

# LeCroy USB*Mobile*HS™

## Protocol Analyzer

## User Manual

**Manual Version 2.15**



**For Software Version 2.15**

15 November, 2005

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Part number: 730-0049-00

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# 1. Overview

The LeCroy USB*Mobile*HS USB Hi-Speed Analyzer is a portable, PC Card based, bus and protocol analyzer that accurately and efficiently debugs, tests and verifies Low, Full, and Hi-Speed USB semiconductors, devices, software and systems. USB*Mobile*HS features the CATC Trace software, the de-facto standard for recording and analyzing USB protocol traffic. The CATC Trace simplifies the overall debug process by using collapsible, color-coded schemes to represent the USB Packet, Transfer and Transaction layers. Its native On-The-Go (OTG) support automatically detects, decodes, and displays the HNP and SRP protocols, including VBus pulsing. The USB*Mobile*HS builds upon LeCroy's experience and knowledge of the needs of the USB development and test communities. The result is a USB bus and protocol analyzer with unprecedented functionality, unparalleled flexibility, and uncompromising user friendliness.

Features	Benefits
Low power, 16 bit, Type II PC Card Design	Personal analyzer. Portable operation with any notebook PC
CATC Trace software display	De-facto industry standard speeds up interpretation and debug of USB traffic. Compatible with LeCroy USB <i>Mobile</i> , Inspector, Chief, Advisor, and USBTracer/Trainer
OTG (On-The-Go) Support	Record and analyze HNP and SRP including the capturing of VBus pulses
Trace Navigator	Define areas of interest and "shrink" viewable Trace to areas of most importance
Advanced Triggering	Isolate important traffic, specific errors or data patterns
Hardware Filtering	Faster analysis by removing non essential fields from the trace
Intelligent Reporting	Quickly identify and track error rates, abnormal bus or timing conditions
Sophisticated Viewing	View Packet, Transaction and Transfer layers of the USB protocol
Downloadable trace viewer software	Share and annotate trace recordings within a development team

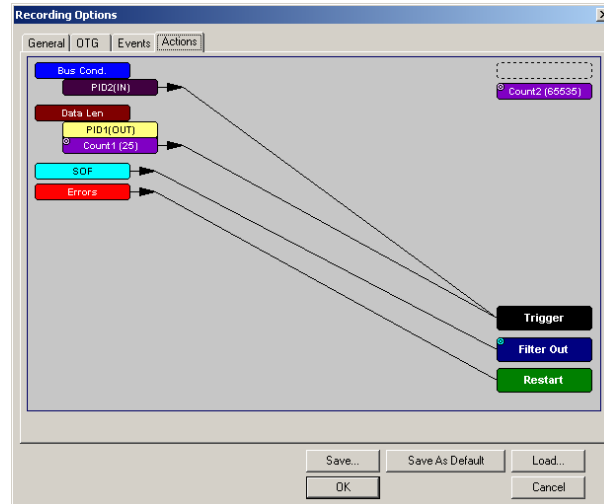
## 1.1 Event Triggering

For efficient development of USB systems, it is critical that users are able to extract important information from a crowded stream of bus traffic, and accurately identify and selectively record information that is of most interest. The Events and Action fields for trigger set-up is intuitive and graphical, thus making pre-recording set-up time efficient.

USB*Mobile*HS provides real-time hardware triggering on the critical components of USB. Users can custom-configure and control order of

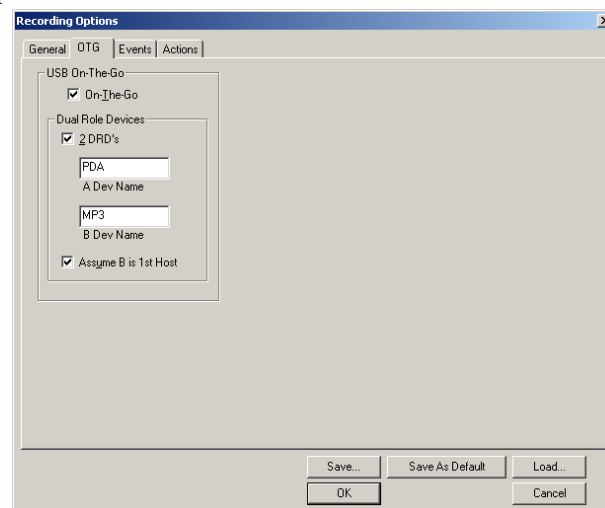
events selected for triggering. The count and sequence options define the rules for data recording sessions. There are two Counters, Filter Out/In and a Restart option that causes sequencing and counting to start again. Any sequence can include up to seven events of any type.

Users can adjust the depth of the recording memory - up to 64 Mbytes - and determine where in the recording the trigger is located.



## 1.2 On The Go Support

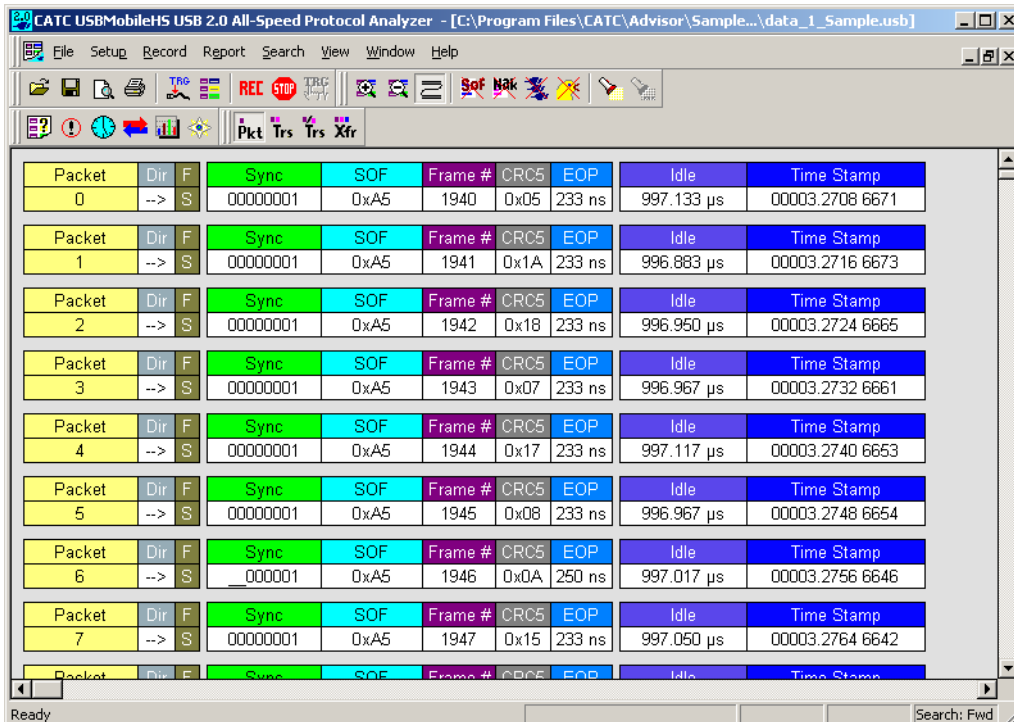
The USB*Mobile*HS supports OTG (On-The-Go) capabilities. OTG is an emerging standard in the USB specifications that allows peer-to-peer connectivity among USB devices and provides a standard USB connection among portable devices. The analyzer identifies both the HNP (Host Negotiation Protocol) and SRP (Session Request Protocol) occurrences, searches for Host A or B, and identifies timing anomalies during HNP and SRP protocols.





## 1.3 The CATC Trace

The CATC Trace's ability to extract critical information quickly and intuitively from a crowded stream of bus traffic is unparalleled. The ability to accurately identify and isolate very specific packets is vital to speeding debug and development time. Powerful Search and Find options allow users to quickly get to specific packets, errors and any data type within a trace file. With filter and hide commands, the CATC Trace removes irrelevant data from the Trace for efficient viewing.



Packet	Dir	F	Sync	SOF	Frame #	CRC5	EOP	Idle	Time Stamp
0	-->	S	00000001	0xA5	1940	0x05	233 ns	997.133 μs	00003.2708 6671
1	-->	S	00000001	0xA5	1941	0x1A	233 ns	996.883 μs	00003.2716 6673
2	-->	S	00000001	0xA5	1942	0x18	233 ns	996.950 μs	00003.2724 6665
3	-->	S	00000001	0xA5	1943	0x07	233 ns	996.967 μs	00003.2732 6661
4	-->	S	00000001	0xA5	1944	0x17	233 ns	997.117 μs	00003.2740 6653
5	-->	S	00000001	0xA5	1945	0x08	233 ns	996.967 μs	00003.2748 6654
6	-->	S	00000001	0xA5	1946	0x0A	250 ns	997.017 μs	00003.2756 6646
7	-->	S	00000001	0xA5	1947	0x15	233 ns	997.050 μs	00003.2764 6642

## 1.4 USB*Mobile*HS System Components

The LeCroy USB*Mobile*HS 2.0 Hi-Speed Protocol Analyzer package includes the following items:

- One LeCroy USB*Mobile*HS analyzer
- One 1-meter **A-B** cable (standard **A** plug to mini **B** plug)
- One 1-meter **A-B** cable (mini **A** plug to mini **B** plug)
- One 15-centimeter On the Go (OTG) adaptor (standard **A** receptacle to mini **A** plug)
- LeCroy USB*Mobile*HS software program installation CD
- Product Documentation

## 1.5 USB Specification

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	Tel: +1/503.296.9892
Forum	Fax: +1/503.297.1090
1730 SW Skyline Blvd.	Web: <a href="http://www.usb.org/">http://www.usb.org/</a>
Suite 203	
Portland, OR 97221	

## 1.6 Features

### *General*

- Fully compliant with USB 2.0 specification
- Supports Full-Speed, Low-Speed, and Hi-Speed USB
- User friendly "CATC Trace" Interface that displays bus traffic using color and graphics
- Trace Viewer available as free non-recording, view-only software
- Three year warranty and hot-line customer support

### *Physical Components*

- PC-Card form factor: Personal analyzer. Low-power, portable operation with any notebook PC.
- Two Mini AB USB ports and cables: Designed to reduce bulk and maintain portability and compact size.
- 64MB of physical recording memory

### *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.

- 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 64 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 USBTracer, USBMobile, 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.

**Note** Refer to Readme.txt on your installation disks for the latest information on features.

## 1.7 Specifications

### *Package*

Dimensions: 5.3 x 2.1 x 0.4 inches  
(135 x 54 x 5 millimeters)

Weight: 1.8 ounces  
(51 grams)

### *Hardware Interface*

Connectors: Standard 16-bit Type II PC Card  
Mini A-B Receptacles

### *Power Consumption*

Idle: 500 milliamps (typical)

Active: 560 milliamps (typical)

### *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

### *Recording Memory Size*

64 MB

### *Host Compatibility*

Works with any PC equipped with a functioning PCMCIA slot and running Microsoft Windows 98SE, Windows Me, Windows 2000, and XP operating systems.

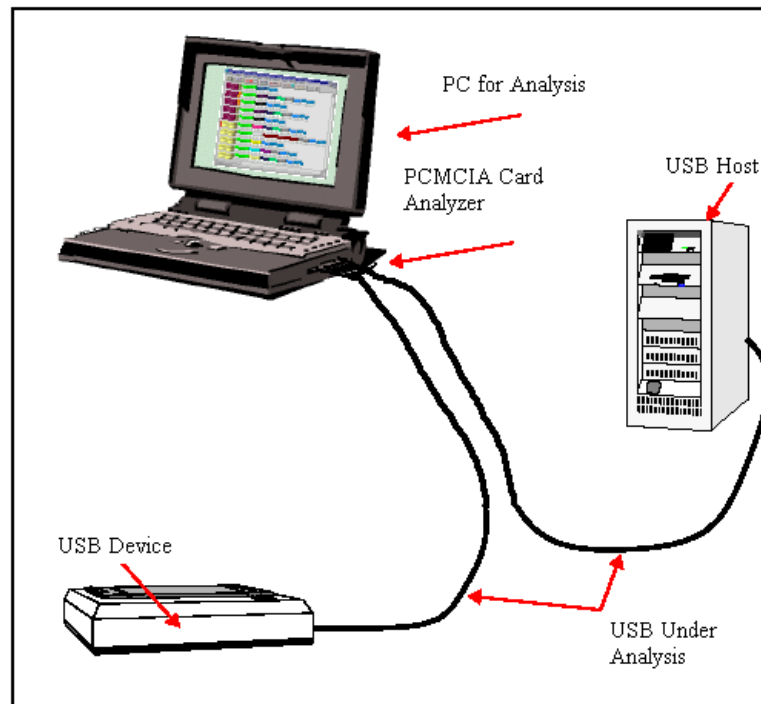
### *Product Warranty*

LeCroy provides a three-year limited warranty on its products.

## 2. Installation

USB*Mobile*HS is controlled through a personal computer PCMCIA slot. It can be used with portable computers for field service and maintenance as well as with desktop units in a development environment.

**Figure 1: USB*Mobile*HS Connection**



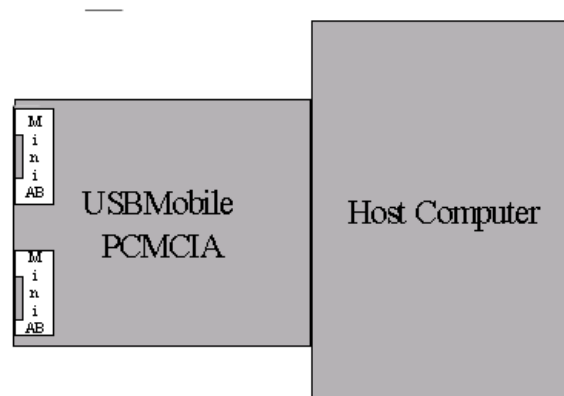
USB*Mobile*HS provides on-the-fly detection of and triggering on such events as specific user-defined bus conditions, packets matching any Packet Identifier (PID), packets matching a Token or Setup transaction, data patterns, and errors and bus conditions. Whether recording manually or with a specified Trigger condition, USB*Mobile*HS continuously records the bus data in a wrap-around fashion until manually stopped or until the Trigger Event is detected and a specified post-Trigger amount of bus 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 USB*Mobile*HS software provides powerful search functions that enable investigation of particular bus 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.

## 2.1 USB Test Ports

Connect a host to one of the mini a-b receptacles (use an adaptor if necessary), and connect your device to the other. It does not matter which receptacle you plug into.



**Note** The USB*Mobile*HS USB 2.0 Classic Analyzer is not a hub device; it connects to a USB branch by inserting a non-intrusive, high impedance tap. Because of the poor signal quality in the middle of a USB cable, LeCroy recommends using the shortest possible cables so that the total length of both cables together is less than 6 feet. The USB cables provided with your analyzer meet this requirement. When longer cables are used, the analyzer might record incorrect data.

## 2.2 Analyzer PC Requirements

The following is a list of recommended configuration for the host machine that runs the USB*Mobile*HS application and that is connected to the USB*Mobile*HS Analyzer:

- Microsoft Windows 98SE, Me, 2000, or XP. The USB*Mobile*HS application can be used on machines with Windows NT 4.0 to view trace files. Microsoft Internet Explorer, version 5 or newer.
- For optimum performance, use processors of Intel's PentiumIII/Pentium4 family, AMD's Athlon/Duron family, or other compatible processors with clock speed of 500mHz or higher (Processors of Intel's Pentium II/Celeron family or AMD's K6 family with clock speed of 300mHz is a minimum).
- For the best performance, it is recommended to have a minimum of 128MB of RAM.
- At least 20MB of free hard disk space is required for the USB*Mobile*HS installation. Additional disk space is needed for storing the recorded data in files during the recordings process (can be as much as 50MB 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).

## 2.3 Software Installation

- Step 1** Insert the USB*Mobile*HS CD-ROM into your computer.
- Step 2** Click **Install Software** when the Auto-Run program is displayed.
- Step 3** Follow the installation instructions on your screen.

The CATC Install Wizard automatically installs the necessary files to the computer's hard drive. The software is installed in the **C:\Program Files\LeCroy\USB*Mobile*HS** directory unless you specify otherwise. Follow the installation instructions on your screen.

## 2.4 Hardware Installation

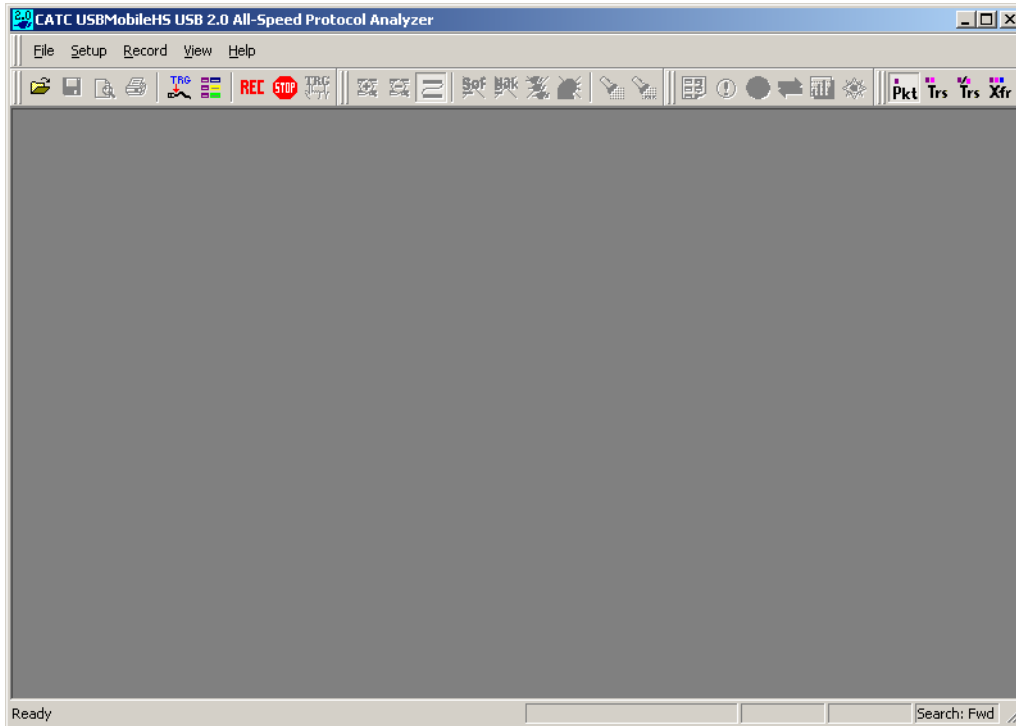
USB*Mobile*HS components and software are easily installed and quickly ready to run on most personal computer systems. You can begin USB recordings after following these initial steps.

- Step 1** Insert the CD-ROM.
- Step 2** Click **NEXT** when you see the **Add New Hardware Wizard** window.
- Step 3** Follow the on-screen Plug and Play instructions under Windows.

**Step 4** Click **Finish** when you see the message that says "Windows has finished installing the software that your new hardware requires" and the file "USB*Mobile*HS.inf" has been installed on your host PC.

**Step 5** Run the program **setup** and follow the on-screen instructions.

Launch the LeCroy USB*Mobile*HS program from the LeCroy programs group. The main software screen opens:



**Step 6** From the **Help** menu, select **About USB*Mobile*HS ...**

If the information below is present, you can record a trace:

- USB*Mobile*HS Software Version
- USB*Mobile*HS Driver Version
- BusEngine Version
- Unit Serial Number

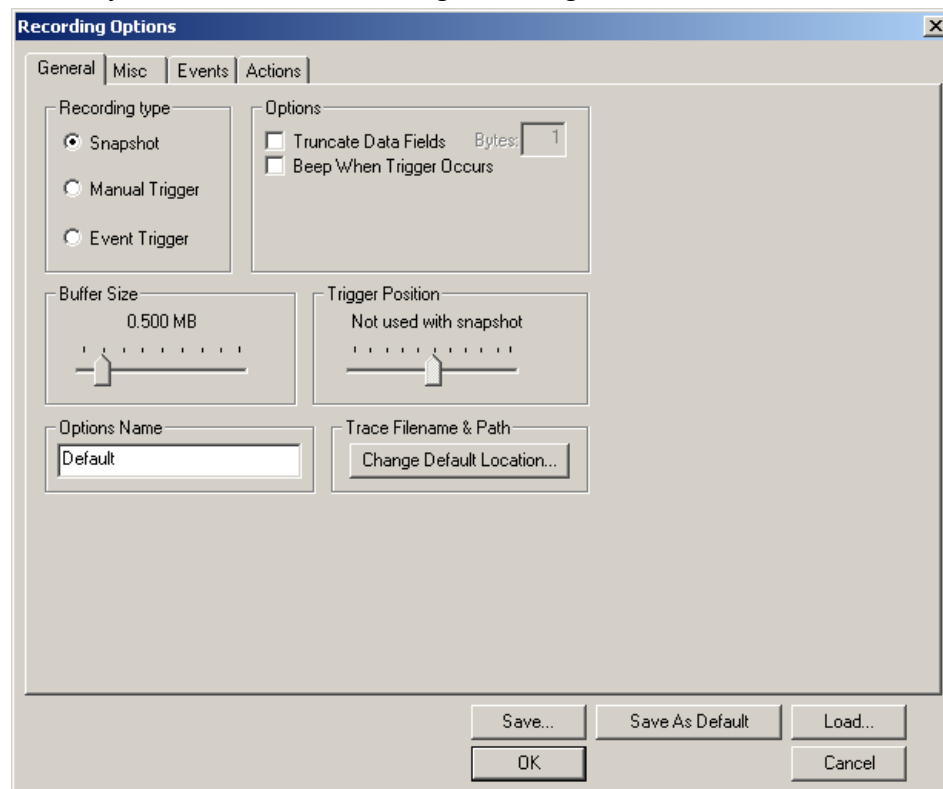


## 2.5 Your First USB Recording

After installing and launching the software, you can test USB*Mobile*HS by performing the following steps.

- Step 1** Connect a USB cable to each of the two connectors on the USB*Mobile*HS module, and 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.

The following dialog box will open showing factory default settings such as “Snapshot” and 1 Mbyte buffer size. For your 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  on the Tool Bar.


USB*Mobile*HS starts to record the USB traffic immediately. After 1 Mbyte of traffic is recorded, the analyzer will upload the data and display the packets in the trace window.

- Step 7** If you wish to terminate the recording before the snapshot automatically completes, click  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 whatever 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 Toolbar.

The standard **Save As** screen appears.

- Step 9** Give the recording a unique name and save it to the appropriate

directory.

## Capturing Your First CATC Trace

After a moment, the recording will terminate and the results will display.

Packet	Dir	F	Sync	SOF	Frame #	CRC5	EOP	Idle	Time Stamp
0	-->	S	00000001	0xA5	1940	0x05	233 ns	997.133 μs	00003.2708 6671
1	-->	S	00000001	0xA5	1941	0x1A	233 ns	996.883 μs	00003.2716 6673
2	-->	S	00000001	0xA5	1942	0x18	233 ns	996.950 μs	00003.2724 6665
3	-->	S	00000001	0xA5	1943	0x07	233 ns	996.967 μs	00003.2732 6661
4	-->	S	00000001	0xA5	1944	0x17	233 ns	997.117 μs	00003.2740 6653
5	-->	S	00000001	0xA5	1945	0x08	233 ns	996.967 μs	00003.2748 6654
6	-->	S	00000001	0xA5	1946	0x0A	250 ns	997.017 μs	00003.2756 6646
7	-->	S	00000001	0xA5	1947	0x15	233 ns	997.050 μs	00003.2764 6642

## Trace View Features

- The USB*Mobile*HS 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 or full-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.

Each row numerates, labels, and color-codes a USB packet

Before Trigger

Packet	Dir	F	Sync	SOF	Frame #	CRC5	EOP	Idle	Time Stamp	
2734	-->	S	00000001	0xA5	721	0x0D	250 ns	996.883 μs	00010.2143 3631	
2735	-->	S	00000001	0xA5	722	0x0F	233 ns	996.900 μs	00010.2151 3619	
2736	-->	S	00000001	0xA5	723	0x10	233 ns	350 ns	00010.2159 3607	
2737	-->	S	00000001	0xB4	0	0	0x08	233 ns	183 ns	00010.2159 3802

After Trigger

Packet	Dir	F	Sync	DATA0	Data	CRC16	EOP	Idle	Time Stamp	
2738	-->	S	00000001	0xC3	8 bytes	0xBB29	233 ns	483 ns	00010.2159 3987	
Packet	Dir	F	Sync	ACK	EOP	Idle	Time Stamp			
2739	<--	S	00000001	0x4B	233 ns	983.200 μs	00010.2159 4510			
Packet	Dir	F	Sync	SOF	Frame #	CRC5	EOP	Idle	Time Stamp	
2743	-->	S	00000001	0xA5	724	0x0E	250 ns	333 ns	00010.2167 3596	
Packet	Dir	F	Sync	IN	ADDR	ENDP	CRC5	EOP	Idle	Time Stamp

Time-stamp appended to each packet

Filtered Traffic is displayed as a gray line

Specifies speed packet transmitted

Indicates a marked comment is set

## 3. Updates

From time to time as modifications are made to the USB*Mobile*HS Hi-Speed USB Analyzer, it is necessary to update the analyzer for optimal performance.

### 3.1 Software, Driver, 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.

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*Mobile*HS...** from the **Help** menu.



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

- USB*Mobile*HS Software Version
- USB*Mobile*HS Driver Version
- BusEngine Version
- Unit Serial Number

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

## 3.2 Software Updates

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

To update the software,

- Step 1** In the **About USB*Mobile*HS** screen, verify which version of USB*Mobile*HS 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.

## 3.3 BusEngine and Driver Updates

The Bus Engine and driver updates are done automatically during software installation. No user interaction is necessary or possible.

## 4. Software Overview

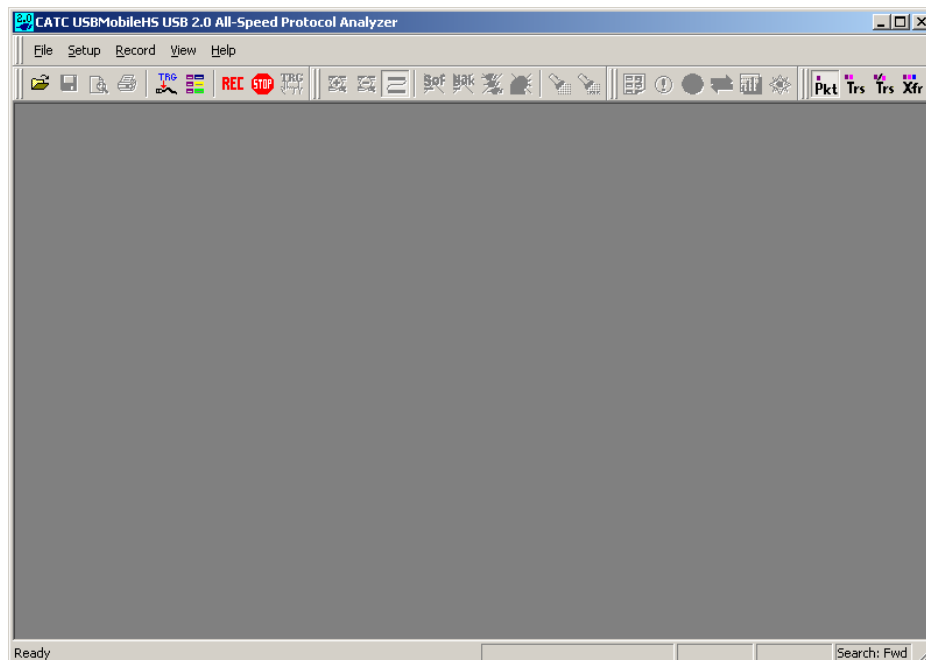
The USB*Mobile*HS software is an application that may be used with or without the Analyzer. When used without an Analyzer, the program functions in a Trace Viewer mode to view, analyze, and print captured protocol traffic from USB*Mobile*HS Analyzers. The software will also allow you to view trace files created by the LeCroy USB*Tracer*, USB*Mobile*, Advisor, Chief, 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*Mobile*HS 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.

### 4.1 Starting the USB*Mobile*HS Program

To starting the USB*Mobile*HS Program:

**Step 1** Click **Start > Programs > LeCroy > LeCroy USB*Mobile*HS**.



## 4.2 Tool Tips

Tool tips provide useful information about fields and buttons. In some cases, tool tips spell out acronyms used in trace fields. In other cases, tool tips provide substantial amounts of additional information. To display a tool tip, position the mouse pointer over an item.



## 4.3 Menus

The following table describes the menus within the application. Note that some menus are context-sensitive...



Menu	Function
<b>File</b>	
Open...	Opens a file.
Close	Closes the current file.
Save As...	Saves all or a specified range of packets from the current file with a specified name.
Print...	Prints part or all of the current traffic data file.
Print Preview	Produces an on-screen preview before printing.
Print Setup...	Sets up your current or new printer.
Edit Comment...	Creates or edits the Trace file comment field.
Export>>	Saves all or part of a trace to a text file or generator file.
Packets to Text (Packet View Format)	Packets to Text (Packet View Format)- Saves trace as text file.
Packets to .CSV (Comma Separated Values for Excel, etc.) ...	Exports traffic data to a file format compatible with spreadsheet and database applications.
Packets to Host Traffic Generator Text File (.utg) ...	Saves trace as script file that can be used by the LeCroy USBTrainer traffic generator to generate host-side traffic.
Packets to Device Emulation Traffic Generation Text File (.utg) ...	Exports packets to Device Emulation files for use on USBTrainer. This option does not export transactions.
Data	Data - Allows Transfer data to be exported as text or binary file.
Import	Imports data from a .vcd file.
Compare Endpoint Data	This command allows the user to select two endpoints of different directions with same address and verify that the data OUT/IN is identical to the data IN/OUT from the other endpoint. This command is useful when running echo-types of tests for data integrity. This command is present in the menu only when a trace file (.usb) is open.
Last File	Lists the last files that were opened.



Menu	Function
<b>Setup</b>	
<u>D</u> isplay Options...	Provides the control of various display options such as color, formats, and filters.
<u>R</u> ecording Options...	Provides setup options for recording, triggering events and filtering events.
<b>Record</b>	
<u>S</u> tart	Causes the Analyzer to begin recording USB activity.
<u>S</u> top	Causes the Analyzer to stop recording.
Upload Again	If the previous upload was only partially uploaded, use this to upload a different portion of the captured trace.
<u>M</u> anual Trigger	Causes a trigger in a trace. This button is only available in Manual Trigger mode.
<b>Report</b>	
<u>F</u> ile Information	Displays information about the recording such as the number of packets and triggering setup.
<u>E</u> rror Summary	Summarizes the errors throughout the recording. Allows for fast navigation to packet with errors.
Timing <u>C</u> alculation	Calculates timing between two packets and bus utilization.
Traffic Summary	Summarizes the numbers and types of packets, transactions, split transactions, and transfers that occurred in the open trace.
<u>B</u> us Utilization	Opens a window that displays graphs of bus utilization data. Once the window is open, the Bus Utilization menu will let you access the following sub-menu options: Hide, Save, Send, Print, Full Screen, View Options, Set Range, Synchronize, Graph Areas.
<b>Search</b>	
<u>G</u> o to <u>T</u> rigger	Positions the display to show the first packet that follows the trigger event.
<u>G</u> o to <u>P</u> acket/ <u>T</u> ransaction/ <u>T</u> ransfer ...	Positions the display to the indicated packet/transaction/transfer number.
<u>G</u> o to <u>M</u> arker »	Positions the display to the selected marked packet.
<u>G</u> o to »	Enables quick searching for specific events using a cascade of pop-up windows.
<u>F</u> ind	Allows complex searches on multiple criteria.
<u>F</u> ind <u>N</u> ext	Repeats the previous Find operation.
<u>S</u> earch Direction	Allows the search direction to be changed from forward to backwards or vice versa.
<b>View</b>	
<u>T</u> oolbars	Displays list of available toolbars.
<u>S</u> tatus Bar	Switches display of the Status Bar on or off.
<u>Z</u> oom <u>I</u> n	Increases the size of the displayed elements.
<u>Z</u> oom <u>O</u> ut	Decreases the size of the displayed elements.
<u>W</u> rap	Wraps displayed packets within the window.
<u>H</u> ide SOF's	Hides Start of Frames.

Menu	Function
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 <i>Mobile</i> HS.
Packet Level	Displays Packets.
Transaction Level	Displays Transactions.
Split Transaction Level	Displays Split Transactions.
Transfer Level	Displays Transfers.
Refresh Decoding	Performs a re-analysis and re-decoding of all of the transactions in the trace

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

<b>Help</b>	
<u>H</u> elp Topics ...	Displays online help.
<u>U</u> ppdate License...	Opens a dialog box for updating your LeCroy license.
<u>D</u> isplay License Information...	Displays information related to licensing.
<u>A</u> bout USB USB <i>Mobile</i> HS ...	Displays version information about USB USB <i>Mobile</i> HS.

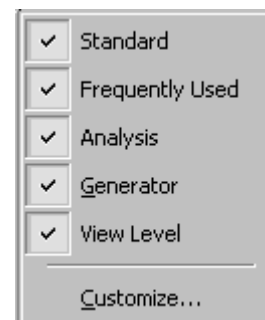
## View Options

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

## Resetting the Tool bar

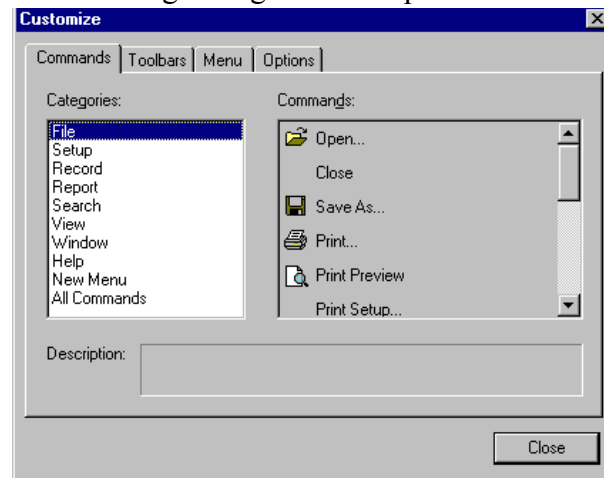
From time to time (such as following a software upgrade) it is possible for the buttons on the toolbar to not match their intended function. You can reset the toolbar by performing the following steps:

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



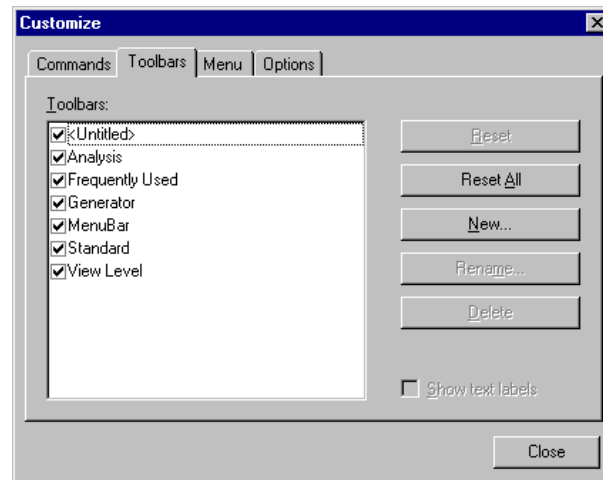
**Step 2** Select **Customize** from the sub-menu.

The following dialog box will open.



**Step 3** Select the **Toolbars** tab.

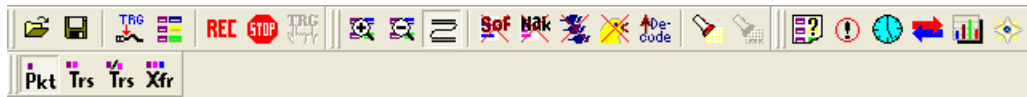
The following dialog box will open.
































**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*Mobile*HS program functions. Tool tips describe the functionality of each icon and menu item as the mouse arrow is moved over the icon/item.

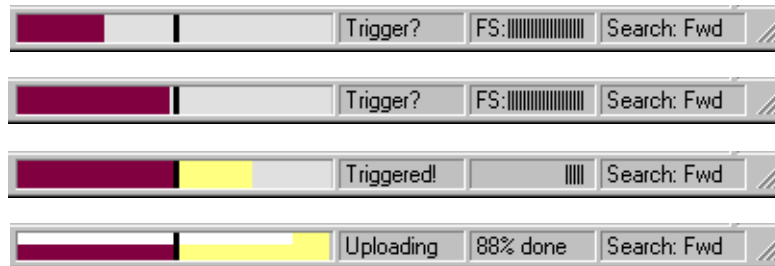
	Open file		Hide Chirps
	Save As		Assign High Level Decodes
	Preview		Find
	Print...		Find Next
	Setup Record Options		File Information Report
	Setup Display Options		Error Report
	Start Recording		Timing and Bus Usage Calculations
	Stop Recording		Traffic Summary
	Manual Trigger		Bus Utilization
	Zoom In		Open the Navigator bar
	Zoom Out		Display Packets
	Wrap		Display Transactions
	Hide SOFs		Display Split Transactions
	Hide NAK'ed transactions		Display Transfers
	Hide Devices		

## 4.4 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 into the default file **data.usb** (or whatever file name you have specified in the Recording Options dialog box.)

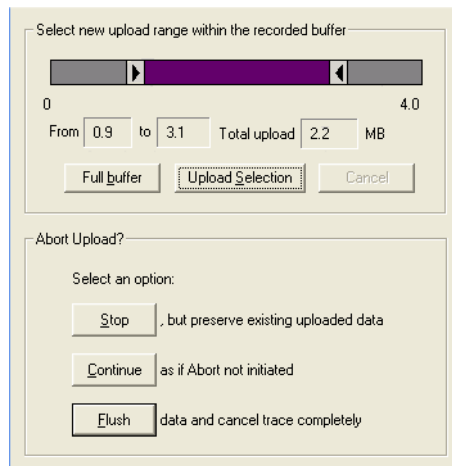
To abort the upload process,

- Press **Esc** on your keyboard or 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 with four options:

- **Full Buffer/Upload Selection** - this option lets you decide how much of the buffer to upload. The slide bar lets you set the range to be uploaded.
- **Stop** - Ends the upload process and preserves whatever part of the recording has been uploaded.
- **Continue** - Resumes the upload process.
- **Flush** - Empties the uploaded trace from the current file.

The Partial Upload button is enabled when you have partially uploaded data. When you click this button, 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.

## 4.5 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.

## 4.6 USB*Mobile*HS 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
Goto Any Error	Shift+E
Goto Channel 0	Ctrl+Shift+0
Goto Channel 1	Ctrl+Shift+1
View Packets	CTRL-1



View Transactions	CTRL-2
View Split Transactions	CTRL-3
View Transfers	CTRL-4

PID	
Goto ACK	Shift+A
Goto DATA0	Shift+0
Goto DATA1	Shift+1
Goto DATA2	Shift+2
Goto DATAx	Shift+D
Goto IN	Shift+I
Goto MDATA	Shift+M
Goto NAK	Shift+N
Goto NYET	Shift+Y
Goto OUT	Shift+O
Goto PING	Shift+G
Goto PRE/ERR	Shift+P
Goto SETUP	Shift+S
Goto SOF	Shift+F
Goto SPLIT	Shift+X
Goto STALL	Shift+L
Bus Conditions	
Goto Reset	Shift+T
Goto Resume	Shift+6
Goto SE0	Shift+Z
Goto SE1	Shift+7
Goto Keep-Alive	Shift+5
Goto Suspend	Shift+U
Goto Chirp	Shift+C
Goto Full Speed J	Shift+J
Goto Full Speed K	Shift+K

OTG	
Goto SRP	Ctrl+Q
Goto HNP	Shift+H
Goto VBus Voltage Change	Shift+V
Goto OTG Host A	Ctrl+Shift+A
Goto 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




## 5. Recording Options

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

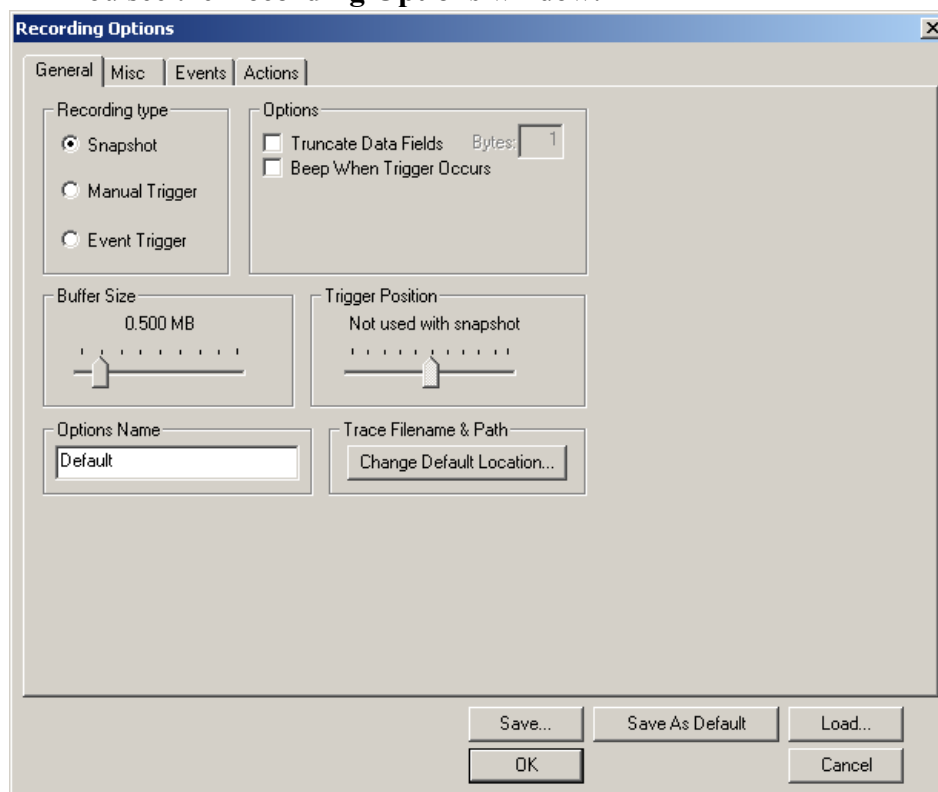
To open the **Recording Options** menu,

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

OR

- Click  on the Tool Bar.

You see the **Recording Options** window:



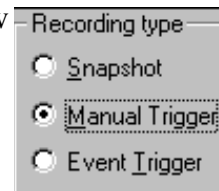
The **Recording Options** window always opens with the **General** tab showing.

## 5.1 General Recording Options



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

### Recording Type

The **Recording Type** box presents three options that allow you to set how USBMobileHS begins and ends a recording. The options are: *Snapshot*, *Manual Trigger*, and *Event Trigger*.





#### *Snapshot*


A Snapshot is a fixed-length recording whose size is determined by the "Buffer Size" box in the Recording Options dialog or by a manual click of the Stop button. Recording begins when  is clicked and ends when either the selected buffer size is filled or the  button is pressed.

#### *Manual Trigger*

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

#### *Event Trigger*

Recording begins when you click  on the Tool Bar.

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

### Options

- **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 box marked "Bytes." USBMobileHS will truncate 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*Mobile*HS will beep three times when a Trigger condition is first detected.

### Buffer Size

You can adjust the size of the recording buffer from 0.4 megabytes to 64 megabytes.

The **Recording type** option determines how this buffer is used. Although there are 64 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."

### Creating a New Recording Options File

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...**  
You see the **Save As** window.
- Step 3 Specify a filename (\*.rec)
- Step 4 Click **Save**.

### Loading a Recording Options File

To load a Recording Options name,

- Step 1 Click **Load ...**  
You see 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.

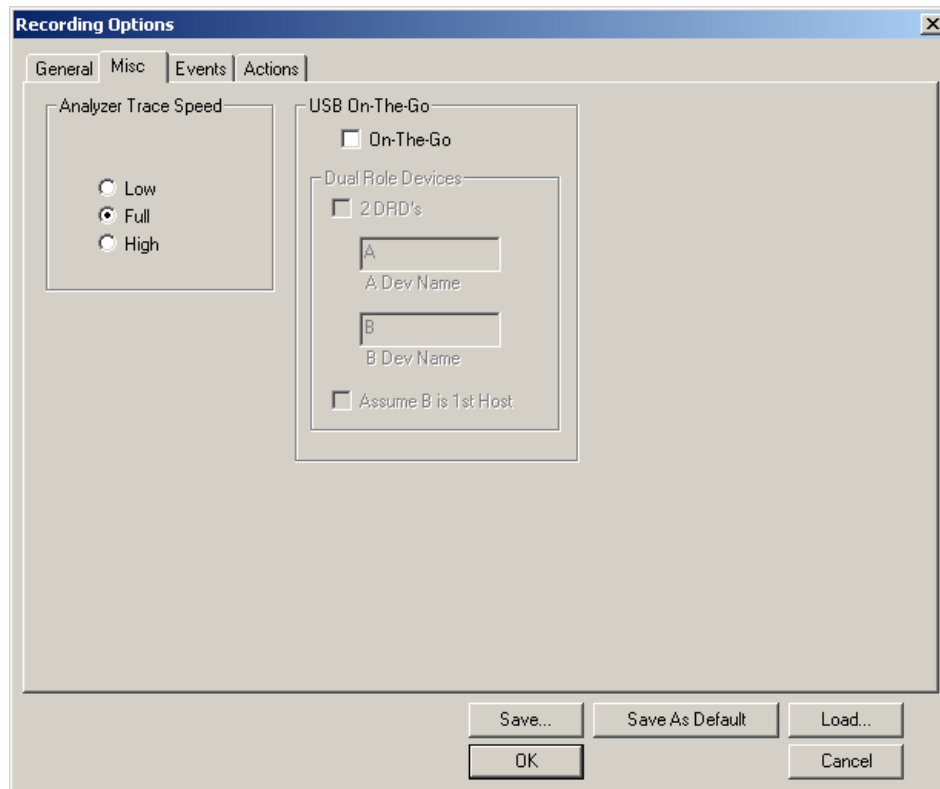
- Click **Trace File Name & Path**.

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



## 5.2 Recording Speed

The **Misc** tab contains settings that let you to tell the analyzer what speed traffic will be running and to configure the analyzer to record On-The-Go traffic.



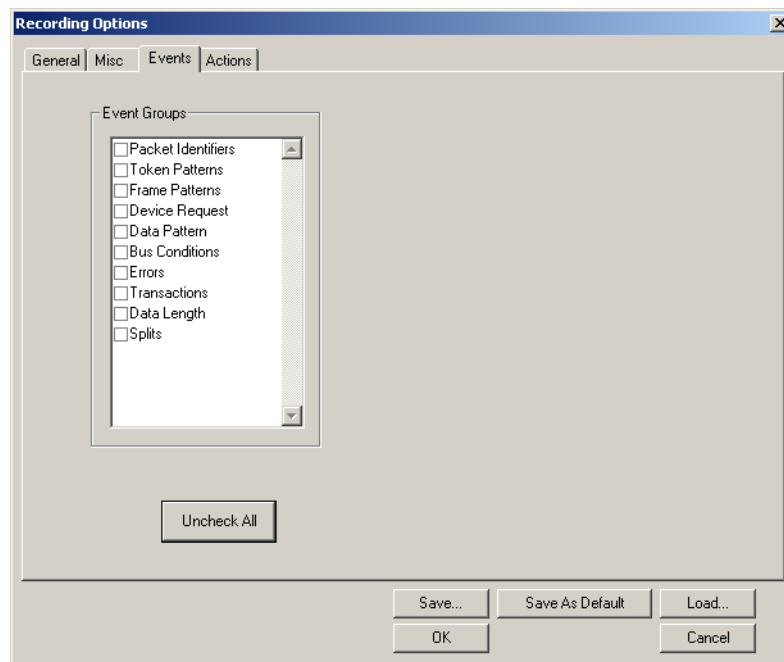
- **On the Go** - Check this if you are tracing an On the Go device. This allows session request protocol detection.
- **Dual Role Devices:**
  - **2DRD** - If both devices are Dual-Role devices, check this box to enable Host Negotiation Protocol (HNP) detection.
  - **A Dev Name** - Enter a name of your choice to refer to the device that receives the mini-**a** plug.
  - **B Dev Name** - Enter a name for the device that receives the mini-**b** plug.
- **Assume B is 1st Host** - Check this box if your scenario is one where the B device is acting as host when the trace is started. If the trace incorrectly identifies the wrong host, you can change it when viewing it by clicking on the host field of a packet and selecting a switch to the other host ID.

## 5.3 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.

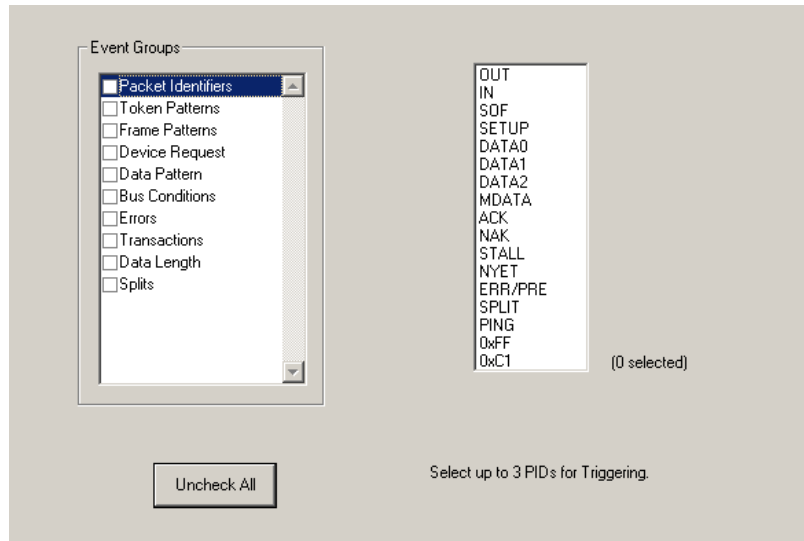
You see the **Event Groups** window:



### Packet Identifiers

- Select **Packet Identifiers** under **Event Groups**.

You see the **Packet Identifiers** window:

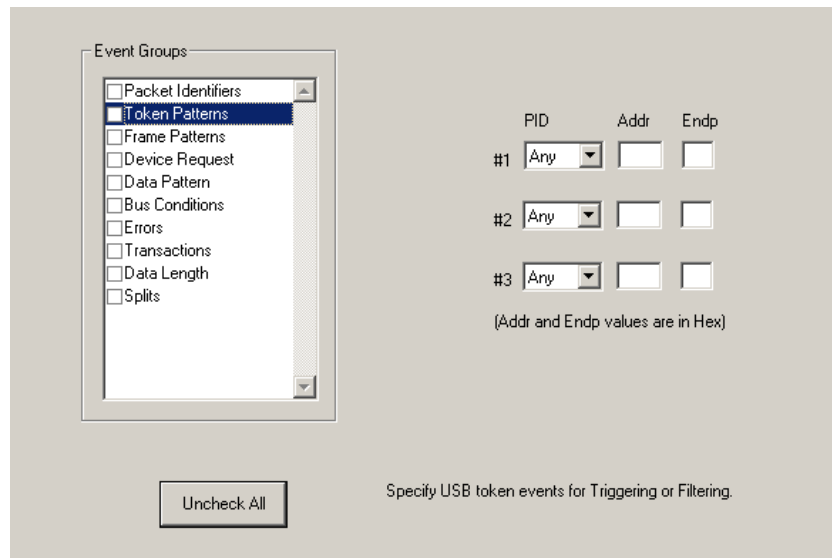


The Packet Identifier (PID) field lists the available packet types. Select up to three packet types to use as a Recording Trigger.

### Token Patterns

- Select **Token Patterns** under **Event Groups**.

You see the **Token Patterns** window:

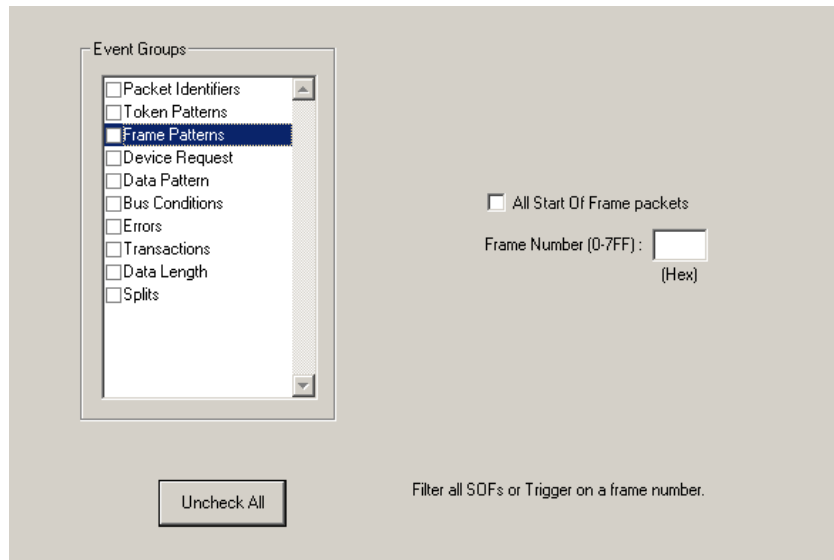


Specify up to three combinations of Address/Endpoint with any of the token PIDs. They can be triggered on or filtered in/out.

### Frame Patterns

- Select **Frame Patterns** under **Event Groups**.

You see the **Frame Patterns** window:

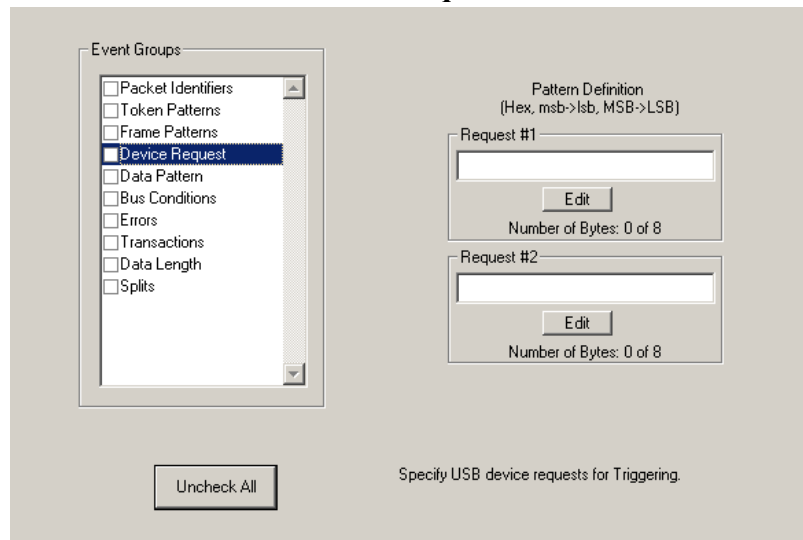


Identify frame patterns you want either to filter out of a Trace View or to use as a Trigger. You can select either **All Start of Frame packets** (SOF) to be filtered out or specify the **Frame Number** of a frame to trigger on.

### Device Requests

- Select **Device Requests** under **Event Groups**.

You see the **Device Requests** window:

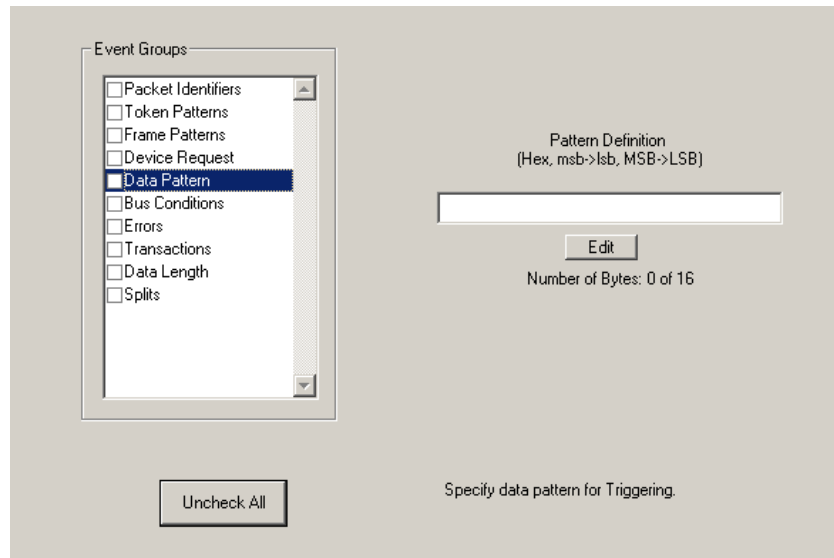


You can select one or two Device Requests for triggering or filtering.

### Data Pattern

- Select **Data Pattern** under **Event Groups**.

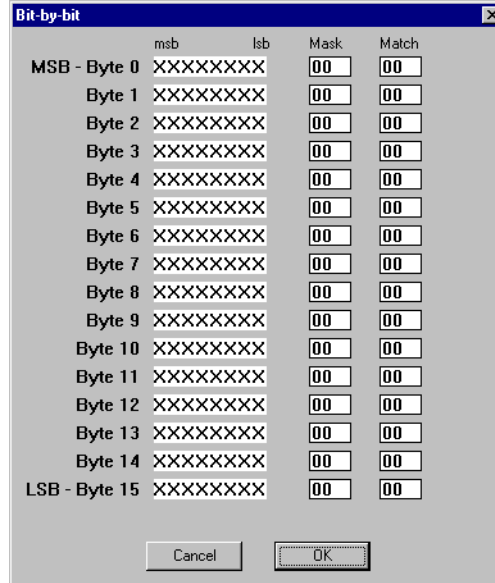
You see the **Data Pattern** window:



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:



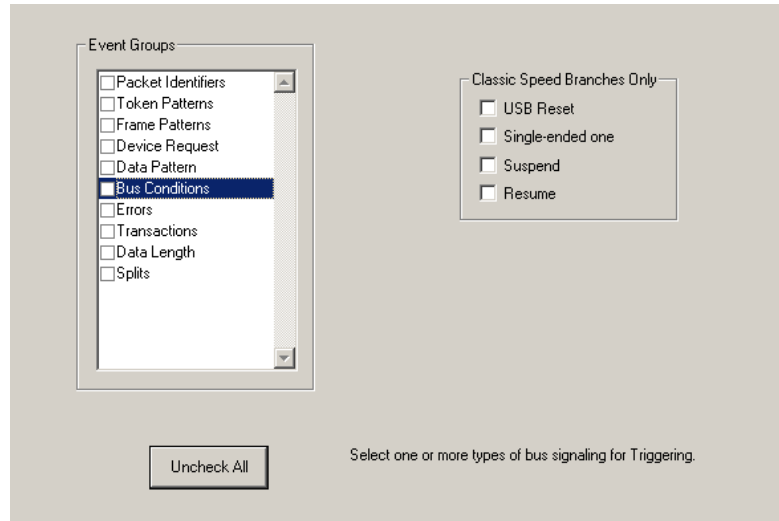
**Step 2** Click your mouse on the bits within each byte that you wish to edit and enter in the appropriate text.

The Mask and Match fields will change to reflect your changes.

## Bus Conditions

- Select **Data Pattern** under **Event Groups**.

You see the **Bus Conditions** window:

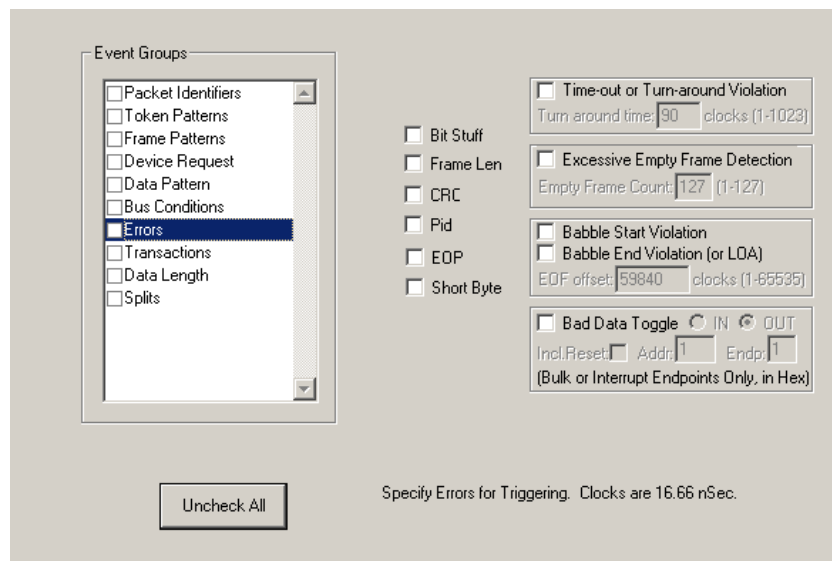


Use any combination of the listed errors as a Trigger.

## Errors

- Select **Errors** under **Event Groups**.

You see the **Errors** window:



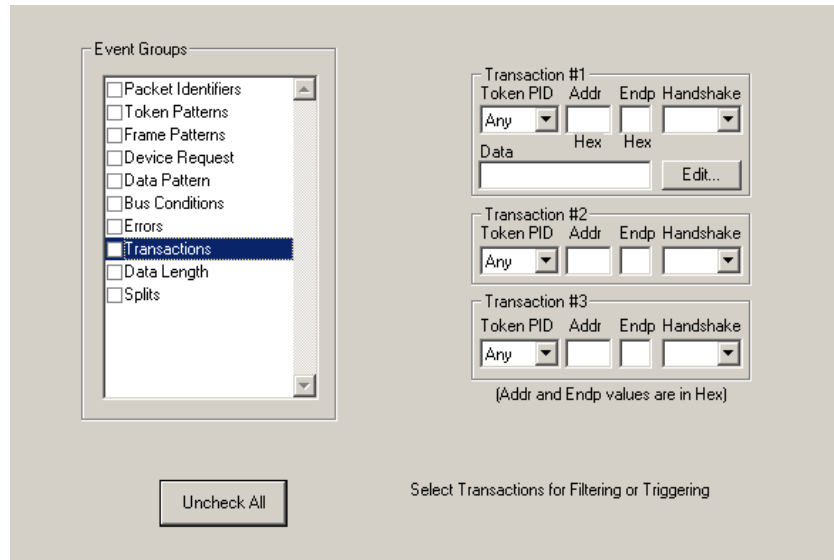
Use any combination of the listed errors as a Trigger.

- 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 or Turn-around 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 (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, toggle state will be assumed to be preserved through the reset.
  - Select **Addr** and/or **Endp** to select Token Addresses and/or Endpoints.

## Transactions

- Select **Transactions** under **Event Groups**.

You see the **Transactions** window:

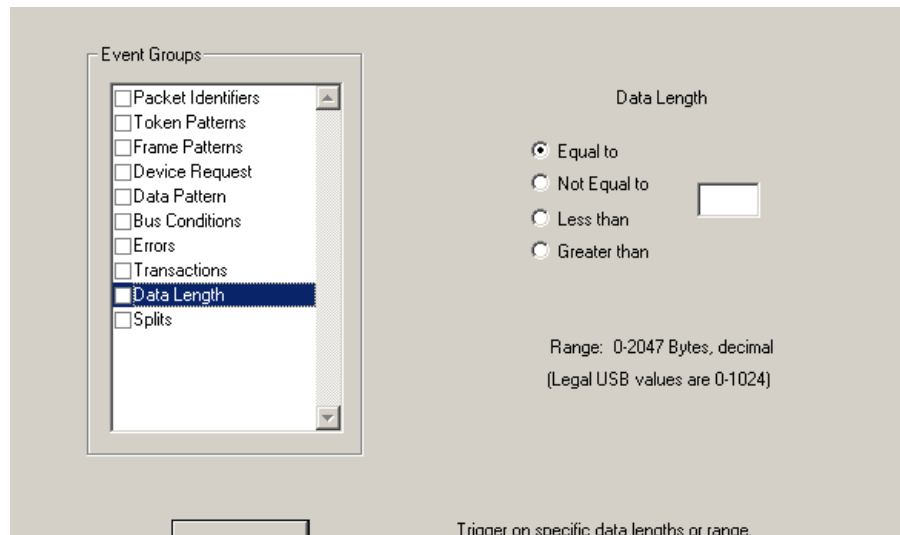


Use any combination of the listed errors as a Trigger.

## Data Length

- Select **Data Length** under **Event Groups**.

You see the **Data Length** window:



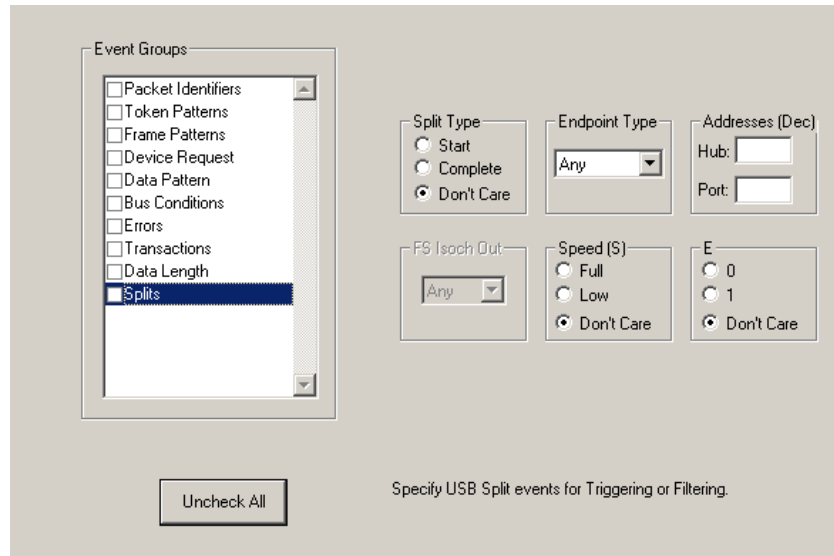
To trigger on data length, enter a value between 0 and 1024 in the box marked **Data Length**.

## 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.

## 5.4 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.

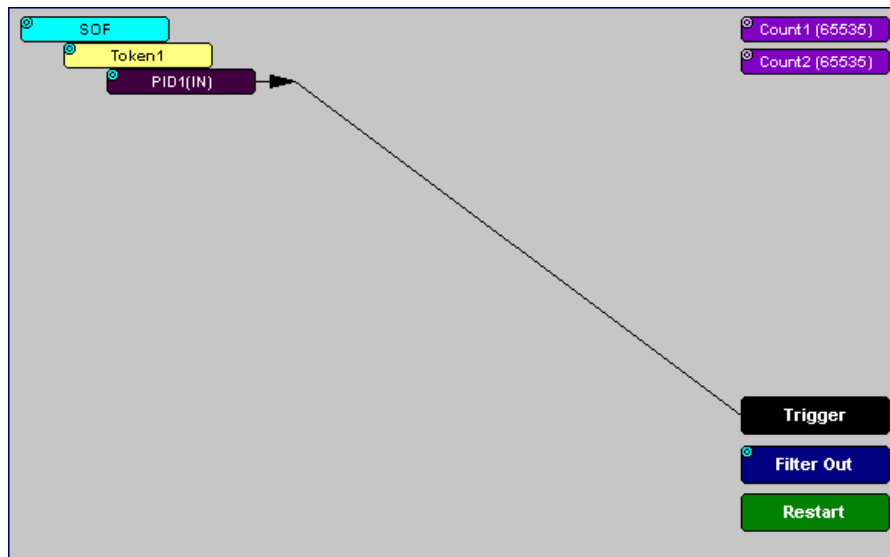
### Actions Window Layout

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*Mobile*HS 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 will display.

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*Mobile*HS's response to Event



conditions. For example, if an Error button is linked to a Trigger button, the Action button tells USB*Mobile*HS to trigger when the error condition occurs.

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

## 5.5 Connecting Events to Actions

To create or edit links between Event buttons, Counters, and Action buttons, you click on an Event button and then click on a Counter or Action. By clicking on an Event, you will cause an arrow to appear that connects the Event button to your mouse. When you click on a Counter or Action button, the arrow becomes anchored to the selected button.

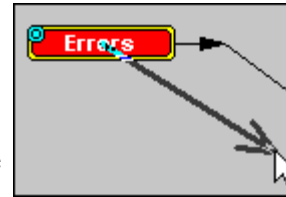
To make an association,

- 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 will move with your mouse pointer.

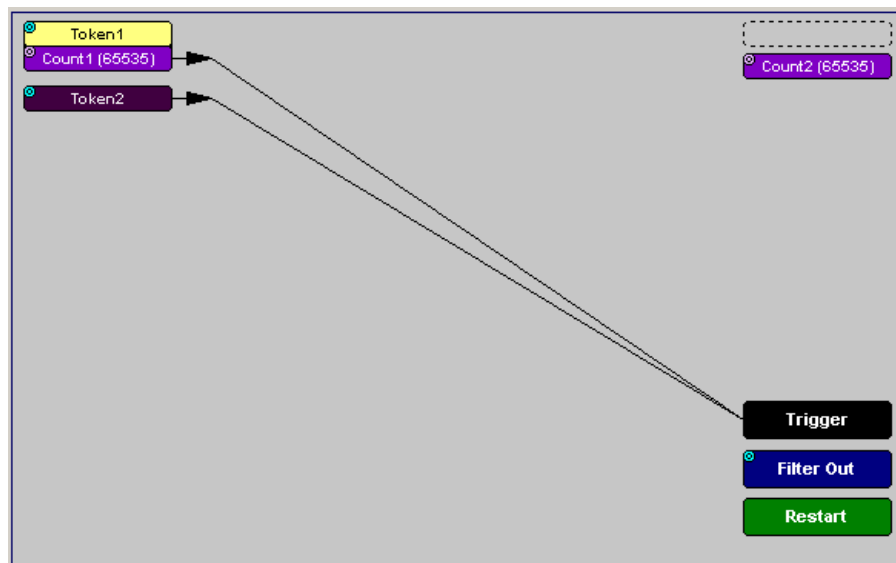
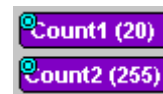


- Step 5** With the pointer over an Actions button, click again the left mouse button again.

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

## 5.6 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.

Selecting an Event will cause an Event button to automatically appear in the Actions window.

**Step 2** Open the Actions window.

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

**Step 3** Click the Event button.

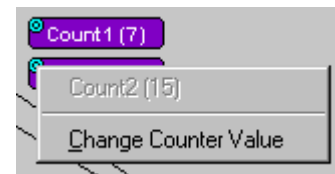
An arrow will appear that will connect the Event button to your mouse pointer.

**Step 4** Click one of the two counters.

The Event will automatically connect to the Counter button and then connect to the Trigger button.

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

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

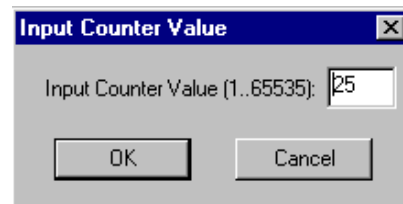


**Step 6** Choose **Change Counter Value**.

A dialog box will open.

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

The dialog box will close and the Counter button will display your selection.

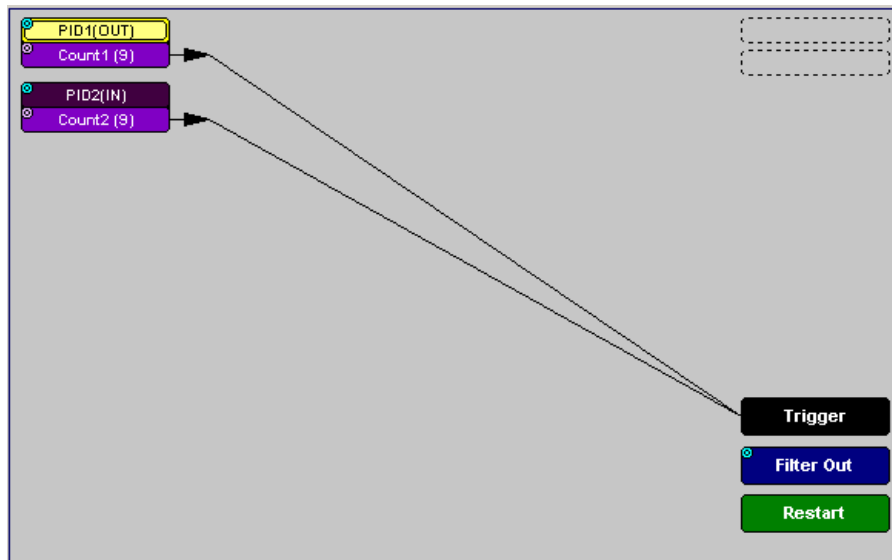


### *Setting Multiple Conditions with Counters*

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 nine Out packets or Count2 has counted nine In packets."



## 5.7 Using Action Buttons

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



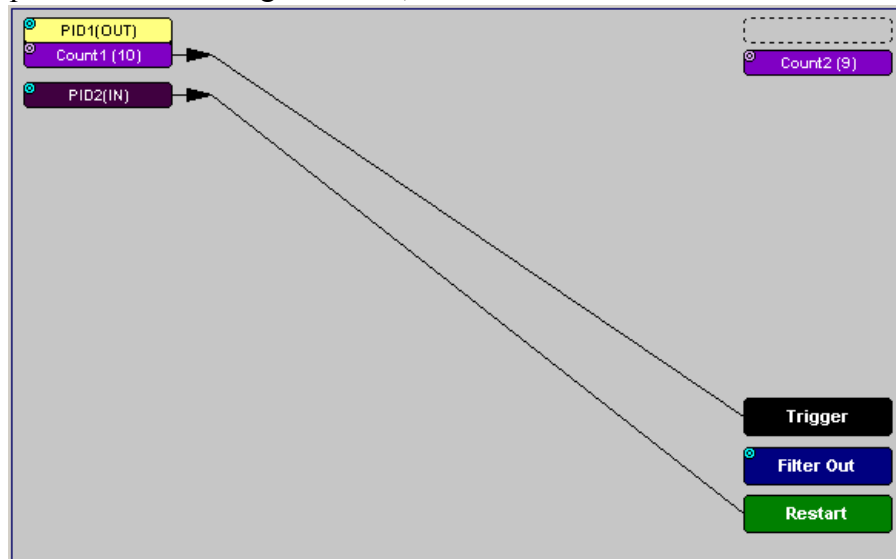
### Trigger

The **Trigger** button enables event triggering.

### Restart

**Restart** causes counters to restart counting when a certain event occurs. When Restart is used there will be at least two links on the screen: 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 Out**" and "**Filter In**".

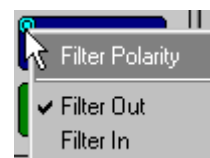
- **Filter In** records ONLY those packets related to the specified event.
- **Filter Out** records all packets EXCEPT those related to the specified event.

**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 Out/In** 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".

## 5.8 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.


## 5.9 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 1** Select **Save As** under **File** on the Menu Bar.

OR

Click  on the Tool Bar.

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

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




## 6. Display Options

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

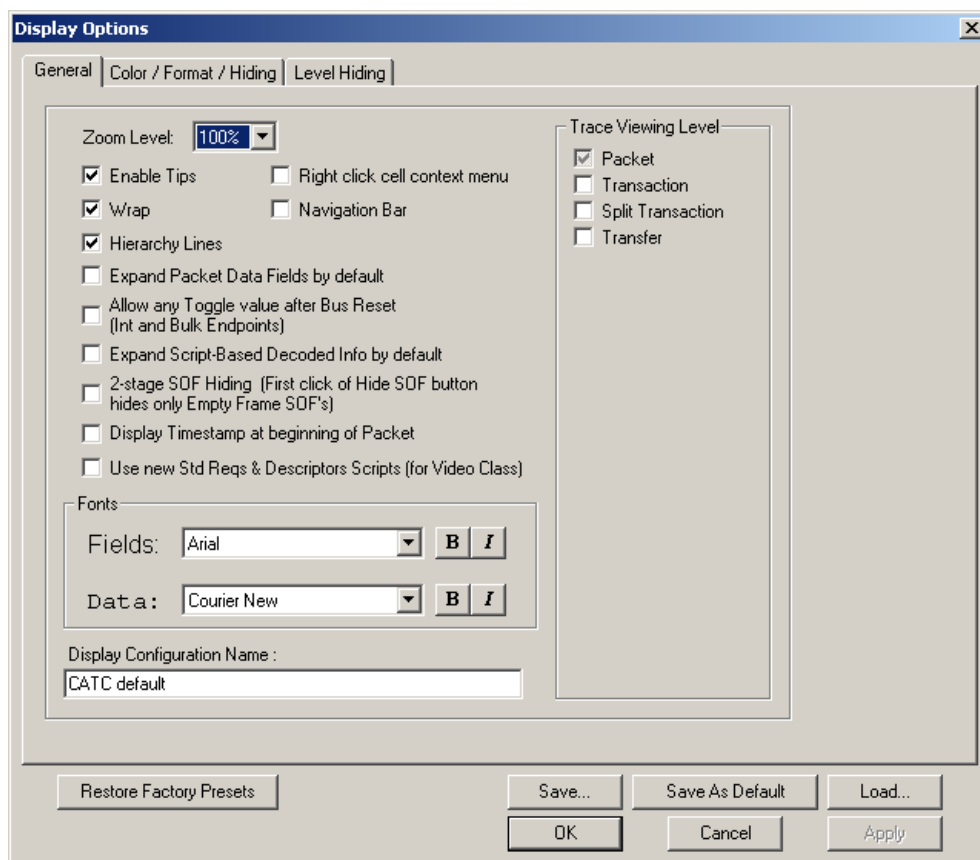
To open the **Display Options** menu,

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

OR

- Click  on the Tool Bar

You see the **Display Options** window:



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

## 6.1 General Display Options

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

- **Zoom Level:** Adjustable in discrete increments from 10% to 200% percent.
- **Enable Tool Tips:** Select to enable tool tips with explanation text to pop up when you position your cursor over various fields in the Trace View.
- **Right click cell context menu:** This option activates the right mouse button so that when clicked it displays pop-up menus in the trace. Normally, the left mouse button is used to display context-sensitive pop-up menus.
- **Navigation Bar:** When selected, opens the Trace Navigator whenever the software is opened.
- **Wrap:** Moves long strings of trace data to the next line so you don't need to scroll sideways to view it.
- **Hierarchy Lines:** Displays lines along the left side of the trace window that show the hierarchical relationship between the Packets, Transactions, Split Transactions, and Transfers.
- **Expand Packet Data Fields by Default:** When selected packet data fields are expanded whenever the software is opened.
- **Allow any Toggle Value after Bus Reset (Int and Bulk Endpoints):** When selected any toggle value is allowed after resetting the BusEngine.
- **Expand Script-based Decoded Info by default:** Expands by default fields using script-based decoding.
- **2-stage SOF Hiding (First click of Hide SOF button hides only Empty Frame SOF's):** Modifies the behavior of the Hide SOF button. If enabled, the Hide SOF button works in two stages. Click once to hide all SOFs that begin frames with no USB traffic. Click twice to hide all SOFs.
- **Display Timestamp at beginning of Packet:** Causes the timestamp to reposition from the end of the packet to the front.
- **Use New Std Reqs and Descriptors Scripts (for Video Class):** To support decoding of the Video Class, it was necessary to re-write the mechanism by which Standard Requests and Descriptors are decoded. This is because most of the Video

configuration information is passed in the Standard GET\_DESCRIPTOR (Config) descriptor bundle, along with the endpoint and interface descriptors, etc. For non-Video traffic, leave this unchecked so the existing Hid, Audio, and other descriptors get decoded by the legacy decoder files.

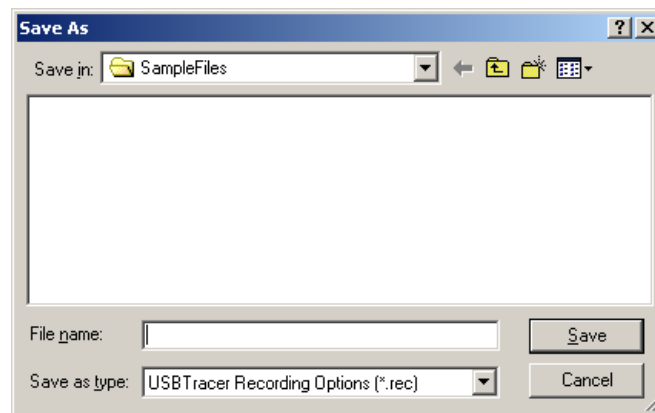
- **Trace Viewing Level:** Allows packets to be displayed as
  - Packets
  - Transactions
  - Split Transactions
  - Transfers
- **Fonts:** Lets you define the appearance of Field and Data text.
- **Display Configuration Name:** Provides a comment field that serves as a descriptive label for the current Display Options file (\*.opt).

### Saving Display Options for Future Use

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

- Step 1** Enter a comment for the new file in the **Display Configuration Name** field.
- Step 2** Click **Save...**

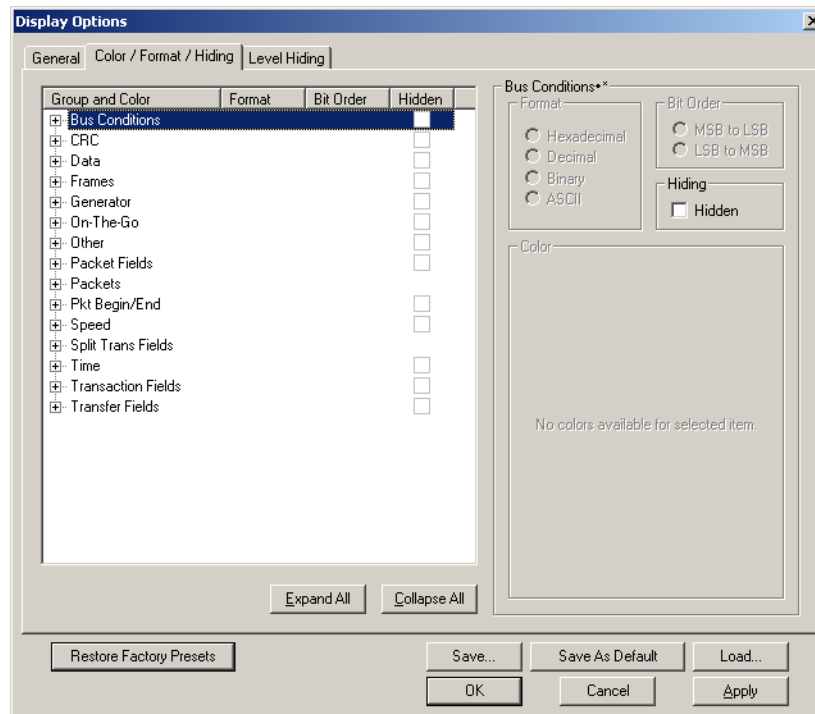
*You see the **Save As** window.*



- Step 3** Specify a filename (\*.opt).
- Step 4** Click **Save**.

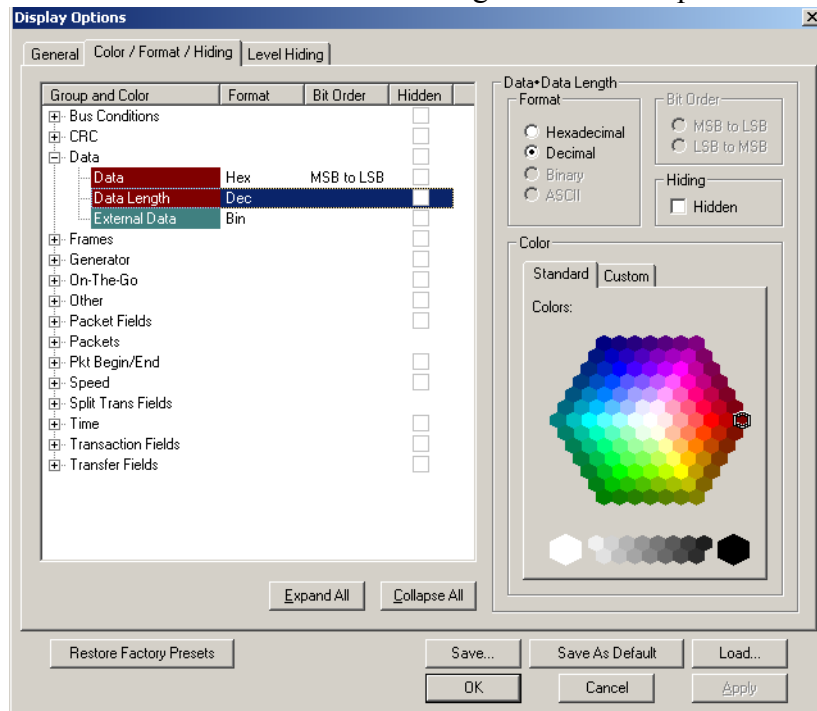
## 6.2 Color/Format/Hiding Display Options

Select the Color/Format/Hiding tab in the Display Options window.



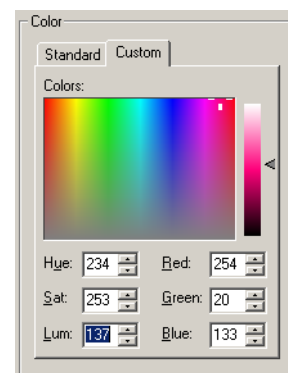
## 6.3 Color Display Options

To specify colors in the display, select an item in the Group and Color column and make the desired color changes in the color pallet screen.



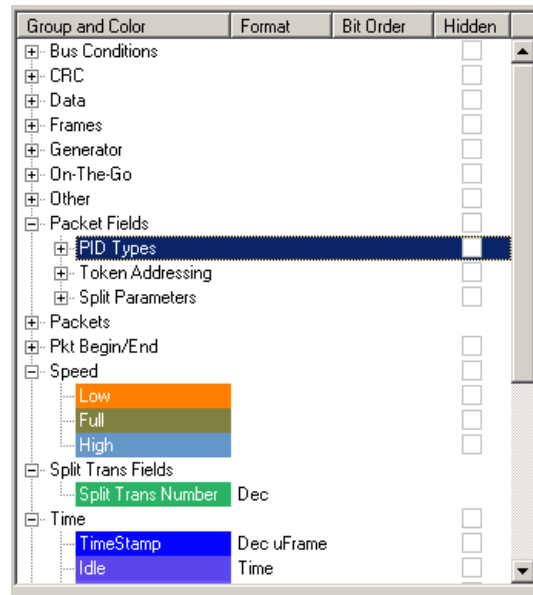
Use this menu to customize the colors associated with each field in the Trace View. You can experiment with this option to achieve the color combination best suited to a particular graphic system. A brighter color might be appropriate for a specific field that should stand out in the display (e.g. the PID Types).

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

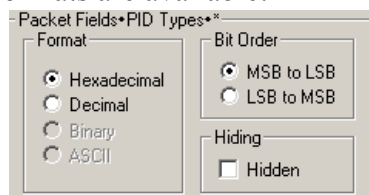


## 6.4 Formats Display Options

Select an item under the Group and Color column to enable the formats radio buttons in the Format section. The format types changes with respect to the item you select under the Group and Color column. For example, if you select an item under Packet Fields, you get the following:



The following formats are available:



Not every format is available for every item.

## 6.5 Hiding Display Options

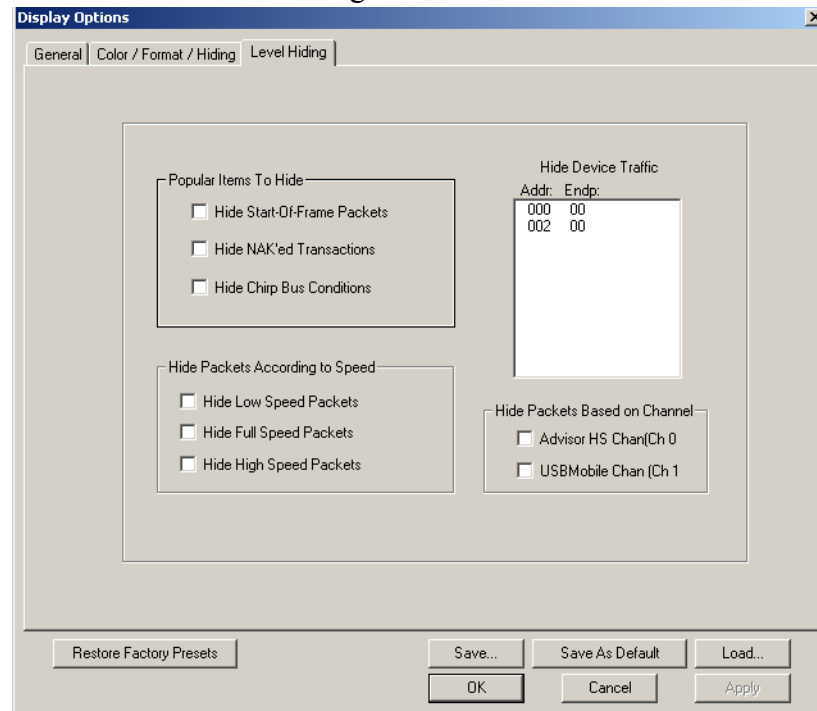
To hide one or more fields from the trace, select the appropriate item from the Group and Color column, click the Hidden checkbox, and click the Save button.



You can also hide packets and transactions from a trace, selecting the desired options from the checkboxes. You can hide SOFs, NAKs, High, Full or Low Speed packets, traffic from one or both recording channels, and Address and Endpoint.

## 6.6 Level Hiding Display Options

The Level Hiding tab allows you hide whole packets such as Start of Frame packets. Select the Level Hiding tab.



## 6.7 Saving Display Options

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

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

- Click **Cancel** to cancel any immediate changes you have made and exit the Display Options menu.
- Click **Apply** to apply your changes while keeping the Display Options window open.




## 7. Reading a Trace

Packet	Dir	H	SOF	Frame #	CRC5	Pkt Len	Idle	Time Stamp
0	-->	S	0xA5	1156.?	0x1C	12	124.767 $\mu$ s	00000.4056 3910
Packet	Dir	H	SOF	Frame #	CRC5	Pkt Len	Idle	Time Stamp
1	-->	S	0xA5	1156.?	0x1C	14	124.767 $\mu$ s	00000.4057 3908
Packet	Dir	H	SOF	Frame #	CRC5	Pkt Len	Idle	Time Stamp
2	-->	S	0xA5	1156.?	0x1C	12	124.800 $\mu$ s	00000.4058 3908
Packet	Dir	H	SOF	Frame #	CRC5	Pkt Len	Idle	Time Stamp
3	-->	S	0xA5	1156.?	0x1C	12	124.800 $\mu$ s	00000.4059 3908
Packet	Dir	H	SOF	Frame #	CRC5	Pkt Len	Idle	Time Stamp
4	-->	S	0xA5	1156.?	0x1C	12	124.767 $\mu$ s	00000.4060 3908

### 7.1 Trace View Features

- The USB*Mobile*HS 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.
- High Speed SOFs display Microframes (shown below.)

Packet	Dir	H	SOF	Frame #	CRC5	Pkt Len	Idle	Time Stamp
0	-->	S	0xA5	1156.?	0x1C	12	124.767 $\mu$ s	00000.4056 3910
Packet	Dir	H	SOF	Frame #	CRC5	Pkt Len	Idle	Time Stamp
1	-->	S	0xA5	1156.?	0x1C	14	124.767 $\mu$ s	00000.4057 3908


  
Microframes

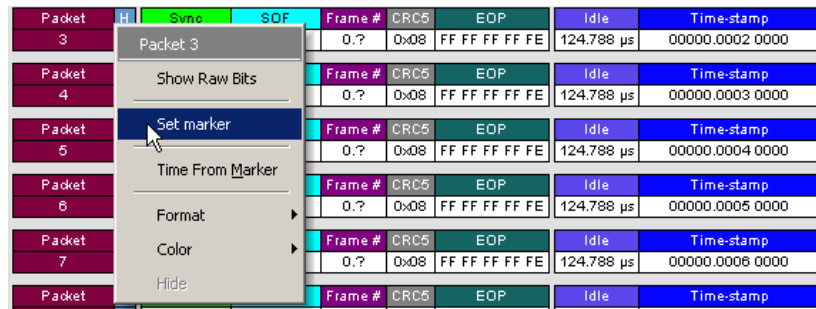
## 7.2 Set Marker

You can define a unique Marker for each packet.

To place a marker on a packet,

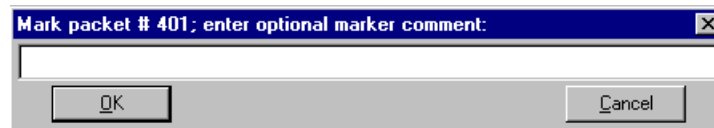
**Step 1** Left-click on **Packet #** for the packet you wish to mark.

You see 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:

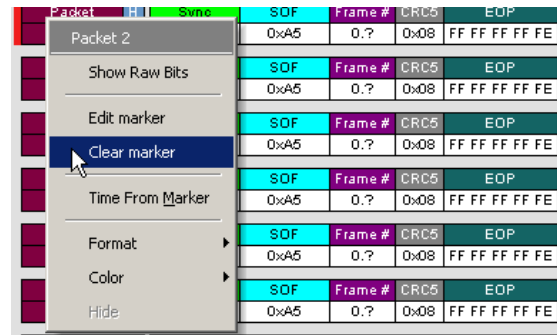
Packet #	F	Sync	SETUP	ADDR	ENDP	CRC5	EOP	Idle
398	S	00000001	0xB4	2	0	0x15	2.50	2

## 7.3 Edit or Clear Marker

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

**Step 1** Left-click on **Packet #** for the chosen packet.

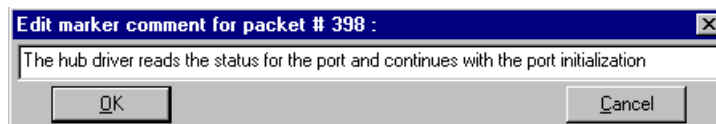
You see the **Packet** menu:



To edit the Marker Comment,

**Step 2** Select **Edit Marker Comment**.

You see the **Edit marker comment** window:



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

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

To clear a Marker,

**Step 5** Click **Clear Marker**.

The vertical red Marker bar disappears.

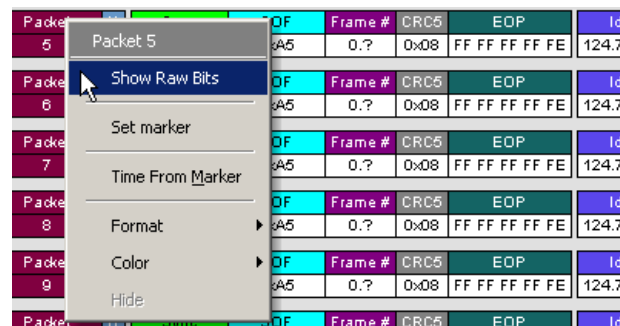
## 7.4 View Raw Bits

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

To view the raw bits,

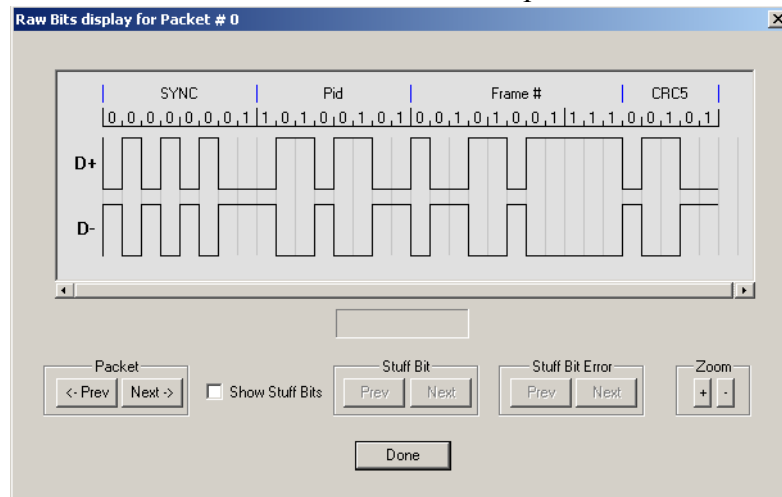
**Step 1** Left-click on **Packet #** for the packet you wish to view.

You see the **Packet** menu:



**Step 2 Select Show Raw Bits.**

You see the Raw Bits View for that packet:



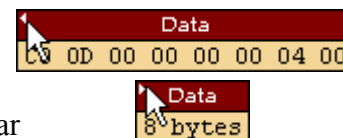
Along the top of the Raw Bits View is a linear strip of the logical bit values with corresponding field demarcations. Bit stuffing is displayed in color. Below the logical bit values is a representation of the D+/D- signaling complete with NRZ encoding. A scroll bar assists in navigation of larger packets. 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.

## 7.5 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.

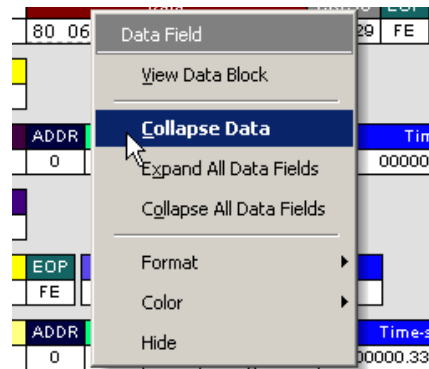
### Using the Data Field Pop-up Menus

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

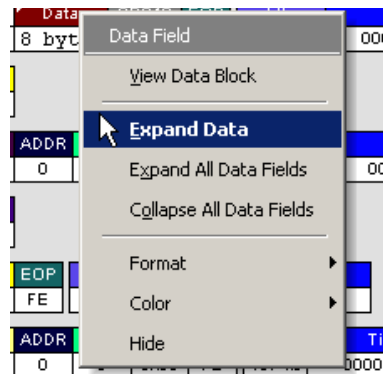
To expand and collapse data using the menu,

- Step 1** Left-click on **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*

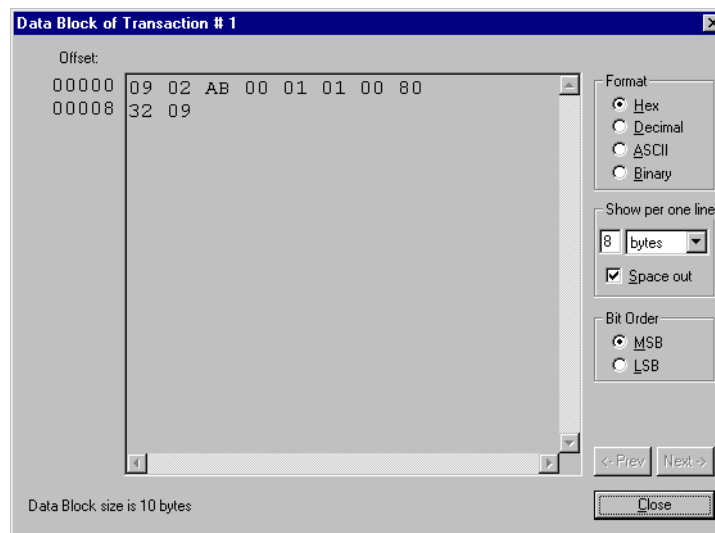
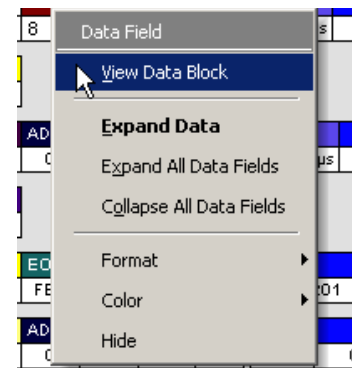
All data fields can be expanded or collapsed by selecting **Expand All Data Fields** or **Collapse All Data Fields** from the data field pop-up menus.

## 7.6 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.

The following dialog box will open.

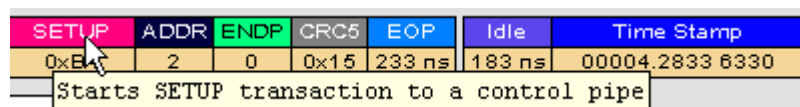


The View Data Block window has options for displaying the raw bits in different formats:

- **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


## 7.7 Pop-up Tool-tips

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



## 7.8 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.


**Note** If you have enabled **2-Stage SOF Hiding** in the General Display Options, then the Hide SOF button works in two stages. Click once to hide all SOFs that begin frames with no USB traffic. Click twice to hide all SOFs.

## 7.9 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.

## 7.10 Hide Devices

Click the  button to get a window that allows you to select any address/endpoint combination to be hidden.

## 7.11 Hide Chirps


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

## 7.12 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,

- Click  to on the toolbar.

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

Transaction	F	OUT	ADDR	ENDP	T	Data	ACK	Time		
1336	S	0x87	1	0	0	8 bytes	0x4B	999.717 μs		
Transaction	F	OUT	ADDR	ENDP	T	Data	ACK			
1337	S	0x87	1	0	1	8 bytes	0x4B			
Packet	Dir	F	Sync	OUT	ADDR	ENDP	CRC5	EOP	Idle	Time Stamp
6946	-->	S	00000001	0x87	1	0	0x17	233 ns	183 ns	00011.6037 1516
Packet	Dir	F	Sync	DATA1	Data	CRC16	EOP	Idle	Time Stamp	
6947	-->	S	00000001	0xD2	8 bytes	0x4FB5	233 ns	500 ns	00011.6037 1701	
Packet	Dir	F	Sync	ACK	EOP	Time	Time Stamp			
6948	<--	S	00000001	0x4B	250 ns	988.000 μs	00011.6037 2225			
Transaction	F	OUT	ADDR	ENDP	T	Data	ACK	Time		
1338	S	0x87	1	0	0	8 bytes	0x4B	999.800 μs		

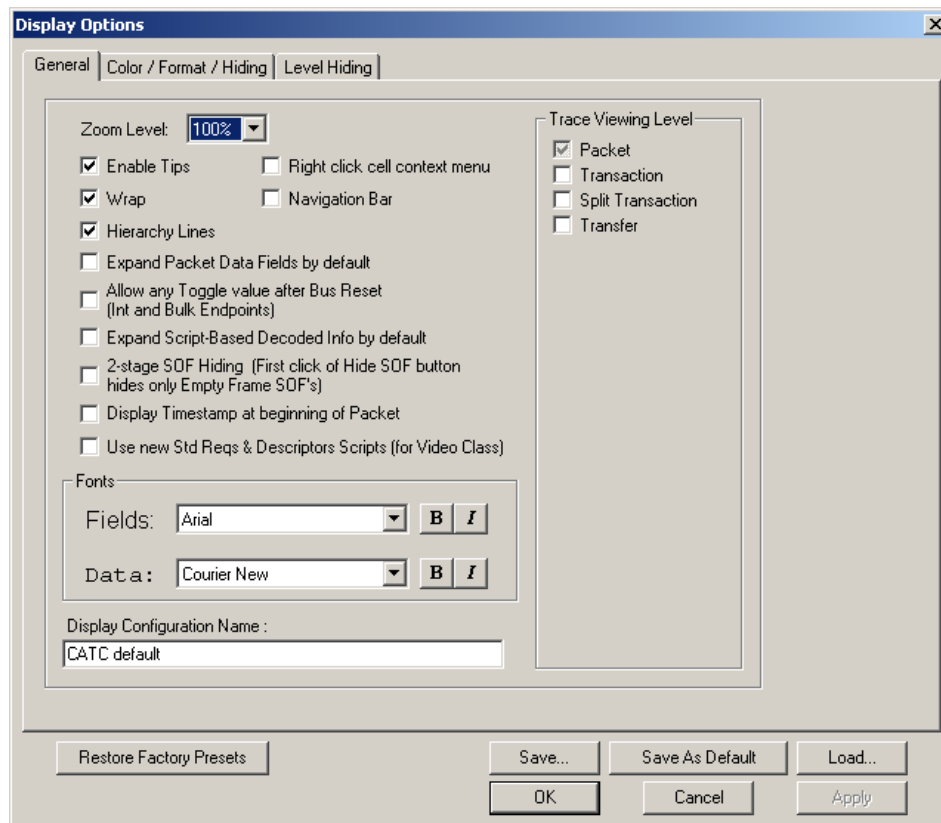
**Note** This menu selection will display a checkmark next to **Show USB transactions** when you have selected it. When you want to switch back to Packet View mode, right-click anywhere in the trace window and then left-click on **Show USB transactions**.

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

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



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



**Step 2** Check **Transactions**.

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

## 7.13 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.

Transaction	F	OUT	ADDR	ENDP	T	Data	ACK	
1337	S	0x87	1	0	1	8 bytes	0x4B	
Packet	Dir	F	Sync	OUT	ADDR	ENDP	CRC5	EDP
6946	-->	S	00000001	0x87	1	0	0x17	233 ns
6947	-->	S	00000001	0x02	8	bytes	0x4FB5	233 ns
6948	-->	S	00000001	0x4B	250 ns	988.000 µs	00011.6037	1516
Transaction	F	OUT	ADDR	ENDP	T	Data	ACK	Time
1338	S	0x87	1	0	0	8 bytes	0x4B	999.800 µs
Transaction	F	OUT	ADDR	ENDP	T	Data	ACK	Time
1339	S	0x87	1	0	1	8 bytes	0x4B	999.800 µs
Transaction	F	OUT	ADDR	ENDP	T	Data	ACK	
1340	S	0x87	1	0	0	8 bytes	0x4B	
Packet	Dir	F	Sync	OUT	ADDR	ENDP	CRC5	EDP
6958	-->	S	00000001	0x87	1	0	0x17	250 ns
6959	-->	S	00000001	0xC3	8	bytes	0x155D	233 ns
6959	-->	S	00000001	0xC3	8	bytes	0x155D	233 ns

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 on the transaction number you wish to view.

You see the **Expand Transaction** menu:

Transaction 1

Expand This Transaction

Expand All Transactions

Collapse All Transactions

Set marker

Format

Color

Hide

T	Data	ACK	Time
1	0 bytes	0x4B	9.733 μs

T	Data	ACK	Time
1	0 bytes	0x4B	20.546 ms

D	T	R	bRequest	wValue	wIndex	wLength
H->D	S	D	SET_ADDRESS	New address 1	0x0000	0

T	Data	ACK	Time
1	0 bytes	0x4B	40.048 ms

D	T	R	bRequest	wValue	wIndex	wLength
D->H	S	D	GET_DESCRIPTOR	DEVICE type	0x0000	18

T	Data	ACK	Time
1	0 bytes	0x4B	9.000 μs

- 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.

## 7.14 Switch to Split Transaction View

To select Split Transaction View,

**Step 1** Click the  button on the toolbar.

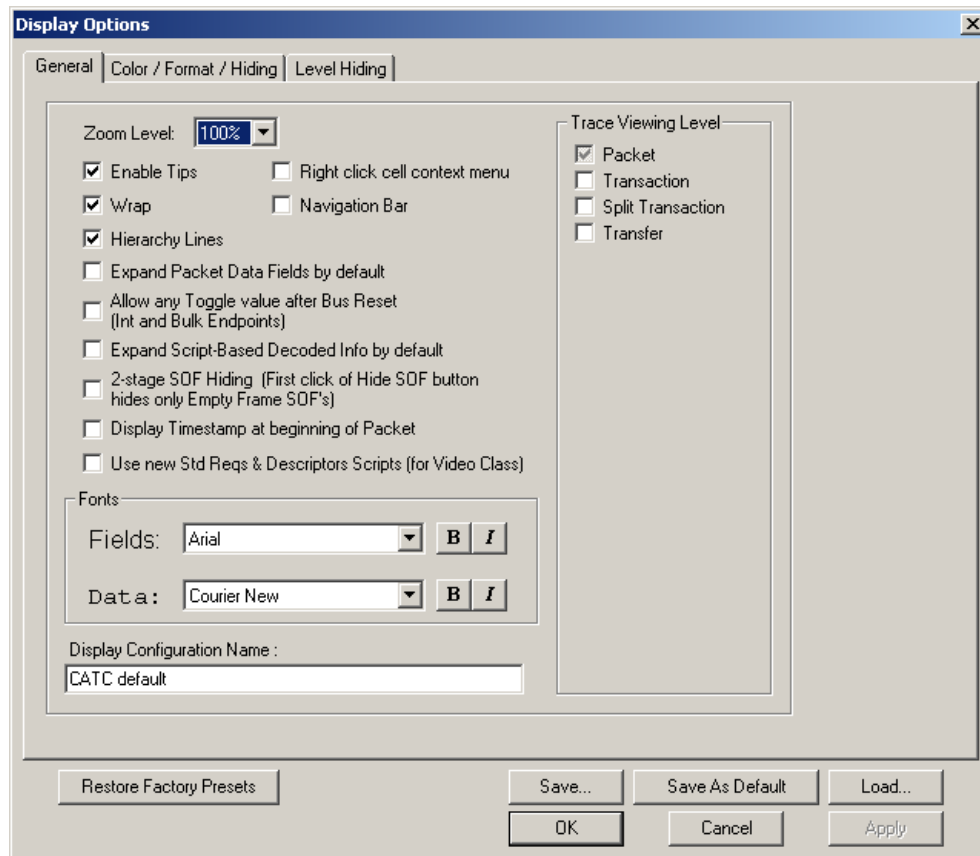
The Trace View screen is re-drawn to display Split Transactions.

Split Trans	L	IN	ADDR	ENDP	T	Data	ACK
44	H	0x96	3	0	1	12 01 00 01 00 00 00 08	0x4B

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**.

## 7.15 Switch to Transfer View

A **Transfer** 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. USBMobileHS 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.

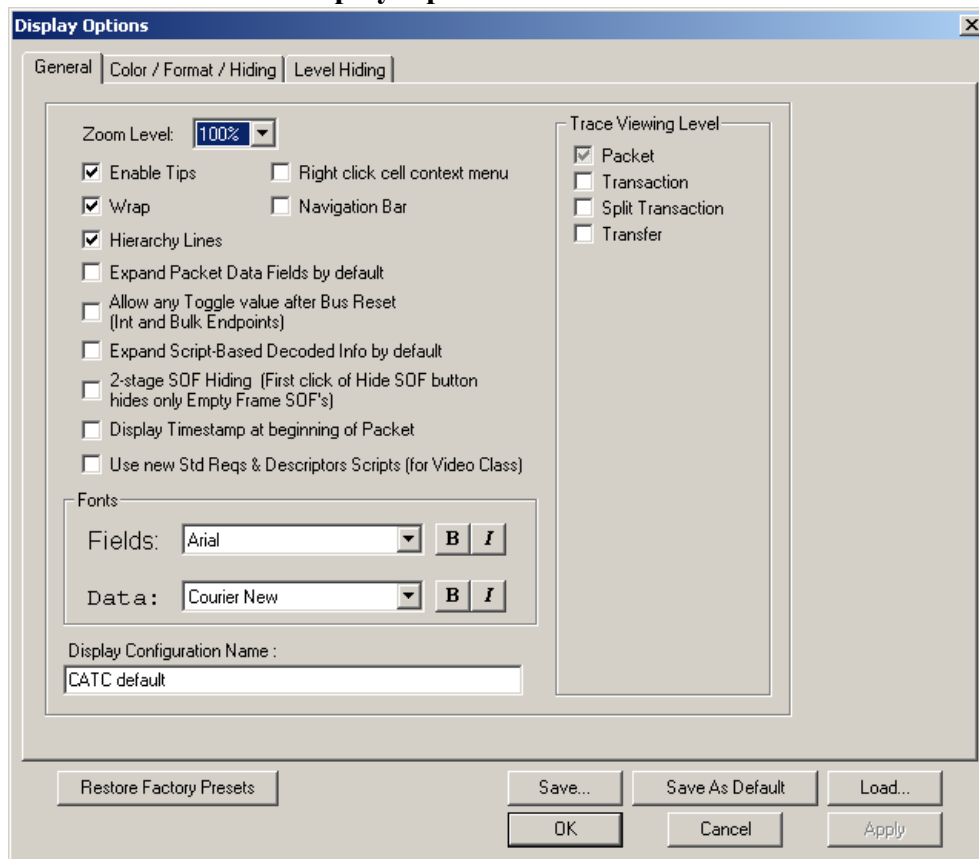
The Trace View screen is re-drawn to display Transfers.

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

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

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

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



**Step 2** Check **Transfers**.

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

## 7.16 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.

Transfer	H	Control	ADDR	ENDP	bRequest	wValue	wIndex	Descriptors
1	S	GET	1	0	GET_DESCRIPTOR	CONFIGURATION type	0x0000	23 descriptors

Transaction	H	SETUP	ADDR	ENDP	D	T	R	bRequest	wValue	wIndex	wLength	A
3	S	0xB4	1	0	D->H	S	D	GET_DESCRIPTOR	CONFIGURATION type	0x0000	171	0

Packet	H	SETUP	ADDR	ENDP	CRC5	Pkt Len	Idle	Time Stamp
16495	S	0xB4	1	0	0x17	8	200 ns	00002.0675 1688

Packet	H	DATA0	Data	CRC16	Pkt Len	Idle	Time Stamp
16496	S	0xC3	80 06 00 02 00 00 AB 00	0xEB26	16	233 ns	00002.0675 1708

Packet	H	ACK	Pkt Len	Time	Time Stamp
16497	S	0x4B	6	7.167 $\mu$ s	00002.0675 1738

Transaction	H	IN	ADDR	ENDP	T	Data	ACK	Time
4	S	0x96	1	0	1	64 bytes	0x4B	7.600 $\mu$ s

Transaction	H	IN	ADDR	ENDP	T	Data	ACK	Time
5	S	0x96	1	0	0	64 bytes	0x4B	7.500 $\mu$ s

Transaction	H	IN	ADDR	ENDP	T	Data	ACK	Time
6	S	0x96	1	0	1	43 bytes	0x4B	9.733 $\mu$ s

Transaction	H	OUT	ADDR	ENDP	T	Data	ACK	Time
7	S	0x87	1	0	1		0x4B	525.027 ms

Transfer	H	Control	ADDR	ENDP	bRequest	wValue	wIndex	Descriptors	Time
2	S	GET	1	0	GET_DESCRIPTOR	DEVICE type	0x0000	DEVICE descriptor	1.224 sec

Transfer	H	Control	ADDR	ENDP	bRequest	wValue	wIndex	Descriptors	Time
3	S	GET	1	0	GET_DESCRIPTOR	STRING type, Index 1	Language ID 0x001B		362.4

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 on the transfer number you wish to view.

You see the **Expand Transfer** menu:

Transfer	F	Control	ADDR	ENDP	bRequest	wValue	wIndex
1					0x0D	0x0000	0x0000
2					0x09	0x0000	0x0000
3					0x0D	0x0000	0x0000
4					0x09	0x0000	0x0000
5					0x0D	0x0000	0x0000
6					0x09	0x0000	0x0000

Transfer 1	Expand This Transfer	Expand All Transfers	Collapse All Transfers	Set marker	Format	Color	Hide
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## Step 2 Select **Expand This USB Transfer**.

The screen displays the selected transfer in expanded format.

Transfer	F	Control	ADDR	ENDP	bRequest	wValue	wIndex	
9	S	SET	1	0	SET_INTERFACE	New alternate setting 0	Interface # 0	

Transaction	F	SETUP	ADDR	ENDP	D	T	R	bRequest	wValue	wIndex	wLength	ACK
1332	S		0x04	1	0	H->D	S	SET_INTERFACE	New alternate setting 0	Interface # 0	0	0x4B

Packet	Dir	F	Sync	SETUP	ADDR	ENDP	CRC5	EOP	Idle	Time Stamp
6925	-->	S	00000001	0x04	1	0	0x17	233 ns	183 ns	00011.5989 1586

Packet	Dir	F	Sync	DATA0	Data	CRC16	EOP	Idle	Time Stamp
6926	-->	S	00000001	0xC3	8 bytes	0x231F	233 ns	483 ns	00011.5989 1771

Packet	Dir	F	Sync	ACK	EOP	Time	Time Stamp
6927	<--	S	00000001	0x4B	233 ns	988.017 μs	00011.5989 2294

Transaction	F	IN	ADDR	ENDP	T	Data	ACK	Time
1333	S		0x06	1	0	1 0 bytes	0x4B	2.000 ms

Transfer	F	Control	ADDR	ENDP	bRequest	wValue	wIndex	Data	Time
10	S	SET	1	0	0x01	0x0000	0x0000	64 bytes	10.998 ms

Transfer	F	Control	ADDR	ENDP	bRequest	wValue	wIndex	Data	Time
11	S	SET	1	0	0x01	0x0000	0x0001	64 bytes	10.998 ms

**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.


## 7.17 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 will see the protocol-specific fields of transfers and transactions decoded in the trace view.

## 7.18 Using the Trace Navigator

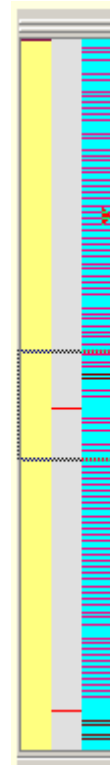
You can use the Trace Navigator to show the structure of the entire trace from different points on the Trace view, thereby refining the trace view to a packet range in the trace that is most interesting to you. This range can be set by you to show smaller parts of the trace.

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.

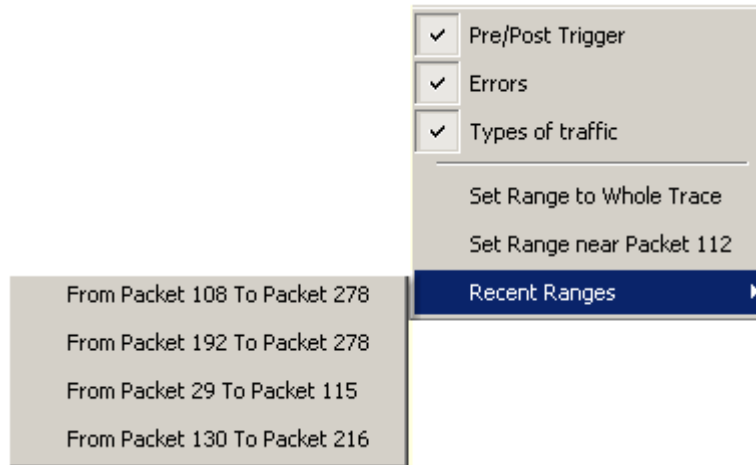
The Navigator bar represents different types of trace information in the order of the packets. The top of each bar corresponds to the first packet in the trace, and the bottom corresponds to the last packet. The Navigator bar is made up of three parts: Pre and Post-Trigger traffic, errors, and types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



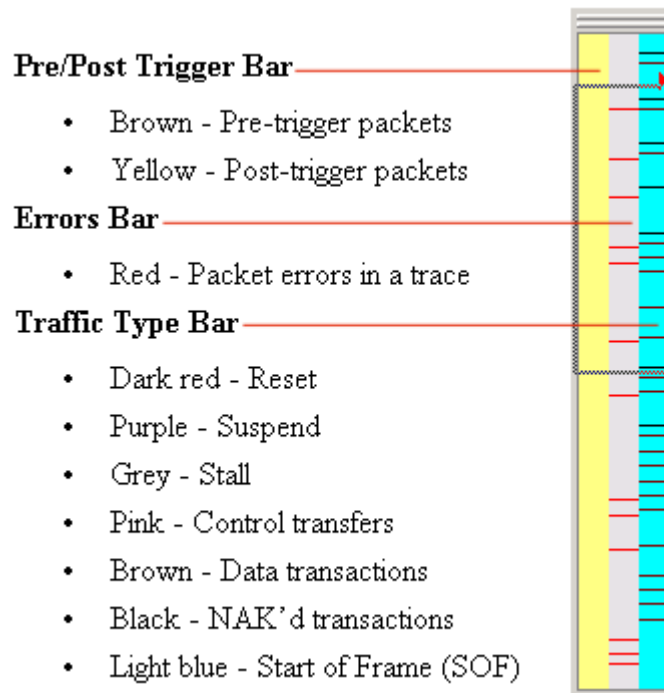


Drag the square at the top of bottom to set the size of a packet range.  
Drag the entire square to set the packet range to different values. A bubble appears showing the packet range while you are setting it.  
Right click on the Navigator to display the pop-up menu.



- 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.
- Recently Used 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.

## 8. Decode Requests

### 8.1 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.

#### USB Request

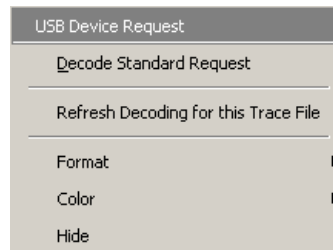
Each USB Device Request is sent using a Control Transfer. Each Control Transfer starts with a SETUP transaction.

To decode a USB Device Request,

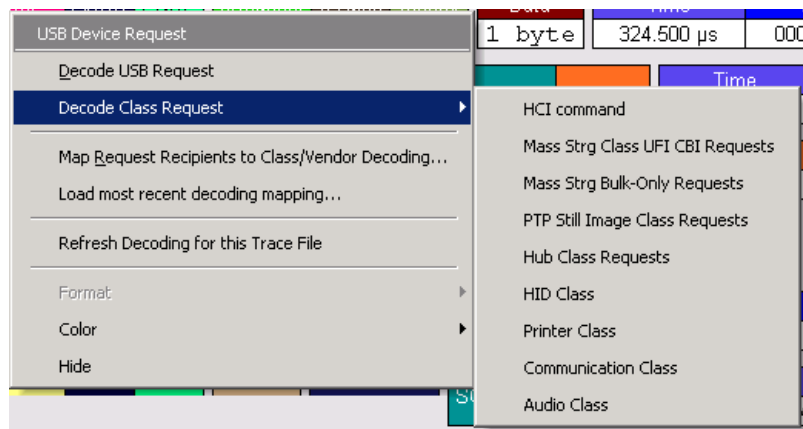
**Step 1** Left-click once in the **SETUP** field of the packet that starts the Request.

**Note:** The menu that appears when you left-click a setup field is context-sensitive and may not appear exactly as shown in the next few examples.

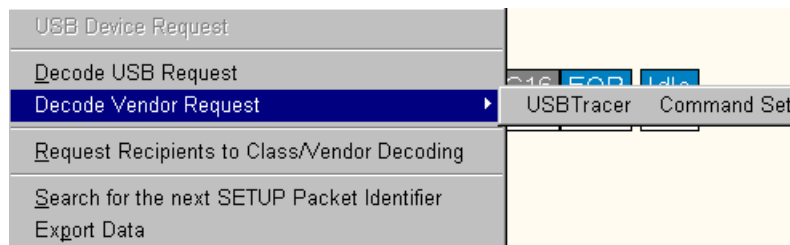
If you select **Standard Request**, you see the **Decode Standard Request** menu:



If you select **Class Request**, you see the **Decode Class Request** menu:

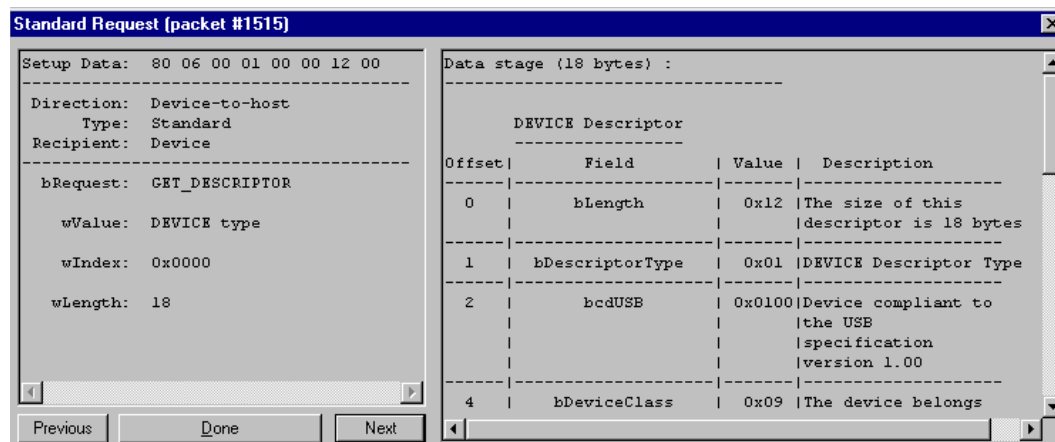


If you select **Vendor Request**, you see the **Decode Vendor Request** menu:



## Decoding Standard Requests

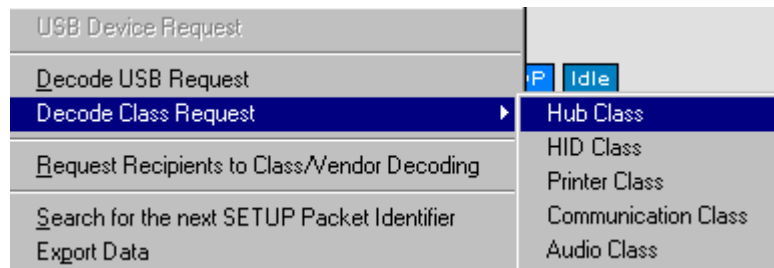
When you select **Decode Standard Request**, you see a window displaying the decoded Standard Request:



Shown here is a GET\_DESCRIPTOR Standard Request.

## Decoding Class Requests

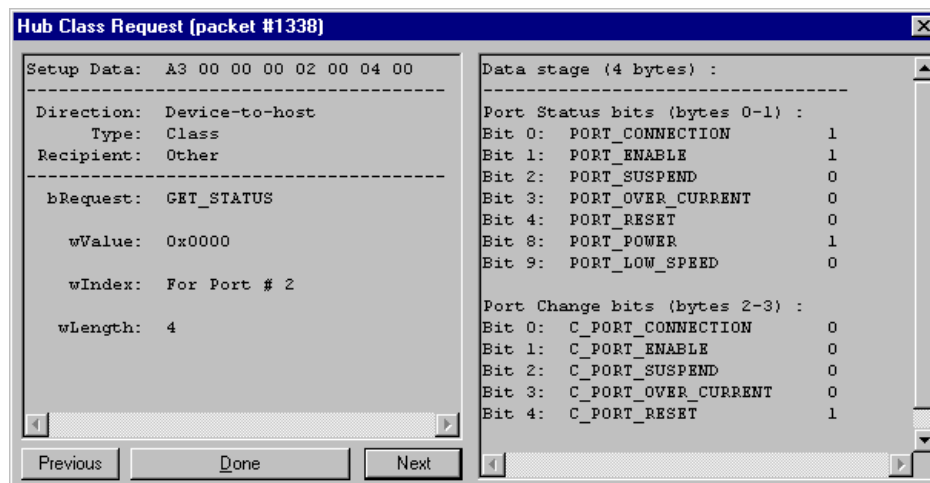
When you select **Decode Class Request**, you see the **Decode Class Request** drop-down menu:



The drop-down menu lists the Classes whose definitions are contained in the Analyzer.

**Step 1** Select the Class which agrees with the Setup Address selected.

You see a Decode Request screen (similar to the one below) that provides you with definitions for the individual fields of the Request and the returned data:

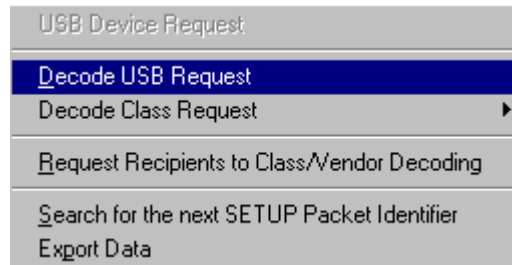


Shown here is a sample **GET\_STATUS** Hub Class Request.

## Decoding Vendor Requests

Decoding a Vendor Request is the same as decoding a Class Request except that you use Vendor Request definitions rather than Class Request definitions.

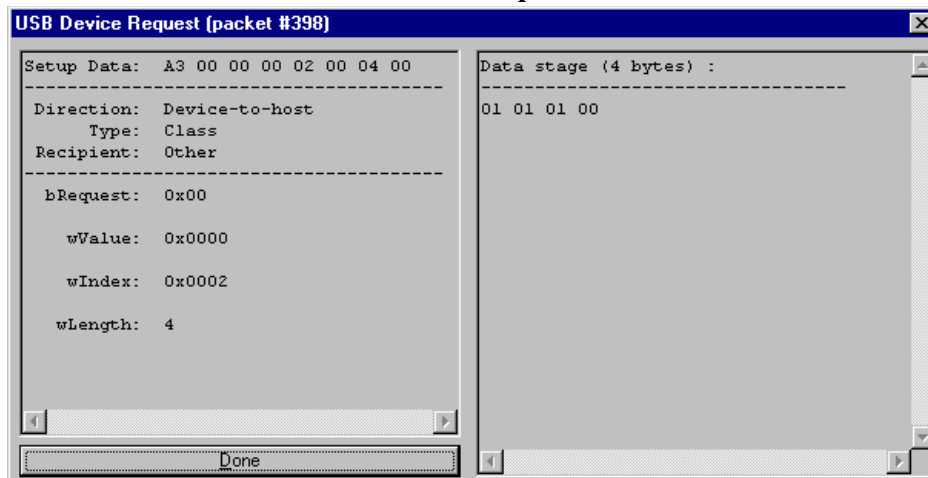
## Decoding USB Requests



When your Decoding request does not belong to any of the defined Decoding groups (Standard, Class, or Vendor),

- Select **Decode USB Request** from the Request menu.

You see the **USB Decode Request** screen.



This screen provides definitions for the individual fields of the Request and the returned data.

## Class and Vendor Definition Files

LeCroy analyzers use script files to decode class and vendor requests. These 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) (Not used with Video Class decoding)

- **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)
- The Analyzer also includes a sample of a **Vendor Request definition file** (vendor.req).

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

**Step 1** Use Notepad 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. This method is more powerful than the old and uses a C-like language. .DEC stands for "decoder" and describes both Class and Vendor requests.

.DEC files are found 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:

- Bluetooth HCI
- Hubs
- Mass Storage
- Still Image/PTP
- Video

If desired, 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***.

**Note** If Video is selected, the Display Options need to be set to "Use new Std Reqs & Descriptors Scripts (for Video Class)" for video. The file **VideoCurrentEntityIdMap\_EditMe.inc** in the VideoClass directory will also need to be edited. You will be assigning entity IDs to corresponding Control types. The instructions are in that file.

## 8.2 Class/Vendor Decoding Options

This interface allows you to 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 choose to display transactions. You see the Decode Class menu for whichever Class type you have selected.

### Request Recipient to Class/Vendor Decoding

To assign a decoding group to a request recipient,

**Step 1** Left-click once in the packet's **SETUP** field.

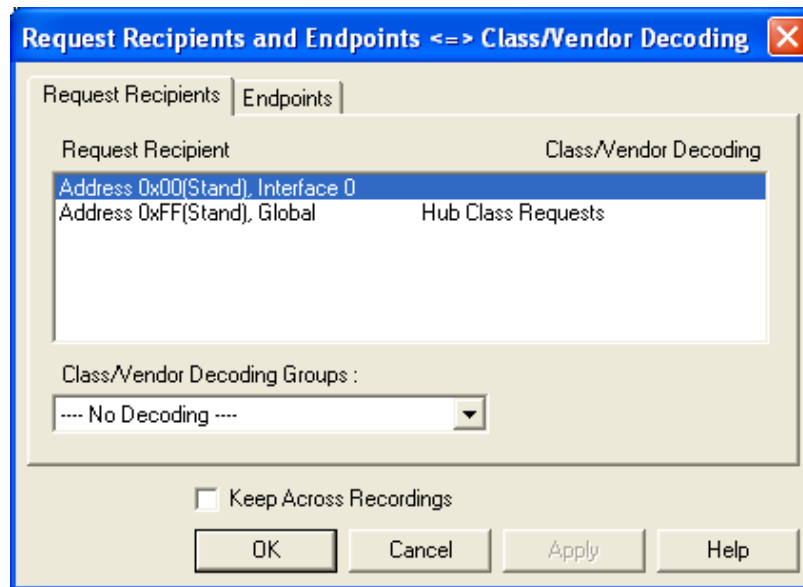
You see the **Decode Request** menu:





**Step 2 Select Request Recipient to Class/Vendor Decoding.**

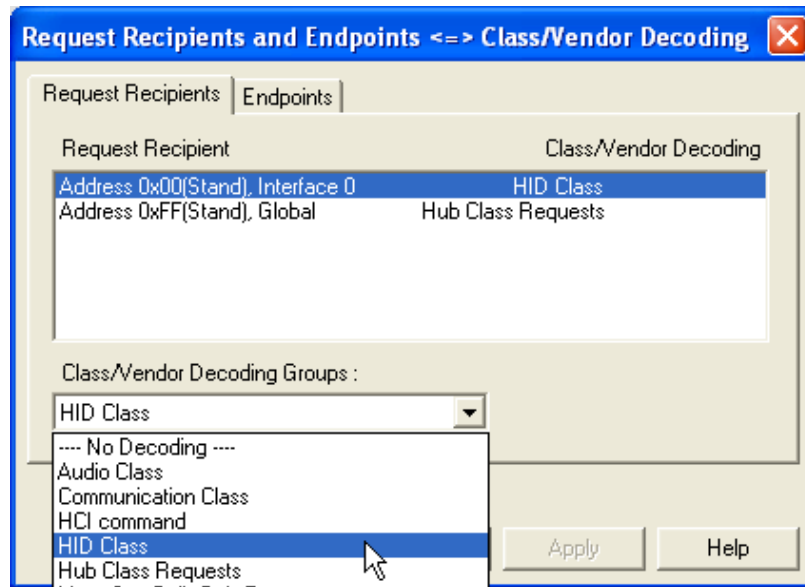
You see the **Request Recipient** window:



The **Request Recipient** field shows all the USB Class and Vendor Request Recipients found in the Trace file. Displayed on the right are the names of Class/Vendor decoding groups currently assigned to recipients. If no decoding is assigned for a recipient, nothing is displayed next to the address.

To select a recipient for which to assign or modify its Class/Vendor decoding,

- Step 1** Display the **Class/Vendor Decoding Groups** drop-down menu.



The drop-down menu lists the defined Class/Vendor request decoding groups.

- Step 2** In the **Request Recipient** field, highlight a Recipient.
- Step 3** From the **Class/Vendor Decoding Groups** drop-down menu, select the decoding group you want to assign to the highlighted Recipient
- OR
- Select **No Decoding** if you do not want any specific decoding.
- Step 4** Repeat the previous step for any additional recipients you would like to map.
- Step 5** Click **OK**.

### Class/Vendor Endpoint Decoding

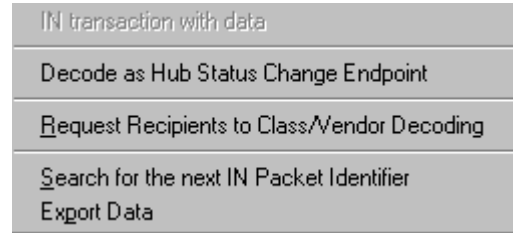
Some usb endpoints can transfer formatted data that is defined in various device class or vendor specifications.

USBMobileHS provides the same decoding capabilities for data sent on endpoints as for device requests. You can define decoding for endpoints by adding EndpointData construct to your .req file (see examples in hub.req and bluetooth.req.)

To assign a Class/Vendor Endpoint decoding,

**Step 1** Left-click once in the packet's **IN** or **OUT** field.

You see the following menu.

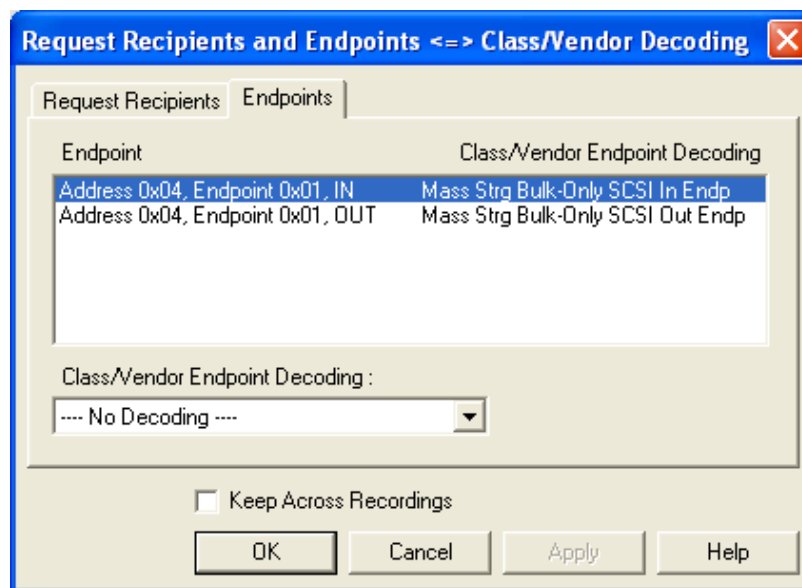


**Step 2** Select **Request Recipient to Class/Vendor Decoding**

You see the Request Recipients and Endpoints dialog box.

**Step 3** Click on the tab marked **Endpoints**.

You see the **Endpoints** dialog box.

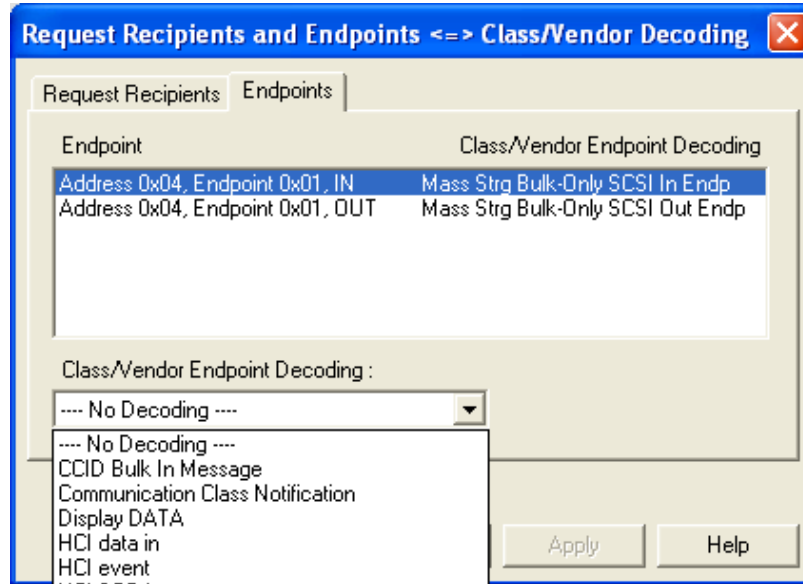


The **Endpoint** field shows all the Endpoints found in the Trace file. Displayed on the right are the names of Class/Vendor Decoding that are currently assigned to Endpoints.

To select an endpoint for assigning or modifying its Class/Vendor decoding,

**Step 1** Display the **Class/Vendor Decoding Groups** drop-down menu

You see the Class/Vendor Endpoint Decoding drop down menu.



**Step 2** In the **Endpoint** field, highlight an address, Endpoint, and Field.

**Step 3** From the **Class/Vendor Endpoint Decoding** drop-down menu, select the type of decoding you want

OR

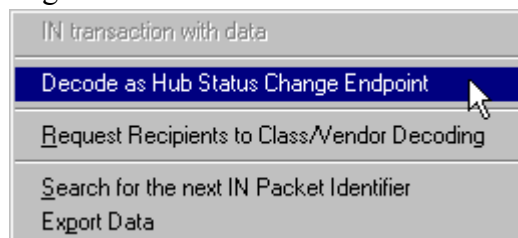
Select **No Decoding** if you don't want any specific decoding.

**Step 4** Repeat the previous step for any additional endpoints you would like to map.

**Step 5** Click **OK**.

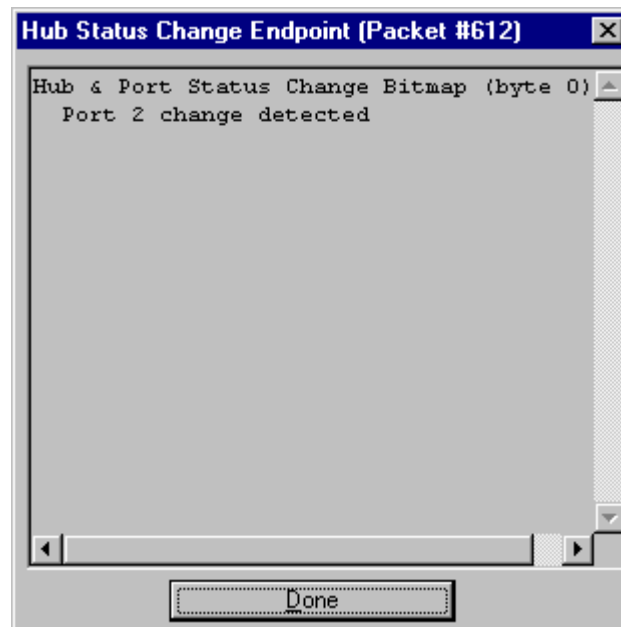
To decode

**Step 1** Left-click the field marked **IN** or **OUT**. You will see the following or similar menu:



**Step 2 Select Decode as Hub Status Change Endpoint**

A text box will open that will display the Hub Status Change Endpoint.





## 9. Other Features

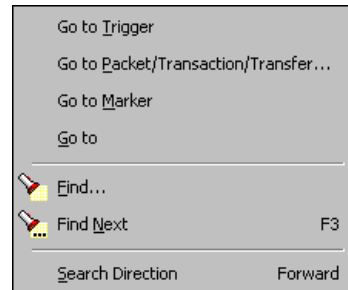
### 9.1 Search

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.

You see 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.

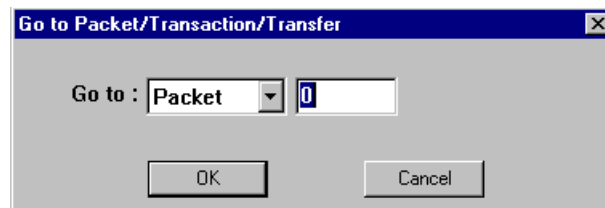
The Trace View is repositioned to the first packet following the Trigger event. This packet will be at the top of the screen.

#### 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**

You see 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**.

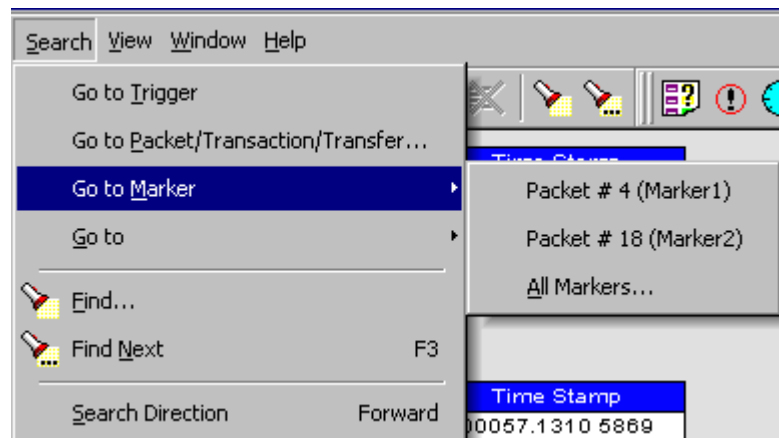
The Trace View is repositioned with the selected packet at the top of your screen.

### 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 CATC Trace**.

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

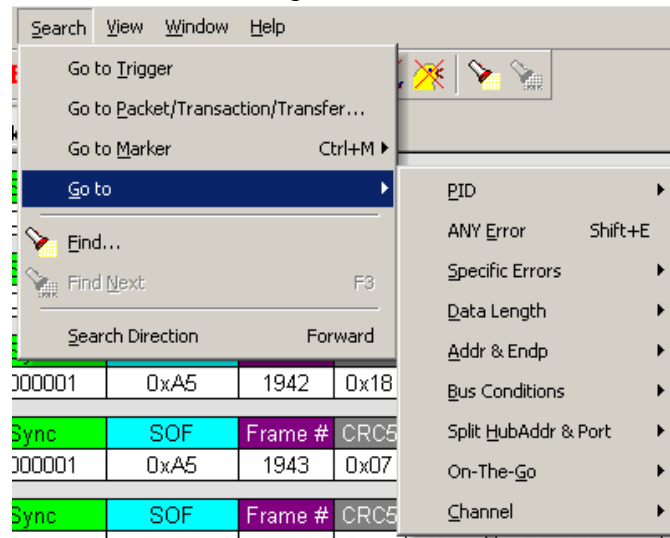
### Go To

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

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

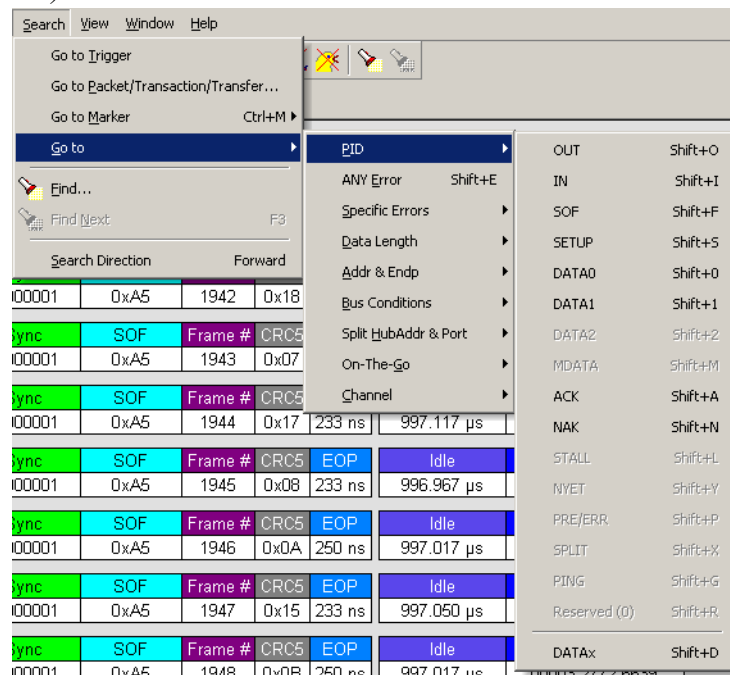


You see the **Go To** drop-down menu:



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

### *Packet IDs (PIDs)*



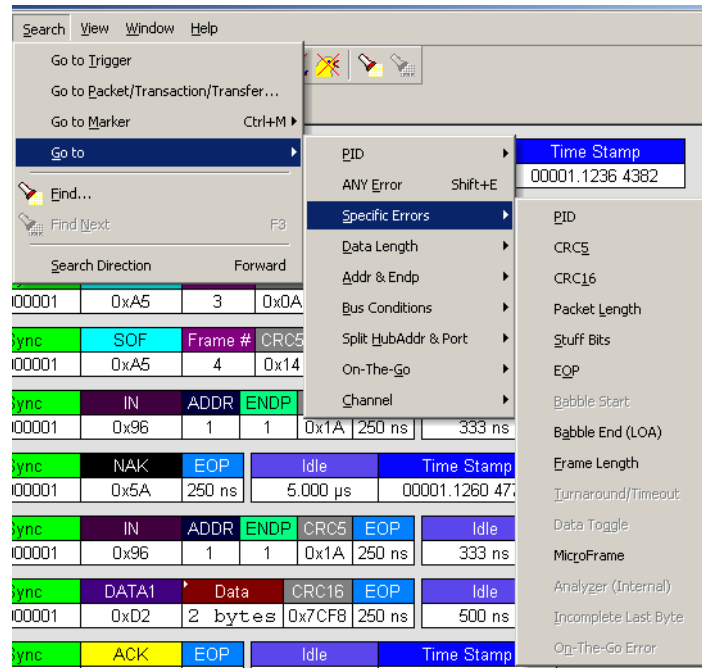
Select the type of packet you want to go to.

### *ANY Error*

Repositions the trace to show the next instance of any error.

## Errors

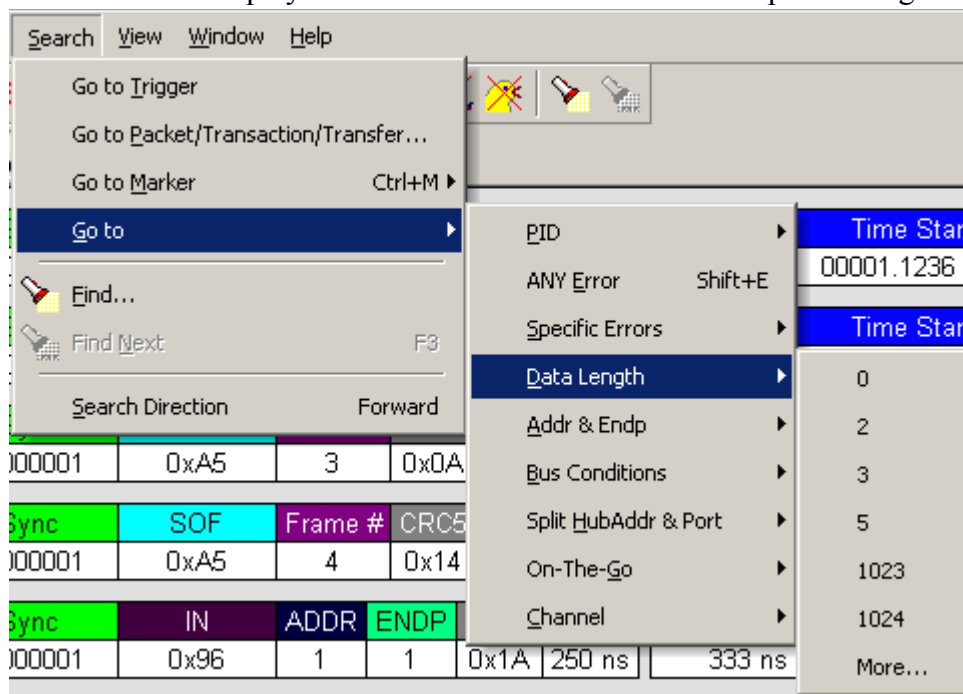
The Errors menu allows you to search for five different types of error: PID, CRC5, CRC16, Packet Length, and Stuff Bits. Menu items will appear in bold if they are present in the trace or grayed out if not present in the trace as shown in the example below.



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

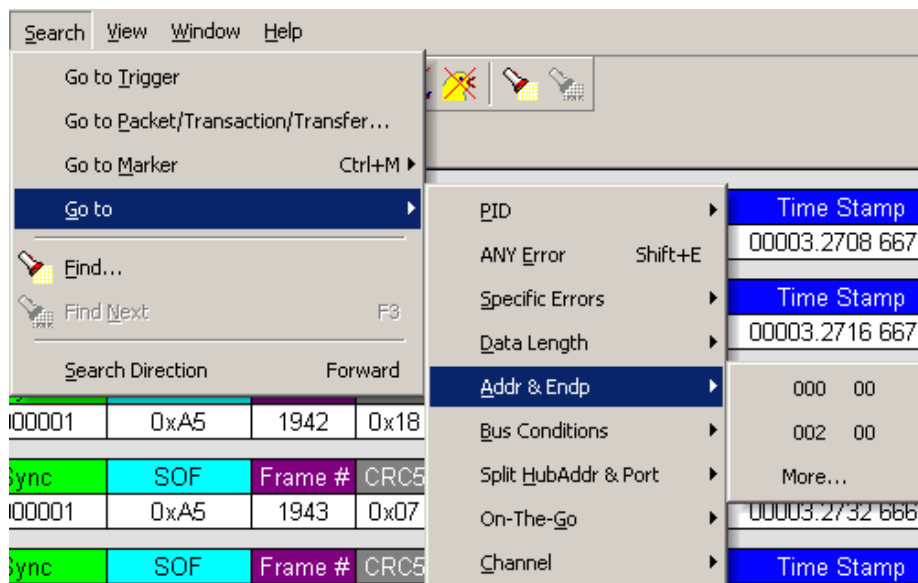
### Data Length

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 will cause the display to move to the next instance of that packet length.



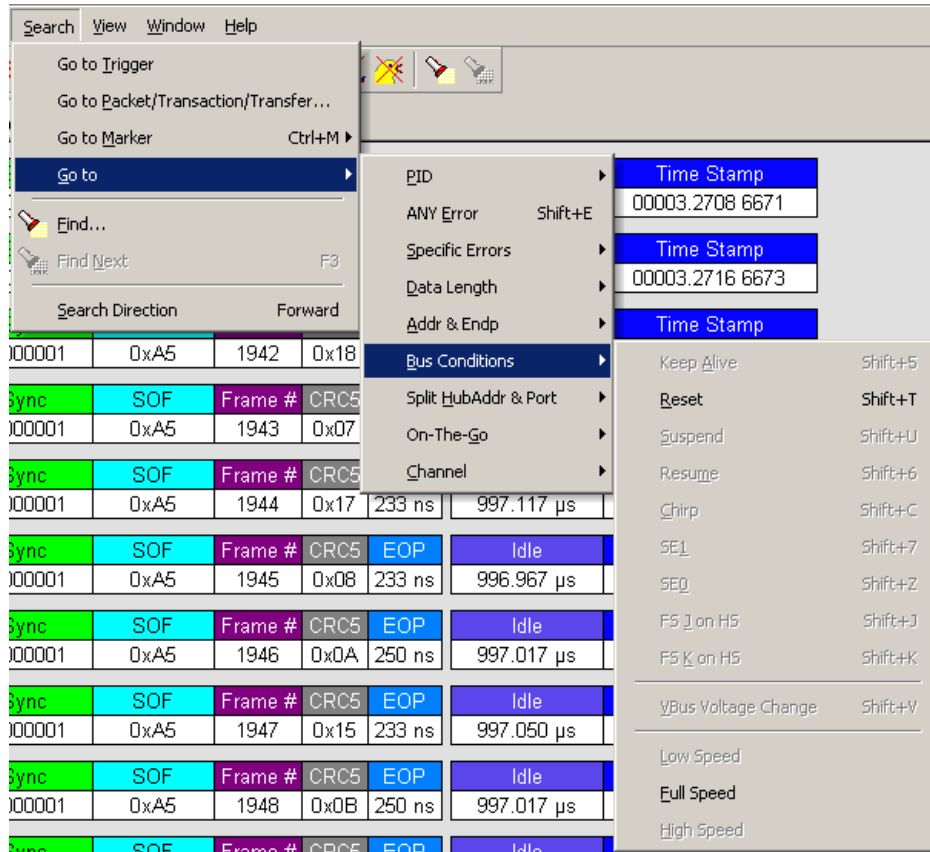
### Addr & Endp

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



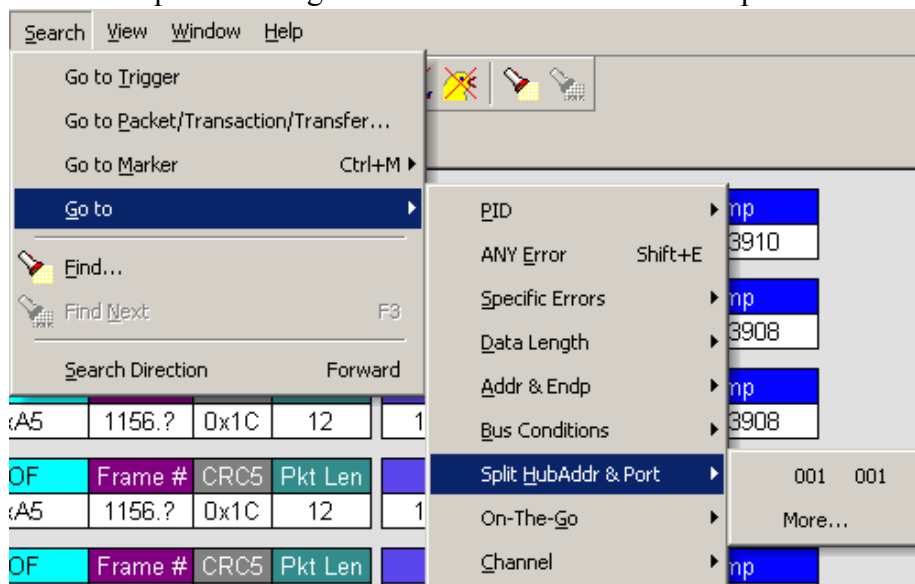
### Bus Conditions

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.



### *Split HubAddr & Port*

Allows you to search by Hub Address and port. If present, the option "More ..." opens a dialog box with a list of addresses and ports.



### *On-the-Go*

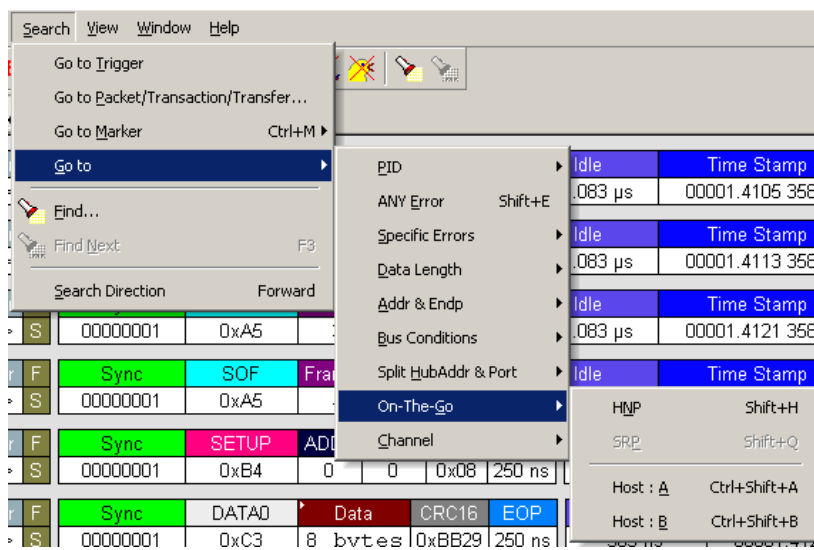
Allows you to search for On-the-go attributes. The On-the-Go sub-menu contains entries for:

**HNP** - Host Negotiation Protocol

**SRP** - Session Request Protocol

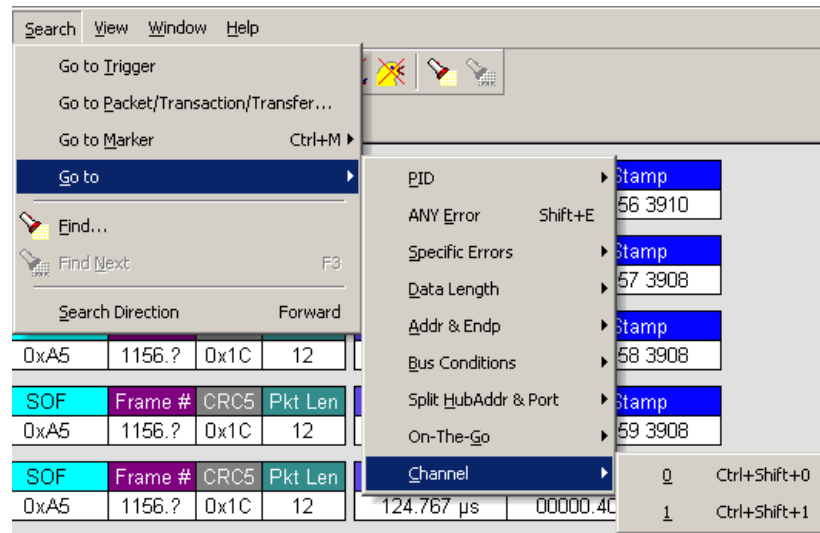
**Host : A** - Hosts with an A plug

**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.

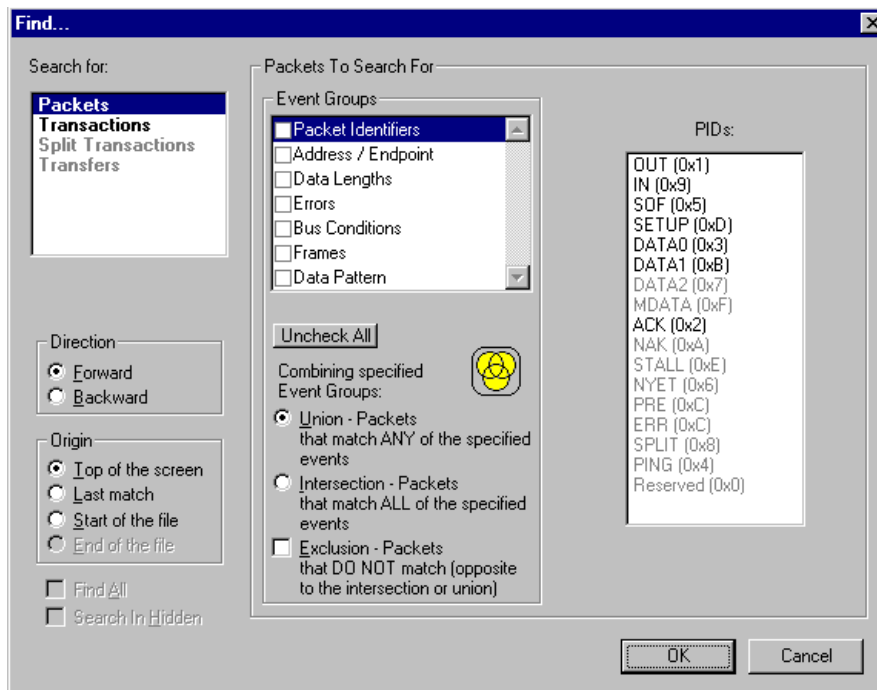
To perform a search,

**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 **Packet**, **Transaction**, **Split Transaction**, or **Transfer** from the top left list box.

Your choice will affect the options presented 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 packets meeting the search criteria will display.

### Find Next

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

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

OR

Click  on the Tool Bar.

### Search Direction

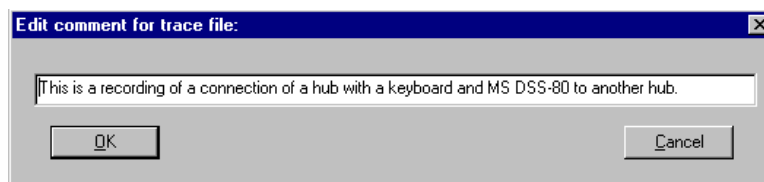
Toggles the search forward or backwards. The current direction is indicated in the menu.

## 9.2 Edit Comment

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

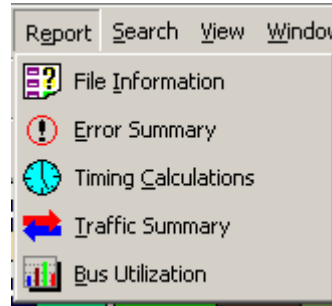
**Step 3** Click **OK**.

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



## 9.3 Reports

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




### File Information

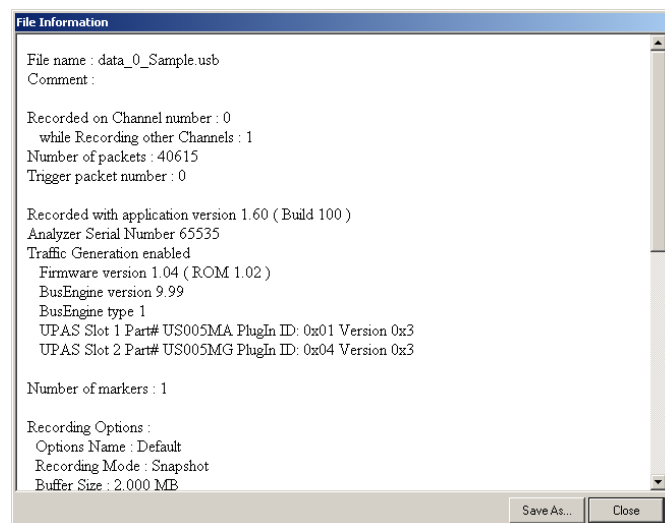
To display a File Information report,

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

OR

Click  in the Tool Bar.

You see 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

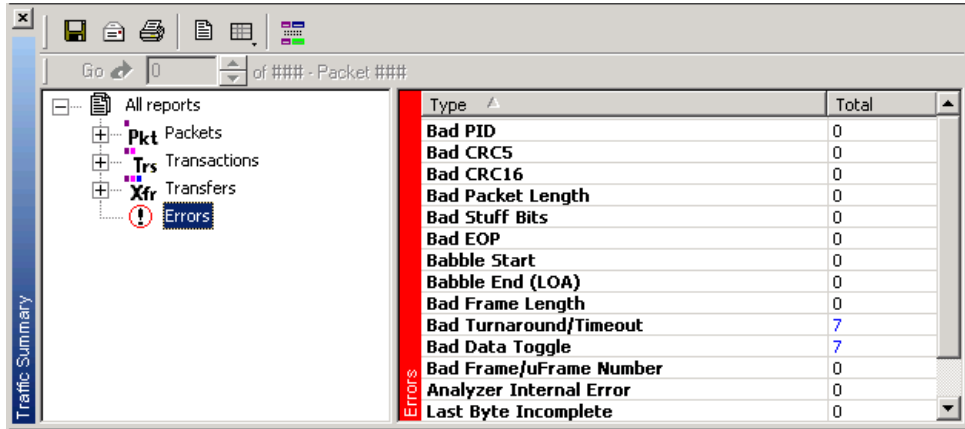
The Error Summary details all errors analyzed throughout the recording.

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

OR

Click  in the Tool Bar.

You see the Error screen below the Trace View:



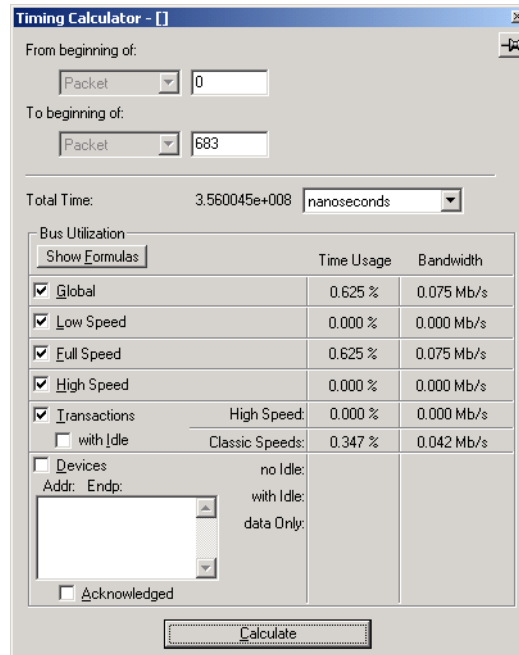
Type	Total
Bad PID	0
Bad CRC5	0
Bad CRC16	0
Bad Packet Length	0
Bad Stuff Bits	0
Bad EOP	0
Babble Start	0
Babble End (LOA)	0
Bad Frame Length	0
Bad Turnaround/Timeout	7
Bad Data Toggle	7
Bad Frame/uFrame Number	0
Analyzer Internal Error	0
Last Byte Incomplete	0

## Timing Calculations

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

- Select **Reports > Timing Calculations** in the Menu or click .

You see the Timing and Bus Usage Calculator screen:



From beginning of: Packet 0

To beginning of: Packet 683

Total Time: 3.560045e+008 nanoseconds

Bus Utilization

Show Formulas

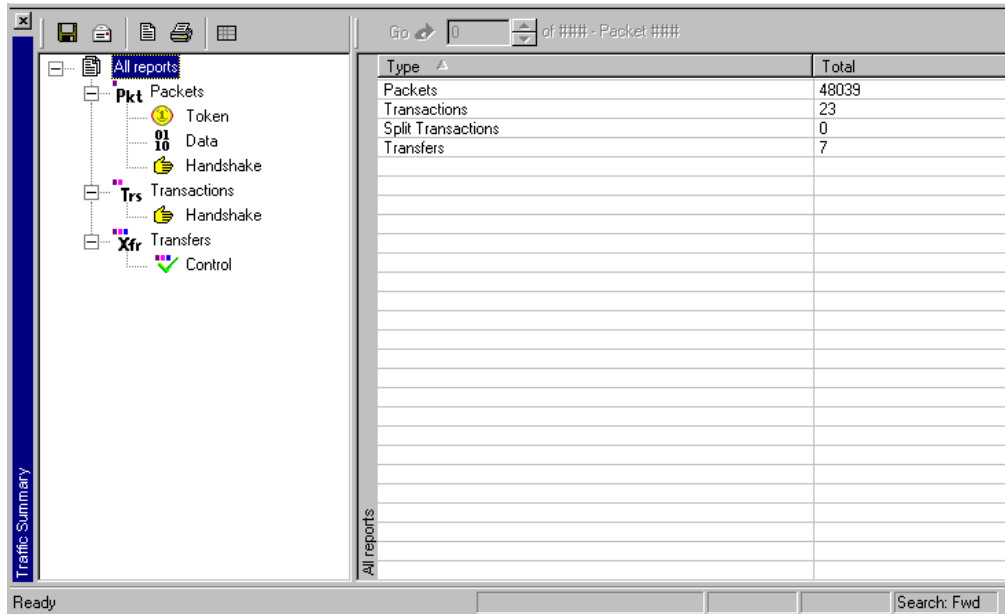
	Time Usage	Bandwidth
<input checked="" type="checkbox"/> Global	0.625 %	0.075 Mb/s
<input checked="" type="checkbox"/> Low Speed	0.000 %	0.000 Mb/s
<input checked="" type="checkbox"/> Full Speed	0.625 %	0.075 Mb/s
<input checked="" type="checkbox"/> High Speed	0.000 %	0.000 Mb/s
<input checked="" type="checkbox"/> Transactions	High Speed: 0.000 %	0.000 Mb/s
<input type="checkbox"/> with Idle	Classic Speeds: 0.347 %	0.042 Mb/s
<input type="checkbox"/> Devices	no Idle:	
Addr: Endp:	with Idle:	
	data Only:	
<input type="checkbox"/> Acknowledged		

Calculate

## Traffic Summary


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

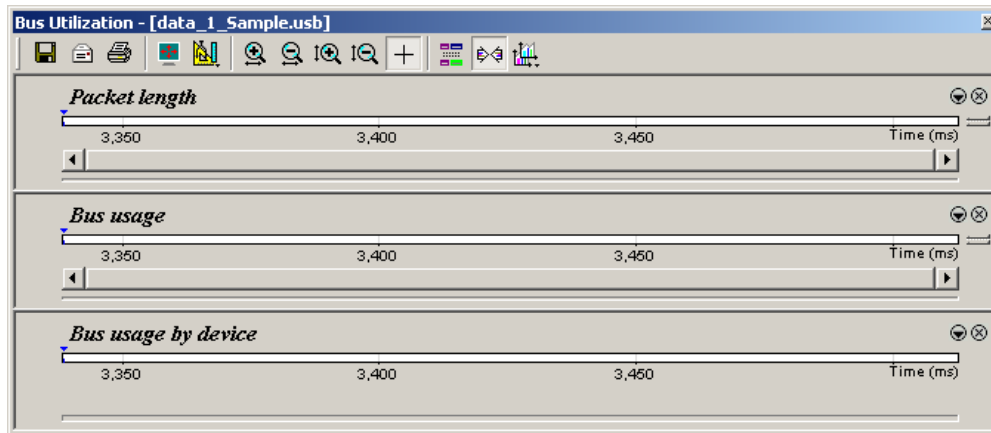
To run **Traffic Summary**, select **Report >Traffic Summary** or click the button marked . You will be prompted to specify a range of packets, then be shown the following window:



## Bus Utilization

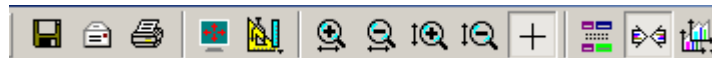
The **Bus Utilization** window displays information on bandwidth use for the three recording channels.

To open the Bus Utilization window, select **Report > Bus Utilization** or click the button marked . A window will open with two graphing 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)		Vertical zoom in
	Email - Creates an email with a *.bmp file attachment of the graphs		Vertical zoom out
	Print		Click and Drag zoom - Click diagonally to select and zoom in on part of the graph
	Full Screen		Select Range
	View Settings - opens a sub-menu with options for formatting the display. See "View Settings Menu" below.		Sync and Graph areas - If two or more graphs are displayed, this button will synchronize the graphs to one another. Once synchronized, the positioning slider of one graph will move the other graphs



Horizontal zoom in




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

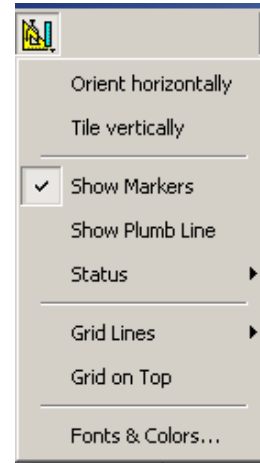


Horizontal zoom out

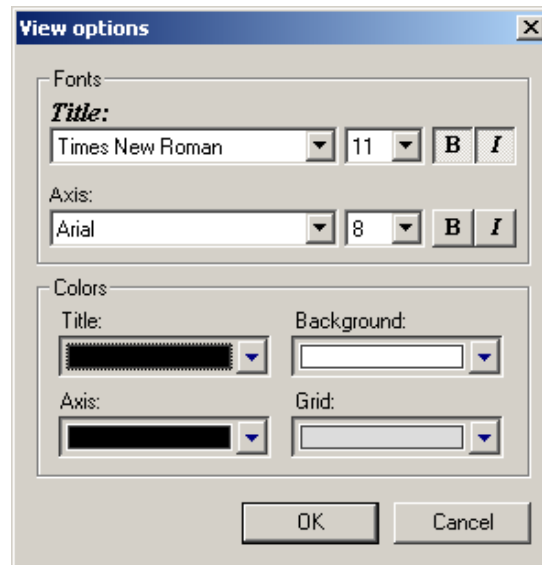
### *View Settings Menu*

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

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




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

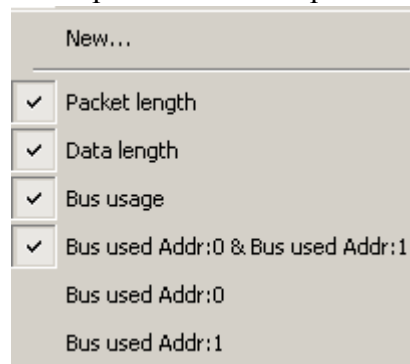


### *Graph Areas Menu*

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

**Step 1** Click the  button.

The Graph Areas menu opens.

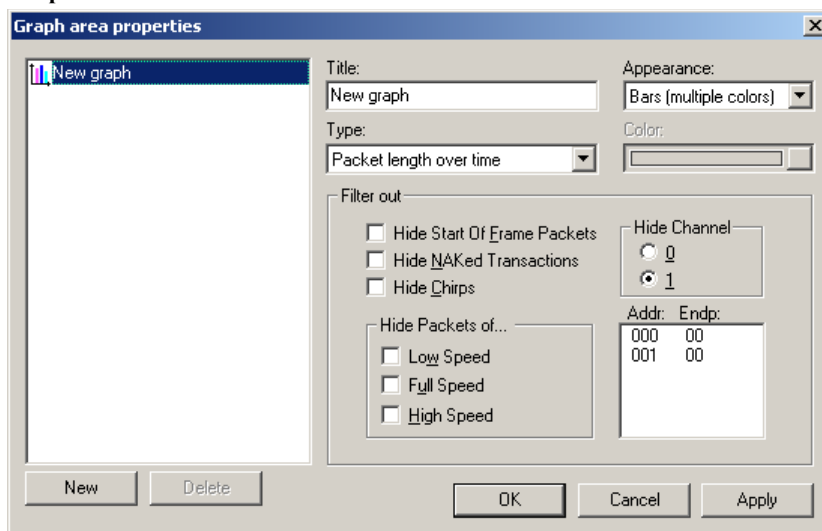


**Step 2** Select the data you want to appear in the Graph Areas window.

To change the properties in the Bus Utilizations graph, follow these steps:

**Step 1** In the **Graph Areas** menu, select what you want your graph to display.

Step 2 Click **OK**.



Or

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





## 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...	<a href="http://www.lecroy.com/">http://www.lecroy.com/</a>

## Limited Hardware Warranty

So long as you or your authorized representative ("you" or "your"), fully complete and return the registration card provided with the applicable hardware product or peripheral hardware products (each a "Product") within fifteen days of the date of receipt from LeCroy or one of its authorized representatives, LeCroy warrants that the Product will be free from defects in materials and workmanship for a period of three years (the "Warranty Period"). You may also complete your registration form via the internet by visiting <http://www.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.

**Coverage During Warranty Period**

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

**How to Obtain Warranty Service**

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

You can reach LeCroy Technical Support at 800-909-7112 or via email at [support@catc.com](mailto: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.

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

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

If LeCroy evaluates and determines there is "no trouble found" in any Product returned or that the returned Product is not eligible for warranty coverage, LeCroy will inform you of its determination. If you thereafter request LeCroy to repair the Product, such labor and service shall be performed under the terms and conditions

of LeCroy's then current repair policy. If you chose not to have the Product repaired by LeCroy, you agree to pay LeCroy for the cost to return the Product to you and that LeCroy may require payment in advance of shipment.

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



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