USB Protocol Suite
User Manual

Software Version 7.26

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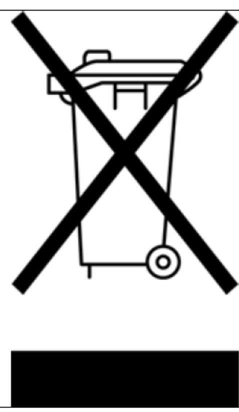

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Chapter 1

Overview

1.1 Common Features

1.1.1 Graphical Bus Traffic Display

Bus traffic displays use color and graphics to show captured transactions.

Packets are on separate rows. Packets receive time stamps and sequential numbers as the system records them. Fields have labels and color codes. The system automatically detects protocol errors and highlights them in red.

You can customize the display color scheme and field formats. You can use the hide feature to suppress SOF packets and uninteresting user-defined packets or fields in different contexts. You can name and save display formats for later use. Pop-up tooltips annotate packet fields.

The display software operates independently of the hardware, allowing it to function as a stand-alone “trace viewer” that you can freely distribute.

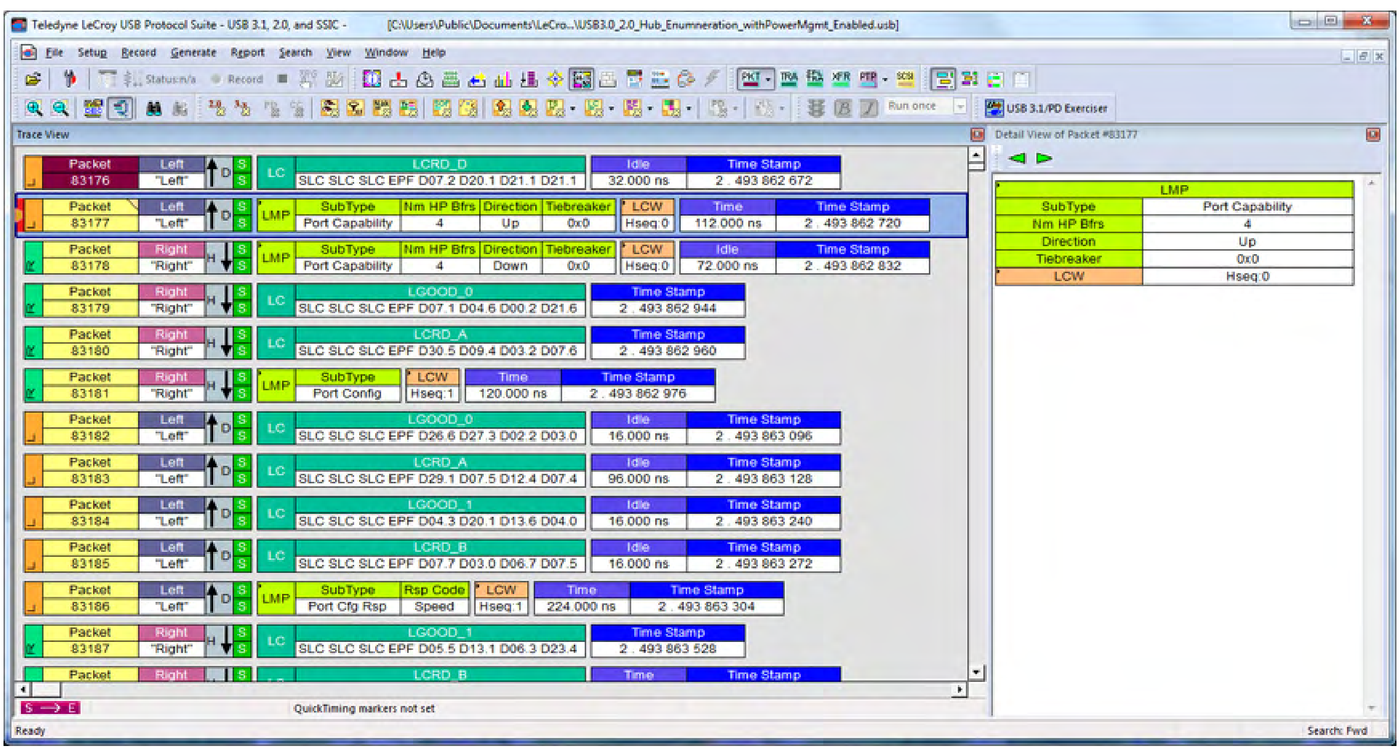


Figure 1.1: Trace Viewer.

1.1.2 Accurate Time Measurement (Voyager, Advisor T3)

The internal counter/timer circuitry enables reliable, accurate (2 ns resolution) time stamping of recorded bus traffic. Traces and measurement and analysis functions display this timing information. Time fields are time stamps, idle times, bit times, or time deltas, in either decimal or hexadecimal format. You can add any number of markers to denote specific packets, you can make further timing measurements from one marker to another or from marker to trigger.

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

The oscillator has 2.5 ppm accuracy.

1.1.3 CrossSync Control Panel (Voyager, Advisor T3)

The CrossSync Control Panel allows you to select analyzers for synchronization and manage the recording process. It supports a wide combination of Teledyne LeCroy's flagship analyzers including PCI Express, USB, DDR, Serial ATA (SATA), Serial Attached SCSI (SAS), Fibre Channel (FC) and Ethernet.

CrossSync is Teledyne LeCroy's analyzer synchronization solution that enables time-aligned display of protocol traffic from multiple daisy-chained analyzers showing packet traffic from multiple high-speed serial busses. A lightweight software control panel allows users to select analyzers for synchronization and manage the recording process. Captured traffic is displayed using the latest analyzer software (in separate windows) with all the protocol specific search and reporting features.

Captured packets are displayed in separate windows that share a common time scale. Navigating the traffic in either direction will scroll to the same timestamp in a synchronized window. When using the CrossSync option, users can access the full complement of analysis capabilities available within the individual Teledyne LeCroy software. Search, reporting, and decoding all operate normally (see "CrossSync Control Panel" on page 145).

This feature is available with the Teledyne LeCroy USB Protocol Suite application.

1.1.4 Comprehensive Error Detection and Analysis

The system detects, and alerts you to, every potential bus error and protocol violation, and their combinations. The Analyzer BusEngine™ circuitry performs real-time triggering on multiple error conditions, such as PID bad, bit stuffing bad, header or data CRC bad, end-of-packet bad, babble, activity loss, frame length violation, time-out or turn-around violation, and data toggle violation. The Analyzer program highlights all hardware-detected errors and further examines the trace file for additional protocol errors, including wrong packet length, data payload violation, and packet termination not on a byte boundary.

1.1.5 Real-Time Event Triggering and Capture Filtering

The Analyzer can accurately identify and selectively record transactions of interest from the crowded stream of bus traffic. The system uses more than a dozen configurable hardware building blocks that you can optimize to perform particular activities. Such “recording resources” can independently await an initialization signal, monitor its external environment (external signals or other resources) in search of a particular event, and take a subsequent action, such as triggering, inclusive or exclusive filtering, and counting. In the user interface, you can select, configure, and combine these resources to search for complex trigger conditions and selectively capture associated transactions.

The system can trigger on basic events, such as specific bus conditions and packet identifiers (PID). It can also trigger on complex events, such as “trigger on the fifth occurrence of a SETUP Token device number nine” or “trigger on a SET INTERFACE request, following a specified eight-byte bulk data pattern match from this scanner, and do not capture any start-of-frame (SOF) packets.”

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

Advanced Event Counting and Sequencing

The count and sequence options define rules for data recording sessions. These options configure and control the order of events selected for triggering or filtering.

Using this feature, you can specify a sequence of up to seven events that must occur before the Analyzer triggers and finishes capturing data, allowing you to specify event types for recording. Without this feature, you may have to scroll through megabytes of recorded data to locate an occurrence of a sequence.

1.1.6 BusEngine Technology

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

1.2 Voyager M310C Analyzer

Warning: The Voyager M310C Power Delivery (PD) Exerciser allows the customer to set Voltages and Current levels to be delivered to/from Devices and Hosts and their connecting cables which may exceed their capabilities.

- **This may cause damage to the devices under test and their cables. Please use caution when writing scripts so that these limitations are not exceeded.**
- **Please Power-cycle the M310C unit after PD usage to insure that the connectors go back to their default Voltage and Current states.**

The Teledyne LeCroy Voyager™ M310C Analyzer and Exerciser system is a multifunction verification system for USB 3.1, SS and SS+, Power Delivery, and 2.0 development and testing. It uses the new USB Type-C™ connectors to monitor both USB and Configuration Channel (CC) traffic and events. It can record traffic and graphically present logical USB transactions and events. It can also generate USB traffic. The system is connected to a laptop or desktop via its USB or Gigabit Ethernet port (see Figure 1.12 on page 50).

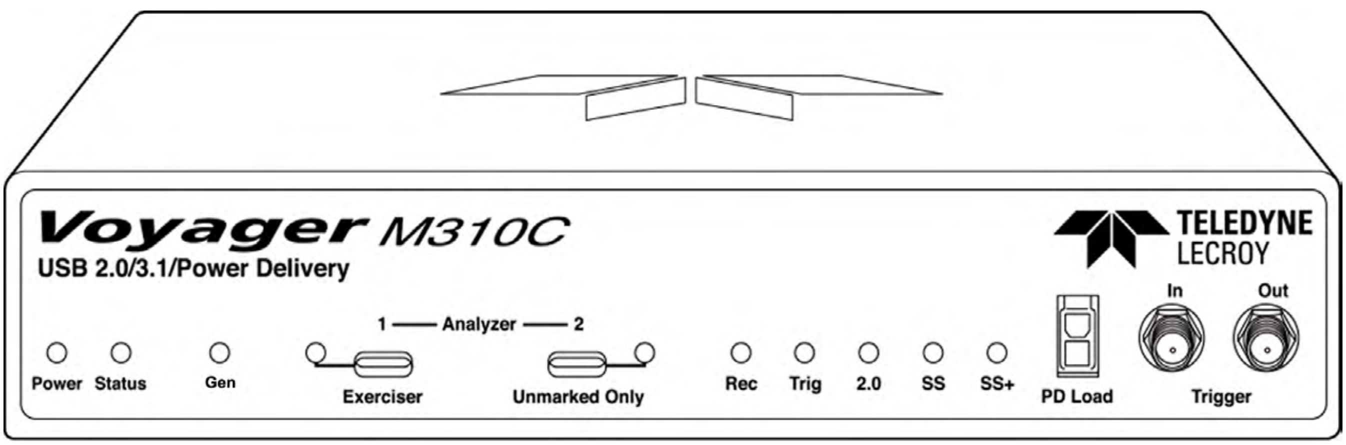


Figure 1.2: Voyager M310C Analyzer Exerciser System.

Please see the **Readme** file on the installation DVD for the latest information on host machine requirements and supported operating systems.

1.2.1 USB 3.1 and 2.0 Features

The system can monitor traffic between USB 2.0 links using standard high-speed compliant cables and USB 3.1 SS (5Gbps) links using compliant USB Type-C™ connector cables.

If configured for USB 3.1 SS+ (10Gbps) testing, the system supports monitoring between SuperSpeed Plus links using USB 3.1 SS+ USB Type-C™ connector cables (see Figure 1.13 on page 51). Analysis of 10 Gbps Super Speed Plus traffic requires the use of short, low-loss, high quality cables, as provided by Teledyne LeCroy with your M310C product. Use of other cables may compromise the signal quality and prevent capturing of the traffic. The use of 2 Electronically Marked cables is not permitted. Electronically Marked cables should use the left connector, marked "1".

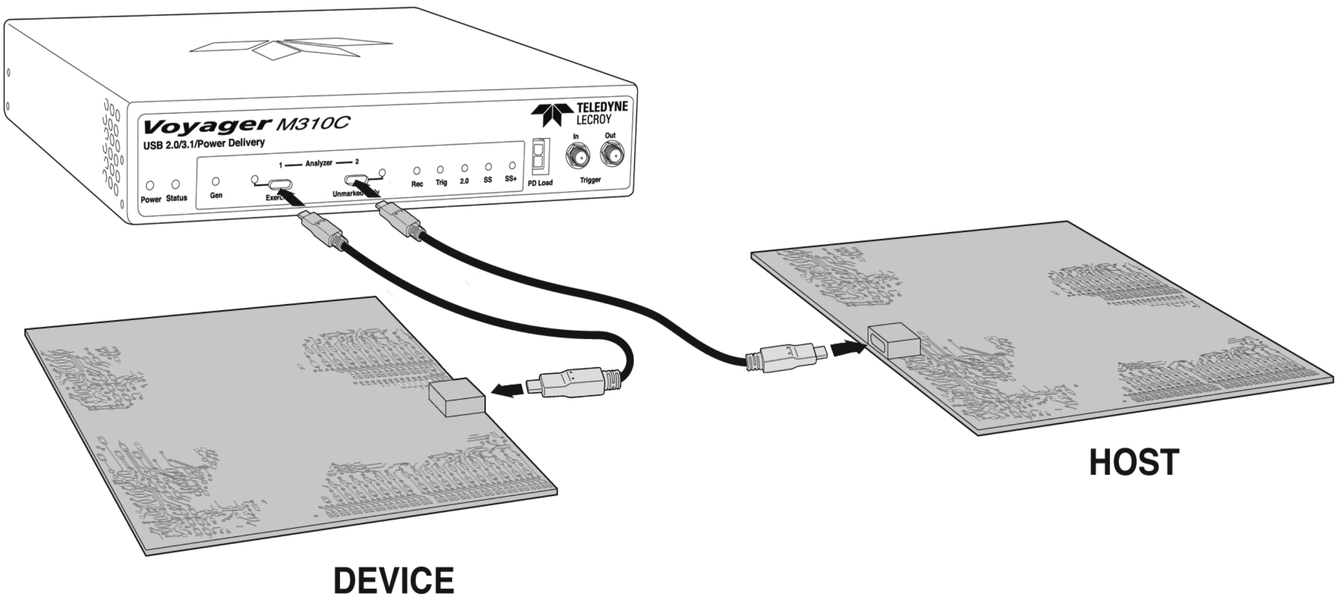


Figure 1.3: Direct Connection using USB 3.1 Cables.

Note: In Analysis mode, Device must be plugged into Connector 1, Host into Connector 2.

1.2.2 General Description

The Analyzer connects to a portable or desktop host machine through the USB port. The host machine configures and controls the Analyzer. The “CATC Trace™” user interface is an industry standard for documenting the performance of high-speed serial protocols.

The USB protocol Analyzer provides traffic capture and analysis. Hardware triggering allows capture of real-time events. Hardware filtering allows filtering different packet types in or out of the recording. Filtering also allows you to preserve recording memory, for extended recording time.

The trace viewer application displays recorded data in colored graphics. The application has advanced search and viewing capabilities that allow you to quickly locate specific data, errors, and other conditions.

The system functions with any host machine having the Microsoft® Windows® XP, Windows 8, or Windows 7 (32 or 64) operating system and a functional USB interface or Ethernet port.

The system provides on-the-fly detection of, and triggering on, such events as Tokens and Errors. Whether recording manually or with a specified trigger condition, the system continuously records the link data, in a wrap-around fashion, until manually stopped or until the system detects the Trigger Event and records the specified post-trigger amount of link data.

Upon detection of a triggering event, the Analyzer continues to record data up to a point specified by you. You can individually enable or disable real-time event detection to allow triggering on events as they happen, including predefined exception or error conditions and user-defined sets of trigger events. An externally supplied signal can trigger the Analyzer.

You can use search functions to investigate particular events. In addition to immediate analysis, you can print any part of the data. You can save the data on disk for later viewing. You can generate timing information and data analysis reports.

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

USB Implementers Forum 1730 SW Skyline Blvd. Suite 203 Portland, OR 97221	Tel: +1/503.296.9892 Fax: +1/503.297.1090 Web: http://www.usb.org/

1.2.3 Features

General

- Fully complies with USB specification revisions.
- Supports the Link Power Management extension.
- Uses field-upgradeable firmware and recording engine.
- Supports all USB speeds (10GB/s, 5 Gb/s, 480 Mb/s, 12 Mb/s, and 1.5 Mb/s).
- Supports capture of Power Delivery protocol and Configuration Channel "CC" events over the CC wire in the USB Type-C™ type cables.
- Displays bus traffic using color and graphics in the user-friendly CATC Trace interface.
- Has free non-recording, view-only Trace Viewer software.
- Comes with online manual.
- Self-diagnoses at power on.
- Uses software upgradable Exerciser function.
- Allows remote control of USB analyzers in a network.

Physical Components

- Desktop or portable Microsoft Windows XP, Windows 8, or Windows 7 (32 or 64) host machine with USB or Ethernet capability
- Plug-and-Play USB installation
- 16 GB of physical data-recording memory
- USB 3.1 Super-Speed connection to desktop or portable host machine
- USB 3.1 USB Type-C™ type connectors for SuperSpeed Plus capture and genera-

tion

- Integrated CATC Sync ports to support cascading analyzers or Cross-Sync configurations

Recording Options

- Versatile triggering: bit-wise value and mask data patterns up to sixteen bytes wide for Setup transactions and data packets
- Triggering on High-Speed PIDs and split transaction special tokens (ERR, SPLIT, PING, NYET, DATA2, and MDATA) (2.0)
- CATC Trace display and enumeration of High-Speed Micro Frames (2.0)
- 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 can filter transactions (for example, NAK'd transactions) (2.0)
- Advanced triggering with event counting and sequencing
- Dedicated trigger for recording input and output used to interface to external test equipment
- Triggering on multiple error conditions: PID bad, bit stuffing bad, CRC bad, end-of-packet bad, babble, activity loss, frame length violation, time-out or turn-around violation, data toggle violation, Token, Bus Conditions, Data Length, and excessive empty frames (2.0)
- Real-time traffic capture filtering and data packet truncation variable up to 256 bytes (2.0)
- Adjustable buffer size from 1 MB to 16 GB
- Idle filtering (3.1)

Display Options

- Utilizes the CATC Trace graphical display of bus packets, transactions, split transactions, and transfers.
- Groups numerous packets and transactions under a single transfer while quickly decoding all essential information.
- Decodes split transactions upstream and downstream of a transaction translator with a special hierarchical view.
- Has reports summarizing key statistics and conditions of interest, with the ability to jump to the selected item in the trace display.
- Indicates trigger position by different pre-trigger and post-trigger packet colors.
- Sets markers to assist with navigation and time calculations. Each marker can contain unique comments.
- Hides start-of-frame (SOF) packets, as well as any packet or transaction from a device address and endpoint.
- Searches for a specific PID.
- Detects and alerts you to every potential bus error and protocol violation, and their combinations.
- Has high-resolution, accurate time stamping of bus packets and timing measurement and analysis functions.
- Allows search and packet hiding.
- Allows device class decoding and user-defined protocol decoding.
- Has a Data View (2.0 and 3.1).

- Uses Link Tracker to view symbols of traffic (3.1).
- Uses a Spec View to show packets in the same format as the USB 3.1 specification (3.1).
- Has 3.1 Quick Timing Markers to immediately show time deltas and bandwidth use.

1.2.4 Traffic Generation

USB 2.0 and 3.1 traffic generation options allow you to transmit custom packets over standard USB cables with low-level control of headers, payloads, timing, and link states. The Exerciser can play back trace files bit-for-bit, allowing validation engineers to recreate problems reported in the field or test-specific functionality.

To build 2.0 generation script files, you can edit example test scenarios or export any traffic stream from a previously recorded trace. The Voyager Exerciser includes a Generation Script Editor.

A script pre-processor allows you to organize script code and create reusable generation blocks.

The Voyager USB 2.0 Exerciser can transmit low, full, or high-speed traffic and supports both host and device emulation. It is backward compatible with existing USB*Trainer* traffic generation scripts.

For USB 2.0 applications, the Exerciser supports both bitstream mode or Intelliframe mode. In Intelliframe mode, the Exerciser can wait for the appropriate response from the DUT before transmitting the next packet. For example, after issuing an IN, the generator waits for the DATAx packet returned by the device to finish, and then issues an ACK. When NAKs are received, the Exerciser can automatically resend the previous packet.

ReadyLink™ Emulation

The Teledyne LeCroy Voyager USB 3.1 Exerciser features ReadyLink Emulation Mode. The ReadyLink feature handles all USB 3.1 link training and link flow control, allowing the emulator to operate at full line rate and respond to the DUT as defined by the specification. The ReadyLink Emulation Mode helps simplify development of USB 3.1 test scenarios.

By default, ReadyLink Emulation Mode automatically manages:

- Header Packet Acknowledgments (L_GOOD_n)
- Buffer Credit (L_CRD_x)
- SKIPs at required intervals (SKP)
- Link Synchronization
  - Responds to LFPS (Polling.LFPS)
  - Responds to polling sequence (Polling.RxEQ)
  - Responds to TS1 / TS2 handshaking sequence
  - Responds to SS.Inactive (with RX.Detect)
  - Responds to 3.1 SS+ LPBM and SCD1 and SCD2 LFPS messages
- Power Management Link Commands
  - Responds to LGO_Un (with LAU)
  - Responds to LAU (with LMPA)

Test scripts can customize ReadyLink Emulation Mode to include error scenarios, such as:

- Header LBADs
- Invalid link commands
- 8B10B / CRC Error
- Running Disparity Error
- Corrupt Link Commands
- Corrupt Flow Control (Wrong L_CRD_x, Wrong L_GOOD_n, Drop L_Good_n)
- Corrupt Header Packet acknowledgment (Send LBAD, LRTY)
- Corrupt Packet Framing (SHP, SDP, END)

At the packet level, you can send customized data payloads anywhere within the stream to insert logic errors, perform corner-case, or do stress testing. Commands, such as the **Set ErrWrongLCRD** command, allow link-layer error injection anywhere within the script.

1.2.5 Notes on LFPS Signals

Voyager M310C Exerciser requires received “Ping” LFPS signals to be a minimum of 50 nanoseconds to be reliably recognized.

Voyager Analyzer can recognize “Ping” LFPS signals above 60 nanoseconds and report their durations to ±70 nanoseconds of accuracy, typically ±15 nanoseconds.

1.3 Voyager M310 Analyzer

The Teledyne LeCroy Voyager™ M310 Analyzer and Exerciser system is a multifunction verification system for USB 3.1 and 2.0 development and testing. It can record traffic and graphically present logical USB transactions and events. It can also generate USB traffic. The system is connected to a laptop or desktop via its USB or Gigabit Ethernet port (see Figure 1.12 on page 50).

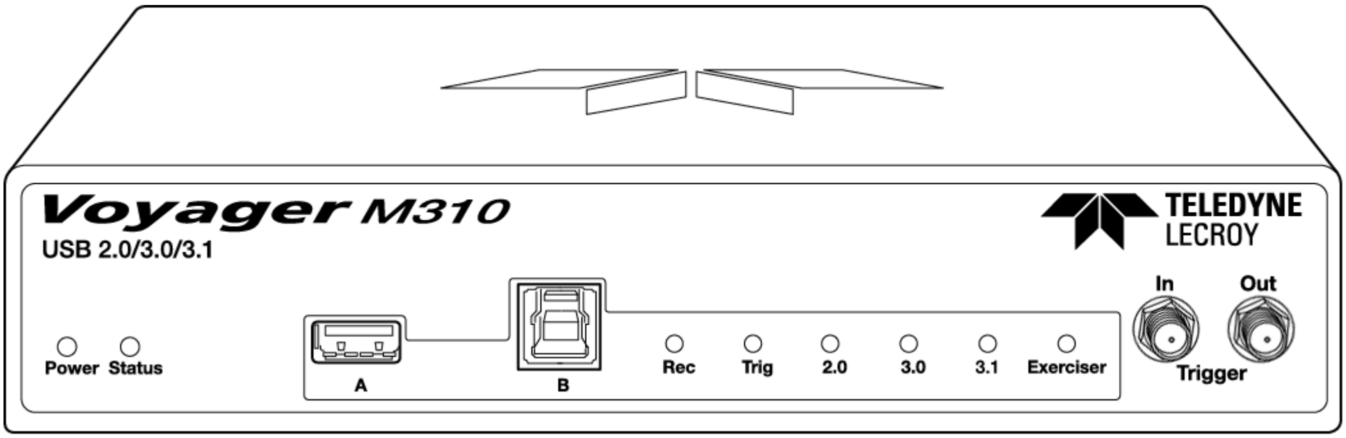


Figure 1.4: Voyager M310 Analyzer Exerciser System.

Please see the **Readme** file on the installation DVD for the latest information on host machine requirements and supported operating systems.

1.3.1 USB 3.1 and 2.0 Features

The system can monitor traffic between USB 2.0 links using standard high-speed compliant cables.

If configured for USB 3.1 SS testing, the system supports monitoring between SuperSpeed links using USB 3.1 SS compliant cables (see Figure 1.13).

If configured for USB 3.1 SS+ (10Gbps) testing, the system supports monitoring between SuperSpeed Plus links using USB 3.1 SS+ compliant cables (see Figure 1.13). Analysis of 10 Gbps Super Speed Plus traffic requires the use of short, low-loss, high quality cables, as provided by Teledyne LeCroy with your M310 product. Use of other cables may compromise the signal quality and prevent capturing of the traffic.

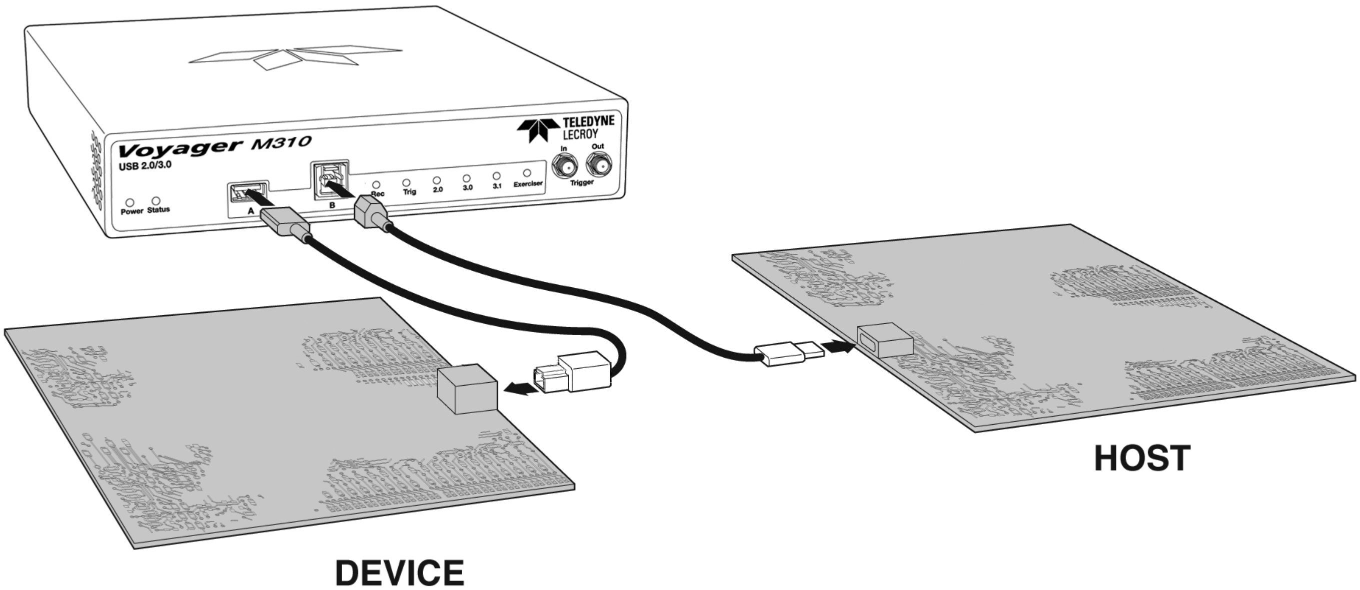


Figure 1.5: Direct Connection using USB 3.1 Cables.

1.3.2 General Description

The Analyzer connects to a portable or desktop host machine through the USB port. The host machine configures and controls the Analyzer. The “CATC Trace™” user interface is an industry standard for documenting the performance of high-speed serial protocols.

The USB protocol Analyzer provides traffic capture and analysis. Hardware triggering allows capture of real-time events. Hardware filtering allows filtering different packet types in or out of the recording. Filtering also allows you to preserve recording memory, for extended recording time.

The trace viewer application displays recorded data in colored graphics. The application has advanced search and viewing capabilities that allow you to quickly locate specific data, errors, and other conditions.

The system functions with any host machine having the Microsoft® Windows® XP, Windows 8, or Windows 7 (32 or 64) operating system and a functional USB interface or Ethernet port.

The system provides on-the-fly detection of, and triggering on, such events as Tokens and Errors. Whether recording manually or with a specified trigger condition, the system continuously records the link data, in a wrap-around fashion, until manually stopped or until the system detects the Trigger Event and records the specified post-trigger amount of link data.

Upon detection of a triggering event, the Analyzer continues to record data up to a point specified by you. You can individually enable or disable real-time event detection to allow triggering on events as they happen, including predefined exception or error conditions and user-defined sets of trigger events. An externally supplied signal can trigger the Analyzer.

You can use search functions to investigate particular events. In addition to immediate analysis, you can print any part of the data. You can save the data on disk for later viewing. You can generate timing information and data analysis reports.

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

USB Implementers Forum 1730 SW Skyline Blvd. Suite 203 Portland, OR 97221	Tel: +1/503.296.9892 Fax: +1/503.297.1090 Web: http://www.usb.org/

1.3.3 Features

General

- Fully complies with USB specification revisions.
- Supports the Link Power Management extension.
- Uses field-upgradeable firmware and recording engine.
- Supports all USB speeds (10GB/s, 5 Gb/s, 480 Mb/s, 12 Mb/s, and 1.5 Mb/s).
- Displays bus traffic using color and graphics in the user-friendly CATC Trace interface.
- Has free non-recording, view-only Trace Viewer software.
- Comes with online manual.
- Self-diagnoses at power on.
- Uses software upgradeable Exerciser function.
- Allows remote control of USB analyzers in a network.

Physical Components

- Desktop or portable Microsoft Windows XP, Windows 8, or Windows 7 (32 or 64) host machine with USB or Ethernet capability
- Plug-and-Play USB installation
- 16 GB of physical data-recording memory
- USB 3.1 Super-Speed connection to desktop or portable host machine
- USB 3.1connectors for SuperSpeed Plus capture and generation
- Integrated CATC Sync ports to support cascading analyzers or Cross-Sync configurations

Recording Options

- Versatile triggering: bit-wise value and mask data patterns up to sixteen bytes wide for Setup transactions and data packets
- Triggering on High-Speed PIDs and split transaction special tokens (ERR, SPLIT, PING, NYET, DATA2, and MDATA) (2.0)
- CATC Trace display and enumeration of High-Speed Micro Frames (2.0)
- 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 can filter transactions (for example, NAK'd transactions) (2.0)
- Advanced triggering with event counting and sequencing
- Dedicated trigger for recording input and output used to interface to external

test equipment

- Triggering on multiple error conditions: PID bad, bit stuffing bad, CRC bad, end-of-packet bad, babble, activity loss, frame length violation, time-out or turn-around violation, data toggle violation, Token, Bus Conditions, Data Length, and excessive empty frames (2.0)
- Real-time traffic capture filtering and data packet truncation variable up to 256 bytes (2.0)
- Adjustable buffer size from 1 MB to 16 GB
- Idle filtering (3.1)

Display Options

- Utilizes the CATC Trace graphical display of bus packets, transactions, split transactions, and transfers.
- Groups numerous packets and transactions under a single transfer while quickly decoding all essential information.
- Decodes split transactions upstream and downstream of a transaction translator with a special hierarchical view.
- Has reports summarizing key statistics and conditions of interest, with the ability to jump to the selected item in the trace display.
- Indicates trigger position by different pre-trigger and post-trigger packet colors.
- Sets markers to assist with navigation and time calculations. Each marker can contain unique comments.
- Hides start-of-frame (SOF) packets, as well as any packet or transaction from a device address and endpoint.
- Searches for a specific PID.
- Detects and alerts you to every potential bus error and protocol violation, and their combinations.
- Has high-resolution, accurate time stamping of bus packets and timing measurement and analysis functions.
- Allows search and packet hiding.
- Allows device class decoding and user-defined protocol decoding.
- Has a Data View (2.0 and 3.1).
- Uses Link Tracker to view symbols of traffic (3.1).
- Uses a Spec View to show packets in the same format as the USB 3.1 specification (3.1).
- Has 3.1 Quick Timing Markers to immediately show time deltas and bandwidth use.

1.3.4 Traffic Generation

USB 2.0 and 3.1 traffic generation options allow you to transmit custom packets over standard USB cables with low-level control of headers, payloads, timing, and link states. The Exerciser can play back trace files bit-for-bit, allowing validation engineers to recreate problems reported in the field or test-specific functionality.

To build 2.0 generation script files, you can edit example test scenarios or export any traffic stream from a previously recorded trace. The Voyager Exerciser includes a Generation Script Editor.

A script pre-processor allows you to organize script code and create reusable generation blocks.

The Voyager USB 2.0 Exerciser can transmit low, full, or high-speed traffic and supports both host and device emulation. It is backward compatible with existing USB*Trainer* traffic generation scripts.

For USB 2.0 applications, the Exerciser supports both bitstream mode or Intelliframe mode. In Intelliframe mode, the Exerciser can wait for the appropriate response from the DUT before transmitting the next packet. For example, after issuing an IN, the generator waits for the DATAx packet returned by the device to finish, and then issues an ACK. When NAKs are received, the Exerciser can automatically resend the previous packet.

ReadyLink™ Emulation

The Teledyne LeCroy Voyager USB 3.1 Exerciser features ReadyLink Emulation Mode. The ReadyLink feature handles all USB 3.1 link training and link flow control, allowing the emulator to operate at full line rate and respond to the DUT as defined by the specification. The ReadyLink Emulation Mode helps simplify development of USB 3.1 test scenarios.

By default, ReadyLink Emulation Mode automatically manages:

- Header Packet Acknowledgments (L_GOOD_n)
- Buffer Credit (L_CRD_x)
- SKIPs at required intervals (SKP)
- Link Synchronization
  - Responds to LFPS (Polling.LFPS)
  - Responds to polling sequence (Polling.RxEQ)
  - Responds to TS1 / TS2 handshaking sequence
  - Responds to SS.Inactive (with RX.Detect)
  - Responds to 3.1 SS+ LPBM and SCD1 and SCD2 LFPS messages
- Power Management Link Commands
  - Responds to LGO_Un (with LAU)
  - Responds to LAU (with LMPA)

Test scripts can customize ReadyLink Emulation Mode to include error scenarios, such as:

- Header LBADs
- Invalid link commands
- 8B10B / CRC Error
- Running Disparity Error
- Corrupt Link Commands
- Corrupt Flow Control (Wrong L_CRD_x, Wrong L_GOOD_n, Drop L_Good_n)
- Corrupt Header Packet acknowledgment (Send LBAD, LRTY)
- Corrupt Packet Framing (SHP, SDP, END)

At the packet level, you can send customized data payloads anywhere within the stream to insert logic errors, perform corner-case, or do stress testing. Commands, such as the **Set ErrWrongLCRD** command, allow link-layer error injection anywhere within the script.

1.3.5 Notes on LFPS Signals

Voyager Exerciser requires received “Ping” LFPS signals to be a minimum of 70 nanoseconds to be reliably recognized.

Voyager Analyzer can recognize “Ping” LFPS signals above 60 nanoseconds and report their durations to ±70 nanoseconds of accuracy, typically ±15 nanoseconds.

1.4 Voyager M3/M3i Analyzer

The Teledyne LeCroy Voyager™ M3/M3i Analyzer and Exerciser system is a multifunction verification system for USB 2.0 and USB 3.1 development and testing. It can record traffic and graphically present logical USB transactions and events. It can also generate USB traffic. The system is connected to a laptop or desktop via its USB or Gigabit Ethernet port (see Figure 1.6 on page 35).

Note: The Voyager M3 and Voyager M3i Analyzer and Exerciser are identical in most respects. The major difference is that Voyager M3i can capture VBus Power information. Otherwise, all mentions of Voyager M3 in this manual also apply to Voyager M3i.

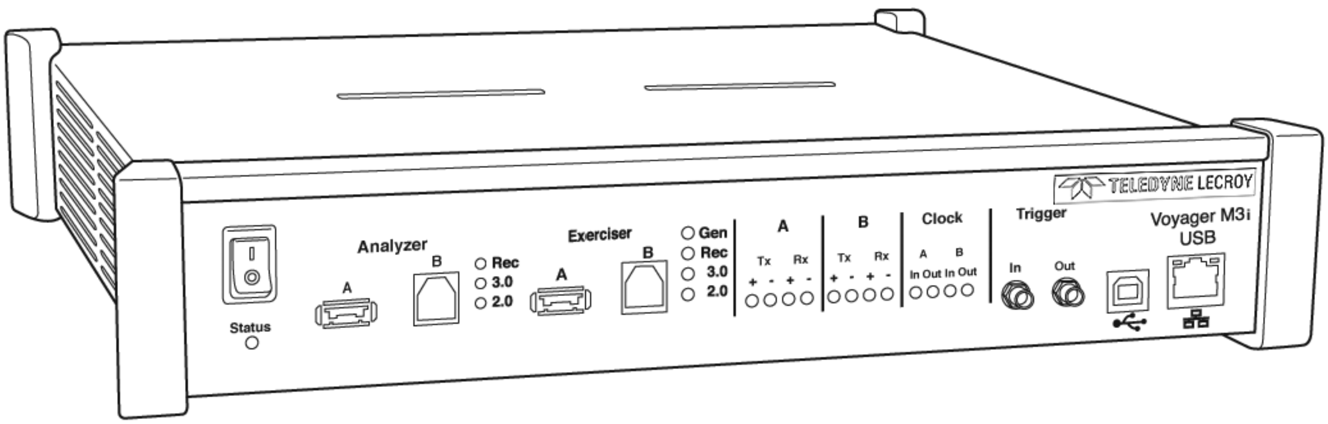


Figure 1.6: Voyager M3/M3i Analyzer Exerciser System.

Please see the **Readme** file on the installation DVD for the latest information on host machine requirements and supported operating systems.

1.4.1 USB 2.0 and USB 3.1 Features

The system can monitor traffic between USB 2.0 links using standard high-speed compliant cables.

If configured for USB 3.1 SS testing, the system supports monitoring between SuperSpeed links using USB 3.1 cables (see Figure 1.7 on page 36) or through direct connection via MMCX-to-SMA coaxial cables (see Figure 1.8).

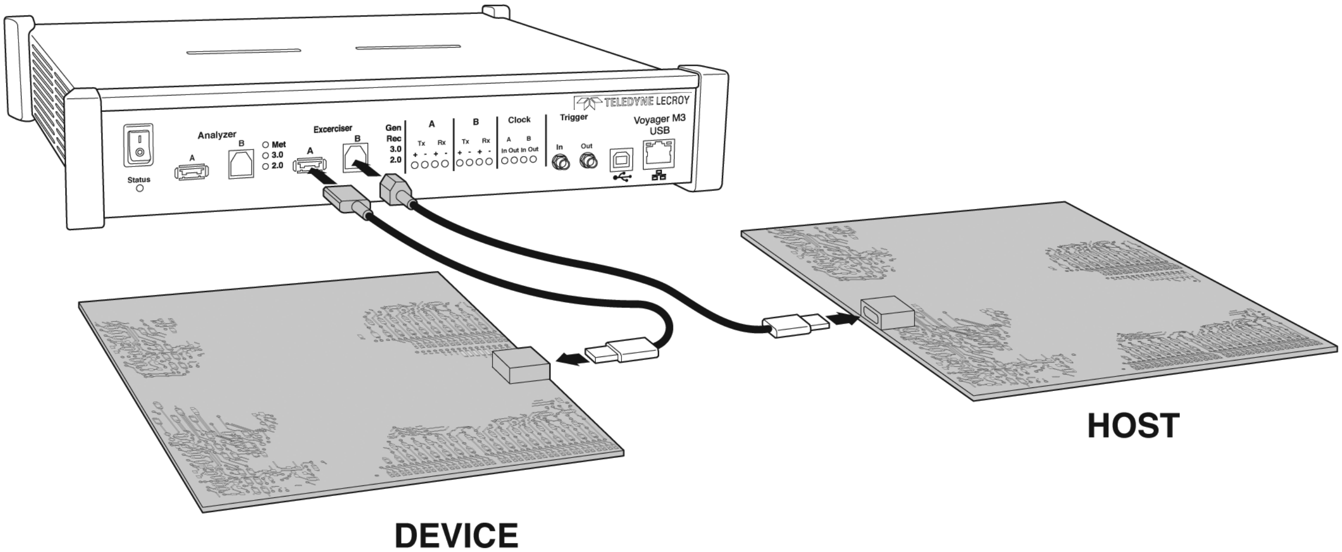


Figure 1.7: Direct Connection using USB 3.1 Cables.

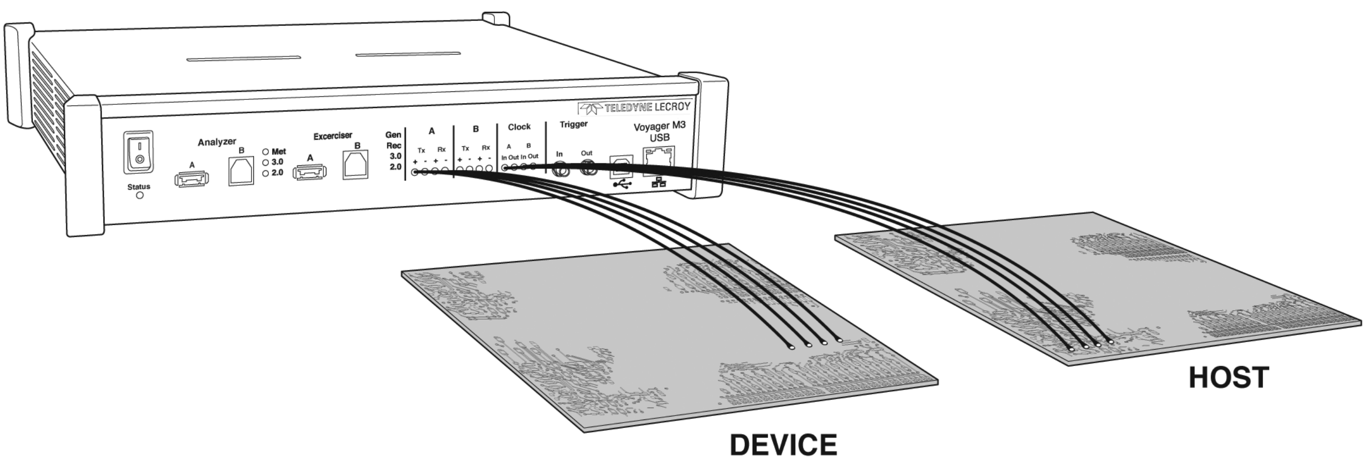


Figure 1.8: Direct Connection using SMA Differential Tap.

1.4.2 General Description

The Analyzer connects to a portable or desktop host machine through the USB port. The host machine configures and controls the Analyzer. The “CATC Trace™” user interface is an industry standard for documenting the performance of high-speed serial protocols.

The USB protocol Analyzer provides traffic capture and analysis. Hardware triggering allows capture of real-time events. Hardware filtering allows filtering different packet types in or out of the recording. Filtering also allows you to preserve recording memory, for extended recording time.

The trace viewer application displays recorded data in colored graphics. The application has advanced search and viewing capabilities that allow you to quickly locate specific data, errors, and other conditions.

The system functions with any personal host machine having the Microsoft® Windows® XP, Windows 8, or Windows 7 (32 or 64) operating system and a functional USB interface or Ethernet port.

The system provides on-the-fly detection of, and triggering on, such events as Tokens and Errors. Whether recording manually or with a specified trigger condition, the system continuously records the link data, in a wrap-around fashion, until manually stopped or until the system detects the Trigger Event and records the specified post-trigger amount of link data.

Upon detection of a triggering event, the Analyzer continues to record data up to a point specified by you. You can individually enable or disable real-time event detection to allow triggering on events as they happen, including predefined exception or error conditions and user-defined sets of trigger events. An externally supplied signal can trigger the Analyzer.

You can use search functions to investigate particular events. In addition to immediate analysis, you can print any part of the data. You can save the data on disk for later viewing. You can generate timing information and data analysis reports.

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

USB Implementers Forum 1730 SW Skyline Blvd. Suite 203 Portland, OR 97221	Tel: +1/503.296.9892 Fax: +1/503.297.1090 Web: http://www.usb.org/

1.4.3 Features

General

- Fully complies with USB specification revisions.
- Supports the Link Power Management extension.
- Uses field-upgradeable firmware and recording engine.
- Supports USB speeds (5 Gb/s, 480 Mb/s, 12 Mb/s, and 1.5 Mb/s).
- Displays bus traffic using color and graphics in the user-friendly CATC Trace interface.
- Has free non-recording, view-only Trace Viewer software.
- Comes with online manual.
- Self-diagnoses at power on.
- Uses software upgradeable Exerciser function.
- Allows remote control of USB analyzers in a network.

Flexible 3.1 Calibration

Each link can be calibrated with respect to received equalization and gain.

Physical Components

- Desktop or portable Microsoft Windows XP, Windows 8, or Windows 7 (32 or 64)

host machine with USB or Ethernet capability
- Plug-and-Play USB installation
- 1 GB or 4 GB of physical data-recording memory
- USB 2.0 Hi-Speed connection to desktop or portable host machine
- Internal wide-range AC power supply
- Expansion port for future enhancements
- SMA connectors and USB 3.1 connectors for SuperSpeed capture and generation
- External clock inputs and outputs

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) (2.0)
- CATC Trace display and enumeration of High-Speed Micro Frames (2.0)
- 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 can filter transactions (for example, NAK'd transactions) (2.0)
- Advanced triggering with event counting and sequencing
- Dedicated trigger for recording input and output used to interface to external test equipment
- Triggering on multiple error conditions: PID bad, bit stuffing bad, CRC bad, end-of-packet bad, babble, activity loss, frame length violation, time-out or turn-around violation, data toggle violation, Token, Bus Conditions, Data Length, and excessive empty frames (2.0)
- Real-time traffic capture filtering and data packet truncation variable up to 256 bytes (2.0)
- Adjustable buffer size from 0.4 MB to 1 GB or 4 GB
- Idle filtering (3.1)

Display Options

- Utilizes the CATC Trace graphical display of bus packets, transactions, split transactions, and transfers.
- Groups numerous packets and transactions under a single transfer while quickly decoding all essential information.
- Decodes split transactions upstream and downstream of a transaction translator with a special hierarchical view.
- Has reports summarizing key statistics and conditions of interest, with the ability to jump to the selected item in the trace display.
- Indicates trigger position by different pre-trigger and post-trigger packet colors.
- Sets markers to assist with navigation and time calculations. Each marker can contain unique comments.
- Hides start-of-frame (SOF) packets, as well as any packet or transaction from a device address and endpoint.
- Searches for a specific PID.
- Detects and alerts you to every potential bus error and protocol violation, and their combinations.
- Has high-resolution, accurate time stamping of bus packets and timing measure-

ment and analysis functions.

- Allows search and packet hiding.
- Allows device class decoding and user-defined protocol decoding.
- Has a Data View (2.0 and 3.1).
- Uses Link Tracker to view symbols of traffic (3.1).
- Uses a Spec View to show packets in the same format as the USB 3.1 specification (3.1).
- Has Quick Timing Markers to immediately show time deltas and bandwidth use.

1.4.4 Hi-Speed Slow Clock

- Trace and generate High-Speed traffic at fractional (slow) clock rate capability (2.0)

1.4.5 Traffic Generation

USB 2.0 and 3.1 traffic generation options allow you to transmit custom packets over standard USB cables with low-level control of headers, payloads, timing, and link states. The Exerciser can play back trace files bit-for-bit, allowing validation engineers to recreate problems reported in the field or test-specific functionality.

To build generation script files, you can edit example test scenarios or export any traffic stream from a previously recorded trace. The Voyager Exerciser includes a Generation Script Editor.

A script pre-processor allows you to organize script code and create reusable generation blocks.

The Voyager USB 2.0 Exerciser can transmit low, full, or high-speed traffic and supports both host and device emulation. It is backward compatible with existing USB*Trainer* traffic generation scripts.

For USB 2.0 applications, the Exerciser supports both bitstream mode or Intelliframe mode. In Intelliframe mode, the Exerciser can wait for the appropriate response from the DUT before transmitting the next packet. For example, after issuing an IN, the generator waits for the DATAx packet returned by the device to finish, and then issues an ACK. When NAKs are received, the Exerciser can automatically resend the previous packet.

ReadyLink™ Emulation

The Teledyne LeCroy Voyager USB 3.1 Exerciser features ReadyLink Emulation Mode. The ReadyLink feature handles all USB 3.1 link training and link flow control, allowing the emulator to operate at full line rate and respond to the DUT as defined by the specification. The ReadyLink Emulation Mode helps simplify development of USB 3.1 test scenarios.

By default, ReadyLink Emulation Mode automatically manages:

- Header Packet Acknowledgments (L_GOOD_n)
- Buffer Credit (L_CRD_x)
- SKIPs at required intervals (SKP)

- Link Synchronization
  - Responds to LFPS (Polling.LFPS)
  - Responds to polling sequence (Polling.RxEQ)
  - Responds to TS1 / TS2 handshaking sequence
  - Responds to SS.Inactive (with RX.Detect)
- Power Management Link Commands
  - Responds to LGO_Un (with LAU)
  - Responds to LAU (with LMPA)

Test scripts can customize ReadyLink Emulation Mode to include error scenarios, such as:

- Header LBADs
- Invalid link commands
- 8B10B / CRC Error
- Running Disparity Error
- Corrupt Link Commands
- Corrupt Flow Control (Wrong L_CRD_x, Wrong L_GOOD_n, Drop L_Good_n)
- Corrupt Header Packet acknowledgement (Send LBAD, LRTY)
- Corrupt Packet Framing (SHP, SDP, END)

At the packet level, you can send customized data payloads anywhere within the stream to insert logic errors, perform corner-case, or do stress testing. Commands, such as the **Set ErrWrongLCRD** command, allow link-layer error injection anywhere within the script.

1.4.6 Notes on LFPS Signals

Voyager Exerciser requires received “Ping” LFPS signals to be a minimum of 150 nanoseconds to be reliably recognized.

Voyager Analyzer can recognize “Ping” LFPS signals above 60 nanoseconds and report their durations to ±15 nanoseconds of accuracy.

1.5 Advisor T3

The Teledyne LeCroy USB Advisor T3™ USB 3.1 Protocol Analyzer is a verification system for USB development and testing. It supports both USB 2.0 and USB 3.1. It can record USB traffic and graphically present the logical transactions and events. It connects to a laptop or desktop host machine through its USB port.

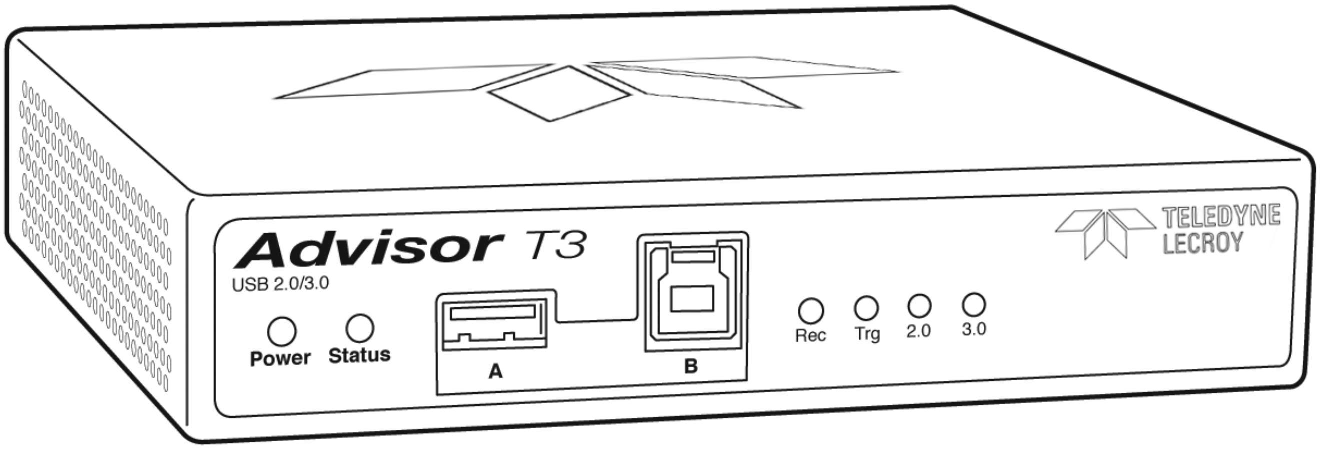


Figure 1.9: Advisor T3.

The system can monitor traffic between USB 2.0 links using standard high-speed compliant cables.

If configured for USB 3.1 testing, the system supports monitoring between SuperSpeed links using USB 3.1 cables.

Please see the **Readme** file on the installation DVD for the latest information on host machine requirements and supported operating systems.

1.5.1 General Description

The Analyzer connects to a portable or desktop host machine through its USB port. The host machine configures and controls the Analyzer. The "CATC Trace™" user interface is an industry standard for documenting the performance of high-speed serial protocols.

The USB protocol Analyzer provides traffic capture and analysis. Hardware triggering allows capture of real-time events. Hardware filtering allows filtering different packet types in or out of the recording. Filtering also allows you to preserve recording memory, for extended recording time.

The trace viewer application displays recorded data in colored graphics. The application has advanced search and viewing capabilities that allow you to quickly locate specific data, errors, and other conditions.

The system functions with any host machine having the Microsoft® Windows® XP, Windows 8, or Windows 7 (32 or 64) operating system and a functional USB interface.

The system provides on-the-fly detection of, and triggering on, such events as Tokens and Errors. Whether recording manually or with a specified trigger condition, the system continuously records the link data, in a wrap-around fashion, until manually stopped or until the system detects the Trigger Event and records the specified post-trigger amount of link data.

Upon detection of a triggering event, the Analyzer continues to record data up to a point specified by you. You can individually enable or disable real-time event detection to allow triggering on events as they happen, including predefined exception or error conditions and user-defined sets of trigger events. An externally supplied signal can trigger the Analyzer.

You can use search functions to investigate particular events. In addition to immediate analysis, you can print any part of the data. You can save the data on disk for later viewing. You can generate timing information and data analysis reports.

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

USB Implementers Forum	Tel: +1/503.296.9892
1730 SW Skyline Blvd.	Fax: +1/503.297.1090
Suite 203	Web: http://www.usb.org/
Portland, OR 97221	

1.5.2 Features

General

- Fully complies with USB specification revisions.
- Has field-upgradeable firmware.
- Supports USB speeds (5 GB/s, 480 MB/s, 12 MB/s, and 1.5 MB/s).
- Displays bus traffic using color and graphics in the CATC Trace interface.
- Has free non-recording, view-only Trace Viewer software.
- Comes with online manual.
- Self-diagnoses at power on.

Flexible 3.1 Calibration

Each link can be calibrated with respect to received equalization and gain.

Physical Components

- Desktop or portable Microsoft Windows XP, Windows 8, or Windows 7 (32 or 64) host machine with USB capability
- Plug-and-Play USB installation
- 2 GB of physical data-recording memory
- USB 2.0 Hi-Speed connection to desktop or portable host machine
- DC power supply
- Expansion port for optional External Trigger In/Out cable, as well as multi-box synchronized recording
- USB 3.1 connectors for SuperSpeed capture and generation

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) (2.0)
- CATC Trace display and enumeration of High-Speed Micro Frames (2.0)
- 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 can filter transactions (for example, NAK'd transactions) (2.0)
- Advanced triggering with event counting and sequencing
- Dedicated trigger for recording input and output used to interface to external test equipment
- Triggering on multiple error conditions: PID bad, bit stuffing bad, CRC bad, end-of-packet bad, babble, activity loss, frame length violation, time-out or turn-around violation, data toggle violation, Token, Bus Conditions, Data Length, and excessive empty frames (2.0)
- Real-time traffic capture filtering and data packet truncation variable up to 256 bytes (2.0)
- Adjustable buffer size from 0.4 MB to 2 GB
- Idle filtering (3.1)

Display Options

- Uses the CATC Trace graphical display of bus packets, transactions, split transactions, and transfers.
- Groups numerous packets and transactions under a single transfer while quickly decoding all essential information.
- Decodes split transactions upstream and downstream of a transaction translator with a special hierarchical view.
- Has reports summarizing key statistics and conditions of interest, with the ability to jump to the selected item in the trace display.
- Indicates trigger position by different pre-trigger and post-trigger colors.
- Sets markers to assist with navigation and time calculations.
- Hides start-of-frame (SOF) packets and any packet or transaction from a device address and endpoint.
- Searches for a specific PID.
- Detects, and alerts you to, every potential bus error and protocol violation, and their combinations.
- Has high-resolution, accurate time stamping of bus packets and timing measurement and analysis functions.
- Has search and packet hiding capabilities.
- Allows comprehensive device class decoding and user-defined protocol decoding.
- Has a Data View (2.0 and 3.1).
- Uses Link Tracker to view symbols of traffic (3.1).
- Has a Spec View to show packets in the same format as the USB 3.1 specification (3.1).
- Uses Quick Timing Markers to immediately show time deltas and bandwidth use.
-

1.6 Mercury T2C

The Teledyne LeCroy Mercury T2C™ USB 2.0 and Power Delivery Protocol Analyzer is a verification system for USB development and testing. It supports USB 2.0. It is designed to record USB traffic and graphically present the logical transactions and events. It connects to a laptop or desktop host machine via USB 2.0. The Mercury T2C is powered by the USB cable using the USB Type-C connectors, so no additional power cord is needed.

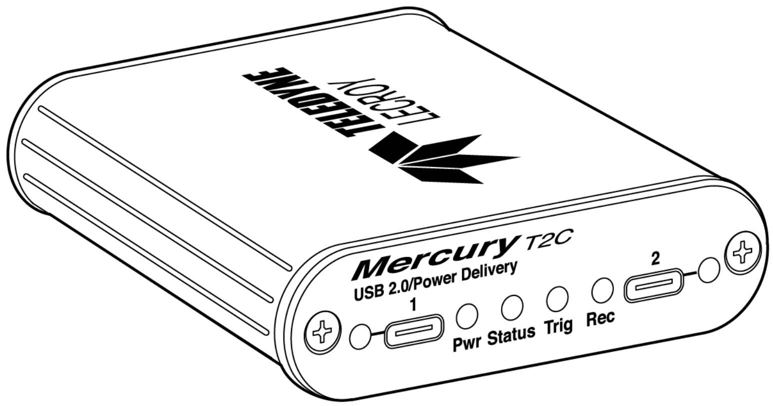


Figure 1.10: Mercury T2C.

The system can monitor traffic between USB 2.0 links using standard high-speed compliant Type-C cables and adapters.

The total length of the cables between the Host Under Test and the Device Under Test should be kept to < 4 feet.

Please see the **Readme** file on the installation DVD for the latest information on host machine requirements and supported operating systems.

1.6.1 General Description

The Analyzer connects to a portable or desktop host machine through its USB port. The host machine configures and controls the Analyzer. The “CATC Trace™” user interface is an industry standard for documenting the performance of high-speed serial protocols.

The USB protocol Analyzer provides traffic capture and analysis. Hardware triggering allows capture of real-time events. Hardware filtering allows filtering different packet types in or out of the recording. Filtering also allows you to preserve recording memory, for extended recording time.

The trace viewer application displays recorded data in colored graphics. The application has advanced search and viewing capabilities that allow you to quickly locate specific data, errors, and other conditions.

The system functions with any host machine having the Microsoft® Windows® XP, Windows 8, or Windows 7 (32 or 64) operating system and a functional USB interface.

The system provides on-the-fly detection of, and triggering on, such events as Tokens and Errors. Whether recording manually or with a specified trigger condition, the system continuously records the link data, in a wrap-around fashion, until manually stopped or until the system detects the Trigger Event and records the specified post-trigger amount of link data.

Upon detection of a triggering event, the Analyzer continues to record data up to a point specified by you. You can individually enable or disable real-time event detection to allow triggering on events as they happen, including predefined exception or error conditions and user-defined sets of trigger events. An externally supplied signal can trigger the Analyzer.

You can use search functions to investigate particular events. In addition to immediate analysis, you can print any part of the data. You can save the data on disk for later viewing. You can generate timing information and data analysis reports.

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

USB Implementers Forum 1730 SW Skyline Blvd. Suite 203 Portland, OR 97221	Tel: +1/503.296.9892 Fax: +1/503.297.1090 Web: http://www.usb.org/

1.6.2 Features

General

- Fully complies with USB specification revisions.
- Has field-upgradeable firmware.
- Supports USB speeds (480 Mb/s, 12 Mb/s, and 1.5 Mb/s).
- Displays bus traffic using color and graphics in the CATC Trace interface.
- Has free non-recording, view-only Trace Viewer software.
- Comes with online manual.
- Self-diagnoses at power on.
- Supports Power Delivery 2.0 over the Type-C cables.
- Provides a pass-through of the USB 3.1 Super-Speed or Alternate Signaling connections, so these ports can work without interference. Note that these lines are NOT analyzed by Mercury T2C.
- Allows for 100 watts of power (20V @ 5 Amps) to flow over VBus, with negligible voltage drop.

Physical Components

- Desktop or portable Microsoft Windows XP, Windows 8, or Windows 7 (32 or 64) host machine with USB capability
- Plug-and-Play USB installation
- 256 MB of physical data-recording memory
- USB 2.0 Hi-Speed connection to desktop or portable host machine
- Expansion port for optional External Trigger In/Out cable

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 display and enumeration of 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 can filter transactions (for example, NAK'd transactions)
- Advanced triggering with event counting and sequencing
- Dedicated trigger for recording input and output used to interface to external test equipment (Optional purchase item)
- Triggering on multiple error conditions: PID bad, bit stuffing bad, CRC bad, end-of-packet bad, babble, activity loss, frame length violation, time-out or turn-around violation, data toggle violation, Token, Bus Conditions, Data Length, and 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 256 MB

Display Options

- Uses the CATC Trace graphical display of bus packets, transactions, split transactions, and transfers.
- Groups numerous packets and transactions under a single transfer while quickly decoding all essential information.
- Decodes split transactions upstream and downstream of a transaction translator with a special hierarchical view.
- Has reports summarizing key statistics and conditions of interest, with the ability to jump to the selected item in the trace display.
- Indicates trigger position by different pre-trigger and post-trigger colors.
- Sets markers to assist with navigation and time calculations.
- Hides start-of-frame (SOF) packets and any packet or transaction from a device address and endpoint.
- Searches for a specific PID.
- Detects, and alerts you to, every potential bus error and protocol violation, and their combinations.
- Has high-resolution, accurate time stamping of bus packets and timing measurement and analysis functions.
- Has search and packet hiding capabilities.
- Allows comprehensive device class decoding and user-defined protocol decoding.
- Has a Data View.
- Uses Quick Timing Markers to immediately show time deltas and bandwidth use.

1.7 Mercury T2

The Teledyne LeCroy Mercury T2™ USB 2.0 Protocol Analyzer is a verification system for USB development and testing. It supports USB 2.0. It is designed to record USB traffic and graphically present the logical transactions and events. It connects to a laptop or desktop host machine via USB 2.0. The Mercury T2 is powered by the USB cable, so no additional power cord is needed.

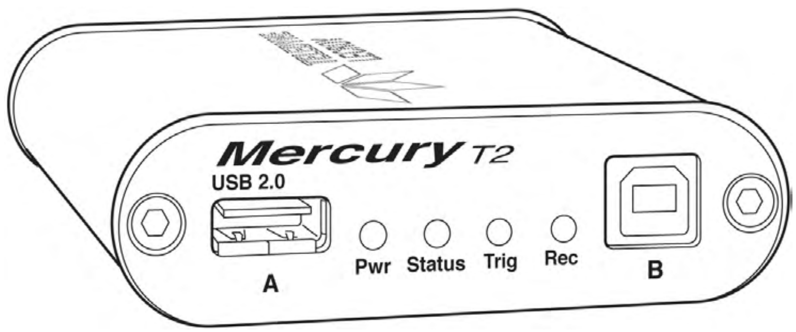


Figure 1.11: Mercury T2.

The system can monitor traffic between USB 2.0 links using standard high-speed compliant cables.

The total length of the cables between the Host Under Test and the Device Under Test should be kept to < 4 feet.

Please see the **Readme** file on the installation DVD for the latest information on host machine requirements and supported operating systems.

1.7.1 General Description

The Analyzer connects to a portable or desktop host machine through its USB port. The host machine configures and controls the Analyzer. The “CATC Trace™” user interface is an industry standard for documenting the performance of high-speed serial protocols.

The USB protocol Analyzer provides traffic capture and analysis. Hardware triggering allows capture of real-time events. Hardware filtering allows filtering different packet types in or out of the recording. Filtering also allows you to preserve recording memory, for extended recording time.

The trace viewer application displays recorded data in colored graphics. The application has advanced search and viewing capabilities that allow you to quickly locate specific data, errors, and other conditions.

The system functions with any host machine having the Microsoft® Windows® XP, Windows 8, or Windows 7 (32 or 64) operating system and a functional USB interface.

The system provides on-the-fly detection of, and triggering on, such events as Tokens and Errors. Whether recording manually or with a specified trigger condition, the system continuously records the link data, in a wrap-around fashion, until manually stopped or until the system detects the Trigger Event and records the specified post-trigger amount of link data.

Upon detection of a triggering event, the Analyzer continues to record data up to a point specified by you. You can individually enable or disable real-time event detection to allow triggering on events as they happen, including predefined exception or error conditions and user-defined sets of trigger events. An externally supplied signal can trigger the Analyzer.

You can use search functions to investigate particular events. In addition to immediate analysis, you can print any part of the data. You can save the data on disk for later viewing. You can generate timing information and data analysis reports.

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

USB Implementers Forum 1730 SW Skyline Blvd. Suite 203 Portland, OR 97221	Tel: +1/503.296.9892 Fax: +1/503.297.1090 Web: http://www.usb.org/

1.7.2 Features

General

- Fully complies with USB specification revisions.
- Has field-upgradeable firmware.
- Supports USB speeds (480 Mb/s, 12 Mb/s, and 1.5 Mb/s).
- Displays bus traffic using color and graphics in the CATC Trace interface.
- Has free non-recording, view-only Trace Viewer software.
- Comes with online manual.
- Self-diagnoses at power on.

Physical Components

- Desktop or portable Microsoft Windows XP, Windows 8, or Windows 7 (32 or 64) host machine with USB capability
- Plug-and-Play USB installation
- 256 MB of physical data-recording memory
- USB 2.0 Hi-Speed connection to desktop or portable host machine
- Expansion port for optional External Trigger In/Out cable

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 display and enumeration of 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 can filter transactions (for example, NAK'd transactions)
- Advanced triggering with event counting and sequencing
- Dedicated trigger for recording input and output used to interface to external

test equipment (Optional purchase item)

- Triggering on multiple error conditions: PID bad, bit stuffing bad, CRC bad, end-of-packet bad, babble, activity loss, frame length violation, time-out or turn-around violation, data toggle violation, Token, Bus Conditions, Data Length, and 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 256 MB

Display Options

- Uses the CATC Trace graphical display of bus packets, transactions, split transactions, and transfers.
- Groups numerous packets and transactions under a single transfer while quickly decoding all essential information.
- Decodes split transactions upstream and downstream of a transaction translator with a special hierarchical view.
- Has reports summarizing key statistics and conditions of interest, with the ability to jump to the selected item in the trace display.
- Indicates trigger position by different pre-trigger and post-trigger colors.
- Sets markers to assist with navigation and time calculations.
- Hides start-of-frame (SOF) packets and any packet or transaction from a device address and endpoint.
- Searches for a specific PID.
- Detects, and alerts you to, every potential bus error and protocol violation, and their combinations.
- Has high-resolution, accurate time stamping of bus packets and timing measurement and analysis functions.
- Has search and packet hiding capabilities.
- Allows comprehensive device class decoding and user-defined protocol decoding.
- Has a Data View.
- Uses Quick Timing Markers to immediately show time deltas and bandwidth use.

1.8 Voyager M3x Analyzer

The Teledyne LeCroy Voyager™ M3x Analyzer and Exerciser system is a multifunction verification system for USB 2.0 and USB 3.1 development and testing. It can record traffic and graphically present logical USB transactions and events. It can also generate USB traffic. The system is connected to a laptop or desktop via its USB or Gigabit Ethernet port (see Figure 1.12 on page 50).

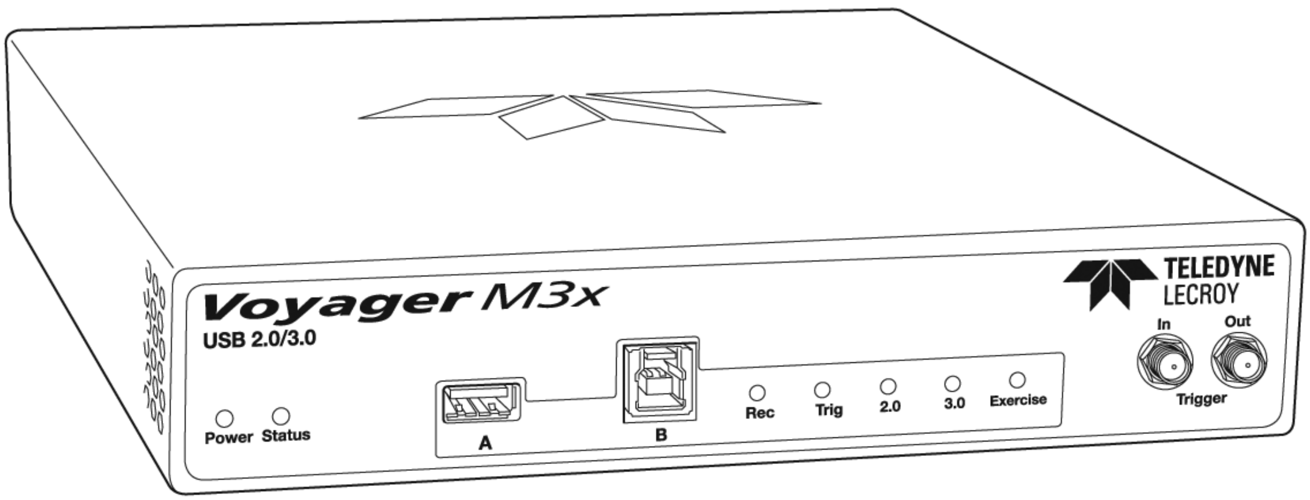


Figure 1.12: Voyager M3x Analyzer Exerciser System

Please see the **Readme** file on the installation DVD for the latest information on host machine requirements and supported operating systems.

1.8.1 USB 2.0 and USB 3.1 Features

The system can monitor traffic between USB 2.0 links using standard high-speed compliant cables.

If configured for USB 3.1 SS testing, the system supports monitoring between SuperSpeed links using USB 3.1 cables (see Figure 1.13).

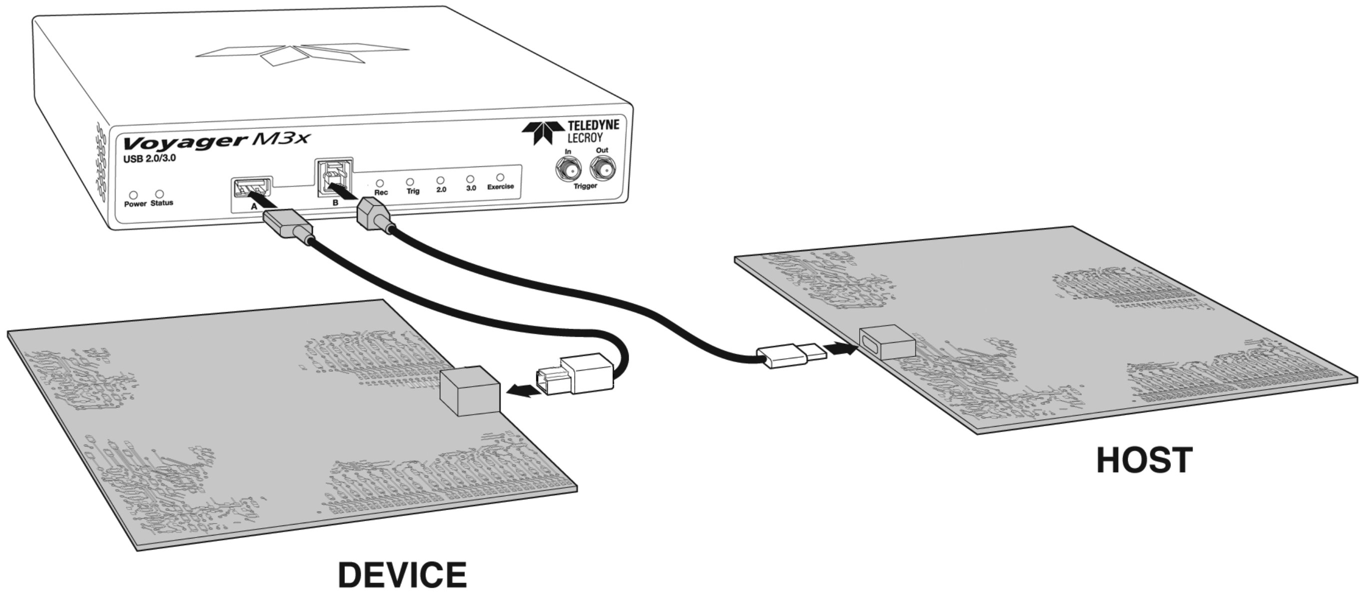


Figure 1.13: Direct Connection using USB 3.1 Cables

1.8.2 General Description

The Analyzer connects to a portable or desktop host machine through the USB port. The host machine configures and controls the Analyzer. The "CATC Trace™" user interface is an industry standard for documenting the performance of high-speed serial protocols.

The USB protocol Analyzer provides traffic capture and analysis. Hardware triggering allows capture of real-time events. Hardware filtering allows filtering different packet types in or out of the recording. Filtering also allows you to preserve recording memory, for extended recording time.

The trace viewer application displays recorded data in colored graphics. The application has advanced search and viewing capabilities that allow you to quickly locate specific data, errors, and other conditions.

The system functions with any host machine having the Microsoft® Windows® XP, Windows 8, or Windows 7 (32 or 64) operating system and a functional USB interface or Ethernet port.

The system provides on-the-fly detection of, and triggering on, such events as Tokens and Errors. Whether recording manually or with a specified trigger condition, the system continuously records the link data, in a wrap-around fashion, until manually stopped or until the system detects the Trigger Event and records the specified post-trigger amount of link data.

Upon detection of a triggering event, the Analyzer continues to record data up to a point specified by you. You can individually enable or disable real-time event detection to allow triggering on events as they happen, including predefined exception or error conditions and user-defined sets of trigger events. An externally supplied signal can trigger the Analyzer.

You can use search functions to investigate particular events. In addition to immediate analysis, you can print any part of the data. You can save the data on disk for later viewing. You can generate timing information and data analysis reports.

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

USB Implementers Forum 1730 SW Skyline Blvd. Suite 203 Portland, OR 97221	Tel: +1/503.296.9892 Fax: +1/503.297.1090 Web: http://www.usb.org/

1.8.3 Features

General

- Fully complies with USB specification revisions.
- Supports the Link Power Management extension.
- Uses field-upgradeable firmware and recording engine.
- Supports USB speeds (5 Gb/s, 480 Mb/s, 12 Mb/s, and 1.5 Mb/s).
- Displays bus traffic using color and graphics in the user-friendly CATC Trace interface.
- Has free non-recording, view-only Trace Viewer software.
- Comes with online manual.
- Self-diagnoses at power on.
- Uses software upgradeable Exerciser function.
- Allows remote control of USB analyzers in a network.

Flexible 3.1 Calibration

Each link can be calibrated with respect to received equalization and gain.

Physical Components

- Desktop or portable Microsoft Windows XP, Windows 8, or Windows 7 (32 or 64) host machine with USB or Ethernet capability
- Plug-and-Play USB installation
- 4 GB of physical data-recording memory
- USB 3.1 Super-Speed connection to desktop or portable host machine
- USB 3.1 connectors for SuperSpeed capture and generation
- Integrated CATC Sync ports to support cascading analyzers or Cross-Sync configurations

Recording Options

- Versatile triggering: bit-wise value and mask data patterns up to sixteen bytes wide for Setup transactions and data packets
- Triggering on High-Speed PIDs and split transaction special tokens (ERR, SPLIT, PING, NYET, DATA2, and MDATA) (2.0)
- CATC Trace display and enumeration of High-Speed Micro Frames (2.0)
- 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 can filter transactions (for example, NAK'd transactions) (2.0)

- Advanced triggering with event counting and sequencing
- Dedicated trigger for recording input and output used to interface to external test equipment
- Triggering on multiple error conditions: PID bad, bit stuffing bad, CRC bad, end-of-packet bad, babble, activity loss, frame length violation, time-out or turn-around violation, data toggle violation, Token, Bus Conditions, Data Length, and excessive empty frames (2.0)
- Real-time traffic capture filtering and data packet truncation variable up to 256 bytes (2.0)
- Adjustable buffer size from 0.4 MB to 4 GB
- Idle filtering (3.1)

Display Options

- Utilizes the CATC Trace graphical display of bus packets, transactions, split transactions, and transfers.
- Groups numerous packets and transactions under a single transfer while quickly decoding all essential information.
- Decodes split transactions upstream and downstream of a transaction translator with a special hierarchical view.
- Has reports summarizing key statistics and conditions of interest, with the ability to jump to the selected item in the trace display.
- Indicates trigger position by different pre-trigger and post-trigger packet colors.
- Sets markers to assist with navigation and time calculations. Each marker can contain unique comments.
- Hides start-of-frame (SOF) packets, as well as any packet or transaction from a device address and endpoint.
- Searches for a specific PID.
- Detects and alerts you to every potential bus error and protocol violation, and their combinations.
- Has high-resolution, accurate time stamping of bus packets and timing measurement and analysis functions.
- Allows search and packet hiding.
- Allows device class decoding and user-defined protocol decoding.
- Has a Data View (2.0 and 3.1).
- Uses Link Tracker to view symbols of traffic (3.1).
- Uses a Spec View to show packets in the same format as the USB 3.1 specification (3.1).
- Has Quick Timing Markers to immediately show time deltas and bandwidth use.

1.8.4 Traffic Generation

USB 2.0 and 3.1 traffic generation options allow you to transmit custom packets over standard USB cables with low-level control of headers, payloads, timing, and link states. The Exerciser can play back trace files bit-for-bit, allowing validation engineers to recreate problems reported in the field or test-specific functionality.

To build 2.0 generation script files, you can edit example test scenarios or export any traffic stream from a previously recorded trace. The Voyager Exerciser includes a Generation Script Editor.

A script pre-processor allows you to organize script code and create reusable generation blocks.

The Voyager USB 2.0 Exerciser can transmit low, full, or high-speed traffic and supports both host and device emulation. It is backward compatible with existing USB*Trainer* traffic generation scripts.

For USB 2.0 applications, the Exerciser supports both bitstream mode or Intelliframe mode. In Intelliframe mode, the Exerciser can wait for the appropriate response from the DUT before transmitting the next packet. For example, after issuing an IN, the generator waits for the DATAx packet returned by the device to finish, and then issues an ACK. When NAKs are received, the Exerciser can automatically resend the previous packet.

ReadyLink™ Emulation

The Teledyne LeCroy Voyager USB 3.1 Exerciser features ReadyLink Emulation Mode. The ReadyLink feature handles all USB 3.1 link training and link flow control, allowing the emulator to operate at full line rate and respond to the DUT as defined by the specification. The ReadyLink Emulation Mode helps simplify development of USB 3.1 test scenarios.

By default, ReadyLink Emulation Mode automatically manages:

- Header Packet Acknowledgments (L_GOOD_n)
- Buffer Credit (L_CRD_x)
- SKIPs at required intervals (SKP)
- Link Synchronization
    - Responds to LFPS (Polling.LFPS)
    - Responds to polling sequence (Polling.RxEQ)
    - Responds to TS1 / TS2 handshaking sequence
    - Responds to SS.Inactive (with RX.Detect)
- Power Management Link Commands
    - Responds to LGO_Un (with LAU)
    - Responds to LAU (with LMPA)

Test scripts can customize ReadyLink Emulation Mode to include error scenarios, such as:

- Header LBADs
- Invalid link commands
- 8B10B / CRC Error
- Running Disparity Error
- Corrupt Link Commands
- Corrupt Flow Control (Wrong L_CRD_x, Wrong L_GOOD_n, Drop L_Good_n)
- Corrupt Header Packet acknowledgment (Send LBAD, LRTY)
- Corrupt Packet Framing (SHP, SDP, END)

At the packet level, you can send customized data payloads anywhere within the stream to insert logic errors, perform corner-case, or do stress testing. Commands, such as the **Set ErrWrongLCRD** command, allow link-layer error injection anywhere within the script.

1.8.5 Notes on LFPS Signals

Voyager Exerciser requires received “Ping” LFPS signals to be a minimum of 150 nanoseconds to be reliably recognized.

Voyager Analyzer can recognize “Ping” LFPS signals above 60 nanoseconds and report their durations to ±15 nanoseconds of accuracy.

1.9 USBTracer/Trainer, USB Advisor, USBMobile HS and USBMobile T2

These CATC analyzers are no longer explicitly supported beginning in version 4.90.

No further validation testing will be done with this equipment, which have been deemed End-Of-Life (EOL) by Teledyne LeCroy. Nothing will be done to remove support of these older devices from the software, but the user should be cautioned that no new bug fixes will be implemented for these analyzers. If problems occur on these EOL'd analyzers in future releases, you will have to uninstall the newer software and install an older release (4.80 or earlier) which will be available on the Teledyne LeCroy Web Site.

Earlier versions of the software include the documentation related to these units in their respective User Manual versions.

Chapter 2

General Description

2.1 Voyager M310C Analyzer

2.1.1 System Components and Packing List

These system components are on the packing list:

- Voyager M310C Protocol Analyzer/Exerciser System
- AC Power Adapter and Cord
- 10 USB Cables
  - 3.1: C-C Unmarked (5A capable) (x2), C-C 5A 10Gbps E-Marked, C-uB, C-B, C-A, C-A Receptacle, A-B
  - 2.0: C-B, C-uB
- Installation DVD-ROM, including documentation
- Quick Start Guide

Product documentation is on the Installation DVD-ROM.

2.1.2 Host Machine Requirements

Please refer to the **USBProtocolSuite_Readme.html** file on the installation DVD for the current host machine and operating system requirements.

2.1.3 Analyzer

The Analyzer is shown in the figure below. Devices (UFP's) should be attached to Connector 1, Hosts (DFP's) to Connector 2.

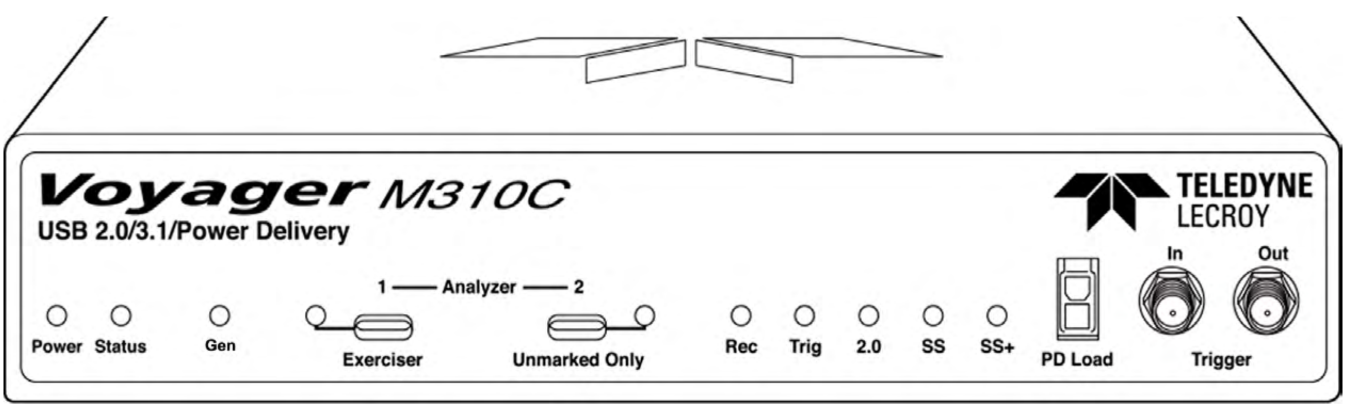


Figure 2.1: Voyager M310C Analyzer Front

The features of the Analyzer are listed in the following table.

Features	Function
Front Panel:	
Power LED	Green if plugged in and powered on
Status LED	Blue if system successfully initializes Red if hardware failure Green while initializing
C Connectors 1 & 2 - LEDs **Off**	No cable attached
Solid Red	Plug is Upside Down, please invert and re-insert
Solid Green	Plug is correctly oriented
Analyzer LEDs	
Gen	Generating Green if generating enabled
Rec	Recording Green if 3.1 recording enabled in Analyzer mode
Trig	Yellow when triggered
2.0	USB 2.0
Solid Yellow	FS SOF's, LS EOP's, or control endpoint traffic
Slow Flashing Yellow	LS Traffic on endpoints other than 0 (resets activity timer as in 3.1)
Fast Flashing Yellow	FS Traffic on endpoints other than 0 (resets activity timer as in 3.1)
Solid Green	HS SOF's or control endpoint traffic
Flashing Green	HS traffic on endpoints other than 0 (resets activity timer as in 3.1)
SS	USB 3.1 SuperSpeed (5 Gbps)
Off	No traffic or LFPS
Solid Yellow	Only Polling LFPS
Slow Flashing Yellow	Low Power States
Fast Flashing Yellow	Symbol Traffic, Training (TS1/TS2/TSEQ)
Solid Green	Link Traffic (U0) LUP, LDN
Blinking Green	TP's and DP's (actual traffic)
SS+	USB 3.1 SuperSpeed Plus (10Gbps)
Off	No traffic or LFPS

Solid Yellow	Only Polling LFPS with LBPM/SCDx messages
Slow Flashing Yellow	Low Power States
Fast Flashing Yellow	Symbol Traffic, Training (TS1/TS2/TSEQ)
Solid Green	Link Traffic (U0) LUP, LDN
Blinking Green	TP's and DP's (actual traffic)
Trigger	
In	SMA external trigger input. Note: Edge detected. (Rising edge only) Voltage required: Signal needs to be > 800mV to see a logic "1", Signal needs to be < 400mV to see a logic "0" . Maximum value of the external input signal which can be input is 5 V. Minimum value is 0 V.
Out	SMA external trigger output. Pulse Width = 280 ns. Pulse Voltage = 3.3 Volts into 1 MegOhms. Pulse Voltage = 2.7 Volts into 50 Ohms. Pulse is positive going.
Rear Panel:	
Sync / Data	Used for Daisy Chaining and Cross Sync with Cable (P/N AC031XXA-X), as well as 8-bit Data Capture and external Trig In/Out (P/N AC050XXA-X) (Cables sold separately) (see Figure 2.7 on page 71). The 8-bit data signals use a threshold of 0.8V, with 50 mV hysteresis. The circuit is 5 volt tolerant.
ETHERNET	Gigabit Ethernet for connection to host machine.
USB	USB 3.1 Super Speed Standard B Connector to host machine.
DC IN	24V, 6.67A power supply connector.
Power Switch	(0/1) Off/On

Note: USB 2.0 Link LEDs operate only while USB 2.0 Recording or Real-Time Statistics (RTS) is running. USB 3.1 LEDs always operate, unless USB 3.1 has been disabled in the Recording Options General Tab.

WARNING: Do not open the Voyager M310C enclosure. No operator serviceable parts are inside. Refer servicing to Teledyne LeCroy customer care.

2.1.4 Specifications

The Analyzer has the following specifications.

Power Requirements

24V DC, 6.67 Amps.

Environmental Conditions

Operating Temperature	0 to 50 °C (32 to 122 °F)
Storage Range	-20 to 80 °C (-4 to 176 °F)
Operating Humidity	10 to 90%, non-condensing
Operating Altitude	Up to 6560 feet (2000 meters)

Probing Characteristics

Connection	SuperSpeed Plus USB Type-C™ connectors: The Voyager SuperSpeed (3.1) analyzer and exerciser port differential input impedance is between 80 and 120 ohms. USB 3.1 USB Type-C™ connector cables High Speed USB Connectors Standard cables **Note**: The USB 2.0 exerciser port is not terminated differentially. The single ended termination is 45 ohms to ground +/- 10% or between 40.5 and 49.5 ohms. The effective differential USB 2.0 termination is between 80 and 100 ohms (90 ohms +/- 10%).

Switches

Power	On/off

Recording Memory Size

8 GB or 16 GB for traffic data capture, timing, state and other data.

2.1.5 Voyager M310C Specific Setup Notes

The Type-C connectors on the front are meant to connect to Hosts (DFP or Downstream Facing Ports) and Devices (UFP or Upstream Facing Ports) as follows:

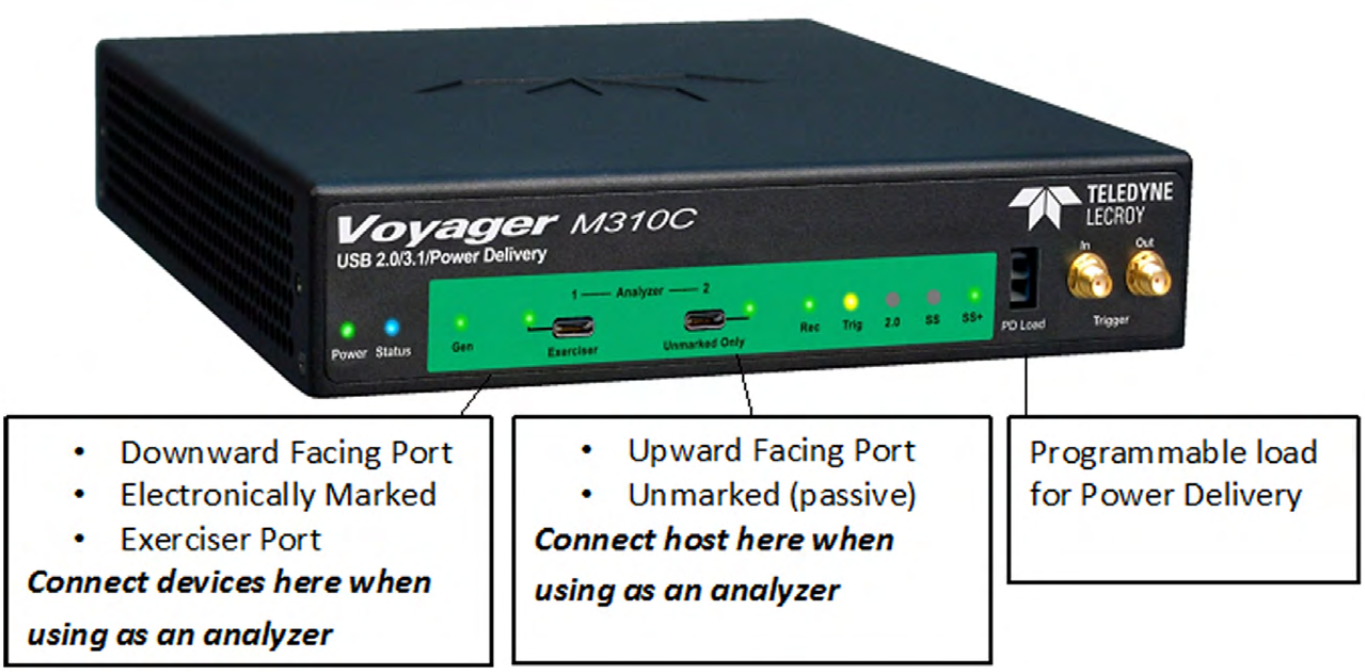


Figure 2.2: Voyager M310C

WARNING: Cable Orientation: The use of 2 Electronically Marked cables is not permitted. Electronically Marked cables should use the left connector (Port 1).

NOTE: Connect Type-C cables to the M310C ports WITH THE CORRECT ORIENTATION. The M310C ports are sensitive to orientation. (This was a deliberate design decision allowing for improved signal integrity.)

You will know the correct orientation from the Connector LEDs.

Red: Flip the plug

Note: Analysis of USB SS+ (10Gbps) traffic requires the use of short, low-loss, high quality cables. The cables provided by Teledyne LeCroy, which have the Teledyne LeCroy label on them, have been verified to provide excellent signal quality. Using other cables may compromise the signal quality and prevent capturing of clean traffic.

Note: See the Application Note "VoyagerM310C_Setup.pdf" for more information.

2.2 Voyager M310 Analyzer

2.2.1 System Components and Packing List

These system components are on the packing list:

- Voyager M310 Protocol Analyzer/Exerciser System
- AC Power Adapter and Cord
- USB cables (7 USB 2.0, 3 USB 3.1)
- Installation DVD-ROM, including documentation
- Micro to Standard USB adapter
- Mini to Standard USB adapter
- Quick Start Guide

Product documentation is on the Installation DVD-ROM.

2.2.2 Host Machine Requirements

Please refer to the **USBProtocolSuite_Readme.html** file on the installation DVD for the current host machine and operating system requirements.

2.2.3 Analyzer

The Analyzer is shown in the figure.

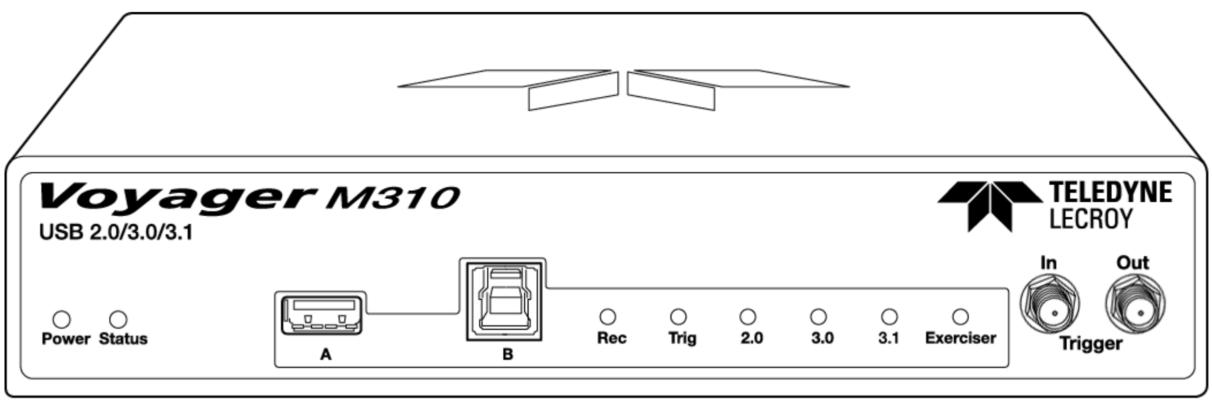


Figure 2.3: Voyager M310 Analyzer Front

The features of the Analyzer are listed in the following table.

Features	Function
Front Panel:	
Power LED	Green if plugged in and powered on
Status LED	Blue if system successfully initializes Red if hardware failure Green while initializing
USB ports (Analyzer and Exerciser)	A (downstream) and B (upstream)
Analyzer LEDs	
Rec	Recording Green if 3.1 recording enabled in Analyzer mode
Trig	Yellow when triggered
2.0	USB 2.0
Solid Yellow	FS SOF's, LS EOP's, or control endpoint traffic
Slow Flashing Yellow	LS Traffic on endpoints other than 0 (resets activity timer as in 3.1)
Fast Flashing Yellow	FS Traffic on endpoints other than 0 (resets activity timer as in 3.1)
Solid Green	HS SOF's or control endpoint traffic
Flashing Green	HS traffic on endpoints other than 0 (resets activity timer as in 3.1)
3.0	USB 3.1 SS (5Gbps), formally also known as 3.0
Off	No traffic or LFPS
Solid Yellow	Only Polling LFPS
Slow Flashing Yellow	Low Power States
Fast Flashing Yellow	Symbol Traffic, Training (TS1/TS2/TSEQ)
Solid Green	Link Traffic (U0) LUP, LDN
Blinking Green	TP's and DP's (actual traffic)
3.1	USB 3.1 SS+ (10Gbps), no longer referred to as 3.1, but it was when we released this product.
Off	No traffic or LFPS
Solid Yellow	Only Polling LFPS with LBPM/SCDx messages
Slow Flashing Yellow	Low Power States
Fast Flashing Yellow	Symbol Traffic, Training (TS1/TS2/TSEQ)

Solid Green	Link Traffic (U0) LUP, LDN
Blinking Green	TP's and DP's (actual traffic)
Exerciser	Generating Green if generating enabled
Trigger	
In	SMA external trigger input. Note: Edge detected. (Rising edge only) Voltage required: Signal needs to be > 800mV to see a logic "1", Signal needs to be < 400mV to see a logic "0" . Maximum value of the external input signal which can be input is 5 V. Minimum value is 0 V.
Out	SMA external trigger output. Pulse Width = 280 ns. Pulse Voltage = 3.3 Volts into 1 MegOhms. Pulse Voltage = 2.7 Volts into 50 Ohms. Pulse is positive going.
Rear Panel:	
Sync / Data	Used for Daisy Chaining and Cross Sync with Cable (P/N AC031XXA-X), as well as 8-bit Data Capture and external Trig In/Out (P/N AC050XXA-X) (Cables sold separately) (see Figure 2.7 on page 71). The 8-bit data signals use a threshold of 0.8V, with 50 mV hysteresis. The circuit is 5 volt tolerant.
ETHERNET	Gigabit Ethernet for connection to host machine.
USB	USB 3.1 Super Speed Standard B Connector to host machine.
DC IN	12V, 5A power supply connector.
Power Switch	(0/1) Off/On

Note: USB 2.0 Link LEDs operate only while USB 2.0 Recording or Real-Time Statistics (RTS) is running. USB 3.1 LEDs always operate, unless USB 3.1 has been disabled in the Recording Options General Tab.

WARNING: Do not open the Voyager M310 enclosure. No operator serviceable parts are inside. Refer servicing to Teledyne LeCroy customer care.

2.2.4 Specifications

The Analyzer has the following specifications.

Power Requirements

12 V DC, 5 amps.

Environmental Conditions

Operating Temperature	0 to 55 °C (32 to 131 °F)
Storage Range	-20 to 80 °C (-4 to 176 °F)
Operating Humidity	10 to 90%, non-condensing
Operating Altitude	Up to 6560 feet (2000 meters)

Probing Characteristics

Connection	SuperSpeed connectors: The Voyager SuperSpeed (3.1) analyzer and exerciser port differential input impedance is between 80 and 120 ohms. USB 3.1 cables High Speed USB Connectors Standard cables **Note**: The USB 2.0 exerciser port is not terminated differentially. The single ended termination is 45 ohms to ground +/- 10% or between 40.5 and 49.5 ohms. The effective differential USB 2.0 termination is between 80 and 100 ohms (90 ohms +/- 10%).

Switches

Power	On/off

Recording Memory Size

8 GB or 16 GB for traffic data capture, timing, state and other data.

2.3 Voyager M3/M3i Analyzer

2.3.1 System Components and Packing List

These system components are on the packing list:

- ❑ Voyager M3/M3i Analyzer Exerciser System
- ❑ AC power cable
- ❑ USB cables (five)
- ❑ Installation DVD-ROM, including documentation
- ❑ Micro to Standard USB adapter
- ❑ Mini to Standard USB adapter
- ❑ Quick Start Guide

Product documentation is on the Installation DVD-ROM.

2.3.2 Host Machine Requirements

Please refer to the **USBProtocolSuite_Readme.html** file on the installation DVD for the current host machine and operating system requirements.

2.3.3 Analyzer

The Analyzer is shown in the figure.

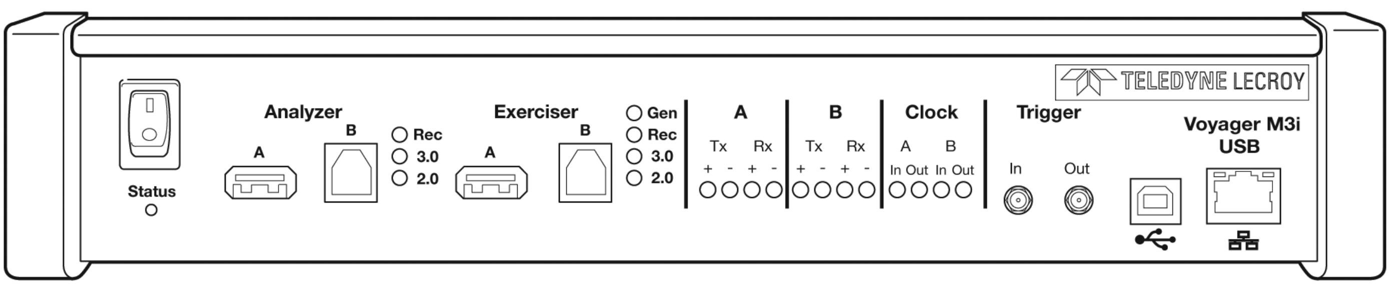


Figure 2.4: Voyager M3/M3i Analyzer Front

The features of the Analyzer are listed in the following table.

Features	Function
Power Switch	**(0/1) Off/On**
Status LED	Blue if system successfully initializes Red if hardware failure Green while initializing
Analyzer Ports	A (downstream) and B (upstream)
Analyzer LEDs	
Rec	Recording Red if 2.0 recording enabled or 3.1 recording enabled in Analyzer mode
3.0	USB 3.1 SuperSpeed (5Gbps), formally known as 3.0 speed.
Off	No traffic or LFPS
Solid Yellow	Only Polling LFPS
Slow Flashing Yellow	Low Power States
Fast Flashing Yellow	Symbol Traffic, Training (TS1/TS2/TSEQ)
Solid Green	Link Traffic (U0) LUP, LDN
Blinking Green	TP's and DP's (actual traffic)
2.0	USB 2.0
Solid Yellow	FS SOF's, LS EOP's, or control endpoint traffic
Slow Flashing Yellow	LS Traffic on endpoints other than 0 (resets activity timer as in 3.1)
Fast Flashing Yellow	FS Traffic on endpoints other than 0 (resets activity timer as in 3.1)
Solid Green	HS SOF's or control endpoint traffic
Flashing Green	HS traffic on endpoints other than 0 (resets activity timer as in 3.1)
Exerciser Ports A (downstream) and B (upstream)	
Exerciser LEDs	
Gen	Generating Green if generating enabled
Rec	Recording Red if 3.1 recording enabled when in Exerciser mode
3.0	USB 3.1 SuperSpeed (5Gbps), formally known as 3.0 speed.

Off	No traffic or LFPS
Solid Yellow	Only Polling LFPS
Slow Flashing Yellow	Low Power States
Fast Flashing Yellow	Symbol Traffic, Training (TS1/TS2/TSEQ)
Solid Green	Link Traffic (U0) LUP, LDN
Blinking Green	TP's and DP's (actual traffic)
2.0	USB 2.0 unused
Note: USB 2.0 Link LEDs operate only while USB 2.0 Recording or Real-Time Statistics (RTS) is running. USB 3.1 LEDs always operate, unless USB 3.1 has been disabled in the Recording Options General Tab.	
A (downstream)	MMCX plug connectors for interfacing
B (upstream)	with USB 3.1 signals
Tx +	Transmit pair
Rx +	Receive pair
Clock A (downstream) **Clock B (upstream)**	MMCX plug connectors for interfacing with external clock source or sink
In	Connects to an external reference clock
Out	Provides reference clock output
Trigger	
In	SMA external trigger input. Note: Edge detected. (Rising edge only) Voltage required: Signal needs to be > 800mV to see a logic "1", Signal needs to be < 400mV to see a logic "0" . Maximum value of the external input signal which can be input is 5 V. Minimum value is 0 V.
Out	SMA external trigger output. Pulse Width = 280 ns. Pulse Voltage = 3.3 Volts into 1 MegOhms. Pulse Voltage = 2.7 Volts into 50 Ohms. Pulse is positive going.
USB	Type B connector for connection to host machine
ETHERNET	Gigabit Ethernet connector for connection to host machine

Note: The rear has only a power connector.

WARNING: Do not open the Voyager M3/M3i enclosure. No operator serviceable parts are inside. Refer servicing to Teledyne LeCroy customer care.

2.3.4 Specifications

The Analyzer has the following specifications.

Power Requirements

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

Environmental Conditions

Operating Temperature	0 to 55 °C (32 to 131 °F)
Storage Range	-20 to 80 °C (-4 to 176 °F)
Operating Humidity	10 to 90%, non-condensing
Operating Altitude	Up to 6560 feet (2000 meters)

Probing Characteristics

Connection	SuperSpeed connectors: The Voyager SuperSpeed (3.1) analyzer and exerciser port differential input impedance is between 80 and 120 ohms. USB 3.1 SS cables MMCX connectors for USB 3.1 High Speed USB Connectors Standard cables **Note**: The USB 2.0 exerciser port is not terminated differentially. The single ended termination is 45 ohms to ground +/- 10% or between 40.5 and 49.5 ohms. The effective differential USB 2.0 termination is between 80 and 100 ohms (90 ohms +/- 10%).

Switches

Power	On/off

Recording Memory Size

1 GB or 4 GB for traffic data capture, timing, state and other data.

2.4 Advisor T3

The Teledyne LeCroy USB Advisor T3™ USB 3.1 Protocol Analyzer is a verification system for USB development and testing. It supports both USB 2.0 and USB 3.1. It can record USB traffic and graphically present the logical transactions and events. It connects to a laptop or desktop host machine via USB 2.0.

The system can monitor traffic between USB 2.0 links using standard high-speed compliant cables.

If configured for USB 3.1 testing, the system supports monitoring between SuperSpeed links using USB 3.1 cables.

2.4.1 Components

The Teledyne LeCroy Advisor T3 Analyzer package includes the following:

- One Teledyne LeCroy USB Advisor T3 Analyzer
- DC Power Adapter
- USB cables (three)
- Installation DVD-ROM, including documentation
- Quick Start Guide
- Carrying Case

2.4.2 Front Panel

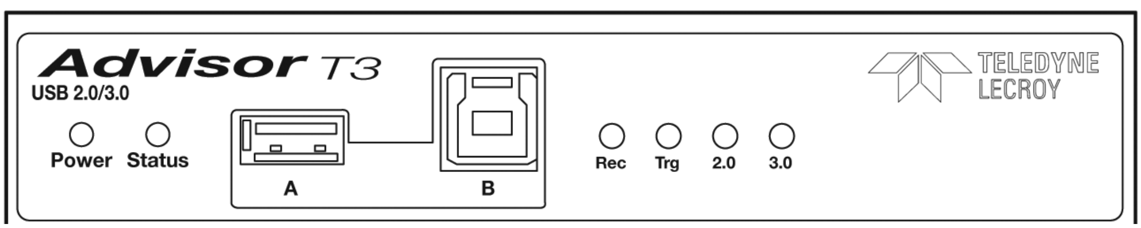


Figure 2.5: Advisor T3 Front Panel

The **front** panel has the following indicators and connectors:

Power LED	Green if on
Status LED	Blue if system successfully initializes. Red while booting. If red for more than a minute, hardware failure. Green while initializing
Analyzer Port A (downstream)	Connects to Device under test.
Analyzer Port B (upstream)	Connects to Host.
Analyzer LEDs	
Rec	Recording (red if recording enabled)
Trig	Trigger (green if triggering)
2.0 USB 2.0	(yellow for Low and Full Speed) (green for Hi Speed)

3.0 USB 3.1 SS (green if link is up; flashes green while data transfers; yellow if polling)

2.4.3 Rear Panel

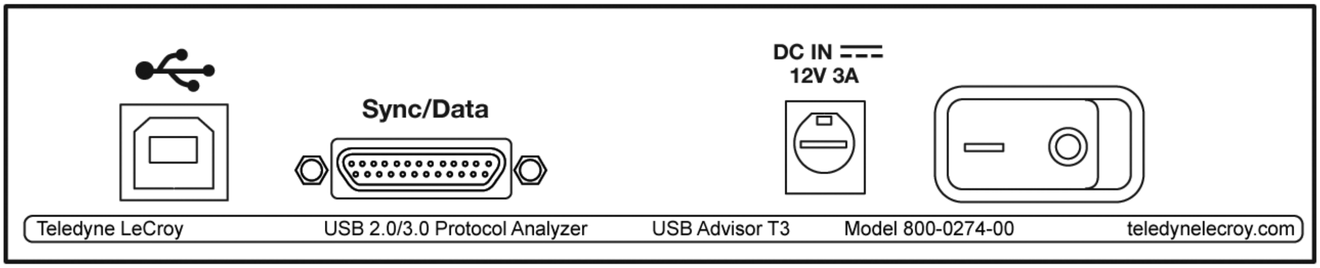


Figure 2.6: Advisor T3 Rear Panel

The **rear** panel has the following indicators and connectors:

USB Type B connector for connection to host machine

Sync/Data

Sync Only Cable

Micro DB-25 to Micro DB-25 external interface cable for supporting Daisy-Chaining, CATC Sync, and Cross Sync functions. (Sold separately, Part # AC031XXA-X)

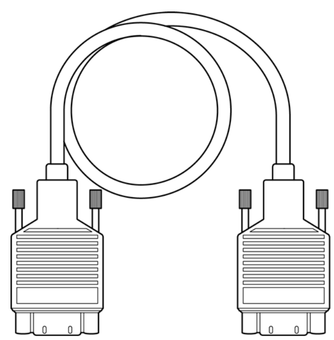


Figure 2.7: Micro DB-25 to Micro DB-25 External Interface Cable

Sync/External Trigger In/Out Cable

Micro DB-25 "Octopus" interface cable for supporting Daisy-Chaining CATC Sync, and Cross Sync functions. Octopus side has DB-9 Male and Female connectors for supporting the Sync functions, and 2 bayonet connectors which support External Trigger In and External Trigger Out signals. (Sold separately, Part # AC030XXA-X)

Trigger In

Bayonet connector external trigger input. Note: Edge detected. (Rising edge only) Voltage required: Signal needs to be > 800mV to see a logic "1", Signal needs to be < 400mV to see a logic "0" . Maximum value of the external input signal which can be input is 5 V. Minimum value is 0 V.

Trigger Out

Bayonet connector external trigger output.

Pulse Width = 280 ns. Pulse Voltage = 3.3 Volts into 1 MegOhms. Pulse Voltage = 2.7 Volts into 50 Ohms. Pulse is positive going.

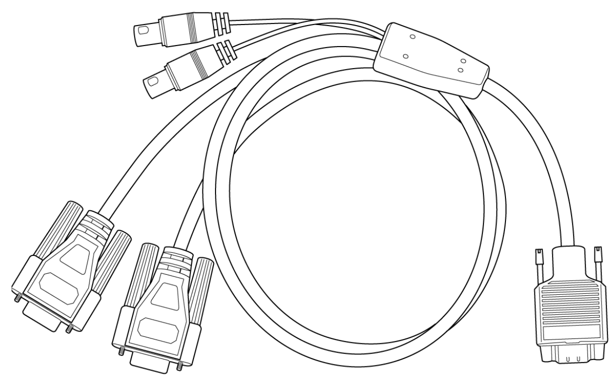


Figure 2.8: Micro DB-25 "Octopus" Interface Cable

Power Connector 12V, 3A DC

Power Switch (0/1)

WARNING: Do not open the enclosure. No operator serviceable parts are inside. Refer servicing to Teledyne LeCroy customer care.

2.4.4 Specifications

The Analyzer has the following specifications.

Power Requirements

12V DC, 3Amps

Environmental Conditions

Operating Temperature	0 to 55 °C (32 to 131 °F)
Storage Range	-20 to 80 °C (-4 to 176 °F)
Operating Humidity	10 to 90%, non-condensing
Operating Altitude	Up to 6560 feet (2000 meters)

Probing Characteristics

Connection	SuperSpeed connectors: The Voyager SuperSpeed (3.1) analyzer and exerciser port differential input impedance is between 80 and 120 ohms. USB 3.1 SS cables High Speed USB Connectors Standard cables **Note**: The USB 2.0 exerciser port is not terminated differentially. The single ended termination is 45 ohms to ground +/- 10% or between 40.5 and 49.5 ohms. The effective differential USB 2.0 termination is between 80 and 100 ohms (90 ohms +/- 10%).

Switches

Power	On/off

Recording Memory Size

1 GB or 4 GB for traffic data capture, timing, state and other data.

2.4.5 Advisor T3 System Setup

Advisor T3 is configured and controlled through a host machine USB port.

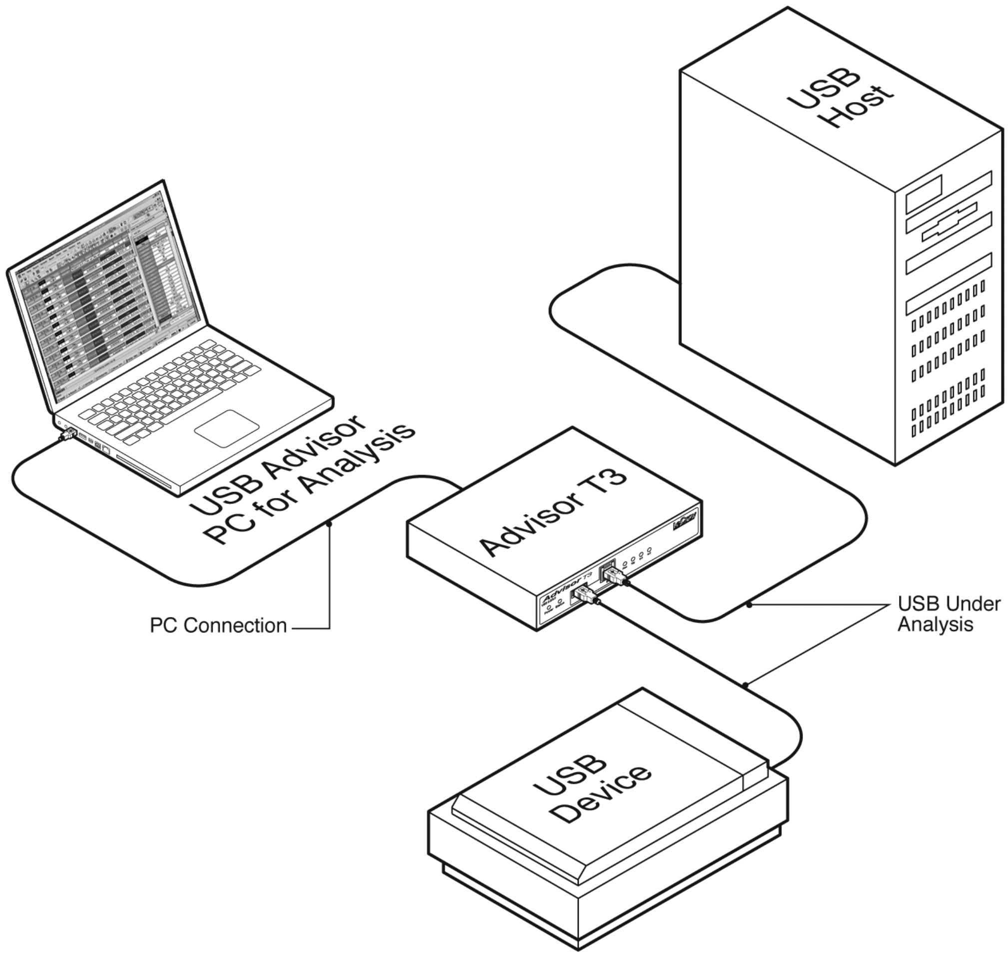


Figure 2.9: Advisor T3 Setup

Note: The Advisor T3 SuperSpeed (3.1) analyzer port differential input impedance is between 80 and 120 ohms.

2.5 Mercury T2C

The LeCroy USB Mercury T2C™ USB 2.0 and Power Delivery Protocol Analyzer is a verification system for USB development and testing. It supports USB 2.0. It is designed to record USB traffic and graphically present the logical transactions and events. It connects to a laptop or desktop host machine via USB 2.0. The Mercury T2C is powered by the USB Type-C cable, so no additional power cord is needed.

2.5.1 Components

The Teledyne LeCroy Mercury T2C Analyzer package includes the following:

- One Teledyne LeCroy USB Mercury T2C Analyzer
- Six USB cables: 2x A-C, C-B, C-uB, C-C, C-A Receptacle
- Installation DVD-ROM, including documentation
- Quick Start Guide

2.5.2 Front Panel

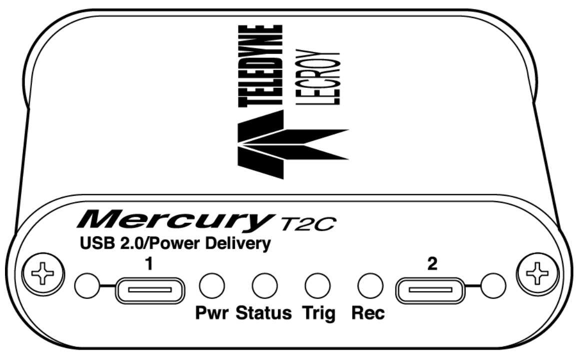


Figure 2.10: Mercury T2C Front Panel

The front panel has the following indicators and connectors:

Connector 1 LED (Green - Good)
(Red - Flip it over!)

Analyzer Connector 1 (downstream) Connects to Device under test (UFP).

Power LED (Green if on)

Status LED (Blue if system successfully initializes)
(Red while booting. If red for more than a minute, hardware failure)
(Green while initializing)

Analyzer LEDs

Trig- Trigger (Green if triggering)

Rec- Recording (Red if recording enabled)

Analyzer Connector 2 (upstream) Connects to Host under test (DFP).

Connector 2 LED (Green - Good)
(Red - Flip it over!)

2.5.3 Rear Panel

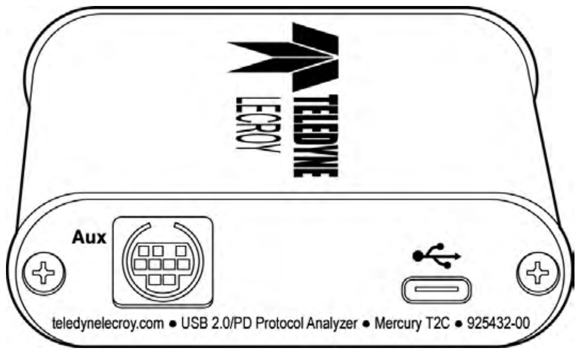


Figure 2.11: Mercury T2C Rear Panel

The **rear** panel has the following indicators and connectors:

USB Type C connector for connection to host machine

Aux 9-pin Mini DIN connector, used for External Trigger In and Out BNC connections. (Cable sold separately, part # AC032XXA-X)

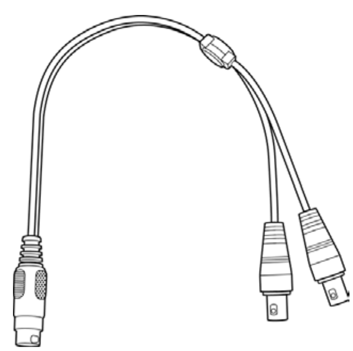


Figure 2.12:

Trigger In Bayonet connector external trigger input. Note: Edge detected. (Rising edge only) Voltage required: Signal needs to be > 800mV to see a logic "1", Signal needs to be < 400mV to see a logic "0" . Maximum value of the external input signal which can be input is 5 V. Minimum value is 0 V.

Trigger Out Bayonet connector external trigger output.

Pulse Width = 280 ns. Pulse Voltage = 3.3 Volts into 1 MegOhms. Pulse Voltage = 2.7 Volts into 50 Ohms. Pulse is positive going.

WARNING: Do not open the enclosure. No operator serviceable parts are inside. Refer servicing to Teledyne LeCroy customer care.

2.5.4 Specifications

The Analyzer has the following specifications.

Power Requirements

Powered by USB Cable. 5V, 0.5 A

Environmental Conditions

Operating Temperature	0 to 50 °C (32 to 122 °F)
Storage Range	-20 to 80 °C (-4 to 176 °F)
Operating Humidity	10 to 90%, non-condensing
Operating Altitude	Up to 6560 feet (2000 meters)

Probing Characteristics

Connection	USB 2.0 USB Type-C™ connector cables High Speed USB Connectors Standard cables

Recording Memory Size

256 MB for traffic data capture, timing, state and other data.

2.5.5 Mercury T2C System Setup

Mercury T2C is configured and controlled through a host machine USB port.

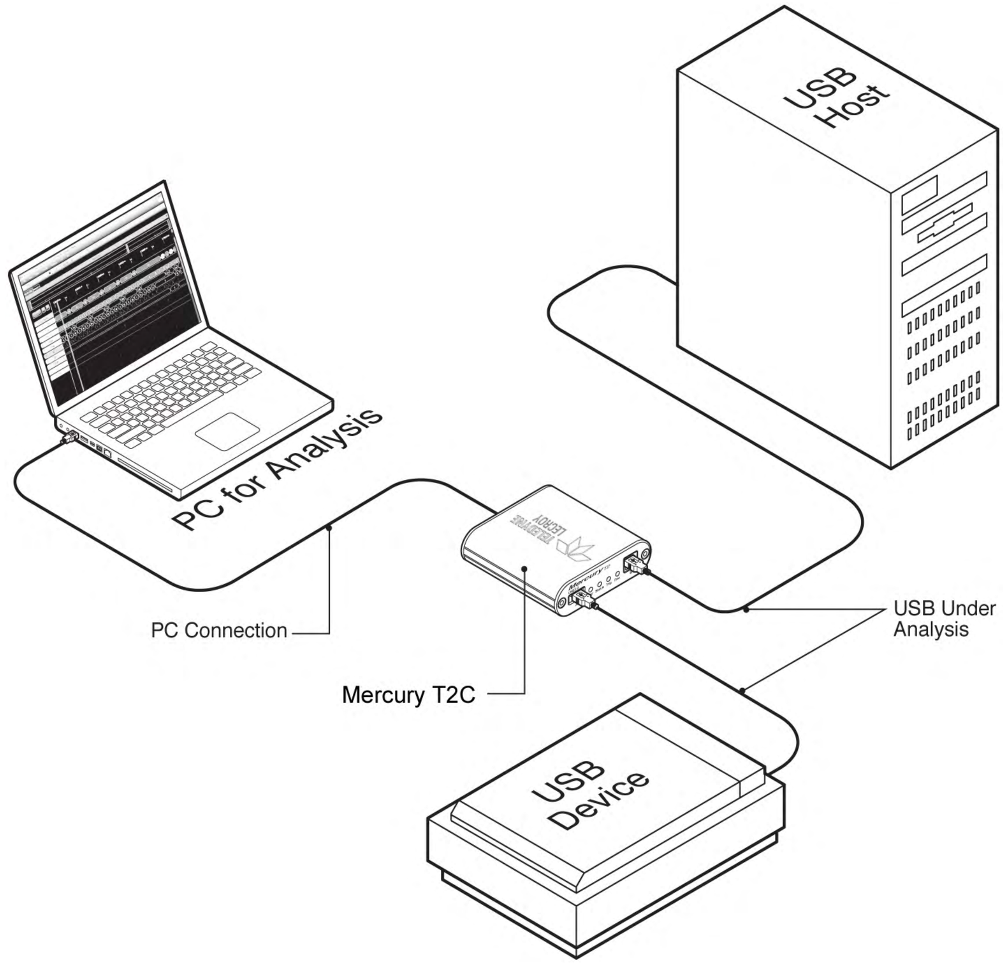


Figure 2.13: Mercury T2C Setup

The Device (UFP) should be reconnect to the Connector 1 (Left side), whereas the Host (DFP) should be connected to Connector 2 (Right side). The device and host should be connected to the cables before inserting into the Analyzer, so the orientation and UFP vs DFP aspect can be determined. Then the cables can be connected to the Mercury T2C. If the LED associated with the Connector shows Red, you need to flip the connector over so it shows Green. The will enable the analyzer to connect all the other signals in a 3.1 cable correctly, allowing the other SS, SS+, or Alternate Modes to work without interruption.

2.6 Mercury T2

The LeCroy USB Mercury T2™ USB 2.0 Protocol Analyzer is a verification system for USB development and testing. It supports USB 2.0. It is designed to record USB traffic and graphically present the logical transactions and events. It connects to a laptop or desktop host machine via USB 2.0. The Mercury T2 is powered by the USB cable, so no additional power cord is needed.

2.6.1 Components

The Teledyne LeCroy Mercury T2 Analyzer package includes the following:

- One Teledyne LeCroy USB Mercury T2 Analyzer
- USB cables (three)
- Installation DVD-ROM, including documentation
- Quick Start Guide

2.6.2 Front Panel

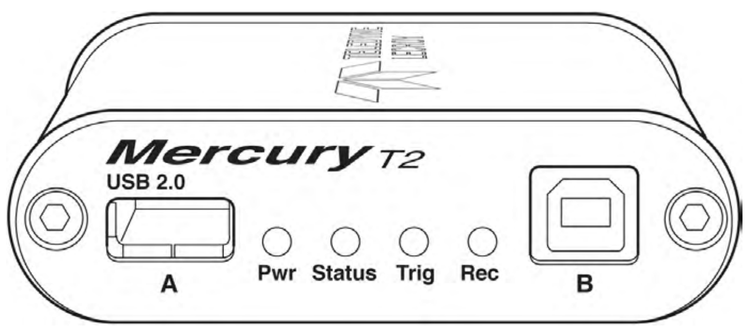


Figure 2.14: Mercury T2 Front Panel

The **front** panel has the following indicators and connectors:

Power LED	Green if powered on by rear USB Host connection
Status LED	Blue if system successfully initializes. Red while booting. If red for more than a minute, hardware failure. Green while initializing
Analyzer Port A (downstream)	Connects to Device under test.
Analyzer Port B (upstream)	Connects to Host under test.
Analyzer LEDs	
Rec	Recording (red if recording enabled)
Trig	Trigger (green if triggering)

2.6.3 Rear Panel

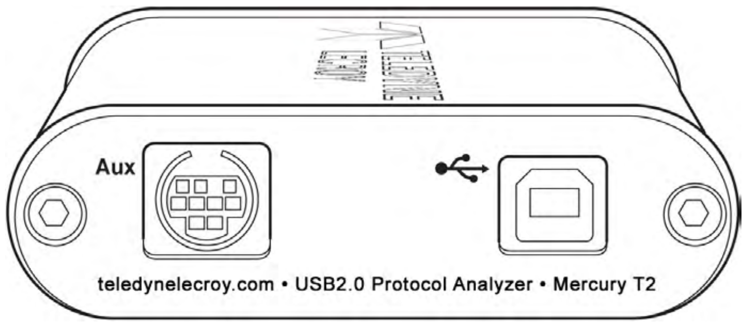


Figure 2.15: Mercury T2 Rear Panel

The **rear** panel has the following indicators and connectors:

USB Type B connector for connection to host machine

Aux 9-pin Mini DIN connector, used for External Trigger In and Out BNC connections. (Cable sold separately, part # AC032XXA-X)

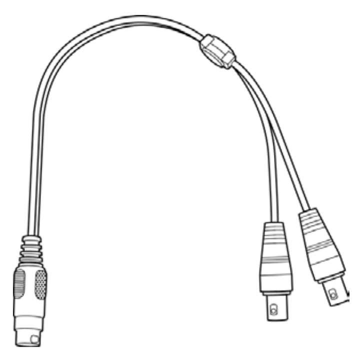


Figure 2.16:

Trigger In Bayonet connector external trigger input. Note: Edge detected. (Rising edge only) Voltage required: Signal needs to be > 800mV to see a logic "1", Signal needs to be < 400mV to see a logic "0" . Maximum value of the external input signal which can be input is 5 V. Minimum value is 0 V.

Trigger Out Bayonet connector external trigger output.

Pulse Width = 280 ns. Pulse Voltage = 3.3 Volts into 1 MegOhms. Pulse Voltage = 2.7 Volts into 50 Ohms. Pulse is positive going.

WARNING: Do not open the enclosure. No operator serviceable parts are inside. Refer servicing to Teledyne LeCroy customer care.

2.6.4 Specifications

The Analyzer has the following specifications.

Power Requirements

Powered by USB Cable. 5V, 0.5 A

Environmental Conditions

Operating Temperature	0 to 50 °C (32 to 122 °F)
Storage Range	-20 to 80 °C (-4 to 176 °F)
Operating Humidity	10 to 90%, non-condensing
Operating Altitude	Up to 6560 feet (2000 meters)

Probing Characteristics

Connection	High Speed USB Connectors

Recording Memory Size

256 MB for traffic data capture, timing, state and other data.

2.6.5 Mercury T2 System Setup

Mercury T2 is configured and controlled through a host machine USB port.

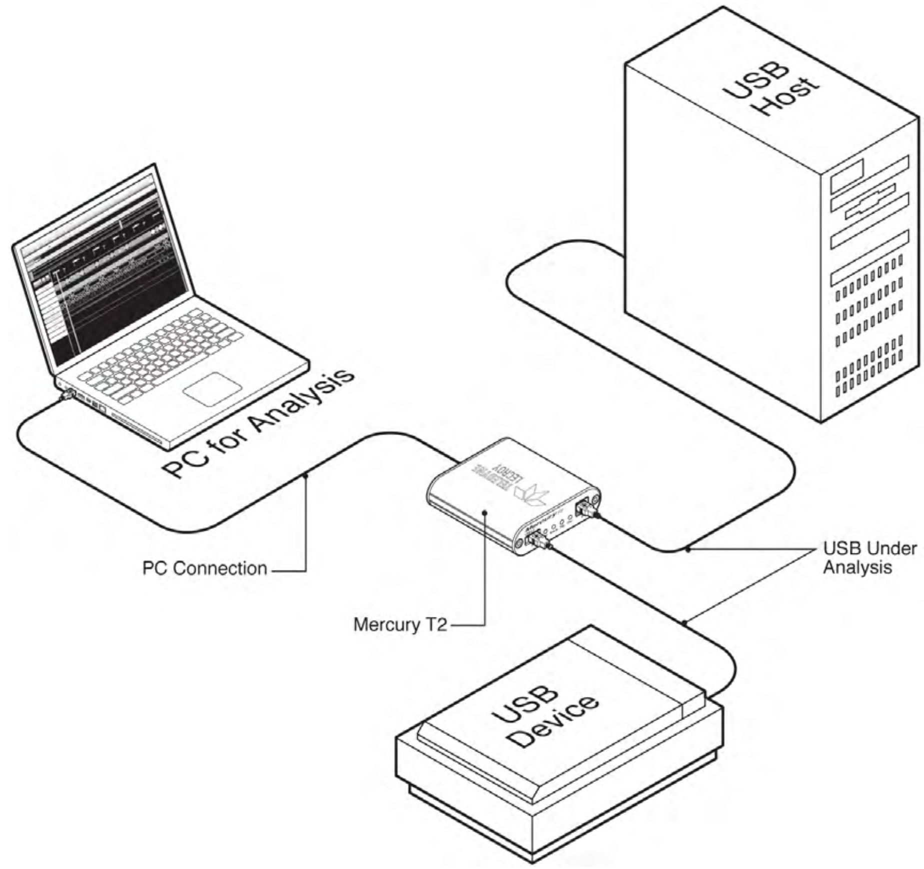


Figure 2.17: Mercury T2 Setup

2.7 Voyager M3x Analyzer

2.7.1 System Components and Packing List

These system components are on the packing list:

- Voyager M3x Analyzer Exerciser System
- AC power cable
- USB cables (7 USB 2.0, 3 USB 3.1)
- Installation DVD-ROM, including documentation
- Micro to Standard USB adapter
- Mini to Standard USB adapter
- Quick Start Guide

Product documentation is on the Installation DVD-ROM.

2.7.2 Host Machine Requirements

Please refer to the **USBProtocolSuite_Readme.html** file on the installation DVD for the current host machine and operating system requirements.

2.7.3 Analyzer

The Analyzer is shown in the figure.

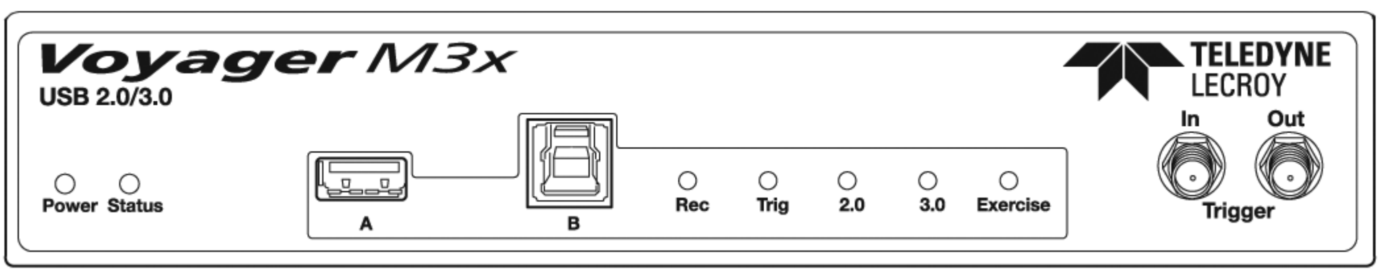


Figure 2.18: Voyager M3x Analyzer Front

The features of the Analyzer are listed in the following table.

Features	Function
Front Panel:	
Power LED	Green if plugged in and powered on
Status LED	Blue if system successfully initializes Red if hardware failure Green while initializing
USB ports (Analyzer and Exerciser)	A (downstream) and B (upstream)
Analyzer LEDs	
Rec	Recording Green if 2.0 recording enabled or 3.1 recording enabled in Analyzer mode
Trig	Yellow when triggered
2.0	USB 2.0
Solid Yellow	FS SOF's, LS EOP's, or control endpoint traffic
Slow Flashing Yellow	LS Traffic on endpoints other than 0 (resets activity timer as in 3.1)
Fast Flashing Yellow	FS Traffic on endpoints other than 0 (resets activity timer as in 3.1)
Solid Green	HS SOF's or control endpoint traffic
Flashing Green	HS traffic on endpoints other than 0 (resets activity timer as in 3.1)
3.0	USB 3.1 SS (formerly known as 3.0)
Off	No traffic or LFPS
Solid Yellow	Only Polling LFPS
Slow Flashing Yellow	Low Power States
Fast Flashing Yellow	Symbol Traffic, Training (TS1/TS2/TSEQ)
Solid Green	Link Traffic (U0) LUP, LDN
Blinking Green	TP's and DP's (actual traffic)
Exerciser	Generating Green if generating enabled
Trigger	

In	SMA external trigger input. Note: Edge detected. (Rising edge only) Voltage required: Signal needs to be > 800mV to see a logic "1", Signal needs to be < 400mV to see a logic "0" . Maximum value of the external input signal which can be input is 5 V. Minimum value is 0 V.
Out	SMA external trigger output. Pulse Width = 280 ns. Pulse Voltage = 3.3 Volts into 1 MegOhms. Pulse Voltage = 2.7 Volts into 50 Ohms. Pulse is positive going.
Rear Panel:	
Sync In	For use in Daisy chaining and CrossSync scenarios.
Sync Out	For use in Daisy chaining and CrossSync scenarios.
ETHERNET	Gigabit Ethernet for connection to host machine.
USB	USB 3.1 Super Speed Standard B Connector to host machine.
DC IN	12V, 5A power supply connector.
Power Switch	(0/1) Off/On

Note: USB 2.0 Link LEDs operate only while USB 2.0 Recording or Real-Time Statistics (RTS) is running. USB 3.1 LEDs always operate, unless USB 3.1 has been disabled in the Recording Options General Tab.

WARNING: Do not open the Voyager M3x enclosure. No operator serviceable parts are inside. Refer servicing to Teledyne LeCroy customer care.

2.7.4 Specifications

The Analyzer has the following specifications.

Power Requirements

12 V DC, 5 amps.

Environmental Conditions

Operating Temperature	0 to 55 °C (32 to 131 °F)
Storage Range	-20 to 80 °C (-4 to 176 °F)
Operating Humidity	10 to 90%, non-condensing
Operating Altitude	Up to 6560 feet (2000 meters)

Probing Characteristics

Connection	SuperSpeed connectors: The Voyager SuperSpeed (3.1) analyzer and exerciser port differential input impedance is between 80 and 120 ohms. USB 3.1 cables High Speed USB Connectors Standard cables **Note**: The USB 2.0 exerciser port is not terminated differentially. The single ended termination is 45 ohms to ground +/- 10% or between 40.5 and 49.5 ohms. The effective differential USB 2.0 termination is between 80 and 100 ohms (90 ohms +/- 10%).

Switches

Power	On/off

Recording Memory Size

1 GB or 4 GB for traffic data capture, timing, state and other data.

2.8 USBTracer/Trainer, USB Advisor, USBMobile HS and USBMobile T2

These CATC analyzers are no longer explicitly supported beginning in version 4.90.

No further validation testing will be done with this equipment, which have been deemed End-Of-Life (EOL) by Teledyne LeCroy. Nothing will be done to remove support of these older devices from the software, but the user should be cautioned that no new bug fixes will be implemented for these analyzers. If problems occur on these EOL'd analyzers in future releases, you will have to uninstall the newer software and install an older release (4.80 or earlier) which will be available on the Teledyne LeCroy Web Site.

Earlier versions of the software include the documentation related to these units in their respective User Manual versions.

Chapter 3

Installation

The Analyzer software installs onto a Microsoft® Windows® XP, Windows 8 or Windows 7 (32 or 64) host machine.

Important: Please uninstall any versions of USB*Tracer*, USB Advisor, or USB*Mobile* HS software on your host machine BEFORE installing USB Protocol Suite. The older software is not compatible with the new software and device drivers. You can load files recorded using the old software into USB Protocol Suite, which will automatically convert them to the new format.

Note: Files recorded with a USB Chief USB 1.1 analyzer are no longer supported and cannot be converted into USB Protocol Suite files.

3.1 Installing the Analyzer Software on the Host Machine

Note: You must install the software before connecting the Analyzer to the host machine for the first time.

Install the software on the host machine administering the Analyzer:

1. Insert the Installation DVD-ROM into the DVD drive on the host machine.
2. The installation automatically starts setup, unless Auto Run is off. In that case, select the DVD-ROM from “My Computer” and click **Setup**.
3. After the warning to close all other programs and before starting the installation, the Install component selection opens.
4. Select components for installation.
5. Click **Next** to complete the installation.
6. To start the application, launch the program from the Start menu:
   Start > Programs > LeCroy > .... Protocol Suite > .... Protocol Suite

Note: The installer adds a service which helps keep your software up-to-date. If you receive a message from your anti-virus software, please do one of the following: Disable your antivirus software until the USB Protocol Suite has completed installing, or choose not to use the Automatic Update feature when you are presented with this option during the installation.

3.2 Setting Up the Analyzer - USB Connection

To set up an Analyzer using a USB connection:

1. Connect the AC power cord to the rear of the Analyzer and to a 100-volt to 240-volt, 50-Hz to 60-Hz, 200-W power outlet.

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

---

2. Connect the USB port to a USB port on the host machine using the LONG (6-foot/2-meter) USB 2.0 cable or 1-meter 3.1 cable.
3. Insert the Installation DVD.
4. Turn on the power switch.

Note: At power-on, the Analyzer initializes itself in approximately ten seconds and performs an exhaustive self-diagnostic that lasts about five seconds. If the diagnostics fail, call Teledyne LeCroy Customer Support for assistance.

---

5. Click **Next** after you see the Add New Hardware Wizard window.
6. Follow the Microsoft® Windows® on-screen Plug-and-Play instructions for the automatic installation of the Analyzer as a USB device on your analyzing host machine (the required USB files are included on the Installation DVD).
7. Click **Finish** when you see the message that says **Windows has finished installing the software that your new hardware requires** and the driver files have been installed in your host machine.
8. Check Analyzer setup in the “Application Startup” section (See “Application Startup” on page 94).

WARNING: Do not change from USB to Ethernet, or back, without power cycling the Analyzer.

Note: Disconnection of USB or Ethernet during capture or uploading of trace data is not supported, and may cause the software to malfunction or crash.

3.3 Setting Up the Analyzer - Ethernet Connection

To set up an Analyzer using an Ethernet connection:

1. Connect the provided AC power cord to the rear of the Voyager M3/M3i and to a 100-volt to 240-volt, 50-Hz to 60-Hz, 200-W power outlet.

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

---

2. Insert the Installation DVD.
3. To use a DHCP network, make sure that the host machine connects to a DHCP network, then connect the Ethernet port on the Analyzer to the DHCP network.

Note: If the DHCP network uses a Firewall, you must set the Firewall to allow the Analyzer device on the network.

Note: Direct connection from the Ethernet port on the host machine to the Ethernet port on the Analyzer is supported in this release. See “IP Settings (Voyager only)” on page 97.

4. Turn on the power switch.

Note: At power-on, the Analyzer initializes itself in approximately ten seconds and performs an exhaustive self-diagnostic that lasts about five seconds. If the diagnostics fail, call Teledyne LeCroy.

5. Complete Analyzer setup in the “Application Startup” section (See “Application Startup” on page 94).

WARNING: Do not change from USB to Ethernet, or back, without cycling to the Analyzer’s power.

Note: Disconnection of USB or Ethernet during capture or uploading of trace data is not supported, and may cause the software to malfunction or crash.

3.3.1 Firewall Exceptions

- The installer provides the option to set Windows Firewall exceptions to enable full communication between USB Protocol Suite and network-attached analyzers.
- The installer only sets such exceptions for Private and Domain networks. For security reasons, the installer will not modify firewall settings for Public networks.
- If the network you use is Public, then either set it as Private or Domain, or manually add a Firewall exception to allow USB Protocol Suite to access all TCP/UDP ports. You may need to contact your network administrator for help with configuring the Firewall.
- The installer does not set exceptions for any 3rd-party firewalls. Contact your network administrator for help with setting exceptions that allow USB Protocol Suite to access all TCP/UDP ports.

3.4 Cascading with CATC SYNC Expansion Card

You can daisy chain two Analyzers, if they both have a CATC SYNC port:

- Voyager M3 and M3i require a CATC Sync Expansion Card for cascading.
- Voyager M3x, M310, M310C, and Advisor T3 have built-in CATC SYNC ports and only require a cross-connect or octopus cable accessory kit.

After Analyzers are connected, recording will start simultaneously and triggers will occur simultaneously, with synchronized timestamps. This feature can be "soft" disconnected by modifying the CATC Sync options on the Recording Options General tab.

You must select both Analyzers in the Device List dialog
(see “Analyzer Devices” on page 96).

Important: If you are using other analyzers (NOT USB!) in your daisy chain (this would include PCIe, DDR, SAS, SAS, FC, net) and do not wish to use the daisy chaining feature of synchronized recordings, you must UNPLUG the cable! If you do not unplug, the electrical signal prevents recording on all Analyzers.

Note: In this software version, daisy chained recording only works if you use two Voyagers OR two Advisor T3s. You cannot use one of each. Also, you must enable **3.1 Auto-Detect/Termination** mode. Manual control does not work.

3.4.1 Capturing USB 2.0 traffic with CATC Sync or Cross Sync

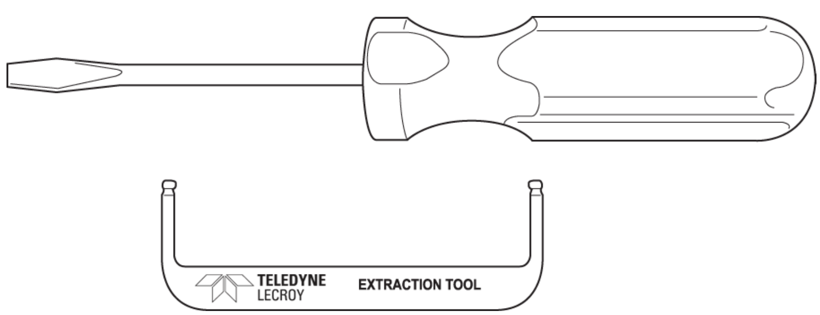
When using Cross Sync or CATC Sync and capturing USB 2.0 traffic, attach the USB 2.0 capturing analyzer device at the OUT connector at the beginning of the CATC SYNC chain. Otherwise, the timestamps will not be synchronized.

The USB 2.0 clock for any downstream Voyager or Advisor T3's will not be synchronized with the upstream CATC-Sync devices, unless there is also 3.1 traffic on the downstream analyzer(s). In cases of CATC-Syncing with USB analyzers capturing 3.1 traffic, all boxes will have the correct synchronized timestamps.

3.4.2 Removing Expansion Cards

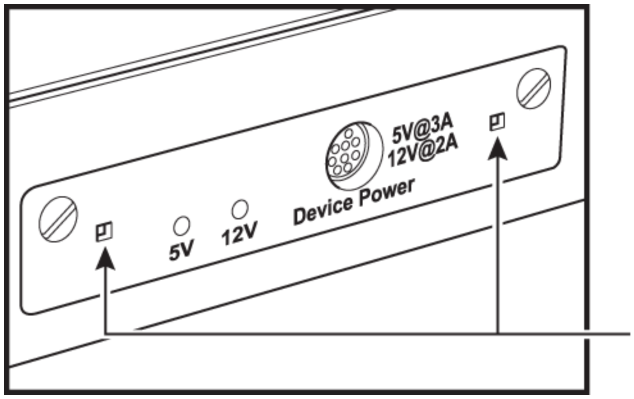
You can remove expansion cards using two tools:

- ❑ Standard (flat blade) 3/16” screwdriver
- ❑ Teledyne LeCroy Extraction Tool (part number 230-0160-00)



To remove an expansion card, follow these steps:

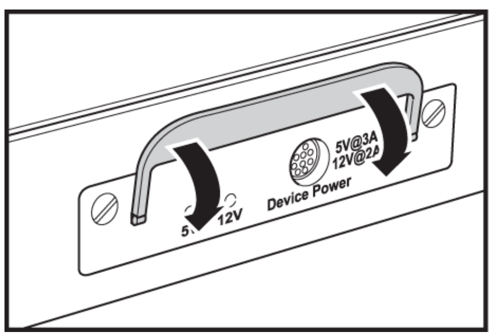
1. Unplug the system from AC power and turn the system so the expansion port is facing you. Note the two retaining screws and the holes for the extraction tool that are located on the panel of the expansion card.



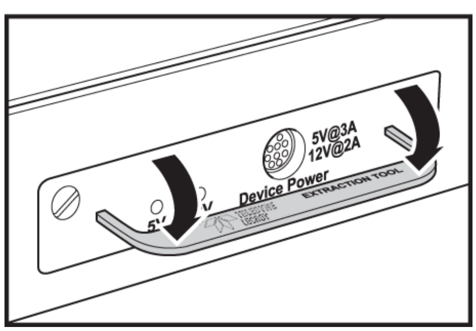
Note: The example shows a different expansion card, but the removal method is the same.

2. Insert the extraction-tool prongs into the holes in the expansion card panel.

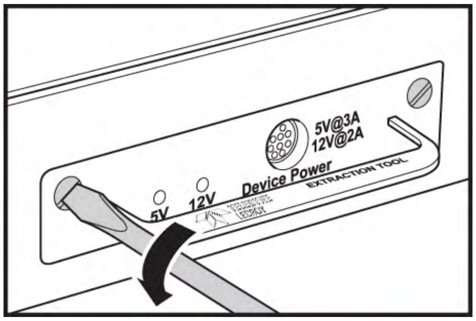
Note: If the prongs do not slip easily into the holes, use a small nail file or similar device to remove paint from the prongs.



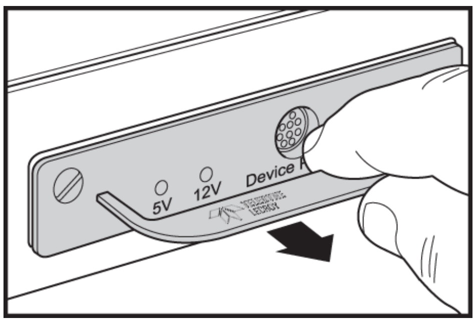
3. Rotate the extraction tool to a horizontal position to lock the prongs into place and make a handle.



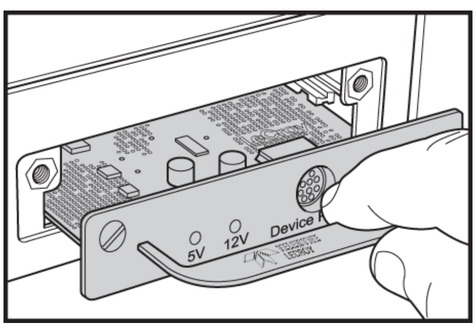
4. Using the screwdriver, loosen both retaining screws by rotating counter-clockwise approximately two full turns, until feeling slight resistance.
   Do not force the retaining screws after two turns.



5. Using the extraction tool as a handle, gently wriggle the expansion card forward about 1⁄8”.



6. Repeat steps 4 and 5 approximately three times, until the card is free from the retaining screws and you can remove the card from the system.



3.5 Application Startup

To start the application, launch the Teledyne LeCroy USB Protocol Suite program from the Start Menu:
Start > All Programs > LeCroy > USB Protocol Suite > USB Protocol Suite
to open the main window (see Figure 3.1 on page 95).

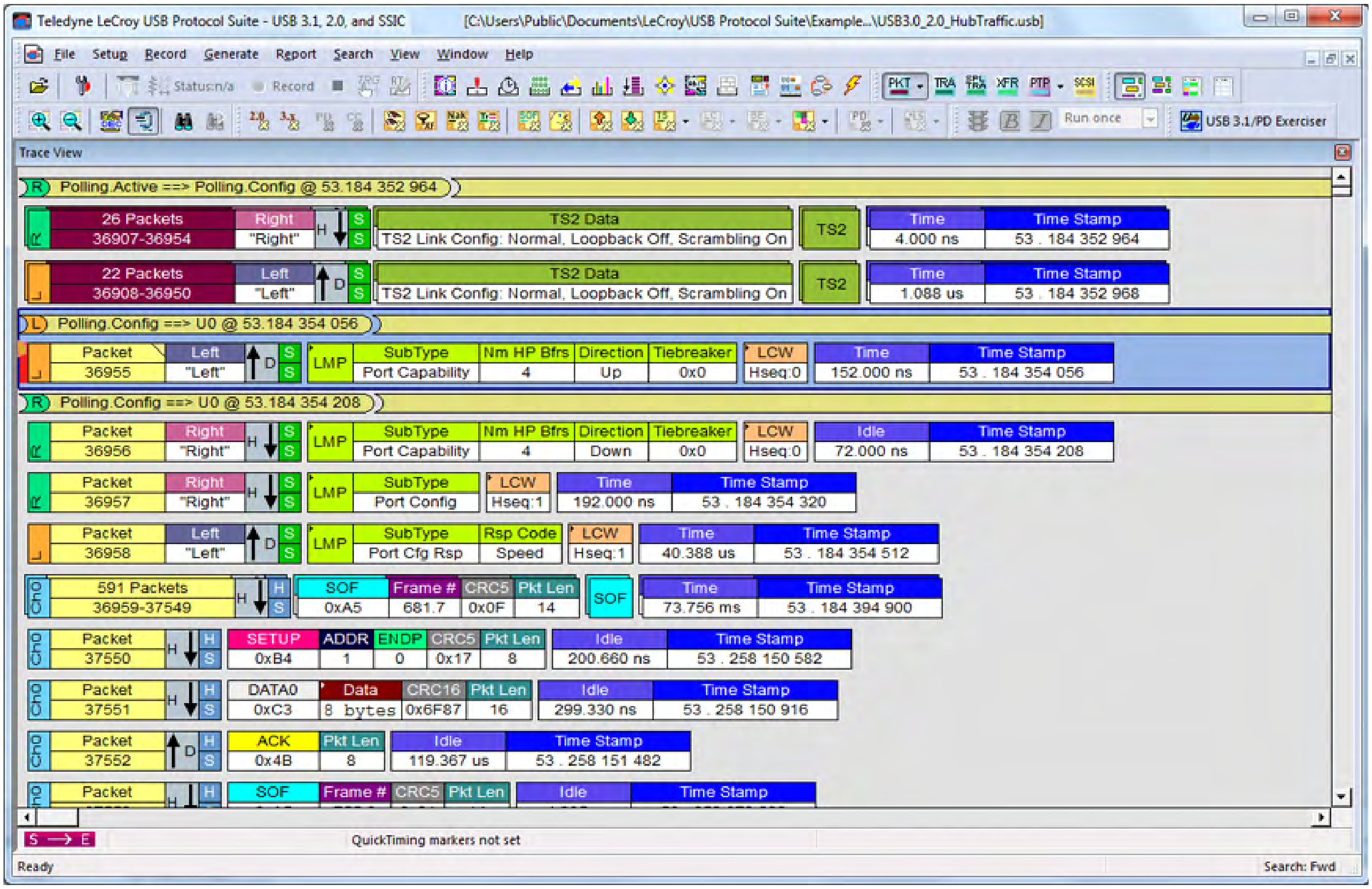


Figure 3.1: Main Window.

You can use the software with or without the system connected to the host machine. Without the Analyzer, the program functions as a trace viewer to view, analyze, and print trace files.

3.5.1 Confirm Proper Hardware Installation and USB or Ethernet Connection

USB Connection

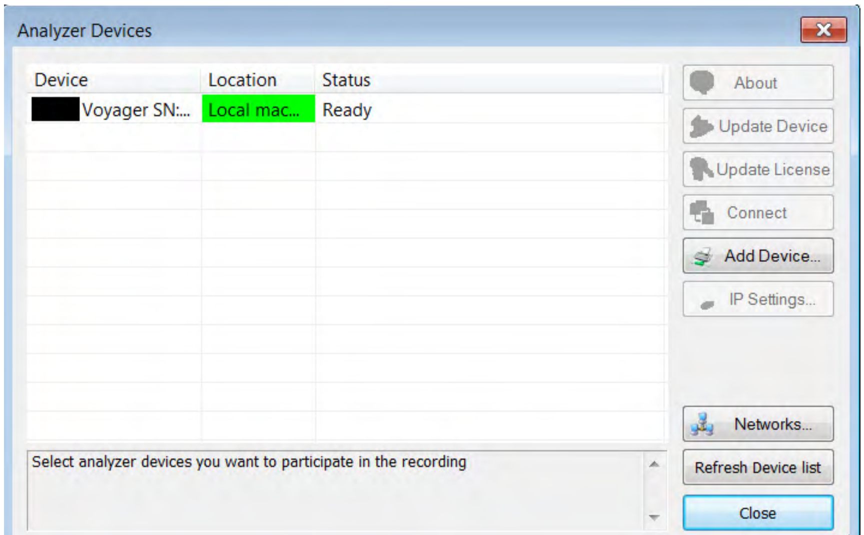
For USB connection, after you open the USB Protocol Suite application, confirm proper installation and USB connection by selecting **About** from the Help menu to view the Software Version, Firmware Version, BusEngine™ Version, and Unit Serial Number in the About window.

Ethernet Connection (Voyager only)

For Ethernet connection, after you open the USB Protocol Suite application, confirm proper installation and Ethernet connection using the Analyzer Devices dialog and the About window.

3.5.2 Analyzer Devices

To show the available Analyzer Devices, select **Setup > All Connected Devices** to display the Analyzer Devices dialog.



The dialog displays the Device, Location, and Status.

You can click:

- **About** to display device information (see “Software, Firmware, and BusEngine Revisions” on page 477).
- **Update Device** (see “Manual Updates to Firmware, BusEngine, and Serdes BusEngine” on page 482)
- **Update License** (see “Updating the Software License” on page 484)
- **Connect** to display the Connection Properties dialog, in which you can set the system to:
  - Automatically connect to the device.
  - Ask to connect to the device.
  - Take no action.
- **Add Device** to display the Add Ethernet Attached Device dialog, in which you can enter an IP Address.
- **IP Settings** to use a DHCP or Static IP address.

To refresh the list of devices, click **Refresh Device List**.

Before starting recording, select the Analyzer you want to use for recording.

3.5.3 IP Settings (Voyager only)

If connected to a device, you can change the IP settings:

- **DHCP** automatically assigns an IP address. DHCP is the default.
- **Static IP** prompts you to enter a specific IP address.

To change from DHCP to Static IP while connected to a device:

1. Select **Setup > All Connected Devices** from the menu bar to display the Analyzer Devices dialog.

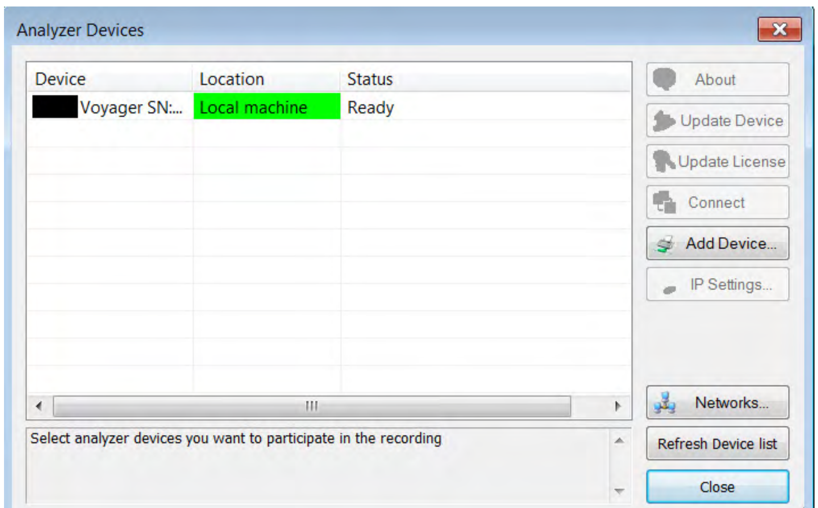


Figure 3.2: Analyzer Devices Dialog.

Note: If you are not connected to a device, the IP Settings command is grayed out.

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2. Select the device to use in the recording, then click the **IP Settings** button to display the Device IP Settings dialog.

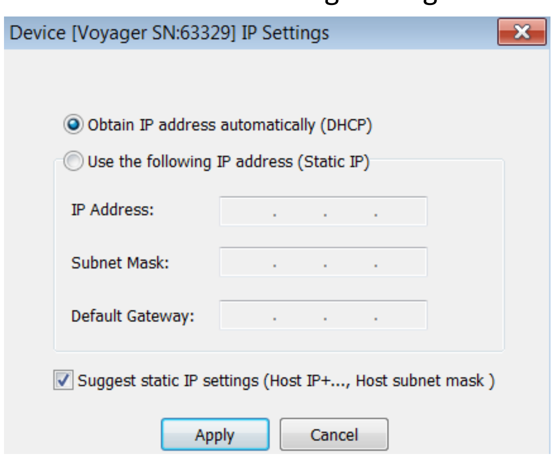


Figure 3.3: Device IP Settings Dialog

Two radio buttons are available:

- Obtain IP address automatically (DHCP) [default]
- Use the following IP Address (Static IP)

3. To change to Static IP, click the **Static IP** radio button.

- Enter the **IP Address**.
- Enter the **Subnet Mask**.
- Enter the **Default Gateway**.

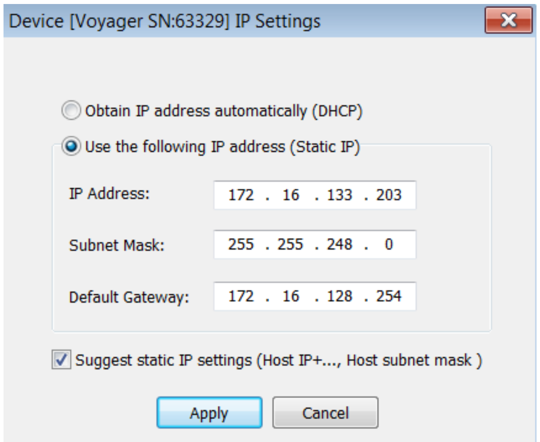


Figure 3.4: Device IP Settings Dialog

Click **Apply** to get a success message and return to the Analyzer Devices dialog.

Note: You can let the system **Suggest static IP settings** (IP address and subnet mask).

---

4. Click **Close** to close the dialog and use the device with a Static IP address.

3.5.4 USB 3.1 Device/Host Signal Parameters (Voyager M3, M3i, M3x, M310, M310C, and Advisor T3)

For USB, to add, remove, edit, load (from a comma-delimited **.csv** file), or save (as a comma-delimited **.csv** file) USB 3.1 devices and to calibrate USB 3.1 connections, select **Setup > USB 3.1 Device/Host Signal Parameters** to display the USB 3.1 Device -> Analyzer -> Host Signal Profiles dialog.

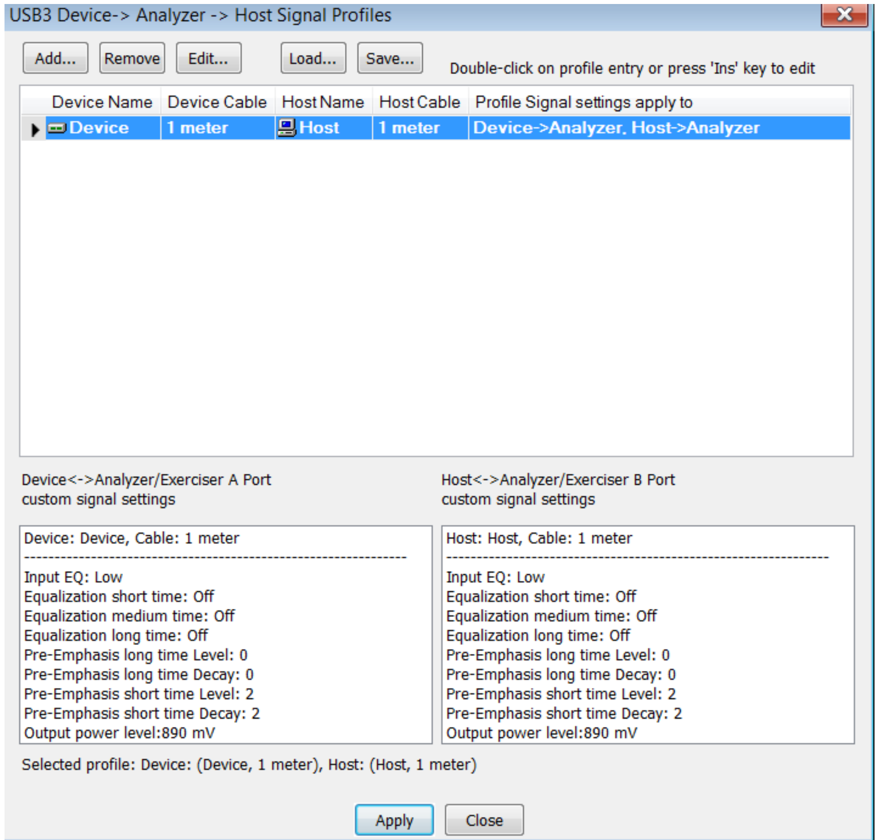


Figure 3.5: USB 3.1 Device Analyzer Host Signal Profiles Dialog.

Voyager M3, M3i and Advisor T3

The dialog lists the Device Name, Device Cable, Host Name, Host Cable, and to what the Profile Signal Settings apply. It also shows Device-to-Analyzer and Host-to-Analyzer custom signal settings.

To add a device, click **Add** to display the USB 3.1 Device -> Analyzer -> Host Signal Parameter Profiles dialog.

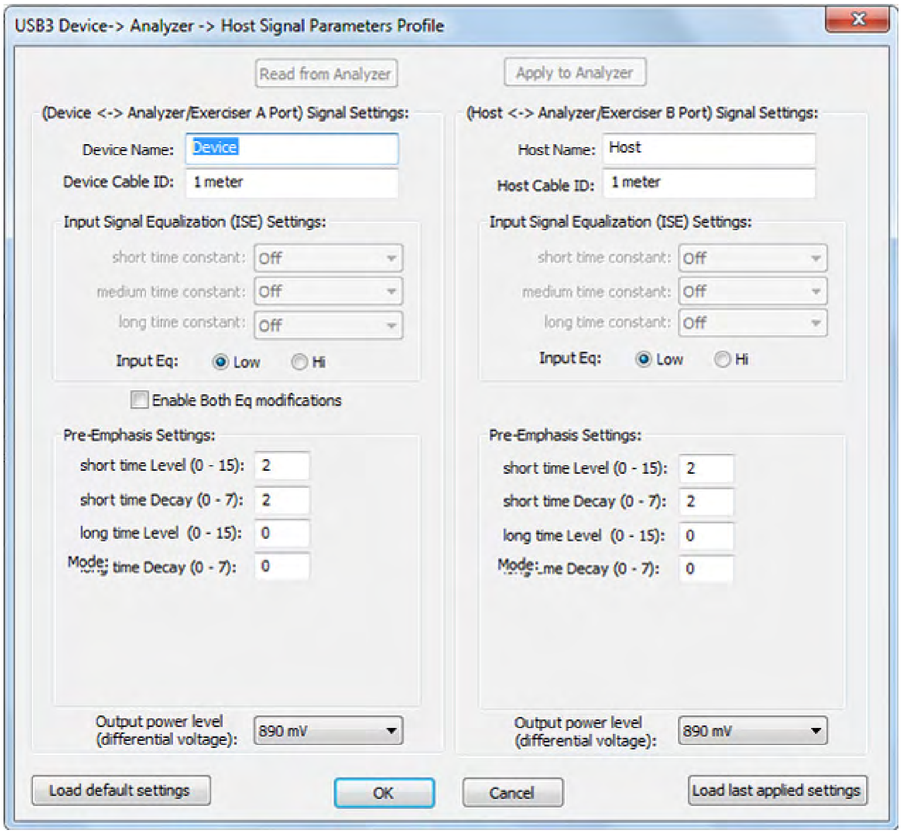


Figure 3.6: USB 3.1 Device Analyzer Host Signal Parameters Profile Dialog Voyager M310, M3, M3i, Advisor T3.

The dialog allows you to **Read from Analyzer**.

The dialog allows you to **Apply to Analyzer**.

You can enter Device to Analyzer Signal Settings:

- Device Name
- Device Cable ID
- **Input Signal Equalization (ISE) Settings**: Short, medium and long time constant (Current, Off, Minimum, Moderate, or Maximum)
- **Pre-Emphasis Settings**: Short and long time level (0 to 15) and short and long time decay (0 to 7)
- **Output Power Level**: Current, or 213 mV to 1294 mV
- You can enter Host to Analyzer Signal Settings:
- Host Name
- Host Cable ID
- **Input Signal Equalization (ISE) Settings**: Short, medium and long time constant (Current, Off, Minimum, Moderate, or Maximum)
- **Pre-Emphasis Settings**: Short and long time level (0 to 15) and short and long time decay (0 to 7)
- **Output Power Level**: Current, or 213 mV to 1294 mV

You can also **Load the default settings** or **Load the last applied settings**.

Input Equalization

Depending on the hardware version of your system, there are two ways to control input equalization. One method requires you to set three time constants, or use the defaults. The other method allows you to select either **Hi** or **Low**, or use the default. The method appropriate for your connected hardware is enabled.

For advanced users only: You can change the values for the “other hardware” by checking **Enable Both Eq modifications**. For example, you might want to do this if you use the same file for both Advisor T3 and Voyager M3i.

Voyager M3x, M310, and M310C

On M3x, M310, and M310C, these settings only control the Analyzer's ability to capture the traffic. The path from the A port to the B port or Port 1 to Port 2 is not subject to any signal conditioning when running in Analyzer mode. When the Voyager is used as an Exerciser, the parameters do effect the transmission and reception signalling.To add a device, click **Add** to display the USB 3.1 Device-> Analyzer -> Host Signal Parameter Profiles dialog.

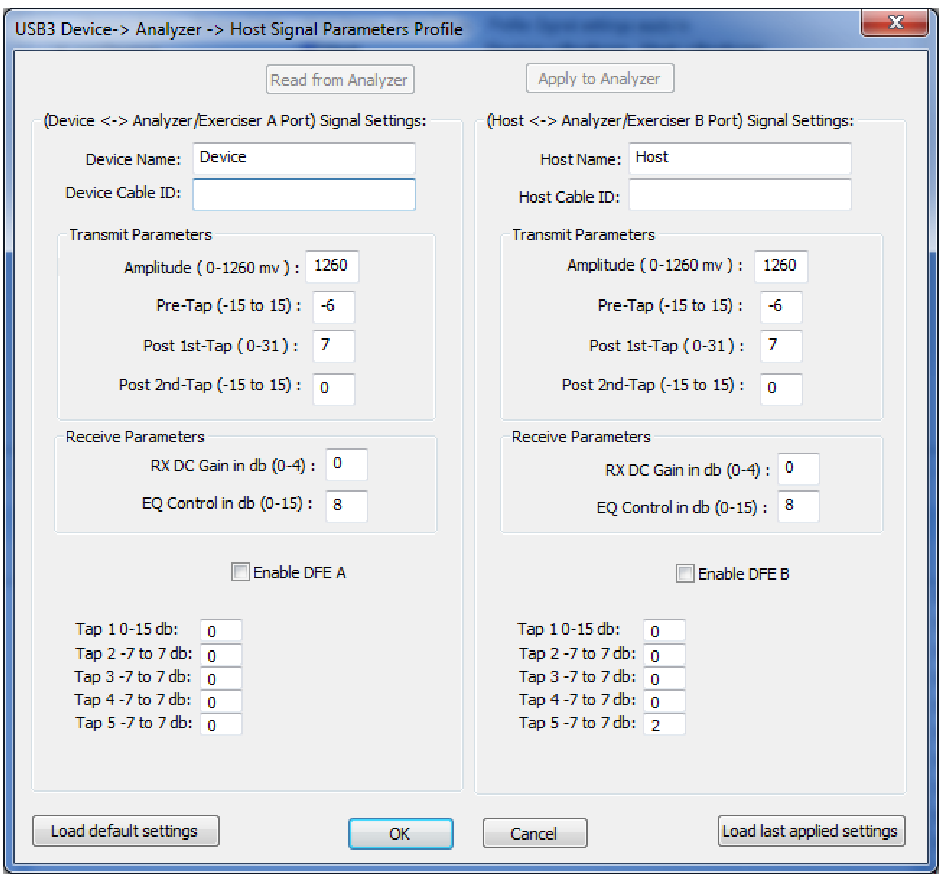


Figure 3.7: USB 3.1 Device Analyzer Host Signal Parameters Profile Dialog M3x.

On M310, you can select to use Auto DFE, which will automatically calibrate the DFE values when a training sequence occurs.

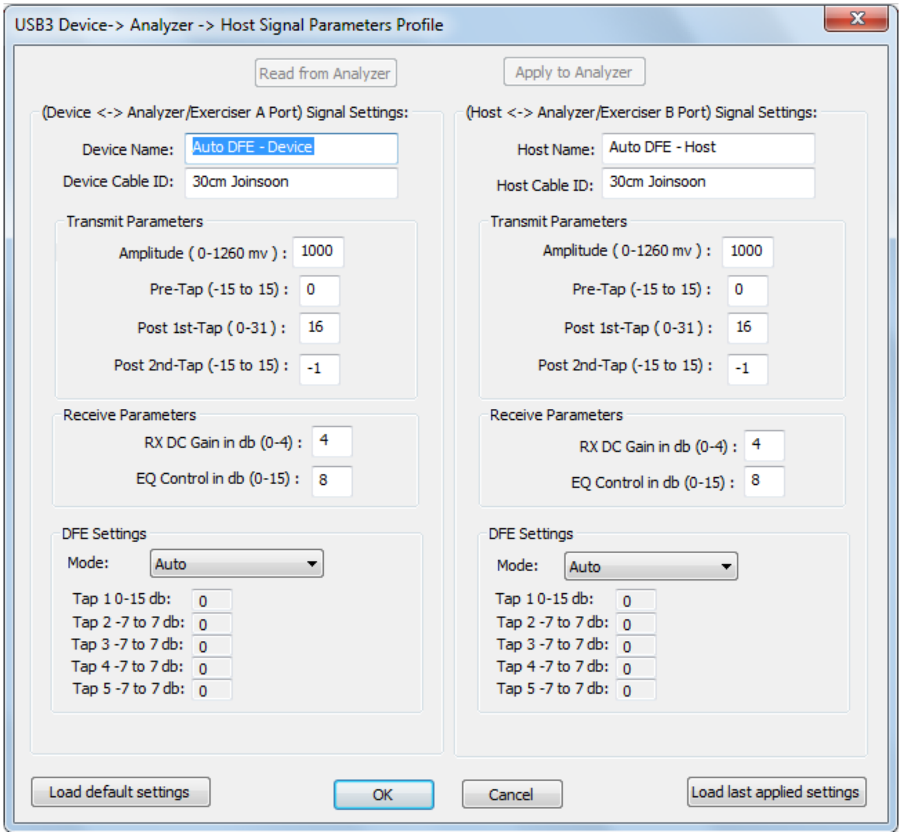


Figure 3.8: USB 3.1 Device Analyzer Host Signal Parameters Profile Dialog M310.

The DFE feature boosts the high frequency components of a signal without noise amplification. The DFE selections are:

- **Auto DFE:** The bus engine SerDes runs Continuous Adaptation DFE during the training sequence (TSEQ) ordered sets to get the best DFE tap coefficients.
- **Off:** No DFE are applied.
- **Manual:** The five explicit Tap values are applied.
- **Triggered Adaptation:** For every change in a PMA analog control setting (Gain and EQ), Triggered Adaptation DFE must run to get new DFE tap coefficients.
- **Continuous Adaptation:** DFE tap coefficients are continuously changed according to the incoming traffic.

These signal conditioning values are similar to the ones used for M3i and AT3. Limits on values accepted are shown in the dialog.

The M310C works in a similar fashion.

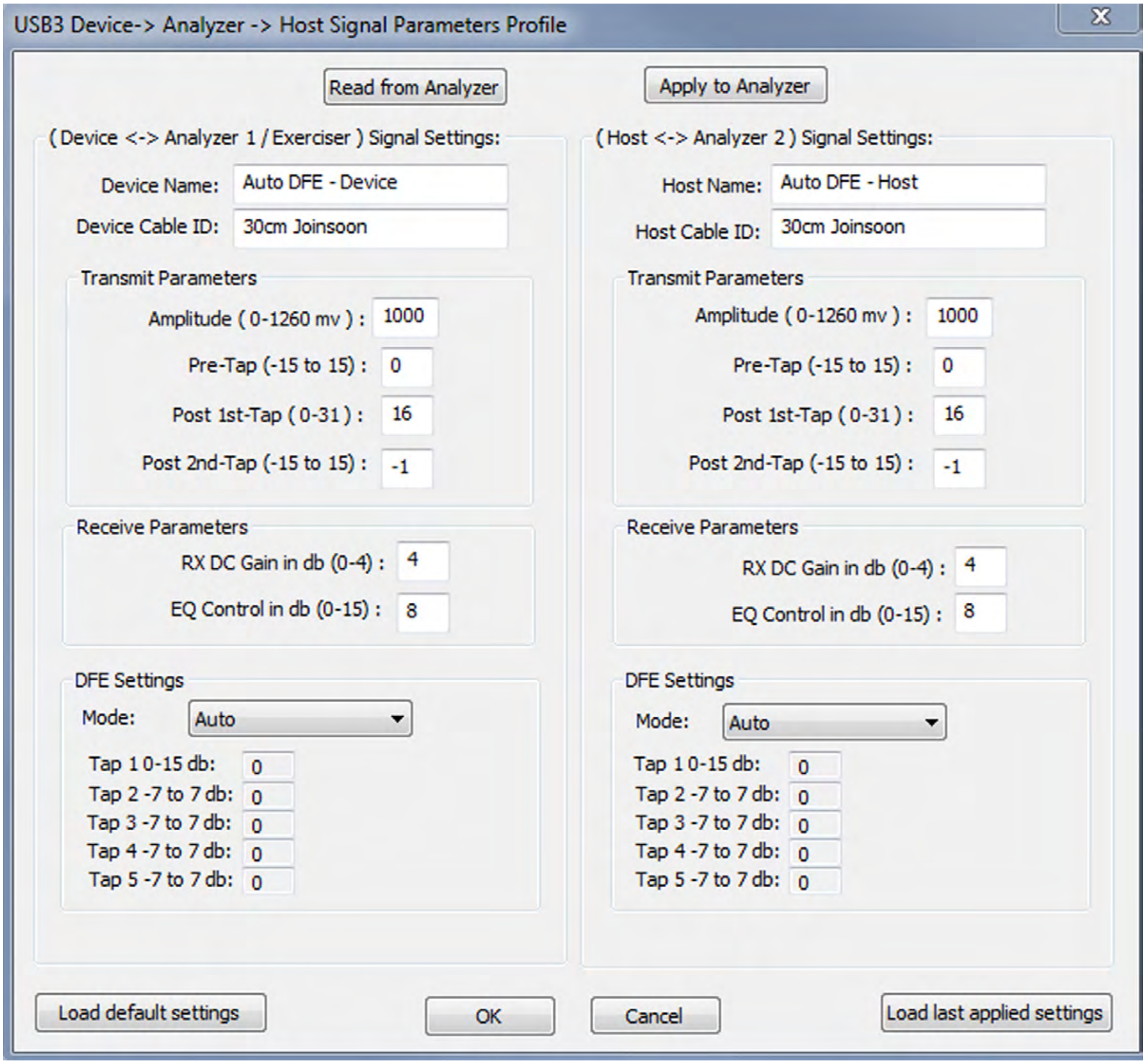


Figure 3.9: USB 3.1 Device Analyzer Host Signal Parameters Profile Dialog M310C.

These signal conditioning values are similar to the ones used for the M310. Limits on values accepted are shown in the dialog.

3.5.5 USB 3.1 Cabling and Signal Integrity

The Analyzer requires two connector discontinuities. In addition, bus-powered devices are susceptible to voltage drops on VBus.

To maintain the best possible signal integrity for all devices under test, use high-quality cabling and use the shortest possible cable lengths. Do not "stress" the system by using long or low-quality cabling that might result in signal degradation.

If you suspect signal integrity problems in capture situations, you should first try using shorter and higher-quality cables to see if this rectifies the problem.

3.6 Your First USB Recording

After installing and launching the software, you can test the system by performing the following steps:

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

Note: Whenever you do connect/disconnect testing, always plug/unplug the “**B**” or "2" connector on the Analyzer (the one that connects to the Host under Test), to insure that the host machine detects the event properly. In some cases, using the “**A**” or "1" Connector (the one attached to your Device) for this purpose can cause the host machine to misinterpret the terminations.

2. Select **Setup > Recording Options** on the Menu Bar.
3. Select the **General** tab to display a dialog box showing factory default settings, such as Snapshot and 4 MB buffer size (see Figure 3.10 on page 104). For the first recording, you can leave these settings unchanged. Under Recording Channels, select **2.0** to record USB 2.0 traffic.

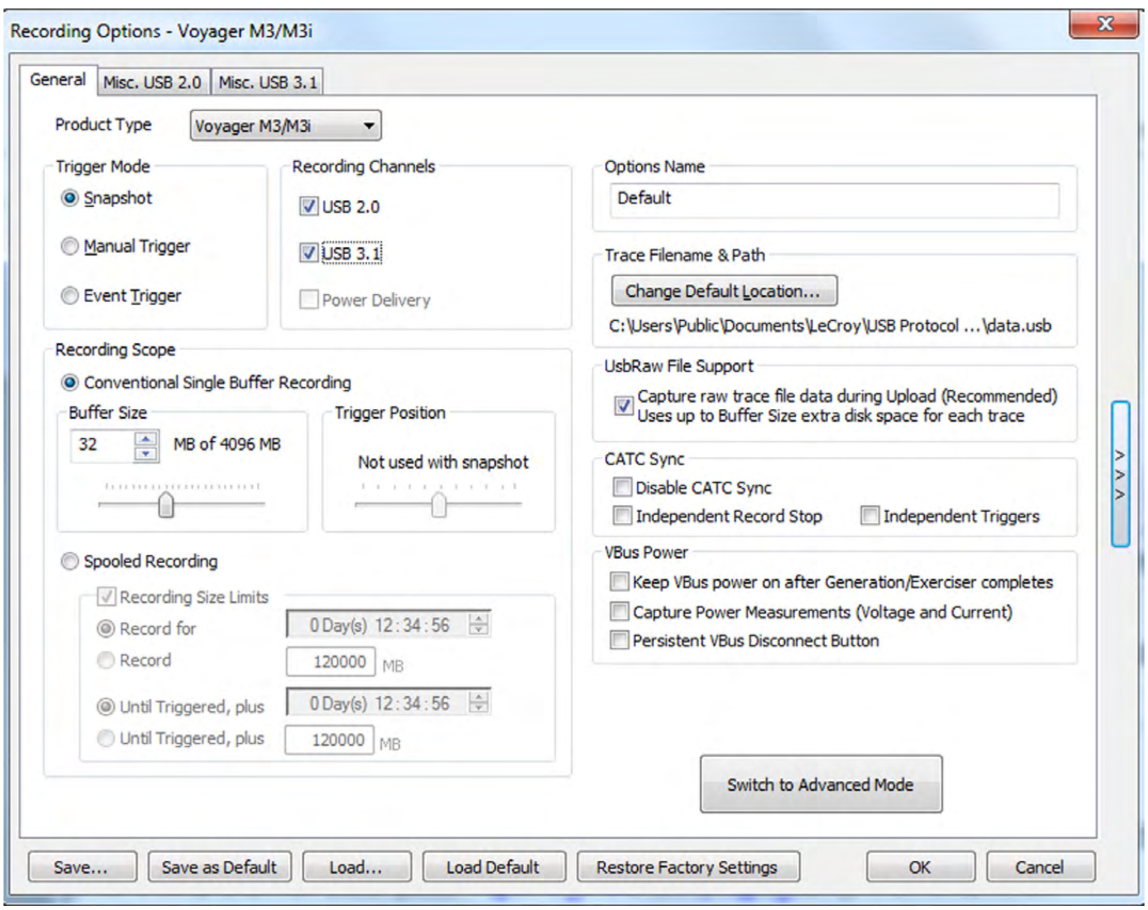


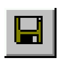
Figure 3.10: Recording Options - Voyager Dialog.

Note: Items not supported on your hardware are grayed out or not shown.

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

5. Turn on the USB devices that are to be tested and cause them to generate USB traffic.
6. Click  on the Tool Bar.
7. The system starts to record the USB traffic immediately. After 4 MB of traffic are recorded, the Analyzer uploads the data and displays the packets in the trace window.
8. To terminate recording before the snapshot automatically completes,

   click  on the Tool Bar.
9. When the recording session finishes, the traffic uploads from the Analyzer to the hard drive on your host machine as a file named **data.usb** or the name you assigned as the default filename. While the file is uploading, you should see a brown progress bar at the bottom of the screen. When the bar disappears, the data has uploaded to disk.
10. To save a current recording for future reference, select **File > Save As** on the Menu Bar.

    OR
11. Click  on the Tool Bar to display the standard **Save As** window.
    Give the recording a unique name and save it to the appropriate directory.

3.6.1 Trace View Features

After the recording terminates, the results display (see Figure 3.11 on page 106).

- The packet view display uses color and graphics to document captured traffic.
- Packets are on separate rows, with individual fields both labeled and color-coded.
- Packets are numbered sequentially (as recorded), time-stamped (with a resolution of 2 ns on 3.1 signaling), and highlighted to show the transmitted speed (low-speed, full-speed, high-speed, or SuperSpeed).
- You can name and save display formats for later use.
- Data fields can collapse to occupy minimal space in the display.

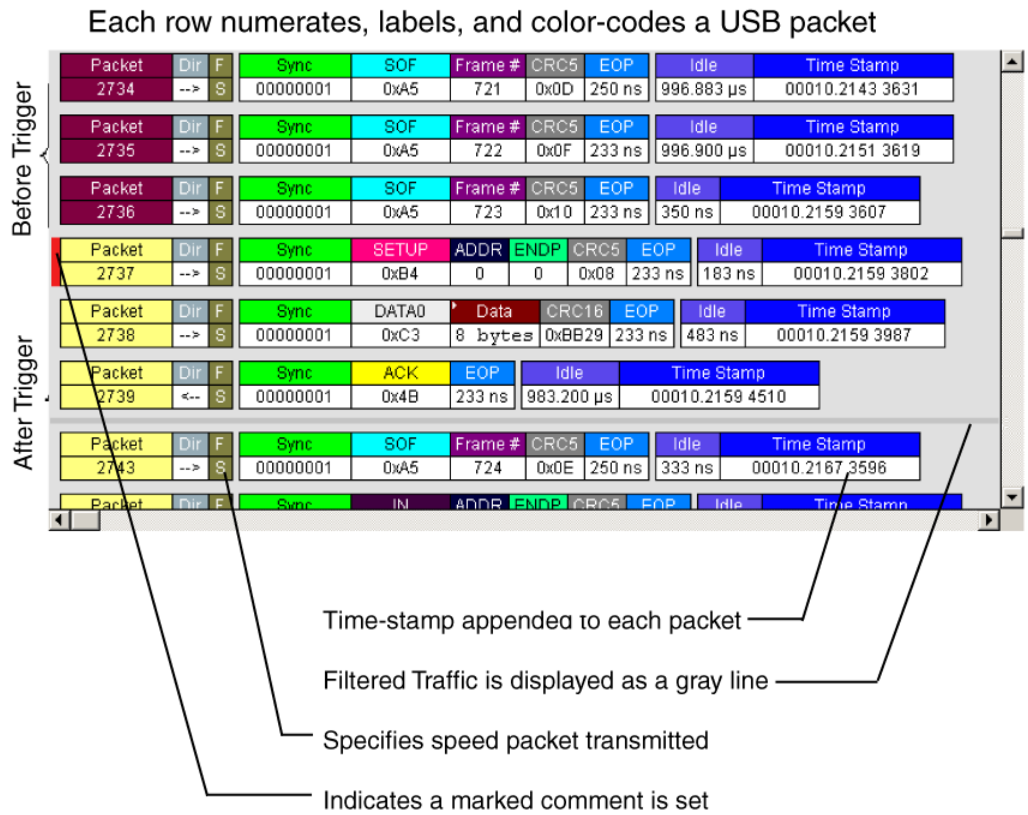


Figure 3.11: Trace View Display

You can start the application from the Desktop or from the installed directory.

The display software can operate independently of the Analyzer. When used without the Analyzer, the program functions in a Trace Viewer mode to view, analyze, and print captured protocol traffic. When used with the Analyzer, you can set trigger conditions, record, monitor, and analyze the activity of your USB bus.

3.7 Notes on Windows 7 and Windows 8 Directory Protections

3.7.1 User Data File Paths

Windows™ 7 and Windows 8 institute a policy which prevents user data from being written into the **Program Files** directory/folder. It was common for applications written for Windows XP (and earlier) to use the **Program Files** folder to store user data. Teledyne LeCroy and CATC products used this folder as a default folder for storing trace files, user option files (**default.opt, default.rec**), scripts, and so on. The default folder for USB Protocol Suite was:

x:\Program Files\Lecroy\USB Protocol Suite\...

Windows 7 and Windows 8 make such paths illegal directories for user data. For Windows 7 and Windows 8, files that are accessible by different user accounts must be in the path

x:\Users\Public\…

To preserve the ability of multiple user accounts to access all the Teledyne LeCroy files that were accessible in Windows XP when using Windows 7 and Windows 8, files that were in the **Program Files** path in Windows XP are now in:

x:\Users\Public\Documents\Lecroy\USB Protocol Suite\…

In some cases, such as paths stored in the Recording Options **.rec** file, the application silently changes this path, so that the Windows 7 and Windows 8 operating systems will accept it as valid.

USB Protocol Suite on Windows XP still uses the **Program Files** directory. However, if a Recording Options file that was created on a Windows 7 system is used on a Windows XP system, trace files will be probably be recorded to a new Windows XP directory called

x:\Users\Public\Documents\Lecroy\USB Protocol Suite\…

This is a legitimate path on a Windows XP system, so there are no conflicts with the operating system.

3.8 Trace File Structure

The captured trace file has an extension of ".usb". When the trace file is loaded, additional decoding and data reduction is done which results in additional files of data which are placed in a folder of the same name as the trace file (with the extension ".tmp"). This allows the trace file to be loaded and displayed quickly during subsequent viewings.

When copying a trace file, or sending it to someone, you can chose to send just the .usb file. In that case, the software re-generates the additional folder and files when the trace is first opened. The other choice is to send the additional folder with contents along with the .usb file, which will save the rebuilding effort when the file is opened again. The choice is up to the user. If you do NOT want these files kept, and don't mind the extra time it takes to re-build these every time you load a trace file, then you can select this in the Recording Options.

If the additional files ever become out of date (newer software structures from a new release, etc.) or if any of the files are lost or damaged, the software will rebuild a fresh version of the information.

3.9 Notes on Windows Sleep and Hibernation Features

Hibernate and Sleep modes are not supported during acquisition, uploading or decoding. The software is designed to not allow the system to go to low power modes. If the user forces the system to go to these modes, the result for USB Protocol Suite is unpredictable, and corrupt files may result.

3.10 Notes on Analyzer/System Grounding

When you use the analyzer with a host machine and Hosts and Devices under test, it is desirable to prevent ground loops by plugging all devices into an outlet with a common ground. If additional external lab equipment issued for Triggering In/Out for debugging purposes, they should also share the same electrical ground. In the absence of these grounds, the user should be aware that ground loops can cause malfunction in triggering signals.

Chapter 4

Software Overview

The USB Protocol Suite application can function 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.

When used with the Analyzer attached to the host machine, you can monitor and analyze the activity of your USB branch from USB ports on the Analyzer front.

4.1 Starting the Program

To start the USB Protocol Suite application:

1. Select **Start** > **All Programs** > **LeCroy** > **USB Protocol Suite > USB Protocol Suite**.

   The main window displays (see Figure 4.1 on page 110).

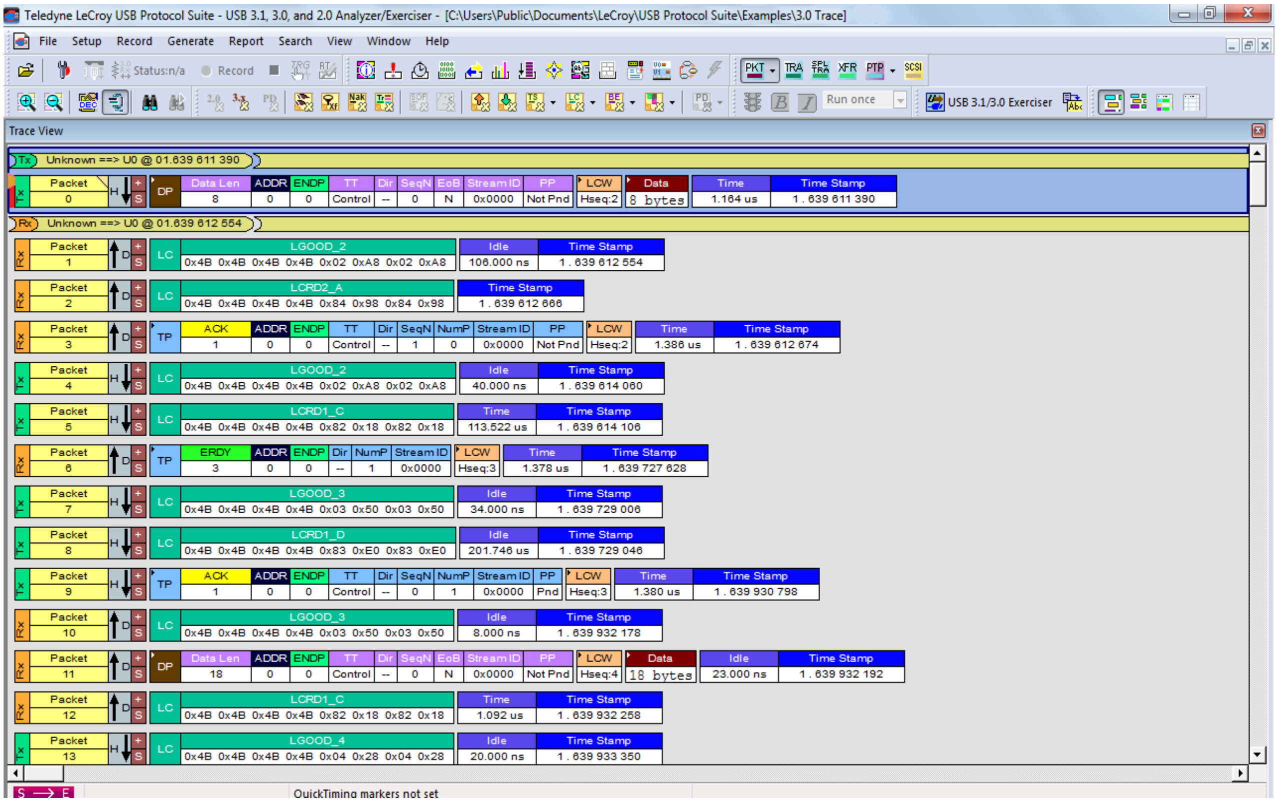
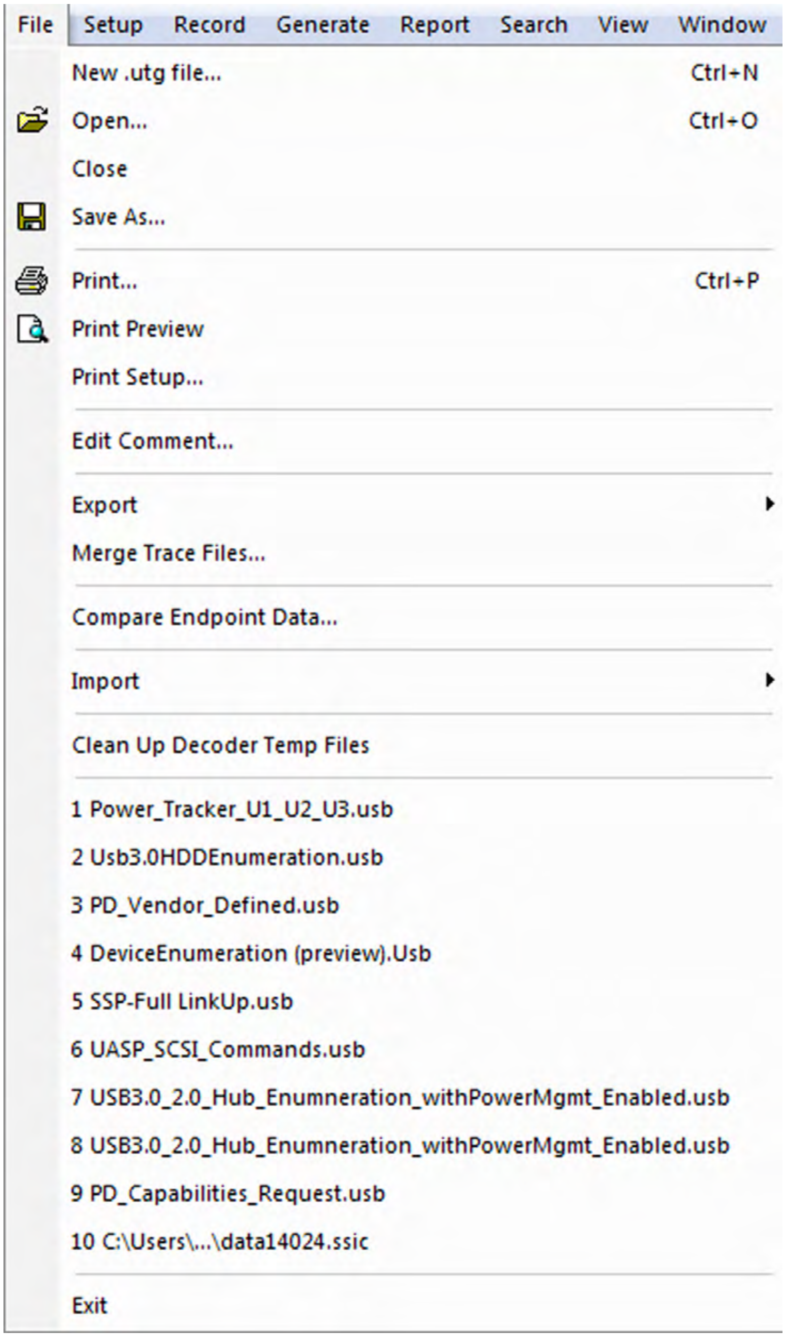


Figure 4.1: Main Window.

4.2 The Main Display Window

The Menus and their functions are described in the tables below.

4.2.1 File Menu

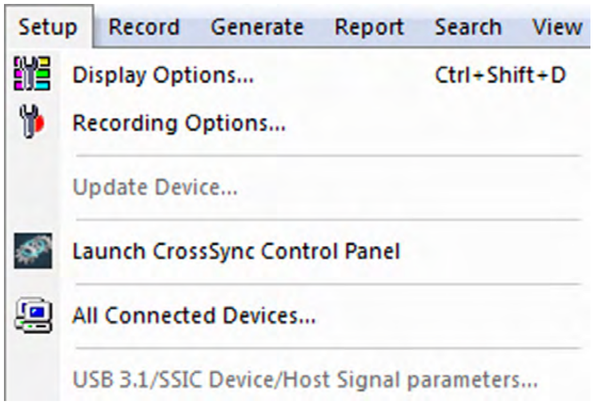


File menu	Functions
New .utg file.	Creates a new, empty traffic generation file. Available only if a trace file (.usb) is open. To edit a .utg file, click Edit as Text in the toolbar.
Open	Opens a file.
Close	Closes the current file.
Save As	Saves all, or a range of, packets from the current file.
Print	Prints part or all of the current traffic data file.
Print Preview	Produces an on-screen preview before printing.
Print Setup	Sets the options for the current or new printer.

File menu	Functions
Edit as Text	Opens the Script Editor. Available only when a traffic generation file (**.utg**) is open. See “Editing a Generation File” on page 408.
Edit Comment	Creates or edits the Trace file comment field. See “Edit Comment” on page 199.
Check Syntax of .utg file	Reads open **.utg** file and checks syntax for errors. Available only when a traffic generation file (**.utg**) is open.
Export>>	Saves all or part of a trace to a text file or generator file.
Packets to Text (Packet View Format)	Saves trace as a text file in Packet View Format.
Packets/ Transaction/ Spreadsheet to. CSV (Comma Separated Values for Excel, etc.) Format)	Saves trace as a comma-separated-values text file for use with Microsoft® Excel. See “Exports to .CSV” on page 124.
Packets to USB 2.0 Host Traffic Generator Text File (**.utg**)	Saves trace as a script file that can be used by a Generator to generate a trace. See “Exporting Packets to USB 2.0 Host Traffic Generator Text File (.utg files)” on page 124.
Packets to USB 2.0 Device Emulation Traffic Generation Text File (**.utg**)	Exports packets to Device Emulation files. This option does not export transactions. See “Exporting Packets to USB 2.0 Host Traffic Generator Text File (.utg files)” on page 124.
Data	Exports Transfer data as a text or binary file.
Merge Trace Files	Merges two simultaneously recorded files into a single file. (This command does not work if the files were recorded at different times).
Compare Endpoint Data	Allows you to select two endpoints of different directions with the same address and verify that the data OUT/IN is identical to the data IN/OUT from the other endpoint. Used when running echo-types of tests for data integrity. Available only when a trace file (**.usb**) is open. (2.0 only)
Import	If you have exported simulations to a defined **.csv** format, you can import data from the **.csv** file to a BusEngine™ data file. To use this feature, you must contact support for information on how to export to a specific-format **.csv** file and then import the file. You can also import SimPass USB files.

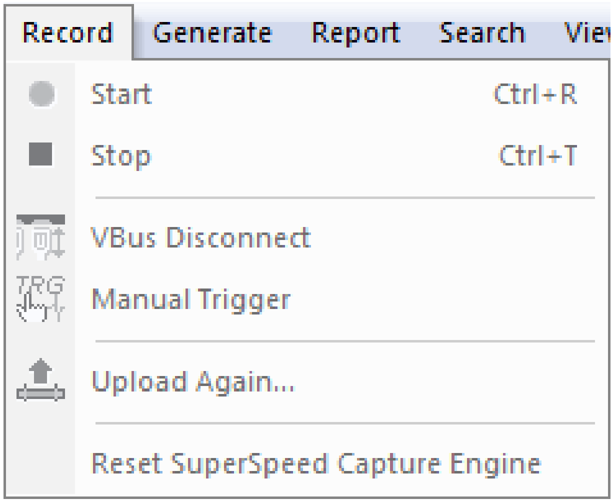
File menu	Functions
Clean Up Decoder Temp Files	Use this selection to intelligently clean up temp files created during the decoder process. This will free up disk space, but make re-loading Trace files much slower, since they will have to be re-decoded.
Exit	Exits the program.

4.2.2 Setup Menu



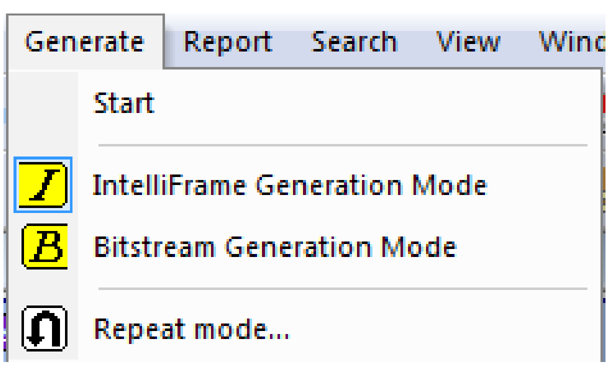
Setup menu	Functions
Display Options	Provides display options such as color, formats, and filters. See “Display Options” on page 231.
Recording Options	Provides setup options for recording, triggering events and filtering. See “Recording Options” on page 329.
Update Device	Updates the BusEngine™ and Firmware manually. See “Manual Updates to Firmware, BusEngine, and Serdes BusEngine” on page 482.
Launch CrossSync Control Panel	Opens the CrossSync multiple-analyzer traffic synchronization software (see CrossSync Control Panel on page 145). For more information, refer to the *CrossSync User Manual.*
All Connected Devices	Opens a dialog box with a list of analyzers connected to the host machine. Lets you select an analyzer and update the BusEngine, Firmware, and licensing information. See “Analyzer Devices” on page 96.
USB 3.1 Device/ Host Signal parameters	Adds, removes, edits, loads, and saves USB 3.1 devices and lists the device name, device cable, host name, host cable, and to what the Profile Signal Settings apply. Used to calibrate 3.1 connections. Also shows custom device-to-analyzer and host-to-analyzer signal settings. See “USB 3.1 Device/Host Signal Parameters (Voyager M3, M3i, M3x, M310, M310C, and Advisor T3)” on page 98.

4.2.3 Record Menu



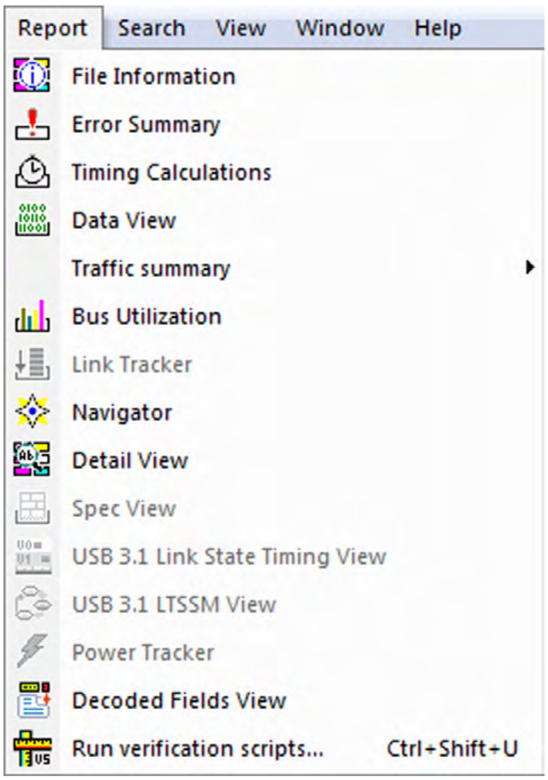
Record menu	Functions
	(see “Recording Status” on page 137.)
Start	Causes the Analyzer to begin recording USB activity.
Stop	Causes the Analyzer to stop recording.
VBus Disconnect	See VBus Disconnect under “Recording” on page 128.
Manual Trigger	See Manual Trigger under “Recording” on page 128.
Upload Again	Allows you to upload a different portion of the captured trace if the previous upload was only partially uploaded.
Reset SuperSpeed Capture Engine	**Voyager M3i Only:** For USB 3.1 traffic capture, in some cases, the Analyzer might not correctly lock onto the 5-GBps signals on power up, or it may unlock after a long period of usage. To issue a soft reset to the SuperSpeed capture engine, select this command. **Note:** After performing the reset, you must retrain the link on your devices.

4.2.4 Generate Menu



Generate menu	Functions
	(see "Traffic Generation 2.0" on page 401.)
Start/Stop	Starts traffic generation. After traffic generation has begun, the **Start** command becomes **Stop** and lets you stop traffic generation.
IntelliFrame Generation Mode	Sets the mode of generation to IntelliFrame. Use before Start. (2.0 only)
Bitstream Generation Mode	Sets the mode of generation to bitstream. Use before Start. (2.0 only)
Repeat Mode	Allows you to repeat once, a specified number of times, or an infinite number of times using the Generation Repeat Mode window. (2.0 only)

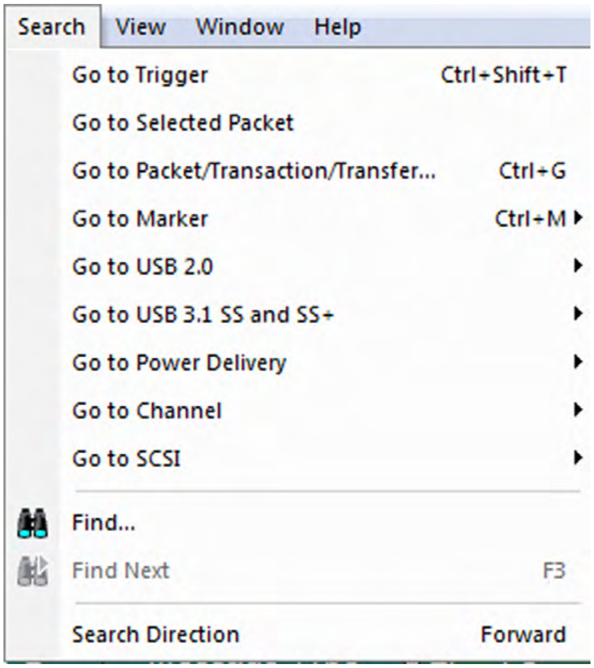
4.2.5 Report Menu



Report menu	Functions
File Information	Displays information about the recording, such as the number of packets and triggering setup. See "Trace Information" on page 272.
Error Summary	Summarizes the errors throughout the recording. Allows for fast navigation to packets with errors. See "Error Summary" on page 275.
Timing Calculations	Calculates timing between two packets and bus utilization. See "Timing Calculations" on page 279.
Data View	Shows packet information. See "Data View" on page 282.

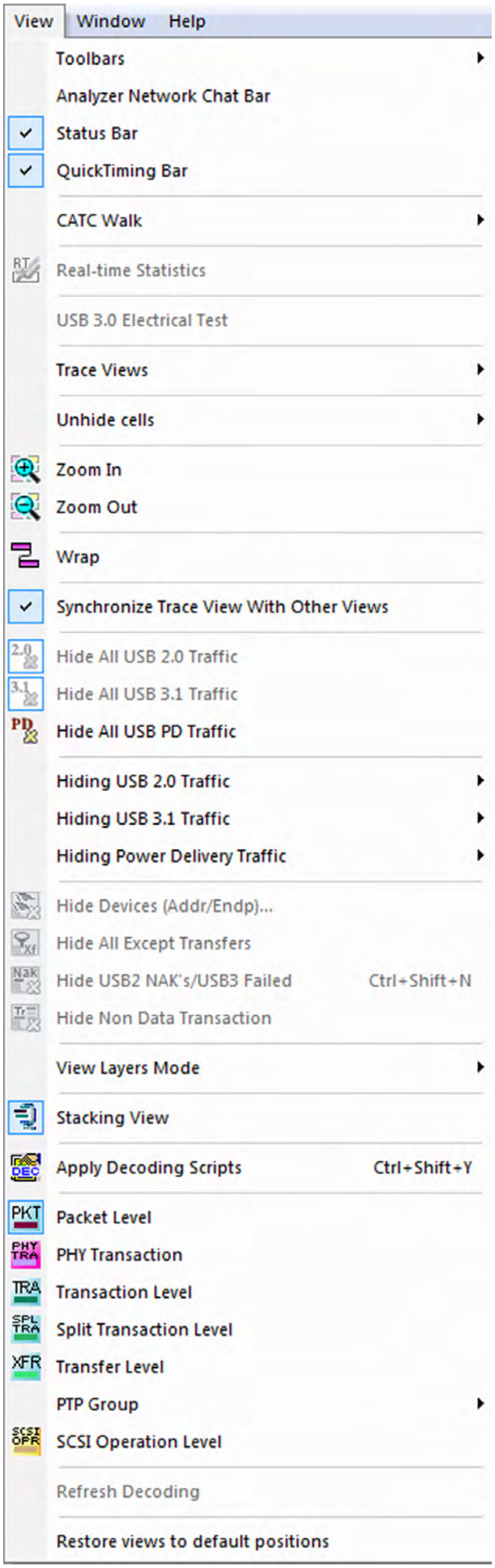
Report menu	Functions
Traffic Summary Report	Summarizes the numbers and types of errors, packets, transactions, split transactions, and transfers that occurred in the open trace. See “Traffic Summary Report” on page 283.
Bus Utilization	Displays graphs of packet length, bus usage, and bus usage by device. See “Bus Utilization” on page 285.
Link Tracker	Opens a window for displaying a detailed chronological view of traffic. The window provides view and navigation options. See “Link Tracker (3.1)” on page 293.
Navigator	Allows you to view the location of errors and triggers in a trace, narrow the range of traffic on display, and jump to any point in the trace. See “Using the Navigator” on page 297.
Detail View	Displays details of selected packet. See “Detail View” on page 304.
Spec View	Shows packet header information and other items, in a view that matches the USB 3.1 specification. See “Spec View” on page 305.
USB 3.1 Link State Timing View	Graphically shows how much time the link spends in each link state. See “USB (3.1) Link State Timing View” on page 306.
USB 3.1 LTSSM view	Displays the LTSSM diagram depicted in the USB 3.1 specification. See “USB (3.1) LTSSM View” on page 308.
Power Tracker	Displays voltage, current, and power. See “Power Tracker” on page 309.
Decoded Fields View	Displays the Decoded Fields View. See “Decoded Fields View” on page 265.
Run Verification Scripts	Opens a window to allow you to run verification scripts over the open trace. See “Running Verification Scripts” on page 320.

4.2.6 Search Menu



Search menu	Functions
	(see **"Searching Traces" on page 201**.)
Go to Trigger	Positions the display to show the first packet that follows the trigger event.
Go to Selected packet	Positions the display to show the selected packet.
Go to Packet/ Transaction/ Transfer	Positions the display to the packet/transaction/transfer number selected in the Go to Packet/Transaction/Transfer menu.
Go to Marker »	Positions the display to the selected marked packet.
Go to USB 2.0»	Positions the display to the selected event, condition, value, or type.
Go to USB 3.1 SS and SS+»	Positions the display to the selected event, condition, value, or type.
Go To Power Delivery	Searches for specific Power Delivery Messages.
Go to Channel	Positions the display at selected channel. Select from 0,1,2 and 3.
Go to SCSI	Positions the display to the selected SCSI Operation, Command Status, Task Management, Task Management Response, Error or SCSI Logical Unit Number.
Find	Allows complex searches on multiple criteria. See "Find" on page 225.
Find Next	Repeats the previous Find operation.
Search Direction	Allows the search direction to be changed from Forward to Backward, or vice versa.

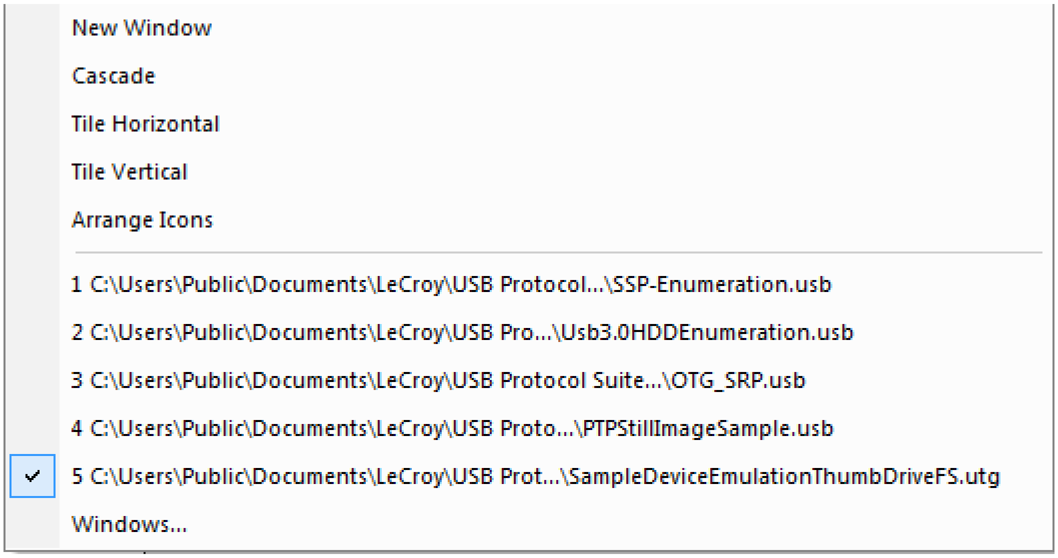
4.2.7 View Menu



View menu	Functions
Toolbars	Displays list of available toolbars. See “Resetting the Toolbar” on page 135.
Analyzer Network Chat Bar	Opens a dialog that allows you to conduct chat sessions over an IP LAN. In order to send and receive electronic text messages, each user must be working with a host machine that is on an IP LAN and also attached to an analyzer.
Status Bar	Switches display of the Status Bar on or off. See “Status Bar” on page 136.
QuickTiming Bar	Quick Timing provides immediate time deltas and bandwidth calculations. If the Start is placed on a packet that contains an Address and Endpoint, the bandwidth for that combination is displayed in the Status Bar below the trace data.
CATC Walk	Select **Play** to start playing the CATC Walk playlist or **Manage Playlists** to display the Edit CATC Walk Playlists dialog to manage playlists.
Real-time Statistics	Allows you to view traffic statistics as they occur. See “Real Time Monitoring” on page 324.
USB Electrical Test	Tests electrical characteristics. See “USB 3.1 Electrical Test Modes” on page 461.
Trace Views	Displays CATC Trace, Compressed CATC Trace, Spreadsheet (Color), or Spreadsheet (B/W).
Unhide cells	Unhide previously hidden Traffic, VBus Power, or Unhide All.
Zoom In	Increases the size of the displayed elements.
Zoom Out	Decreases the size of the displayed elements.
Wrap	Wraps displayed packets within the window.
Synchronize Trace View with Other Views	Synchronizes the Trace view with other views
Hide All USB 2.0 Traffic	Hides all the USB 2.0 traffic (low speed, full speed, and high speed).
Hide All USB 3.1 Traffic	Hides all the SuperSpeed and SuperSpeed+ traffic.
Hide All Power Delivery Traffic	Hides all the power delivery traffic.
Hiding USB 2 Traffic	Hides. SOF’s: Start of Frames Chirps: Chirp-K and Chirp-J Bus conditions (these are recorded only)

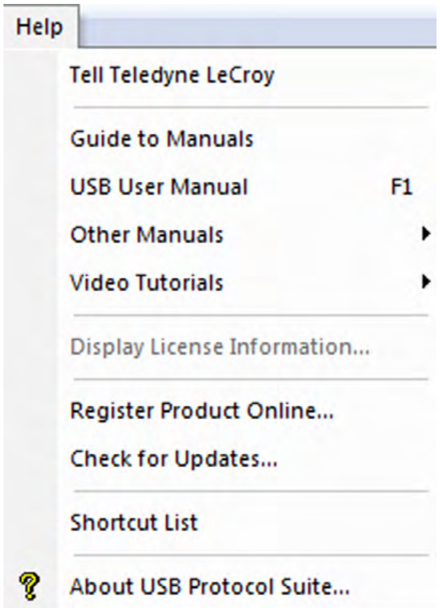
View menu	Functions
Hiding USB 3.1 Traffic	Hides: Hide All Except Transfers Hide Upstream Transfers Hide Downstream Packets Training Sequence Packets - TSEQ, TS1/TS2 Hide Link Commands - LUP/LDN, Flow Control, Power Management Bus Event - Hide LFPS Packets, Hide Electrical Idles, Hide Terminations Miscellaneous - Hide LMP Packets, Hide ISO Time Stamp Packets, Hide Inter-Packet Symbols, Hide Skip Sequences, Hide Logical Idle Packets, Hide Loopback Packets (BCNT, BRST, BERC), Hide Compliance Packets Hide LTSSM Transition Indicators
Hide Devices (Addr/Endp....	Opens the Hiding Devices dialog displaying packets belonging to specified devices by address and endpoint
NAKs/NRDYs	Shows/Hides NAK'd and NRDY'd Transactions
View Layers Mode	Display All Layers, Application Layers, or Lower USB Layers.
Stacking View	Puts a group of packets in one row, to shorten display. See "Stacking" on page 174.
Apply Decoding Scripts	Decoding scripts set the values of the display and recording options for optimum views of trace information from specific vendors or classes of data. This menu option allows you to select the vendor or class of data for the request recipients and endpoints listed in the Request Recipients and Endpoints menu. You can keep the settings across recordings. See "Decode Requests" on page 245.
Packet Level	Displays Packets.
Transaction Level	Displays Transactions.
Split Transaction Level	Displays Split Transactions.
Transfer Level	Displays Transfers.
PTP Group	**PTP Transaction Level** displays PTP Transactions **PTP Object Transfer Level** displays PTP Objects **PTP Session Level** displays PTP Sessions
SCSI Operation Level	Displays SCSI Operation Level
Refresh Decoding	Forces the software to re-decode transactions and transfers. Useful if you have applied a decoding mapping which helps fully decode a sequence of transfers, as is the case with Mass Storage decoding.
Restore views to default positions	If your windows/views end up in a Layout that is not desired, you can select this item to put them into the default state preferred by the application.

4.2.8 Window Menu



Window menu	Functions
New Window	Switches display of the Tool Bar on or off.
Cascade	Displays all open windows in an overlapping arrangement.
Tile Horizontal	Displays all open windows in a above-below arrangement.
Tile Vertical	Displays all open windows in a side-by-side arrangement.
Arrange Icons	Arranges minimized windows at the bottom of the display.
Windows ...	Displays a list of open windows.

4.2.9 Help Menu



Help menu	Functions
Tell Teledyne LeCroy	Report a problem to Teledyne LeCroy Support via e-mail. This requires that an e-mail client be installed and configured on the host machine.
Guide to Manuals	Invokes a web page which guides you to the correct documentation for the analyzer you are using.
USB User Manual	Displays the USB Protocol Suite User Manual. It can be used as on-line help.
Other Manuals	Select to display the Automation, Verification Script Engine (VSE), Script Decode Language or USB 3.1 Exerciser Manual PDFs. It can be used as on-line help.
Video Tutorials	Has links to YouTube videos that describe Voyager features: Basic USB 3.1 Recording, USB 3.1 Basic Triggering, USB 3.1 Advanced Triggering, Troubleshooting USB 3.1 Connection Issues, USB 3.1 Packet Header Display, USB 3.1 Compliance (Part 1). USB 3.1 Compliance (Part 2)
Display License Information	Displays information related to licensing. Also used to update a license key. See "License Information" on page 483.
Register Product Online	Register at the Teledyne LeCroy website. See "Registering Online" on page 485.

Help menu	Functions
Check for Updates	Use the Internet to analyze your system for licensed updates. You can set the system to automatically check for updates at application startup in the Teledyne LeCroy USB Protocol Suite Software Update window. See “Software Updates” on page 478.
Shortcut List	Displays the Shortcuts List of navigation, common, search, decode levels, and miscellaneous mouse and keyboard shortcuts. See “Shortcut List” on page 486.
About USB Protocol Suite	Displays version information about the Analyzer and the USB Protocol Suite. See “Software, Firmware, and BusEngine Revisions” on page 477.

4.2.10 Exports to .CSV

.CSV files may be created as exports from the contents of 2.0 CATC Trace Packet and Transaction Views, 3.1 CATC Trace Packet views, and any Spreadsheet view. The output is limited to 1 million rows.

Export Packets to .CSV

When viewing 2.0 or 3.1 Packets in either the CATC Trace view or the CATC Trace Compressed view, selecting **Export > Packets to .CSV** exports the packets to a **.csv** file in a pre-configured format. The first row of that **.csv** file shows what each column represents.

Export Transactions to .CSV

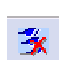
When viewing 2.0 Packets in either the CATC Trace view or the CATC Trace Compressed view, selecting **Export > Transactions to .CSV** exports the 2.0 transactions to a **.csv** file in a pre-configured format. The first row of that **.csv** file shows what each column represents.

Export Spreadsheet View to .CSV

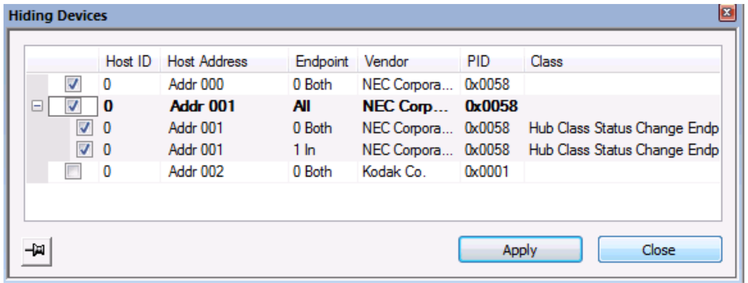
When viewing 2.0 Packets in either the Black and White or Colored Spreadsheet Views Trace view, selecting **Export > Spreadsheet to .CSV** exports the contents of the spreadsheet to a **.csv** file in a pre-configured format. The columns match the columns as you have defined them in your Spreadsheet view.

4.2.11 Exporting Packets to USB 2.0 Host Traffic Generator Text File (.utg files)

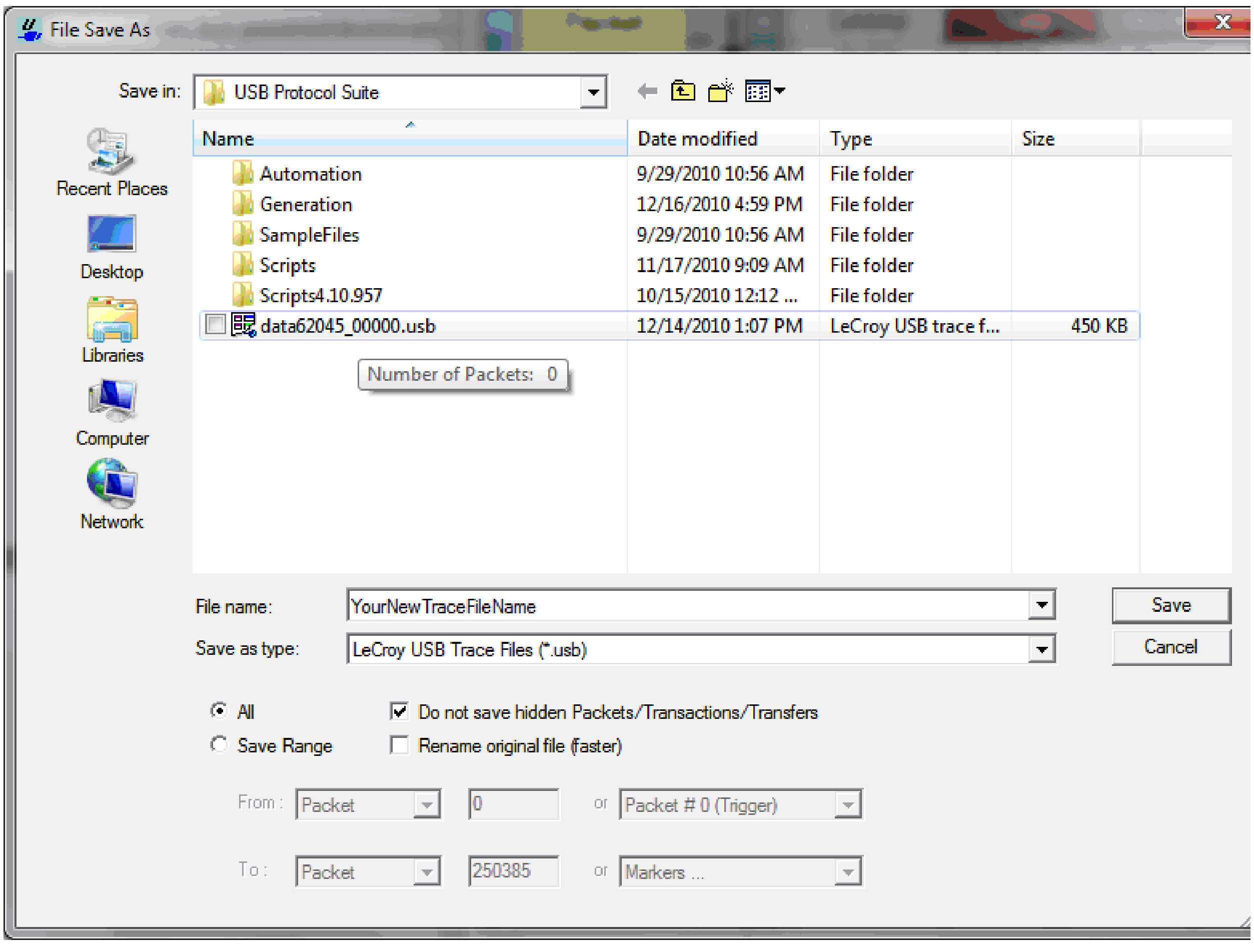
Before exporting to a **.utg** file, first make sure the **.usb** file contains traffic for only one device:

1. Hide all other device addresses in the trace, leaving only the address of your device and the **Address 0** (the default enumeration address).
2. Click on the Hide Devices  icon.

   The following dialog displays.

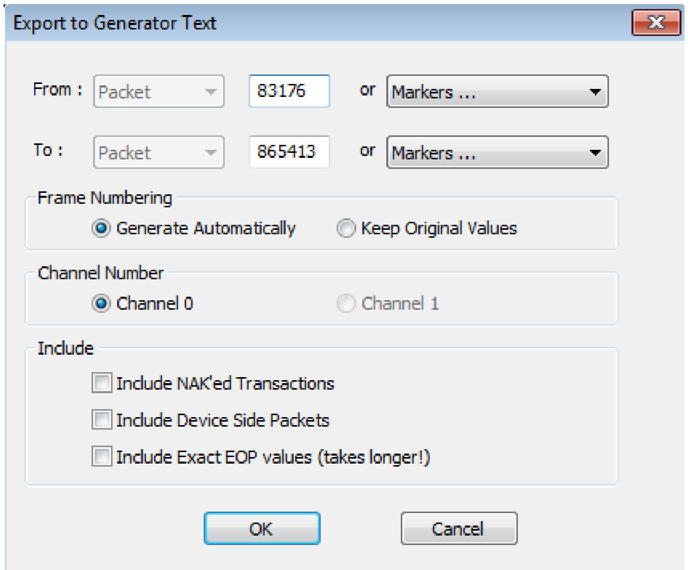


3. Save to a new file using the **All** and
   Do not save hidden Packets/Transactions/Transfers selections.



4. On the new file, you can now:
   Click **File > Export** and select **Packets to USB 2.0 Host Traffic Generator Text File (.utg)...**

   The following dialog displays.

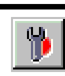


5. If the captured file was Hi Speed and was recorded in Auto-Speed Detect mode, you must add a **ping = here** statement before the first SOF packets in the **.utg** file. This is required because, when the capture is made in Auto-Speed Detect mode, the first "Ping" sequence is not captured in the trace file.

4.3 Tool Bar

The Tool Bar provides quick and convenient access to the most popular program functions. Tool tips briefly describe the functionality of each icon and menu item as the mouse arrow is moved over the icon/item.

4.3.1 Files, Searches, and Options

	Open file		Setup Recording Options. See “Recording Options” on page 329.
	Find (see “Find” on page 225)		Find Next

4.3.2 Zoom and Wrap

	Zoom In		Zoom Out

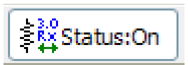
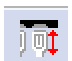
4.3.3 Miscellaneous

	Display Realtime Statistics. See “Real Time Monitoring” on page 324.		Assign High Level Decodes. See “Decode Requests” on page 245.
	Display Stacking View. See “Stacking” on page 174.		

4.3.4 Analysis (Reports)

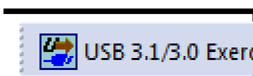
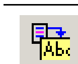
	Trace Information Report See “Trace Information” on page 272.		Error Report See “Error Summary” on page 275.
	Timing and Bus Usage Calculations See “Timing Calculations” on page 279.		Traffic Summary Report See “Traffic Summary Report” on page 283.
	Data View See “Data View” on page 282.		Bus Utilization See “Bus Utilization” on page 285.
	Link Tracker See “Link Tracker (3.1)” on page 293.		Spec View See “Spec View” on page 305.
	Open the Navigator bar See “Using the Navigator” on page 297.		Detail View See “Detail View” on page 304.
	Decoded Fields View. See “Decoded Fields View” on page 265.		Show USB 3.1 LTSSM View See “USB (3.1) LTSSM View” on page 308.
	Show USB 3.1 Link State Timing View. See “USB (3.1) Link State Timing View” on page 306.		Show Power Tracker. (Power captures are supported only on Voyager M3i and M3x.) See “Power Tracker Toolbar” on page 312.
	Run Verification Scripts. See “Running Verification Scripts” on page 320.		

4.3.5 Recording

	SuperSpeed (USB 3.1) receiver terminations of Analyzer: **M3i:** If both Analyzer ports are set to Auto in Recording Options, this button is dimmed. If either port is set to Manual, this button can apply or remove USB 3.1 termination. **M3:** This button is always enabled, and Auto mode is not supported.		
	Start Recording		Manual Trigger
	Stop Recording		
	Momentary VBus Disconnect (On systems that support it) Causes the VBus power between the Host and the Device connected through the Analyzer A and B USB ports to be broken for 1 second, simulating a unplug-plugin cycle. This is the recommended method of creating plug-in scenarios. **Note**: This button can be changed to make it work as a toggle between VBus On and VBus off. This can be modified on the Recording Options General tab. **Note**: When Disconnect is done during recording, it may cause capturing of IPS (undecodable symbols) and false triggering of CRC triggers, because packets will be abruptly stopped in the middle of a symbol stream. **Note**: Disconnection of USB or Ethernet during capture or uploading of trace data is not supported, and may cause the software to malfunction or crash.		

4.3.6 Generator (Traffic Generation for USB 3)

Please see “Traffic Generation 3.1 Exerciser” on page 437.

	Go to USB 3.1 Exerciser window.		Manual Trigger
	Display Export to Script dialog.		

4.3.7 Generator (Traffic Generation for USB 2)

Please see "Traffic Generation 2.0" on page 401.

	Start or Stop Traffic Generation (available if you have the Traffic Generation module).		Bitstream and Intelliframe modes
Run once			Repeat Mode. This button becomes active when a traffic generation file (*.utg) is open. It only applies during Host Emulation. Device Emulation does not support looping.

4.3.8 View Level

Please see "Switch to Transactions View" on page 182 and the following.

	Display Packets. See "Trace View Features" on page 149.		Display PTP Objects. See "Switch to PTP Object Transfers" on page 191.
	Display Transactions. See "Switch to Transactions View" on page 182.		Display PTP Sessions. See "Switch to PTP Sessions" on page 192.
	Display Split Transactions. See "Switch to Split Transaction View" on page 187.		Display SCSI Operations
	Display Transfers. See "Switch to Transfer View" on page 188.		PTP Group Click the arrow to display the PTP Levels
	Display PTP Transactions See "Switch to PTP Transactions" on page 191.		

4.3.9 Trace Views

Please see "Compressed CATC Trace View" on page 193 and "Spreadsheet View" on page 194.

	Normal CATC Trace View		Compressed CATC Trace
	Spreadsheet View (Color)		Spreadsheet View (B/W)

Hide Protocols

	Hide all USB 2.0 traffic		Hide all USB 3.1 traffic
	Hide all power delivery Traffic		

Hiding Traffic (2.0 & 3.1)

You can Hide Devices and NAK's NRDY's by clicking the buttons in the table below or from the **View** menu. Click **View** and select **Hide Devices (Addr/Endp)...** as shown in Figure 4.2 on page 131**.**

	Hide Devices		Hide NAK's/NRDY's.
	Hide All Packets Except Transfers Packets		Hide Non-Data Transactions which hides streaming transaction and ERDY transactions.

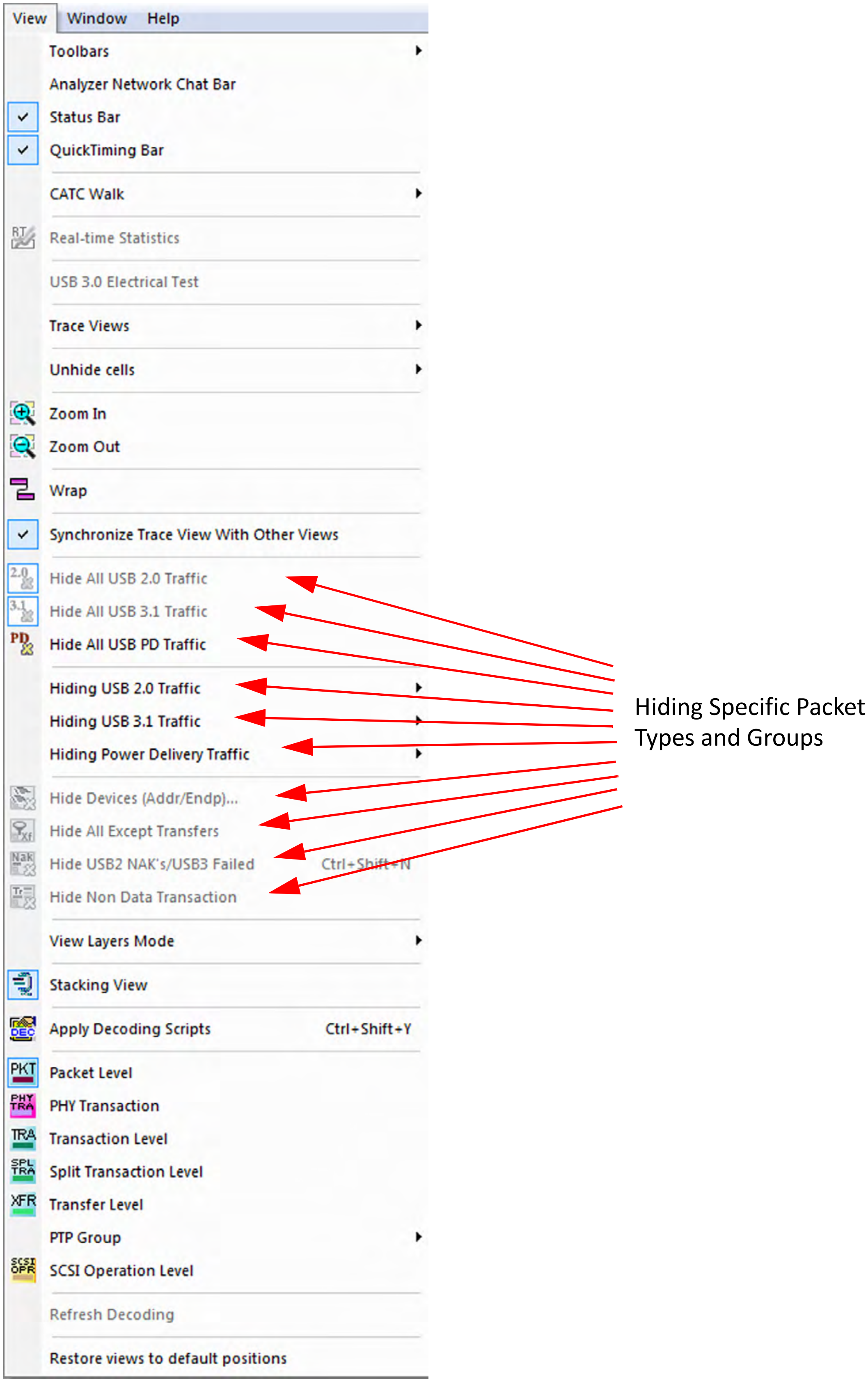


Figure 4.2: Selecting Hide Devices

The **Hiding Devices** dialog is invoked as shown in Figure 4.3 on page 132.

Check the upper level box (hierarchically) to hide all communications on an address, or the lower level to hide individual endpoints.

Clicking on the Pin will make the dialog stay available after applying the hiding. The Class is determined from the class decoder mapping, which could have occurred either automatically or via the user applying it explicitly.

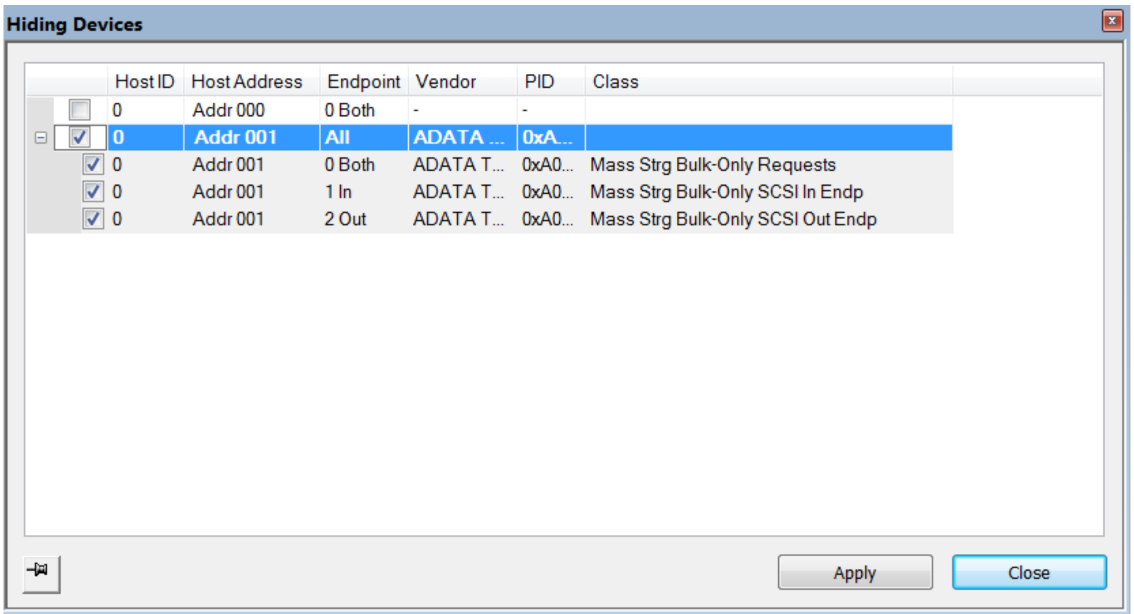


Figure 4.3: Hiding Devices Dialog.

Check the upper level box (hierarchically) to hide all communications on an address, or the lower level to hide individual endpoints.

Clicking on the Pin will make the dialog stay available after applying the hiding. The Class is determined from the class decoder mapping, which could have occurred either automatically or via the user applying it explicitly.

In various locations, the list of Link, Address, Endpoint and Direction is shown in the Display Options dialog under the USB 2.0 Packet Hiding and USB 3.1 Packet Hiding tabs as shown in Figure 4.4 on page 133.

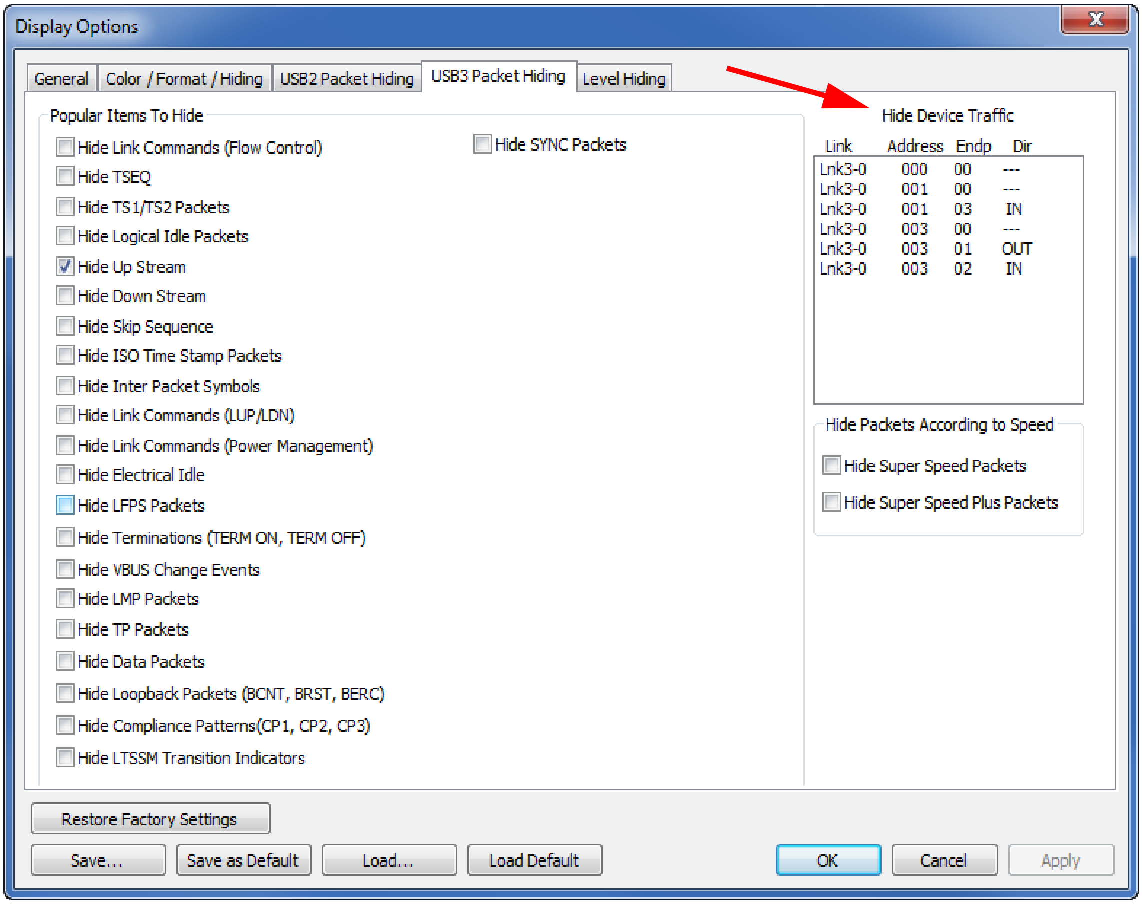
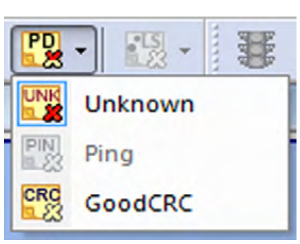


Figure 4.4: Display Option Dialog Showing Hide Device Traffic

USB 2.0 Display/Hide

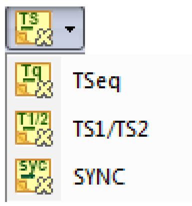
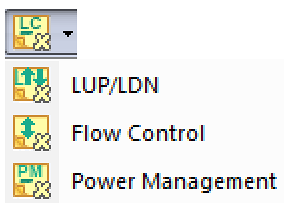
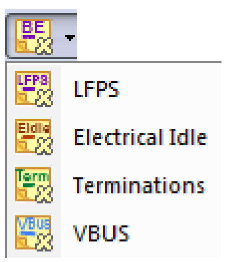
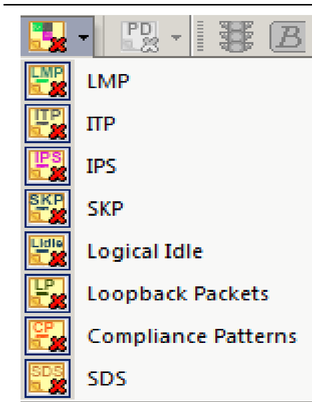
Select from the following options to hide USB 2.0 traffic. Refer to "Hiding Traffic (2.0 & 3.1)" on page 130.



USB 3.1 Display/Hide

	Hide SOFs.		Hide Chirps

Select from the following options to hide USB 3.1 traffic. Refer to "Hiding Traffic (2.0 & 3.1)" on page 130.

	Hide Upstream Packets.
	Hide Downstream Packets.
	Hide Link Training Sequences: (TSEQ, TS1/S2, Sync).
	Hide Link Commands: LUP/LDN, Flow Control, Power Management
	Hide Bus Events: LFPS Packets, Electrical Idles, Termination, VBUS
	Hide Miscellaneous Packets: LMP, ISO Time Stamp, Inter-Packet Symbols, Skip Sequences, Logical Idle, Loopback (BCNT, BRST, BERC), Compliance Pattern
	Hide Power Delivery Items

4.4 Tooltips

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

4.5 View Options

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

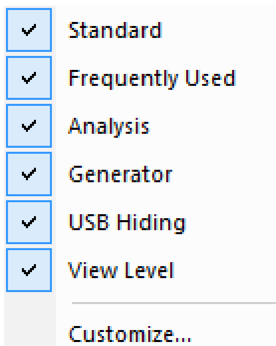


Figure 4.5: View Options Dialog

4.5.1 Resetting the Toolbar

From time to time (such as following a software upgrade), it is possible for the buttons on the toolbar not to match their intended function.

To reset the toolbar:

1. Select **View > Tool bars** from the menu bar.
2. Select **Customize** from the submenu to display the Customize dialog box.

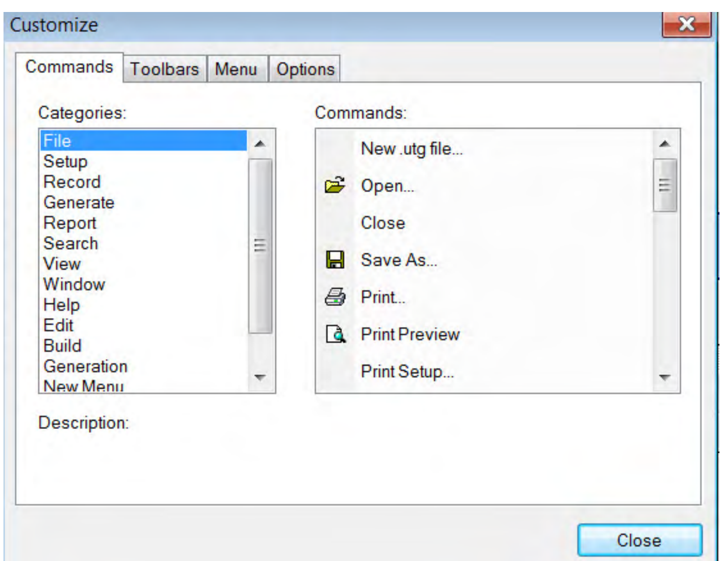


Figure 4.6: Customize Dialog

3. Select the **Toolbars** tab to display the Toolbars page of the Customize dialog box (see the following figure).

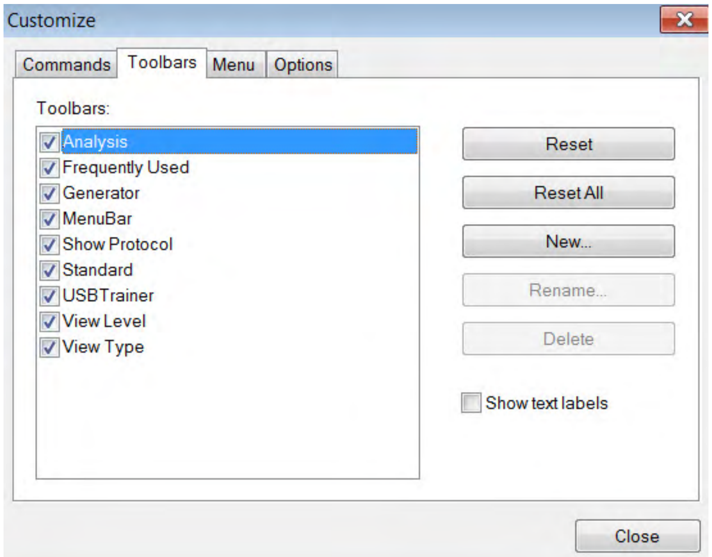


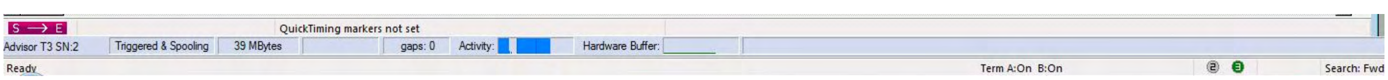
Figure 4.7: Toolbars Dialog

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

   The toolbar resets to the factory defaults.

4.6 Status Bar

The Status Bar is located at the bottom of the main display window.



Depending on the current activity, the left side of the bar has segments that indicate the hardware, status, size, activity, and buffer.

The right side of the bar has segments that indicate port status, link status, and search direction.

- 2 : 2.0 traffic
- 3: 3.1 SuperSpeed (SS) traffic, 5Gbps
- 3+: 3.1 SuperSpeedPlus (SS+) traffic, 10Gbps

Figure 4.8: Status Bar

4.6.1 Recording Progress

When you begin recording, the Status Bar displays an indicator.

As recording progresses, the indicator changes to reflect the recording progress graphically:

A black vertical line illustrates the location of the Trigger Position that you selected in Recording Options.

- Pre-Trigger progress is 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 indicator wiggles as it waits for the trigger.
- After the trigger occurs, the field to the right of the Trigger Position fills with the after-trigger color specified in the Display Options.
- When recording is complete, the upper half of the progress indicator fills with white, indicating the progress of the data upload to the host machine.

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 Status Bar adjusts accordingly to begin uploading the most recently recorded data.

The indicator 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 indicator is normalized to fill the space within the Status Bar.

4.6.2 Recording Status

During recording, the current Recording Status is in a segment. When you activate the **Record** function, this segment flashes a message depending on the selected Recording Options, such as **Waiting for Trigger**, **Uploading** or **Rec/Uploading**.

The status bar displays **Waiting for Trigger** while waiting for trigger to occur based on the settings defined in the Recording Options.

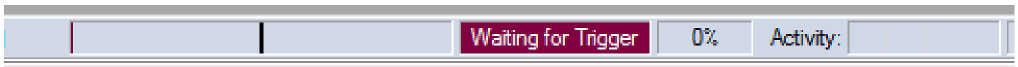


Figure 4.9: Status Bar - Waiting For Trigger

The status bar displays **Uploading** when recording is complete and is being uploaded.

Figure 4.10: Status Bar - Uploading

The status bar displays **Rec/Uploading** when recording and uploading is done simultaneously.

Figure 4.11: Status Bar - Rec/Uploading

The status bar displays **Triggered** when the trigger condition has occurred, but uploading has not commenced yet.

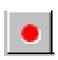
Figure 4.12: Status Bar - Triggered

The traffic data copies to disk (overwriting any previous version of this file) using the default file name **data.usb**. You can also create a file name by specifying one in the Recording Options dialog box.

To abort the upload process:

- Press **Esc** on the keyboard

OR

- Again click  in the Tool Bar.

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

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

The Partial Upload button enables when you have partially uploaded data. When you click **Partial Upload**, a dialog box displays options on what portion of data you want to upload again (see the following figure).

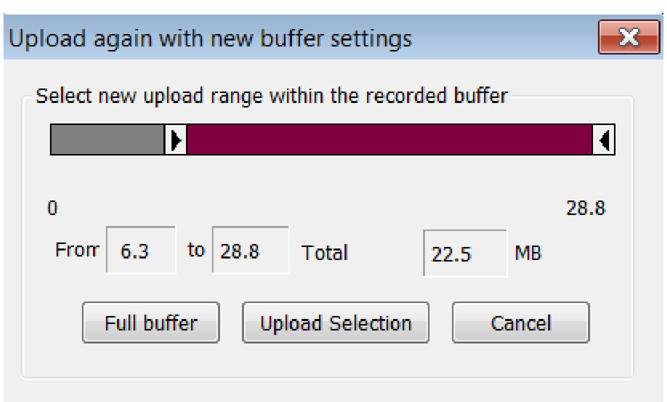


Figure 4.13: Partial Upload Options Dialog

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

- 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.

4.6.3 Recording Activity

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

The more vertical bars that display, the greater the amount of activity recording. If there are no vertical bars, there is no recording activity.

During uploading, the percent of the completed upload displays.

Note: If packets are filtered from the recording, or data are truncated, recording activity reduces.

4.6.4 Cable Status

Mercury T2C: Cable Status

The Mercury T2C has cable status LEDs on the front panel. See Figure 4.14.

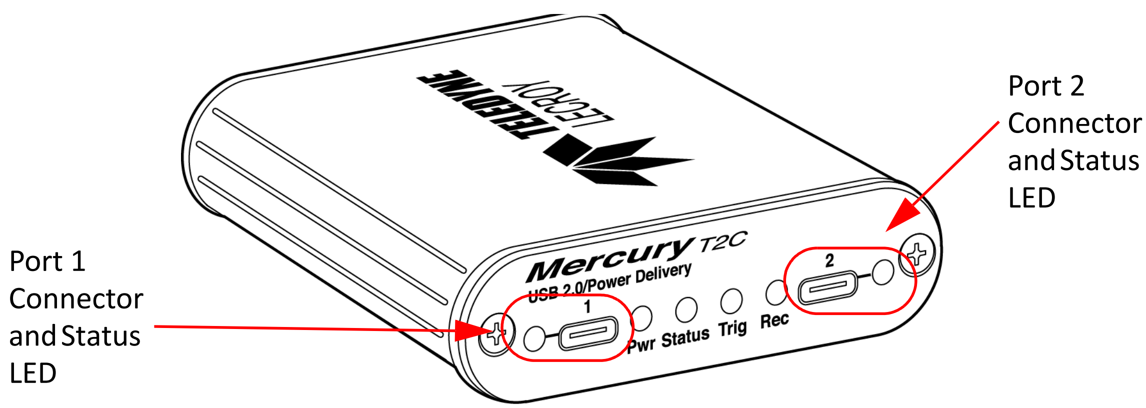


Figure 4.14: Mercury T2C “C” Connectors and LED Status Indicators

The “C” cable can be inserted into Connectors 1 or 2 on the Mercury T2C front panel right-side up (correctly) or upside down (incorrectly). If they are inserted incorrectly (upside down) the LED will glow RED. If they are inserted correctly (right-side up) the LED will glow GREEN.

Note: If the cable is inserted incorrectly, just unplug it, turn it over and re-connect it.

The status of the LEDs is mimicked by the Teledyne LeCroy USB Protocol Suite software display, in the status field at the bottom of the display. See Figure 4.15 on page 140.

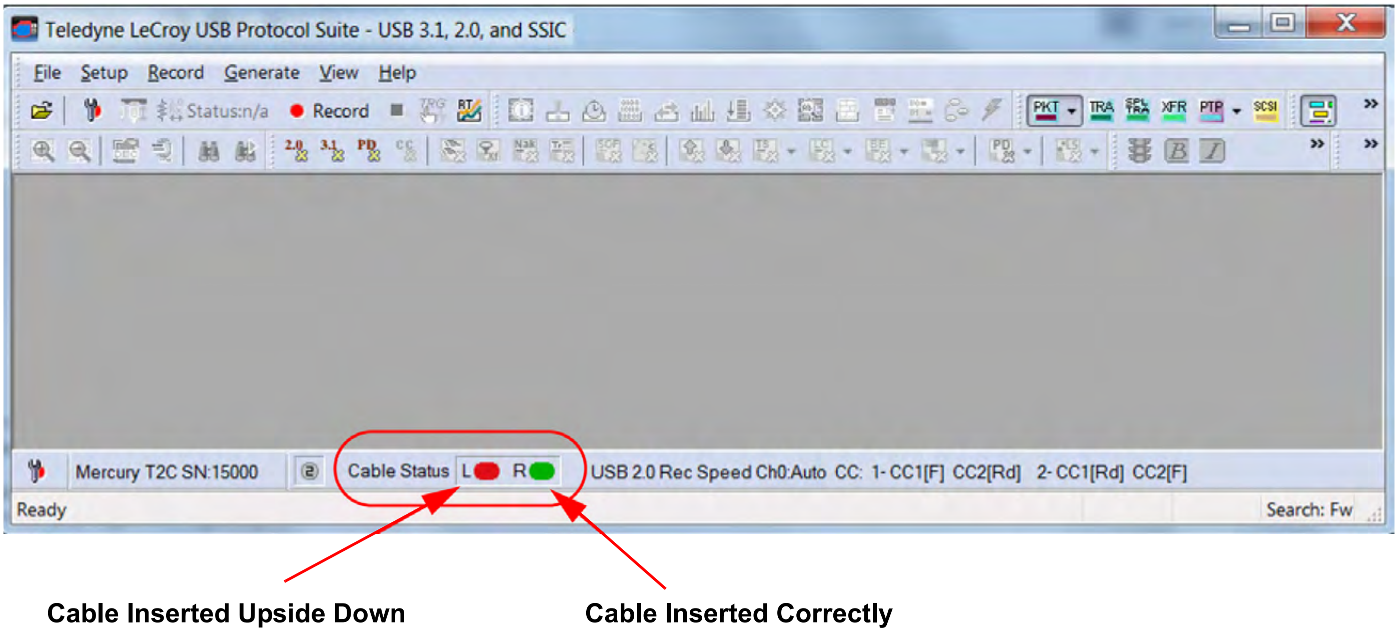


Figure 4.15: Status Bar in S/W Display Menu

Voyager 310C: Cable Status

The Voyager 310C has similar "C" cable connectors and Status LEDs. See Figure 4.16. They work in a similar way as the Status LEDs on the Mercury T2C. The Status LED operation is also mimicked in the Status Bar, at the bottom of the Teledyne LeCroy USB Protocol Suite software display menu.

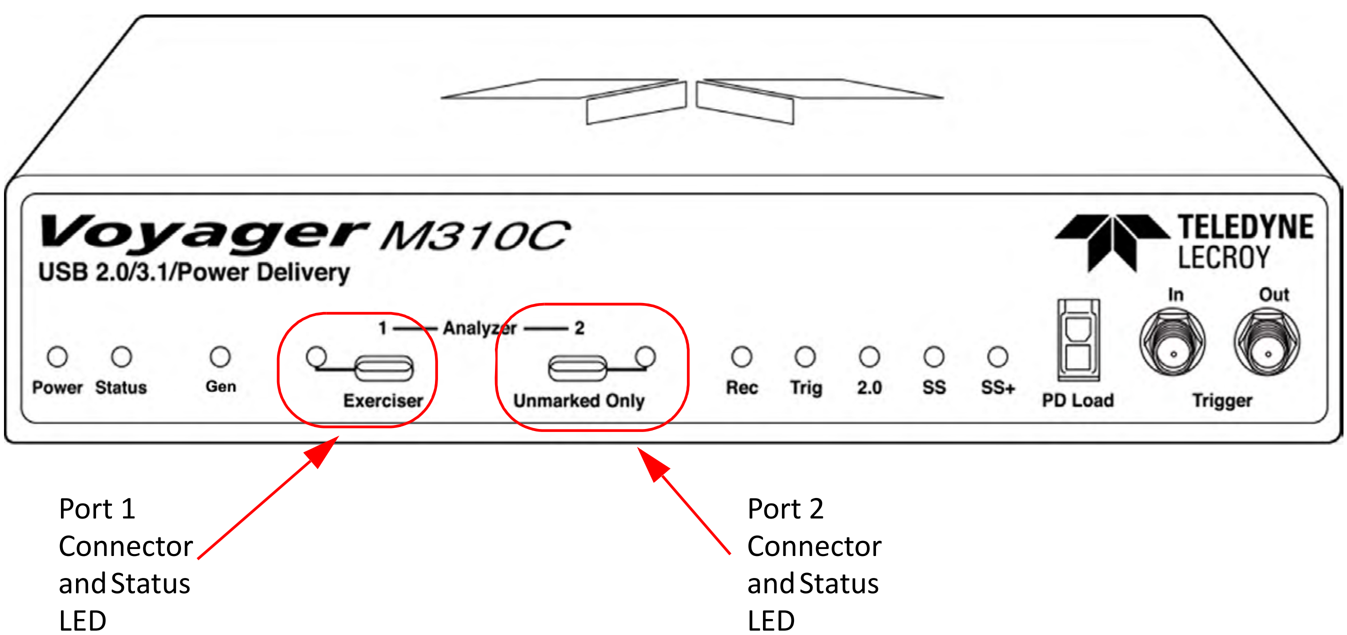


Figure 4.16: Voyager 310C: "C" Connectors and LED Status Indicators

4.6.5 Search Status

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

4.7 Device Status

4.7.1 Device Status Details Window

The status of various device characteristics, such as Terminations, Speeds, Link States etc. can be found in the Device Status Details Window. This status window can be invoked by clicking the button in the lower left section of the Status Bar (see Figure 4.17) at the bottom of the Main Menu.

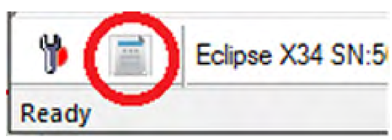


Figure 4.17: Device Status Details Window Button

This will bring up the following Device Status Details Window (see Figure 4.18).

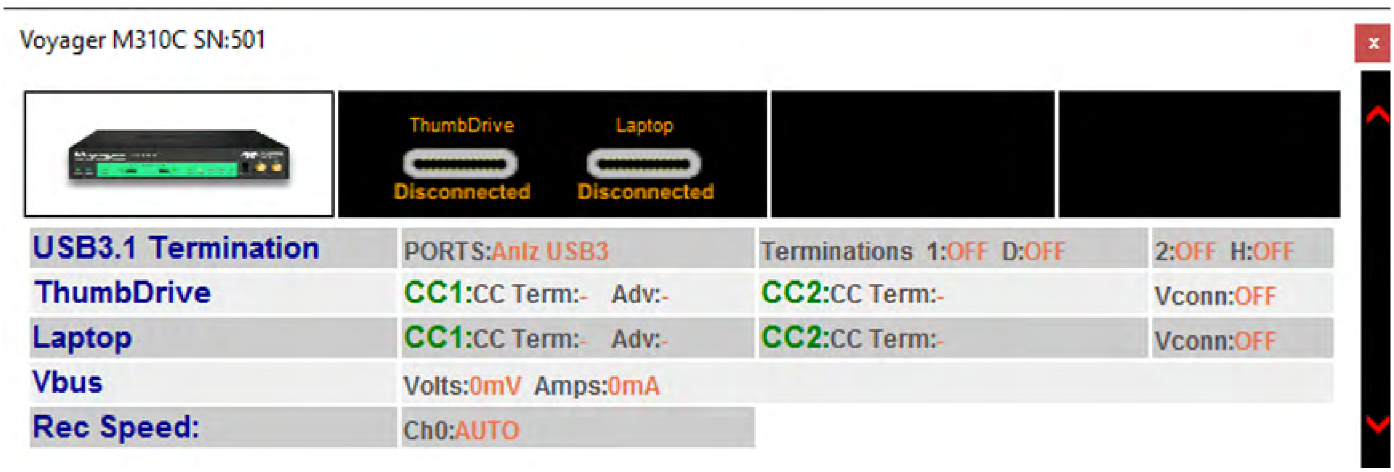


Figure 4.18: Device Status Details Window

Contents of Device Status Details Window

The contents of this window can vary with the Analyzer type being used, as well as the types of traffic being captured (2.0, 3.1, PD) The possibilities include:

1. Name of Device
   - User-assigned name from Recording Options
2. Type-C Cable Connection Inversion Status
   - **Off:** No cable attached
   - **Solid Red:** Plug is Upside Down, please invert and reinsert
   - **Solid Green:** Plug is correctly oriented
3. 3.1 Link Status
   - **Off:** No traffic or LFPS
   - **Solid Yellow:** Only Polling LFPS
   - **Slow Flashing Yellow:** Low Power States
   - **Fast Flashing Yellow:** Symbol Traffic, Training (TS1/TS2/TSEQ)
   - **Solid Green:** Link Traffic (U0) LUP, LDN
   - **Blinking Green:** TP's and DP's (actual traffic)
4. USB 3.1 Terminations

This includes the On/OFF terminations of the Unit under Test (UUT), as well as the terminations presented by the Analyzer to those uUT's. The Numbers indicate the Analyzer Terminations, the others are the DUT and HUT.

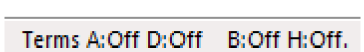
5. Type-C Cable Status
   - CC termination
   - Advertised Current Capability
   - VConn On/Off state
6. VBus Voltage and Current
7. Selected recording Speed

4.7.2 SuperSpeed Termination Status

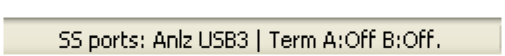
The lower right middle of the Status Bar shows the SuperSpeed Termination status.

Note: The status is the status of the Analyzer’s port, not of the device or host under test.

When in Analyzer-only mode, it shows the termination status of the Analyzer A/1 and B/2 ports AND the status of the far-end Host and Device terminations (Denoted H and D).



If the analyzer is in manual termination mode, the far end values are unknown, so they are not shown.



When in Exerciser mode, it shows the status of the Exerciser A or B port and the far end Device or Host, using the same A/1, B/2, D, H convention.

Polling occurs when the Application CPU is not busy.

The polling interval is reflected in a small dot (.) at the end of the string in the Status Bar.

Note: Terminations reflect what the Analyzer is presenting to the device or host. The Analyzer changes these terminations while attempting to connect the Host DUT and Device DUT together using the SuperSpeed connection protocol. For more information about the Recording buttons, see "Recording" on page 128.

4.7.3 Link Status

The circles 2 and 3 on the lower right of the Status Bar represent the equivalent colors of the link states for USB 2.0 and USB 3.1.

Analyzer

3+	USB 3.1 SS+
Off:	No traffic or LFPS.
Solid Yellow:	Only Polling LFPS
Slow Flashing Yellow:	Low Power States
Fast Flashing Yellow:	Symbol Traffic, Training (TS1/TS2/TSEQ)
Solid Green:	Link Traffic (U0) LUP, LDN
Blinking Green:	TP's and DP's (actual traffic)
3	USB 3.1 SS
Off:	No traffic or LFPS.
Solid Yellow:	Only Polling LFPS
Slow Flashing Yellow:	Low Power States
Fast Flashing Yellow:	Symbol Traffic, Training (TS1/TS2/TSEQ)
Solid Green:	Link Traffic (U0) LUP, LDN
Blinking Green:	TP's and DP's (actual traffic)
2 Solid Yellow:	FS SOF's, LS EOP's, or control endpoint traffic
Slow Flashing Yellow:	LS Traffic on endpoints other than 0 (resets activity timer as in 3.1)
Fast Flashing Yellow:	FS Traffic on endpoints other than 0 (resets activity timer as in 3.1)
Solid Green:	HS SOF's or control endpoint traffic
Flashing Green:	HS traffic on endpoints other than 0 (resets activity timer as in 3.1)

Exerciser

3+		USB 3.1 SS+
	Off:	No traffic or LFPS.
	Solid Yellow:	Only Polling LFPS
	Slow Flashing Yellow:	Low Power States
	Fast Flashing Yellow:	Symbol Traffic, Training (TS1/TS2/TSEQ)
	Solid Green:	Link Traffic (U0) LUP, LDN
	Blinking Green:	TP's and DP's (actual traffic)
3		3.1 SS
	Off:	No traffic or LFPS.
	Solid Yellow:	Only Polling LFPS
	Slow Flashing Yellow:	Low Power States
	Fast Flashing Yellow:	Symbol Traffic, Training (TS1/TS2/TSEQ)
	Solid Green:	Link Traffic (U0) LUP, LDN
	Blinking Green:	TP's and DP's (actual traffic)
2		USB 2.0 unused

Note: USB Type-C™ Connector Ports Insertion Status (Voyager M310C only)
Off: No connector inserted
Red: Connector inserted up-side down. Please unplug, flip, and re-insert.

Note: USB 2.0 Link LEDs operate only while USB 2.0 Recording or Real-Time Statistics (RTS) is running. USB 3.1 LEDs always operate, unless USB 3.1 has been disabled in the Recording Options General Tab.

4.8 Navigation Tools

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

4.8.1 Zoom In

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

- Click  on the Tool Bar.

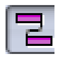
4.8.2 Zoom Out

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

- Click  on the Tool Bar.

4.8.3 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.

4.9 CrossSync Control Panel

The CrossSync Control Panel allows you to select analyzers for synchronization and manage the recording process.

4.9.1 Launching the CrossSync Control Panel

To launch CrossSync from the USB Protocol Suite software application, select the **Setup > Launch CrossSync Control Panel**. Or, you can launch CrossSync from the 'Start' menu.

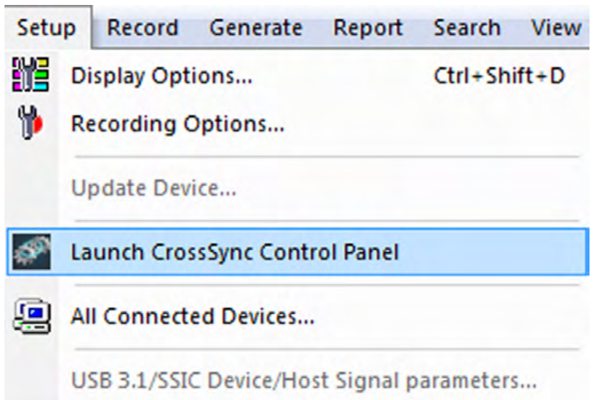


Figure 4.19: Launching CrossSync from the USB Protocol Suite Application

For more information, refer to the *CrossSync Control Panel User Manual*.

Note: If you are using CrossSync, USB Compliance Suite, or any application that uses the Automation Interface to the USB Protocol Suite, and the system prompts you that it cannot write a trace file to disk:

1. Make sure that the trace-file destination folder has write/create permissions. (For example, the target directory might be the network file system, which typically does not have write/create permissions.)
2. Make sure that the Windows (or other) Firewall Settings for USB Protocol Suite are set to **Public**.

4.10 Analyzer Keyboard Shortcuts

Several frequently-used operations have keyboard shortcuts, they are listed below.

Operation	Key Combination
Trace Navigation	
Find Next	F3
Search Backwards	Ctrl+B
Search Forwards	Ctrl+F
Jump to First Packet	Ctrl+Home
Jump to Last Packet	Ctrl+End
Go to Any Error	Shift+E
Go to Channel 0	Ctrl+Shift+0
Go to Channel 1	Ctrl+Shift+1
Go to Trigger	Ctrl+Shift+T
Move packet selection up	Shift + Up Arrow
Move packet selection down	Shift + Down Arrow
PID	
Go to ACK	Shift+A
Go to DATA0	Shift+0
Go to DATA1	Shift+1
Go to DATA2	Shift+2
Go to DATAx	Shift+D
Go to IN	Shift+I
Go to MDATA	Shift+M
Go to NAK	Shift+N
Go to NYET	Shift+Y
Go to OUT	Shift+O
Go to PING	Shift+G
Go to PRE/ERR	Shift+P
Go to SETUP	Shift+S
Go to SOF	Shift+F
Go to SPLIT	Shift+X
Go to STALL	Shift+L
Go to EXT	Shift+R
Bus Conditions	
Go to Reset	Shift+T
Go to Resume	Shift+6

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

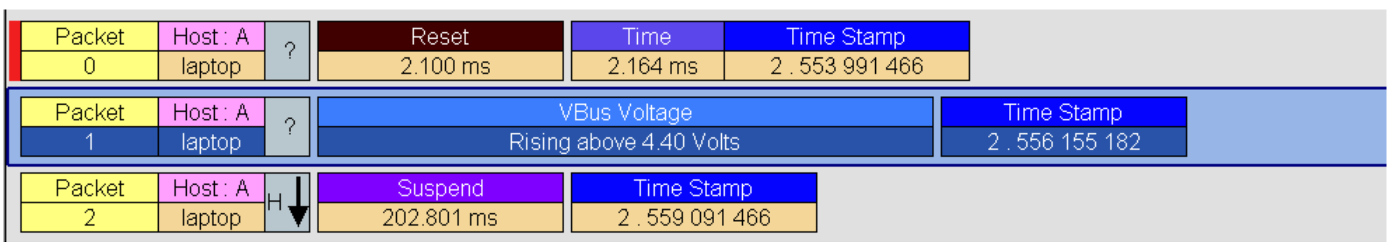
Chapter 5

Reading a Trace

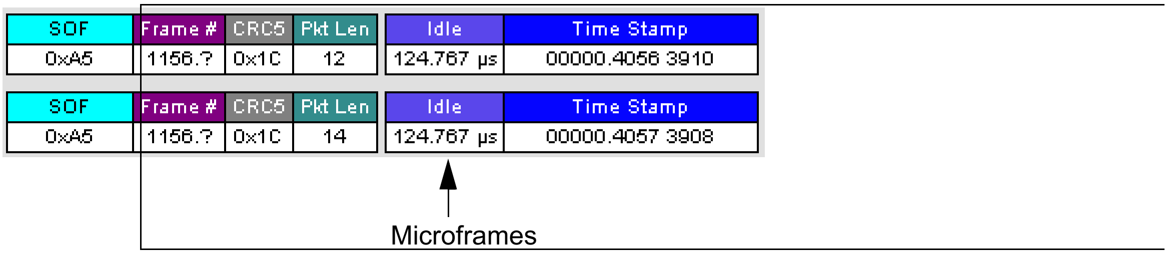
5.1 Trace View Features

The Trace View has these features:

- Packet view display uses color and graphics to document captured traffic.
- Selected packets, transactions, and so on, are highlighted with a blue background and black border. The selected packet is synchronized amongst views. Views which show data from a single packet, transaction, etc., (Data View, Detail View, Spec View) will show the contents of this Selected Packet.



- To move packet selection up or down, click **Shift-Up-Arrow** or **Shift-Down-Arrow**
- Packets are on separate rows, with individual fields both labeled and color-coded.
- Packets are numbered (sequentially, as recorded), time-stamped (with a resolution of 8 ns), and highlighted to show the transmitted speed (low-speed, full-speed, or high-speed).
- Display formats can be named and saved for later use.
- Pop-up Tool Tips detail the contents of packet fields.
- Data fields can collapse to occupy minimal space in the display, and you can zoom in and out to optimize screen use.
- The display software can operate independently of the hardware and so can function as a stand-alone Trace Viewer that may be freely distributed.
- High Speed SOFs display Microframes (shown below.)



5.1.1 Anchor Points - Synchronized Views

Anchors are provided to indicate the synchronization points between views when scrolling. These are indicated by  a goldenrod Trapezoid. When views are synchronized, the time denoted by these anchor points in the different views should be the same.

The position within the views are different according to the type of view window. The Anchor is normally the first packet on the screen in the CATC Trace views and Spreadsheet Views. Refer to Figure 5.19 through Figure 5.3.

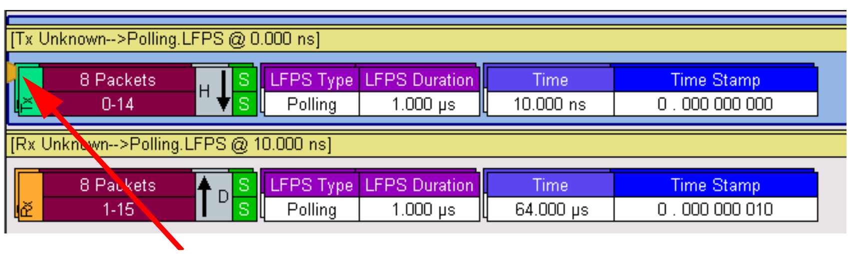


Figure 5.1: Anchor Point in the CATC Trace View

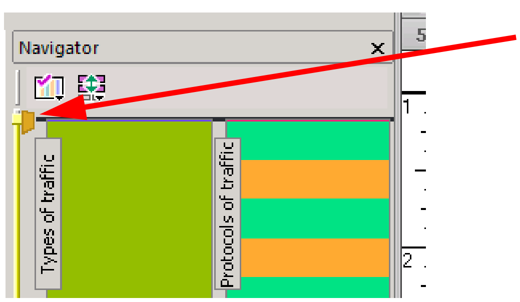


Figure 5.2: Anchor Point in the Navigator Panel

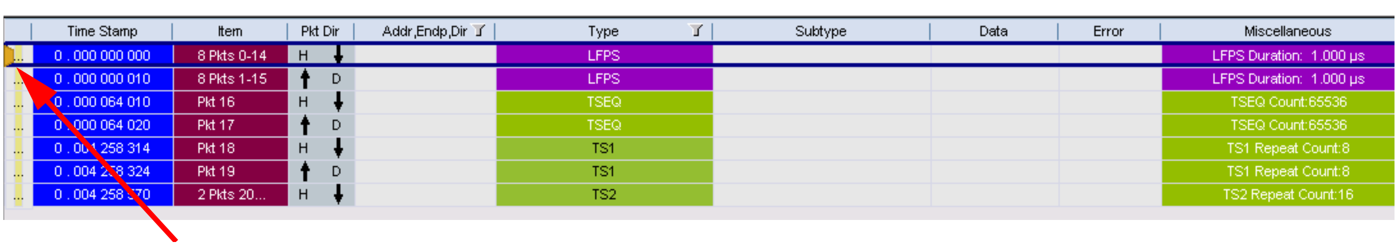


Figure 5.3: Anchor Point in the Spreadsheet View

In the Link Tracker view, it is normally on the third row of the display (see the following screen capture).

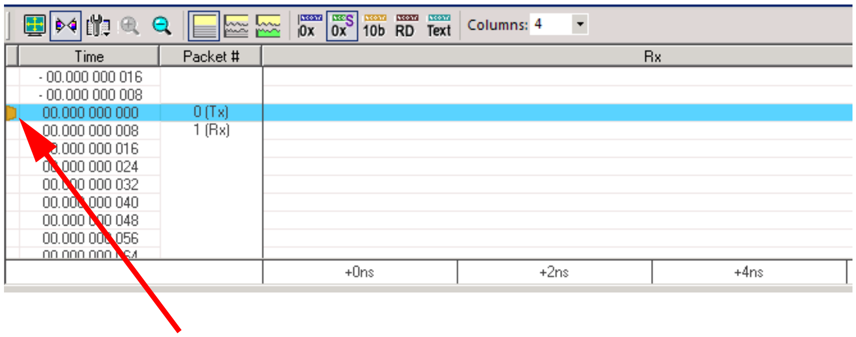


Figure 5.4: Anchor Point in the Link Tracker View

On time based views, (Link State Timing View, Power Tracker View, Bus Utilization View, etc.), it is normally in the center. Refer to the anchor point in the Power Tracker View in the figure below.

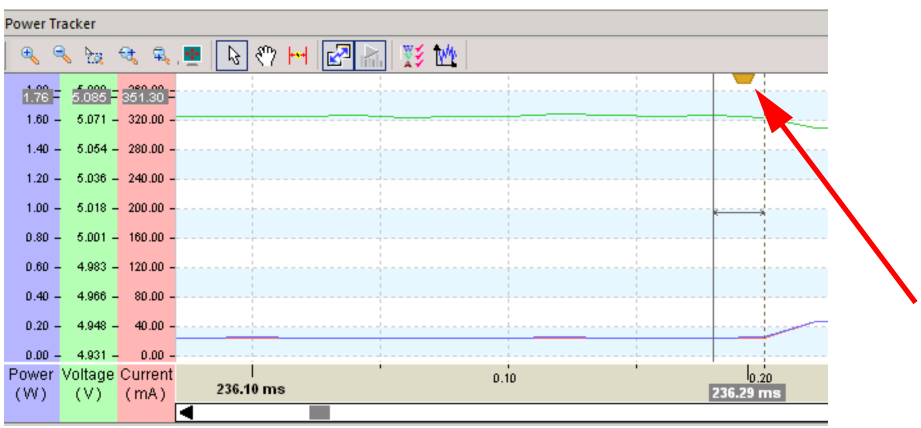


Figure 5.5: Anchor Point in the Power Tracker View

The Anchor point can be independent of the current selected item, although you can move the selected item to the anchor point by double-clicking on it. Double-clicking selects it and moves it to the Anchor Point.

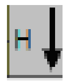
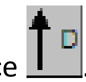
5.1.2 USB 3.1 Packets

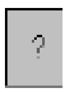
USB 3.1 has the following packet types:

- Link Commands (Flow Control)
- Link Training Sequences (TS1, TS2, TSEQ)
- Logical Idle Packets
- Upstream Packets
- Downstream Packets
- Skip Sequences
- ISO Time Stamp Packets
- Inter-Packet Symbols (unexpected packets)

- Link Commands (other than Flow Control)
- LMP Packets
- Electrical Idles
- LFPS Packets
- Termination Packets (Time stamped when termination is detected by Analyzer)
- VBus On/OFF

5.1.3 Packet Direction

The Packet Direction field displays the direction the packet or signal was traveling on the bus: Downstream from a Host  or Upstream from a Device .

In most cases, direction can be determined unambiguously. However, some signals and situations, including protocol errors, cannot be determined with high confidence, since either Host or Device might be responsible for them. Such cases are marked as Question Marks  in the trace.

Rather than mis-identifying the signal, the software requires you to determine direction (or note an error condition, which experience has shown is rare). In most cases, you can assume the direction based on the sequence of events that occurred.

5.1.4 Power Delivery Packet Direction

Power Delivery Packets occur on a multi-drop connection. For the Consumers and Providers of Power Delivery, the direction is indicated by the Sink and Source directions cell, and the message is indicated as an SOP type. See Figure 5.6: .

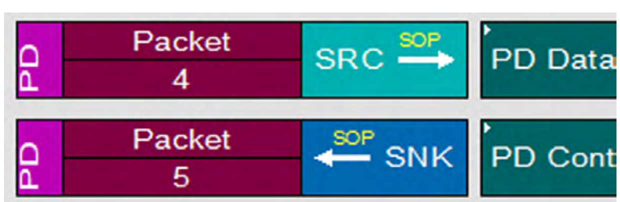


Figure 5.6: Power Delivery Packet Direction

For Cable packets, the indicator is that the source or destination is an SOP' or SOP'' source or destination, as shown below in

Figure 5.7: Cable Packet Power Delivery

5.2 Markers

This section explains the features of Markers. A marker is an entity that flags a physical or logical item of interest within a trace file. A marker contains one or more attachments. You can add a marker to a trace file or unmark a trace file by removing the marker.

Markers are represented graphically in a different way in the application.You can not only add markers to the packets but it is granular enabling you to also add markers to individual cells.

5.2.1 Markers Overview

This functionality provides the user an easy way to navigate through attachments which is a discrete piece of information or data added to a marker, for example, a text description or file, an attachment of a trace file by a predefined order, video or audio files, URL links or any other files.

5.2.2 Functionality of Markers

The markers functionality allows you to add markers to:

- Whole packets or frames
- Specific Cells
- Specific values within a cell: Bytes, words, etc.

You can add attachments to markers (see Figure 5.8 on page 153).

Right-click on any cell of a packet and select **Set Marker** from the menu as shown below or click **Ctrl +K.**

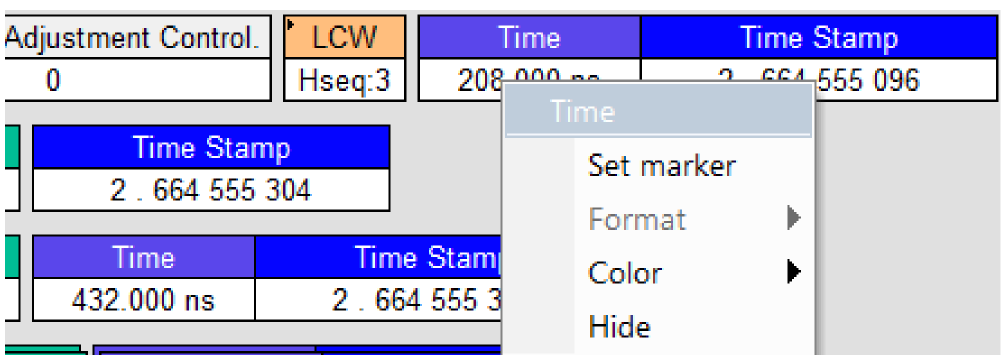


Figure 5.8: Time Dialog

The Create Marker dialog displays.

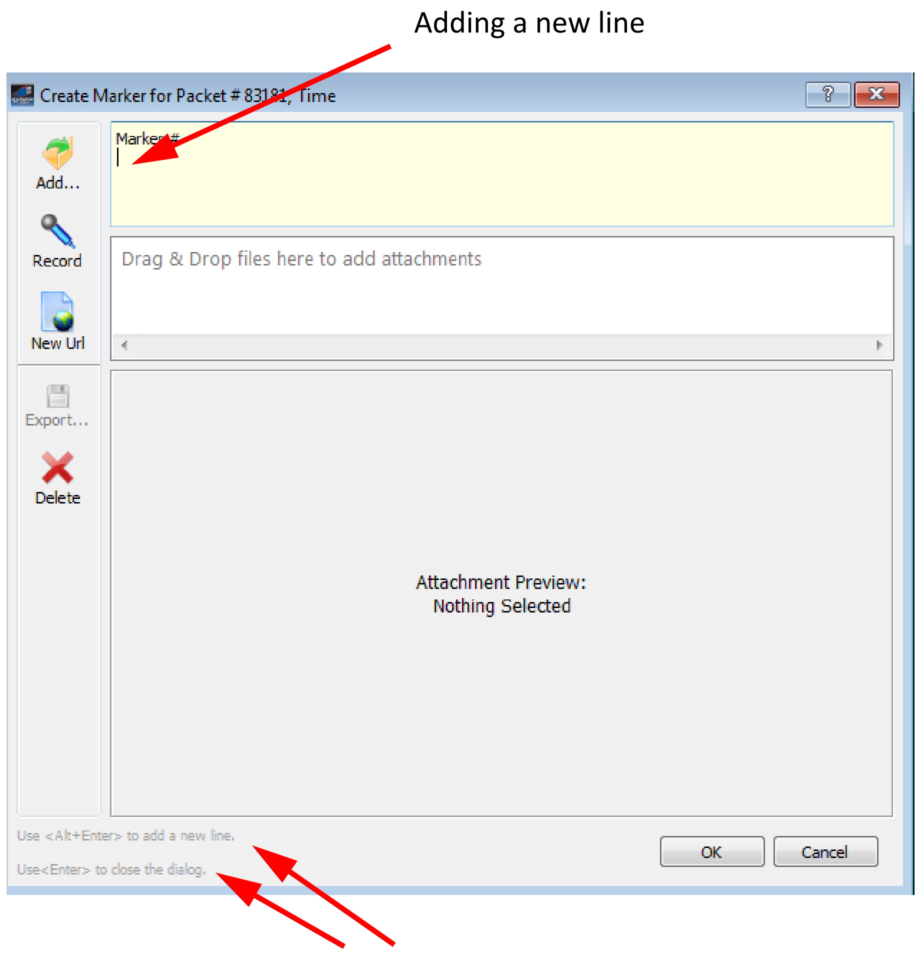
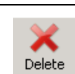
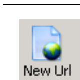


Figure 5.9: Create Marker for Packet Dialog

Click **Enter** to close the Marker dialog.

Click **ALT+Enter** to add a new line.

As shown above you can:

	Add icon. Click on this icon to add any file. See “Adding an Attachment” on page 155.		Export icon. Click on this icon to export an attachment.
	Record icon. Click on this icon to record audio. See “Recording an Audio File” on page 156.		Delete icon. Click on this icon to delete an attachment
	New URL icon. Click on this icon to add any URL.		

5.2.3 Attaching Markers

You can attach a discrete piece of information/data to a marker, for example, a text description or file, an attachment of a trace file by a predefined order, video or audio files, URL links or any other files. You can also remove an attachment from a Marker.

5.2.4 Adding an Attachment

Perform the following steps to add an attachment to a marker:

1. Right-click on any cell in the trace and select **Set Marker.**

   The Create Marker window displays.
2. Click on the **Add** icon.

   The **Add File to the Marker** dialog displays.
3. Go to the file and select it to add it to the marker as an attachment.
4. Click **Open**.

   The file will appear in the Create Marker for Transfer... dialog (see Figure 5.10 on page 155). The Marker # appears in the top panel, the icons are displayed in the second panel and you can click on the icon on the third panel to view the file you are about to attach.
5. Click **OK** to add the attachments.

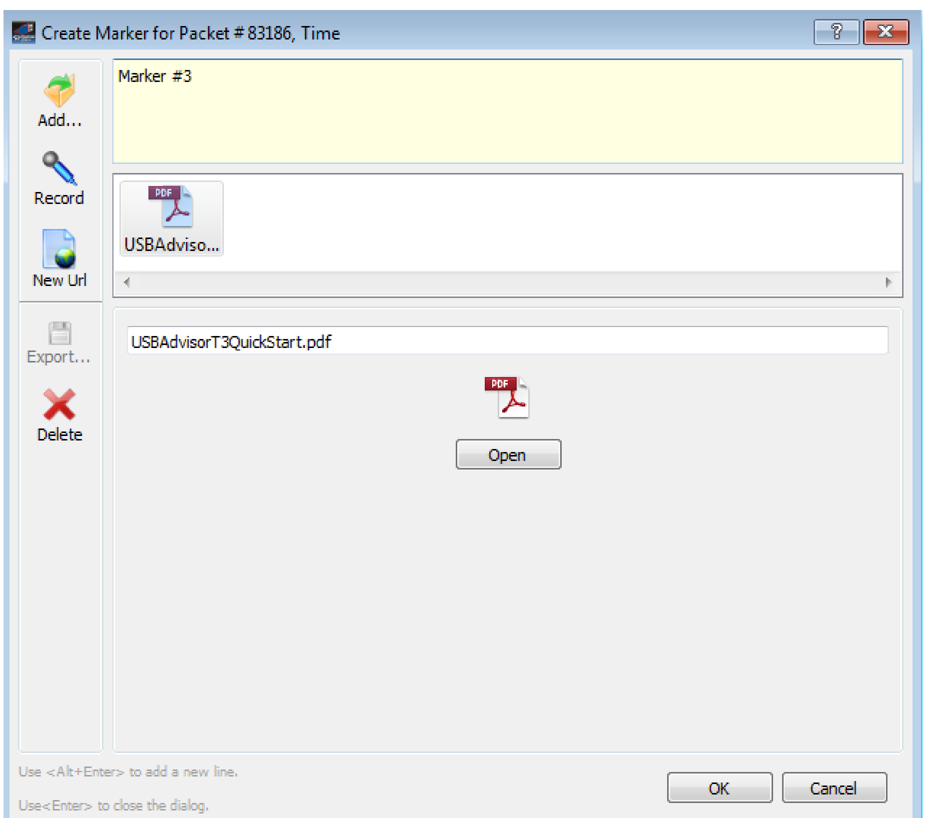


Figure 5.10: Create Marker for Transfer Dialog

5.2.5 Recording an Audio File

The audio quality supports voice attachment and is not designed for high-quality audio Playback of audio content is not limited and depends on the formats supported by the installed playback engine.

Click the record icon and speak into the microphone to record an audio file.

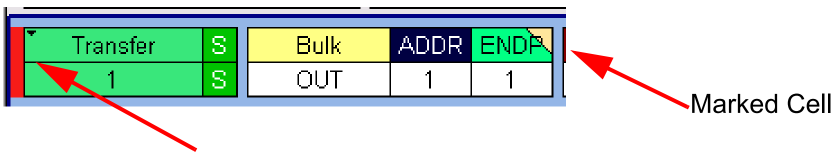
Note: This functionality is disabled if a microphone is not installed.

5.2.6 Video Files supported

The user can attach video clips to the trace file ("add to the marker"). The playback of the Video clips is limited to the formats that are supported by the video codecs installed in the system.

5.2.7 Attachment Types and Visualization

The markers are represented graphically by a yellow triangle at the top right of the marked item and a red vertical bar at the left-most cell of a packet as shown below.



A marker may comprise any number of attachments of any types.

5.2.8 Embedded Attachments to a Marker

Embedded files are attached to the item marked and transported with the trace. You can embed the following types of files to a marker:

- Audio Files
- Video Files
- Image Files
- YouTube Files
- Web Pages
- Text Attachments
- Other Attachments

Attachments are embedded in the marker and saved in the trace file. Once attachments are placed in a marker, the marker can then be presented to a user in a story structured form. On opening the marker the window resembles the marker editing dialog.

Note: The use of Audio and Video markers is limited to the file types supported on a user's system. CATC Walk has been tested with .mp3 and .wmv files, which are supported by Windows as installed. If additional codecs are installed, they should also work, but it is the user's responsibility to choose formats that will work for whomever they intend to exchange CATC trace files (no different than email attachments in this regard). Because of this dependency on installed codecs, there are situations where bugs in the codecs supplied by Microsoft or third-party applications can prevent proper operation of the USB Protocol Suite application. See the USB protocol Suite Read-Me file for more information if you have problems with application crashes, etc.

5.2.9 Viewing Attachments of a Marker

If you hover over the marked cell (yellow triangle at the top right of the marked item), refer to "Attachment Types and Visualization" on page 157, a window pops up displaying the contents of the marked cell (see Figure 5.11 on page 158).

While hovering over the marked cell, it can start playing the start of the audio or video file, but it will stop after a short time due to the Analyzer PC's system timeout for Tooltips.

You must click on it to open the audio or video attachment for further listening or viewing.

To view an attachment you can click on any of the icons in the attachment bar and or you can double-click on the icon itself to open the attachment.

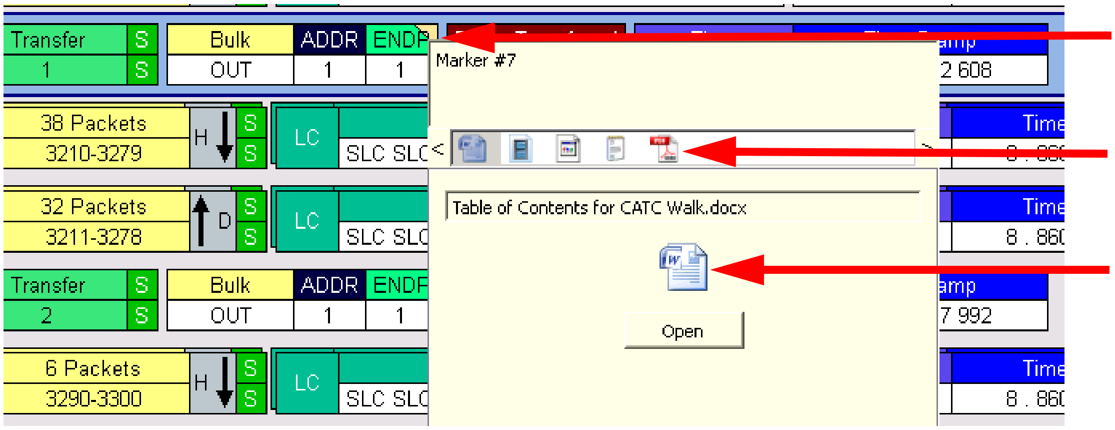


Figure 5.11: Pop-up Displaying Marker Contents

Text

The text attachment is displayed in the icon bar and in the main pop-up window. Text attachments are always shown at the top. The attachment file name is displayed in the field as shown below.

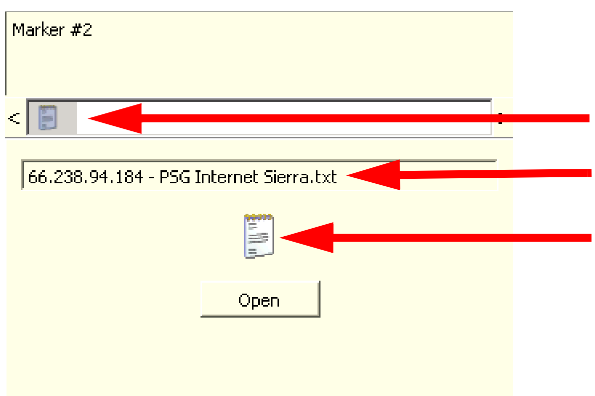


Figure 5.12: Text Attachment Pop-up Window

If there is no attachment, **No Attachments** displays in the status bar at the bottom.

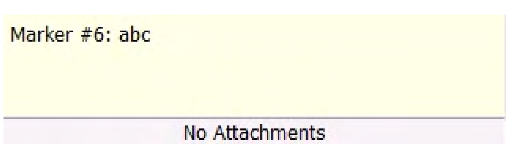


Figure 5.13: No Attachments Pop-up Window

If there are attachments, the status bar is hidden. You can move the cursor to an attachment icon in the list view and a preview of the attachment starts.

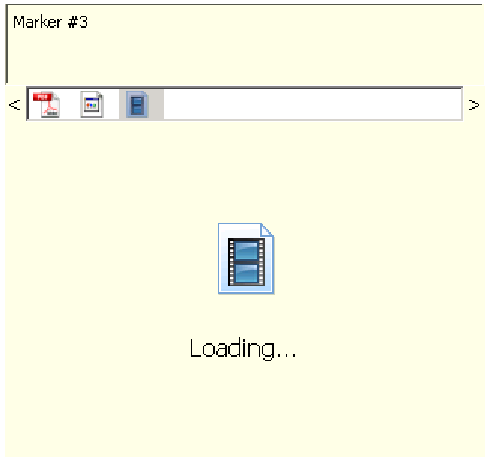
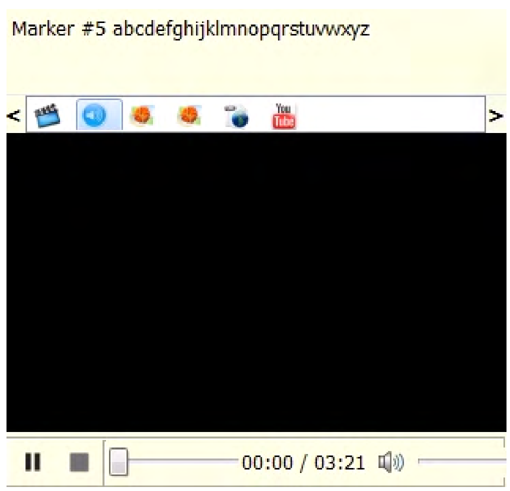


Figure 5.14: Preview Attachments Pop-up Window

Audio

Audio snippets that are recorded and attached to certain point of interest in a trace can be played. The basic Play, Start, Stop, Pause buttons are displayed to listen to the audio file.



Video

Video clips that are recorded and attached to certain point of interest in a trace can be played. The video is embedded in the tooltip with simple playback controls.

File Attachment

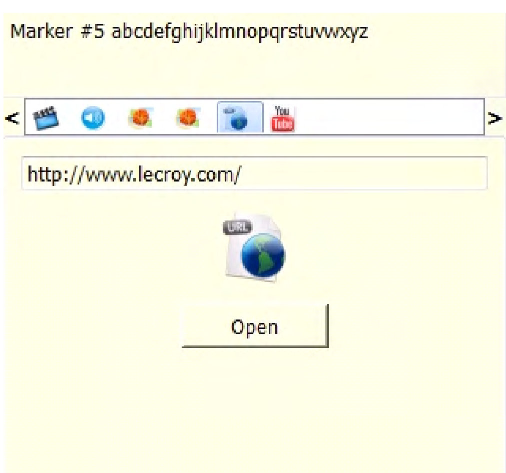
You can attach any kind of file, including images, PDFs, documents, media files, etc.

URL Link

You can specify a URL that links to a web page (i.e., YouTube), a network location, or a local file-system location.

Web Link

Due to the small size, the web page is not embedded in the callout. You can use the **Open** button to open the web link in the default web browser.



YouTube Video

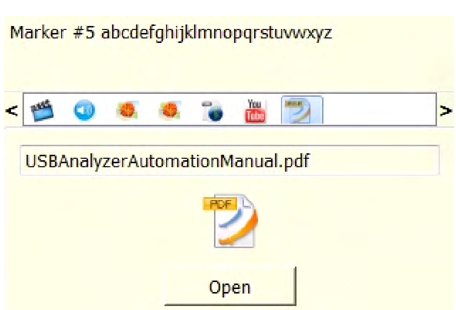
YouTube's video player is embedded for YouTube Video playback.

Images

The image is embedded in the trace.

Other Attachments

Click the **Open** button to open the attachment file with the system's default application for that file type.



5.2.10 Edit Marker

To edit a marker, right-click on the marked item and select **Edit marker** from the menu or **Ctrl + L.** The Edit Marker dialog displays. This Edit Marker window can be used to edit one marker at a time.

You can do the following in the Edit Marker dialog:

- Edit text attachment.
- Record audio attachment.
- Add URL link attachment
- Add a file attachment. Click on **File** and click the **Open** button or drag and drop the file.
- Preview audio/video/image/URL/YouTube attachment or open other files with system default application.
- Save an attachment to a file.
- Remove attachment.

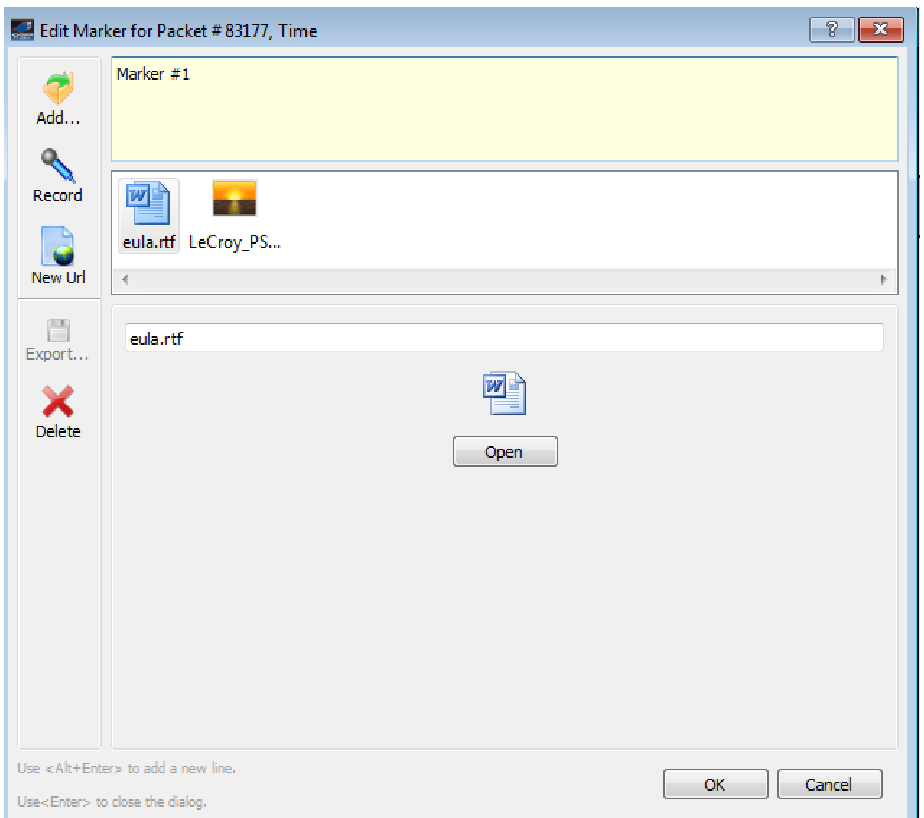


Figure 5.15: EDIT Marker for Packet Dialog

5.2.11 All Markers Window

Select **Search > Go to Marker > All Markers** or press **Ctrl + M** to display a list of all the markers in the file. The window uses a tree structure to show packets, fields and markers. The features of the Markers window are:

- All Markers are displayed
- All attachments within the marker are displayed. Hovering over the marker displays a tool-tip displaying the size of all the attachments.
- You can collapse or expand the item marked to view the attachments
- The Time and size of audio and video files are displayed
- You can edit Playlists from this window
- You can edit, delete a marker or delete all markers from this location
- You can filter attachments within the marker
- You can select a range of markers by clicking **Shift** and selecting a range
- You can select multiple markers by clicking **Ctrl** and selecting individual markers
- Double-click on a marker to go to that marker in the trace and close the dialog

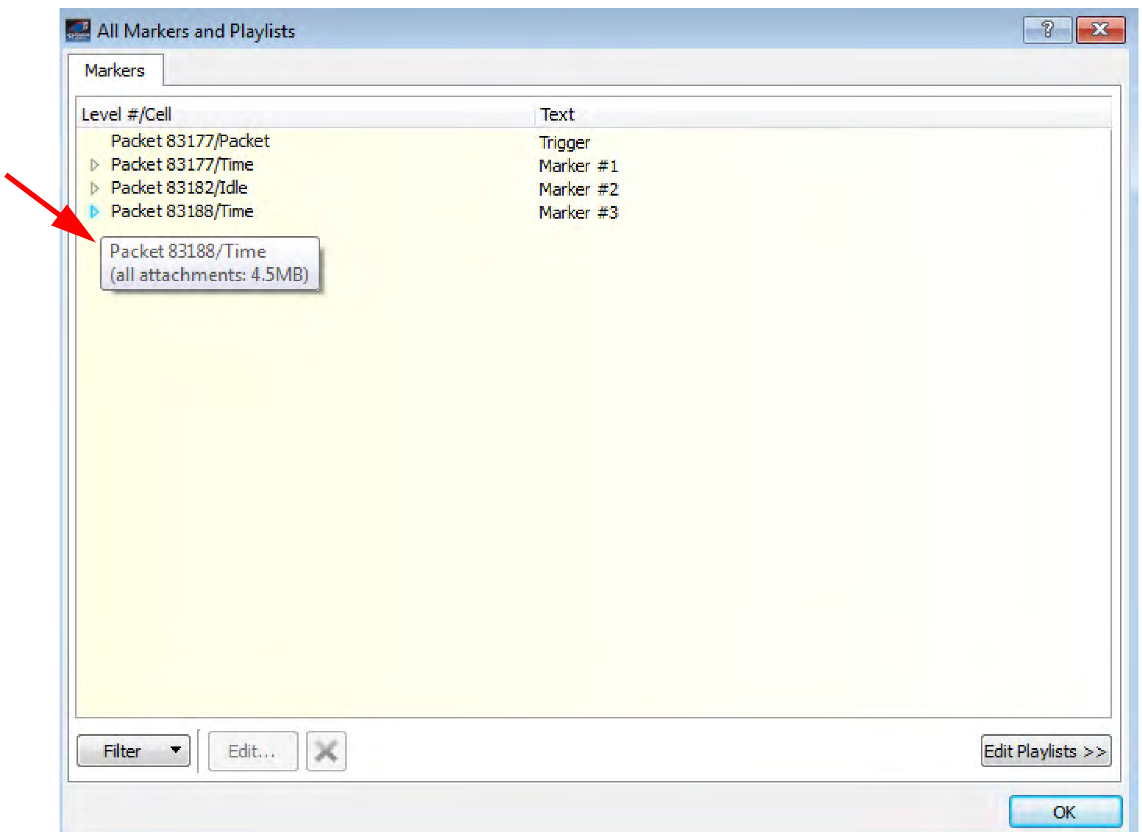


Figure 5.16: Edit Marker Dialog

Clicking delete on markers to delete markers with attachments displays the Delete Marker(s) dialog. Checking the "Don't ask again" checkbox will not display this confirmation dialog again (see Figure 5.17 on page 164).

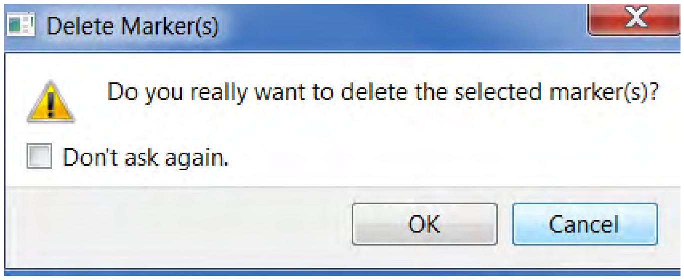


Figure 5.17: Confirmation Dialog

You can filter to show or hide text, image, audio, video, URL, YouTube videos and other files.

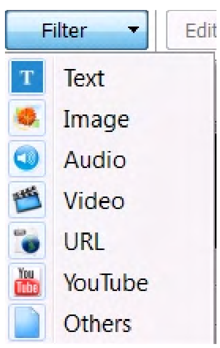


Figure 5.18: Filter Dialog

5.3 CATC Walk Playlist

This feature allows users to configure sequences of attachments into playlists. Any arbitrary order of attachments are allowed, and there are no limits on the number of playlists supported. This feature can be used for collaborating among developers as well for training, support and marketing purposes.

To access a playlist click on the **View** menu in the top toolbar of application, select **CATC Walk** and then select **Manage Playlists** (see Figure 5.19 on page 165).

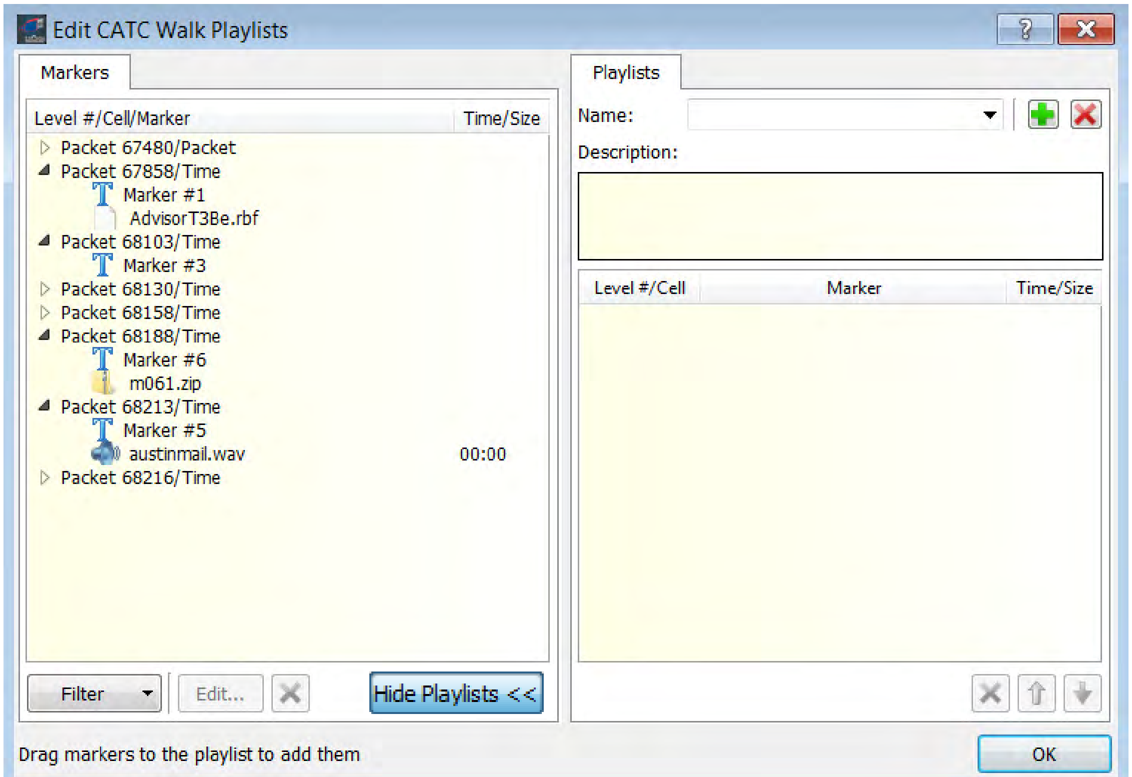


Figure 5.19: Edit CATC Walk Playlists Dialog

5.3.1 Playlist Functionality

You can do the following to manage playlists:

- Remove or edit current playlists
- Edit the playlist name
- Edit the playlist description
- List the sequence of attachments in current playlist
- List of all available attachments and drag/drop to a playlist.

As shown in the previous figure the Playlist window lists the markers with their attachments on the left and the playlist on the right (see Figure 5.20 on page 166).

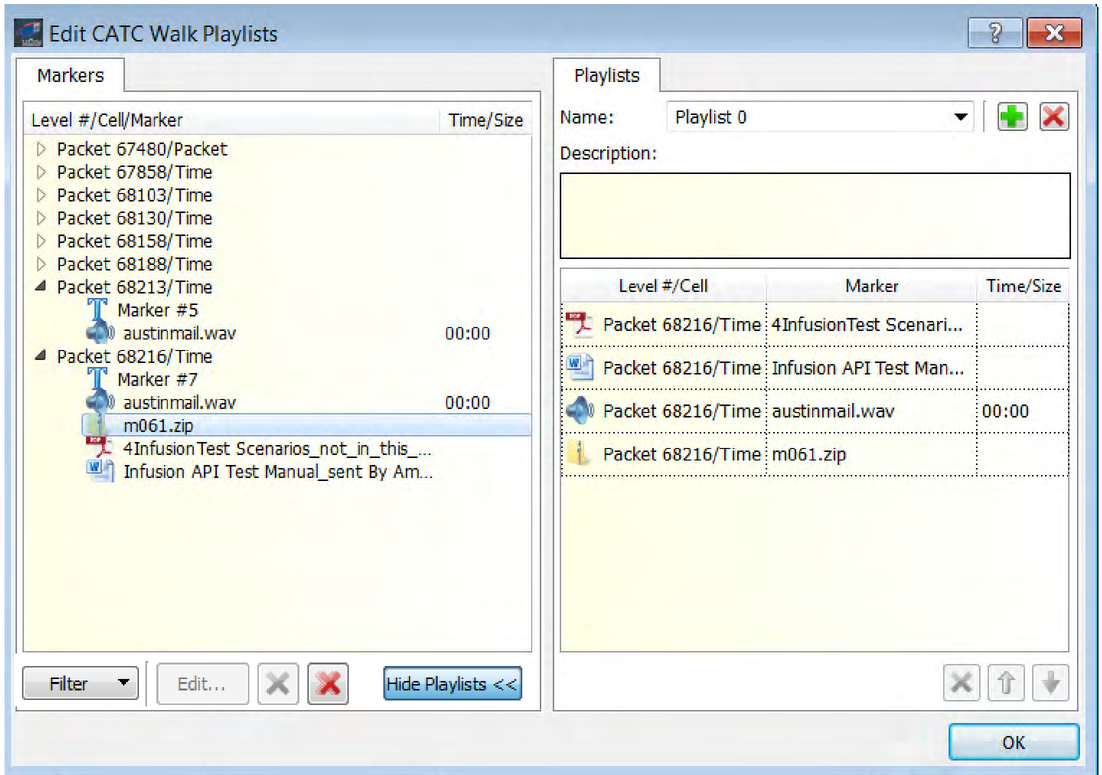


Figure 5.20: Edit CATC Walk Playlists Dialog

You can drag and drop and item or attachment from the **Marker** panel into the **Playlist** panel and build a story. Give a description of the playlist in the **Description** field and you can give a name to the playlist in the **Name** field.

You can add a new playlist by clicking on the green plus sign (+) on the right top corner of the Playlist panel, or delete a playlist by clicking the red (x) button.

If you have more than one playlist saved click on the Name drop-down arrow to select it. The drop-down menu lists all the available playlists

5.3.2 Playback Window

To playback a playlist, click on the **View** menu in the top toolbar of application, select **CATC Walk** and then select **Play > Playlist 1** as shown below.

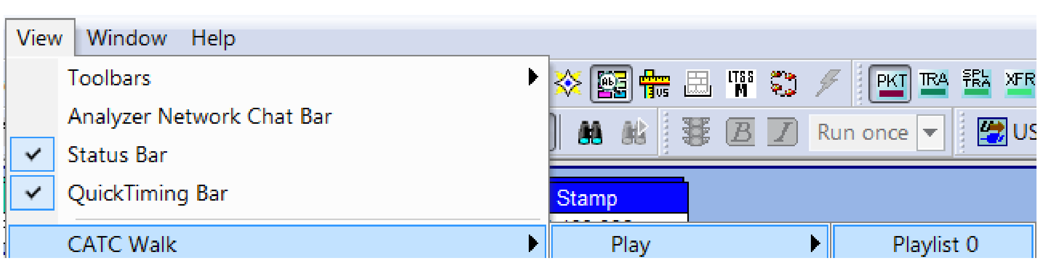


Figure 5.21: View Dialog

The attachment item starts to play in the playback window (see Figure 5.22 on page 167).

Figure 5.22: Playback Window

The playback window is resizable. The close button at the top right corner and the size grip for resizing at the bottom right corner will hide automatically when moving the cursor out of the window.

Users can provide commentary to a captured trace, converting it into a script or a story and can transfer this meta-information to others. Playlist Playback Controls.

Playlist Playback Controls

The playlist playback control buttons are:

- Play/Pause
- Stop
- Jump to Next attachment
- Jump to Previous attachment
- Seek slider for seeking to positions in media streams
- Volume slider
- Playback speed slider (for text attachments)

As a playlist is played back, the playback window is displayed in close proximity to the marked area, just like a regular tooltip window (see Figure 5.23 on page 168).

As the playback progresses, the view jumps to the element corresponding to the current attachment being played and the marked element is highlighted. During playback the user is prevented from interacting with the trace. To reinforce this restriction, the trace view is grayed-out visually, and only the packet with the item corresponding to the current attachment is colorized.

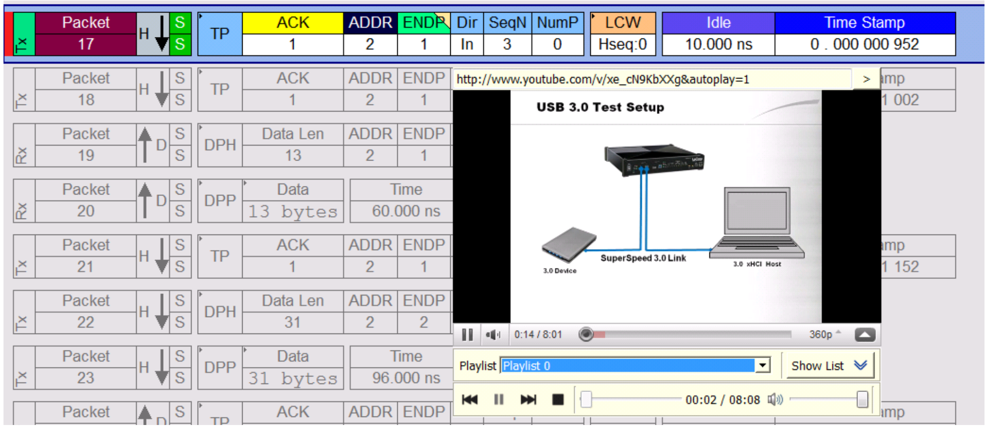


Figure 5.23: Playlist Playback View

5.4 Time Stamp

The Time Stamp field displays the time in "Seconds.Nanoseconds" (decimal).

The Time Stamp is at the beginning of the packet or bus condition. However, the Time Stamp is at the end of Sync for Low and Full Speed packets.

In the General tab of the Display Options, you can set the Time Stamp Position to be **At the end, At the beginning**, or **Merge with Packet/Transaction/Transfer**. See "General Display Options" on page 232.

To change the time stamp, right-click the **Time Stamp** field to display the Time Stamp menu:

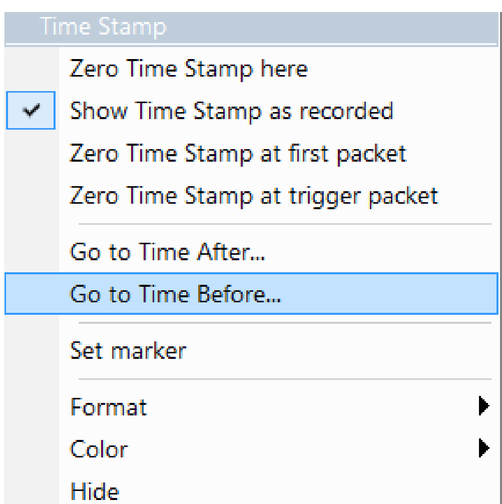


Figure 5.24: Time Stamp Dialog

You can:

- Place the Zero Time Stamp at this packet
- Show the recorded Time Stamp
- Place the Zero Time Stamp at the first packet
- Place the Zero Time Stamp at the trigger packet.

Note: You cannot place the Zero Time Stamp at a packet when in the Calendar.

You can also go to the Time After in seconds, or the Time Before in seconds.

Note: Time stamps are corrected to match our more accurate 2.5 ppm clock. After the error due to calculating via 2 ns nominal timing of symbols reaches 8 nsec, the system will correct the next time stamp by using the value obtained from the 2.5 ppm time stamp clock. This can result in “jumps” either forward or backward by this amount of time in captures, and may result in “blank” locations in the Link Tracker view. These should not be construed as mistakes in the traffic, but as a modification necessary for us to provide the most accurate time stamps over the range of a trace.

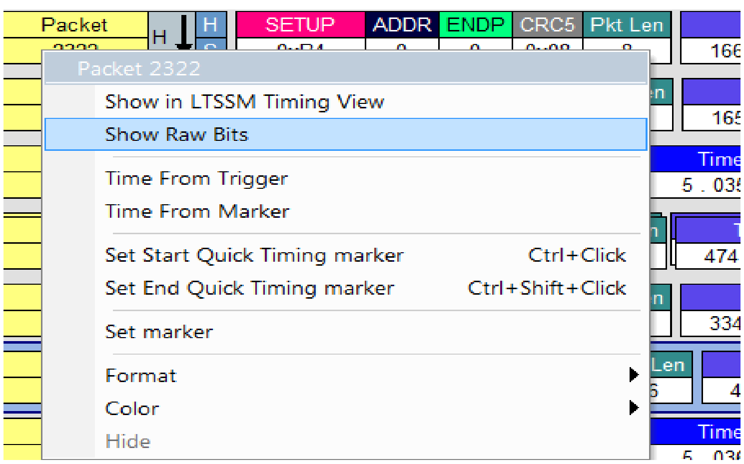
You can also create a new marker by selecting **Set marker**.

5.5 View Raw Bits (2.0)

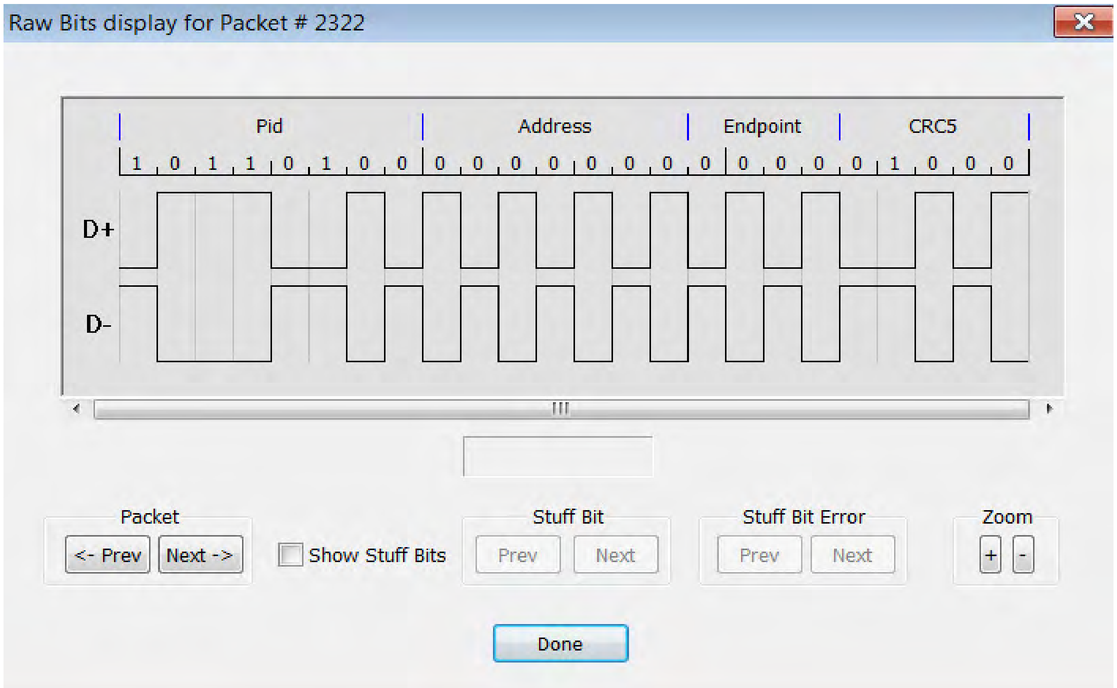
You can expand a specific packet to view the raw bits in detail.

To view raw bits:

1. Right-click **Packet #** for the packet to view, to display the **Packet** menu:



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



Along the top of the Raw Bits View is a linear strip of the logical bit values with corresponding field demarcations. Bit stuffing is 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. Use the two buttons under the label **Packet** to view previous or next packets. Two buttons under the label **Zoom** allow you to zoom in or out on packets.

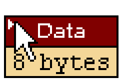
5.6 Expanding and Collapsing Data Fields

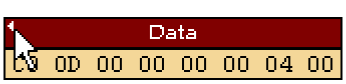
You can expand a Data field to view it in greater detail or collapse it when you want a more compact view.

The sizes for displaying in Collapsed or Expanded fields can be configured on the Display Options General Tab.

5.6.1 Using the Expand/Collapse Data Field Arrows

To expand or collapse a Data Field, click the small triangular arrow on the left side of the data field.





5.6.2 Double-Clicking to Expand/Collapse Data Fields

You can expand or collapse Data fields by double-clicking anywhere in the data field.

5.6.3 Expanding or Collapsing All Data Fields

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

5.6.4 Using the Data Field Pop-up Menus

You can expand or collapse data fields by clicking a data field and selecting **Expand Data** or **Collapse Data** from the pop-up menu.

To expand and collapse data using the menu:

1. Right-click **Data** in the Data packet to expand or collapse to display the Data Field menu.

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

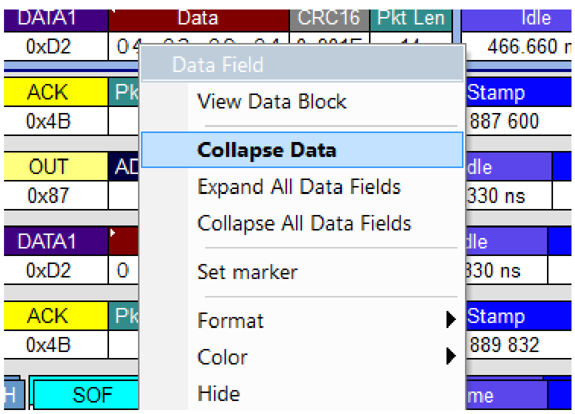


Figure 5.25: Data Field menu

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

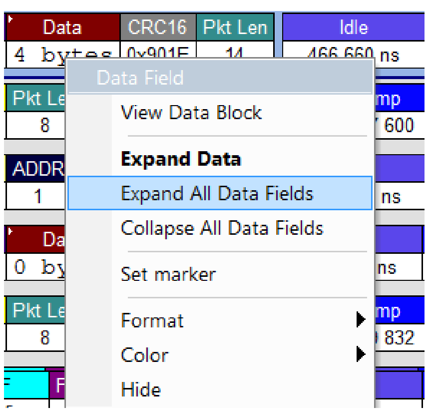


Figure 5.26: Data Field menu

2. Select the **Expand Data** or **Collapse Data** menu item.

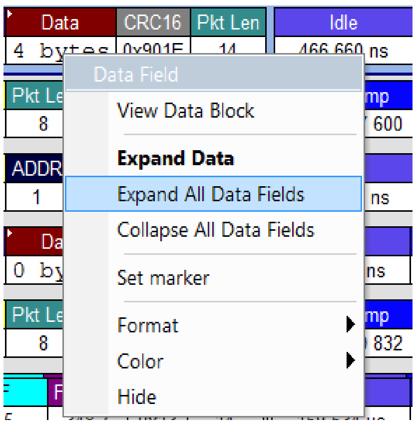
The Trace View repositions, with the selected packet(s) in the format that you specified.

Expand or Collapse All Data Fields

To expand or collapse all data fields, select **Expand All Data Fields** or **Collapse All Data Fields** from the data field pop-up menus.

5.7 Format/Color/Hide Fields

From the field context menu, you can often find Format, Color, and Hide menu selections.



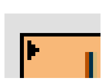
You can change the Format of the cell’s value to Hex, Decimal, Binary or ASCII.

You can change the Color of the field header.

You can Hide ALL instances of the field in the trace, which you can also do in the Display Options dialog (see “Color/Format/Hiding Display Options” on page 234).

To unhide ALL instances of a field, select **View > Unhide cells** and select the field from the list of hidden fields, or right-click in the trace background, select **Unhide cells,** and select the field to unhide from the list. You can also use the Display Options dialog (see “Color/Format/Hiding Display Options” on page 234).

5.7.1 Hide/Show Field when Packet Section is Collapsed

A caret **>**  in the upper left of a field shows whether the field is collapsible and expandable (see “Expanding and Collapsing Data Fields” on page 170).

When a field is collapsible/expandable, you can choose whether the field is shown or hidden when its set of fields is in the collapsed state. Thus, you can determine which fields are more critical to view in these two modes. Do NOT confuse this with Hide Fields (see “Format/Color/Hide Fields“above), which hides the field everywhere, without regard to collapse/expand state.

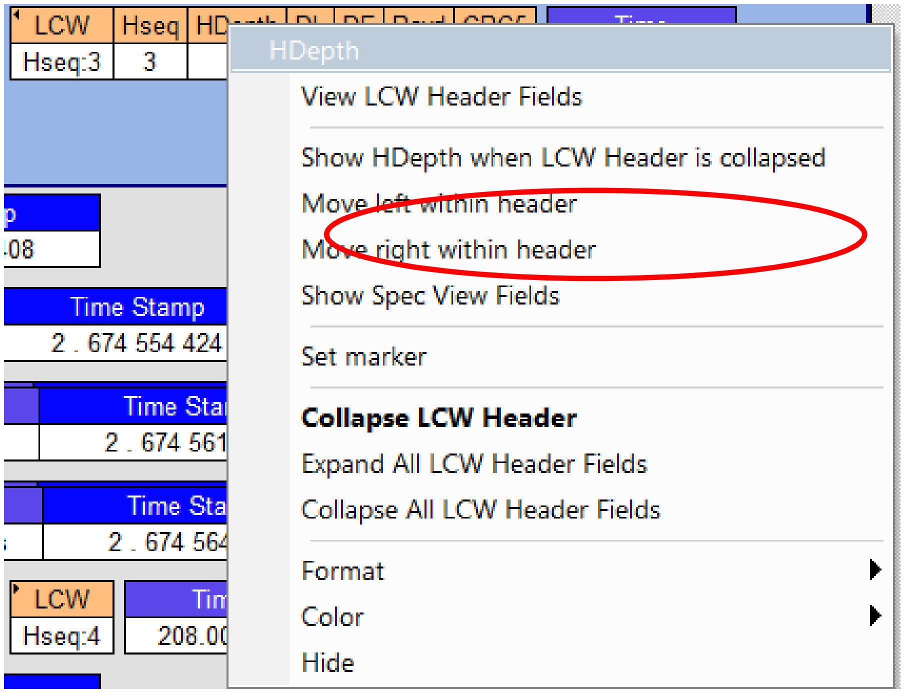


Figure 5.27: Hide/Show Field

5.8 View Data Block

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

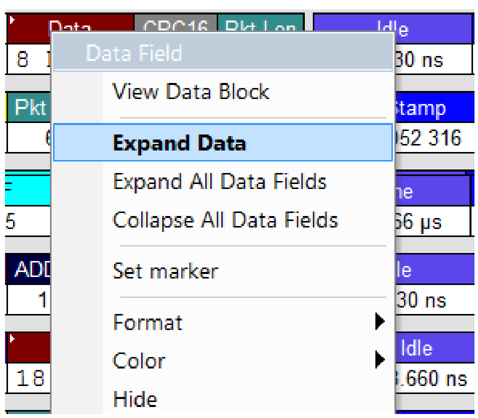


Figure 5.28: View Data Block Pop-up Menu

To view these bits:

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

2. Select **View Data Block** or the **Data View** button to open the Data Block dialog box (see Figure 5.29 on page 174).

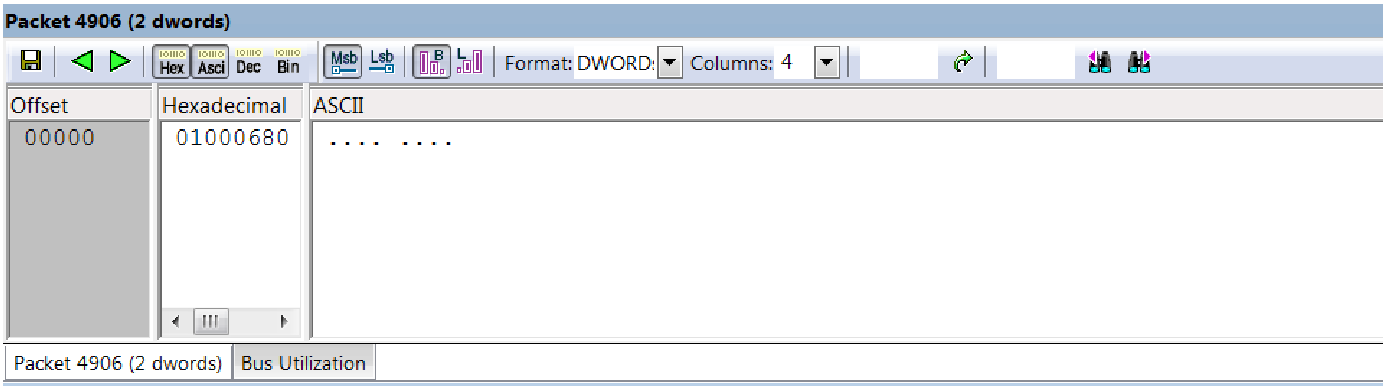


Figure 5.29: Data Block Dialog

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

5.9 Pop-up Tool-tips

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

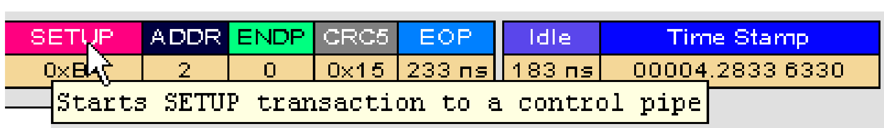


Figure 5.30: Pop-up Tool-tips

5.10 Stacking

Puts a group of packets in one row, to shorten display. Stacking conserves space in the trace view by displaying repeating items (or item groups) as one item, along with the number of repeats. The item types which are included in a stacked entry are shown in the solid colored square fields that appear when stacking is invoked. Additionally, you can hold the mouse over the packet/transaction field to see the count and types of items (see Figure 5.32 on page 175).

- For USB 2.0, stacking items (or item groups) can be SOF, Chirp (merges J's and Ks into one stacked display unit), or NAK'ed (split) Transaction.
- For USB 3.1, stacking items (or item groups) can be TSEQ, TS1 with same Link Functionality, TS2 with same Link Functionality, LFPS with same Type, LUP, LDN, or NAK'ed Transaction. Configuration Channel (CC) Events can also be stacked. See Figure 5.33 on page 175 and Figure 5.34 on page 176.

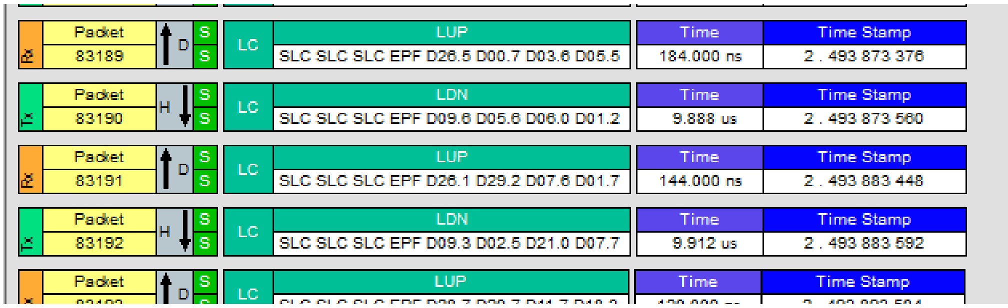


Figure 5.31: Un-stacked View

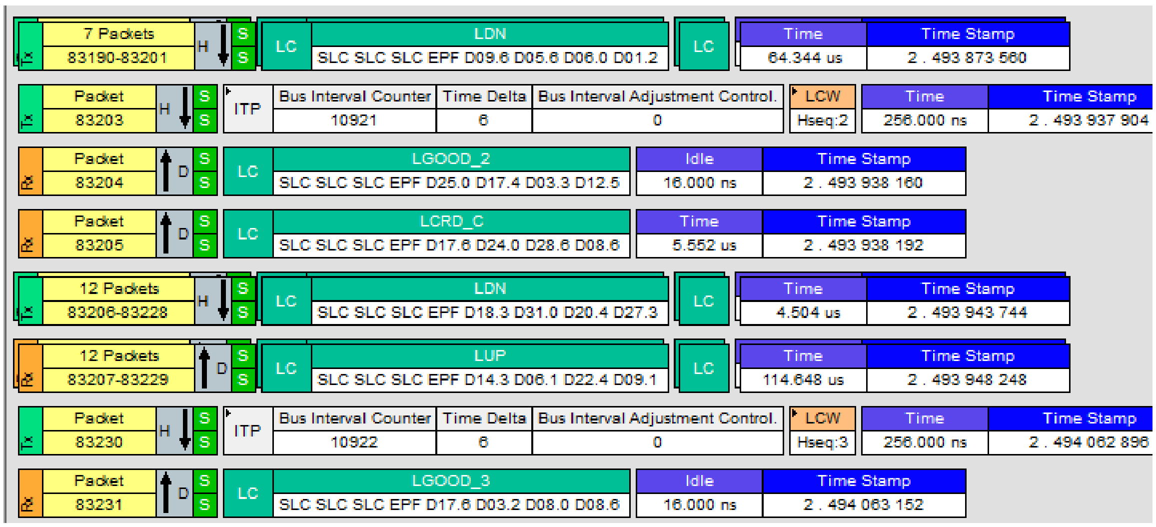


Figure 5.32: Stacked View

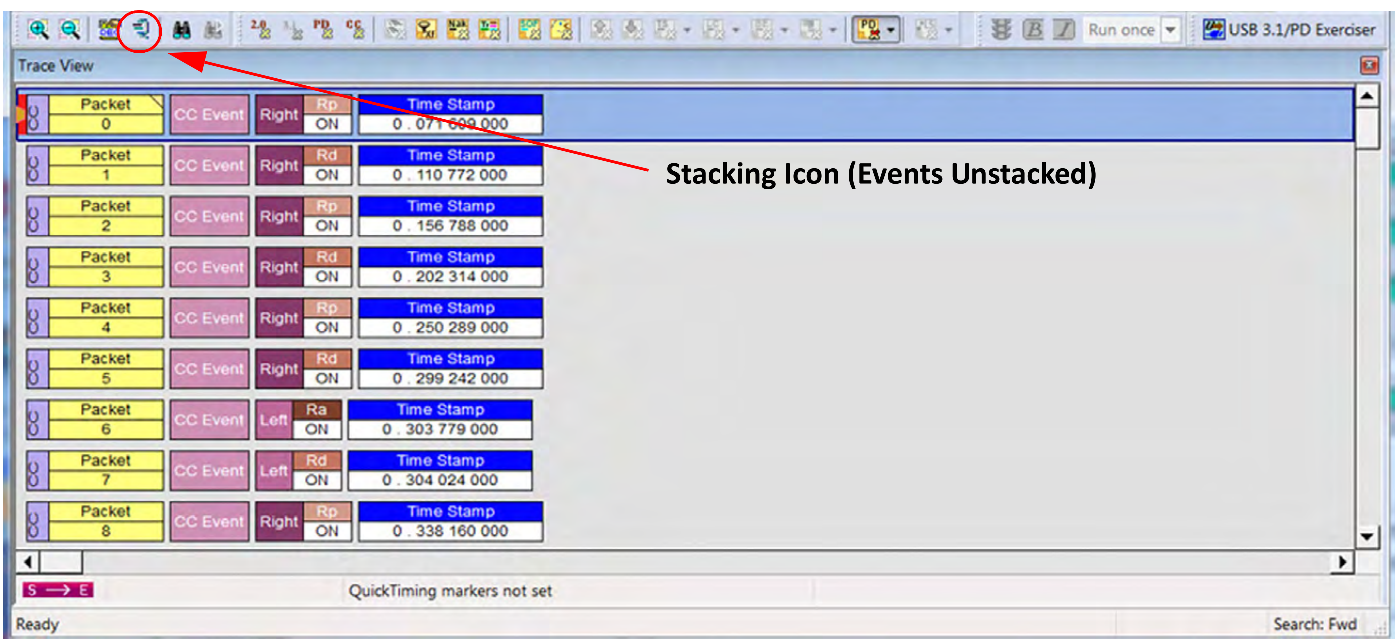


Figure 5.33: Unstacked CC Events

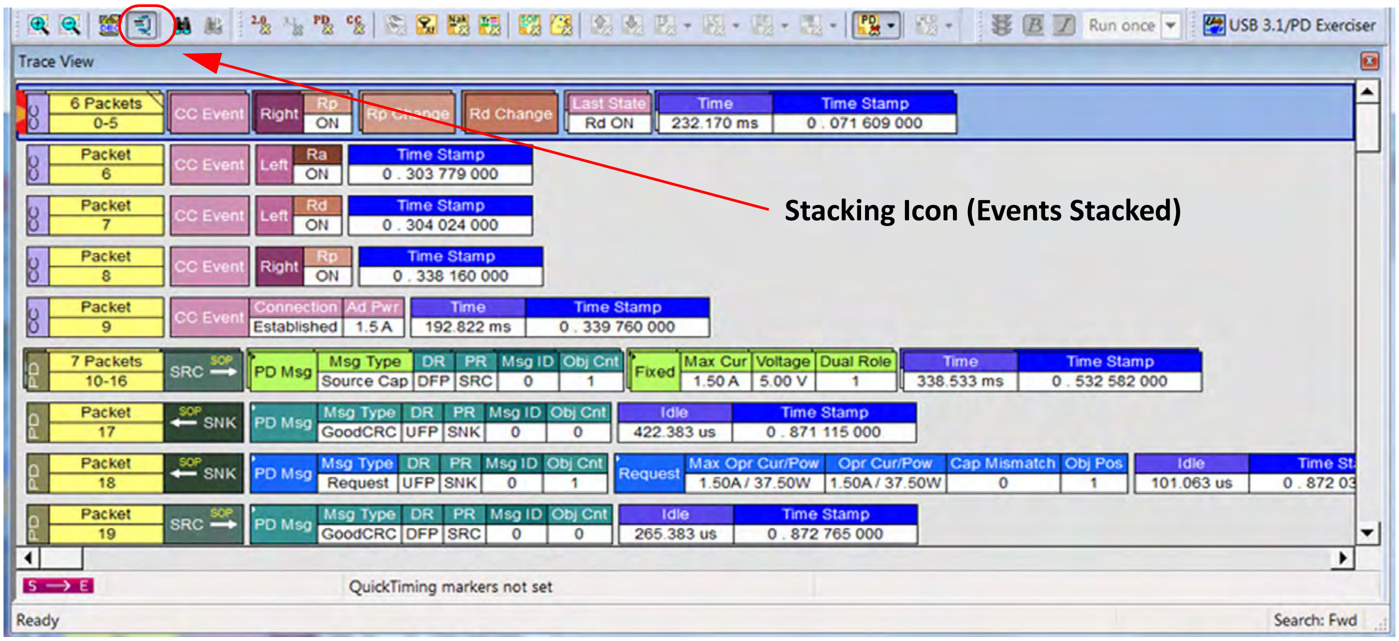


Figure 5.34: Stacked CC Events

Note: Items are grouped regardless of any intervening Skip Sequence, Electrical Idle, or Logical Idle symbols. If any of these occur during a stream of the repeating stacking item, they are not displayed.

Note on unexpected 3.1 Idle times in traces which include Logical Idle and/or SKPs: There will occasionally be "Idle" fields (typically 8ns) between packets which do not seem to make sense within a continuous set of captured data, such as amongst idles and SKPS. These are a by-product of the mechanism which compensates for timestamp / event rate matching between the various time bases. There are 3 clock domains (Rx, Tx, and our precision timestamp) that need to be represented in the trace. The nominal 2nSec / symbol Transmit and Receive clocks can vary up to 500ppm per the USB Specification, whereas the Analyzer is accurate to 3ppm. The small idle time at the end of a packet is there to compensate for this clock drift difference between the protocol clocks and our precision clock, and to try to maintain the most accurate relationship amongst these clocks. The Timestamp field is always based on our 3ppm clock timestamp.

5.11 Hide Traffic Toolbar

The Hide toolbar allows you to selectively hide data traffic that you're not interested in. See Figure 5.35. The highlighted buttons indicate the loaded trace contains that type of data traffic.

Figure 5.35: Hide Traffic Toolbar

5.11.1 Hide All USB 2.0 Traffic

Click the  button to hide all the USB 2.0 Traffic (Low Speed, Full Speed, and Hi Speed).

5.11.2 Hide All USB 3.1 Traffic

Click the  button to hide all the SuperSpeed and SuperSpeed+ Traffic.

5.11.3 Hide All Power Delivery Traffic

Click the  button to hide all the Power Delivery Traffic.

5.11.4 Hide Configuration Channel Traffic

Click the  button to hide all the Configuration Channel (CC) Traffic.

5.11.5 Hiding Items Indicators

Items can be hidden individually as well as in groups. The Icons change to reflect the state of hiding of the items.

The Red "X" indicates that an item or group of items is hidden. A Clear "**X**" indicates that an item or group of items is shown (not hidden). See Figure 5.36.

Figure 5.36: Hidden/Shown Items

If all the items in a group do not have the same Hidden state, then the "X" will be shown as half Clear and half Red. See Figure 5.37.

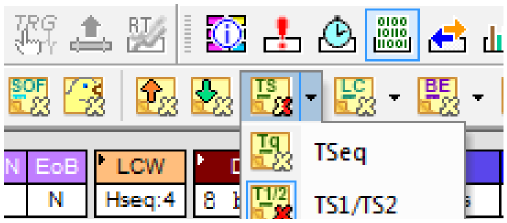


Figure 5.37: All Items not in Hidden State

5.11.6 Hide Devices

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

5.11.7 Hide All Packets Except Transfers Packets.

Click the  button show/hide All Packets Except Transfers Packets.

5.11.8 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.

This also hides 3.1 NRDY transactions, if they are virtual equivalents of a 2.0 NAK situation.

5.11.9 Hide SOF Packets (2.0)

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 the  button to show/hide all SOF packets.

Note: This also hides low-speed EOPs.

5.11.10 Hide Chirps (2.0)

Click the  button to hide any Chirped-J or Chirped-K packets recorded in a USB 2.0 Hi-Speed trace.

5.11.11 Hide Upstream Packets (3.1)

Click the  button to Hide Upstream Packets.

5.11.12 Hide Downstream Packets (3.1)

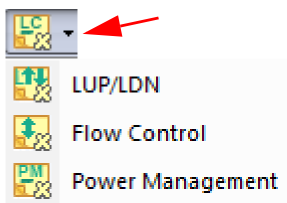
Click the  button to Hide Downstream Packets.

5.11.13 Hide Link Training Sequences (3.1)

Click the 

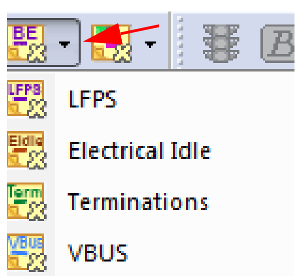
button to Hide Link Training Sequences and select from the options to show/hide TSEQ TS1/TS2. For 3.1 SS+ traces, you can hide the SYNC packets.

5.11.14 Hide Link Commands (Flow Control) (3.1)

Click the 

button and select from the options to show/hide Link Commands (LUP/LDN, Flow Control or Power Management).

5.11.15 Hide Bus Events (3.1)

Click the 

button and select from the options to show/hide Bus Events (LFPS, Electrical Idle, Termination or VBus On/Off).

5.11.16 Hide Miscellaneous Packets (3.1)

Click the 

button and select from the options to show/hide:

- LMP
- ISO Time Stamp
- Inter-Packet Symbols
- Skip Sequences
- Logical Idle
- Loopback (BCNT, BRST, BERC)
- Compliance Pattern
- SDS - Start Data Stream

5.11.17 Hide Power Delivery Packets

Click  to hide:

- Unknown
- PING
- GoodCRC

5.11.18 Hide All Transactions Except Stream Id Numbers

This selection found when clicking on the Stream Id field of a USB 3.1 Data Packet will allow you to select a small range of Stream Id's to display without showing other transactions that don't use this Stream Id (see Figure 5.38 on page 180).

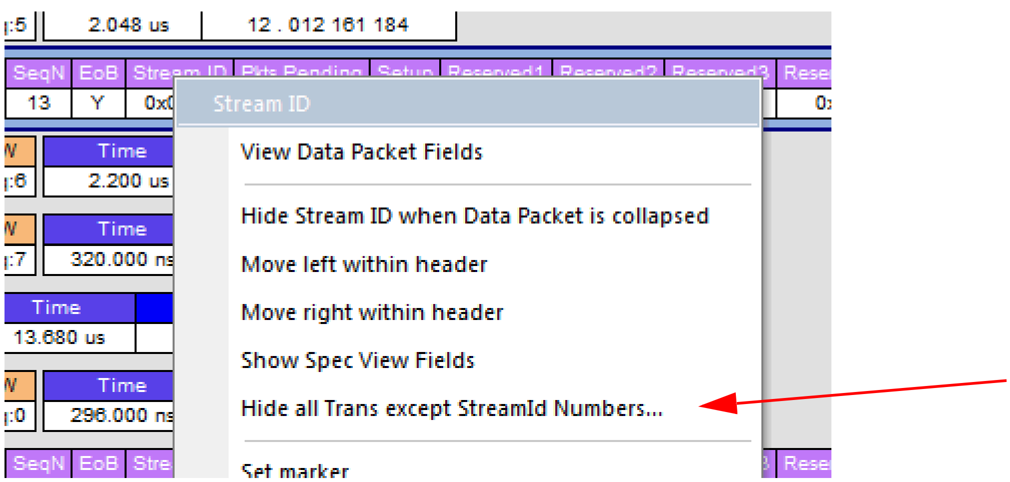


Figure 5.38: Right-clicking on the Stream Id field of a USB 3.1 Data Packet

Right-click on the Stream Id field of a USB 3.1 Data Packet and select Hide all Trans except StreamID Numbers.... to display the Hide Packets dialog (see Figure 5.39 on page 181).

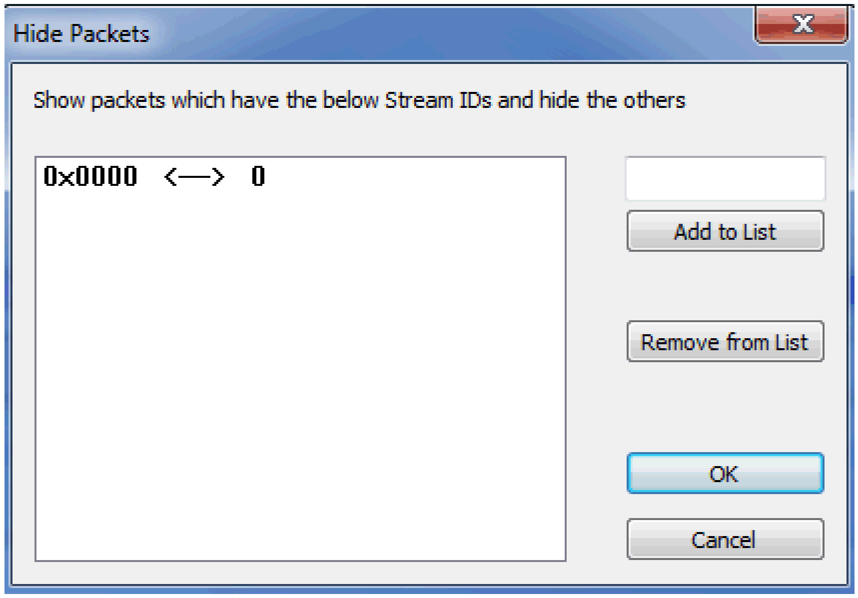
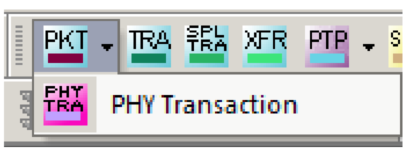


Figure 5.39: Hide Packets Dialog

This allows you to select the stream Id's you want to display. Add the items to the list that you want to show, and remove Stream Id's that you want to hide. Selecting the ones you want to see is done because the range of Stream Id's is much too large to specify the ones you want to hide explicitly.

5.11.19 Show/Hide Packets: SuperSpeed+ PHY Transaction



With SuperSpeed+, PHY Transactions are made up of pulse width modulated LFSR signals. By selecting the PHY Transaction level, these are displayed as SCDx, PHY Capability and PHY Ready LBPM Messages. This eliminates showing large numbers of LFSRs and electrical Idle periods which would need to be interpreted as portions of these messages.

5.12 Switch to Transactions View

5.12.1 Transaction View from Toolbar

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:

1. Click  on the toolbar.
   The Trace View screen is re-drawn to display Transactions.

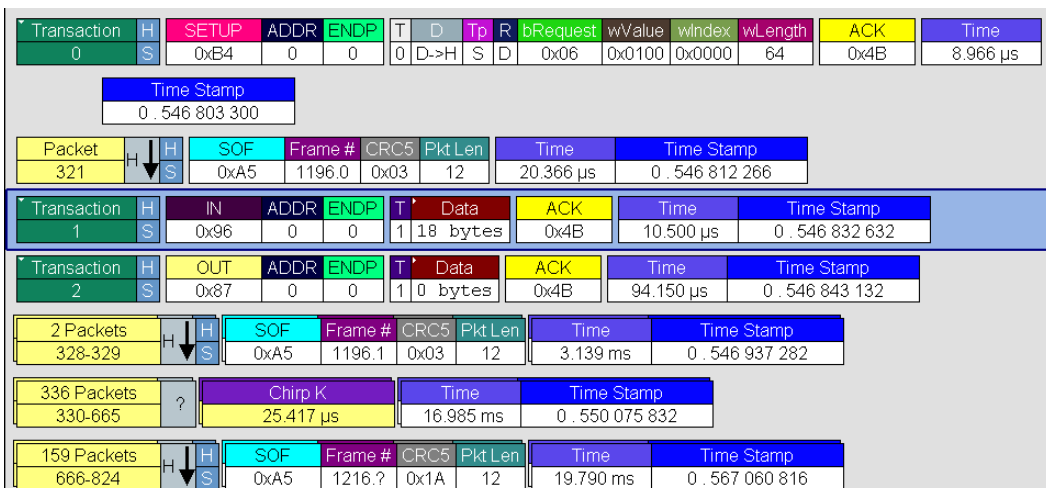


Figure 5.40: Transactions View

Note: This menu selection displays a check next to **Transaction Level** 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 **Transaction Level**.

Note: This view also shows Extension Transactions, such as the Link Power Management (LPM) transaction defined by the USB 2.0 LPM specification, as shown below.

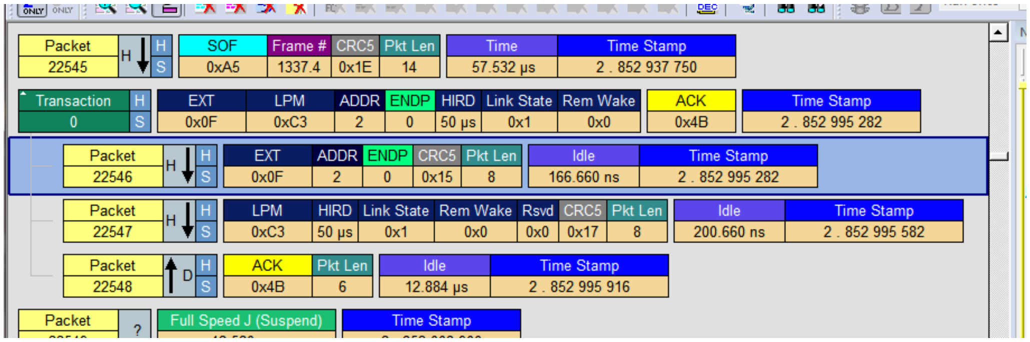


Figure 5.41: Link Power Management View

5.12.2 Transaction View from Menu Bar

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

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

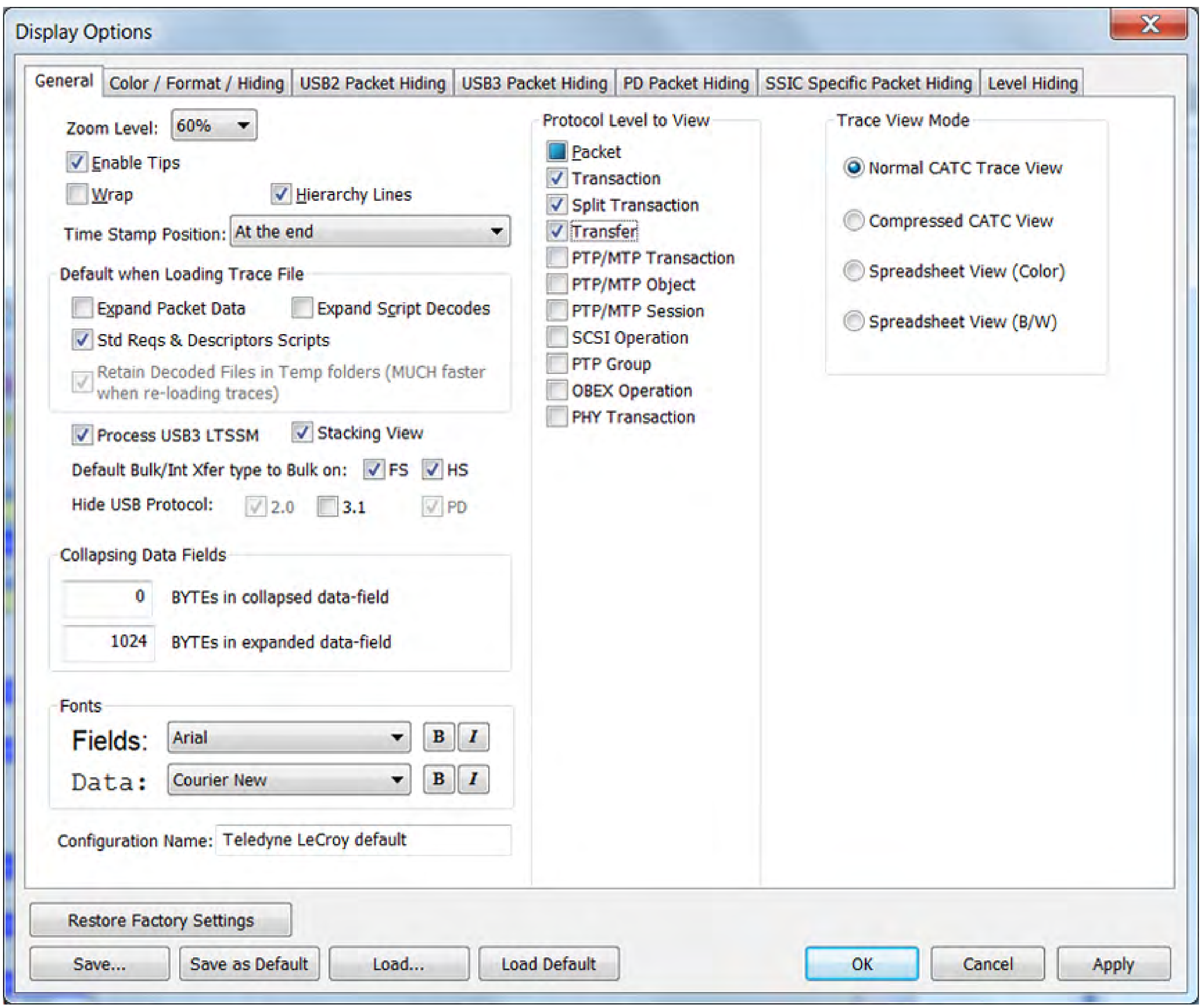


Figure 5.42: Display Options General Dialog

2. Check **Transaction.**
3. Click **OK.**

5.12.3 Power Delivery Transactions

Power Delivery Transactions are also viewable at this level. See Figure 5.43.

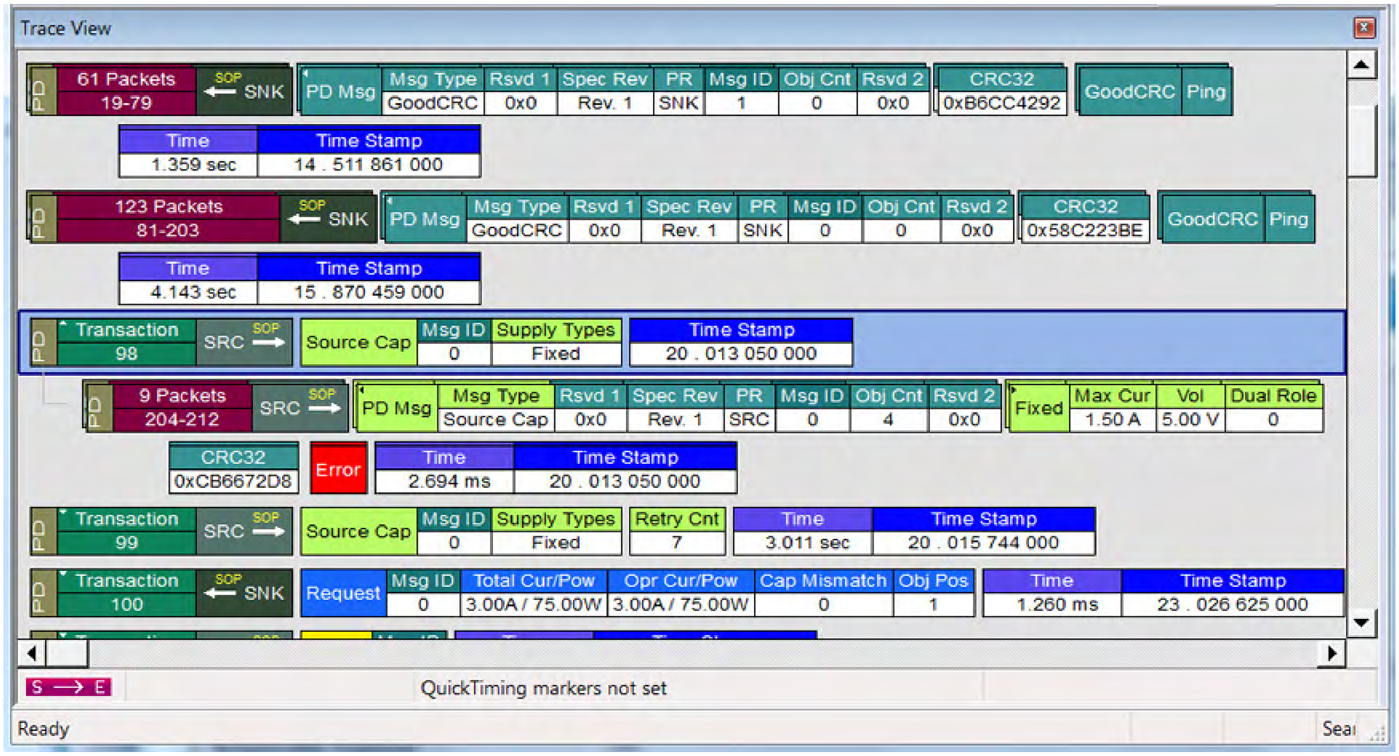


Figure 5.43: Power Delivery Transactions

5.12.4 Power Delivery Packets

If you right click in a Power Delivery Packet the following menus pops up. See Figure 5.44.

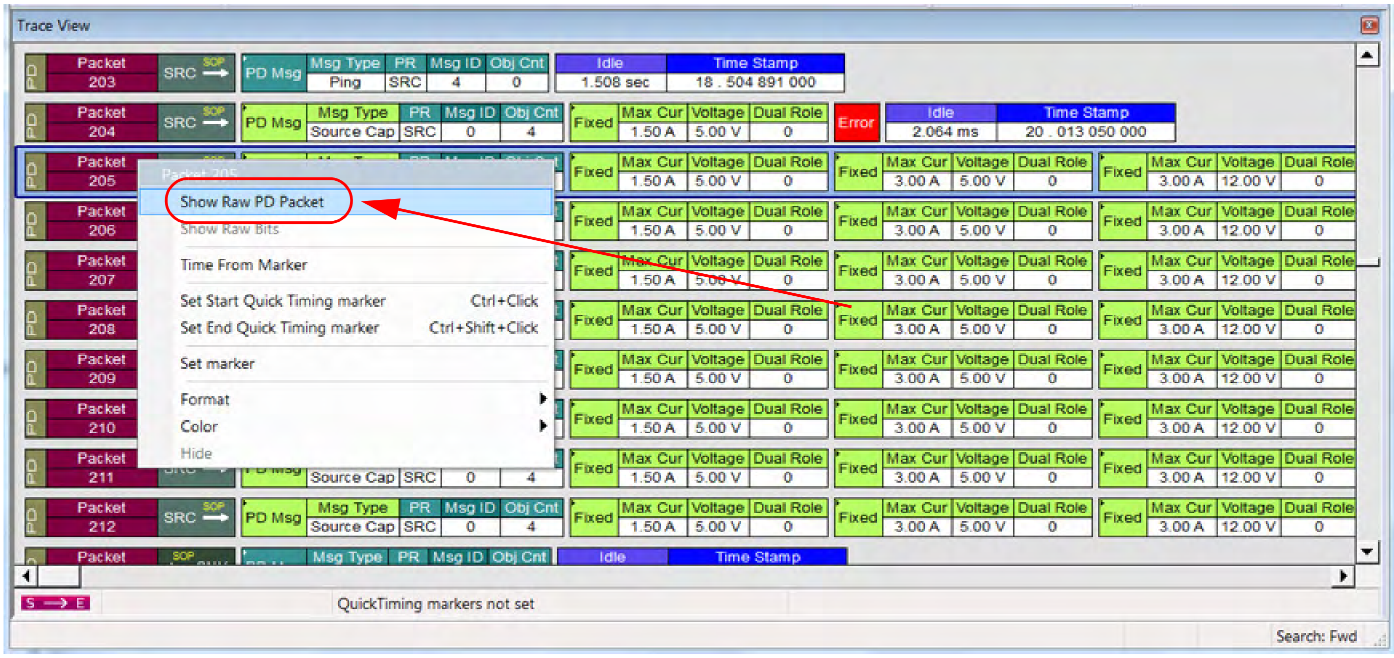


Figure 5.44: Power Delivery Packet: Right Click

From the pop up menu you can choose to view the Raw PD data by clicking on Show Raw PD Packet. See Figure 5.45.

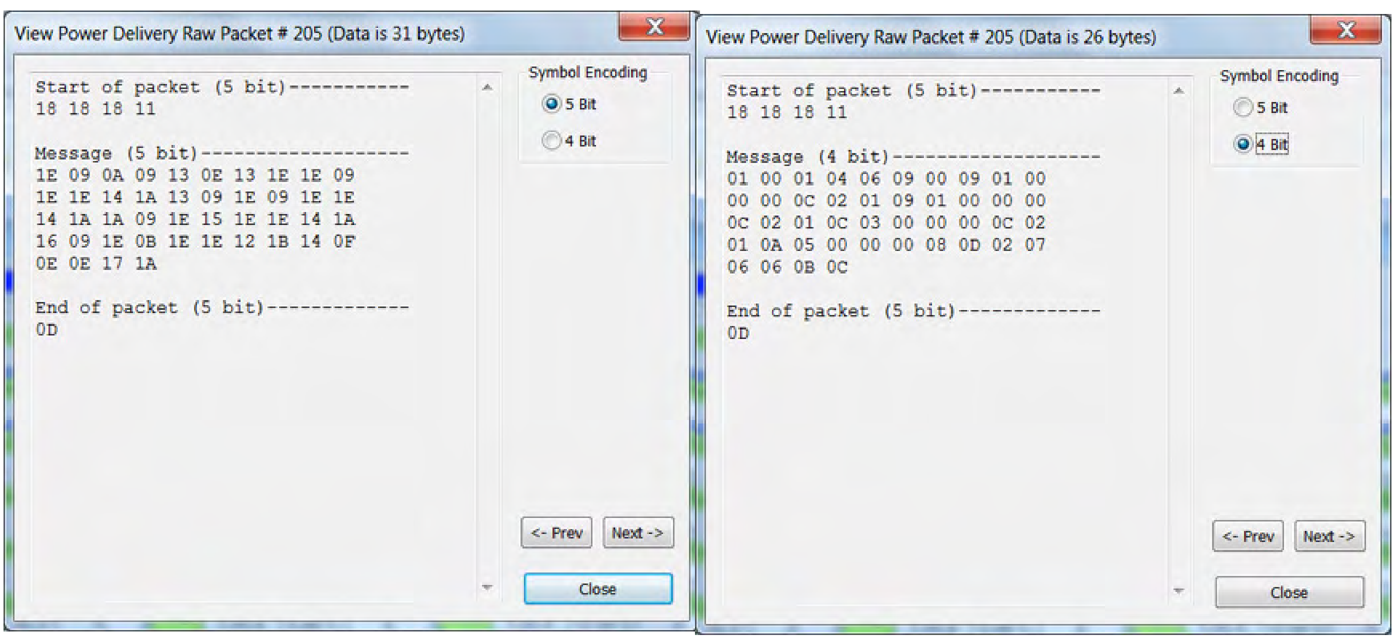


Figure 5.45: Show Raw PD Packet: 5b vs. 4b Encoding

5.13 View Decoded Transactions

After you set Display Options, the Trace View screen is re-drawn to display decoded transactions in the colors and format you selected (see Figure 5.46 on page 186).

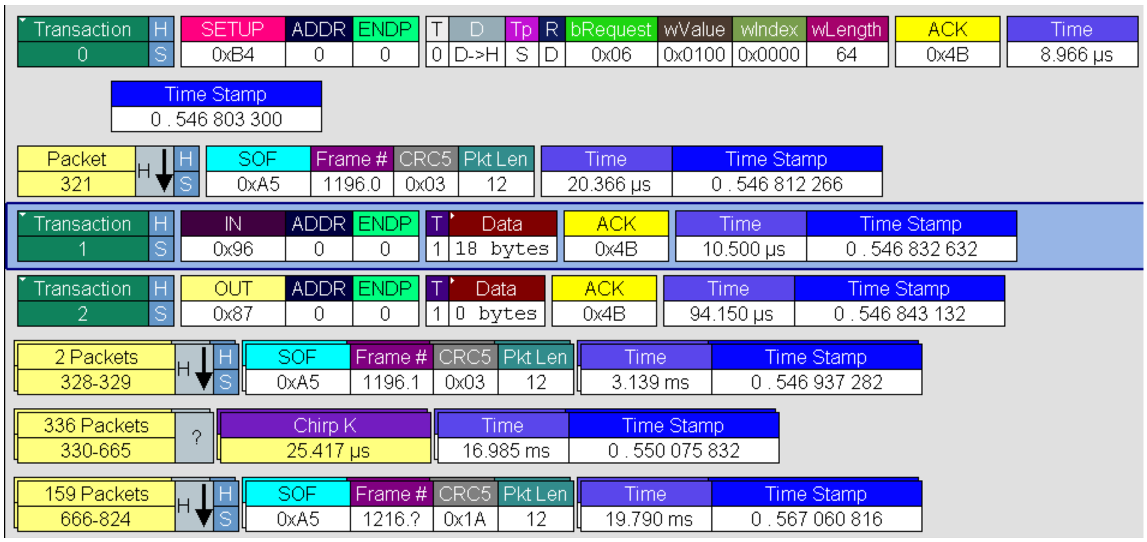


Figure 5.46: Decoded Transactions

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.

Note: If CRC errors are found in a DATAx (2.0) packet or a DP (3.1) packet, the data in that packet will not be promoted to the Transaction, Transfer/, and so on, levels above, since it is assumed that the data will be re-sent. The data count will show as 0 Bytes.

5.13.1 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:

1. Right-click the transaction number you wish to view to display the Expand Transaction menu (see Figure 5.47 on page 187.)

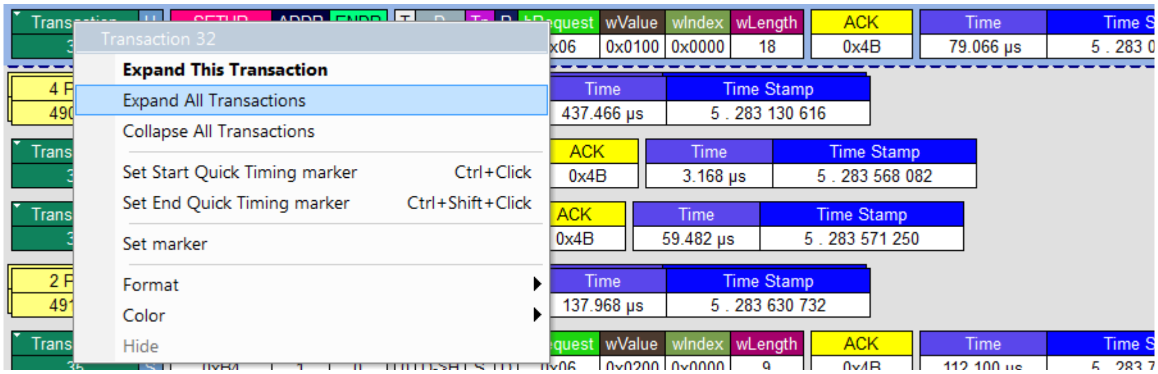


Figure 5.47: Expand Transaction Menu

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. You can double-click the **Transaction number field** to toggle back and forth between collapsed and expanded views.

5.14 Switch to Split Transaction View

To select Split Transaction View:

1. Click the  button on the toolbar.

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

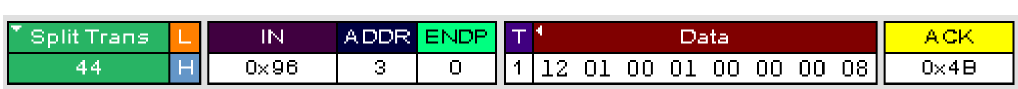


Figure 5.48: Split Transaction View

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

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

   You see the Display Options General window:

2. Check **Split Transaction.**

5.15 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. The system can display 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:

1. Click  on the toolbar.

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

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

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

1. Select **Display Options** under Setup to display the Display Options General window:
2. Check **Transfer.**
3. Click **OK.**

5.16 View Decoded Transfers

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

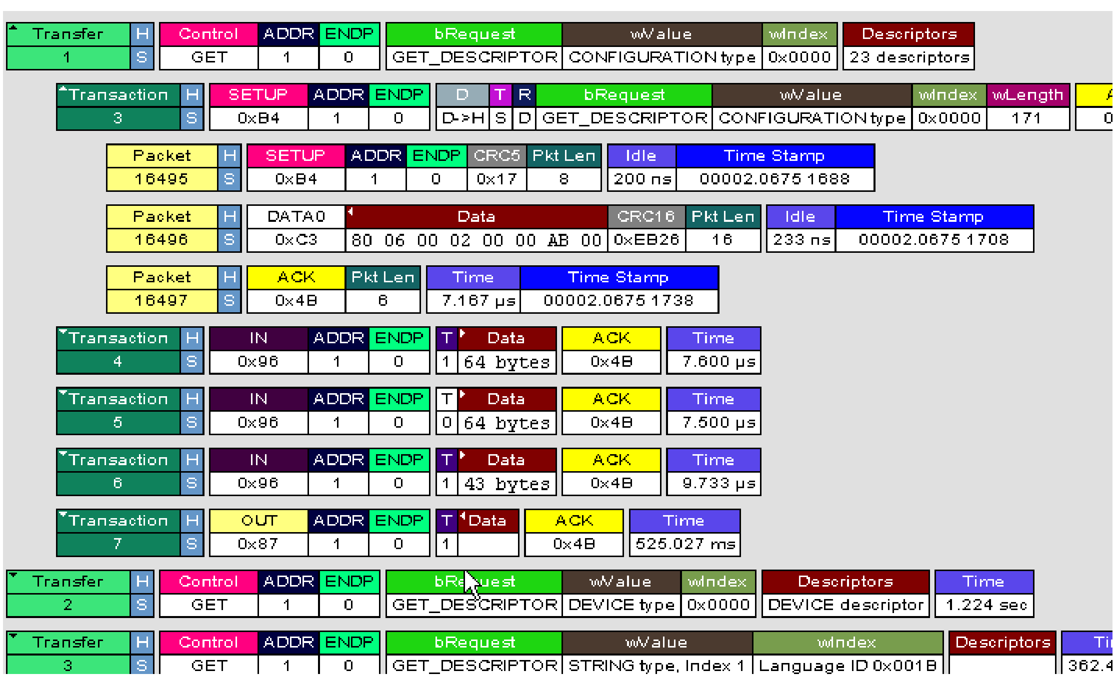


Figure 5.49: Decoded Transfers

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.

Note: If CRC errors are found in a DATAx (2.0) packet or a DP (3.1) packet, the data in that packet will not be promoted to the Transaction, Transfer, and so on, levels above, since it is assumed that the data will be re-sent. The data count will show as 0 Bytes.

5.16.1 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:

1. Right-click the transfer number you wish to view to display the Expand Transfer menu:

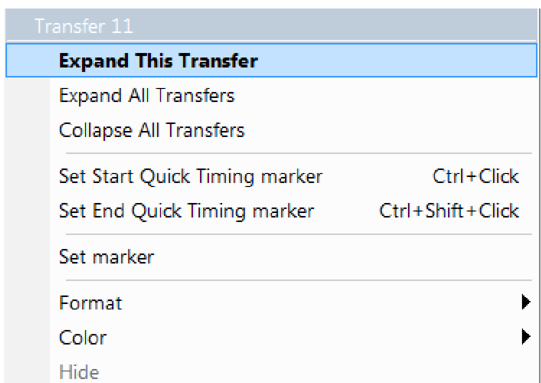


Figure 5.50: Expand This Transfer Menu Option

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

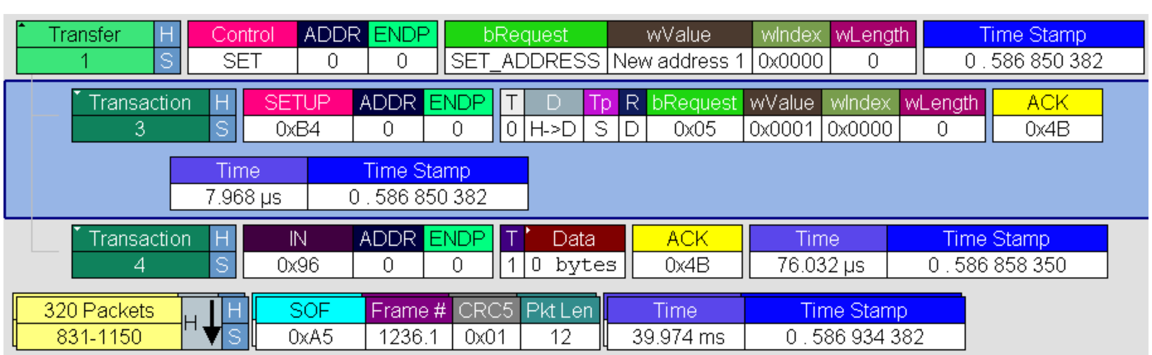


Figure 5.51: Transfer Displayed in Expanded Format

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

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

Note that you can choose to expand or collapse

- **Only** the selected Transfer

OR

- **All** Transfers

It is not necessary to use the **Expand/Collapse Transfers** menu to shift between expanded and collapsed views of a transfers. You can double-click the **Transfer number field** to toggle back and forth between collapsed and expanded views.

5.17 Decoding Protocol-Specific Fields in Transactions and Transfers

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

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

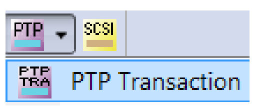
5.18 Switch to PTP Transactions

The Analyzer supports the Picture Transfer Protocol (PTP) and also supports the Media Transfer Protocol (MTP), which is an extension of PTP. The Analyzer can track PTP transactions, object transfers, and sessions.

A **transaction** is a standard sequence of phases for invoking an action. In PTP, an Initiator-initiated action provides input parameters, responses with parameters, and binary data exchange, and is a single **PTP Transaction**. Also, a single Asynchronous Event sent through the interrupt pipe is a single PTP Transaction.

The PTP Transaction trace viewing level is the lowest PTP level.

To view PTP transactions, switch to the PTP Transaction trace viewing level:

- ❑ Click 

on the toolbar.

OR

- ❑ Select **View > PTP Group > PTP Transaction Level**.

OR

- ❑ Select **Setup > Display Options** to display the Display Options window, check **PTP Transaction**, and then click **OK.**

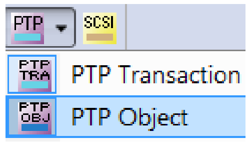
5.19 Switch to PTP Object Transfers

A logical object on a device has a unique 32-bit identifier (**object handle**). The object handle is also unique for the session (defined below). An **object transfer** contains all the transactions for an object handle. In PTP, all of an object handle's PTP Transactions are a single **PTP Object Transfer**.

A PTP Object Transfer can include both PTP Transactions that involve an Initiator-initiated action (for example, **GetObject**, **DeleteObject**, and **GetObjectInfo** transactions) and PTP Transactions that involve a single Asynchronous Event sent through the interrupt pipe.

The PTP Object Transfer trace viewing level is the middle PTP level.

To view PTP object transfers, switch to the PTP Object Transfer trace viewing level:

- Click 

on the toolbar.

OR

- Select **View > PTP Group > PTP Object Level**.

OR

- Select **Setup > Display Options** to display the Display Options window, check **PTP Object**, and then click **OK.**

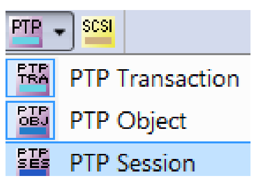
5.20 Switch to PTP Sessions

A **session** is a state of persisting communication between a device and a host during which the connection is continuous and the login and other communication parameters do not change. A session begins with an **OpenSession** operation, which establishes the communications connection and parameters, and ends with a **CloseSession** operation.

A session contains all object transfers (and their transactions), plus all transactions that do not belong to object transfers, between an OpenSession operation and a CloseSession operation. For PTP, all PTP Object Transfers and all PTP Transactions that occur from the OpenSession operation to the CloseSession operation is a single **PTP Session**.

The PTP Session trace viewing level is the highest PTP level.

To view PTP sessions, switch to the PTP Session trace viewing level:

- Click 

on the toolbar.

OR

- Select **View > PTP Group > PTP Session Level**.

OR

- Select **Setup > Display Options** to display the Display Options window, check **PTP Session**, and then click **OK.**

5.21 Switch to SCSI Operations

To view SCSI operations, switch to SCSI Operations viewing level:

- Click 

on the toolbar.

OR

- Select **View > SCSI Operation Level**.

OR

- Select **Setup > Display Options** to display the Display Options window, check **SCSI Operation**, and then click **OK.**

5.21.1 SCSI Metrics

The SCSI Metrics are:

- Address
- **Number Of Transfers**: Total number of transfers that compose the SCSI operation
- **Response Time**: Time to transmit on the USB link, from the beginning of the first transfer in the SCSI operation to the end of the last transfer in the SCSI operation
- **Latency**: Time from the transmission of the SCSI command to the first data transmitted for the SCSI IO operation
- **Data To Status Time**: Time between the end of data transmission for the SCSI operation and the status transfer
- **Payload**: Number of payload bytes transferred by the SCSI operation

5.22 Compressed CATC Trace View

The Compressed CATC Trace view shows fields in the format “Attribute: Value”, whereas the normal CATC View shows the attribute name on top and the value below.

The Compressed CATC Trace view has almost all the information of the normal CATC View and behaves mostly the same way, while displaying more information on each window (see Figure 5.52 on page 194).

To compress the CATC Trace:

- Click  on the toolbar.

OR

- Select **View > Trace Views > Compressed CATC Trace.**

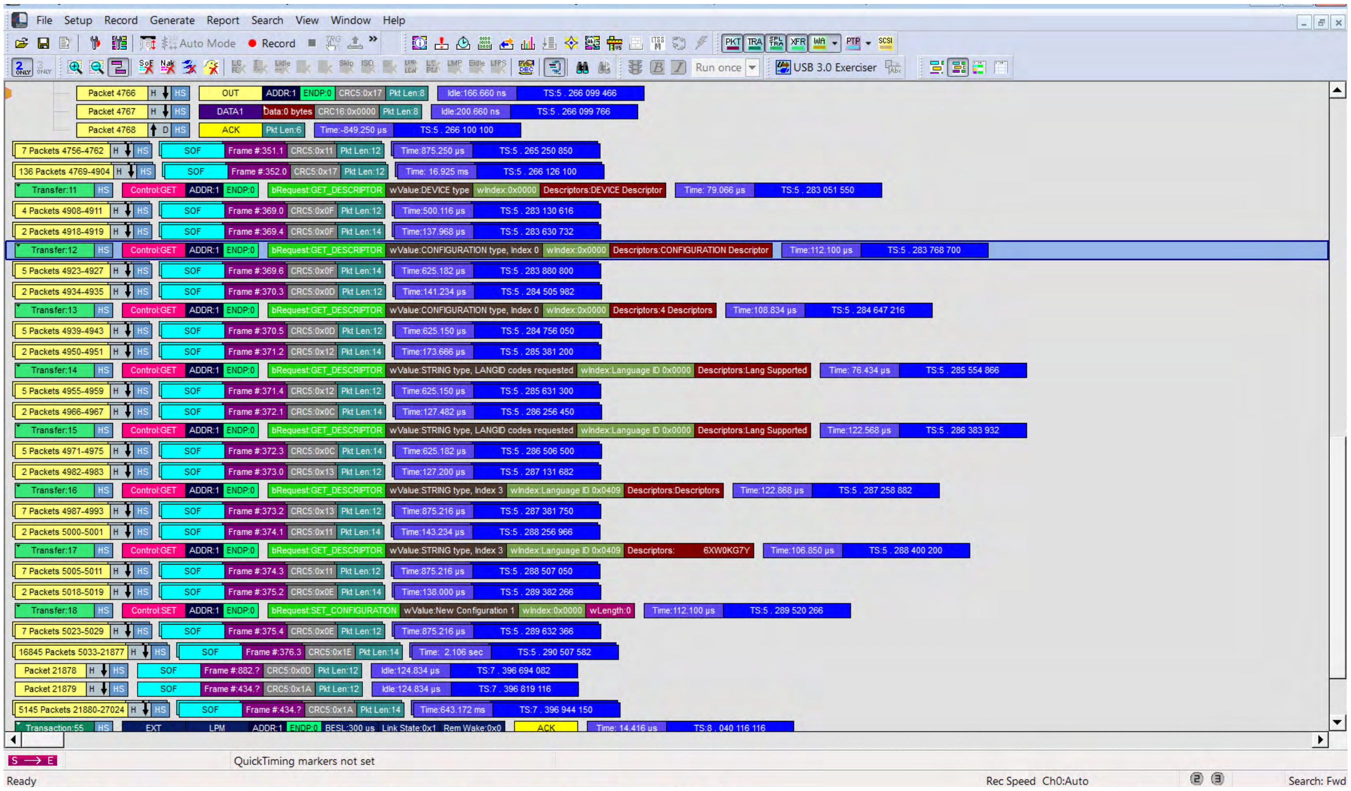


Figure 5.52: Compressed CATC Trace

- Click  on the toolbar to return to the normal CATC Trace View, or Select **View > Trace Views > CATC Trace.**

5.23 Spreadsheet View

You can view the CATC Trace as a spreadsheet in color or black and white (see Figure 5.53 on page 195).

- Click  on the toolbar, or
- Select **View > Trace Views > Spreadsheet (Color)**.

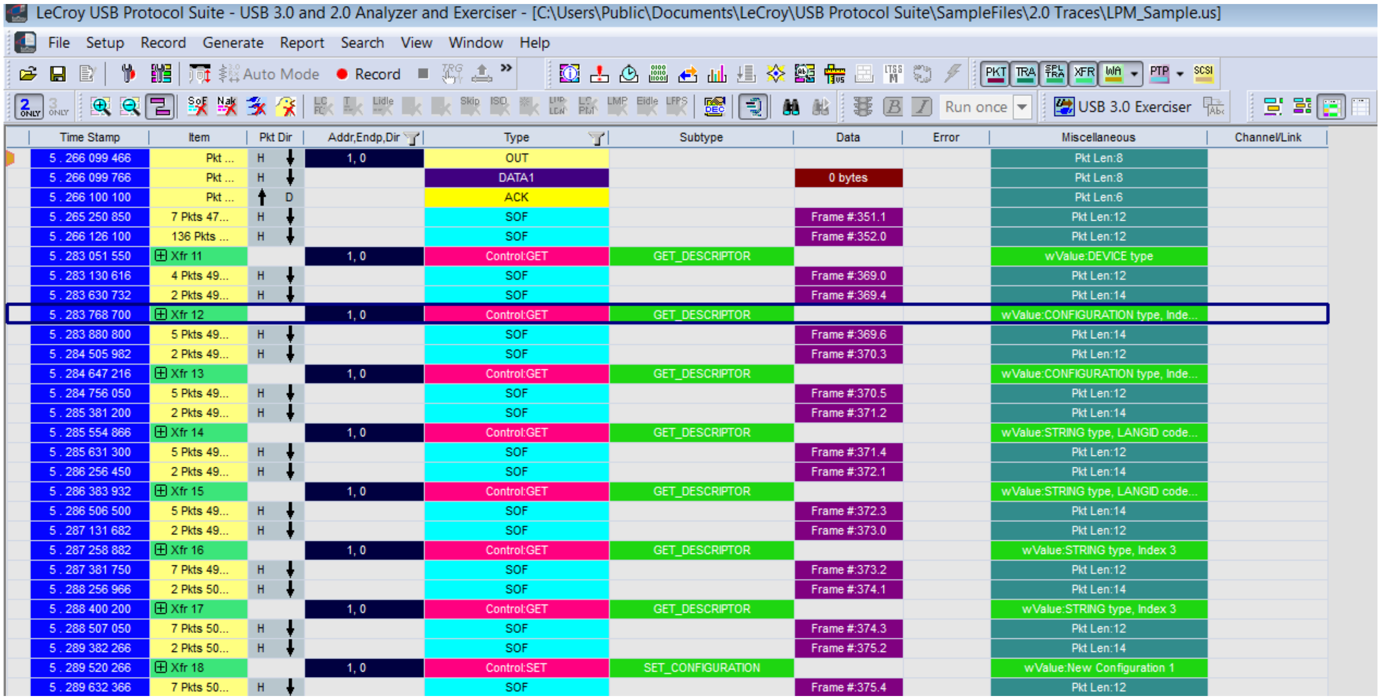


Figure 5.53: Spreadsheet View (Color)

- Click  on the toolbar, or
- Select **View > Trace Views > Spreadsheet (B/W)**. See Figure 5.54 on page 195.

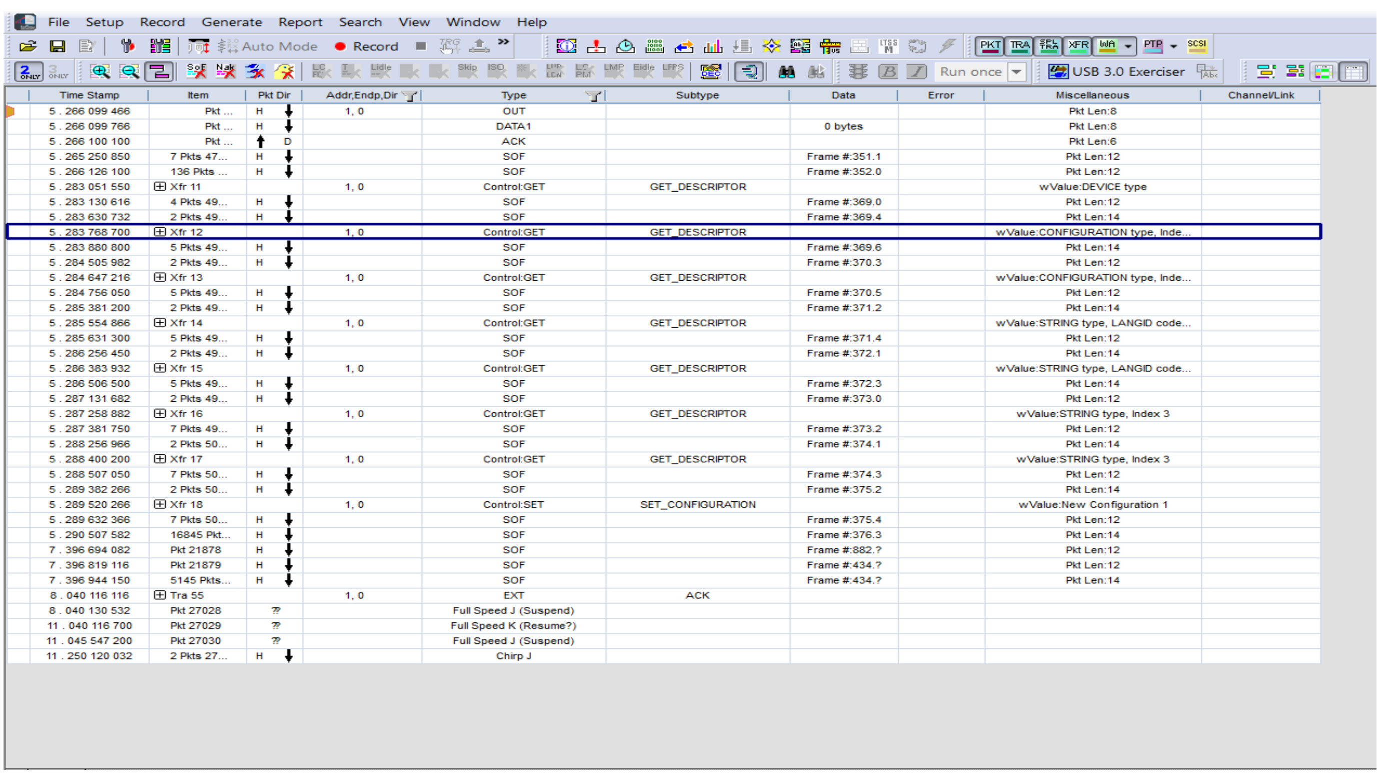


Figure 5.54: Spreadsheet View (Black And White)

5.23.1 Columns

To add a column, right-click a column header, select **Add Column,** and then select the column name. You can also add a column by dragging the attribute field (in the left column) from the Detail View into the Spreadsheet View.

To delete a column, right-click a column header and then select **Remove Column**.

To reposition a column, drag the column header to the new position.

To resize columns, select the column divider and drag the divider to the right or left.

5.23.2 Rows

To manipulate rows, right-click the left-most column gray area to display the following commands:

Display Options	Opens the Display Options menu (see “Display Options” on page 231).
CATC Walk	See and manage playlists. (see “CATC Walk Playlist” on page 164).
Real-time Statistics	Allows you to view traffic statistics as they occur. See “Real Time Monitoring” on page 324.
USB 3.1 Electrical Test	Displays the USB3 Electrical Test dialog. (see “USB 3.1 Electrical Test Modes” on page 461).
Trace Views	Displays CATC Trace, Compressed CATC Trace, Spreadsheet (Color), or Spreadsheet (B/W).
Unhide cells	Unhide previously hidden Traffic, VBus Power, or ALL
Zoom In	Increases the size of the displayed elements.
Zoom Out	Decreases the size of the displayed elements.
Wrap	Wraps displayed packets within the window.
Hide All USB 2.0 Traffic	Hides all the USB 2.0 traffic (low speed, full speed, and high speed).
Hide All USB 3.1 Traffic	Hides all the SuperSpeed and SuperSpeed+ traffic.
Hide All Power Delivery Traffic	Hides all the power delivery traffic.
Hiding USB 2.0 Traffic	Hides. SOF’s: Start of Frames NAK’s: NAK’ed Transactions Devices: Packets belonging to specified devices by address and endpoint Chirps: Chirp-K and Chirp-J Bus conditions (these are recorded only)

Hiding USB 3.1 Traffic	Hides: Link Commands (Flow Control) Link Training Sequences (TS1, TS2, TSEQ) Logical Idle Packets Upstream Packets Downstream Packets Skip Sequences ISO Time Stamp Packets Inter-Packet Symbols Link Commands (Other than Flow Control) LMP Packets Electrical Idles LFPS Packets LTSSM Transition Indicators
Hide Devices (Addr/ Endp)...	Opens the Hiding Devices dialog displaying packets belonging to specified devices by address and endpoint (see "Hiding Traffic (2.0 & 3.1)" on page 130).
Hide NAK's/NRDY's	Shows/hides the Nak'd and Nrdy'd (see "Hiding Traffic (2.0 & 3.1)" on page 130).
View Layers Mode	Display All Layers, Application Layers, or Lower USB Layers.
Stacking View	Puts a group of packets in one row, to shorten display (see "Stacking" on page 174).
Apply Decoding Scripts	Decoding scripts set the values of the display and recording options for optimum views of trace information from specific vendors or classes of data. This menu option allows you to select the vendor or class of data for the request recipients and endpoints listed in the Request Recipients and Endpoints menu. You can keep the settings across recordings. See "Decode Requests" on page 245.
Packet Level	Displays Packets.
Transaction Level	Displays Transactions.
Split Transaction Level	Displays Split Transactions.
Transfer Level	Displays Transfers.
PTP Group	**PTP Transaction Level** displays PTP Transactions **PTP Object Transfer Level** displays PTP Objects **PTP Session Level** displays PTP Sessions

SCSI Operation Level	Displays SCSI Operation Level
Refresh Decoding	Forces the software to re-decode transactions and transfers. Useful if you have applied a decoding mapping which helps fully decode a sequence of transfers, as is the case with Mass Storage decoding.

5.23.3 Detail View and Spreadsheet View

In the Spreadsheet View, double-click a packet, transaction, or transfer, or select a field and then select **Report > Detail View** or click or on the toolbar, to display the Detail View (see Figure 5.55 on page 198).

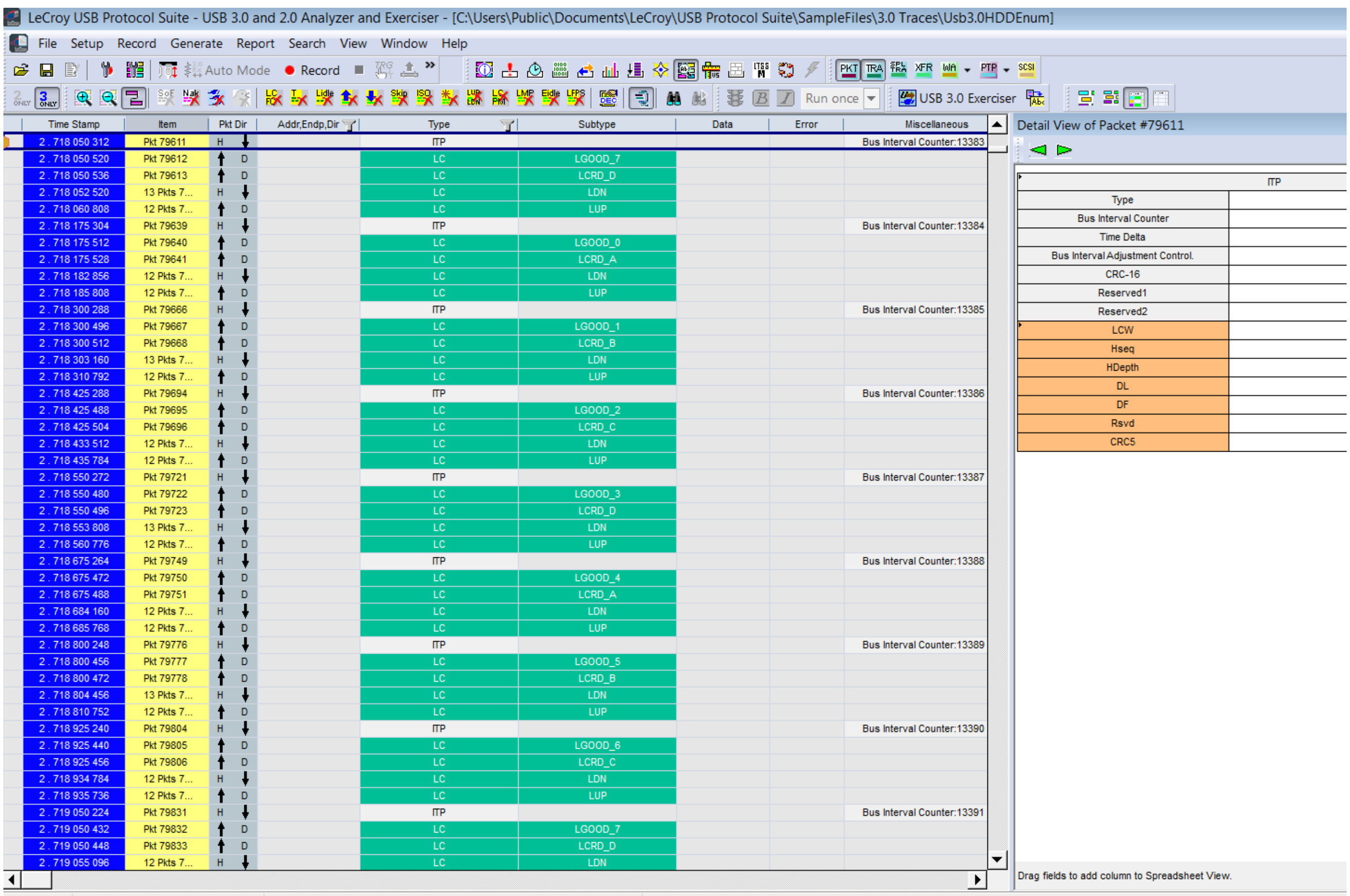


Figure 5.55: Detail View in Spreadsheet View

To put a Detail View header in the Spreadsheet View, drag the header to a column divider in the Spreadsheet View.

5.24 Edit Comment

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

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

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

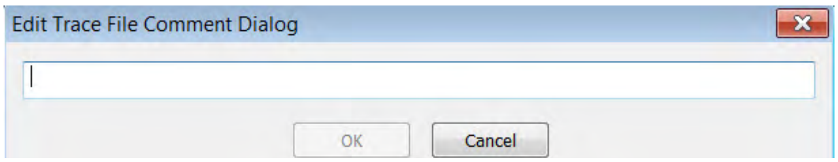


Figure 5.56: Edit Comments For Trace File Dialog

2. Create, view, or edit the comment.
3. Click **OK**.

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

Chapter 6

Searching Traces

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

To view the Search options:

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

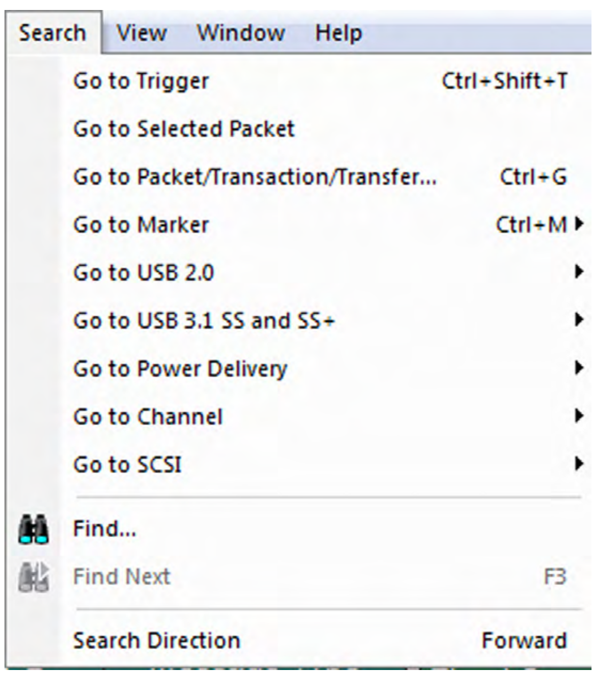


Figure 6.1: Search Drop-down Menu

6.1 Go to Trigger

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

To display a Trigger Event:

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

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

The resulting item will be shown as selected in the view.

Packet Selection works with Go to Trigger.

6.2 Go to Selected Packet

To display a selected packet select **Go to Selected Packet** under **Search** on the Menu Bar.

6.3 Go to Packet/Transaction/Transfer

To display a specific packet:

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

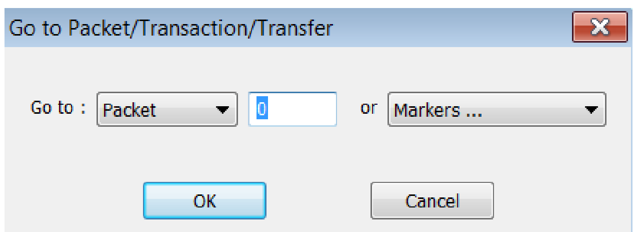


Figure 6.2: Go To Packet/Transaction/Transfer Dialog

2. Select the desired viewing level (packet, transaction etc.) from the drop-down menu next to the words **Go to**.
3. Enter the number of the packet you want to display.
4. Click **OK.** The Trace View is repositioned with the selected packet at the top of your screen. The resulting item will be shown as selected in the view.

6.4 Go to Marker

To instruct the Analyzer to display a marked packet:

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:

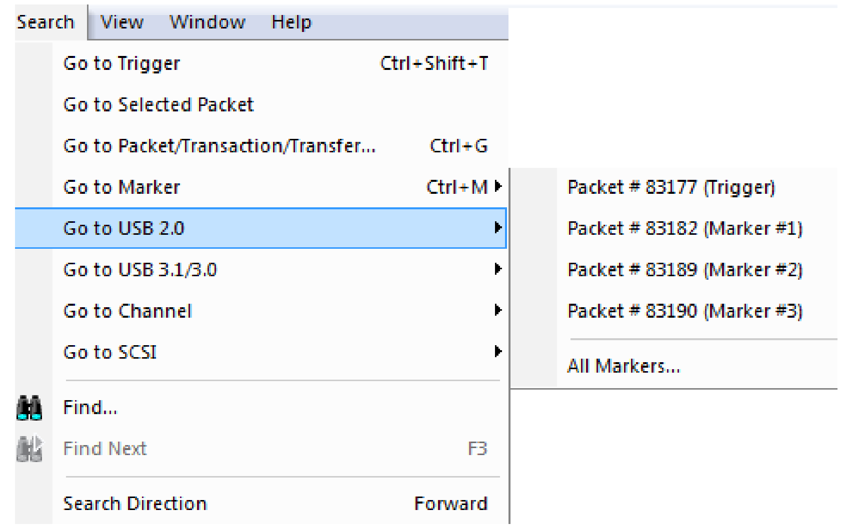


Figure 6.3: Go To Marker Menu Option

2. Select the desired packet from the displayed list. The Trace View is repositioned with the selected packet at the top of your screen. The resulting item will be shown as selected in the view.

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 "Markers" on page 153.

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

Packet Selection works with Go to Marker.

6.5 Go To USB 2.0

The Go To USB 2.0 feature takes you directly to an event in a Trace.

1. Select Go To USB 2.0 under Search on the Menu Bar to display the Go To USB 2.0 drop-down menu. For USB 2.0 data, the menu is:

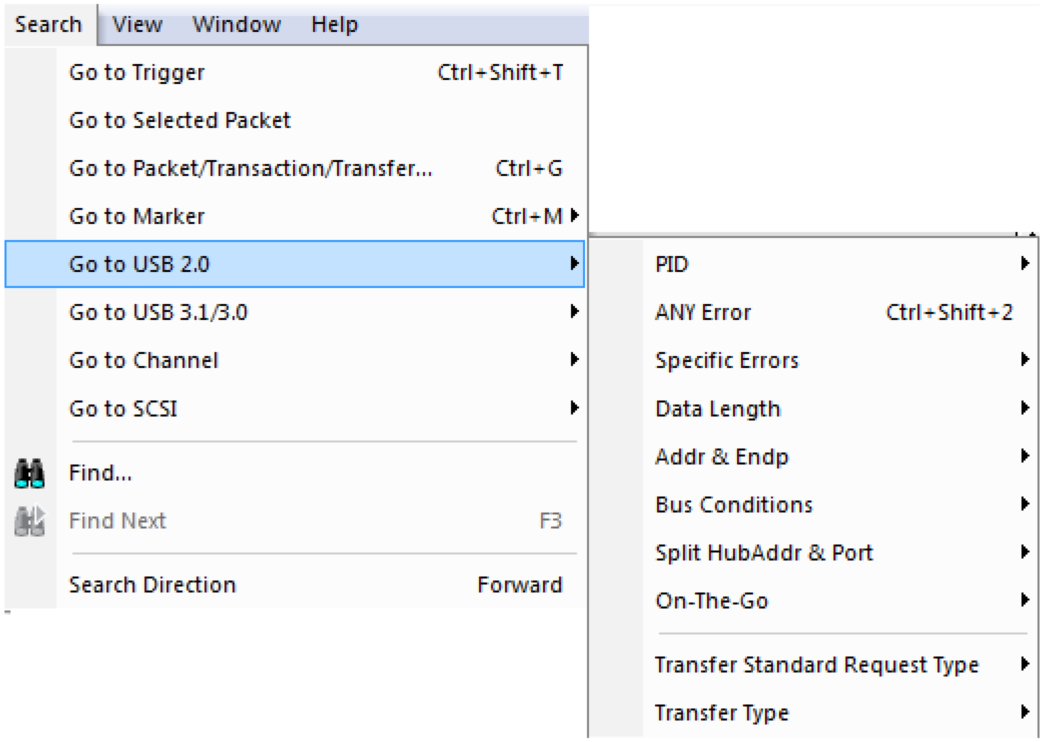


Figure 6.4: Go To USB 2.0 Menu Option

2. Select the event you want to go to and enter the necessary information. The resulting item will be shown as selected in the view.

6.5.1 Packet IDs (PIDs)

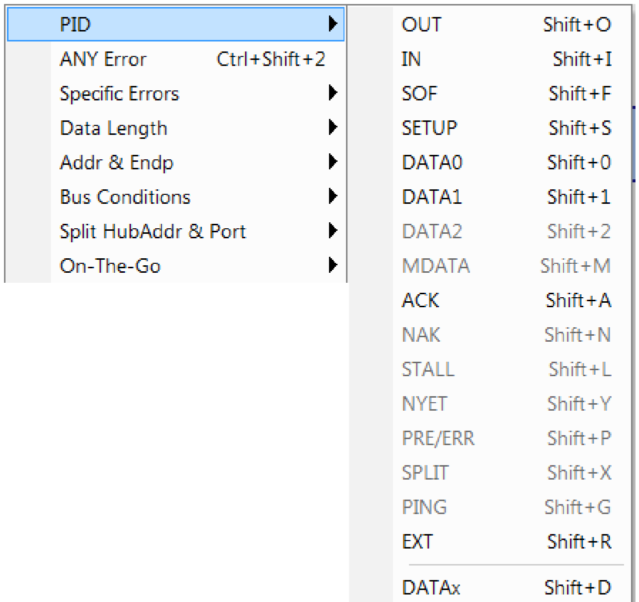


Figure 6.5: Packet IDs

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

6.5.2 ANY Error

Repositions the trace to show the next instance of any error. You can press **Ctrl+Shift+2** to go to the first error of any type.

6.5.3 Errors

The Errors menu allows you to search for five different types of error: PID, CRC5, CRC16, Packet Length, and Stuff Bits. Menu items appear in bold if they are present in the trace or are grayed out if not present in the trace (see Figure 6.6 on page 206).

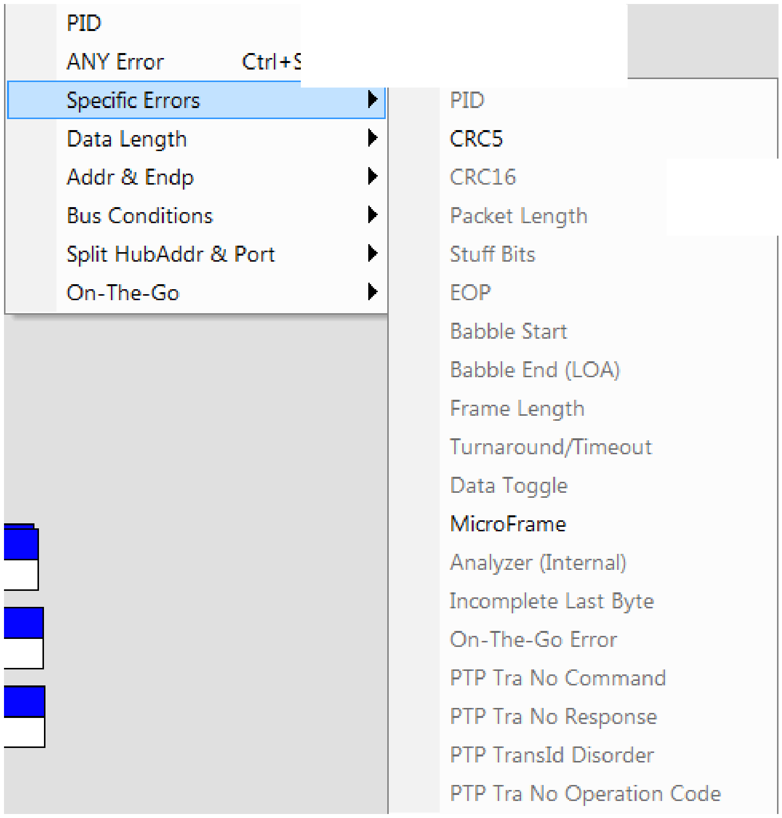


Figure 6.6: Errors Menu Option

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

6.5.4 Data Length

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

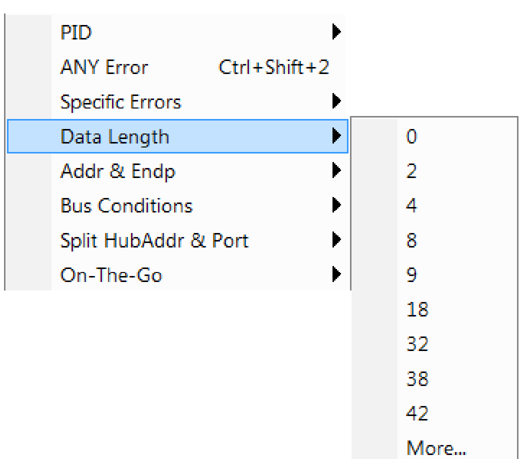


Figure 6.7: Data Length Menu Option

6.5.5 Addr & Endp

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

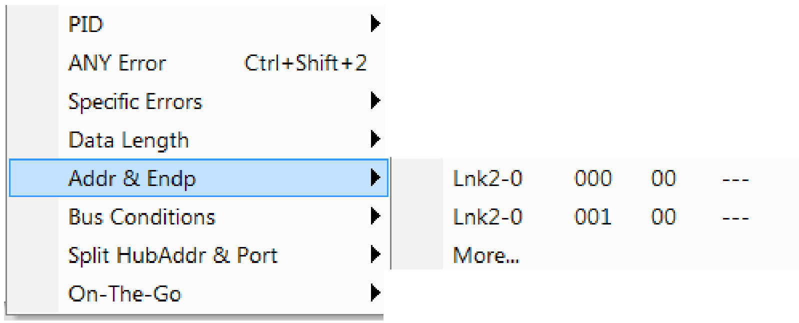


Figure 6.8: Addr & Endp Menu Option

6.5.6 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.

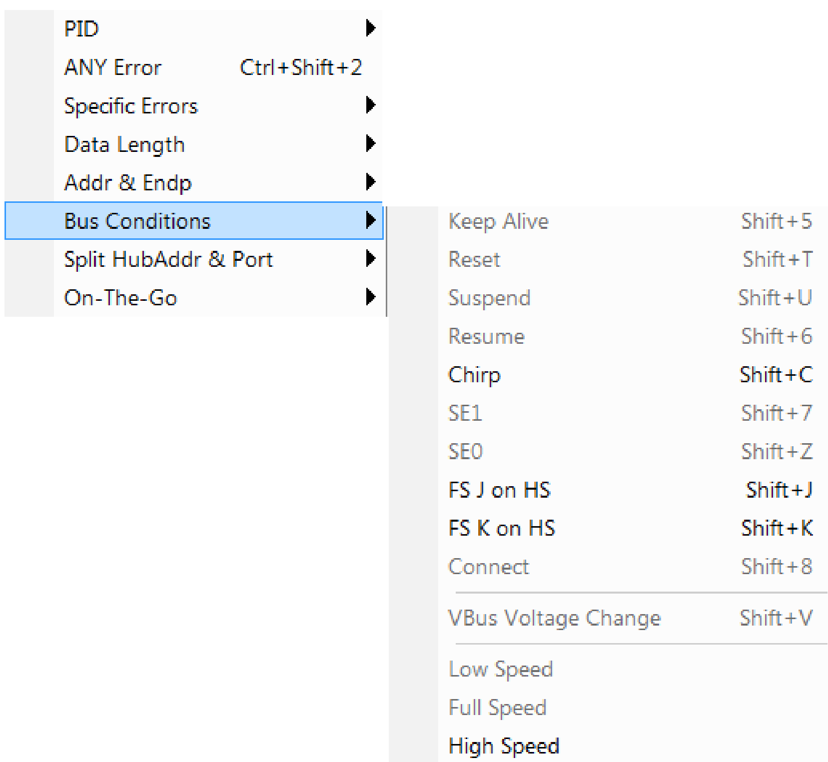


Figure 6.9: Bus Conditions Menu Option

6.5.7 Split HubAddr & Port

Allows you to go to a split hub address and port.

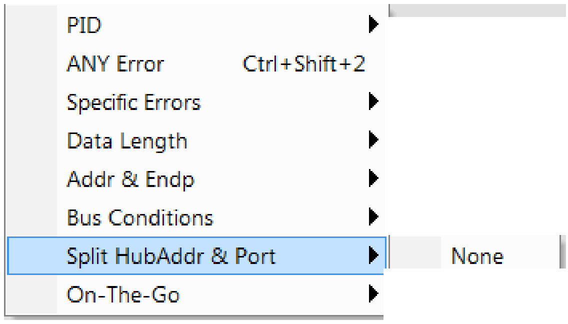


Figure 6.10: Split HubAddr & Port Menu Option

6.5.8 On-the-Go

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

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

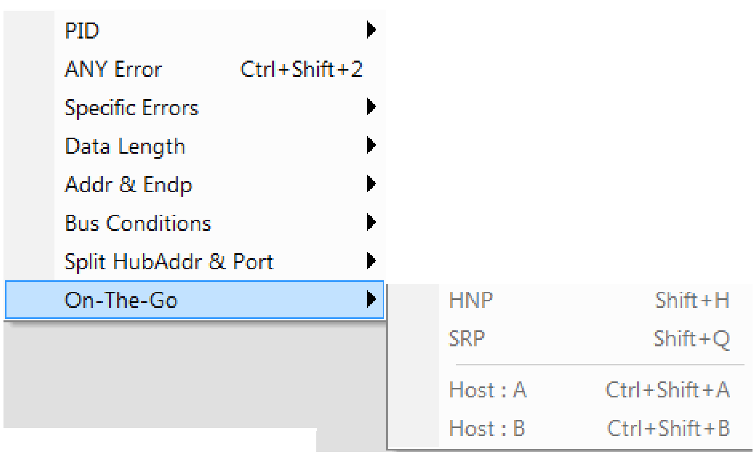


Figure 6.11: On-the-Go Menu Option

6.5.9 Transfer Standard Request Type

Allows you to search for Transfer Standard Request Type attributes.

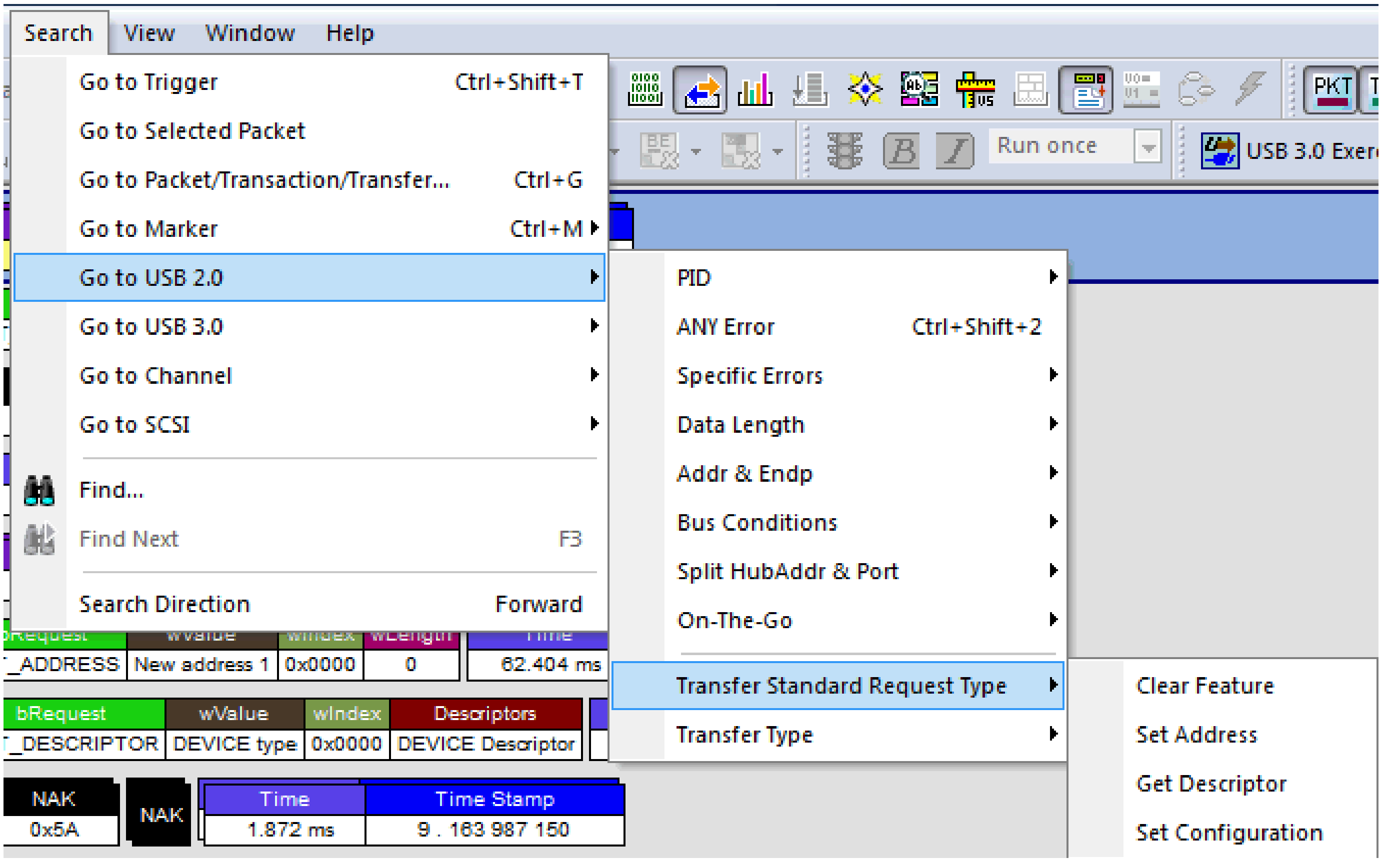


Figure 6.12: Transfer Standard Request Type Option

6.5.10 Transfer Type

Allows you to search for Transfer Type attributes.

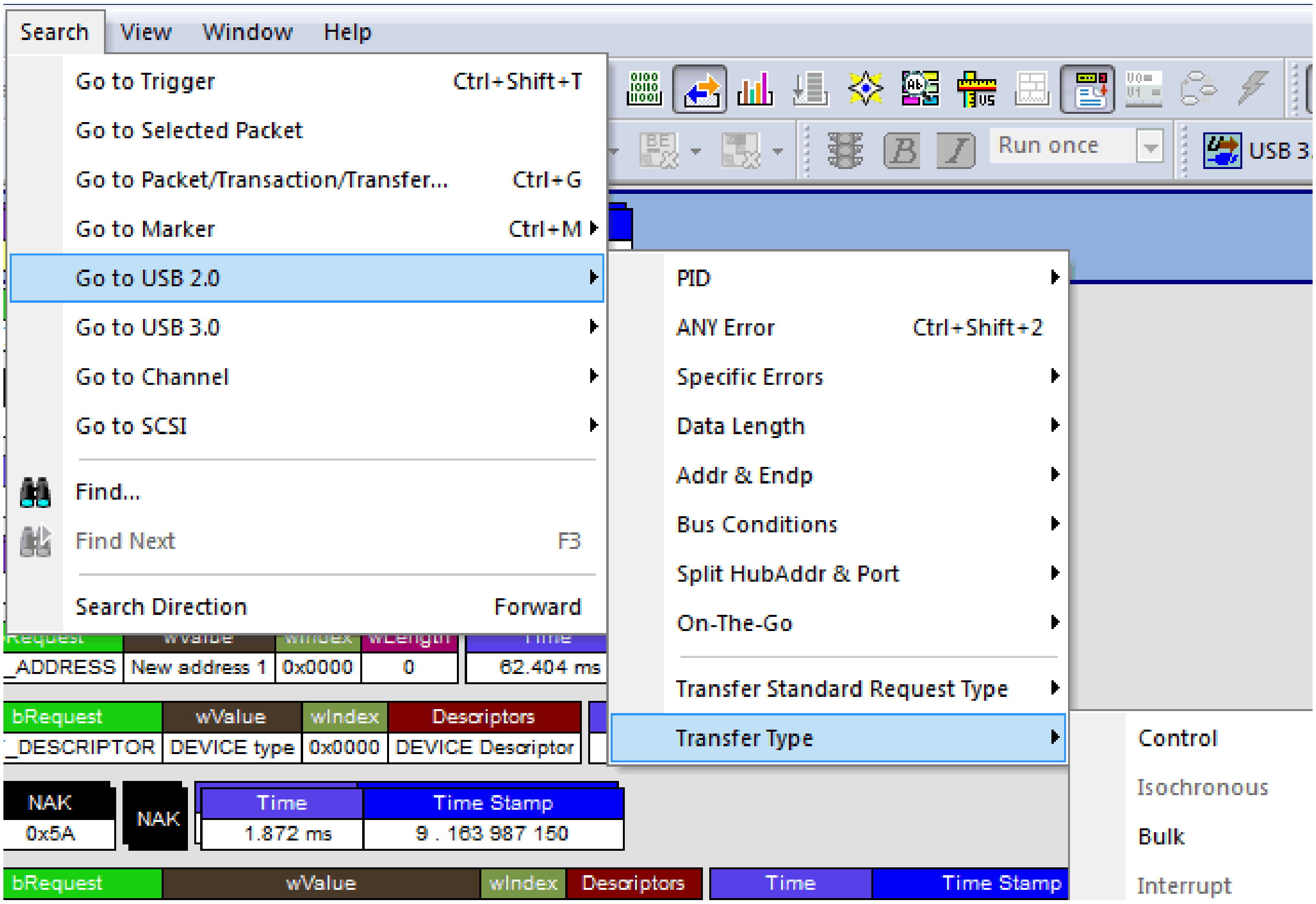


Figure 6.13: Transfer Type Option

6.6 Go To USB 3.1

The Go To USB 3.1 feature takes you directly to an event in a Trace.

1. Select **Go To USB 3.1** under Search on the Menu Bar to display the Go To USB 3.1 drop-down menu. For 3.1 data, the menu is:

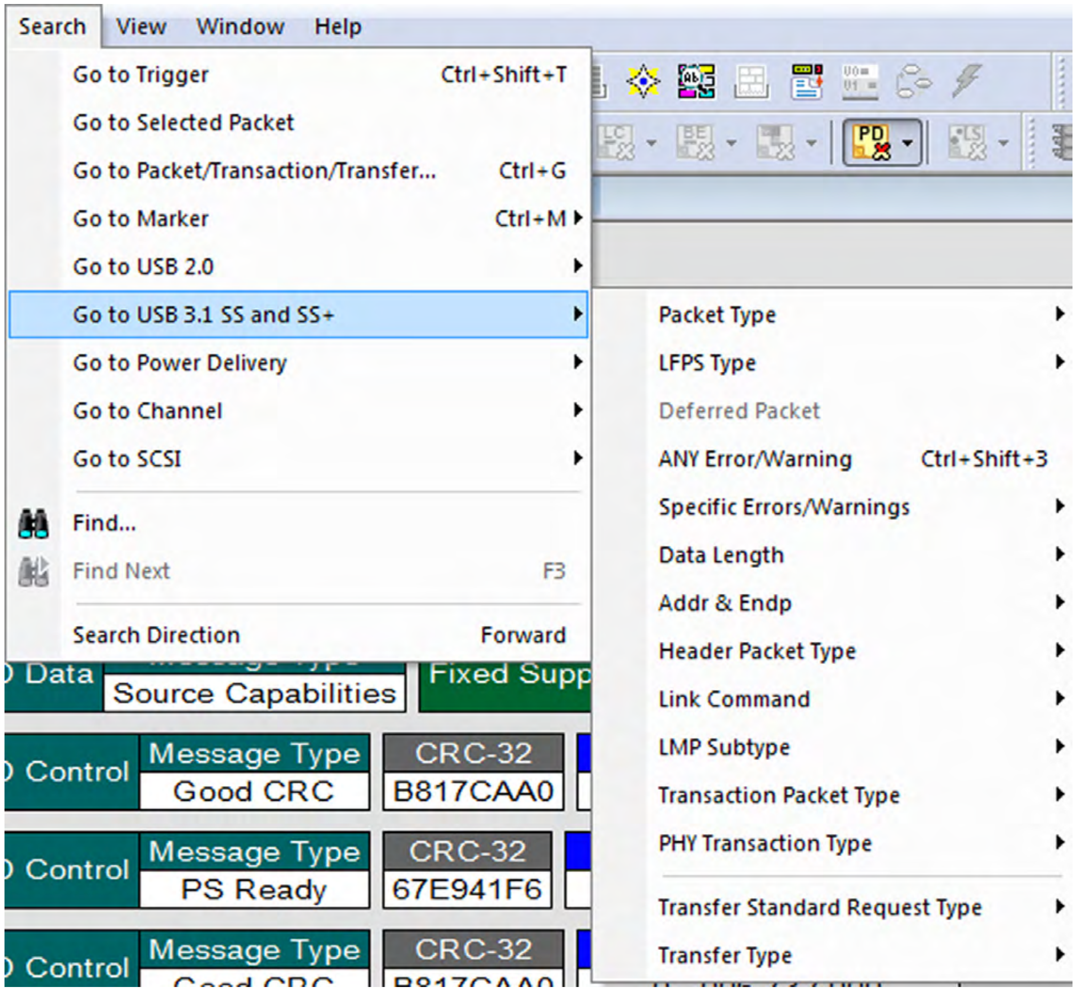


Figure 6.14: Go To USB 3.1 Menu Option

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

   The resulting item will be shown as selected in the view.

6.6.1 Packet Type

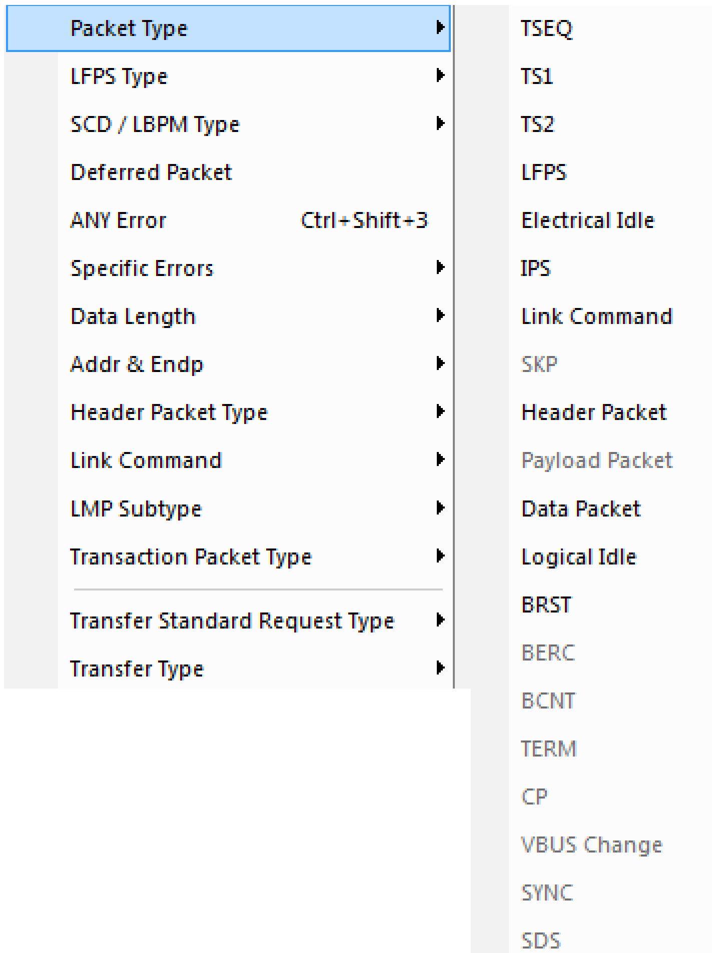


Figure 6.15: Packet Type Menu Option

Select the Packet Type to which you want to go.

6.6.2 LFPS Type

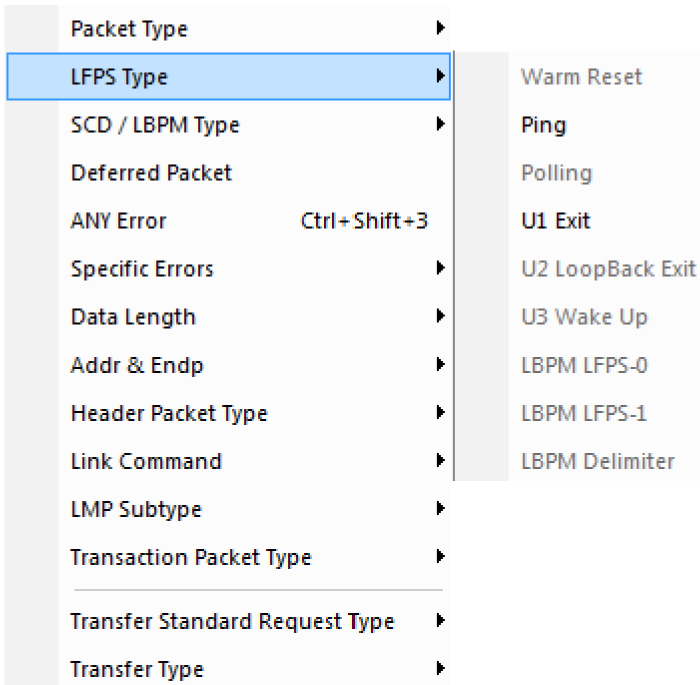


Figure 6.16: LFPS Type Menu Option

Select the LFPS Subtype to which you want to go.

6.6.3 Deferred Packet

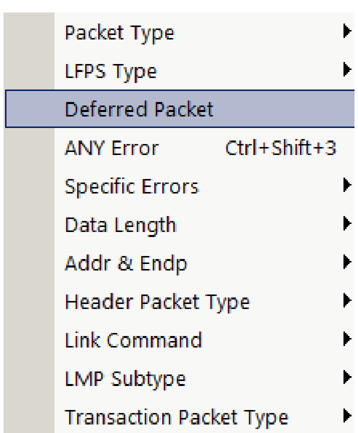


Figure 6.17: Deferred Packet Menu Option

6.6.4 ANY Error

Repositions the trace to show the next instance of any error. You can press **Ctrl+Shift+3** to go to the first error of any type.

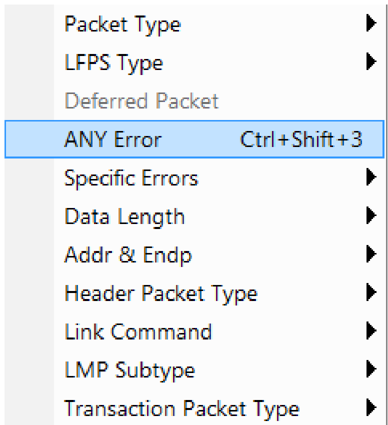


Figure 6.18: Any Error Menu Option

6.6.5 Specific Errors

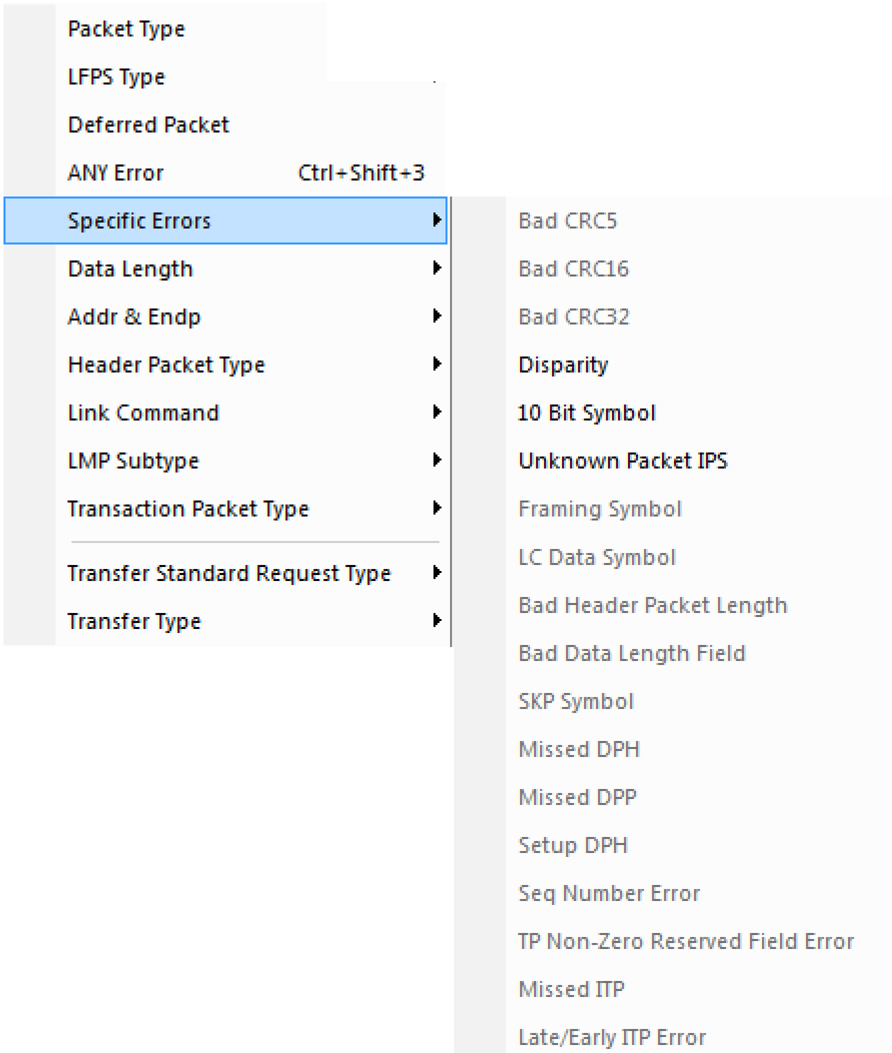


Figure 6.19: Specific Errors Menu Option

Select the specific error to which you want to go.

Note: Seq Number Error refers to Transaction Sequence Numbers (0 to 31), not to Link Control Word (LCW) sequences.

6.6.6 Data Length

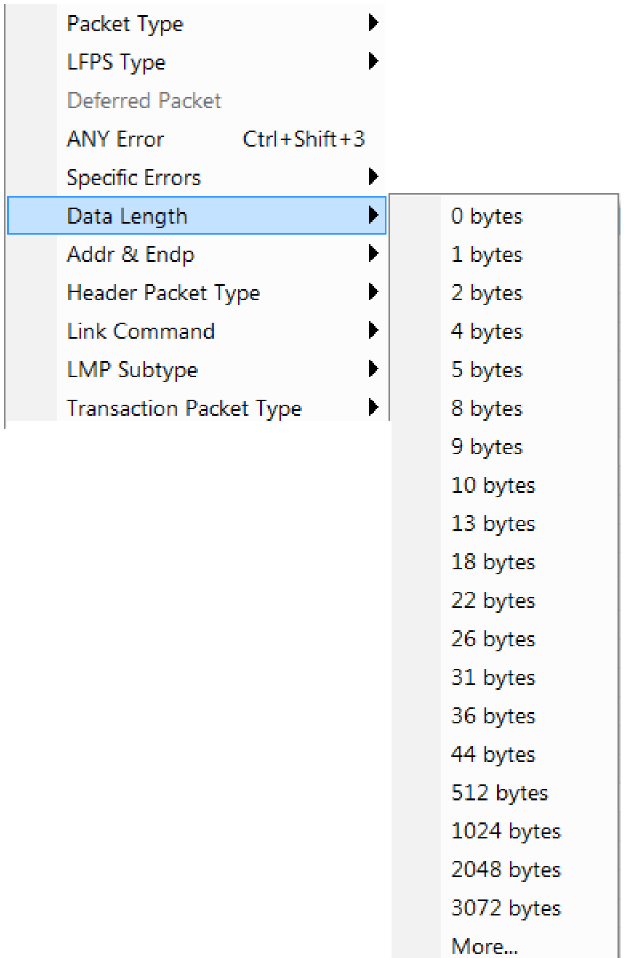


Figure 6.20: Data Length Menu Option

Select the data length to which you want to go.

6.6.7 Address and Endpoint

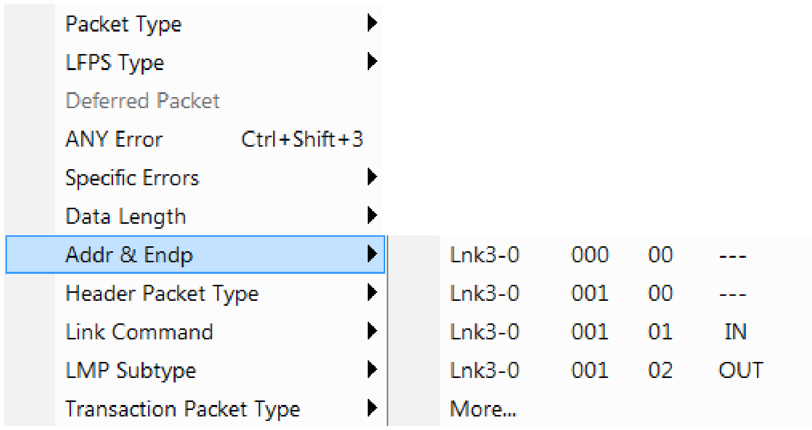


Figure 6.21: Address and Endpoint Menu Option

Select the address and endpoint to which you want to go.

6.6.8 Header Packet Type

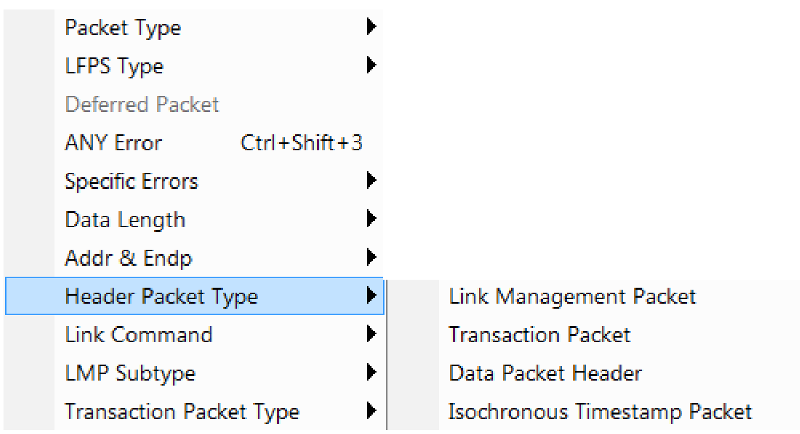


Figure 6.22: Header Packet Type Menu Option

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

6.6.9 Link Command

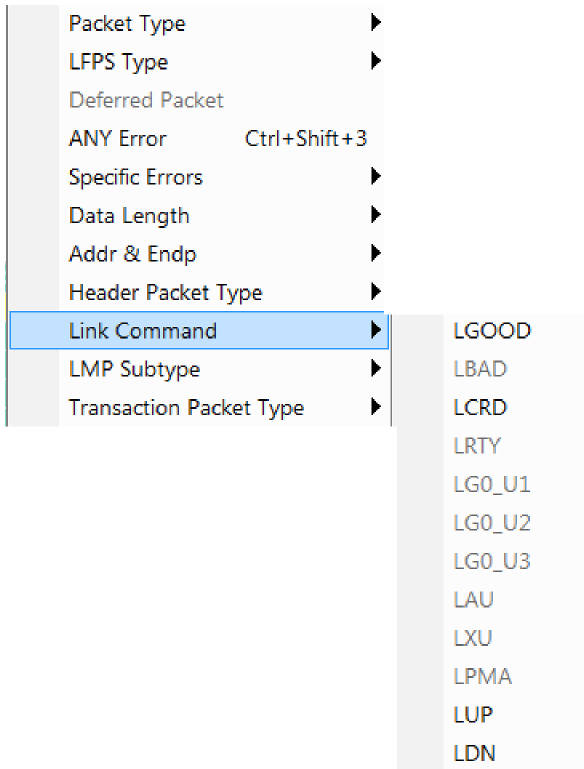


Figure 6.23: Link Command Menu Option

Select the link command to which you want to go.

6.6.10 LMP Subtype

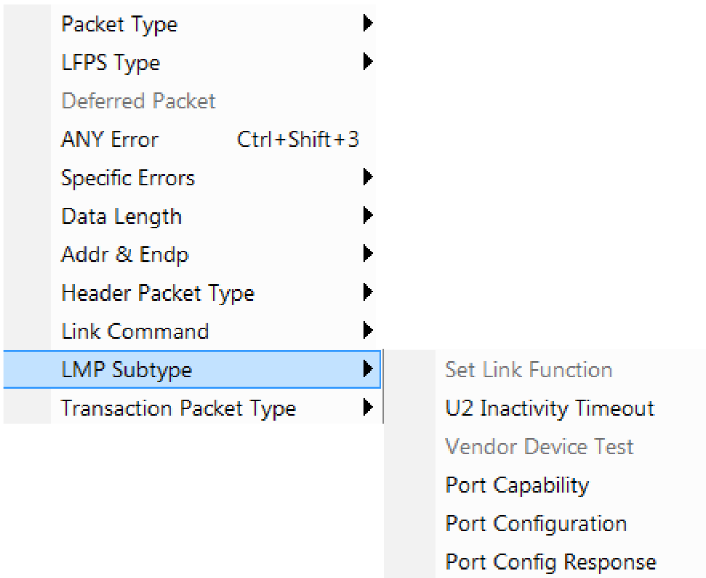


Figure 6.24: LMP Subtype Menu Option

Select the LMP Subtype to which you want to go.

6.6.11 Transaction Packet Type

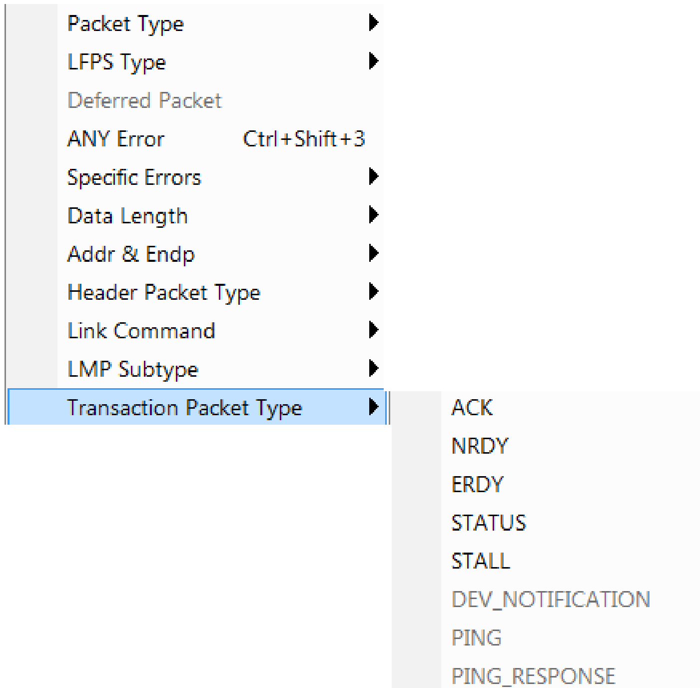


Figure 6.25: Transaction Packet Type Menu Option

Select the Transaction Packet Type to which you want to go.

6.6.12 Transfer Standard Request Type

Allows you to search for Transfer Standard Request Type attributes.

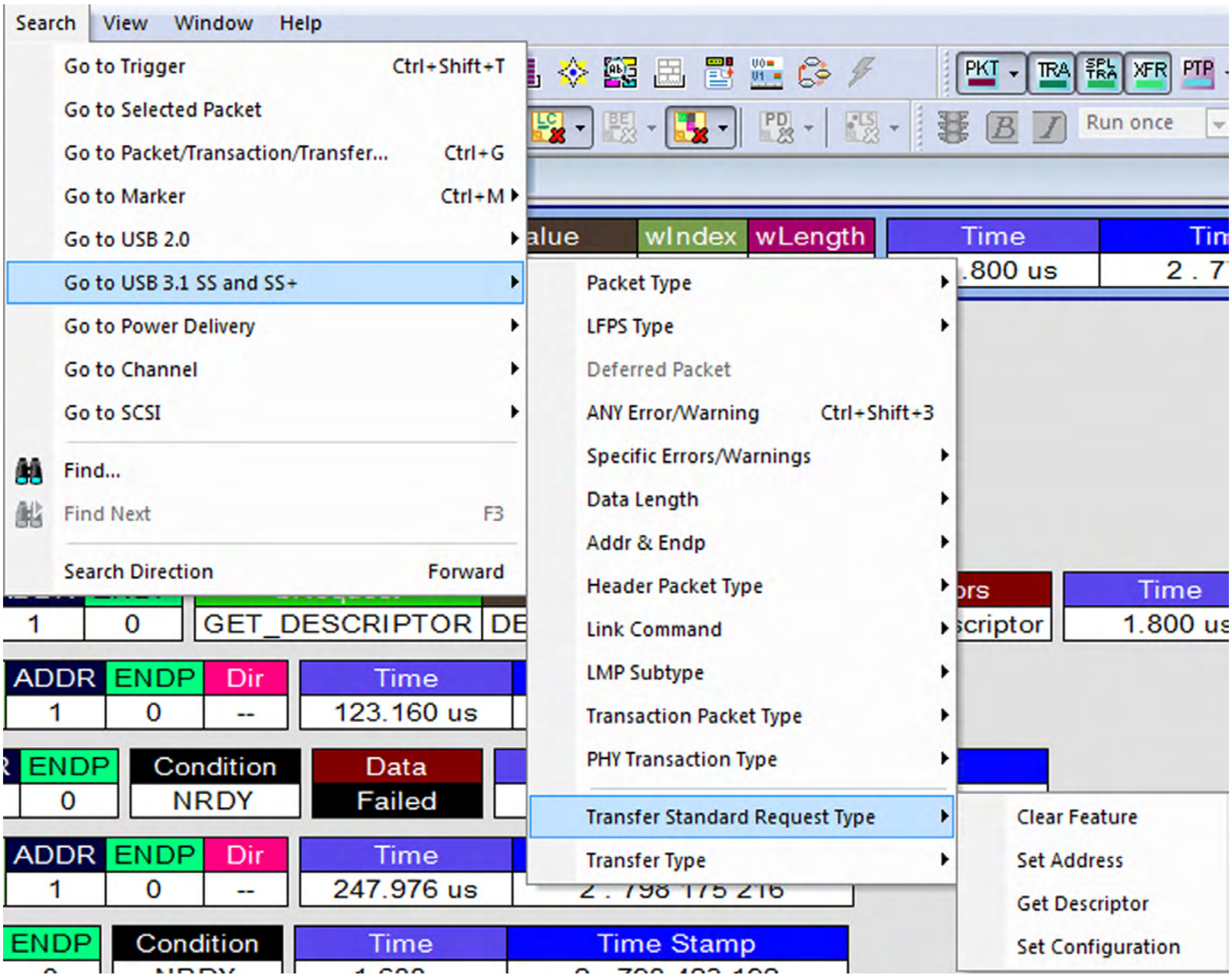


Figure 6.26: Transfer Standard Request Type Option

6.6.13 Transfer Type

Allows you to search for Transfer Type attributes.

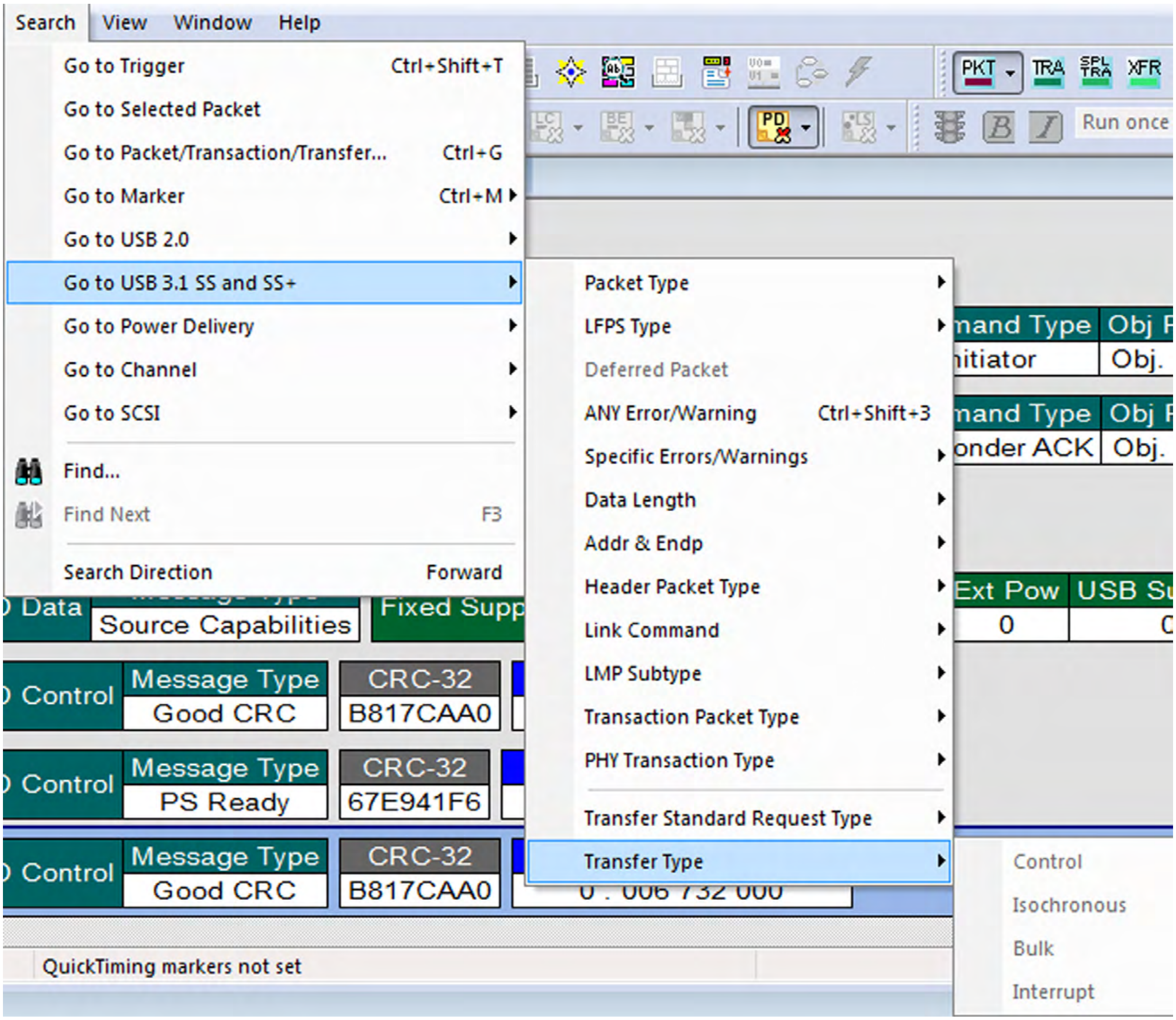
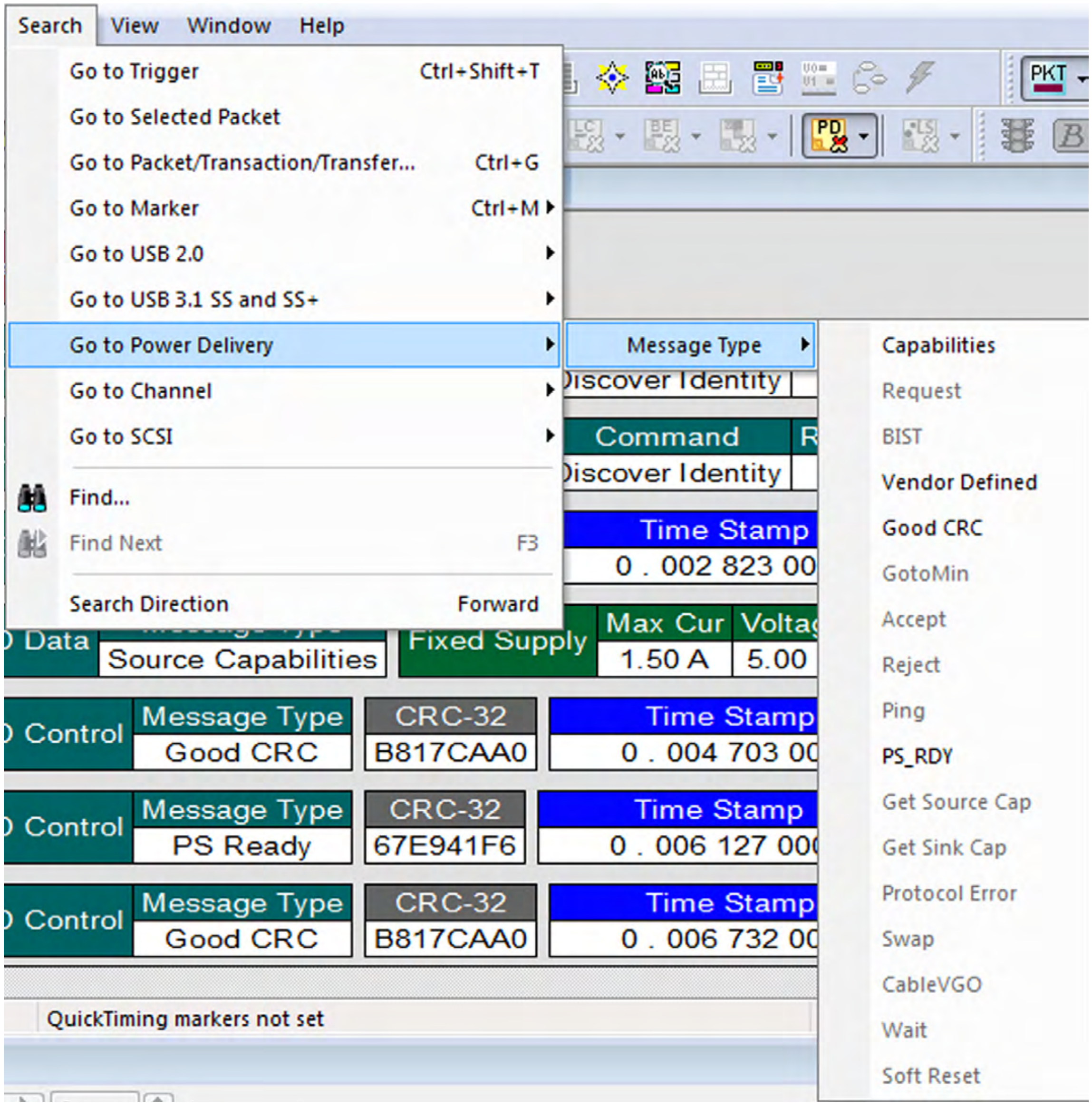


Figure 6.27: Transfer Type Option

6.7 Go To Power Delivery



6.7.1 Go To Channel

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

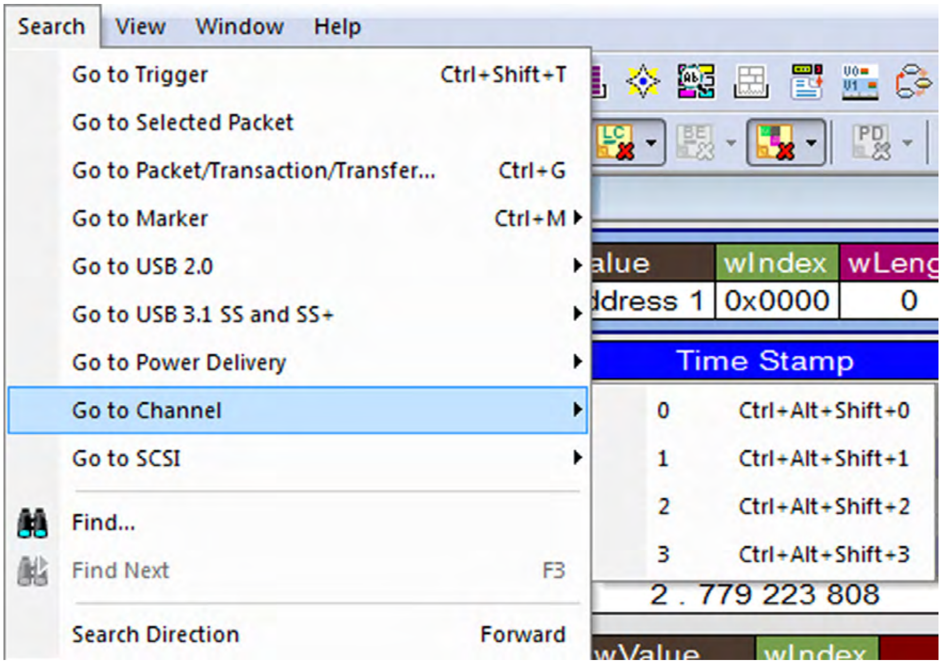


Figure 6.28: Channel Menu Option

6.8 Go To SCSI

The Go To SCSI feature takes you to a SCSI Operation, Command Status, Task Management, Task Management Response, Error or SCSI Logical Unit Number.

6.8.1 Go To SCSI Menu Selection Example

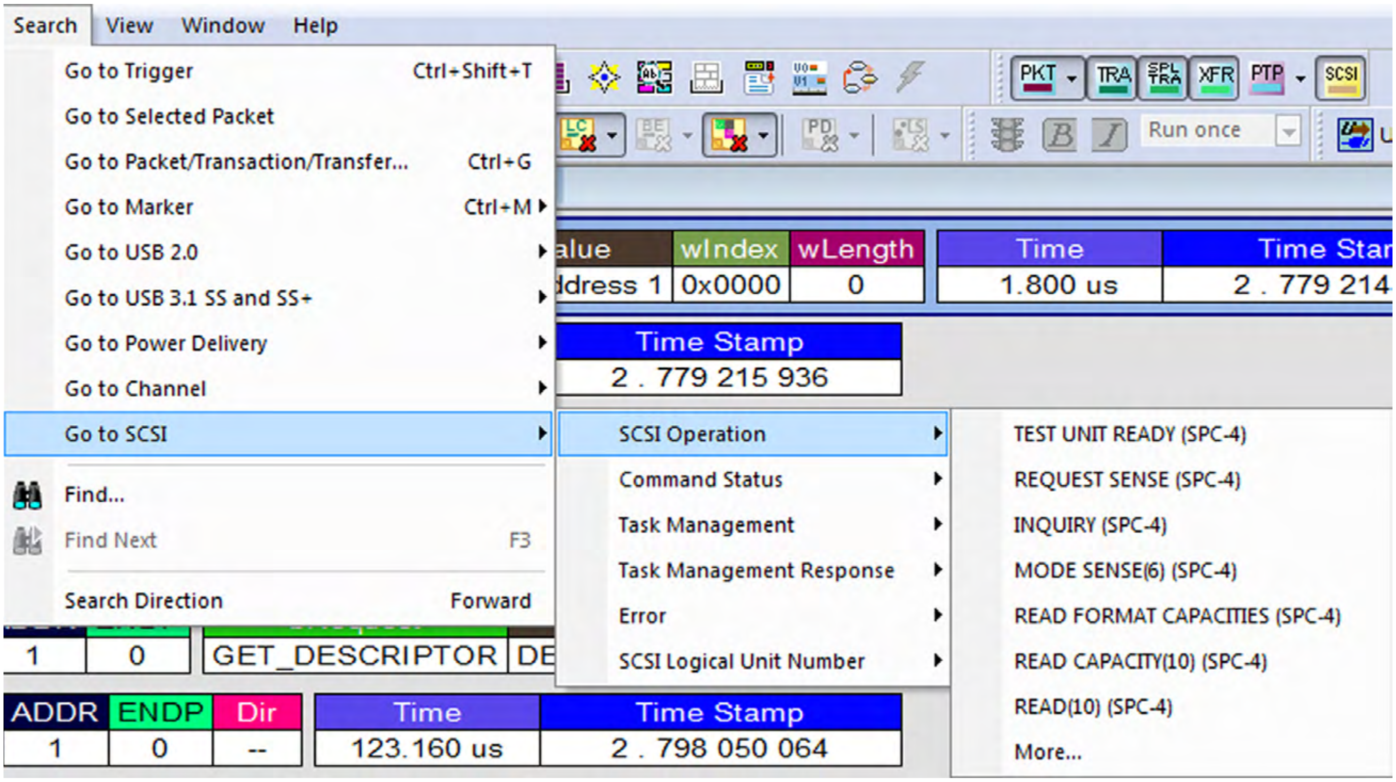


Figure 6.29: Go To SCSI Menu Selection Example

6.9 Find

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

6.9.1 Using the Find Function

To run **Find**, select **Search > Find** or by click  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 in which packets or events are excluded from a trace, using the **Exclusion** option.

To perform a search:

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

   OR

   Click  in the Tool Bar.

   You see the User-Defined Find Events screen:

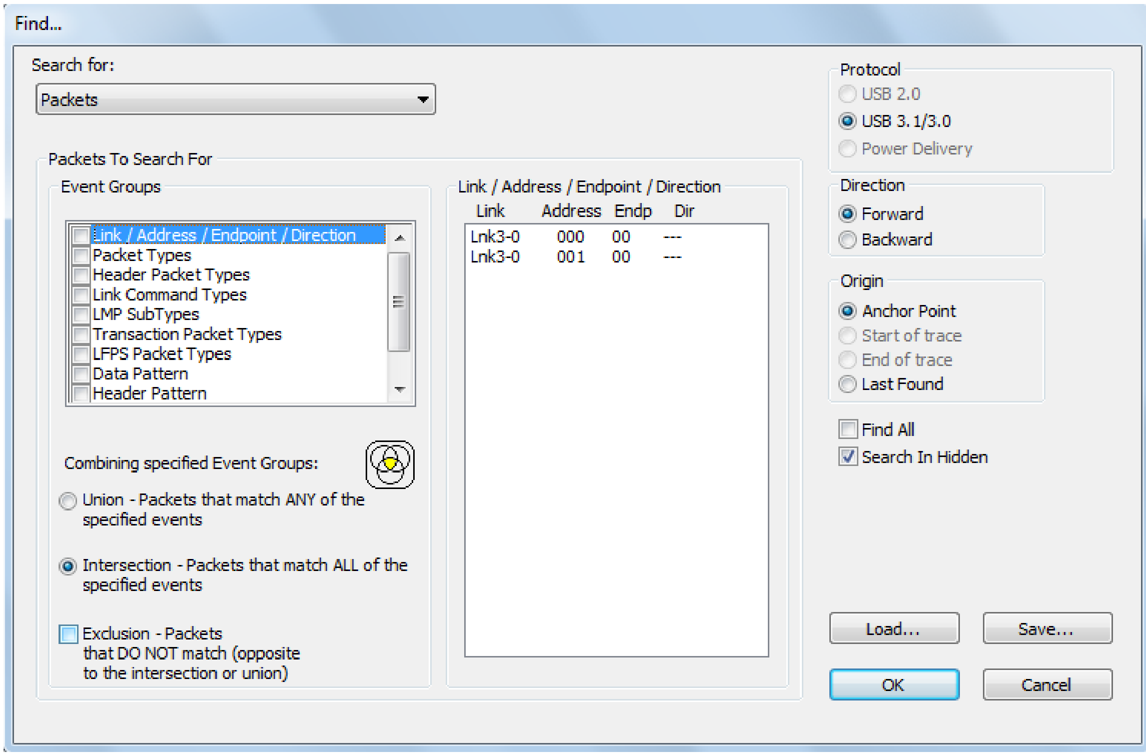


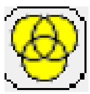
Figure 6.30: Find Dialog.

2. If the file has both USB 2.0 and USB 3.1 traffic, select either of these technologies in the Protocol area (upper right): **USB 2.0**, **USB 3.1** or **Power Delivery**.
3. Select **Packets, Transactions**, **Split Transactions**, **Transfers, PTP/MTP Transactions, PTP/MTP Objects**, **PTP/MTP Sessions**, or **SCSI Operations** from the top left list box to list that type of event in the Events Group box.
4. Select one or more events from the **Events Group** box:
   - Address/Endpoint
   - Address/RPipe
   - Bus Conditions
   - Command Status
   - Data Lengths
   - Data Pattern
   - Errors
   - Frames
   - Handshake
   - Header Packet Types
   - Link Command Types
   - LMP Subtypes
   - Object Counts
   - Object Handler
   - Object Format Type
   - On-the-Go Protocol
   - Operation Code
   - Packet Identifiers

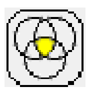
- ❑ Packet Types (Header, PHY, Event, Transaction)
- ❑ Result Status
- ❑ SCSI Command
- ❑ Split
- ❑ Task Management
- ❑ Task Management Response
- ❑ Transaction Packet Types
- ❑ Transfer Lengths

5. 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.)

6. Optionally set the search **Direction** and **Origin**.
7. Optionally check to **Search in Hidden.** This option looks for the selected items even if you have currently hidden them.
8. Optionally check to **Find All.** This option opens a new Trace View window that contains ONLY the items for which you are searching. Subsequent searches or actions cannot modify this window, so it never contains any other packets. Use this option only when you want to check how many packets a specific search criterion puts in the Main Trace View.
9. Click **OK**.

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

The resulting item will be shown as selected in the view.

Packet Selection works with Find.

6.9.2 Power Delivery and Configuration Channel (CC) Elements

A similar mechanism is provided to find Power Delivery and CC elements.

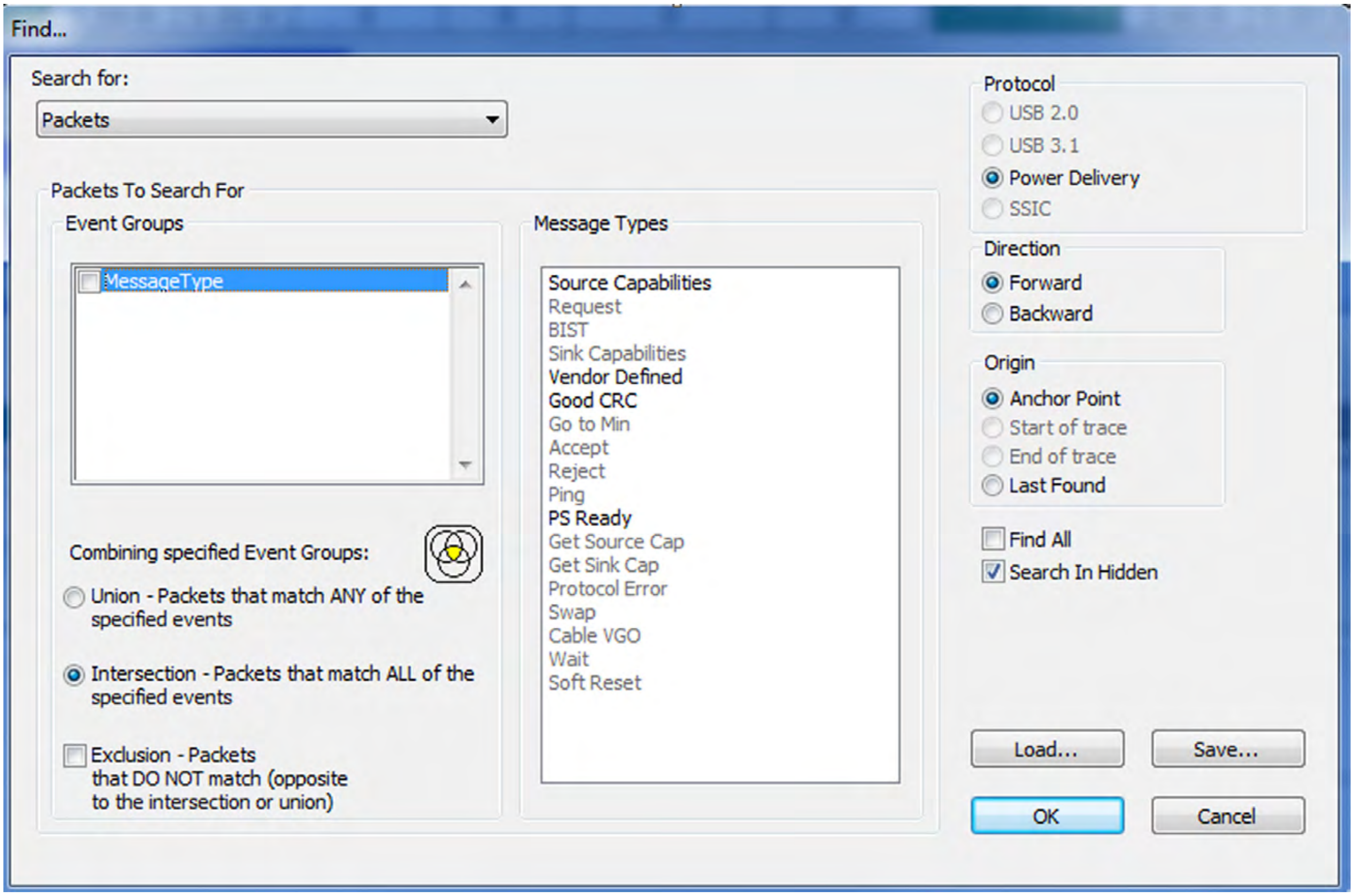


Figure 6.31: Power Delivery and CC Elements

6.9.3 Data Pattern Mask and Match

If you select Data Pattern as the Event Group in the Find dialog, you can set the Bitmask, Mask, and Match for each bit.

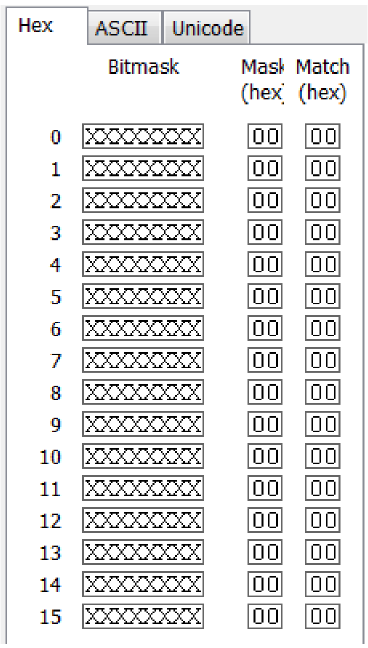


Figure 6.32: Data Pattern Mask and Match Dialog

Bitmask and Match always correlate. When you set Bitmask or Match. the other changes to maintain their correlation.

Note: If you set Bitmask/Match before setting Mask, the Mask changes to the default mask. You must change to the Mask that you want.

If you set an appropriate Mask before setting Bitmask/Match, the Mask does not change automatically to a default mask if you change Bitmask/Match.

6.10 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.

6.11 Search Direction

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

Chapter 7

Display Options

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

To open the Display Options window:

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

OR

- ❑ Click  on the Tool Bar:

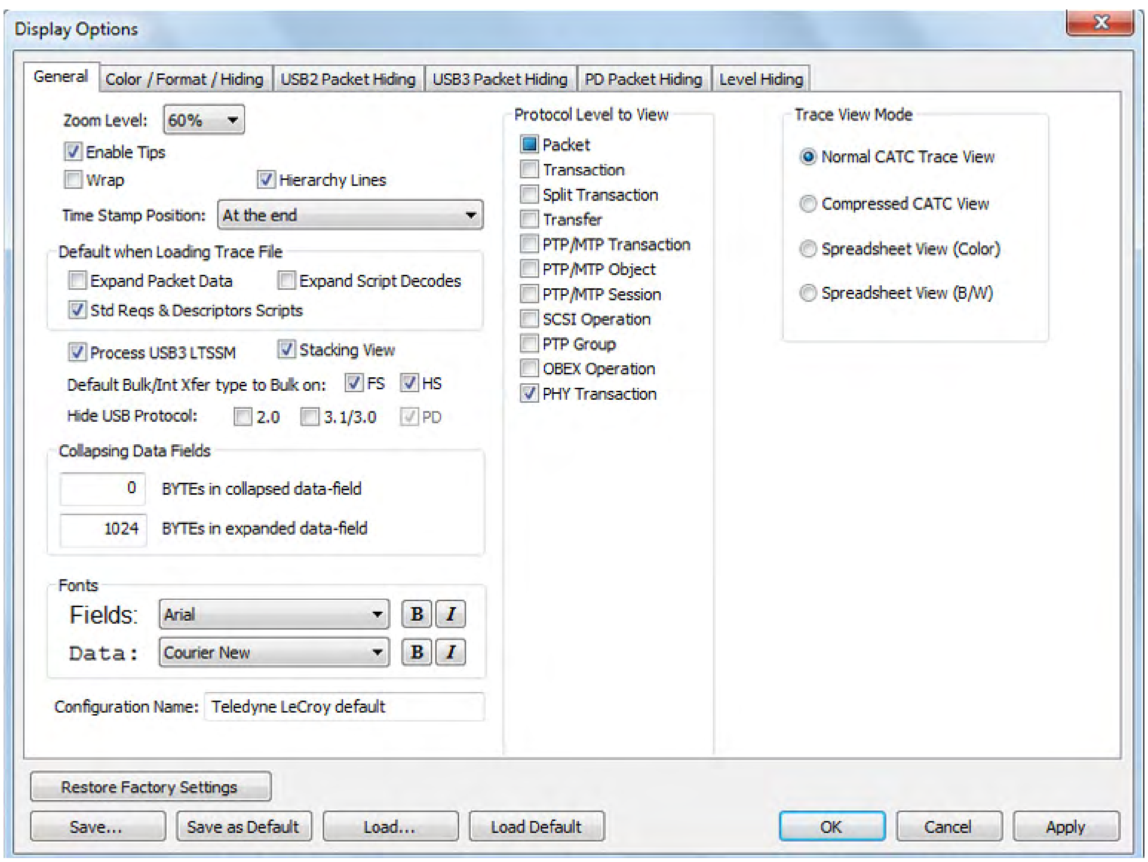


Figure 7.1: Display Options General Dialog

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

7.1 General Display Options

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

- **Zoom Level**: Zooms out from 100% (default) to 10% or zooms in from 100% to 200%.
- **Enable Tips**: Pops up text when you position the cursor over a field.
- **Wrap**: Wraps lines of traffic information instead of truncating lines at the right edge of the display.
- **Hierarchy Lines**: Displays lines on the left side of Trace View showing the hierarchy from Packets to Transactions to Split Transactions to Transfers if you show higher-level decodes.
- **Timestamp Position**: Aligns the Timestamp field **At the beginning** (in a column on the left side of the Trace View), **At the end** (in a column on the left side of the Trace View), or **Merge with Packet/Transaction/Translation**. Selecting this option allows easier comparison with previous or following timestamps.
- **Default when Loading Trace File** - The following three features are applied only when the trace file is loaded. It does not do anything to a trace that is being viewed.
  - **Expand Packet Data**: Displays packet data fields in expanded mode. If this option is not selected, packet data fields display in collapsed mode, and you can expand them manually.
  - **Expand Script Decodes**: Displays decoded transfer fields in expanded mode. If this option is not selected, decoded transfer fields display in collapsed mode, and you can expand them manually.
  - **Std Reqs & Descriptors Scripts**: Use dynamically loaded **.DEC** files (rather than **.REQ** and **.DSC** files) for decoding Class and Vendor requests or endpoints.
- **Process USB3 LTSSM**: Enables the software processing needed for the LTSSM views. Disable if you do not need link state information.
- **Stacking View**: See “Stacking” on page 174.
- **Default Bulk/Int Xfer type to Bulk on**: Select **FS** and/or **HS.**
  In most cases, the USB Protocol Suite can determine whether an endpoint is an Interrupt or Bulk endpoint and apply the proper decoding. However, in some cases, the USB Protocol Suite cannot distinguish traffic from these two Transfer Types and defaults to Interrupt endpoint. For FS and/or HS, you can set the software to default to Bulk endpoint, typically when you know that captured traffic is Bulk, not Interrupt.

Note: In the Trace view, you can change the Transfer Type by right-clicking the **INT** or **BULK** field and selecting the appropriate option.

- **Hide USB Protocol:** Use USB 2.0, USB 3.1 or Power Delivery.
- **Collapsing Data Fields**
  - **BYTEs in collapsed data-field**: Enter the number of bytes (0 to 4096) to display in a collapsed data field. In this example, the value entered is eight. The collapsed field displays the first eight bytes even though the field contains 64 bytes (see Figure 7.2 on page 233).

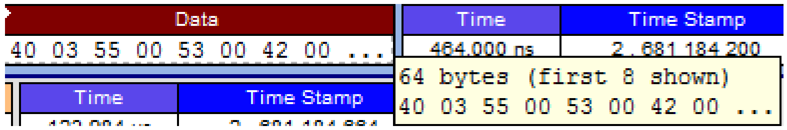


Figure 7.2: First 8 Bytes Displayed in a Field with 64 Bytes.

- **BYTEs in expanded data-field**: Enter the number of bytes (1 to 4096) to display in an expanded data field. In this example, the value entered is 32. The collapsed field displays the first thirty two bytes even though the field contains 64 bytes.

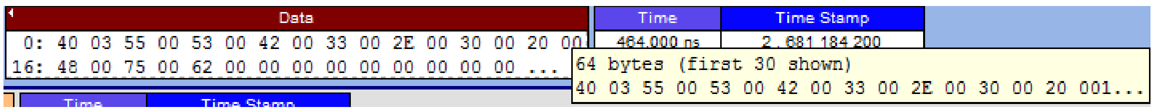


Figure 7.3: First 32 Bytes Displayed in a Field with 64 Bytes.

- **Protocol Level to View**: Displays Packet, Transaction, Split Transaction, PTP/MTP Transaction, PTP/MTP Object, PTP/MTP Session, SCSI Operation, PTP Group and OBEX Operation.
- **Trace View Mode**: Displays Normal CATC Trace View, Compressed CATC View, Spreadsheet View (Color), and Spreadsheet View (B/W).
- **Fonts**: Sets the font type and bold or italic style for Fields and Data.
- **Configuration Name**: You can name the current set of Display Options values for use with an **.opt** file. (The options file can have a different name.)
- **Restore Factory Settings**: Sets all Display Options values to the installed values. This does NOT change the default settings that are loaded when the application starts. If you want the Factory Settings to be your default, you must Save As Default after Restoring the Factory Settings.

7.2 Color/Format/Hiding Display Options

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

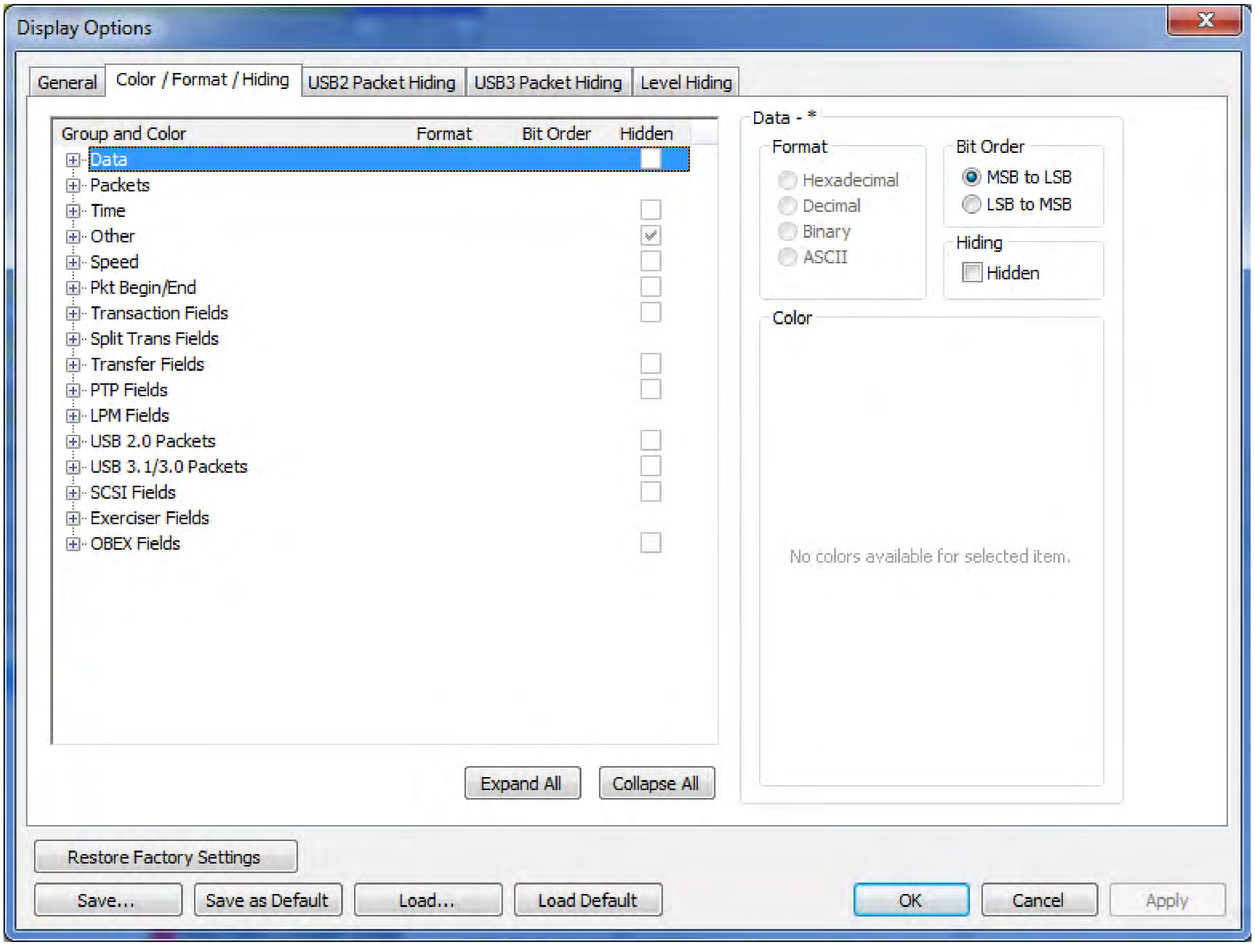


Figure 7.4: Display Options Color/Format/Hiding Dialog.

7.2.1 Color Display Options

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

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

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

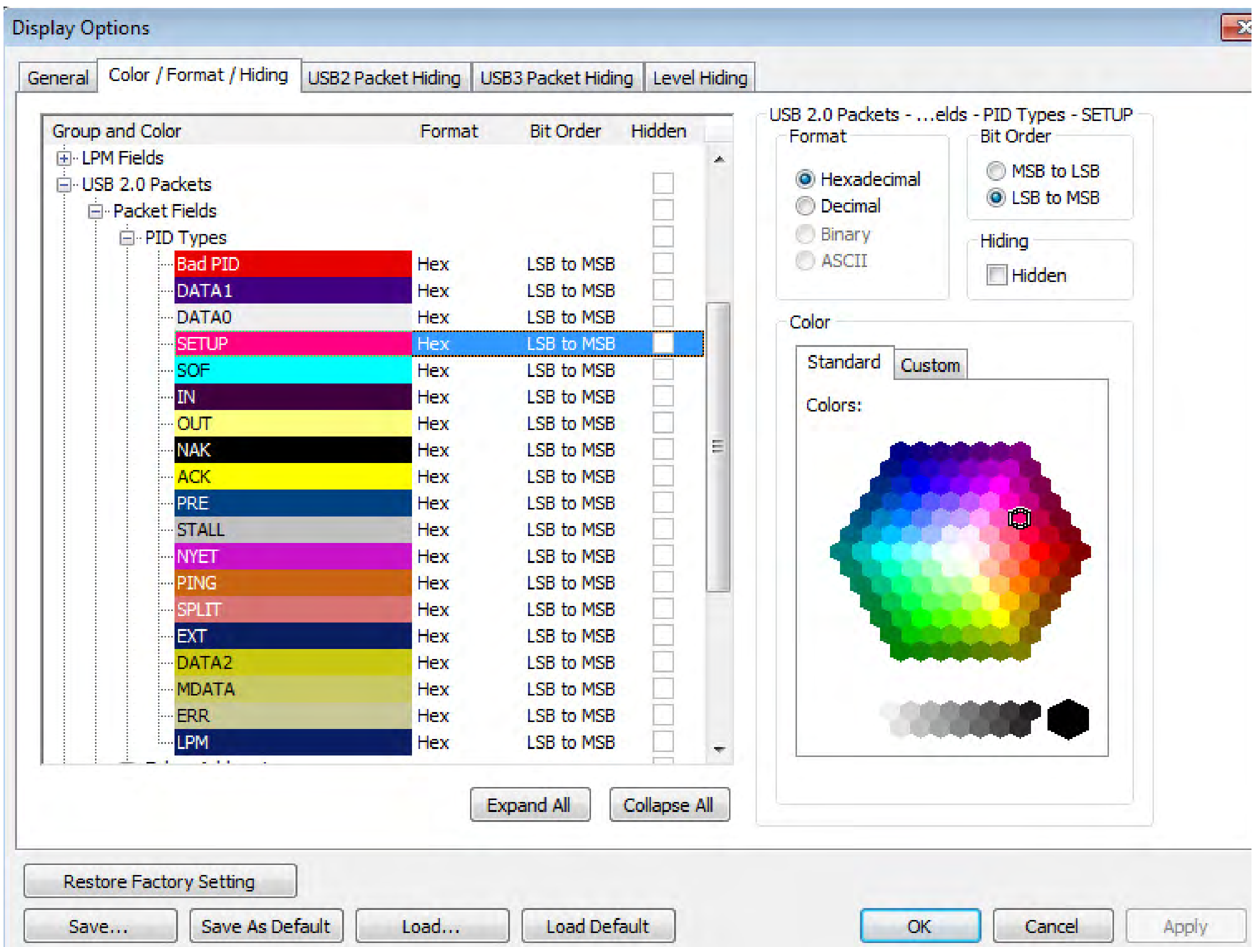
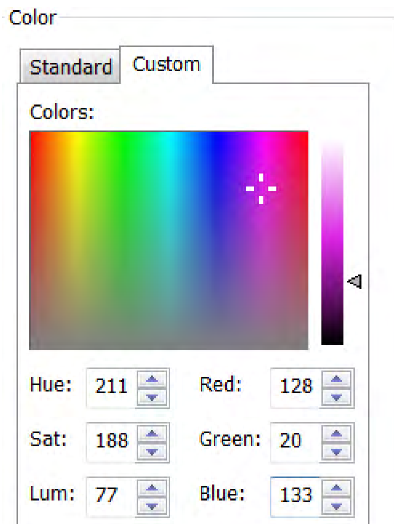


Figure 7.5: Display Options Color/Format/Hiding Dialog Group and Color Pane.

To customize colors, use the Custom tab.



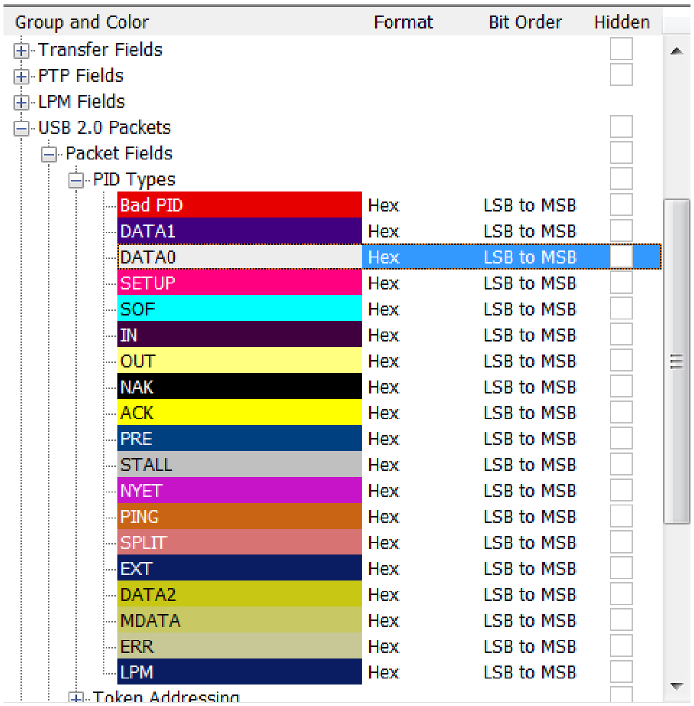
Note: You cannot change the color of an Invalid Data (packet error) field. It is permanently set to red.

7.2.2 Format Display Options

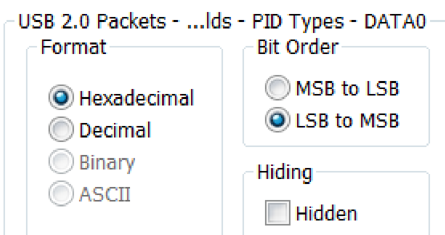
For each type of data in each group of data, the program has a default data format. Examples of number data formats are Bin (binary), Dec (decimal), and Hex (hexadecimal). Examples of date and time data formats are Hex uFrame, Dec uFrame, Date & Time, Time, Bit Time, seconds, microseconds, and nanoseconds.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

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

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



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

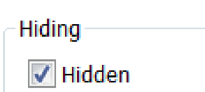


If available, select Bit Order in the Format section. The options are MSB to LSB or LSB to MSB.

7.2.3 Hiding Display Options

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

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



7.3 USB 2.0 Packet Hiding Options

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

- Start of Frame packets
- NAK'ed transactions
- Chirp Bus conditions
- SE0 Bus conditions
- High, Full, or Low Speed packets
- Channel 0 or Channel 1 packets

You can allow any toggle value after bus reset (Int and Bulk Endpoints). Depending on the device, after Bus Reset the endpoint toggle state might or might not be reset. Selecting this option prevents display of a toggle violation error.

You can have 2-stage SOF hiding. You can display all SOFs, hide all SOFs, or hide empty SOFs (show only SOFs with endpoint traffic and hide empty frames). Selecting this option allows you to hide empty SOFs with one click of the Hide SOF button or hide all SOFs with two clicks of the Hide SOF button.

Select the **USB 2.0 Packet Hiding** tab, then select the data types to hide (see Figure 7.6 on page 238.)

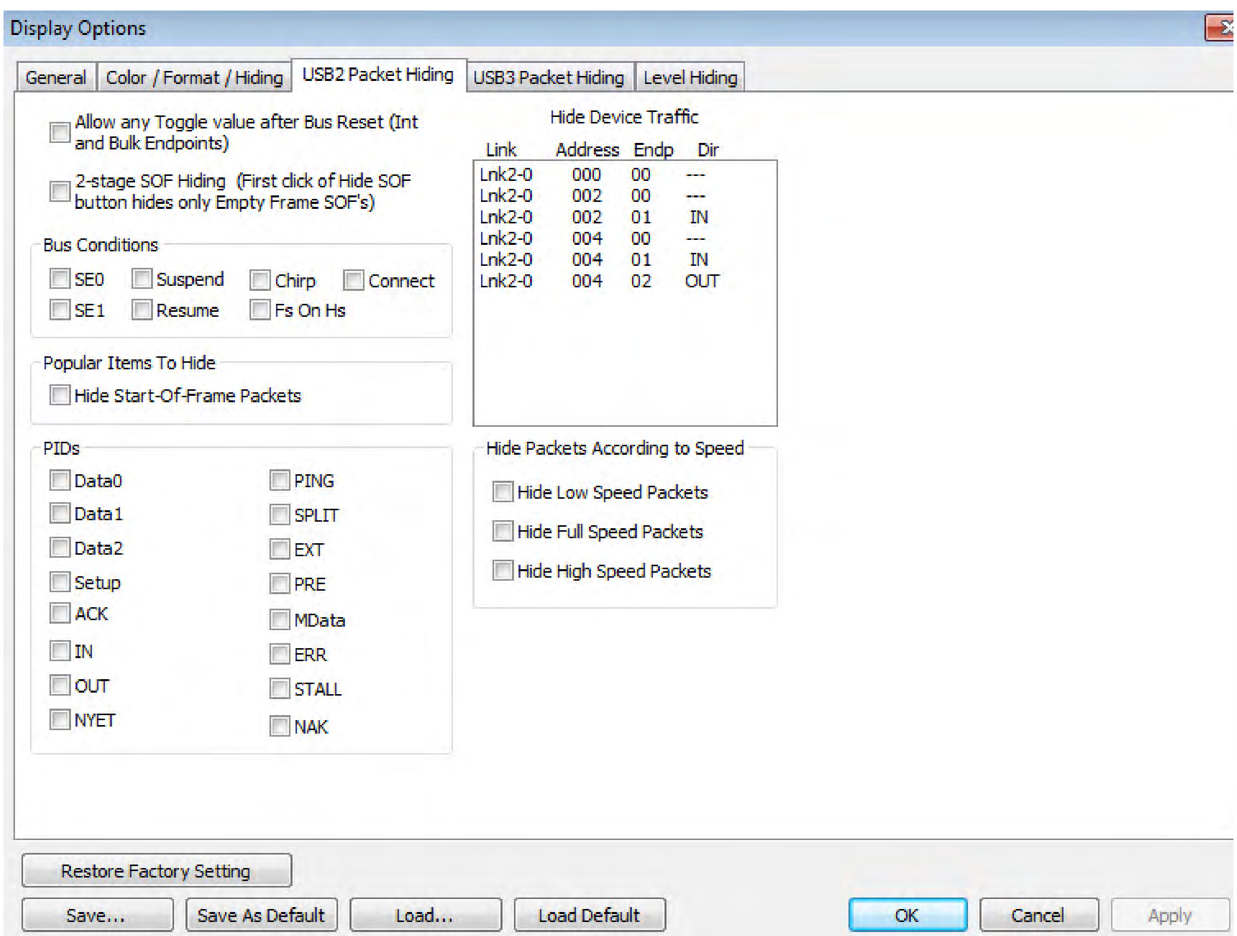


Figure 7.6: Display Options USB 2.0 Packet Hiding Dialog.

7.4 USB 3.1 Packet Hiding Options

By default, no data packets, transactions, Start-Of-Frame packets, PIDS or bus conditions are hidden. You can hide:

- Link Commands (Flow Control)
- Training Sequences (TSEQ)
- Training Sequences (TS1, TS2, TSEQ)
- Logical Idle Packets
- Upstream Packets
- Downstream Packets
- Skip Sequences
- ISO Time Stamp Packets
- Inter-Packet Symbols (unexpected packets)
- Link Commands (Power Management)
- Electrical Idles
- LFPS Packets
- Terminations (TERM ON, TERM OFF)
- VBUS Change Events
- LMP Packets
- TP Packets
- Data Packets
- Loopback Packets (BCNY, BRST, BERC)
- Compliance Patterns (CP1, CP2, CP3)
- LTSSM Transition Indicators
- SYNC Packets

Select the **USB3 Packet Hiding** tab, then select the data types to hide (see Figure 7.7 on page 240.)

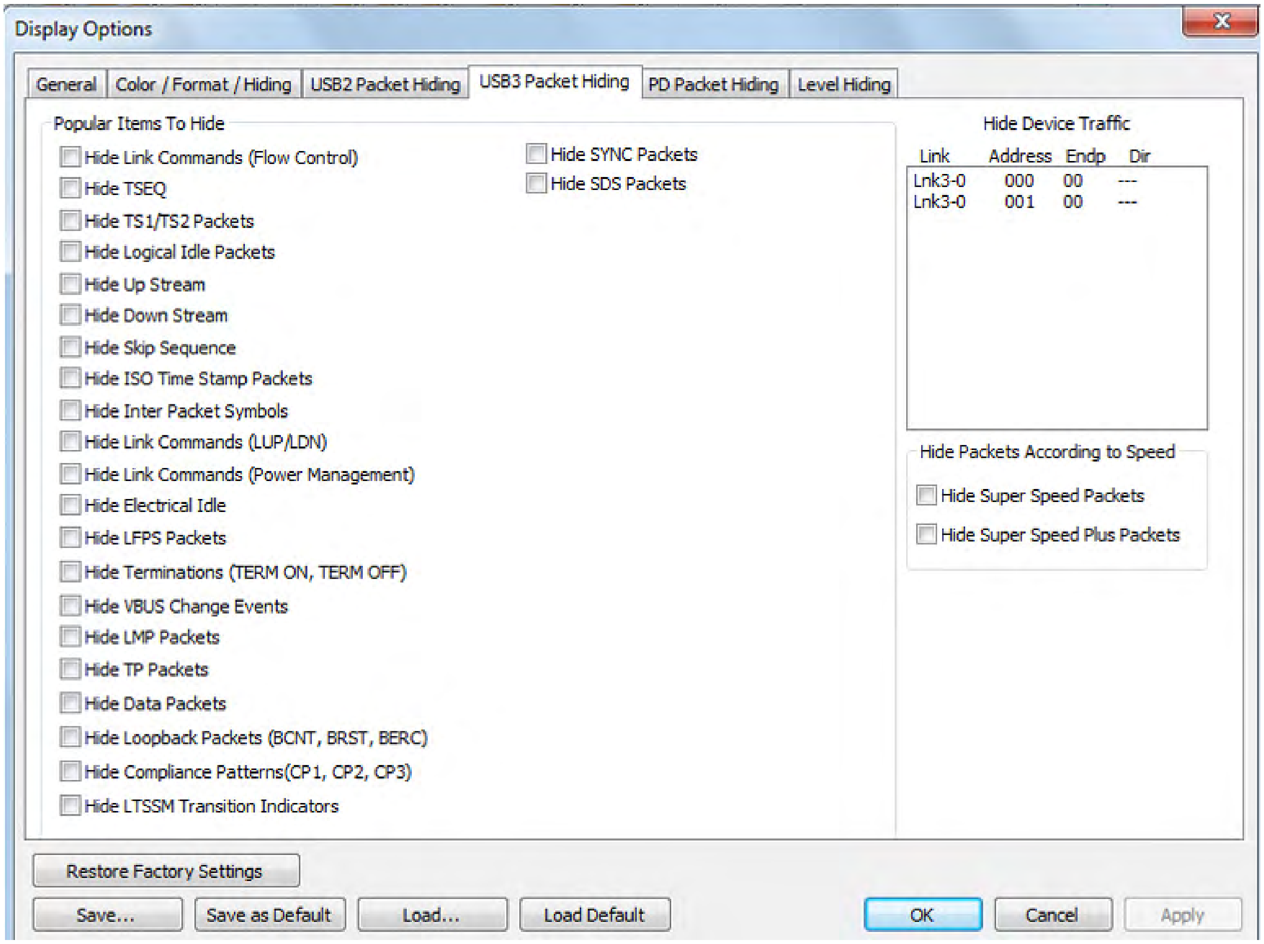
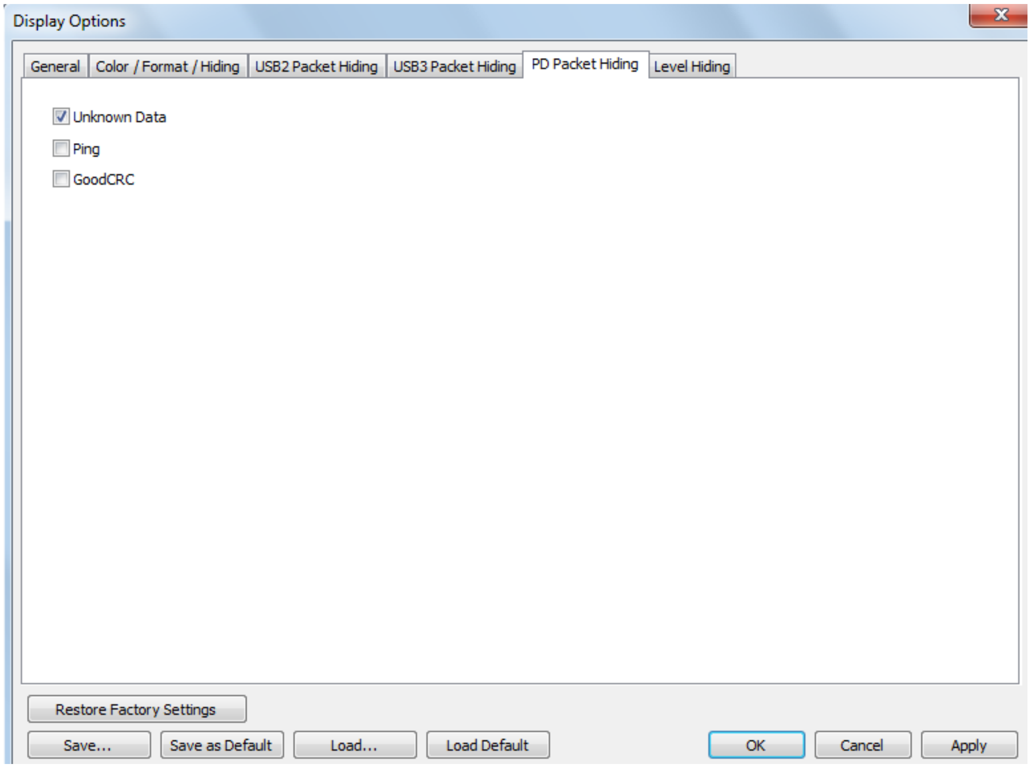


Figure 7.7: Display Options USB3 Packet Hiding Dialog.

7.5 PD Packet Hiding



7.6 Level Hiding Options

By default, no levels of transaction items, transfer items or upper layer items are hidden. You can select from the dialog what you want hidden.

Select the **Level Hiding** tab, then select the level types to hide (see Figure 7.8 on page 242.)

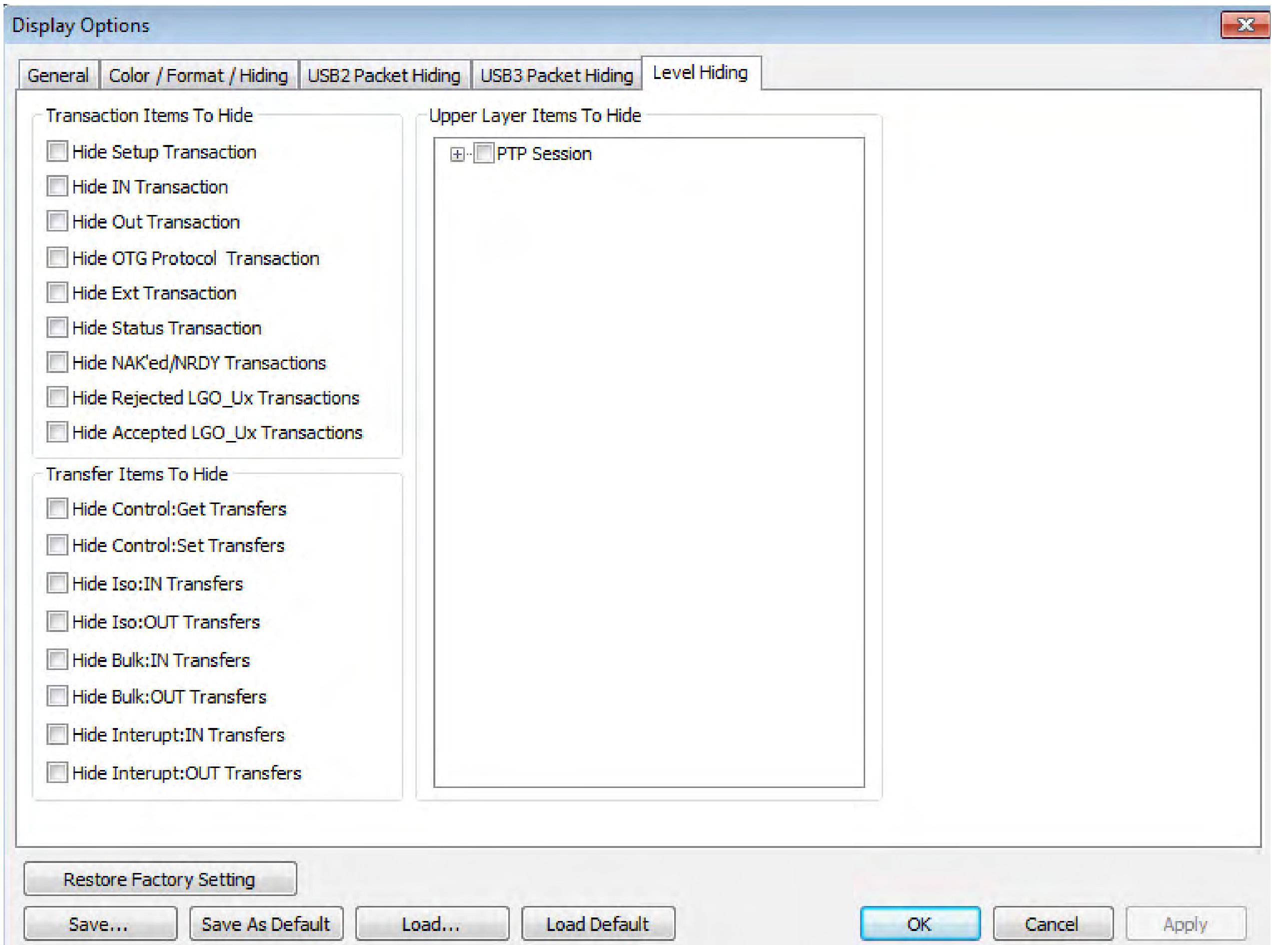


Figure 7.8: Level Hiding Dialog

7.7 Saving/Loading Display Options

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

- To save the current Display Options values in an options file for use in future sessions, click **Save**. Enter a file name without a file name extension. The program adds the **.opt** extension. (The file must have an **.opt** file name extension.)
- To load a previously saved **.opt** file, click **Load** and select a file name.
- To save the current Display Options values in the **default.opt** options file for use as the default display options, click **Save as Default**. (Do not delete the **default.opt** file.)
- To load the Default values, click **Load Defaults**. When you start the application, this is the setting that is invoked automatically.
- To apply the current Display Options values, click **Apply**. The Display Options window remains open.
- To apply the current Display Options values and close the Display Options window, click **OK**.

To cancel unsaved changes to display values and exit the Display Options window, click **Cancel**.

7.8 Restore Factory Setting

This restores to default values of the application. It does not save these settings as default. If you want them to be the default settings, you must click on the "Save as Default" button after you restore to the factory settings.

Chapter 8

Decode Requests

8.1 Class and Vendor Definition Files

Teledyne LeCroy Analyzers use script files to decode class and vendor requests. The script files are read when the application is initialized. After reading, the Analyzer decodes class and vendor requests as instructed by the files.

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

Note: The **.dec** files listed in the following table, on the next page, are in the **Scripts** directory under the installation directory.

USB Decode	USB Decoder Name	USB-IF Base Class	Codes Sub Class	Proto-col ID
Audio Class decoding 2.0	Audio	01h		
AudioClass\Audio1.0Requests.dec				
AudioClass\Audio2.0Requests.dec				
Communications and CDC* Control	Communication	02h		
Direct Line Control Model	Communication	02h	01h	
Abstract Control Model	Communication	02h	02h	
Telephone Control Model	Communication	02h	03h	
Multi-Channel Control Model	Communication	02h	04h	
CAPI Control Model	Communication	02h	05h	
Ethernet Networking Control Model	Communication	02h	06h	
ATM Networking Control Model	Communication	02h	07h	
Wireless Handset Control Model	Communication	02h	08h	
Device Management Model	Communication	02h	09h	
Mobile Direct Line Model	Communication	02h	0Ah	
OBEX Model	Communication	02h	0Bh	
Communication Device Subclass/EEM	Communication	02h	0Ch	
Communications\CommRequests.dec				
Communications\CommInterrupt.dec				
Communications\CommCDCEEM.dec				
Device Firmware Update	DevFirmwareUpdate	0xFE	0x01	0x02
HID (Human Interface Device)	HID	03h		
HUT (HID extension)	HID	Extension		
Monitor (HID extension)	HID	Extension		
Physical Interface (force-feedback extension to HID)	HID	Extension		
Point of Sale Devices (HID extension)	HID	Extension		
Power (HID extension)		Extension		
Hid\hid.dec	HID			
Hid\Hid_Req.dec				
Physical	HID	05h		
Hid\hid.dec				
Hid\Hid_Req.dec				
*: The CDC Decoder includes the ECM class decoding				

USB Decode	USB Decoder Name	USB-IF Base Class	Codes Sub Class	Protocol ID
Still Imaging Class StillImageClass\PTPStillImageBulkIn.dec StillImageClass\PTPStillImageBulkOut.dec StillImageClass\PTPStillImageRequests.dec StillImageClass\PTPStillInterrupt.dec	PTP Still Image	06h	01h	01h
Printer Printer\Printer_req.dec	Printer	07h	01h	xxh
Mass Storage	Mass Storage	08h		
SCSI/Bulk Protocol MassStorageClass\MS_BulkOnly_Requests.dec MassStorageClass\MS_BulkOnlySCSIInEndpoint.dec MassStorageClass\MS_BulkOnlySCSIOutEndpoint.dec MassStorageClass\MS_BulkOnlySCSIOutEndpoint.dec	Mass Storage SCSI Bulk	08h	06h	50h
UFI (floppy)/CBI Protocol MassStorageClass\MS_UFI_CBI_Requests.dec MassStorageClass\MS_UFI_CBI_BulkInEndp.dec MassStorageClass\MS_UFI_CBI_BulkOutEndp.dec MassStorageClass\MS_UFI_CBI_InterruptEndp.dec	MassStrg Class UFI CBI	08h	04h	00h
Hub support HubClass\HubClassRequests.dec HubClass\HubClassStatusEndpoint.dec	Hub Class	09h		
Picture Transfer Protocol (PTP) [Photographic and Imaging Manufacturers Association (PIMA) 15740 and ISO 15740] StillImageClass\PTPStillImageBulkIn.dec StillImageClass\PTPStillImageBulkOut.dec StillImageClass\PTPStillImageRequests.dec StillImageClass\PTPStillInterrupt.dec	PTP Still Image	Extension		

USB Decode	USB Decoder Name	USB-IF Base Class	Codes Sub Class	Proto-col ID
Communications Device Class (CDC*) Data Communications\CDCDataBulkIn_wCTE.dec Communications\CDCDataBulkIn_wPW.dec Communications\CDCDataBulkIn_wPW_wCTE.dec Communications\CDCDataBulkOut_wCTE.dec Communications\CDCDataBulkOut_wPW.dec Communications\CDCDataBulkOut_wPW_wCTE.dec Communications\CDCDataIsochIn_wCTE.dec Communications\CDCDataIsochIn_wPW.dec Communications\CDCDataIsochIn_wPW_wCTE.dec Communications\CDCDataIsochOut_wCTE.dec Communications\CDCDataIsochOut_wPW.dec Communications\CDCDataIsochOut_wPW_wCTE.dec	CDC*	0Ah	xxh	
*: The CDC Decoder includes the ECM class decoding				

USB Decode	USB Decoder Name	USB-IF Base Class	Codes Sub Class	Proto-col ID
Smart Card (CCID)	CCID and ICCD	0Bh	00h	
SmartCard\CCIDBulkIn.dec				
SmartCard\CCIDBulkOut.dec				
SmartCard\CCIDInterrupt.dec				
SmartCard\CCID_req.dec				
SmartCard\ICCDBulkIn.dec				
SmartCard\ICCDBulkOut.dec				
SmartCard\ICCDInterrupt.dec				
SmartCard\ICCD_req_Ver.A.dec				01h
SmartCard\ICCD_req_Ver.B.dec				02h
Video Class (UVC) decoding 1.1 (currently at 1.0)		0Eh		
VIDEO CONTROL	Video	0Eh	01h	00h
VIDEO STREAMING	Video	0Eh	02h	00h
VIDEO INTERFACE COLLECTION	Video	0Eh	03h	00h
VideoClass\VideoBulkIn.dec				
VideoClass\VideoBulkOut.dec				
VideoClass\VideoInterrupt.dec				
VideoClass\VideoIsochIn.dec				
VideoClass\VideoIsochOut.dec				
VideoClass\Video1.0Requests.dec				
VideoClass\Video1.1Requests.dec				
Wireless Controller				
BT	HCI	E0h	01h	01h
		E0h	01h	02h
		E0h		
Remote Network Driver Interface Specification (RNDIS)	Remote NDIS	EFh	02h	02h
USB3 Vision				
USB3 Vision	USB3 Vision	EFh	05h	00h
VIsionControl.dec				
VisionEvent.dec				
VisionStream.dec				

USB Decode	USB Decoder Name	USB-IF Base Class	Codes Sub Class	Protocol ID
Miscellaneous Device Class		EFh		
Interface Association Descriptor	Standard, so no decoder method needed	EFh	02h	01h
Cable Based Association Framework (CBAF) Requests Standard\StandardRequests.dec IEEE\IEEECompanies.dec Virtual\VirtualDATAIn.dec Virtual\VirtualDATAOut.dec Virtual\VirtualUARTIn.dec Virtual\VirtualUARTOut.dec	Association Frameworks	EFh	03h	01h
IrDA Bridge	IrDA Bridge	FEh	02h	00h
ATAPI	ATAPI	08h	02h	50h
IP	IP			
HTTP	HTTP			
Personal Healthcare Devices PersonalHealthcare\PersonalHealthcareRequest.dec PersonalHealthcare\PersonalHealthcareDescriptors.inc PersonalHealthcare\PersonalHealthcareDataBulkIn.dec PersonalHealthcare\PersonalHealthcareDataBulkOut.dec PersonalHealthcare\PersonalHealthcareDataBulk.inc	Personal Healthcare	0Fh		
Content Security Devices ContentSecurity\ContentSecurityRequest.dec ContentSecurity\ContentSecurityDescriptors.inc ContentSecurity\ContentSecurityInterrupt.dec	Content Security	0Dh		

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***.

8.2 Class/Vendor Decoding Options

The software will automatically assign decoders based on the enumeration sequence in a recorded file. If the enumeration sequence is not captured, or if software assigns an incorrect decoder, you may manually select a decoder.

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

8.2.1 Mapping Request Recipient to Class/Vendor Decoding

To assign a decoding group to a request recipient,

1. Click the **Apply Decoding Scripts** button  on the Toolbar or press **Ctrl+Shift+Y**
   OR
   Right-click the **Control Transfer** field to display the USB Device Request menu:
2. Select **Map Request Recipients to Class/Vendor Decoding** to display the Request Recipients and Endpoints dialog box:

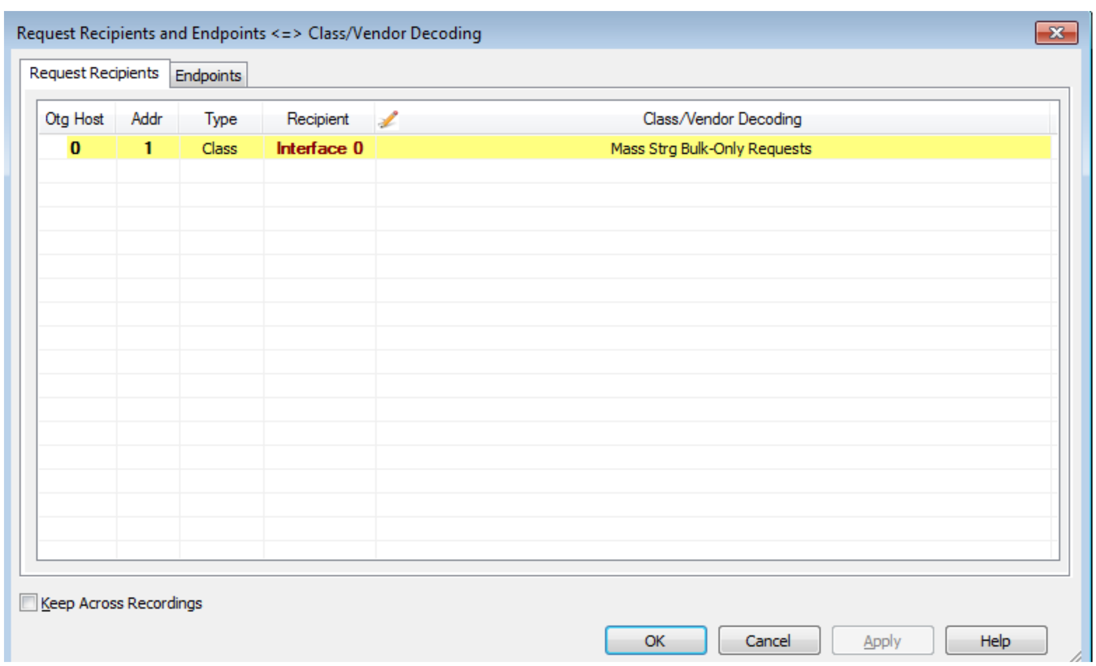


Figure 8.1: Request Recipients and Endpoints - Class/Vendor Decoding Request Recipients Tab

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

3. Select a recipient.
4. Display the **Class/Vendor Decoding Groups** drop-down menu.

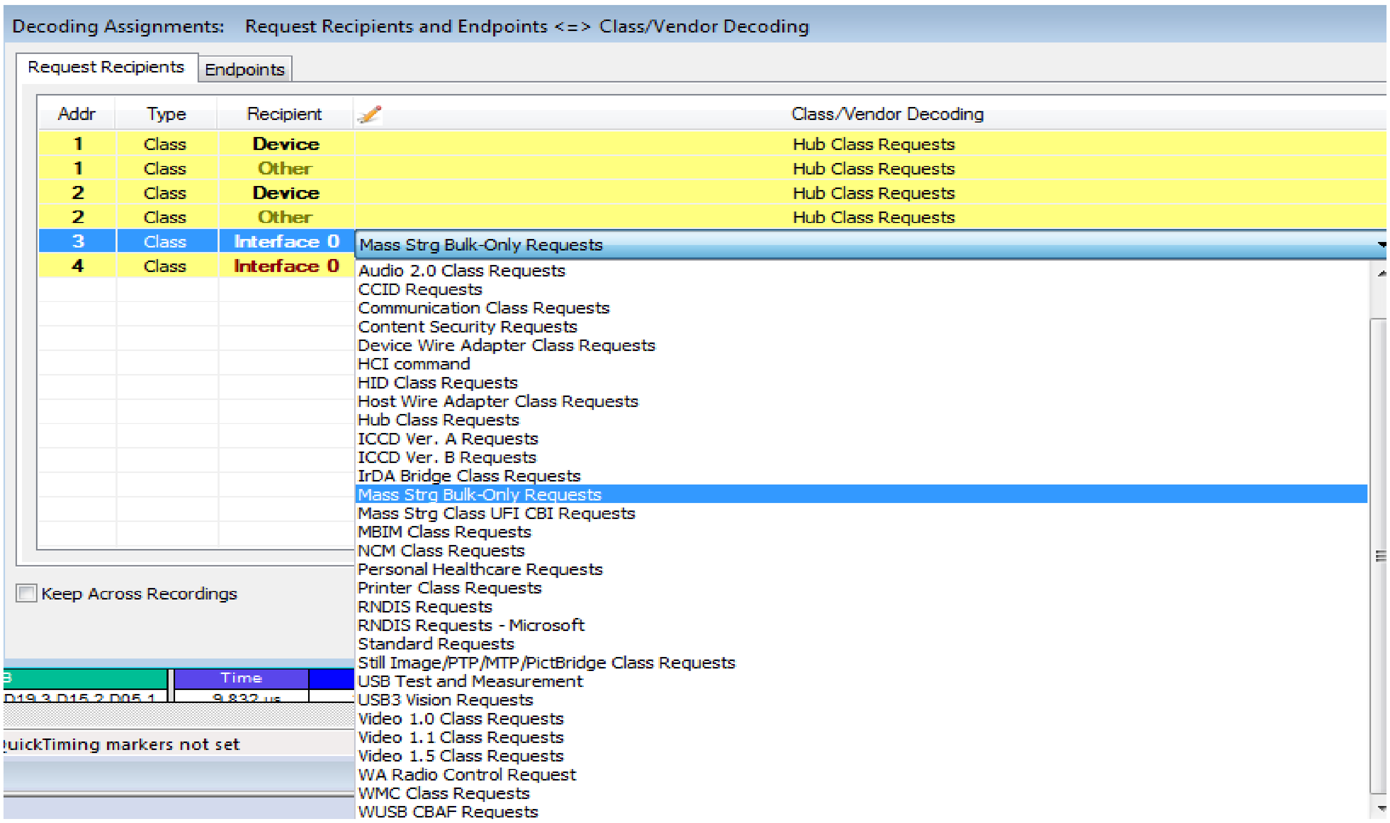


Figure 8.2: Class/Vendor Decoding Groups Drop-down Menu.

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

- No Decoding
- Audio 1.0 Class Requests
- Audio 2.0 Class Requests
- CCID Requests
- Communication Class Requests
- Content Security Requests
- HCI Command
- HID Class Requests
- Hub Class Requests
- ICCD Ver. A Requests
- ICCD Ver. B Requests
- IrDA Bridge Class Requests
- Mass-Strg Bulk-Only Requests
- Mass-Strg Class UFI CBI Requests
- MBIM Class Requests

- NCM Class Requests
- Personal Healthcare Requests
- Printer Class Requests
- RNDIS Requests
- RNDIS Requests - Microsoft
- Standard Requests
- Still Image/PTP/MTP/PictBridge Class Requests
- USB Test and Measurement
- USB3 Vision Requests
- Video 1.0 Class Requests
- Video 1.1 Class Requests
- Video 1.5 Class Requests
- WA Radio Control Request
- WMC Class Requests
- WUSB CBAF Requests

5. Select a decoding group.

   OR

   Select **No Decoding** if you do not want any specific decoding.
6. Repeat the previous steps for additional recipients.
7. To retain a mapping from trace to trace DURING an application session, select the **Keep Across Recordings** checkbox.
8. Click **OK**.

8.2.2 Mapping Endpoint to Class/Vendor Decoding

To assign a Class/Vendor Endpoint decoding,

1. Click the **Apply Decoding Scripts**  on the Toolbar or press **Ctrl+Shift+Y**

   OR

   Right-click the **Bulk/Int Transfer** field to display the USB Device Request menu.
2. Select **Map Endpoint to Class/Vendor Decoding** to display the Request Recipients and Endpoints dialog box.
3. Click the **Endpoints** tab to display the **Endpoints** dialog box.

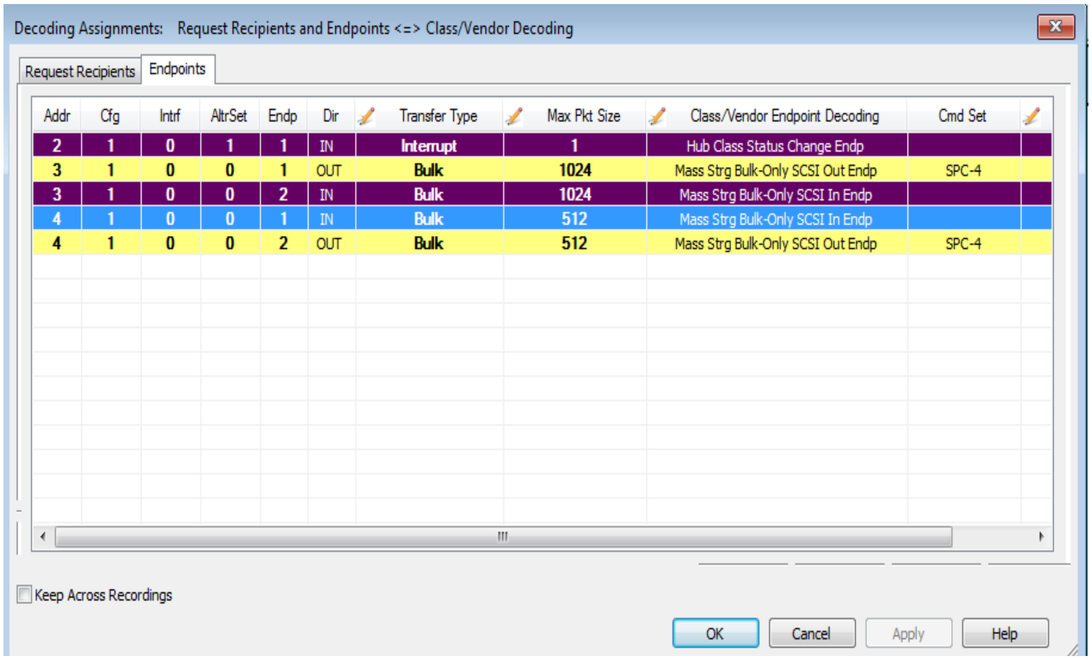


Figure 8.3: Request Recipients and Endpoints - Class/Vendor Decoding Endpoints Tab

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

The Transfer Type field shows all transfer types found in the trace file.

4. Display the **Transfer Type** drop-down menu:

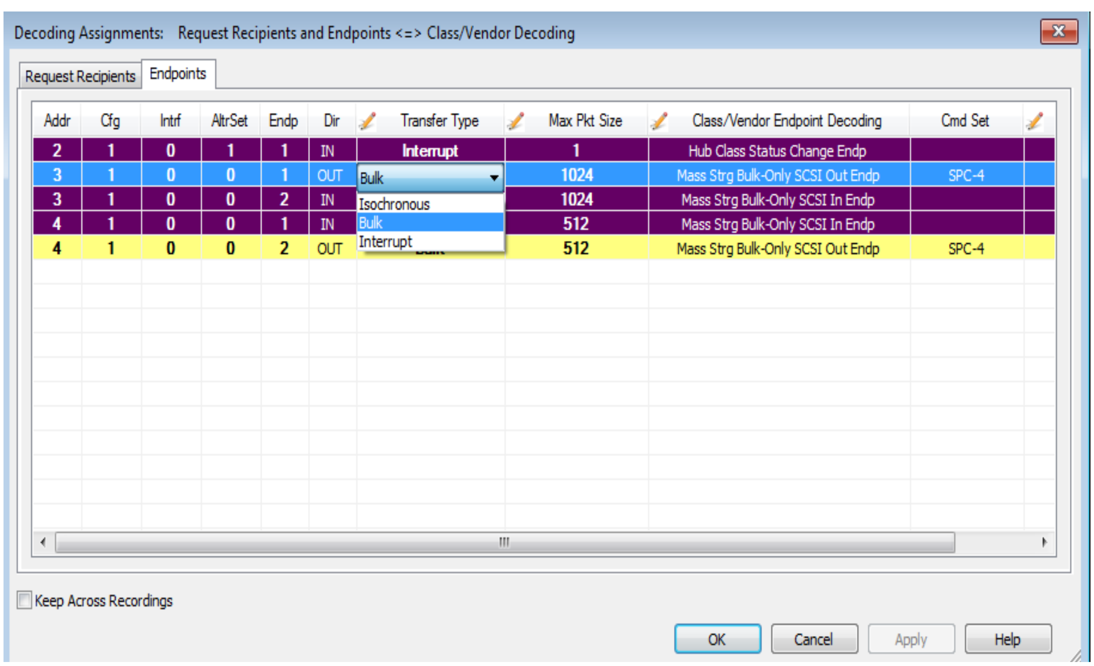


Figure 8.4: Transfer Type Drop-down Menu.

The Transfer Type options for both IN and OUT endpoint are:

- Isochronous

Note: Choosing "1 Tran 1 Xfer" will speed up the decoding option tremendously!

- Bulk
- Interrupt

5. Select the transfer Type.

   The selections displayed in the Class/Vendor Endpoint Decoding drop-down menu depend on the transfer Type selected.

6. Enter the size in the Max Pkt. Size field.
7. Select an endpoint.
8. Display the **Class/Vendor Endpoint Decoding** drop-down menu (see Figure 8.5 on page 255):

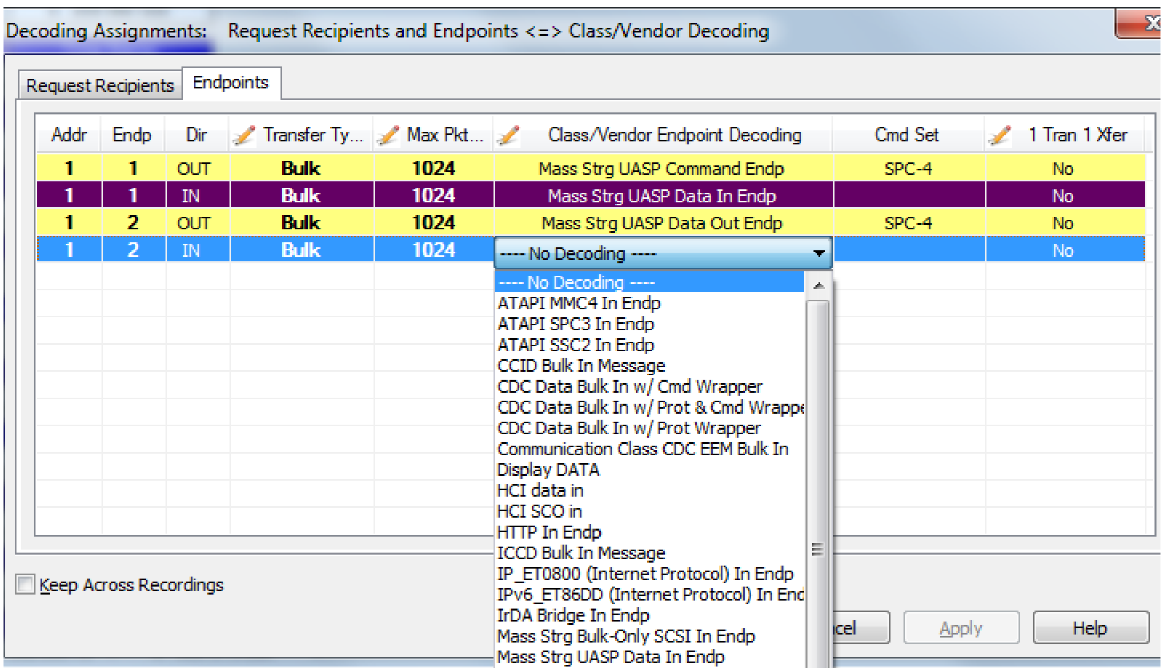


Figure 8.5: Class/Vendor Endpoint Decoding Drop-down Menu.

The Isochronous Transfer Type and Interrupt Transfer Type options for an OUT endpoint are:

- No Decoding
- CDC Data Isoch Out w/CMD Wrapper
- CDC Data Isoch Out w/Prot & CMD Wrapper
- CDC Data Isoch Out w/Prot Wrapper
- Video Isoch Out

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

- No Decoding

- ATAPI MMC4 Out Endp
- ATAPI SPC3 Out Endp
- ATAPI SSC2 Out Endp
- CCID Bulk Out Message
- CDC* Data Bulk Out w/ Cmd Wrapper
- CDC* Data Bulk Out w/ Prot & Cmd Wrapper
- CDC* Data Bulk Out w/ Prot Wrapper
- Communication Class CDC* EEM Bulk Out
- Display DATA
- HCI data out
- HCI SCO out
- HID Interrupt out Endp
- HTTP Out Endp
- ICCD Bulk Out Message
- IP_ET0800 (Internet Protocol) Out Endp
- IPv6_ET0800 (Internet Protocol) Out Endp
- IrDA Bridge Out Endp
- Mass Strg Bulk-Only SCSI Out Endp
- Mass Strg UASP Command Endp
- Mass Strg UASP Data Out Endp
- Mass Strg UFI_CBI Bulk Out Endp
- MBIM Bulk Out
- NCM Bulk Out
- PHDC Bulk Out Message
- RNDIS_PACKET_MSG Bulk Out
- Still Image/PTP/MTP/PictBridge Bulk Out
- TCP (Transmission Control Protocol) Out Endp
- USBTMC Bulk Out Endp
- Video Bulk Out
- Virtual UART

*: The CDC Decoder includes the ECM class decoding

The Cmd Set options for an OUT endpoint for Bulk Transfer Type are:

- SPC-4
- SBC-3
- SMC-3
- SSC-4
- MMC-6
- SSC-2
- SES-2
- SAT-3

Note: The Cmd Set options are only available for the **Mass Strg Bulk-Only SCSI Out Endp** selection in **Class/Vendor Endpoint Decoding**.

For HID Interrupt In Endpoint, you will be provided a column to select the decoder with or without the Report ID Field. See the figure below.

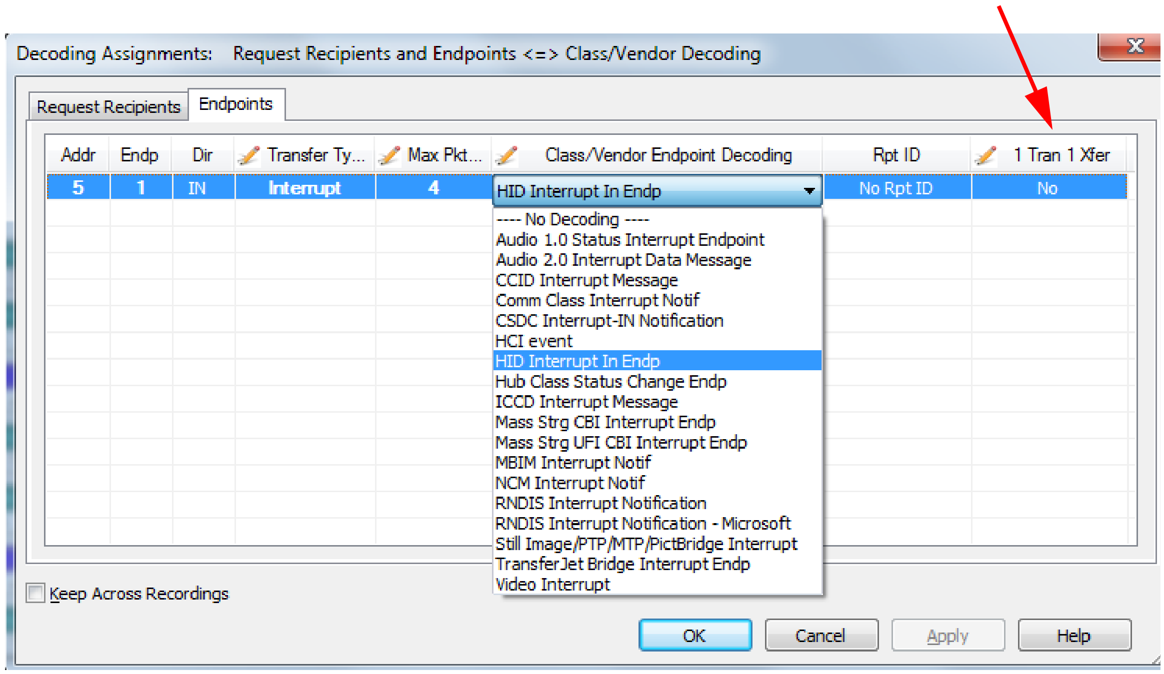


Figure 8.6: 1 Tran 1 Xfer column

The Isochronous Transfer Type options for an IN endpoint are:

- No Decoding
- CDC Data Isoch Out w/CMD Wrapper
- CDC Data Isoch Out w/Prot & CMD Wrapper
- CDC Data Isoch Out w/Prot Wrapper
- Video Isoch Out

The Interrupt Transfer Type options for an IN endpoint are:

- No Decoding
- Audio 1.0 Status Interrupt Endpoint
- Audio 2.0 Interrupt Data Message
- CCID Interrupt Message
- Comm Class Interrupt Notif
- CSDC Interrupt-IN Notification
- HCI event
- HID Interrupt in Endp
- Hub Class Status Change Endp
- ICCD Interrupt Message
- Mass Strg CBI Interrupt Endp
- Mass Strg UFI CBI Interrupt Endp
- MBIM Interrupt Notif
- NCM Interrupt Notif
- RNDIS Interrupt Notification

- RNDIS Interrupt Notification - Microsoft
- Still Image/PTP/MTP/PictBridge Interrupt
- Video Interrupt
- WA Radio Notif Endp

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

- No Decoding
- ATAPI MMC4 In Endp
- ATAPI SPC3 In Endp
- ATAPI SSC2 In Endp
- CCID Bulk In Message
- CDC* Data Bulk In w/ Cmd Wrapper
- CDC* Data Bulk In w/ Prot & Cmd Wrapper
- CDC* Data Bulk In w/ Prot Wrapper
- Communication Class CDC EEM Bulk In
- Display DATA
- HCI data in
- HCI SCO in
- HTTP In Endp
- ICCD Bulk In Message
- IP_ET0800 (Internet Protocol) In Endp
- IPv6_ET086DD (Internet Protocol) In Endp
- IrDA Bridge in Endp
- Mass Strg Bulk-Only SCSI In Endp
- Mass Strg UASP Data In Endp
- Mass Strg UASP Status Endp
- Mass Strg UFI_CBI Bulk In Endp
- MBIM Bulk In
- NCM Bulk In
- PHDC Bulk In Message
- RNDIS Bulk IN
- Still Image/PTP/MTP/PictBridge Bulk In
- TCP (Transmission Control Protocol) In Endp
- USB3 Vision Events
- USBTMC Bulk IN Endp
- Video Bulk In
- Virtual UART

*: The CDC Decoder includes the ECM class decoding

9. Select the type of decoding.

   OR

   Select **No Decoding** if you do not want any specific decoding.
10. The USB Protocol Suite decoding engine uses different rules like “Short Packet” [Packets with length less than Max packet size], “Transferring required data by endpoint” to collect transactions under transfers. But, in some cases [like Interrupt or Isochronous transfers] transfer collection uses a simple rule of “1 transaction 1 transfer”. When this option is set as “yes”, any transaction at selected endpoint will

make a transfer level packet which could be decoded by transfer level scripts. In particular, streams of Isochronous data can be decoded MUCH more quickly if this rule is selected. To select this model of transfer, use the "1 Tran 1 Xfer" column to select it (see Figure 8.6 on page 257).

11. Repeat the previous steps for any additional endpoints you would like to map.
12. To retain a mapping from trace to trace DURING an application session, select the **Keep Across Recordings** checkbox.
13. Click **OK**.

8.3 General Options

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

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

8.3.1 Decoding USB Device Requests

To decode a USB Device Request:

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

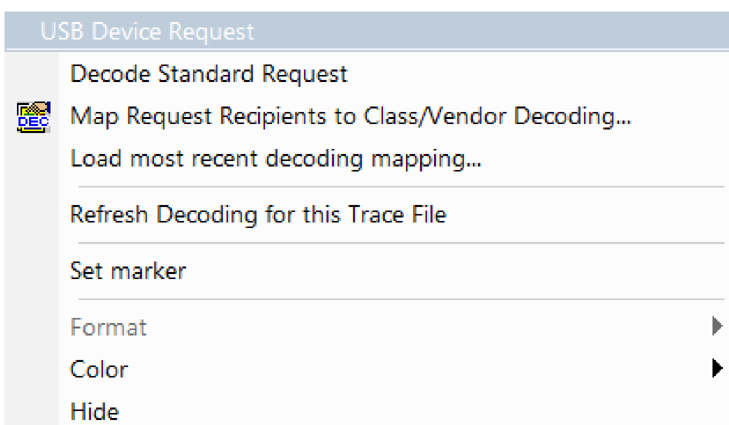


Figure 8.7: USB Device Request Dialog

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

2. To refresh decoding, click Refresh Decoding for this Trace File. Use this option to reanalyze all transactions.
3. To use the previous decoding, click **Load most recent decoding mapping**.

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

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

Note: You can also change the format, color, and hidden status of fields, using the same methods as in Display Options. (Chapter 7, "Display Options," on page 231)

8.3.2 Decoding Standard Requests

To decode a standard request:

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

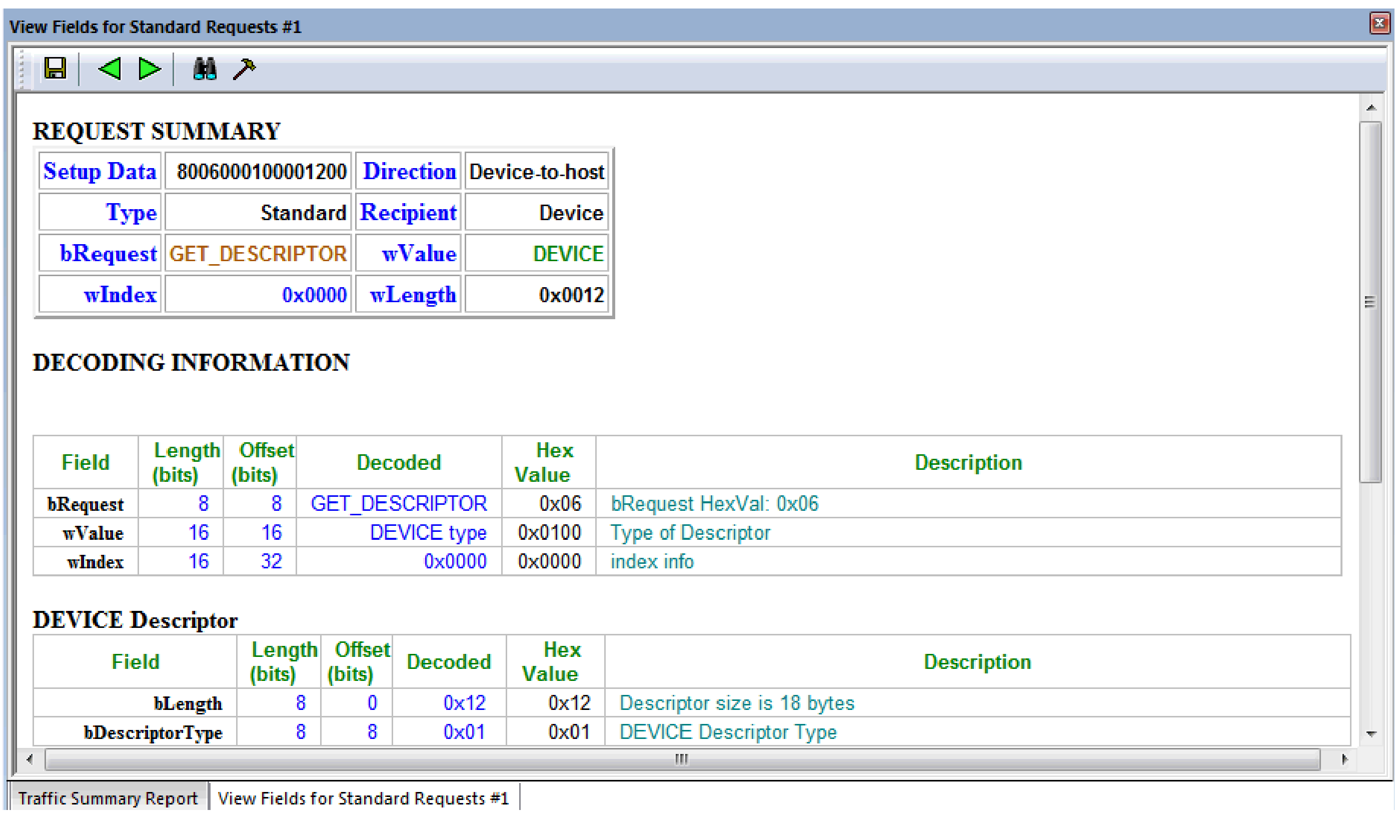


Figure 8.8: View Fields for Standard Requests Dialog

2. To find a word in the text box, click the **Find** button. Enter the word in the Find What field. To use a case-sensitive search, check **Match Case**. To find only the exact word, check **Match Whole Word Only.** You can search **Up** or **Down**. To search, click **Find Next.**
3. To save the View Fields text box as an HTML file, click the **Save As** button, enter a file name in the Save As dialog box, then click **Save**.

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

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

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

USB Implementers Forum 1730 SW Skyline Blvd. Suite 203 Portland, OR 97221	Tel: +1/503.296.9892 Fax: +1/503.297.1090 Web: http://www.usb.org/

8.3.3 Decoding Class Requests

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

To decode a class request:

1. From the USB Device Request menu, select **Decode ... Request** to display the View Fields for ... Class Requests text box (see Figure 8.9 on page 261).

   The following figure shows a View Fields for Hub Class Requests decoding:

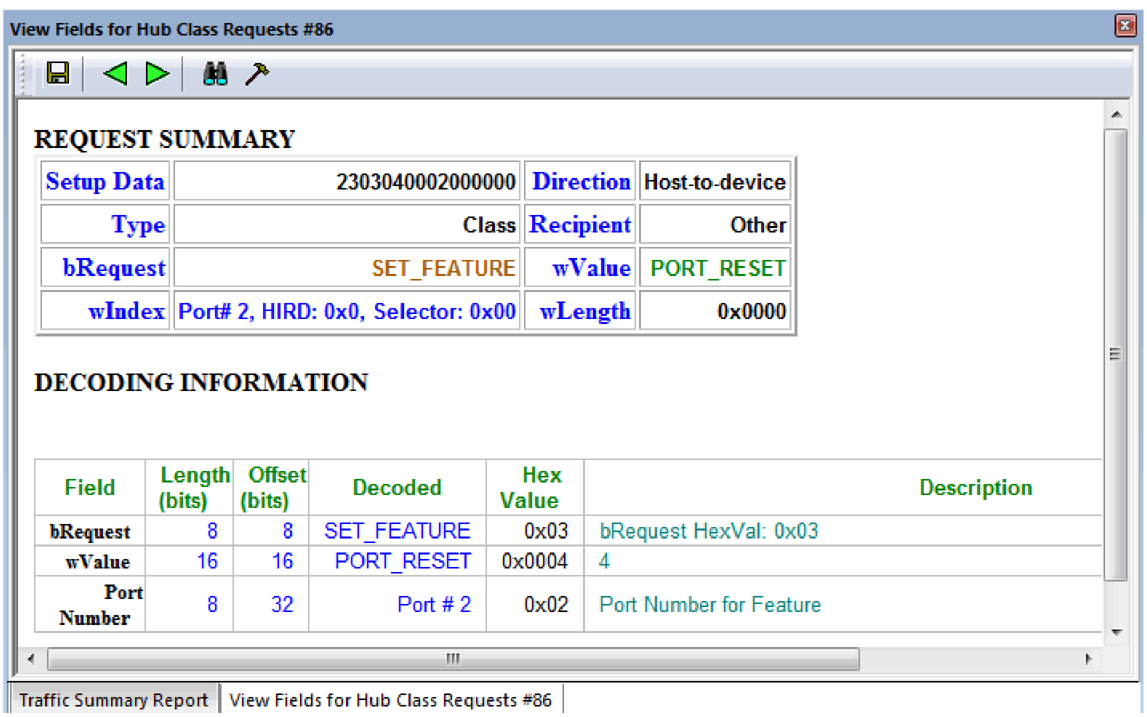


Figure 8.9: View Fields for Hub Class Requests Dialog

8.3.4 Decoding Vendor Requests

To decode a vendor request:

- From the USB Device Request menu, select **Decode ... Request** to display the

View Fields for ... Vendor Requests text box.

An example of a vendor request is Command Set.

8.3.5 Decoding Undefined USB/WUSB Device Requests

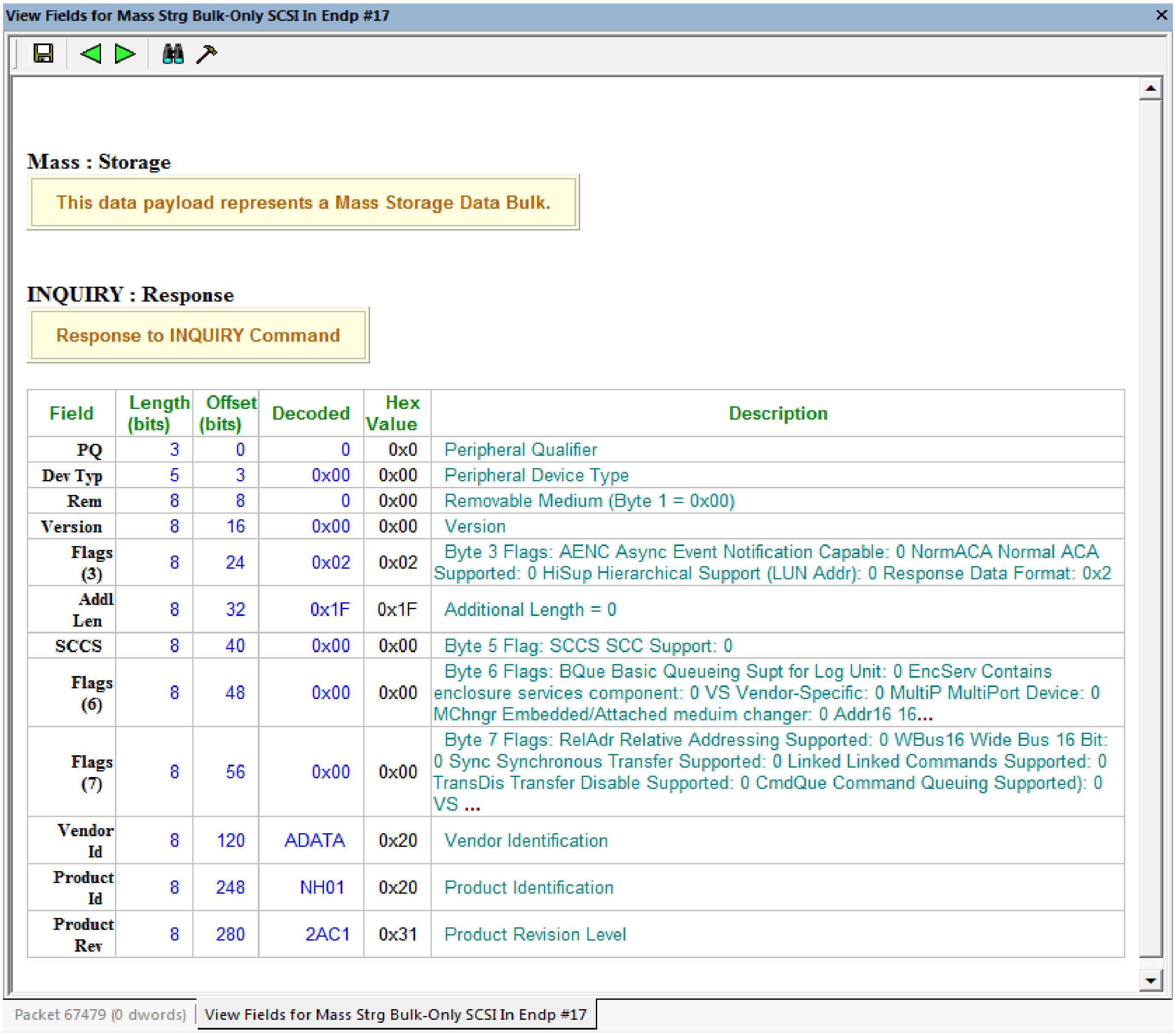
A Decoding Request may not belong to any of the defined decoding groups (Standard, Class, or Vendor).

8.3.6 Decoding using Endpoint Information

To decode using the endpoint information:

1. Right-click the **Bulk/Int Transfer** field to display the Bulk/Int Transfer (IN/OUT transaction with data) menu.
2. Select **Decode as ... Endp** to open a View Fields for ... Endp text box.

   The figure on the next page shows a Mass Strg Bulk-Only SCSI IN Endp decoding:



Field	Length (bits)	Offset (bits)	Decoded	Hex Value	Description
PQ	3	0	0	0x0	Peripheral Qualifier
Dev Typ	5	3	0x00	0x00	Peripheral Device Type
Rem	8	8	0	0x00	Removable Medium (Byte 1 = 0x00)
Version	8	16	0x00	0x00	Version
Flags (3)	8	24	0x02	0x02	Byte 3 Flags: AENC Async Event Notification Capable: 0 NormACA Normal ACA Supported: 0 HiSup Hierarchical Support (LUN Addr): 0 Response Data Format: 0x2
Addl Len	8	32	0x1F	0x1F	Additional Length = 0
SCCS	8	40	0x00	0x00	Byte 5 Flag: SCCS SCC Support: 0
Flags (6)	8	48	0x00	0x00	Byte 6 Flags: BQue Basic Queueing Supt for Log Unit: 0 EncServ Contains enclosure services component: 0 VS Vendor-Specific: 0 MultiP MultiPort Device: 0 MChngr Embedded/Attached meduim changer: 0 Addr16 16...
Flags (7)	8	56	0x00	0x00	Byte 7 Flags: RelAdr Relative Addressing Supported: 0 WBus16 Wide Bus 16 Bit: 0 Sync Synchronous Transfer Supported: 0 Linked Linked Commands Supported: 0 TransDis Transfer Disable Supported: 0 CmdQue Command Queuing Supported): 0 VS ...
Vendor Id	8	120	ADATA	0x20	Vendor Identification
Product Id	8	248	NH01	0x20	Product Identification
Product Rev	8	280	2AC1	0x31	Product Revision Level

Figure 8.10: View Fields for Mass Strg Bulk-Only SCSI IN Endp Dialog

8.3.7 Changing the Layout of Decode Requests

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

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

To change the layout of decode requests display:

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

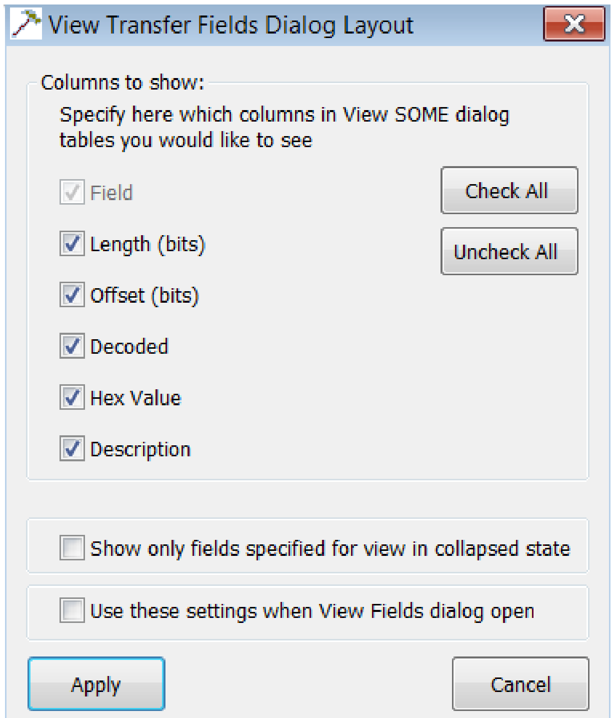


Figure 8.11: View Transfer Fields Dialog Layout

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

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

3. To show only the fields of Collapsed mode, check **Show only fields specified for view in collapsed mode**.
4. To retain settings for future viewing of Decode Request fields, check **Use these settings when View Fields dialog opens**.

8.3.8 Decoded Fields View

This works much the same as the decoder dialog above, except that it is invoked from the toolbar icon and does not block the use of other windows. It can be docked to the side or allowed to float.

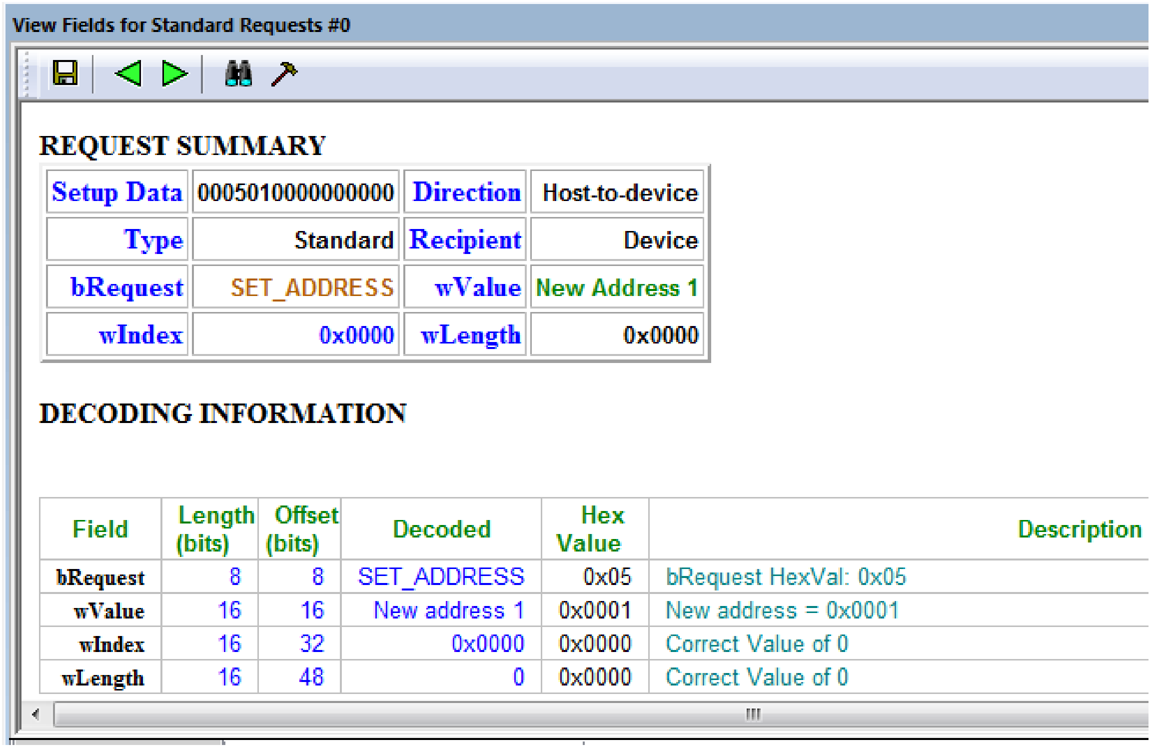
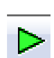


Figure 8.12: Decoded Fields View

	Save decoded Fields in .html format.
	Show previous decoded fields.
	Show next decoded fields.
	Find text in the View Fields page.
	Displays View Transfer Fields Dialog Layout dialog (see Figure 8.13 on page 266) allowing you to specify different kinds of presentation formats for the View Fields dialog.

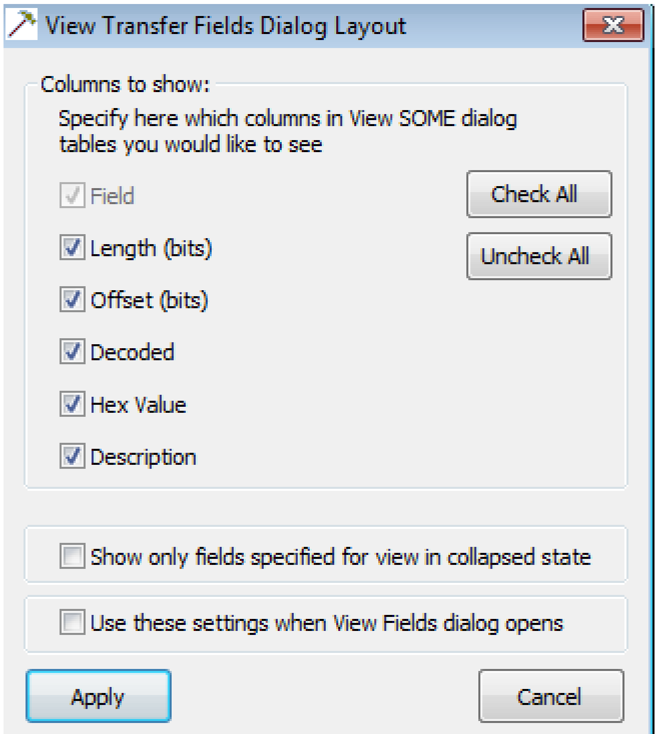


Figure 8.13: View Transfer Fields Dialog Layout Dialog

Chapter 9

Reports

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

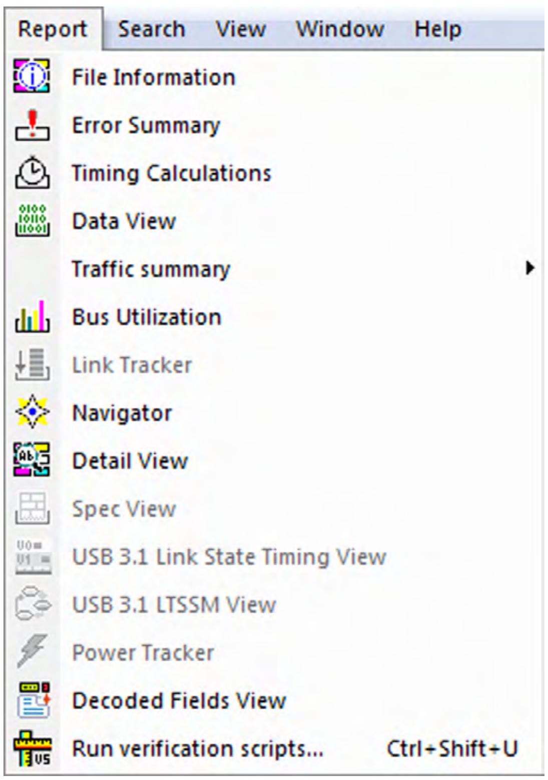


Figure 9.1: Report Menu

Reports assist you in analyzing traffic recorded by the Analyzer. The available reports are:

- **Trace Information**: To view general information about the trace file.
- **Error Summary**: To view a count of errors in a trace file.
- **Timing Calculations**: To view timing measured between two events set within the trace file.
- **Data View (Packet Data)**: Shows packet payload contents.
- **Traffic Summary Report**: To view a summary of protocol-related information in the trace file summary information about a selected group of items in the trace file (such as a count of particular frame or packet types).
- **Bus Utilization**: To display information on bandwidth usage for the transmit and receive channels.

- **Link Tracker (3.1)**: Displays a detailed chronological view of events.
- **Navigator**: Navigates within the trace to view the location of errors and triggers, narrow the range of traffic on display, and jump to any point in the trace.
- **Detail View**: Shows details of selected packet.
- **Spec View (3.1)**: Shows packet header information and other items, in a view that matches the USB 3.1 specification.
- **USB 3.1 Link State Timing View**: Graphically shows how much time the link spends in each link state.
- **USB 3.1 LTSSM View**: Displays the LTSSM diagram depicted in the USB 3.1 specification.
- **Power Tracker:** Displays voltage, current, and power. You can select Hide, Full Screen, Sync by Time, or Real Time Monitor.
- **Decoded Fields View**: See "Decoded Fields View" on page 265
- **Run Verification Scripts**: Opens a window to allow you to run verification scripts over the open trace.

Reports are available from the Report menu and buttons on the Tool bar. Tools are available from the Tools menu.

9.1 View Docking and Floating Windows.

Similar to the windows in most Windows™ programs, most report views are dockable and tab-able. To help guide the docking of windows, drop targets are provided so that you can drag the cursor to those locations and be confident of the location your window will be docked. See Figure 9.2 and Figure 9.3 on page 271.

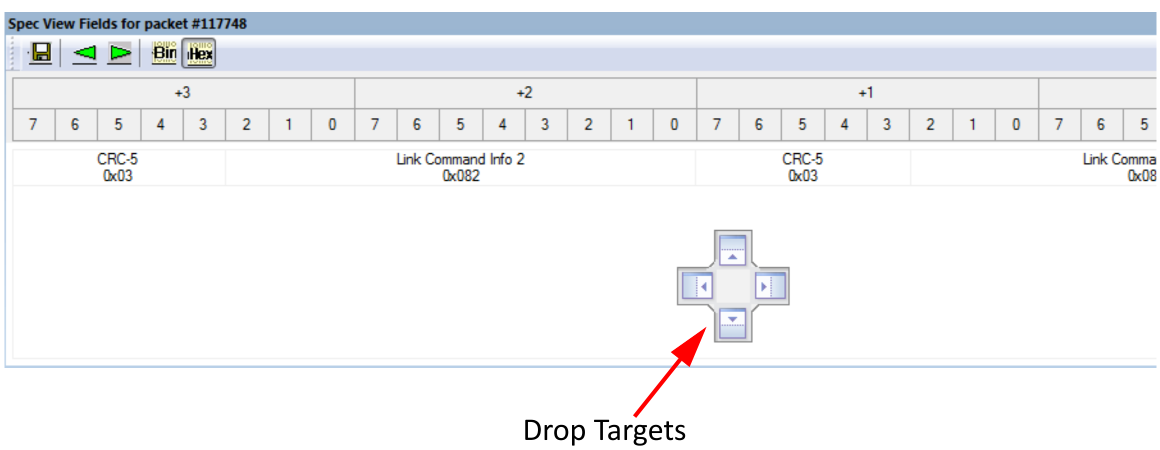
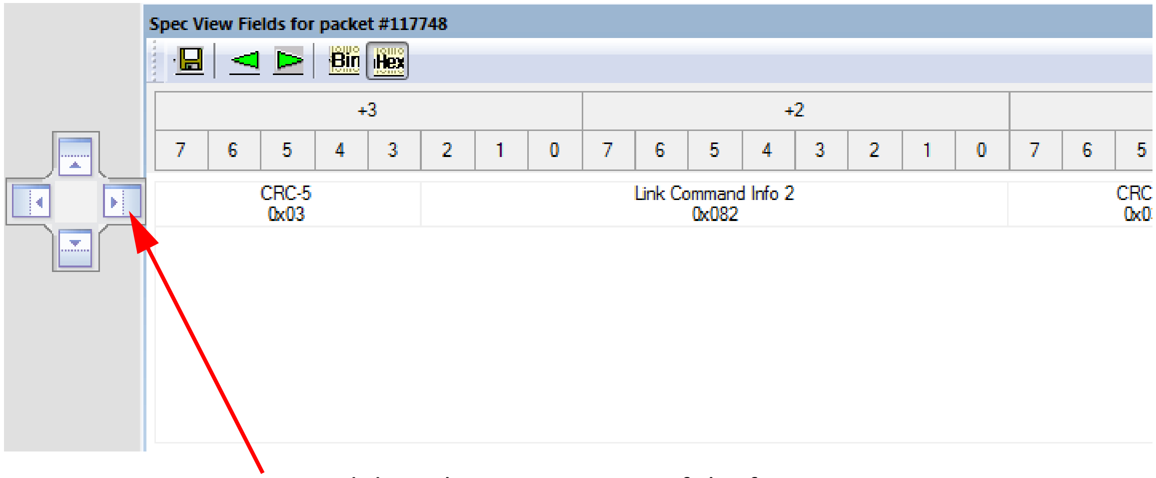


Figure 9.2: Drop Target



Drag and drop the report at one of the four targets

Figure 9.3: Drag and Drop Report in Target

Note: When you open a report view, the software attempts to apply the user preferences used when you most recently viewed the report.

Note: If you have any trouble with your view windows, and want to set it back to the default, Select "Restore views to default positions" from the View menu.

9.2 Trace Information

To display a Trace Information report, select **File Information** under **Report** in the Menu Bar, or click in the Tool Bar to display the Trace Information screen. You can click on the hyperlinks: **File info**, **Hardware info**, **Recording Options** or **License info** to navigate to that section. See Figure 9.4: and Figure 9.5: on page 273.

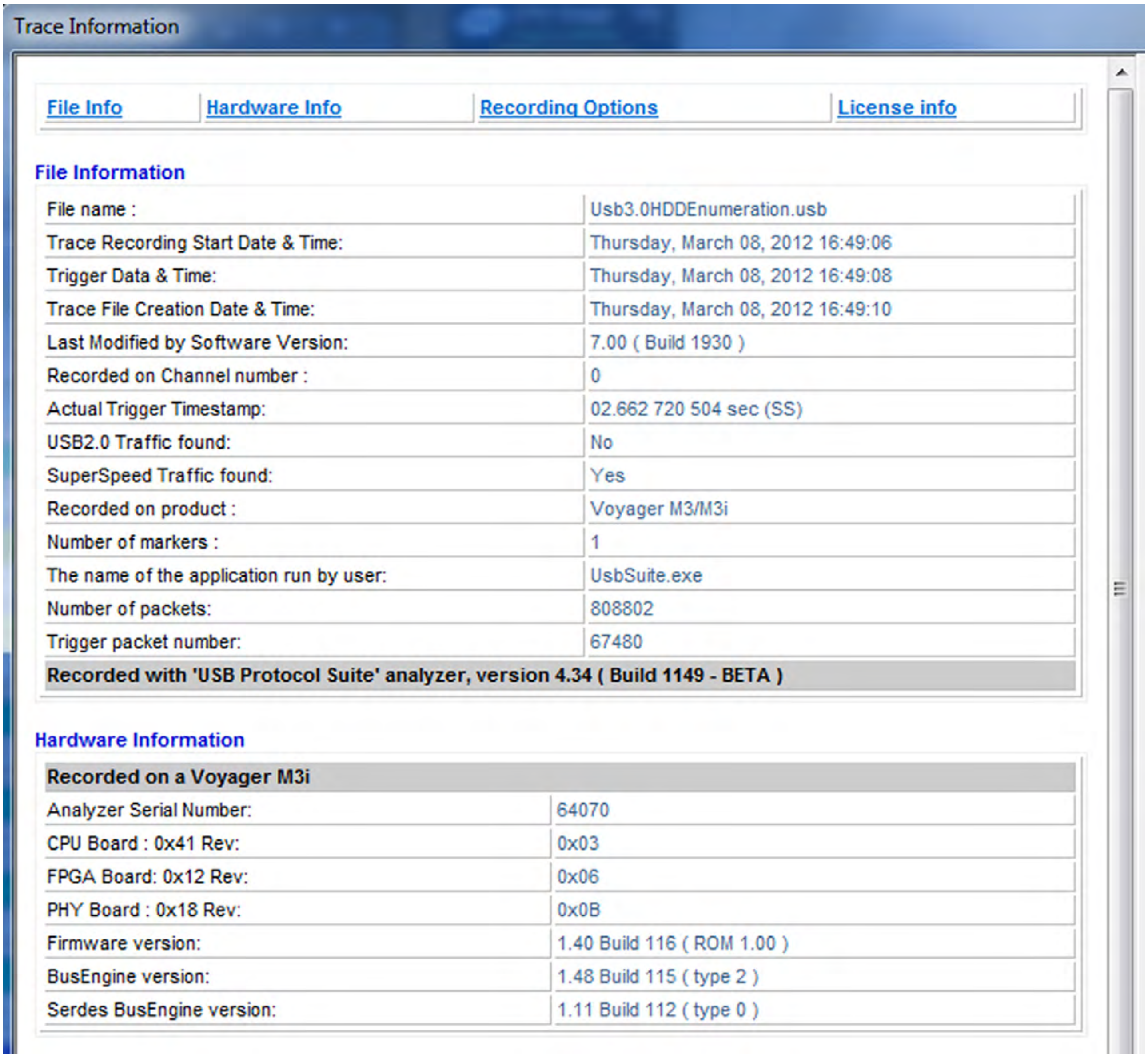
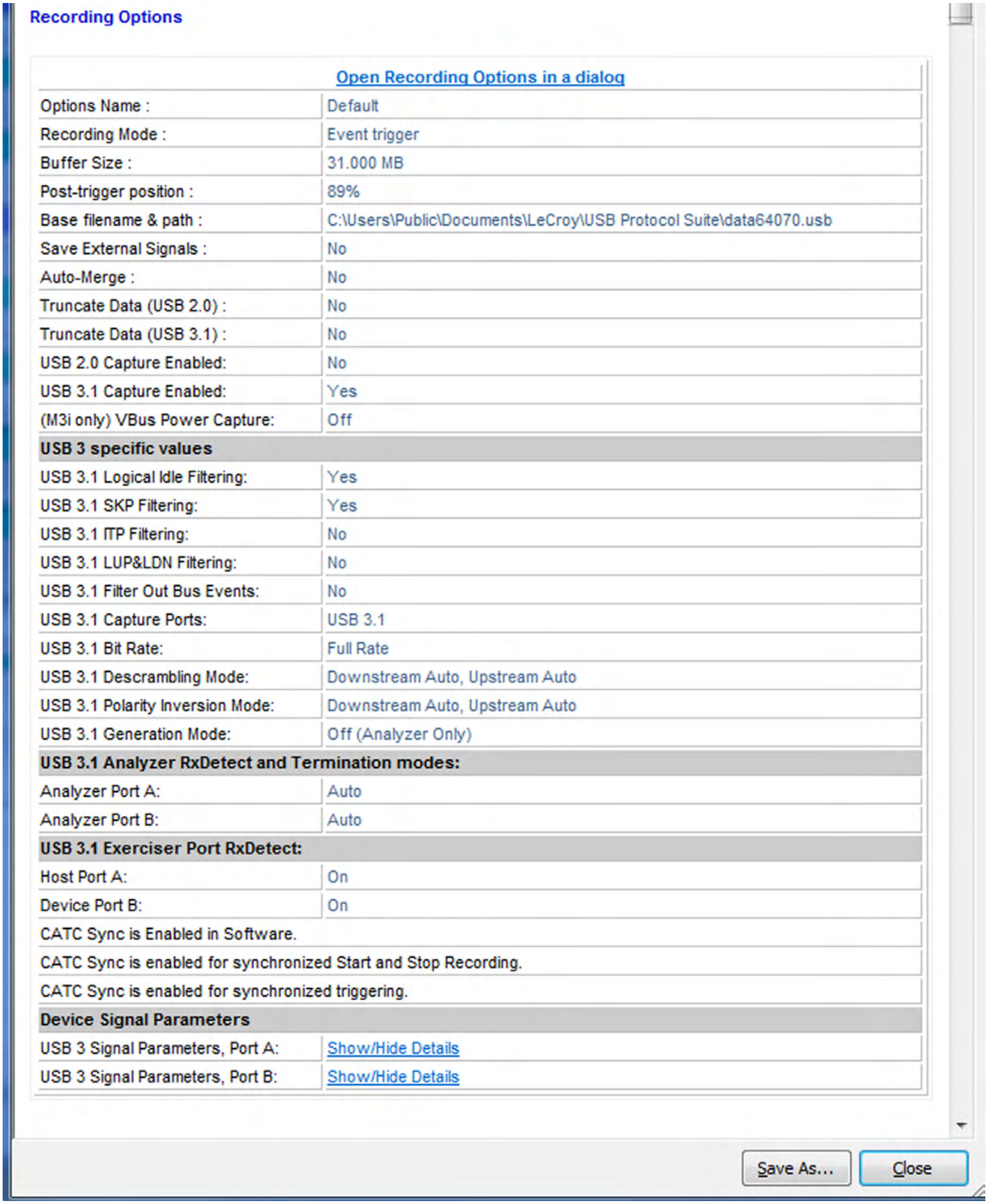


Figure 9.4: Top of Trace Information Report



Recording Options

Open Recording Options in a dialog

Options Name :	Default
Recording Mode :	Event trigger
Buffer Size :	31.000 MB
Post-trigger position :	89%
Base filename & path :	C:\Users\Public\Documents\LeCroy\USB Protocol Suite\data64070.usb
Save External Signals :	No
Auto-Merge :	No
Truncate Data (USB 2.0) :	No
Truncate Data (USB 3.1) :	No
USB 2.0 Capture Enabled:	No
USB 3.1 Capture Enabled:	Yes
(M3i only) VBus Power Capture:	Off
USB 3 specific values	
USB 3.1 Logical Idle Filtering:	Yes
USB 3.1 SKP Filtering:	Yes
USB 3.1 ITP Filtering:	No
USB 3.1 LUP&LDN Filtering:	No
USB 3.1 Filter Out Bus Events:	No
USB 3.1 Capture Ports:	USB 3.1
USB 3.1 Bit Rate:	Full Rate
USB 3.1 Descrambling Mode:	Downstream Auto, Upstream Auto
USB 3.1 Polarity Inversion Mode:	Downstream Auto, Upstream Auto
USB 3.1 Generation Mode:	Off (Analyzer Only)
USB 3.1 Analyzer RxDetect and Termination modes:	
Analyzer Port A:	Auto
Analyzer Port B:	Auto
USB 3.1 Exerciser Port RxDetect:	
Host Port A:	On
Device Port B:	On
CATC Sync is Enabled in Software.	
CATC Sync is enabled for synchronized Start and Stop Recording.	
CATC Sync is enabled for synchronized triggering.	
Device Signal Parameters	
USB 3 Signal Parameters, Port A:	Show/Hide Details
USB 3 Signal Parameters, Port B:	Show/Hide Details

Figure 9.5: Bottom of Trace Information Report

The Trace 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.

The Trace Information dialog provides a link, **Open Recording Options in a dialog**, so you can load a copy of the recording options that existed when the file was recorded.

To see the Device Signal Parameters that were used for your 3.1 captures, click on the hyperlink Show/Hide details to expand the information.

9.3 Error Summary

The Error Summary details all errors analyzed throughout the recording. After the report displays, click USB 2.0 Errors (see Figure 9.6) or USB 3.1 Errors (see Figure 9.7 on page 277) to view the respective errors.

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

OR

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

9.3.1 USB 2.0 Errors

The figure below and the table following it list and describe the USB 2.0 errors.

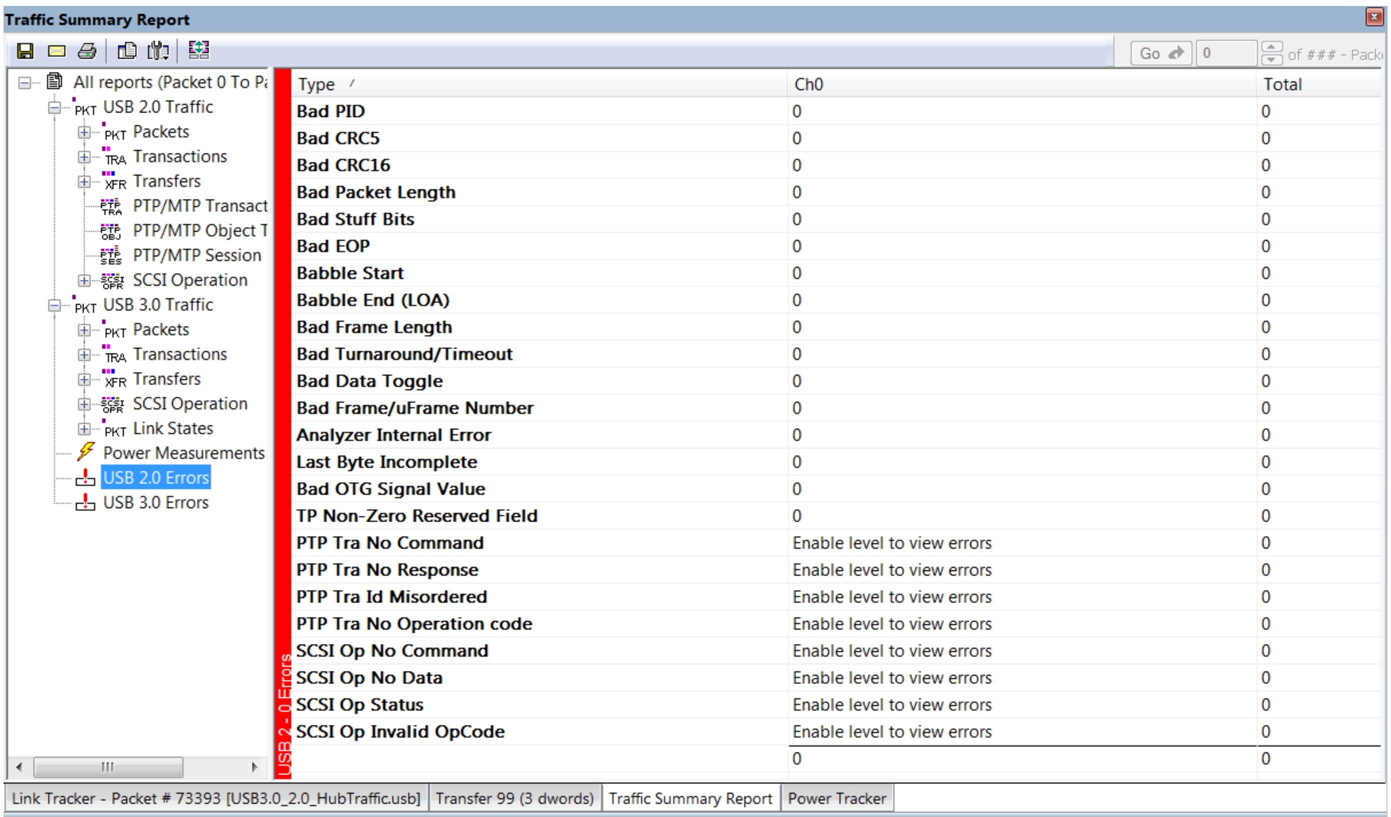


Figure 9.6: Traffic Summary Report (USB 2.0)

The following table lists each USB 2.0 error type and its description.

Error Type	Error Description
Bad PID	The Packet ID is malformed. Either it is not a USB 2.0 Specification defined value, or the upper nibble is not equal to the inverted bit value of the lower nibble.
Bad CRC5	The CRC5 field has an incorrect value. The packet is corrupt (either the data or the CRC itself).

Error Type	Error Description
Bad CRC16	The CRC16 field has an incorrect value. The packet is corrupt (either the data or the CRC itself).
Bad Packet Length	The packet is shorter or longer than expected.
Bad Stuff Bits	The NRZI encoding has a problem.
Bad EOP	The End of Packet signaling does not conform to the USB 2.0 Specification.
Babble Start	The packet started too late in the Frame or Microframe.
Babble End (LOA)	The packet ended to late in the Frame or Microframe.
Bad Frame Length	The Frame or Microframe time was out of spec. (expected ~1 ms or ~125µSec)
Bad Turnaround/ Timeout	The device or host took too long to respond to a packet within a transaction.
Bad Data Toggle	Unexpected Data Toggle value; incorrect according to the USB 2.0 Specification.
Bad Frame/uFrame Number	Frame number not sequential, or not exactly 8 repetitions of a frame number in a High Speed frame sequence.
Analyzer Internal Error	Teledyne LeCroy hardware capture problem (not a USB error).
Last Byte Incomplete	The packet length in bytes was not modulo 8.
Bad OTG Signal Value	The OTG signal was not within USB 2.0 OTG Specification.
TP Non-Zero Reserved Field	A reserved value within a Transaction Packet has a non-zero value.
PTP Tra No Command	No command seen in this PTP Transfer.
PTP Tra No Response	No response seen in this PTP Transfer.
PTP Tra Id Misordered	The Transfer ID's appear to be in the wrong order.
PTP Tra No Operation code	The operation code is missing in this PTP transfer.
SCSI Op No Command	The Command is missing from this SCSI Operation.
SCSI Op No Data	The Data is missing from this SCSI Operation.
SCSI Op status	Invalid Status is found for this SCSI Operation.
SCSI Op Invalid OpCode	The SCSI OpCode is not supported by the current standards.

9.3.2 USB 3.1 Errors

The figure below and the table following it list and describe the USB 2.0 and 3.1 errors.

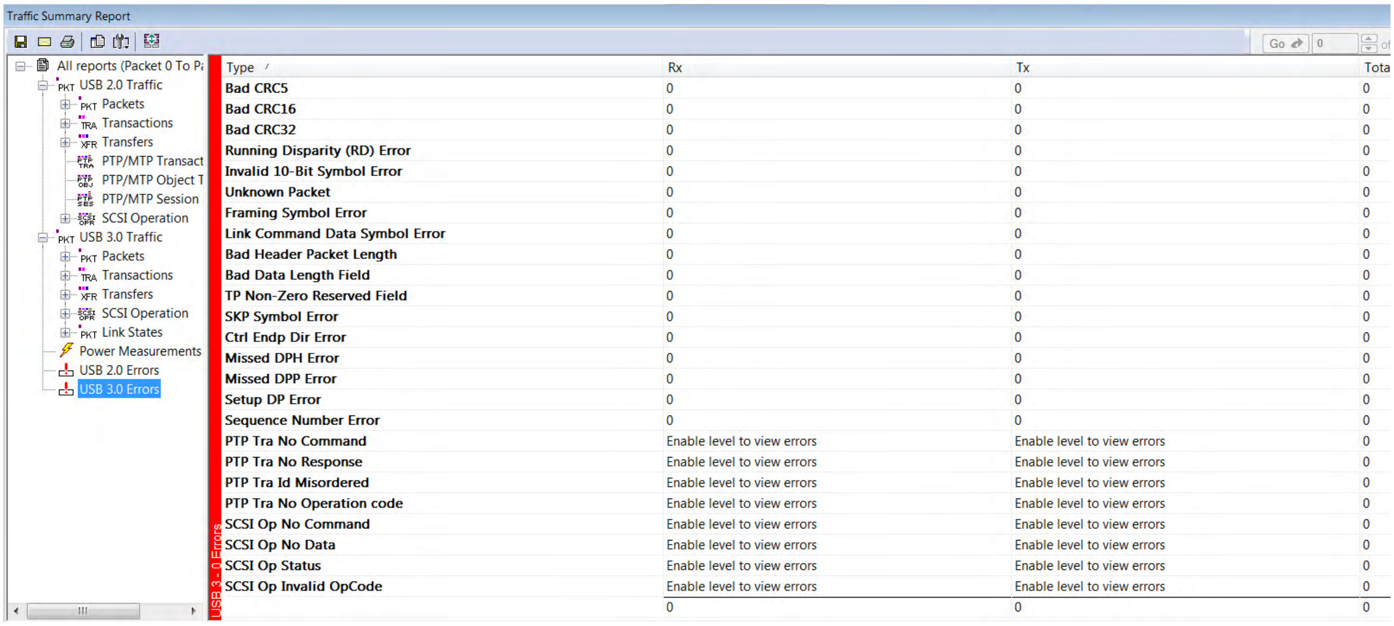


Figure 9.7: Traffic Summary Report (USB 3.1)

The following table lists each USB 3.1 error type and its description.

Error Type	Error Description
Bad CRC5	The CRC5 field has an incorrect value. The packet is corrupt (either the data or the CRC itself).
Bad CRC16	The CRC16 field has an incorrect value. The packet is corrupt (either the data or the CRC itself).
Bad CRC32	The CRC32 field has an incorrect value. The Packet is corrupt (either the data or the CRC itself).
Running Disparity (RD) Error	The symbol captured has an incorrect number of "1" bits than expected by following the 10-bit symbol encoding rules.
10-bit Symbol Error (Inv Sym)	An illegal/undefined 10-bit symbol pattern was detected. Not all combinations of 10-bits are legal in this 8B/10B scheme.
Unknown Packet	The type of the packet declared in the header is not supported in the USB 3.1 Specification.
Framing Symbol Error	The sequence of framing symbols found is not supported by the USB 3.1 Specification.
Link Command Data Symbol Error	A data field in the link command has an incorrect symbol value.
Bad Header Packet Length	Header Packet has a length other than 16 bytes.
Bad Data Length Field	The Data Packet Header has a wrong value in the Data Length field.

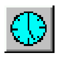
Error Type	Error Description
TP non-zero Reserved Field	A reserved value within a Transaction Packet has a non-zero value.
SKP Symbol error	An error was detected in the Skip Sequence.
Ctrl Endp Dir Error	The bit indicating the direction of this control stage is inconsistent with the USB 3.1 Specification.
Missed DPH Error	The expected Data Packet Header was not captured as expected.
Missed DPP Error	The Data Packet Payload was not seen after the Data Header Packet as required by the USB 3.1 Specification.
Setup DP Error	The format of the Setup DPH is incorrect (Seq # !=0, Datalength != 8, etc.).
Sequence Number Error	The DP or TP Sequence Number is not in the order expected according to the USB 3.1 Specification.
PTP Tra No Command	No command seen in this PTP Transfer.
PTP Tra No Response	No response seen in this PTP Transfer.
PTP Tra Id Misordered	The Transfer ID's appear to be in the wrong order.
PTP Tra No Operation code	The operation code is missing in this PTP transfer.
SCSI Op No Command	The Command is missing from this SCSI Operation.
SCSI Op No Data	The Data is missing from this SCSI Operation.
SCSI Op status	Invalid Status is found for this SCSI Operation.
SCSI Op Invalid OpCode	The SCSI OpCode is not supported by the current standards.

9.4 Timing Calculations

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

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

OR

- ❑ Click  in the Tool Bar to display the Timing Calculator screen:

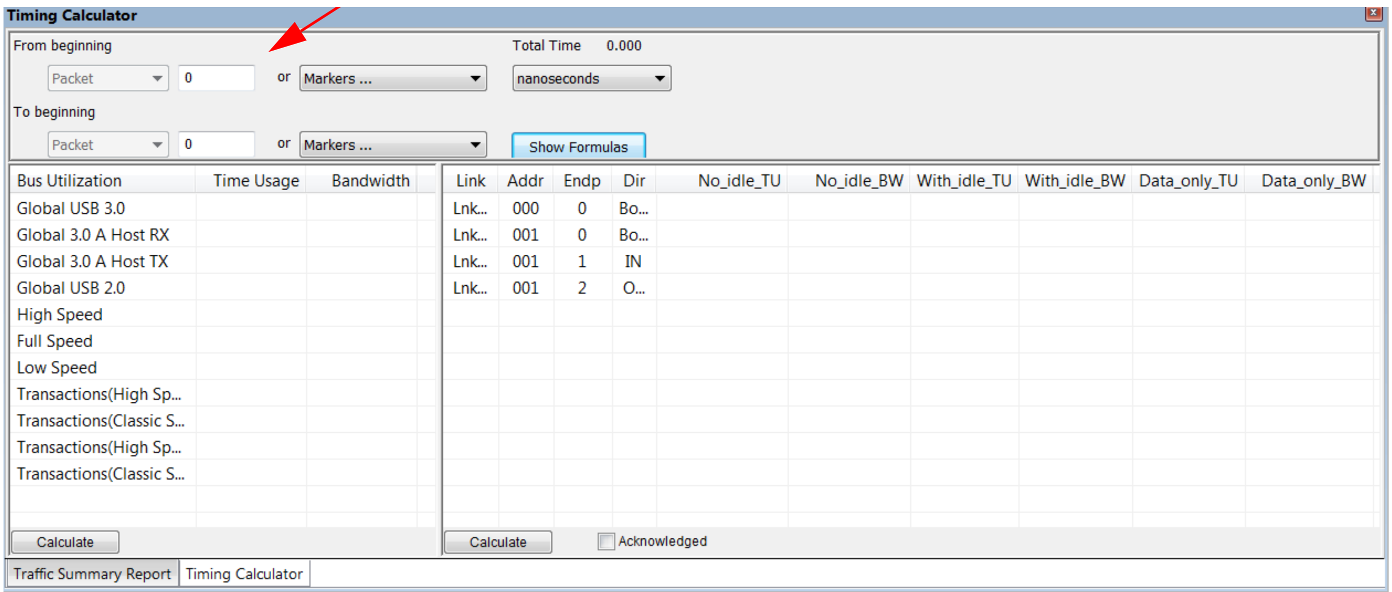
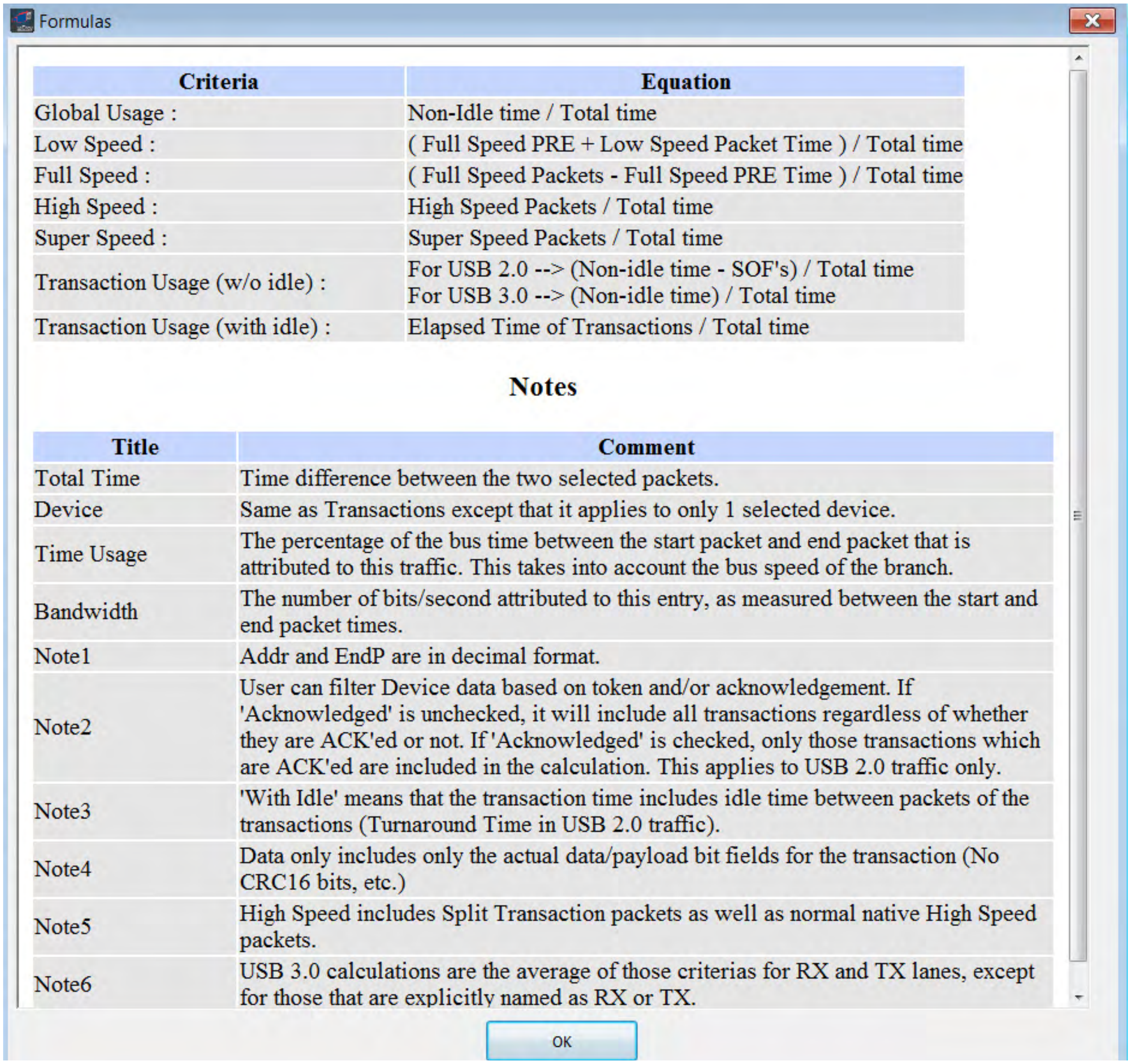


Figure 9.8: Timing Calculations Report

1. In the **From beginning** field, enter the first packet number or Markers.
2. In the **To beginning of** field, enter the last packet number or Markers.
3. In the **Total Time** field, select **nanoseconds, microseconds, milliseconds**, or **seconds**.
4. Click the **Show Formulas** button to display the Formulas window (see Figure 9.9 on page 280, with the formulas used.
5. If you want to include only acknowledged packets, click the **Acknowledged** checkbox. This will exclude non-Acknowledged data transfers from the calculations, leaving only the "effective" data transfer that the higher layers will see. (No re-try's, etc.)



Formulas

Criteria	Equation
Global Usage :	Non-Idle time / Total time
Low Speed :	(Full Speed PRE + Low Speed Packet Time) / Total time
Full Speed :	(Full Speed Packets - Full Speed PRE Time) / Total time
High Speed :	High Speed Packets / Total time
Super Speed :	Super Speed Packets / Total time
Transaction Usage (w/o idle) :	For USB 2.0 --> (Non-idle time - SOF's) / Total time For USB 3.0 --> (Non-idle time) / Total time
Transaction Usage (with idle) :	Elapsed Time of Transactions / Total time

Notes

Title	Comment
Total Time	Time difference between the two selected packets.
Device	Same as Transactions except that it applies to only 1 selected device.
Time Usage	The percentage of the bus time between the start packet and end packet that is attributed to this traffic. This takes into account the bus speed of the branch.
Bandwidth	The number of bits/second attributed to this entry, as measured between the start and end packet times.
Note1	Addr and EndP are in decimal format.
Note2	User can filter Device data based on token and/or acknowledgement. If 'Acknowledged' is unchecked, it will include all transactions regardless of whether they are ACK'ed or not. If 'Acknowledged' is checked, only those transactions which are ACK'ed are included in the calculation. This applies to USB 2.0 traffic only.
Note3	'With Idle' means that the transaction time includes idle time between packets of the transactions (Turnaround Time in USB 2.0 traffic).
Note4	Data only includes only the actual data/payload bit fields for the transaction (No CRC16 bits, etc.)
Note5	High Speed includes Split Transaction packets as well as normal native High Speed packets.
Note6	USB 3.0 calculations are the average of those criterias for RX and TX lanes, except for those that are explicitly named as RX or TX.

OK

Figure 9.9: Formulas Window

6. Click **Calculate** (see red arrow in Figure 9.8 on page 279) in the left side to display the Bus Utilization, Time Usage, and Bandwidth. Bus Utilization is:
   - Global USB 3.1
   - Global 3.1 A Host RX
   - Global 3.1 A Host TX
   - Global USB 2.0
   - High Speed
   - Full Speed
   - Low Speed
   - Transactions (High Speed with Idle)
   - Transactions (Classic Speed with Idle)
   - Transactions (High Speed without Idle)

- ❑ Transactions (Classic Speed without Idle)

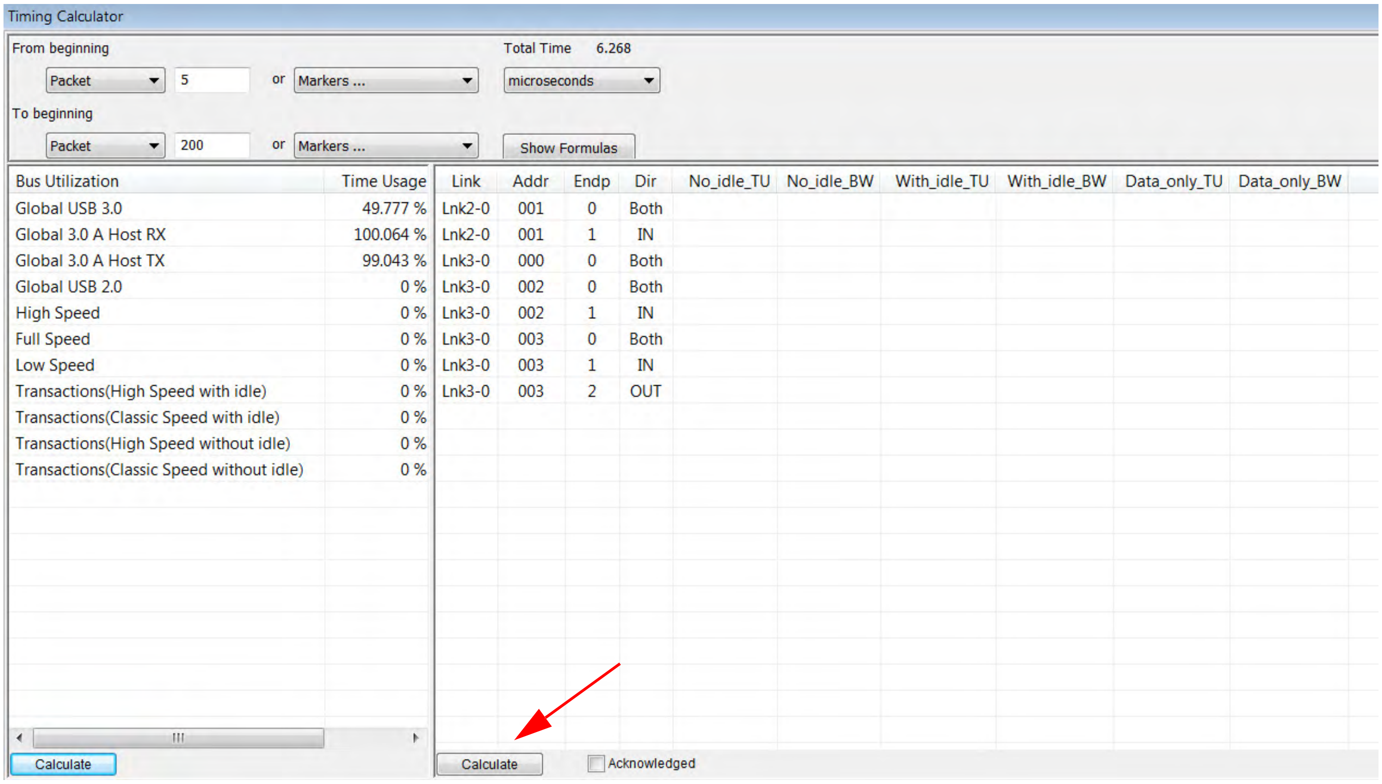


Figure 9.10: Timing Calculator Report

Total Time is in the Total Time field.

7. Click **Calculate** (see red arrow in the figure above) in the right side to display:
   - ❑ Address
   - ❑ Endpoint
   - ❑ Direction
   - ❑ No Idle Time Usage
   - ❑ No Idle Bandwidth
   - ❑ With Idle Time Usage
   - ❑ With Idle Bandwidth
   - ❑ Data only Time USage
   - ❑ Data only Bandwidth

You can also click the **Acknowledged** checkbox.

Note: Bandwidth and other calculations do not have accurate meaning if taken over a small range of packets. It is recommended that you choose a range that includes at least a few USB frames or Microframes so that the measurements give realistic values. The larger the range, the more accurate these calculations will be.

9.5 Data View

The Data View window shows packet information.

To obtain the Data View window, select **Report > Data View**

or click the  toolbar icon.

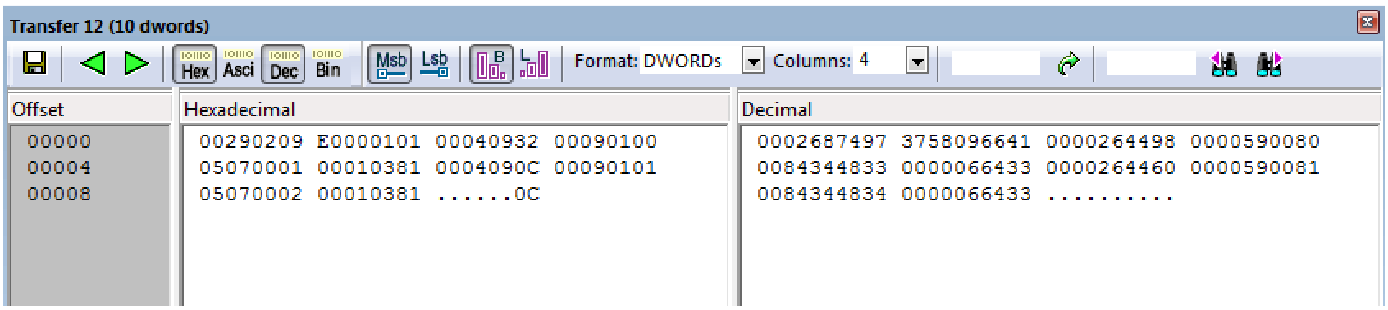


Figure 9.11: Data View Report

The Data View toolbar buttons allow you to:

- Save
- Go to Previous or Next
- Display Hexadecimal, ASCII, Decimal, or Binary
- Use MSB Format or LSB Format
- Use Big Endian or Little Endian

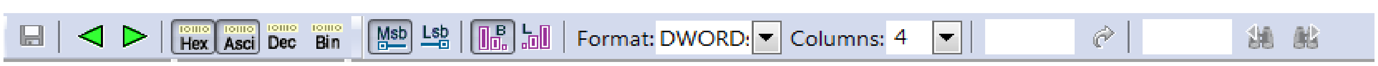


Figure 9.12: Data View Toolbar

The Format field allows you to enter the number of BYTEs, WORDs, or DWORDs per line.

The Columns field allows you to set the number of columns.

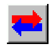
You can enter an offset in the Scroll to Offset field and click the **arrow** to scroll there.

You can enter text in the Search field and click **Search Previous** or **Search Next** to go there.

9.6 Traffic Summary Report

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

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

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

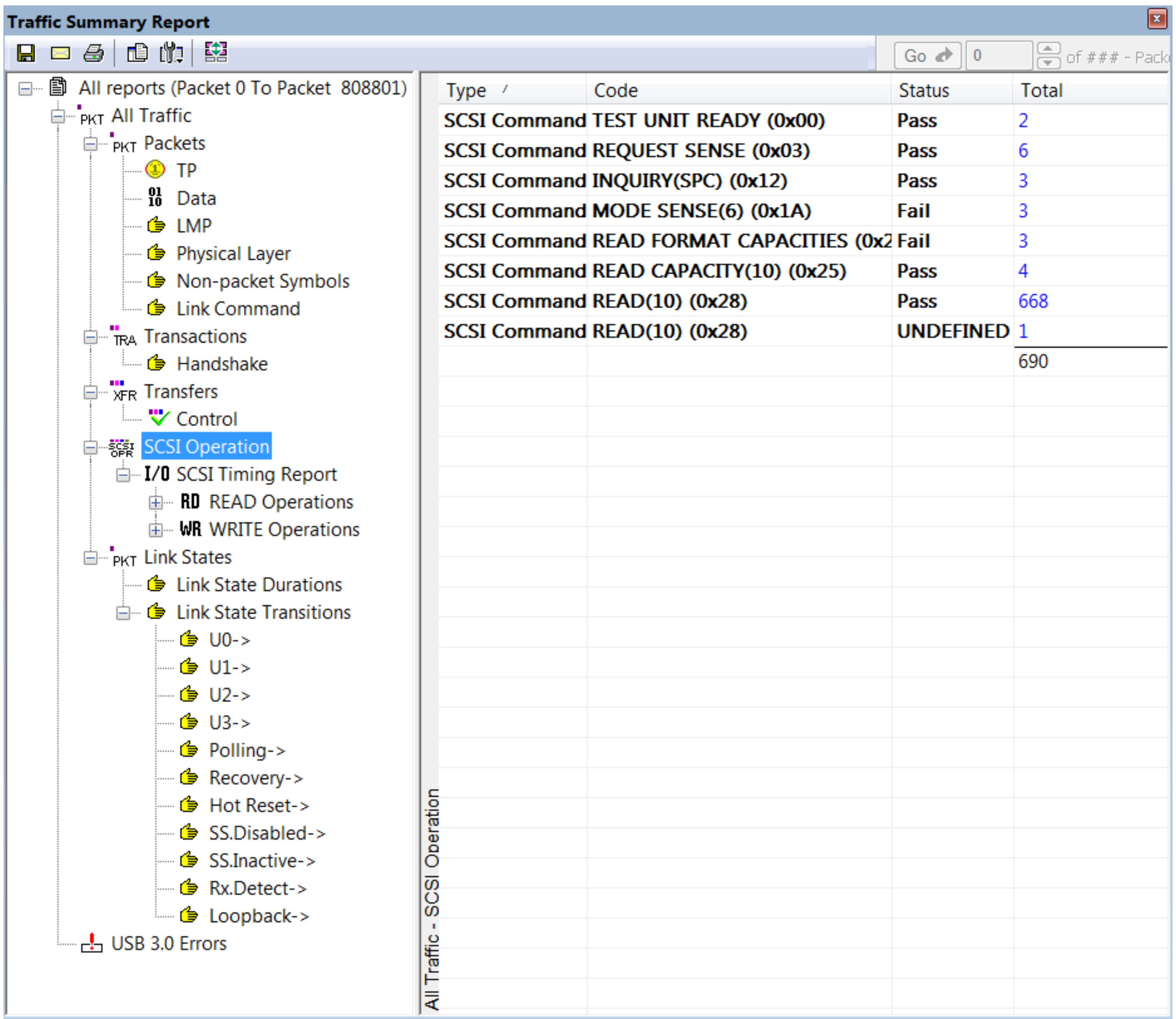


Figure 9.13: Traffic Summary Report

Click the Options button (see red arrow above) to display the Options menu (see Figure 9.14 on page 284) which allows you to show Grid lines, Row selection, and Tight columns. You can have Event Navigation: Skip hidden items, Show hidden items, and Prompt each time.

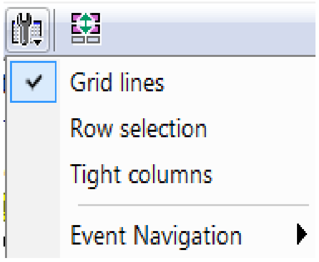


Figure 9.14: Options Menu

Click to display the Select Range dialog.

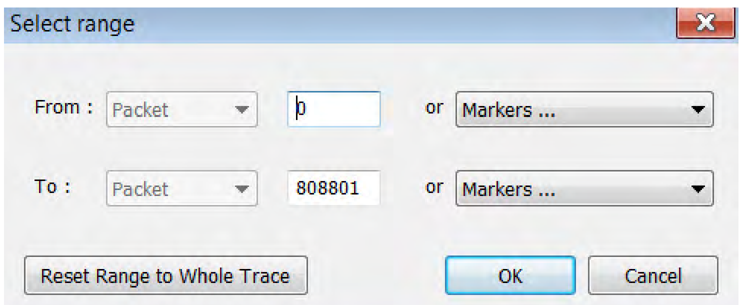


Figure 9.15: Select Range Dialog

Enter a number **From** and a number **To.**

You can **Reset Range to Whole Trace**.

9.6.1 SCSI Metrics

The SCSI Metrics are:

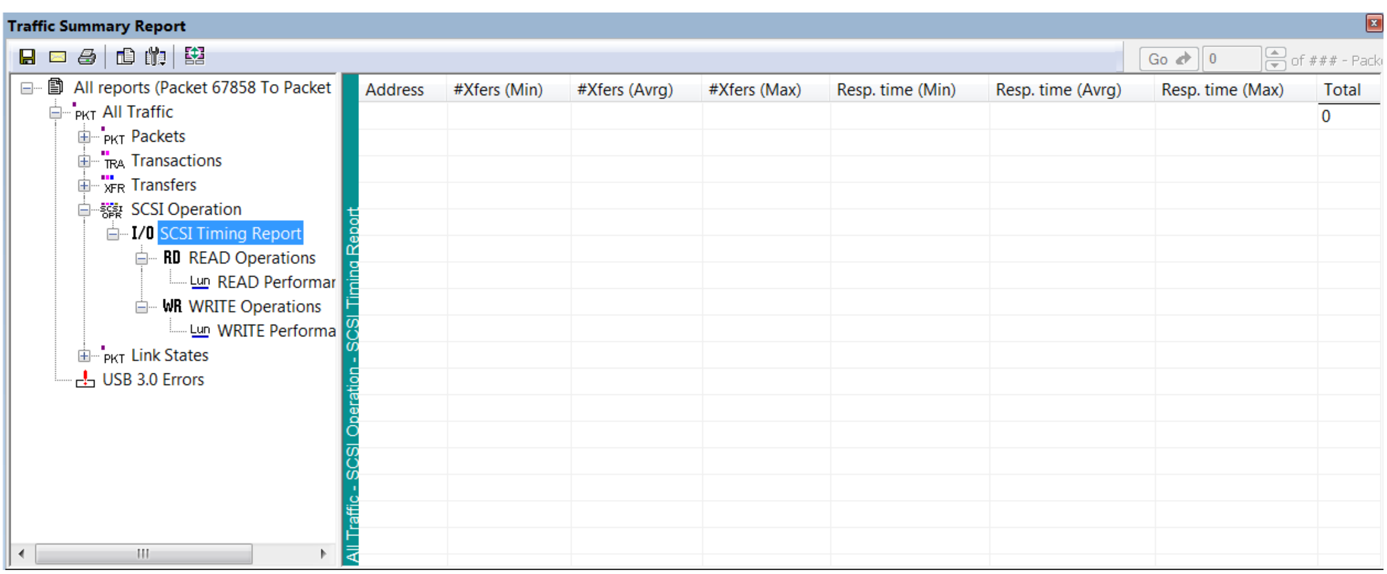


Figure 9.16: SCSI Metrics Report

- **Address**
- **Number Of Transfers (Min., Avrg., Max.)**: Total number of transfers that compose the SCSI operation
- **Response Time (Min., Avrg., Max.)**: Time to transmit on the USB link, from the beginning of the first transfer in the SCSI operation to the end of the last transfer in the SCSI operation
- **Latency**: Time from the transmission of the SCSI command to the first data transmitted for the SCSI IO operation
- **Data To Status Time**: Time between the end of data transmission for the SCSI operation and the status transfer
- **Payload**: Number of payload bytes transferred by the SCSI operation

9.6.2 Power Delivery (PD) Traffic Summary Report

Power Delivery Traffic, Errors, and Warnings are also available on Power Delivery equipped analyzers in the Traffic Summary Report. See Figure 9.17.

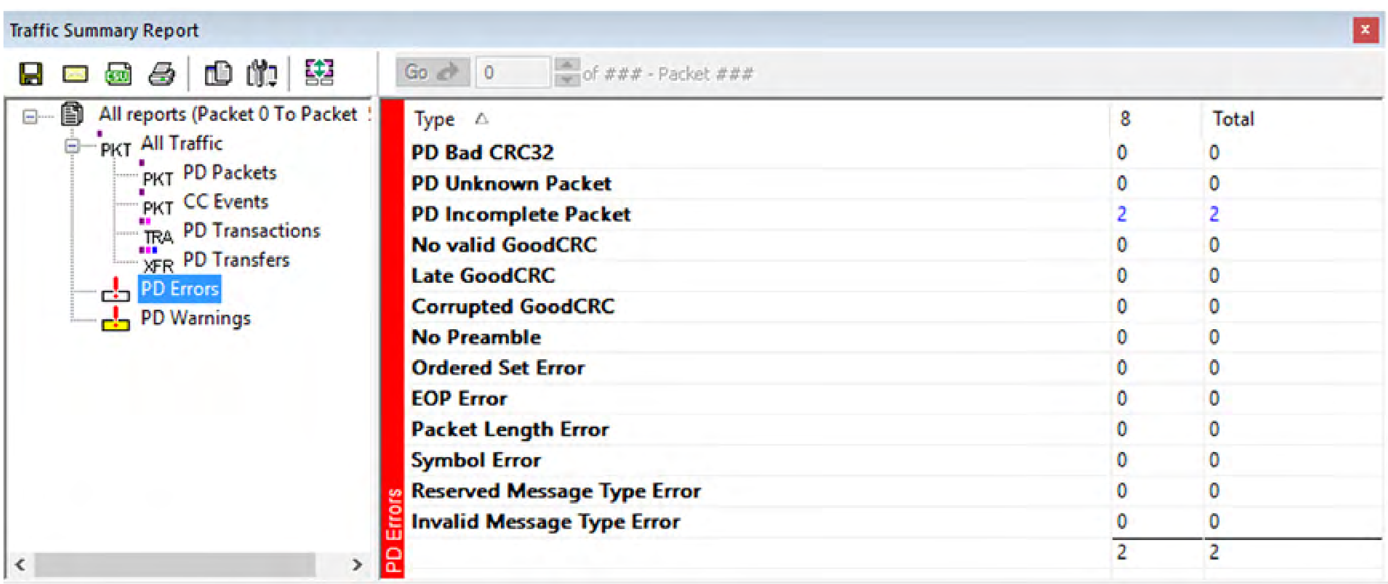


Figure 9.17: Power Delivery Traffic Summary

9.7 Bus Utilization

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

To open the Bus Utilization window, select **Report >Bus Utilization**

or click the button marked .

A window opens with graph areas. For USB 2.0, the display is similar to the following:

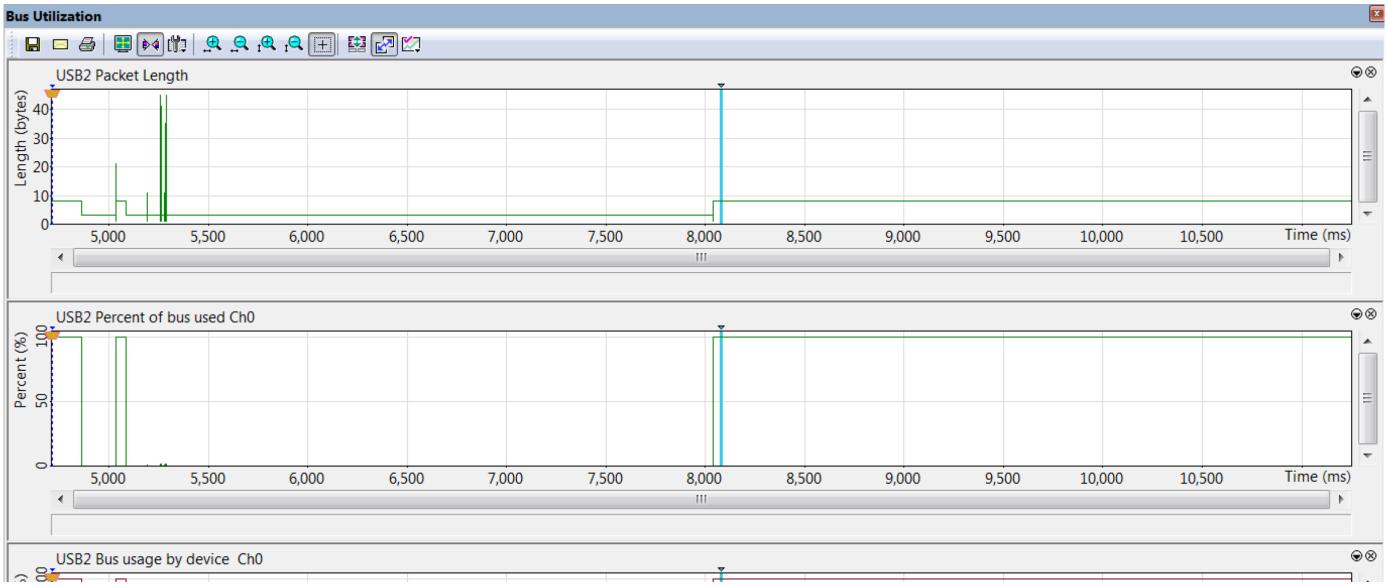


Figure 9.18: Bus Utilization Window

For USB 3.1, the display is similar to the following:

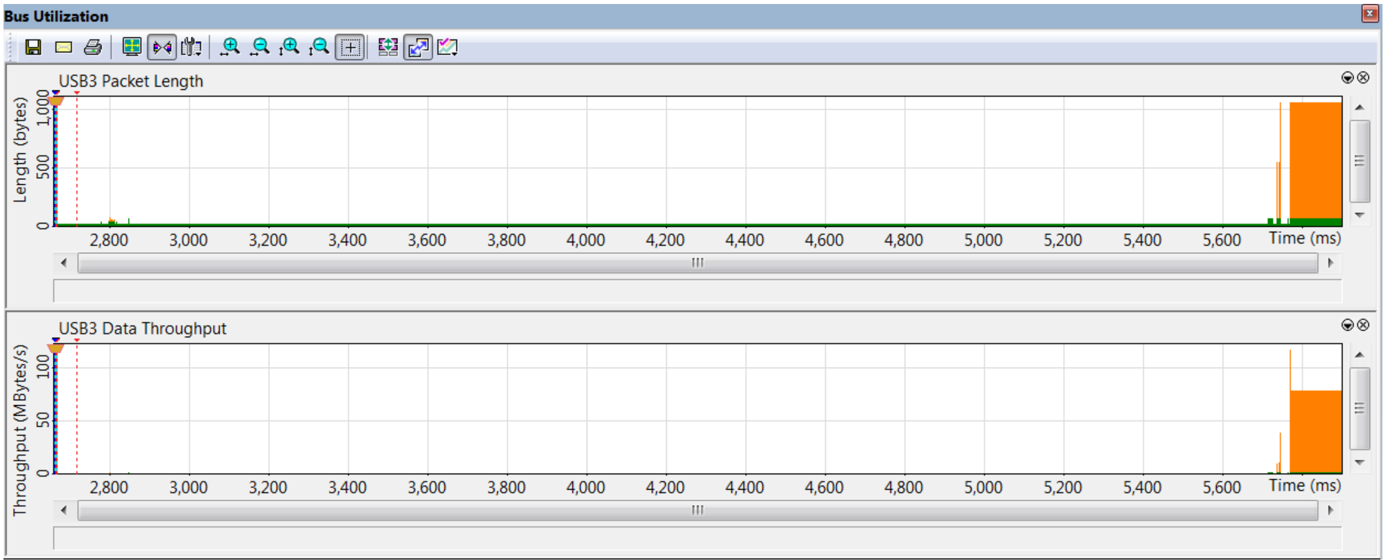
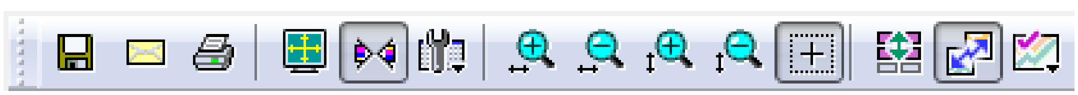


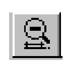
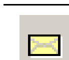
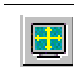
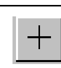
Figure 9.19: Bus Utilization Window

9.7.1 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)		Horizontal zoom out
	Email - Creates an email with a *.bmp file attachment of the graphs		Vertical zoom in
	Print		Vertical zoom out
	Full Screen		Click and Drag zoom - Click diagonally to select and zoom in on part of the graph

	Synchronize with Other Views. See Synchronize with other Views. Synchronizes the View windows so that a move in one window repositions the other. See “Link Tracker Buttons” on page 296.		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 synchronizes the graphs to one another. Once synchronized, the positioning slider of one graph moves the other graphs.
	Horizontal zoom in		Graph Areas - Presents options for displaying additional graphs of data lengths, packet lengths, and percentage of bus utilized.

9.7.2 View Settings Menu

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

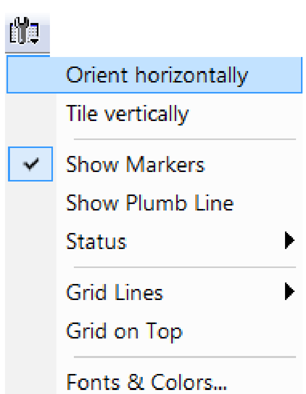


Figure 9.20: View Settings Menu

- **Orient Horizontally**: changes the orientation of bus usage to horizontal. After selecting this option, the menu has Orient Vertically.
- **Tile Vertically**: tiles the two graphs vertically (i.e., side by side). After selecting this option, the menu has Tile Horizontally.
- **Show Markers**: Places "tick" marks along the x axis of each graph.
- Show Plumb Line
- **Status**: Opens a sub-menu with the following options:
  - **Bar**: Displays a status bar at bottom of graph.
  - **Tooltip**: Causes a tooltip to appear if you position your mouse pointer over part of the graph and leave it there for a couple of seconds.
  - **No Grid**: Turns off tooltips and the status bar.

- **Grid Lines**: Opens a sub-menu with the following options:
  - Both Axis: Displays both X and Y axis grid lines
  - X Axis: Displays X axis grid lines
  - Y Axis: Display Y axis grid lines
  - None: Turns off grid lines
- **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:

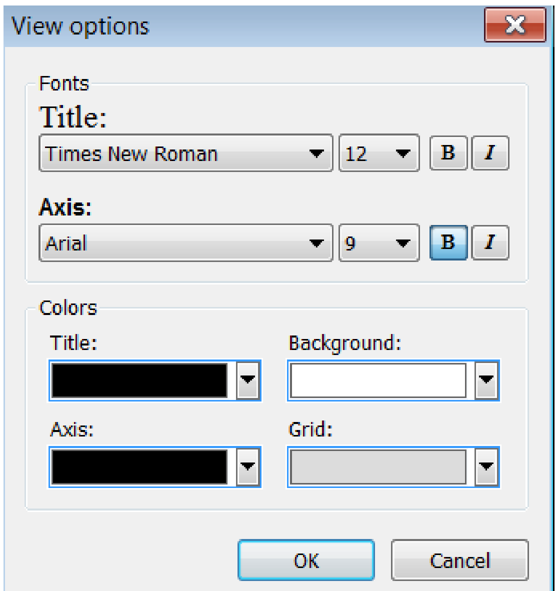


Figure 9.21: View Options Menu

9.7.3 Graph Areas Menu

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

1. Click the  button to open the Graph Areas menu. For USB 2.0. the display is similar to the following:

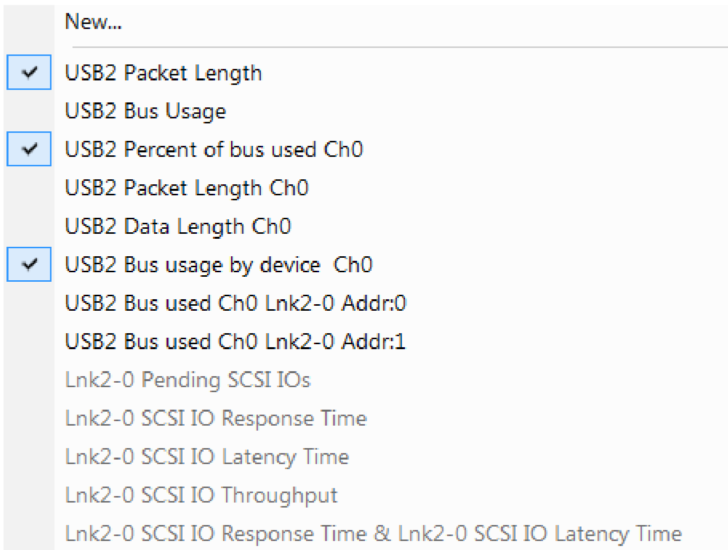


Figure 9.22: Graph Areas Menu USB 2.0

For USB 3.1. the display is similar to the following:

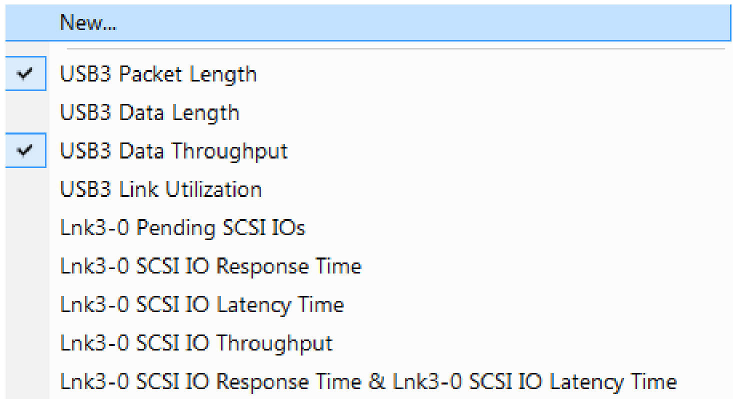


Figure 9.23: Graph Areas Menu USB 3.1

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

Change the Properties in the Bus Utilization Graph

To change the properties in the Bus Utilization graph:

1. In the Graph Area properties dialog box (see Figure 9.24 on page 292), select the options to display in the graph display, then click **OK**.

Creating a New Bus Utilization Graph

To create a new Bus Utilizations graph:

1. Select **New** in the Graph Areas menu.
2. In the Graph Area properties dialog box (see Figure 9.24 on page 292), select the options to display in the graph.
3. Enter a Title for the new graph, then click **OK**.

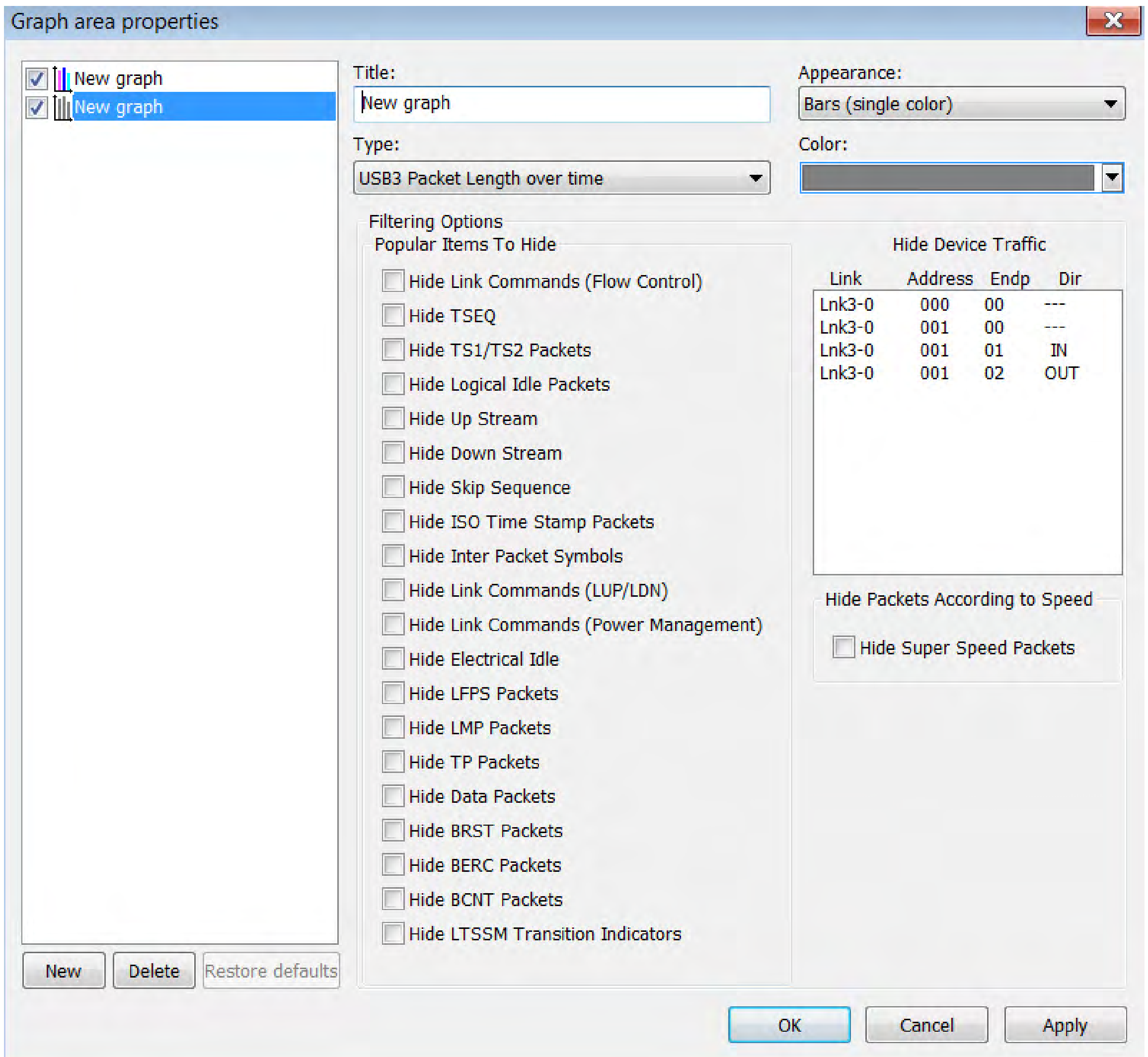


Figure 9.24: Graph Area Properties Dialog

9.8 Link Tracker (3.1)

The Link Tracker window displays a detailed chronological view of events. Events are shown on a channel-by-channel basis in columns within the window.

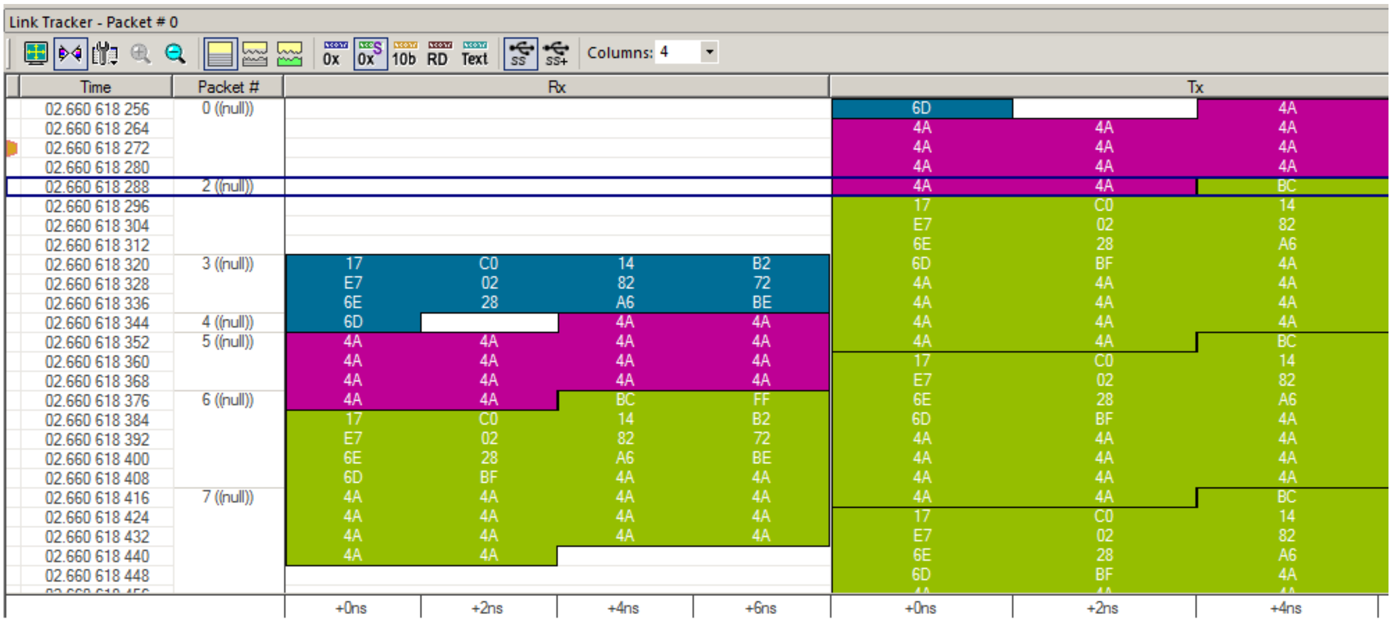


Figure 9.25: Link Tracker Window

You can select the number of columns to view more or less data at one time.

Each time slot in the vertical axis represents the minimum time that a DWORD requires to traverse the bus when the "Columns" is selected as 4.

Note: On Symbol Displays: There will occasionally be "blank" symbols inserted into the Link Tracker display (or symbols removed) to compensate for timestamp rate matching between the various time bases. This has to do with the problem that there are 3 clock domains (Rx, Tx, and our precision timestamp) that need to be represented in the trace. The nominal 2nSec / symbol Transmit and Receive clocks can vary up to 500ppm per the USB Specification, whereas the Analyzer is accurate to 3ppm. Blank entries and missing entries in the link tracker are there to compensate for this difference, and to try to maintain the most accurate relationship amongst these clocks and present the closest time relationship between the downward stream and the upward stream. The clock listed in the Time column is our precision 3ppm clock timestamp.

Toolbar: Presents buttons for changing the format of the Link Tracker window.

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

9.8.1 Using the Link Tracker Window

The Link Tracker window can be reformatted in several ways.

Zooming In and Out

Zooming out can give you a quick, high-level view of a trace. A fully zoomed out trace only shows columns and colored lines. Using the colors, you can see what types of traffic run through the trace.

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

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

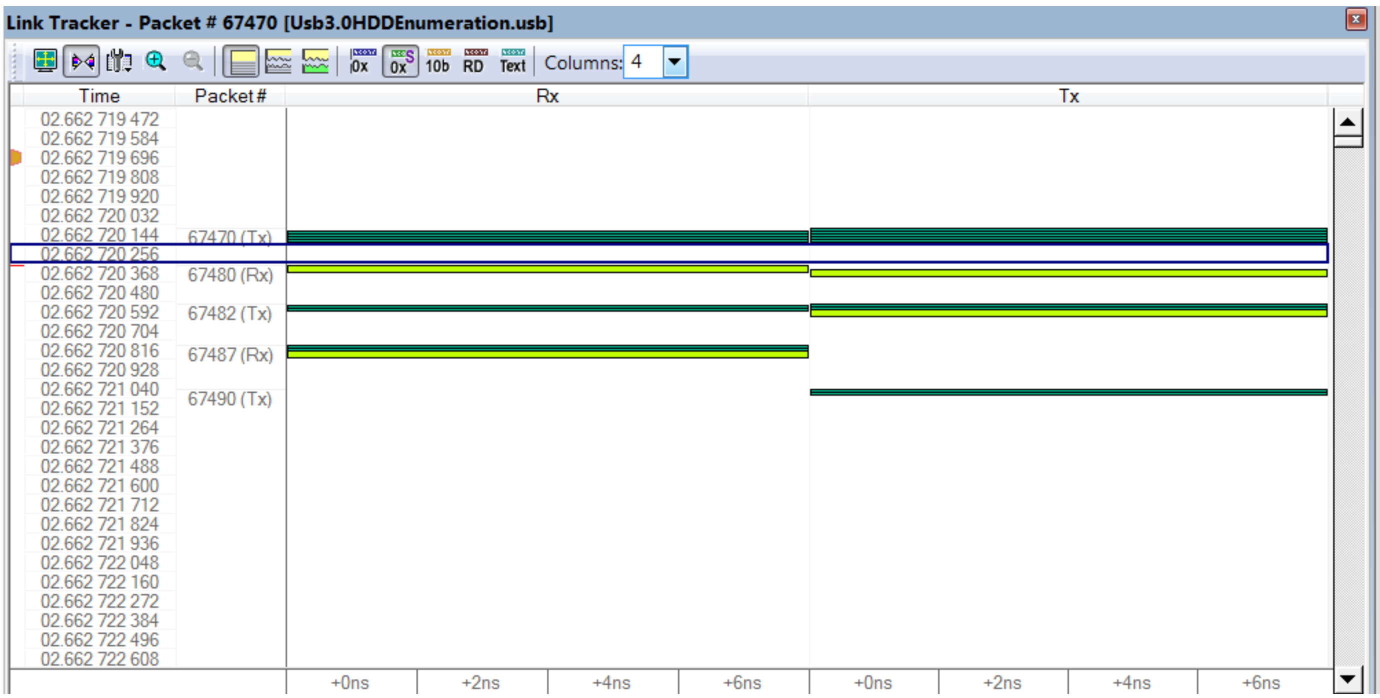


Figure 9.26: Link Tracker Window Zoomed Out

Collapsing Idle Time, Enabling Tool tips, and Resetting Column Widths

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

Collapsible Idle Time: Opens a dialog box for setting the Idle time value. Setting a value tells the Analyzer when to collapse Idle times and display them as grayed out strips within the Bus View window.

Time Format: Seconds or Clock

Reset Column Widths: This option resets column widths to their defaults and enables columns to resize themselves automatically any time the application window is resized. Normally, columns automatically resize themselves if the application window is made larger or smaller. However, if you manually resize any columns in the Bus View window, column widths become static. Thereafter, if you resize the application window, the Bus View columns do not adjust automatically. Reset Column Widths re-enables the automatic resizing capability.

Reset Columns Order: Return to default column sequence.

Docking and Undocking the Window

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

Setting Markers

Markers can be set on any event within the Link Tracker window.

To set a marker, right-click an event, then select **Set Marker** from the pop-up menu.

Once marked, you can navigate to events with the **Go to Marker** command in the Search menu.

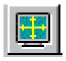
Markers set in the Link Tracker window display the packet number and DWORD number. In contrast, markers set in the Trace window just show the packet number.

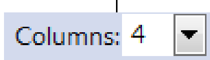
Hiding Traffic

You can hide Idles and other data from the Link Tracker window by clicking the **Hide** buttons on the toolbar.

9.8.2 Link Tracker Buttons

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

	Full Screen. Expands the Link Tracker window to fill the entire screen.
	Synchronize with Other Views. Synchronizes Views so that a move in one window repositions the other. Because of the differences in scale and logic between the Link Tracker and Trace view window, scrolling produces different effects depending on which window is being scrolled. Scrolling in the trace window causes the Link Tracker window to rapidly jump from event to event. Long periods of idle time are thus skipped. Scrolling in the Link Tracker window, in contrast, produces modest movements within the trace window. Scrolling in the Link Tracker window causes the trace window to pause until the beginning of a packet is displayed. At that point, the trace window repositions itself. While scrolling long Idle periods or through the contents of a packet, the trace window does not move.
	View Options. Opens a menu with three options: **Collapsible Idle Time** (Collapse Idle Bigger Than **n** nanoseconds. **Note:** Does not affect Collapse Idle Plus.) **Time Format** (Seconds, Clock) **Reset Columns Widths** (return to default widths) **Reset Columns Order** (return to default column sequence) See “Using the Link Tracker Window” on page 293 for further details.
	Zoom In
	Zoom Out
	Continuous Time Scale. No collapsing.
	Collapse Idle. Do not show some periods of Link being idle.
	Collapse Idle Data. Do not show periods of Link being idle.
	Show Descrambled Bytes

	Show Scrambled Bytes
	Show 10b Codes
	Show Symbols
	Show packet Fields
	Show USB 2.0/3.1 packets
	Show USB 3.1 packets
	Columns to view

9.9 Using the Navigator

The trace Navigator is a tool for navigating within the trace. It allows you to view the location of errors and triggers in a trace and to narrow the range of traffic on display. It also allows you to quickly jump to any point in the trace.

9.9.1 Displaying the Navigator

Click  in the toolbar, select **Report > Navigator**, or select the Navigation Bar checkbox in the Display Options General window to display the Navigator window (see Figure 9.27 on page 298).

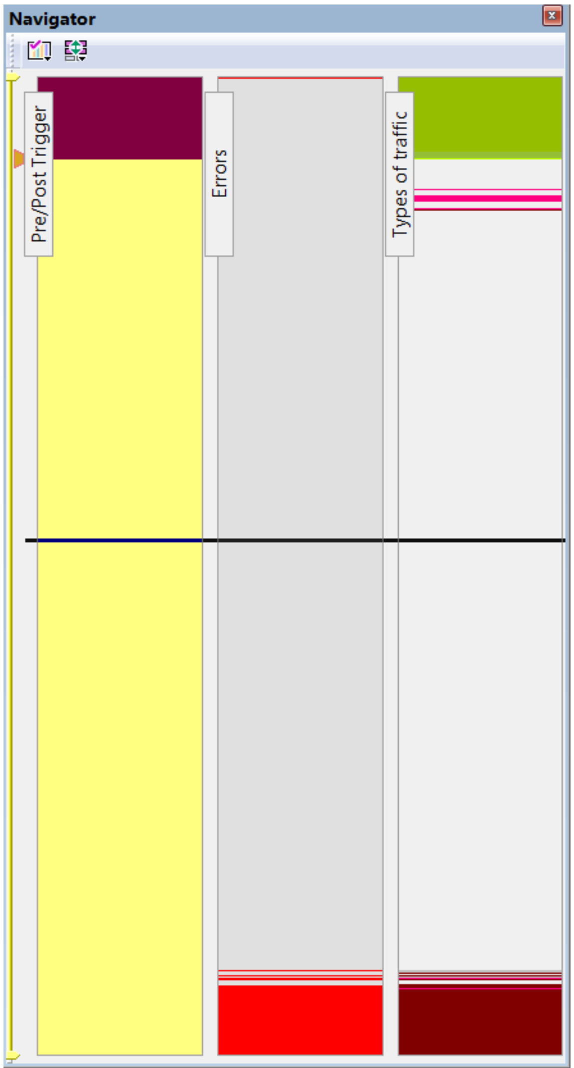


Figure 9.27: Navigator Window

The Navigator appears on the right side of the Main window. It has a two-button toolbar and a vertical slider bar. It also has colored panes for navigating the trace in different ways. You set which panes are displayed through Navigator pop-up menus.

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.

Drag the yellow caret, at the top or bottom, to set the packet range. When you move the caret, a message shows the packet range.

The blue caret indicates the current packet position in the trace view.

9.9.2 Navigator Toolbar

The Navigator toolbar lets you quickly set Navigator features. The toolbar has two buttons.

Navigator Ranges: This button brings up a pop-up menu that lets you reset the Navigator range. The range determines what packets are viewable in the trace display.

Navigator Panes: This button has two purposes: To select which Navigator panes appear and to bring up the Navigator legend. The legend determines how information is shown in the panes.

9.9.3 Navigator Ranges

You set the viewing range by dragging the **yellow range delimiters** along the slider.

To set the lowest packet viewable, drag the **top delimiter up**. As you do so, a tool tip appears to indicate the current range. Stop dragging when you reach the desired lowest packet.

To set the highest packet viewable, drag the **bottom delimiter down**. Stop when the tool tip indicates you are at the desired highest packet.

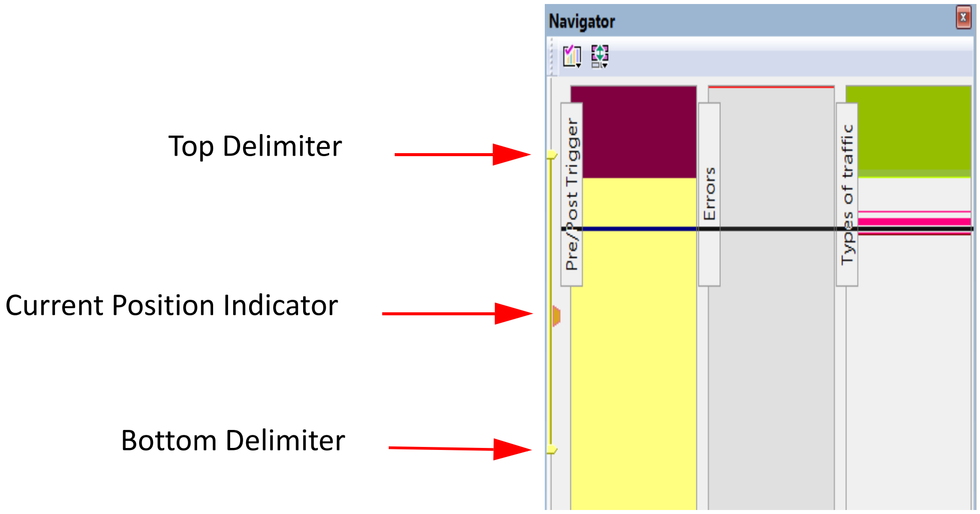


Figure 9.28: Navigator Delimiter

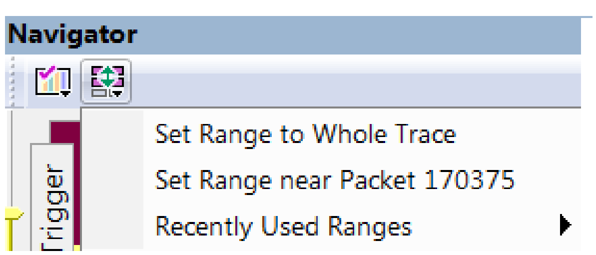
To Determine Current Position

In addition to the two yellow range delimiters, the slider has a **golden current-position** indicator (see above). The current-position indicator shows where you are in the trace display with respect to the possible viewing range.

For example, suppose you set viewing range to packet 0 through packet 500 (the top range delimiter is at packet 0, and the bottom range delimiter is at packet 500). If you then move the current-position indicator on the slider to midway between the top and bottom delimiters, then packet 250 appears in the middle of the trace display.

To Reset Navigator Range

You can reset the Navigator range using the toolbar **Navigator Range** button. Press the button to bring up the Navigator Range drop-down menu.



The menu has the following options:

- **Set Range to Whole Trace**: Allows you to reset the range to include the entire trace file contents. The top range delimiter is placed at the lowest packet number in the trace. The bottom range delimiter is placed at the highest packet number in the trace.

- **Set Range Near Packet xxx**: Allows you to collapse the range so that only the packets immediately above and below the xxx packet are displayed. The xxx packet is whatever packet is currently at the top in the trace display.
- **Recently Used Ranges**: Allows you to reset the range to any of a number of recently used (previously set) ranges.

9.9.4 Navigator Panes

You can display any combination of trace Navigator panes.

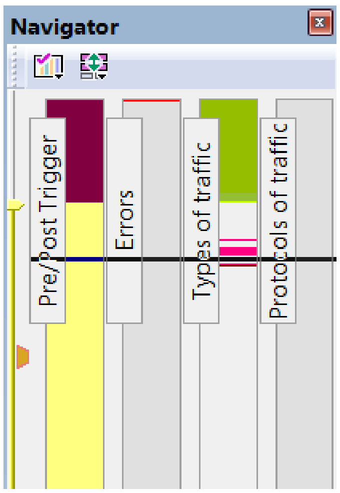


Figure 9.29: Navigator Panes

From left to right, the panes are: Pre/Post Trigger, Errors, Traffic Types, and Protocols of Traffic. Each pane represents the entire trace with respect to different types of information. The top of each pane represents the start of the trace file, and the bottom represents the end of the trace file.

- **Pre/Post Trigger:** To view the trigger event in the trace and the relative size of pre-trigger and post-trigger portions of the trace. The two portions are set apart as different colors. The trigger event occurs at the point the two colors meet.
- **Errors:** To view any errors in the trace. A thin red line represents each error in the pane.
- **Traffic Types:** To view the types of packets that occur in the trace. A different color represents each packet type in the pane. The relative size of colored portions in the pane corresponds to the amounts of the various packet types in the trace. As described below, you can use the Navigator legend to change the types of packets that take precedence in the display.
- **Protocols of Traffic**: To view USB 2.0, USB 3.1 Host Tx, or USB 3.1 Host Rx.

To Show/Hide Navigator Panes

You can show/hide any of the panes using pop-up menus accessible through right-click the **Navigator Panes** button or by right-click anywhere in any Trace Navigator pane.

Navigator Slider

The Navigator slider appears at the left of Navigator panes. The slider has **yellow upper and lower range delimiters** and a **golden current-position** indicator (see Figure 9.28 on page 300).

The Navigator slider lets you to set the range of packets viewable in the trace display. In other words, it sets scrolling range of the display. You can scroll the display up to the lowest packet number in the viewing range. You can scroll the display down to the highest packet number in the viewing range.

Navigator Legend

The Navigator legend lets you control the display of content in Navigator panes.

You bring up the legend through the Navigator Panes drop-down menu. Press the toolbar **Navigator Panes** button to access the menu. Select the **Legend** option to bring up the Navigator Legend dialog box.

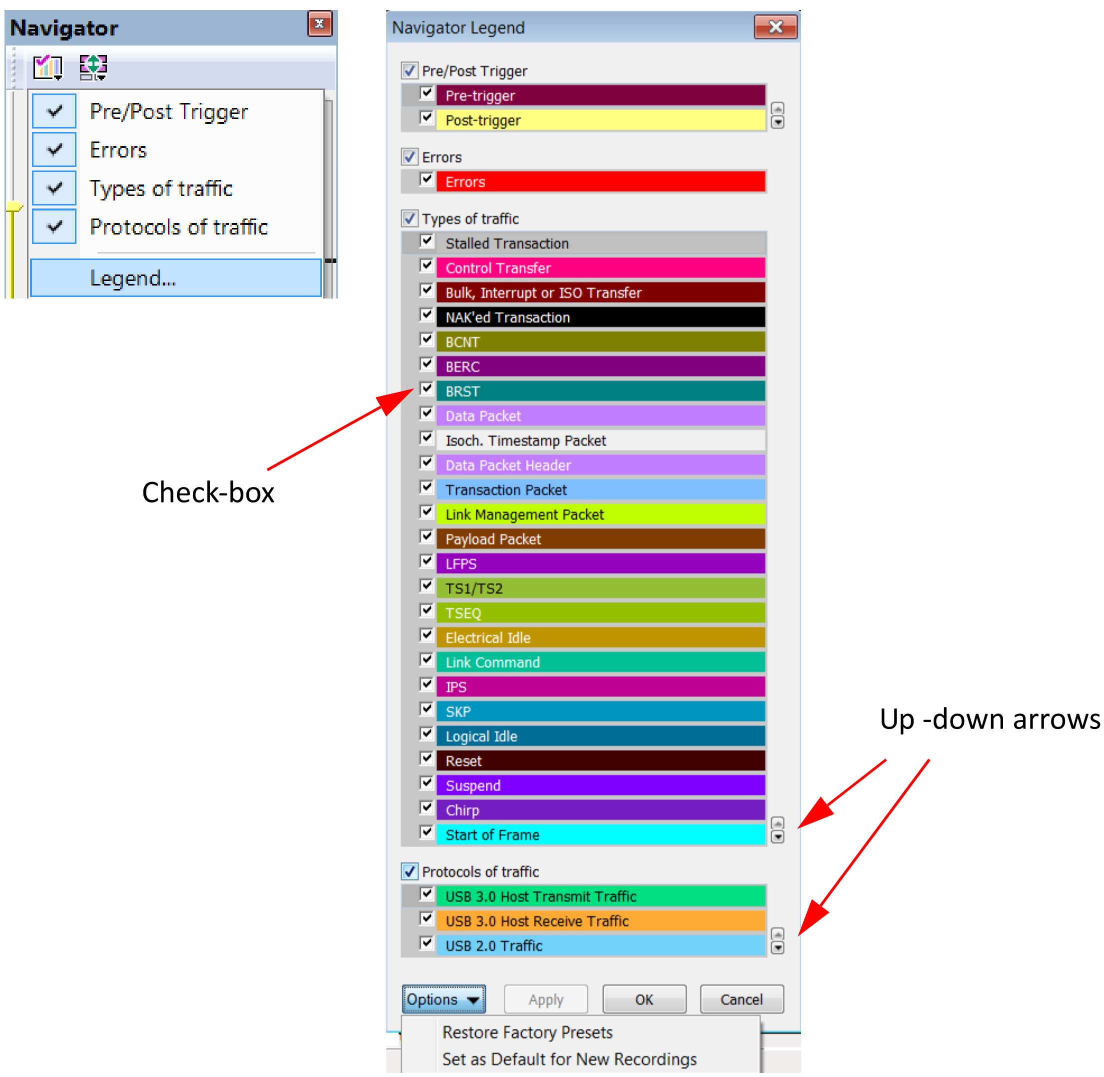


Figure 9.30: Navigator Legend Dialog

The Navigator Legend dialog box has areas corresponding to each of the panes. Each area has check boxes that allow you to hide/display information in the pane. You can set the priority of information displayed in the panes using the up and down triangles on the right.

Using the Legend to Show/Hide Navigator Panes

To use the legend to show/hide an entire pane, use the **checkbox** next to the name of each pane in the legend.

In the case of the Pre/Post Trigger and Errors areas, the action of show/hide in the legend is identical to that provided by Trace Navigator pop-up menus.

In the case of the Traffic Types pane, there is no equivalent show/hide available through the pop-up menus.

Using the Legend to Set the Priority of Information Display

You can use the legend to set the priority of information displayed in the Pre/Post Trigger Traffic Type panes. This is a two-step process.

1. For a particular item in a pane, click the **column next to the checkbox** for the item. That labels the item as currently active.
2. Next, use the **up-down** arrows at the lower-right of the area to move the item higher or lower in priority.

In the case of the Traffic Type pane, priority determines display priority of each packet type. For portions of the trace that are dominated by a particular packet type, this setting no effect: only the color corresponding to that packet type is displayed in that portion of the pane. Suppose, however, that part of the trace includes equal or near equal numbers of several types of packets. In that case, you can use the legend to select which among those types is represented in that portion of the Traffic Types pane. This allows you to view only packets of interest in crowded portions of the trace display.

9.10 Detail View

The Detail View window shows packet details.

To obtain the Detail View window, select **Report > Detail View**

or click the toolbar icon.

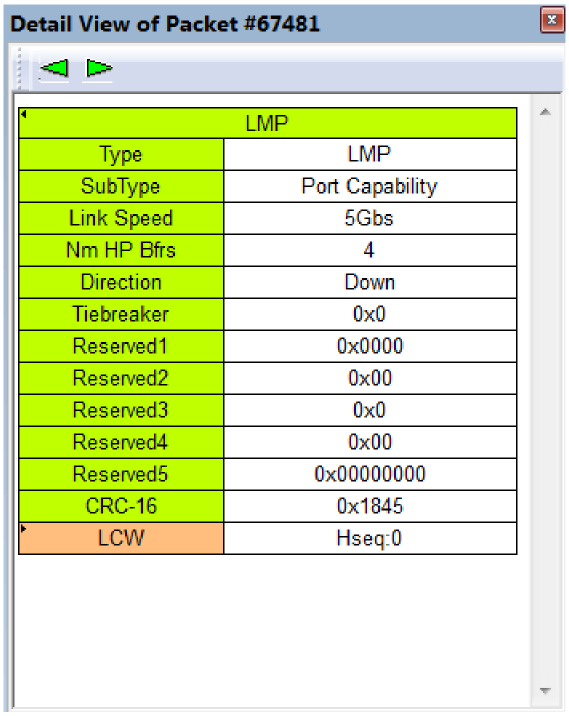


Figure 9.31: Detail View Window

The Data View toolbar buttons allow you to Go to Previous or Next.

Expanding a data field displays the Data View.

9.10.1 Detail View and Spreadsheet View

To put a Detail View header in the Spreadsheet View, drag the header to a column divider in the Spreadsheet View.

9.11 Spec View

The Spec View shows packet header information.

To obtain the Spec View, select **Report > Spec View**

or click the  Spec View toolbar icon.

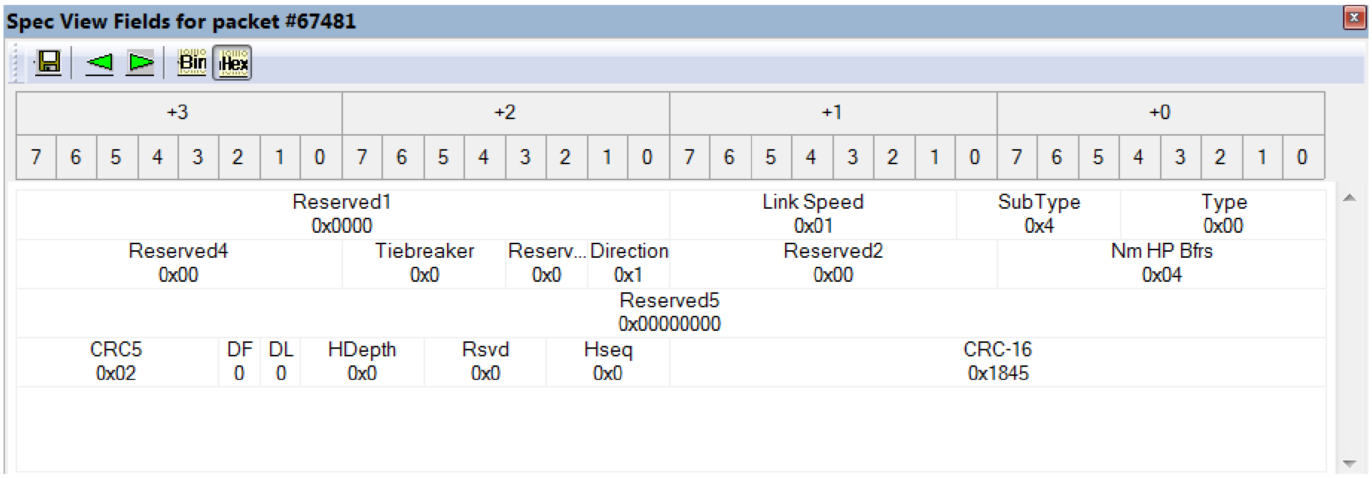
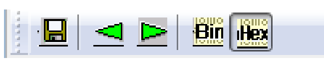


Figure 9.32: Spec View

The toolbar allows you to Save, go to Previous or Next and display Binary or Hexadecimal.



9.12 USB (3.1) Link State Timing View

The Link State Timing View graphically shows how much time the link spends in each link state.

Click  to display the USB 3.1 Link State Timing View (see Figure 9.33 on page 306).

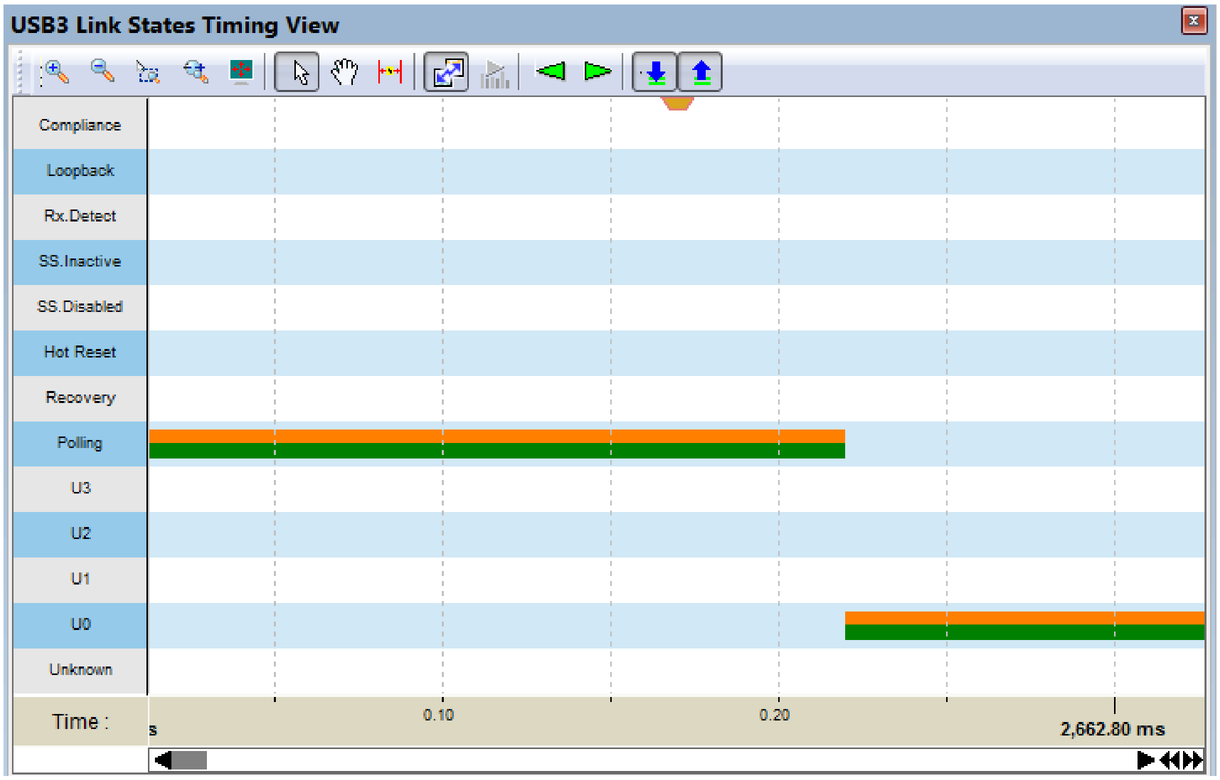
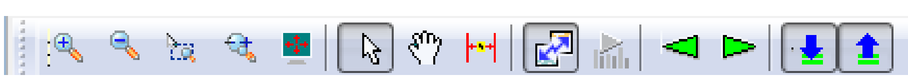


Figure 9.33: USB 3.1 Link State Timing View

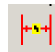
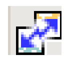
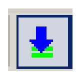
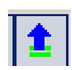
The States are Compliance, Loopback, Rx.Detect, SS.Inactive, SS.Disabled, Hot Reset, Recovery, Polling, U3, U2, U1,U0, and Unknown.

Time is displayed along the bottom in microseconds.

9.12.1 USB (3.1) Link State Timing View Toolbar



The buttons have the following functions:

	Vertical zoom in		Insert Time markers. After clicking, click in the display to make a red vertical line. Select and drag the line to indicate a time interval between two lines.
	Vertical zoom out		Sync by Time. Synchronize the USB 3.1 Link State Timing States View and the Trace View.
	Zoom by Selection		Monitor
	Zoom by Horizontal Drag		Go to previous link state
	Full Screen		Go to next link state
	Pointer Mode		Show Downstream port link states.
	Hand Panning		Show Upstream port link states.

9.12.2 USB (3.1) LTSSM View

The LTSSM View displays the LTSSM diagram depicted in the USB 3.1 specification.

Click  to display the USB 3.1 LTSSM View.

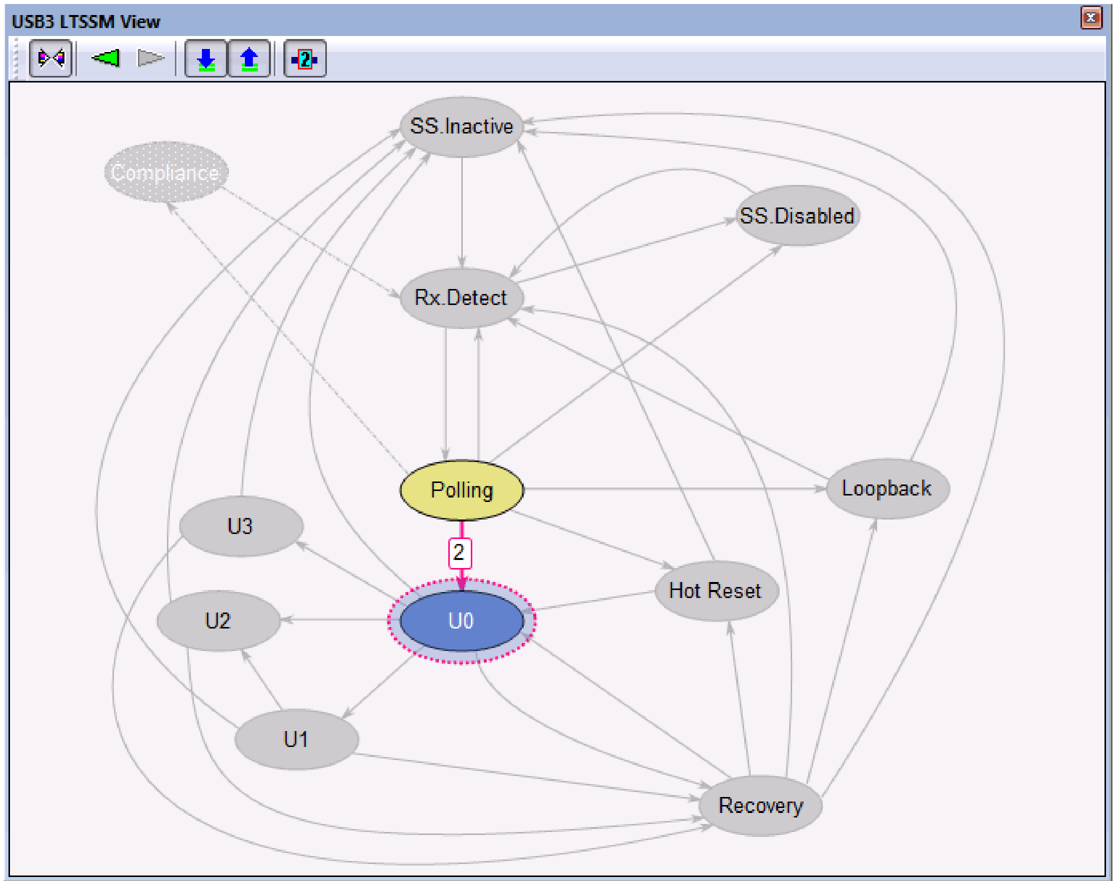
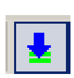


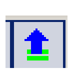
Figure 9.34: USB 3.1 LTSSM View

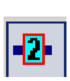
Click  to synchronize the LTSSM View and Trace View.

Click the left arrow  to go to previous link state.

Click the right arrow  to go to next link state.

Click the down arrow  to show Downstream port link states.

Click the up arrow  to show Upstream port link states.

Click  to show number of transitions.

Note: To enable LTSSM buttons, open the **Display Options** dialog. In the General tab, check the **Process USB 3.1 LTSSM** checkbox. Click **Save As Default**. Reopen the trace file.

9.13 Power Tracker

Note: Power Capture can only be enabled on licensed versions of Voyager M3i, M3x, M310, and M310C.

The Power Tracker displays the power, voltage, and current at each time.

Select **Report > Power Tracker**, or click  to display the Power Tracker. See Figure 9.35.

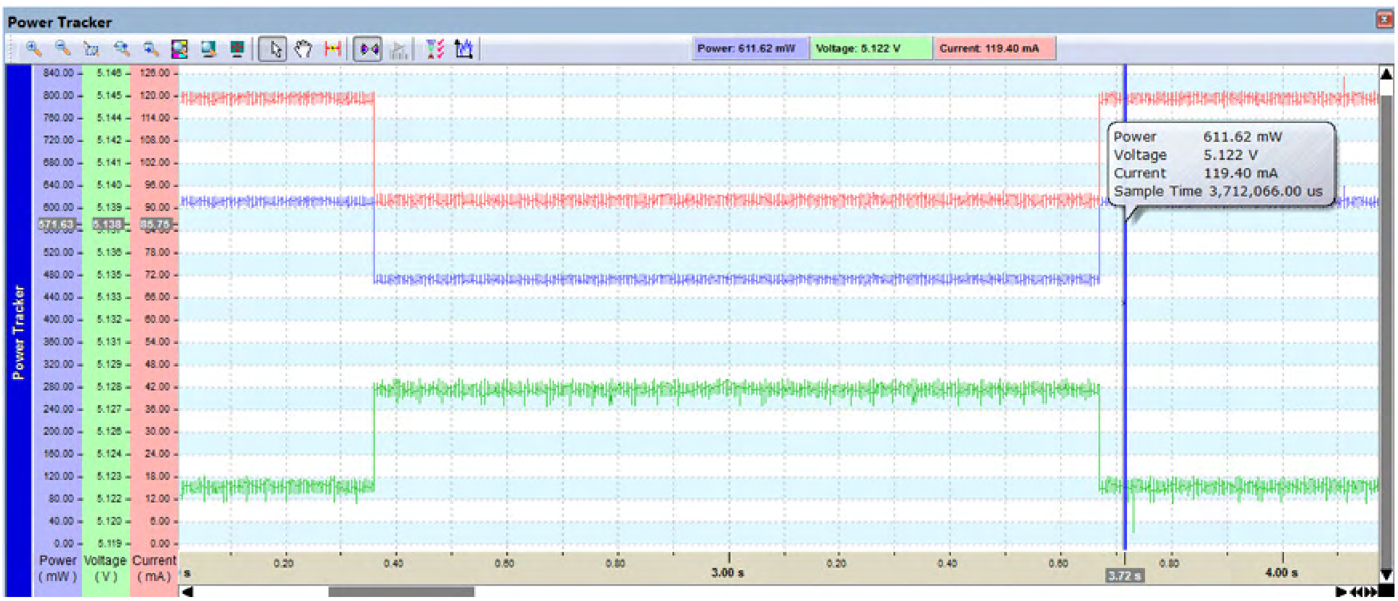


Figure 9.35: Power Tracker

9.13.1 Right Click Pop Up Menu

If you right click withing the display, the following window will pop up: See Figure 9.36.

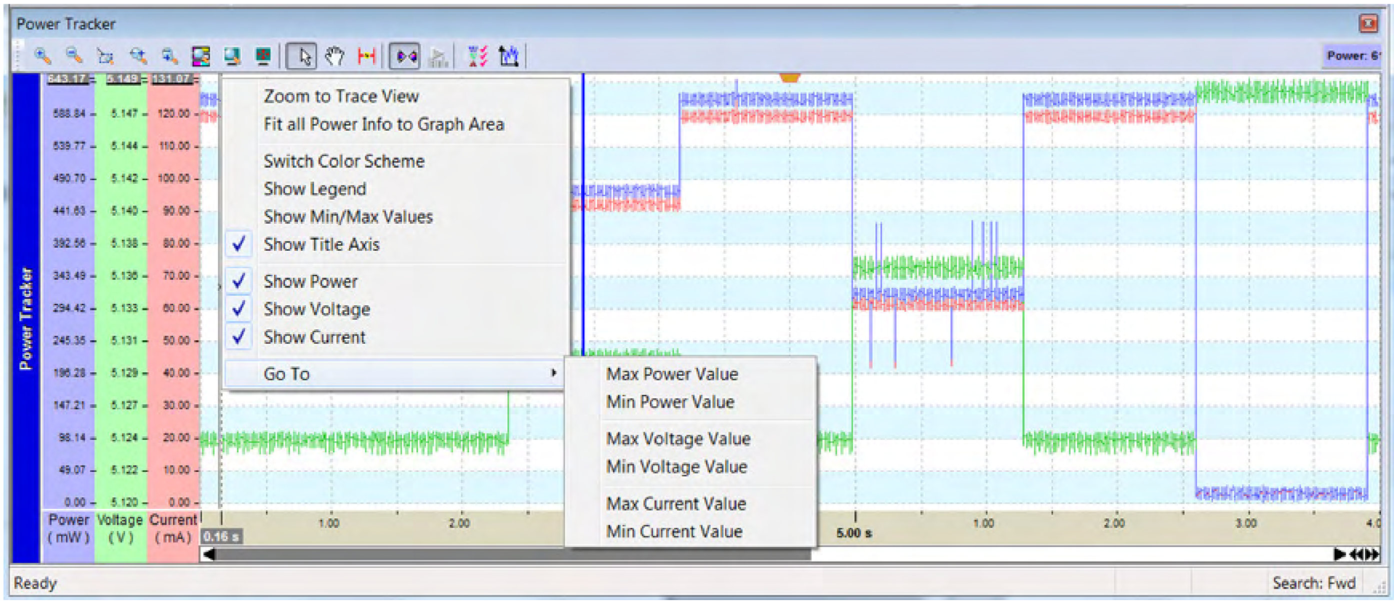


Figure 9.36: Right Click in Display Menus

Many of the features in the popup menu not available as separate buttons, except:

- Zoom to Trace View and Fit all
- Power Info to Graph Area

If you select Switch Color Scheme the Power, Voltage and Current background colors will change to black/blue/red. See Figure 9.37

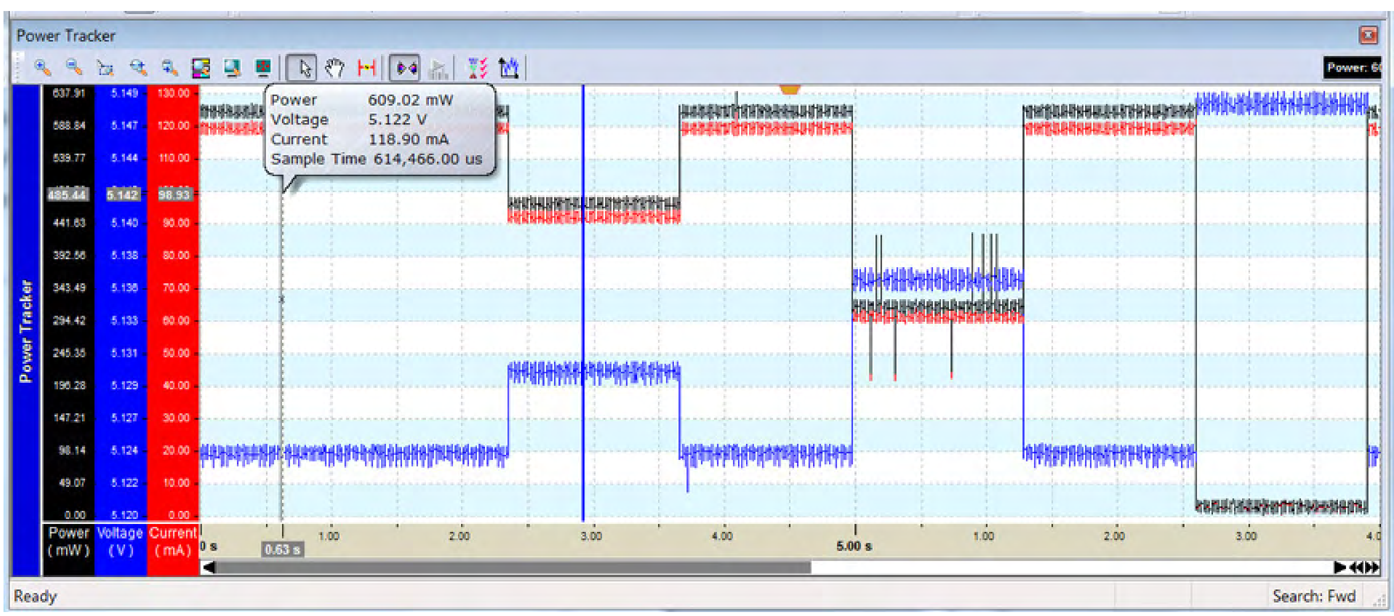


Figure 9.37: Update Color Scheme of Legend

If you select Show Legend and Show Min/Max Values, they will show up in the display. See Figure 9.38 on page 311.

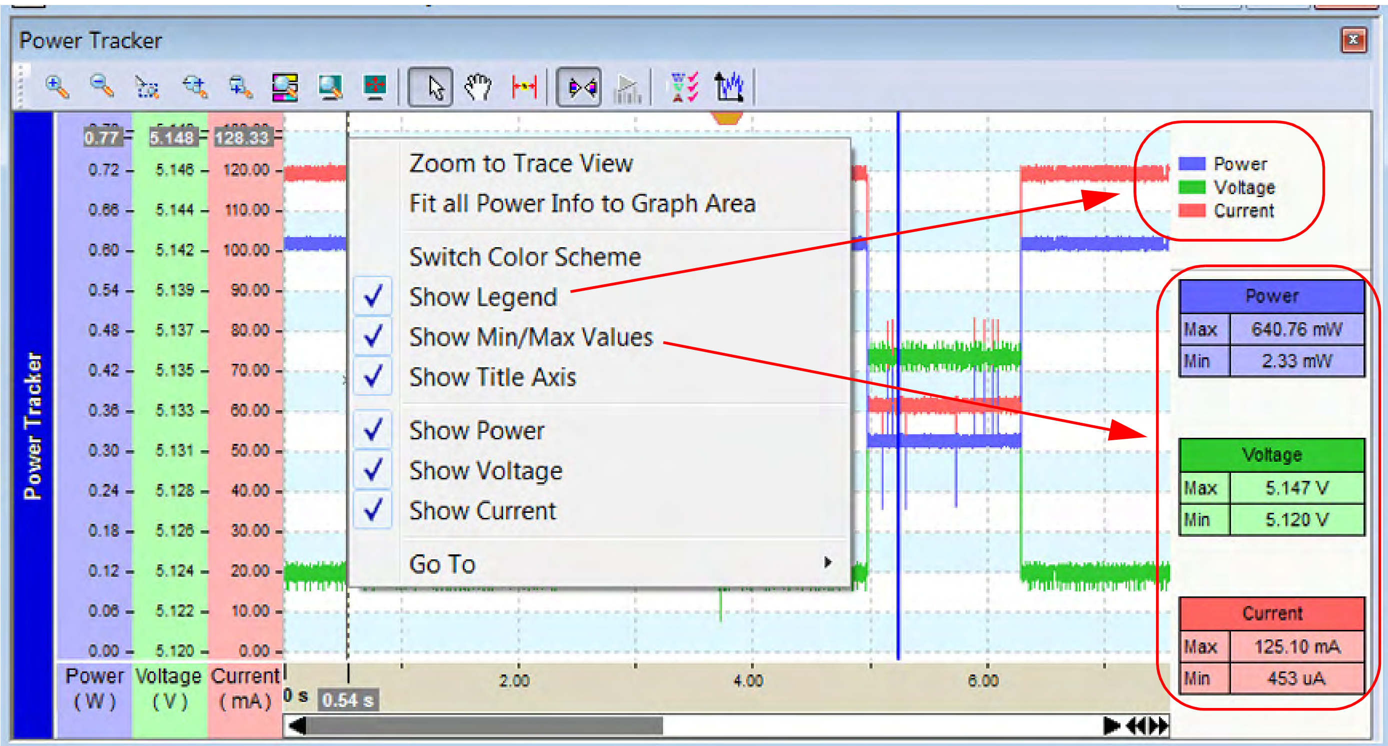


Figure 9.38: Show Legend, Show Min/Max Values

9.13.2 Power Tracker Options

If you select Power Tracker from the Report menu, you can select Hide, Full Screen, Sync by Time, or Real Time Monitor (see "Power Tracker Toolbar" on page 312).

The left side shows power, voltage, and current levels. Right-clicking a column allows you to select the vertical-scale origin. The origin is 0 or near the minimum measurement value.

The horizontal axis shows time in milliseconds. You can navigate with the slider. The slider sets the left vertical line. The distance to the right dashed vertical line represents the sampling interval.

You can use time markers to measure times in this view. To delete markers, right-click the marker and select **Delete Marker(s)**.

You can show/hide minimum and maximum values for Power, Voltage, and Current by right-clicking and choosing **Show Min/Max Values** from the popup menu.

Note: The Min or Max values presented here are not exactly the same as those shown in the CATC or Spreadsheet views. This is because this view presents the values as they exist when sampled at 20 microsecond intervals. The values shown in the Packet type views are linearly interpolated from these samples to show the approximate value at the time the packet is timestamped.

You can go to the time at which Minimum or Maximum values of Power, Voltage, or Current occur by right-clicking and choosing **Go To** from the popup menu and then choosing a submenu item.

The Power Tracker samples are acquired from the start of the recording to the finish. Since packet traffic or other "Bus Condition" events can start long after the recording starts or finish long before the recording ends, many power samples in these end ranges can "map" to the first packet or last packet in a trace. For all events, when synchronizing between the Power Tracker view and other views, the items associated in the other views are the ones closest in time to the timestamp of the Power Tracker sample.

Note: Power measurement accuracy for Current is +/- 10 mA.
Power measurement accuracy for Voltage is +/- 50 mV.
Power measurement accuracy for Power is +/- 50 mW.

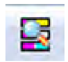
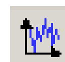
The sampling period of the current and voltage is once every 20 microseconds, or 50 KHz.

9.13.3 Power Tracker Toolbar

Figure 9.39: Power Tracker Toolbar

The buttons have the following functions:

	Zoom in (see Figure 9.40 on page 313).		Pointer Mode (see Figure 9.48 on page 317).
	Zoom out (see Figure 9.41 on page 314).		Hand Panning (see Figure 9.49 on page 318).
	Zoom by Selection (see Figure 9.42 on page 314).		Insert Time markers. After clicking, click in the display to make a red vertical line. Select and drag the line to indicate a time interval between two lines. (see Figure 9.50 on page 318).
	Zoom by Horizontal Drag (see Figure 9.43 on page 315).		Sync by Time. Synchronize the USB 3.1 Link State Timing States View and the Trace View, see Figure 9.51 on page 319).
	Zoom by Vertical Drag (see Figure 9.44 on page 315).		Monitor during capture (Power Tracker Data Displayed in Real Time).

	Zoom to Visible part of Trace (Power Tracker Info close to Packet of interest, see Figure 9.45 on page 316).		Show/Hide Power Tracker Types: Power, Voltage, and/or Current (see Figure 9.52 on page 319).
	Fit All Power Info to Graph Area (Power Info for Entire Trace Visible, see Figure 9.46 on page 316).		Change Power Tracker graph type: Bar, Line, and/or Point (see Figure 9.53 on page 320).
	Full Screen (see Figure 9.47 on page 317).		

The effects of the ToolBar Buttons are shown below:

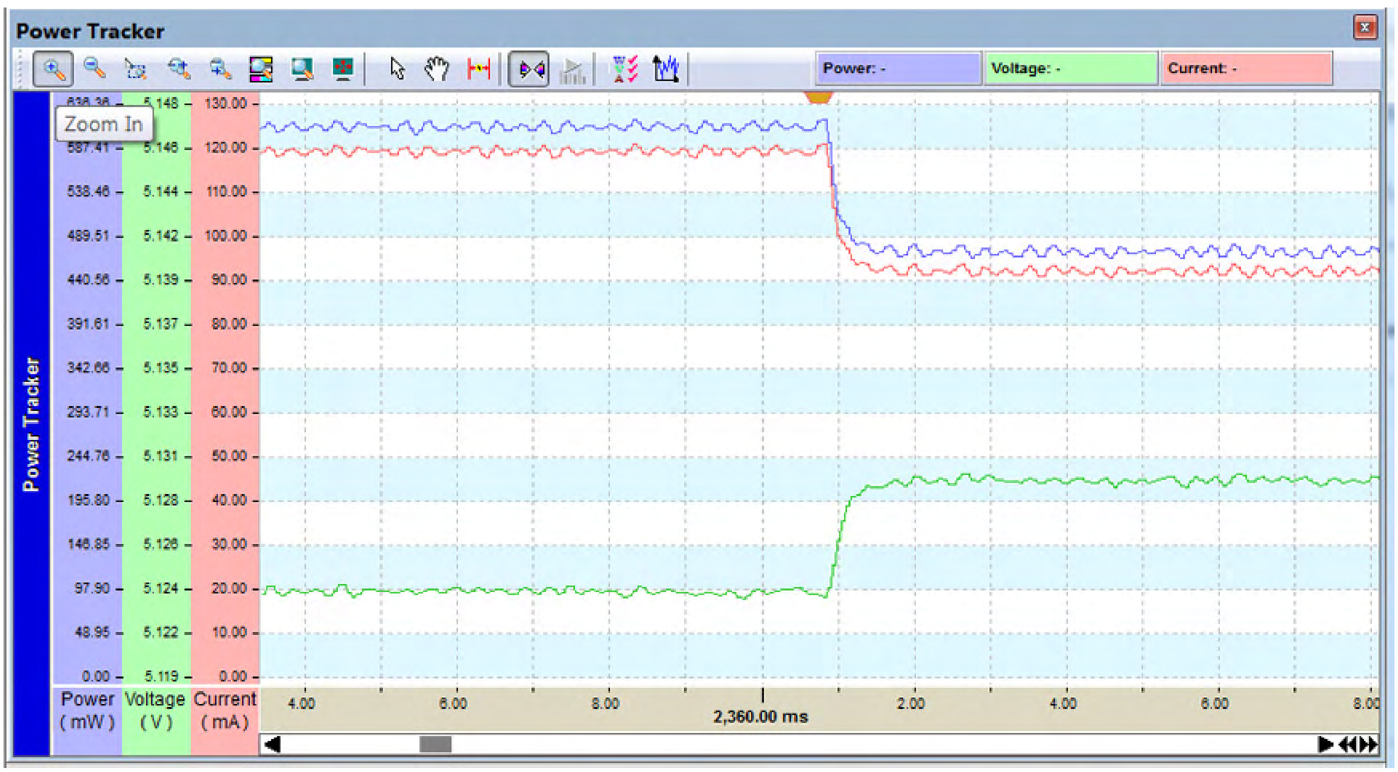


Figure 9.40: Power Tracker ToolBar Button: Zoom In

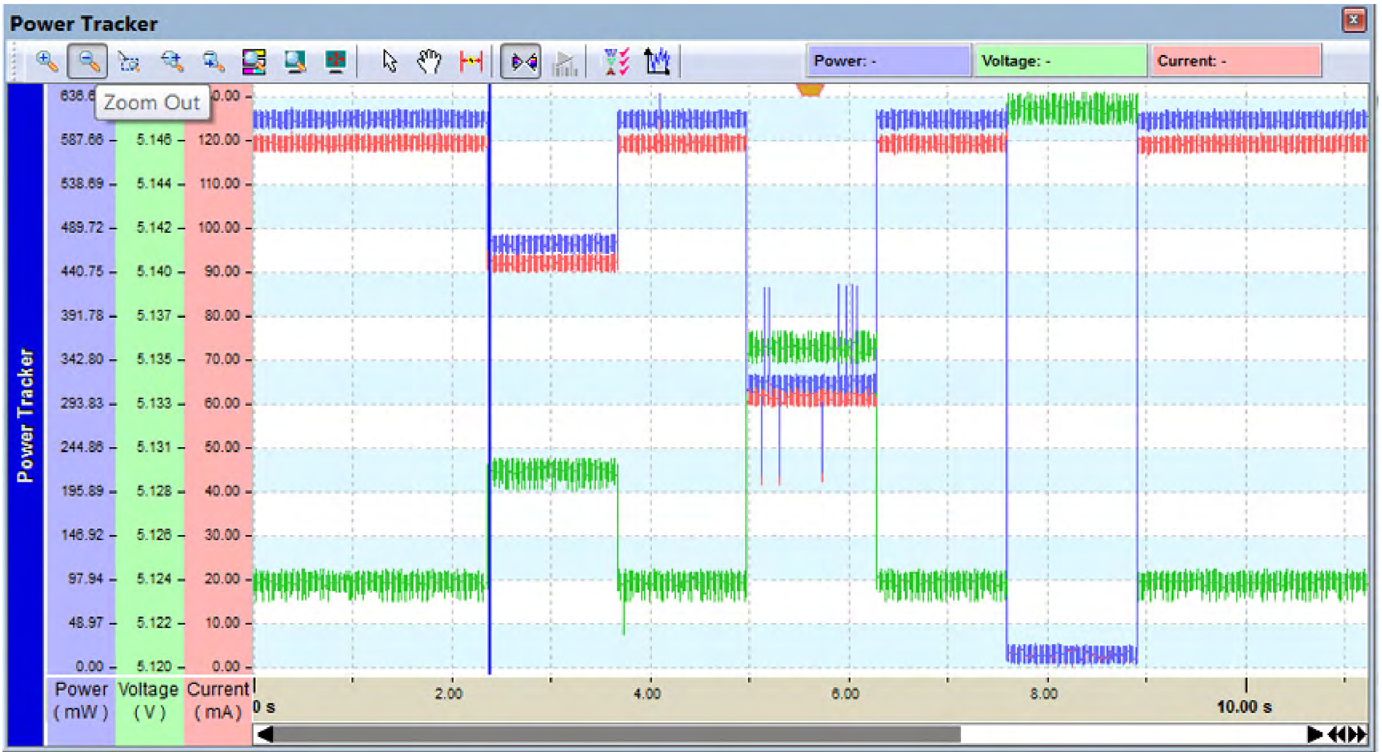


Figure 9.41: Power Tracker ToolBar Button: Zoom Out

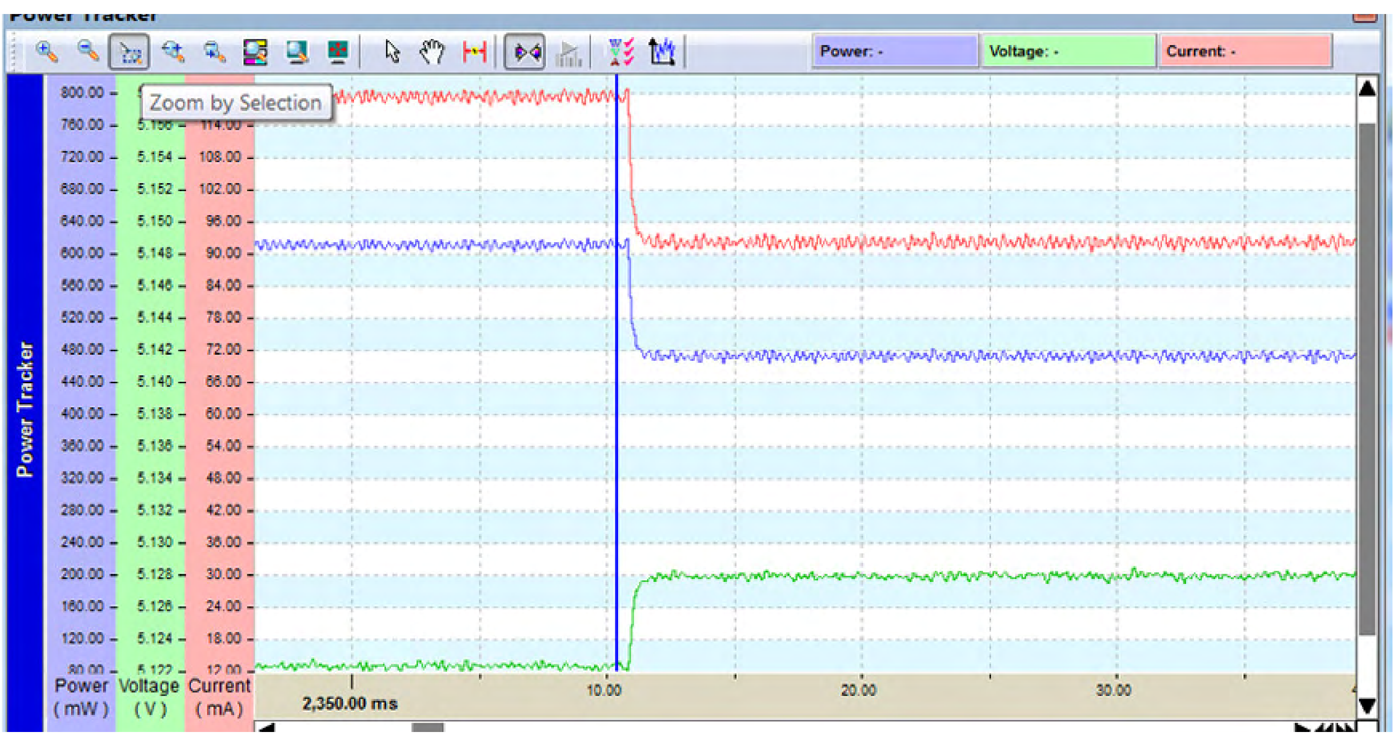


Figure 9.42: Power Tracker ToolBar Button: Zoom By Selection

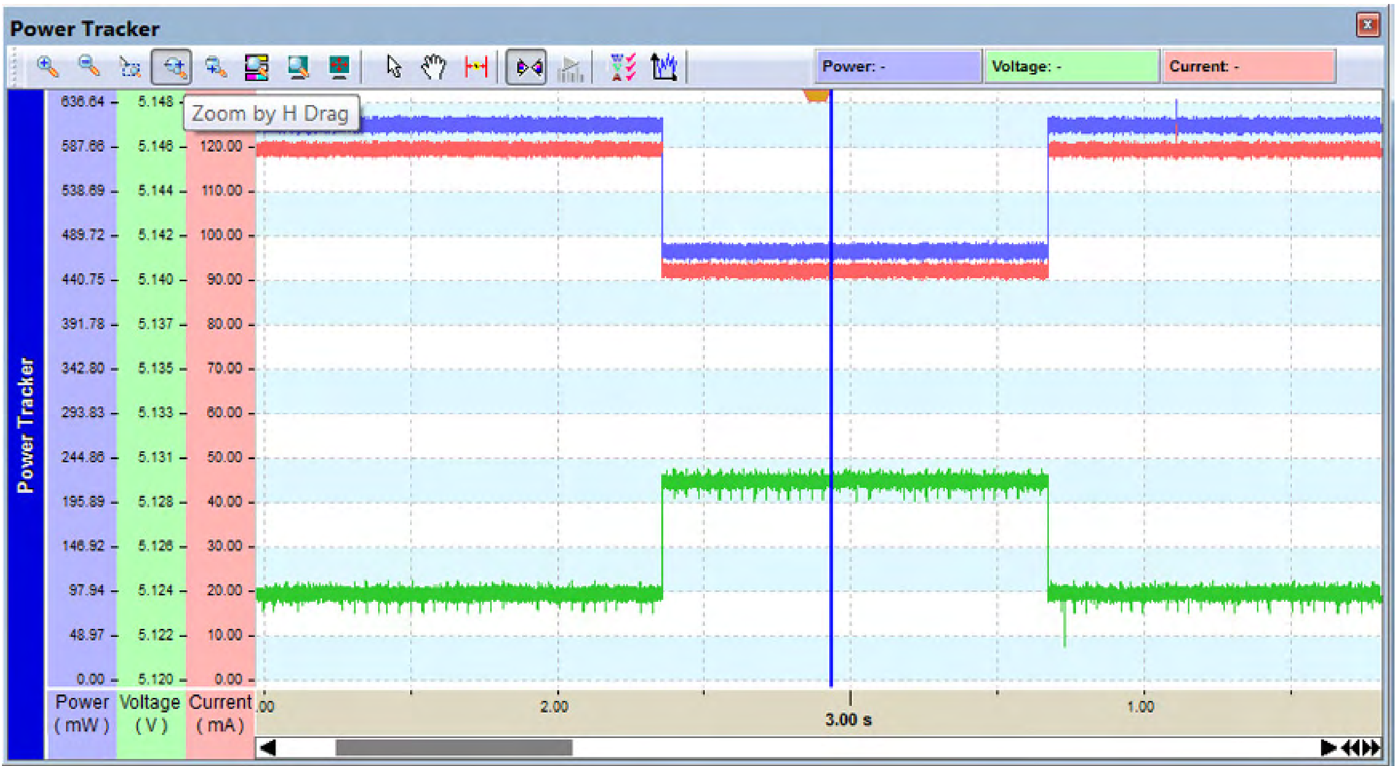


Figure 9.43: Power Tracker ToolBar Button: Zoom by Horizontal Drag

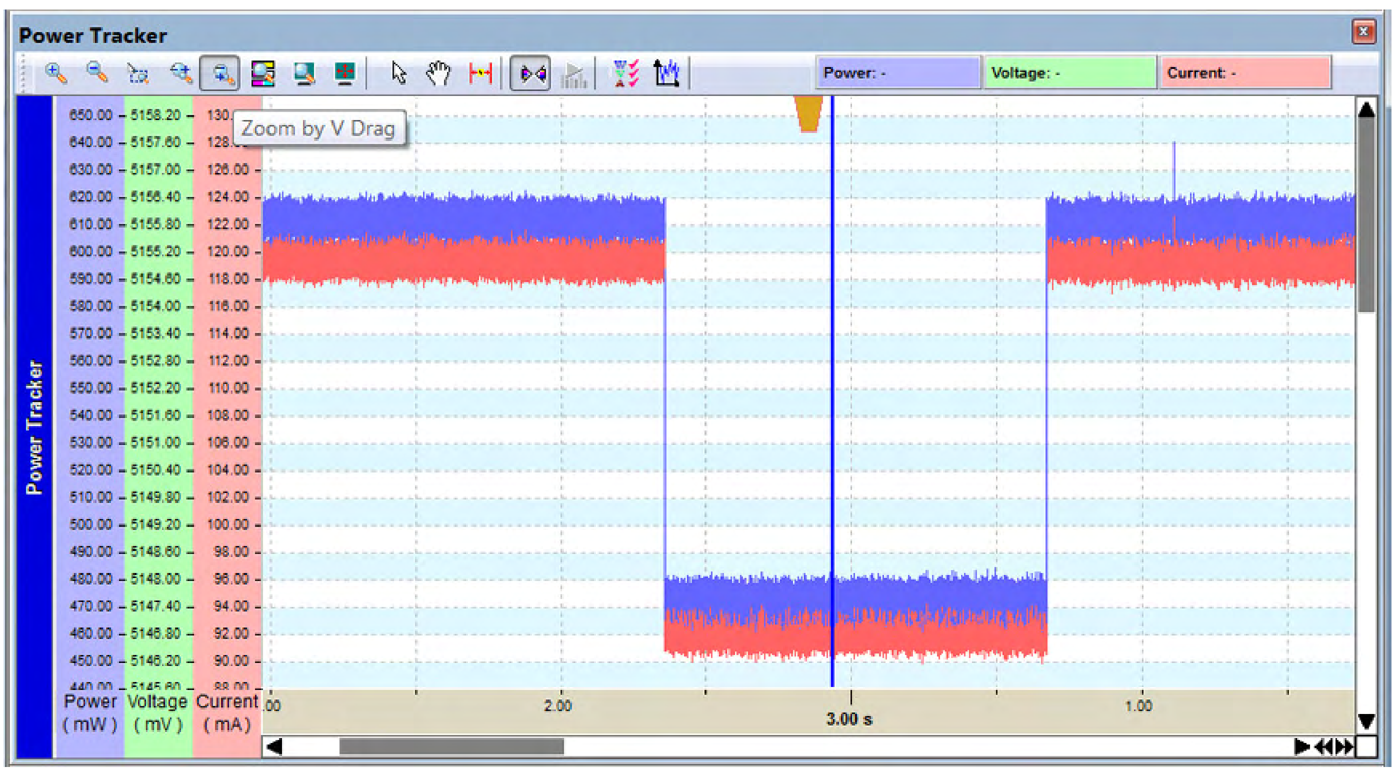


Figure 9.44: Power Tracker ToolBar Button: Zoom by Vertical Drag

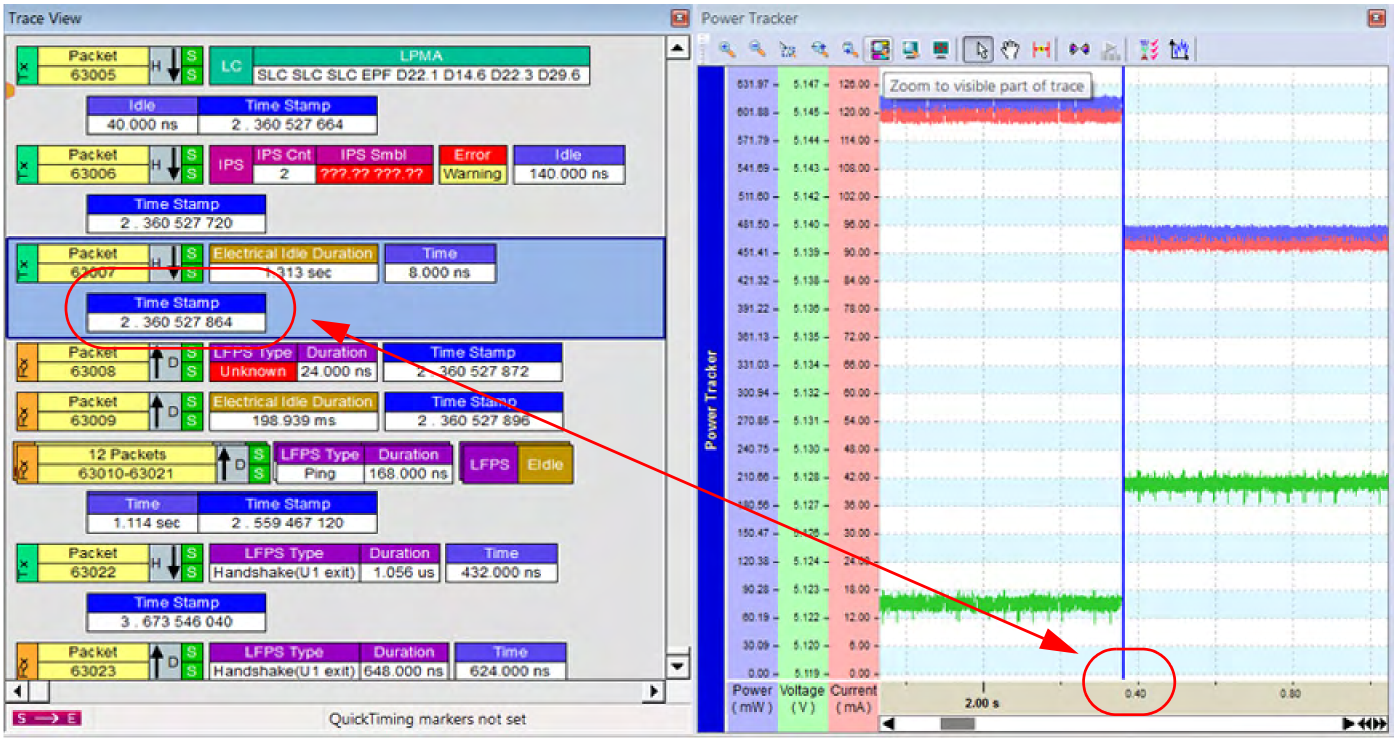


Figure 9.45: Power Tracker ToolBar Button: Zoom to Visible Part of Trace

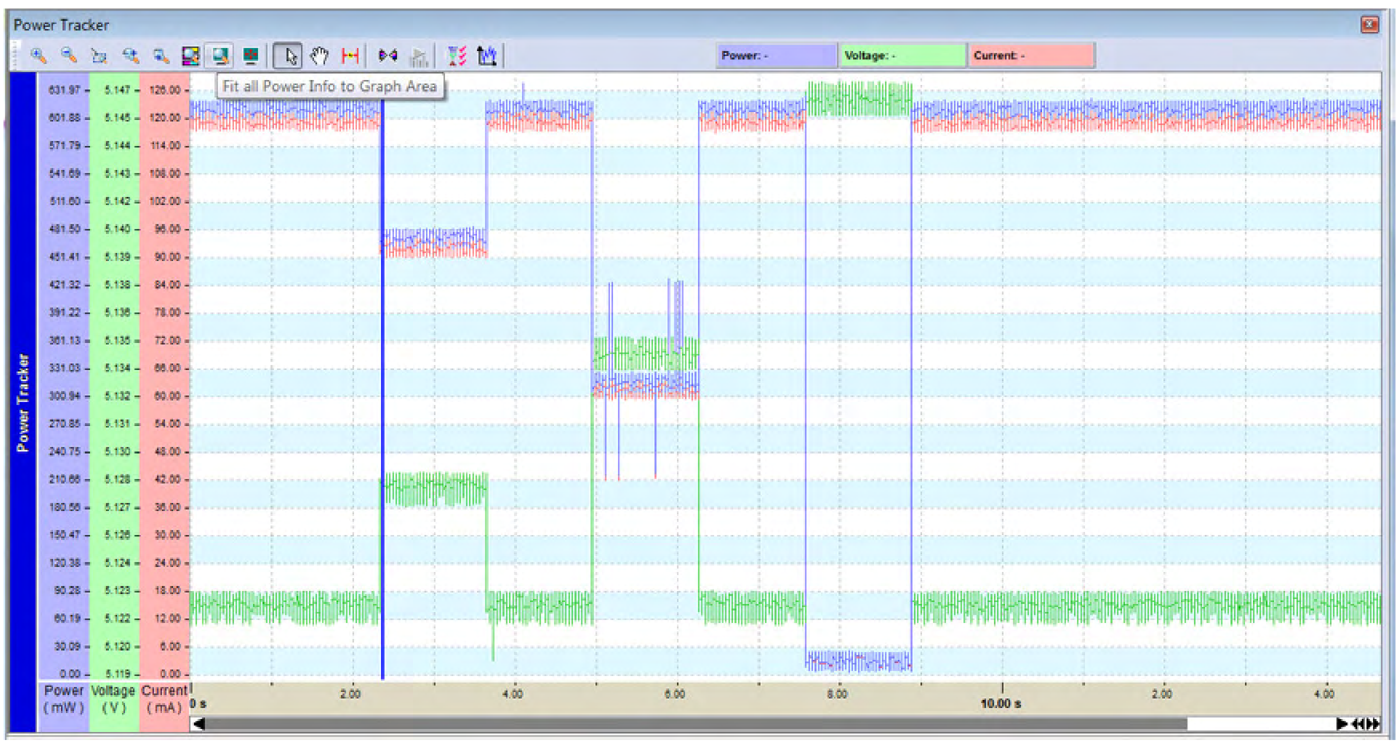


Figure 9.46: Power Tracker ToolBar Button: Fit All Power Info to Graph Area

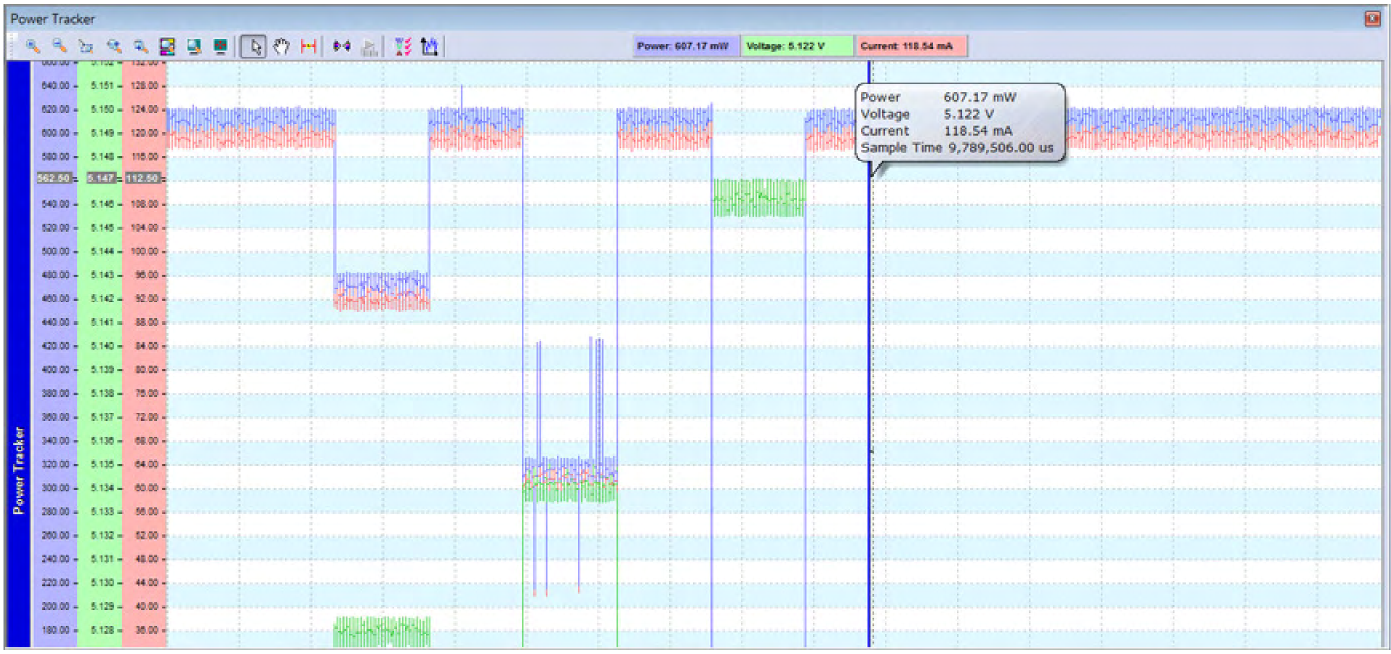


Figure 9.47: Power Tracker ToolBar Button: Full Screen

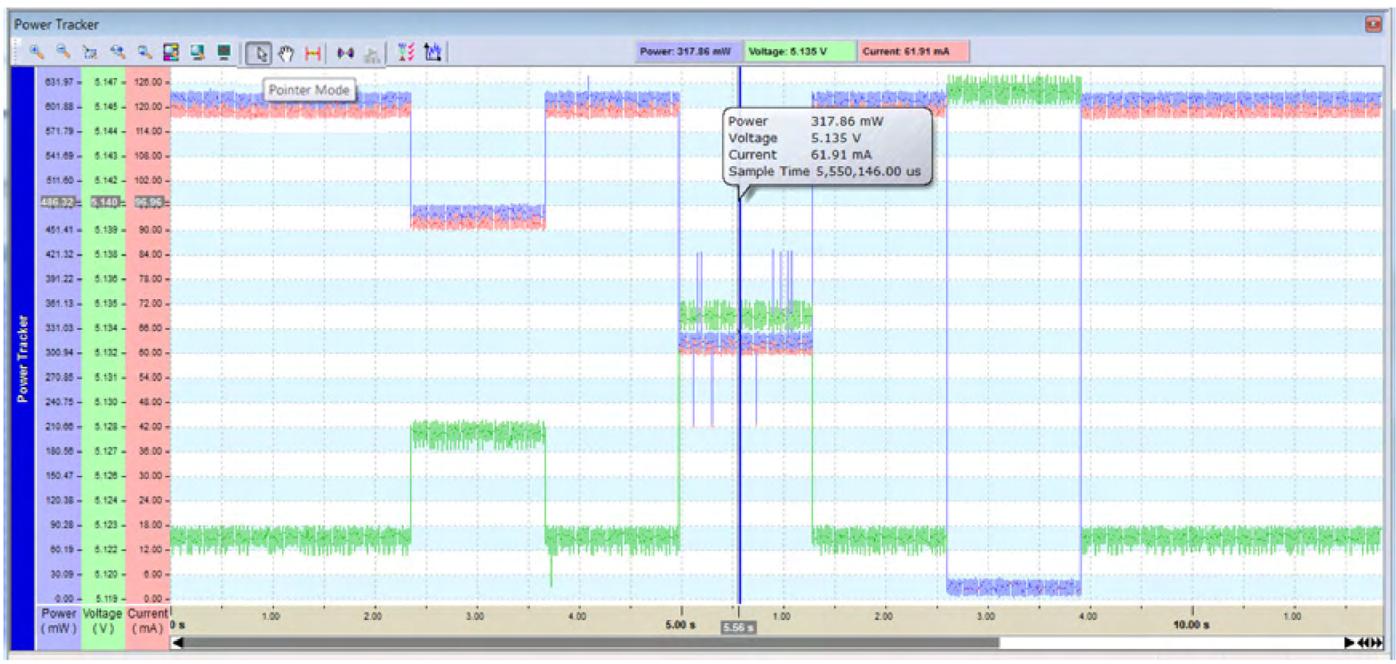


Figure 9.48: Power Tracker ToolBar Button: Pointer Mode

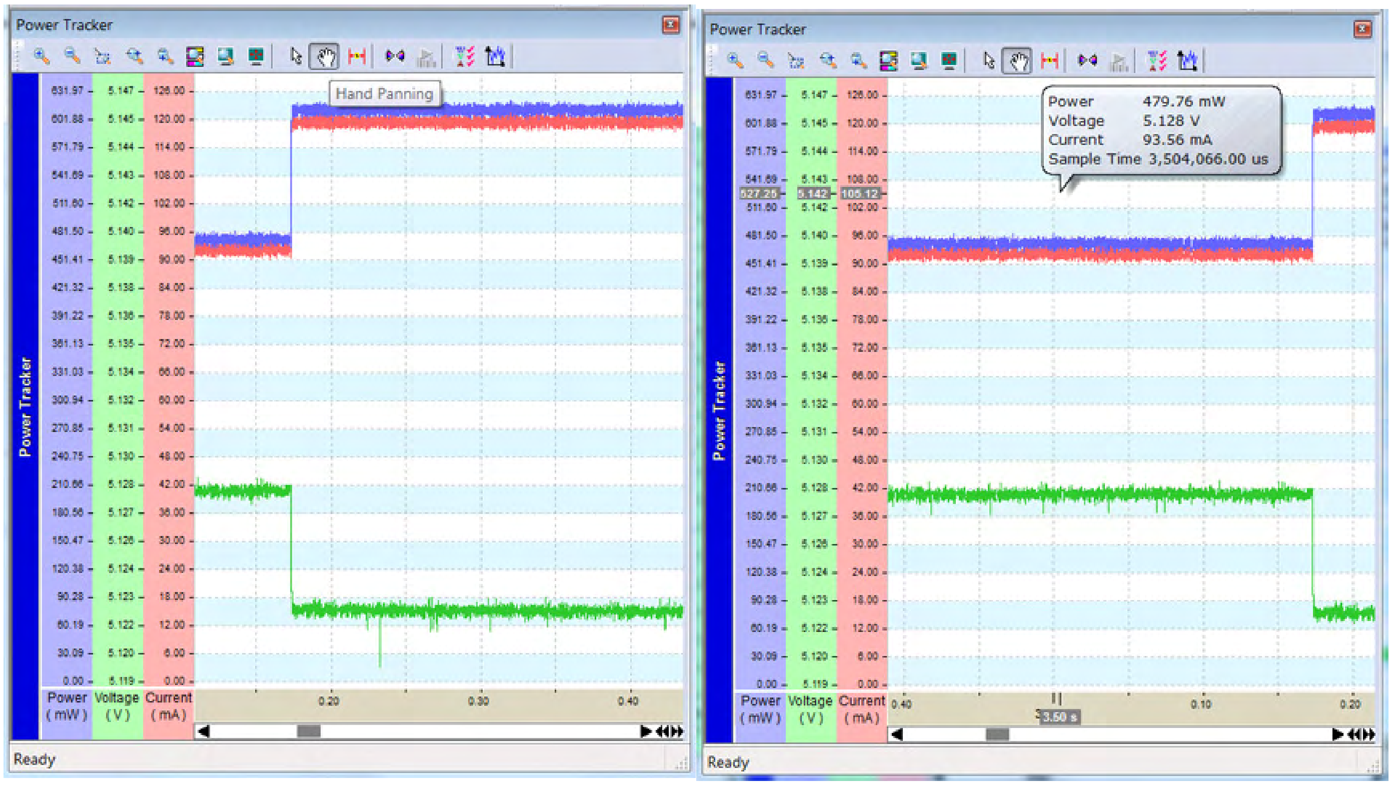


Figure 9.49: Power Tracker ToolBar Button: Hand Panning

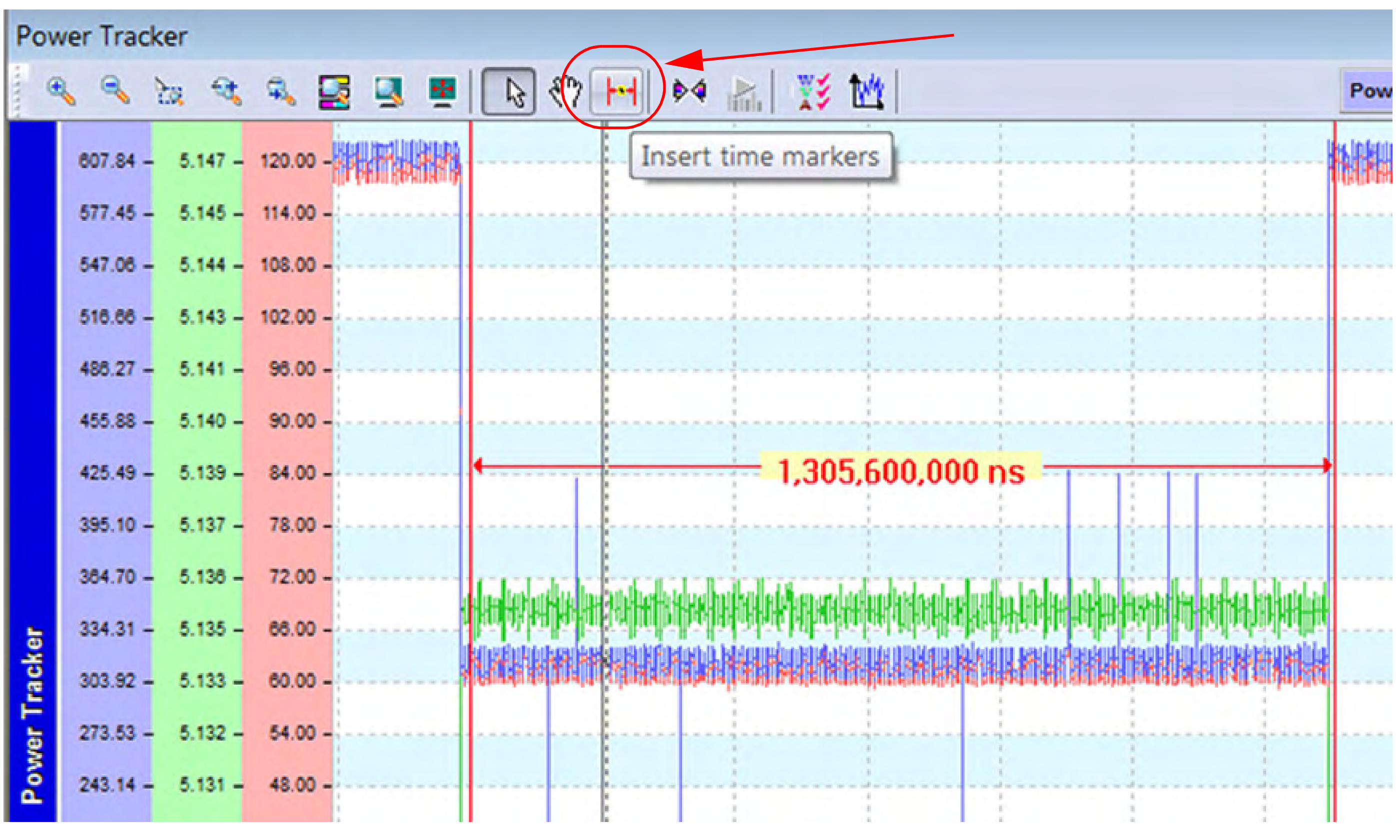


Figure 9.50: Power Tracker ToolBar Button: Insert Time Markers

Figure 9.51: Power Tracker ToolBar Button: Sync by Time

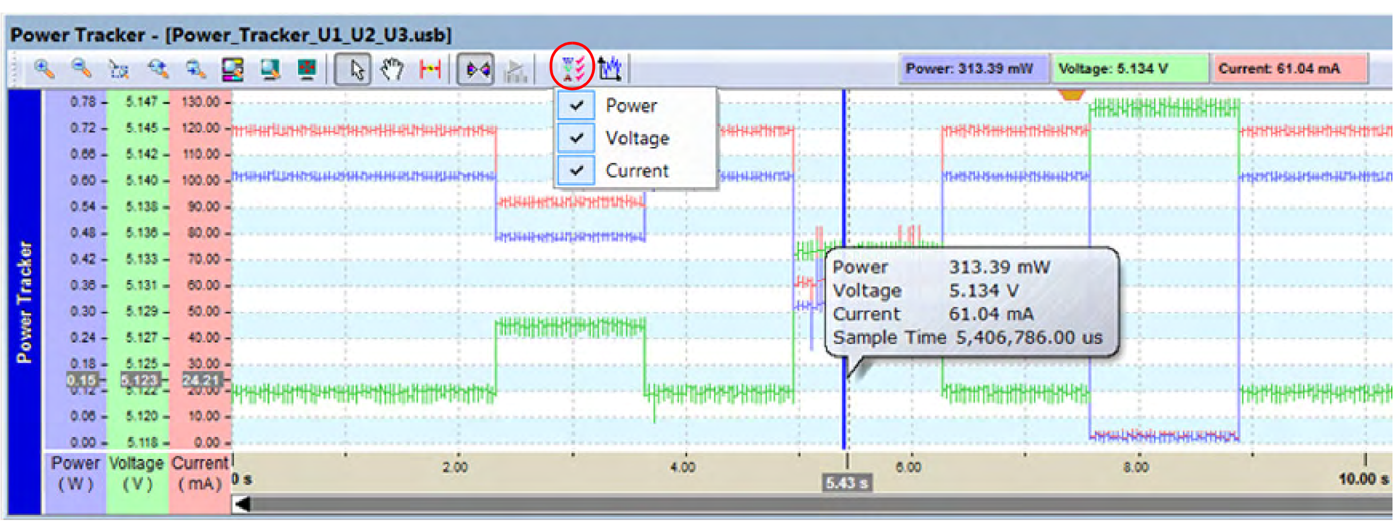


Figure 9.52: Power Tracker ToolBar Button: Show/Hide Power Tracker Types

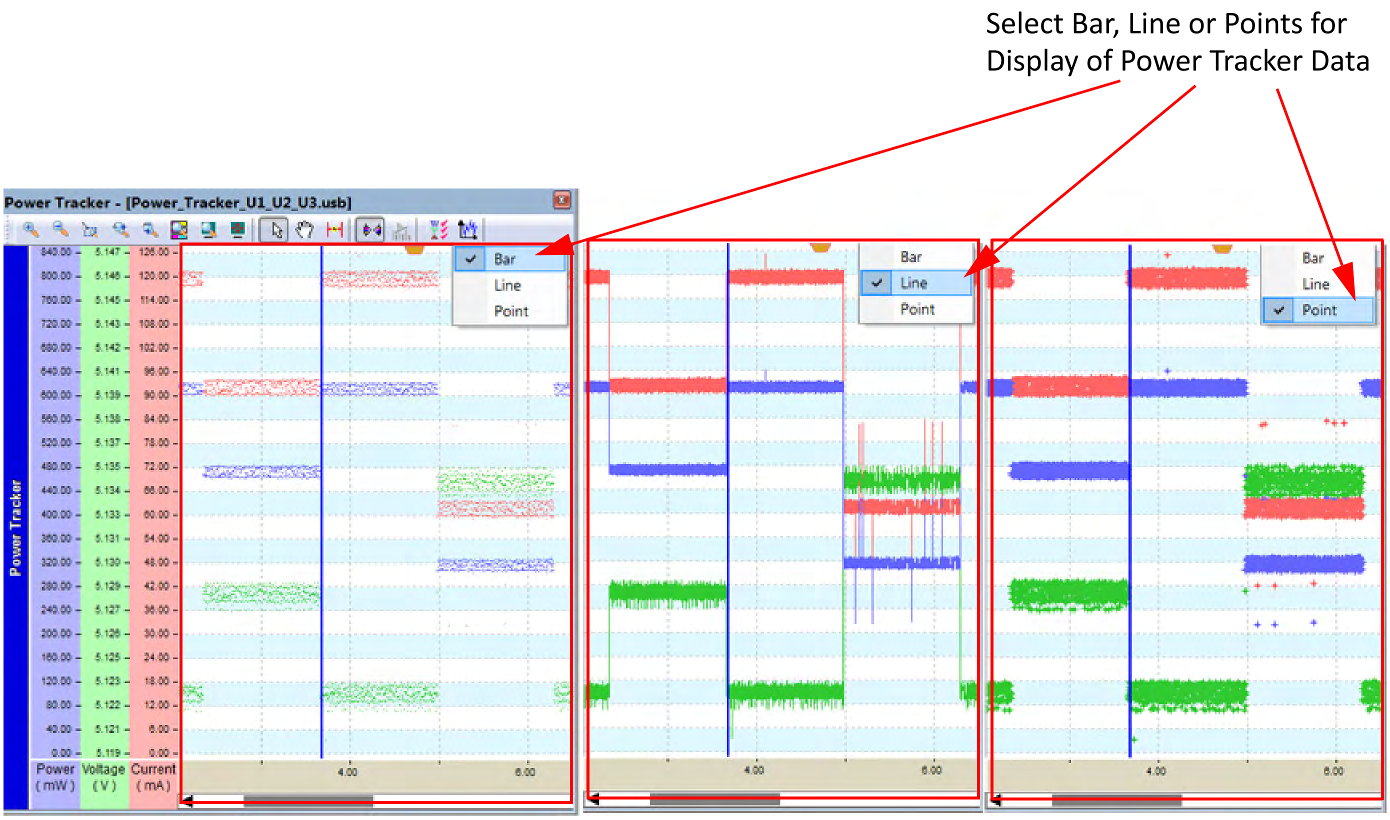


Figure 9.53: Power Tracker ToolBar Button: Change Power Tracker Graph Type

9.14 Decoded Fields view

See “Decoded Fields View” on page 265 for information.

9.15 Running Verification Scripts

You can perform custom post-process analysis of the open trace by running a verification script over the trace. A verification script instructs the application to send trace and analysis information to the script. A verification script also contains script code (written using Teledyne LeCroy Script Language) used to process trace data and output that data in different formats.

Note: You may write your own verification scripts to perform custom verification and analysis. For information on how to write a verification script, see the *Verification Script Engine Reference Manual*.

To run a verification script over a trace:

1. Select the main menu item **Report > Run verification scripts,** or press **Ctrl+Shift+U** or

   click the **Run verification scripts** button  on the main tool bar.

The Run verification scripts dialog opens (see Figure 9.54 on page 321), from which you choose, then run, one or several verification scripts:

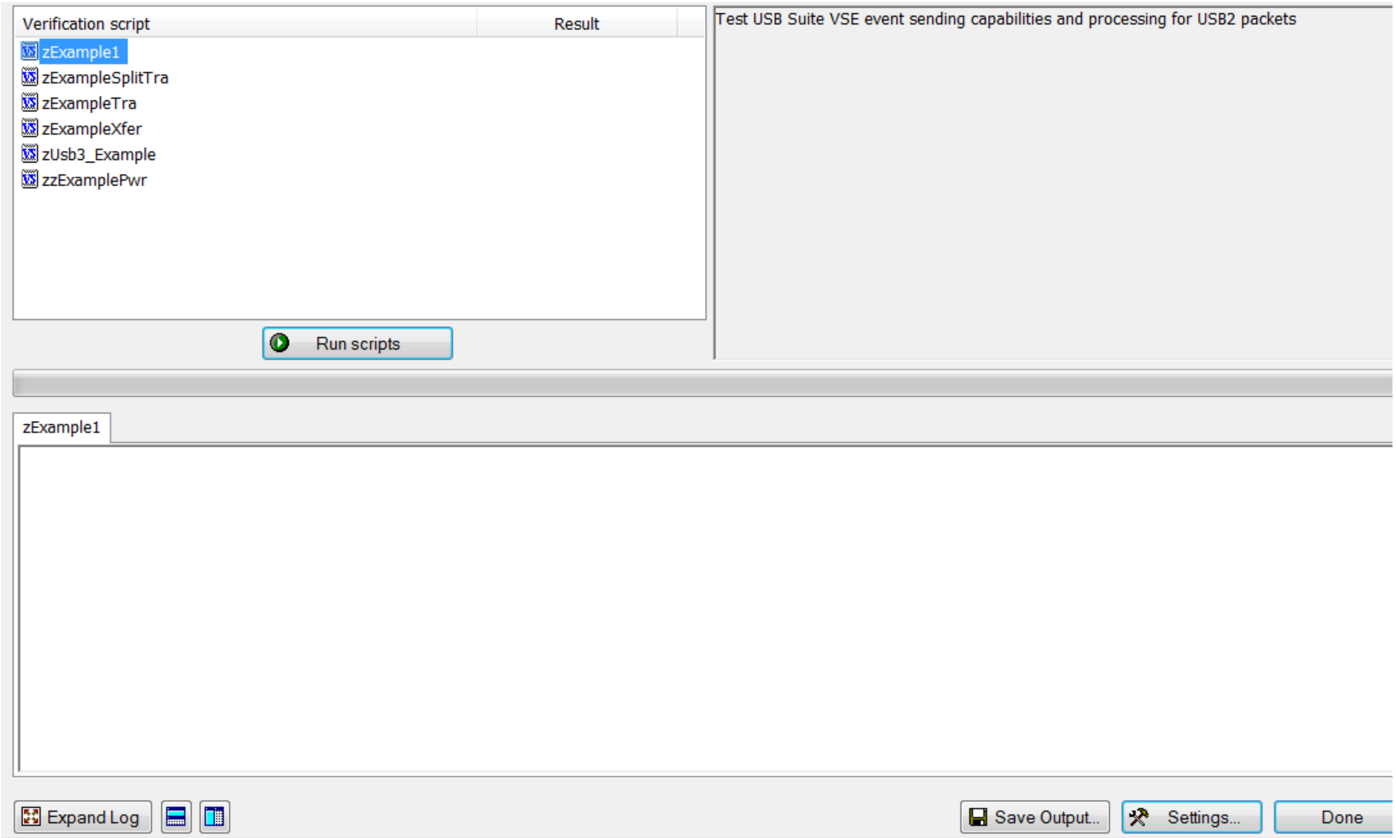
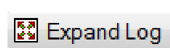
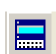
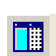


Figure 9.54: Run Verification Scripts Dialog

To expand log, click the Expand Log button .

To find a view related to the verified trace, and place the window under it, click .

To find a view related to the verified trace, and place the window to the right, click .

To save output, click the **Save Output** button.

2. Press the button **Run scripts** after you select scripts to run. VSE starts running the selected verification scripts, shows script report information in the output windows, and presents the results of verifications in the script list (see Figure 9.55 on page 322).

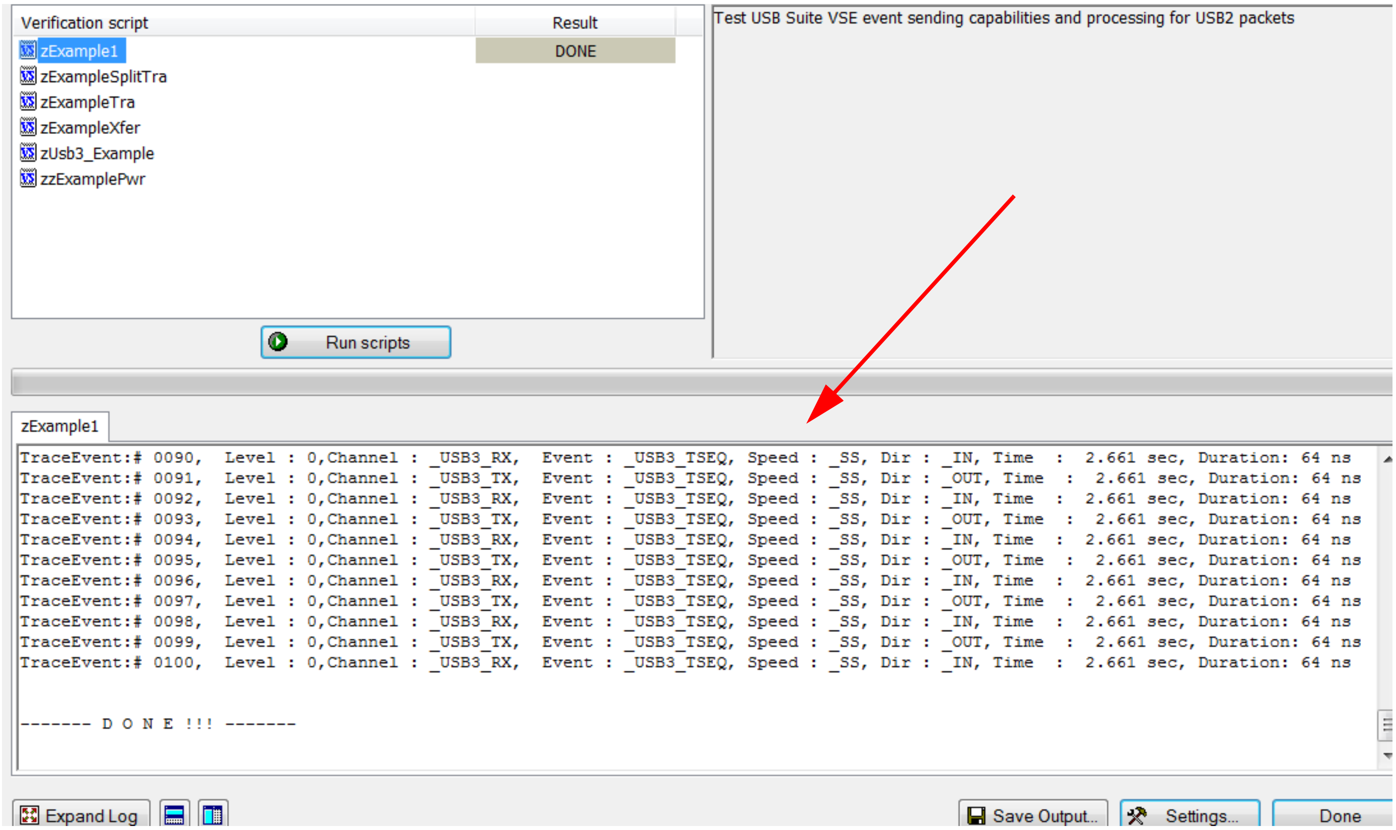


Figure 9.55: Verification Script Results

3. Right-clicking in the script list displays some additional operations over selected scripts.

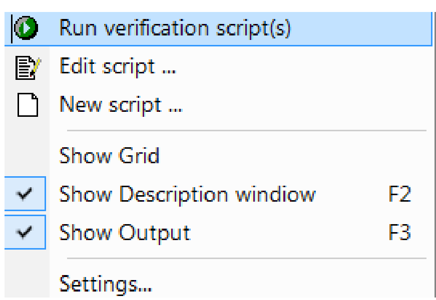


Figure 9.56: Right-click Options

Run verification script(s): Start running selected script(s).

Edit script: Edit selected scripts in the editor application specified in Editor settings.

New script: Create a new script file using the template specified in Editor settings.

Show Grid: Show/hide a grid in the verification script list.

Show Description window: Show/hide the script description window (**Shortcut key F2**).

Show Output: Show/hide the script output windows (**Shortcut key F3**).

Settings: Open a special Setting dialog to specify different settings for VSE.

4. After choosing **Settings** from the drop-down list or the button, the Settings dialog appears (see Figure 9.57 on page 323.)

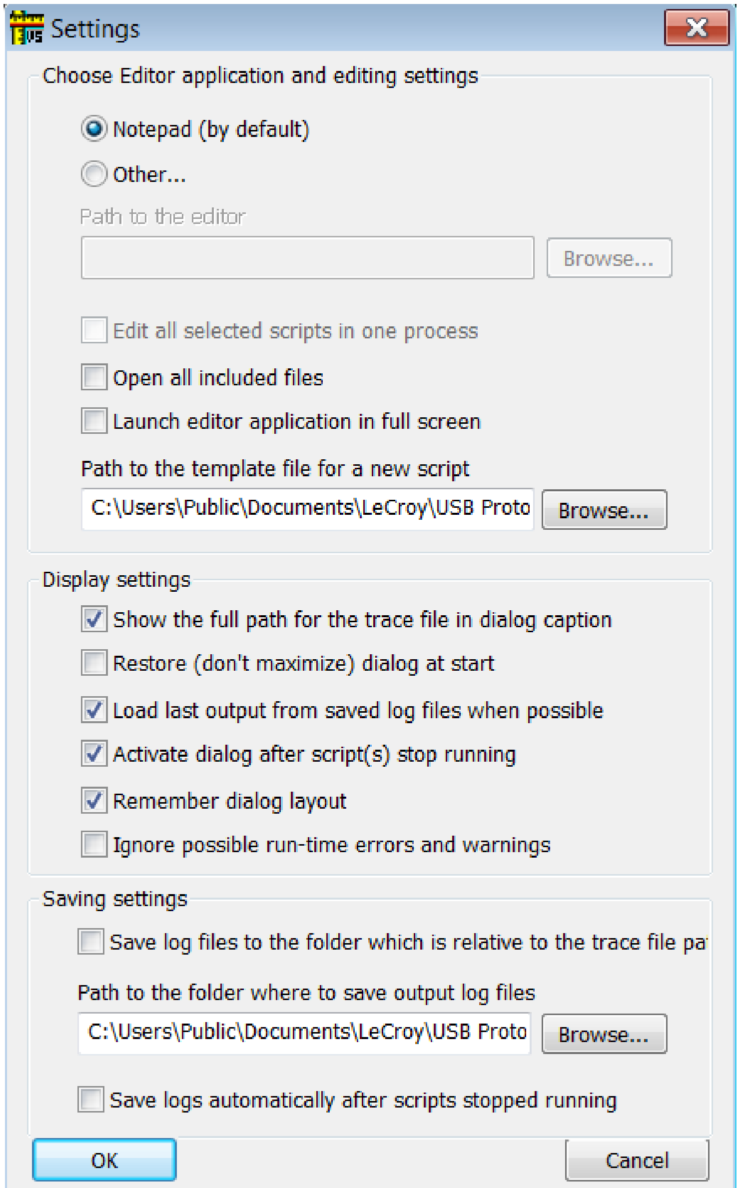


Figure 9.57: Settings Dialog

You can **Choose the editor application**: Notepad or other.

Path to the editor: If you choose other above, then this enabled for choosing a path to the editor.

Edit all selected scripts in one process: If the editor supports multiple documents, you can edit all scripts in the editor.

Open all included files: You can edit included files, as well as the main script.

Launch editor application in full screen: You can use whole screen.

Path to template file for a new script: You can use a template for the script.

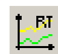
Display Settings can show full trace-file path, restore dialog at start, load last output from save log files, activate dialog after scripts have run, remember dialog layout, and ignore errors and warnings.

Saving Settings can save log files to relative file folder, indicate output log file path, and save logs automatically.

9.16 Real Time Monitoring

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

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

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

The display is similar to Figure 9.58 on page 324.

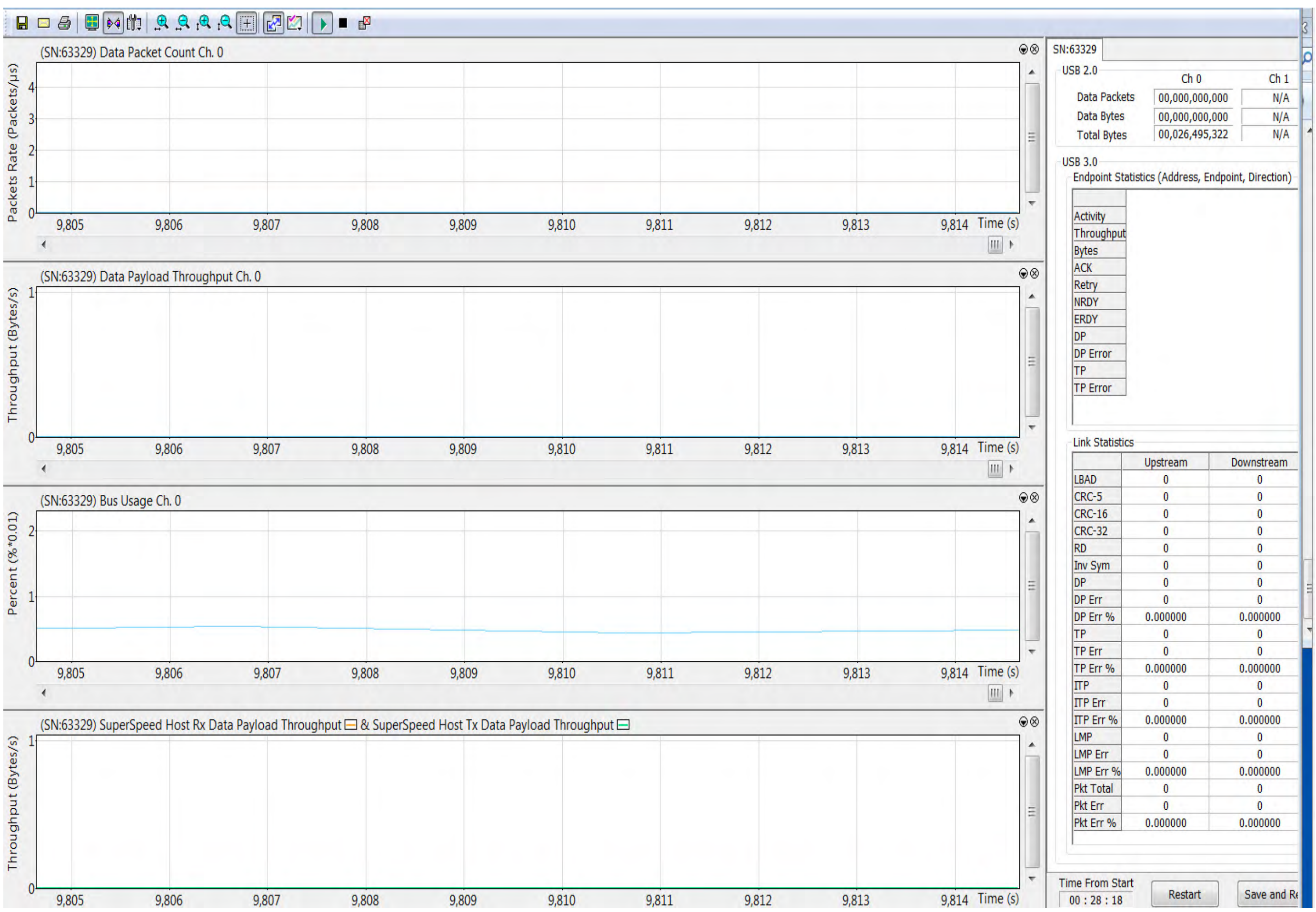


Figure 9.58: Real Time Statistics window

For USB 3.1, the Real-Time Statistics window can display a SuperSpeed graph of real-time link activity.

The Link Statistics are displayed on the right bottom panel in the previous screen capture. They are defined as:

RD: Running Disparity Errors

Inv Sym: Invalid 10-Bit Symbol

Refer to the “Error Summary” on page 275 for further explanation.

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

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

To stop the monitor, press .

9.16.1 Real-Time Statistics Buttons

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

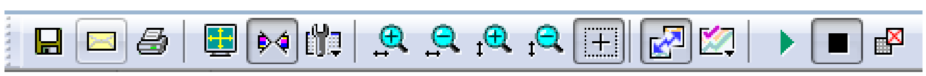
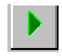
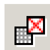


Figure 9.59: Real time Statistics Buttons

The buttons have the following functions:

	Save As - Saves Real-Time graphs as bitmap files (*.**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		
	Synchronize with other Views. Synchronizes the View windows so that a move in one window repositions the other. See “Link Tracker Buttons” on page 296.		Sync and Graph areas - If two or more graphs are displayed, this button synchronizes the graphs to one another. Once synchronized, the positioning slider of one graph moves the other graphs.

	View Settings - opens a sub-menu with options for formatting the display. See “View Settings Menu” below.		Graph Areas - Presents options for displaying additional graphs of data lengths, packet lengths, and percentage of bus utilized.
	Horizontal zoom in		Start. Starts the Real-Time Monitor.
	Horizontal zoom out		Stop Real-Time Monitoring.
	Reset graphs.		

To clear the counters in the “Statistics Accumulation” area,

click the **Restart**  button.

To save a snapshot Microsoft Excel **.csv** file of the data before clearing the values,

click the **Save and Restart**  button.

The file is in the same folder where Trace files are saved.

The naming convention of the file is:

RTS_Capture_YYYY-MM-DD_HH-MM-SS.csv

Note: Because file writing must happen immediately, there is no file naming dialog.

Note: If you click the button more than once a second, the previous file with the same timestamp will be lost.

9.16.2 Real-Time Statistical Monitor Pop-up Menu

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

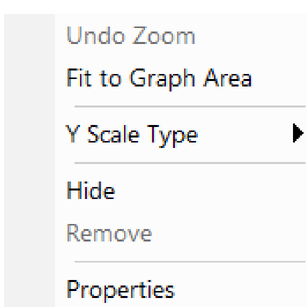


Figure 9.60: Real-Time Statistical Monitor Pop-up Menu

- **Undo Zoom**: If you have zoomed in, undoes the zoom.
- **Fit to Graph Area**: Displays graph so that the entire trace fits inside the graph

area.

- **Y Scale Type**:
- ***Linear***: Converts display to linear format.
- ***Logarithmic***: Converts display to logarithmic format.
- **Hide**: Hides the selected graph.
- **Remove**: Removes the selected graph.
- **Properties**: Opens a dialog box with options for changing the colors, titles and other features of the graphs.

9.16.3 Displaying Multiple Graphs

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

To view two or three graphs simultaneously,

click the **Graph Areas**  button.

The following menu opens.

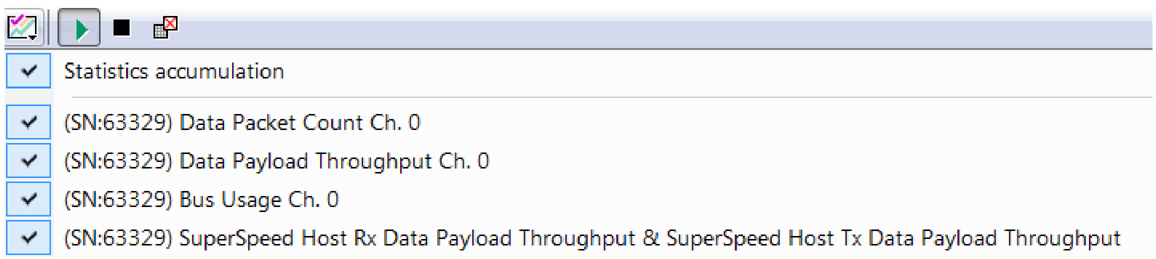


Figure 9.61: Graph Areas Menu Options

Selecting a checkbox displays the selected graph type:

- **Statistics Accumulation**: Plots the percentage of Link utilization by non-idle traffic for both directions of the link.
- **Data Packet Count (Packets/s)**: Plots counts of Data Packets per second for both directions of the link.
- **Data Payload Throughput (MBytes):** Plots data payload throughput for both directions of the link.
- **Bus Usage**: Plots amount of Bus usage.
- **SuperSpeed Host Rx Data Payload & SuperSpeed Host Tx Data Payload**: For USB 3.1, the Real-Time Statistics window can display a SuperSpeed graph of real-time link activity.

Chapter 10

Recording Options

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

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

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

OR

- Click  on the Tool Bar.

You see the **Recording Options** dialog box for the Voyager M310, in Simple Mode for recording options (see Figure 10.1 on page 330.)

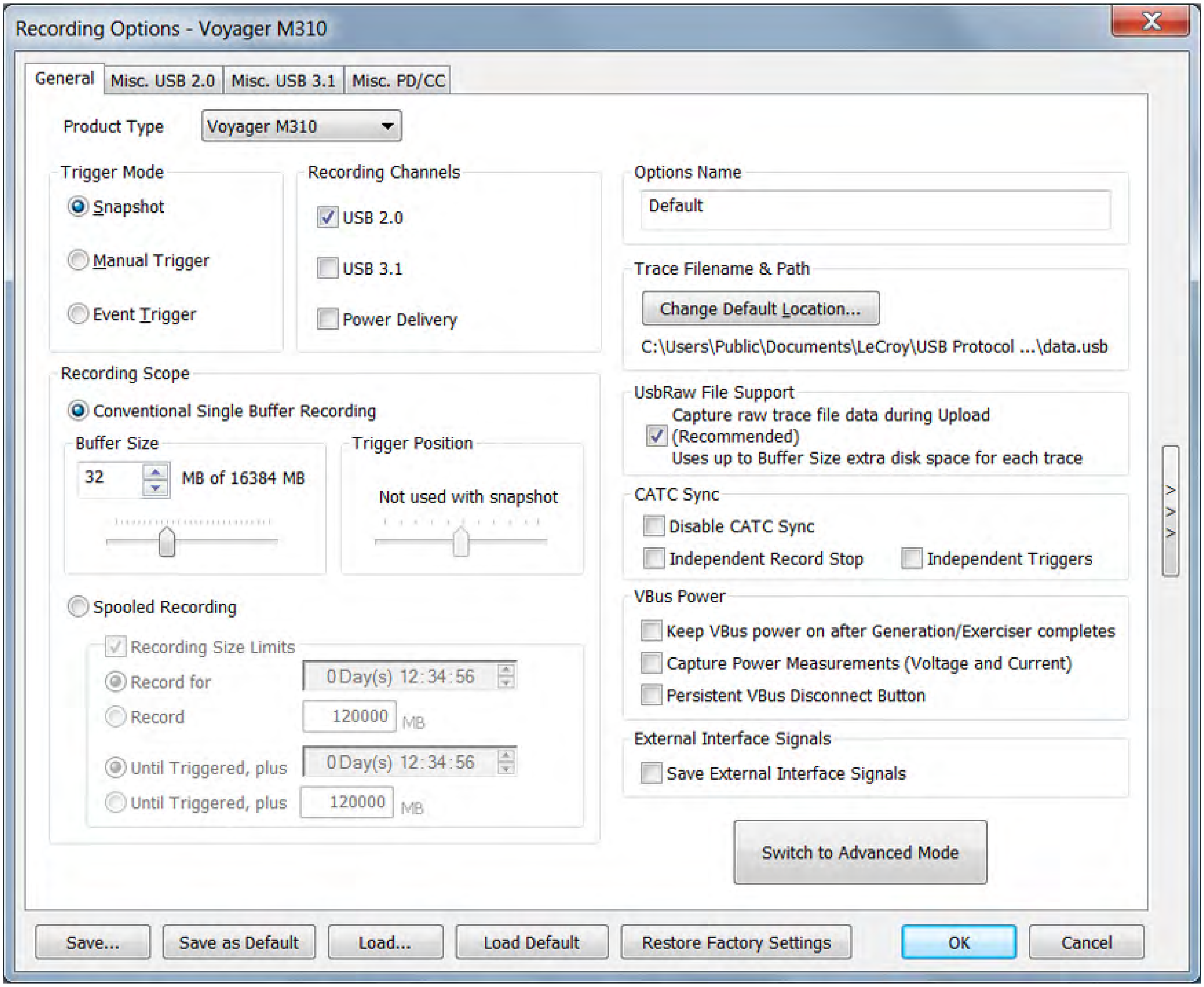


Figure 10.1: Recording Options - General Tab Voyager M310: Simple Mode.

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

Note: Tabs available differ depending on attached analyzer type. If no analyzer is attached, you can select any product. See “Recording Option Summary Tab” on page 400.

10.1 Recording Options Modes

The General tab shows either the Basic or Advanced Recording Options Mode. Simple Mode for recording options is for simple Recording Options. Advanced mode provides more sophisticated Recording Rules that enable complex filters, triggers, and sequencing. You can switch modes by clicking the **Switch to Basic Mode** or **Switch to Advanced Mode** button.

10.1.1 Advanced Mode: Voyager M3, M3i and M3x

In Advanced Mode, the Recording Options dialog box for the Voyager M3, M3i, and M3x is shown below, see Figure 10.2.

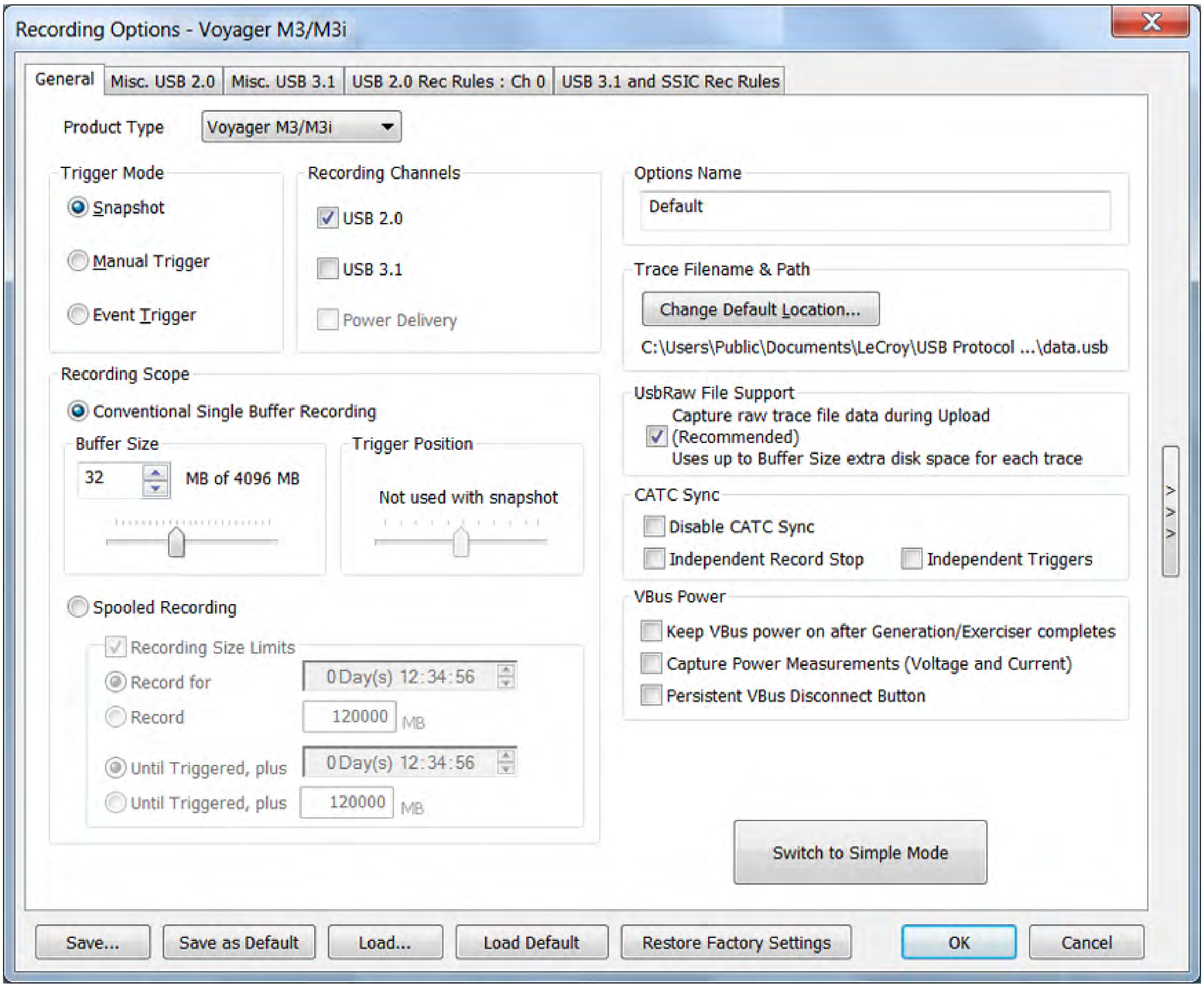


Figure 10.2: Voyager M3, M3i, and M3x: General Tab in Advanced Mode

10.1.2 Simple Mode: Advisor T3

In Simple Mode for recording options, the Recording Options dialog box for the Advisor T3 is shown below, see Figure 10.3.

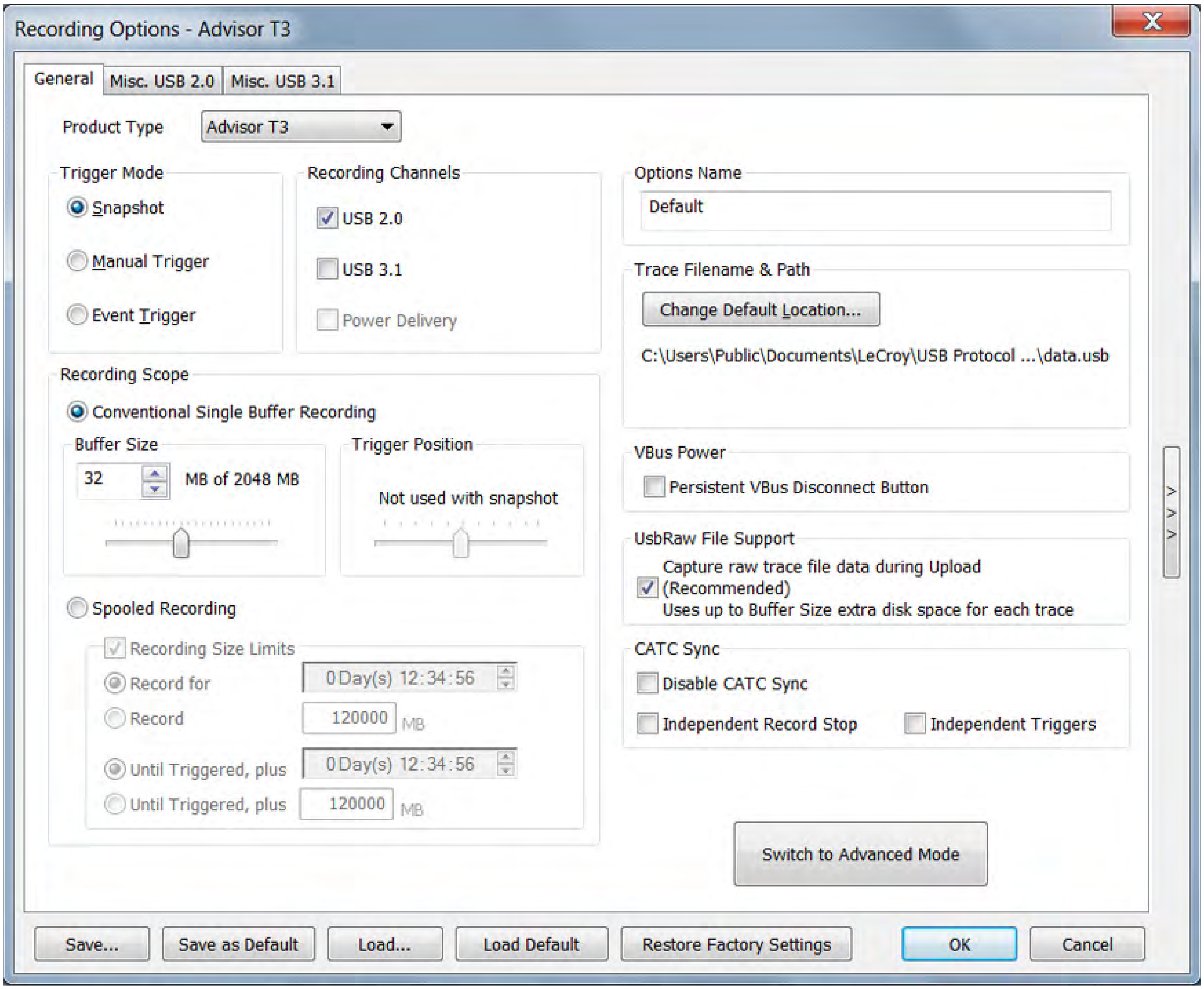


Figure 10.3: Advisor T3: General Tab in Simple Mode for Recording Options

10.1.3 Advanced Mode: Advisor T3

In Advanced Mode, the Recording Options dialog box for the Advisor T3 is shown below, see Figure 10.4.

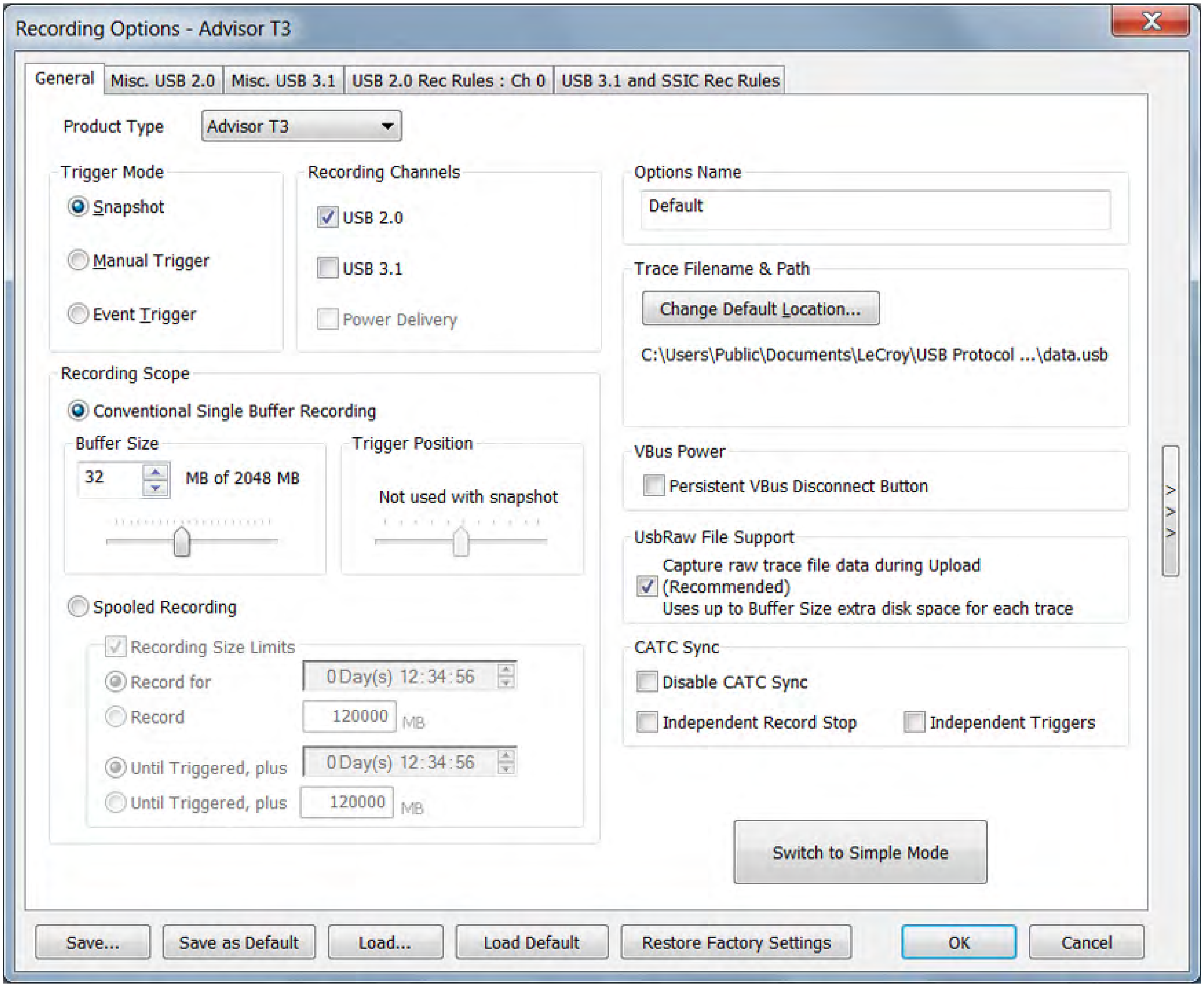


Figure 10.4: Advisor T3: Recording Options - General Tab in Advanced Mode

10.1.4 Simple Mode: Mercury T2

In Simple Mode for recording options, the Recording Options dialog box for Mercury T2 has the General and Misc. USB 2.0 tabs. See Figure 10.5.

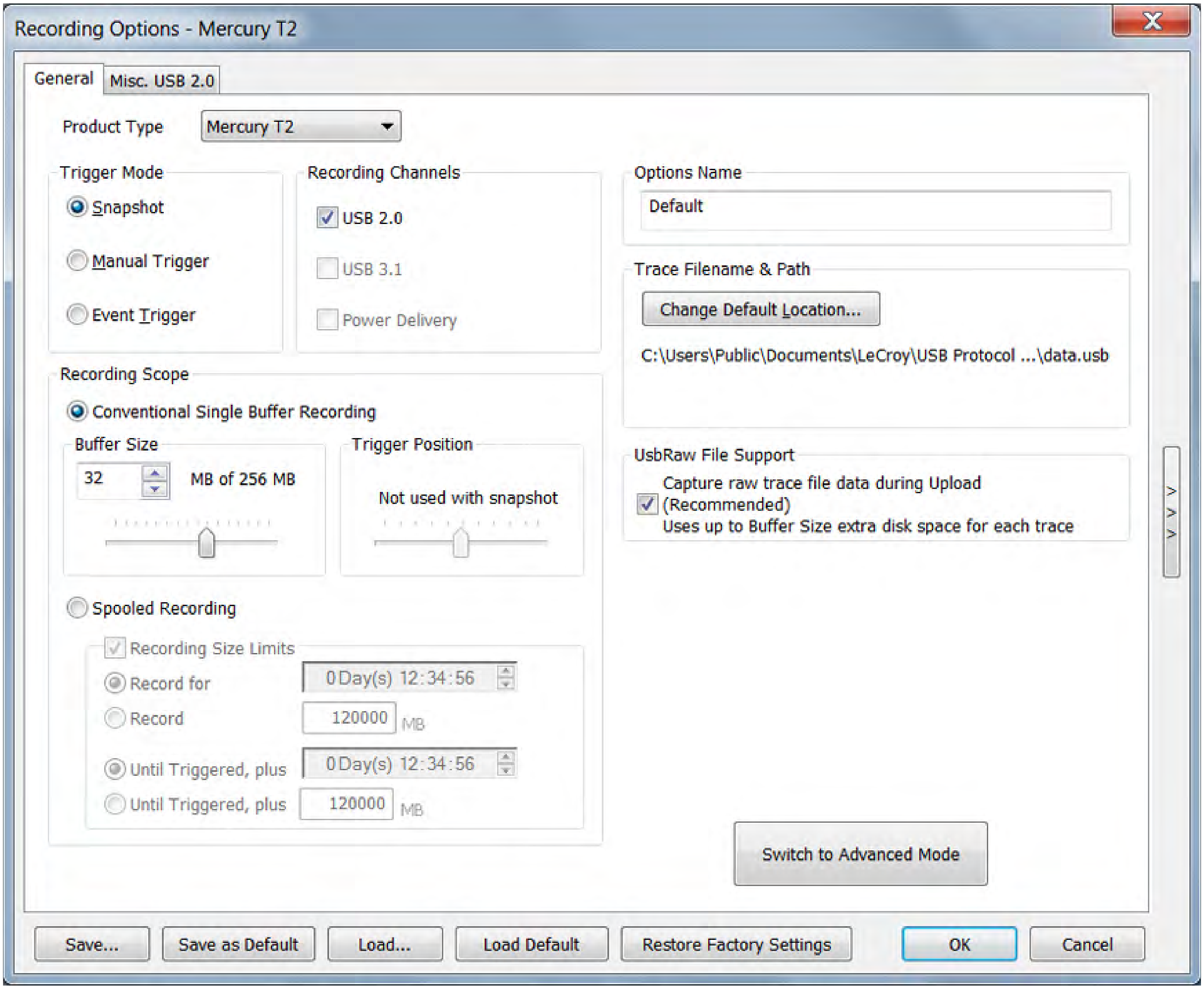


Figure 10.5: Mercury T2: Recording Options - General Tab in Simple Mode

10.1.5 Advanced Mode: Mercury T2

In Advanced Mode, the Recording Options dialog box for Mercury T2 has the General, Misc. USB 2.0 and USB 2.0 Rec Rules: Ch 0 tabs. See Figure 10.6.

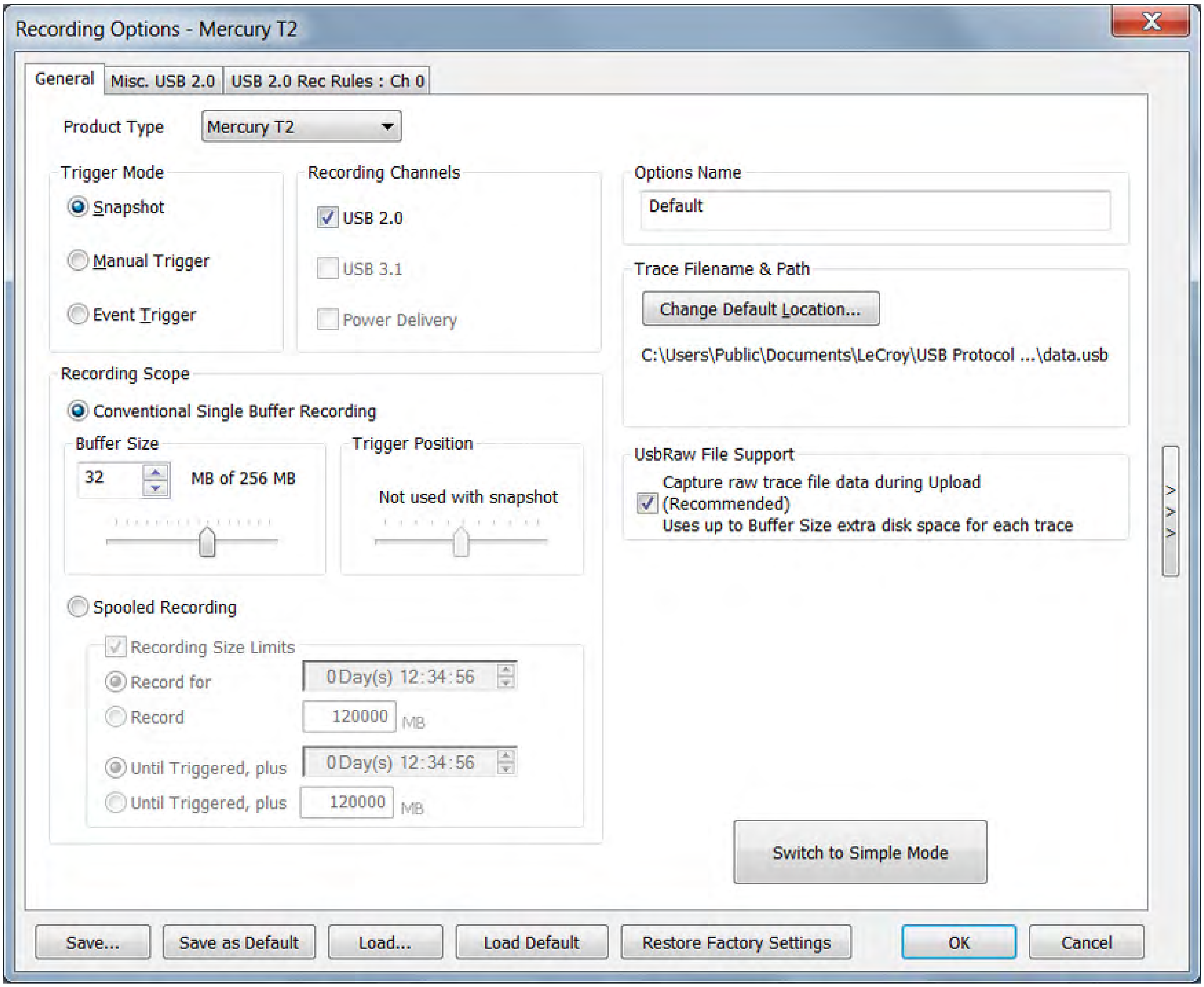


Figure 10.6: Mercury T2: Recording Options - General Tab in Advanced Mode

10.1.6 Simple Mode: Mercury T2C

In Simple Mode for recording options, the Recording Options dialog box for Mercury T2C has the General, Misc. USB 2.0 and Misc. PD/CC tabs. See Figure 10.7.

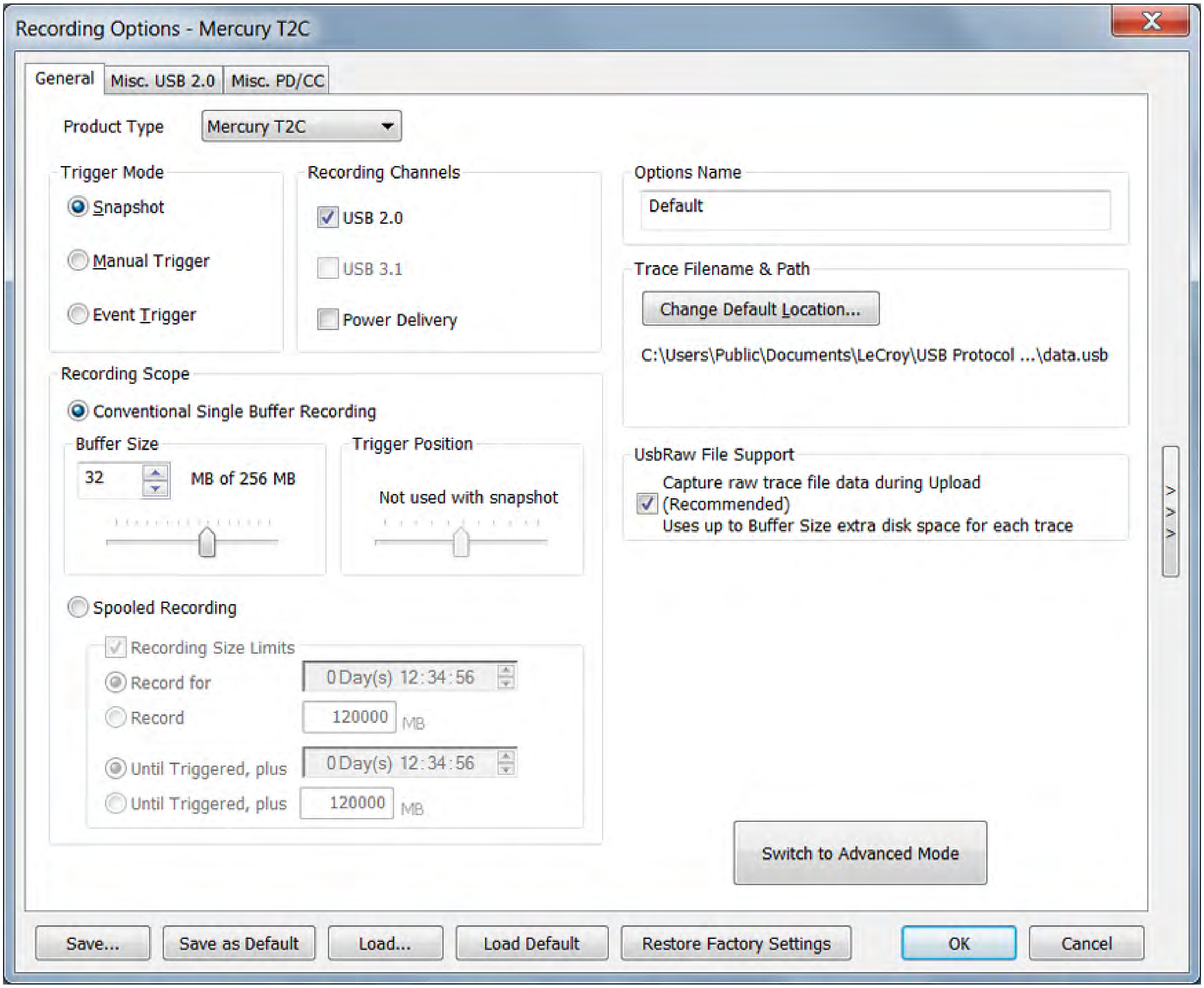


Figure 10.7: Mercury T2C: Recording Options - General Tab in Simple Mode

The Simple Trigger Options for Power Delivery (PD)/Channel Configuration (CC) events are shown in Figure 10.8 on page 337.

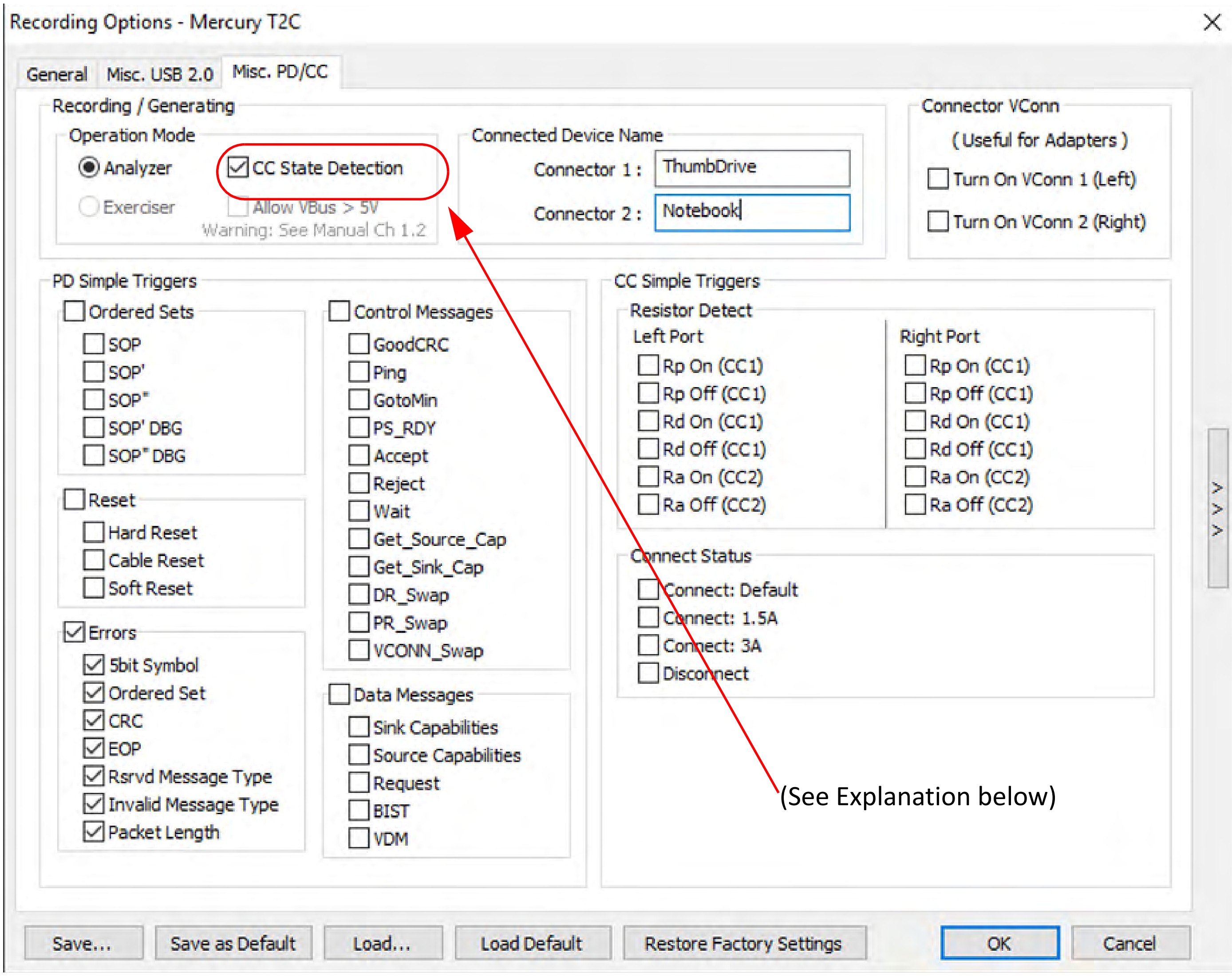


Figure 10.8: Mercury T2C: Recording Options for PD and CC Events

CC State Detection: Mercury T2C

When enabled, the Analyzer captures CC State transitions by monitoring the voltages seen on the CC pins. (This is the Default setting.) In this mode, the Analyzer connects CC1 from Connector 1 to Connector 2 whenever the states of the CC pins are appropriate for PD communication. If this item is unchecked, then the CC states are NOT monitored, and the CC1 line is connected across the connectors at all times. This may be helpful during debugging when the CC voltage is not found to be within the correct thresholds.

Note: This mode (when CC Detection is disabled) is to be used for low-level debugging only, as the behavior of many state transitions can be broken. The LED reporting will not work as expected, and the ability to distinguish between the Left and Right port traffic is eliminated. Choose this at your own risk, normally under the guidance of Teledyne LeCroy representative.

10.1.7 Advanced Mode: Mercury T2C

In Advanced Mode, the Recording Options dialog box for Mercury T2C has the General, Misc. USB 2.0, Misc. PD/CC and USB 2.0 Rec Rules: Ch 0 tabs. See Figure 10.9.

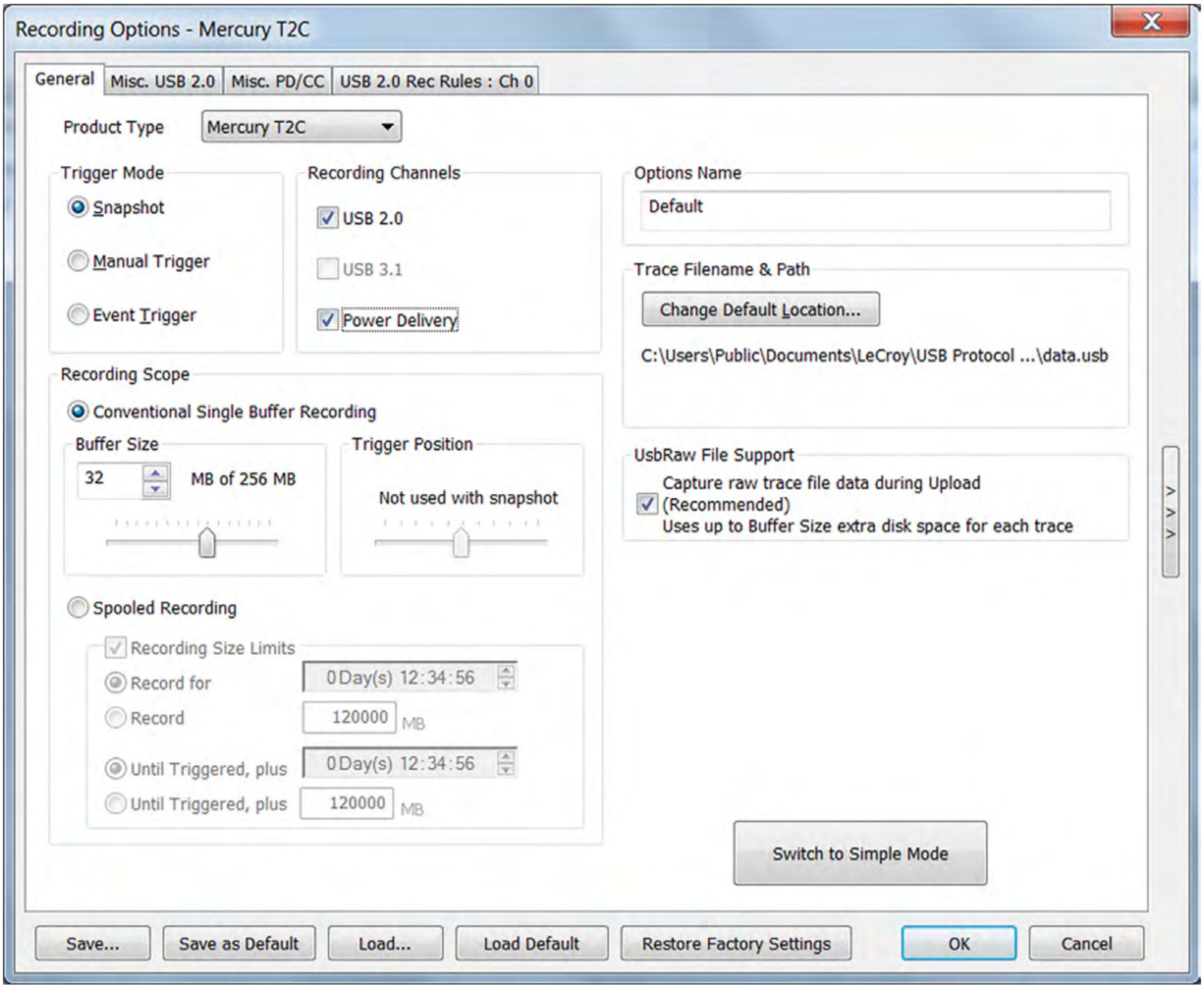


Figure 10.9: Mercury T2C: Recording Options General Tab in Advanced Mode

The Trigger options for Misc. Power Delivery (PD)/Channel Configuration (CC) events are the same in both Simple and Advanced Mode. See Figure 10.11 on page 340.

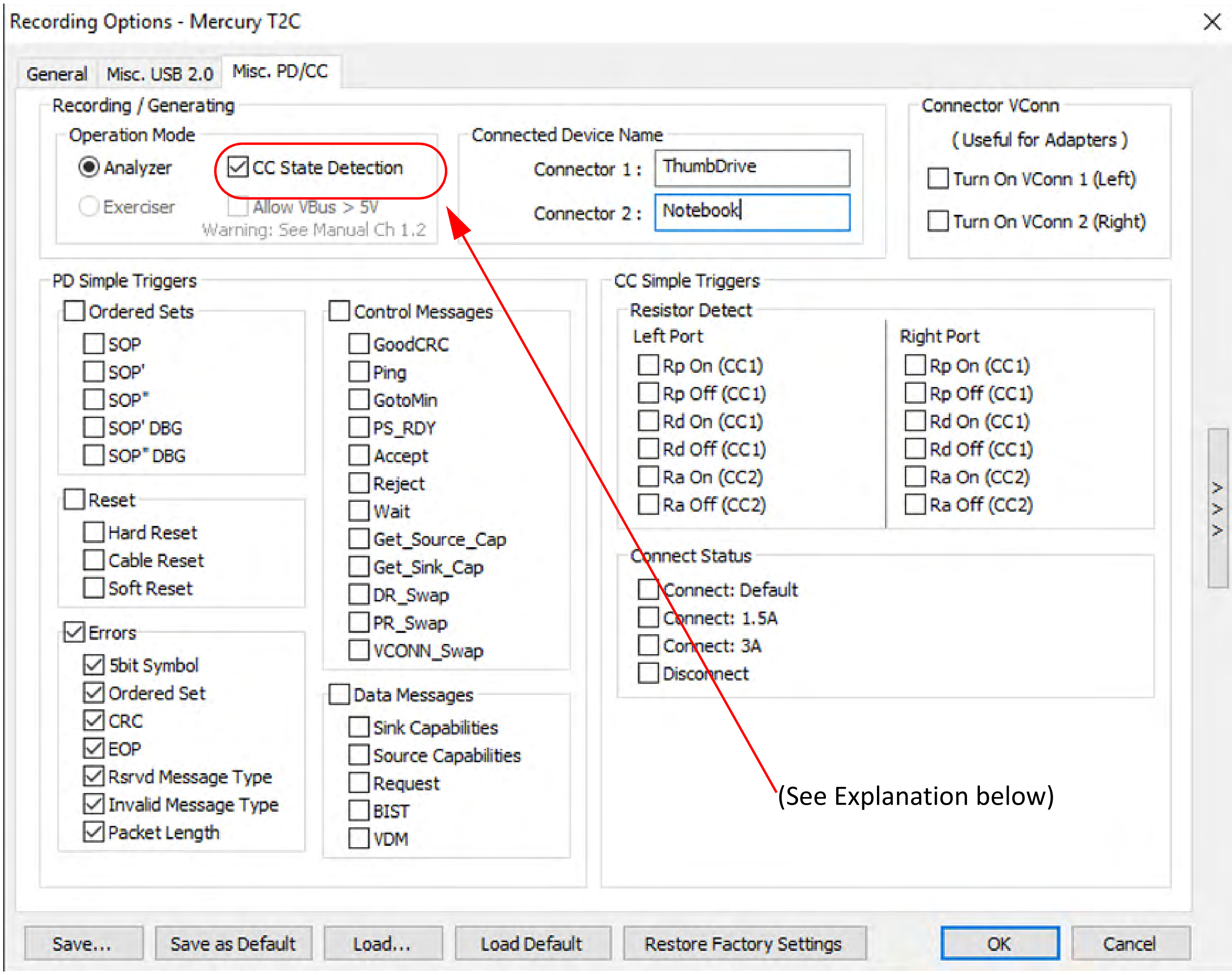


Figure 10.10: Mercury T2C: Recording Options for PD and CC Events

CC State Detection: Mercury T2C

When enabled, the Analyzer captures CC State transitions by monitoring the voltages seen on the CC pins. (This is the Default setting.) In this mode, the Analyzer connects CC1 from Connector 1 to Connector 2 whenever the states of the CC pins are appropriate for PD communication. If this item is unchecked, then the CC states are NOT monitored, and the CC1 line is connected across the connectors at all times. This may be helpful during debugging when the CC voltage is not found to be within the correct thresholds.

Note: This mode (when CC Detection is disabled) is to be used for low-level debugging only, as the behavior of many state transitions can be broken. The LED reporting will not work as expected, and the ability to distinguish between the Left and Right port traffic is eliminated. Choose this at your own risk, normally under the guidance of Teledyne LeCroy representative.

10.1.8 Simple Mode: Voyager M3x

In Simple Mode for recording options, the Recording Options dialog box for the Voyager M3x is:

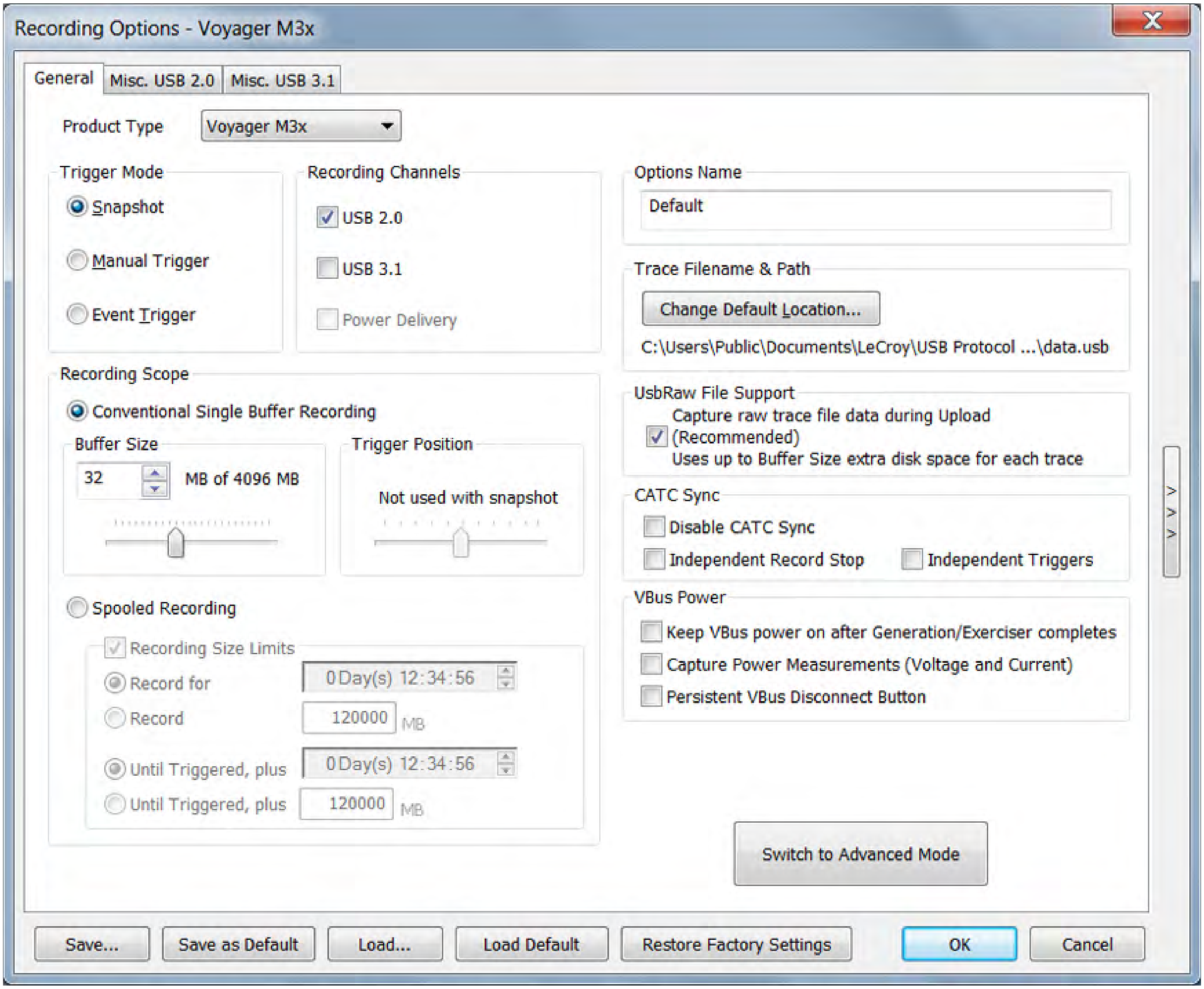


Figure 10.11: Voyager M3x: Recording Options General Tab in Simple Mode

10.1.9 Advanced Mode: Voyager M3x

In Advanced Mode, the Recording Options dialog box for the Voyager M3x is shown below, see Figure 10.12.

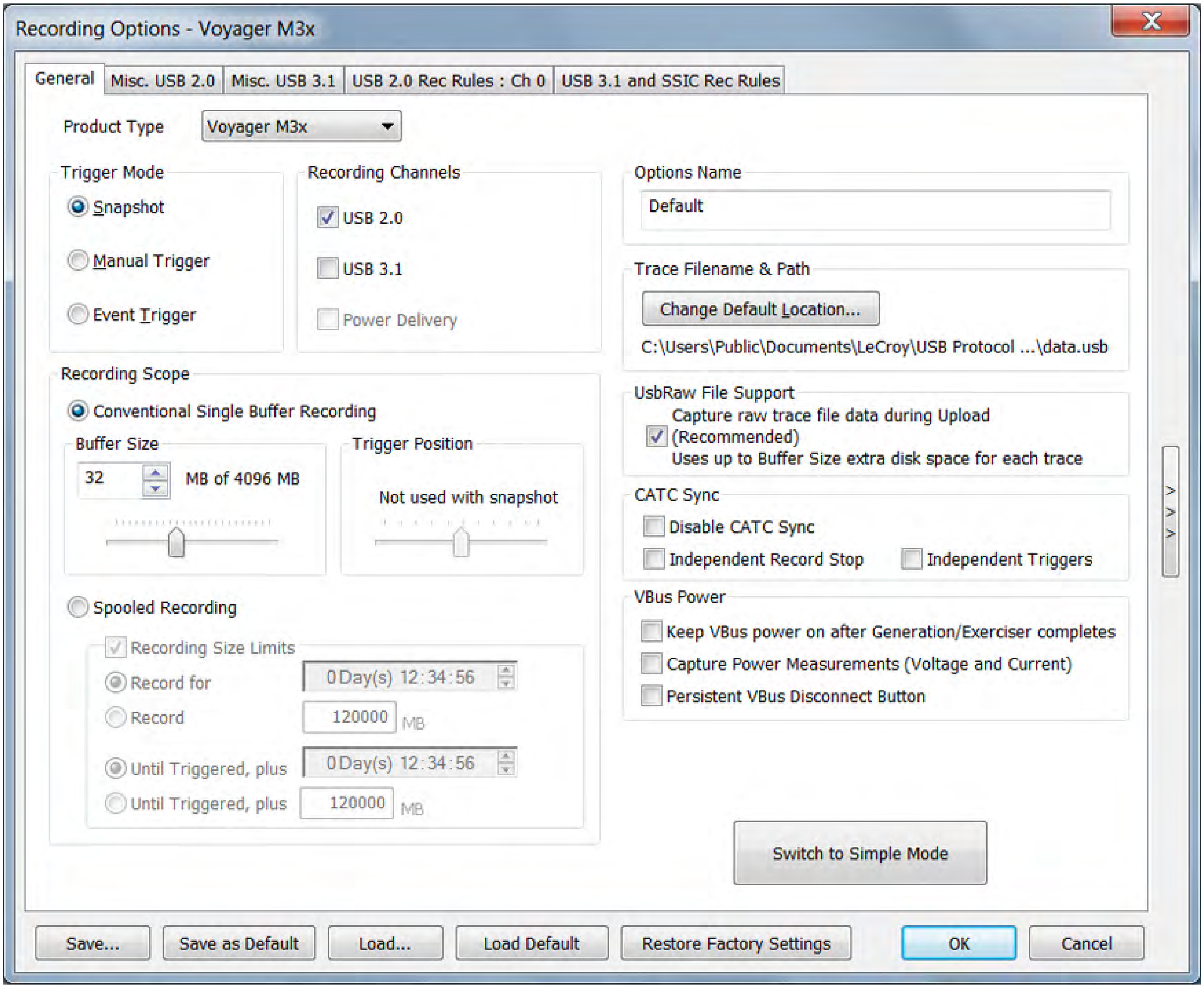


Figure 10.12: Voyager M3x: Recording Options General Tab in Advanced Mode

10.1.10 Simple Mode: Voyager M310C

In Simple Mode the Voyager M310C has options for Misc. USB2.0, Misc. USB3.1 and Misc. PD/CC. See Figure 10.13.

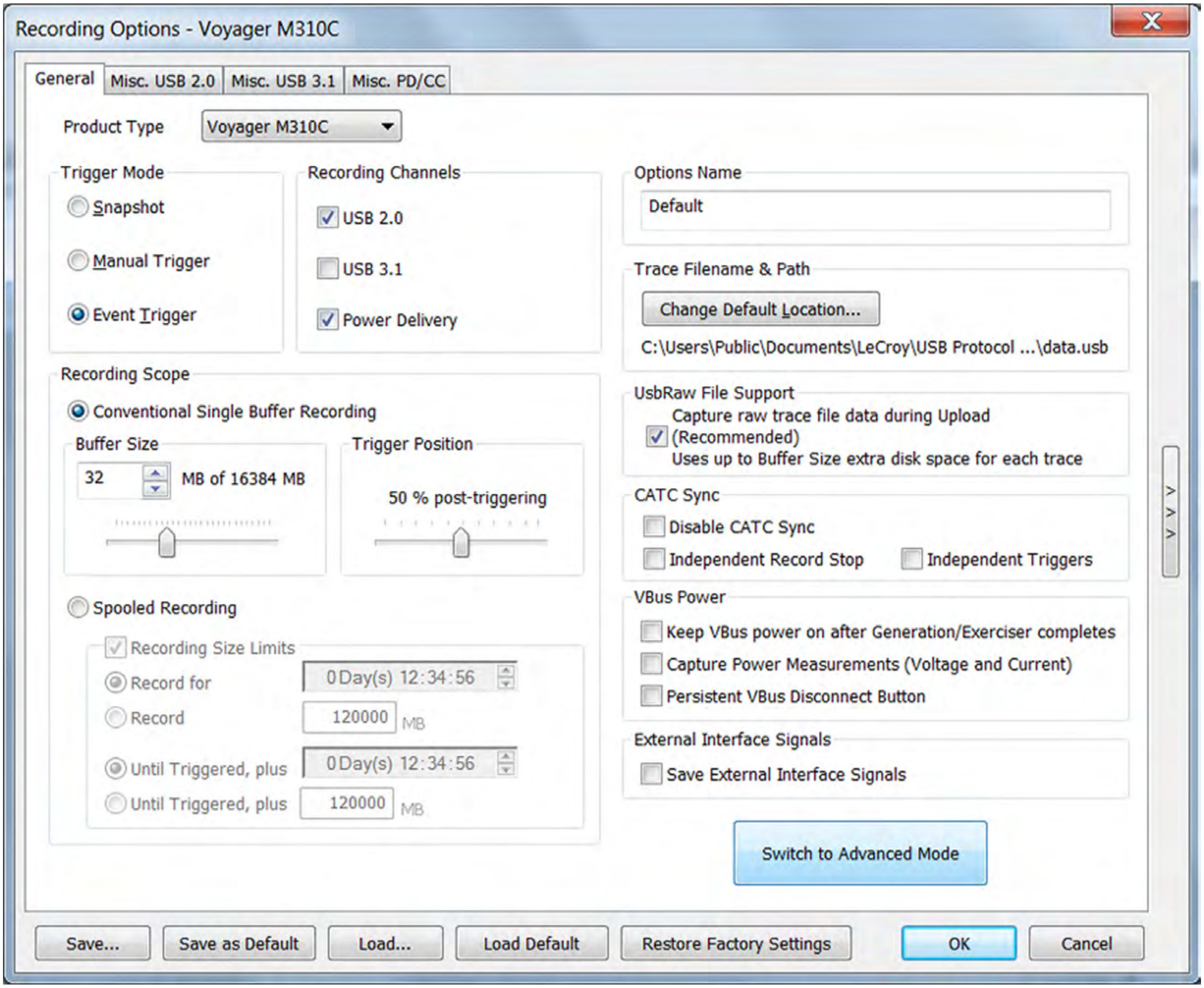


Figure 10.13: Voyager M310C: Simple Mode Recording Options

The Simple Trigger Options for Power Delivery (PD) and Channel Configuration (CC) events are shown in Figure 10.14 on page 343.

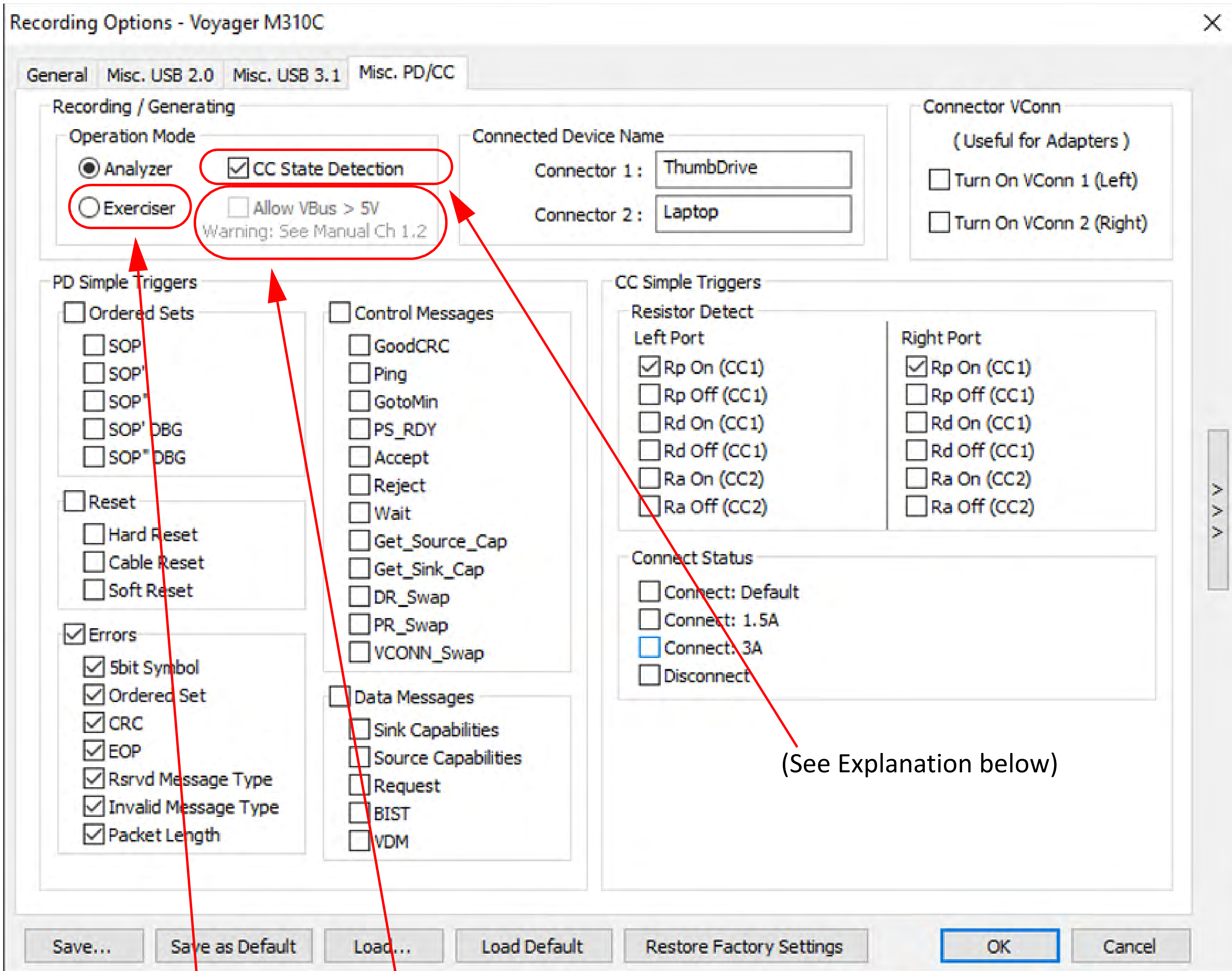


Figure 10.14: Voyager M310C: Recording Options for PD and CC Events

WARNING: This checkbox changes the mode from analyzing two connected Power Delivery partners to one where the M310C acts as one of the partners, running scripts to implement the customer's desired behaviors. For more information on the usage of the Power Delivery Exerciser, see the included document "USB Power Delivery Exerciser Manual". It is normally located in C:\Program Files (x86)\LeCroy\USB Protocol Suite\Documents

WARNING: This checkbox allows you to generate voltages on VBus as high as 20 Volts. See “Voyager M310C Analyzer” on page 22. Since this can damage devices which are not tolerant of anything more than 5 Volts, it is unwise to check this unless you are sure your scripts are written so that they do not damage your equipment or cables. It is recommend that you always use 5 Amp cables for most Power Deliver Exerciser scenarios.

CC State Detection: Voyager M310C

When enabled, the Analyzer captures CC State transitions by monitoring the voltages seen on the CC pins. (This is the Default setting.) In this mode, the Analyzer connects CC1 from Connector 1 to Connector 2 whenever the states of the CC pins are appropriate for PD communication. If this item is unchecked, then the CC states are NOT monitored, and the CC1 line is connected across the connectors at all times. This may be helpful during debugging when the CC voltage is not found to be within the correct thresholds.

Note: This mode (when CC Detection is disabled) is to be used for low-level debugging only, as the behavior of many state transitions can be broken. The LED reporting will not work as expected, and the ability to distinguish between the Left and Right port traffic is eliminated. Choose this at your own risk, normally under the guidance of Teledyne LeCroy representative.

10.1.11 Advanced Mode: Voyager M310C

In Advanced Mode the Voyager M310C has options for Misc. USB2.0, Misc. USB3.1, Misc. PD/CC, USB 2.0 Rec Rules: CH0 and USB3.1 and SSIC Rec Rules. See Figure 10.15.

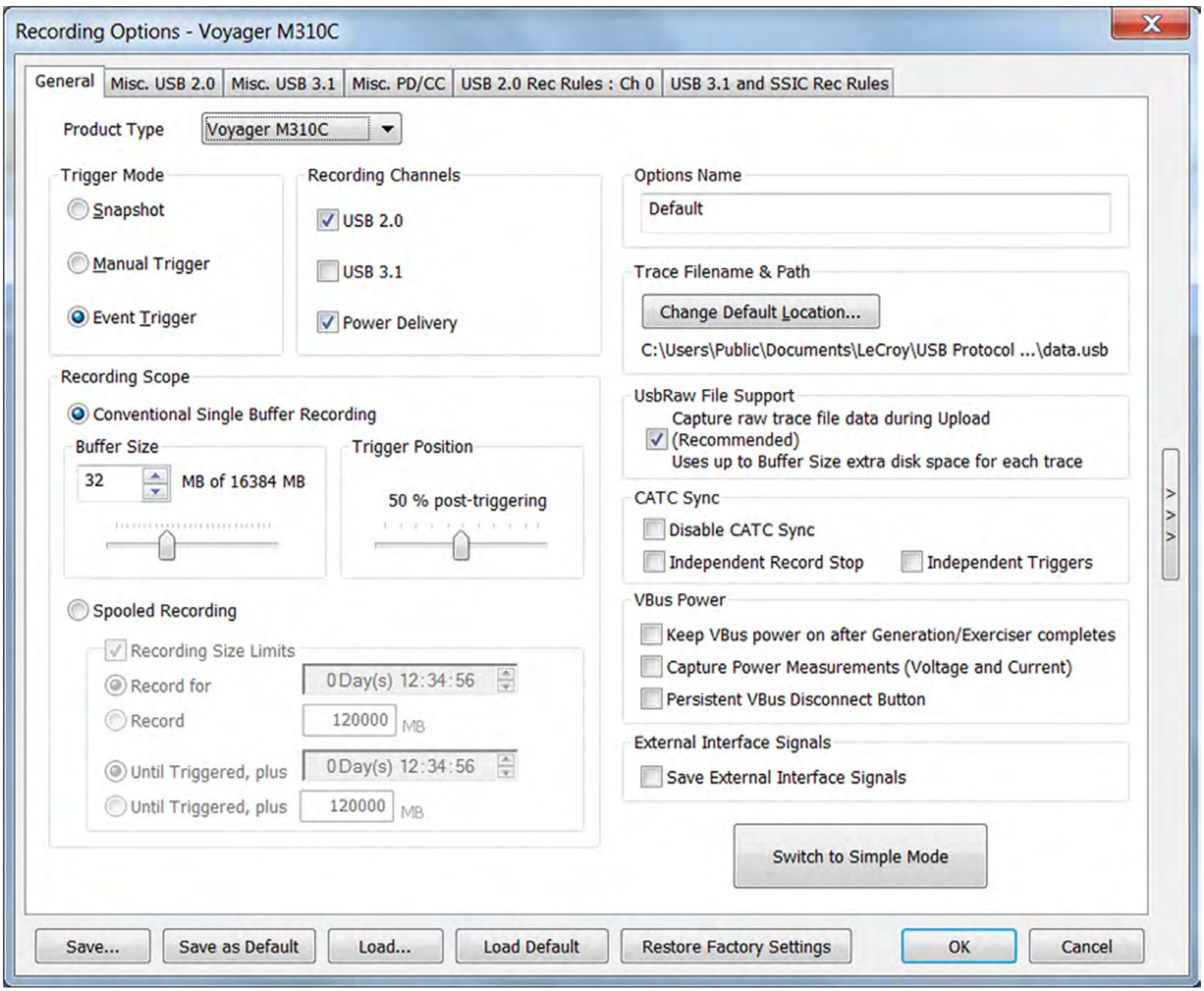


Figure 10.15: Voyager M310C: Advanced Mode Recording Options

The Trigger options for Misc. Power Delivery (PD)/Channel Configuration (CC) events are the same in both Simple and Advanced Mode. See Figure 10.16 on page 345.

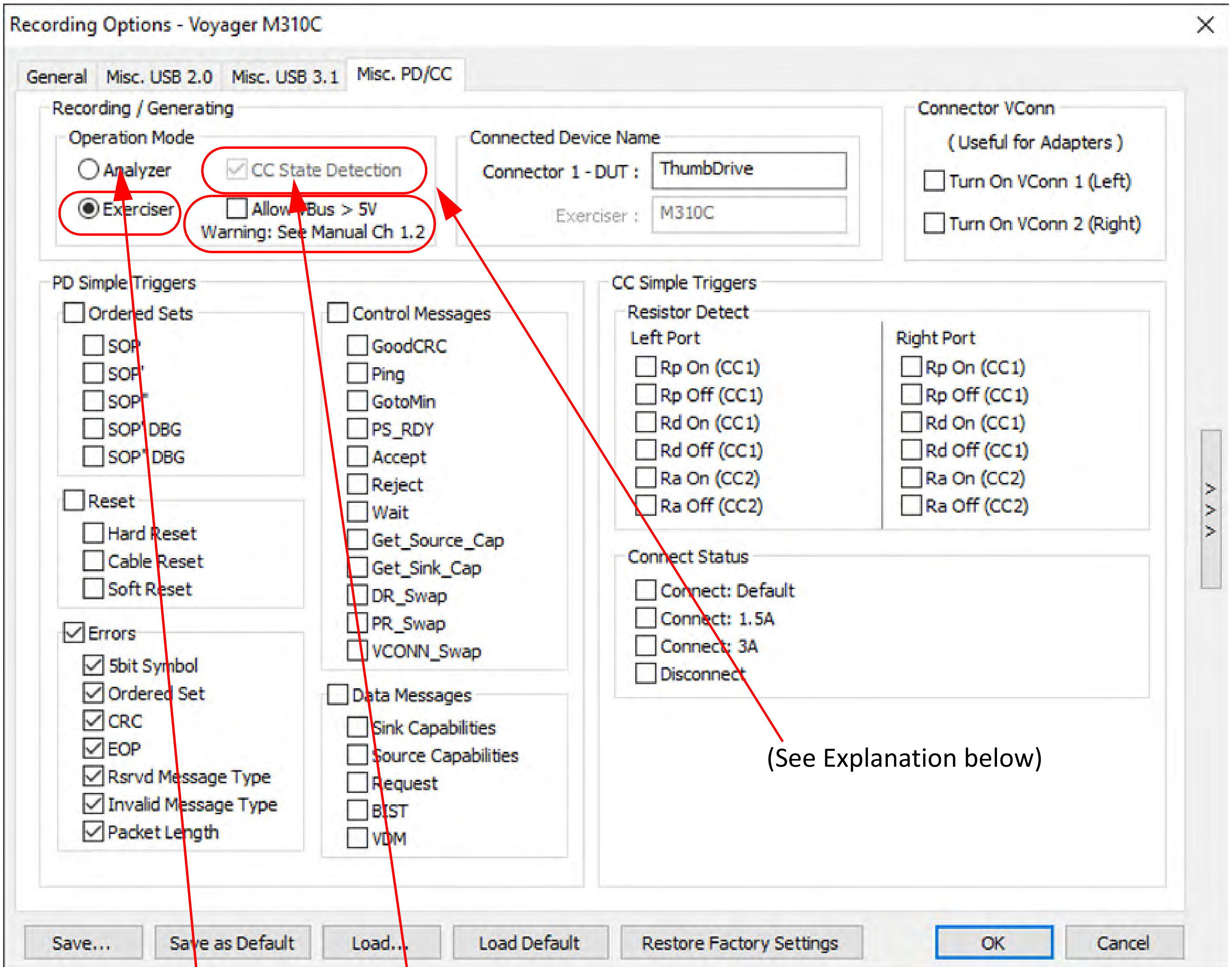


Figure 10.16: Voyager M310C: Recording Options for PD and CC Events

WARNING: This checkbox changes the mode from analyzing two connected Power Delivery partners to one where the M310C acts as one of the partners, running scripts to implement the customer's desired behaviors. For more information on the usage of the Power Delivery Exerciser, see the included document "USB Power Delivery Exerciser Manual". It is normally located in C:\Program Files (x86)\LeCroy\USB Protocol Suite\Documents

WARNING: This checkbox allows you to generate voltages on VBus as high as 20 Volts. See “Voyager M310C Analyzer” on page 22. Since this can damage devices which are not tolerant of anything more than 5 Volts, it is unwise to check this unless you are sure your scripts are written so that they do not damage your equipment or cables. It is recommend that you always use 5 Amp cables for most Power Deliver Exerciser scenarios.

CC State Detection: Voyager M310C

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Note: This mode (when CC Detection is disabled) is to be used for low-level debugging only, as the behavior of many state transitions can be broken. The LED reporting will not work as expected, and the ability to distinguish between the Left and Right port traffic is eliminated. Choose this at your own risk, normally under the guidance of Teledyne LeCroy representative.

10.2 General Recording Options

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

10.2.1 Product

You can select one of the following products:

- Voyager M310C
- Voyager M3/M3i
- Voyager M3x
- Voyager M310
- Advisor T3
- Mercury T2
- Mercury T2C
- USBTracer/Trainer*
- USB Advisor*
- USBMobile HS and USBMobile T2*

* These analyzers are no longer formally supported and tested beginning in release 4.90, although nothing was done to prevent them from still working. See “USBTracer/Trainer, USB Advisor, USBMobile HS and USBMobile T2” on page 87 for more information.

10.2.2 Trigger Mode

The **Trigger Mode** box presents three options that allow you to set how the Analyzer begins and ends a recording.

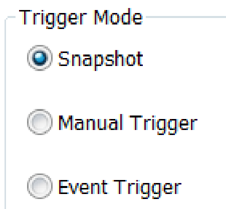


Figure 10.17: Trigger Mode Dialog

The options are: *Snapshot, Manual Trigger,* and *Event Trigger.*

Snapshot

A Snapshot is a fixed-length recording. The size of this recording is set by

the Buffer Size box. Recording begins when is clicked and ends

when either the selected buffer size is filled or the button is pressed.

Manual Trigger

Some Teledyne LeCroy analyzer models include a manual trigger button on the front panel of the system. The manual trigger option can be used when you elect to initiate the recording by pressing the manual trigger button.

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.

10.2.3 Recording Channels 2.0 and 3.1

You can select **USB 2.0** and/or **USB 3.1** as the recording channel. Both can be captured simultaneously. Do NOT capture in 2.0 mode when 3.1 Clock/Speed selection is in any of the slow modes, as these modes do not scale for USB 2.0 traffic.

If user selects different external trigger modes in the Recording Rules when doing simultaneous USB 2.0/USB 3.1 captures, the trigger mode for USB 3.1 will be applied.

3.1 Channel is used to record SuperSpeed 5Gbps Gen 1 traffic and SuperSpeed+ 10Gbps Gen 2 traffic. SuperSpeed+ captures are only supported on Voyager M310 and M310C.

10.2.4 Power Delivery Recording Channel

Enabling this on systems that are licensed for Power Delivery will capture the signaling over the Configuration Channel (CC) wire in the USB Type-C™ connector. This is supported only on Voyager M310C and Mercury T2C.

TABLE 10.1: Recording Modes Summary

Model	USB2.0	USB3.1	Power Delivery
Voyager M310	Yes	Yes*	N/A
Voyager M310C	Yes	Yes*	Yes**
Voyager M3x	Yes	Yes	N/A
Voyager M3/M3i	Yes	Yes	N/A
Advisor T3	Yes	Yes	N/A
Mercury T2	Yes	N/A	N/A
Mercury T2C	Yes	N/A	Yes

Note: * Includes SuperSpeed+ 10Gbps Gen 2 captures.

Note: ** The voyager M310C can also record Vbus On and Vbus Off events when in Power Delivery Capture mode. The Mercury T2C does not capture those events.

10.2.5 Recording Scope (Voyager, Advisor T3 and Mercury)

Select either:

- **Conventional Single Buffer Recording:** Select **Buffer Size** (see below). The analyzer limits the data amount captured to the selected buffer size. Use the **Trigger Position** slider (see below) to control the data amounts captured pre-trigger and post-trigger.

OR

- **Spooled Recording:** The analyzer begins recording data to the analyzer memory when the record button is pressed. The entire analyzer memory (2 GB or 4 GB) is used to buffer data while simultaneously uploading the trace file to an attached storage device.

Set **Recording Size Limits**. If you use Snapshot, you can optionally use **Record for** an elapsed time or **Record** a number of megabytes.
If you use Manual Trigger or Event Trigger, you can optionally use the **Until Triggered, plus** options to enter post-trigger limits by megabytes or elapsed time. These options allow you to specify a trigger event to start the recording. When these options are used, the trigger position slider is not active. The trigger event is within the first 100 packets. The balance of the memory captures traffic occurring post trigger.

Note: You can use Snapshot, Manual Trigger, or Event Trigger trigger mode with either Recording Scope: Conventional Single Buffer Recording or Spooled Recording.

Note: When capturing SS or SS+ traffic with Spooled Recording, the traffic rate may overflow the system's ability to upload data to disk. In the event of overflow, the analyzer stops the recording automatically, even if the trigger event has not yet occurred. This can occur in 3.1 traffic as well as in 2.0 traffic. The analyzer does not drop data or leave gaps in the recording. Instead, it automatically uploads all the traffic stored in memory. You must make sure that the traffic being recorded does not overrun the buffer in this mode, by either adjusting the actual data transmissions between the host and device, or by adding filters to the analyzer recording to reduce the quantity of data per second that the analyzer is capturing and uploading to the Analyzer host machine.

10.2.6 Buffer Size

You can adjust the size of the recording buffer from a very small size up to the maximum available in your product.

The **Trigger Mode** option determines how this buffer is used. Although the Analyzer has a large physical memory, 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.

Note: To make the full buffer available for recording, you can select to **Disable Generator Memory** in the Misc.USB 2.0 tab of the Recording Options dialog (M3i Only).

10.2.7 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 **trigger mode**.

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

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

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

10.2.8 Options Name

The **Options Name** is a descriptive label of the current Recording Options settings. Options Names are associated with files that have a **.rec** suffix.

The default option name is **default**. **Default** preserves the current Recording Options settings.

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

Because Options Names are descriptive labels and not file names, you can enter in any text you like into the box. Your labels can be very descriptive such as "Trigger on High Speed traffic when CRC errors occur".

To create a new Recording Options name:

1. Enter a comment for the new file in the **Options Name** field.
2. Click **Save** to display the **Save As** window.
3. Specify a filename (***.rec**)
4. Click **Save.**

To load a Recording Options name:

1. Click **Load** to display the **Open** window.
2. From the list of **.rec** files, select the one that represents your Options Name.

   The options settings for that name then display.

10.2.9 Trace File Name & Path

Trace File Name & Path is the location for saving your trace file. The default recording file name is **data.usb** for recordings and its associated data in a folder with the same name (but with the extension .tmp). If you are recording on both channels, then the system creates two files: **data_0.usb** for Channel 0, and **data_1.usb** for Channel 1.

- ❑ Click **Trace File Name & Path.**

Click **Change Default Location** to display a **Specify Trace File Name** dialog in which to enter the recording file name ***.usb** for all subsequent recordings.

Note: The serial number of the analyzer will be added to the filename if more than one USB analyzer is being used.

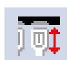
Note: Due to restrictions on where files can be written by users in Windows™ 7 and Windows 8, the USB Protocol Suite software may implicitly change a directory from the Program Files path **x:\Program Files\Lecroy\...** t o the user's data path **x:\Users\Public\Documents\Lecroy\...**

This is done (for example) when the desired Trace File Name & Path has such a reference in the Recording Options file. Note that when the opposite situation occurs (a Windows 7 and Windows 8 path is referenced), no implicit directory changes are made, since the Windows 7 and Windows 8 path is legal on an XP system. See “Notes on Windows 7 and Windows 8 Directory Protections” on page 106 for more information.

Important: Make sure that you do not attempt to save traces on a network drive on which you do not have create or write permissions. Such an operation is not supported in the current software.

10.2.10 VBus Power

You can control power settings:

- **Keep VBus Power on after Generation/Exerciser completes:** Check if you want to keep the Host VBus on at completion of a 2.0 or 3.1 Trainer/Exerciser script.
- **Capture Power Measurements (Voltage and Current)**: Record voltage and current.
- **Persistent VBus Disconnect Button**: Check if you want the modify the behavior of the "Momentary Disconnect" function (Invoked through the API or by the  button). When checked, the operation works as a "toggle" of the connection mode, remaining in the OFF state until you invoke it again to change it back to ON. This can be used to turn off the VBus for long periods of time. The normal unchecked behavior is for the button to cycle OFF-ON automatically, with the off duration lasting about a half a second. Uses extra disk space corresponding to the size specified in Buffer Size for each trace.

10.2.11 USB Raw File Support

Check this box to capture trace file data during upload. This is recommended. If you are having any problems with your captures, this file is necessary for allowing Teledyne LeCroy Support personnel to debug the issue.

10.2.12 CATC Sync (Voyager and AdvisorT3 only)

These allow you to override the normal CATC Sync behavior when two or more voyagers are connected by a CATC Sync cable.

- Disable CATC Sync: System behaves as if no cable were attached.
- Independent Record Stop: If checked, the boxes will start recording at the same time, and timestamps will be synchronized, but the boxes will stop recording independently (normal CATC Sync behavior is that they stop whenever either one stops.)
- Independent Triggers: When checked, the triggers on the boxes are independent. (Normal CATC Sync behavior is that any box triggers all boxes, synchronized trigger timestamps.)

Note: The settings for all analyzers must be the same for these CATC sync overrides to work. The behavior of the systems is not defined in the case where these values are different for each analyzer. It is up to the user to select them correctly based on his usage scenario.

10.3 Save External Signals

This feature saves eight bits of data from the M310's Octopus Cable (Part number AC050XXA-X) by sampling every 20 microseconds. The values are shown in conjunction with each packet displayed. The value is equal to whatever was sampled prior to the start of the displayed packet. This feature can be used along with a development system to track external events.

10.4 Recording Options-Misc. USB 2.0

The **Misc. USB 2.0** page presents options for setting (see Figure 10.18 on page 353):

- **Analyzer Trace Speed**: Select Auto-Detect, Low, Full, or High.
- **USB On-the-Go**: Check **On-the-Go SRP**. Optionally select **Dual Role Devices** as **2 DRD’s** and enter device names. Optionally assume that B is the first host.
- **Generator/Analyzer Clocking Overrides**: Select **Slow Clock** and enter number of megahertz. **Note:** Auto-Detect mode does not allow Slow Clock.
- **Generator-related Parameters**: Choose parameters and device address location.
- **Options**: Truncate data fields

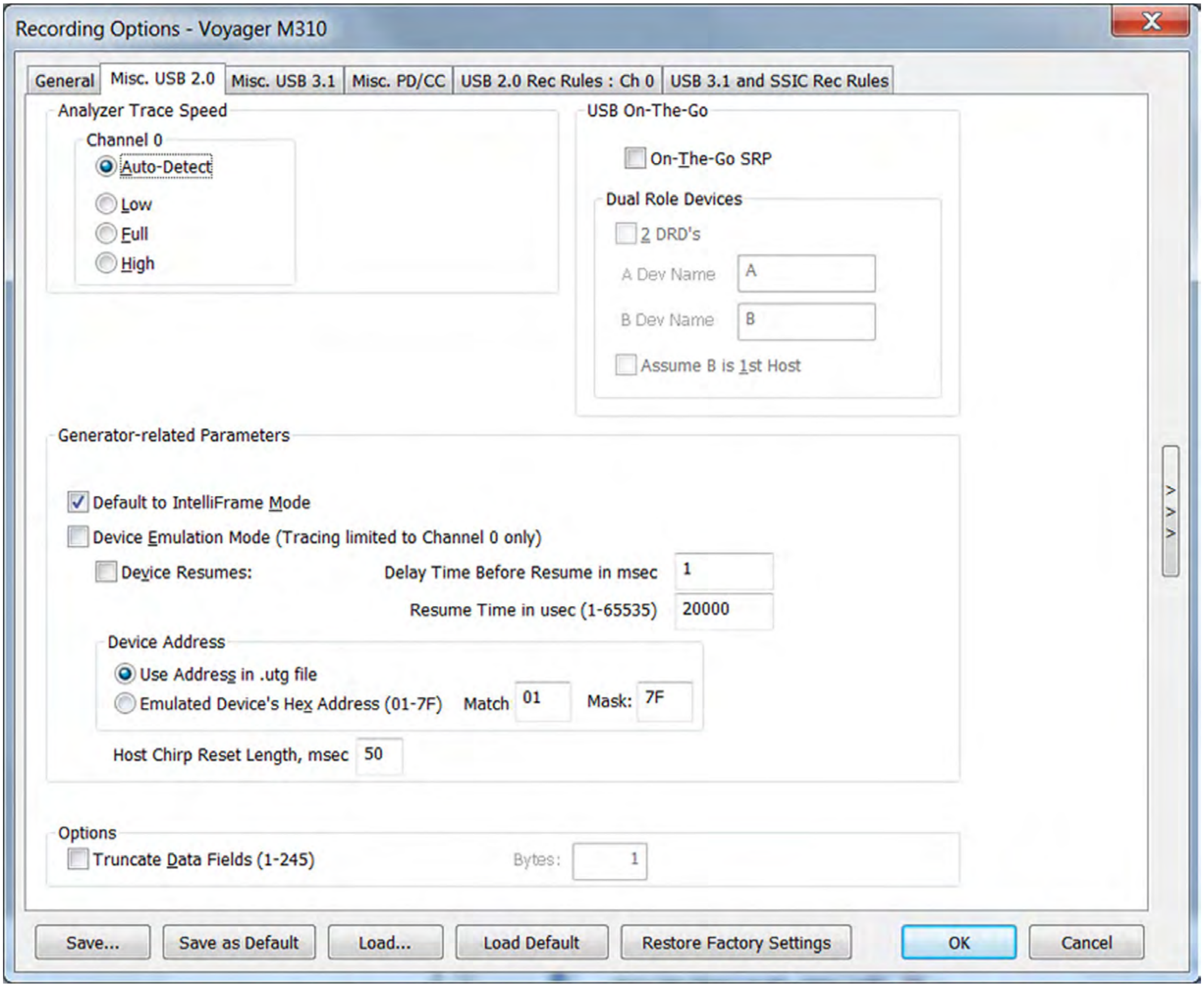


Figure 10.18: Recording Options Misc. USB 2.0.

10.4.1 Analyzer Trace Speed

This option sets the speed of the traffic recorded by the Analyzer. The default setting is **Auto-detect**. This setting tells the Analyzer to discover what speed traffic is running and to label packets accordingly. Auto-Detect will find a speed and lock on it permanently for the duration of the trace. If traffic speed changes, it will not be seen by the analyzer. If you are having problems with your recordings, you might try setting the traffic speed to one of the fixed values -- Low, Full, and Hi speed. These settings are used when you want to manually set the traffic speed. It can take ~ 6 ms for the High Speed detection to occur in Auto-Detect mode, so it is possible to miss some packets with this method.

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

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

When selecting a fixed speed, the analyzer will stay on that speed regardless of traffic. To capture more than one speed requires looping through multiple 2.0 ports (USBTracer or 2 daisy chained analyzers such as Voyager or Advisor T3)

Notes on Hi-Speed Recordings

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

This condition occurs during speed negotiation:

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

10.4.2 Generator/Analyzer Clocking Overrides

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

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

1. In the **Misc. USB 2.0** tab, make sure you are out of Auto-Detect mode.
2. Select the **Slow Clock** checkbox.
3. In the **Divide By** field, enter a value.
4. Click **OK**.

Note: Due to ASIC changes in the Voyager M3x/M310/M310C design, slow speed generation and capture at Hi Speed is NOT supported.

10.4.3 USB On-The-Go

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

10.4.4 Generator-related Parameters

You can set traffic generation parameters:

- **Disable Generator Memory**: Use the whole Capture Buffer for the trace. Not applicable to Voyager M3x/M310/M310C.
- **Default to IntelliFrame Mode**: Rather than Bitstream Mode.
- **Device Emulation Mode**: Limit tracing to Channel 0. You can check **Device Resumes**, then set the **Delay Time Before Resume** (in milliseconds, from 1 to 65535) and **Resume Time** (in milliseconds, from 1 to 65535).
- You can set traffic generation parameters for the Device Address:
- **Use Address in .utg file**: The traffic generation file has an address.
- **Emulated Device's Hex Address** (01-3F): Enter the **Mask** and **Match** for the emulated device.

You can also enter the **Host Chirp Reset Length** (in milliseconds, from 1 to 69).

10.4.5 Data Truncation Option

- **Truncate Data Fields (2.0):** Allows data fields to be truncated during recording in order to save Analyzer memory and allow recording of more packets. Enter a minimum data length value in the Bytes box. The system truncates the data to the stated value (or up to 5 bytes more to optimize operation efficiency in the Analyzer hardware).

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

10.5 Recording Options - Misc. USB 3.1 for Voyager

The **Misc. USB 3.1** tab presents options for setting Recording Ports, Descrambling, Polarity Inversion, Spread Spectrum Clock, Recording/Generating, Simple Filters and Truncate Data Fields, Simple Triggers, Clock/Speed Selection, and M3i Connector Termination/RxDetect.

Note: Voyager M3x/M310/M310C do not support Port Configurations nor Very Slow Clock modes.

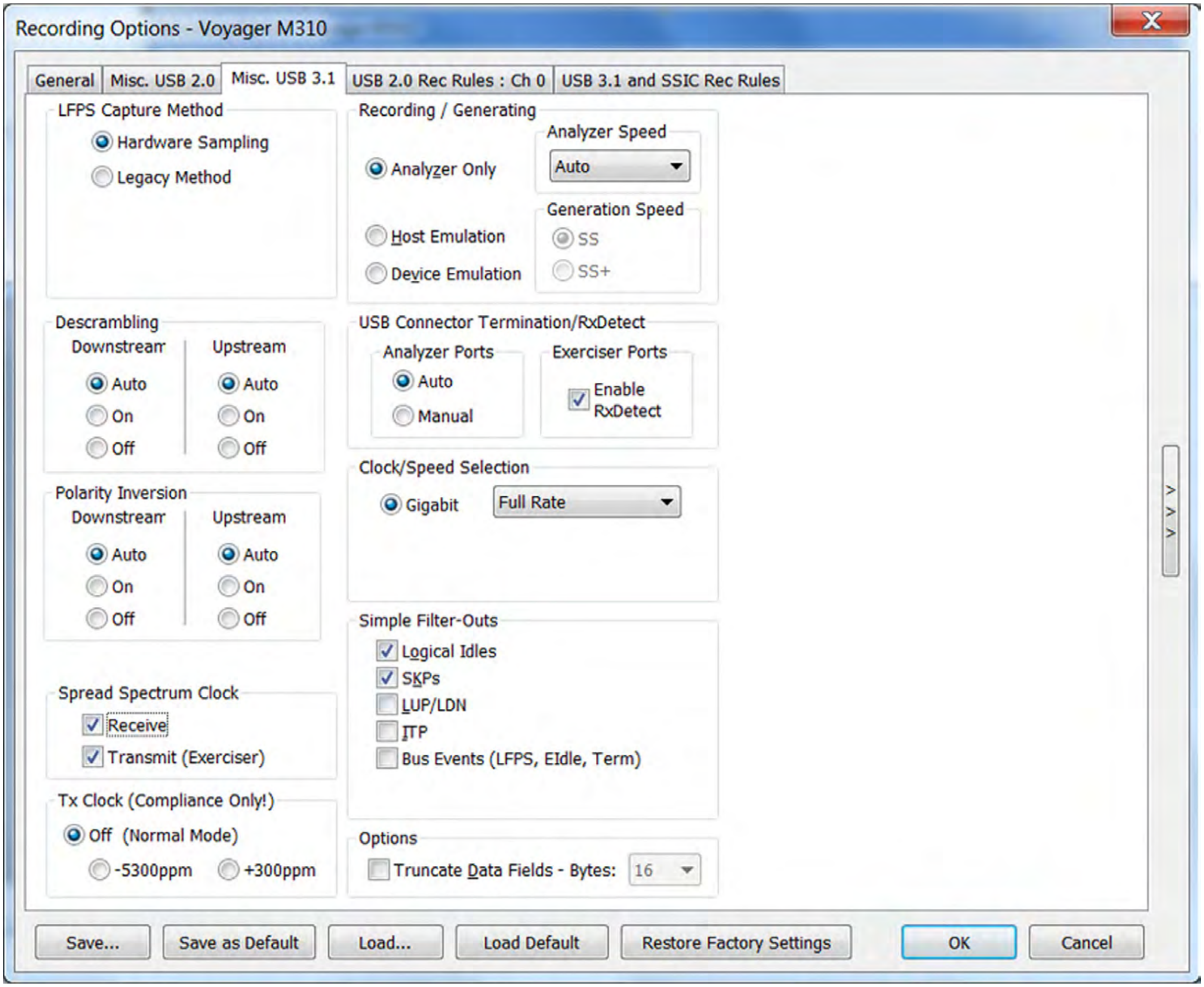


Figure 10.19: Recording Options - Misc. USB 3.1 for Voyager M310/M310C.

Note: Filtering LUP/LDN will apply to both channels on Power Delivery Systems, since the Data Roles can be swapped.

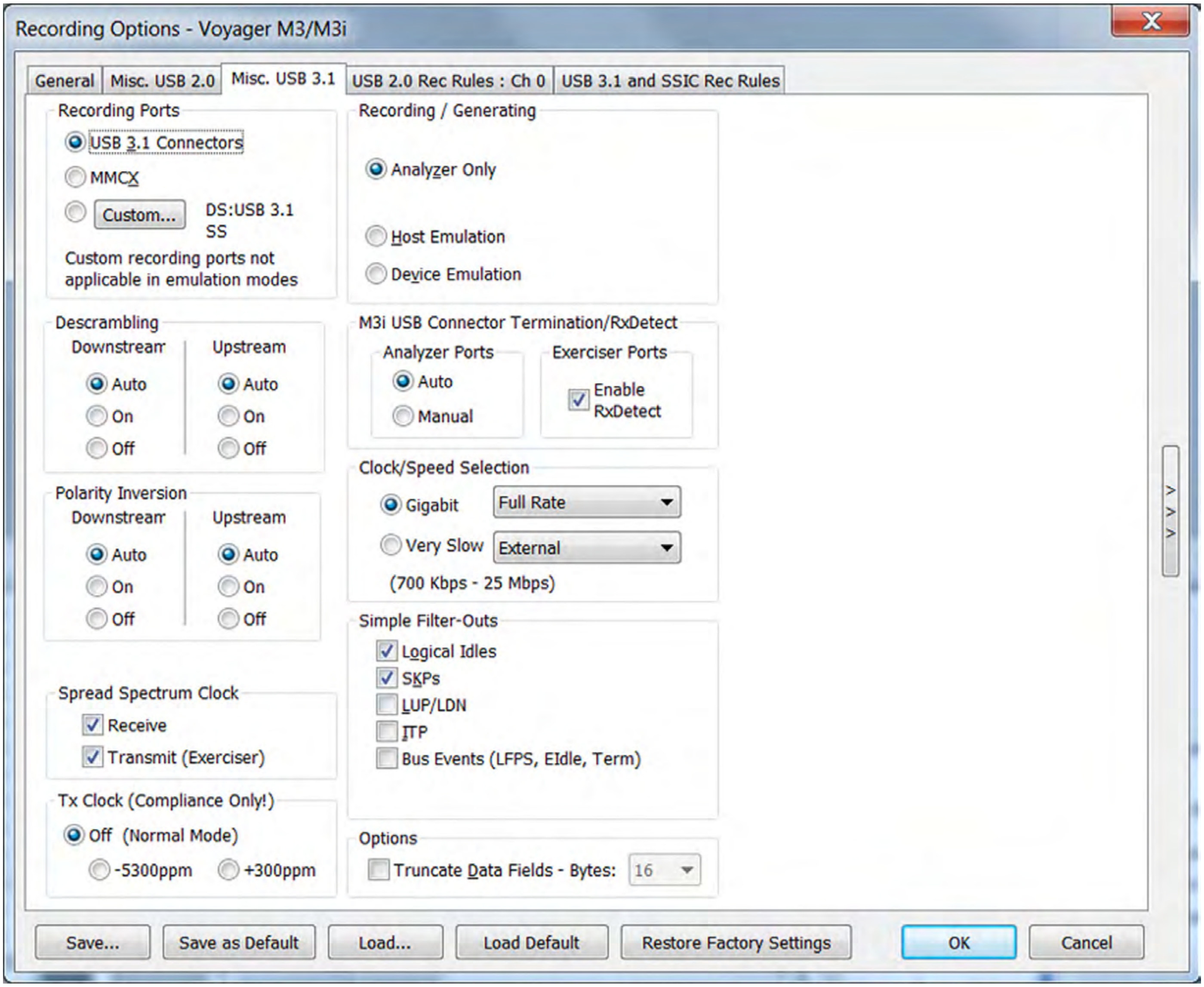


Figure 10.20: Recording Options - Misc. USB 3.1 for Voyager M3 and M3i.

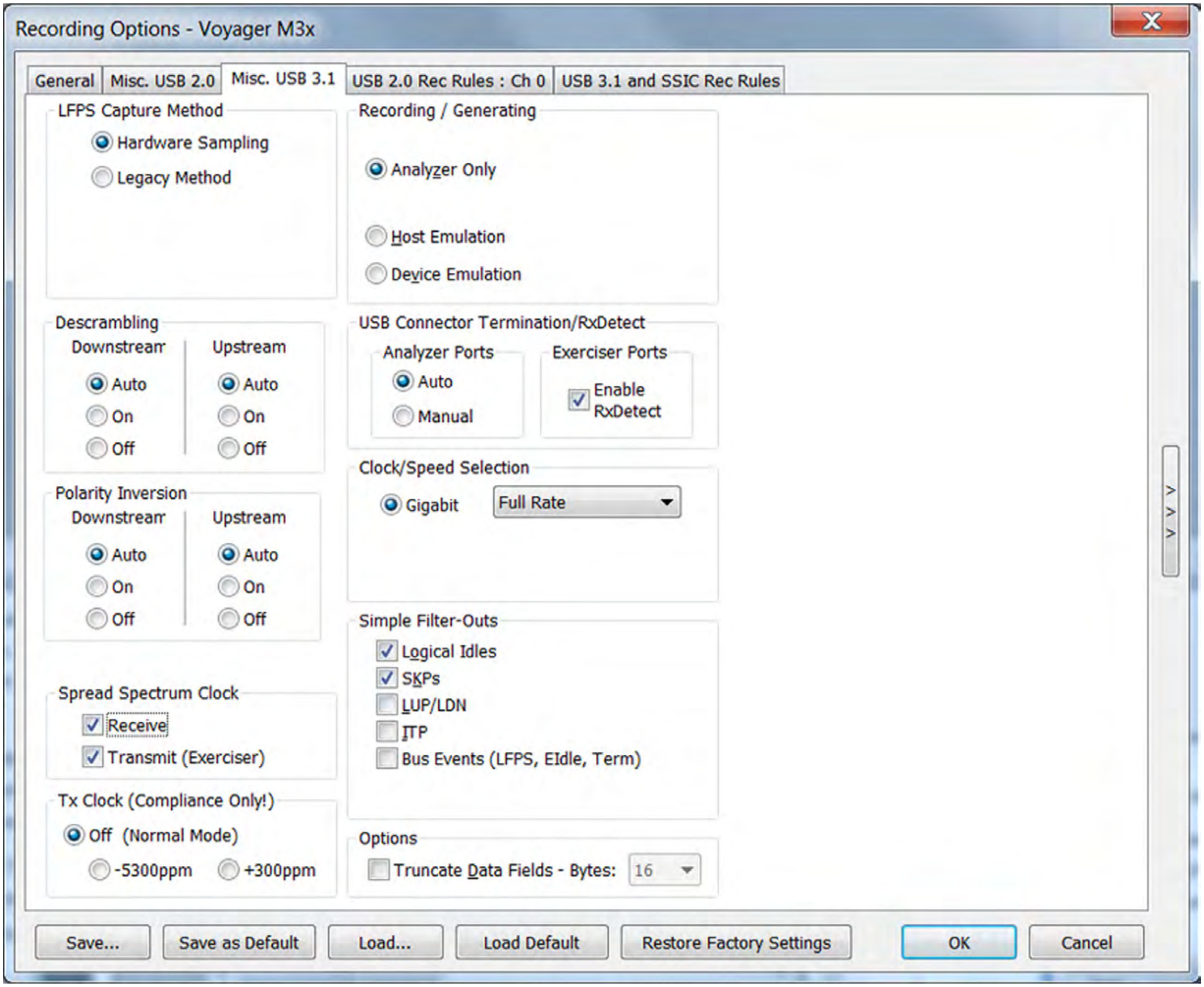


Figure 10.21: Recording Options - Misc. USB 3.1 for Voyager M3x.

LFPS Capture Method - The Voyager M3x has a special circuit designed to capture LFPS with very accurate timing. If for some reason a device or host is found which is not electrically compatible with this new design, the user can switch to the Legacy method which is used on previous USB 3.1 analyzers (Voyager M3x only).

For Recording Ports, select **USB 3.1 Connectors, MMCX**, or **Custom (DS:USB 3.1, US:USB 3.1)**. The custom option allows you to change the recording channels to use a mix of MMCX and USB 3.1 connectors (Voyager M3, M3i only).

For Descrambling, Downstream and/or Upstream, select On, Off, or Auto.

For Polarity Inversion, Downstream and/or Upstream, select **On, Off**, or **Auto**.

Note: For Spread Spectrum Clock, select **Transmit (Exerciser)** to apply Spread Spectrum Clocking to the transmitter. To adjust the receivers to be more tolerant to Spread Spectrum Clocking, select **Receive**. The Transmitter and Receive commands are independent of each other.

For Recording/Generating, select **Analyzer Only, Host Emulation**, or **Device Emulation.**

For Simple Filters, you can **Filter-Out Logical Idles, Filter-Out SKPs, Filter-Out LUP/LDN**, **Filter-Out ITP** or **Filter-Out Bus Events (LFPS, EIdle, Term)**.

Note: For Simple Triggers, for Downstream and Upstream triggers, you can select **Logical Idle, SHP, SDP, SLC, EPF, END, EDB, COM, SKP**, **K-Code, Symbol Error, RD Error, DP Length Error, Term On, Term Off and BCNT.**
For CRC Error Triggers, for Downstream and Upstream triggers: **CRC32, CRC16, CRC5 LCW,** and/or **CRC5 LC**.
For Framing Error Triggers, for Downstream and Upstream triggers: **SLC, SDP, SHP, EPF.**
For Low Power States, for Downstream and Upstream triggers: **U1, U2,** and/or **U3**. For U2, trigger only works for explicitly directed entry to U2. It does NOT work for the case when U1 times out and implicitly goes to U2, as the bus engine does not track this timeout value.
If you trigger on a CRC error type, the traffic in the trace file at or near the trigger may display as IPS (Inter-packet symbols), because the software might not detect proper framing symbols. Consequently, searches for CRC errors may not find the CRC trigger location.
To cause a trigger signal to appear on the External Trigger Out facility when the simple trigger(s) occur, select the **External Trigger Out with Simple Triggers**: checkbox.

For Clock/Speed Selection, select **Gigabit** as **5.0, 2.5, or 1.25 Gbps**. For Voyager M3/Mi, the **Very Slow** option allows you to customize the clocking frequency the Analyzer uses when capturing data. You can select **External or Internal** (see “Very Slow Clock Usage” section below.) Do NOT capture in 2.0 mode when 3.1 clock is in any of the slow modes.

For Termination/RxDetect (USB connectors only), you can select **Auto** or **Manual** for Analyzer Ports and **Enable RxDetect** for Exerciser Ports.

For Analyzer Ports, if you select the Manual mode, the Term button in the toolbar is enabled. For more information about the Recording buttons.

Note: The **Auto RxDetect** mode has been designed to recognize 3.1 hosts and devices and present 3.1 terminations to them when they are plugged in. However, some cases have timing that can cause the Host and Device not to connect or to go into USB 2.0 mode. If either of these timing cases occurs, click the **Momentary Disconnect** button on the toolbar to cause a Disconnect/Reconnect cycle of the VBus. If cycling does not work, disable and then re-enable the xHCI Host controller driver in the Windows 7 Device Manager of your PDK.

Truncate Data Fields -

Truncate the data fields in a Data Payload packet to the length specified in the pull-down selection. The actual amount captured is at LEAST the amount selected and may be up to 8 bytes more, depending on traffic, to increase efficiency of the Analyzer hardware.

Note: Truncating the payload will allow for more packets to fit in a trace, but it has the potential to prevent accurate decoding to higher layers (transfers, SCSI, etc).

M310/M310C Specific Selections

Analyzer Speed

Select to Auto-Detect either SS (5 Gbps) or SSP (10Gbps) traffic, or explicitly choose either one.

Generation Speed

Select either SS (5 Gbps) or SSP (10 Gbps) speeds for the Exerciser scenario.

10.5.1 Very Slow Clock Usage (Voyager M3/M3i ONLY)

The Voyager M3/M3i USB 3.1 Verification platform supports slower than standard clock rates for prototype and simulation testing. All Voyager 3.1 Pro systems include the option to select ½ and ¼ clock rates. This Gigabit clock can operate at 2.5 GHz (5 Gbps), 1.25 GHz (2.5 Gbps), and 625 MHz (1.25 Gbps) over standard USB cables. This “fractional clock” mode is also supported over the SMA (coaxial) inputs on the front of Voyager platforms that include the SMA option.

Two extra-cost slow clock options can enable use of external clock sources to synchronize the frequency of the Voyager system at slower clock rates:

- The upper-end of this external clocking supports rates from 12.5 MHz (25 Mbps) to as low at 350 kHz (700 Kbps). The Voyager slow clock kit USB-AC01-V01-X (see the table below) provides this capability and includes SMA-to-MMCX cables for attaching the external clock source. The external clock source is generated by the system ref-clock on the DUT or by a dedicated clock generator.
- To achieve clock frequencies below 350 kHz requires minor customization of the Voyager hardware platform. Teledyne LeCroy offers customization option USB-AC06-V01-X to remove capacitors on the SMA inputs only. This allows users to configure input frequencies at rates lower than 800 Hz for both protocol traffic generation and analysis.
- Very Slow Speed requires MMCX Connectors. The USB plug ports are not supported.

The table below outlines Voyager options for slow clock.

Model Number	Clock Frequency	Included
USB-TZP3-V02-X Voyager M3i Voyager M3i Pro Analyzer - Exerciser System	2.50 GHz (5.00 Gbps) 1.25 GHz (2.50 Gbps) 625 MHz (1.25 Gbps)	✔

USB-AC01-V01-X Voyager M3i USB 3.1 Slow Clock kit (includes 4 MMCX-to-SMA adapter cables and software license to support external clock input for Voyager M3 USB 3.1 analyzer and exerciser platform)	12.5 MHz to 350 kHz	
USB-AC06-V01-A Voyager USB 3.1 Custom MMCX Slow Clock (custom MMCX-SMA port for ultra slow clock operation)	Below 350 kHz	
USB-FE03-V01-X Voyager M3 USB 3.1 SMA probe kit (includes eight (8) MMCX-to-SMA cables and license key for SMA differential input tap)	NA	

Analyzer mode (but not Exerciser mode) requires a clock to both the Clock-A-In connector and the Clock-B-In connector on the front panel. The Clock-A-Out connector outputs the identical signal that was supplied to the Clock-A-In connector. The Clock-B-Out connector outputs the identical signal that was supplied to the Clock-B-In connector. You can use Clock-A-Out and Clock-B-Out to pass through the actual DUT onboard clock. If the Host DUT connects to port A, its Tx clock-out port should connect to Clock-A-In. Then, the Clock-A-Out can connect to the Device DUT Rx clock-in port. On the opposite side, the Device DUT Tx clock-out port should connect to Clock-B-In. Then Clock-B-Out can connect to the Host DUT Rx clock-in port.

Note: The Clock Out feature is only supported on Voyager M3i.

If Voyager is in Host Emulation mode, connect the clock to the Clock-A-In connector. The Exerciser uses this clock as its transmit clock and provides the identical output to the Clock-A-Out connector.

If Voyager is in Device Emulation mode, connect the clock to the Clock-B-In connector.

Example setups using Voyager USB 3.1 in Exerciser Device Emulation mode over SMA inputs with External Slow Clock option

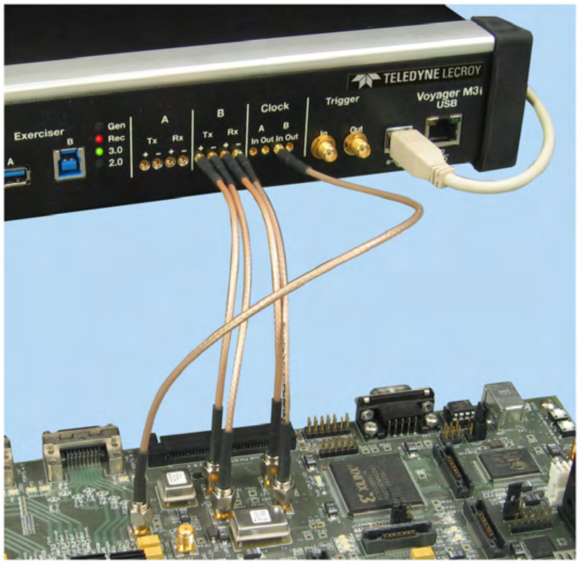


Figure 1: On-board clock signal

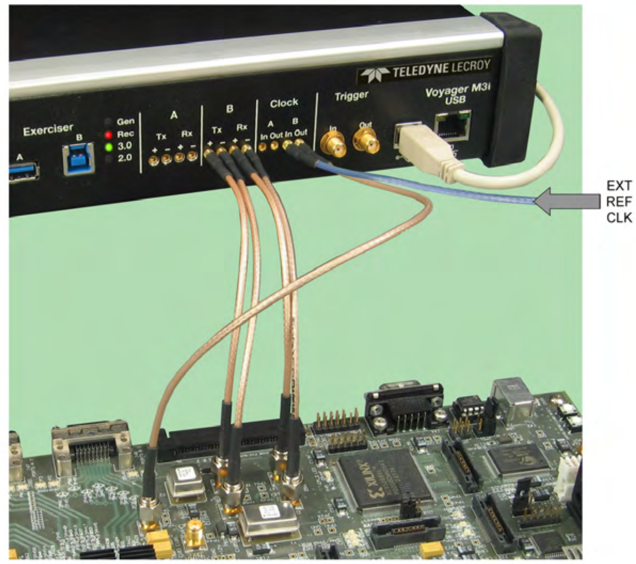


Figure 2: External reference clock

The Exerciser uses this clock as its transmit clock and provides the identical output to the Clock-B-Out connector. The analyzer scales down the timestamps in trace files to the clocks in use, so a symbol remains a 2-ns entity regardless of the clocking frequency value. All time values displayed in trace information reflect this scaled value, allowing easy comparison with the USB 3.1 specification. If the DUT provides its own Tx clock, you can connect the DUT clock to Clock In.

Note: Teledyne LeCroy recommends using a LVPECL clock driver, which can drive a 50-ohm load with a minimum peak-to-peak voltage swing of 200 mV. Maximum peak-to-peak voltage swing should not exceed 1700 mV. Note that these voltages are single ended, because only one of the differential signals is connected using the coaxial cable.

Note: On Voyager M3i only, there is an option to use the Internal 10-Mbps clock as a clock source. The Voyager 5-MHz clock is on both the Clock-A-Out and Clock-B-Out connectors. However, Teledyne LeCroy does not recommend using the Voyager clock. Voyager clock input is AC coupled and has no requirement for common mode voltage.

- For Host emulation, connect Clock Out A to Clock In A. You can use Clock Out B as the clock source for the DUT.
- For Device emulation, connect Clock Out B to Clock In B. You can use Clock Out A as the clock source for the DUT.

IMPORTANT: If you switch from Very Slow Clock back to Gigabit data rates, you must save the recording options and then power-cycle the Voyager.

External Clock Input Specifications

The external clock input is 3.3-volt LVPECL and operates on the USB 3.1 differential signals only (not USB 2.0 signals). Device setup should be AC coupled at the clock input with a 10-uF ceramic capacitor.

When enabled, the external slow clock option affects both the SuperSpeed analyzer (record) and the exerciser (transmit) frequencies. The clock source must be able to drive a 50-ohm load with a minimum peak-to-peak voltage swing of 200 mV. Maximum peak-to-peak voltage swing should not exceed 1700 mV. Note that these voltages are single ended, as only one of the differential signals is connected via the coaxial cable.

When operating at 1.25-Gbps to 5-Gbps modes, the data lines are directly connected to Rocket I/O ports. The very slow external clock mode will bypass the high speed Rocket I/O logic and use a SERDES implemented in the FPGA fabric. The low end of clock speed is limited by the value of the AC coupling caps on the inputs and the trace impedance. The SMA inputs use a 0.1-uF capacitor with a nominal trace impedance of 50 ohms. This mandates the 350-kHz slow clock limit over the Voyager SMA inputs.

Some software-based emulation environments require rates as low as 10 Hz. For this application, Teledyne LeCroy offers a one-time customization of the Voyager hardware platform by removing the 0.1-uF capacitor on the Voyager SMA inputs, allowing the clock inputs to track externally supplied clock frequencies below 350 kHz. Although removal of this capacitor will render the SMA input ports non-compliant with 5-Gbps signaling, the native USB 3.1 connectors will continue to operate within the USB 3.1 electrical specification.

10.6 Recording Options - Misc. USB 3.1 for Advisor T3

The **Misc. USB 3.1** tab presents options for setting Descrambling, Termination/RxDetect, Polarity Inversion, Simple Filters, and Truncate Data Fields.

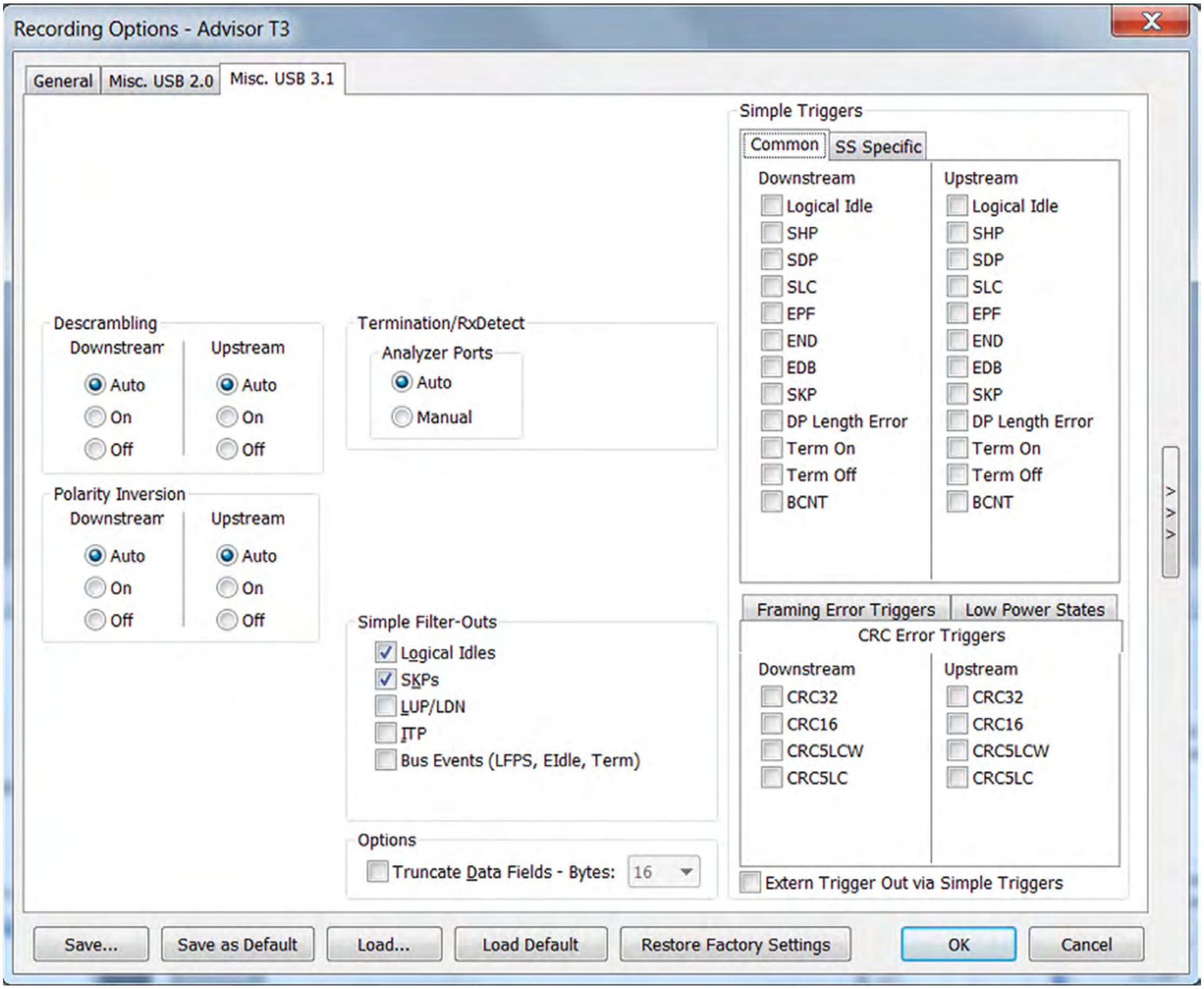


Figure 10.22: For Descrambling, Downstream and/or Upstream, select On, Off, or Auto.

For Termination/RxDetect you can select **Auto** or **Manual** for Analyzer Ports and **Enable RxDetect** for Exerciser Ports.

For Analyzer Ports, if you select the Manual mode, the Term button in the toolbar is enabled. For more information about the Recording buttons, see "Recording" on page 128.

Note: The **Auto RxDetect** mode has been designed to recognize 3.1 hosts and devices and present 3.1 terminations to them when they are plugged in. However, some cases have timing that can cause the Host and Device not to connect or to go into USB 2.0 mode. If either of these timing cases occurs, click the **Momentary Disconnect** button on the toolbar to cause a Disconnect/ Reconnect cycle of the VBus. If cycling does not work, disable and then re-enable the xHCI Host controller driver in the Windows 7 Device Manager of your PDK.

For Polarity Inversion, Downstream and/or Upstream, select **On, Off**, or **Auto**. For Simple Filters, you can **Filter-Out Logical Idles, Filter-Out SKPs, Filter-Out LUP/LDN**, **Filter-Out ITP** or **Filter-Out Bus Events (LFPS, EIdle, Term)**.

For Simple Triggers you can select the relevant Downstream and Upstream Triggers.

Select one of the Framing Error Triggers, Low Power States and CRC Error Triggers.

Truncate Data Fields

Truncate the data fields in a Data payload Packet to the length specified in the pull-down selection.

Check External Trigger Out with Sample Triggers if needed.

Note: Truncating the payload will allow for more packets to fit in a trace, but it has the potential to prevent accurate decoding to higher layers (transfers, SCSI, etc).

10.7 Recording Rules Actions and Action Properties

Note: For both USB 2.0 and USB 3.1.

The Actions are:

Action	Description
Trigger	Indicate Trigger event in the captured trace file.
Stop Recording	Stop further recording once the trigger condition has been met. (USB 3.1 only) This action is active in any of the three Trigger Modes (Snapshot, Event Trigger, Manual Trigger).
Filter-In	Include in the trace file the event specified (and no others). This action is active in any of the three Trigger Modes (Snapshot, Event Trigger, Manual Trigger).
Filter-Out	Exclude from the trace file the event specified. This action is active in any of the threeTrigger Modes (Snapshot, Event Trigger, Manual Trigger).
Advance the Sequence	Go to the next state in this sequence (sequence in which this action is located).
Restart All	Restart all sequences.
External Trigger Pulse HIGH	Send HIGH pulse on external trigger output.
Properties	Opens the Event Properties dialog box.

Filter-Out

Filtering Start-of-Frames (SOF's) in USB 2.0 captures can inhibit the ability of the software to decode upper layers (transfer and above) properly. The SOF is used as a delimiter of traffic in the analysis heuristics, and its absence can cause a failure to recognize whether transactions should be joined into a given transfer. If you are seeing transfers that do not appear correct (for example, at the SCSI level), and you have filtered SOF's, it is recommended that you repeat the capture with filtering of SOF's turned off.

Similarly, if ITP packets are filtered from a USB 3.1 capture, it is impossible to distinguish between false and real sequence errors, so it is not recommended to filter these. If they are filtered, sequence errors should be ignored.

Trigger

Trigger position in the resulting trace cannot always be determined precisely, due to hardware limitations. In >95% of the cases, the trigger packet shown in the trace file is the one which caused the trigger. In the other exception cases, it should still always be within three packets of the actual triggering event.

Stop Recording

This will stop recording very quickly after the trigger condition occurs, but requires a small amount of post-trigger traffic before it completes. This is done so that a trigger on a packet will still allow the remaining part of that packet to be captured. For this reason, it is not recommend to use Stop Recording action for events which are not followed by any more traffic, such as Term-Off. In these cases, the recording will appear stuck waiting for the additional small amount of activity.

Error Event Action Properties

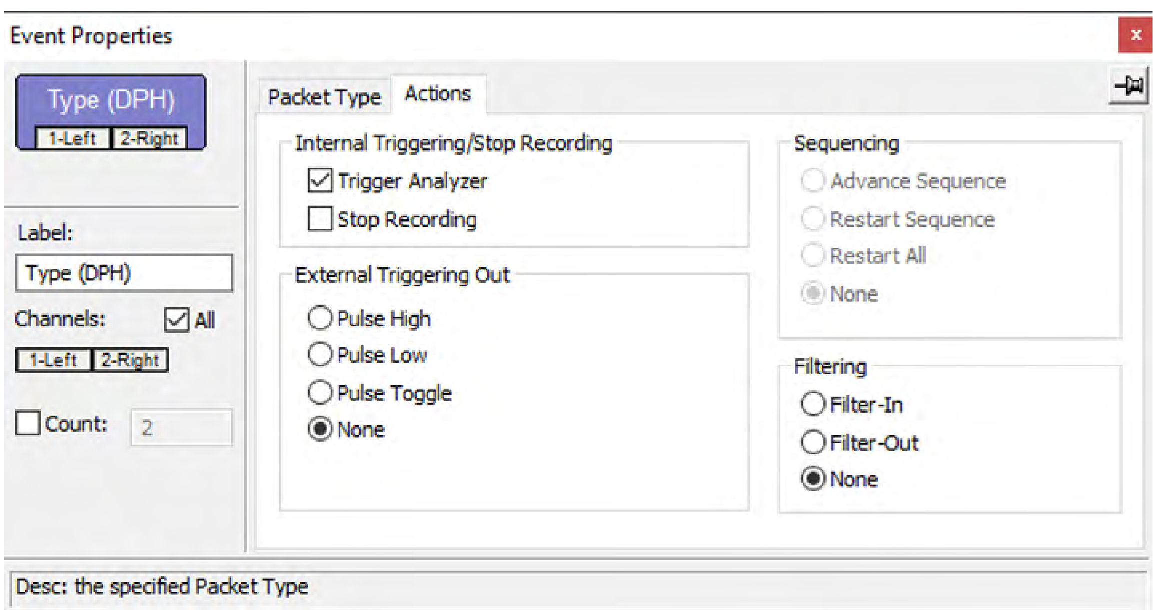


Figure 10.23: Event Properties: Actions Dialog.

You can set Internal Triggering, External Triggering, Sequencing, and Filtering.

Note: Due to analyzer limitations in USB 3.1 capturing, some items cannot be filtered when they occur back-to-back in the capture stream. These items include small packets, such as LMP packets. When these items occur back-to-back, it can cause filtering not to work. In some cases, it can cause unexpected symbols to be captured as Inter-Packet Symbols (IPS), which cannot be decoded to real USB 3.1 packets by the analyzer software.

10.8 Recording Rules - USB 2.0

Use the Recording Rules to set triggers and filters for USB 2.0.

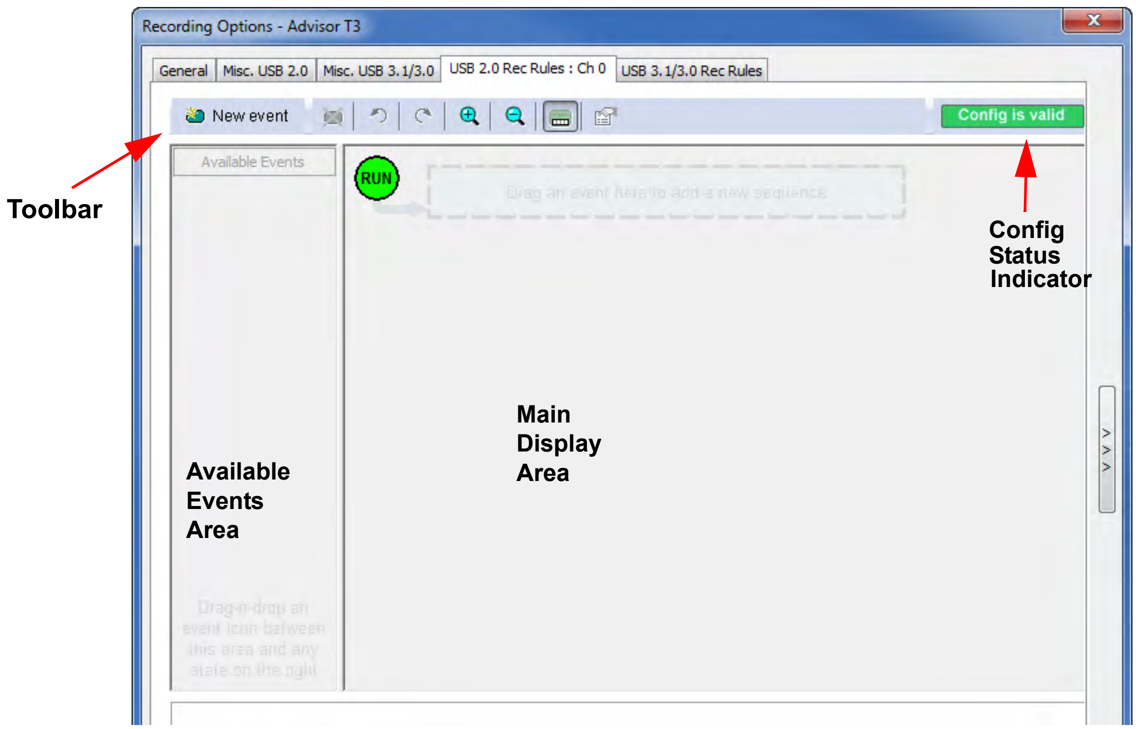


Figure 10.24: Recording Rules USB 2.0 Dialog.

The page has the following areas:

- **Toolbar:** Contains buttons that control the Recording Rules page.
- **Available Events Area:** Area where you can park Event buttons that you intend to use in the Main Display area.
- **Main Display Area:** Area where you configure trigger and filter rules. You configure rules by dragging Event buttons from the Available Events area and then assigning actions to those buttons.
- **Config Status Indicator:** A button that indicates if the rule is valid or invalid. If a trigger or filter rule is configured correctly, the button is green and indicates Config is Valid. If a rule is not configured correctly, the button is red and indicates Config is Invalid.

Pop-Up Menus: When you right-click a button or area in the Recording Rules page, a context-sensitive pop-up menu appears that lets you do operations that relate to that button or area.

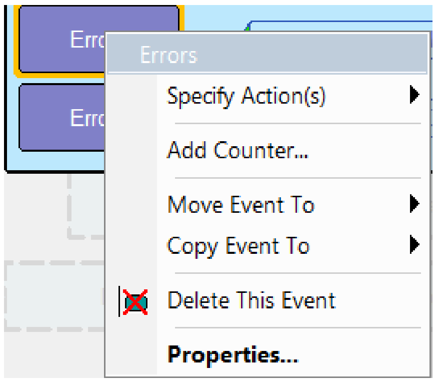


Figure 10.25: PO-Up Menu.

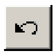
Properties Dialogs: When you click the Show/Hide Properties Dialog button for an event, action, or state, a dialog allows you to perform the same operations as in the pop-up menus.

10.8.1 Recording Rules Toolbar

The Recording Rules toolbar buttons control the Recording Rules page.

Figure 10.26: Recording Rules Toolbar.

TABLE 10.2: Recording Rules Buttons

	New Event. Creates a new event in the Available Events area.		Zoom Out. Makes the display appear smaller.
	Delete Event. Deletes the selected event.		Show/Hide Channels. Shows or hides the channel icon on the Event button.
	Undo. Undoes the change made to Recording Rules page. The Undo buffer has unlimited size.		Show/Hide Properties Dialog. Shows or hides the properties dialog of the selected event, action, or state.
	Redo. Restores changes done to the Recording Rules page.		This display appears when the current Recording Rules configuration can be executed by the hardware.
	Zoom In. Enlarges the display (see note). There are five zoom levels. The default level is the middle one.		This display appears when the current Recording Rules configuration cannot be executed by the hardware.

Note: If you have a wheel on the mouse, you can zoom by holding down the CTRL key and rolling the mouse wheel.

10.8.2 Recording Rules Page: How It Works

You can think of the Recording Rules page as a workspace for creating recording rules (rules that determine how the analyzer records traces). Recording rules are combinations of events and actions.

An event and the action or actions associated with it form a rule state. One or more states are encapsulated in a sequence.

Note: There can be from one to 512 states within a sequence. You can associate one or more events with each state, and you assign each event a different action or the same action.

A sequence that has only one state is called a single-state sequence. The analyzer continuously watches for each event in the sequence and executes the corresponding action if the event is detected.

A sequence that has multiple states is a multi-state sequence. The states are arranged in a hierarchy, with a top state and successively lower states. Only one state in a multi-state sequence is active at a time. The analyzer does not go to a successive state unless it is directed to do so by the previous state.

Sequences are described in detail in "Using Sequences" later in this chapter.

Briefly, creating a rule involves the following steps:

1. Creating Event buttons in the Available Events area.
2. Drag-and-drop of Event buttons to the appropriate areas (cells) in the Main Display area.
3. Assigning an action or actions to each Event button.

10.8.3 Creating Event Buttons

To create a rule, first create one or more Event buttons. As you create Event buttons, they appear in the Available Events area. You then can drag-and-drop them into the Main Display area.

To create event buttons:

1. Click the **New Event** button at the left side of the toolbar to display the New Event pop-up menu (see Figure 10.27 on page 372).

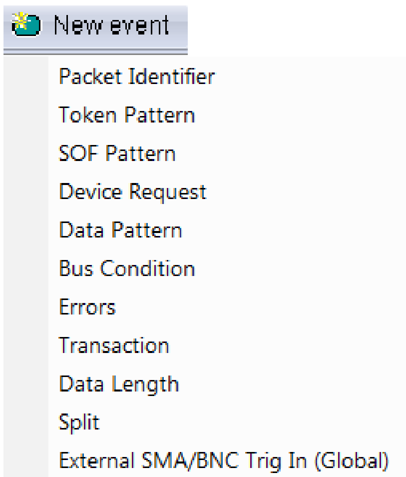


Figure 10.27: New Event Pop-up Menu.

2. Select an event, such as Errors. The event appears in the Available Events area.

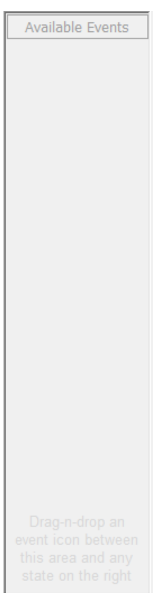


Figure 10.28: Available Events Area.

10.8.4 Dragging a Button to the Main Display Area

After you create an Event button in the Available Events area, you can drag the button to the Main Display area and drop it in the appropriate cell (a cell is a grayed-out rectangle with a dashed line around it). You can think of each cell as a target for drag-and-drop of an Event button.

There are two types of cell that might appear: Sequence cell and State cell. In the Main Display area, they are labelled as follows:

- **Sequence cell**: Drag an event here to add a new sequence.
- **State cell**: Drag an event here to add another state.

If there currently are no events in the Main Display area, a single sequence cell appears at the top of the area.

To drag-and-drop the Event button:

1. Place the mouse cursor on the Event button in the Available Events area. Click the left mouse button.
2. Drag the button to the cell. When the button is in the cell, a dashed highlight line appears around the cell. Drop the button in the cell (release the left mouse button). The Event button appears in the cell.

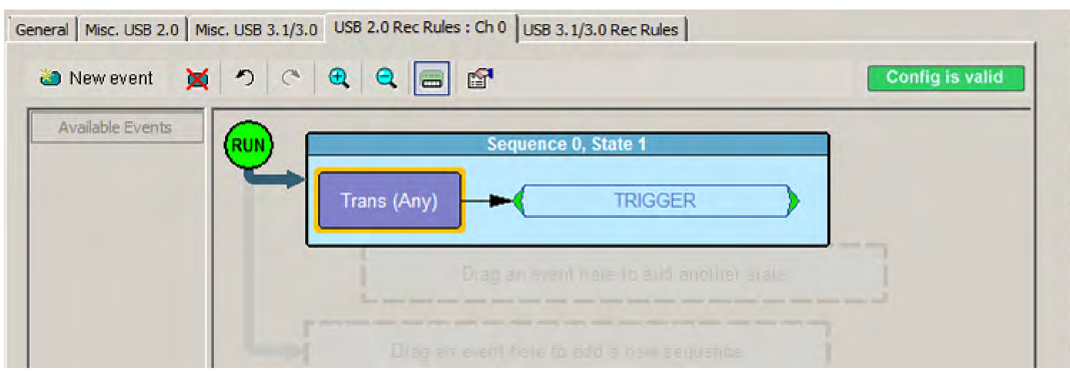


Figure 10.29: Events Button in Cell.

The default label for the first cell is "Sequence 0, State 1." As described later in this section, you can change that label using the Properties pop-up for that cell.

Two new cells appear under the first cell. The first of these new cells is a state cell that allows you to create another state in rule Sequence 0 (to make Sequence 0 a multi-state sequence).

The second of the new cells is to create a separate sequence, which would be labelled Sequence 1.

10.8.5 Assigning an Action

After you have dropped the Event button in a cell in the Main Display area, you can assign an action to the event.

Note: If you do not assign an action to an Event button, the analyzer ignores the event.

To assign an action to an Event button:

1. Right-click the **Event** button to display a pop-up menu (see Figure 10.30 on page 374.)

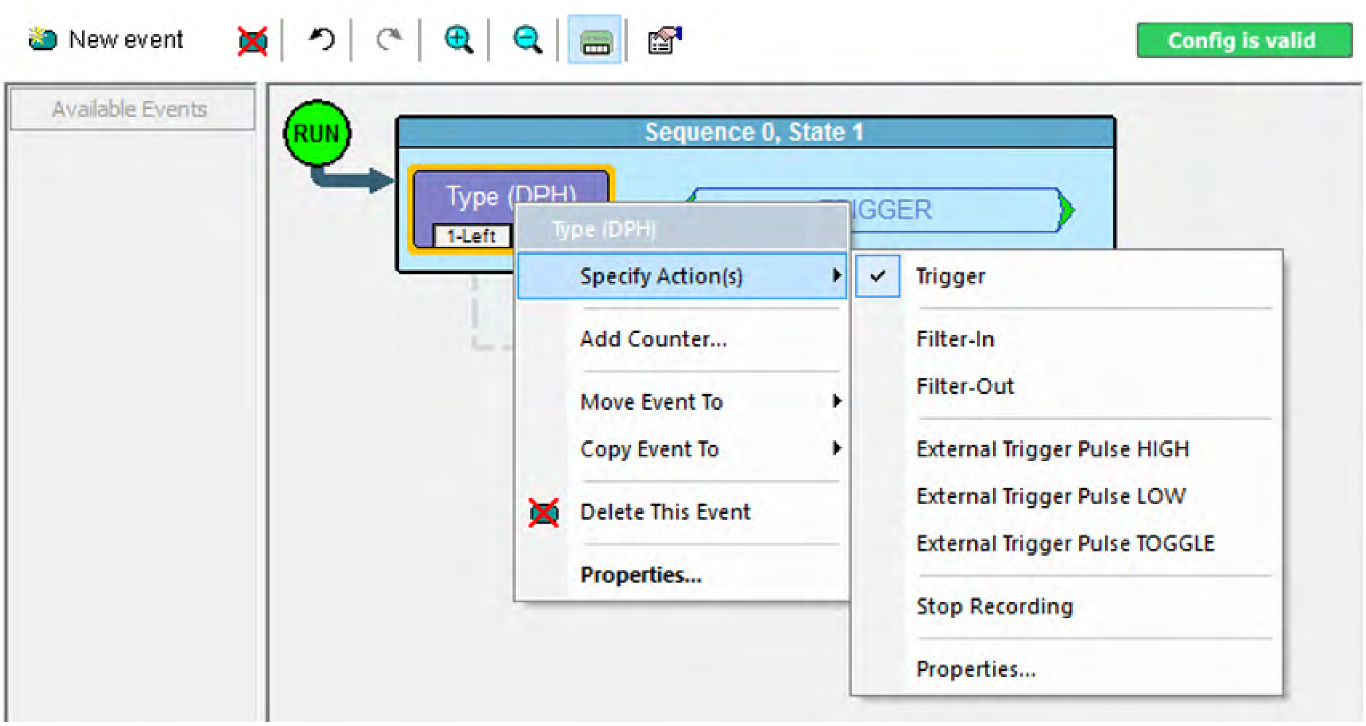


Figure 10.30: Assigning Action to Event Button.

2. Select **Specify Action**, and then choose an action from the submenu. The menu closes, and the action is assigned.

Note: You can also set actions within the Properties dialog for each event. Double-click the Event button to open the Properties dialog, then select the Actions tab and set your actions. See Figure 10.31.

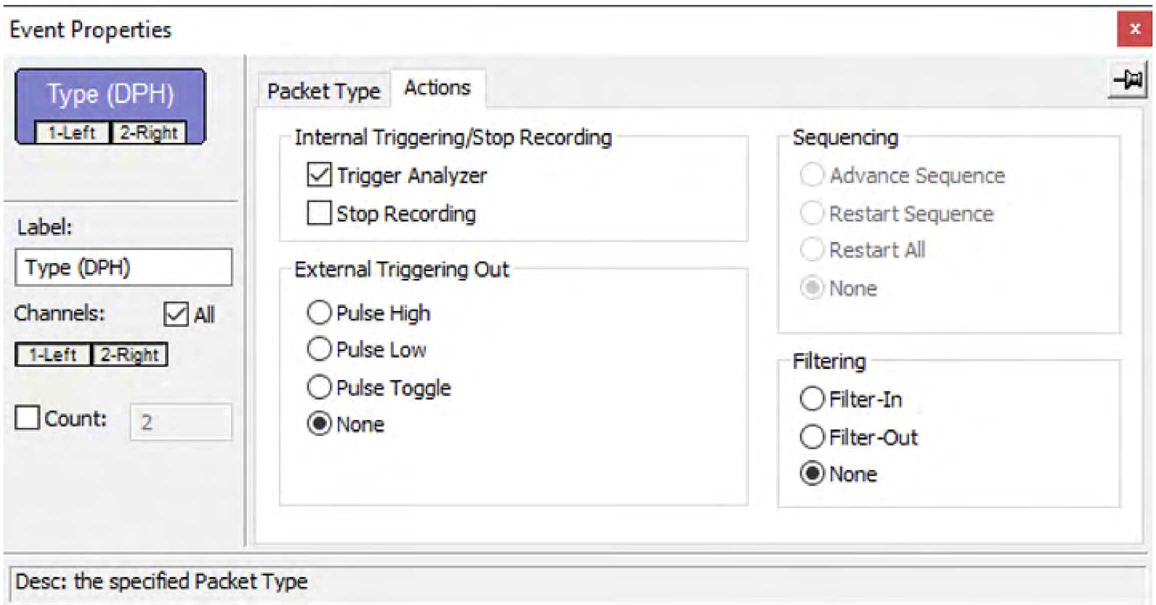


Figure 10.31: Action Assigned.

10.8.6 Recording Rules Pop-Up Menus

The Recording Rules window has context-sensitive pop-up menus that are associated with the following types of object: cells, events, and actions.

Cell Pop-up Menu

If you click a cell in the Main Display area that has an Event button contained in it, the Cell pop-up menu appears. The Cell pop-up menu has the following options.

- **New Event**: Displays the same menu that you get when you click the New Event button on the toolbar.
- **Properties**: Displays the Properties dialog for the selected cell.

Action Pop-up Menu

If you click an Action button in the Main Display area, the Action pop-up menu appears. The Action pop-up menu has the following trigger and filter options:

- **Trigger**: Sets or clears Trigger action.
- **Filter-In**: Sets or clears Filter-In action. If Filter-In is set, you cannot use Filter-Out (it is disabled).

Note: The Filter-In function is meant to be used to capture traffic for a specific device address or specific device endpoint by specifying the ones that should be captured. It does not Filter-Out certain packets which are not associated with specific devices, such as Strat-Of-Frames (SOF's)

- **Filter-Out:** Sets or clears Filter-Out action. If Filter-Out is set, you cannot use Filter-In (it is disabled).

Note: Examples that show use of filters are provided later in this chapter.

Advance the Sequence: Creates an event sequence consisting of the event you clicked on and an event in a successive state of the sequence. A thick arrow appears from the selected event and points downward. See Figure 10.32.

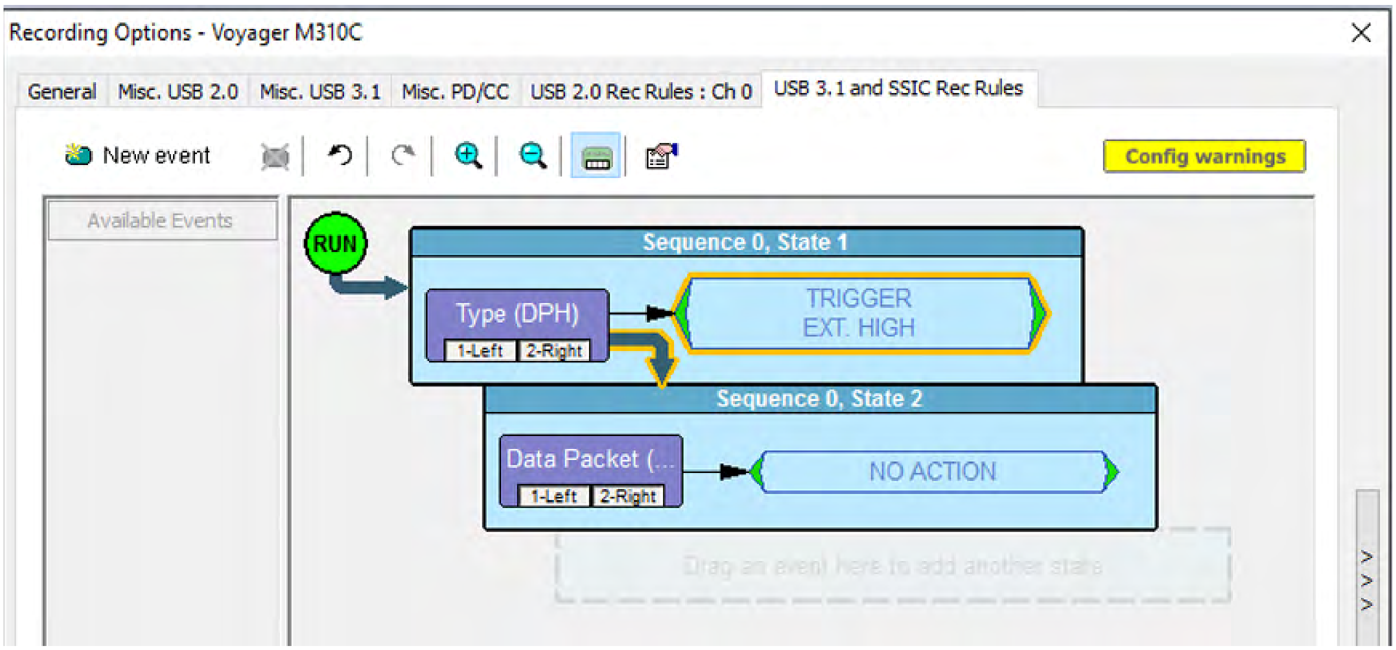


Figure 10.32: Advancing the Sequence.

In other words, the **Advance the Sequence** button is the link between two states in a multi-state sequence. The **Advance the Sequence** arrow tells the analyzer to go to the next state if it detects the event at the tail (origin) of the arrow.

The Action pop-up menu has the following restart and trigger options:

- **Restart the Sequence (not shown)**: Restarts the sequence. Note that this option is context-sensitive and only appears if you have created a multi-state sequence. A thick arrow appears from the selected event and point upward towards the first event in the sequence.
- **Restart All:** Restarts all rules in all sequences and in the global state and displays an arrow and a Restart All button. This action precludes selecting Advance the Sequence and Restart the Sequence.
- **External Trigger Pulse HIGH:** Sends an output signal with a Pulse High format through the output ports on the back of the UPAS. Pulse High is the default format. Pulse High causes the analyzer to transmit a 5-volt, 40-nanosecond signal. Teledyne LeCroy Protocol Analyzers use a TTL compatible output driver. This driver is not intended to drive a 50 ohm DC load. When doing so the output level is reduced from 3.3 volts to 2.2 volts. This does not harm the output driver. To see the full level, it is required to change the input impedance on the device receiving the trigger from 50 ohms DC to high impedance.
- **Properties**: Displays the Action Properties dialog for the selected action.

Event Pop-up Menu

If you click an Event button in the Main Display area, the Event pop-up menu appears. The Event pop-up menu has the following options:

- **Specify Action(s)**: Opens the Actions submenu, allowing you to assign an action to the event. Options on this submenu are the same as those on the Action pop-up, described previously.
- **Add Counter:** Adds a counter to count a specified number of times the event occurs before the analyzer executes the corresponding action.
- **Move Event to:** Moves the selected event to a different position in the Recording Rules window.
- **Copy Event to:** Copies the selected event to a different position in the Recording Rules window.
- **Delete This Event:** Deletes the selected Event. Alternatively, you can use the Delete button on the toolbar or keyboard to delete events.
- **Properties**: Displays the Event Properties dialog for the selected event.

10.8.7 Events and Event Properties for USB 2.0

Recording rules are associations between events and actions. These associations determine how trace recording occurs.

For Voyager, the supported events for USB 2.0 are:

- Packet Identifier
- Token Pattern
- SOF Pattern
- Device Request
- Data Pattern
- Bus Condition
- Errors
- Transaction
- Data Length
- Split
- External Trigger In (see **Notes on External Trigger In** below)

For Tracer/Trainer, the supported events for USB 2.0 are:

- Packet Identifier
- Token Pattern
- SOF Pattern
- Device Request
- Data Pattern
- Bus Condition
- Errors

Note: External Input Signal (UPAS 2500) (see **Notes on External Trigger In** below)
External input triggers only work on Channel 0 on the USB Tracer/Trainer.

- Transaction
- Data Length
- Split
- Extern Data7-Data0 In (UPAS 2500)

For Advisor, the supported events for USB 2.0 are:

- Packet Identifier
- Token Pattern
- SOF Pattern
- Device Request
- Data Pattern
- Bus Condition
- Errors
- Transaction
- Data Length
- Split

For Mobile, the supported events for USB 2.0 are:

- Packet Identifier
- Token Pattern
- SOF Pattern
- Device Request
- Data Pattern
- Bus Condition
- Errors
- Transaction
- Data Length
- Split

Notes on External Trigger In

Input threshold value for Voyager and Advisor T3 is 0.8 V.
Input threshold values for USB Tracer/Trainer are between 0.8 V and 2 V (TTL Levels).

The minimum value of the external input signal which can be input to Voyager, Advisor T3, and USB Tracer/Trainer is 0 V. The maximum value is 5 V.

Event Properties (of the Error Event)

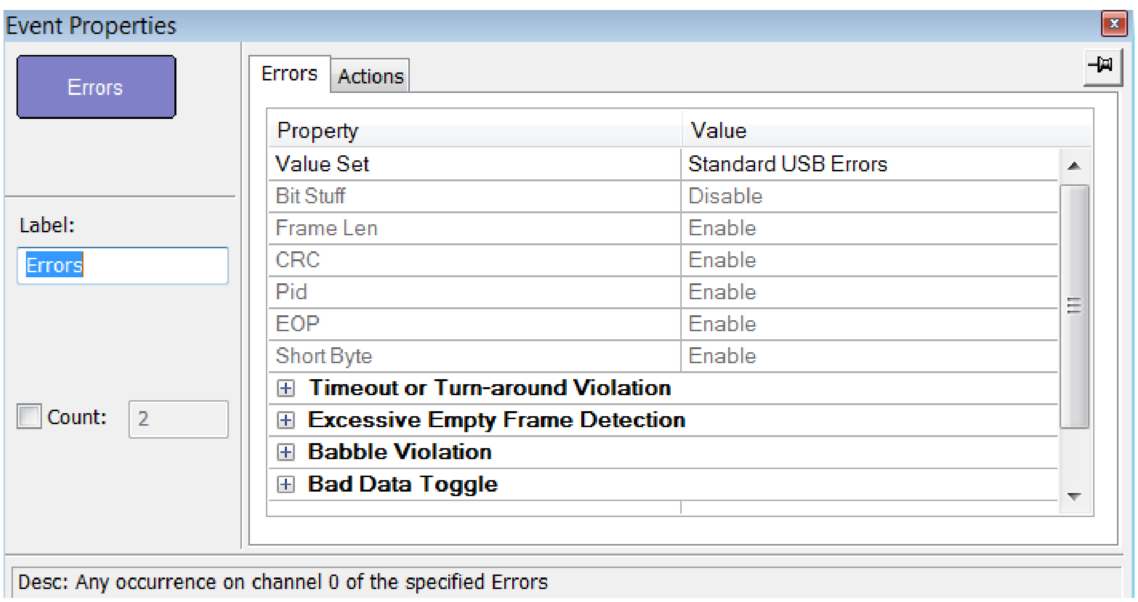


Figure 10.33: Event Properties Dialog.

The dialog lists the Properties and their Values.

Note: The default values of Babble clocks and Time-out or Turnaround violation are based on the recording speed selected in the 2.0 Misc tab. If the selected speed is Auto-Detect, the defaults are based on Hi Speed traffic, since this is the most prevalent speed today.
If you change the recording speed AFTER you have defined error events, the Babble clocks and Time-out or Turnaround violation values are NOT updated, so you can get a false trigger or a missed error.

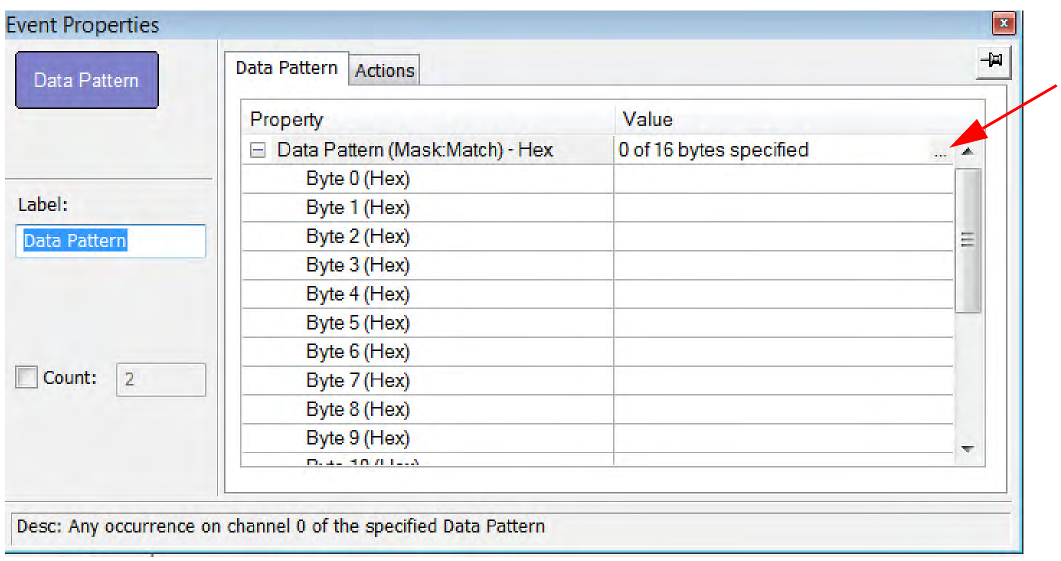
Therefore, to ensure Babble and Turnaround triggers have the correct default values, you should follow this procedure:

1. Set the Recording Speed to the explicit value you are going to be capturing (Hi, Full, or Low) in the 2.0 Misc tab. Do not use Auto-Detect.
2. Delete any error triggers from the Rec Rules tab.
3. Save your recording options as Default.
4. Close the Recording Options dialog.
5. Open the Recording Options Dialog.
6. Select the Errors trigger in the Rec Rules Tab.
7. If capturing Hi Speed, verify that the default value for Babble trigger is 7435.
8. If capturing Full or Low Speed, verify that the default value for Babble trigger is 59840.

If you always leave the speed set to a specific value due to testing the same device or class of devices all the time, the values will remain correct when you open the Rec Rules dialog.

Data Pattern Mask and Match

If you select Data Pattern as the Event, you can set Data Pattern event properties in the Event Properties dialog.



Click the "**...**" button at the right of the first line to display the Data Pattern dialog (see Figure 10.34 on page 381).

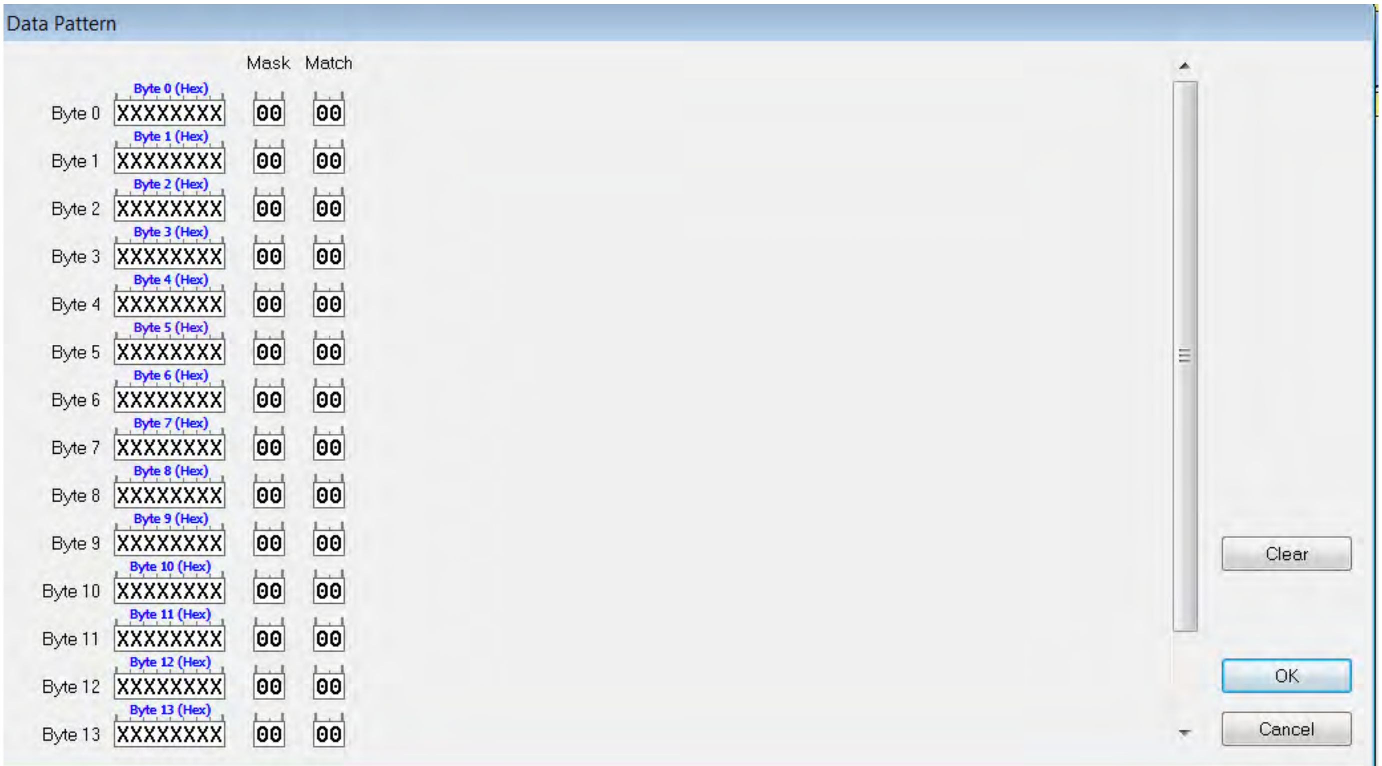


Figure 10.34: Data Pattern Dialog.

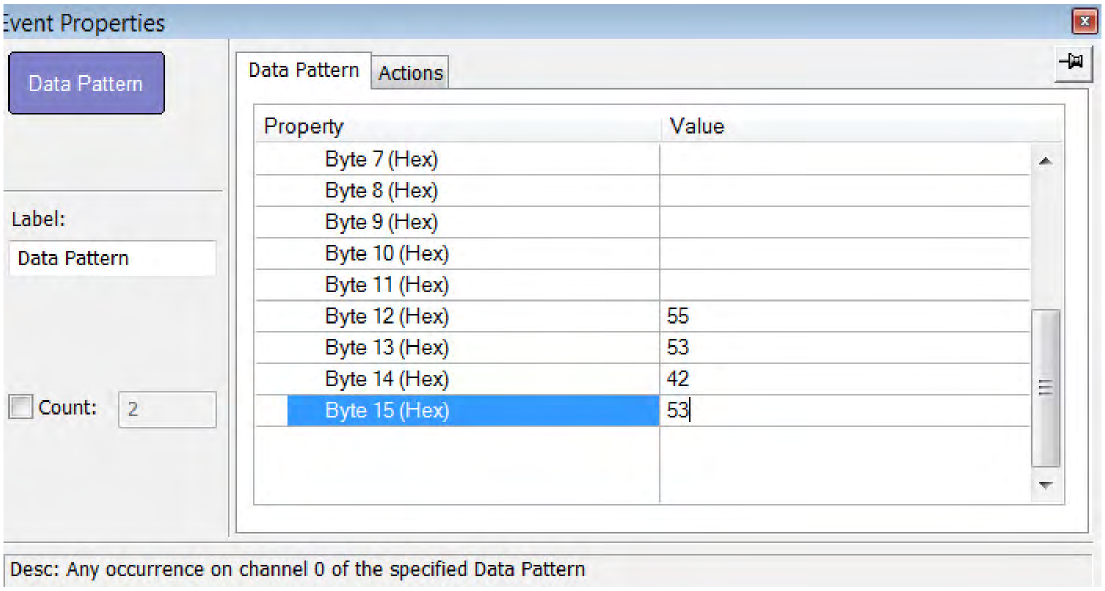
In the Data Pattern dialog, you can set the Bitmask, Mask, and Match for each bit,

Bitmask and Match always correlate. When you set Bitmask or Match, the other changes to maintain their correlation.

Note: If you set Bitmask/Match before setting Mask, the Mask changes to the default mask. You must change to the Mask that you want.

If you set an appropriate Mask before setting Bitmask/Match, the Mask does not change automatically to a default mask if you change Bitmask/Match.

Note: If you are trying to match less than 16 bytes of data and want it to match the pattern in a data payload which might be less than 16 bytes, align your pattern to the END of the 16 byte mask/match array. For example, if you want to match the SCSI header “USBS” in a payload that MIGHT be less than 16 bytes, you would fill out the table as follows:



This will match the pattern in a payload of sizes 4 through 1024.

10.8.8 Counters for USB 2.0

Counter: A counter tells the Analyzer to search for *x* instances of the selected event. For example, if you enter **10**, the Analyzer counts 10 instances of the selected event before it performs whatever action you assign. Counters cannot be applied to events with Filter Actions. The maximum counter value is 65,535.

Triggers can be set on multiple instances of an event. For example, you can set a trigger to occur following five instances of any DLP. To configure the Analyzer to look for multiple events, you enable Counters. Counters tell the Analyzer how many occurrences of an event for which it should wait before triggering. For example, use a counter to Trigger following the 16th occurrence of an error or DLLP message.

Events and Actions

Within events, counters determine how many times the event must occur before the associated actions are triggered. Event counters typically have two properties:

- **Count Randomly**: Can be set to “Yes” or “No” (default value is “No”). If set to “Yes”, the event repeats a random number of times (between 1 and the value set in the property Max Random Count, which replaces the property Counter Value when “Yes” is selected), before the action is triggered.
- **Counter Value**: Number of repeats required when Count Randomly is set to “No”. The default value is 1.

Within actions, counters determine how many times the system calls the action before it acts. Action counters typically have two properties:

- **Random**: Can be set to “Yes” or “No” (default value is “No”). If set to “Yes”, the action triggers a number of occurrences before the action takes place. That number ranges randomly between 1 and the value set in the property At least every Nth occurrence, which replaces the property Every Nth occurrence when

"Yes" is selected.

- **Every Nth occurrence**: Number of times the system calls the action before it acts.

Note that there is some overlap in the way these counters can be used. For example, in the simple case of a single event leading to a single action, it makes no difference whether you specify the event to require five repeats before triggering the action, or the action to require five occurrences before it acts.

However, in the case of combined events and/or actions, the separate counters provide flexibility in designing test cases. For example, consider the case where Event_1 OR Event_2 leads to Action. If Event_1 has a counter of 5, then the Action triggers either when Event_1 has repeated five times or when Event_2 happens the first time, whichever occurs first.

But if the event counters are set to 1 and the Action counter is set to 5, then the Action happens after five occurrences of EITHER Event_1 or Event_2.

Number of Analyzer Counters

This analyzer includes two USB 2.0 counters. If you try to assign more, you will get a warning.

Packets

You must assign a packet, event, or logical expression to a counter and/or timer.

Using a Counter

To use a counter:

1. Click an event to display an arrow.
2. Click a counter. This causes the counter to attach itself to the bottom of the event. An arrow automatically connects the counter to the Trigger button.

Setting a Counter

To set a counter:

1. Open the Recording Rules page, select an event, and drag it to the Global State or Sequence cell.
2. Counts can only be set on a per channel basis, so press the Up or Down channel buttons to select the channel on which the count is performed.
3. Right-click the selected event and select **Add Counter** from the menu to open the Properties dialog.
4. In the text box to the right of the label Count, enter a value. Make sure the checkbox to the left of the word **Count** is checked.
5. Click the **X** in the top right corner of the dialog box to close the dialog. A counter button should appear just below your selected event.

Changing a Counter Value

To change the counter value:

1. Click the small blue dot in the upper-left corner of the counter button. A menu appears.
2. Select **Change Counter Value**.
3. Enter a new value in the pop-up dialog box. This causes the new value to appear in the counter button.

10.9 Using Sequences

10.9.1 Using a Single-State Sequence

As described previously, a sequence can be single-state or multi-state. A single-state sequence is a simple combination of events and actions. You cannot create looping or branching conditions with this type of sequence.

A multi-state sequence allows you to branch successively to (advance to) lower states in the sequence or to loop to the front of the sequence (restart the sequence).

10.9.2 Using a Multi-State Sequence

Multi-state sequences allow you to create conditions that branch down to successive states or loop back to the beginning of the sequence. They are more complex than single-state sequences but very powerful.

10.9.3 Using Independent Sequences

You can use up to two independent sequences. By default, they are labeled Sequence 0 and Sequence 1.

The two sequences operate in parallel and have no effect on each other with the following exception. Either of the two sequences can contain the action Restart All. This action restarts both sequences in the Main Display area.

10.10 Recording Rules - USB 3.1 SS+ (Voyager M310/M310C only) 3.1 SS (Voyager/Advisor T3 only)

Use the Recording Rules to set triggers for USB 3.1.

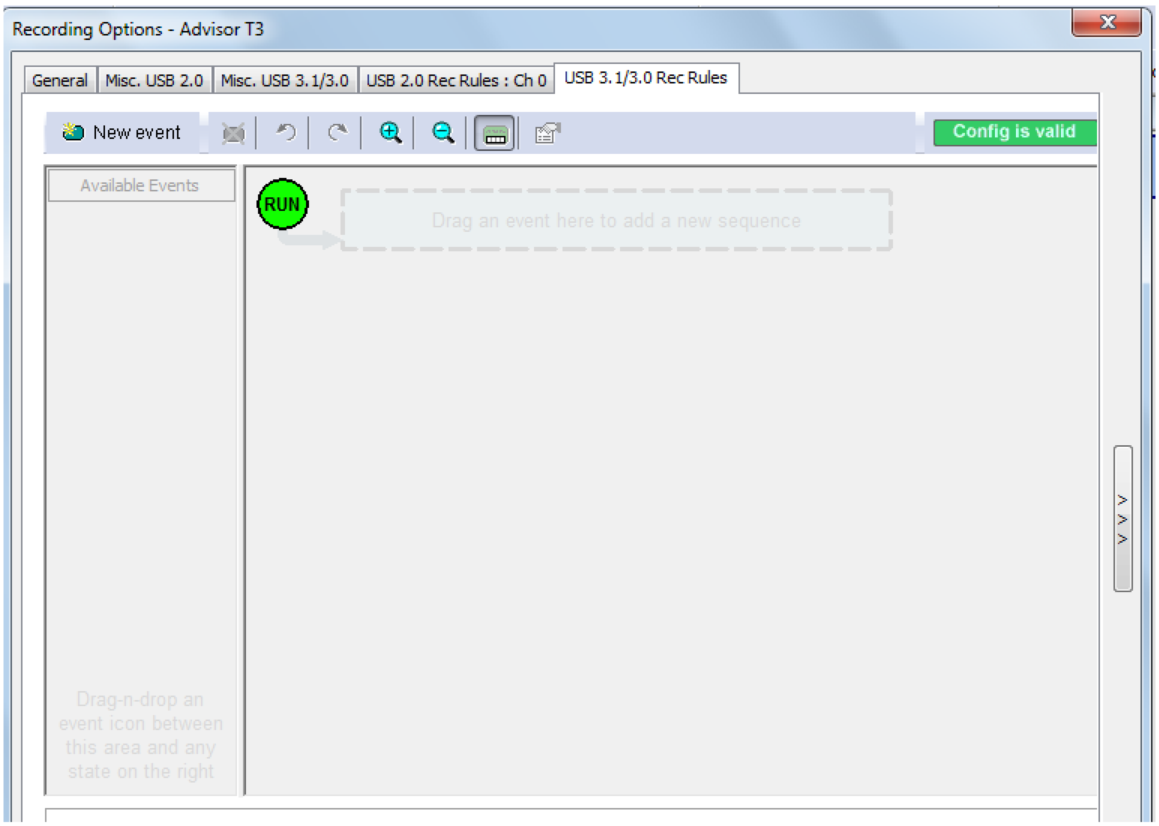


Figure 10.35: Recording Rules USB 3.1.

The page has the same areas as the USB 2.0 Recording Rules (see “Recording Options - Misc. USB 3.1 for Advisor T3” on page 364):

Pop-Up Menus: When you right-click a button or area in the Recording Rules page, a context-sensitive pop-up menu appears that lets you do operations that relate to that button or area, in the same way as for the USB 2.0 Recording Rules.

Properties Dialogs: When you click the Show/Hide Properties Dialog button for an event, action, or state, a dialog allows you to perform the same operations as in the pop-up menus, in the same way as for the USB 2.0 Recording Rules.

10.10.1 Recording Rules Toolbar

The Recording Rules toolbar buttons control the Recording Rules page and are the same as for the USB 2.0 Recording Rules (see “Recording Rules Toolbar” on page 369).

Note: If you have a wheel on the mouse, you can zoom by holding down the CTRL key and rolling the mouse wheel.

10.10.2 Recording Rules Page: How It Works

You can think of the Recording Rules page as a workspace for creating recording rules (rules that determine how the analyzer records traces). Recording rules are combinations of events and actions. For how the Recording Rules page works, see “Recording Rules Page: How It Works” on page 371.

Note: Recording Rules for USB 3.1 currently do not support more than two independent states.

10.10.3 Creating Event Buttons

To create a rule, first create one or more Event buttons. As you create Event buttons, they appear in the Available Events area. You then can drag-and-drop them into the Main Display area.

To create event buttons, see “Creating Event Buttons” on page 372. The following events are available for USB 3.1 recording rules (see Figure 10.36 on page 387):

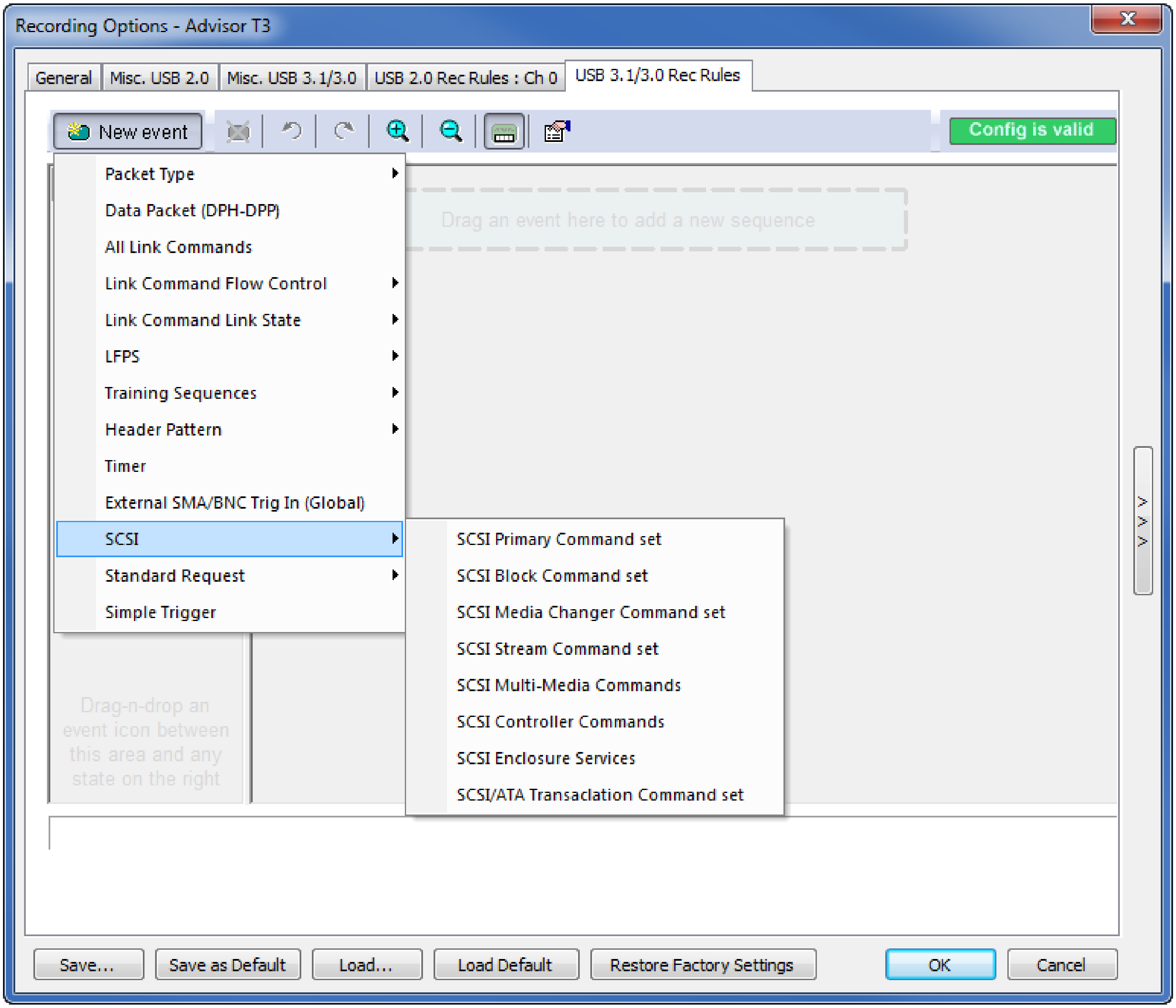


Figure 10.36: Events for USB 3.1.

10.10.4 Dragging a Button to the Main Display Area

After you create an Event button in the Available Events area, you can drag the button to the Main Display area and drop it in the appropriate cell (a cell is a grayed-out rectangle with a dashed line around it). You can think of each cell as a target for drag-and-drop of an Event button (see Figure 10.37 on page 388.)

There are two types of cell that might appear: Sequence cell and State cell. In the Main Display area, they are labelled as follows:

- **Sequence cell**: Drag an event here to add a new sequence.
- **State cell**: Drag an event here to add another state. **Note**: Recording Rules for USB 3.1 currently do not support more than two independent states.

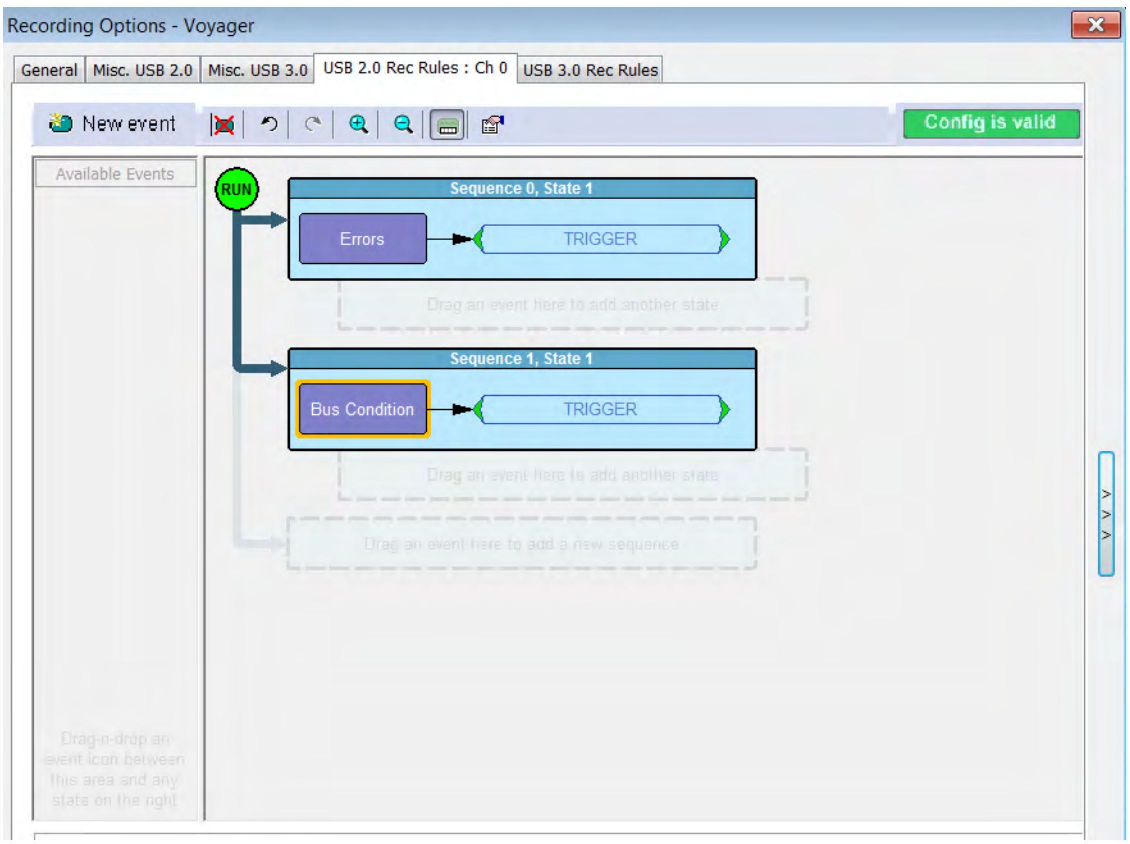


Figure 10.37: Sequence and State Cells.

If there currently are no events in the Main Display area, a single sequence cell appears at the top of the area.

To drag-and-drop the Event button, see “Dragging a Button to the Main Display Area” on page 373

10.10.5 Assigning an Action

After you have dropped the Event button in a cell in the Main Display area, you can assign an action to the event.

Note: If you do not assign an action to an Event button, the analyzer ignores the event.

To assign an action to an Event button, see “Assigning an Action” on page 374.

Note: You can also set actions within the Properties dialog for each event. Double-click the Event button to open the Properties dialog, then select the Actions tab and set your actions.

10.10.6 Recording Rules Pop-Up Menus

The Recording Rules window has context-sensitive pop-up menus that are associated with the following types of object: cells, events, and actions.

Cell Pop-up Menu

If you click a cell in the Main Display area that has an Event button contained in it, the Cell pop-up menu appears. The Cell pop-up menu has the following options.

- **New Event**: Displays the same menu that you get when you click the New Event button on the toolbar.
- **Properties**: Displays the Properties dialog for the selected cell.

Event Pop-up Menu

If you click an Event button in the Main Display area, the Event pop-up menu appears (see “Event Pop-up Menu” on page 377).

Action Pop-up Menu

If you click an Action button in the Main Display area, the Action pop-up menu appears (see “Action Pop-up Menu” on page 375):

Note: Recording Rules for USB 3.1 currently do not support more than two independent states. The Advance Sequence option is not currently available for USB 3.1 recording rules.

10.10.7 Actions and Action Properties

For the available Actions and Action Properties, see “Recording Rules Actions and Action Properties” on page 366.

Action Properties

For the Action Properties, you can set Internal Triggering and External Triggering.

Recording Rules for USB 3.1 currently do not support more than two independent states. The Advance Sequence option is not currently available for USB 3.1 recording rules.

10.10.8 Events and Event Properties for USB 3.1

Recording rules are associations between events and actions. These associations determine how trace recording occurs. The supported events for USB 3.1 are:

- Packet Type
  - Link Management Packets
  - Transaction Packets
  - Data Packet Header
  - Isoch Timestamp Packets
- Data Packet (DP) (for software version 3.71 and higher)
- Data Packet (DPH+DPP) (for software version 3.70 and lower)
  See Data Pattern note below.
- All Link Commands
- Link Command Flow Control
  - LGOOD_0 through LGOOD_7 and LGOOD_n
  - LBAD
  - LCRD_A through LCRD_D and LCRD_x
  - LRTY
- Link Command Link State
  - LGO_U1, LGO_U2, LGO_U3
  - LAU
  - LXU
  - LMPA
  - LUP
  - LDN
- LFPS
  - Polling
  - Ping
  - Warm Reset (see Warm Reset Note below)
  - U1 Exit
  - U2/Loopback Exit
  - U3 Wakeup
  - SCD1
  - SCD2
  - LBPM
  - All
- Training Sequences
  - TS1
  - TS2
  - TSEQ
- Header Pattern
  - Link Management Packet
    - Set Link Function
    - U2 Inact Tmt
    - Vndr Dev Test
    - Port Capability
    - Port Config

        - Port Cfg Rsp
    - Transaction Packet
        - ACK
        - NRDY
        - ERDY
        - STATUS
        - STALL
        - DEV_NOTIFICATION
        - PING
        - PING_RESPONSE
        - HOST_NOTIFICATION
    - Data Packet Header
    - Isoch Timestamp Packet)
- Timer
- External Trigger In (Voyager)
- External SMA/BNC Trig In (Global)
- SCSI
    - Primary Command Set
    - Block Command Set
    - Media Changer Command Set
    - Stream Command Set
    - Multi-Media Commands
    - Controller Commands
    - Enclosure Services
- Standard Request
    - GET_STATUS
    - CLEAR_FEATURE
    - SET_FEATURE
    - SET_ADDRESS
    - GET_DESCRIPTOR
    - SET_DESCRIPTOR
    - GET_CONFIGURATION
    - SET_CONFIGURATION
    - GET_INTERFACE
    - SET_INTERFACE
    - SYNCH_FRAME
    - SET_SEL
    - SET_ISOCH_DELAY
- Simple Triggers
    - Basic Triggers
        - Logical Idle
        - SHP
        - SDP
        - SLC
        - EPF
        - END
        - EDB

    - COM
    - SKP
    - K-Code
    - Symbol Error
    - RD Error
    - DP Length Error
    - Term On
    - Term Off
    - BCNT
    - CRC32
    - CRC16
    - CRC5LCW
    - CRC5LC
- Framing Error Triggers
    - SLC
    - SDP
    - SHP
    - END
- Low Power States
    - U1
    - U2
    - U3

Note: Data Pattern Matching - For USB 3.1, only the first 32 Byte positions can be matched for triggering. It is not a floating window as it is for USB 2.0 Data Pattern Match.

Note: Warm Reset Trigger - The position of this trigger in the file can be deceptive due to the imbalance of traffic between the transmit and receive traffic. It can be helpful to hide upstream or downstream traffic to see where it occurred with respect to traffic on the one stream.

Event Properties

The Event Properties dialog lists the Properties and their Values (see "Events and Event Properties for USB 2.0" on page 378).

Note: The Header Pattern tab is different for the USB 3.1 recording rules.

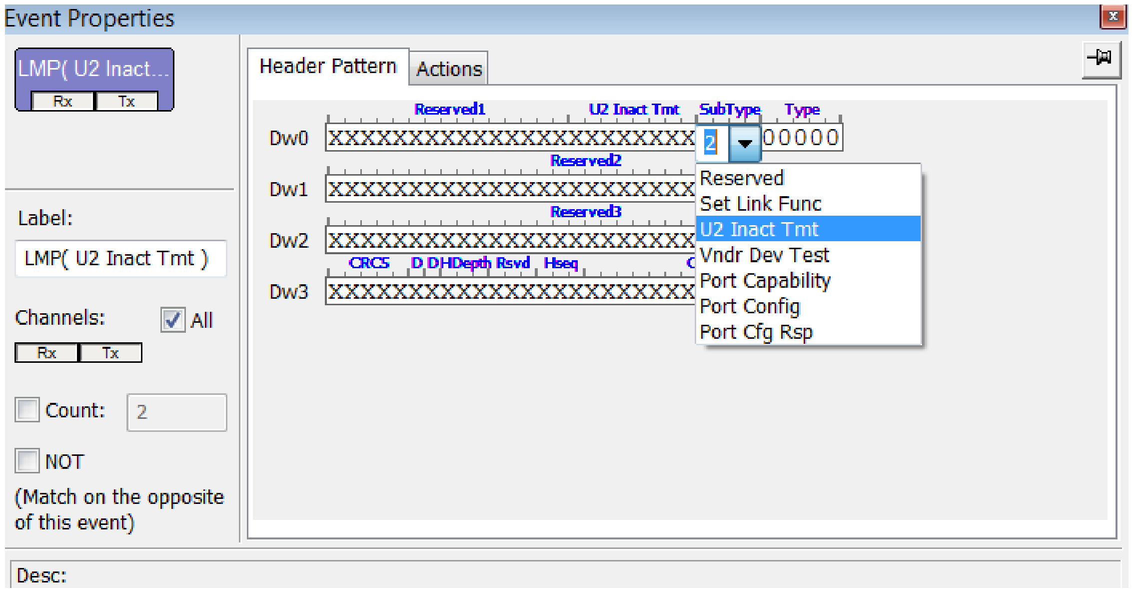


Figure 10.38: Event Properties - Header Pattern Dialog.

Most fields are mask and match. The Type and Subtype fields have drop-down menus. You can set the Subtype to:

- Reserved
- Set Link Func
- U2 Inact Tmt
- Vndr Development Test
- Port Capability
- Port Config
- Port Cfg Rsp

10.10.9 Counters and Timers for USB 3.1

Timer: A timer counts the time from a starting event to a final event. For example, if you enter **10**, the Analyzer counts 10 nanoseconds or milliseconds after the starting event before it performs whatever action you assign. Timers cannot be applied to events with Filter Actions. The maximum timer value is 65,535.

Counter: A counter tells the Analyzer to search for *x* instances of the selected event. For example, if you enter **10**, the Analyzer counts 10 instances of the selected event before it performs whatever action you assign. Counters cannot be applied to events with Filter Actions. The maximum counter value is 65,535.

Triggers can be set on multiple instances of an event. For example, you can set a trigger to occur following five instances of any DLP. To configure the Analyzer to look for multiple events, you enable Counters. Counters tell the Analyzer how many occurrences of an event for which it should wait before triggering. For example, use a counter to Trigger following the 16th occurrence of an error or DLLP message.

Events and Actions

Within events, counters determine how many times the event must occur before the associated actions are triggered. Event counters typically have two properties:

- **Count Randomly**: Can be set to “Yes” or “No” (default value is “No”). If set to “Yes”, the event repeats a random number of times (between 1 and the value set in the property Max Random Count, which replaces the property Counter Value when “Yes” is selected), before the action is triggered.
- **Counter Value**: Number of repeats required when Count Randomly is set to “No”. The default value is 1.
- Within actions, counters determine how many times the system calls the action before it acts. Action counters typically have two properties:
- **Random**: Can be set to “Yes” or “No” (default value is “No”). If set to “Yes”, the action triggers a number of occurrences before the action takes place. That number ranges randomly between 1 and the value set in the property At least every Nth occurrence, which replaces the property Every Nth occurrence when “Yes” is selected.
- **Every Nth occurrence**: Number of times the system calls the action before it acts.

Note: There is some overlap in the way these counters can be used. For example, in the simple case of a single event leading to a single action, it makes no difference whether you specify the event to require five repeats before triggering the action, or the action to require five occurrences before it acts.

However, in the case of combined events and/or actions, the separate counters provide flexibility in designing test cases. For example, consider the case where Event_1 OR Event_2 leads to Action. If Event_1 has a counter of 5, then the Action triggers either when Event_1 has repeated five times or when Event_2 happens the first time, whichever occurs first.

But if the event counters are set to 1 and the Action counter is set to 5, then the Action happens after five occurrences of EITHER Event_1 or Event_2.

Number of Analyzer Counters and Timers

The Analyzer includes one event counter and one time counter (timer). If you try to assign more, you get a warning.

Packets

You must assign a packet, event, or logical expression to a counter and/or timer.

Using a Counter

To use a counter:

1. Click an event to display an arrow.
2. Click a counter. This causes the counter to attach itself to the bottom of the event. An arrow automatically connects the counter to the Trigger button.

Note: For Timers, do **NOT** use a timer as the first event in a sequence, since this first "event" will be the start of recording, and this is not a precise or predictable point in time from which to start timing. Use timers only AFTER the first event.

Setting a Counter

To set a counter:

1. Open the Recording Rules page, select an event, and drag it to the Global State or Sequence cell.
2. Counts can only be set on a per channel basis, so press the Up or Down channel buttons to select the channel on which the count is performed.
3. Right-click the selected event and select **Add Counter** from the menu to open the Properties dialog.
4. In the text box to the right of the label Count, enter a value. Make sure the checkbox to the left of the word **Count** is checked.
5. Click the **X** in the top right corner of the dialog box to close the dialog. A counter button should appear just below your selected event.

Changing a Counter Value

To change the counter value:

1. Click the small blue dot in the upper-left corner of the counter button to display a menu.
2. Select **Change Counter Value**.
3. Enter a new value in the pop-up dialog box. The new value appears in the counter button.

10.10.10 Configuration Validity

The USB Protocol Suite Software monitors the current trigger and filter configuration to ascertain whether or not it is valid. The configuration may not be valid because of any of the following reasons:

- More resources are configured than exist in the hardware.
- Conflicts occur between shared hardware resources.
- Configurations may be incomplete, such as choosing an event like “SCSI Command” but not selecting a specific command.

If **Config** is not valid (red), you must fix the problem, so that the green **Config is Valid** shows in the status area. If this is not done, the configuration will not be applied to the current Recording Rules, and the trigger or filter will not function.

10.11 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.

10.12 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.

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:

1. 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.

Note: Disconnection of USB or Ethernet during capture or uploading of trace data is not supported, and may cause the software to malfunction or crash.

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:

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

   OR

   Click on the Tool Bar.

   You see the standard **Save As** screen.
2. Give the recording a unique name and save it to the appropriate directory.

10.13 Merging Trace Files

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

Note: The system can merging High Speed and Classic Speeds traffic into a single merged file if the **Auto-Merge 2 Channel Trace Files** option is checked in the Recording Options dialog box.

To merge two trace files:

1. Select **File > Merge Trace Files** to display a dialog box asking for the first source file (see Figure 10.39 on page 398).

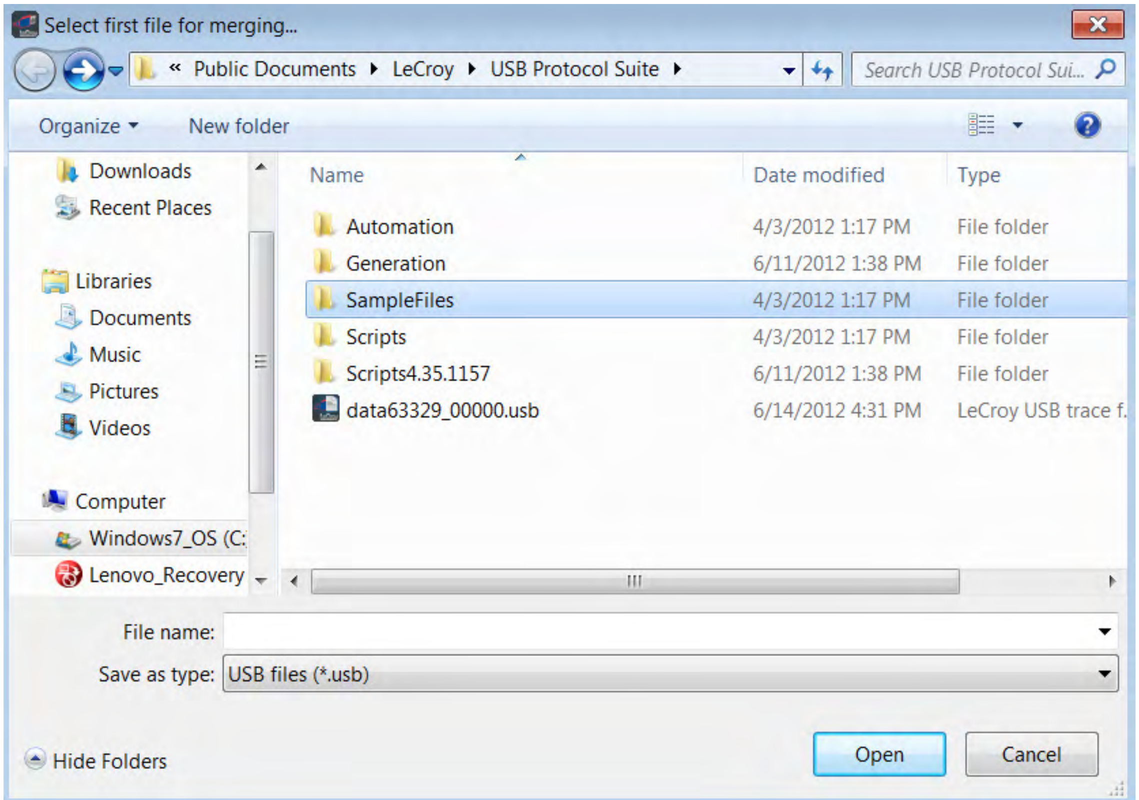


Figure 10.39: Select First File For merging Dialog.

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

---

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

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

---

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

   Confirm your choices. See Figure 10.40 on page 399.

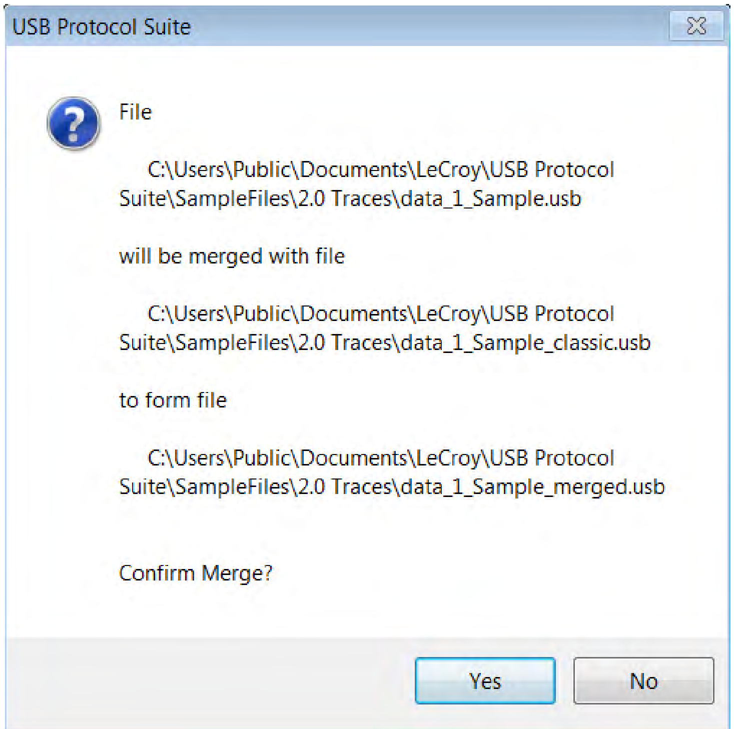


Figure 10.40: Confirm Choice.

4. Click **Yes**.

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

10.14 Recording Option Summary Tab

Click the vertical triple greater-than (<) symbols on the right to display the Recording Options Summary tab:

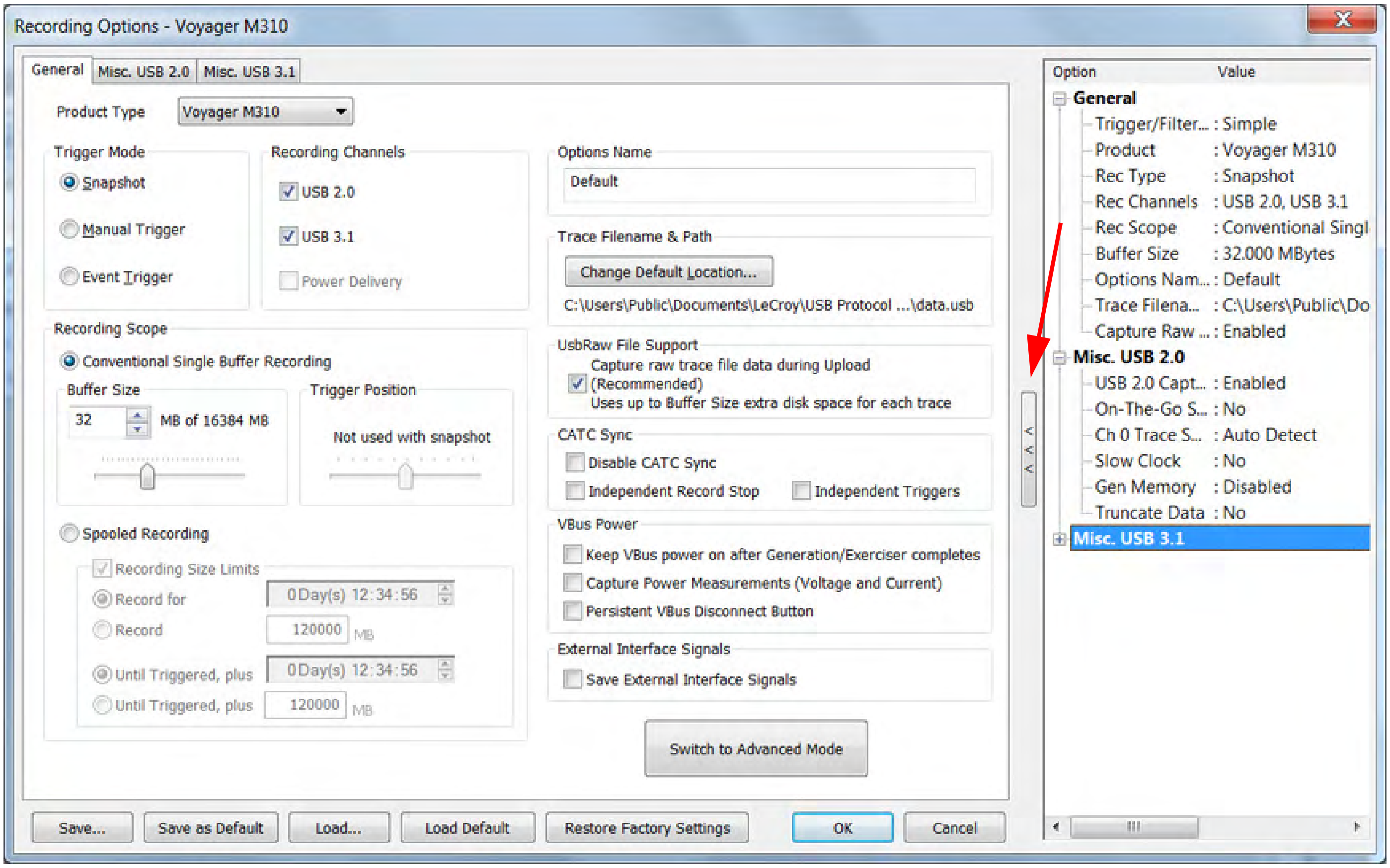


Figure 10.41: Recording Options - Summary Tab.

The Summary tab provides an easy-to-read summary of the currently selected options.

Chapter 11

Traffic Generation 2.0

USB 2.0 Traffic Generation allows you to generate USB 2.0 traffic and test designs under realistic conditions. Traffic Generation can also transmit known bad packets, providing an opportunity for engineers to observe how a device handles specific adverse conditions.

The 2.0 Generation scripts can create almost arbitrary streams of packets, but the responsibility for creating a sequence which performs in an expected way is left to the user. For example, if a Host Emulation script starts with just sending bulk data on an endpoint, no real device purchased in the store can react to it, as it expects to be enumerated and be in the correct state when the Bulk transfer begins. In the Device Emulation situation, it is expected that the device will supply all the correct enumeration responses, in the order expected by the host, for it to proceed to it's normal behavior mode. Since different hosts may enumerate devices in slightly different orders, you may have to adjust the device emulation script file to match this. By creating the Host Emulation or Device Emulation script from the process of exporting from a real trace with a real Device or Host, the likelihood of starting out with a working script is increased enormously, since the behavior should be repeatable.

Note: For traffic generation for USB 3.1, see "Traffic Generation 3.1 Exerciser" on page 437.

11.1 Connecting to Voyager M3/M3i

The connections differ for Host Emulation and Device Emulation.

Full Speed, Low Speed, and Hi Speed connections are the same.

Hi/Full/Low Speed Host Emulation

For Host Emulation Hi, Full, or Low Speed, connect to the Voyager M3/M3i according to the following diagram (see Figure 11.1 on page 402.).

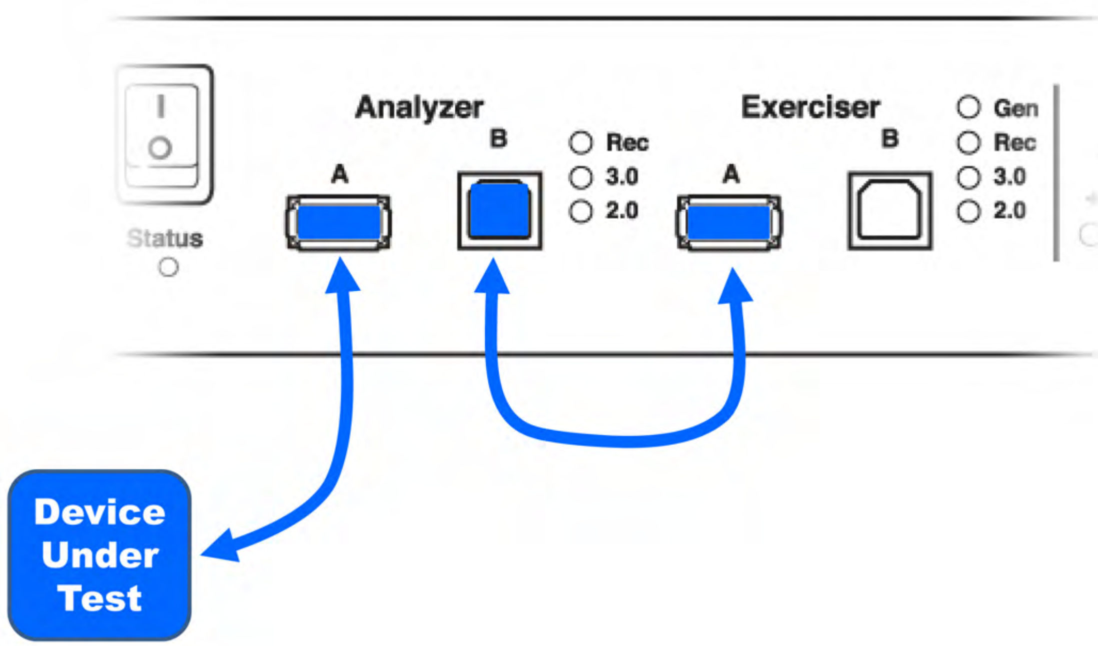


Figure 11.1: Connections to the Voyager M3/M3i.

Hi/Full/Low Speed Device Emulation

For Device Emulation Hi, Full, or Low Speed, connect to the Voyager according to the following diagram.

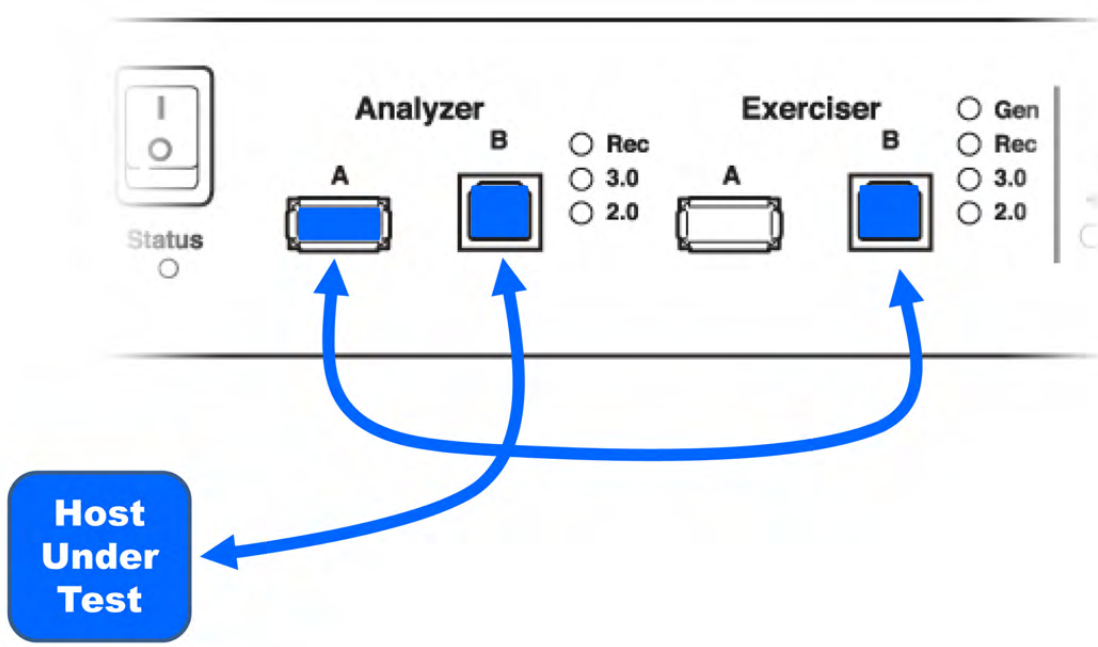


Figure 11.2: Connections to the Voyager M3/M3i.

11.2 Connecting to Voyager M3x

The connections differ for Host Emulation and Device Emulation.

Full Speed, Low Speed, and Hi Speed connections are the same.

Hi/Full/Low Speed Host Emulation

For Host Emulation Hi, Full, or Low Speed, connect to the Voyager according to the following diagram (see Figure 11.1 on page 402).

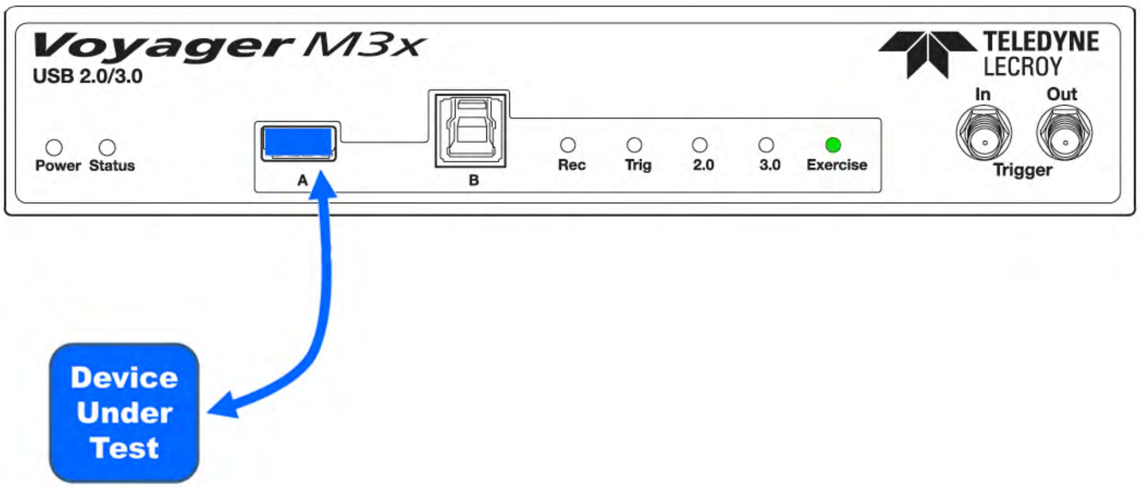


Figure 11.3: Connections to the Voyager M3x.

Hi/Full/Low Speed Device Emulation

For Device Emulation Hi, Full, or Low Speed, connect to the Voyager according to the following diagram.

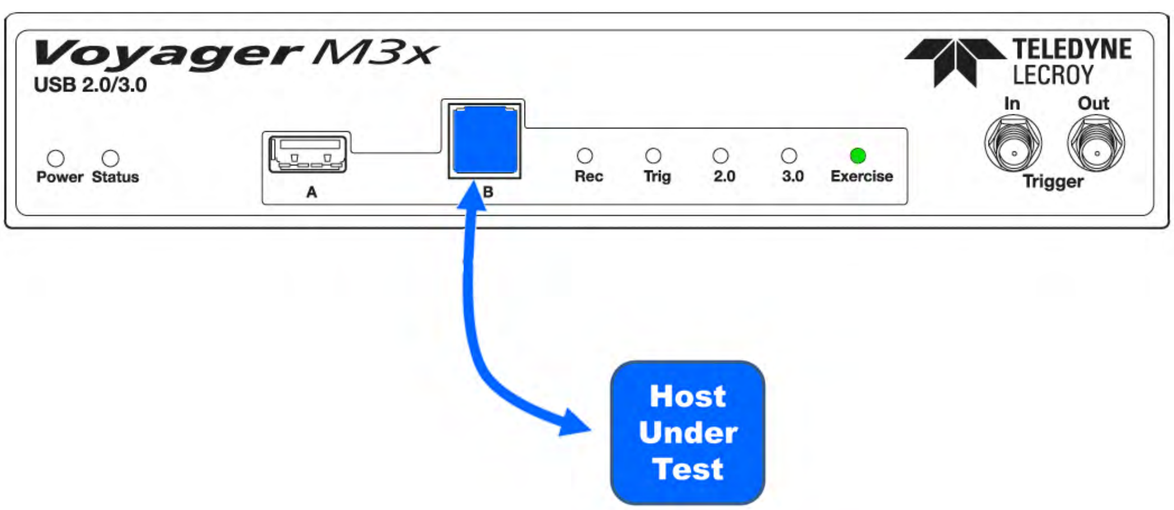


Figure 11.4: Connections to the Voyager M3x.

11.3 Connecting to Voyager M310

The connections differ for Host Emulation and Device Emulation.

Full Speed, Low Speed, and Hi Speed connections are the same.

Hi/Full/Low Speed Host Emulation

For Host Emulation Hi, Full, or Low Speed, connect to the Voyager according to the following diagram (see Figure 11.1 on page 402).

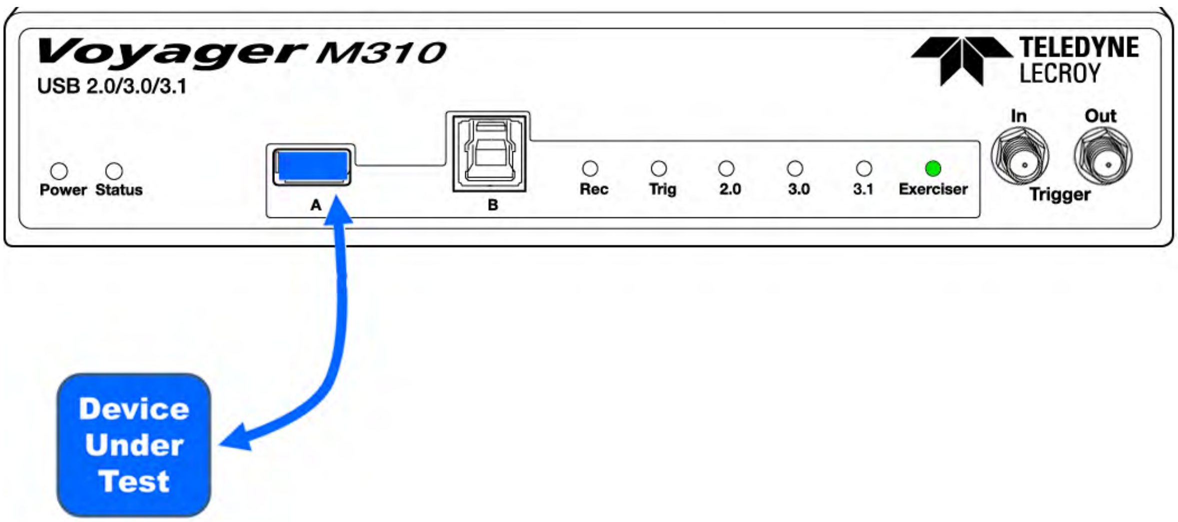


Figure 11.5: Connections to the Voyager M310.

Hi/Full/Low Speed Device Emulation

For Device Emulation Hi, Full, or Low Speed, connect to the Voyager according to the following diagram.

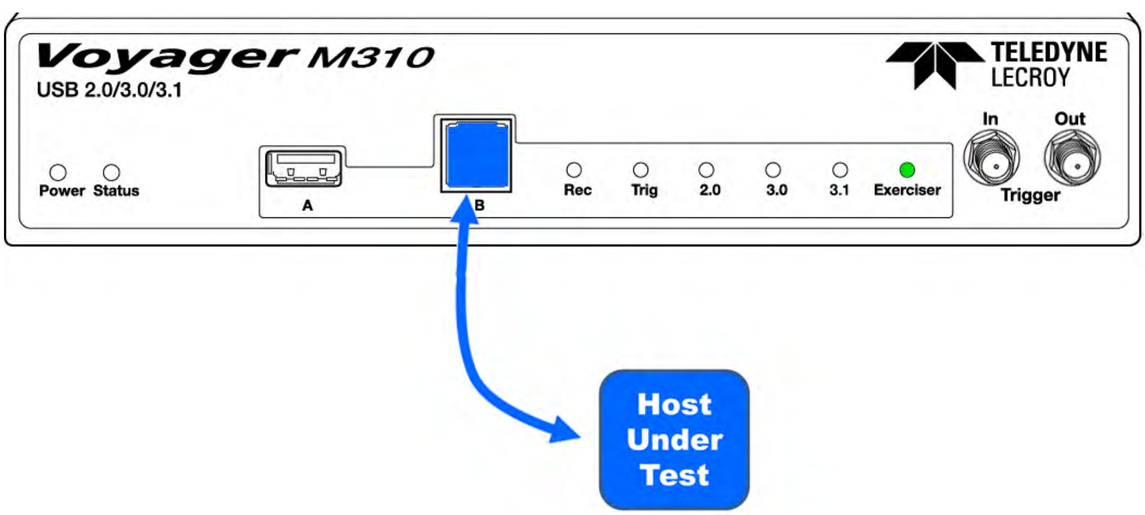


Figure 11.6: Connections to the Voyager M310.

11.4 Connecting to Voyager M310C

In all cases (Low Speed, Full Speed, Hi Speed) you attach to the left USB Type-C connector (the one with "Exerciser" written below it.) Selection between Host and Device emulation is done in the Recording Options dialog. (see Figure 11.1 on page 402).

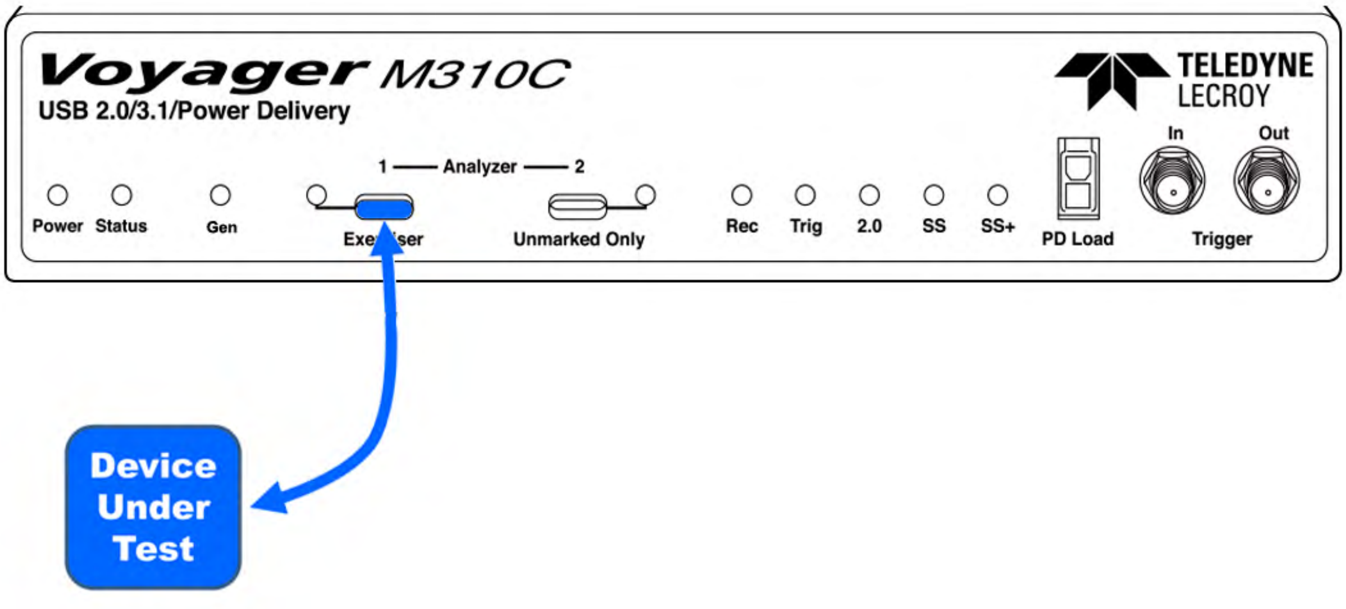


Figure 11.7: Connections to the Voyager M310C: Device Under Test.

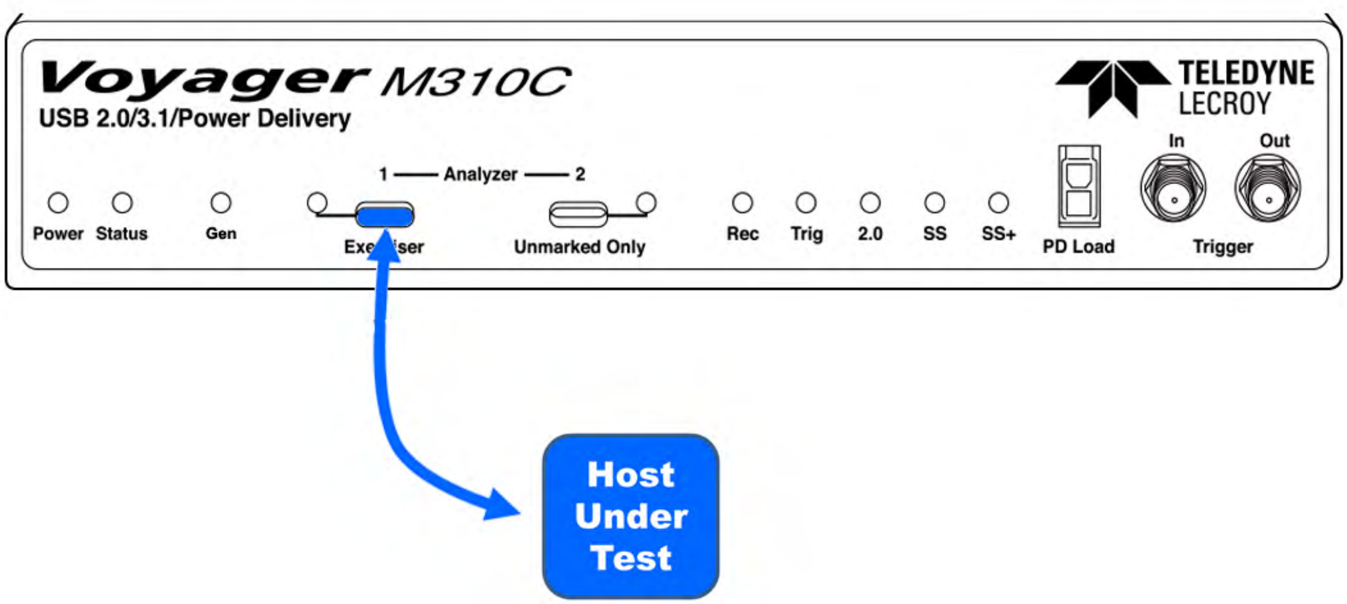


Figure 11.8: Connections to the Voyager M310C: Host Under Test.

11.5 Traffic Generation Files

The system generates USB 2.0 traffic from traffic generation files (***.utg**) which are text-based script files that instruct the Generator how to generate USB 2.0 traffic. These script files can be edited with either a simple text editor such as Notepad or with the Script Editor utility provided by the application. The Script Editor utility has several aids to simplify the process of writing and editing scripts: tool-tips, drop-down menus, and colored fields.

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

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

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

file_type=UPAS
file_version=2
file_speed=HIGH

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

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

Figure 11.9: Script example of a Traffic Generation File.

This generation file causes the system to simulate a hub and to generate 24,320 packets. See “Device Emulation” on page 415 for details about the format of traffic generation files.

11.6 Creating Traffic Generation Files

If you choose to write a script with a text editor, a good way to start is to edit an example generation file.

For Windows 7 and Windows 8, an example such as:
FS_Enum_Break_Wrap_Sample.utg, HS_Hub_Sample.utg in the directory **C:\Users\Public \Documents\LeCroy\USB Protocol Suite\Examples\2.0 Host Emulation** or **SampleDeviceEmulationThumbDriveFS.utg** in the directory **C:\Users\Public\ Documents\LeCroy\USB Protocol Suite\Examples\2.0 Device Emulation**.

For Windows XP, an example such as: **FS_Enum_Break_Wrap_Sample.utg, HS_Hub_Sample.utg**, or **SampleDeviceEmulationThumbDriveFS.utg**, in the directory **C:\Program Files\LeCroy\USB Protocol Suite\Examples\2.0 Host Emulation** or **C:\Program Files\LeCroy\USB Protocol Suite\Examples\2.0 Device Emulation**.

You can open a generation file with Notepad or other editor and then add or remove text as needed.

11.6.1 Creating a Traffic Generation File with the Export Command

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

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

To use the Export command:

1. Start the application.
2. Open a trace that has the pattern of traffic that you would like to generate.
3. Select **File > Export** from the menu bar to display the File Export menu:

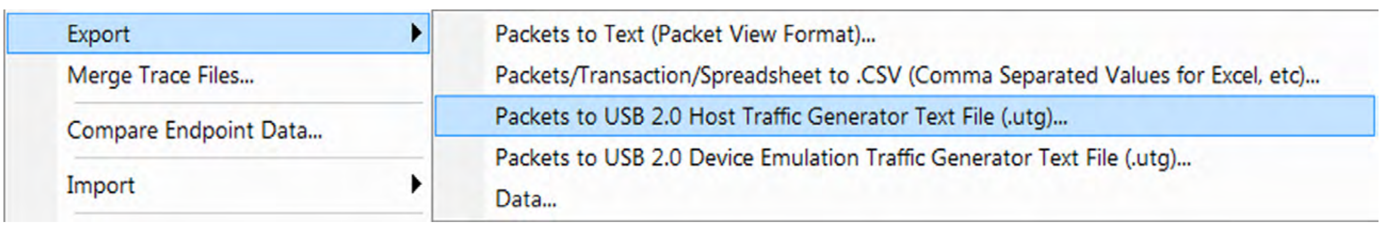


Figure 11.10: File Export Menu

4. Select **Packets to Host Traffic Generator Text File** from the **Export** drop-down menu. You see the **Export to Generator Text** dialog (Figure 11.11 on page 407).

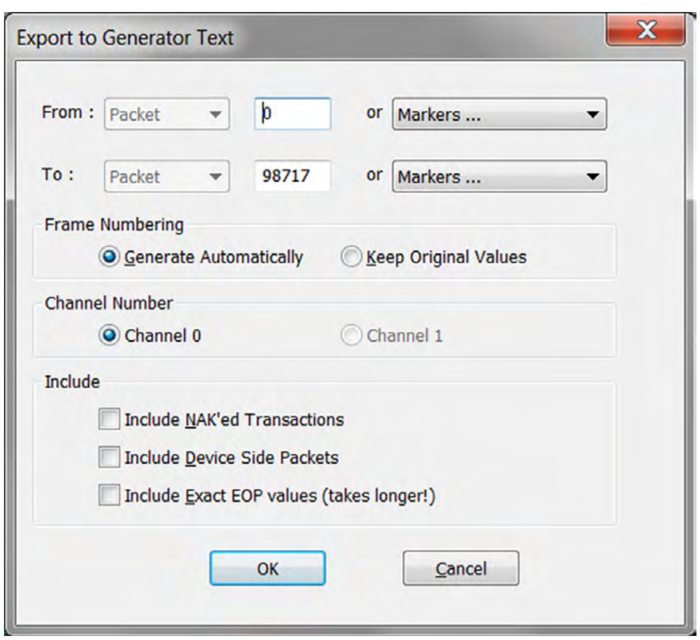


Figure 11.11: Export to Generator Text Window

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

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

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

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

11.7 Editing a Generation File

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

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

The Script Editor window opens in the lower portion of the trace window (Figure 11.12 on page 408).

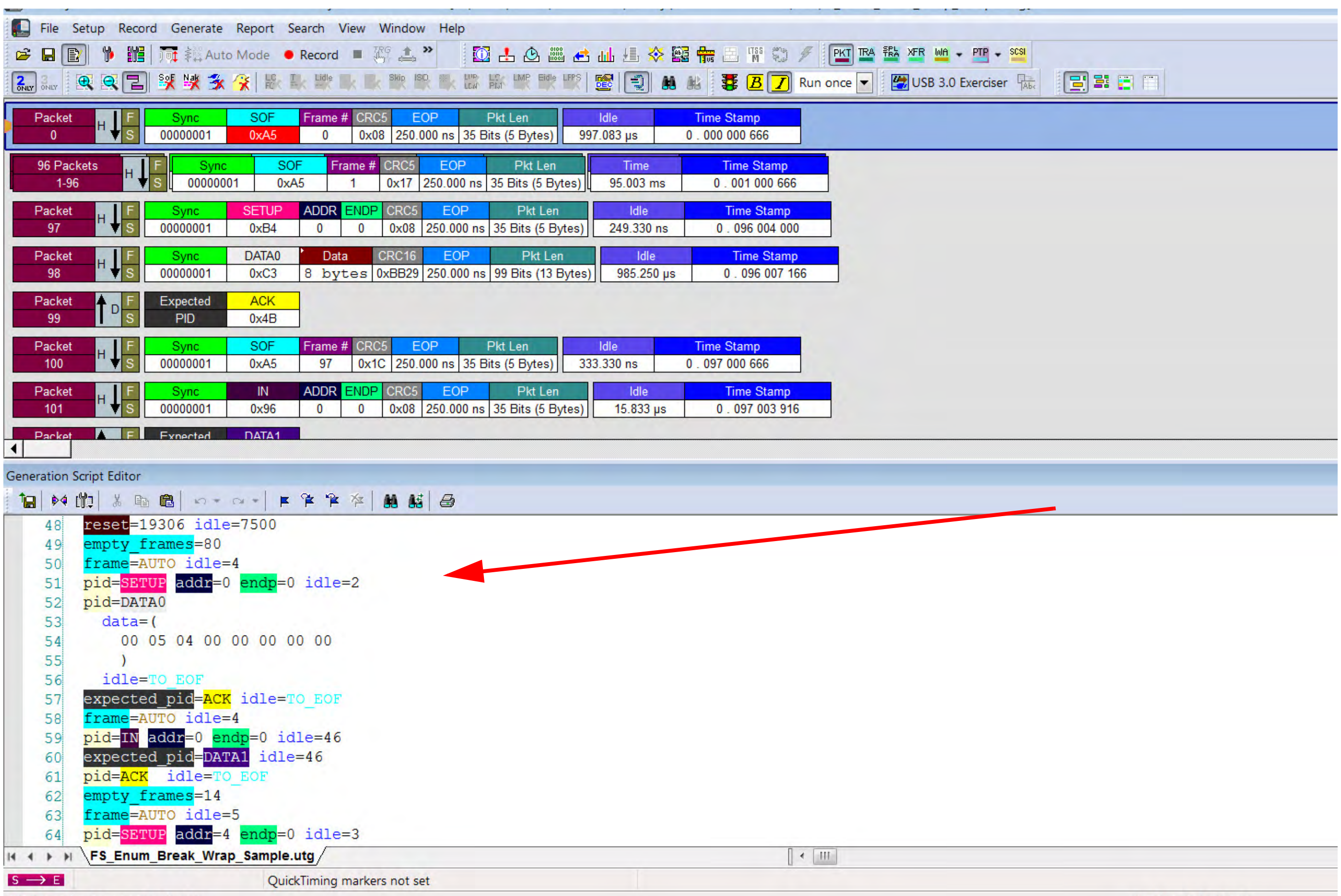
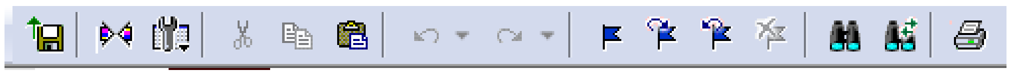


Figure 11.12: Script Editor

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

11.7.1 Toolbar

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



The buttons have the following functions:

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

11.7.2 View Options Menu

The View Options button has a menu with three options:

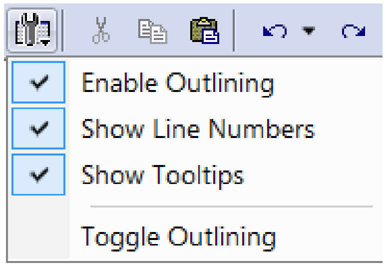


Figure 11.13: View Options Menu

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

11.7.3 Pop-up Menu

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

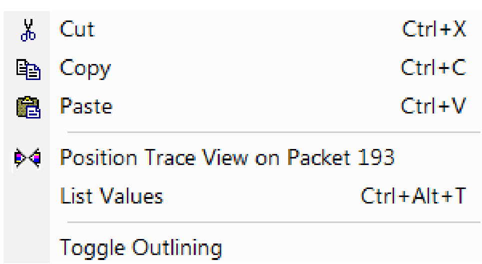


Figure 11.14: Pop-up Menu

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

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

11.7.4 File Tabs

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

Figure 11.15: File Tabs

11.7.5 Error Log

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

11.7.6 Tooltips

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

11.8 Loading the Generation File

The USB Traffic Generation files are scripts that instruct the Analyzer how to generate USB traffic. A traffic generation file contains text in special format and is named with a ***.utg** extension. These files can be created by any text editor, or using the **File > Export > Packets to 2.0 Host Traffic Generator Text File (.utg)..,** menu selection when viewing a Trace File. There are several examples of Traffic Generation files included with the installation of the software.

To load a generation file:

1. Select **File > Open ...** from the menu to display the Open dialog (see Figure 11.16 on page 412):

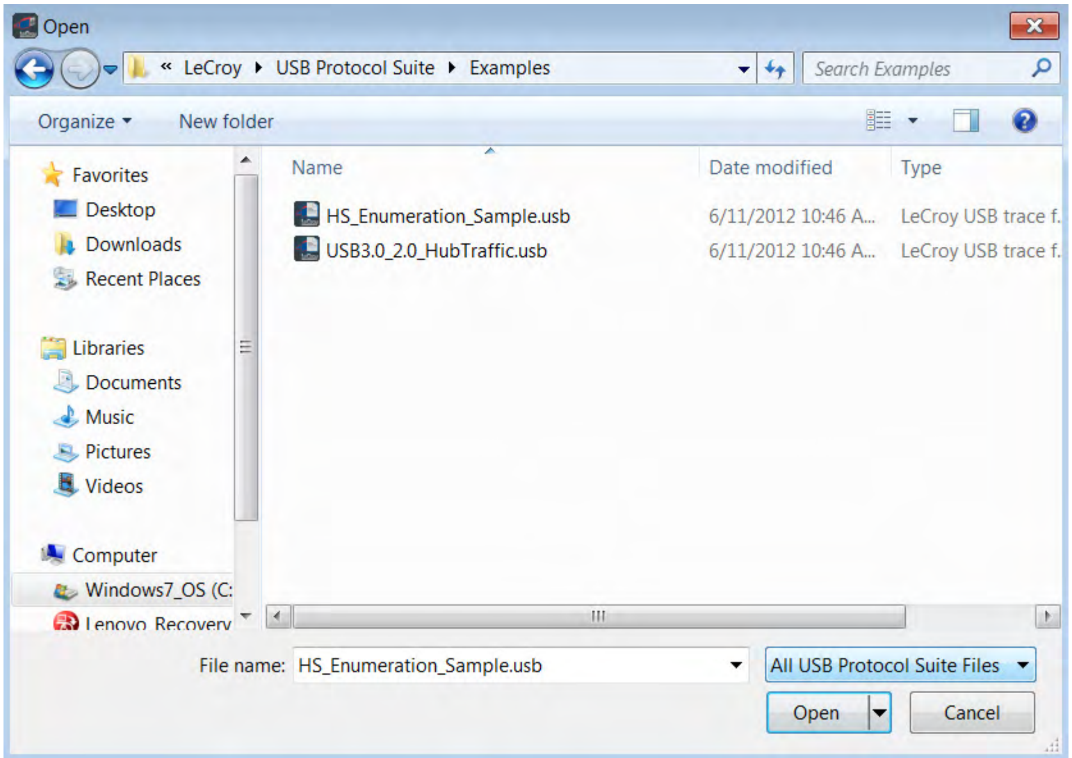


Figure 11.16: Open Dialog

2. Select **Generation Files (*.utg)** from the drop-down menu marked **All USB Protocol Suite Files** to display a list of Traffic Generation files.
3. Select a Traffic Generation file (*.utg).
4. Click **Open**. The file opens (see Figure 11.17 on page 413.)

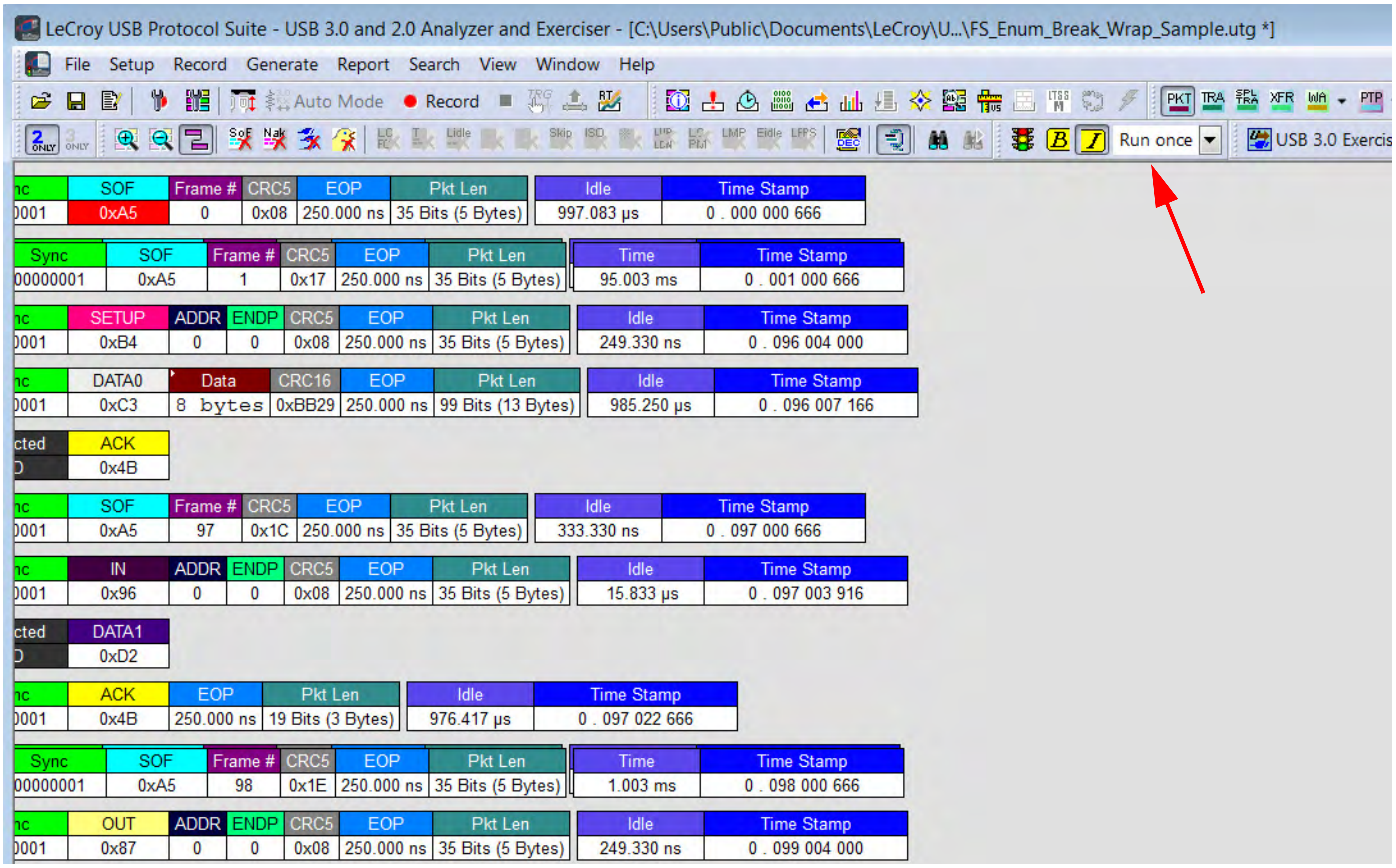


Figure 11.17: Traffic Generation File

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

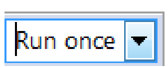


Figure 11.18: Repeat Drop-down Menu

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

5. Select the ***Generation mode*** in which to generate traffic (see below for an explanation) by depressing or undepressing the IntelliFrame button  on the toolbar:

- ❑ Depressed = IntelliFrame
- ❑ Undepressed = Bitstream

11.8.1 Traffic Generation Modes: Bitstream vs. Intelliframe

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

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

Note: Device emulation only works in Intelliframe mode.

Note: In IntelliFrame mode, the hardware generates SOFs and Pings, so these cannot be altered (force CRC value, explicit frame number, and so on). If you want to explicitly corrupt or manage these PID types, you must use Bitstream mode.

11.9 Starting Traffic Generation

To start traffic generation, click  on the Tool Bar.

11.10 Repeating a Generation Session

If you wish to repeat a generation session, press the Traffic Generation Start/ Stop  button again. There is no need to reload the **.utg** file.

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

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

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

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

11.11 Stop Traffic Generation

To instruct the Analyzer to halt traffic generation:

- Click  on the Tool Bar.

11.12 Device Emulation

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

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

11.12.1 Creating a Generation File

Generation files can be created one of two ways:

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

OR

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

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

11.12.2 Setting Generation Options

1. Set the Traffic Generation options by configuring the **Misc** page in the Recording Options dialog box: **Setup** > **Recording Options** > **Misc**
2. In the Misc page, select **Device Emulation Mode**.
3. Configure Resume settings.
   - If you want the simulated device to issue Resumes, then select **Device Resumes** and enter a delay time (in milliseconds). If you do not select Device Resumes, then the emulated device waits for a Host to issue a Resume.
   - If you want the simulated device to take its address from the Traffic Generation (.utg) script file, then select **Use Address in .utg file.** This option causes the system to read the **.utg** file and assign a Device Address based on the device traffic that it sees in the file.

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

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

11.12.3 Run the Traffic Generation Script File

1. Connect the system's port B (either Hi Speed or Classic Speed) to the Host.
2. Open the Traffic Generation **.utg** file.
3. Begin traffic generation by clicking .

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

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

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

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

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

11.13 Voyager M3x/M310/M310C USB 2.0 Script Limitations

Due to architectural changes in the Voyager M3x/M310C design, some features previously available on USBTracer and Voyager M3/M3i have been limited.

USB 2.0 scripts are now more limited in size. Host scripts are limited to 64KBytes (approximately 16K lines). For BitStream mode emulation, this 64K allows for only 32KBytes of traffic, including idle bits. For example, a Full Speed Frame consists of 1 millisecond of traffic at 12 MB/second, so this would be 12 KB of traffic just for one frame. So you could send a maximum traffic of less than 3 mSec (about 2.5 frames) before the 64K of memory would be used up.

Device Emulation Scripts are limited to 4KBytes per endpoint (approximately 1K lines per endpoint), with the exception that Endpoint 0 (the control endpoint) can handle more: it is limited to 64KBytes (approximately 16K lines).

In addition, on the Voyager M3x/M310, the ability to create arbitrary bit streams (using raw_data, raw_data_bits, and bit_stuff key codes) is not supported for Hi Speed traffic. Finally, slow speed (divide by 40, divide by 80, etc.) generation for Hi Speed traffic is also not supported.

11.14 Format of Traffic Generation Files

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

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

- The data format for data fields such as Pids and Raw bits is hex.
- Each packet definition consists of this set of assignments: **key=value**.
- White space is permitted around the equal sign.
- There are no restrictions on dividing packet definition to lines nor is it necessary to define each packet in a separate line, although it is recommended.
- The maximum number of characters in a line is 250.
- The characters **#** and**;** indicate end-of-line comments (i.e. the rest of the line is ignored)
- Comments are not allowed within brackets ( ).
- No keys or values are case-sensitive.

Each packet definition starts with one of these assignments:

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

OR

- **frame=N** (where N is an eleven bit value of the frame number or the strings **auto** and **keep_alive**).
- A bus condition definition starts with one of these assignments:
- **reset=N** (where N is a positive integer or string)
- **suspend=N** (where N is a positive integer)
- **resume=N** (where N is a positive integer)
- **chirp=here**

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

11.14.1 Script Control of Intelliframe vs Bitstream modes

To force the **.utg** file to run in IntelliFrame mode, add the following text string to the **FIRST LINE** of the **.utg** file.

```
;intelliframe=ON
```

To force the **.utg** file to run in Bitstream mode, add the following text string to the **FIRST LINE** of the **.utg** file.

```
;intelliframe=OFF
```

These commands are useful if an automated interface, such as the USB Compliance Suite, is running a script.

If you run the script manually, to allow selection of IntelliFrame or Bitstream mode from the toolbar, make sure the **.utg** file has no such Intelliframe command line.

11.14.2 Sample Syntax

```
; Start of Frames (SOF's)
frame=auto idle=TO_EOF  ; 1 empty frame, frame number generated
automatically
frame=23 idle=TO_EOF    ; 1 empty frame, frame number is 23
empty_frames=73         ; 73 empty frames, frame numbers generated
automatically

; Tokens (always need Address and Endpoint)
pid=SETUP addr=2 endp=3
pid=IN addr=1 endp=0 idle=TO_EOF
pid=IN addr=1 endp=0 CRC=0x1E idle=TO_EOF; Force a CRC value
pid=OUT addr=1 endp=0 idle=368
pid=PING addr=1 endp=0 idle=368

; Split
pid=SPLIT hub_addr=5 sc=1 port=2 s=0 e=1 et=2

; Data

pid=DATA0
  data=(
    23 03 08 00 01 00 00 00
    )
  idle=500 ; 8 bytes

 ; Link Power Management.  These 2 must be consecutive
 pid=EXT addr=1 endp=0 idle=368
 pid=LPM hird=1 link_state=1 remote_wake=0 idle=368
```

TABLE 11.3: Support Keys for Defining Fields within a packet.

Key Code	Format	Description
File Control Keys		
file_type	UPAS CHIEF	This must be included at the beginning of the file to determine the speed of packets to be generated. Value must be **file_type=UPAS** to allow for High speed traffic, IntelliFrame operation, **expected_pid** and **device_pid** key support. Full and Low speed traffic, and Bitstream operation are supported on all **file_type=** values. If this statement does not appear in the file, the default is **file_type=CHIEF**, allowing backward compatibility with older USB Chief™ **.usb** files.
file_version	integer	This must be included after the **file_type=** key to determine the version of this file. Value is currently 3. Usage: **file_version=3**
file_mode	HOST DEVICE	Sets generation mode to host or device. For generation to work, this must match the selection found in the Recording Options > Misc dialog.
file_speed	HIGH HI FULL LOW	This must be included after the **file_version=** key to determine the speed of packets to be generated. Values are HIGH, HI, FULL, or LOW. Example: **file_speed=FULL**. Only one **file_speed=** is allowed per .**utg** file, but low speed traffic on a full speed bus can be created by adding the **speed=LOW** key to a low speed packet in a file defined as **file_speed=FULL**. No other mixing of speeds is allowed. HI is the same as HIGH and was added to conform to the USB terms.
loop_count wrap_count	0 through 16382 or "infinite"	These two terms are interchangeable. Host Emulation Only. This key defines the loop count for each memory segment. Examples: **loop_count=INFINITE** or **wrap_count=9**

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
wrap loop	HERE	This key marks the **wrap point** in the traffic. When generation is in Repeat mode, all the traffic before the wrap point is going to be sent once. All the traffic after the wrap point is going to be repeated in a loop. The usage of the keyword is **wrap=HERE** or **loop=HERE**. For Device Emulation, the value would be a memory segment number, so that the looping is associated with only that one endpoint, such as **wrap=4**.
skip	HERE	Causes a region in the **.utg** file to be ignored, as if commented out. Can be used multiple times in the file. Must be used in conjunction with **skip_end=HERE**. Example: **skip=HERE frame=auto** makes this statement be ignored! skip_end=HERE
skip_end	HERE	Causes a region in the **.utg** file to be ignored, as if commented out. See above in **skip=HERE**.
stop	string	If you want to run only some first portion of the beginning of a **.utg** file, insert this statement where you want generation to halt. This saves having to edit a file into smaller files when testing a portion of traffic. The usage of the keyword is **stop=HERE**.

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
break	HERE	**Host Generation Only.** Enables you to generate up to a point in the **.utg** file, then wait for input before continuing in the file. During the breakpoint time, the traffic signal icon in the toolbar flashes yellow, indicating that a breakpoint was hit. When you click the traffic light icon, generation resumes. If you want to stop rather than continue, select **Stop** from the Generation menu or hit the **Start/Stop** button on the front of the generator module. Start-of-frames are issued automatically during the breakpoint duration. When you resume running, traffic begins after another start-of-frame is issued. The **break=HERE** statement must be inserted between **frame=xxx** statements. Syntax example: frame=AUTO break=HERE frame=AUTO

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
Endpoint Configuration		
begin_config	HERE	Defines the beginning of the region in the file used to configure the endpoint types. The configuration is necessary to determine the default behavior of the NAK retry mechanism during IntelliFrame operation. Between the **begin_config=HERE** and the **end_config=HERE** statements is a series of **config_endpoint=xxx** statements, which define each endpoint's type and default retry behavior. The config region must precede any actual packet or bus condition statements. For Device Emulation, the config region is mandatory. It provides the mapping of the endpoints into their corresponding segments of Analyzer memory, which contain the traffic for those endpoints. When exporting to a **.utg** file from a trace file, these sections are created automatically. Syntax example: **begin_config=HERE**

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
end_config	HERE	Terminates the region in the file used for configuring the endpoints. See **begin_config**. Syntax example: **end_config=HERE**
config_endpoint	CONTROL INTERRUPT ISOCHRONOUS BULK	Begins a statement that defines a particular endpoint's type, default retry behavior (Host Generation only), and memory segment (Device Emulation only). Usage example: **config_endpoint=BULK addr=1** endp=3 direction=OUT retry=TRUE retry_next_frame=FALSE
endp_mem_seg	1 2 3 4 5 6 7 8	Device Emulation Only. Separates each endpoint function into a different queue (also referred to as a Memory Segment) of commands and responses. There are a maximum of eight of these queues, and each has a unique address/direction combination. For control endpoints, one queue is shared by both directions of the endpoint. Traffic on the Default Endpoint (Address 0, Endpoint 0) shares the same queue as the endpoint 0 of the selected device address (the address it gets from the Host through the SetAddress request). These always use **endp_mem_seg=1**. These are all set automatically when exporting a trace file to a Device Emulation **.utg** file.
direction	IN OUT	Defines the transfer direction of data for the specified endpoint. For all transfer types but CONTROL, there can be two distinct logical connections using the same address and endpoint. They would differ only in defined direction. Syntax example: **direction=IN**

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
retry	TRUE FALSE	**Host Generation Only.** Defines whether an automatic retry should be performed on packets to/from this endpoint in the case that they are NAKed (or in some cases NYETed), or if a timeout on device response occurs. RETRY only works for the Pids: Setup, In, and Out. If TRUE, the Exerciser automatically retries the specified sequence if a Pid is received on the bus which does not match the **expected_pid**, or if a timeout occurs. The generator re-issues the host packet(s) after waiting either 1/10th of a frame, or until after the next start-of-frame (depending on the value set for **retry_next_frame**). The retries continue until the **expected_pid** is received. When a retry attempt finds its **expected_pid**, the Exerciser automatically generates a new start-of-frame before continuing with the rest of the Gen File. (The start-of-frame is either an SOF packet or a keep-alive signal.) If FALSE, the Exerciser waits for a Pid before proceeding. There is no timeout. If a Pid is received which does not match the **expected_pid**, the Exerciser continues to wait for the correct Pid to appear. If the user stops the generation, a message states that the generator was waiting patiently for the **expected_pid**, and it never showed up. The user must examine the problem by viewing the trace file. This statement can also be used in conjunction with any **pid=xxx** statement in the **.utg** file. This can be done to override the configured or default retry behavior. Syntax example: **retry=TRUE**

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
retry_next_frame	TRUE FALSE	Host Generation Only. Determines when a retry will be attempted after a failed match of an **expected_pid**. This statement only applies if a **retry=TRUE** statement also exists. If TRUE, the Exerciser waits until the current frame completes, issues a start of frame, and then retries the transaction. If FALSE, the Exerciser waits 1/10th of a frame before retrying the transaction. Before each retry attempt, the Exerciser checks to see where in the frame interval it is. If it is too close to the EOF, it automatically generates the next start-of-frame before performing the retry. If it is not too close to the EOF, it performs the retry without generating a new frame. This statement can also be used in conjunction with any **pid=xxx** statement in the .**utg** file. This can be done to override the configured or default retry behavior. Syntax example: **retry_next_frame=FALSE**

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
ping_on_retry	TRUE FALSE	Host Generation Only. Determines whether an OUT transaction is retried by repeating the OUT-DATAx sequence, or whether a PING sequence should be initiated. If TRUE, the Exerciser automatically generates PINGs (and retries) before going through a Retry Loop. PINGs are repeated until an ACK is received, and then the original OUT-DATAx transaction Sequence is attempted. During the PING retries, the Exerciser automatically generates frames. When the original Retry Sequence receives its **expected_pid**, the Exerciser generates a new frame before continuing with the Gen File. If FALSE, the original transaction is always retried. This statement can also be used in conjunction with any **pid=xxx** statement in the .**utg** file. This can be done to override the configured or default retry behavior. Syntax example: **ping_on_retry=TRUE**
ping_after_nyet		Host Generation Only. If TRUE, the Exerciser automatically generates PINGs (and retries) after receiving a NYET instead of the **expected_pid**. This feature is only used if the **expected_pid** is an ACK. PINGs are retried until an ACK is received. When the PING is ACKed, the Exerciser generates a new frame before continuing with the Gen File. If FALSE, the Exerciser continues as if an ACK occurred. This statement can also be used in conjunction with any **pid=xxx** statement in the **.utg** file. This can be done to override the configured or default retry behavior. Syntax example: **ping_after_nyet=TRUE**

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
Packet Starting Keys		
pid	8 bits (0-0xFF) or pid string	Host Generation Only. Use this as the first key of most packets sent by the Host (Exception: Use **frame=** for SOF packets). The key should be assigned to a valid packet identifier string per the USB specification: SETUP, IN, OUT, DATA0, DATA1, ACK, PRE, PING, SPLIT, DATA2, MDATA, EXT, or LPM. Optionally, you may assign this key a raw eight bit value to force an error condition. **Warning**: If you specify **PID=0xNN**, you must use **raw_data=( )** to specify the rest of the packet data, because the packet structure is unknown.
expected_pid	pid string	Host Generation Only. Use this as the PID key for packets which are expected to be sent by the device. In IntelliFrame mode, the generator waits until this PID has completed before sending the next generated packet or bus condition. The key should be assigned to a valid packet identifier string per the USB specification: DATA0, DATA1, ACK, NAK, STALL, NYET, DATA2, MDATA, EXT, or LPM. The generator engine waits forever until this **expected_pid** appears, so the user may have to hand edit the file to achieve the desired results. For example, if a NAK comes where the **expected_pid** was a DATA1, the user should edit the **.utg** file to move the **pid=IN** command to later in the file by inserting some **frame=AUTO idle=TO_EOF** pairs before it. This allows time for the device to be ready for the IN. If **RETRY=TRUE** for this address/endpoint, the NAKs are ignored and the SOF's are generated automatically until the expected PID occurs.

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
device_pid	pid string	Use this as the first key of most packets sent by a device. The key should be assigned to a valid packet identifier string per the USB specification: DATA0, DATA1, ACK, NAK, STALL, NYET, DATA2, MDATA, EXT, or LPM. Normally, the **device_pid=** statement is NOT present in a Host Generation .**utg** file, because the device responses are intended to come from real devices. By default, Host Generation files exported from Trace Files do NOT include **device_pid=** statements. **Warning:** If you specify **PID=0xNN**, you must use **raw_data=( )** to specify the rest of the packet data, because the packet structure is unknown.
frame	11 bits or AUTO AUTONUMBER KEEP_ALIVE	Creates a start of frame packet and generates a SOF PID as expected. The key should be assigned a value of the frame number, AUTO, AUTONUMBER, or KEEP_ALIVE. **Note**: An explicit frame number is supported only when the generator is in "Bitstream Mode". AUTO instructs the generator to increment the frame number automatically. AUTONUMBER is exactly the same as AUTO. Customers requested this string to make it easier to understand. They are treated identically. KEEP_ALIVE instructs the Analyzer to generate a low-speed EOP in place of a SOF packet for traffic on a low-speed branch (**file_speed=LOW**). For Device Emulation, this statement is ignored by the Device Emulator, but serves to organize the **.utg** file in a more readable manner.

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
empty_frame	integer	**Host Generation Only.** This key creates a sequence of start of frame packets with **idle=TO_EOF** values for the idle time. This results in N empty frames, where N is the integer value specified. If the branch speed is LOW, the frames contain only the keep-alive standalone EOP's. This key makes for an easier to manage **.utg** file by eliminating the need for many lines of **frame=AUTO idle=TO_EOF** statements. Usage: **empty_frames=23**; insert 23 empty frames here
host_exp_pid	PID	Device Emulation Only. Defines the PID that is expected to be received from the Host. The Device Emulator waits until this PID has completed before sending the next generated packet. The key should be assigned to a valid packet identifier string per the USB specification: SETUP, IN, OUT, DATA0, DATA1, ACK, DATA2, or MDATA. PRE and PING are for Hubs only and are not supported. Each memory segment waits forever until it receives the expected PID to its address/ endpoint, so the user may have to hand edit the file to achieve the desired results. Each endpoint memory segment acts independently.

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
Bus Condition Keys		
reset	positive integer or LS_EOP	**Host Generation Only.** Indicates the number of microseconds that single-ended zeros (SE0) are driven onto the bus. Assign a positive integer to this key. This key can also be assigned the string **LS_EOP** to drive two low-speed bit times of SE0 followed by one bit time of J.
se0	positive integer <2500	**Host Generation Only.** Same SE0 signal as reset, but the range is in nanoseconds (accuracy: +/- 33 ns).
suspend	positive integer	**Host Generation Only.** Indicates the number of microseconds of idle and suspend after the previous packet (for example, for ten milliseconds of suspend, the key should equal 13000). Assign a positive integer to this key. Note that suspend begins after 3 milliseconds of idle.
resume	positive integer	Host Generation Only. Indicates the number of microseconds of K driven onto the bus. Assign a positive integer to this key. For a proper resume sequence, this should be followed by the condition **reset=LS_EOP speed=LOW**.
wait_resume	HERE	**Host Generation Only.** Place this immediately before a **resume=<>** statement to implement a device resume, also known as Remote Wakeup. This causes the host to wait for the device to issue the Resume (K) condition before the Host proceeds with its own Resume signalling. This statement MUST be followed by the **resume=<> statement**.
chirp	HERE	Used to create a chirp sequence for a High Speed generation. Usage: **chirp=HERE**

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
wait_vbus	VALID	Device Emulation Only. Wait for VBus to go Hi.
termination	HERE	Device Emulation Only. Set terminations now.
wait_termination	HERE	Host Emulation Only. Only for Voyager. Wait until Device Speed terminations are seen before proceeding.
Keys for Packet Fields		
speed	LOW	Used to cause a low speed packet on a full speed branch. The only legal value is **speed=LOW**.
addr	7 bits (0-127)	Assign a value for the address field.
endp	4 bits (0-15)	Assign a value for the endpoint number field.
hub_addr	7 bits (0-127)	Host Generation Only. Assign a value for the **hub_address** field of a SPLIT packet.
port	7 bits (0-127)	Host Generation Only. Assign a value for port field of a SPLIT packet.
data	(AB CD)	Assign data bytes for the data field. Use the following syntax: data=(12 34 56 78 90 AB CD EF DC 13 40 78 11 CA 70 65) You can wrap bytes of the data field to the next line. The bytes are in the order they come across the bus, and the bits within the bytes are in MSB to LSB order. Maximum number of bytes allowed is 1049.
crc	5 bits (0x0-0x1F) or 16 bits (0x0-0xFFFF)	Assign a value for the crc field. The default value is the correct crc calculated for the packet.
s	0 or 1	Host Generation Only. Assign a value for the s (High Speed SPLIT Start/Speed) field.
sc	0 or 1	Host Generation Only. Assign a value for the sc (High Speed SPLIT Start/Complete) field.

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
e	0 or 1	Host Generation Only. Assign a value for the e (High Speed SPLIT End) field.
et	0 to 3	Host Generation Only. Assign a value for the et (High Speed SPLIT Endpoint Type) field: 0 = Control 1 = Isoch 2 = bulk 3 = Interrupt
hird	4 bits (0-15)	Host Generation Only. Assign the Host Initiated Resume Duration. Default value is 0. For a description of the values 1 through 15, see the *Link Power Management Specification*.
link_state	4 bits (0-15)	Host Generation Only. Assign the link state. Currently, the only legal link_state value is 1, for L1 (Sleep). Default value is 0, so set the link_state value to 1.
remote_wake	0 or 1	Host Generation Only. Disable or enable Remote Wakeup. Default value is 0, which disables Remote Wakeup. To enable Remote Wakeup, set the value to 1.
eop	positive integer	Assign a positive integer for the length of the end of packet (EOP). The default value is the correct length (2 bits of SE0, 1 bit of J). The value is reflected by **<val-1>** bits of SE0 plus one bit of J.
hi_eop	(AB CD) Hex	Used to generate a high speed EOP pattern. The bytes are in the order they come across the bus, and the bits within the bytes are in LSB to MSB order. Maximum number of bytes allowed is 13.

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
idle	positive integer or TO_EOP	Defines the length of idle after the current packet. Assign a positive integer or string to this key. The positive integer indicates the number of full-speed or low-speed bit times. The default value is around 4 bits for Classic speeds and around 150 bits for High speeds. When this keyword is assigned a string TO_EOF, USB Chief automatically calculates the amount of idle remaining in the frame. When handshaking with a device, you can use this keyword to add idle where you anticipate a packet being returned from the device. The **idle=** key is always associated with the proceeding packet or bus condition, so you should not put file control keys between the packet or bus condition statement and the **idle=** statement.
marker	string	Assign a string in quotation marks to be put in the marker for the defined packet.
raw_data **Not supported for Hi Speed Traffic on Voyager M3x/ M310.**	(aa bb)	Use to send a non-modulo 8 number of bits in a classic speed **raw_data** packet. It is only valid in conjunction with the **raw_data** statement. Normally, every bit of the array defined in a **raw_data=(xx yy)** type of statement would be sent. However, particularly in the case where **bit_stuff=off**, you need more control over the number of bits to be output on the bus. By adding the statement **raw_data_bits = 11**, only the first 11 bits of the defined bytes are sent. For the following case, **raw_data=(8F F0) raw_data_bits=13** the output bitstream would be: 1111 0001 0000 1 (Each byte is described in MSB to LSB format, but is output on the wire in LSB to MSB format.)

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
raw_data_bits **Not supported for Hi Speed Traffic on Voyager M3x/ M310.**	integer	Use to send a non-modulo 8 number of bits in a classic speed **raw_data** packet. It is only valid in conjunction with the **raw_data** statement. Normally, every bit of the array defined in a **raw_data=(xx yy)** type of statement would be sent. However, particularly in the case where **bit_stuff=off**, you need more control over the number of bits to be output on the bus. By adding the statement **raw_data_bits = 11**, only the first 11 bits of the defined bytes are sent. For the following case, **raw_data=(8F F0) raw_data_bits=13** the output bitstream would be: 1111 0001 0000 1 (Each byte is described in MSB to LSB format, but is output on the wire in LSB to MSB format.)
bit_stuff **Not supported for Hi Speed Traffic on Voyager M3x.**	OFF ON	Assign the string **OFF** to disable bit stuffing within the current packet. The default value is **ON**.
sync	integer 2-40	Assign an integer from 2 to 40 to represent the sync field. The integer is the number of zeros transmitted before the one. For Low and Full Speed files, the default value is 7 to give a sync of 00000001. For High Speed files, the default value is 31 resulting in a sync of 00000000000000000000000000000001.
retry ping_on_retry ping_on_nak retry_next_frame	TRUE FALSE	Host Generation Only. These four keys may be applied to individual packets to override the behavior in a given instance. Normally, they are used in the **config_endpoint** statement. See their descriptions in the Endpoint Configuration section earlier.
Keys for Class Decoding These keys are populated into the .utg. script file automatically whenever the menu command File > Export to .utg file is run. These keys do not need to be edited.		
sd_prod		

TABLE 11.3: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
sd_vend		
sd_bm_req_type		
sd_interface		
sd_host_id		
sd_class_code		
sd_subclass		
sd_protocol		
sd_end_sd		

Chapter 12

Traffic Generation 3.1 Exerciser

The USB 3.1 Exerciser allows you to generate USB 3.1 traffic and test designs under realistic conditions. Traffic Generation can also transmit known bad packets, providing an opportunity for engineers to observe how a device handles specific adverse conditions.

Note: For traffic generation for USB 2.0, see "Traffic Generation 2.0" on page 401.

12.1 Connecting to Voyager M3/M3i

The connections differ for Host Emulation and Device Emulation.

Full Speed, Low Speed, Hi Speed, and SuperSpeed connections are the same.

You only need to plug into the Exerciser ports, because there is an internal Analyzer tap.

12.1.1 Host Emulation

For Host Emulation, connect a cable from Device under Test to Exerciser "A" port.

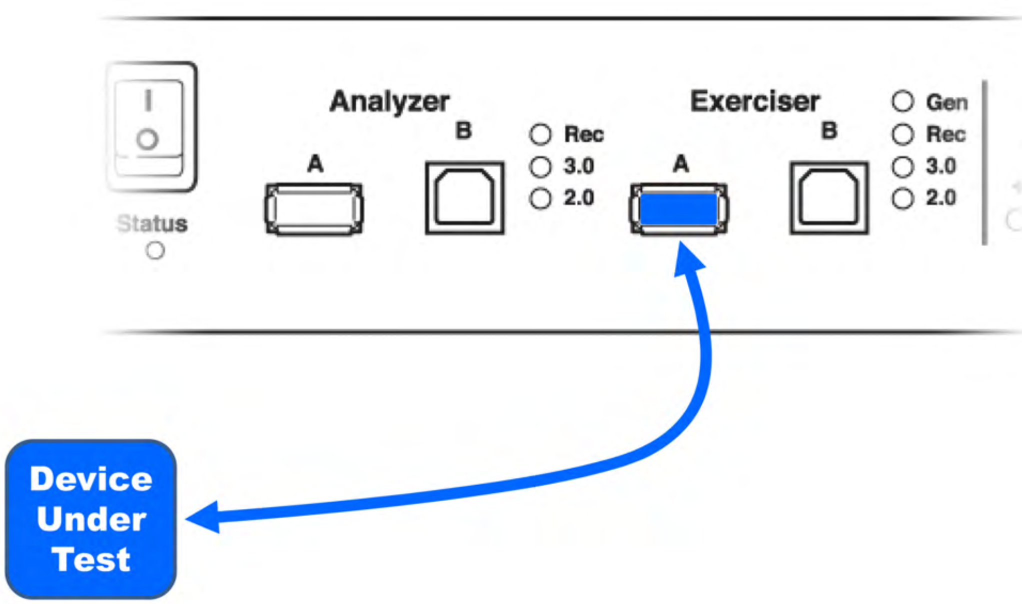


Figure 12.1: Connecting a Cable from Device under Test to Exerciser "A" Port.

12.1.2 Device Emulation

For Device Emulation, connect a cable from Host under Test to Exerciser “B” port.

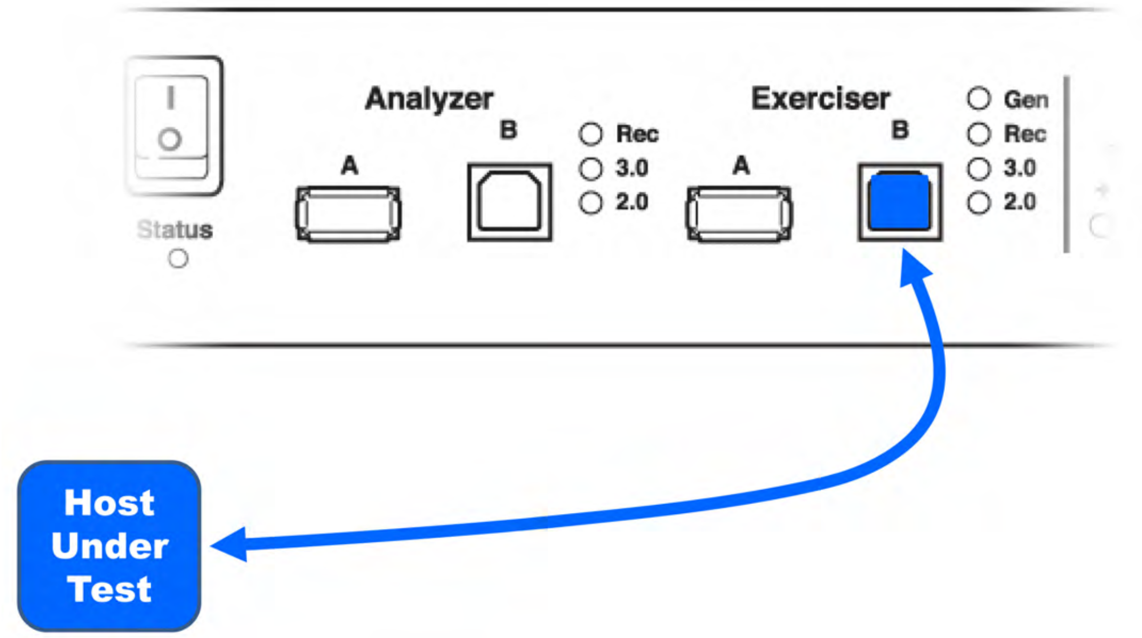


Figure 12.2: Connecting a Cable from Host under Test to Exerciser “B” Port.

12.2 Connecting to Voyager M3x

The connections differ for Host Emulation and Device Emulation.

Full Speed, Low Speed, Hi Speed, and SuperSpeed connections are the same.

12.2.1 Host Emulation

For Host Emulation, connect a cable from Device under Test to “A” port.

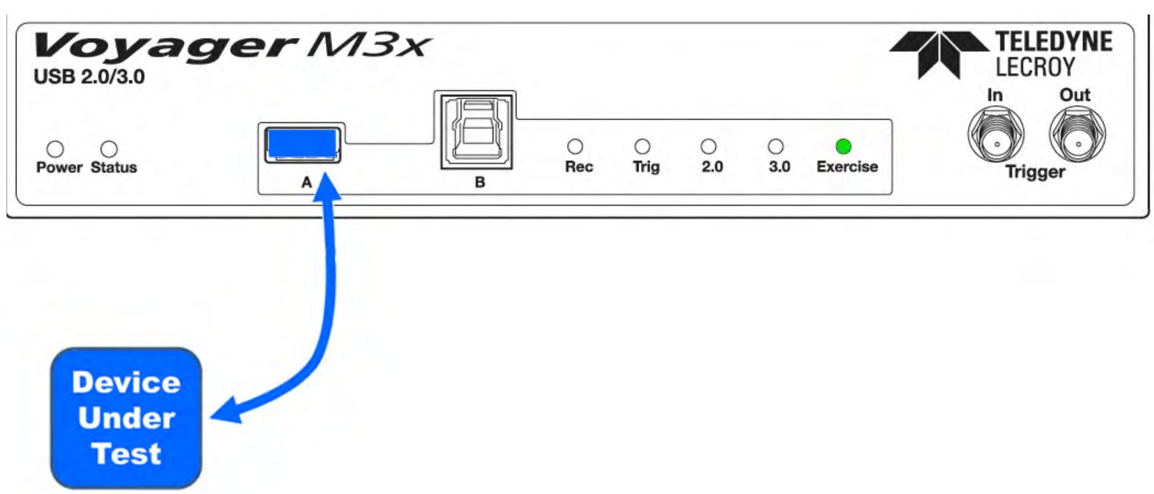


Figure 12.3: Connecting a Cable from Device under Test to “A” Port.

12.2.2 Device Emulation

For Device Emulation, connect a cable from Host under Test to “B” port.

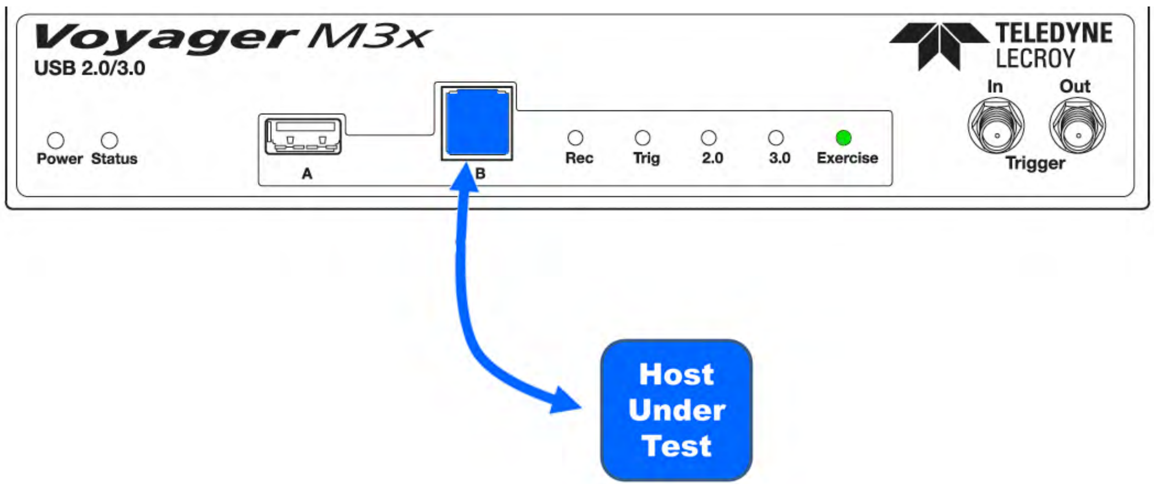


Figure 12.4: Connecting a Cable from Host under Test to “B” Port.

12.3 Connecting to Voyager M310

The connections differ for Host Emulation and Device Emulation.

Full Speed, Low Speed, Hi Speed, and SuperSpeed connections are the same.

You only need to plug into the Exerciser ports, because there is an internal Analyzer tap.

12.3.1 Host Emulation

For Host Emulation, connect a cable from Device under Test to Exerciser “A” port.

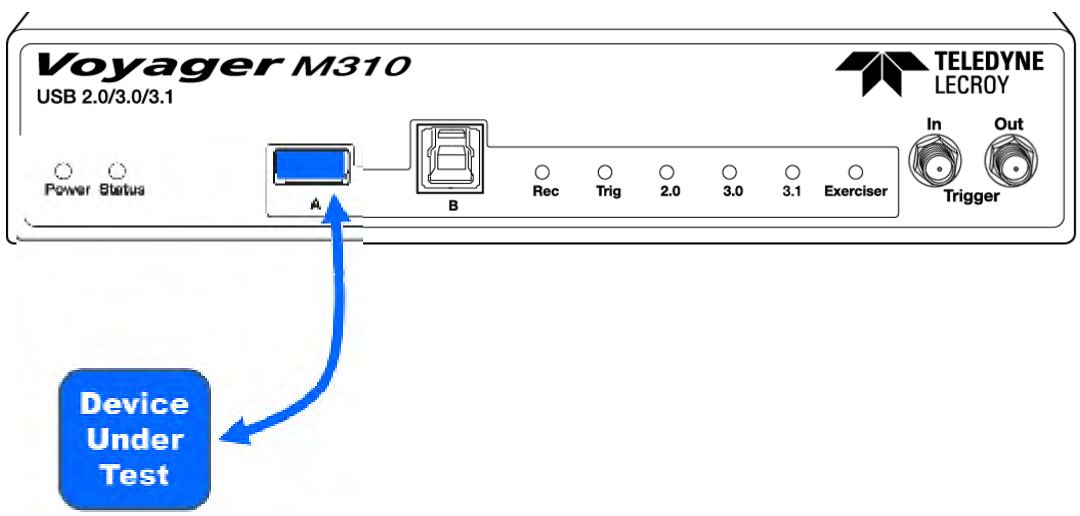


Figure 12.5: Connecting a Cable from Device under Test to Exerciser “A” Port.

12.3.2 Device Emulation

For Device Emulation, connect a cable from Host under Test to Exerciser “B” port.

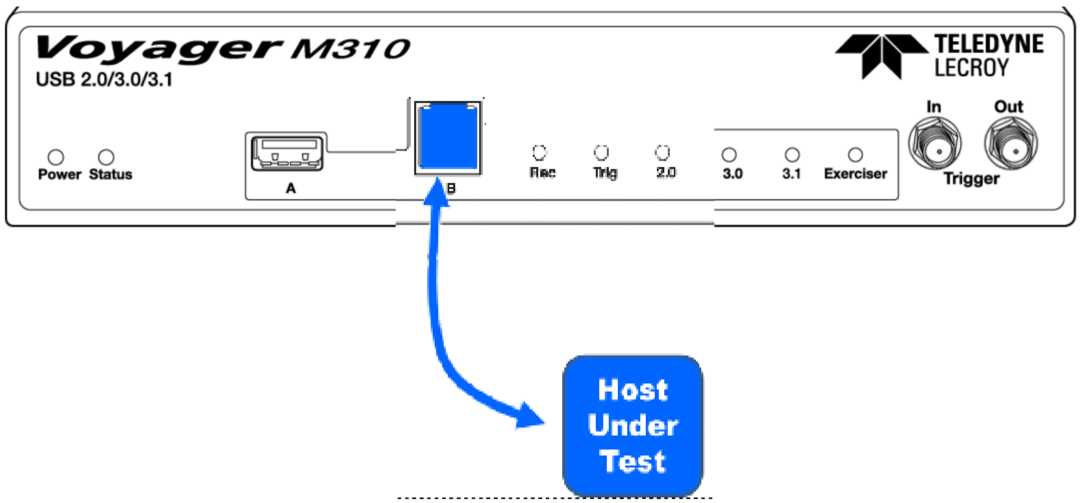


Figure 12.6: Connecting a Cable from Host under Test to Exerciser “B” Port.

12.4 Connecting to Voyager M310C

In all cases (SS, SS+) you attach to the left USB Type-C™ connector (the one with "Exerciser" written below it.) Selection between Host and Device emulation is done in the Recording Options dialog.

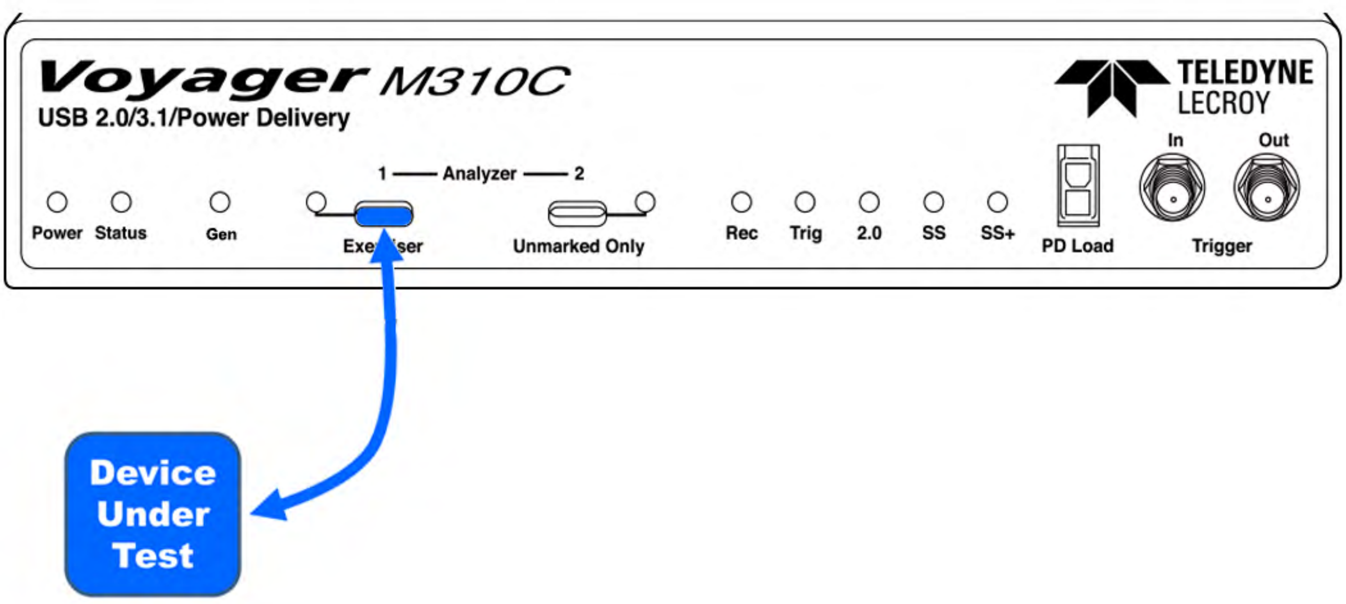


Figure 12.1: Connecting a Cable from Device under Test to Exerciser “A” Port.

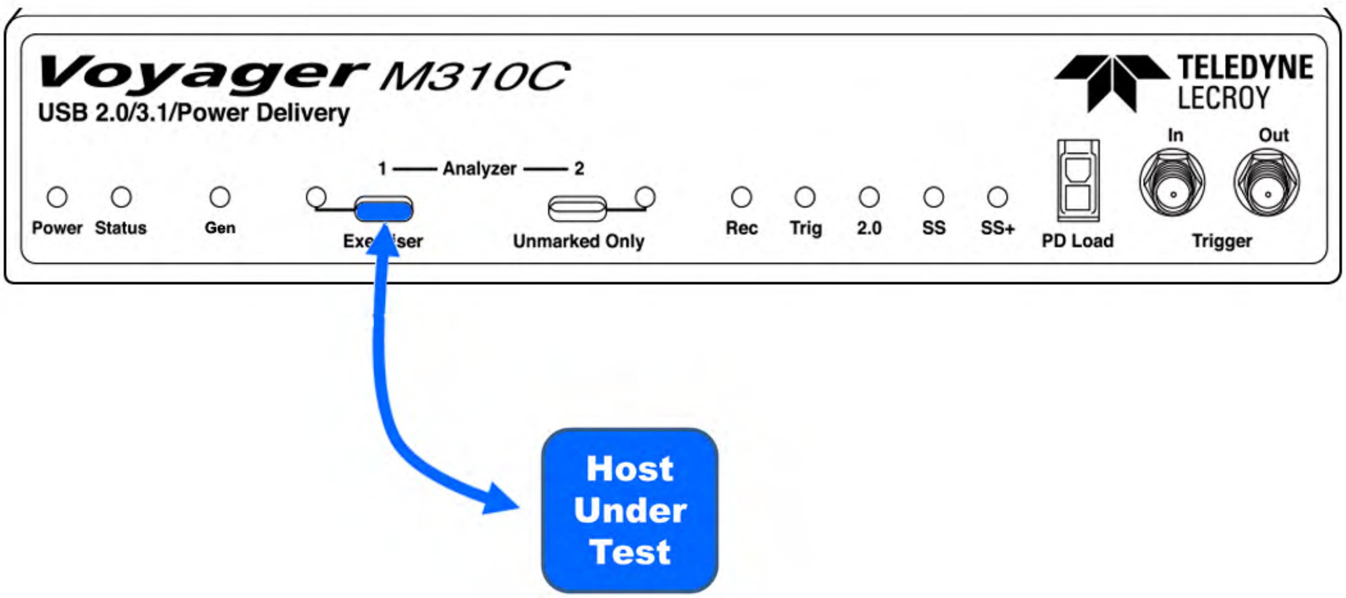


Figure 12.2: Connecting a Cable from Host under Test to Exerciser “A” Port.

12.5 Transaction Engine

The Transaction Engine allows Voyager hardware to automatically handle low-level protocol elements, for quicker response and higher data throughput. Some Transaction Engine features are:

- **Retry Upon RX NRDY TP**: Exerciser automatically waits for ERDY and then retries Header TP or ACK TP.
- **Upon RX of Data burst packets**: Exerciser automatically sends ACK TP with proper SEQ number for all received packets.
- **Upon RX of DP with out of order SEQ number**: Exerciser sends ACK TP with missing SEQ number and Retry bit set to 1.
- **Upon RX of DP with Host Error bit set**: Exerciser (in Device Emulation mode) automatically waits for ERDY and then retries packet.
- **Upon RX of Stream Transfer with out-of-order data packets**: Exerciser sends ACK TP with correct Stream ID and SEQ number.

Note: For more information on the theory of operation of the Transaction Engine and the use of the Scripting language, consult the Voyager USB 3.1 Exerciser Generation Script Language Reference Manual.

12.6 Transaction Engine

The Transaction Engine allows Voyager hardware to automatically handle low-level protocol elements, for quicker response and higher data throughput. Some Transaction Engine features are:

- **Retry Upon RX NRDY TP**: Exerciser automatically waits for ERDY and then retries

Header TP or ACK TP.

- **Upon RX of Data burst packets**: Exerciser automatically sends ACK TP with proper SEQ number for all received packets.
- **Upon RX of DP with out of order SEQ number**: Exerciser sends ACK TP with missing SEQ number and Retry bit set to 1.
- **Upon RX of DP with Host Error bit set**: Exerciser (in Device Emulation mode) automatically waits for ERDY and then retries packet.
- **Upon RX of Stream Transfer with out-of-order data packets**: Exerciser sends ACK TP with correct Stream ID and SEQ number.

Note: For more information on the theory of operation of the Transaction Engine and the use of the Scripting language, consult the Voyager USB 3.1 Exerciser Generation Script Language Reference Manual.

12.7 Exerciser Files

The system generates USB 3.1 traffic from traffic generation files (***.usb3g**) which are text-based script files that instruct the Exerciser how to generate USB 3.1 traffic. These script files can be edited with either a simple text editor such as Notepad or with the Script Editor utility provided by the application.

12.8 Creating Exerciser Files

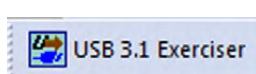
If you choose to write a script with a text editor, a good way to start is to edit a sample generation file.
For Windows 7 and Windows 8, an example such as: **MassStorageEnumeration.USB3g, SampleEnumHostTx.usb3g**, or **SampleMassStorageHostTx.usb3g**, in the directory **C:\Users\Public\Documents\LeCroy\USB Protocol Suite\Examples\3.1 Host Emulation\LowLevelScripts**.

For Windows XP, an example such as: **MassStorageEnumeration.USB3g, SampleEnumHostTx.usb3g**, or **SampleMassStorageHostTx.usb3g**, in the directory **C:\Program Files\LeCroy\USB Protocol Suite\Examples\3.1 Host Emulation\LowLevelScripts**.

You can open a generation file with Notepad or other editor and then add or remove text as needed.

For complete information on these and other Exerciser commands, see the Exerciser User Manual (VoyagerUSB3ExerciserScriptLanguage.pdf) included in your installation Documents folder.

12.9 Exerciser Window

Click the **USB 3.1 Exerciser** 

button to open the USB 3.1, Protocol Exerciser window.

12.9.1 Exerciser Menus

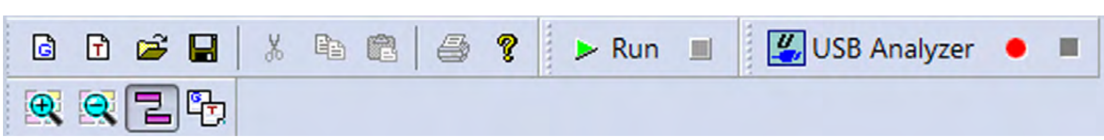
The Exerciser menus are:

Menu	Function
File	
New Graphic Scenario	Creates a new, empty, graphic traffic generation file.
New Text Scenario	Creates a new, empty, text traffic generation file.
Open	Opens a file.
Save	Saves the current file.
Save As	Saves all or a range of packets from the current file.
Close	Closes the current file.
Print	Prints part or all of the current traffic data file.
Print Preview	Produces an on-screen preview before printing.
Print Setup	Sets the options for the current or new printer.
Exit	Exits the program.
Edit	
Undo	Undoes previous command.
Redo	Redoes undone command.
Cut	Deletes selected text.
Copy	Copies selected text
Paste	Pastes copied text.
Toggle Bookmark	Moves back and forth between bookmarks (scripts only).
Next Bookmark	Goes to the next bookmark (scripts only).
Previous Bookmark	Goes to the previous bookmark (scripts only).
Clear All Bookmarks	Removes all bookmarks (scripts only).
Find	Displays the Find dialog (scripts only). You can match case, find whole word only, and search up or down.
Replace	Opens the Replace dialog to find text and replace it (scripts only). You can match case, find whole word only, and search up or down.
Find Next	Finds the next text entered in the Find dialog (scripts only).
Go to	Opens the Go To Line dialog, in which you can enter a line number (scripts only).

Menu	Function
Select All	Select all text in the current file (scripts only).
Generation	
Run Scenario	Starts traffic generation.
Stop Scenario	Stops traffic generation.
Preview Trace	Checks script for errors and displays trace.
Build (scripts only)	
Compile	Starts traffic generation (scripts only).
View	
Main Toolbars	Switches display of the Main toolbar on or off.
Graphical Toolbar	Switches display of the Graphical toolbar on or off (graphics only).
Views Toolbar	Switches display of the Views toolbar on or off (scripts only).
Script Toolbar	Switches display of the Script toolbar on or off (scripts only).
Status Bar	Switches display of the Status Bar on or off.
Zoom In	Increases the size of the displayed elements (graphics only).
Zoom Out	Decreases the size of the displayed elements (graphics only).
Wrap	Wraps displayed packets within the window (graphics only).
Convert	Converts graphic scenario to text scenario (graphics only).
Window	
Cascade	Displays all open windows in an overlapping arrangement.
Tile	Displays all open windows in a above-below arrangement.
Arrange Icons	Arranges minimized windows at the bottom of the display.
Close All	Closes all open windows.
Help	
About	Displays version information about the Voyager M3/M3i and the USB Protocol Suite. See “Software, Firmware, and BusEngine Revisions” on page 477.

12.9.2 Main Exerciser Toolbar

The Main Exerciser toolbar contains buttons for saving your edits, navigating, searching, and other functions.



The buttons have the following functions:

	New Graphic Scenario		New Text Scenario
	Open file.		Save. Saves your edits and immediately updates the setting bars and Frames shown in the trace window.
	Cut.		Copy.
	Paste.		Print.
	About		
Run	Run Scenario.		Stop Scenario.
USB Analyzer	Go to USB Analyzer window.		Start Recording.
	Stop Recording.		

12.10 Script Editor

After you open an existing generation script file or create a new text scenario in the Script Editor, use the following steps to edit or build a script. The Script Editor utility has several aids to simplify the process of writing and editing scripts: tool-tips, drop-down menus, and colored fields.

12.10.1 Highlighting

- All known commands and parameters are highlighted in **blue**.
- All predefined values and command modifiers are highlighted in **brown**.
- Comments are in **green**.
- Errors are in **red**.

12.10.2 Text Editing Commands

The Script Editor supports standard editor commands using toolbar buttons and Edit menu commands:

- Undo/Redo
- **Cut/Copy/Paste:** Also available by right-clicking a command to display a menu
- **Bookmarks:** Toggle, Previous/Next, and Clear All
- Find/Replace/Find Next/Go to

12.10.3 Help

Right-click a command to display a menu from which you can choose Help.

12.10.4 Properties Window

The Properties window lists all parameters and their values for the selected script command. Parameters/values can be changed by entering text into the text boxes or by selecting items from pull-down menus.

12.10.5 File Tabs

At the top of the Script Editor window is a tab with the name of the open generation file.

If there are **Include** statements in the generation file that link it to other generation files, these files automatically open and display as tabs at the top of the window. You can click the tabs to toggle between the open generation files.

12.10.6 Errors

When you compile a script and have an error, the error appears in the Error tab at the bottom of the application window. Each error has a file name, line number, and description. Double-clicking the error jumps to the line number.

A red square appears next to the line number that contains the error.

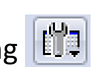
A yellow square appears next to the line number that has a warnings.

Note: You cannot run a script that has syntax errors.

12.10.7 Output

When you compile a script that generates output or when the application sends you a message, the information appears in the Output tab.

12.10.8 Options Menu

You can set text options in the Options menu by clicking :

- **Enable Outlining:** Adds a hierarchy of levels to the script.
- **Show Line Numbers:** Displays the line numbers at the left of the window.
- **Show Tooltips:** When you place the cursor over an item, information about the item appears.
- **Enable IntelliSense:** Starts the IntelliSense program.
- **Toggle Outlining:** If Enable Outlining is checked, allows you to expand or collapse the outlining levels.

12.10.9 Outlining

If you enable outlining at the Options button, you can **collapse** or **expand** code blocks. You can toggle outlining at the Options button or by right-clicking a command to display a menu from which you can choose Toggle Outlining.

12.10.10 Line Numbers

If you enable line numbers at the Options button, each line has a line number.

12.10.11 Tooltips

If you show tooltips at the Options button, tooltips appear when you place the cursor over a button or command.

12.10.12 Text Snippets

Text snippets appear in the Text Snippets window (see Figure 12.3 on page 448.) You can drag and drop a text snippet into the script. The available text snippets are:

- **Send:** Enter a packet template name, with options to delay or override.
- **SendPipeCommand**: Enter a command name, pipe type, total length, setup, data pattern, asn, store data, and send erdy.
- **SetSequenceNumber**: Enter a pipe type, device address, endpoint number, data directory, sequence number, and enable.
- **SendFile:** Enter a file path, device address, endpoint, delay, start sequence number, payload_size, stream ID, and route string.
- **PrepareWaitPkt**: Enter packet type as TP or DP, requested packet subtype for TP, packet endpoint number, packet device address, packet direction, and packet stream ID.
- **WaitPacket**: Enter packets to wait (default is 1) and start wait at last end (default is 1) or not (0).
- **TxSleep**: Enter an interval.
- **Set Link State**: Enter a link state.
- **Loop**: Enter a counter.
- **Start Recording**: Enter the Recorded Options File Path and Name and the Trace File Path and Name. Indicate whether to keep the old trace.
- **Stop Recording**: Enter 0 (no WaitForUpload) or 1 (WaitForUpload). You can also force to stop recording.
- **Trigger Analyzer:** Has no options.
- **for**: Enter code between the braces.
- **Call**: Enter a Procedure name and the procedure parameters.
- **Packet Size**: Enter an integer or a template.
- **Pattern Size**: Enter an integer or a data pattern.
- **Field Size**: Enter an integer or a field name.
- **Set**: After the set command, enter a setting and its value.
- **Trace_B**: Enter a message.
- **Trace**: Enter a message.
- **StartDeviceFrameworkHandler**: Starts or stops the Device Framework Handler

task on the Trainer

- **InitDevice**: Initializes operation of Device Emulation for a device.
- **AddDescriptor**: Adds a descriptor structure to the descriptor list for a device.
- **WaitForDeviceRequest**: Allows synchronizing the execution of the automatic Device Framework Handler with the rest of the script.
- **AddDrive**: Sets up Drive Emulation for the device that is being emulated.
- **DeviceEnumerationInit.snpt:** Text snippet for device enumeration.

Note: In the syntax for Text Snippets, the /* and */ stand for comment marks. Do not use either the / or * when you enter a parameter. For example in:

Send /*packet template name*/

the entry might look like this:

Send Name1

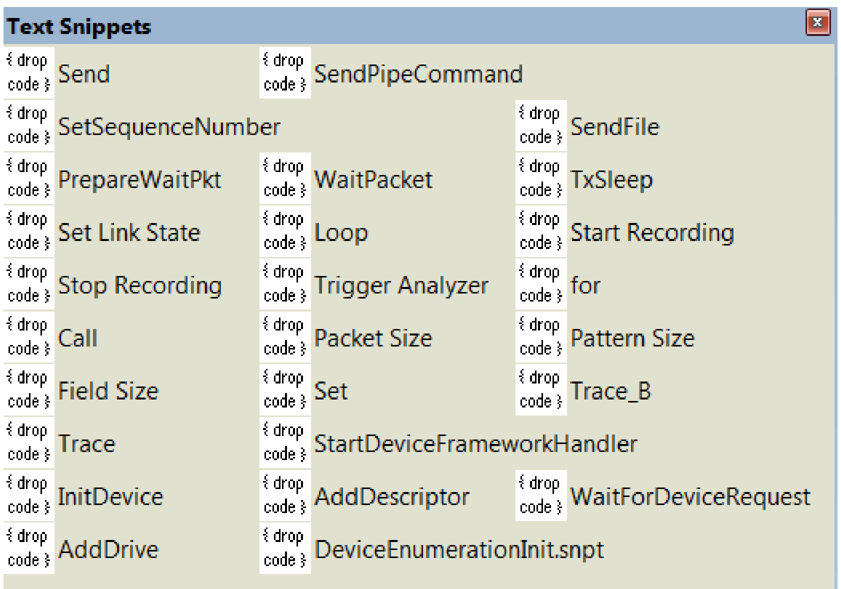


Figure 12.3: Text Snippets Window

Note: For information about each command, see the *Voyager USB 3.1 Exerciser - Generation Script Language Reference Manual*.

12.10.13 Views Toolbar

The Views toolbar contains buttons for viewing text snippets, Output window, and Error Output window.

Figure 12.4: Views Toolbar

The buttons have the following functions:

	View Toolbox Text Snippets.		View Output window
	View Error Output window.		.

12.10.14 Script Toolbar

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

Figure 12.5: Script Toolbar

The buttons have the following functions:

	Undo.		Add/Remove bookmark. Allows markers to be set or removed to aid in navigation.
	Redo		Go to next bookmark.
	View Options. Opens a menu with three options: Enable Outlining, Toggle Outlining, and Show Line Numbers. See **View Options Menu** below.		Go to previous bookmark.
	Compile.		Clear all bookmarks.
	Find.		Find and Replace.
			Find Next

12.10.15 Pop-up Menu

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

- Cut
- Copy
- Paste
- Toggle Outlining

- Open All Include Files

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

12.10.16 Error Log

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

12.10.17 Tooltips

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

12.11 Creating a Script using the Script Editor

Before creating a script, read the *Voyager USB 3.1 Exerciser Generation Script Language Reference Manual* to become familiar with all parts of a script and their order, learn about the commands and their parameters, and see an example script.

To create a script, do the following in the USB 3.1, Protocol Exerciser window:

1. Click the  **New Generation Scenario** button or select **File > New Generation Scenario** to display a blank script.

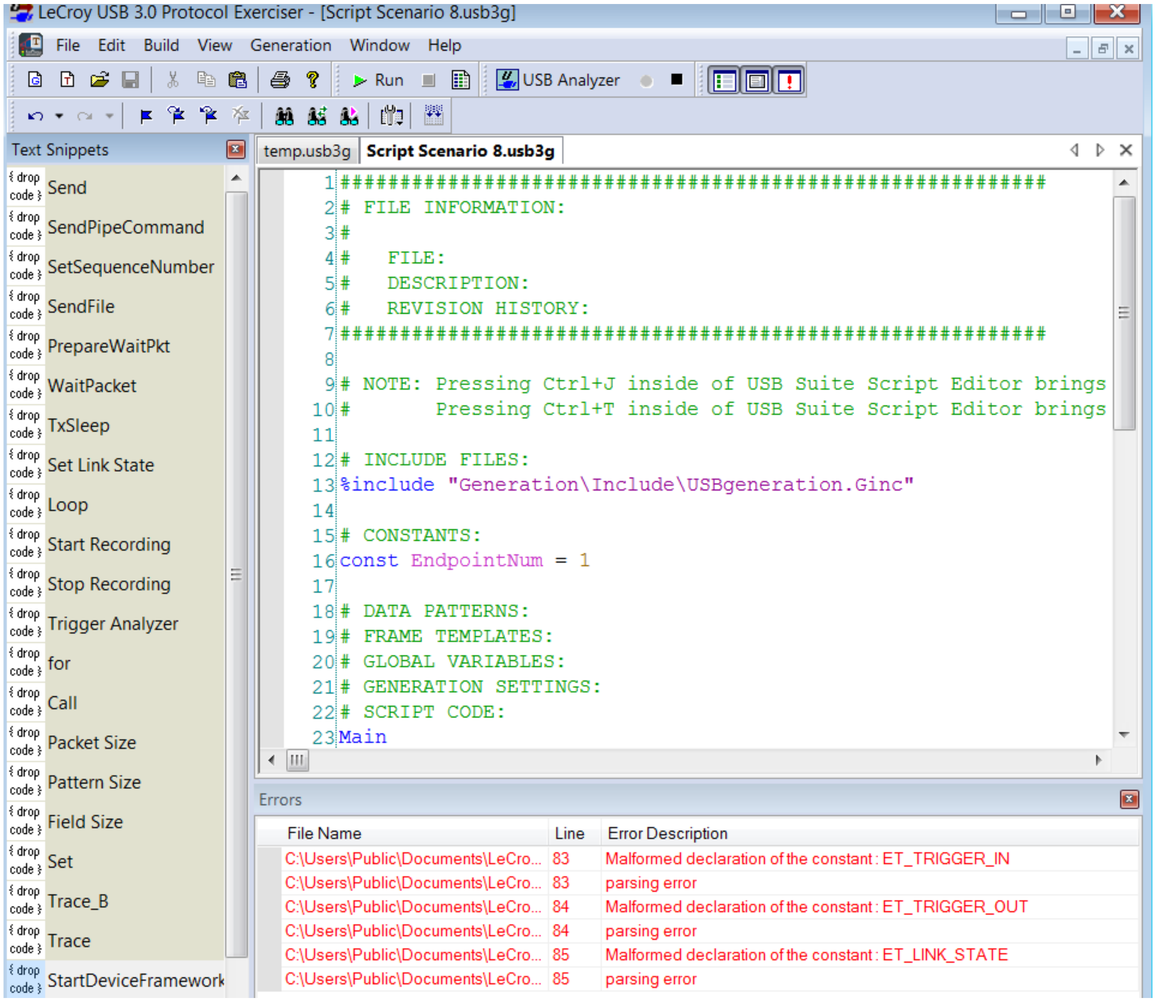


Figure 12.6: Script Scenario

The file name appears on the tab for the file.

2. Enter file information in beginning comment lines:

```
##########################################################
# FILE INFORMATION:
# FILE:
# DESCRIPTION:
# REVISION HISTORY:
##########################################################
```

3. Add a comment line by starting the line with #:

```
# INCLUDE FILES:
```

4. To include main definitions and templates, add an include file line:

```
%include "Include\FrameworkLib.ginc"
```

5. Add constants:

```
Const EndpointNum = 1
Const DeviceNumber = 1
```

6. Add data patterns:

```
DataPattern SetAddrReq   = { 00 05 00 00 00 00 00 00 }
```

7. Add frame and structure templates:

   struct DeliveryID

```
{
    Sel : 1 = 1     # Stream Index
    Val : 3
}
```

8. (optional) Add global variables.
9. (optional) Add generation settings.
10. Add the **Main** generation procedure, such as the following example:

```
Main
{
    # Place your generations instructions here.
    SetLinkState (LinkState = U0)
    Call GetDescriptor(EndpointNum,0,DEVICE_DESC,0x00,
                   0x00,0x1200,WaitTPSleep,WaitDPSleep)
     Call SetAddress(EndpointNum, DeviceNumber * 256,
                   WaitTPSleep, WaitDPSleep)
}
```

Note: You can use the Text Snippets on the left Text Snippets panel to add commands and their parameters.

11. Add other generation procedures (see Figure 12.7 on page 453). For how to set up other generation procedures, see Appendix A of the *Voyager USB 3.1 Exerciser Generation Script Language Reference Manual*.

temp.usb3g | **Script Scenario 8.usb3g**

```
###########################################################
# FILE INFORMATION:
#
#    FILE:
#    DESCRIPTION:
#    REVISION HISTORY:
###########################################################

# NOTE: Pressing Ctrl+J inside of USB Suite Script Editor brings up the list of available instructions/directives."
#       Pressing Ctrl+T inside of USB Suite Script Editor brings up the list of available packet templates."

# INCLUDE FILES:
%include "Include\FrameworkLib.ginc"

# CONSTANTS:
const EndpointNum = 1
const DeviceNumber = 1

const WaitTPSleep = 200
const WaitDPSleep = 200
set Mode = HOST
# DATA PATTERNS:
# FRAME TEMPLATES:
# GLOBAL VARIABLES:
# GENERATION SETTINGS:
# SCRIPT CODE:
Main
{
    # Place your generations instructions here.

     SetLinkState  (LinkState = U0

     Call GetDescriptor(EndpointNum,0, DEVICE_DESC,0x00,0x00,0x1200,WaitTPSleep,WaitDPSleep

     Call SetAddress(EndpointNum, DeviceNumber * 256,WaitTPSleep, WaitDPSleep)
}
```

Figure 12.7: Script Scenario

12. (optional) You can use the Text Snippets on the left Text Snippets panel to add commands and their parameters.
13. Click the **Compile** button or select **Build > Compile** to check the file for errors. The application lists any errors in the Errors tab.
14. Click the **Save** button or select **File > Save** to save the file.

Note: Saving the file automatically compiles it.

12.12 Graphical Scenario Editor

The Graphical Scenario Editor allows you to create Host Emulator scenarios (only), using high-level constructs and graphical elements.

After inserting an item, you can modify these elements through simple edit boxes and pull-down selections by clicking on elements.

You can insert the following items:

- High-Level SCSI Commands (SPC-3, SBC-2, SMC-2, SSC-2, MMC-5, SCC-2, and SES-2)

- High-Level Task Management Functions
- Bus Enumeration / Control Requests
- Settings
- Mass Storage Transfer Packets
- Instructions (Start Loop, End Loop, Delay, Stop Exerciser)

After you create a new graphical scenario, use the following steps to edit or build the scenario.

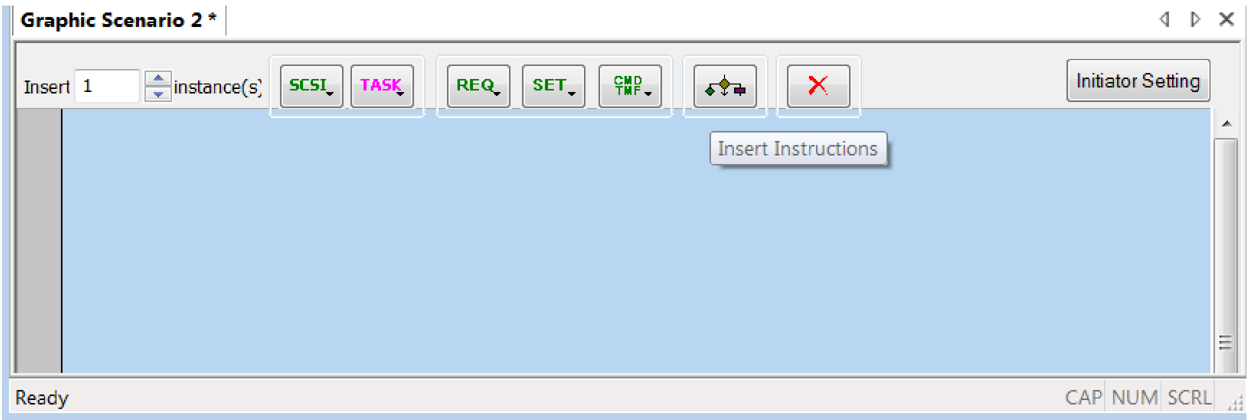
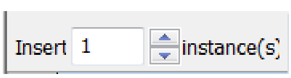


Figure 12.8: Graphical Scenario Editor

12.12.1 Graphical Scenario Window

The Graphical Scenario window contains SCSI, TASK, REQ, SET, Insert Instructions, and Delete Selected Item buttons. You can **Insert** 1 to 20 instances.



SCSI command:

- SPC-4
- SBC-3
- SMC-3
- SSC-4
- MMC-6
- SCC-2
- SES-2

Task button:

- Abort Task
- Abort Task Set
- Clear Task Set
- LUN Reset
- Clear ACA
- Query Task
- Query Task Set
- I T Nexus Reset
- Query Asynchronous Event

REQ button:

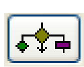
- Bus Enumeration
- Device Requests:
  - Clear Feature
  - Get Configuration
  - Get Descriptor
  - Get Interface
  - Get Status
  - Set Address
  - Set Configuration
  - Set Descriptor
  - Set Feature
  - Set Interface
  - Set Status
  - Synch Frame
  - Set Sel
  - Set Isoch Delay

SET button:

- ErrLostLGOOD
- ErrWrongLGOOD
- ErrLostLCRD
- ErrWrongLCRD
- ErrCorruptLinkCmd
- ErrCorruptLMP
- ErrDisparity
- ErrWrongSymbol
- ErrLBAD
- ErrLostLGOODAdv
- ErrWrongLGOODAdv
- ErrLostLCRDAdv
- ErrWrongLCRDAdv
- SetLinkState

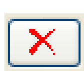
CMD/TMF button inserts Mass Storage transfer items in BOT or UAS based on Active Device (See Initiator Emulator Setting)

- Command
- Task Management



Instruction items:

- Start Loop
- End Loop
- Delay
- Stop



Delete Selected Item(s). Selected item(s) are marked by horizontal arrow(s) on left bar.

There are different ways to select items:

- Click item for single selection.
- Use Ctrl, Shift, or Ctrl+ A, or drag mouse around item(s) for multiple selections

12.12.2 Initiator Setting

The Initiator Settings button displays the Initiator Settings dialog.

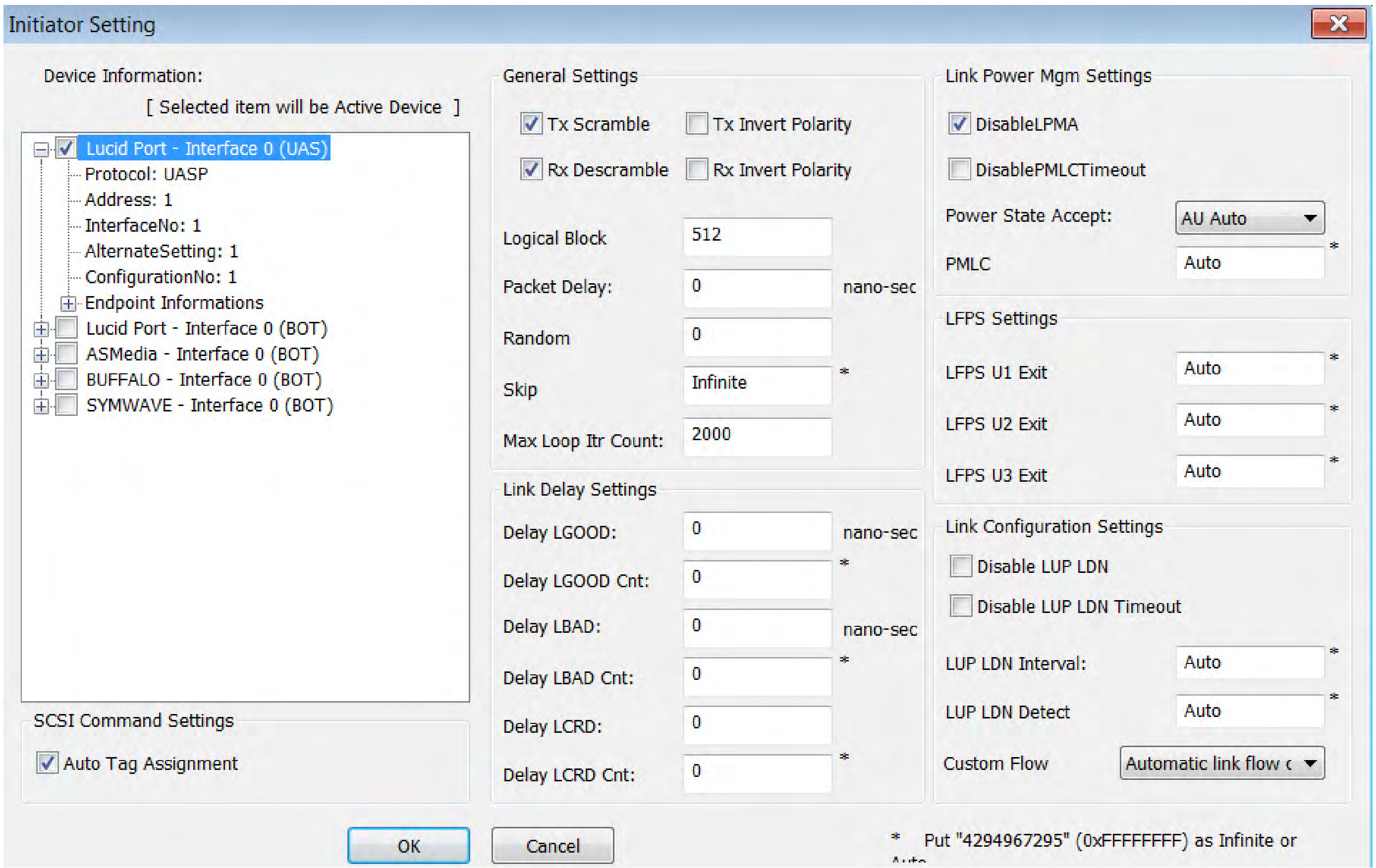


Figure 12.9: Initiator Setting Dialog

Device Information

The left pane shows Device Information, as expected from enumeration, so this pane shows general device information from a pre-configure file. The Device Information **DeviceInfo.cfg** file is in the **Generation** directory under the **users** directory. You can edit this file.

For each device, the following information is in the **DeviceInfo.cfg** file:

- Name
- Protocol (UASP or BOT)
- Address
- InterfaceNo
- AlternateSetting
- ConfigurationNo
- Endpoint Information
- EndpointNo

- Direction (IN or OUT)
- Max Burst Size
- PipeUsageId
- Endpoint Type (only for UAS protocol)

Note: You can only select one device from the Device List as the active device. Required information for the project is defined by the active device. The active protocol in the project is defined by the active device.

Note: If you have already inserted some items in the project, and then you change the active device, if the new active device is in another protocol (UAS or BOT), the software will try to convert all information to the selected protocol (based on the active device), and sometimes information may be lost.

SCSI Command Settings

Auto Tag Assignment: You can choose Auto Tag Assignment for SCSI Commands. Then the tag will be assigned automatically for SCSI Commands (starts with 1 and continually increments). If you deselect this feature, you must check the tag value of all SCSI Commands in the project and make them unique in each run.

General Settings

The middle pane has General Settings: Tx Scramble, Rx Descramble, Port Configuration Ack, Tx Invert Polarity, and Rx Invert Polarity checkboxes.

You can set Logical Block Size, Packet Delay, Random Seed, Skip Timer, and Maximum Loop Iteration Count.

Link Delay Settings

The middle pane has Link Delay Settings: Delay for LGOOD, LGOOD Count, LBAD, LBAD Count, LCRD, and LCRD Count.

Link Power Management Settings

The right pane has Link Power Management Settings. You can disable LPMA and PMLC Timeout. You can set Power State Accept and PMLC Timeout.

LFPS Settings

The right pane has LFPS Settings. You can set Exit TBurst for U1, U2, and U3.

Link Configuration Settings

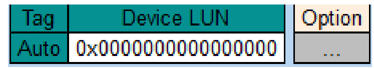
The right pane has Link Configuration Settings. You can disable LUP LDN and LUP LDN Timeout.

You can set LUP LDN Interval and Detect Timeout.

You can select a Custom Flow Control, such as Automatic Link Flow Control, No LGOOD Detect, No LCRD Detect, No LGOOD Generation, No LCRD Generation, or No Flow Control.

Note: A value of 4294967295 (0xFFFFFFFF) indicates that a default value will be used (Infinite or Auto).

12.12.3 Option Button

After inserting a SCSI Command, a Task Management Functions, or a Transfer packet, at the end of the packet an extra button, called Option 

displays. Click this button, to set some protocol errors and command settings for that item.

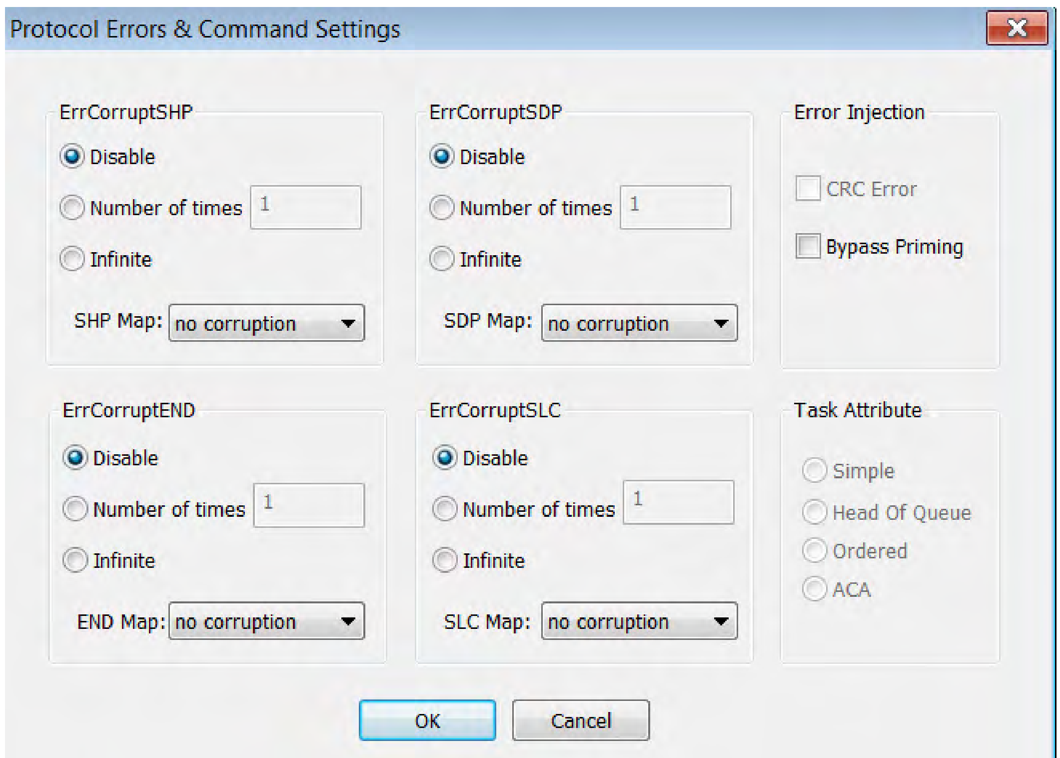


Figure 12.10: Protocol Errors and Command Settings

ErrCorruptSHP section has Disable, Number of items, Infinite, and SHP Map (no corruption or Corrupt Symbol 1, 2, or 3).

ErrCorruptSDP section has Disable, Number of items, Infinite, and SDP Map (no corruption or Corrupt Symbol 1, 2, or 3).

ErrCorruptEND section has Disable, Number of items, Infinite, and END Map (no corruption or Corrupt Symbol 1, 2, or 3).

ErrCorruptSLC section has Disable, Number of items, Infinite, and SLC Map (no corruption or Corrupt Symbol 1, 2, 3, or 4).

Error Injection section has CRC Error or Bypass Priming.

Task Attribute section has Sample, Head of Queue, Ordered, and ACA.

Script Scenarios

For some special purposes in which graphical scenario features are limited, you can convert a graphical scenario to a script scenario, which you can then modify.

Note: The software does not support converting a text scenario to a graphic scenario.

Save

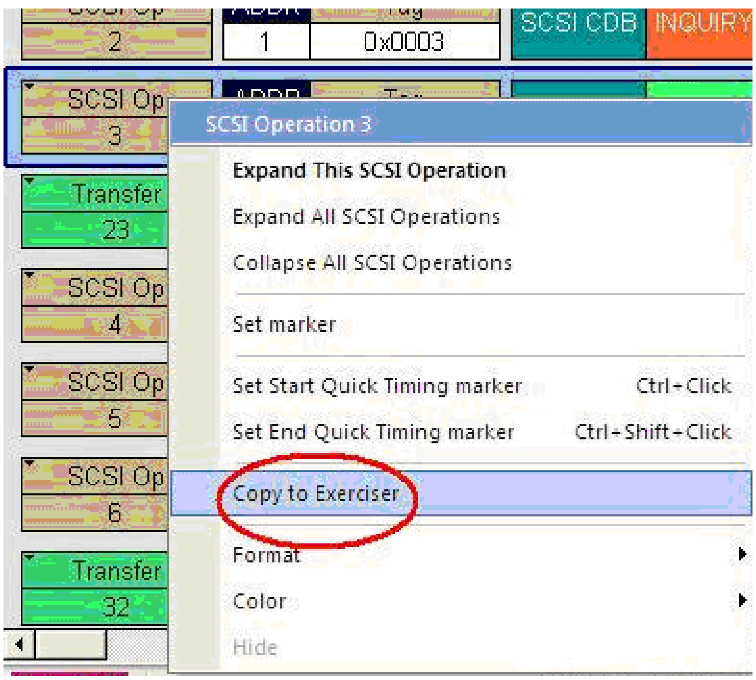
You can save a created project by selecting **File > Save**.

You can run a saved project by selecting **Generation > Run Scenario** or using the Run Toolbar.

12.12.4 Copy SCSI Operation from Trace File and Paste to Exerciser Scenario

To select a SCSI command from a trace file to use in an Exerciser scenario:

1. Right-click any SCSI packet and select **Copy to exerciser** from the menu:



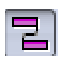
2. Go to the Graphical View of the Exerciser, right-click in the view, and select **paste** from the menu.

Note: Copy to Exerciser function only copies to USB 3 Exerciser scripts (.usb3g). Due to limitations in the USB 2.0 generator architecture, .utg files cannot accept high level functions such as SCSI operations.

12.12.5 Graphical Toolbar

The Graphical toolbar contains buttons for zooming, wrapping, and converting from graphic scenario to text scenario.

The buttons have the following functions:

	Zoom In		Zoom Out
	Wrap		Convert from graphic scenario to text scenario.

12.13 Loading and Running the Generation File

The USB 3.1 Traffic Generation files are scripts that instruct the Analyzer how to generate USB 3.1 traffic. A traffic generation file contains text in special format and is named with a ***.usb3g** extension. There are several examples of Traffic Generation files included with the installation of the software.

To load a generation file:

1. Select **File > Open ...** from the menu to display the Open dialog box.
2. Select **Usb3Script Files (*.usb3g)** from the drop-down menu marked **Files of Type** to display a list of USB 3.1 Traffic Generation files.
3. Select a Traffic Generation file (*.usb3g).
4. Click **Open**.

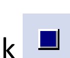
12.13.1 Starting Traffic Generation

To start traffic generation, click 

on the Tool Bar.

Click the **Trace Preview**  button to check the file.

12.13.2 Stop Traffic Generation

To instruct the Analyzer to halt traffic generation, click  on the Tool Bar.

12.14 USB 3.1 Electrical Test Modes

In the Electrical Test window, you can use Loopback mode and Compliance mode.

To access the Electrical Test window, you must connect to the Voyager system.

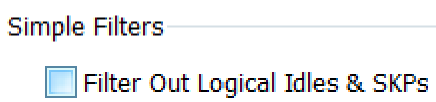
12.14.1 Loopback Mode

The Voyager USB 3.1 Electrical Test window supports entry to the Polling.Loopback substate. For receiver testing, the device under test (loopback slave) is placed in a special test mode and echoes back a predefined loopback pattern. The Voyager system can initiate this special mode (loopback master) and generate the basic loopback pattern. **The intended use of this feature is to allow designers to test their implementation of entering Loopback Mode. It is NOT intended to be used for receiver tolerance testing!**

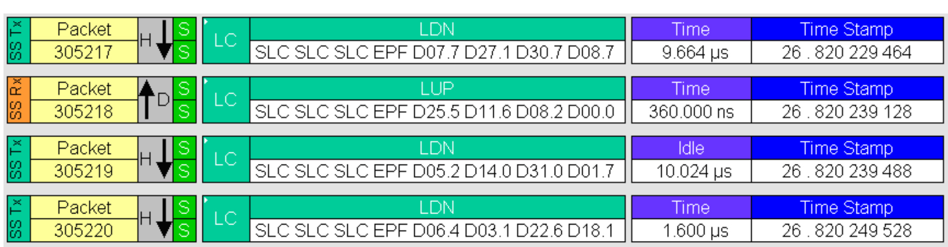
Full compliance testing requires the addition of jitter tolerance measurements to the loopback stream. Specialized equipment, such as Teledyne LeCroy's PERT Receiver Tolerance Test system, should be used to introduce jitter and perform the full electrical layer compliance testing process.

Loopback Mode test procedure

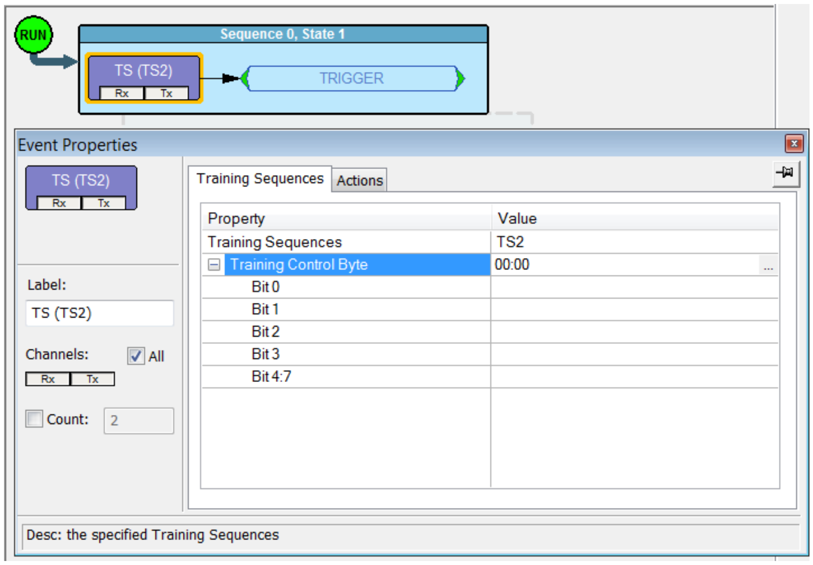
1. Connect the DUT to the Exerciser port:
   For Device Loopback: Attach DUT to Port A
   For Host Loopback: Attach DUT to Port B
2. Set recording options:
   For Device DUT Loopback: Set Voyager as Host Emulator
   For Host DUT Loopback: Set Voyager as Device Emulator
3. In the Misc USB 3.1 tab, uncheck the **Filter-Out Logical Idles an Filter-Out SKPs** option.



Initiating loopback mode requires that the DUT successfully link trains with the Voyager exerciser. Verify that the link reaches U0 by pressing the Record button and looking at traffic for LUP/ LDN link commands.



You can optionally set the analyzer to record the Loopback traffic to verify that the system enters loopback. If you elect to record Loopback traffic, it is recommended that you set Trigger on the Loopback command by setting Trigger on TS2 with loopback bit asserted.



4. Select the **Electrical Test** window from the View Menu.
5. Click the **Loopback Test** check box.

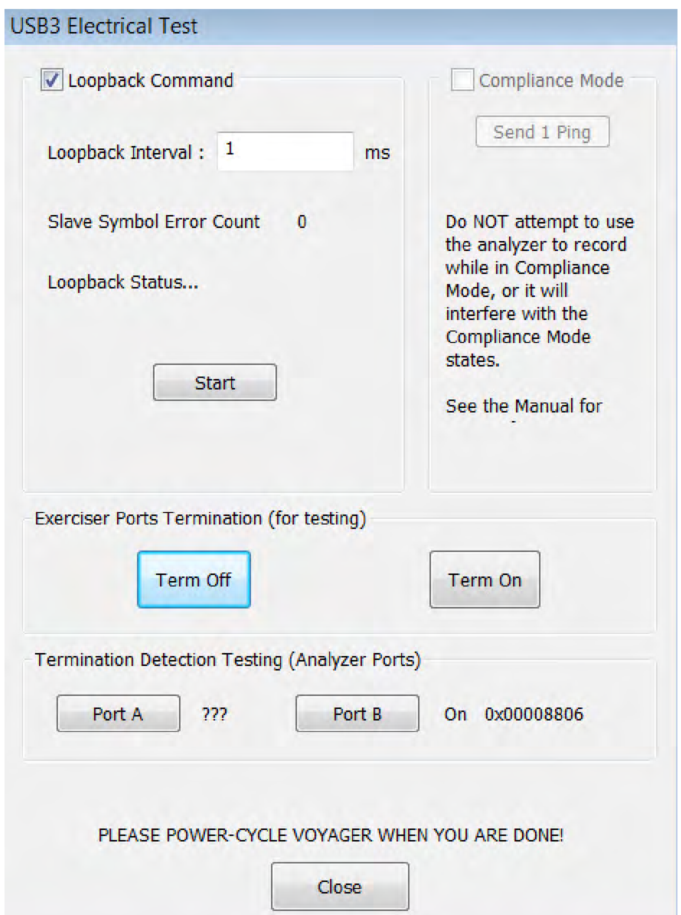


Figure 12.11: USB 3.1 Electrical Test

Use the **termination buttons** to verify that a device sees (or does not see) termination from the exerciser ports. After you finish, be sure to put them back in the mode that you expect them to be in when done.

6. Set the **Loopback Interval**. This is the time interval in milliseconds in which each of the BERT ordered sets (BRST, BDAT, and BERC) will be transmitted. The minimum value is 1 ms. The maximum value is 2^28 = 268,435,456 ms.
7. Press the **Start** button.

   Loopback entry and pattern generation occurs immediately after the link partners complete training. SSC is enabled within the transmitted loopback pattern. If the analyzer is used to record the exchange, the loopback traffic should appear in both upstream and downstream directions, with individual BERT ordered sets.

In the image below, the Voyager initiates loopback testing on a host (upstream) port. Uncheck the **Hide Logical Idle Packets** option, on the toolbar or View menu. Then use the **Link Tracker** to verify that the pattern is transmitted (see Figure 12.12 on page 464)

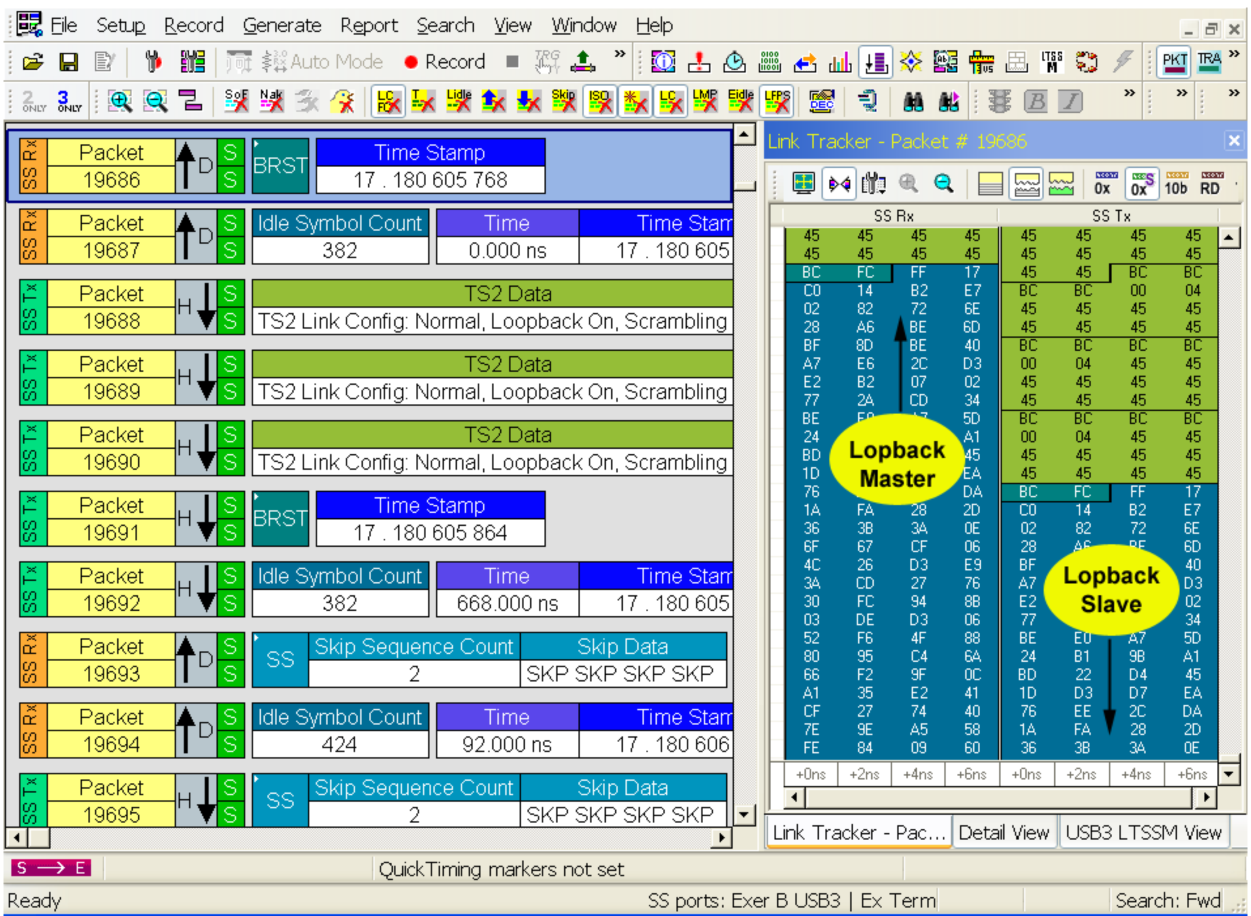


Figure 12.12: Device Initiates Loopback Mode with SuperSpeed Host.

The loopback sequence is transmitted for the defined interval and automatically repeats until the **Stop** button is pressed. The Electrical Test window automatically monitors the loopback patterns for receiver errors and displays the following:

- Number of Symbols

- Number of Transmitted Errors
- Number of Received Errors
- Status of Loopback Mode

Note: The Voyager Loopback Mode does not alter the transmitted signal and does not perform the jitter tolerance electrical test defined in USB-IF Electrical Layer Compliance Specification. Specialized equipment, such as Teledyne LeCroy's PERT Receiver Tolerance Test system, should be used to introduce jitter as defined by the Electrical Layer Compliance Specification.

12.14.2 Compliance Mode

The Voyager USB 3.1 Electrical Test window supports entry to the Polling.Compliance substate. This initiates the transmission of the pseudo-random data pattern generated by the scrambled D10.0 compliance sequence. The Voyager system USB 3.1 Electrical Test window can initiate the required test modes, while an attached oscilloscope is used to measure the transmitted compliance patterns.

After the DUT is in the Compliance state and is sending a compliance pattern (CP0), the pattern will be transmitted continuously until a ping LFPS is detected at the DUT receiver. The Voyager system does not send a compliance pattern but remains in electrical idle while the Compliance mode is operational. The Voyager can transmit subsequent ping.lfps signals interactively to advance the DUT to the next compliance pattern.

Note: The Voyager and Advisor T3 have the ability to capture particular Compliance Patterns which have framing formats similar to packets. This includes CP1, CP2 and CP3. The other patterns are bitstreams which the analyzer is unable to lock on, so they would appear as IPS (Inter Packet Symbols) which are un-decodable.

Compliance Mode test procedure

1. Connect the DUT or HUT to a test fixture board (for example, an Intel board), so that transmit signals go to the oscilloscope and receive signals come from the analyzer.

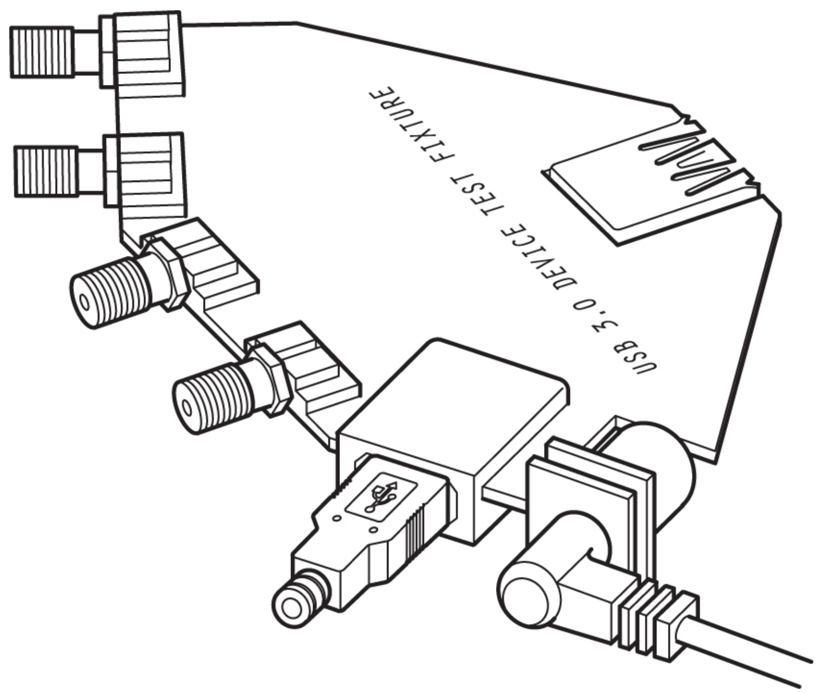


Figure 12.13: Intel Test Fixture

The following two photos show an example connection.

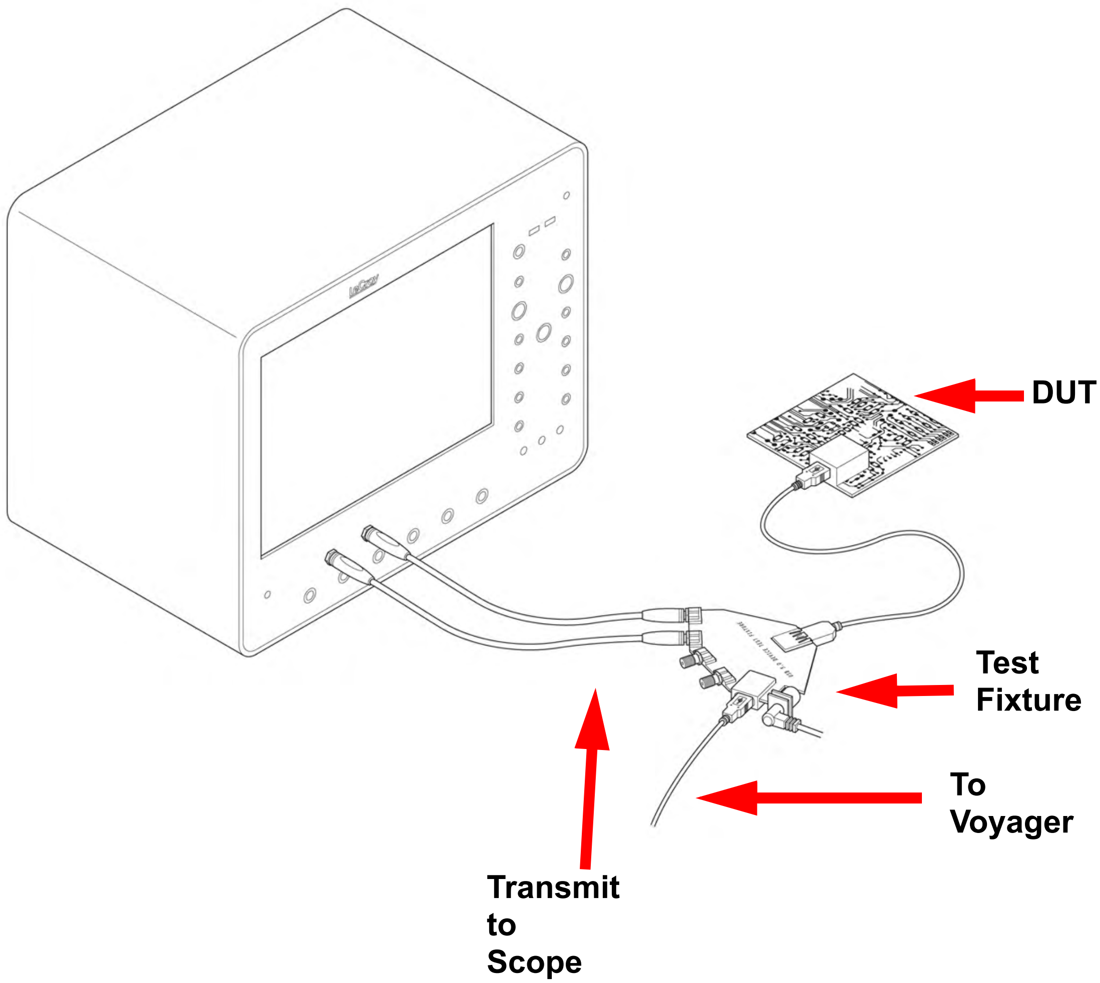


Figure 12.14: Test Fixture to DUT and Oscilloscope Connections

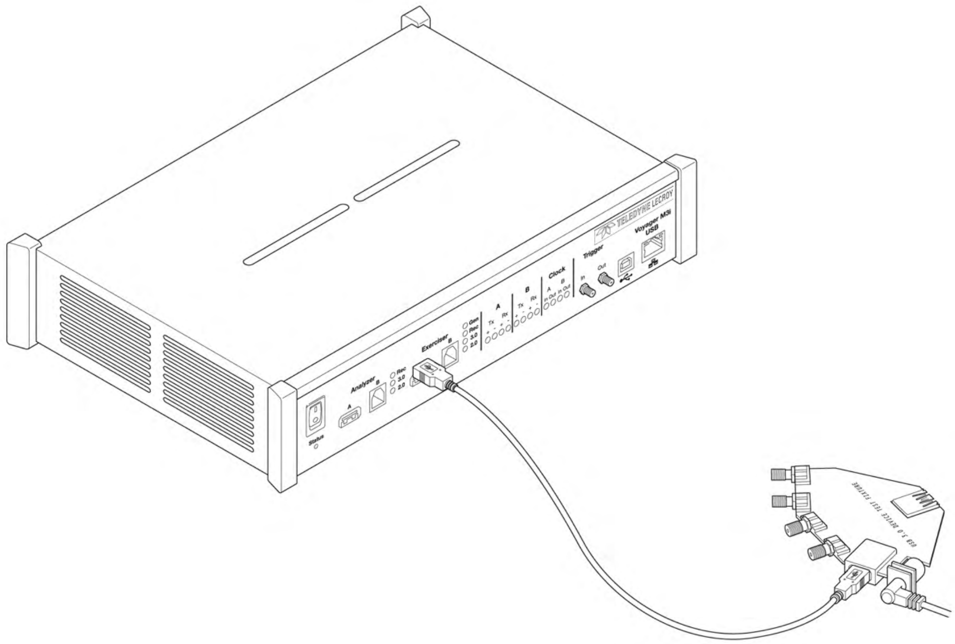


Figure 12.15: Test Fixture to Voyager Connection

2. Set the Recording Options, in the Misc USB 3.1 tab, to run the Electrical tests.

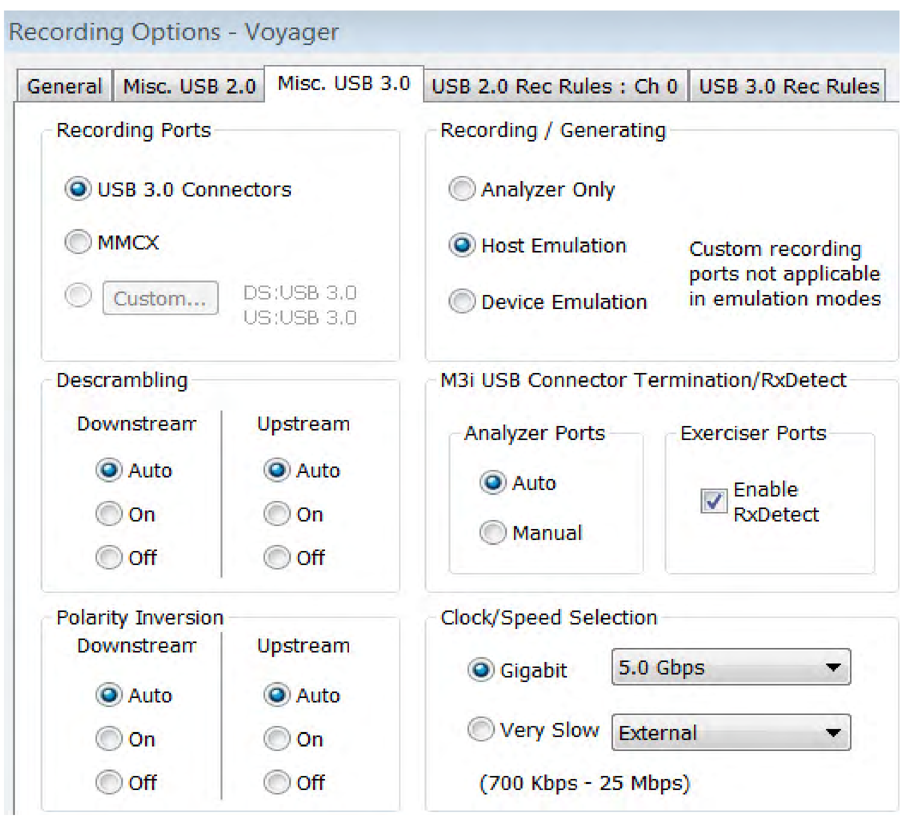


Figure 12.16: Recording Options - Misc. USB 3.1 Tab

To test a USB Device, in the Recording/Generating section, select **Host Emulation** mode.

To test a USB Host, or the downstream port of a USB 3 hub, select **Device Emulation** mode.

In the M3i USB Connector Termination/RxDetect section, in the Analyzer Ports subsection, select **Manual** termination.

Click the **OK** button to apply the options.

3. After you set up the system, make sure that the USB cable is NOT plugged into Voyager, and then select **USB 3.1 Electrical Test** from the View menu.

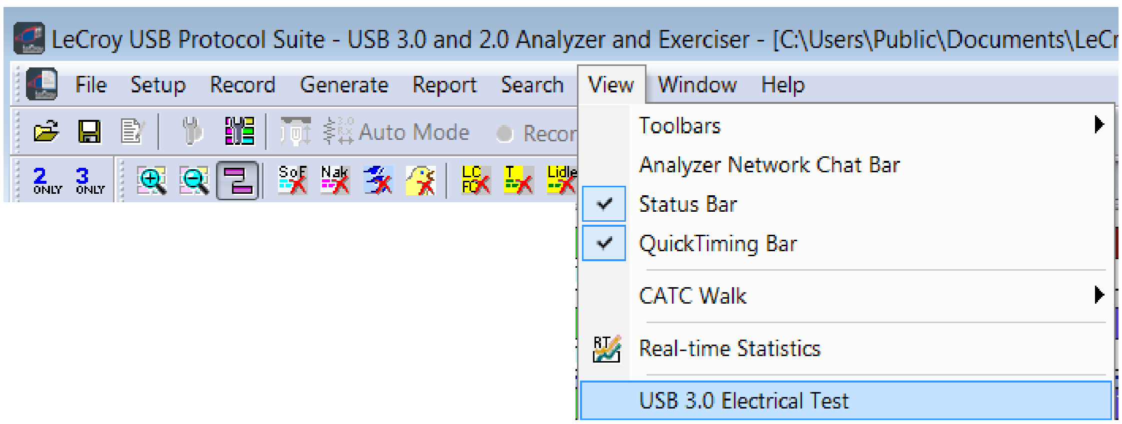


Figure 12.17: View Menu

4. In the USB 3.1 Electrical Test dialog, check the **Compliance Mode** box (see Figure 12.18 on page 470.)

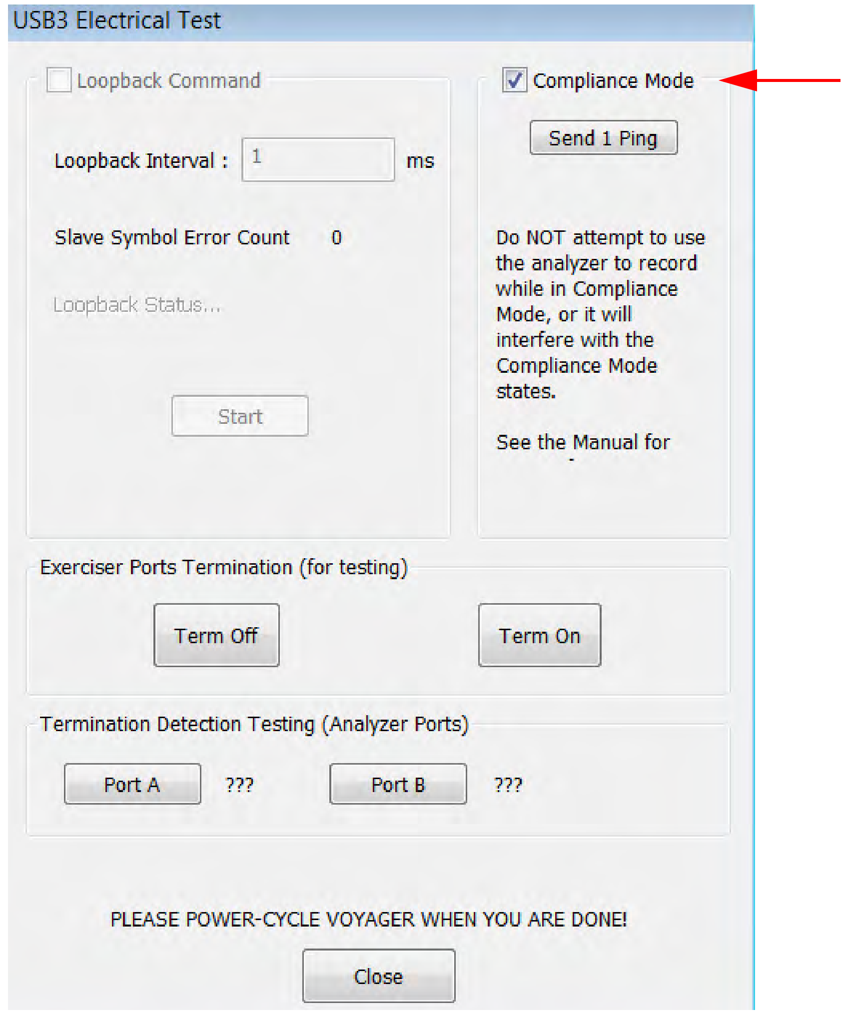


Figure 12.18: USB 3.1 Electrical Test Dialog

5. To test the USB 3 signals, first connect the DUT/HUT to the appropriate Exerciser port. Do not click any buttons. The DUT/HUT should see termination on the port, but no LFPS signaling, and go to the CP0 pattern.

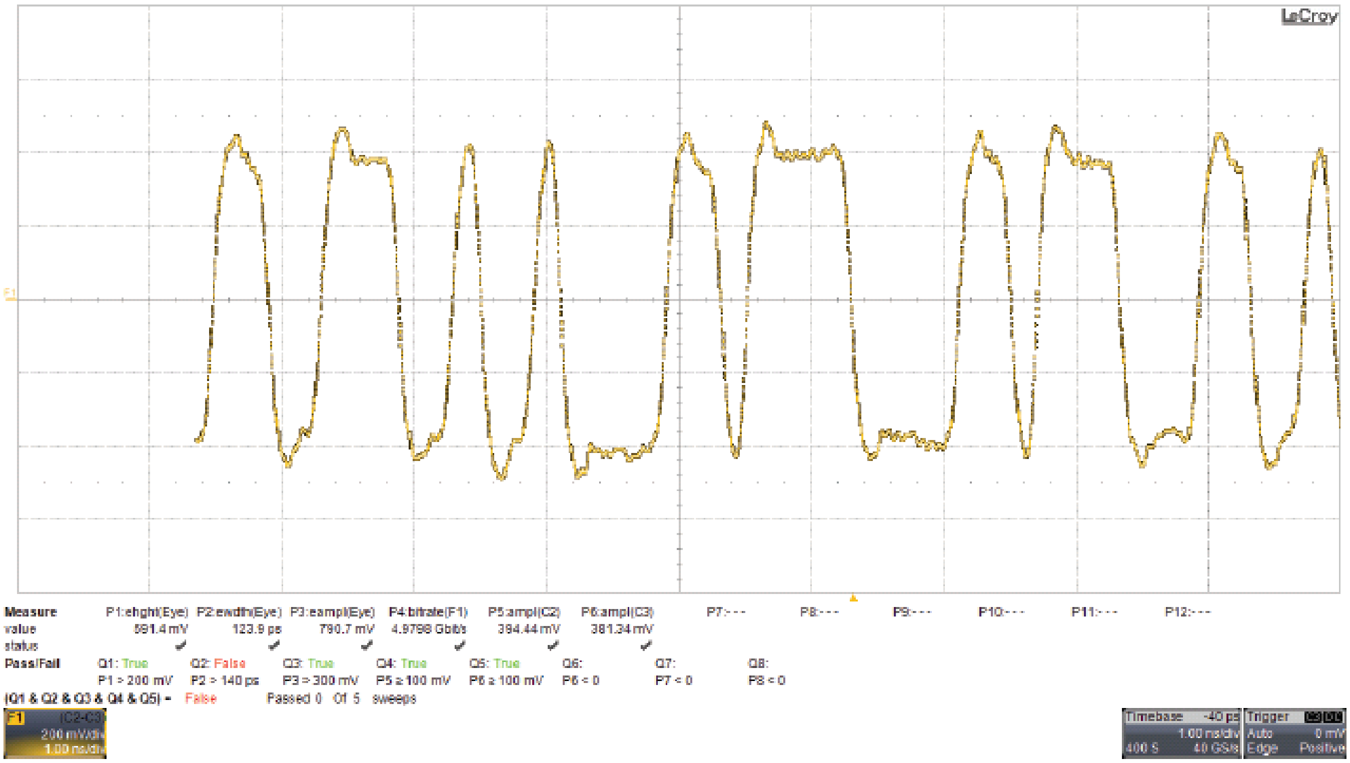


Figure 12.19: Typical CP0 Pattern

6. To display subsequent Compliance patterns, click the **Send 1 Ping** button once for each advance to the next pattern. The following photos show the appearance of the signals for each CP pattern, as captured by a Teledyne LeCroy oscilloscope.
   Use these photos as guides to verify that you are seeing expected patterns.

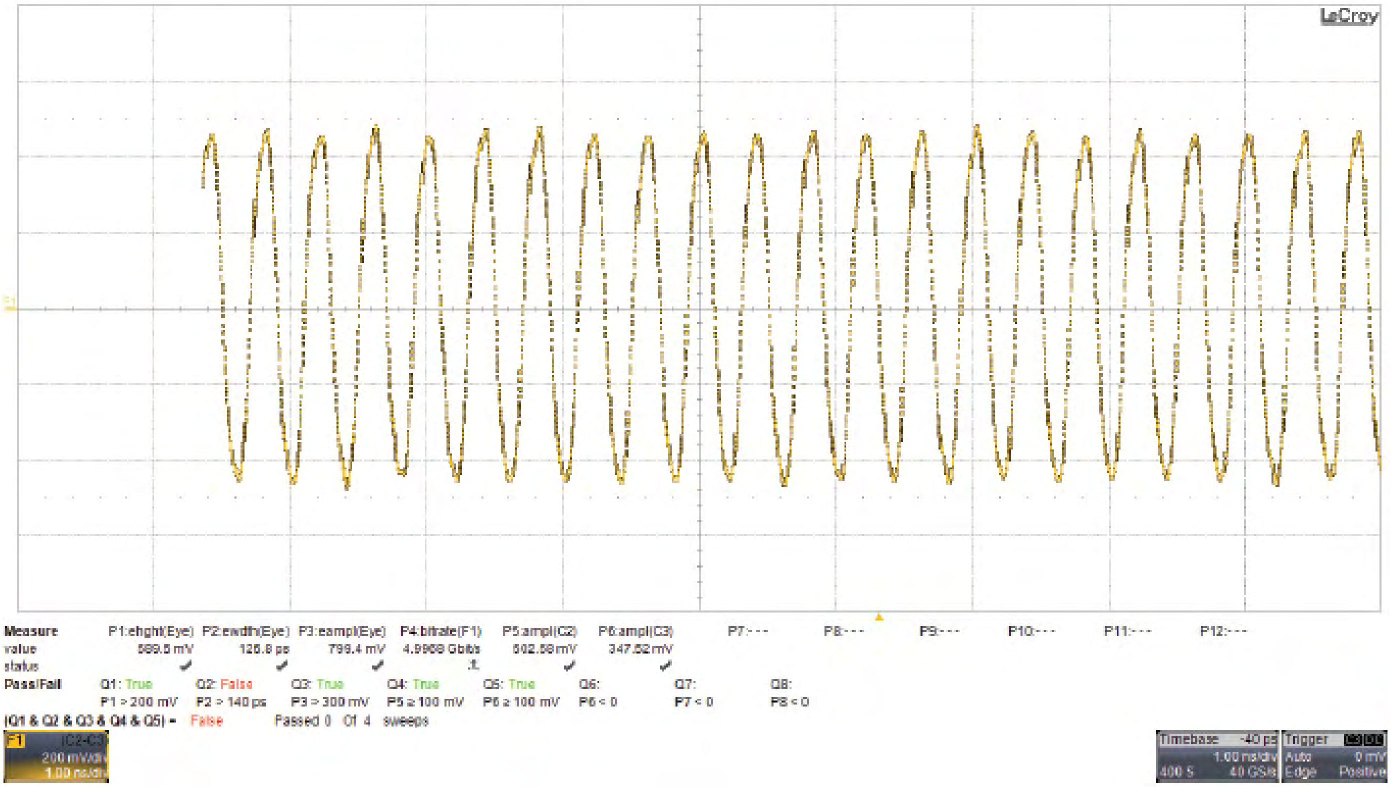


Figure 12.20: Typical CP1 Pattern

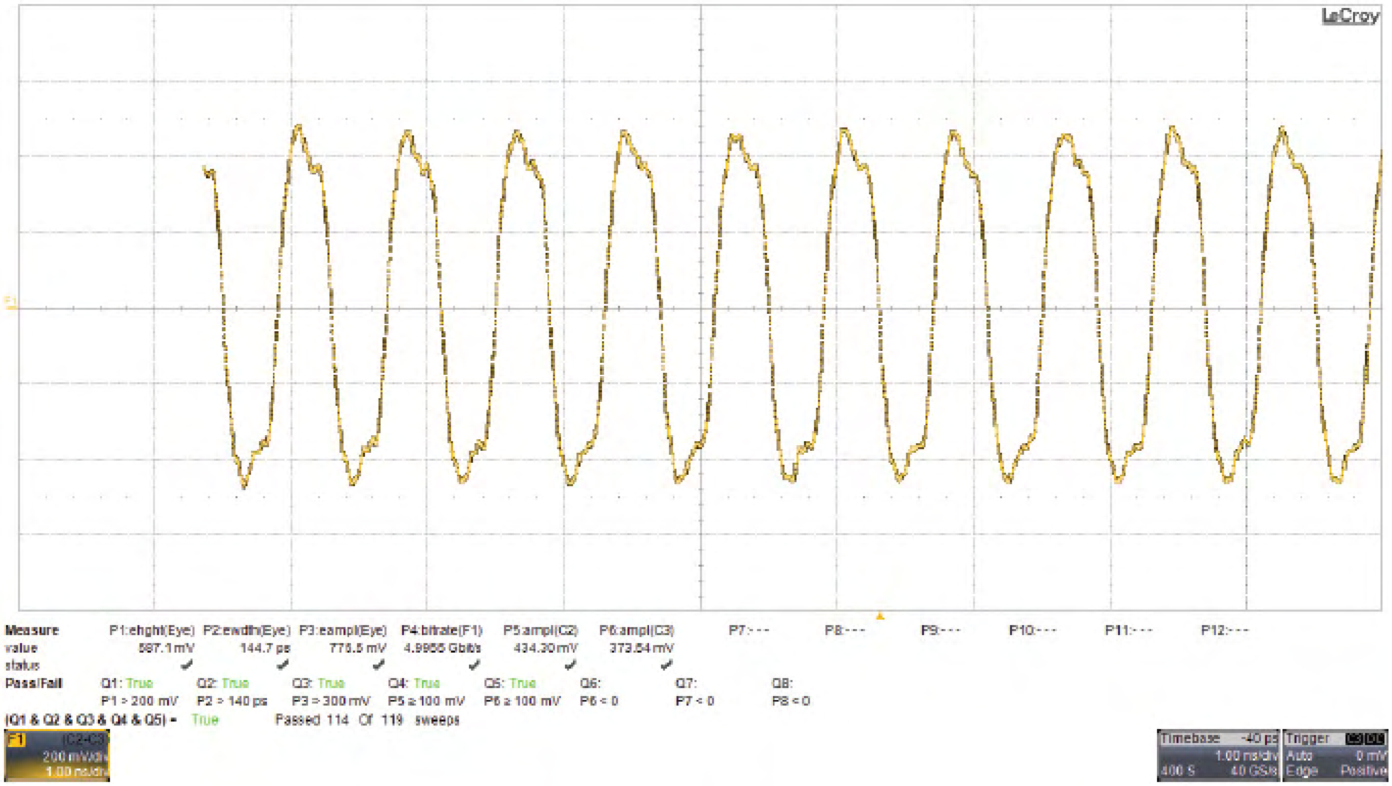


Figure 12.21: Typical CP2 Pattern

.

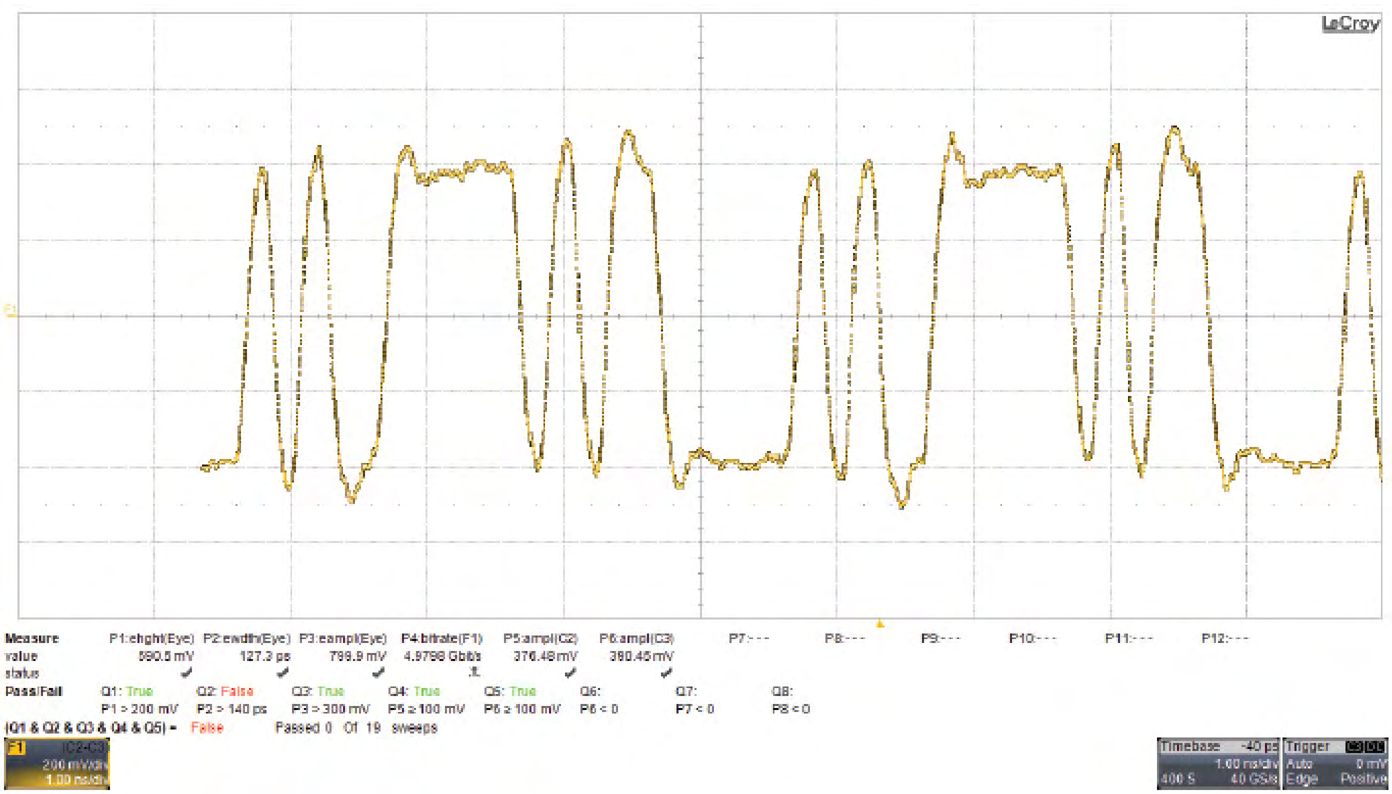


Figure 12.22: Typical CP3 Pattern

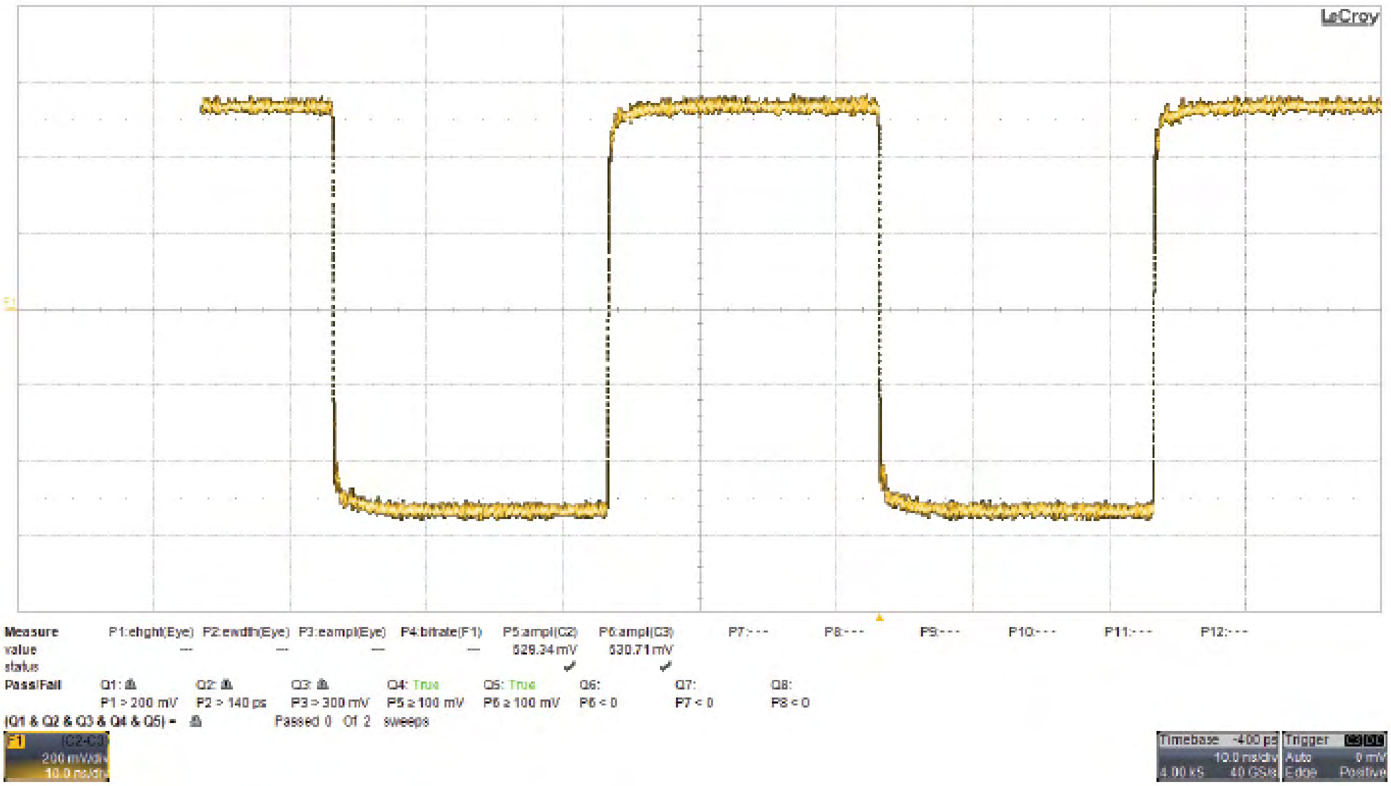


Figure 12.23: Typical CP5 Pattern

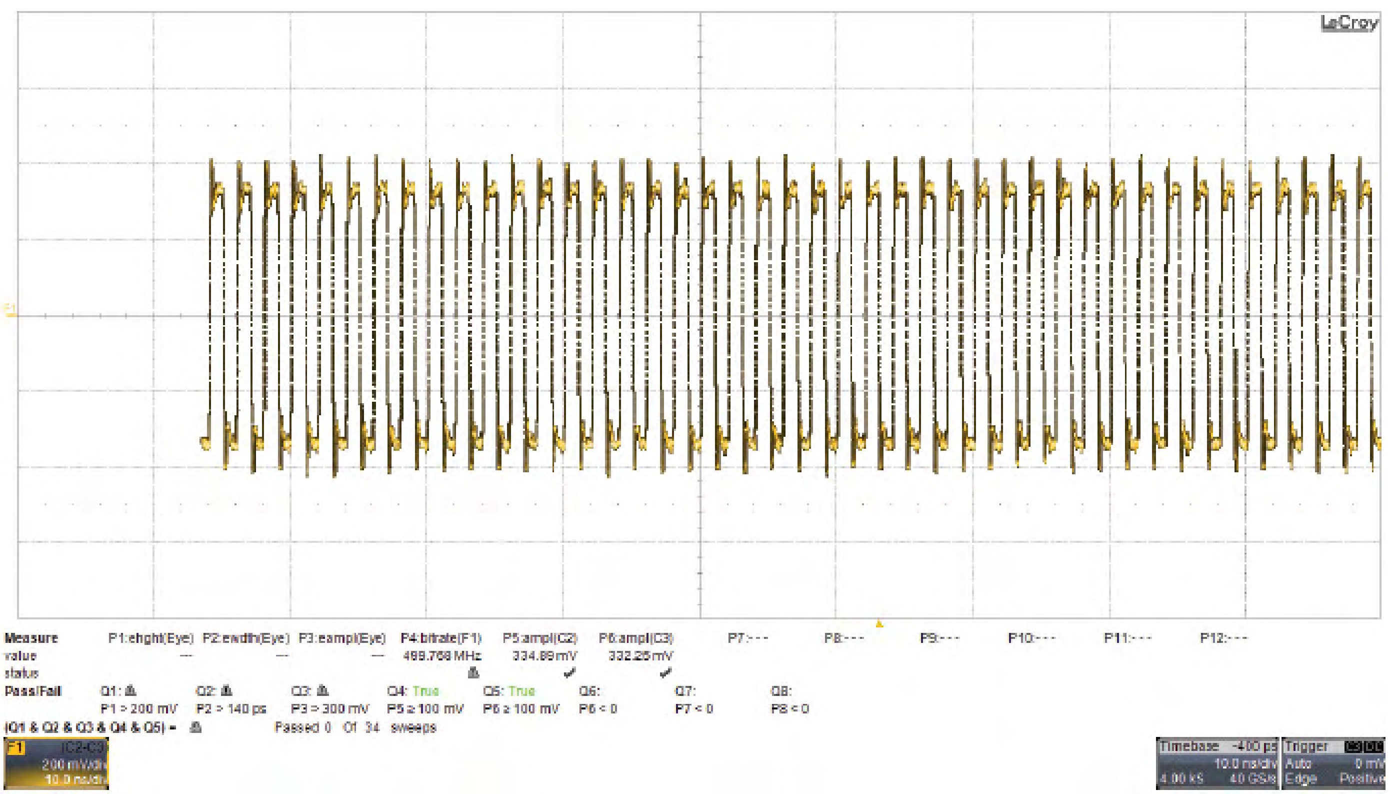


Figure 12.24: Typical CP6 Pattern

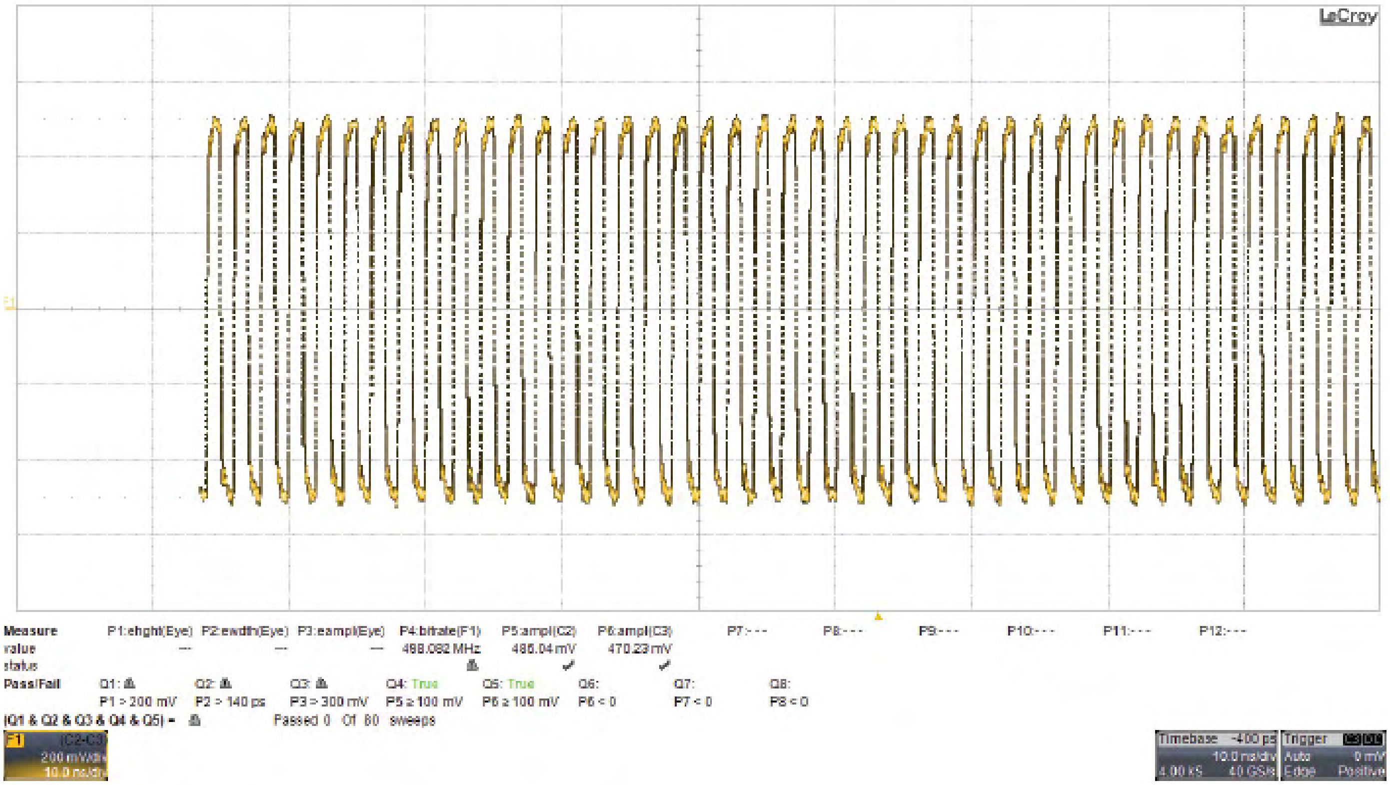


Figure 12.25: Typical CP7 Pattern

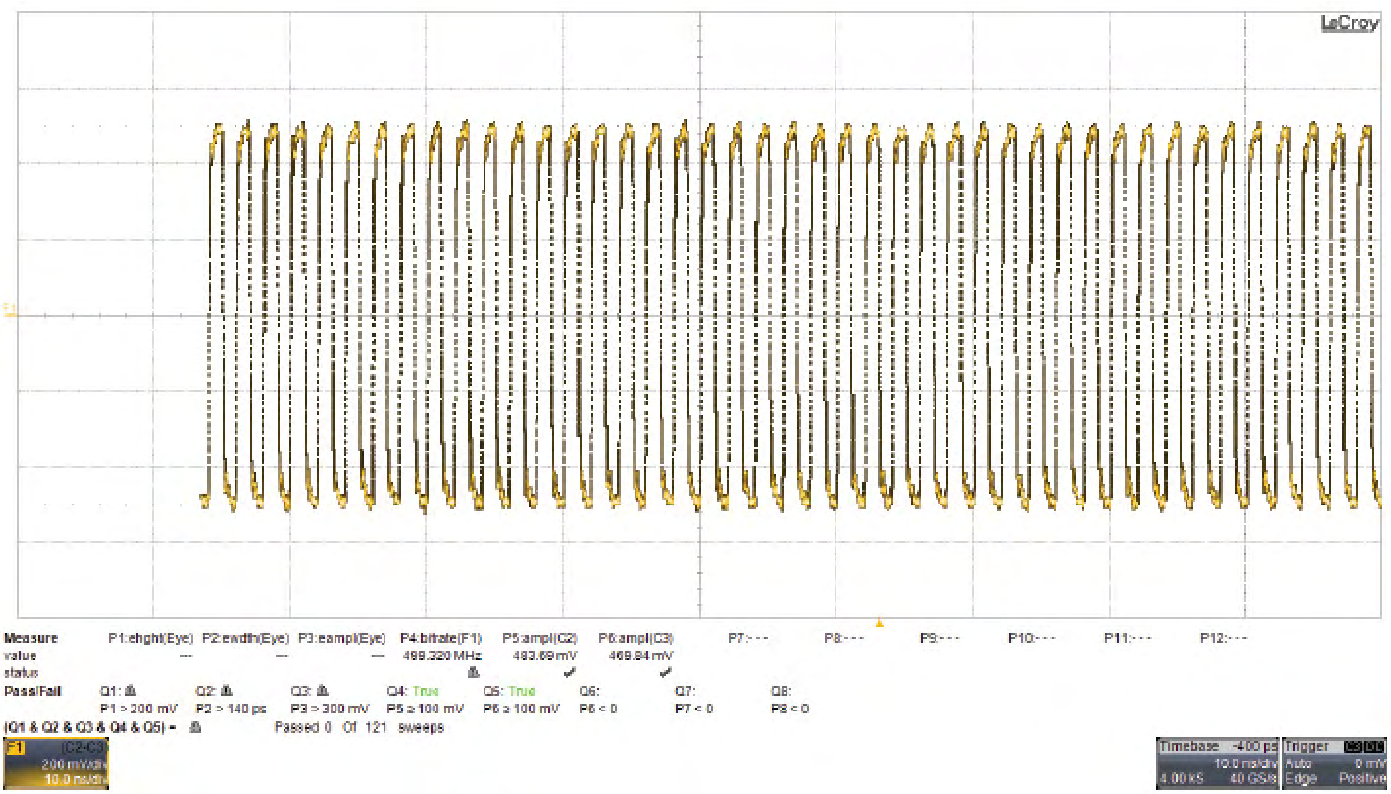


Figure 12.26: Typical CP8 Pattern

Note: CP patterns for 3.1 SS+ not provided.

Chapter 13

Updates

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

13.1 Software, Firmware, and BusEngine Revisions

The **Readme.txt** file on the first installation disk and in the installed directory gives last-minute updates about the current release. Included with each release are the most recent downloadable images of the Firmware and the BusEngine™.

Once the Analyzer has completed the self diagnostics and is connected to the host machine, you can check the latest revision of the software and BusEngine by selecting **About USB Protocol Suite...** from the **Help** menu.

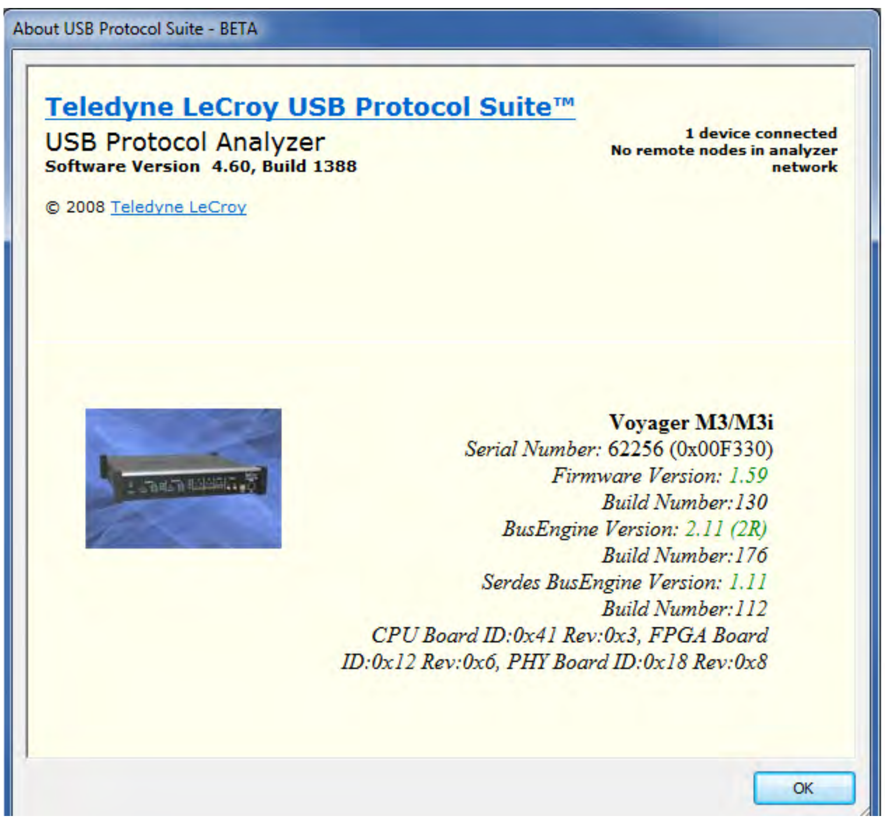


Figure 13.27: About Window

About details revisions of the following software and hardware:

- Software Version
- Unit Serial Number
- Firmware Version
- BusEngine Version
- Serdes BusEngine Version
- CPU Board ID
- FPGA Board ID
- PHY Board ID

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

13.2 Software Updates

You can check for software updates manually, or the application can automatically check for updates at startup.

Note: To check for software updates and to download available updates, you need an open internet connection.

13.2.1 Manual Check for Software Updates

In the application, you can check for software updates:

1. Select **Help > Check for Updates...** to display the Software Update window.

   If no update is available, the window is:

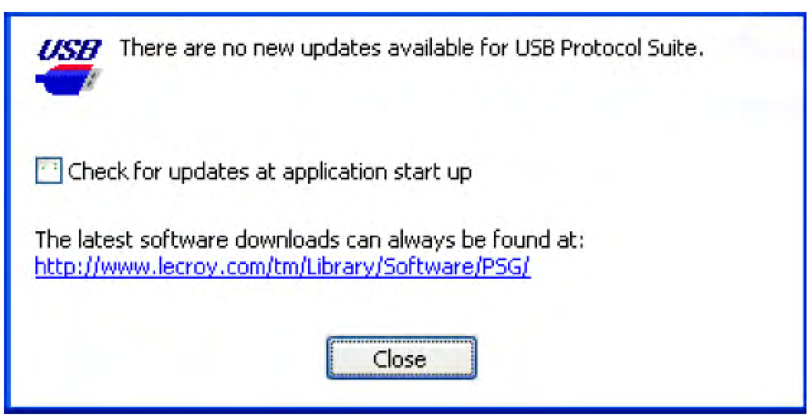


Figure 13.1: No Update Available Window

If an update is available, the window is:

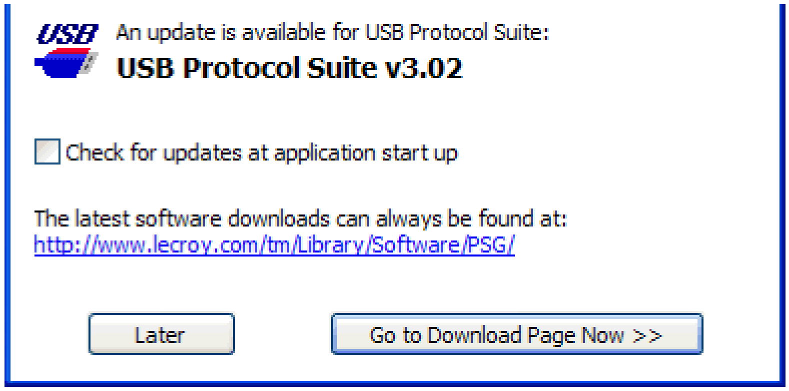


Figure 13.2: Update is Available Window

To install an available update, click **Go to Download Page Now** to go to the Teledyne LeCroy web site. Follow the on-screen instructions to download and install the software update.

To install available updates later, click **Later** to close the window and return to the application. **Note:** If you select **Later**, when you are later ready to install, again select **Help > Check for Updates…**, then download and install the software update.

13.2.2 Automatic Check for Software Updates

You can set the application to automatically check for software updates, either during software installation or in the installed application.

After enabling automatic software update checking, when you start the application, the application checks for any software updates. If an update is available, the application notifies you. **Note:** To automatically check for software updates, you need an open internet connection.

Note: Automatic checking for software updates does not download, install, or update the application. It only notifies you that an update is available. After receiving notification, you must use the Software Update window to download and install the latest version of the application.

During Software Installation

During software installation, a window asks if you would like to receive automatic notification when software updates are available. Select the checkbox to enable automatic checking for software updates.

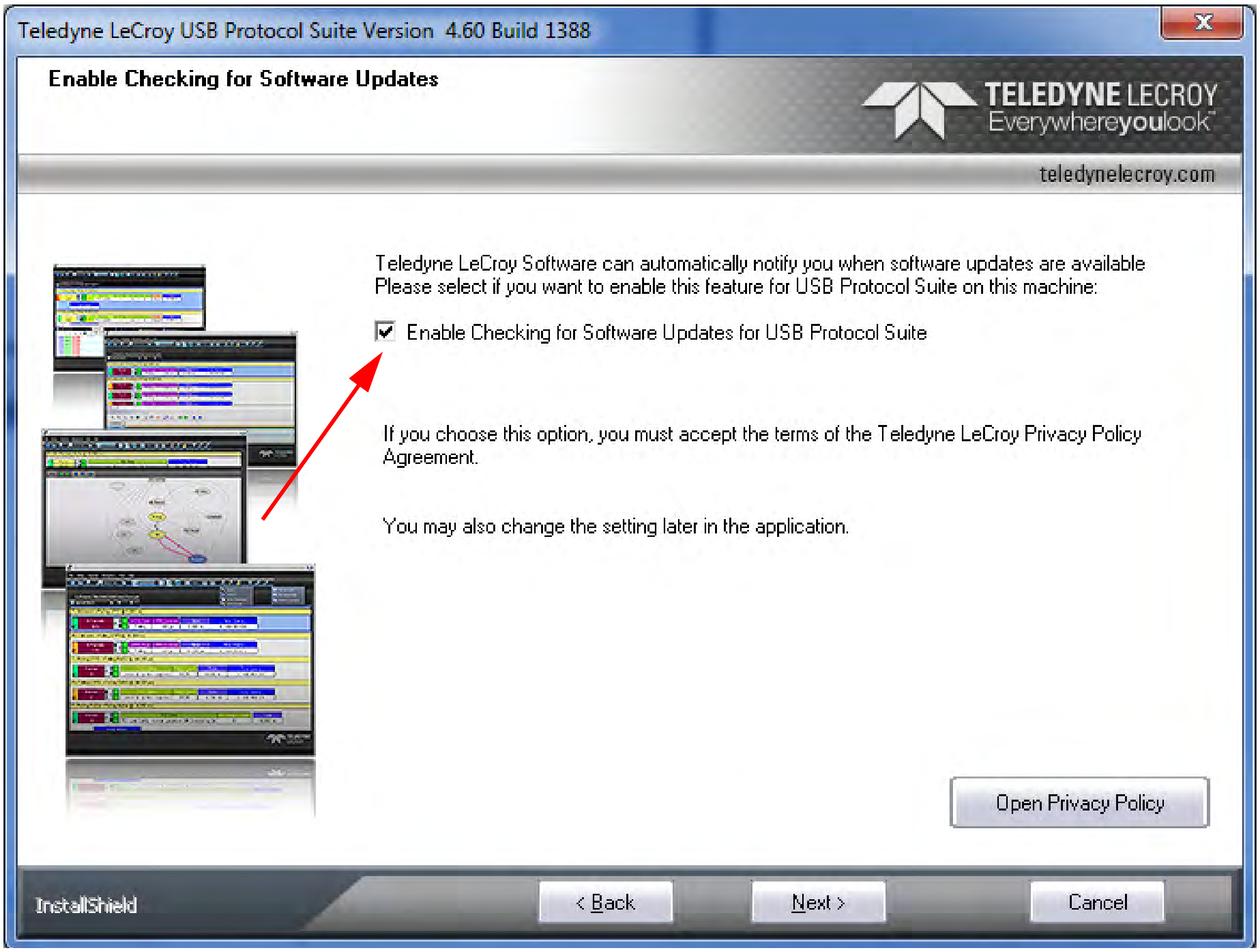


Figure 13.3: Checkbox for Automatic Updates

When you enable automatic notification of software updates, you accept the Teledyne LeCroy Privacy Policy Agreement. Click the **Open Privacy Policy** button to view the agreement.

In the Application

In the application, you can set the software to automatically check for software updates:

1. Select **Help > Check for Updates...** to display the Software Update window.

   If no update is available, the window is:

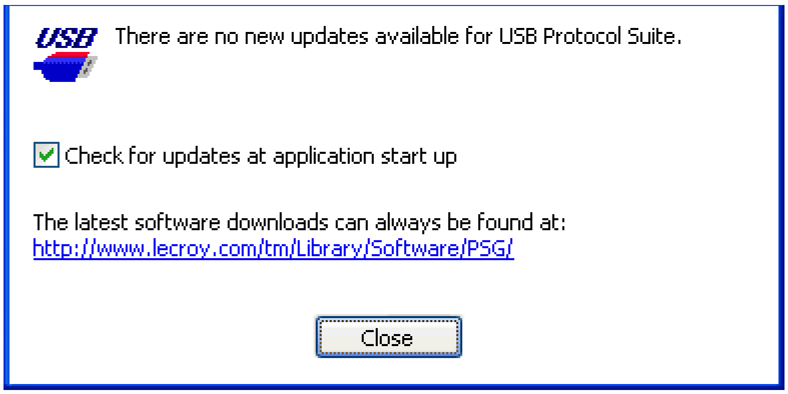


Figure 13.4: No Update Available Window

   If an update is available, the window is:

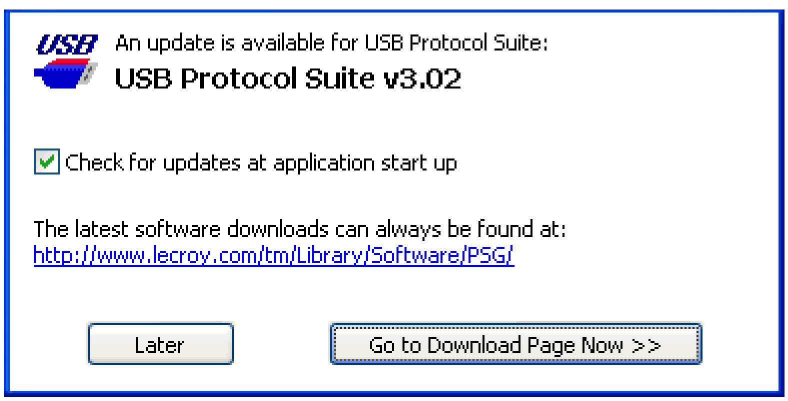


Figure 13.5: Update is Available Window

2. To enable automatic checking for software updates, select the **Check for updates at application start up** checkbox.

   The next time you open the application, if you have an open internet connection, the application will notify you if an update is available.

13.3 BusEngine and Firmware Updates

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

Note: During Firmware and/or Bus Engine updates, you must maintain power and communication connectivity (USB or Ethernet) to the device for the entire update process, and you must allow it to complete the operation.   Failure to do so may result in an inoperable unit which would need to be shipped back to Teledyne LeCroy for repair.

13.3.1 Updating the BusEngines

The BusEngine core is the heart of the Analyzer. Using state-of-the-art Electronically Programmable Logic Device (EPLD) technology, it incorporates both the high speed recording engine and the configurable building blocks that implement data/ state/error detections, triggering, capture filtering, external signal monitoring, and event counting and sequencing. The BusEngine program and the Serdes BusEngine program, and the Firmware that manages the internal microcontroller, are fully field upgradeable.

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

13.3.2 Updating the Firmware

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

13.3.3 Automatic Updates

When the USB Protocol Suite software is upgraded, the software may become incompatible with the BusEngine, Serdes BusEngine, and/or Firmware. The next time you connect to the analyzer, the application will prompt you if any of the components needs to be updated. Follow the on-screen instructions to complete the update.

13.3.4 Manual Updates to Firmware, BusEngine, and Serdes BusEngine

You can manually update the Firmware, BusEngine™, and/or Serdes BusEngine by performing the following steps:

1. Select **Setup > Update Device** on the Menu Bar to display the Update Device dialog (see following figure):

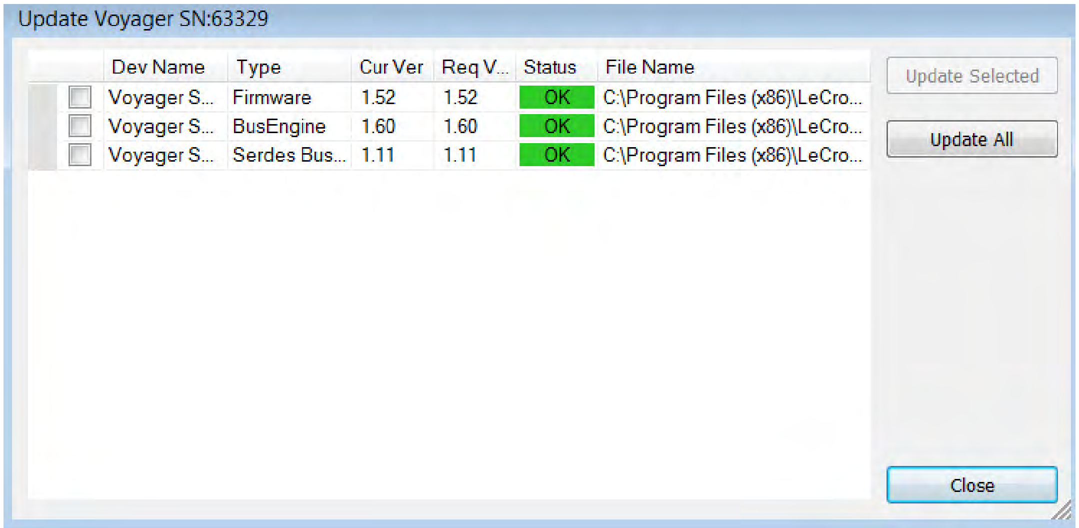


Figure 13.6: Update Device Dialog

The dialog shows the Device Name, Type, Current Version, Required Version, Status, and File Name.

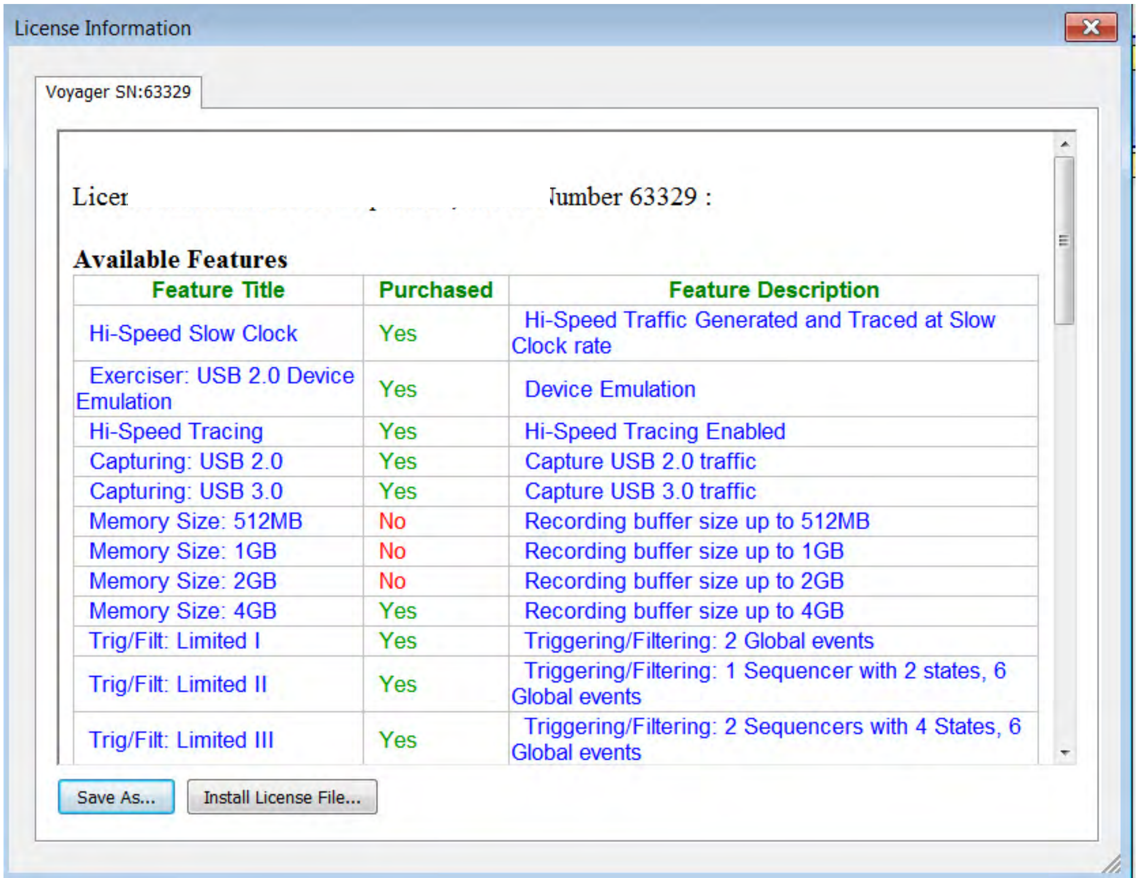
Note: Updating the CATCSync Bus Engine can take up to 40 minutes. For that reason, it is recommended that you do **not** update it when its current status is "**OK**".

---

2. To update the Firmware, BusEngine, and/or Serdes BusEngine, first select its check box.
3. Click **Update Selected** or click **Update All** to update all three.
4. The most current files were copied to your **\LeCroy\USB Protocol Suite** directory when you installed the program.
5. Power cycle the Analyzer. Re-initialization takes a couple of minutes.

13.4 License Information

You can view license information by selecting **Display License Information** from the **Help** menu. The License Information window provides a list of the named features supported by the current software version (see following figure).



Feature Title	Purchased	Feature Description
Hi-Speed Slow Clock	Yes	Hi-Speed Traffic Generated and Traced at Slow Clock rate
Exerciser: USB 2.0 Device Emulation	Yes	Device Emulation
Hi-Speed Tracing	Yes	Hi-Speed Tracing Enabled
Capturing: USB 2.0	Yes	Capture USB 2.0 traffic
Capturing: USB 3.0	Yes	Capture USB 3.0 traffic
Memory Size: 512MB	No	Recording buffer size up to 512MB
Memory Size: 1GB	No	Recording buffer size up to 1GB
Memory Size: 2GB	No	Recording buffer size up to 2GB
Memory Size: 4GB	Yes	Recording buffer size up to 4GB
Trig/Filt: Limited I	Yes	Triggering/Filtering: 2 Global events
Trig/Filt: Limited II	Yes	Triggering/Filtering: 1 Sequencer with 2 states, 6 Global events
Trig/Filt: Limited III	Yes	Triggering/Filtering: 2 Sequencers with 4 States, 6 Global events

Figure 13.7: License Information Dialog

Named features enabled on your host machine are indicated by **Yes** in the Purchased column. Named features that are not enabled on your host machine are indicated by **No** in the Purchased column. Whether or not named features are enabled depends on the license key stored in your analyzer.

If you try to use a feature for which you do not yet have a license, the program displays the License Protection Message. Named features that are not enabled on your host machine are indicated by **No** in the Purchased column. To use the feature, you must purchase a license.

13.5 Updating the Software License

A current license agreement with Teledyne LeCroy entitles the Analyzer owner to continued technical support and access to software updates as they are published on the Teledyne LeCroy website.

If your license expires, you must obtain a license key from Teledyne LeCroy (refer to the contact information at the back of this manual.)

After you obtain a license key, follow these steps to install it:

1. From the Help menu, select **Display License Information** to display the License Information Dialog (see Figure 13.7 on page 484).

1. Select **Install License File** to display the Select License Key File dialog.

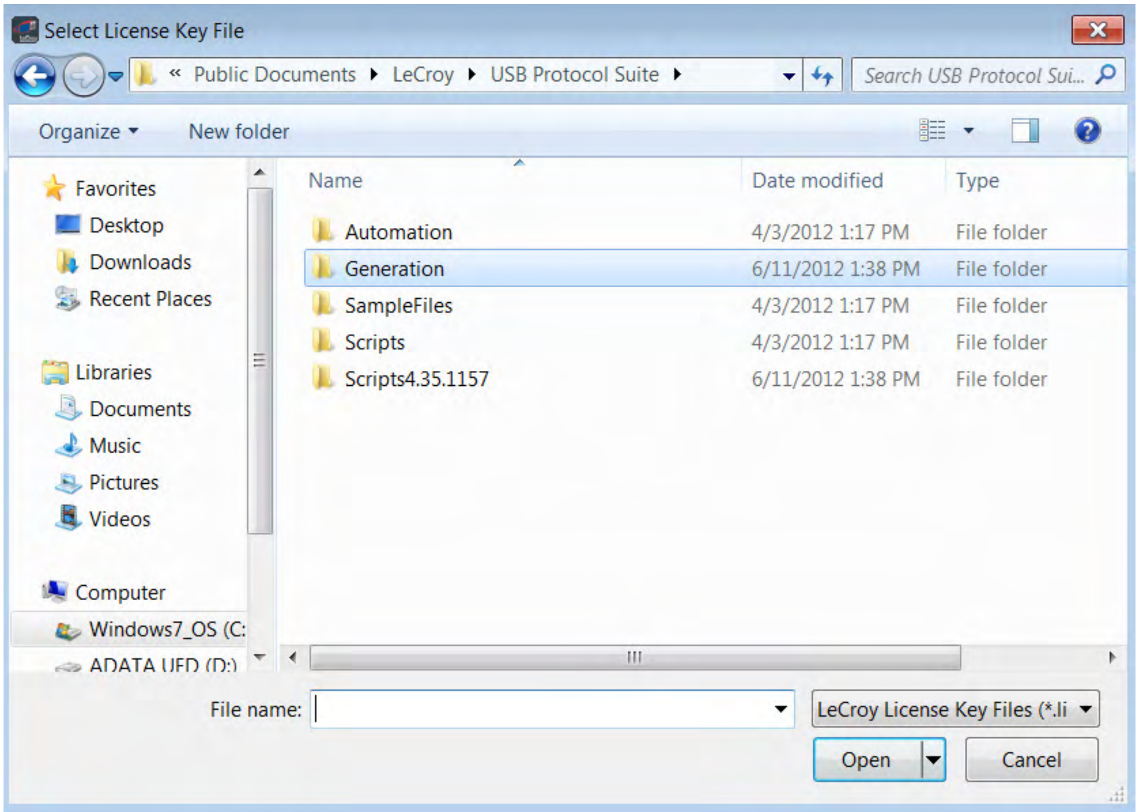


Figure 13.8: Select License Key File Dialog

2. Enter the path and filename for the license key.
   OR
3. Browse to the directory that contains the license key and select the ***.lic** file.
4. Click **Open**.

13.6 Registering Online

To register the product online, select **Help > Register Product Online**.

13.7 Shortcut List

To display the Shortcut List, select **Help > Shortcut List**.

Shortcuts List

Navigation

Desired Function	Mouse or Keyboard Action
Select Item Position	Single-Click Left Mouse Button
Select Item Position, move it to Anchor Point	Double-Click Left Mouse Button
Scroll Up/Down	Up/Down Arrow Key
Scroll Up/Down	Drag or click Vertical Scroll Bar Controls
Scroll Up/Down	Scroll Wheel Up/Down
Scroll to First/Last Position	Ctrl + Home/End
Scroll Up/Down, move selection	Shift + Up/Down Arrow
Scroll Up/Down, move selection	Shift + Left/Right Arrow
Scroll Up/Down n units	Scroll Wheel Up/Down
Scroll Up/Down One Page	PageUp/PageDown
Scroll Up/Down One Page, move selection	Shift + Page Up/Page Down
Scroll View Left/Right	Left/Right Arrows
Scroll Left/Right	Drag or click Horizontal Scroll Bar Controls

Common

Desired Function	Mouse or Keyboard Action
Display Options	Ctrl + Shift + D
Copy	Ctrl + C / Ctrl + Insert
Cut	Ctrl + X / Shift + Delete
Paste	Ctrl + V / Shift + Insert
Undo	Ctrl + Z / Alt + Back
File Open	Ctrl + O
Print	Ctrl + P
Go to unit	Ctrl + G
Go to Marker	Ctrl + M
Manual trigger	F5
Hide NAK's/NRDY's	Ctrl + Shift + N
Decoder Mapping	Ctrl + Shift + Y
Start Recording	Ctrl + R
Stop Recording	Ctrl + T
Recording options	Ctrl + Shift + R
Search forward	Ctrl + F
Search next	F3
Search backward	Ctrl + B

Search

Desired Function	Mouse or Keyboard Action
Search Trigger	Ctrl + Shift + T
Search any USB2 error	Ctrl + Shift + 2
Search any USB3 error	Ctrl + Shift + 3
Search MDATA	Shift + M
Search DATA2	Shift + 2
Search DATA1	Shift + 1
Search DATA0	Shift + 0
Search SETUP	Shift + S
Search SOF	Shift + F
Search IN	Shift + I
Search OUT	Shift + O
Search STALL	Shift + L
Search NYET	Shift + Y
Search NAK	Shift + N
Search ACK	Shift + A
Search PRE/ERR	Shift + P
Search PING	Shift + G
Search SPLIT	Shift + X
Search EXT	Shift + R
Search DATAx	Shift + D
Search Channel 0	Ctrl + Alt + Shift + 0
Search Channel 1	Ctrl + Alt + Shift + 1
Search Channel 2	Ctrl + Alt + Shift + 2
Search Channel 3	Ctrl + Alt + Shift + 3
Search Chirp	Shift + C
Search FS-J	Shift + J
Search FS-K	Shift + K
Search KeepAlive	Shift + 5
Search OTG HNP	Shift + H
Search OTG HOST A	Shift + Ctrl + A
Search OTG HOST B	Shift + Ctrl + B
Search OTG SRP	Shift + Q
Search RESET	Shift + T
Search RESUME	Shift + 6
Search SE0	Shift + Z
Search SE1	Shift + 7
Search SUSPEND	Shift + U

Decode Levels

Desired Function	Mouse or Keyboard Action
Enable/Disable Packet decodings	Ctrl + 1
Enable/Disable Transaction decodings	Ctrl + 2
Enable/Disable Split-Transaction decodings	Ctrl + 3
Enable/Disable Transfer decodings	Ctrl + 4
Enable/Disable SCSI decodings	Ctrl + 5
Enable/Disable PTP decodings	Ctrl + 7

Miscellaneous

Desired Function	Mouse or Keyboard Action
Hide Chirp	Ctrl + Shift + C
Hide Nak	Ctrl + Shift + N
Hide SOF	Ctrl + Shift + S
Traffic Generate	Ctrl + Shift + G
Assign request	Ctrl + Shift + Y
Set Marker to Selected Packet	Ctrl + L
Set Marker to Field under Mouse	Ctrl + K

Close

Figure 13.9: Shortcut List Window

13.8 Video Tutorials

To display the list of Video Tutorials available, select **Help > Video Tutorials**.

Appendix A

China Restriction of Hazardous Substances Table

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

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

EFUP (对环境友好的使用时间) 使用条件:
温度: 5摄氏度到40摄氏度
湿度: 5% - 95%最大相对湿度 (无冷凝)
高度: 最高2000米

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

EFUP (Environmental Friendly Use Period) Use Conditions:

Temperature	5C to 40C
Humidity	5% to 95% max RH (non-condensing)
Altitude	Up to 2000 meters

Appendix B

Contacting Teledyne LeCroy

Type of Service	Contact	
Call for technical support	US and Canada:	1 (800) 909-7112
	Worldwide:	1 (408) 653-1260
Fax your questions	Worldwide:	1 (408) 727-6622
Write a letter	Teledyne LeCroy Protocol Solutions Group Customer Support 3385 Scott Blvd. Santa Clara, CA 95054-3115 USA	
Send e-mail	psgsupport@teledynelecroy.com	
Visit Teledyne LeCroy's web site	teledynelecroy.com/	

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