggle value after Bus Reset (Int and Bulk Endpoints)**: Depending on the device, after Bus Reset the endpoint toggle state might or might not be reset. Selecting this option prevents display of a toggle violation error.
- **Expand Script-Based Decoded Info by default**: Displays decoded transfer fields in expanded mode. If this option is not selected, decoded transfer fields display in collapsed mode, and you can expand them manually.

- **2-stage SOF Hiding**: You can display all SOFs, hide all SOFs, or hide empty SOFs (show only SOFs with endpoint traffic and hide empty frames). Selecting this option allows you to hide empty SOFs with one click of the Hide SOF button or hide all SOFs with two clicks of the Hide SOF button.
- **Error Report**: Displays the Errors section of the Traffic Summary window.
- **Timing Calculator**: Displays the Timing Calculator window from the beginning of a packet or marker to the beginning of another packet or marker, including Total Time unit, Bus Utilization Time and Bandwidth, and selected Global, Low Speed, Full Speed, High Speed, Transactions, and Devices.
- **Traffic Summary**: Displays the Traffic Summary window, showing all reports, including Packets, Transactions, Transfers, and Errors.
- **Bus Utilization**: Displays the Bus Utilization window, including Packet length, Bus usage, and Bus usage by device.
- **Navigator**: Displays the Navigation bar, including Pre/Post Triggers, Errors, and Types of Traffic.
- **Real-Time Statistics**: Displays the Real-Time Statistics window, including Data Packet Count, Data Payload Throughput, and Bus Usage.
- **Trace Viewing Level**: Displays Packets, Transactions, Split Transactions, Transfers, Host Wire Adapter Segments, Host Wire Adapter Transfers, Device Wire Adapter Segments, or Device Wire Adapter Transfers.
- **Fonts**: Sets the font type and bold or italic style for Fields and Data.
- **Configuration Name**: You can name the current set of Display Options values for use with an **.opt** file. (The options file can have a different name.)
- **Restore Factory Presets**: Sets all Display Options values to the installed values.

7.2 Color/Format/Hiding Display Options

To modify the colors, formats, and hiding options, select the Color/Format/Hiding tab.

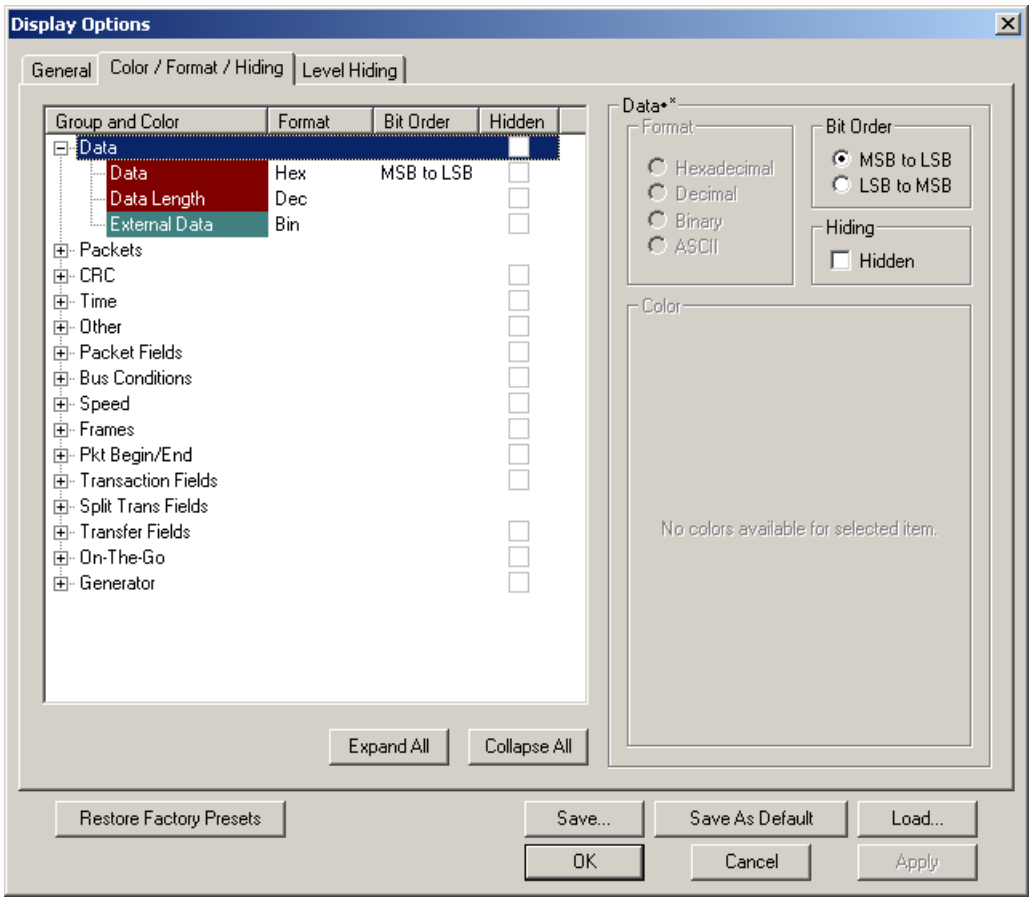


Color Display Options

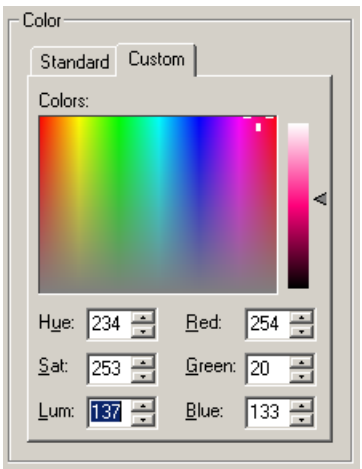
The program uses a default set of colors for each type of data in each group of data. The colors and color combinations are appropriate for most graphic systems. You can alter any color.

To specify a color for an information type, in the Color/Format/Hiding tab, select a row (such as Data) in the Group and Color column and expand it.

Select a data type (such as Data Length) in the Group, then select a color in the Color section, using Standard or Custom colors. Use a bright color for each important field.



To customize colors, use the Custom tab.



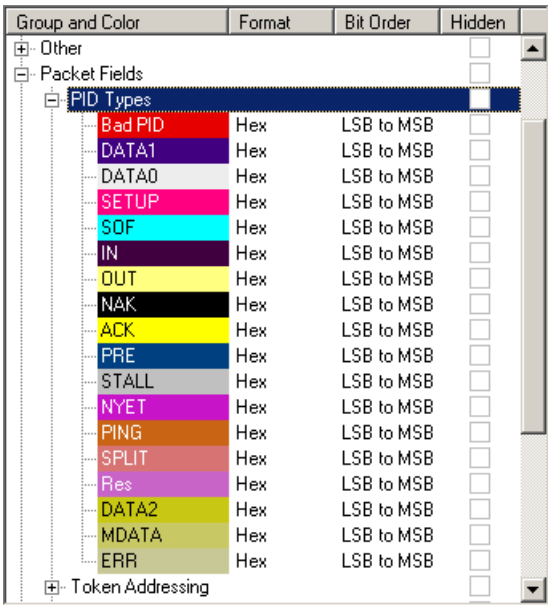
Note You cannot change the color of an Invalid Data (packet error) field. It is permanently set to red.

Formats Display Options

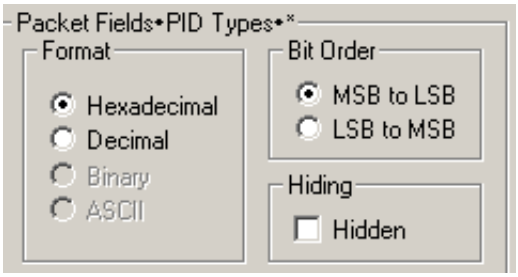
For each type of data in each group of data, the program has a default data format. Examples of number data formats are Bin (binary), Dec (decimal), and Hex (hexadecimal). Examples of date and time data formats are Hex uFrame, Dec uFrame, Date & Time, Time, Bit Time, seconds, microseconds, and nanoseconds. An example of a text data format is ASCII. You can alter some data formats.

To specify a data format for an information type, in the Color/Format/Hiding tab, select a row (such as Packet Fields) in the Group and Color column and expand it.

Select a data type (such as PID Types) in the Group:



Select a format in the Format section. The following formats are available for PID Types:



If available, select Bit Order in the Format section. The options are MSB to LSB or LSB to MSB.

Hiding Display Options

By default, no data is hidden. You can hide any group of data and any type of data. You can hide transactions, SOFs; NAKs; High, Full, or Low Speed packets; traffic from one or both recording channels; and Addresses and Endpoints.

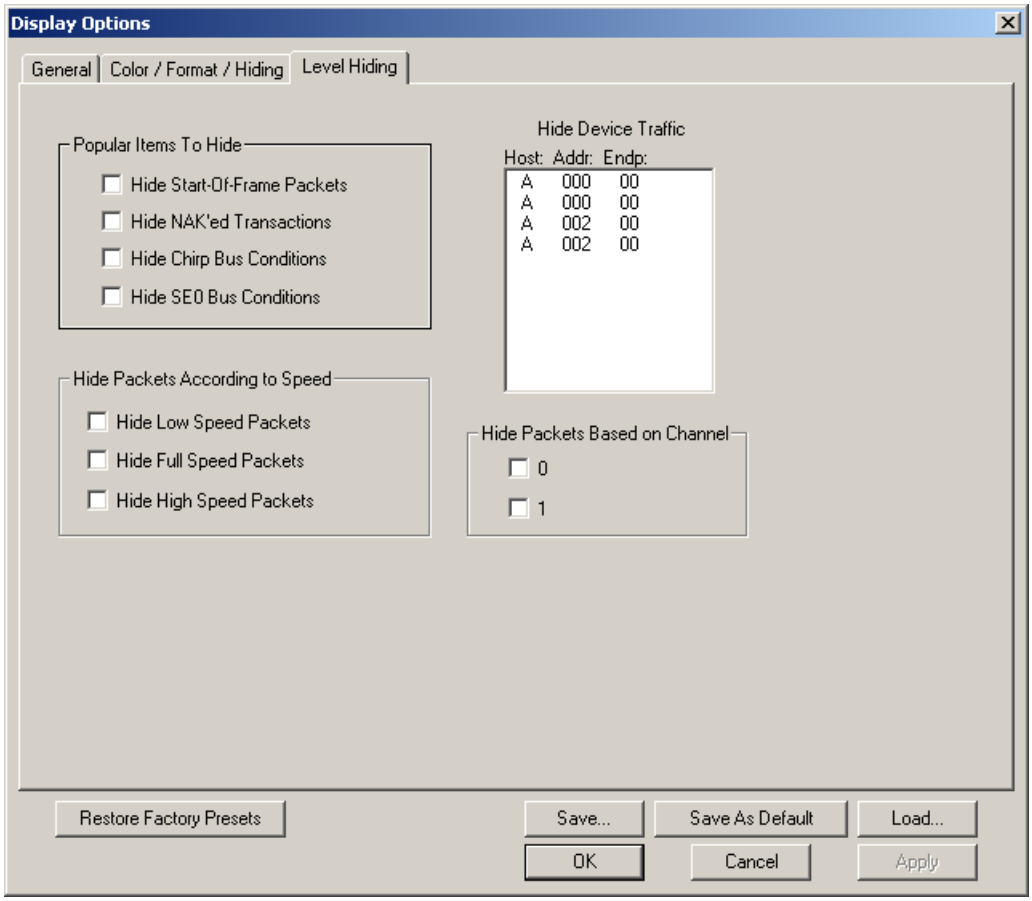
To hide one or more fields, select the Group and Data type in the Group and Color column, then click the Hidden checkbox in the display or the Hidden checkbox in the Hidden section of the Format section.

7.3 Level Hiding Display Options

By default, no data packets, transactions, or bus conditions are hidden. You can hide:

- Start of Frame packets
- NAK'ed transactions
- Chirp and SEO Bus conditions
- High, Full, or Low Speed packets
- Channel 0 or Channel 1 packets

Select the Level Hiding tab, then select the data types to hide.

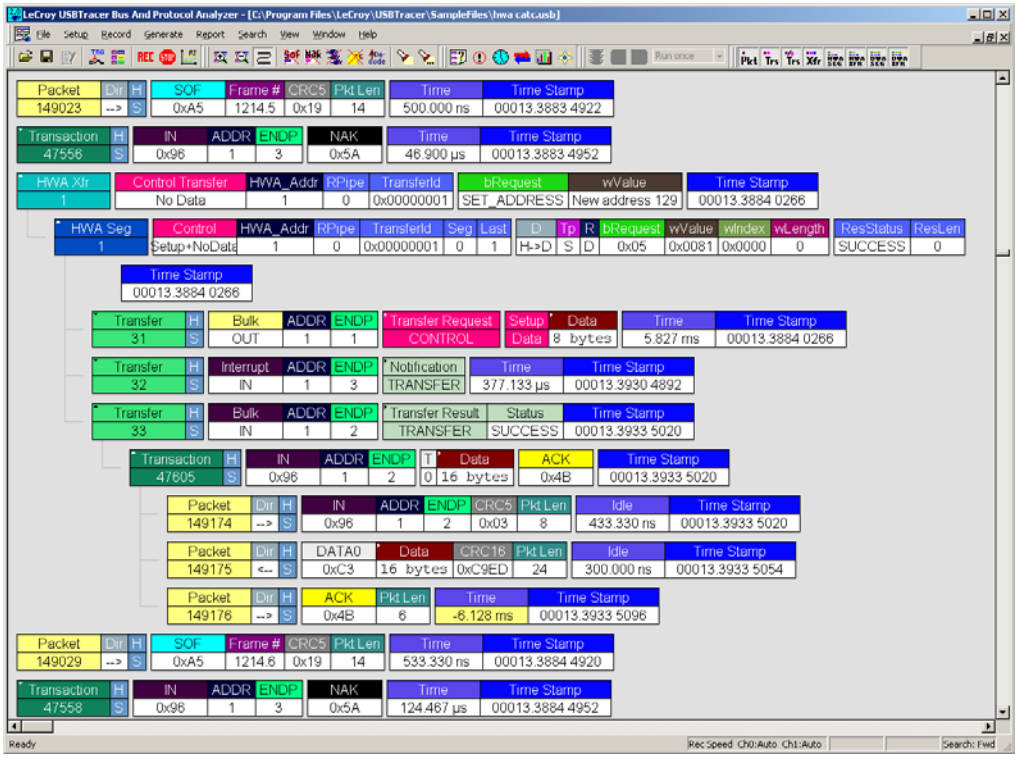


7.4 Saving Display Options

You can save a set of Display Options values, make a set the default settings, or use a saved set of values with the commands at the bottom of the **Display Options** window:

- To save the current Display Options values in an options file for use in future sessions, click **Save**. Enter a file name without a file name extension. The program adds the **.opt** extension. (The file must have an **.opt** file name extension.)
- To load a previously saved **.opt** file, click **Load** and select a file name.
- To save the current Display Options values in the **default.opt** options file for use as the default display options, click **Save as Default**. (Do not delete the **default.opt** file.)
- To apply the current Display Options values, click **Apply**. The Display Options window remains open.
- To apply the current Display Options values and close the Display Options window, click **OK**.
- To cancel unsaved changes to display values and exit the Display Options window, click **Cancel**.

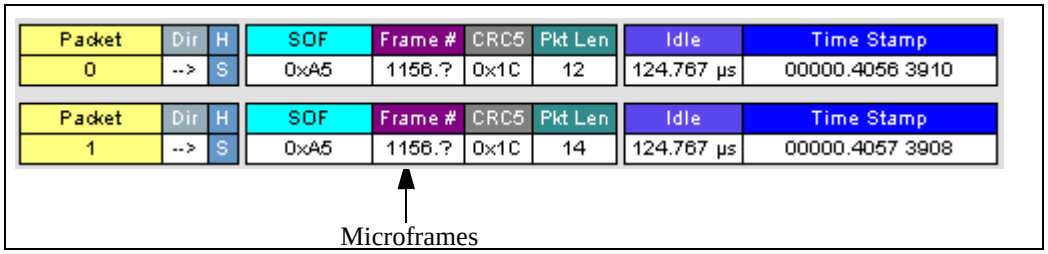
8. Reading a Trace



8.1 Trace View Features

- The USB*Tracer* packet view display makes extensive use of color and graphics to fully document the captured traffic.
- Packets are shown on separate rows, with their individual fields both labeled and color coded.
- Packets are numbered (sequentially, as recorded), time-stamped (with a resolution of 16.67 ns), and highlighted to show the transmitted speed (low-speed, full-speed or high-speed).
- Display formats can be named and saved for later use.
- Pop-up Tool Tips detail the contents of packet fields.
- Data fields can be collapsed to occupy minimal space in the display and you can zoom in and out to optimize screen utilization.
- The display software can operated independently of the hardware and so can function as a stand-alone Trace Viewer that may be freely distributed.

- High Speed SOFs display Microframes (shown below.)

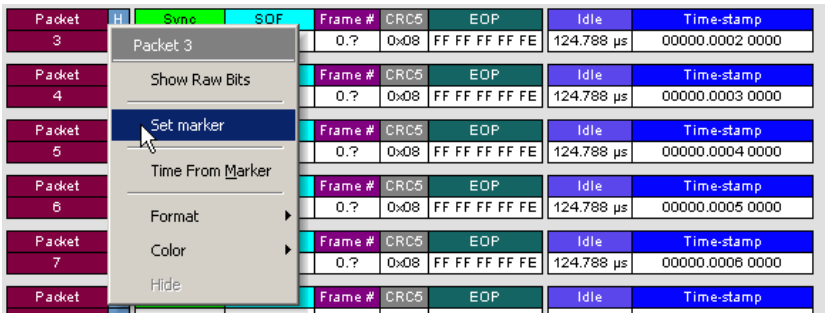


8.2 Set Marker

You can define a unique Marker for each packet.

To place a marker on a packet:

Step 1 Left-click **Packet #** for the packet you wish to mark to display the Packet menu:



Step 2 Select **Set Marker**.

You see the **Edit Marker Comment** window where you can enter a unique comment about this packet.:

Step 3 Enter your comment.

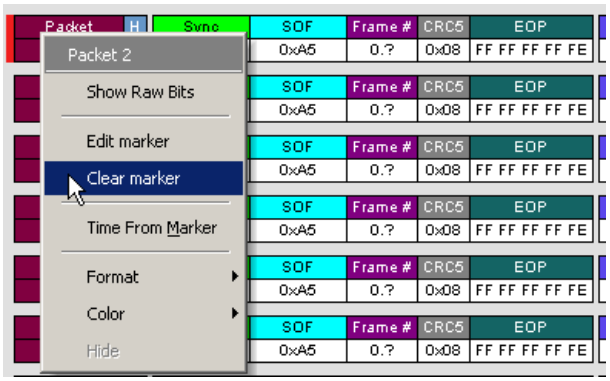
Step 4 Click **OK**.

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

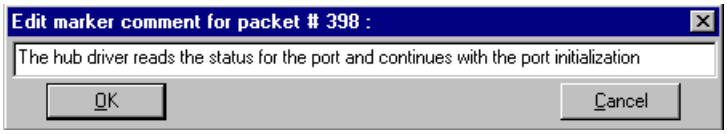
8.3 Edit or Clear Marker

To clear or edit the comments associated with a packet marker:

Step 1 Left-click **Packet #** to display the Packet menu:



Step 2 To edit the Marker Comment, select **Edit Marker Comment** to display the **Edit marker comment** window. Edit the comment, then click **OK**:



Step 3 To clear a Marker, click **Clear Marker**.

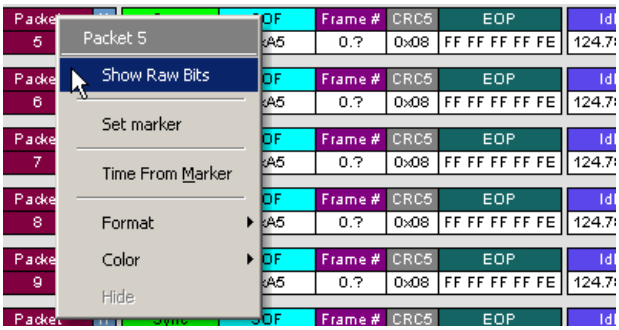
The vertical red Marker bar disappears.

8.4 View Raw Bits

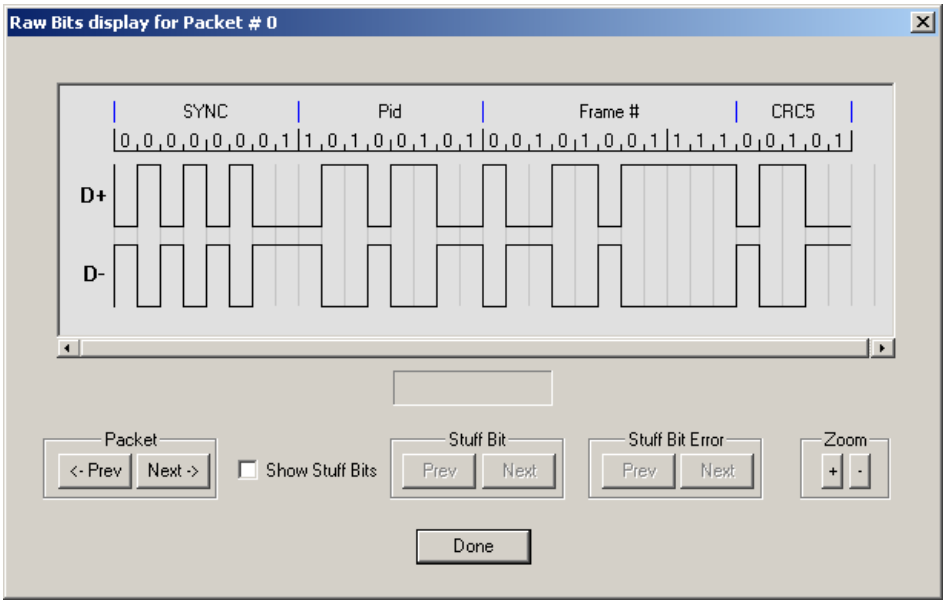
You can expand a specific packet to view the raw bits in detail.

To view the raw bits:

Step 1 Left-click **Packet #** for the packet you wish to view to display the **Packet** menu:



Step 2 Select **Show Raw Bits** to display the Raw Bits View for that packet:

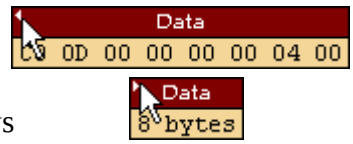


Along the top of the Raw Bits View is a linear strip of the logical bit values with corresponding field demarcations. Bit stuffing is displayed in color. Below the logical bit values is a representation of the D+/D- signaling complete with NRZ encoding. A scroll bar assists in navigation of larger packets. Two buttons under the label **Packet** are used to view previous or next packets. Two buttons under the label **Zoom** allow you to zoom in or out on packets.

8.5 Expanding and Collapsing Data Fields

You can expand a Data field to view it in greater detail or collapse it when you want a more compact view.

Using the Expand/Collapse Data Field Arrows



Data Fields can be easily expanded or collapsed by clicking the small triangular arrows on the left side of the data field.

Double-Clicking to Expand/Collapse Data Fields

Data fields can also be expanded or collapsed by double-clicking anywhere in the data field.

Expanding or Collapsing All Data Fields

Expand or collapse all data fields by holding down the button for more than a second.

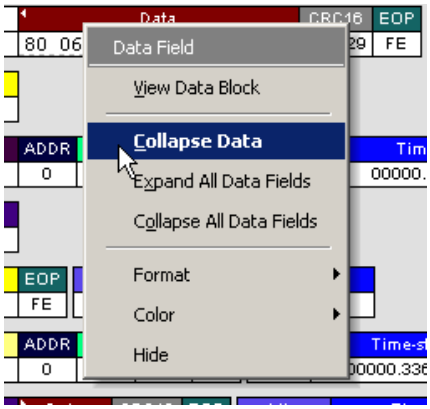
Using the Data Field Pop-up Menus

Data fields can expanded or collapsed by clicking in a data field and selecting Expand Data or Collapse Data from the pop-up menu.

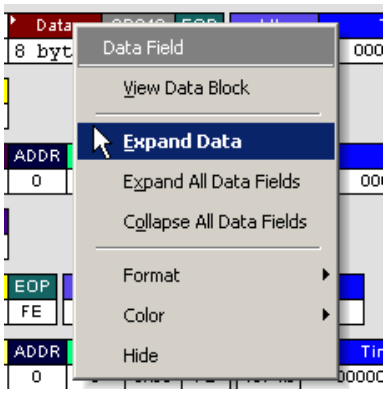
To expand and collapse data using the menu:

Step 1 Left-click **Data** in the Data packet you want to expand or collapse.

If your Data Trace View is currently expanded, you see the **Collapse Data** menu:



If your Data Trace View is currently collapsed, you see the **Expand Data** menu:



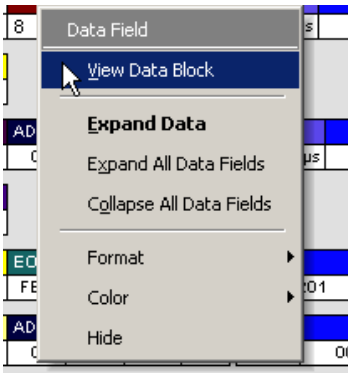
Step 2 Select the desired Expand Data or Collapse Data menu item.

The Trace View is repositioned with the selected packet(s) adjusted in the format you have specified.

Expand or Collapse All Data Fields

All data fields can be expanded or collapsed by selecting **Expand All Data Fields** or **Collapse All Data Fields** from the data field pop-up menus.

8.6 View Data Block

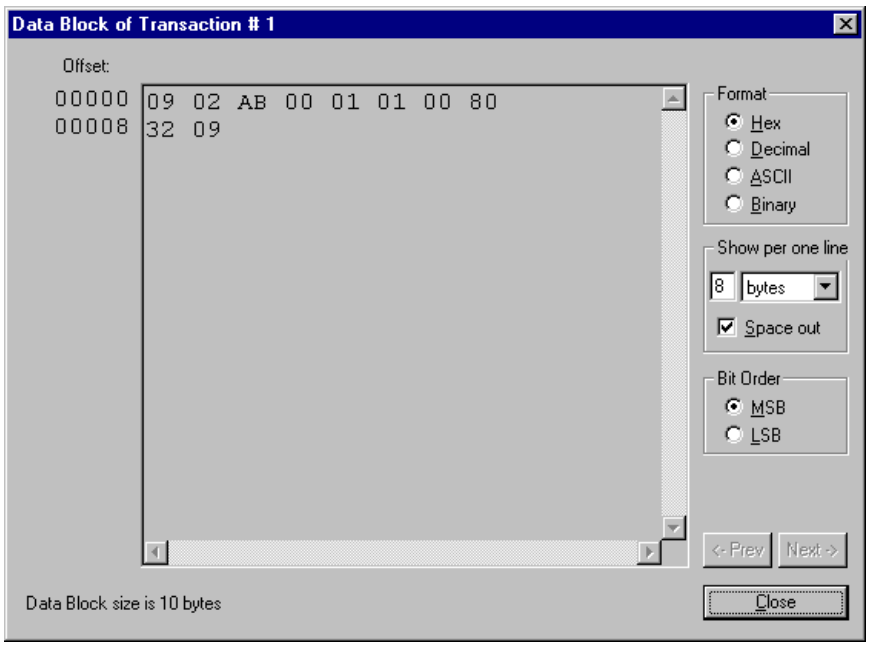


The data field pop-up menu has an option for viewing the raw bits in a data field.

To view these bits:

Step 1 Click in the data field to open the data field pop-up menu.

Step 2 Select **View Data Block**.to open the Data Block dialog box.

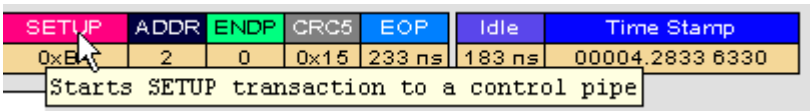


The View Data Block window has options for displaying the raw bits in different formats:

- **Format**: Lets you display data in Hex, Decimal, ASCII or Binary formats
- **Show Per Line**: Lets you control how many bits are displayed per line
- **Bit Order**: Most Significant Bit, Least Significant Bit

8.7 Pop-up Tool-tips

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



8.8 Hide SOF Packets

You can hide Start-of-Frame (SOF) packets that may be uninteresting in a given context from a Trace View by clicking the Hide SOF Packets button on the Tool Bar:

- Click to hide all SOF packets.

8.9 Hide NAKs

You can hide NAKs that may be uninteresting in a given context from a Trace View by clicking the Hide NAKs button on the Tool Bar:

- Click to hide all NAK packets.

8.10 Hide Devices

Click the button to open a menu for select any address/endpoint combination to be hidden. Hit the Ctrl key to select multiple values. This menu can be moved from its default location and floated in the trace window for later use.

8.11 Hide Chirps

Click the button to hide any Chirped-J or Chirped-K packets recorded in a USB trace.

8.12 Switch to Transactions View

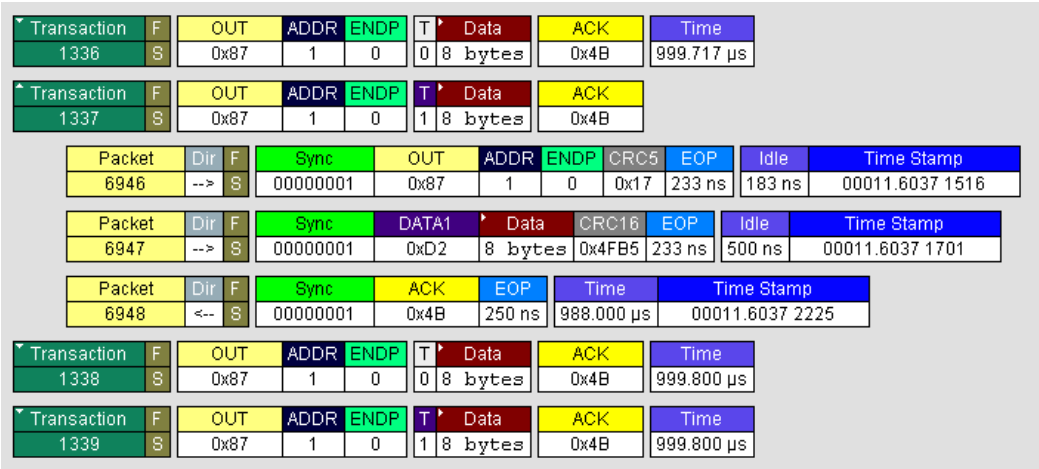
A **Transaction** is defined in the USB specification as the delivery of service to an endpoint. This consists of a token packet, an optional data packet, and an optional handshake packet. The specific packets that make up the transaction vary based upon the transaction type.

The program default display mode is Packet View. Before you can view decoded transactions, you must switch from Packet View to Transactions View.

To select Transactions View:

Step 1 Click to on the toolbar.

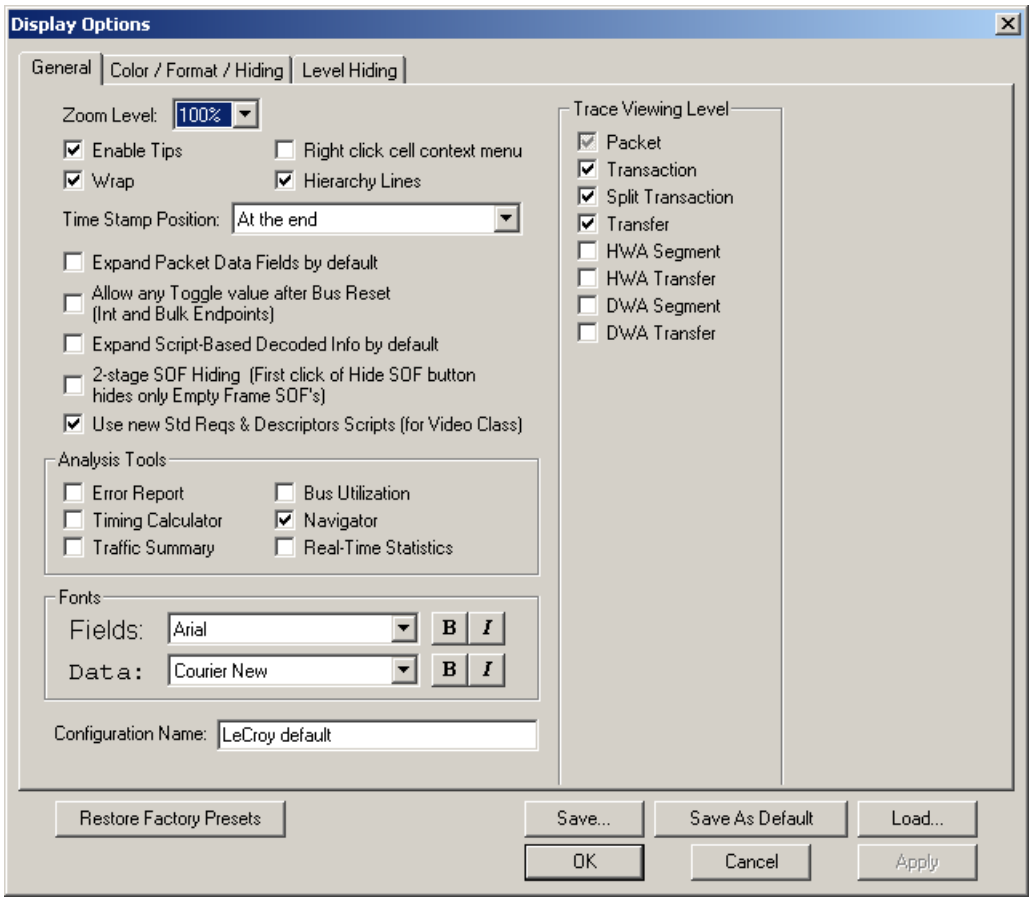
The Trace View screen is re-drawn to display Transactions.



Note This menu selection displays a check next to **Show USB transactions** when you have selected it**.** When you want to switch back to Packet View mode, right-click anywhere in the trace window and then left-click **Show USB transactions**.

You can also switch to Transaction View from the Menu Bar:

Step 1 Select **Display Options** under **Setup** to display the **Display Options General** window:

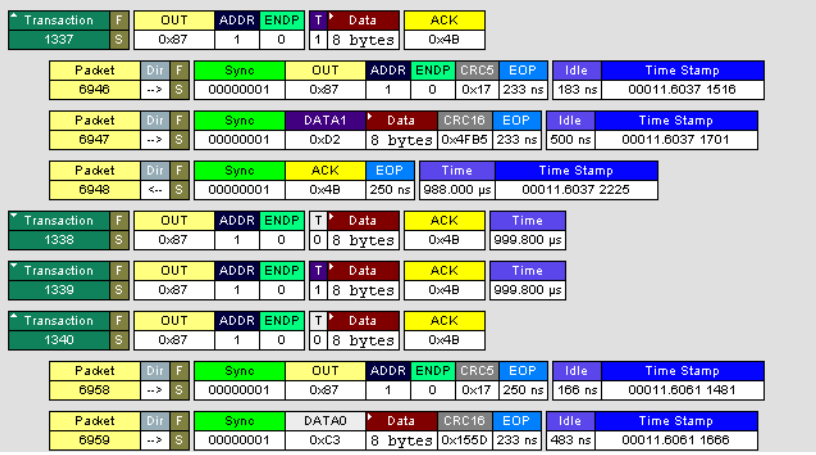


Step 2 Check **Transactions.**

Step 3 Click **OK.**

8.13 View Decoded Transactions

Once you set Display Options, the Trace View screen is re-drawn to display decoded transactions in the colors and format you selected.



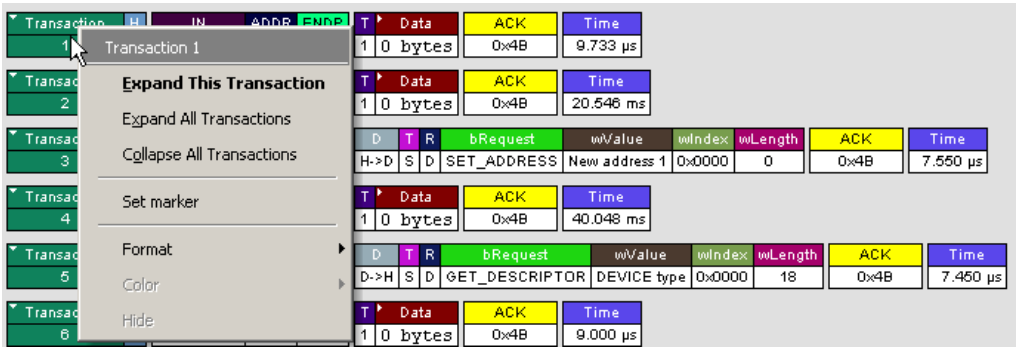
When you instruct the Analyzer to display USB transactions, the components of each transaction are collected from the current recording and are grouped and indented below each decoded transaction. Each row shows a transaction with a unique numeration, a label, and color-coded decoding of important data.

Expanded and Collapsed Transactions

You can expand a specific transaction to view its parts, which are grouped and indented below the transaction.

To expand a transaction:

Step 1 Left-click the transaction number you wish to view to display the **Expand Transaction** menu:



Step 2 Select **Expand This Transaction**.

The screen displays the selected transaction in expanded format.

Note The Expand/Collapse transaction feature operates as a toggle: when one format is active, the other appears as an option on the Expand/Collapse drop-down menu.

To collapse a transaction, perform the same operation and select **Collapse This Transaction**.

Note that you can choose to expand or collapse

- **Only** the selected Transaction

  OR

- **All** Transactions

It is not necessary to use the **Expand/Collapse Transactions** menu to shift between expanded and collapsed views of a transaction:

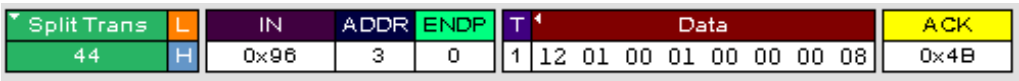
- Double-click in the Transaction number field to toggle back and forth between collapsed and expanded views.

8.14 Switch to Split Transaction View

To select Split Transaction View:

Step 1 Click the button on the toolbar.

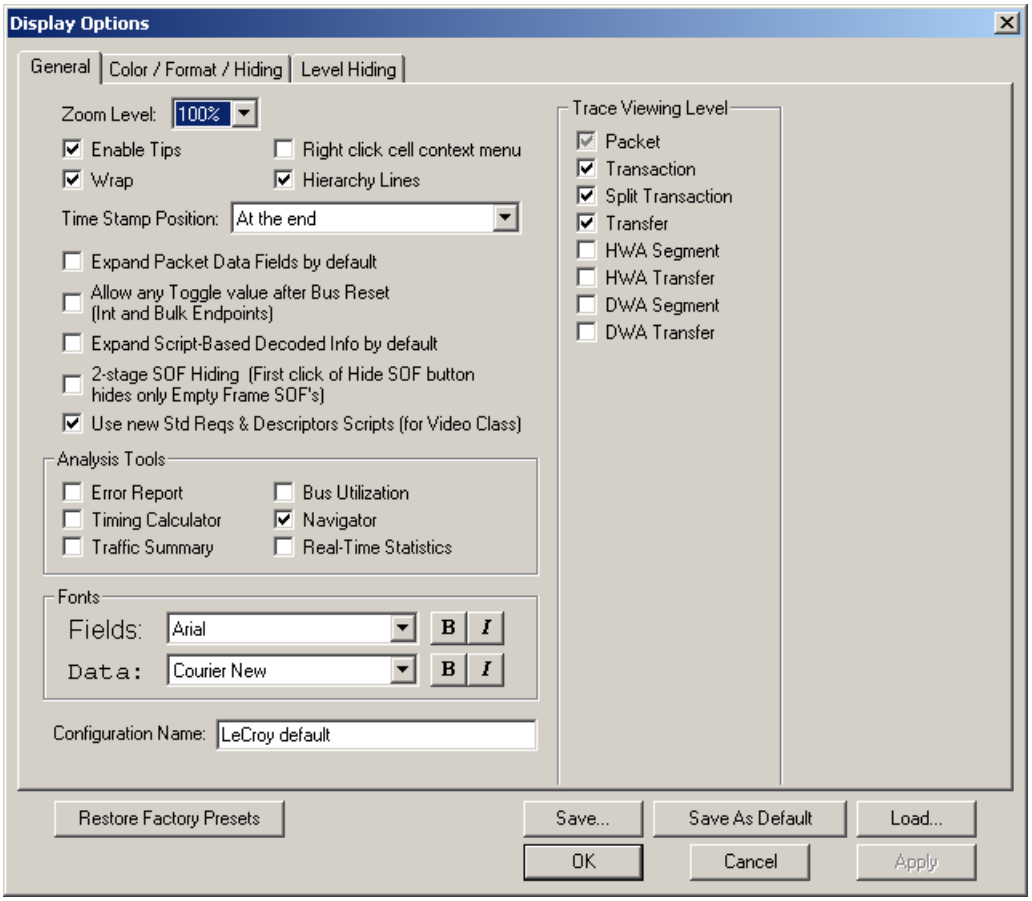
The Trace View screen is re-drawn to display Split Transactions.



You can also switch to Split Transactions View from the Menu Bar:

Step 1 Select **Display Options** under **Setup**.

You see the **Display Options General** window:



Step 2 Check **Split Transactions.**

8.15 Switch to Transfer View

A Tr**ansfer** is defined in the USB specification as one or more transactions between a software client and its function. USB transfers can be one of four kinds: Control, Interrupt, Bulk, and Isochronous. USB*Tracer*™ is capable of displaying all four types.

The default display mode is Packet View. Before you can view decoded transfers, you must switch from Packet View (or Transaction View) to Transfer View.

To select Transfer View:

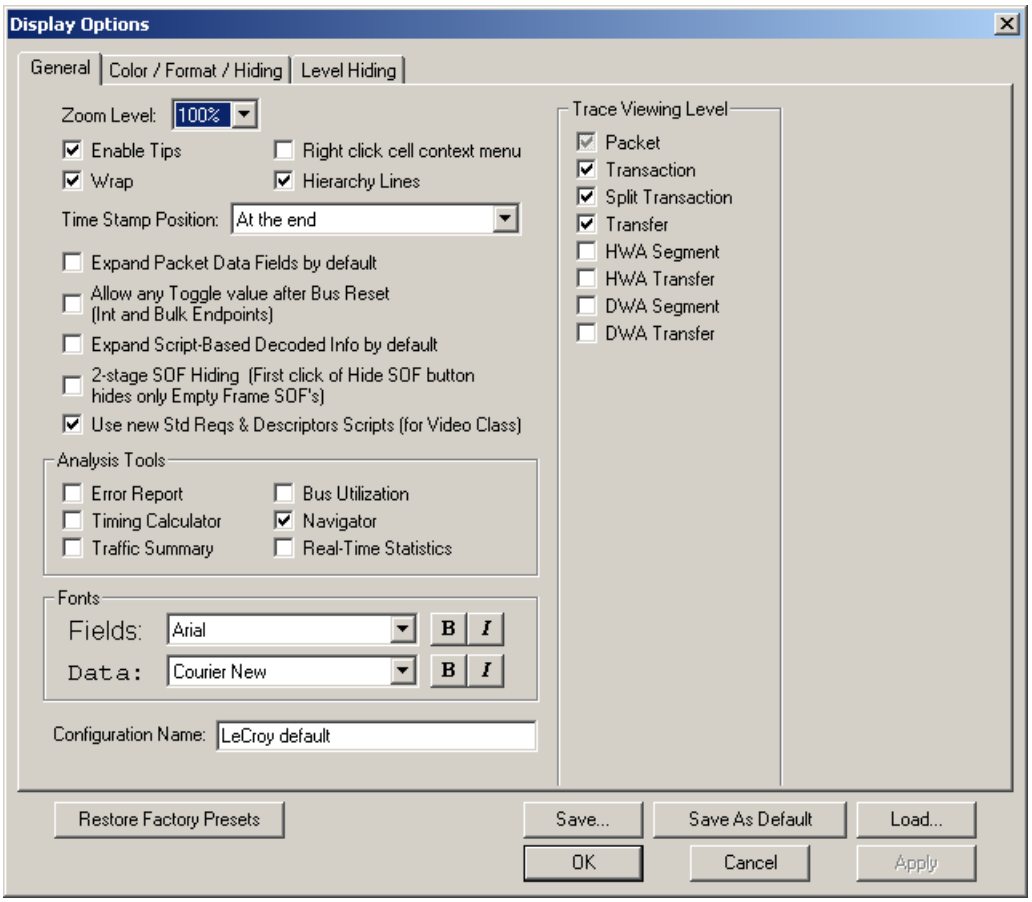
Step 1 Click on the toolbar.

The Trace View screen is re-drawn to display Transfers.

Note Selecting **Show USB transfers** adds a check next to this menu item. If you want to return to Packet View, open the menu and reselect **Show USB transfers**. This action removes the check and returns the display to Packet View.

You can also switch to Transfer View from the Menu Bar:

Step 1 Select **Display Options** under **Setup** to display the **Display Options General** window:



Step 2 Check **Transfers.**

Step 3 Click **OK.**

8.16 View Decoded Transfers

Once you set Display Options, the Trace View screen is re-drawn to display decoded transfers in the colors and format you selected.

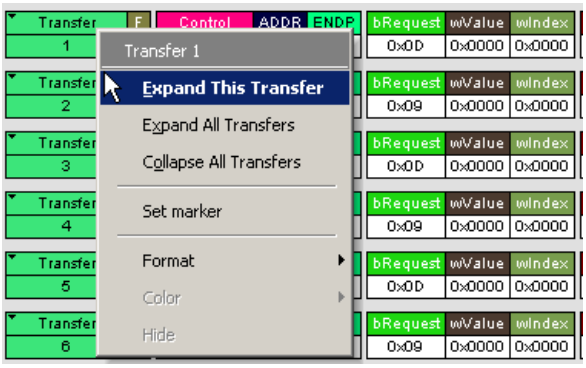
When you instruct the Analyzer to display USB transfers, the components of each transfer are collected from the current recording and are grouped below each decoded transfer. Each transfer row shows a transfer with a unique numeration, a label, and color-coded decoding of important data.

Expanded and Collapsed Transfers

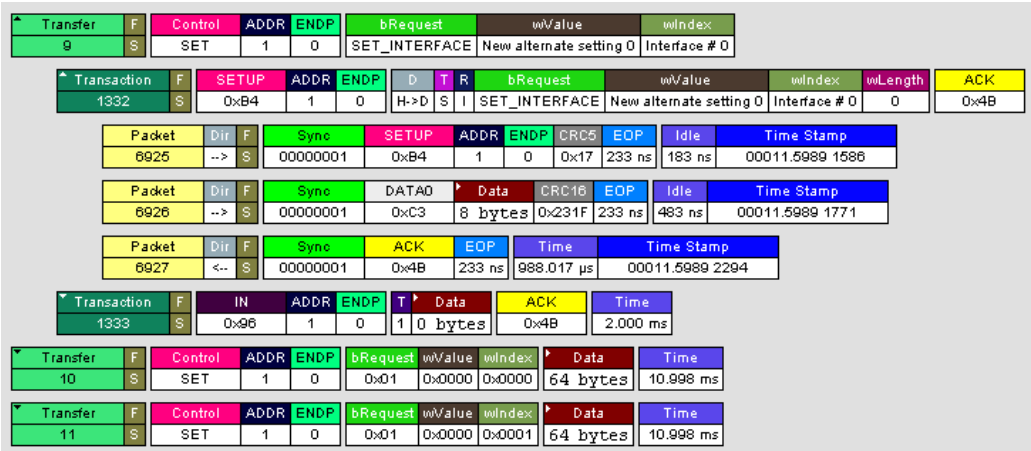
You can expand a specific transfer to view its parts, which are grouped and indented below the transfer.

To expand a transfer:

Step 1 Left-click the transfer number you wish to view to display the **Expand Transfer** menu:



Step 2 Select **Expand This USB Transfer** to display the selected transfer in expanded format.



Note The Expand/Collapse transfer feature operates as a toggle: when one format is active, the other appears as an option on the Expand/Collapse drop-down menu.

To collapse a transfer, perform the same operation and select **Collapse This USB Transfer**.

Note that you can choose to expand or collapse

- **Only** the selected Transfer

  OR

- **All** Transfers

It is not necessary to use the **Expand/Collapse Transfers** menu to shift between expanded and collapsed views of a transfers:

- Double-click in the Transfer number field to toggle back and forth between collapsed and expanded views.

8.17 Decoding Protocol-Specific Fields in Transactions/Transfers

When transfers or transactions are displayed, the fields in setup transactions or control, interrupt, and Bulk transfers by default do not get decoded and are shown in hexadecimal values. The exceptions are setup transactions and control transfers for standard USB device requests which are always decoded.

In order to show specific decoding for class- and vendor-specific device requests and endpoints, you have to use the decoding association mechanism that is described in Chapter 9 on decoding. When you have performed the association, you see the protocol-specific fields of transfers and transactions decoded in the trace view.

8.18 Switch to Host Wire Adapter Segment View

A **Host Wire Adapter Segment** is one or more transfers between a PC and a host wire adapter. To view host wire adapter segments, switch to the Host Wire Adapter Segment trace viewing level.

To select the Host Wire Adapter Segment trace viewing level:

- Click on the toolbar.

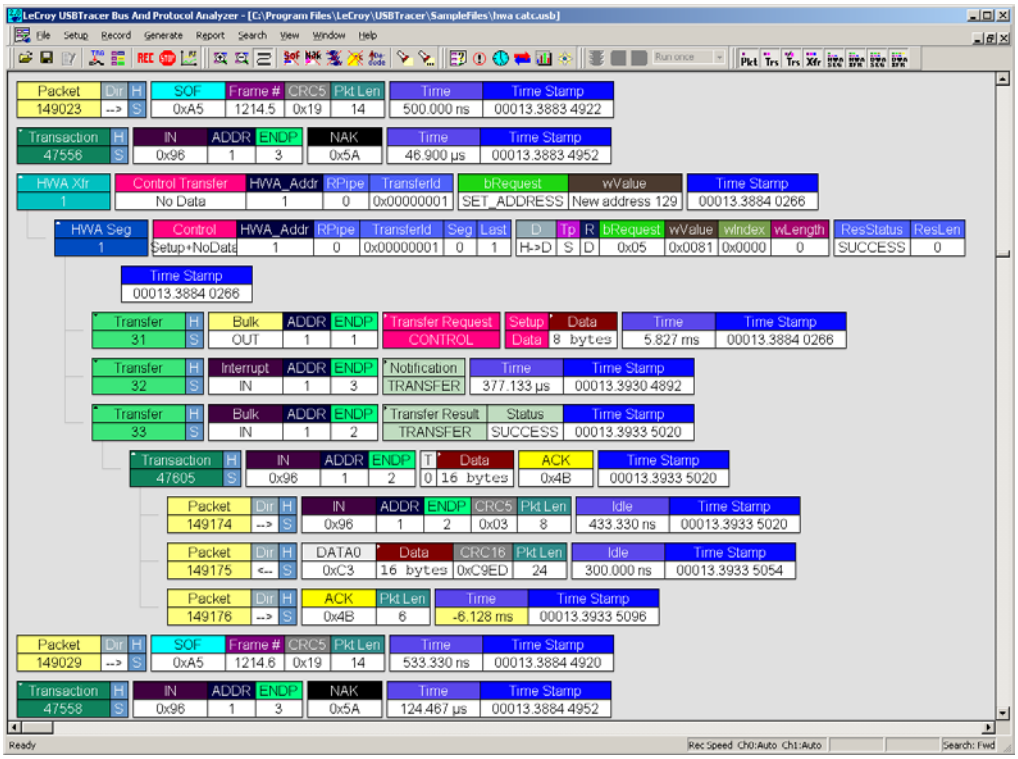
  OR

  Select **View > Show Host Wire Adapter Segment**.

  OR

  Select **Setup > Display Options** to display the Display Options window, check **HWA Segment**, and then click **OK.**

  The program redraws the trace view.



8.19 Switch to Host Wire Adapter Transfer View

A **Host Wire Adapter Transfer** is one or more wire adapter segments or one or more transfers between a PC and a host wire adapter. To view host wire adapter transfers, switch to the Host Wire Adapter Transfer trace viewing level.

To select the Host Wire Adapter Transfer trace viewing level:

- Click on the toolbar.

  OR

  Select **View > Show Host Wire Adapter Transfer**.

  OR

  Select **Setup > Display Options** to display the Display Options window, check **HWA Transfer**, and then click **OK.**

8.20 Switch to Device Wire Adapter Segment View

A **Device Wire Adapter Segment** is one or more transfers between a PC and a device wire adapter. To view device wire adapter segments, switch to the Device Wire Adapter Segment trace viewing level.

To select the Device Wire Adapter Segment trace viewing level:

- Click on the toolbar.

  OR

  Select **View > Show Device Wire Adapter Segment**.

  OR

  Select **Setup > Display Options** to display the Display Options window, check **DWA Segment**, and then click **OK.**

8.21 Switch to Device Wire Adapter Transfer View

A **Device Wire Adapter Transfer** is one or more wire adapter segments or one or more transfers between a PC and a device wire adapter. To view device wire adapter transfers, switch to the Device Wire Adapter Transfer trace viewing level.

To select the Device Wire Adapter Transfer trace viewing level:

- Click on the toolbar.

  OR

  Select **View > Show Device Wire Adapter Transfer**.

  OR

  Select **Setup > Display Options** to display the Display Options window, check **DWA Transfer**, and then click **OK.**

8.22 Using the Trace Navigator

You can use the Trace Navigator to show the structure of the entire trace from different points on the Trace view, thereby refining the trace view to a packet range in the trace that is most interesting to you. This range can be set by you to show smaller parts of the trace.

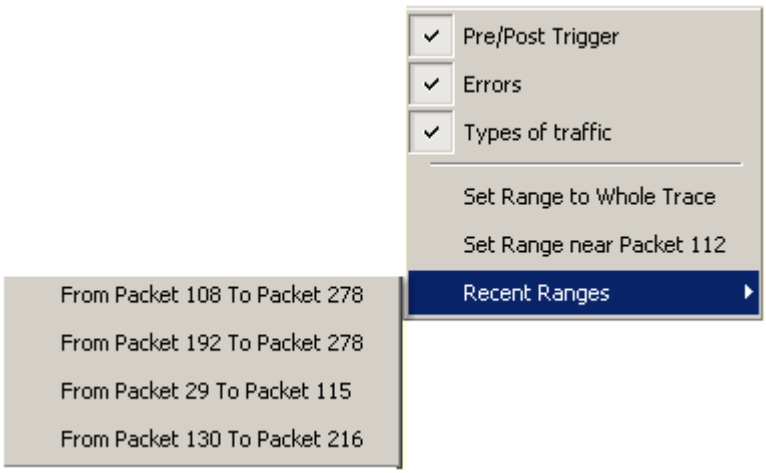
To display the Navigator bar, click in the toolbar or select the Navigation Bar checkbox in the Display Options General window.

The Navigator bar can be repositioned in the trace and can be oriented horizontally or vertically, docked or undocked by dragging the parallel bars at the top or side of the Navigator bar. By default, the Navigator bar appears vertically to the right of the trace window.

The Navigator bar represents different types of trace information in the order of the packets. The top of each bar corresponds to the first packet in the trace, and the bottom corresponds to the last packet. The Navigator bar is made up of three parts: Pre and Post-Trigger traffic, errors, and types of traffic.

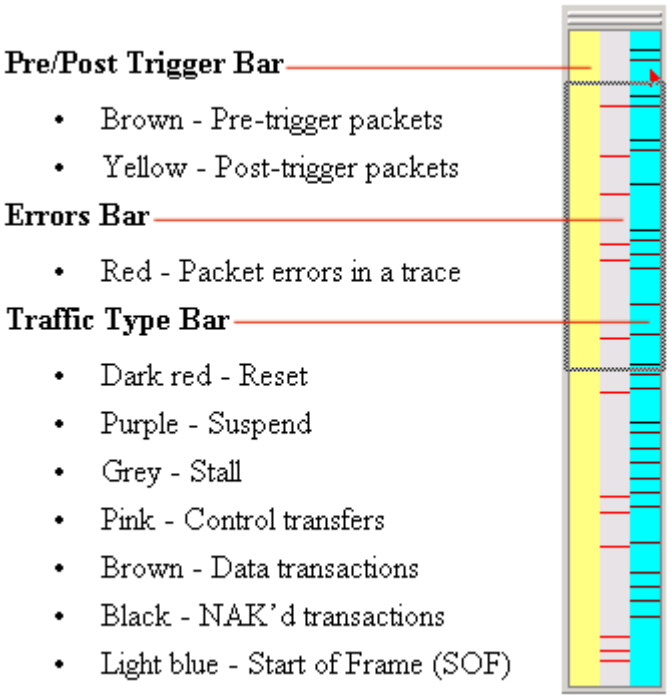
At any time, a line in the navigator bar of one pixel in height represents a fraction of the trace data. If the Navigation bar is 400 pixels high, then each bar in this example would represent 1/400 of the trace. If the trace had 4000 packets total, each bar would represent ten packets. In the Types of Traffic portion of the navigation bar, the color of the bar would be that of the most important item in those ten packets. See "Navigator Bar Attributes" on the next pages.

Drag the square at the top of bottom to set the size of a packet range. Drag the entire square to set the packet range to different values. A bubble appears showing the packet range while you are setting it. Right-click the Navigator to display the pop-up menu.



- **Pre/Post Trigger, Errors, Types of Traffic**: Shows or hides specific type of traffic from the Navigator.
- **Set Range to Whole Trace**: Resets packet range to the entire trace.
- **Set Range near Packet number**: Sets the packet range near the packet where your mouse pointer is positioned in the Navigator bar.
- **Recent Ranges**: Displays a history of ranges that were previously selected.

Navigator Bar Attributes



The traffic types above are shown in order of importance. For example, if a NAK'd transaction occurred in the same sample area as a SOF, the NAK would take precedence, and the Navigator would show the black bar.

9. Decode Requests

9.1 Class and Vendor Definition Files

LeCroy analyzers use script files to decode class and vendor requests. The script files are read when the application is initialized. Once read, the analyzer then decodes class and vendor requests as instructed by the files.

.REQ Files and .DSC Files - Represent the old method of decoding. **.REQ** stands for Requests and **.DSC** stands for Descriptors. This method was originally developed for some of LeCroy's earlier USB analyzers and uses fixed definitional structures. LeCroy provides **.req** files for the following requests and classes:

- **Standard Requests** (**standard.req**)
- **Hub Class** (**hub.req**): No longer used: replaced by Script Decoder version **.dec** files
- **HID Class** (**hid.req**)
- **Printer Class** (**printer.req**)
- **Communications Class** (**communication.req**)
- **Audio Class** (**audio.req**)
- **Bluetooth USB HCI commands and events** (**bluetooth.req**): No longer used: replaced by Script Decoder version **.dec** files)
- **Vendor Request definition file** (**vendor.req**)

To add your own **.req** file for a Class or Vendor Request:

Step 1 Use the **Notepad** application to create and edit your own Request Definition file (for example, **my_vendor_commands.req**).

Note To learn to write such a file, review the Request (**.req**) files provided by LeCroy.

Step 2 Add the name of your Request file to the **request.lst** file.

Step 3 Click **Setup**. The decoding menu in the Class/Vendor List appears.

.DEC Files - Represents the new method of decoding. DEC stands for "decoder" and describes both Class and Vendor requests in a C-like language. The .**DEC** files are in the **Scripts** directory under the application directory. Each **.dec** file stores an endpoint or request decode. When the application starts, these files are loaded dynamically. Subdirectories are supported.

The following **.dec** files are provided:

- Hid
- Mass Storage Class
  - SCSI Bulk Protocol
  - UFI CBI Protocol
- PTP Still Image Class Requests
- Smart Card
- Standard Requests
- Video Class Requests
- Virtual
- Wire Adapter Class Requests and Radio Control Request

You can create your own **.dec** file for a Class or Vendor Request. For more information on the format of these Script Decoder files and the Script Decoding language, read the ***Script Decoder Manual***.

9.2 Class/Vendor Decoding Options

You can permanently assign a class or vendor decoding for an address and/or endpoint or interface in a trace file. Once assigned, the decoding occurs automatically when you display transactions.

Mapping Request Recipient to Class/Vendor Decoding

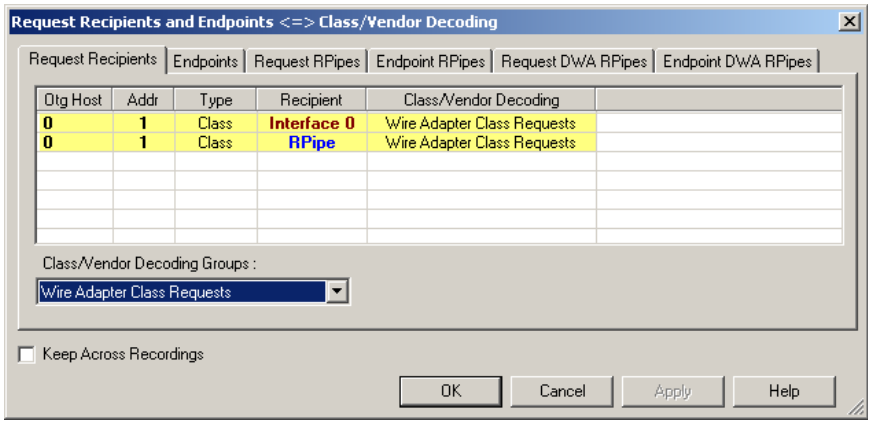
To assign a decoding group to a request recipient,

Step 1 Click the **Apply Decoding Scripts** button on the Toolbar.

OR

Left-click the **Control Transfer** field to display the USB Device Request menu:

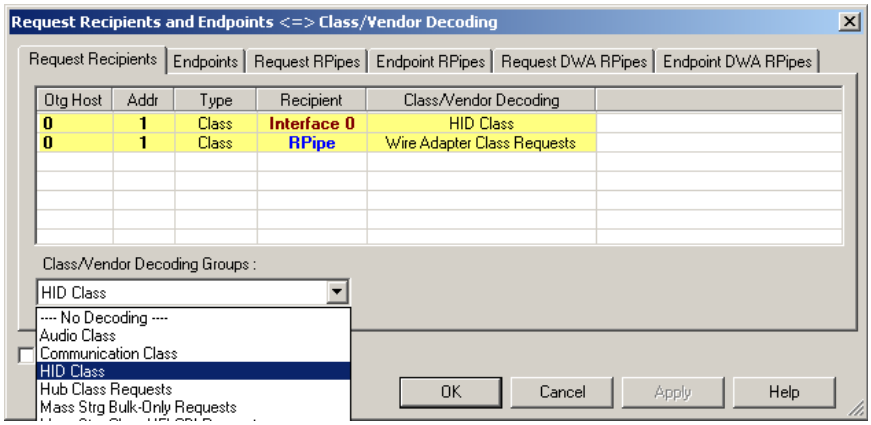
Step 2 Select **Map Request Recipients to Class/Vendor Decoding** to display the Request Recipient and Endpoints dialog box:



The Recipient field shows all Class and Vendor Request Recipients found in the trace file. The display shows the Host, Address, and Type (Class or Vendor) for the recipient. On the right are the names of Class/Vendor Decoding groups currently assigned to recipients. If blank, no decoding is assigned for a recipient.

Step 3 Select a recipient.

Step 4 Display the **Class/Vendor Decoding Groups** drop-down menu.



The drop-down menu lists the defined Class/Vendor request decoding groups. The Class/Vendor Decoding Groups are:

- No Decoding
- Audio Class
- Communication Class
- HID Class
- HUB Class Requests
- Mass-Strg Bulk-only Requests
- Mass-Strg Class UFI CBI Requests
- Printer Class
- PTP Still Image Class Requests
- Standard Requests
- Video Class Requests
- Wire Adapter Radio Control Requests
- Wire Adapter Class Requests

Step 5 Select a decoding group.

OR

Select **No Decoding** if you do not want any specific decoding.

Step 6 Repeat the previous steps for additional recipients.

Step 7 To retain a mapping from trace to trace DURING an application session, select the **Keep Across Recordings** checkbox.

Step 8 Click **OK**.

Mapping Endpoint to Class/Vendor Decoding

To assign a Class/Vendor Endpoint decoding,

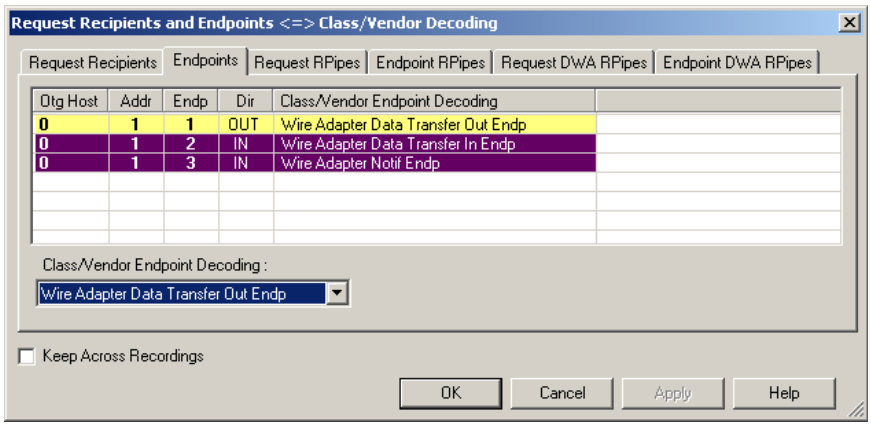
Step 1 Click the **Apply Decoding Scripts** button on the Toolbar.

OR

Left-click the **Bulk/Int Transfer** field to display the USB Device Request menu.

Step 2 Select **Map Endpoint to Class/Vendor Decoding** to display the Request Recipients and Endpoints dialog box.

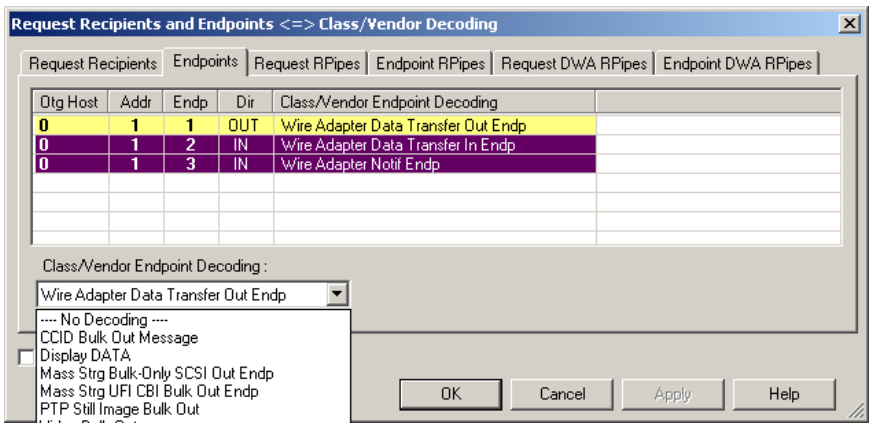
Step 3 Click the **Endpoints** tab to display the **Endpoints** dialog box.



The Endpoint field (Endp) shows all Endpoints found in the trace file. The displays shows the Host, Address, and Direction for the recipient. On the right are the names of Class/Vendor Endpoint Decoding groups currently assigned to endpoints. If blank, no decoding is assigned for a recipient.

Step 4 Select an endpoint.

Step 5 Display the **Class/Vendor Endpoint Decoding** drop-down menu:



The Class/Vendor Endpoint Decoding options for an OUT endpoint are:

- No Decoding
- CCID Bulk Out Message
- Display DATA
- Mass Strg Bulk-Only SCSI Out Endp
- Mass Strg UFI_CBI Bulk Out Endp
- PTP Still Image Bulk Out
- Video Bulk Out
- Video Isoch Out
- Virtual UART
- Wire Adapter Data Transfer Out Endp

The Class/Vendor Endpoint Decoding options an IN or Interrupt endpoint are:

- No Decoding
- CCID Bulk In Message
- Communication Class Notification
- Display DATA
- HID In Endp
- Hub Class Status Change Endp
- Mass Strg Bulk-Only SCSI In Endp
- Mass Strg CBI Interrupt Endp
- Mass Strg UFI_CBI Bulk In Endp
- Mass Strg UFI_CBI Interrupt Endp
- PTP Still Image Bulk In
- PTP Still Image Interrupt
- Video Bulk In
- Video Interrupt
- Video Isoch In
- Virtual UART
- Wire Adapter Radio Notif Endp
- Wire Adapter Data Transfer In Endp
- Wire Adapter Notif Endp

Step 6 Select the type of decoding.

OR

Select **No Decoding** if you do not want any specific decoding.

Step 7 Repeat the previous steps for any additional endpoints you would like to map.

Step 8 To retain a mapping from trace to trace DURING an application session, select the **Keep Across Recordings** checkbox.

Step 9 Click **OK**.

Mapping Request RPipe to Class/Vendor Decoding

Before mapping Request RPipes to Class/Vendor Decoding, you must first assign the following endpoint decoders:

- Wire Adapter Data Out
- Wire Adapter Data In
- Wire Adapter Notif

To assign a decoding group to a Request RPipe:

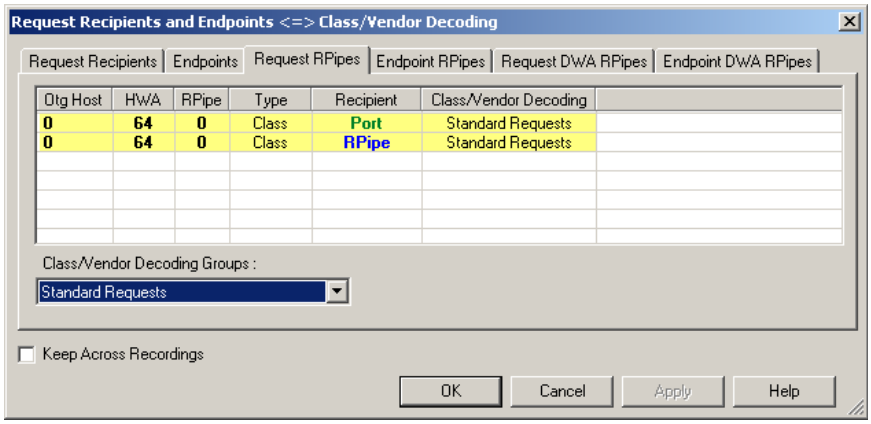
Step 1 Click the **Apply Decoding Scripts** button on the Toolbar.

OR

Left-click the **Control Transfer** field to display the USB Device Request menu.

Step 2 Select **Map RPipe to Class/Vendor Decoding** to display the Request Recipient and Endpoints dialog box.

Step 3 Click the **Request RPipes** tab to display the Request RPipes dialog box:



The Recipient field shows all Class and Vendor Request recipients found in the trace file. The RPipe field shows all Class and Vendor Request RPipes found in the trace file. The displays shows the Otg Host, HWA address, and Type (Class or Vendor) for the recipient. On the right are the names of Class/Vendor Decoding groups currently assigned to recipients. If blank, no decoding is assigned for a recipient.

Step 4 Select a recipient.

Step 5 Display the **Class/Vendor Decoding Groups** drop-down menu. The Class/Vendor Decoding Groups are the same as for Request Recipients.

Step 6 Select a decoding group.

OR

Select **No Decoding** if you do not want any specific decoding.

Step 7 Repeat the previous steps for additional recipients.

Step 8 To retain a mapping from trace to trace DURING an application session, select the **Keep Across Recordings** checkbox.

Step 9 Click **OK**.

Mapping Endpoint RPipe to Class/Vendor Decoding

To assign a Class/Vendor Endpoint RPipes decoding:

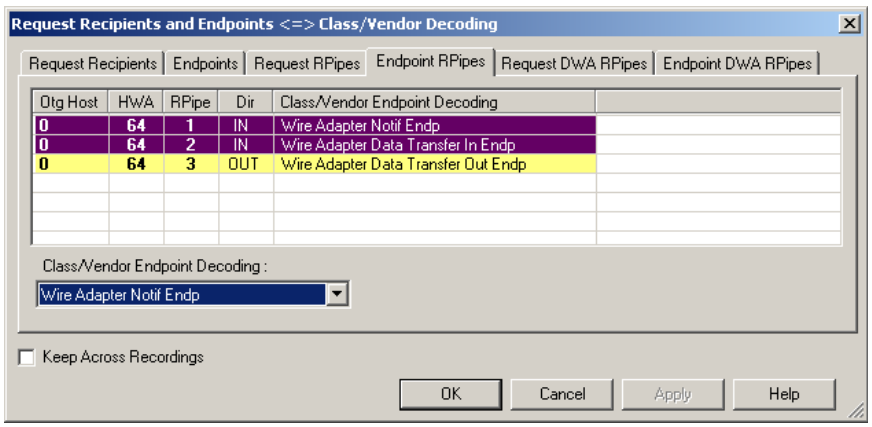
Step 1 Click the **Apply Decoding Scripts** button on the Toolbar.

OR

Left-click the **Bulk/Int Transfer** field to display the USB Device Request menu.

Step 2 Select **Map Endpoint RPipe to Class/Vendor Decoding** to display the Request Recipients and Endpoints dialog box.

Step 3 Click the **Endpoint RPipes** tab to display the Endpoint RPipes dialog box:



The RPipe field shows all RPipes found in the trace file. The displays shows the Otg Host, HWA address, and Direction for the recipient. On the right are the names of Class/Vendor Endpoint Decoding groups currently assigned to endpoints. If blank, no decoding is assigned for a recipient.

Step 4 Select an endpoint RPipe.

Step 5 Display the **Class/Vendor Endpoint Decoding** drop-down menu. The Class/Vendor Endpoint Decoding options are the same as for Endpoints.

Step 6 Select the type of decoding.

OR

Select **No Decoding** if you do not want any specific decoding.

Step 7 Repeat the previous steps for any additional RPipes you would like to map.

Step 8 To retain a mapping from trace to trace DURING an application session, select the **Keep Across Recordings** checkbox.

Step 9 Click **OK**.

Mapping Request DWA RPipe to Class/Vendor Decoding

Before mapping Request DWA RPipes to Class/Vendor Decoding, you must first assign the following endpoint decoders:

- Wire Adapter Data Out
- Wire Adapter Data In
- Wire Adapter Notif

To assign a decoding group to a Request RPipe:

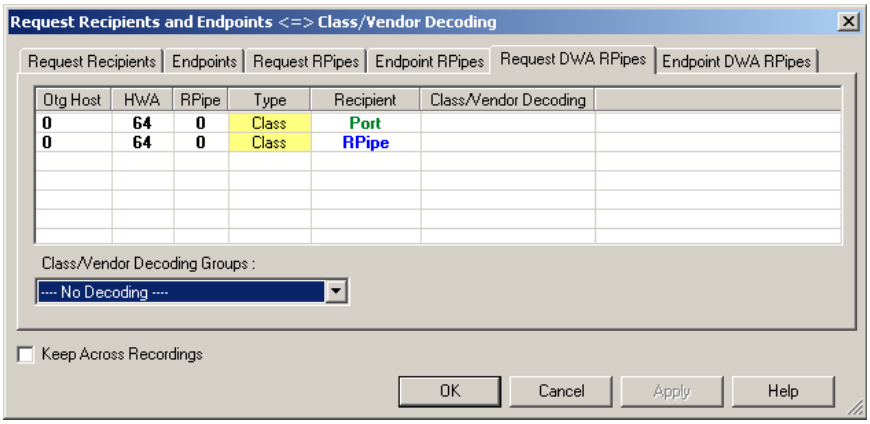
Step 1 Click the **Apply Decoding Scripts** button on the Toolbar.

OR

Left-click the **Control Transfer** field to display the USB Device Request menu.

Step 2 Select **Map DWA RPipe to Class/Vendor Decoding** to display the Request Recipient and Endpoints dialog box.

Step 3 Click the **Request DWA RPipes** tab to display the Request DWA RPipes dialog box:



The Recipient field shows all Class and Vendor Request recipients found in the trace file. The RPipe field shows all Class and Vendor Request RPipes found in the trace file. The displays shows the Otg Host, HWA address, and Type (Class or Vendor) for the recipient. On the right are the names of Class/Vendor Decoding groups currently assigned to recipients. If blank, no decoding is assigned for a recipient.

Step 4 Select a recipient.

Step 5 Display the **Class/Vendor Decoding Groups** drop-down menu. The Class/Vendor Decoding Groups are the same as for Request Recipients.

Step 6 Select a decoding group.

OR

Select **No Decoding** if you do not want any specific decoding.

Step 7 Repeat the previous steps for additional recipients.

Step 8 To retain a mapping from trace to trace DURING an application session, select the **Keep Across Recordings** checkbox.

Step 9 Click **OK**.

Mapping Endpoint DWA RPipes to Class/Vendor Decoding

To assign a Class/Vendor Endpoint DWA RPipes decoding:

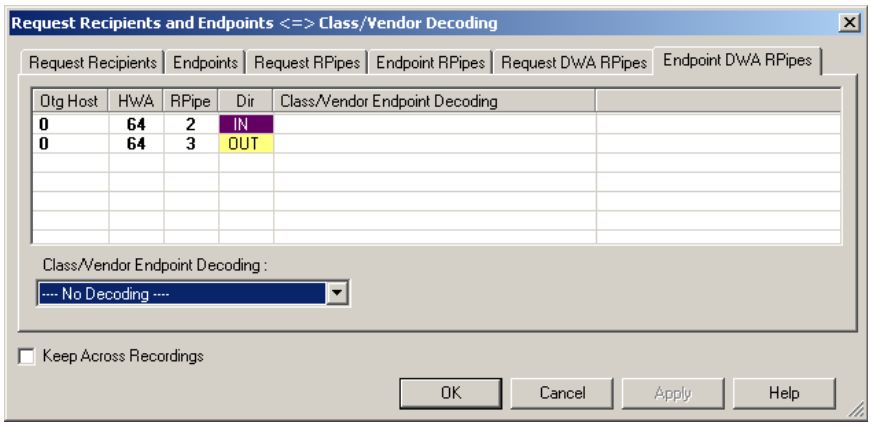
Step 1 Click the **Apply Decoding Scripts** button on the Toolbar.

OR

Left-click the **Bulk/Int Transfer** field to display the USB/WUSB Device Request menu.

Step 2 Select **Map Endpoint RPipe to Class/Vendor Decoding** to display the Request Recipients and Endpoints dialog box.

Step 3 Click the **Endpoint RPipes** tab to display the Endpoint RPipes dialog box:



The RPipe field shows all RPipes found in the trace file. The displays shows the Otg Host, HWA address, and Direction for the recipient. On the right are the names of Class/Vendor Endpoint Decoding groups currently assigned to endpoints. If blank, no decoding is assigned for a recipient.

Step 4 Select an endpoint DWA RPipe.

Step 5 Display the **Class/Vendor Endpoint Decoding** drop-down menu. The Class/Vendor Endpoint Decoding options are the same as for Endpoints.

Step 6 Select the type of decoding.

OR

Select **No Decoding** if you do not want any specific decoding.

Step 7 Repeat the previous steps for any additional RPipes you would like to map.

Step 8 To retain a mapping from trace to trace DURING an application session, select the **Keep Across Recordings** checkbox.

Step 9 Click **OK**.

9.3 General Options

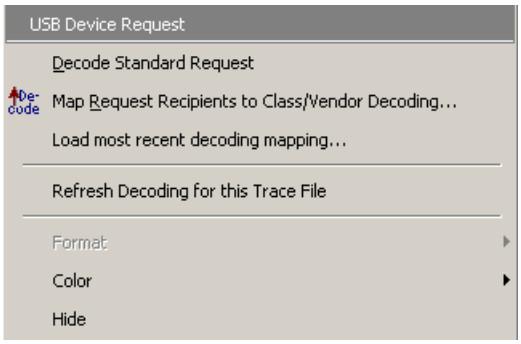
Commands are transferred on USB using special control transfers called USB Device Requests. The Analyzer can decode Device Requests as they are defined in the USB specifications and various Device Class and Vendor specifications.

Each USB Device Request is sent using a Control Transfer. Each Control Transfer starts with a SETUP transaction.

Decoding USB Device Requests

To decode a USB Device Request:

Step 1 Left-click the **Control Transfer** field or the **SETUP** field of the USB Device Request to display the USB Device Request menu:



Note The menus shown in this section are context-sensitive. You may see slightly different menus.

Step 2 To refresh decoding, click Refresh Decoding for this Trace File. Use this option to reanalyze all transactions.

Step 3 To use the previous decoding, click **Load most recent decoding mapping**.

This option loads the most recent mapping of endpoints/requests to decoding types that was done on a previous trace. If the endpoints of the new trace are the same as the last one mapped, the mappings are applied to the current trace. This saves the user from having to constantly apply the mapping to a new trace every time the application is restarted and a new trace created.

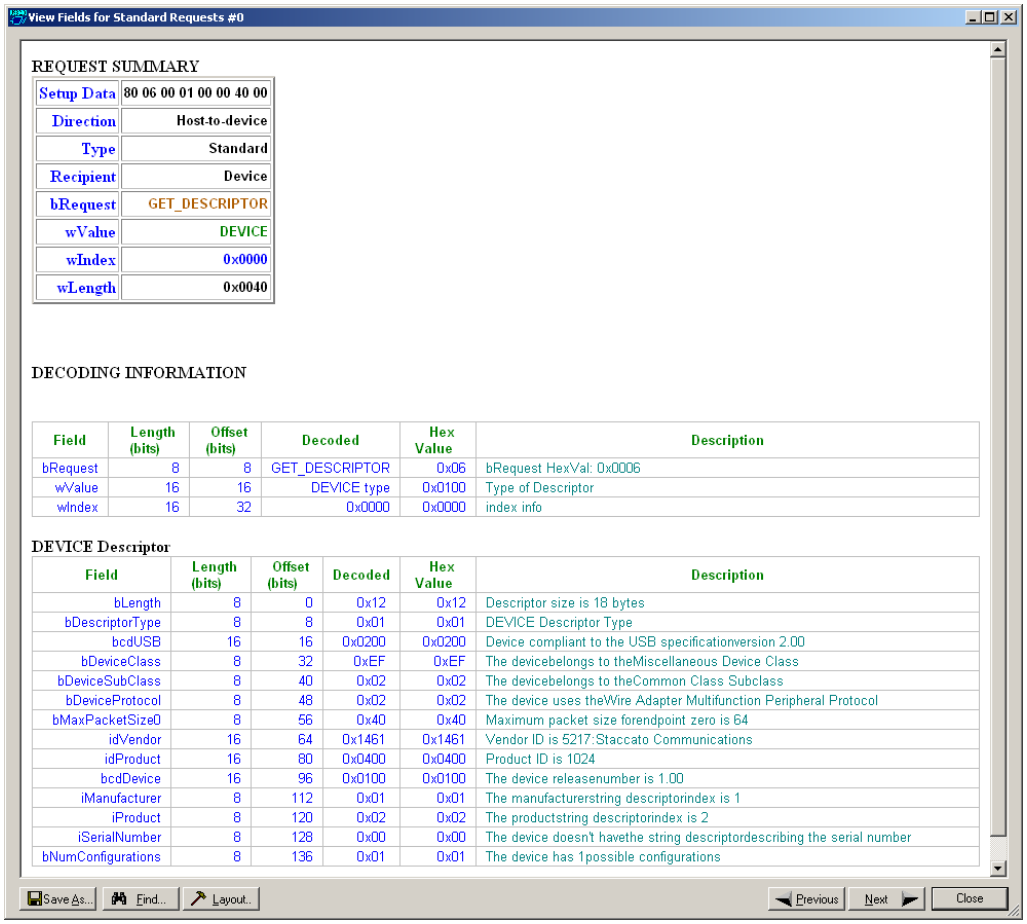
The ability to retain the mapping from trace to trace DURING an application session already exists: the Keep Across Recordings button in the endpoint map dialog. This new feature simplifies the process when the application has been re-started.

Note: You can also change the format, color, and hidden status of fields, using the same methods as in Display Options. (See Chapter 6, Display Options.)

Decoding Standard Requests

To decode a standard request:

Step 1 From the USB Device Request menu, select **Decode Standard Request** to display the View Fields for Standard Request text box:



Step 2 To find a word in the text box, click the **Find** button. Enter the word in the Find What field. To use a case-sensitive search, check **Match Case**. To find only the exact word, check **Match Whole Word Only.** You can search **Up** or **Down**. To search, click **Find Next.**

Step 3 To save the View Fields text box as an HTML file, click the **Save As** button, enter a file name in the Save As dialog box, then click **Save**.

Step 4 To view the previous or next Transfer Control field request of the same request type, click **Previous** or **Next**.

The View Fields for Standard Request dialog box displays field definitions and values of the Standard Request.

For field definitions, please refer to the *Universal Serial Bus Specification, version 2.0*. The USB specification is available from the USB Implementers Forum (USB-IF) at:

USB Implementers Forum
1730 SW Skyline Blvd.
Suite 203
Portland, OR 97221

Tel: +1/503.296.9892
Fax: +1/503.297.1090
Web: http://www.usb.org/

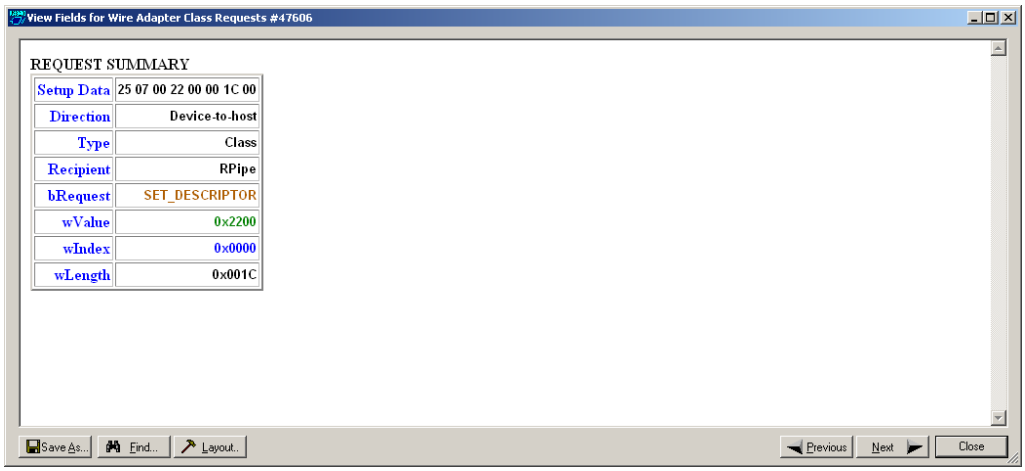
Decoding Class Requests

Examples of a class request are Mass-Strg Class UFI CBI Requests, PTP Still Image Class Requests, Video Class Requests, and Wire Adapter Class Requests.

To decode a class request:

Step 1 From the USB Device Request menu, select **Decode ... Request** to display the View Fields for ... Class Requests text box.

The following figure shows a Wire Adapter Class Requests decoding:



Decoding Vendor Requests

To decode a vendor request:

- From the USB Device Request menu, select **Decode ... Request** to display the View Fields for ... Vendor Requests text box.

An example of a vendor request is UWBTracer™ Command Set.

Decoding Undefined USB/WUSB Device Requests

A Decoding Request may not belong to any of the defined decoding groups (Standard, Class, or Vendor).

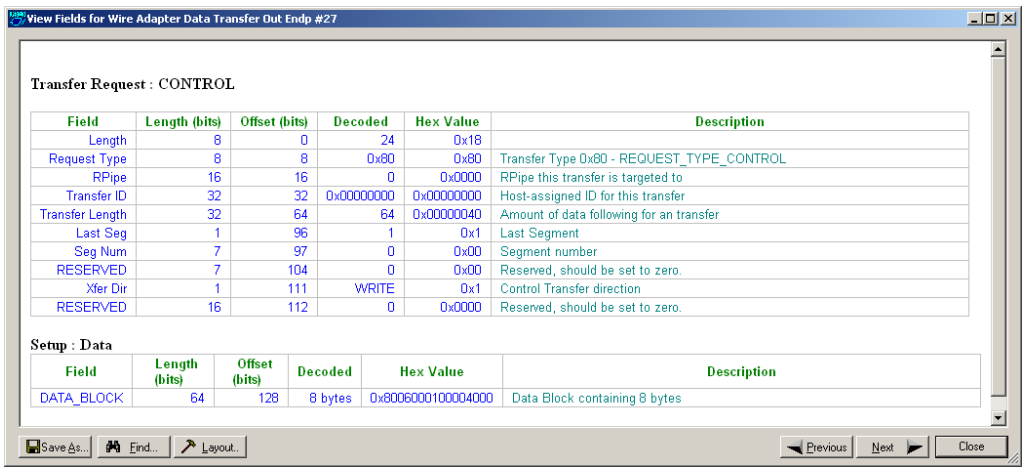
Decoding using Endpoint Information

To decode using the endpoint information:

Step 1 Left-click the **Bulk/Int Transfer** field to display the Bulk/Int Transfer (IN/OUT transaction with data) menu.

Step 2 Select **Decode as ... Endp** to open a View Fields for ... Endp text box.

The following figure shows a Wire Adapter Data Transfer Out Endp decoding:



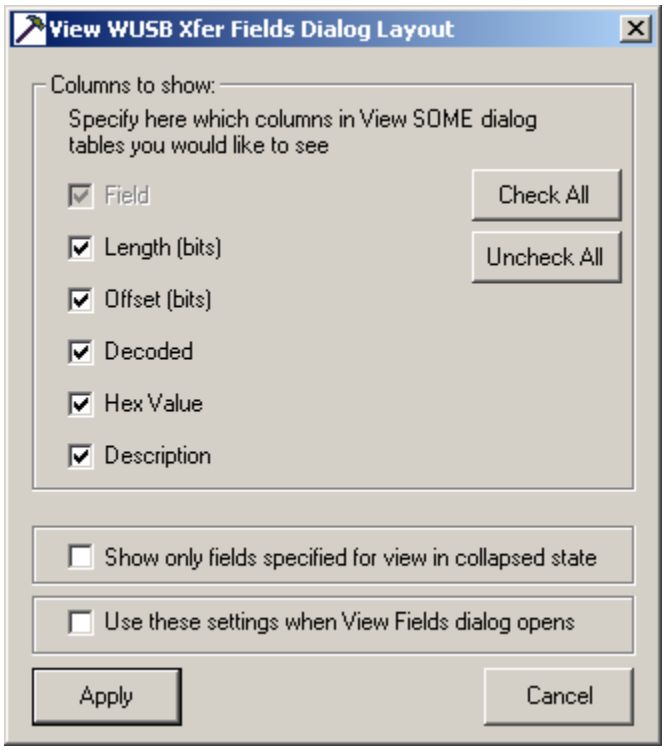
Changing the Layout of Decode Requests

In the View ... Fields windows, the Decoding Information and the Descriptor information blocks (following the Request Summary information) have the following columns:

- **Field**: such as bRequest, wValue, wIndex, bLength, bDescriptorType, wTotalLength
- **Length in bits**
- **Offset in bits**
- **Decoded**: hex value typically equal to Hex Value
- **Hex Value**: hex value typically equal to Decoded
- **Description**: short description of field

To change the layout of decode requests display:

Step 1 Click **Layout** to display the View ... Fields Dialog Layout dialog box:



Step 2 To display the available columns of data, use the checkboxes for **Length, Offset, Decoded, Hex Value**, and **Description**.

You can **Check All** or **Uncheck All**.

Step 3 To show only the fields of Collapsed mode, check **Show only fields specified for view in collapsed mode**.

Step 4 To retain settings for future viewing of Decode Request fields, check **Use these settings when View Fields dialog opens**.

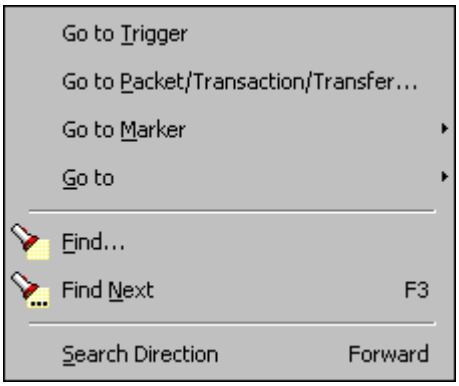
10. Other Features

10.1 Search

The Search feature provides several options for searching through recorded traffic, allowing you to find specific packets based on triggering status, packet number, marking, or content.

To view the Search options:

- Click **Search** in the Menu bar to display the Search drop-down menu:



Go to Trigger

Note **Go to Trigger** is enabled only when a trigger has created the traffic file.

To display a Trigger Event:

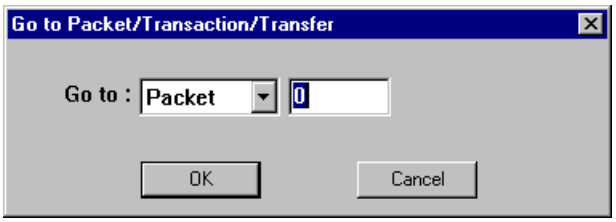
- Select **Go to Trigger** under **Search** on the Menu Bar.

The Trace View is repositioned to the first packet following the Trigger event. This packet is at the top of the screen.

Go to Packet/Transaction/Transfer

To display a specific packet:

Step 1 From the menu bar, select the command **Search > Go to Packet/Transaction/Transfer** to display the **Go to Packet** window:



Step 2 Select the desired viewing level (packet, transaction etc.) from the drop-down menu next to the words **Go to**.

Step 3 Enter the number of the packet you want to display.

Step 4 Click **OK.**

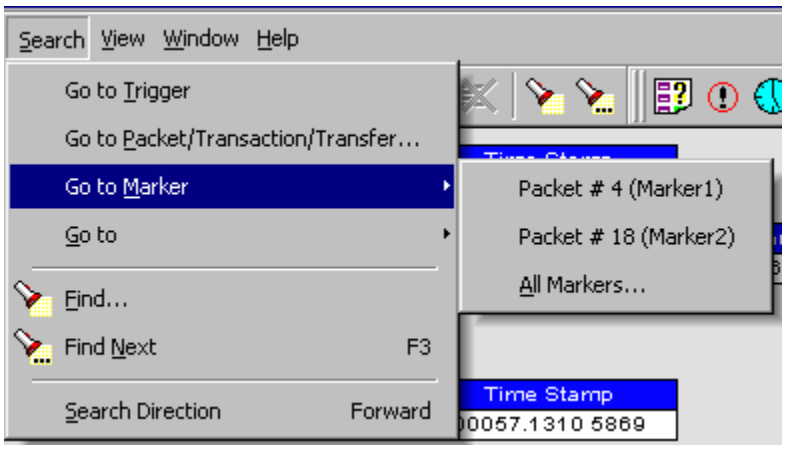
The Trace View is repositioned with the selected packet at the top of your screen.

Go to Marker

To instruct the Analyzer to display a marked packet:

Step 1 Select **Go to Marker** under **Search** on the Menu Bar.

You see a drop-down menu listing the marked packets in that Trace View:



Step 2 Select the desired packet from the displayed list.

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

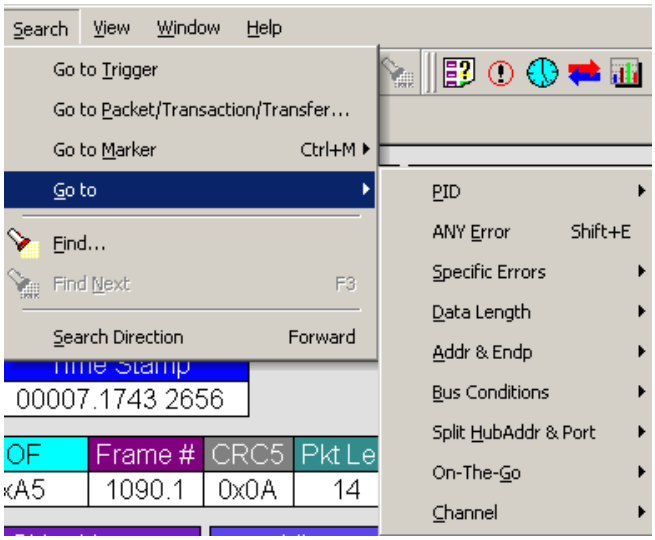
Note The **Go to Marker** feature functions in conjunction with the **Set Marker** feature. The comments within the parentheses following each marked packet are added or edited with the **Set Marker** feature. Please refer to **Set Marker** in **Reading a Trace**.

You can use **Ctrl+M** to go immediately to the All Markers dialog.

Go To

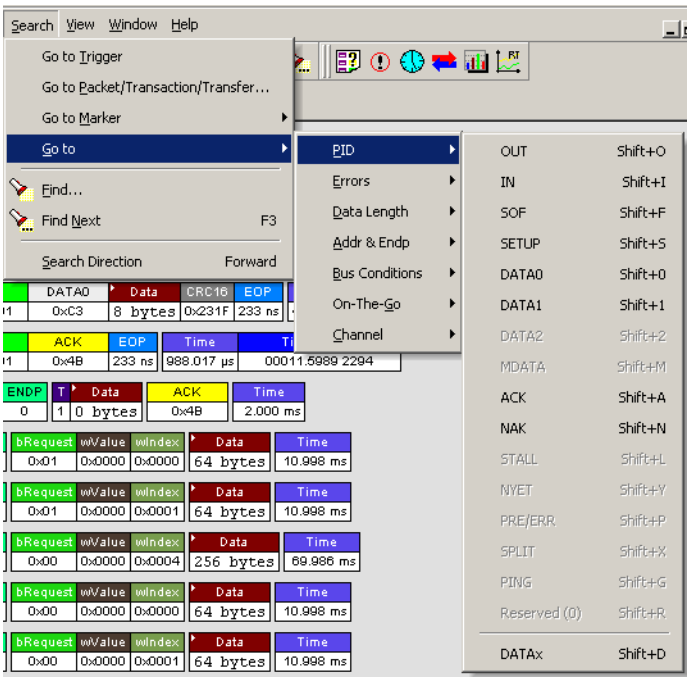
The **Go To** feature takes you directly to an event in a Trace.

Step 1 Select **Go To** under **Search** on the Menu Bar to display the **Go To** drop-down menu:



Step 2 Select the event you want to go to and enter the necessary information.

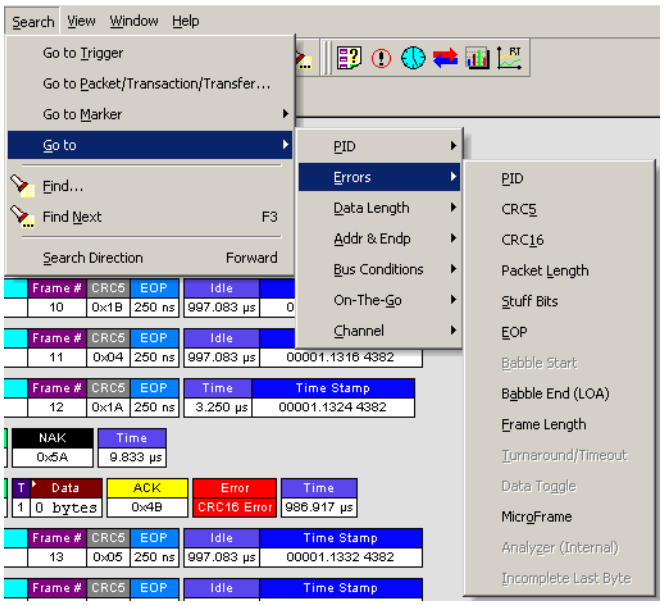
Packet IDs (PIDs)



Select the type of packet to which you want to go.

Errors

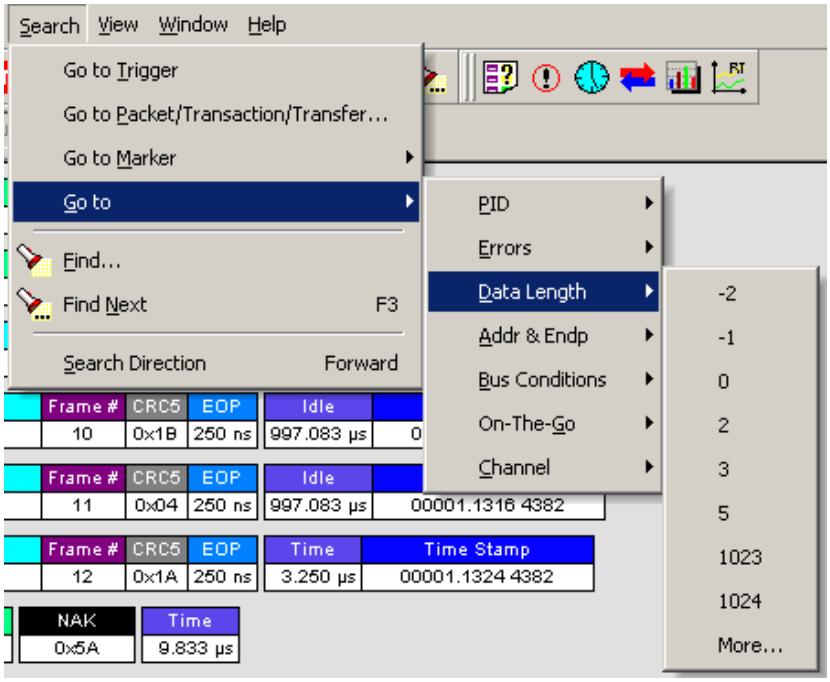
The Errors menu allows you to search for five different types of error: PID, CRC5, CRC16, Packet Length, and Stuff Bits. Menu items appear in bold if they are present in the trace or are grayed out if not present in the trace, as shown in the example below.



You can press **Shift+E** to go to the first error of any type.

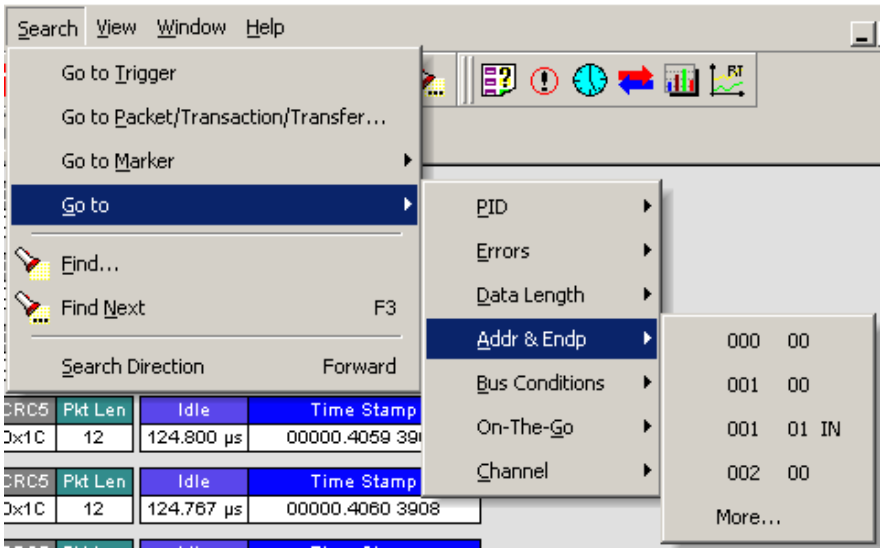
Data Length

Allows you to search for data packets of particular lengths. Lengths are displayed in Bytes in a drop down menu as shown below. Selecting a length causes the display to move to the next instance of that packet length.



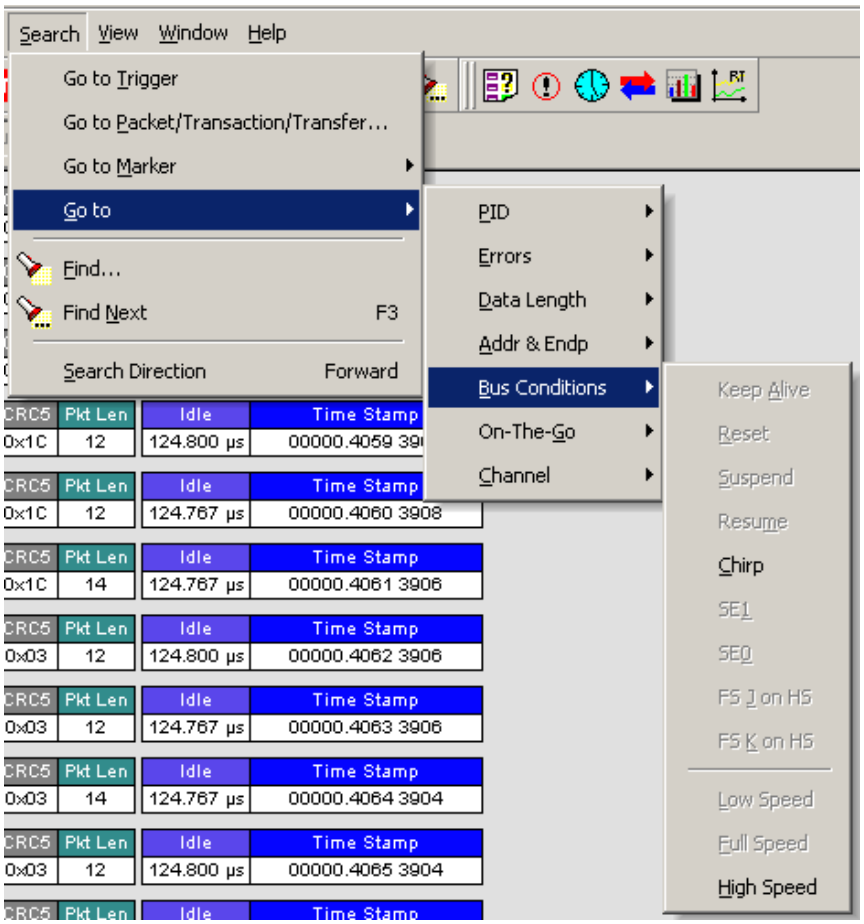
Addr & Endp

The Addr & Endp feature allows you to search for the next packet which contains a particular address and endpoint. All available address endpoint combinations are displayed in the pull down menu.



Bus Conditions

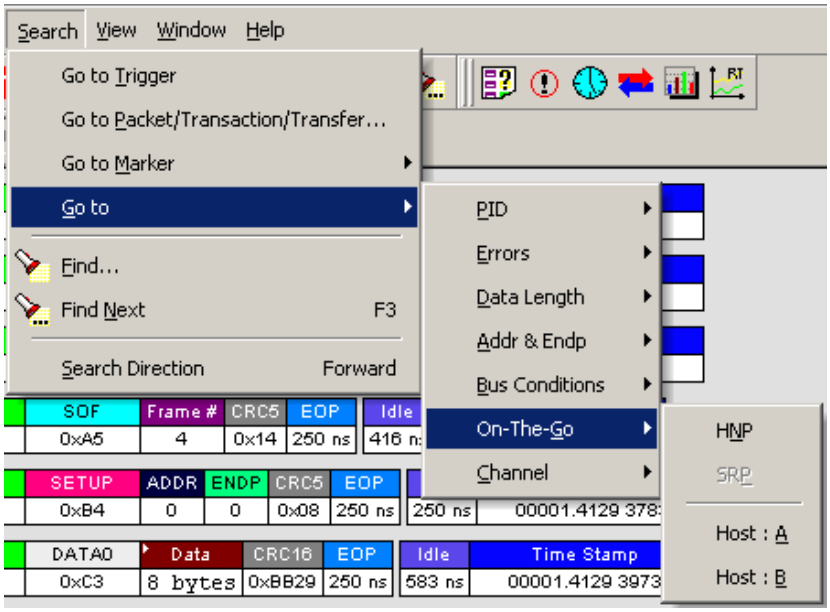
Allows you to search by bus conditions such as traffic speed, reset, and suspend. All available bus conditions are displayed in the pull down menu.



On-the-Go

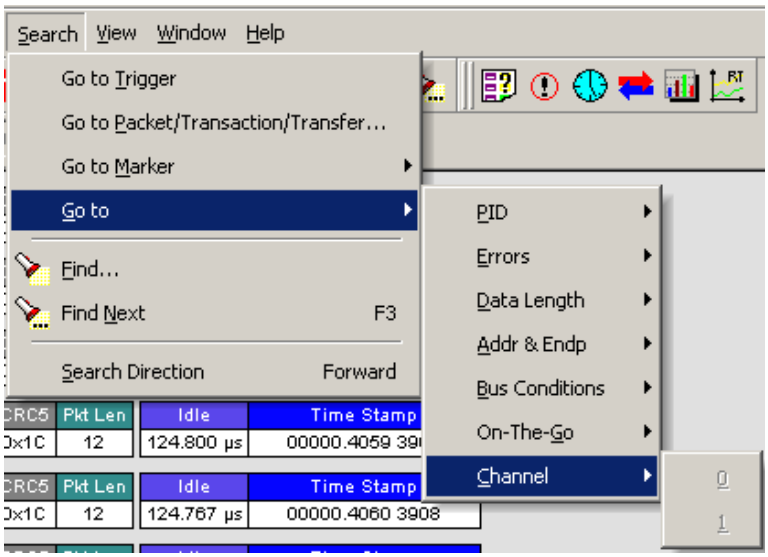
Allows you to search for On-the-go attributes. The On-the-Go submenu contains entries for:

- **HNP**: Host Negotiation Protocol
- **SRP**: Session Request Protocol
- **Host: A**: Hosts with an A plug
- **Host: B**: Hosts with a B plug



Channel

Allows you to search for traffic by 1 (Classic-Speed) or 0 (Hi-Speed).



Find

Find allows searches to be conducted on an open trace using one or more criteria. You can search by packet, transactions, split transaction, transfer, by packet type and by fields within packets.

Find is run by selecting **Search >Find** or by clicking on the toolbar.

Searches can combine criteria using the options **Intersection** and **Union**. **Intersection** creates AND statements such as "Find all packets with *x* and *y*." **Union** creates OR statements such as "Find all packets with *x* OR *y*."

You can also perform searches whereby packets or events are excluded from a trace. The **Exclusion** allows searches to be conducted.

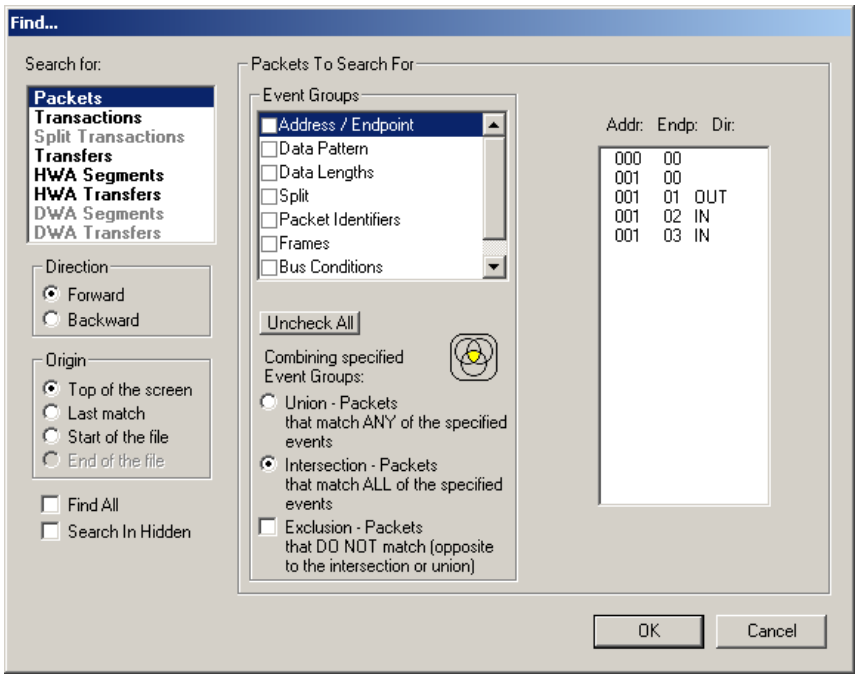
To perform a search:

Step 1 Select **Find...** under **Search** on the Menu Bar

OR

Click in the Tool Bar.

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



Step 2 Select **Packets, Transactions**, **Split Transactions**, **Transfers, HWA Segments, HWA Transfers, DWA Segments,** or **DWA Transfers,** from the top left list box to list that type of event in the Events Group box.

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

Step 4 Select one of the following options:

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

- **Intersection:** Find packets matching ALL of the specified events.

- **Exclusion:** Exclude packets matching any of the specified events.

  Exclusion works with the other two options: Select **Union** *AND* **Exclusion** (=Exclude packets with ANY of the following fields) or **Intersection** *AND* **Exclusion** (=Exclude packets with ALL of the following fields.)

Step 5 If desired, set the search **Direction** and **Origin**.

Step 6 Click **OK**.

After the search finishes, the program displays the packets meeting the search criteria.

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.

Search Direction

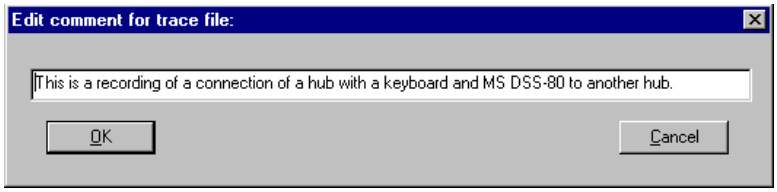
Toggles the search forward or backwards. The current direction is indicated in the menu.

10.2 Edit Comment

You can create, view, or edit the 100-character comment field associated with each Trace file. These comments are visible in the Windows® Explorer if the "Comments" attribute is included in the Details view.

Step 1 Select **Edit Comment** under **File** on the Menu Bar.

You see the **Edit comment for trace file** window:



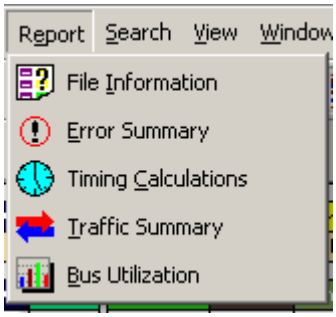
Step 2 Create, view, or edit the comment.

Step 3 Click **OK**.

You can view comments in Windows Explorer by selecting the "Comments" attribute.

10.3 Reports

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



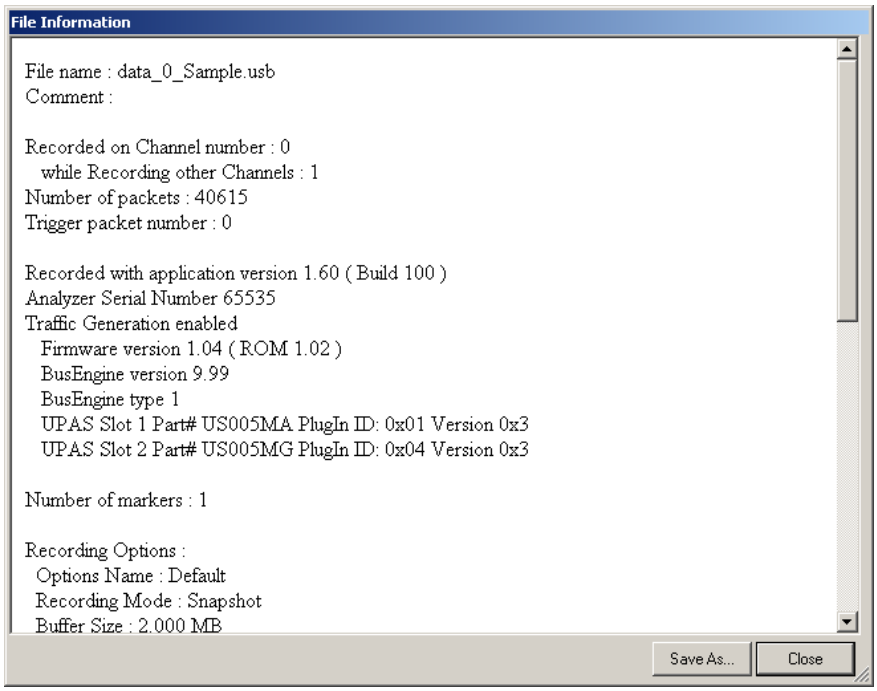
File Information

To display a File Information report:

- Select **File Information** under **Report** in the Menu Bar.

  OR

- Click in the Tool Bar to display the File Information screen:



The File Information report provides information about how the recording was made, what the buffer settings were, what the trigger options were, and what version of all the Analyzer hardware was used to make the recording.

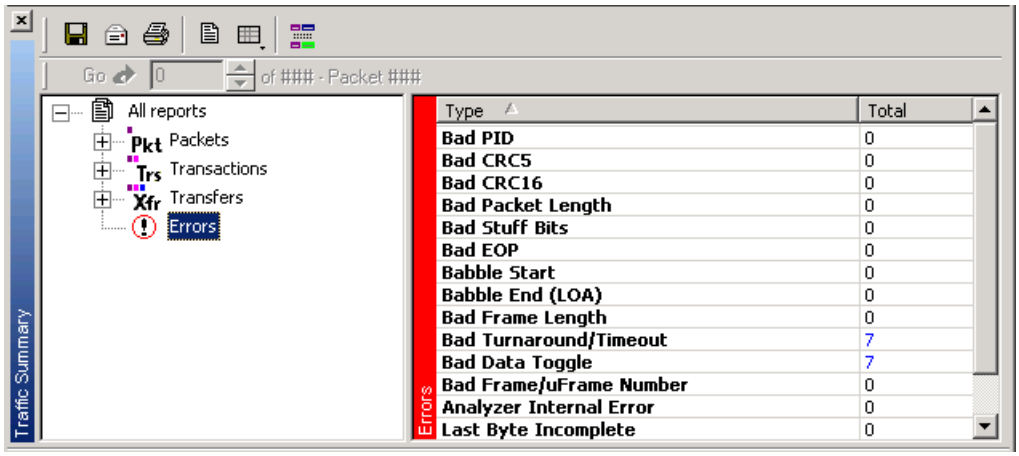
Error Summary

The Error Summary details all errors analyzed throughout the recording.

- Select **Error Summary** under **Report** in the Menu Bar

  OR

- Click in the Tool Bar to display the Error screen below the Trace View:



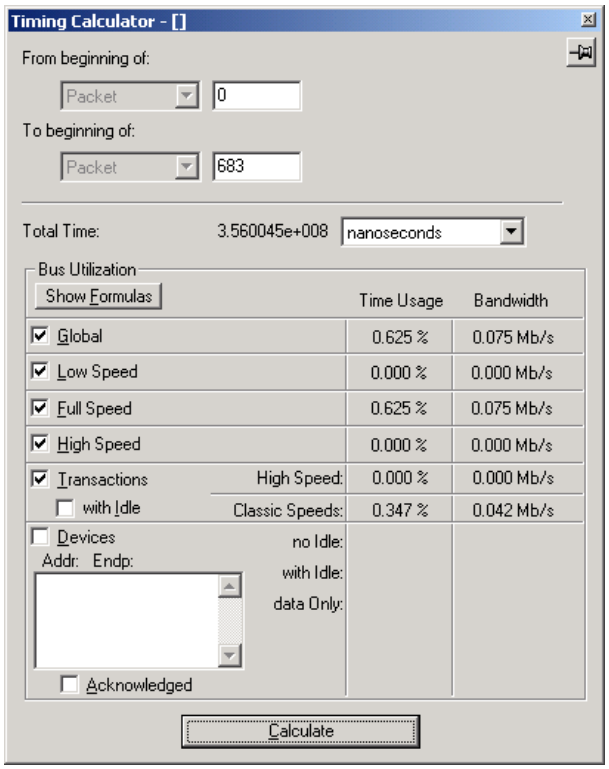
Timing Calculations

The Timing Calculator is used to measure timing between any two packets.

- Select **Timing Calculations** under **Report** in the Menu Bar

  OR

- Click in the Tool Bar to display the Timing and Bus Usage Calculator screen:

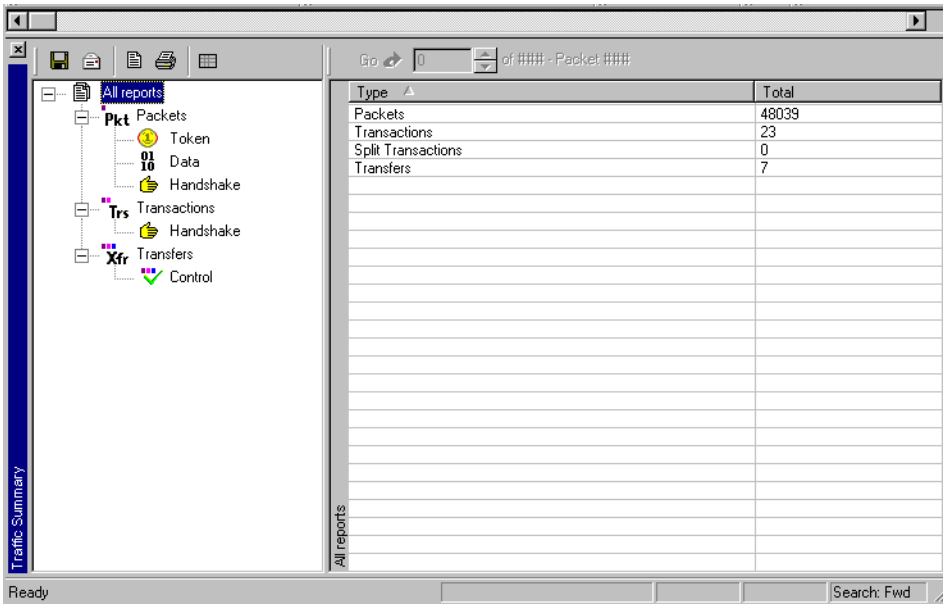


Traffic Summary

Traffic Summary summarizes the numbers and types of packets, transactions etc. that occurred in the open trace.

To run **Traffic Summary**, select **Report >Traffic Summary** or

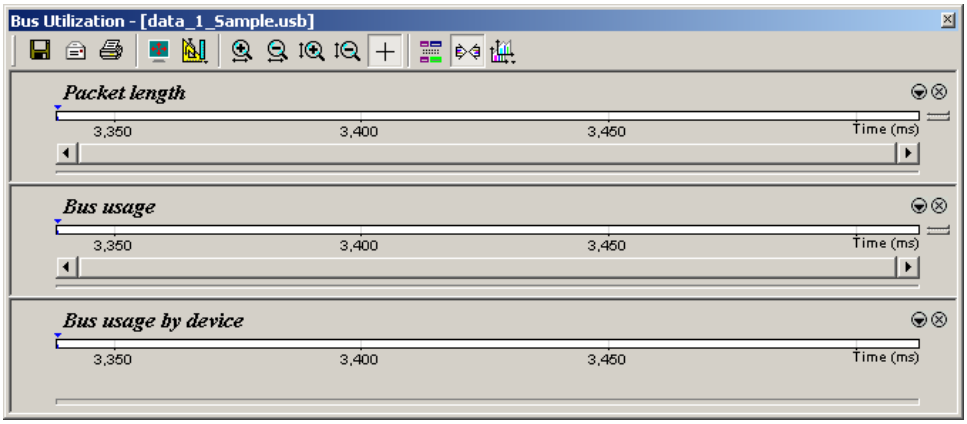
click the button marked . The program prompts you to specify a range of packets, then displays the following window:



Bus Utilization

The **Bus Utilization** window displays information on bandwidth use for the three recording channels.

To open the Bus Utilization window, select **Report >Bus Utilization** or click the button marked . A window opens with graph areas:



Bus Utilization Buttons

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

The buttons have the following functions:

Save As - Saves the graphs as a bitmap file (*.bmp)

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

Print

Full Screen

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

Horizontal zoom in

Horizontal zoom out

Vertical zoom in

Vertical zoom out

Click and Drag zoom - Click diagonally to select and zoom in on part of the graph

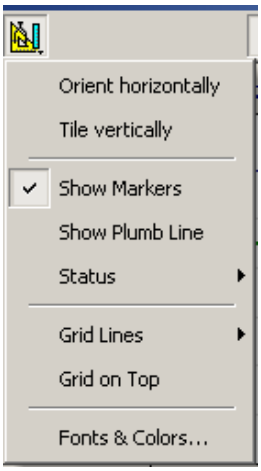
Select Range

Sync and Graph areas - If two or more graphs are displayed, this button synchronizes the graphs to one another. Once synchronized, the positioning slider of one graph moves the other graphs.

Graph Areas - Presents options for displaying additional graphs of data lengths, packet lengths, and percentage of bus utilized.

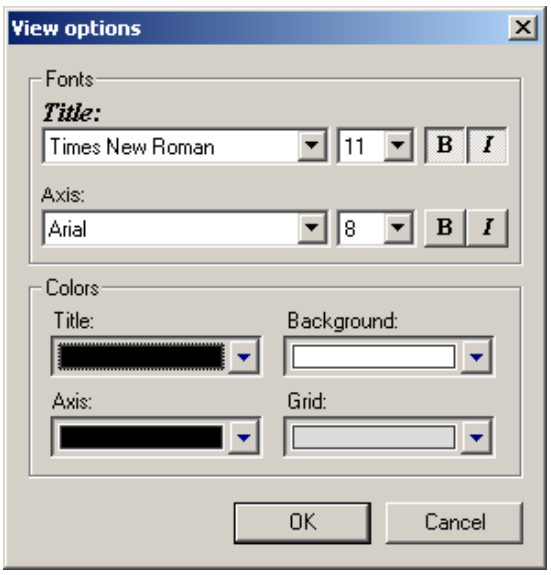
View Settings Menu

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 has Orient Vertically.
- **Tile Vertically**: tiles the two graphs vertically (i.e., side by side). After selecting this option, the menu has Tile Horizontally.
- **Show Markers**: Places "tick" marks along the x axis of each graph.
- **Show Plumb Line**
- **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:

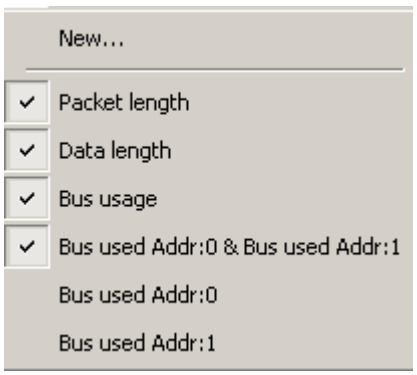


Graph Areas Menu

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

To view information:

Step 1 Click the button to open the Graph Areas menu.

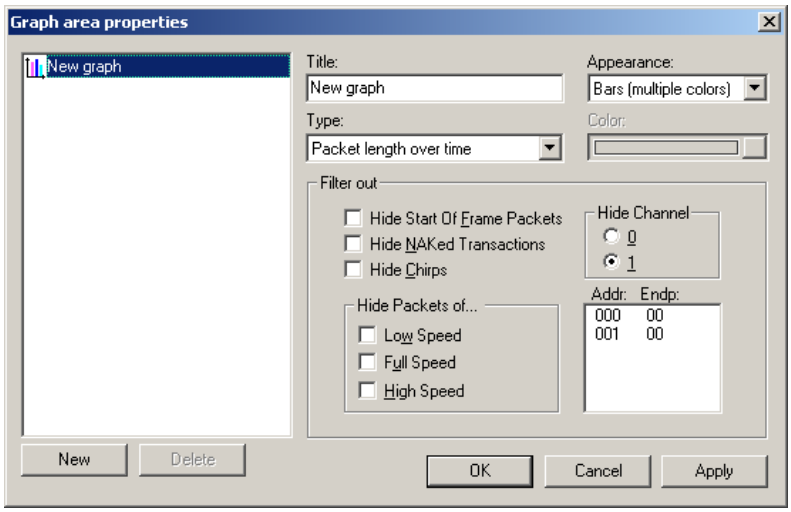


Step 2 Select the data you want to appear in the Graph Areas window.

Step 3 To make a new graph, click **New**.

To change the properties in the Bus Utilizations graph:

Step 1 In the **Graph Area** properties dialog box, select what you want your graph to display, then click **OK**.



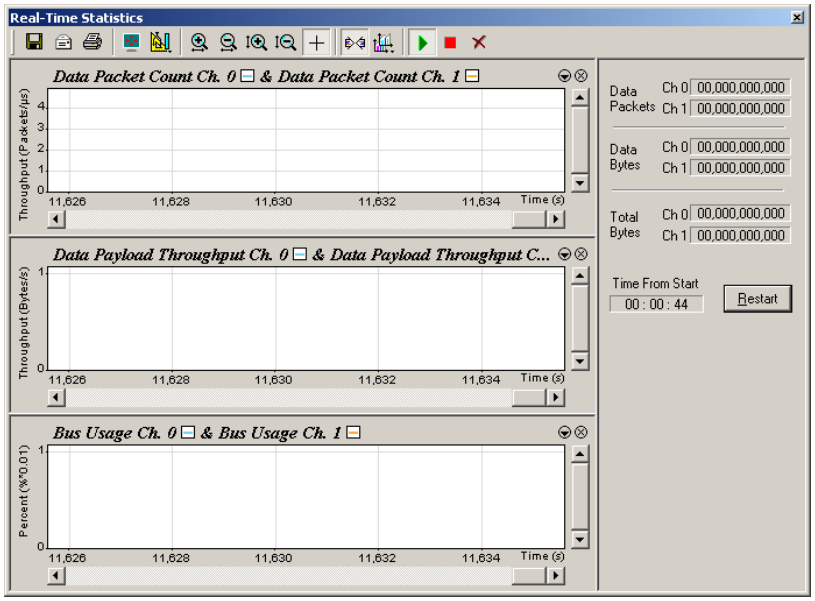
Step 2 To make a new graph, click **New**.

Real Time Monitoring

The Real-Time Statistics window displays a graph of real-time link activity.

Real Time Statistics displays a summary of the traffic currently being recorded by the analyzer.

To display the Real-Time Statistics window, click in the Tool Bar to open the Real Time Statistics window:



In order to see a graph of traffic, you must start recording.

After starting InfiniBand link activity, press to start the Real-Time statistics monitor. As traffic is recorded, data is streamed in real time to this window and presented in a format of your choice.

To stop the monitor, press .

Real-Time Statistics Buttons

The Real-Time Statistics toolbar has buttons for changing the format of the displayed data and for exporting data:

The buttons have the following functions:

Save As - Saves Real-Time graphs as bitmap files (*.**bmp**)

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

Print

Full Screen

Vertical zoom in

Vertical zoom out

Click and Drag zoom - Click diagonally to select and zoom in on part of the graph

Select Range

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

Horizontal zoom in

Horizontal zoom out

Sync and Graph areas - If two or more graphs are displayed, this button synchronizes the graphs to one another. Once synchronized, the positioning slider of one graph moves the other graphs.

Graph Areas - Presents options for displaying additional graphs of data lengths, packet lengths, and percentage of bus utilized.

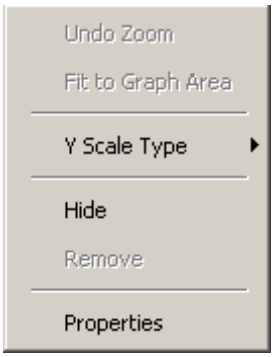
Start. Starts the Real-Time Monitor.

Stop Real-Time Monitoring.

Reset. Resets the graphs.

Real-Time Statistical Monitor Pop-up Menu

If you right-click a graph in the Real-Time window, a pop-up menu appears with options for changing the format of the display:



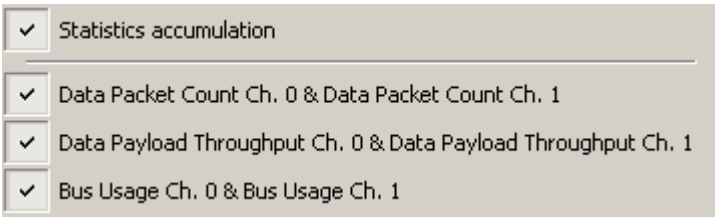
- **Undo Zoom**: If you have zoomed in, undoes the zoom.
- **Fit to Graph Area**: Displays graph so that the entire trace fits inside the graph area.
- **Y Scale Type**:
  - ***Linear***: Converts display to linear format.
  - ***Logarithmic***: Converts display to logarithmic format.
- **Hide**: Hides the selected graph.
- **Properties**: Opens a dialog box with options for changing the colors, titles and other features of the graphs.

Displaying Multiple Graphs

The Real Time Statistics window gives you the ability to create up to three separate graphing windows so that you can create separate graphs of traffic and tile them vertically. Within these windows, you can format the graphs in a number of ways.

- To view two or three graphs simultaneously, click the **Graph Areas** button.

The following menu opens.



Selecting a checkbox displays the selected graph type:

- **Statistics Accumulation**: Plots the percentage of Link utilization by non-idle traffic for both directions of the link.
- **Data Packet Count (Packets/s)**: Plots counts of Data Packets per second for both directions of the link.
- **Data Payload Throughput (MBytes):** Plots data payload throughput for both directions of the link.
- **Bus Usage**: Plots amount of Bus usage.

11. Traffic Generation with USB*Trainer*

USB*Trainer*™ is a USB Traffic Generator module that plugs into the right slot of the Universal Protocol Analyzer System (UPAS).

USB*Trainer* is designed to generate USB traffic so that engineers can test designs under realistic conditions. Traffic Generation can also be used to transmit known bad packets, providing an opportunity for engineers to observe how a device handles specific adverse conditions.

USB*Trainer* Traffic Generation Files

USB*Trainer* generates USB traffic from traffic generation files (***.utg**) which are text-based script files that instruct the Generator how to generate USB traffic. These script files can be edited with either a simple text editor such as Notepad or with the Script Editor utility provided by the USB*Tracer*™ application. The Script Editor utility has several aids to simplify the process of writing and editing scripts: tool-tips, drop-down menus, and colored fields.

The script example below shows the beginning of a traffic generation file created through the **Export** command. This command provides an easy way to create a generation file - you open a trace file, then run the **Export** command. The trace serves as a blueprint for the traffic generation file.

The example below shows several commented lines followed by some instructions.

```
;  File C:\Documents and Settings\Administrator\Desktop\enummeration\High_Hub_Sample.usb.
;  Packets 0 to 24328.

;  Device Side Packets were filter out during Export
;  NAK'ed transactions were filtered out during Export
;  Saved from Channel  0.

file_type=UPAS
file_version=2
file_speed=HIGH

chirp=here  ; This needs to be added by hand, since the Export function does not export it.

frame=auto idle=TO_EOF
frame=auto idle=TO_EOF
frame=auto idle=TO_EOF
frame=auto idle=TO_EOF
frame=auto idle=TO_EOF
frame=auto idle=TO_EOF
frame=auto idle=TO_EOF
frame=auto idle=TO_EOF
```

This generation file causes USB*Trainer* to simulate a hub and to generate 24,320 packets. See “Device Emulation” on page 160 for details about the format of traffic generation files.

Creating Traffic Generation Files

If you choose to write a script with a text editor, a good way to start is to edit the sample generation file that is provided: **HS_Hub_Sample.utg**. This file is located in the same directory as the USB*Trainer* application (for example, **C:\Program Files\LeCroy\USBTrainer**). You can open this generation file with Notepad or other editor and then add or remove text as needed.

Creating a Traffic Generation File with the Export Command

The Export command on USB*Tracer* offers an easy alternative method of creating a generator file. This command converts the trace to a ***.utg** file, removes all device traffic, and leaves only the traffic from the host device. You can then use this file to emulate the host and determine whether the device under test is generating the correct traffic.

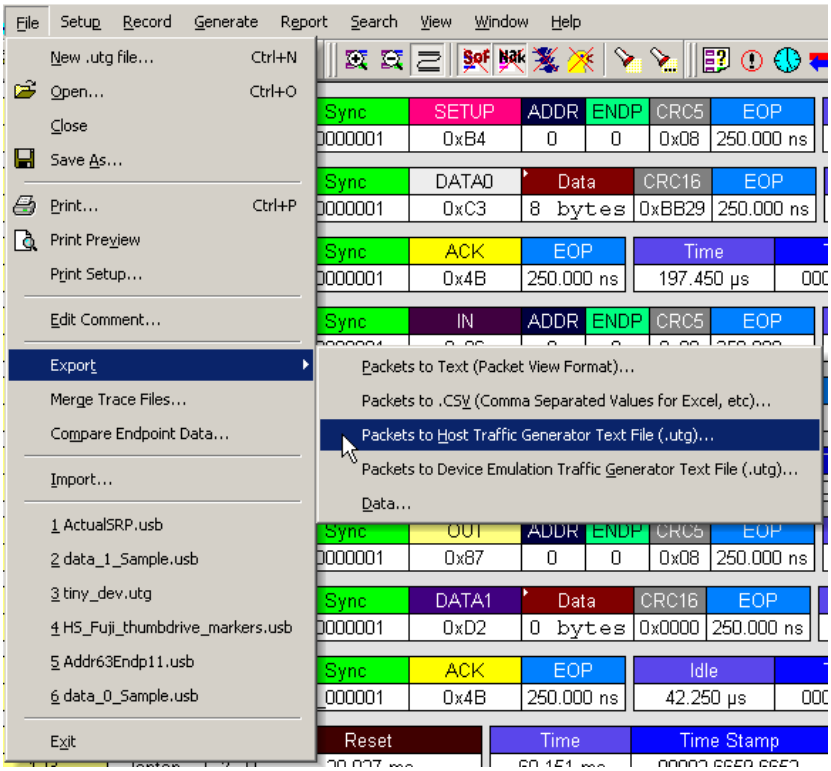
When creating a **.utg** file through the Export Packets to Text (Generator Text File Format) menu selection, it is suggested that you use the default values presented. Adding NAK transactions clutters the **.utg** file, and including the device side packets creates a .**utg** file which does not work with a real device attached.

To use the **Export** command:

Step 1 Start USB*Tracer.*

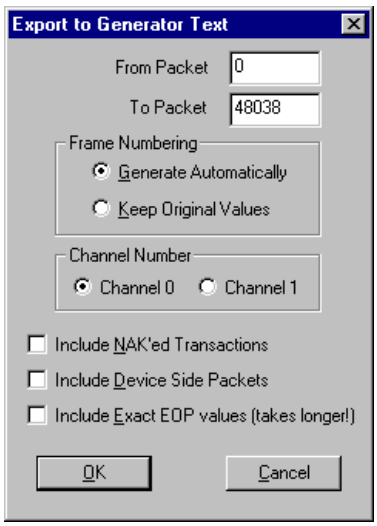
Step 2 Open a trace that has the pattern of traffic you would like to generate.

Step 3 Select **File > Export** from the menu bar to display the File Export menu:



Step 4 Select **Packets to Text (Generator Text File Format)** from the **Export** drop-down menu.

You see the **Export to Generator Text** window:



Step 5 Enter the numbers of the first and last packets in the series.

Note The device packets are removed from the exported generator text. This is essential in creating a generator text file that can be used to handshake with your device.

Step 6 You can opt to regenerate the frame numbers and remove the NAKed transactions.

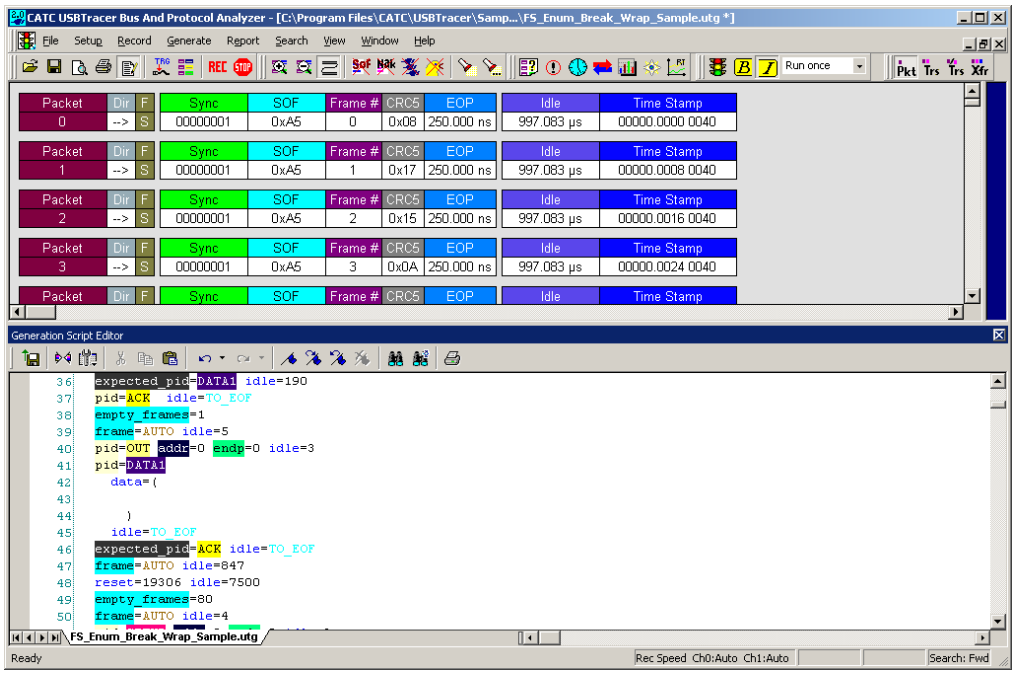
Once the generator text file is exported, you may need to edit the file and adjust idle time to properly anticipate the responses from your device.

11.1 Editing a Generation File

A **.utg** file is a text file that can be edited with any text editor such as Notepad. A better editing option, however, is Script Editor, an utility that is built into the USB*Tracer*™ application. Script Editor provides the usual editing functions such as select, cut, copy, and paste but also adds tool-tips, colored keywords, drop-down parameter values, and expandable/collapsible packet data fields.

To launch the Script Editor, click the **Script Editor** button on the toolbar or right-click the trace window and choose **Edit as Text**.

The Script Editor window opens in the lower portion of the trace window.



The Script Editor divides into three areas: the toolbar, the script window, and the file tabs at the bottom of the window. If errors occur, a log opens at the bottom of the window.

Toolbar

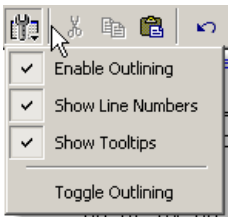
The Script Editor toolbar contains buttons for saving your edits, navigating, searching and other functions.

The buttons have the following functions:

	Save. Saves your edits and immediately updates the setting bars and Frames shown in the trace window.		Add/Remove bookmark. Allows markers to be set or removed to aid in navigation.
	View Options. Opens a menu with three options: Enable Outlining, Toggle Outlining, and Line Numbers. See **View Options Menu** below.		Go to next bookmark.
	Cut.		Go to previous bookmark.
	Copy.		Clear all bookmarks.
	Paste.		Find.
	Undo.		Find and Replace.
	Redo.		Print.

View Options Menu

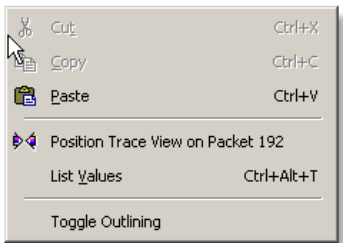
The View Options button has a menu with three options:



- **Enable Outlining**: Adds an expandable/collapsible tree structure to the left side of the Script Editor showing the hierarchical relationships of the script lines.
- **Show Line Numbers**: Adds line numbers to the left side of the Script Editor window.
- **Show Tooltips**: Enables tooltips to appear when the mouse pointer is suspended over a script item.

Pop-up Menu

Right click anywhere in the script window to open a pop-up menu with the following options:



- Cut
- Copy
- Paste
- Position Trace View on Packet *xxx*
- List Values
- Toggle Outlining

The List Values option displays the types of values that can be entered for a parameter in a line. To see the types of values, select the current parameter, then choose **Show Values** from the pop-up menu.

File Tabs

At the bottom of the window is a tab that shows the name of the **.utg** file. If your **.utg** file has an Include statement in it, the supporting Include files automatically open when the **.utg** file is first opened. Tabs for the opened Include files appear at the bottom of this window.

Error Log

Whenever you create a scripting error, a log opens at the bottom of the application window. When the error is corrected, the window automatically closes.

Tooltips

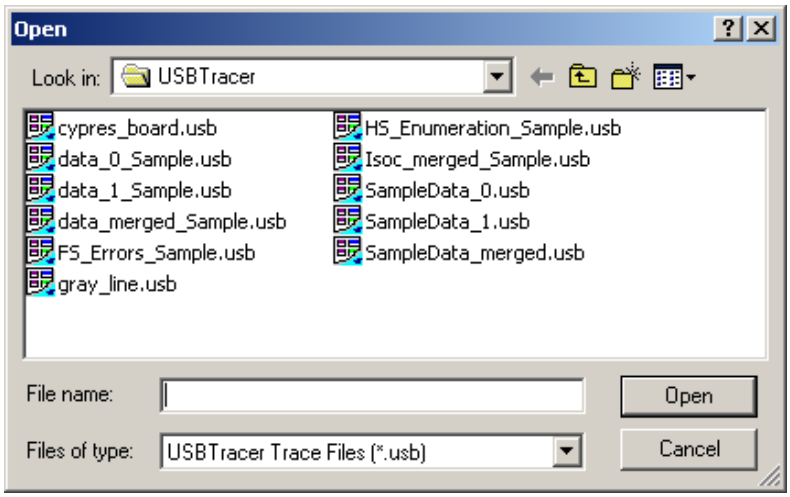
The Script Editor window includes extensive tooltips for each keyword. To see a tooltip, hold the mouse pointer over a keyword.

11.2 Loading the Generation File

The USB Traffic Generation files are scripts that instruct the analyzer how to generate USB traffic. A traffic generation file contains text in special format and is named with a "*.utg" extension. These files can be created by any text editor, or using the **File > Export > Packets to Text (Generator File Format)** menu selection when viewing a Trace File. There are several examples of Traffic Generation files included with the installation of the USBTracer software.

To load a generation file:

Step 1 Select **File > Open ...** from the menu to display the Open dialog box:

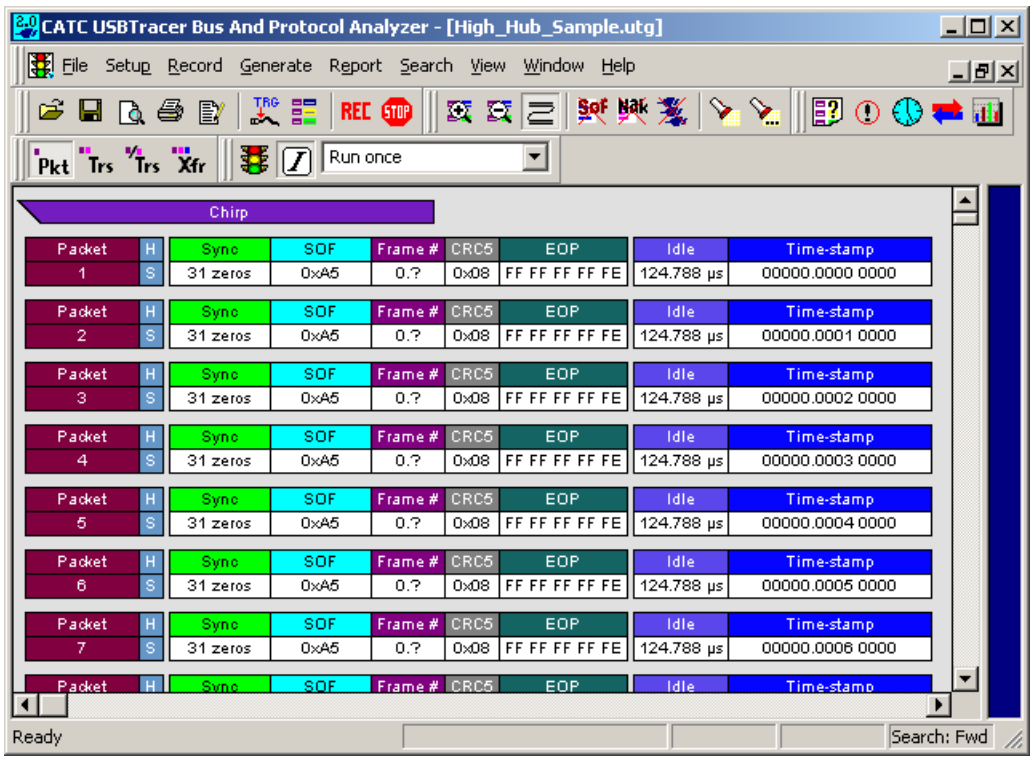


Step 2 Select **USB Tracer Generation Files (*.utg)** from the drop-down menu marked **Files of Type** to display a list of Traffic Generation files.

Step 3 Select a Traffic Generation file (*.utg).

Step 4 Click **Open**.

The file opens.



Step 5 Decide how many times you want the traffic pattern to be generated, then select a value from the **Repeat** drop-down menu.

The **Repeat mode** allows for a single pass through the generation file, looping forever, or looping 1 to 65,534 times, as desired by the user. If a "wrap=HERE" location is found in the **.utg** file, that location is where the looping portion begins. The loop end is at the end of the **.utg file** or up to the "stop=HERE" statement in the file.

Step 6 Select the ***Generation mode*** in which to generate traffic (see below for an explanation) by depressing or undepressing the

IntelliFrame button on the toolbar:

- Depressed = IntelliFrame
- Undepressed = Bitstream

Traffic Generation Modes: Bitstream vs. Intelliframe

IntelliFrame and **Bitstream** are modes that control how the generator interacts with other devices when it is generating traffic.

- **Bitstream Mode** -In Bitstream Mode, the generator constructs a bitstream of traffic based on the UTG file and assumes that packets start at pre-calculated times. For example, after an IN packet, the generator waits a calculated fixed time before presenting an ACK. The time between them is determined by the "idle=" time statement in between the IN and ACK packets in the **.utg** file. In this mode, every bit time of a generation stream (including idles and SE0's) is represented by 4 bits of data, so the file to be downloaded to the Generator can be very large.
- **IntelliFrame Mode -** In IntelliFrame mode, the generator can wait for Device responses to complete before it continues generating more host packets. For example, after issuing an IN, the generator looks for the DATAx packet issued by the device to finish, and then issues an ACK. This way, the data length can vary and does not need to be pre-calculated. Also, using the "idle=TO_EOF" statement allows the generator to calculate where the end of the frame occurs, so that a subsequent "frame=AUTO" statement creates a Start of Frame at the correct time. Moreover, the Generator can be made to retry transactions that are NAKed automatically, and to use the PING protocol where appropriate. Retries can be made to occur within the same frame or in the next frame. For further information on the flexible behavior that can be instituted during the generation, see the syntax descriptions for the generation files here. An additional advantage of the IntelliFrame mode is that it creates an image in the Generator's memory that is MUCH smaller than that of the Bitstream mode, so it downloads much faster.

Note Device emulation only works in Intelliframe mode.

Starting Traffic Generation

To start traffic generation, click on the Tool Bar.

Repeating a Generation Session

If you wish to repeat a generation session, press the

Traffic Generation Start/Stop button again. There is no need to reload the **.utg** file.

You can make an additional entry in a Generator Text File that allows you to specify a portion of the file for repetition:

- Enter **wrap=here** in the Generator Text File.

The traffic above the entry is run only once. The traffic below the entry is repeated continuously.

Note For a usage example, see the sample file **Wrap.utg**.

Stop Traffic Generation

To instruct the Analyzer to halt traffic generation:

- Click on the Tool Bar.

11.3 Device Emulation

Device Emulation is a licensed option that allows USBTrainer to generate device-side traffic. Like host traffic generation, device emulation uses text-based generation files (.utg) to generate traffic.

Device emulation has three steps: create a generation file, configure generation settings, and then generate traffic.

Creating a Generation File

Generation files can be created one of two ways:

- Write a generation script file using either LeCroy's context-sensitive script editor or any text editor that you choose.

  OR

- Use a pre-recorded trace file that has the type of traffic that you want to generate. This file is a blueprint for the traffic generation script file.

If you decide to use a pre-recorded trace file as a generation blueprint, then verify that the trace file contains traffic for only one device. If it does not, hide all the other devices (**Setup > Level Hiding**) and save the file as a new file without the hidden traffic (**File > Save As** and check the option **Do not save hidden packets/transactions/transfers**).

Setting Generation Options

Step 1 Set the Traffic Generation options by configuring the **Misc** page in the Recording Options dialog box:

Setup > **Recording Options** > **Misc**

Step 2 In the Misc page, select **Device Emulation Mode**.

Step 3 Configure Resume settings.

- If you want the simulated device to issue Resumes, then select **Device Resumes** and enter a delay time (in milliseconds). If you do not select Device Resumes, then the emulated device waits for a Host to issue a Resume.
- If you want the simulated device to take its address from the Traffic Generation (.utg) script file, then select **Use Address in .utg file.** This option causes the USBTrainer to read the **.utg** file and assign a Device Address based on the device traffic that it sees in the file.

Note In this release, the Device Emulator does not look at the Set Address in the script, so if your host controller is running more than one device, it may enumerate your device emulator incorrectly when you begin to generate traffic. The solution is to manually assign a device address. To manually configure the Device Address, select Emulated Device's Hex Address and enter an address or mask (Note: A mask allows the USBTrainer to respond to multiple device addresses.)

Step 4 Click **OK** to close the Recording Options dialog and apply the changes. The generation settings take effect as soon as you execute a script.

Run the Traffic Generation Script File

Step 1 Connect the USBTrainer's port B (either Hi Speed or Classic Speed) to the Host.

Step 2 Open the Traffic Generation **.utg** file.

Step 3 Begin traffic generation by clicking .

When execution begins, USBTrainer reads the entire generation file and then parses the generation commands into groups according to their endpoints. Each of the parsed groups of commands are then written into dedicated memory segments in the generator. Up to eight memory segments can be created for the various endpoints. In the case of Endpoint 0 or any Control endpoints, a single memory segment is created.

Each memory segment can be thought of as a queue of the commands and responses for a particular endpoint that occur in the generation file.

Commands are stored sequentially within each memory segment as they occur in the generation file. For example, if a generation file has a sequence of command X and Y for the Endpoint 1, the commands are extracted in this order and placed in the Endpoint 1 memory segment.

When the host calls for a particular device endpoint response, the first command listed in that endpoint memory segment is then executed. With each subsequent call to the same endpoint, commands are executed sequentially down the list as they occur in the memory segments. For example, if three calls were made to Endpoint 0 IN, then the first three commands in that endpoint's memory segment would then execute.

Note Each of the endpoint memory segments execute independently: there are no behavioral interactions between the individual endpoints.

11.4 Format of the Traffic Generation Files

Whether you create a traffic generation from scratch or use the **Export** command in USB*Tracer*, there are a few rules about the format of the generation file that you should review. These are presented in this section.

Traffic is generated from a text file named ***.utg**. Within the text file:

- The data format for data fields such as Pids and Raw bits is hex.
- Each packet definition consists of this set of assignments: **key=value**.
- White space is permitted around the equal sign.
- There are no restrictions on dividing packet definition to lines nor is it necessary to define each packet 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)
- Comments are not allowed within brackets ( ).
- No keys or values are case-sensitive.

Each packet definition starts with one of these assignments:

- **pid=N** (where N is a string representing a valid packet identifier or an eight bit value)

  OR

- **frame=N** (where N is an eleven bit value of the frame number or the strings **auto** and **keep_alive**).

A bus condition definition starts with one of these assignments:

- **reset=N** (where N is a positive integer or string)
- **suspend=N** (where N is a positive integer)
- **resume=N** (where N is a positive integer)
- **chirp=here**

Subsequent assignments after a packet's starting assignment define the values of particular fields within the packet. If a field is not defined, it is assumed to be **0**. Values are assumed to be decimal unless they are prefixed with **0x** and then are interpreted as hexadecimal. Values within a data block assignment are always assumed to be hexadecimal and should not be prefixed by **0x**.

Table 2: Support Keys for Defining Fields within a Packet

Key Code	Format	Description
File Control Keys		
file_type	’UPAS’ ’CHIEF’	This must be included at the beginning of the file to determine the speed of packets to be generated. Value must be "file_type=UPAS" to allow for High speed traffic, IntelliFrame operation, 'expected_pid' and 'device_pid' key support. Full and Low speed traffic, and Bitstream operation are supported on all "file_type=" values. If this statement does not appear in the file, the default is "file_type=CHIEF", allowing backward compatibility with older USB Chief™ **.usb** files.
file_version	integer	This must be included after the "file_type=" key to determine the version of this file. Value is currently 3. Usage: "file_version=3"
file_mode	’HOST’ ’DEVICE’	Sets generation mode to host or device. For generation to work, this must match the selection found in the Recording Options > Misc dialog.
file_speed	'HIGH' ’HI’ ’FULL’ 'LOW'	This must be included after the "file_version=" key to determine the speed of packets to be generated. Values are "HIGH', 'HI', 'FULL', or 'LOW'. Example: "file_speed=FULL". Only one "file_speed=" is allowed per **.utg** file, but low speed traffic on a full speed bus can be created by adding the "speed=LOW" key to a low speed packet in a file defined as "file_speed=FULL". No other mixing of speeds is allowed. 'HI' is the same as 'HIGH' and was added to conform to the USB terms.
loop_count wrap_count	0 through 16382 or "infinite"	These two terms are interchangeable. Device Emulation Only. This key defines the loop count for each memory segment. Examples: "loop_count=INFINITE" or "wrap_count=9"
wrap loop	’HERE’	This key marks the "wrap point" in the traffic. When generation is in Repeat mode, all the traffic before the wrap point is going to be sent once, all the traffic after the wrap point is going to be repeated in a loop. The usage of the keyword is "wrap=HERE" or "loop=HERE". For Device Emulation, the value would be a memory segment number, so that the looping is associated with only that one endpoint, such as "wrap=4".
skip	’HERE’	Causes a region in the **.utg** file to be ignored, as if commented out. Can be used multiple times in the file. Must be used in conjunction with "skip_end=HERE". Example: skip=HERE frame=auto makes this statement be ignored! skip_end=HERE
skip_end	’HERE’	Causes a region in the **.utg** file to be ignored, as if commented out. See above in "skip=HERE".

Key Code	Format	Description
stop	string	If you want to run only some first portion of the beginning of a **.utg** 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. The usage of the keyword is "stop=HERE".
break	'HERE'	**Host Generation Only.** Enables you to generate up to a point in the .**utg** file, then wait for input before continuing in the file. During the breakpoint time, the traffic signal icon in the toolbar flashes yellow, indicating that a breakpoint was hit. When you click the traffic light icon, the generation resumes. If you want to stop rather than continue, select **Stop** from the Generation menu or hit the **Start/Stop** button on the front of the generator module. Start-of-frames are issued automatically during the breakpoint duration. When you resume running, traffic begins after another start-of-frame is issued. The "break=HERE" statement must be inserted between "frame=xxx" statements. Syntax example: frame=AUTO break=HERE frame=AUTO
Endpoint Configuration		
begin_config	'HERE'	Defines the beginning of the region in the file used to configure the endpoint types. The configuration is necessary to determine the default behavior of the NAK retry mechanism during IntelliFrame operation.Between the "begin_config=HERE" and the "end_config=HERE" statements is a series of "config_endpoint=xxx" statements, which define each endpoint's type and default retry behavior. The config region must precede any actual packet or bus condition statements. For Device Emulation, the config region is mandatory. It provides the mapping of the endpoints into their corresponding segments of analyzer memory, which contain the traffic for those endpoints. When exporting to a **.utg** file from a trace file, these sections are created automatically. Syntax example: begin_config=HERE
end_config	'HERE'	Terminates the region in the file used for configuring the endpoints. See "begin_config". Syntax example: end_config=HERE
config_endpoint	'CONTROL' 'INTERRUPT' 'ISOCHRONOUS' 'BULK'	Begins a statement that defines a particular endpoint's type, default retry behavior (Host Generation only), and memory segment (Device Emulation only) Usage example: config_endpoint=BULK addr=1 endp=3 direction=OUT retry=TRUE retry_next_frame=FALSE

Key Code	Format	Description
endp_mem_seg	1 2 3 4 5 6 7 8	**Device Emulation Only.** Separates each endpoint function into a different queue (also referred to as a Memory Segment) of commands and responses. There are a maximum of eight of these queues, and each has a unique address/direction combination. For control endpoints, one queue is shared by both directions of the endpoint. Traffic on the Default Endpoint (Address 0, Endpoint 0) shares the same queue as the endpoint 0 of the selected device address (the address it gets from the Host through the SetAddress request). These always use "endp_mem_seg=1". These are all set automatically when exporting a trace file to a Device Emulation **.utg** file.
direction	'IN' 'OUT'	Defines the transfer direction of data for the specified endpoint. For all transfer types but CONTROL, there can be two distinct logical connections using the same address and endpoint. They would differ only in defined direction. Syntax example: direction=IN
retry	'TRUE' 'FALSE'	**Host Generation Only.** Defines whether an automatic retry should be performed on packets to/from this endpoint in the case that they are NAKed (or in some cases 'NYETed'), or if a timeout on device response occurs. RETRY only works for the Pids: Setup, In, and Out. If 'TRUE', the Trainer automatically retries the specified sequence if a Pid is received on the bus which does not match the 'expected_pid', or if a timeout occurs. The generator re-issues the host packet(s) after waiting either 1/10th of a frame, or until after the next start-of-frame (depending on the value set for 'retry_next_frame') The retries continue until the 'expected_pid' is received. When a retry attempt finds its 'expected_pid', the Trainer automatically generates a new start-of-frame before continuing with the rest of the Gen File. (The start-of-frame is either an SOF packet or a keep-alive signal.) If 'FALSE', the Trainer waits for a Pid before proceeding. There is no timeout. If a Pid is received which does not match the 'expected_pid', the Trainer continues to wait for the correct Pid to appear. If the user stops the generation, a message states that the generator was waiting patiently for the "expected_pid", and it never showed up. The user must examine the problem by viewing the trace file. This statement can also be used in conjunction with any "pid=xxx" statement in the **.utg** file. This can be done to override the configured or default retry behavior. Syntax example: retry=TRUE

Key Code	Format	Description
retry_next_frame	'TRUE' 'FALSE'	**Host Generation Only.** Determines when a retry will be attempted after a failed match of an 'expected_pid'. This statement only applies if a "retry=TRUE" statement also exists. If 'TRUE', the Trainer waits until the current frame completes, issues a start of frame, and then retries the transaction. If 'FALSE', the Trainer waits 1/10th of a frame before retrying the transaction. Before each retry attempt, the Trainer checks to see where in the frame interval it is. If it is too close to the EOF, it automatically generates the next start-of-frame before performing the retry. If it is not too close to the EOF, it performs the retry without generating a new frame. This statement can also be used in conjunction with any "pid=xxx" statement in the **.utg** file. This can be done to override the configured or default retry behavior. Syntax example: retry_next_frame=FALSE
ping_on_retry	'TRUE' 'FALSE'	**Host Generation Only.** Determines whether an OUT transaction is retried by repeating the OUT-DATAx sequence, or whether a PING sequence should be initiated. If 'TRUE', the Trainer automatically generates PINGs (and retries) before going through a Retry Loop. PINGs are repeated until an ACK is received, and then the original OUT-DATAx transaction Sequence is attempted. During the PING retries, the trainer automatically generates frames. When the original Retry Sequence receives its 'expected_pid', the Trainer generates a new frame before continuing with the Gen File. If 'FALSE', the original transaction is always retried.This statement can also be used in conjunction with any "pid=xxx" statement in the **.utg** file. This can be done to override the configured or default retry behavior. Syntax example: ping_on_retry=TRUE
ping_after_nyet		**Host Generation Only.** If 'TRUE', the Trainer automatically generates PINGs (and retries) after receiving a NYET instead of the 'expected_pid'. This feature is only used if the 'expected_pid' is an ACK. PINGs are retried until an ACK is received. When the PING is ACKed, the Trainer generates a new frame before continuing with the Gen File. If 'FALSE', the Trainer continues as if an ACK occurred. This statement can also be used in conjunction with any "pid=xxx" statement in the **.utg** file. This can be done to override the configured or default retry behavior. Syntax example: ping_after_nyet=TRUE

Key Code	Format	Description
Packet Starting Keys		
pid	8 bits (0-0xFF) or pid string	**Host Generation Only.** Use this as the first key of most packets sent by the Host (Exception: use "frame=" for SOF packets). The key should be assigned to a valid packet identifier string per the USB specification: 'SETUP', 'IN', 'OUT', 'DATA0', 'DATA1', 'ACK', 'PRE', 'PING', 'SPLIT', 'DATA2', or 'MDATA'. Optionally, you may assign this key a raw eight bit value to force an error condition. **Warning**: If you specify PID=0xNN, you must use "raw_data=( )" to specify the rest of the packet data, because the packet structure is unknown.
expected_pid	pid string	**Host Generation Only.** Use this as the PID key for packets which are expected to be sent by the device. In IntelliFrame mode, the generator waits until this PID has completed before sending the next generated packet or bus condition. The key should be assigned to a valid packet identifier string per the USB specification: 'DATA0', 'DATA1', 'ACK', 'NAK', 'STALL', 'NYET', 'DATA2', or 'MDATA'. The generator engine waits forever until this "expected_pid" appears, so the user may have to hand edit the file to achieve the desired results. For example, if a NAK comes where the "expected_pid" was a DATA1, the user should edit the .**utg** file to move the "pid=IN" command to later in the file by inserting some "frame=AUTO idle=TO_EOF" pairs before it. This allows time for the device to be ready for the IN. If "RETRY=TRUE" for this address/endpoint, the NAKs are ignored and the SOF's are generated automatically until the expected PID occurs.
device_pid	pid string	Use this as the first key of most packets sent by a device. The key should be assigned to a valid packet identifier string per the USB specification: 'DATA0', 'DATA1', 'ACK', 'NAK', 'STALL', 'NYET', 'DATA2', or 'MDATA'. Normally, the "device_pid=" statement is NOT present in a Host Generation .**utg** file, because the device responses are intended to come from real devices. By default, Host Generation files exported from Trace Files do NOT include "device_pid=" statements. **Warning:** If you specify "PID=0xNN", you must use "raw_data=( )" to specify the rest of the packet data, because the packet structure is unknown.

Key Code	Format	Description
frame	11 bits or 'AUTO' 'KEEP_ALIVE'	Creates a start of frame packet and generates a SOF PID as expected. The key should be assigned a value of the frame number, 'AUTO', or 'KEEP_ALIVE'. The string 'AUTO' instructs the generator to increment the frame number automatically. The string 'KEEP_ALIVE' instructs the analyzer to generate a low-speed EOP in place of a SOF packet for traffic on a low-speed branch ("file_speed=LOW"). For Device Emulation, this statement is ignored by the Device Emulator, but serves to organize the **.utg** file in a more readable manner.
empty_frame	integer	**Host Generation Only.** This key creates a sequence of start of frame packets with "idle=TO_EOF" values for the idle time. This results in N empty frames, where N is the integer value specified. If the branch speed is LOW, the frames contain only the keep-alive standalone EOP's. This key makes for an easier to manage **.utg** file by eliminating the need for many lines of "frame=AUTO idle=TO_EOF" statements. Usage: empty_frames=23 ; insert 23 empty frames here
host_exp_pid	PID	**Device Emulation Only.** Defines the PID that is expected to be received from the Host. The Device Emulator waits until this PID has completed before sending the next generated packet. The key should be assigned to a valid packet identifier string per the USB specification: 'SETUP', 'IN', 'OUT', 'DATA0', 'DATA1', 'ACK', 'PING', 'DATA2', or 'MDATA'. 'PRE' and 'PING' are for Hubs only, and are not supported. Each memory segment waits forever until it receives the expected PID to it's address/endpoint, so the user may have to hand edit the file to achieve the desired results. Each endpoint memory segment acts independently.
Bus Condition Keys		
reset	positive integer or 'LS_EOP'	**Host Generation Only.** Indicates the number of microseconds that single-ended zeros (SE0) are driven onto the bus. Assign a positive integer to this key. This key can also be assigned the string 'LS_EOP' to drive two low-speed bit times of SE0 followed by one bit time of J.
se0	positive integer <2500	**Host Generation Only.** Same SE0 signal as reset, but the range is in nanoseconds (accuracy: +/- 33ns).
suspend	positive integer	**Host Generation Only.** Indicates the number of microseconds of idle and suspend after the previous packet (e.g., for ten milliseconds of suspend the key should equal 13000). Assign a positive integer to this key. Note that suspend begins after 3 milliseconds of idle.

Key Code	Format	Description
resume	positive integer	**Host Generation Only.** Indicates the number of microseconds of K driven onto the bus. Assign a positive integer to this key. For a proper resume sequence, this should be followed by the condition "reset=LS_EOP speed=LOW".
wait_resume	HERE	**Host Generation Only.** Place this immediately before a "resume=<>" statement to implement a device resume, also known as Remote Wakeup. This causes the host to wait for the device to issue the Resume (K) condition before the Host proceeds with its own Resume signalling. This statement MUST be followed by the "resume=<> statement".
chirp	'HERE'	Used to create a chirp sequence for a High Speed generation. Usage: chirp=HERE
wait_vbus	'VALID'	**Device Emulation Only.** Wait for VBus to go Hi.
termination	'HERE'	**Device Emulation Only.** Set terminations now.
Keys for Packet Fields		
speed	'LOW'	Used to cause a low speed packet on a full speed branch. The only legal value is "speed=LOW".
addr	7 bits (0-127)	Assign a value for the address field.
endp	4 bits (0-15)	Assign a value for the endpoint number field.
hub_addr	7 bits (0-127)	**Host Generation Only.** Assign a value for the hub_address field of a SPLIT packet.
port	7 bits (0-127)	**Host Generation Only.** Assign a value for port field of a SPLIT packet.
data	(AB CD)	Assign data bytes for the data field. Use the following syntax: data=(12 34 56 78 90 AB CD EF DC 13 40 78 11 CA 70 65). You can wrap bytes of the data field to the next line. The bytes are in the order they come across the bus, and the bits within the bytes are in MSB to LSB order. Maximum number of bytes allowed is 1049.
crc	5 bits (0x0-0x1F) or 16 bits (0x0-0xFFFF)	Assign a value for the crc field. The default value is the correct crc calculated for the packet.
s	0 or 1	**Host Generation Only.** Assign a value for the s (High Speed SPLIT Start/Speed) field.
sc	0 or 1	**Host Generation Only.** Assign a value for the sc (High Speed SPLIT Start/Complete) field.
e	0 or 1	**Host Generation Only.** Assign a value for the e (High Speed SPLIT End) field.
et	0-3	**Host Generation Only.** Assign a value for the et (High Speed SPLIT Endpoint Type) field. 0-Control, 1-Isoch, 2-bulk, 3-Interrupt

Key Code	Format	Description
eop	positive integer	Assign a positive integer for the length of the end of packet (EOP). The default value is the correct length (2 bits of SE0, 1 bit of J). The value is reflected by <val-1> bits of SE0 plus one bit of J.
hi_eop	(AB CD) Hex	Used to generate a high speed EOP pattern. The bytes are in the order they come across the bus, and the bits within the bytes are in LSB to MSB order. Maximum number of bytes allowed is 13.
idle	positive integer or 'TO_EOP'	Defines the length of idle after the current packet. Assign a positive integer or string to this key. The positive integer indicates the number of full-speed or low-speed bit times. The default value is around 4 bits for Classic speeds, and around 150 bits for High speeds. When this keyword is assigned a string 'TO_EOF', USB Chief automatically calculates the amount of idle remaining in the frame. When handshaking with a device, you can use this keyword to add idle where you anticipate a packet being returned from the device. The "idle=" key is always associated with the proceeding packet or bus condition, so you should not put file control keys between the packet or bus condition statement and the "idle=" statement.
marker	'string'	Assign a string in quotation marks to be put in the marker for the defined packet.
raw_data	(aa bb)	Use to send a non-modulo 8 number of bits in a classic speed 'raw_data' packet. It is only valid in conjunction with the 'raw_data' statement. Normally, every bit of the array defined in a "raw_data=(xx yy)" type of statement would be sent. However, particularly in the case where "bit_stuff=off", you need more control over the number of bits to be output on the bus. By adding the statement "raw_data_bits = 11", only the first 11 bits of the defined bytes are sent. For the following case, raw_data=(8F F0) raw_data_bits=13 the output bitstream would be: 1111 0001 0000 1 (Each byte is described in MSB to LSB format, but is output on the wire in LSB to MSB format.)

Key Code	Format	Description
raw_data_bits	integer	Use to send a non-modulo 8 number of bits in a classic speed 'raw_data' packet. It is only valid in conjunction with the 'raw_data' statement. Normally, every bit of the array defined in a "raw_data=(xx yy)" type of statement would be sent. However, particularly in the case where "bit_stuff=off", you need more control over the number of bits to be output on the bus. By adding the statement "raw_data_bits = 11", only the first 11 bits of the defined bytes are sent. For the following case, raw_data=(8F F0) raw_data_bits=13 the output bitstream would be: 1111 0001 0000 1 (Each byte is described in MSB to LSB format, but is output on the wire in LSB to MSB format.)
bit_stuff	'OFF' 'ON'	Assign the string **OFF** to disable bit stuffing within the current packet. The default value is **ON**.
sync	integer 1-40	Assign an integer from 1 to 40 to represent the sync field. The integer is the number of zeros transmitted before the one. For Low and Full Speed files, the default value is 7 to give a sync of '00000001'. For High Speed files, the default value is 31 resulting in a sync of '00000000000000000000000000000001'.
retry ping_on_retry ping_on_nak retry_next_frame	'TRUE' 'FALSE'	**Host Generation Only.** These four keys may be applied to individual packets, to override the behavior in a given instance. Normally, they are used in the 'config_endpoint' statement. See their descriptions in the Endpoint Configuration section earlier.
Keys for Class Decoding		
These keys are populated into the **.utg**. script file automatically whenever the menu command **File** > **Export to .utg file** is run. These keys do not need to be edited.		
sd_prod		
sd_vend		
sd_bm_req_type		
sd_interface		
sd_host_id		
sd_class_code		
sd_subclass		
sd_protocol		
sd_end_sd		

How to Contact LeCroy

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…	LeCroy Customer Support 3385 Scott Blvd. Santa Clara, CA 95054	
Send e-mail…	support@catc.com	
Visit LeCroy's web site…	http://www.lecroy.com/	

Limited Hardware Warranty

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

What this Warranty Does Not Cover

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

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

How to Obtain Warranty Service

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

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