



TELEDYNE LECROY
Everywhere you look™

USB Protocol Suite

User Manual



Software Version 8.50

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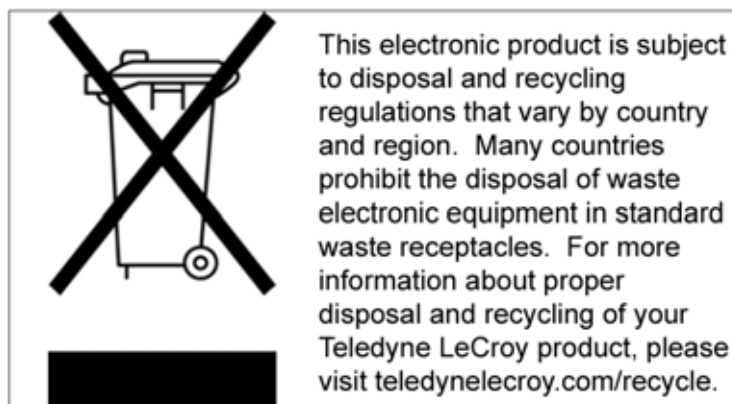
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WEEE Program



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Chapter 1

Overview

Note: Regarding USB4 vs. Thunderbolt 3 (TBT3)

The Voyager M4x supports both USB4 and Thunderbolt 3 (TBT3) capture and analysis. The term USB4 will be used throughout this manual to denote the features involving capturing both USB4 traffic as well as legacy TBT3 traffic. Where differences exist, a note will provide explanation.

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.

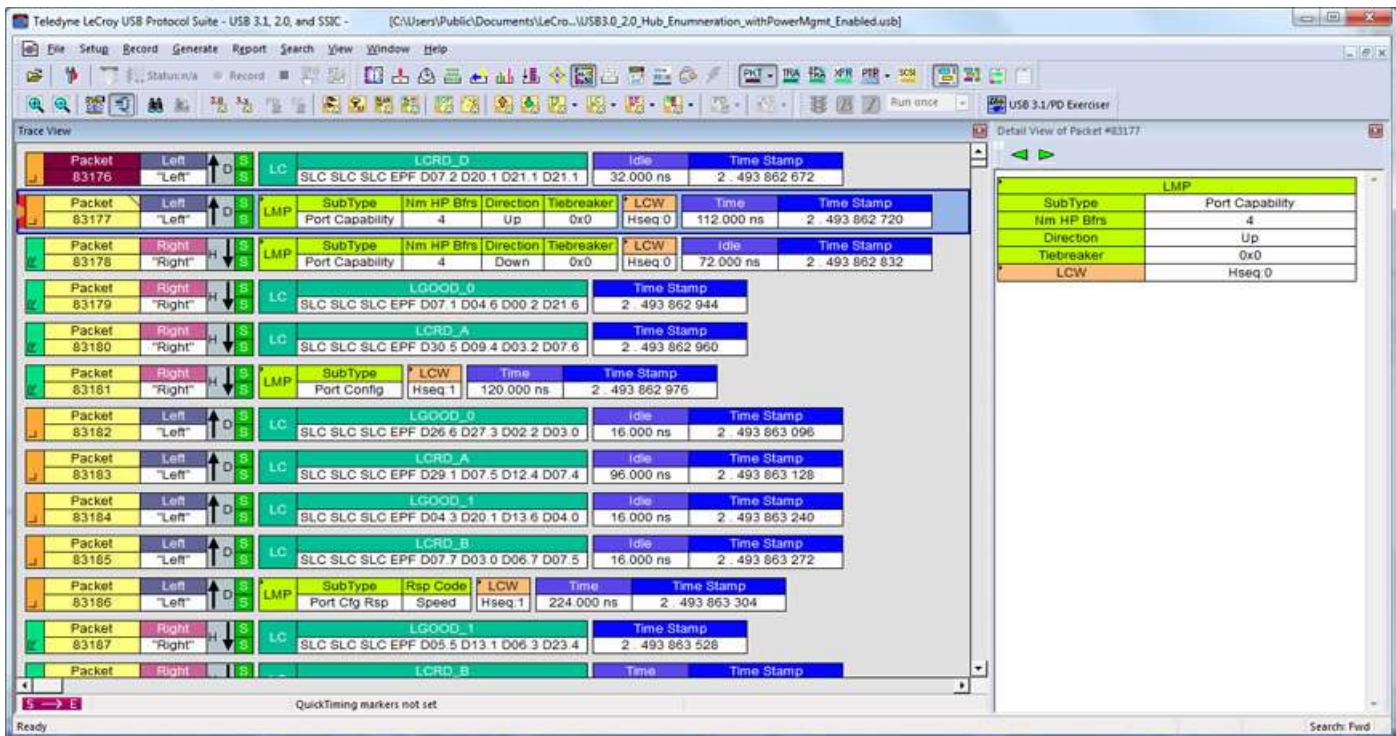


Figure 1.1: Trace Viewer.

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 234](#)).

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 M4x Analyzer

The Teledyne LeCroy Voyager™ M4x Analyzer and Exerciser system is a multifunction verification system for USB4, USB 3.2, SS and SS+, Power Delivery 2.0 and 3.0, and USB 2.0 development and testing. It uses the 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 1.17 on page 49](#)).

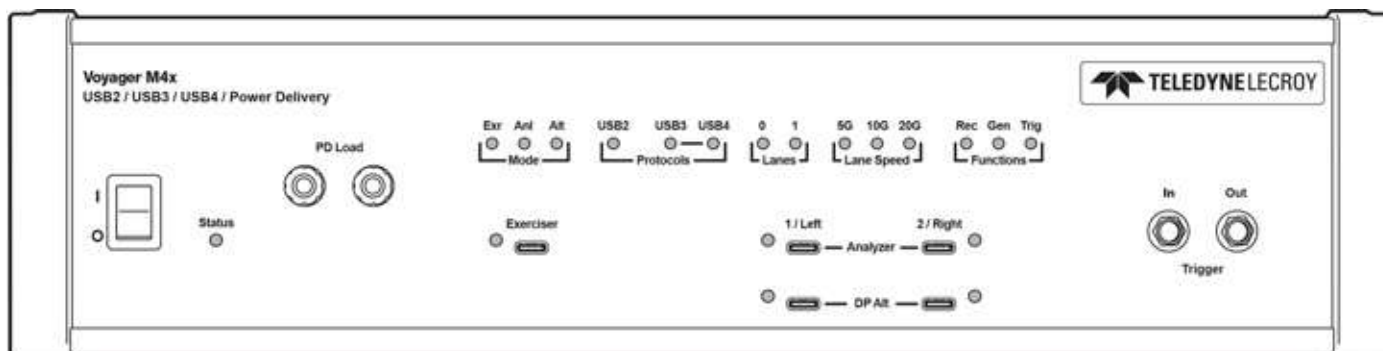


Figure 1.2: Voyager M4x Analyzer Exerciser System.

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

<https://teledynelecroy.com/sw/usb/>

1.2.1 USB4, 3.2 and 2.0 Features

The system can monitor traffic between USB 2.0 links using standard high-speed compliant cables. USB 3.2 SS Gen 1 (5Gbps) and USB 3.2 SS+ Gen 2 (10Gbps) links require using compliant USB Type-C™ connector cables. USB4 requires USB4-compliant cables.

If configured for USB4 testing, the system supports monitoring between links using USB4 Type-C™ connector cables (see [Figure 1.18 on page 50](#)). Analysis of 40 Gbps traffic requires the use of short, low-loss, high quality cables, as provided by Teledyne LeCroy with your M4x 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 may be used in either (but not both) the connectors marked "Left" and "Right". The E-Marked cable should be connected to the Downstream Facing Port (typically a host connector), as opposed to an Upstream Facing Port, to allow for Alt-Mode negotiation.

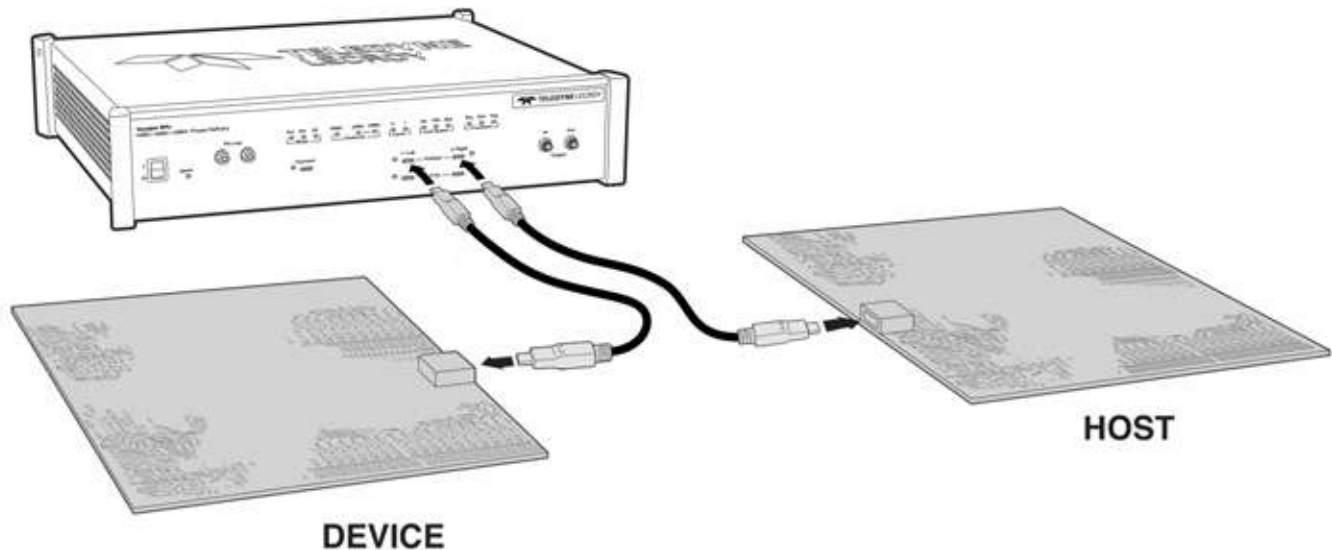


Figure 1.3: Typical Direct Connection using USB 3.2 Cables.

Note: In Analysis mode, it is **preferred** that the Device be plugged into Connector 1 and the Host into Connector 2. The M4x will also work if the Host is plugged into Connector 1 and the Device is plugged 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® 10, or Windows 7 (64-bit version) 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 <future>, 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	

1.2.3 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 (USB4 40/20 Gb/s, USB 3.2 20Gb/s, 10Gb/s, 5Gb/s <future>, USB 2.0, 480 Mb/s, 12 Mb/s, and 1.5 Mb/s).
- ❑ Supports capture of Power Delivery 2.0 and 3.0 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 upgradeable Exerciser function <future>.
- ❑ Allows remote control of USB analyzers from a local PC.

Physical Components

- ☐ Desktop or portable Microsoft Windows 10, or Windows 7 (64-bit) host machine with USB or Ethernet capability
- ☐ Plug-and-Play USB installation
- ☐ 32 GB of physical data-recording memory
- ☐ USB 3.2 Super-Speed connection to desktop or portable host machine
- ☐ USB 3.2 USB Type-C™ type connectors for 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 <future for USB4>
- ☐ 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 32 GB
- ☐ Idle filtering

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 <future for USB4>.
- ☐ 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 3.2).
- ❑ Uses Link Tracker to view symbols of traffic (3.2 x1 only).
- ❑ Uses a Spec View to show packets in the same format as the USB 3.2 specification.
- ❑ Has Quick Timing Markers to immediately show time deltas and bandwidth use.

1.2.4 Notes on LFPS Signals

Voyager M4x 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 M310P Analyzer



Warning: The Voyager M310P 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 M310P unit after PD usage to insure that they go back to their default Voltage and Current states.**

The Teledyne LeCroy Voyager™ M310P Analyzer and Exerciser system is a multifunction verification system for USB 3.2, SS and SS+, Power Delivery 2.0 and 3.0, and USB 2.0 development and testing. It uses the 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 1.17 on page 49](#)).

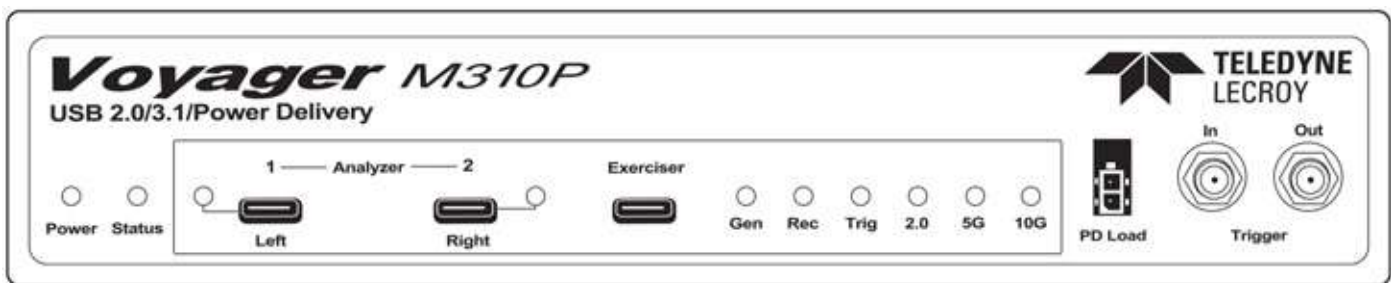


Figure 1.4: Voyager M310P Analyzer Exerciser System.

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

<https://teledynelecroy.com/sw/usb/>

1.3.1 USB 3.2 and 2.0 Features

The system can monitor traffic between USB 2.0 links using standard high-speed compliant cables and USB 3.2 SS Gen 1 (5Gbps) and USB 3.2 SS+ Gen 2 (10Gbps) links using compliant USB Type-C™ connector cables.

If configured for USB 3.2 SS+ (10Gbps) testing, the system supports monitoring between SuperSpeed Plus links using USB 3.2 SS+ USB Type-C™ connector cables (see [Figure 1.18 on page 50](#)). 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 M310P 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 may be used in either (but not both) the connectors marked "Left" and "Right".

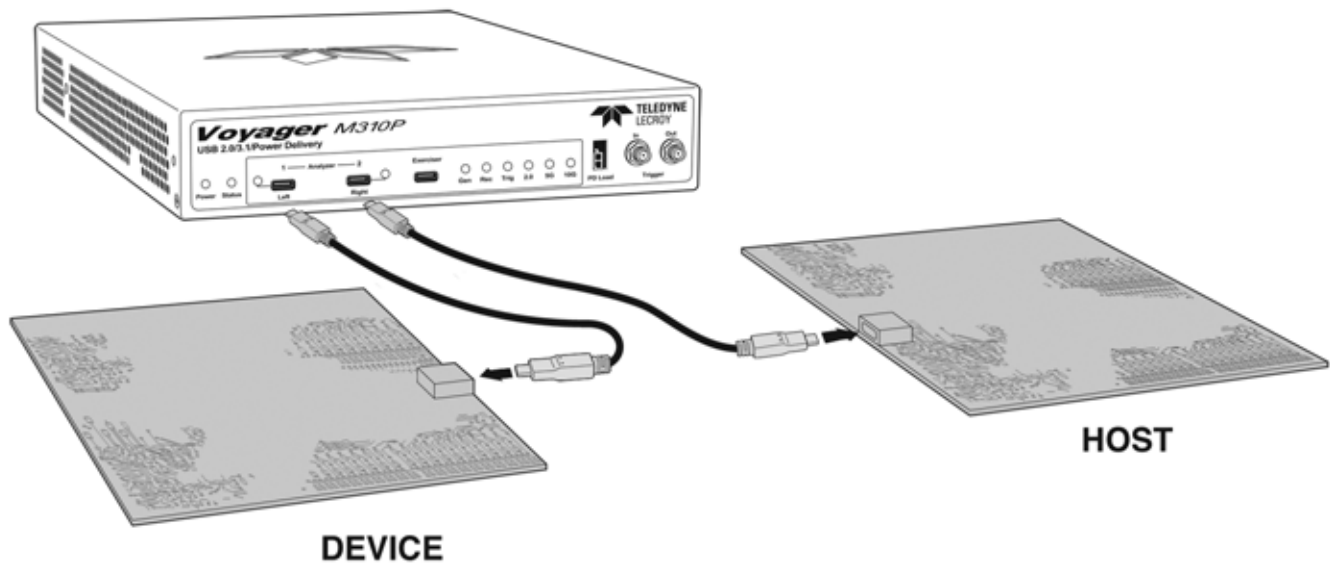


Figure 1.5: Typical Direct Connection using USB 3.2 Cables.

Note: In Analysis mode, it is **preferred** that the Device be plugged into Connector 1 and the Host into Connector 2. See [“Voyager M310P Specific Setup Notes” on page 65](#) for a more detailed description. The M310P will also work if the Host is plugged into Connector 1 and the Device is plugged into Connector 2.

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

1.3.3 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).
- ☐ Supports capture of Power Delivery 2.0 and 3.0 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 upgradeable Exerciser function.
- ☐ Allows remote control of USB analyzers from a local PC.
- ☐ Passive Tapping of the SuperSpeed Signals is the least intrusive method of capturing packets and events: No Termination Proxies necessary.

Physical Components

- ❑ Desktop or portable Microsoft Windows 10, 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 3.2 Super-Speed connection to desktop or portable host machine
- ❑ USB 3.2 USB Type-C™ type connectors 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 (3.2)

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 3.2).
- ❑ Uses Link Tracker to view symbols of traffic (3.2).
- ❑ Uses a Spec View to show packets in the same format as the USB 3.2 specification (3.2).
- ❑ Has Quick Timing Markers to immediately show time deltas and bandwidth use.

1.3.4 Traffic Generation

USB 2.0 and 3.2 traffic generation options allow you to transmit custom packets over standard USB cables with low-level control of headers, payloads, timing, and link states.

USB 2.0 Trainer

The USB 2.0 Trainer 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 2.0 Trainer 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 Trainer 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 Trainer supports both bitstream mode or Intelliframe mode. In Intelliframe mode, the Trainer 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 Trainer can automatically resend the previous packet.

USB 3.2 Exerciser ReadyLink™ Emulation

The Teledyne LeCroy Voyager USB 3.2 Exerciser features ReadyLink Emulation Mode. The ReadyLink feature handles all USB 3.2 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 3.2 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 3.2 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 M310P 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.

1.4 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 they 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 3.2, SS and SS+, Power Delivery 2.0 and 3.0, and USB 2.0 development and testing. It uses the 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 1.17 on page 49](#)).

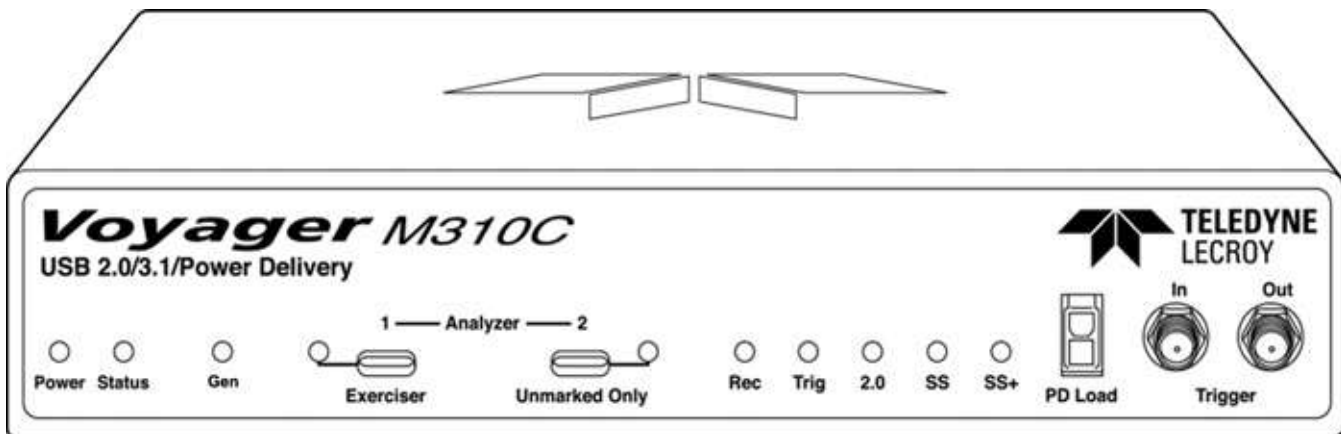


Figure 1.6: Voyager M310C Analyzer Exerciser System.

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

<https://teledynelecroy.com/sw/usb/>

1.4.1 USB 3.2 and 2.0 Features

The system can monitor traffic between USB 2.0 links using standard high-speed compliant cables and USB 3.2 SS Gen 1 (5Gbps) and USB 3.2 SS+ Gen 2 (10Gbps) links using compliant USB Type-C™ connector cables.

If configured for USB 3.2 SS+ (10Gbps) testing, the system supports monitoring between SuperSpeed Plus links using USB 3.2 SS+ USB Type-C™ connector cables (see [Figure 1.18 on page 50](#)). 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".

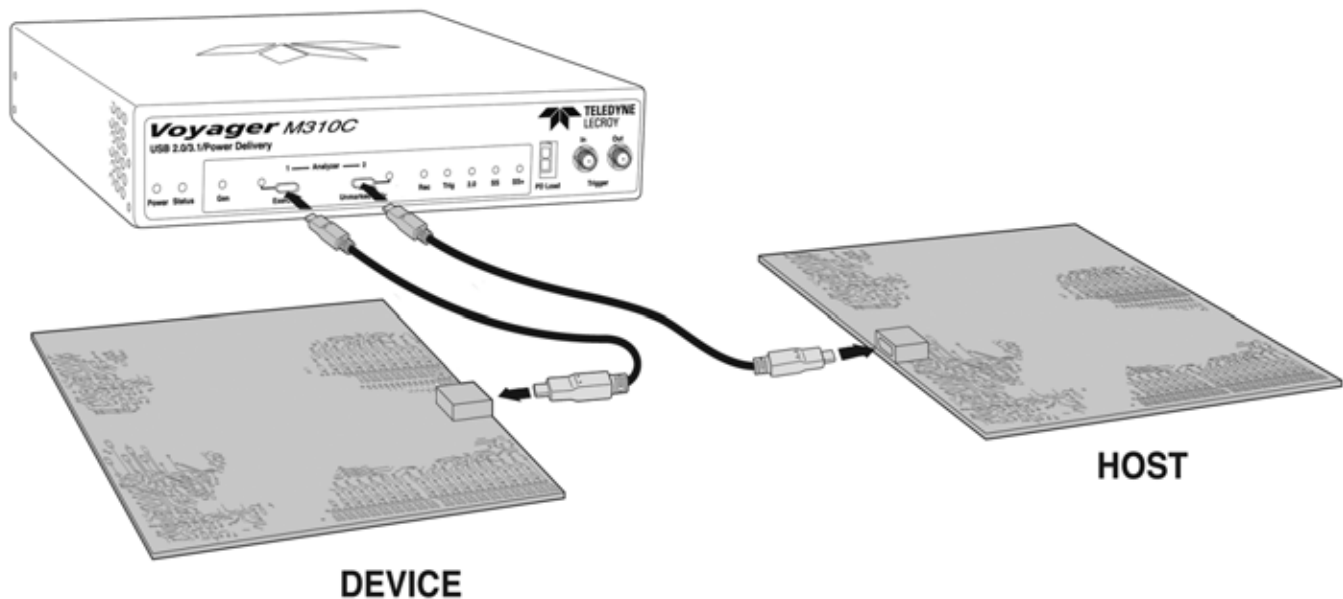


Figure 1.7: Typical Direct Connection using USB 3.2 Cables.

Note: In Analysis mode, it is **preferred** that the Device be plugged into Connector 1 and the Host into Connector 2. See [“Voyager M310C Specific Setup Notes” on page 71](#) for a more detailed description. The M310C will also work if the Host is plugged into Connector 1 and the Device is plugged into Connector 2.

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 host machine having the Microsoft® Windows® 10, 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	Tel: +1/503.296.9892
1730 SW Skyline Blvd.	Fax: +1/503.297.1090
Suite 203	Web: http://www.usb.org/
Portland, OR 97221	

1.4.3 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 2.0 and 3.0 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 upgradeable Exerciser function.
- ☐ Allows remote control of USB analyzers from a local PC.

Physical Components

- ☐ Desktop or portable Microsoft Windows 10, 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 3.2 Super-Speed connection to desktop or portable host machine
- ☐ USB 3.2 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 (3.2)

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 3.2).
- ❑ Uses Link Tracker to view symbols of traffic (3.2).

- ❑ Uses a Spec View to show packets in the same format as the USB 3.2 specification (3.2).
- ❑ Has Quick Timing Markers to immediately show time deltas and bandwidth use.

1.4.4 Traffic Generation

USB 2.0 and 3.2 traffic generation options allow you to transmit custom packets over standard USB cables with low-level control of headers, payloads, timing, and link states.

USB 2.0 Trainer

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

For USB 2.0 applications, the Trainer supports both bitstream mode or Intelliframe mode. In Intelliframe mode, the Trainer 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 Trainer can automatically resend the previous packet.

USB 3.2 Exerciser ReadyLink™ Emulation

The Teledyne LeCroy Voyager USB 3.2 Exerciser features ReadyLink Emulation Mode. The ReadyLink feature handles all USB 3.2 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 3.2 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 3.2 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.

1.4.5 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.

1.5 Voyager M310 Analyzer

The Teledyne LeCroy Voyager™ M310 Analyzer and Exerciser system is a multifunction verification system for USB 3.2 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 1.17 on page 49](#)).

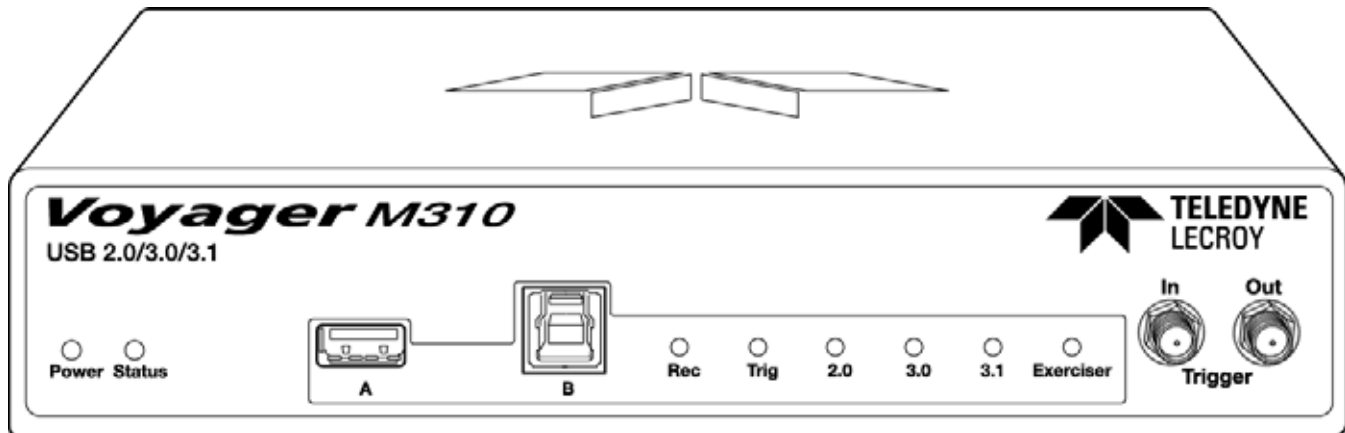


Figure 1.8: Voyager M310 Analyzer Exerciser System.

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

<https://teledynelecroy.com/sw/usb/>

1.5.1 USB 3.2 and 2.0 Features

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

If configured for USB 3.2 SS testing, the system supports monitoring between SuperSpeed links using USB 3.2 SS compliant cables (see [Figure 1.18 on page 50](#)).

If configured for USB 3.2 SS+ (10 Gbps) testing, the system supports monitoring between SuperSpeed Plus links using USB 3.2 SS+ compliant cables (see [Figure 1.18 on page 50](#)). 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.

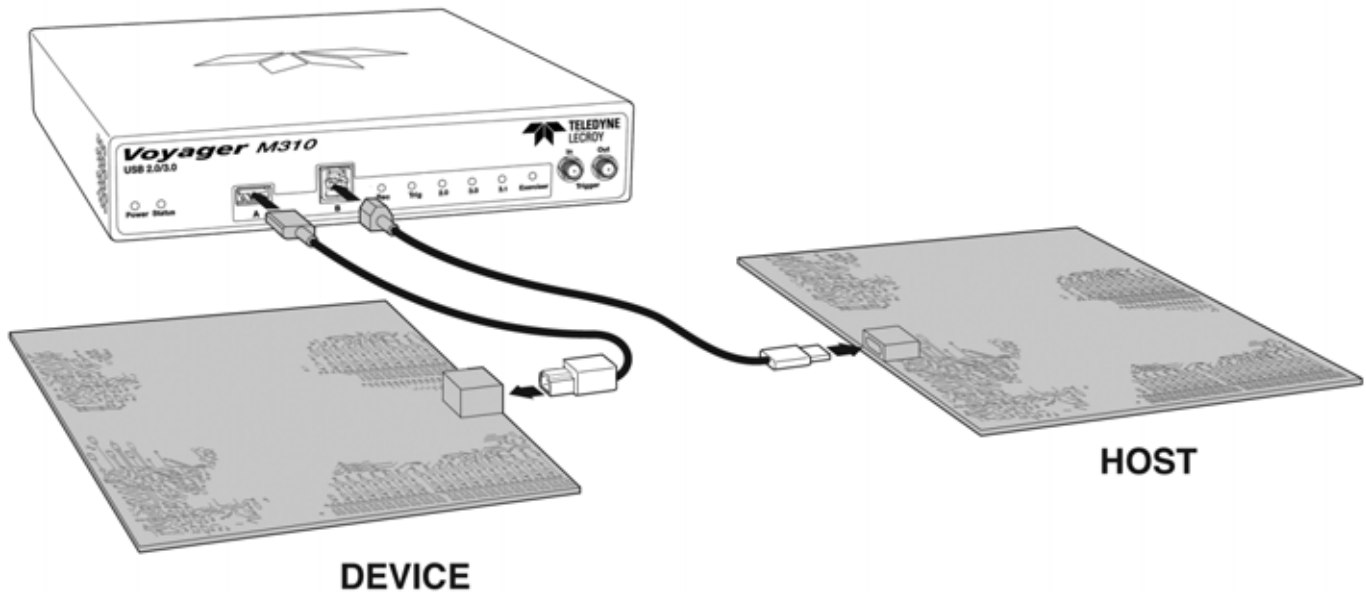


Figure 1.9: Direct Connection using USB 3.2 Cables.

1.5.2 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® 10, 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:

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Suite 203	Web: http://www.usb.org/
Portland, OR 97221	

1.5.3 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 from a local PC.

Physical Components

- ☐ Desktop or portable Microsoft Windows 10, 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 3.2 Super-Speed connection to desktop or portable host machine
- ☐ USB 3.2 connectors 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 (3.2)

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 3.2).
- ❑ Uses Link Tracker to view symbols of traffic (3.2).
- ❑ Uses a Spec View to show packets in the same format as the USB 3.2 specification (3.2).
- ❑ Has Quick Timing Markers to immediately show time deltas and bandwidth use.

1.5.4 Traffic Generation

USB 2.0 and 3.2 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 *USBTrainer* 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 3.2 Exerciser features ReadyLink Emulation Mode. The ReadyLink feature handles all USB 3.2 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 3.2 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 3.2 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.

1.5.5 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.

1.6 Voyager M3i Analyzer

The Teledyne LeCroy Voyager™ M3i Analyzer and Exerciser system is a multifunction verification system for USB 2.0 and USB 3.2 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 1.10](#)).

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.

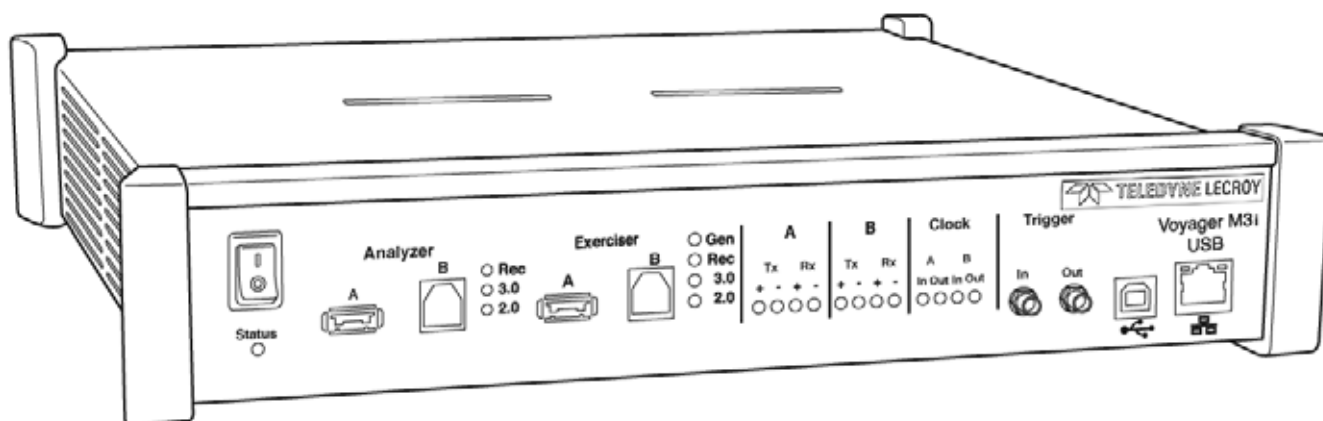


Figure 1.10: Voyager M3i Analyzer Exerciser System.

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

<https://teledynelecroy.com/sw/usb/>

1.6.1 USB 2.0 and USB 3.2 Features

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

If configured for USB 3.2 SS testing, the system supports monitoring between SuperSpeed links using USB 3.2 cables (see [Figure 1.11 on page 31](#)) or through direct connection via MMCX-to-SMA coaxial cables (see [Figure 1.12 on page 31](#)).

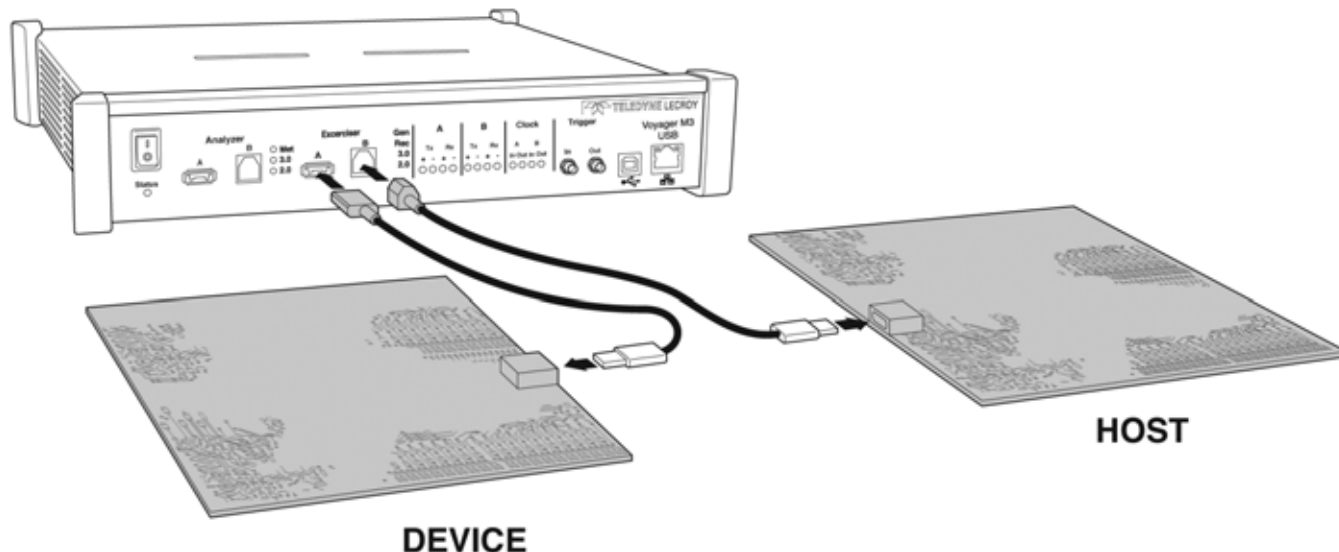


Figure 1.11: Direct Connection using USB 3.2 Cables.

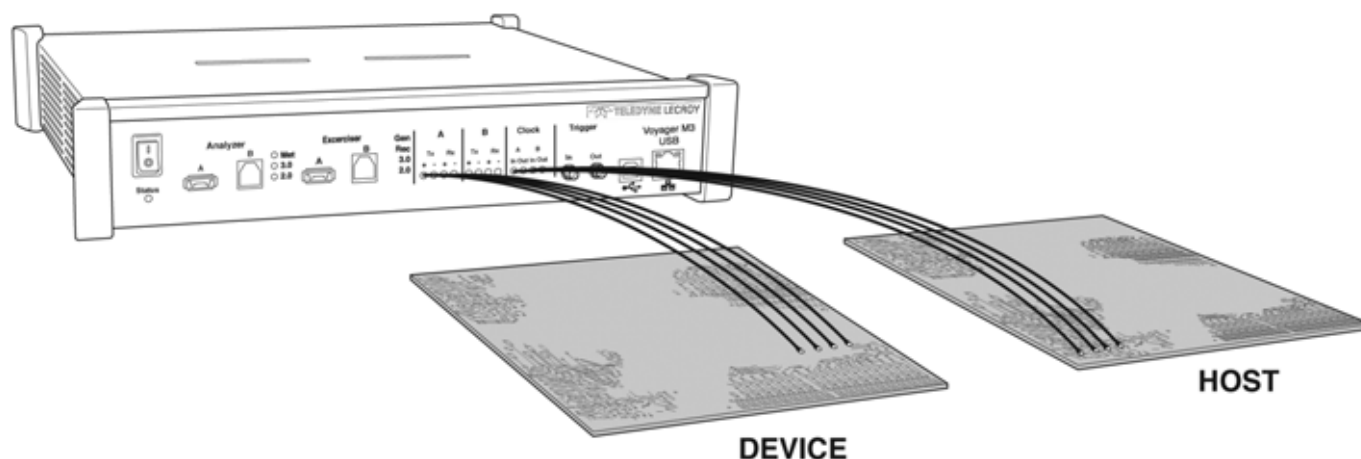


Figure 1.12: Direct Connection using SMA Differential Tap.

1.6.2 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® 10, 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	Tel: +1/503.296.9892
1730 SW Skyline Blvd.	Fax: +1/503.297.1090
Suite 203	Web: http://www.usb.org/
Portland, OR 97221	

1.6.3 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 3.2 Calibration

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

Physical Components

- ☐ Desktop or portable Microsoft Windows 10, 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
- ❑ Extension port for future enhancements
- ❑ SMA connectors and USB 3.2 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 (3.2)

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 3.2).
- ❑ Uses Link Tracker to view symbols of traffic (3.2).
- ❑ Uses a Spec View to show packets in the same format as the USB 3.2 specification (3.2).
- ❑ Has Quick Timing Markers to immediately show time deltas and bandwidth use.

1.6.4 Hi-Speed Slow Clock

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

1.6.5 Traffic Generation

USB 2.0 and 3.2 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 *USBTrainer* 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 3.2 Exerciser features ReadyLink Emulation Mode. The ReadyLink feature handles all USB 3.2 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 3.2 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.

1.6.6 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.

1.7 Advisor T3

The Teledyne LeCroy USB Advisor T3™ USB 3.2 Protocol Analyzer is a verification system for USB development and testing. It supports both USB 2.0 and USB 3.2. 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.

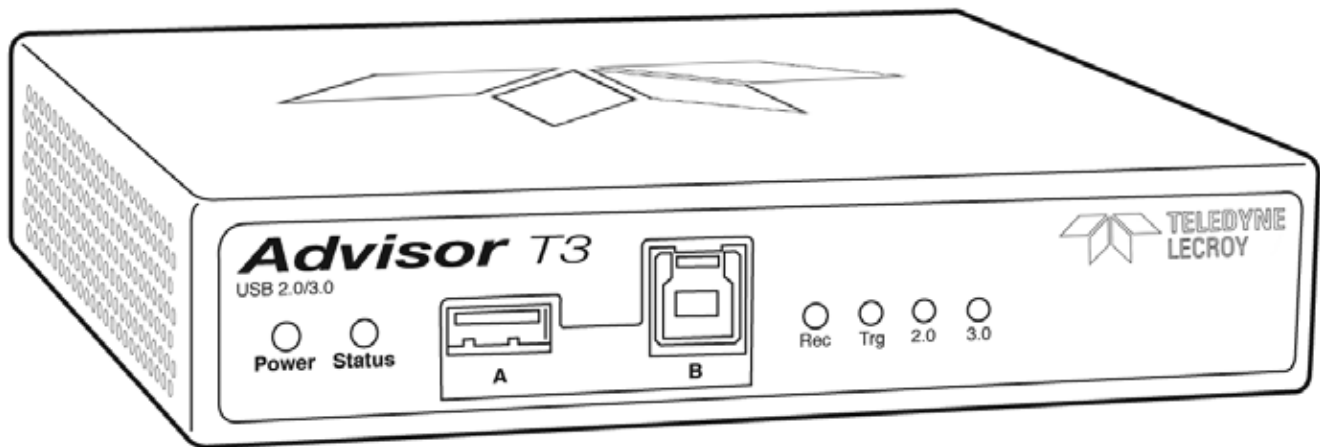


Figure 1.13: Advisor T3.

The system can monitor traffic between USB 2.0 links using standard high-speed compliant cables. If configured for USB 3.2 testing, the system supports monitoring between SuperSpeed links using USB 3.2 cables.

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

<https://teledynelecroy.com/sw/usb/>

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® 10, 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:

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

1.7.2 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 3.2 Calibration

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

Physical Components

- ☐ Desktop or portable Microsoft Windows 10, 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 3.2 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 (3.2)

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 3.2).
- Uses Link Tracker to view symbols of traffic (3.2).
- Has a Spec View to show packets in the same format as the USB 3.2 specification (3.2).
- Uses Quick Timing Markers to immediately show time deltas and bandwidth use.
-

1.8 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.

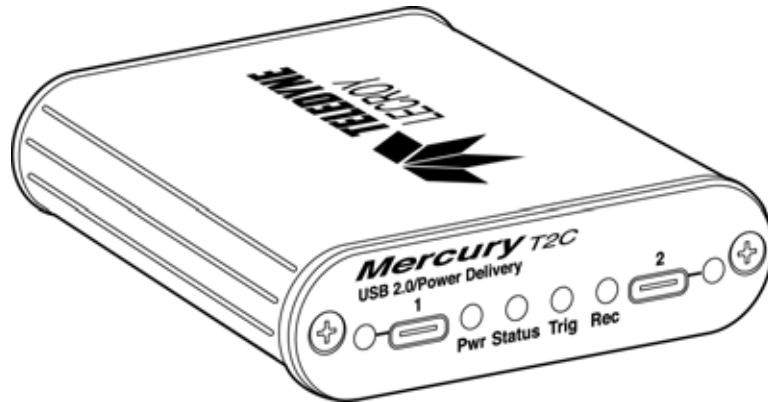


Figure 1.14: Mercury T2C.

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 from the software installation site for the latest information on host machine requirements and supported operating systems.

<https://teledynelecroy.com/sw/usb/>

1.8.1 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® 10, 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	

1.8.2 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 and 3.0 over the Type-C cables.
- ☐ Provides a pass-through of the USB 3.2 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 10, 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 turnaround 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.

1.9 Mercury T2P

The Teledyne LeCroy Mercury T2P™ USB 2.0 and Power Delivery Protocol Analyzer is a verification system for USB development and testing. It supports USB 2.0, Power Delivery, Type-C, and Side Band traffic for Thunderbolt 3, USB4, or Display Port Aux channel packets. It is designed to record USB traffic and graphically present the logical transactions, events, and Power Usage. It connects to a laptop or desktop host machine via USB 2.0. The Mercury T2P is powered by the USB cable using the USB Type-C connectors, so no additional power cord is needed.



Figure 1.15: Mercury T2P.

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 from the software installation site for the latest information on host machine requirements and supported operating systems.

<https://teledynelecroy.com/sw/usb/>

1.9.1 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® 10, 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:

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Suite 203	Web: http://www.usb.org/
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1.9.2 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 and 3.0 over the Type-C cables.
- ☐ Provides a pass-through of the USB 3.2 Super-Speed or Alternate Signaling connections, so these ports can work without interference. Note that these lines are NOT analyzed by Mercury T2P.
- ☐ Allows for 100 watts of power (20V @ 5 Amps) to flow over VBus, with negligible voltage drop.
- ☐ Captures Current and Voltage on Vbus and Vconn for display in Power Tracker.
- ☐ Captures Display Port Aux Channel Packets when using a Display Port or HDMI Alternate Mode Adapter.
- ☐ Captures Thunderbolt 3 Low Speed Packets over the Type-C SBU channel when using Thunderbolt Alt Mode

Physical Components

- ❑ Desktop or portable Microsoft Windows 10, Windows 8, or Windows 7 (32 or 64) host machine with USB capability
- ❑ Plug-and-Play USB installation
- ❑ 512 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 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 1 MB to 512 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.
- ❑ Power Tracker view shows Current and Voltage samples coordinated with Packet timestamps.

1.10 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.

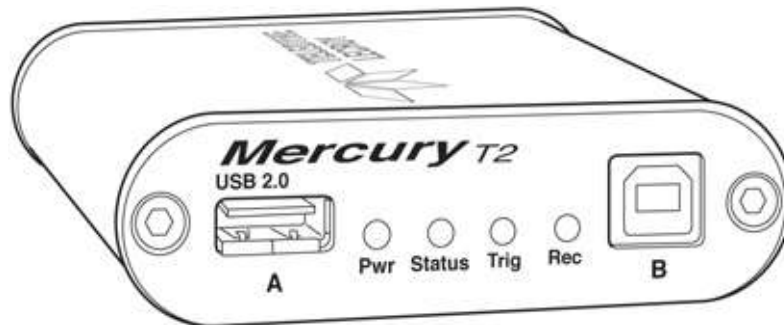


Figure 1.16: Mercury T2.

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 from the software installation site for the latest information on host machine requirements and supported operating systems.

<https://teledynelecroy.com/sw/usb/>

1.10.1 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® 10, 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	

1.10.2 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 10, 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.

1.11 Voyager M3x Analyzer

The Teledyne LeCroy Voyager™ M3x Analyzer and Exerciser system is a multifunction verification system for USB 2.0 and USB 3.2 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 1.17](#)).

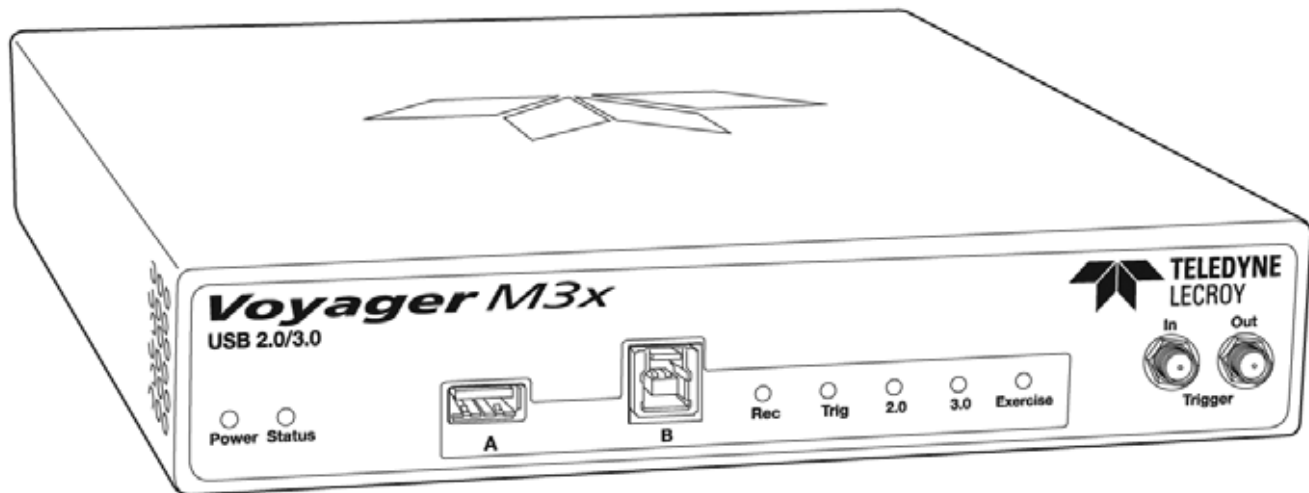


Figure 1.17: Voyager M3x Analyzer Exerciser System

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

<https://teledynelecroy.com/sw/usb/>

1.11.1 USB 2.0 and USB 3.2 Features

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

If configured for USB 3.2 SS testing, the system supports monitoring between SuperSpeed links using USB 3.2 cables (see [Figure 1.18 on page 50](#)).

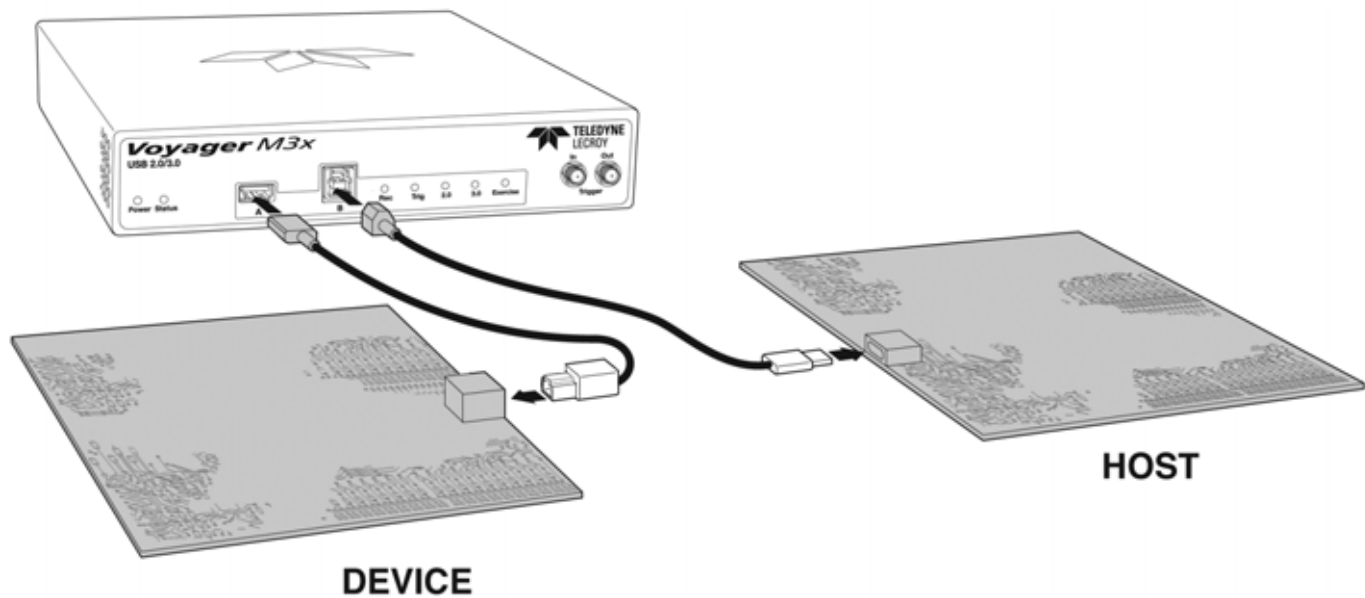


Figure 1.18: Direct Connection using USB 3.2 Cables

1.11.2 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® 10, 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	Tel: +1/503.296.9892
1730 SW Skyline Blvd.	Fax: +1/503.297.1090
Suite 203	Web: http://www.usb.org/
Portland, OR 97221	

1.11.3 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 3.2 Calibration

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

Physical Components

- ☐ Desktop or portable Microsoft Windows 10, 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 3.2 Super-Speed connection to desktop or portable host machine
- ☐ USB 3.2 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 (3.2)

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 3.2).
- ❑ Uses Link Tracker to view symbols of traffic (3.2).
- ❑ Uses a Spec View to show packets in the same format as the USB 3.2 specification (3.2).
- ❑ Has Quick Timing Markers to immediately show time deltas and bandwidth use.

1.11.4 Traffic Generation

USB 2.0 and 3.2 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 *USBTrainer* 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 3.2 Exerciser features ReadyLink Emulation Mode. The ReadyLink feature handles all USB 3.2 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 3.2 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.

1.11.5 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.

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

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

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 M4x Analyzer

2.1.1 System Components and Packing List

These system components are on the packing list:

- ☐ Voyager M4x Protocol Analyzer/Exerciser System
- ☐ AC Power Cord
- ☐ 11 USB Cables
 - USB4/USB 3.2: C-C Unmarked 40Gbps (X2), C-C eMarked 40Gbps, C-C Vconn-thru 40Gbps
 - USB 3.2: C-uB, C-B, C-A, C-A Receptacle, A-B
 - USB 2.0: C-B, C-uB
- ☐ Quick Start Guide

2.1.2 Host Machine Requirements

Please refer to the [USBProtocolSuite_Readme.html](#) file from the software installation site for the current host machine and operating system requirements.

2.1.3 Analyzer

The Analyzer is shown in the figures below. Devices (UFP's) should be attached to Connector 1, Hosts (DFP's) to Connector 2. (The analyzer works in either direction, this way is preferred by Teledyne LeCroy.)

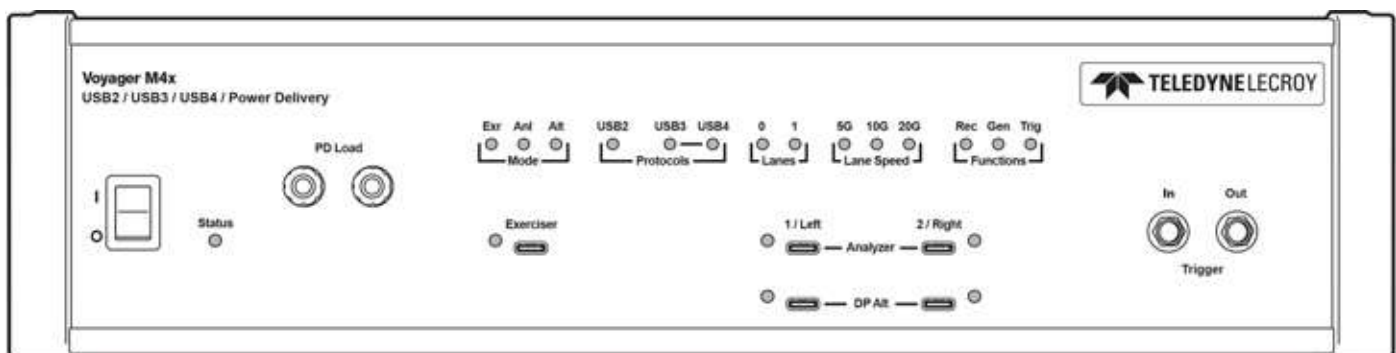


Figure 2.1: Voyager M4x Analyzer Front

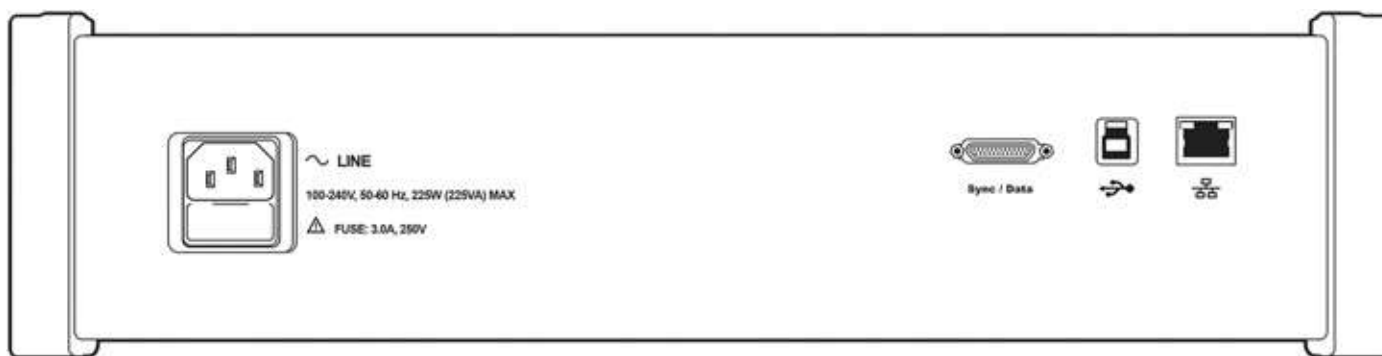


Figure 2.2: Voyager M4x Analyzer Rear

M4x Features

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
Mode	
Exr	Green: Exerciser or Trainer Mode
Anl	Green: Analyzer Mode - USB4, USB 3.2, USB 2.x, PD, TBT3
Alt	Green: DP Alt mode - USB 2, PD, Display Port Aux Channel
Protocols	
USB2	Yellow: Low and Full Speed Green: Hi Speed
USB3	Green: USB 3.2 Capture is enabled (x1 or x2)
USB4	Green: USB4/TBT3 Capture is enabled
Lane	
0	Green: Lane 0 is Active
1	Green: Lane 1 is Active
Lane Speed	
5G	Green: Data Speed on Rx/Tx is 5Gbps/lane
10G	Green: Data Speed on Rx/Tx is 10Gbps/lane
20G	Green: Data Speed on Rx/Tx is 20Gbps/lane
Functions	

Rec	Green: Recording (if Recording enabled)
Gen	Green: Exerciser/Generator is active
Trig	Yellow: Triggered (if trigger occurred)
Analyzer Connectors 1/Left and 2/Right	
LEDs Off	No cable attached
Solid Red	Plug is Upside Down, please invert and re-insert
Solid Green	Plug is correctly oriented
DP Alt Connectors 1/Left and 2/Right	
LEDs Off	No cable attached
Solid Red	Plug is Upside Down, please invert and re-insert
Solid Green	Plug is correctly oriented
Trigger	
In	SMA external trigger input. Note: Edge detected (Rising or Falling) 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. These conditions will trigger the analyzer to start recording or will trigger the action specified in the Advance Recording Options (if applicable). See “Advanced Mode: Voyager M310P (Analyzer)” on page 267 .
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 2.12 on page 81). 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 3.2 Super Speed Standard B Connector to host machine.
AC IN	100-250V AC, 250 Watts.
Power Switch	(0/1) Off/On

WARNING: Do not open the Voyager M4x 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

100-250V AC, 225 Watts.

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	USB4 grade USB Type-C™ connectors: The Voyager analyzer and exerciser port differential input impedance on the USB4 signal wires is between 80 and 120 ohms. 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

32 GB for traffic data capture, timing, state and other data.

2.1.5 Voyager M4x Specific Setup Notes

The Type-C connectors on the front are meant to connect to Hosts (which have a DFP or Downstream Facing Port) and Devices (which have a UFP or Upstream Facing Port) as indicated in the [Figure 2.6](#) below. Note that it will work with the "other way" (Host on Left, Device on Right), but it is preferred to connect as indicated so that the default setup is similar to our previous 10 USB Analyzers, which used an "A" connector on left and a "B" connector on the right. This makes the traces easier to understand and support by our Support Team, and reduces the number of setup diagrams to follow. Of course, the data roles can swap via USB Protocol, and our traces will track that. So, you can follow our suggestion or not, and it will still work.

WARNING: The use of two (2) Electronically Marked cables is not permitted.

NOTE: Connect Type-C cables to the M4x ports WITH THE CORRECT ORIENTATION. The M4x 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 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.

2.2 Voyager M310P Analyzer

2.2.1 System Components and Packing List

These system components are on the packing list:

- ☐ Voyager M310P Protocol Analyzer/Exerciser System
- ☐ 160 Watt AC Power Adapter and Cord
- ☐ 10 USB Cables
 - 3.2: 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
- ☐ Quick Start Guide

2.2.2 Host Machine Requirements

Please refer to the [USBProtocolSuite_Readme.html](#) file from the software installation site for the current host machine and operating system requirements.

2.2.3 Analyzer

The Analyzer is shown in the figures below. Devices (UFP's) should be attached to Connector 1, Hosts (DFP's) to Connector 2. (The analyzer works in either direction, this way is preferred by Teledyne LeCroy.)

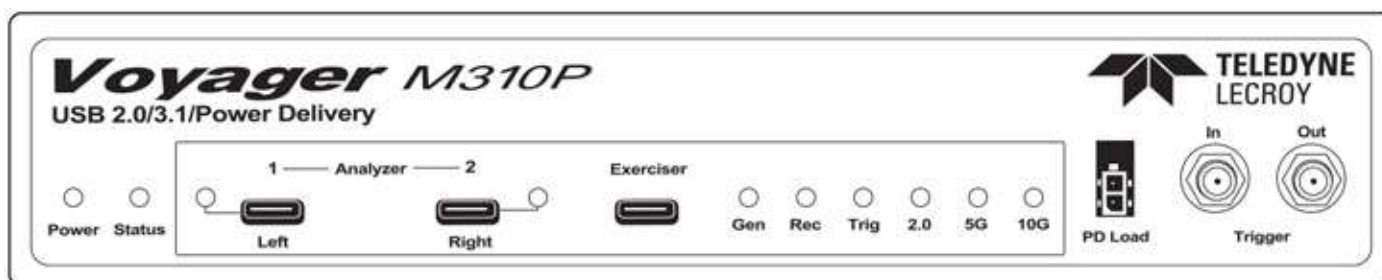


Figure 2.1: Voyager M310P Analyzer Front

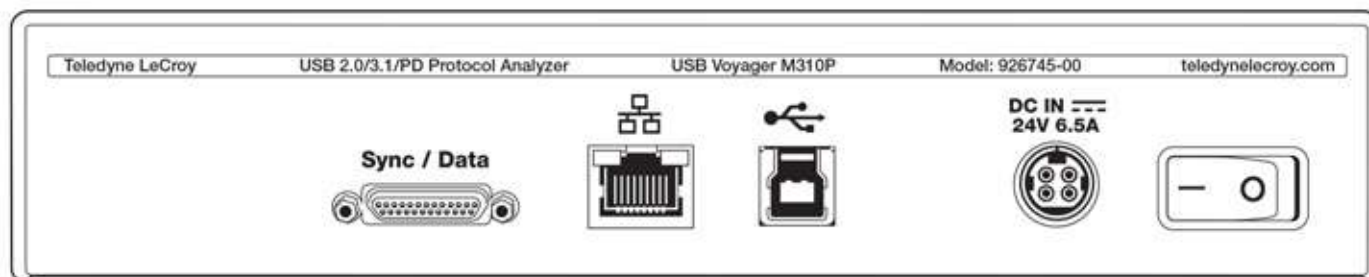


Figure 2.2: Voyager M310P Analyzer Rear

M310P Features

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
Analyzer 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
Solid Yellow	Special Condition: See “M310P / M4x: Yellow LED” on page 376 .
Additional LEDs	
Gen	Generating Green if generating enabled
Rec	Recording Green if 3.2 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 3.2)
Fast Flashing Yellow	FS Traffic on endpoints other than 0 (resets activity timer as in 3.2)
Solid Green	HS SOF's or control endpoint traffic
Flashing Green	HS traffic on endpoints other than 0 (resets activity timer as in 3.2)
5G	USB 3.2 SuperSpeed Gen 1 (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)
10G	USB 3.2 SuperSpeed Plus Gen 2 (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 or Falling) 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. These conditions will trigger the analyzer to start recording or will trigger the action specified in the Advance Recording Options (if applicable). See “Advanced Mode: Voyager M310P (Analyzer)” on page 267 .
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 2.12 on page 81). 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 3.2 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 3.2 LEDs always operate, unless USB 3.2 has been disabled in the Recording Options General Tab.

WARNING: Do not open the Voyager M310P 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

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 (3.2) analyzer and exerciser port differential input impedance is between 80 and 120 ohms. USB 3.2 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.

2.2.5 Voyager M310P Specific Setup Notes

The Type-C connectors on the front are meant to connect to Hosts (which have a DFP or Downstream Facing Port) and Devices (which have a UFP or Upstream Facing Port) as indicated in the [Figure 2.6](#) below. Note that it will work with the "other way" (Host on Left, Device on Right), but it is preferred to connect as indicated so that the default setup is similar to our previous 10 USB Analyzers, which used an "A" connector on left and a "B" connector on the right. This makes the traces easier to understand and support by our Support Team, and reduces the number of setup diagrams to follow. Of course, the data roles can swap via USB Protocol, and our traces will track that. So, you can follow our suggestion or not, and it will still work.

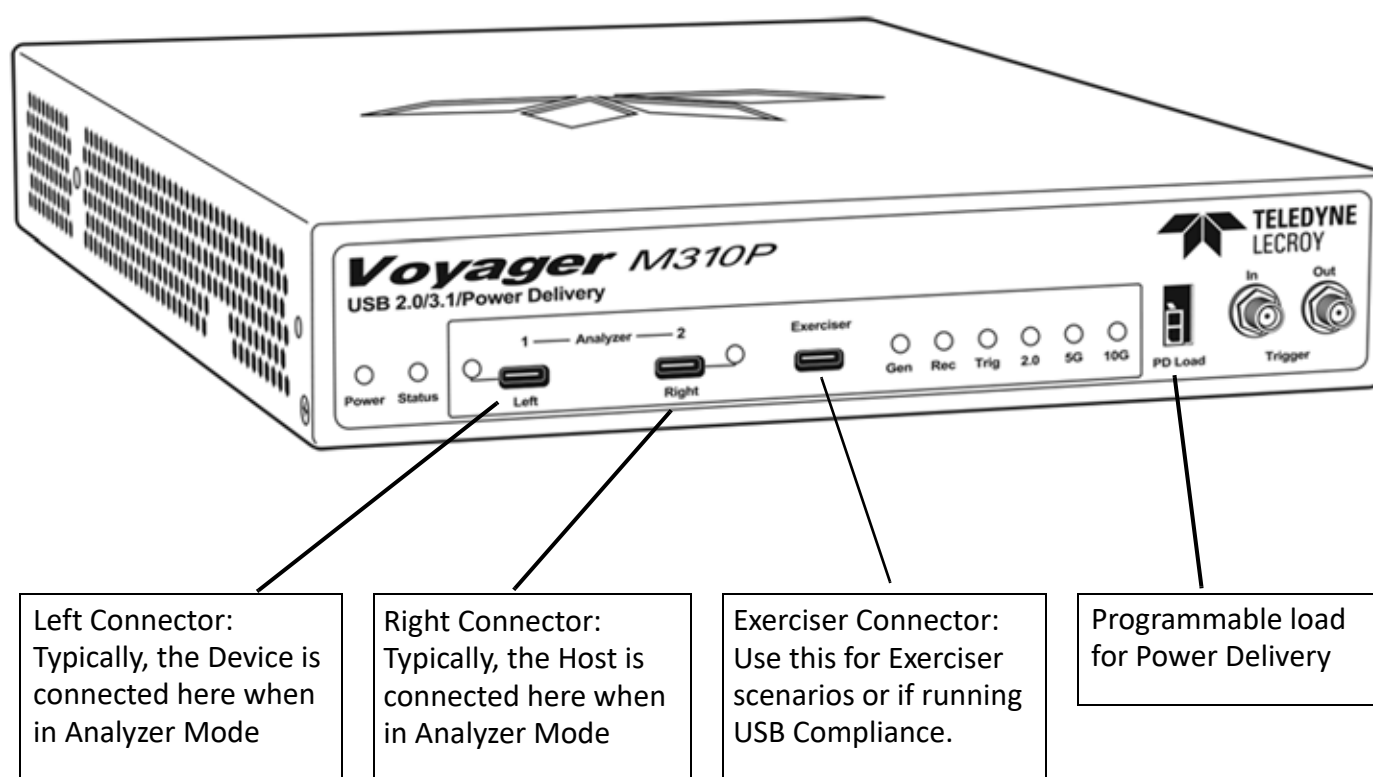


Figure 2.3: Voyager M310P Preferred Connection Method

WARNING: Cable Orientation: The use of two (2) Electronically Marked cables is not permitted.

NOTE: Connect Type-C cables to the M310P ports **WITH THE CORRECT ORIENTATION**. The M310P 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.

2.3 Voyager M310C Analyzer

2.3.1 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
 - 3.2: 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
- ☐ Quick Start Guide

2.3.2 Host Machine Requirements

Please refer to the [USBProtocolSuite_Readme.html](#) file from the software installation site for the current host machine and operating system requirements.

2.3.3 Analyzer

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

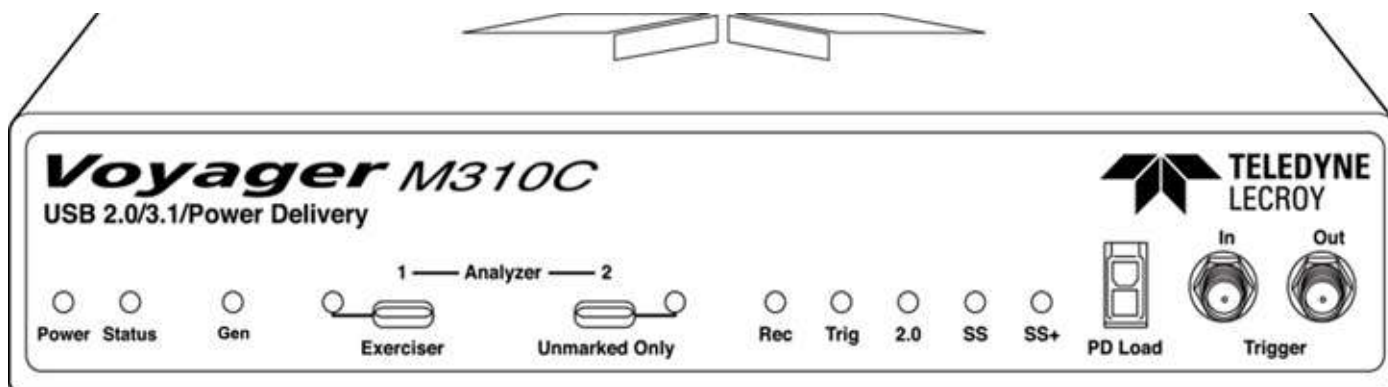


Figure 2.4: Voyager M310C Analyzer Front

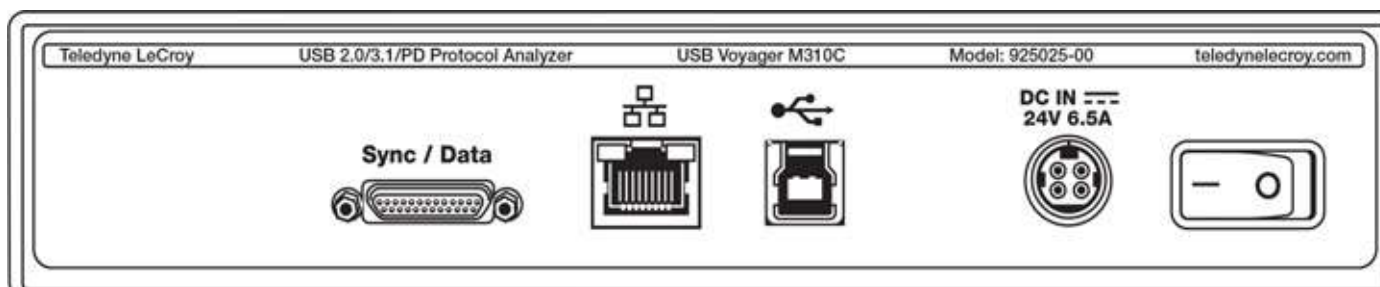


Figure 2.5: Voyager M310C Analyzer Rear

M310C Features

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
Solid Yellow	Special Condition: See “M310C, Mercury T2C, Mercury T2P: Yellow LED” on page 376.
Analyzer LEDs	
Gen	Generating Green if generating enabled
Rec	Recording Green if 3.2 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 3.2)
Fast Flashing Yellow	FS Traffic on endpoints other than 0 (resets activity timer as in 3.2)
Solid Green	HS SOF's or control endpoint traffic
Flashing Green	HS traffic on endpoints other than 0 (resets activity timer as in 3.2)
SS	USB 3.2 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 3.2 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 or Falling) 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. These conditions will trigger the analyzer to start recording or will trigger the action specified in the Advance Recording Options. See “Advanced Mode: Voyager M310C (Analyzer Mode)” on page 263.
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 2.12 on page 81). 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 3.2 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 3.2 LEDs always operate, unless USB 3.2 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.

2.3.4 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 (3.2) analyzer and exerciser port differential input impedance is between 80 and 120 ohms. USB 3.2 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.

2.3.5 Voyager M310C Specific Setup Notes

The Type-C connectors on the front are meant to connect to Hosts (which have a DFP or Downstream Facing Port) and Devices (which have a UFP or Upstream Facing Port) as indicated in the [Figure 2.6](#) below. Note that it will work with the “other way” (Host on Left, Device on Right), but it is preferred to connect as indicated so that the default setup is similar to our previous 10 USB Analyzers, which used an “A” connector on left and a “B” connector on the right. This makes the traces easier to understand and support by our Support Team, and reduces the number of setup diagrams to follow. Of course, the data roles can swap via USB Protocol, and our traces will track that. So, you can follow our suggestion or not, and it will still work.

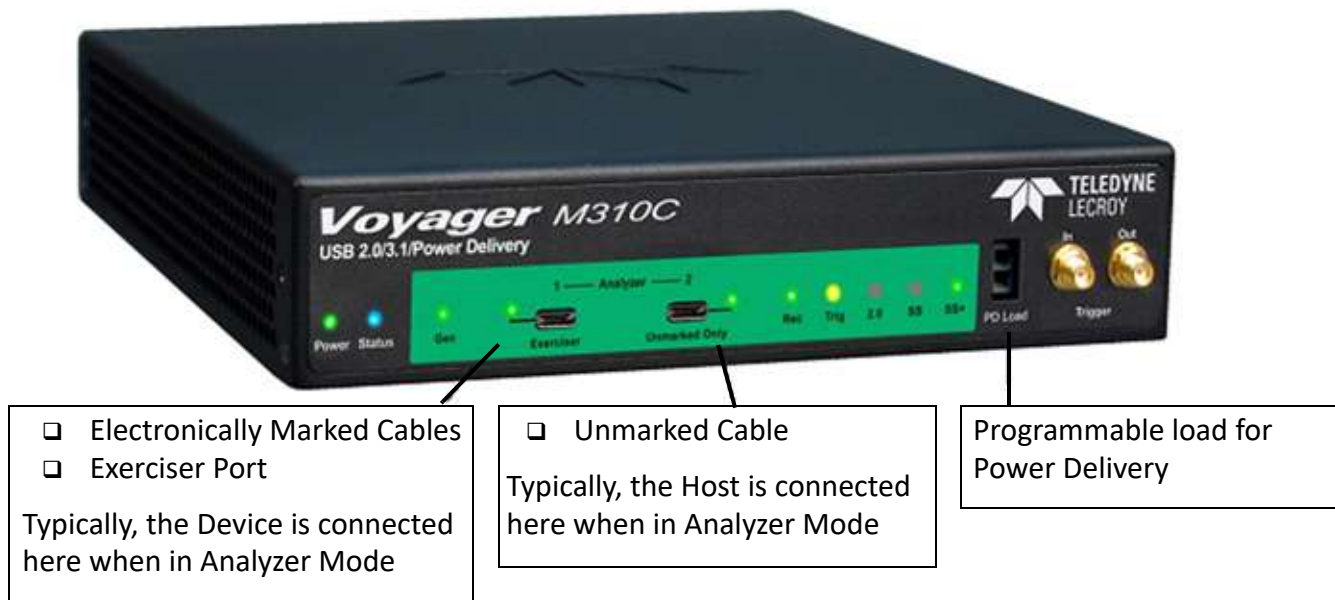


Figure 2.6: Voyager M310C Preferred Connection Method

WARNING: Cable Orientation: The use of 2 Electronically Marked cables is not permitted. Electronically Marked cables should preferably 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.

2.4 Voyager M310 Analyzer

2.4.1 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 3.2)
- ☐ Micro to Standard USB adapter
- ☐ Mini to Standard USB adapter
- ☐ Quick Start Guide

2.4.2 Host Machine Requirements

Please refer to the [USBProtocolSuite_Readme.html](#) file from the software installation site for the current host machine and operating system requirements.

2.4.3 Analyzer

The Analyzer is shown in the figures below.

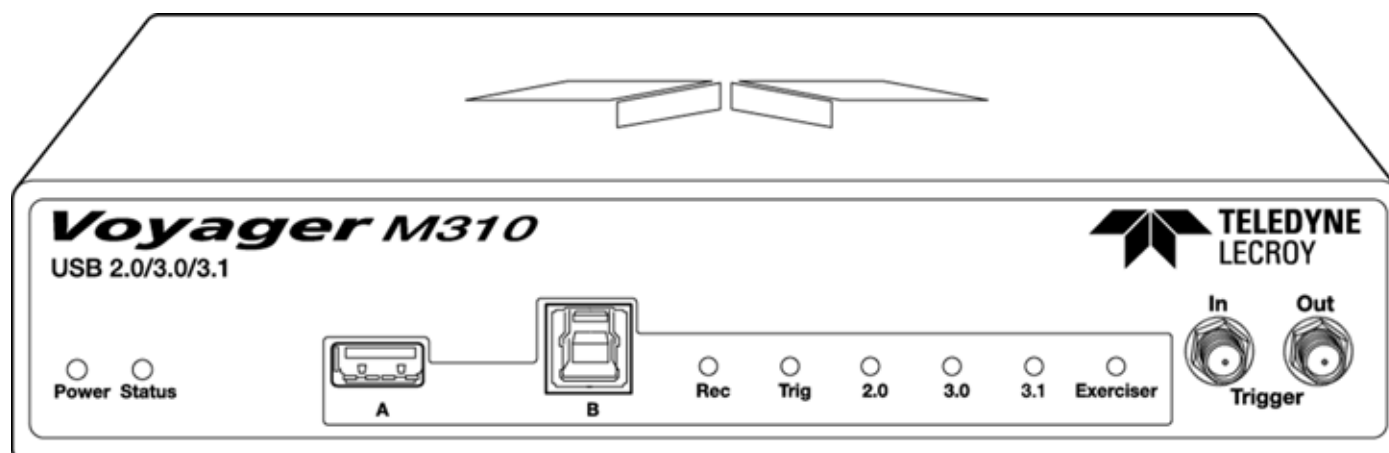


Figure 2.7: Voyager M310 Analyzer Front

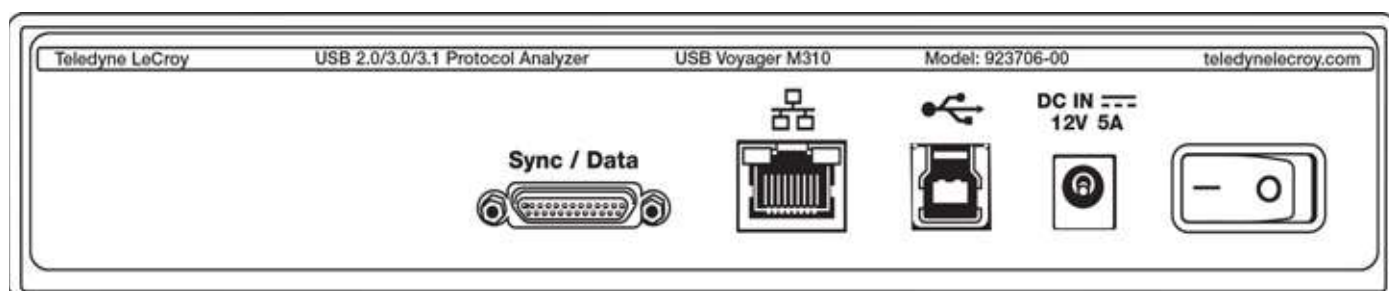


Figure 2.8: Voyager M310 Analyzer Rear

M310 Features

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 3.2 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 3.2)
Fast Flashing Yellow	FS Traffic on endpoints other than 0 (resets activity timer as in 3.2)
Solid Green	HS SOF's or control endpoint traffic
Flashing Green	HS traffic on endpoints other than 0 (resets activity timer as in 3.2)
3.0	USB 3.2 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)
3.2	USB 3.2 SS+ (10Gbps), no longer referred to as 3.2, 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 or Falling) 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. These conditions will trigger the analyzer to start recording or will trigger the action specified in the Advance Recording Options. See "Advanced Mode: Voyager M310C (Analyzer Mode)" on page 263.
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 2.12 on page 81). 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 3.2 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 3.2 LEDs always operate, unless USB 3.2 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.

2.4.4 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 (3.2) analyzer and exerciser port differential input impedance is between 80 and 120 ohms. USB 3.2 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.

2.5 Voyager M3i Analyzer

2.5.1 System Components and Packing List

These system components are on the packing list:

- ☐ Voyager M3i Analyzer Exerciser System
- ☐ AC power cable
- ☐ USB cables (five)
- ☐ Micro to Standard USB adapter
- ☐ Mini to Standard USB adapter
- ☐ Quick Start Guide

2.5.2 Host Machine Requirements

Please refer to the [USBProtocolSuite_Readme.html](#) file from the software installation site for the current host machine and operating system requirements.

2.5.3 Analyzer

The Analyzer is shown in the figure.

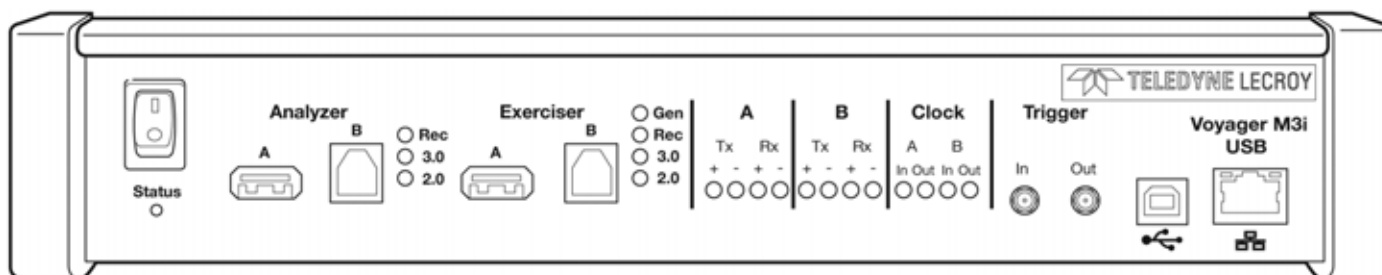


Figure 2.9: Voyager M3i Analyzer Front

M3i Features

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 3.2 recording enabled in Analyzer mode
3.0	USB 3.2 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 3.2)
Fast Flashing Yellow	FS Traffic on endpoints other than 0 (resets activity timer as in 3.2)
Solid Green	HS SOF's or control endpoint traffic
Flashing Green	HS traffic on endpoints other than 0 (resets activity timer as in 3.2)
Exerciser Ports A (downstream) and B (upstream)	
Exerciser LEDs	
Gen	Generating Green if generating enabled
Rec	Recording Red if 3.2 recording enabled when in Exerciser mode

3.0	USB 3.2 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 3.2 LEDs always operate, unless USB 3.2 has been disabled in the Recording Options General Tab.

A (downstream)	MMCX plug connectors for interfacing
B (upstream)	with USB 3.2 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 or Falling) 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. These conditions will trigger the analyzer to start recording or will trigger the action specified in the Advance Recording Options. See “Advanced Mode: Voyager M3, M3i and M3x” on page 245.
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 M3i 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

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 (3.2) analyzer and exerciser port differential input impedance is between 80 and 120 ohms. USB 3.2 SS cables MMCX connectors for USB 3.2 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.

2.6 Advisor T3

The Teledyne LeCroy USB Advisor T3™ USB 3.2 Protocol Analyzer is a verification system for USB development and testing. It supports both USB 2.0 and USB 3.2. 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 3.2 testing, the system supports monitoring between SuperSpeed links using USB 3.2 cables.

2.6.1 Components

The Teledyne LeCroy Advisor T3 Analyzer package includes the following:

- ☐ One Teledyne LeCroy USB Advisor T3 Analyzer
- ☐ DC Power Adapter
- ☐ USB cables (three)
- ☐ Quick Start Guide
- ☐ Carrying Case

2.6.2 Front Panel

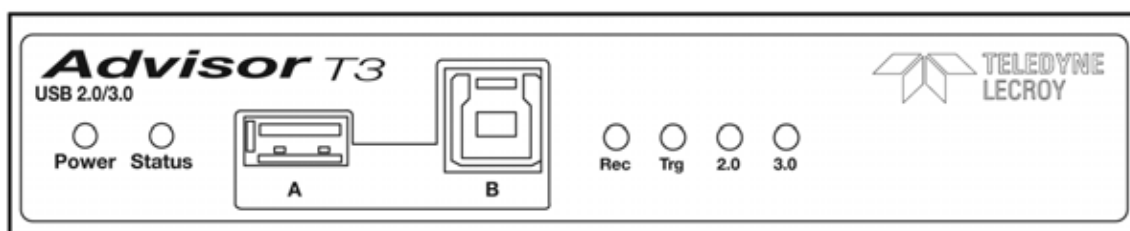


Figure 2.10: Advisor T3 Front Panel

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 3.2 SS	(green if link is up; flashes green while data transfers; yellow if polling)

2.6.3 Rear Panel

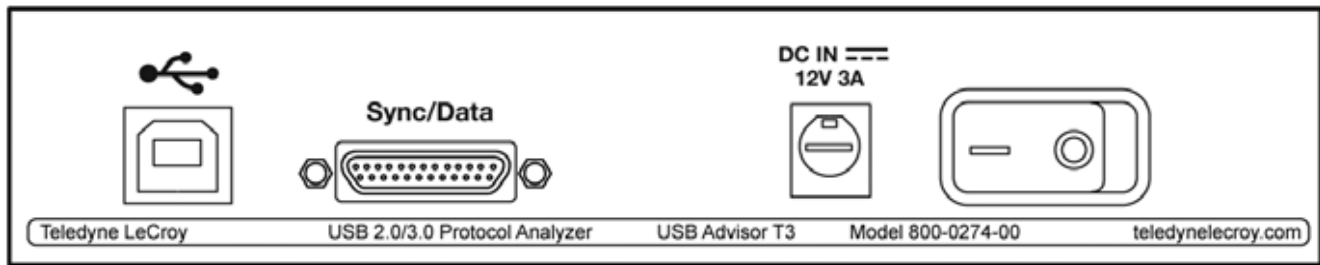


Figure 2.11: Advisor T3 Rear Panel

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)

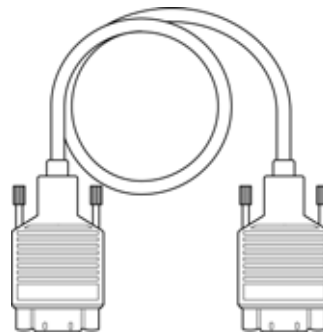


Figure 2.12: Micro DB-25 to Micro DB-25 External Interface Cable

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 or Falling) 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.

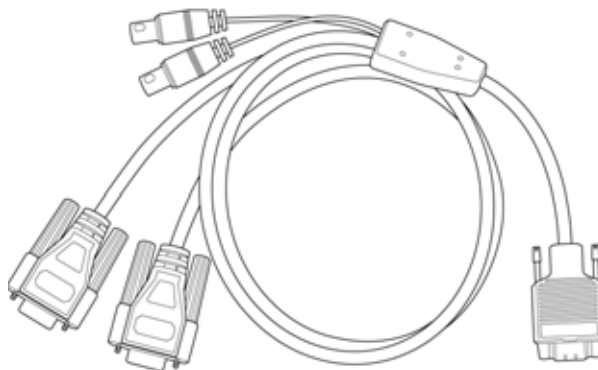


Figure 2.13: Micro DB-25 "Octopus" Interface Cable

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.

2.6.4 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 (3.2) analyzer and exerciser port differential input impedance is between 80 and 120 ohms. USB 3.2 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.

2.6.5 Advisor T3 System Setup

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

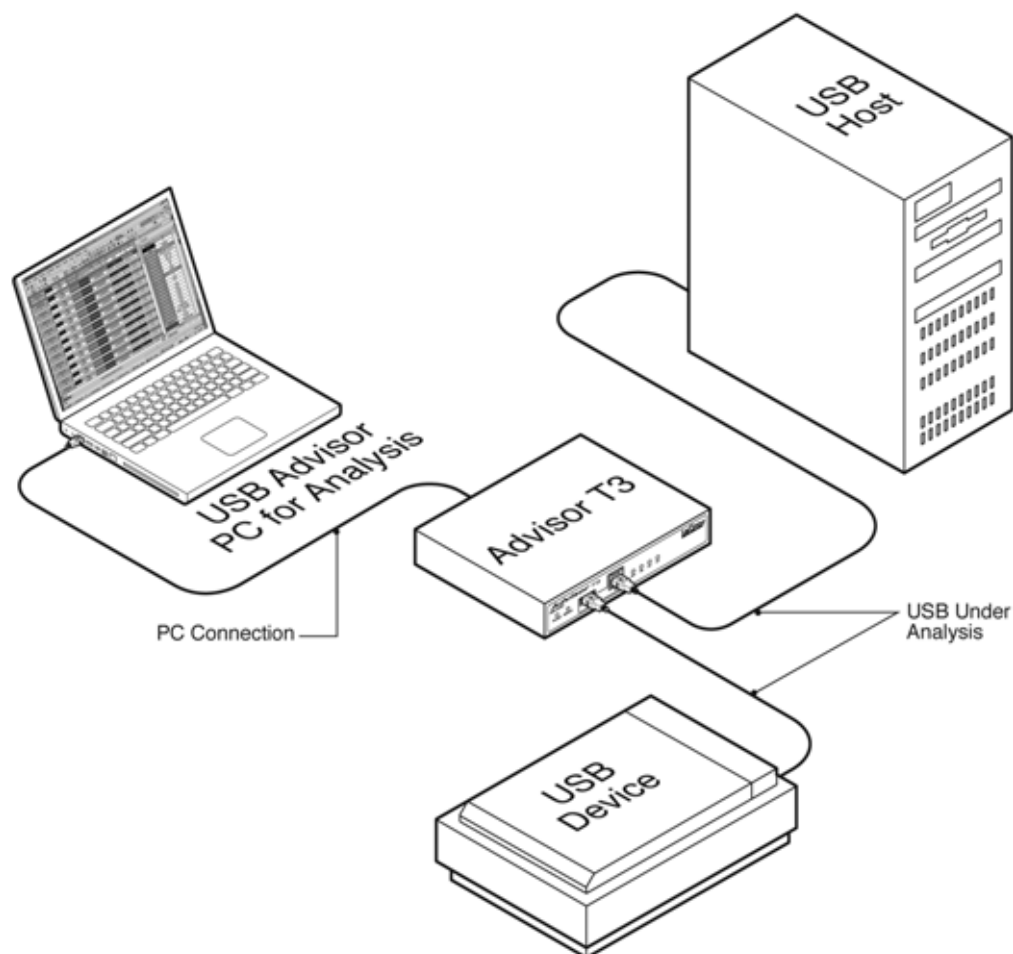


Figure 2.14: Advisor T3 Setup

Note: The Advisor T3 SuperSpeed (3.2) analyzer port differential input impedance is between 80 and 120 ohms.

2.7 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.

2.7.1 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
- ❑ Quick Start Guide

2.7.2 Front Panel

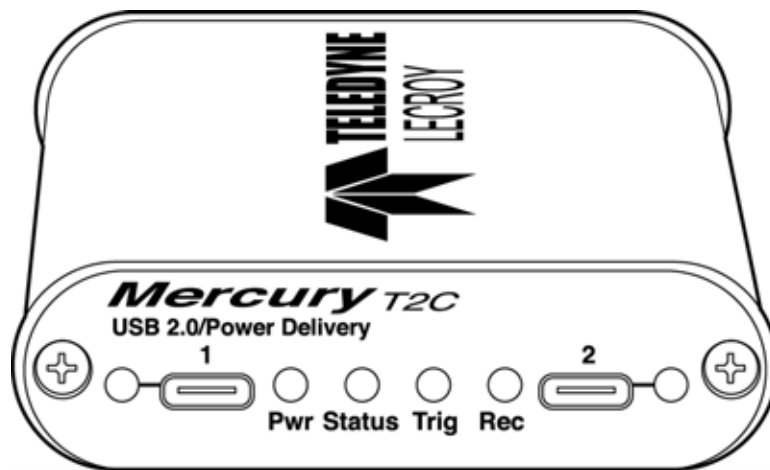


Figure 2.15: Mercury T2C Front Panel

The front panel has the following indicators and connectors:

Connector 1 LED	(Green - Good)
	(Red - Flip it over!)
	(Solid Yellow - Special Condition: See “M310C, Mercury T2C, Mercury T2P: Yellow LED” on page 376)
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!)

(Solid Yellow - Special Condition: See

[“M310C, Mercury T2C, Mercury T2P: Yellow LED” on page 376](#))

2.7.3 Rear Panel

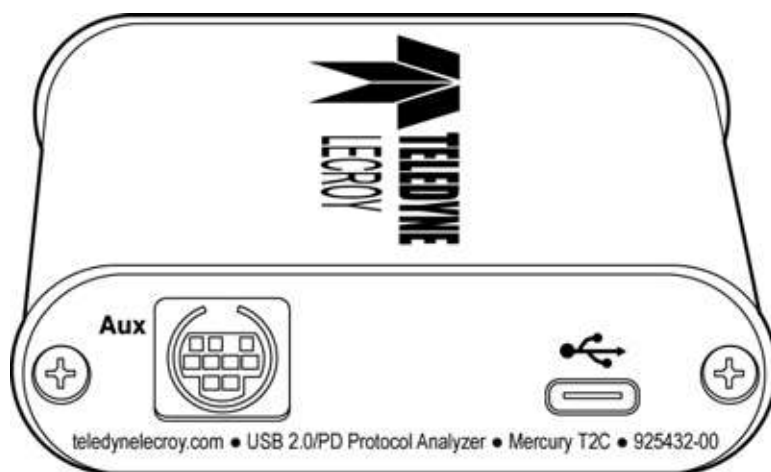


Figure 2.16: Mercury T2C Rear Panel

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)

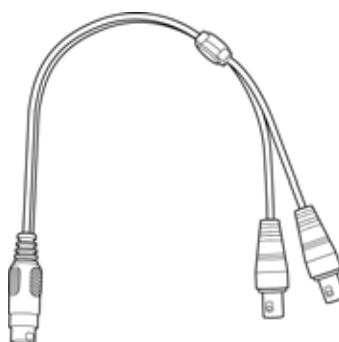


Figure 2.17:

Trigger In

Bayonet connector external trigger input. Note: Edge detected (Rising or Falling) 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.

2.7.4 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.

2.7.5 Mercury T2C System Setup

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

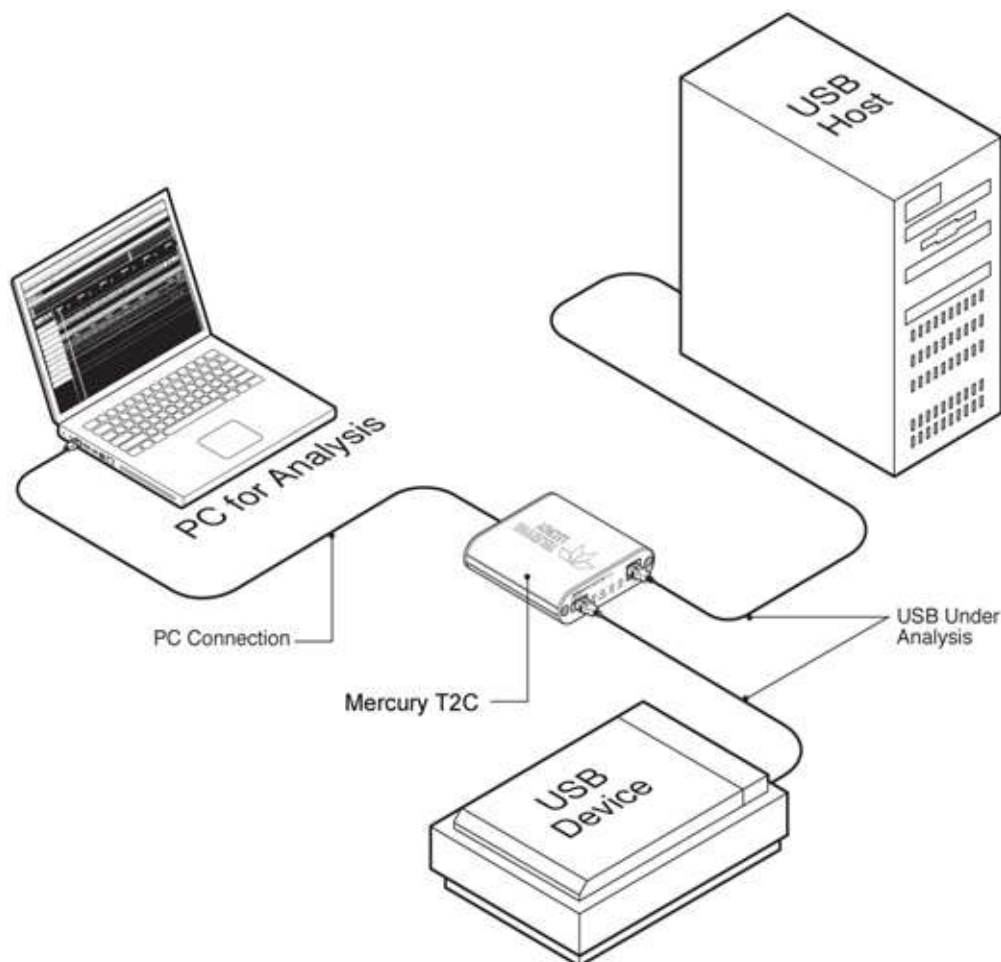


Figure 2.18: Mercury T2C Setup

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. This will enable the analyzer to connect all the other signals in a 3.2 cable correctly, allowing the other SS, SS+, or Alternate Modes to work without interruption.

2.8 Mercury T2P

The LeCroy USB Mercury T2P™ USB 2.0 and Power Delivery Protocol Analyzer is a verification system for USB development and testing. It supports USB 2.0, Power Delivery and Type-C, as well as Aux Port Display Port or Thunderbolt 3 Low Speed traffic. It is designed to record USB traffic and graphically present the logical transactions, events, and Power samples. It connects to a laptop or desktop host machine via USB 2.0. The Mercury T2P is powered by the USB Type-C cable, so no additional power cord is needed.

2.8.1 Components

The Teledyne LeCroy Mercury T2P Analyzer package includes the following:

- ❑ One Teledyne LeCroy USB Mercury T2P Analyzer
- ❑ Six USB cables: 2x A-C, C-B, C-uB, C-C, C-A Receptacle
- ❑ Quick Start Guide

2.8.2 Front Panel

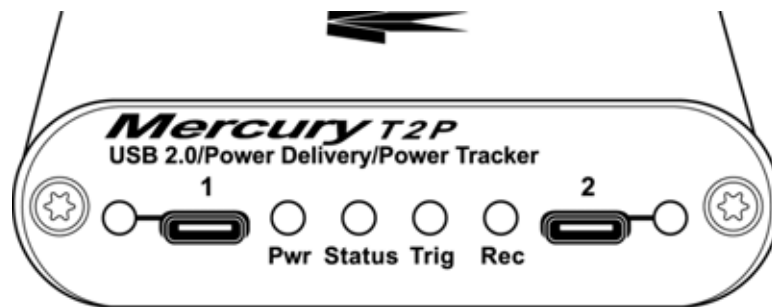


Figure 2.19: Mercury T2P Front Panel

The front panel has the following indicators and connectors:

Connector 1 LED	(Green - Good) (Red - Flip it over!) (Solid Yellow - Special Condition: See "M310C, Mercury T2C, Mercury T2P: Yellow LED" on page 376)
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!) (Solid Yellow - Special Condition: See "M310C, Mercury T2C, Mercury T2P: Yellow LED" on page 376)

2.8.3 Rear Panel

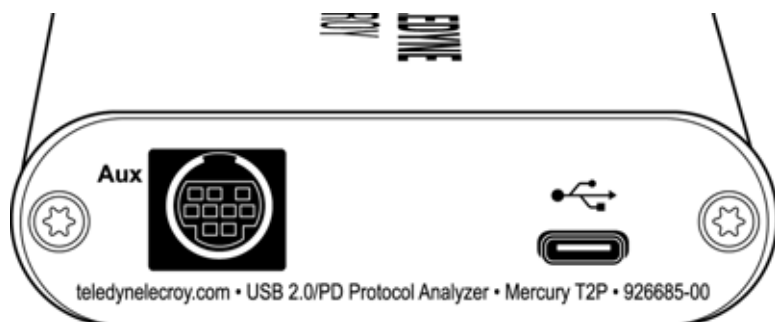


Figure 2.20: Mercury T2P Rear Panel

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)

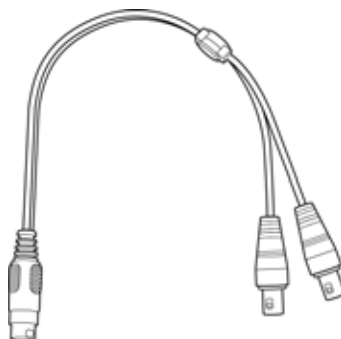


Figure 2.21:

Trigger In	Bayonet connector external trigger input. Note: Edge detected (Rising or Falling) 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.

2.8.4 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

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

2.8.5 Mercury T2P System Setup

Mercury T2P is configured and controlled through a host machine USB port.

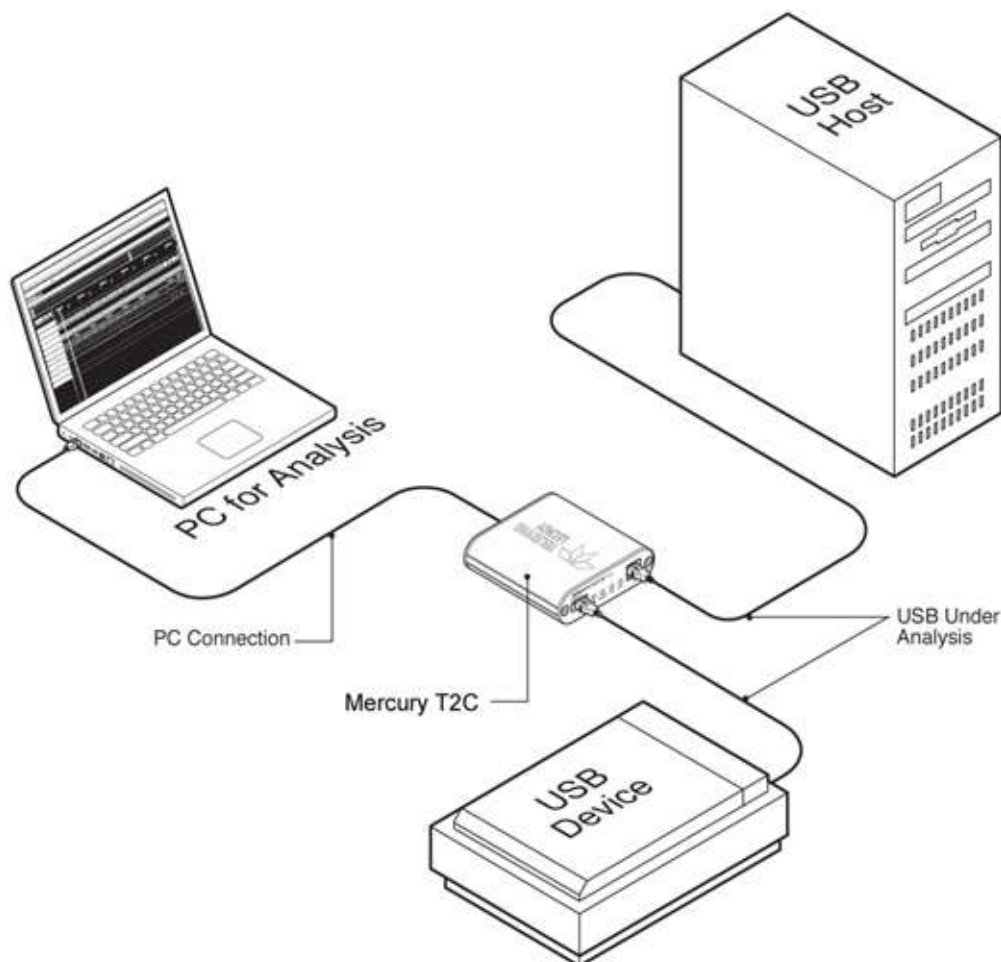


Figure 2.22: Mercury T2P Setup

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 T2P. If the LED associated with the Connector shows Red, you need to flip the connector over so it shows Green. This will enable the analyzer to connect all the other signals in a 3.2 cable correctly, allowing the other SS, SS+, or Alternate Modes to work without interruption.

2.9 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.

2.9.1 Components

The Teledyne LeCroy Mercury T2 Analyzer package includes the following:

- ☐ One Teledyne LeCroy USB Mercury T2 Analyzer
- ☐ USB cables (three)
- ☐ Quick Start Guide

2.9.2 Front Panel

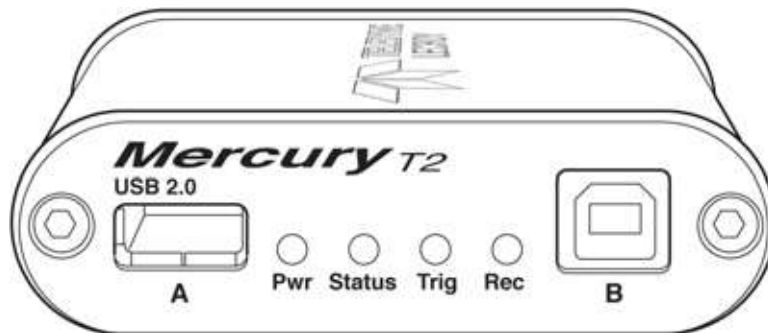


Figure 2.23: Mercury T2 Front Panel

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)

2.9.3 Rear Panel

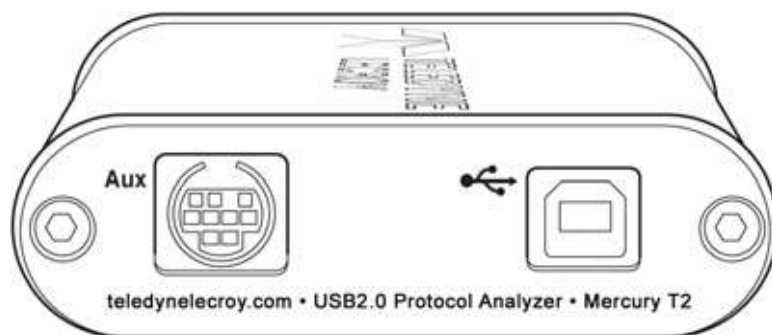


Figure 2.24: Mercury T2 Rear Panel

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)

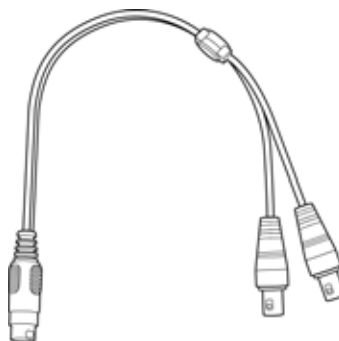


Figure 2.25:

Trigger In	Bayonet connector external trigger input. Note: Edge detected (Rising or Falling) 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.

2.9.4 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.

2.9.5 Mercury T2 System Setup

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

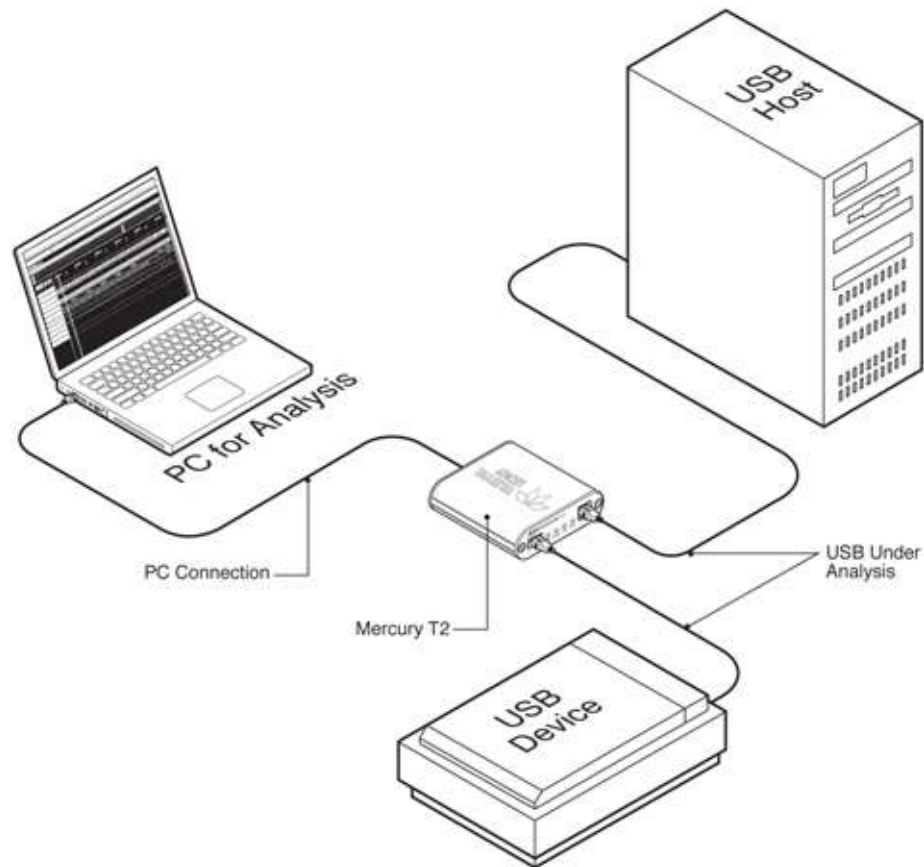


Figure 2.26: Mercury T2 Setup

2.10 Voyager M3x Analyzer

2.10.1 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 3.2)
- ☐ Micro to Standard USB adapter
- ☐ Mini to Standard USB adapter
- ☐ Quick Start Guide

2.10.2 Host Machine Requirements

Please refer to the [USBProtocolSuite_Readme.html](#) file from the software installation site for the current host machine and operating system requirements.

2.10.3 Analyzer

The Analyzer is shown in the figures below.

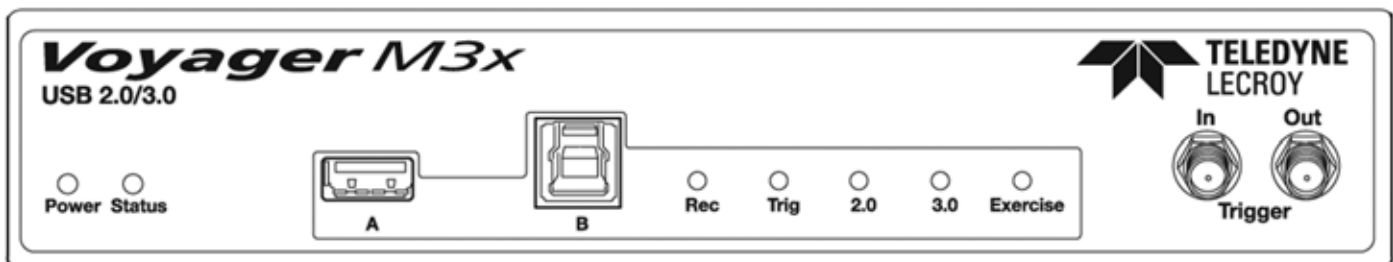


Figure 2.27: Voyager M3x Analyzer Front

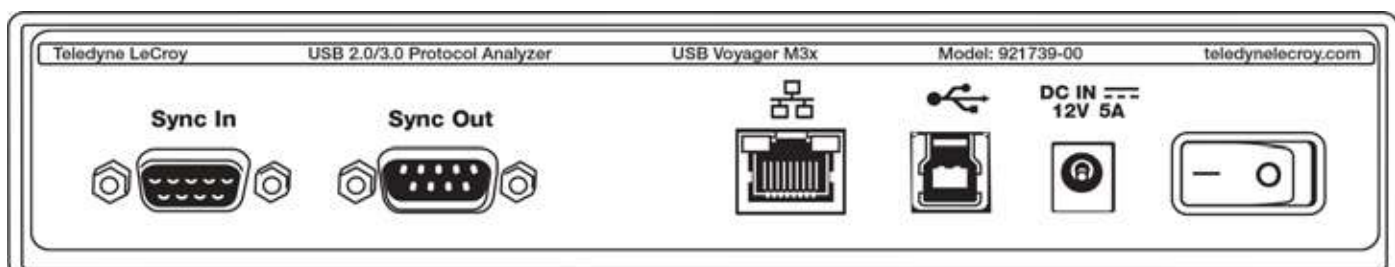


Figure 2.28: Voyager M3x Analyzer Rear

M3x Features

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 3.2 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 3.2)
Fast Flashing Yellow	FS Traffic on endpoints other than 0 (resets activity timer as in 3.2)
Solid Green	HS SOF's or control endpoint traffic
Flashing Green	HS traffic on endpoints other than 0 (resets activity timer as in 3.2)
3.0	USB 3.2 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 or Falling) 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. These conditions will trigger the analyzer to start recording or will trigger the action specified in the Advance Recording Options. See “Advanced Mode: Voyager M3x” on page 260.
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 3.2 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 3.2 LEDs always operate, unless USB 3.2 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.

2.10.4 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 (3.2) analyzer and exerciser port differential input impedance is between 80 and 120 ohms. USB 3.2 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.

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

These CATC analyzers are no longer supported beginning in version 7.65.

To use these older analyzers 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 USB Protocol Suite Analyzer software installs onto a Microsoft® Window® host machine using the Windows Server 2016, Windows Server 2019 or Windows 10 64-bit operating systems.

Important: Please uninstall any versions of *USBTracer*, *USB Advisor*, or *USBMobile* HS software on your host machine BEFORE installing USB Protocol Suite. The older software is not compatible with the new software and device drivers.

Note: Files recorded with USB Chief USB , USBTracer, USB Advisor, or USBMobile analyzers 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.

3.1.1 Downloading the USB Protocol Suite software

You can download the latest version of the USB Protocol Suite software from the following site:

<https://teledynelecroy.com/sw/usb/>

Note: First-time user registration is required.

3.1.2 Windows Server 2016/2019

If you are using Windows Server 2016/2019, the Teledyne LeCroy USB Protocol Suite Software needs to be added to the firewall exceptions to ensure that the application can find the analyzers over your Ethernet network.

To add the USB Protocol Suite Software application to the firewall exceptions perform the following steps.

1. Open the Control Panel. See [Figure 3.1](#).

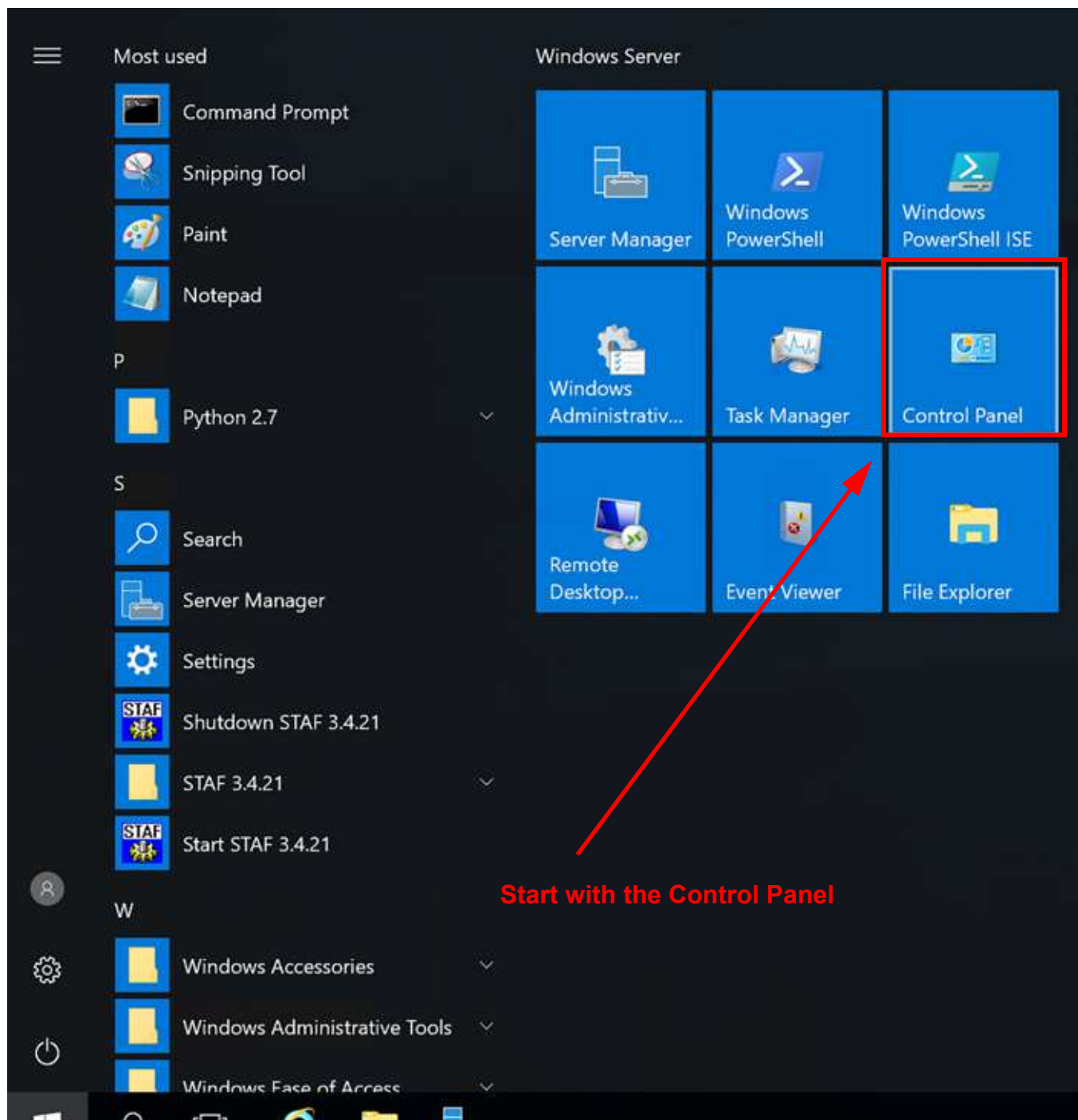


Figure 3.1: Windows Server 2016/2019: Start Menu -> Control Panel

2. From the Control Panel, select the “Systems and Security” screen. See [Figure 3.2](#).

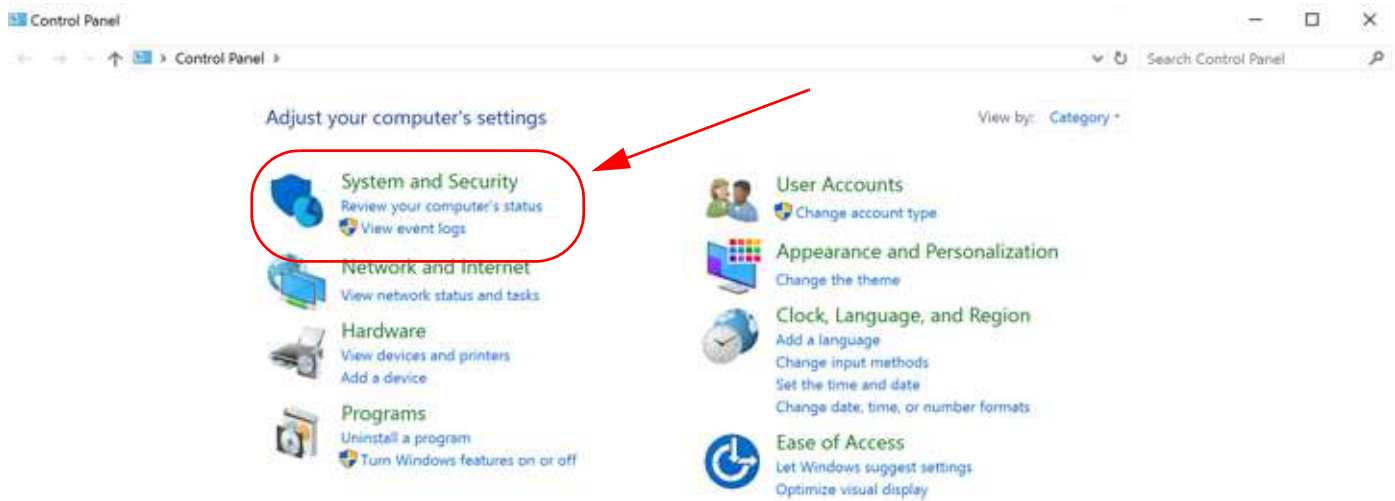


Figure 3.2: Windows Server 2016/2019: Control Panel -> System and Security Screen

3. From the Control Panel -> System and Security Screen, select “Allow an App through Windows Firewall”. See [Figure 3.3](#).

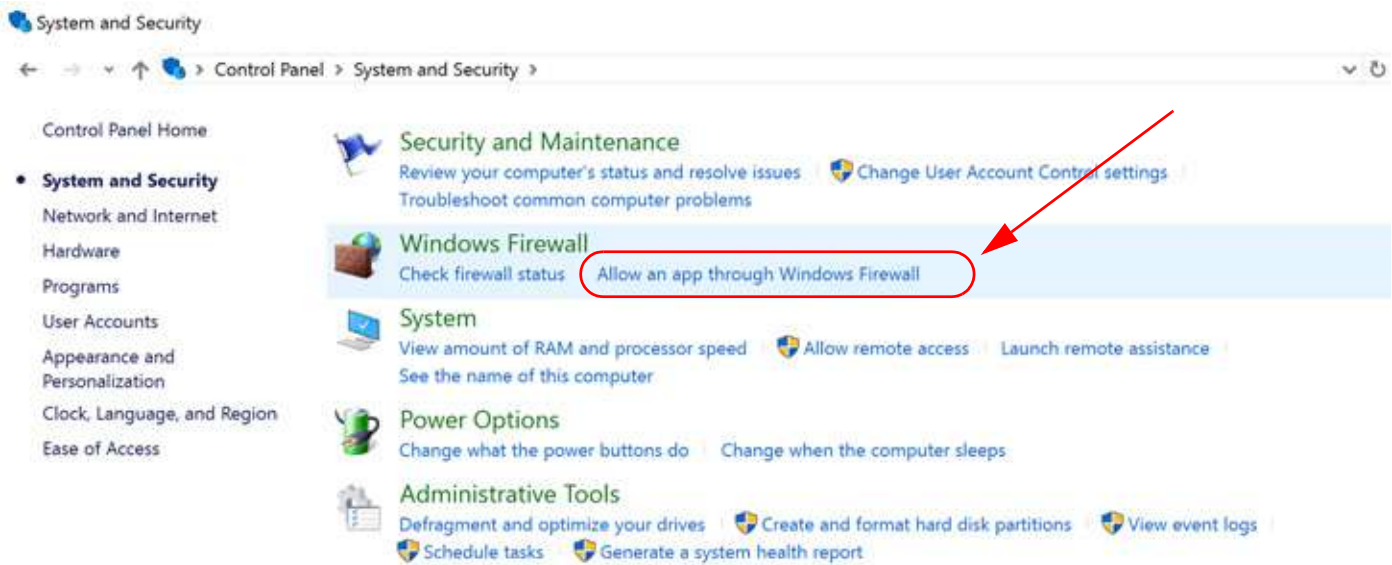


Figure 3.3: Windows Server 2016/2019: Allow an App Through Windows Firewall

4. From the Windows Firewall screen -> Allow apps to communicate through Windows Firewall, select "Change settings", then select "Allow another program". See Figure 3.4.

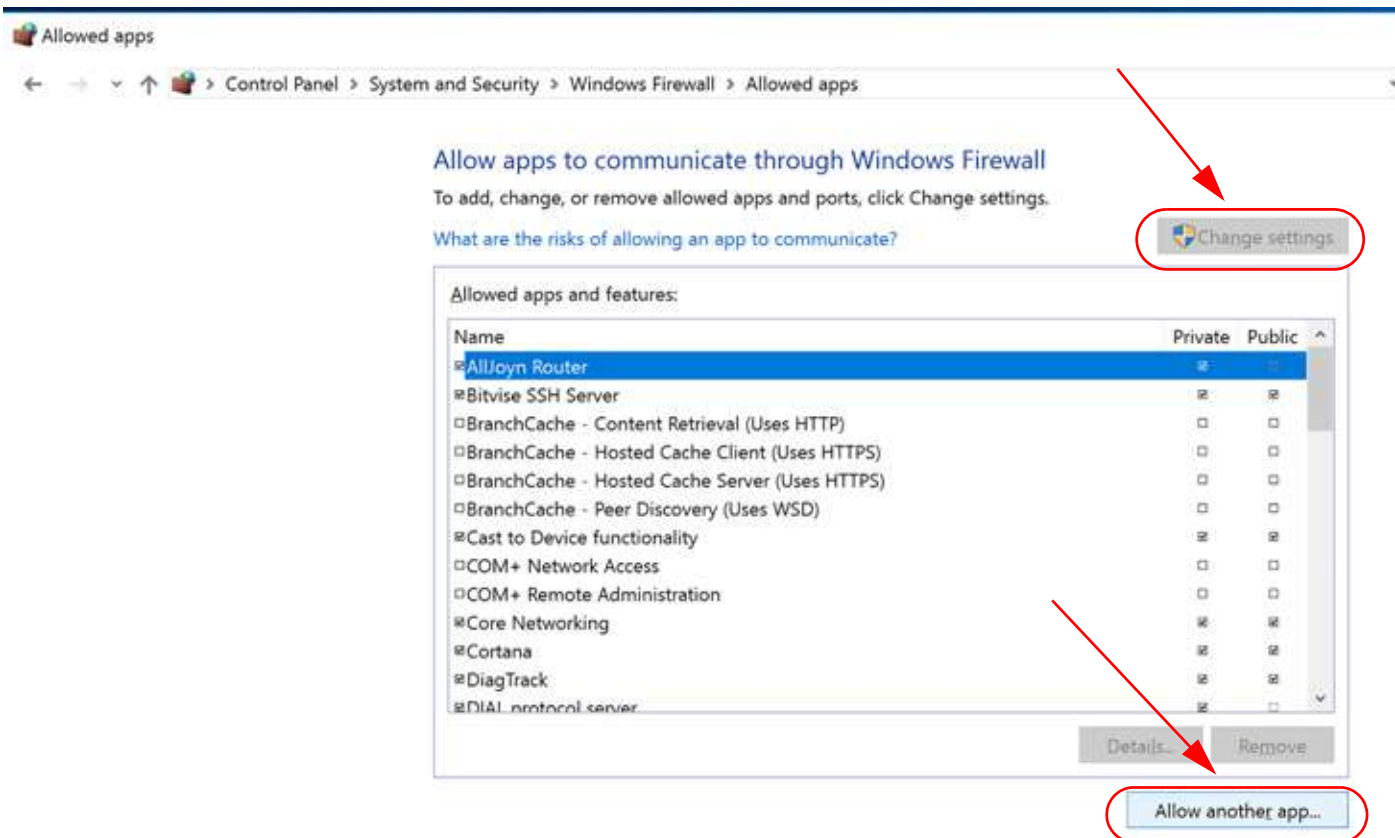


Figure 3.4: Windows Server 2016/2019: Change Settings -> Allowed Another app

5. From the User Account Control screen, select "Yes". [Figure 3.5](#).

Note: This screen may be optional if you have already allowed Microsoft Windows to make changes to your computer.

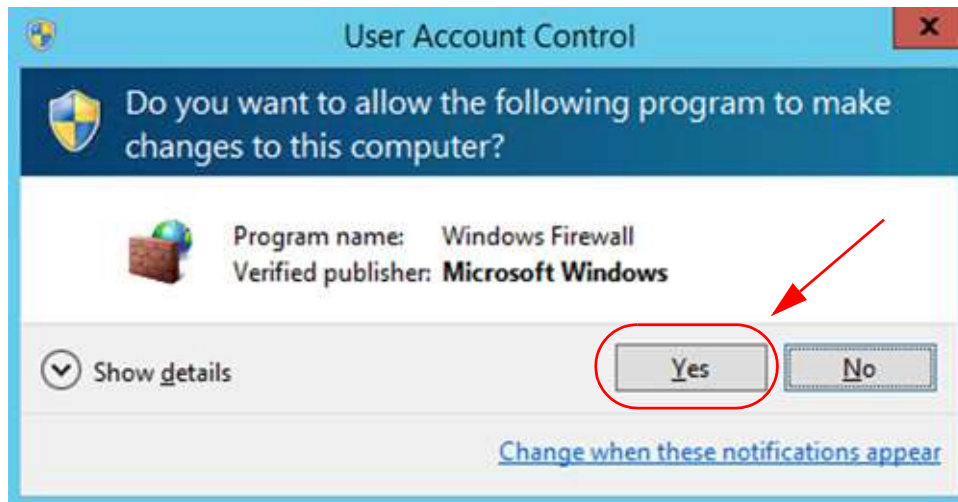


Figure 3.5: Windows Server 2016/2019: User Account Control

6. From the “Add an app” screen, select the Browse button. See [Figure 3.6](#).

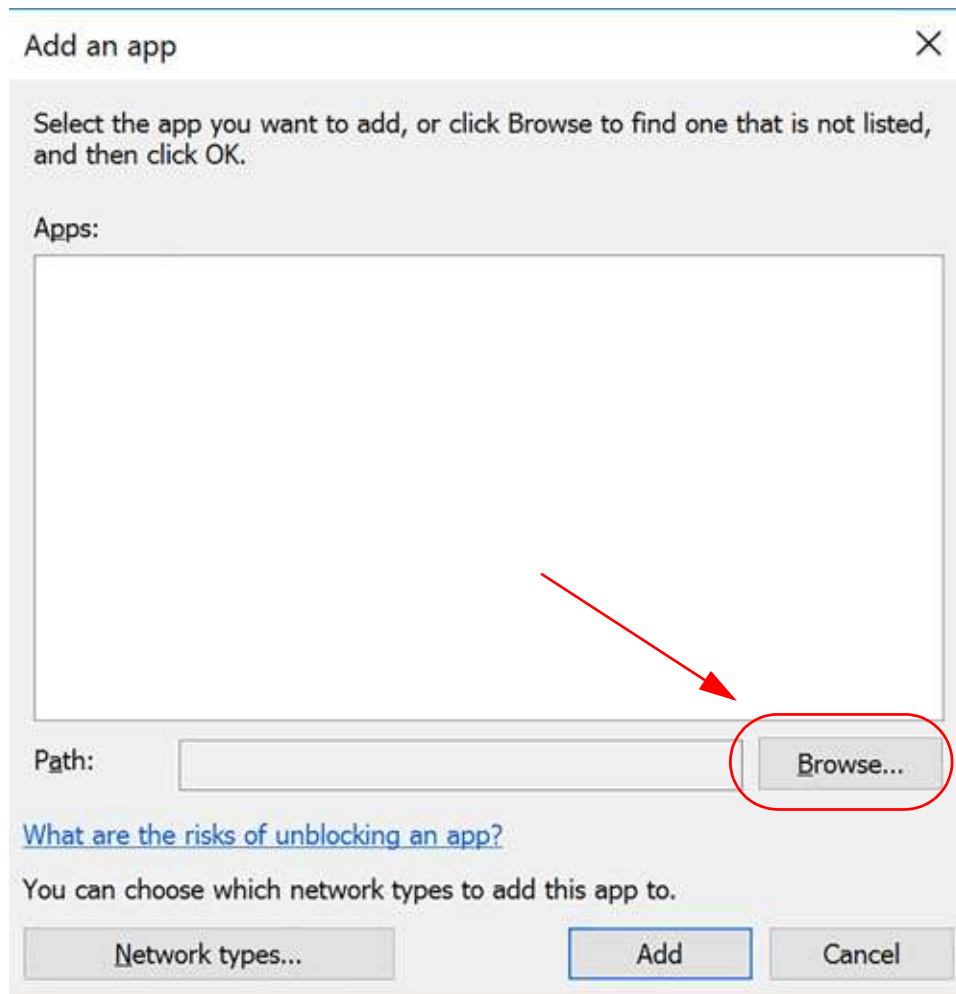


Figure 3.6: Windows Server 2016/2019: Add an App

7. In the Browse window navigate to the location of the installation directory for the USB Protocol Suite you are installing. The Teledyne LeCroy USB Protocol Suite is typically installed on your machine in the C:\Program Files\LeCroy\USB Protocol Suite directory. See [Figure 3.7](#).

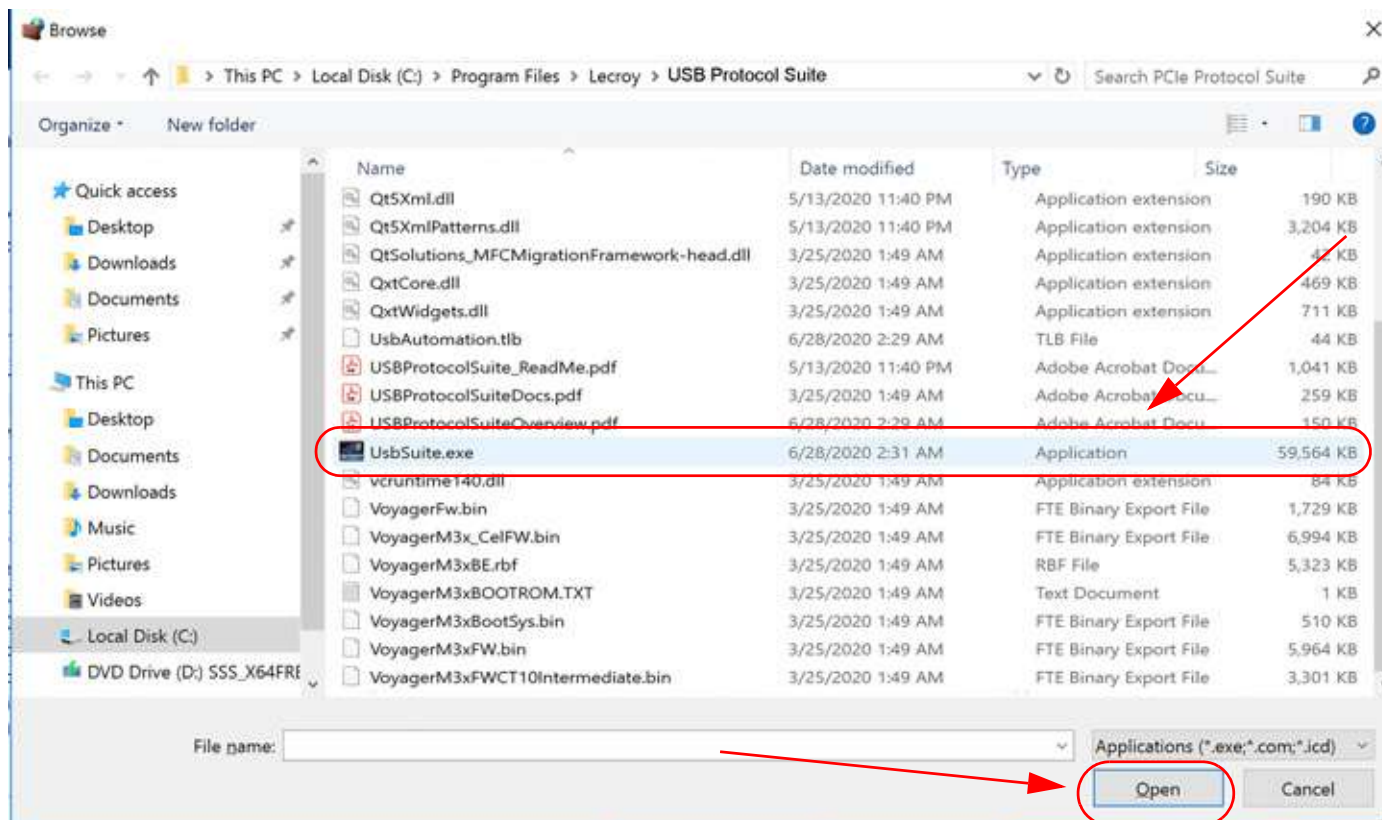


Figure 3.7: Windows Server 2016/2019: Browse to Find Application -> USB Protocol Suite Application

8. Select the USB Protocol Suite executable file (with the .exe extension) and click on "Open".

9. If necessary, select the Teledyne LeCroy USB Protocol Suite you want to add. Then click on “ADD”, this will add the Teledyne LeCroy USB Protocol Suite software to the Apps allowed through the Firewall. See [Figure 3.8](#).

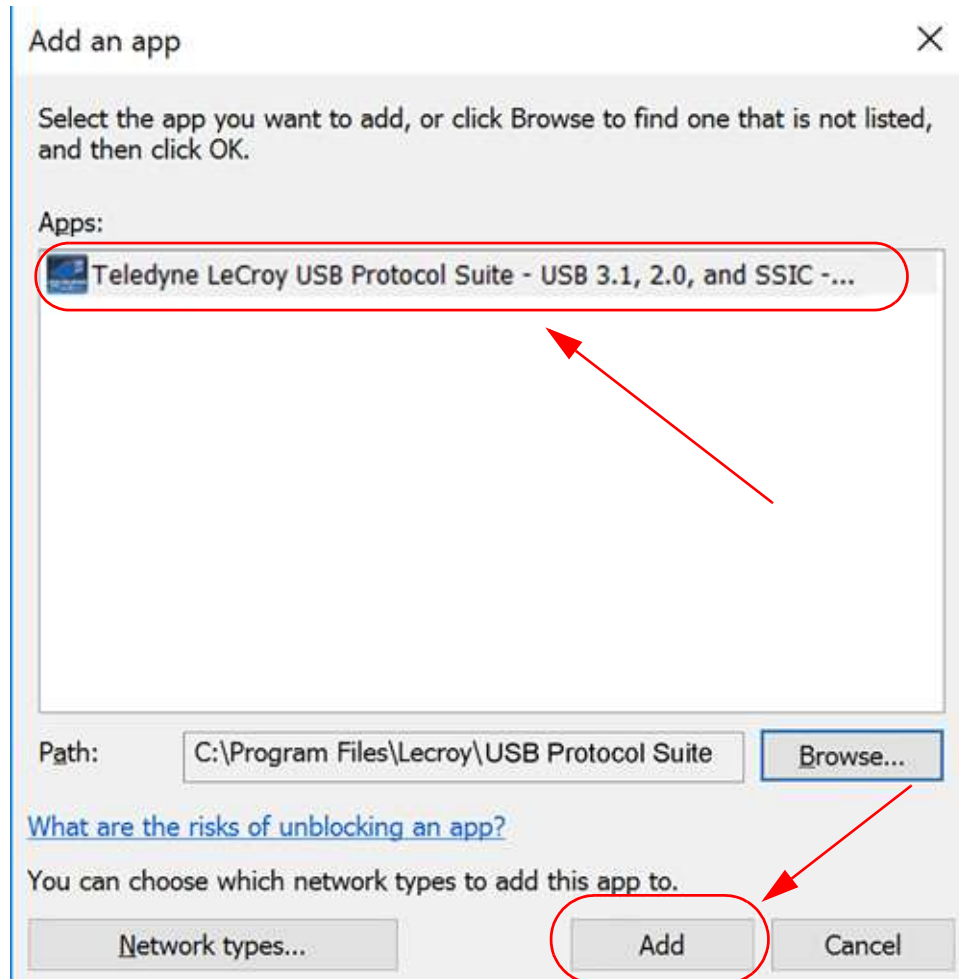


Figure 3.8: Windows Server 2016/2019: Add an Application to the Firewall Exceptions

10. After the Application has been added, you can see it in the “Allow apps to communicate through Windows Firewall” screen. See [Figure 3.9](#).

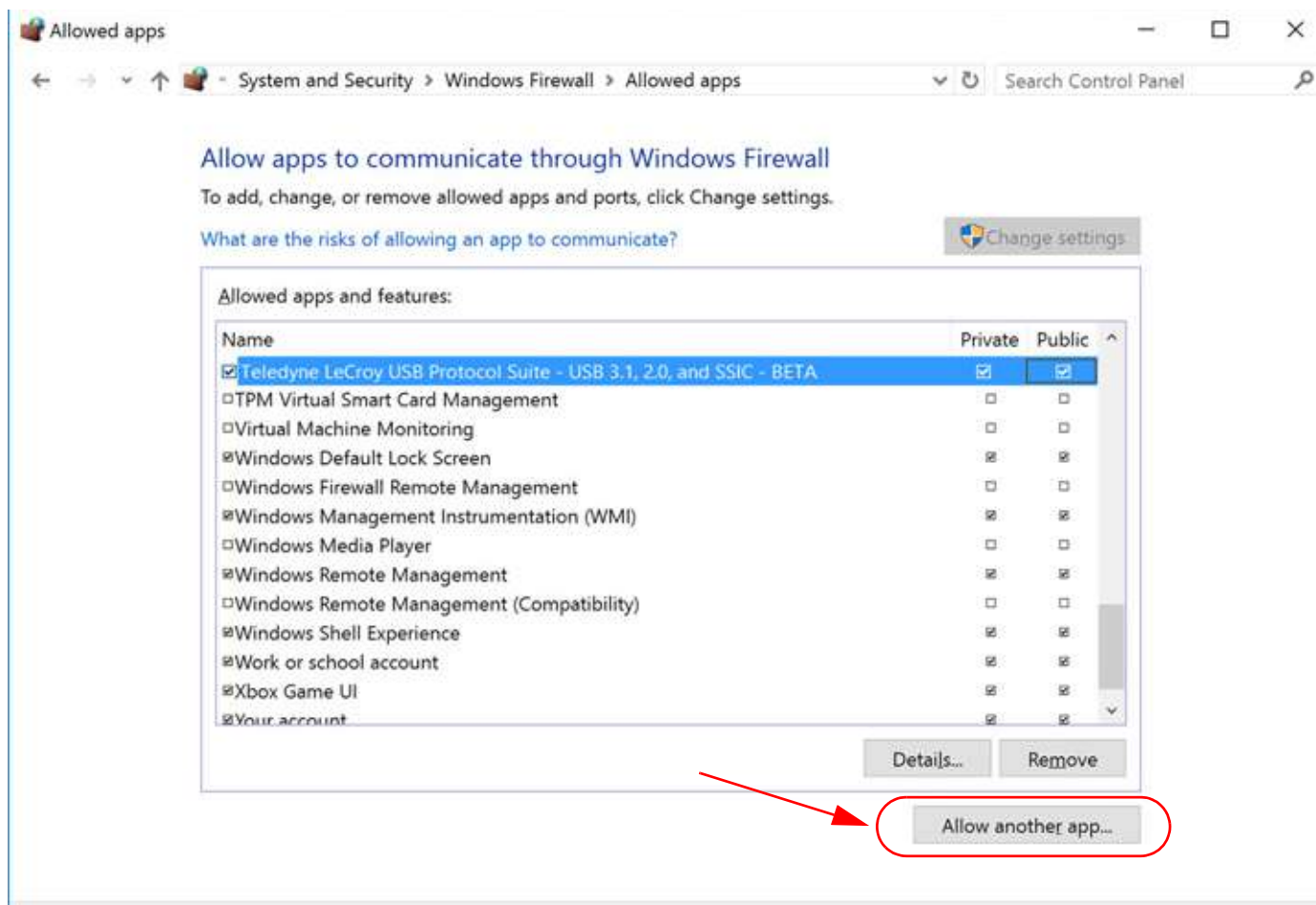


Figure 3.9: Windows Server 2016/2019: Add Teledyne LeCroy USB Protocol Suite to Allowed Applications

Click “OK” and you’re done with updating the Firewall.

3.1.3 Allow USB Protocol Suite Through Local Firewall

To add the USB Protocol Suite Software application to the firewall exceptions perform the following steps for a Windows 10 installation.

1. Open the Control Panel. See [Figure 3.10](#).

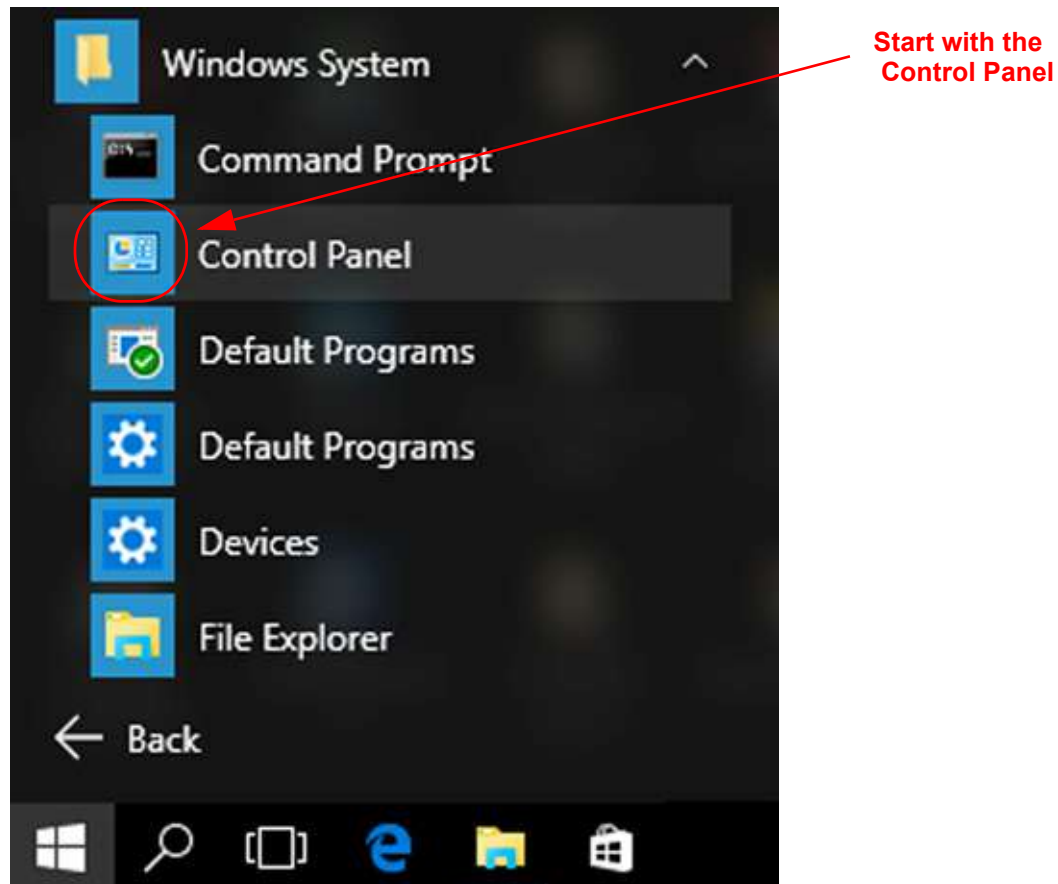


Figure 3.10: Windows 10: Start Menu -> Control Panel

2. From the Control Panel, select the “Systems and Security” screen. See [Figure 3.11](#).

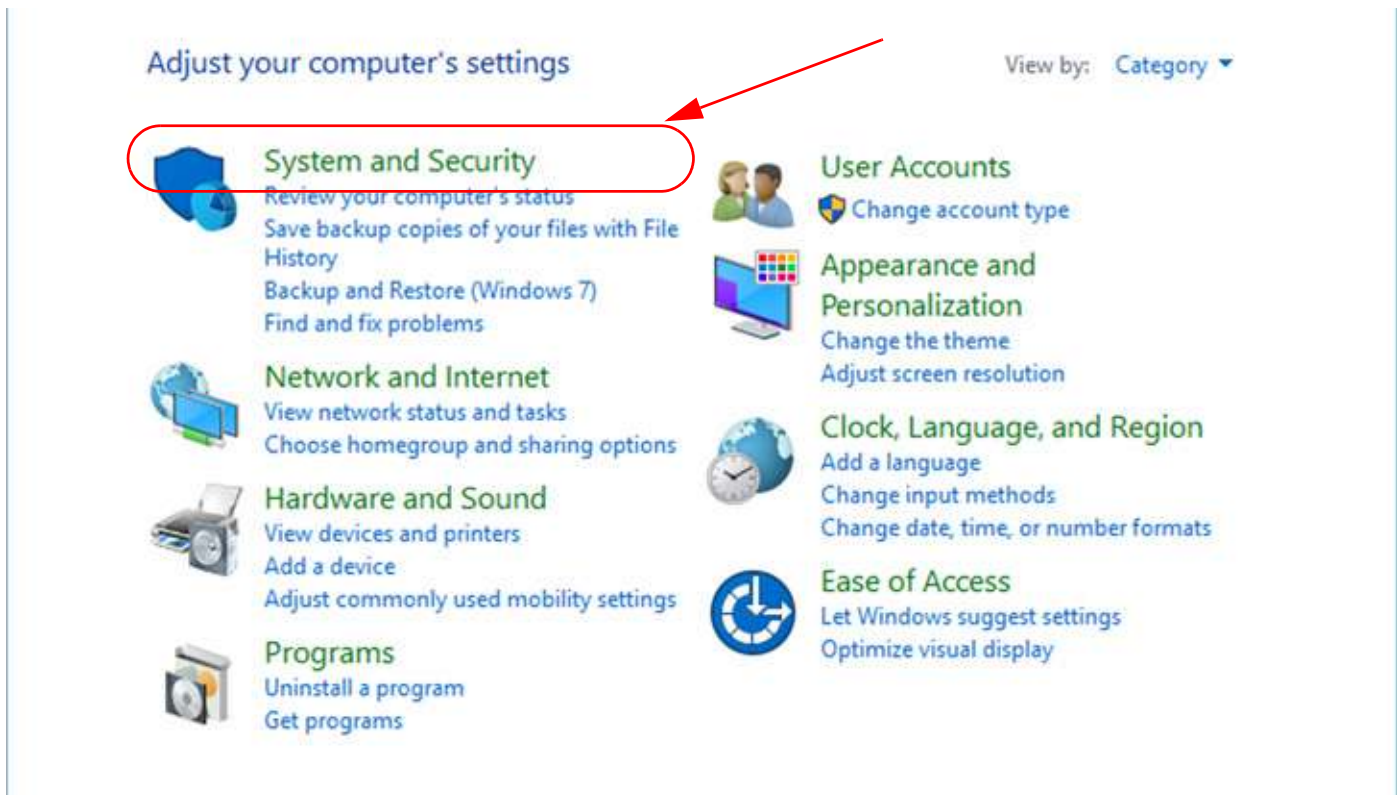


Figure 3.11: Windows 10: Control Panel -> System and Security Screen

3. From the Control Panel -> System and Security Screen, select "Allow an App through Windows Firewall". See [Figure 3.12](#).

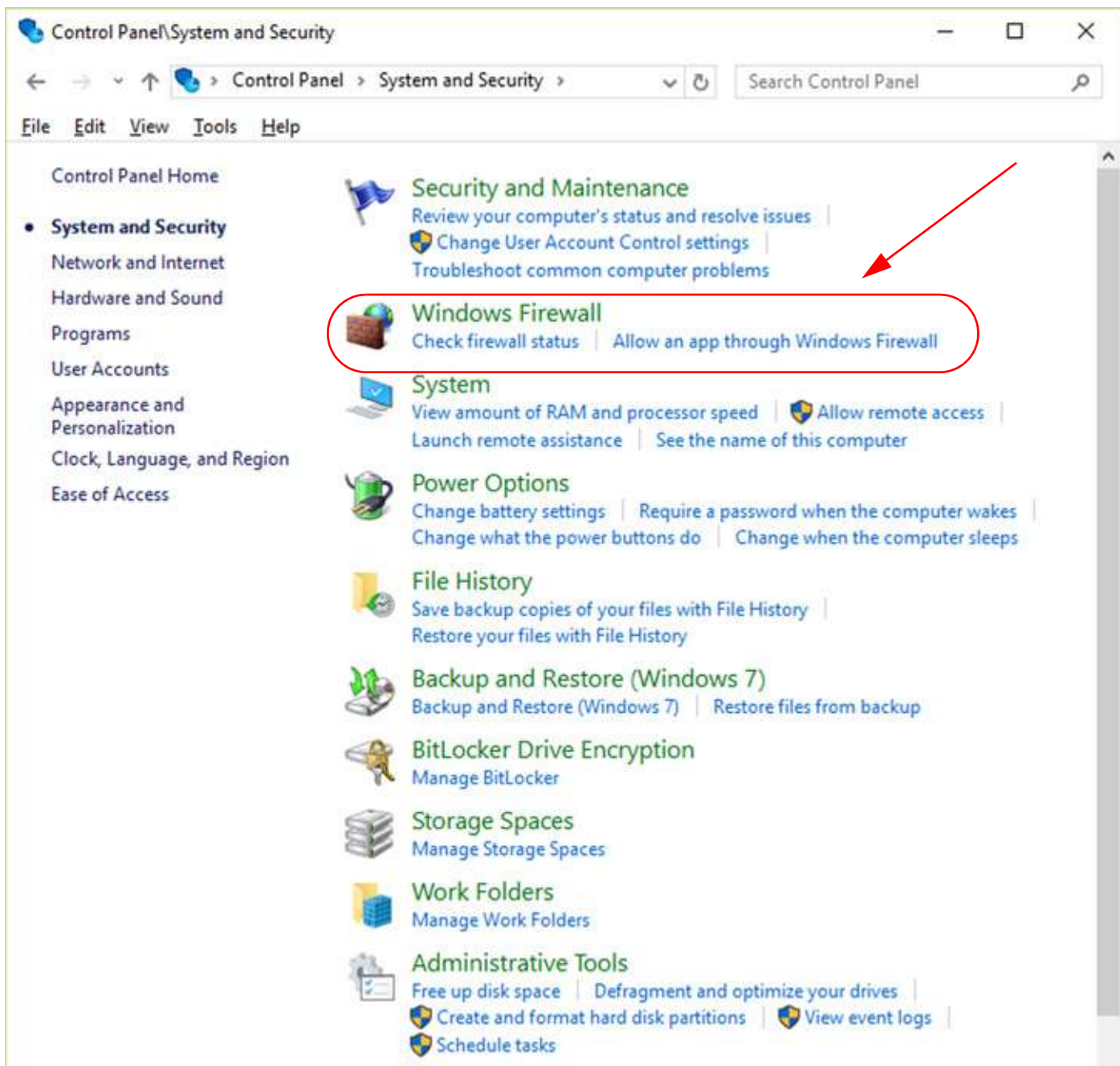


Figure 3.12: Windows 10: Allow an App Through Windows Firewall

4. From the Windows Firewall screen -> Allow apps to communicate through Windows Firewall, select “Change settings”, then select “Allow another program”. See Figure 3.13 and Figure 3.14 on page 117.

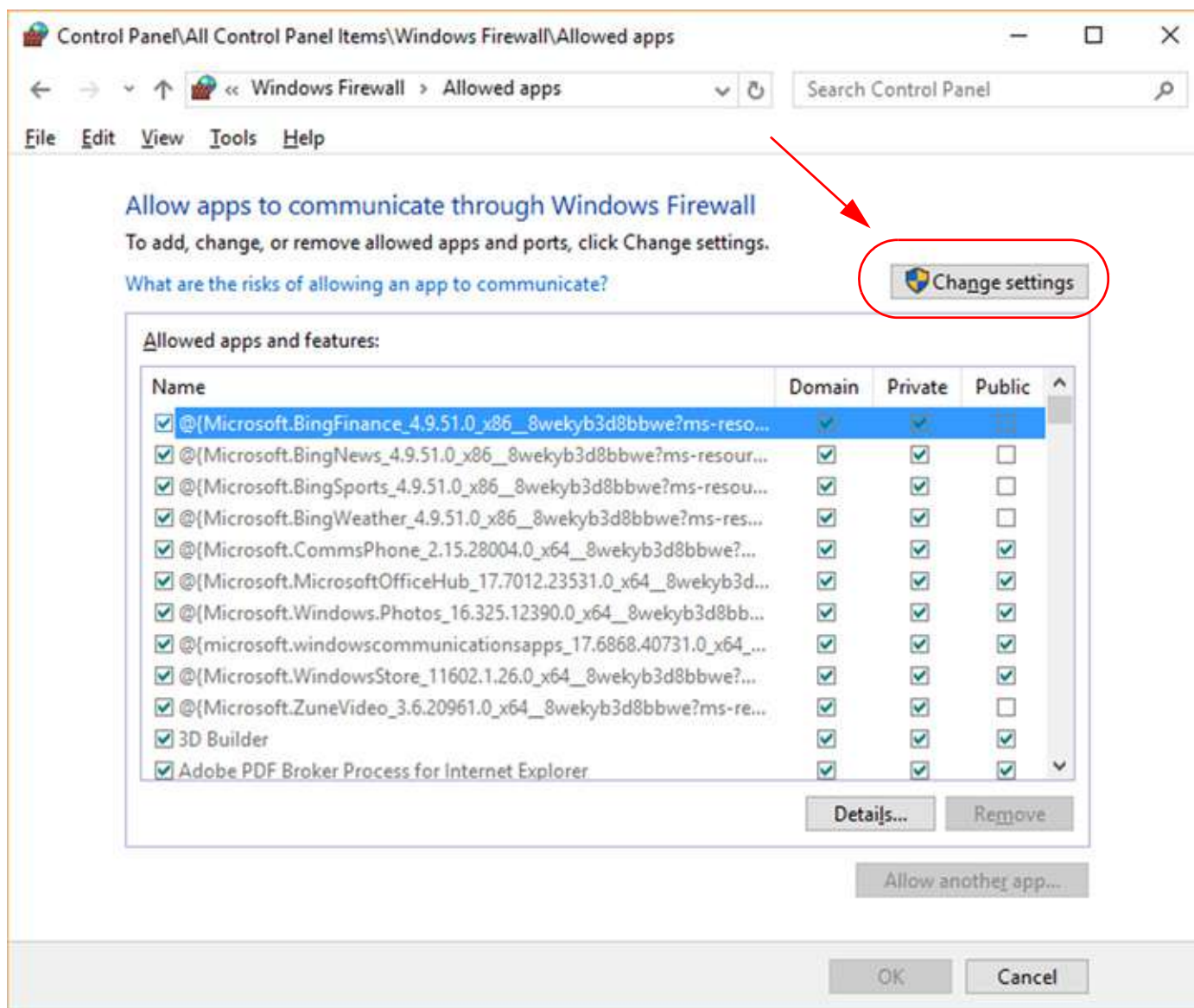


Figure 3.13: Windows 10: Change Settings -> Change settings

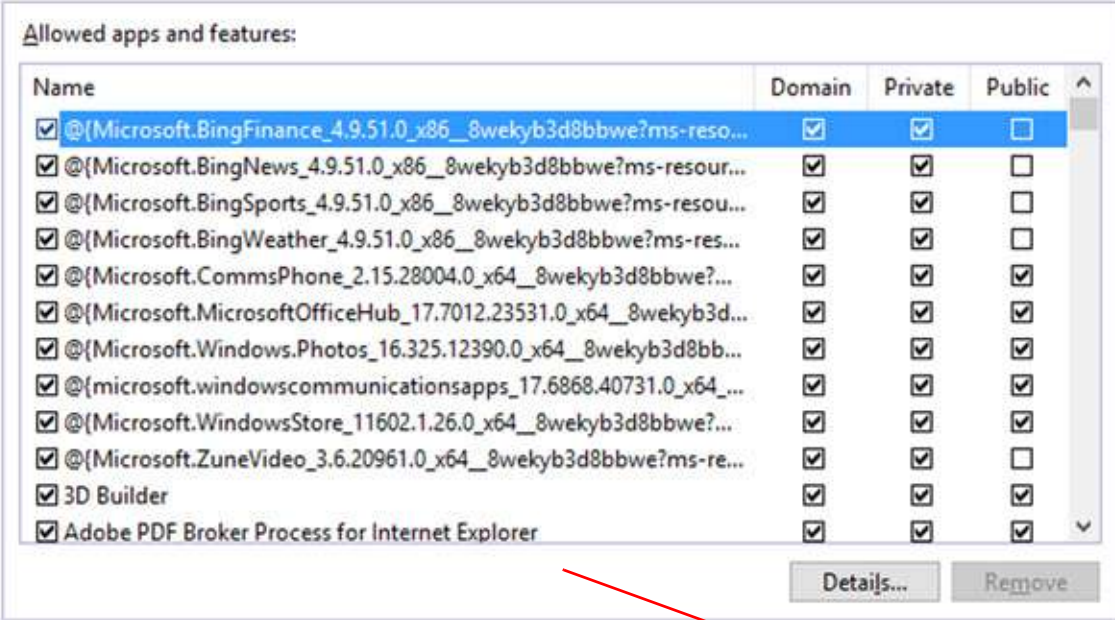


Figure 3.14: Windows 10: Change Settings -> Allowed Another app

5. From the User Account Control screen, select “Yes”. [Figure 3.15](#).

Note: This screen may be optional if you have already allowed Microsoft Windows to make changes to your computer.

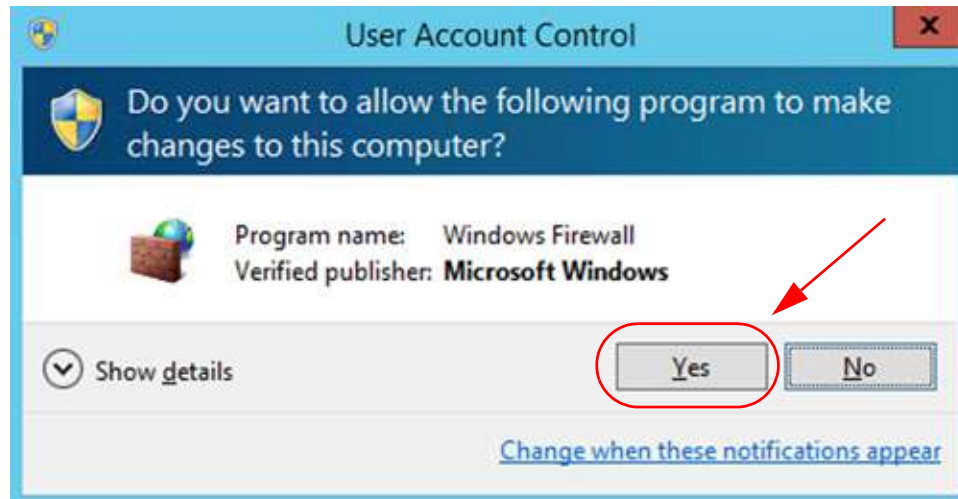


Figure 3.15: Windows 10: User Account Control

6. From the “Add an app” screen, select the Browse button. See [Figure 3.16](#).

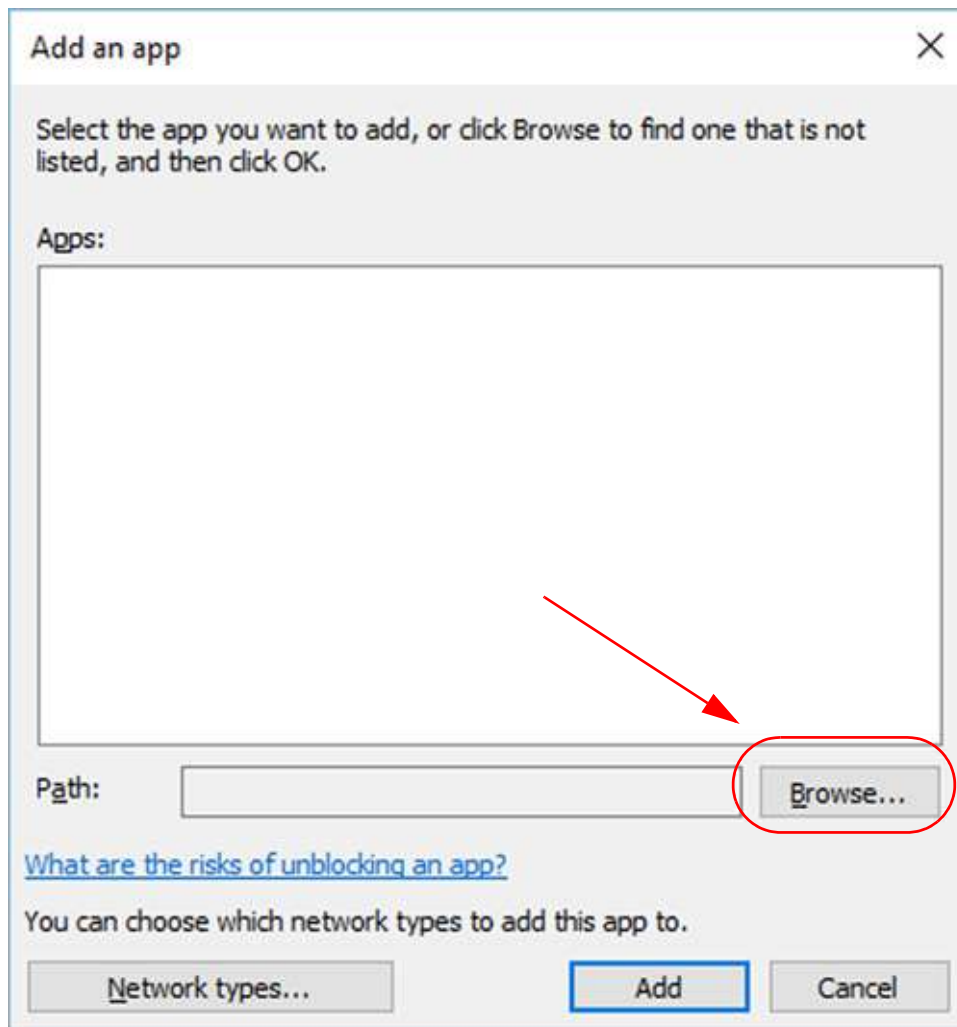


Figure 3.16: Windows 10: Add an App -> Browse

7. In the Browse window navigate to the location of the installation directory for the USB Protocol Suite you are installing. The Teledyne LeCroy USB Protocol Suite is typically installed on your machine in the C:\Program Files (x86)\LeCroy\USB Protocol Suite directory. See [Figure 3.17](#).

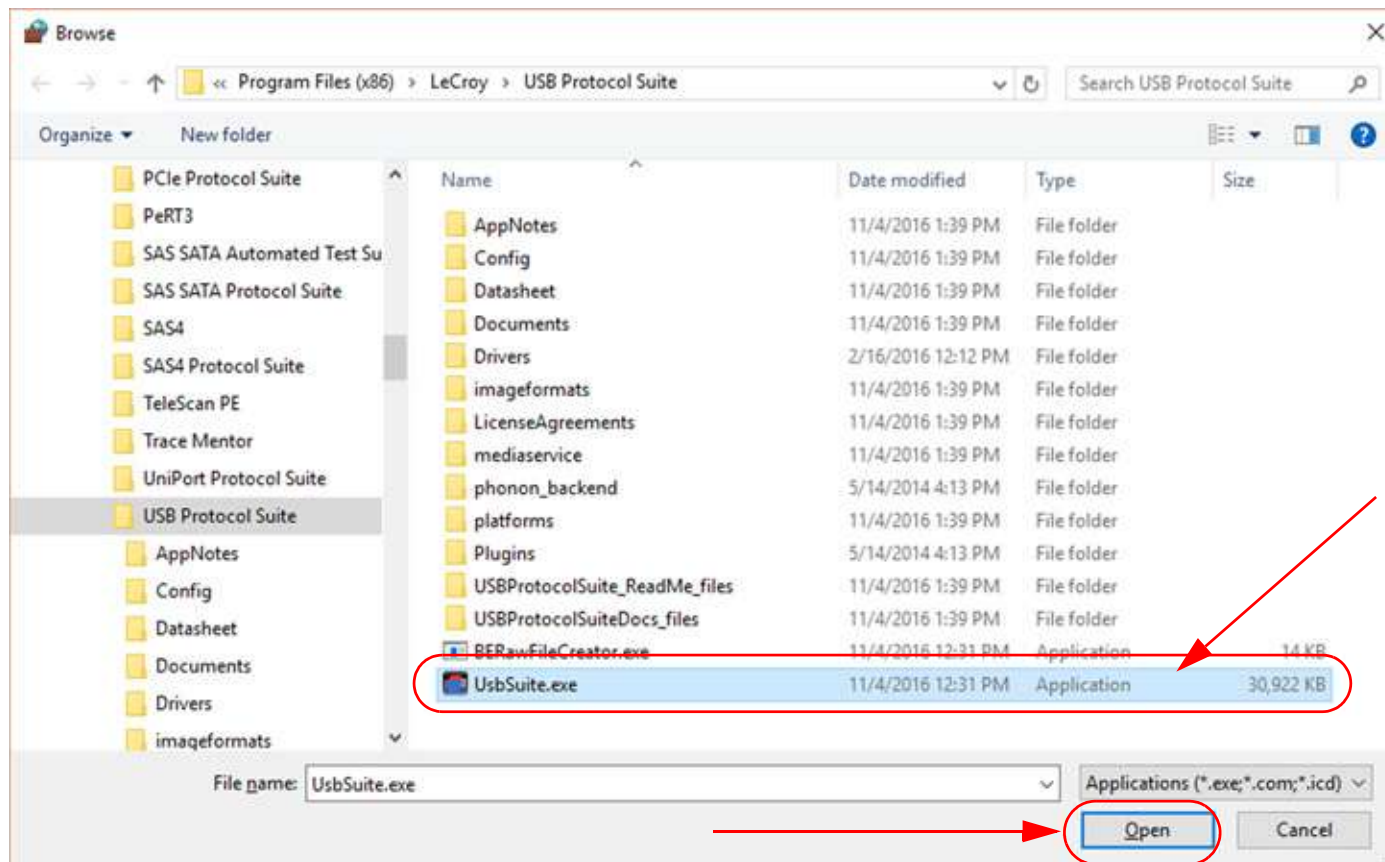


Figure 3.17: Windows 10: Browse to Find Application -> USB Protocol Suite Application

8. Select the USB Protocol Suite executable file (with the .exe extension) and click on "Open".

9. If necessary, select the Teledyne LeCroy USB Protocol Suite you want to add. Then click on “ADD”, this will add the Teledyne LeCroy USB Protocol Suite software to the Apps allowed through the Firewall. See [Figure 3.17](#).

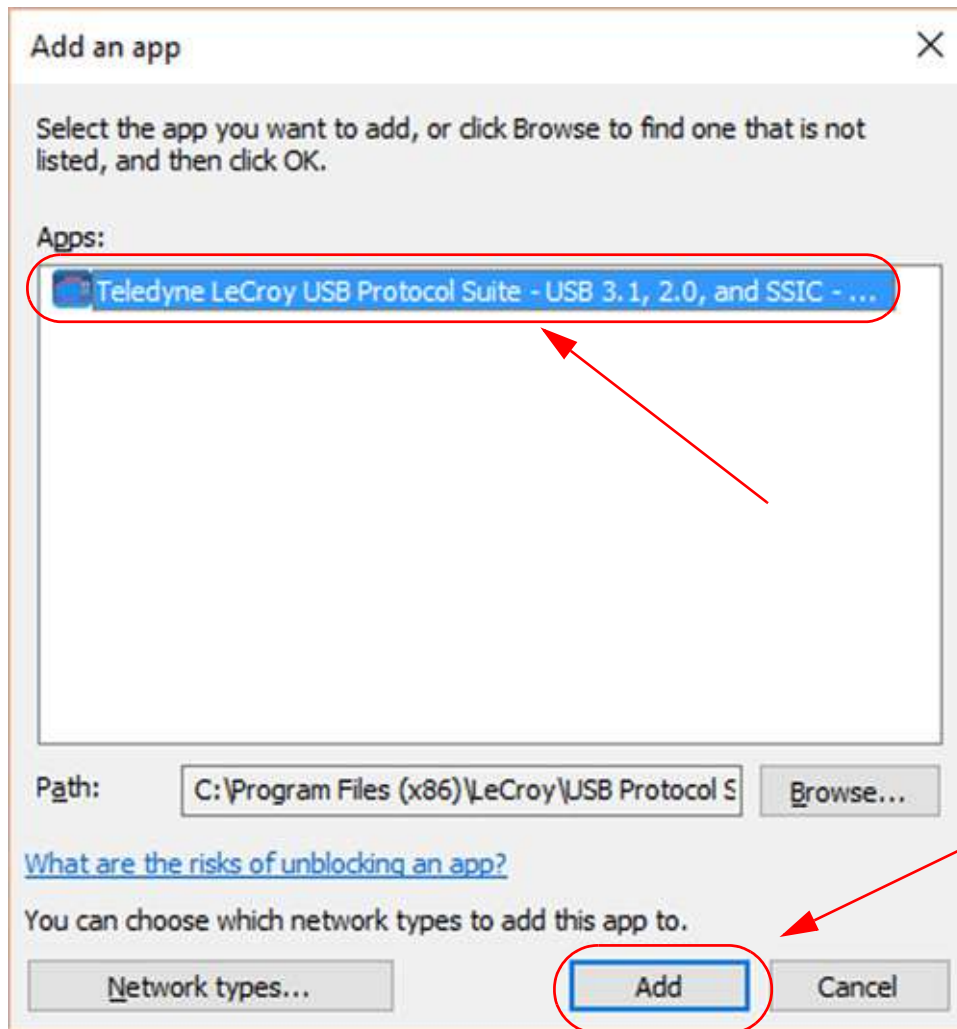


Figure 3.18: Windows 10: Add an Application to the Firewall Exceptions

10. After the Application has been added, you can see it in the “Allow apps to communicate through Windows Firewall” screen. See [Figure 3.18](#).

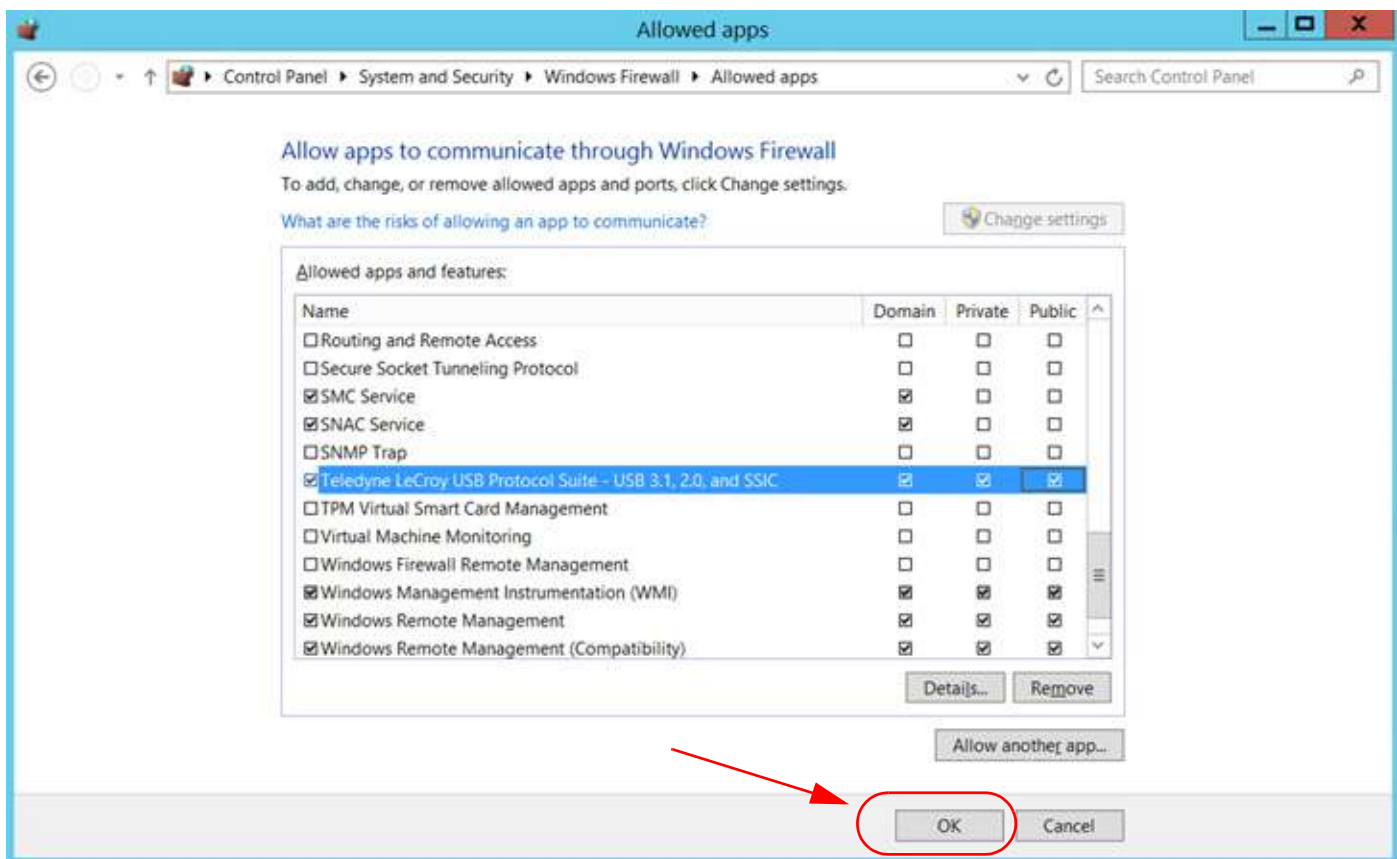


Figure 3.19: Windows 10: Add Teledyne LeCroy USB Protocol Suite to Allowed Applications
Click “OK” and you’re done with updating the Firewall.

3.1.4 Launching the USB Protocol Suite

To start the application, launch the program from the Start menu:

Start > Programs > LeCroy > USB Protocol Suite > USB 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, 300-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 3.2 cable.
3. Download the most current software for your analyzer from <https://teledynelecroy.com/sw/usb/>
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 up to 4 minutes. 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 with the Installation software).
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 138](#)).

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 M3i and to a 100-volt to 240-volt, 50-Hz to 60-Hz, 300-W power outlet or attach the appropriate DC adapter for your analyzer.

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. Download the most current software from:
<https://teledynelecroy.com/sw/usb/>
3. At this point you can connect from your host machine to the analyzer using either a Static IP Address (using a Static IP Address is helpful if you are planning to attach the analyzer to your local PC and want to use the ethernet connection) or a Dynamic IP address if you are on a network. The steps for each method are described below.

3.3.1 Using a Static IP Address

In some cases, you might find it desirable to use a direct Ethernet connection from you Analyzer PC to the USB Analyzer. One reason might be that you want them separated by more than 1 meter, which is the typical USB cable length. Or you might not have a USB 3.2 (5Gbps) port on your Host PC, so Ethernet would be faster than USB 2.0 transfers.

To make this connection, it is required that you set the Static IP Address on you PC, then use a USB cable (temporarily) to set a Static IP address on your USB Analyzer. After this is done, you can do a direct Ethernet connection from your PC to the Analyzer.

Setting a Static IP Address on your PC

1. To use a Static IP address, first set up your computer's IP address to a Static IP Address. Start by opening your Control Panel (Start -> Windows System -> Control Panel) and selecting the Network and Sharing Center icon. (See [Figure 3.20 on page 125](#)).

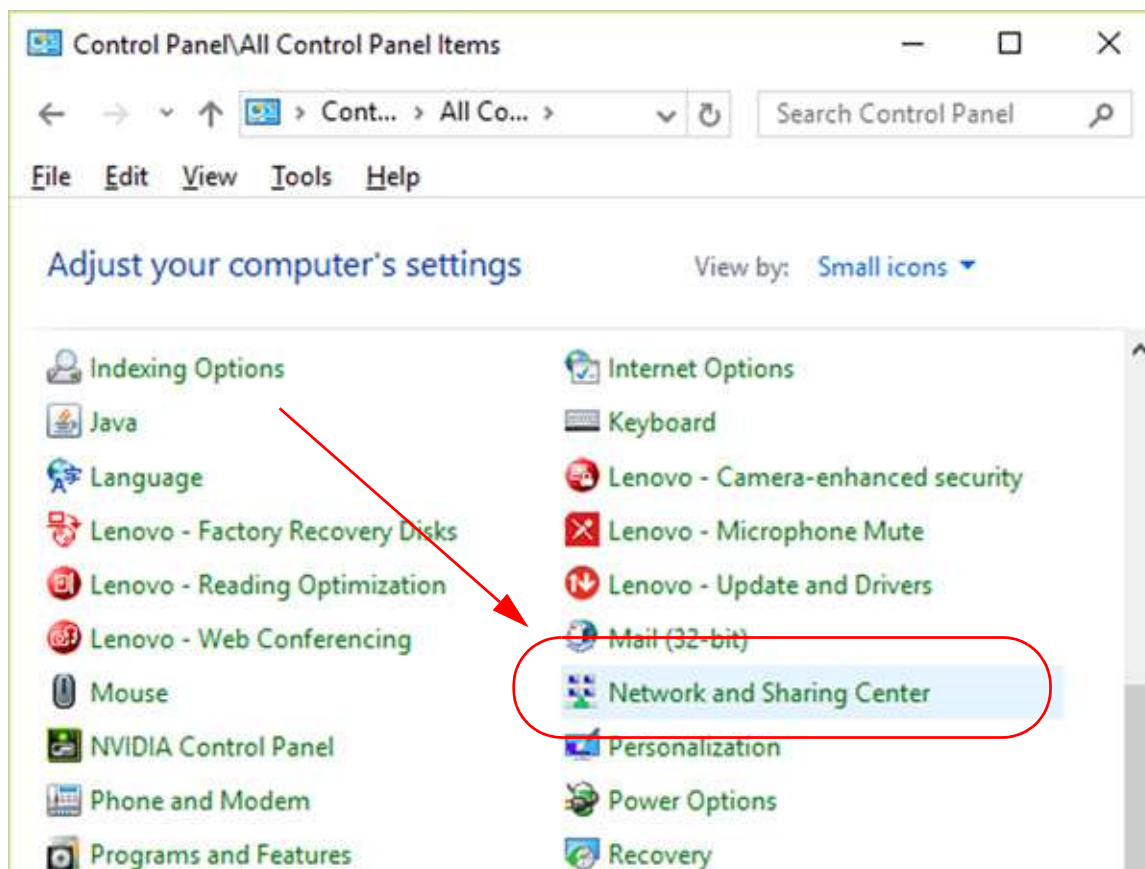


Figure 3.20: Control Panel: All Items -> Network and Sharing Center

2. This will bring up the Network and Sharing Center Menu. See [Figure 3.21](#)

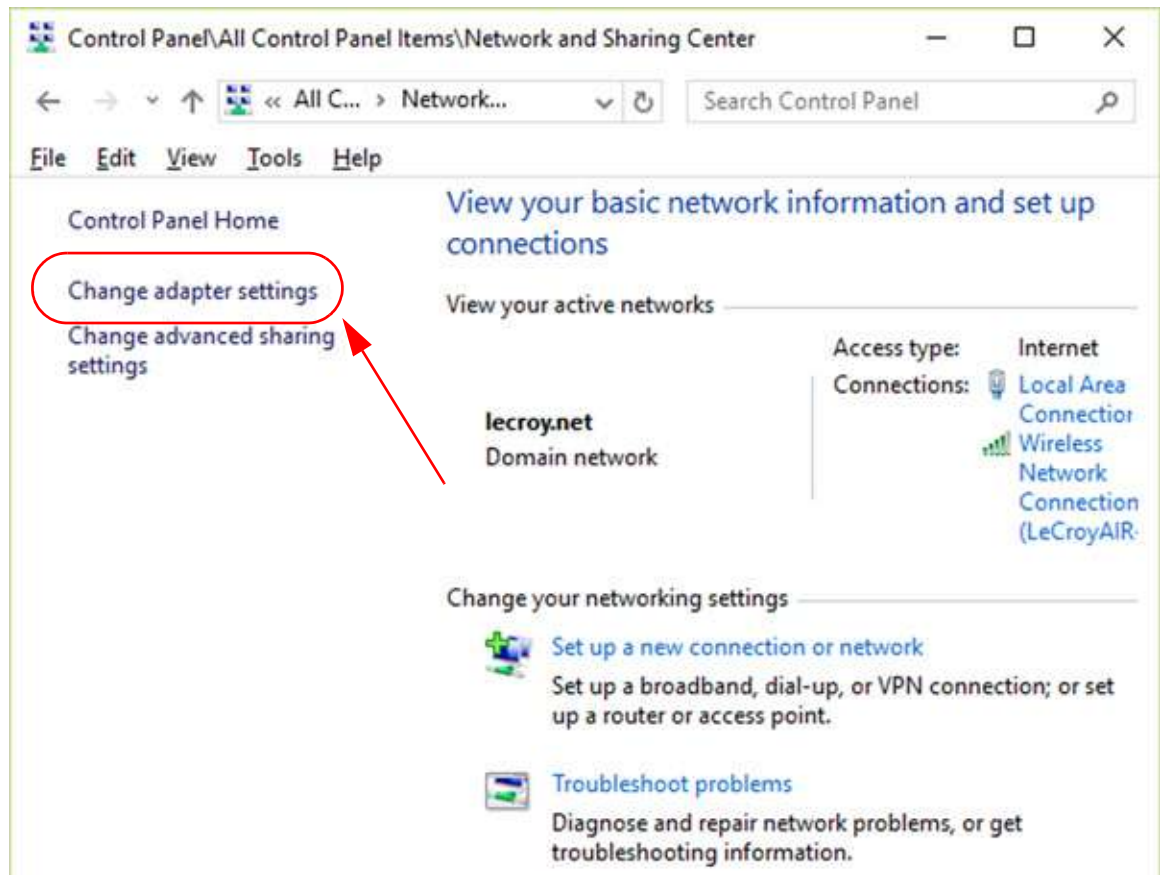


Figure 3.21: Control Panel: Change Adapter Settings

3. Click on “Change Adapter Settings” and the Local Area Connection icon will pop up. See [Figure 3.22](#).

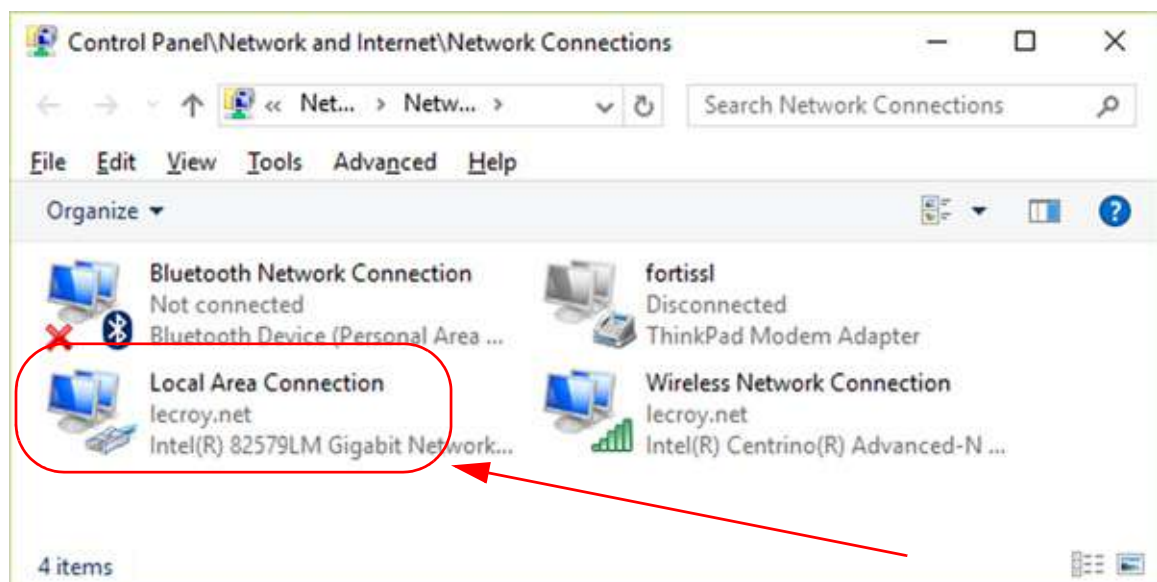


Figure 3.22: Local Area Connection Icon

- Now click on the Local Area Connection icon to set up IPv4 Properties (see [Figure 3.23](#)).

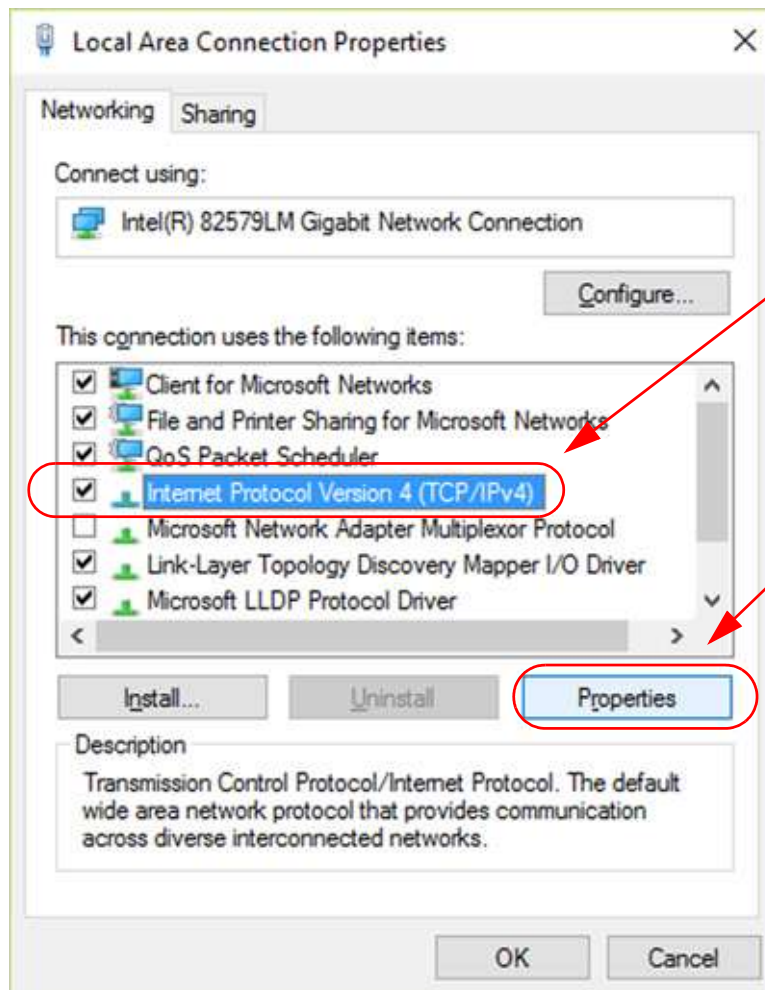


Figure 3.23: IPv4: Properties

- Click on “Properties” and this will bring up a dialog box to enter your local Static IP Settings. See [Figure 3.24 on page 128](#).

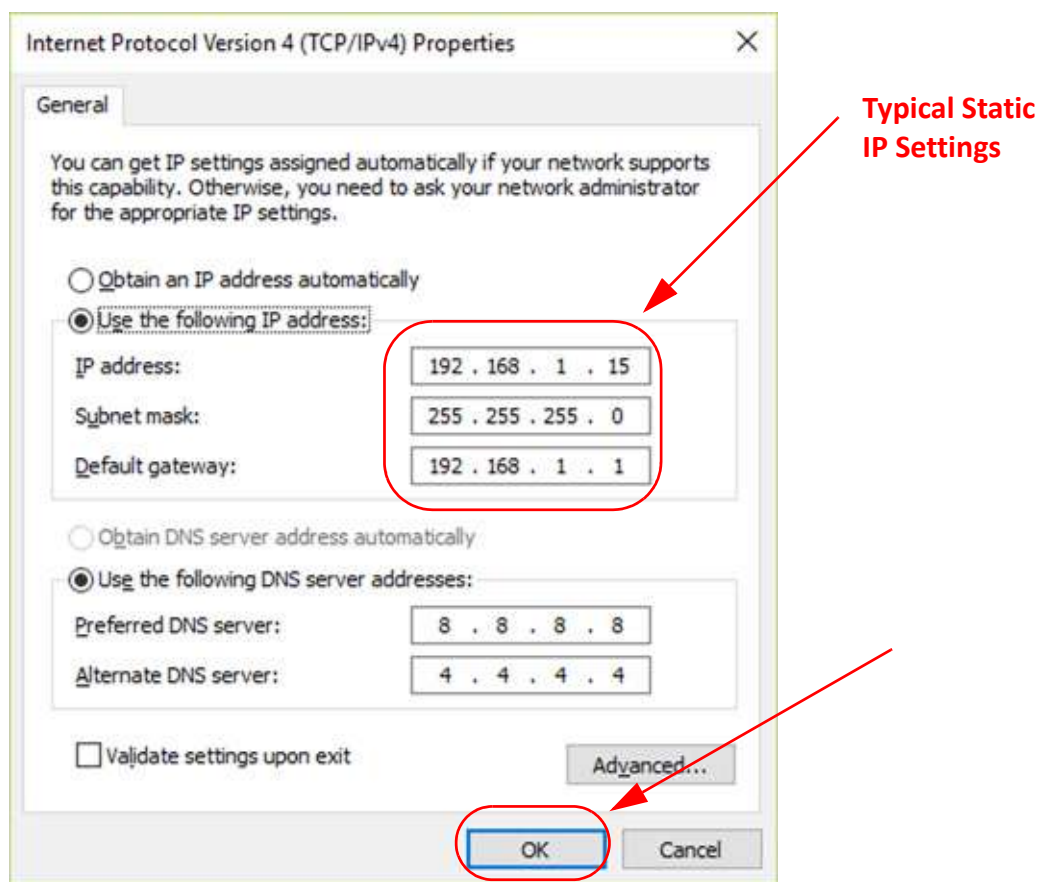
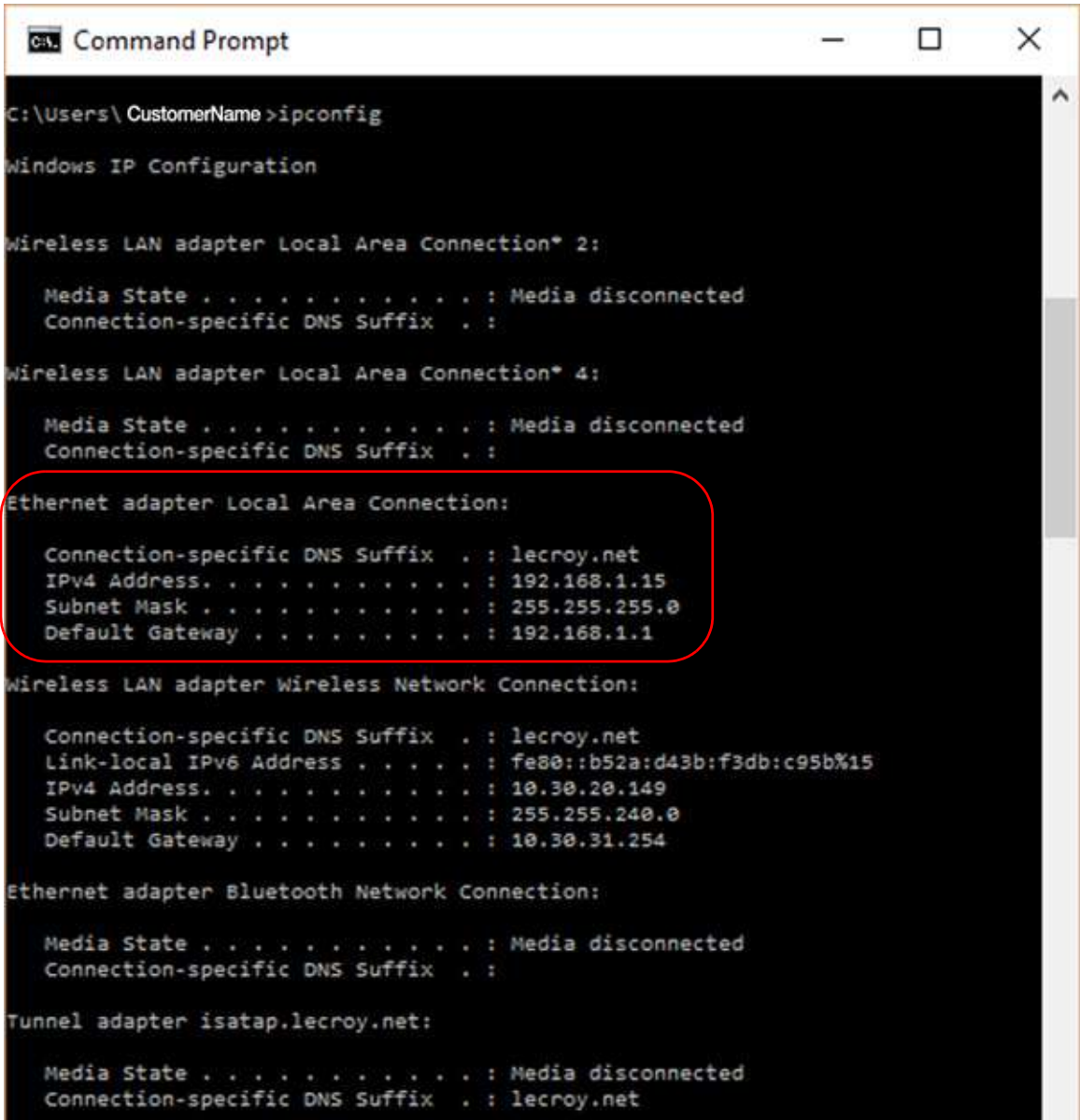


Figure 3.24: Setting Static IP Address

6. After setting the IP Address, Subnet mask and Default gateway, click on “OK” and these settings will be used by your host computer.
7. To verify that your IP Address has been changed, open a Command Prompt window (also available from Start -> All Apps -> Windows System). See



```
C:\Users\CustomerName>ipconfig

Windows IP Configuration

Wireless LAN adapter Local Area Connection* 2:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Wireless LAN adapter Local Area Connection* 4:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  . : lecroy.net
    IPv4 Address. . . . . : 192.168.1.15
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.1.1

Wireless LAN adapter Wireless Network Connection:

    Connection-specific DNS Suffix  . : lecroy.net
    Link-local IPv6 Address . . . . . : fe80::b52a:d43b:f3db:c95b%15
    IPv4 Address. . . . . : 10.30.20.149
    Subnet Mask . . . . . : 255.255.240.0
    Default Gateway . . . . . : 10.30.31.254

Ethernet adapter Bluetooth Network Connection:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Tunnel adapter isatap.lecroy.net:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : lecroy.net
```

Figure 3.25: Command Prompt Window: ipconfig

Setting a Static IP Address on your USB Analyzer

1. Connect your PC to the Analyzer with a USB cable.
2. Now power on your analyzer (with the USB cable attached).
3. After the analyzer has initialized, Start the USB Protocol Suite software and select "Setup -> All Connected Devices". See [Figure 3.26 on page 130](#).

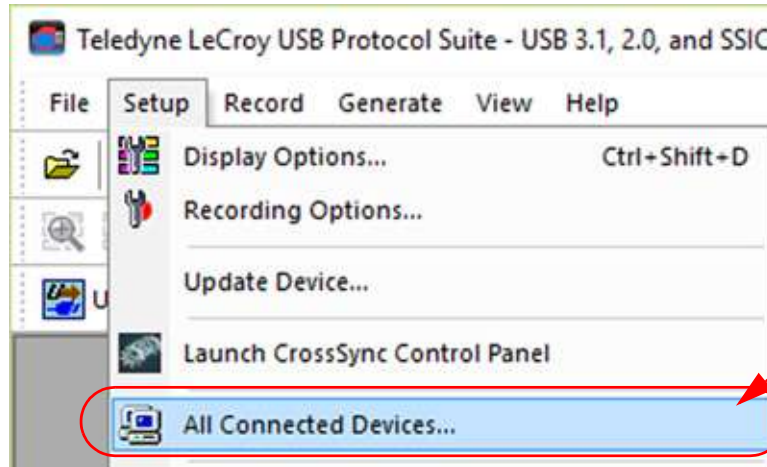


Figure 3.26: Setup: All Connected Devices

4. Select All Connected Devices and the following window pops up, showing you the connected USB analyzer. In this case we have a Voyager M310C Ready to Connect. See [Figure 3.27](#).

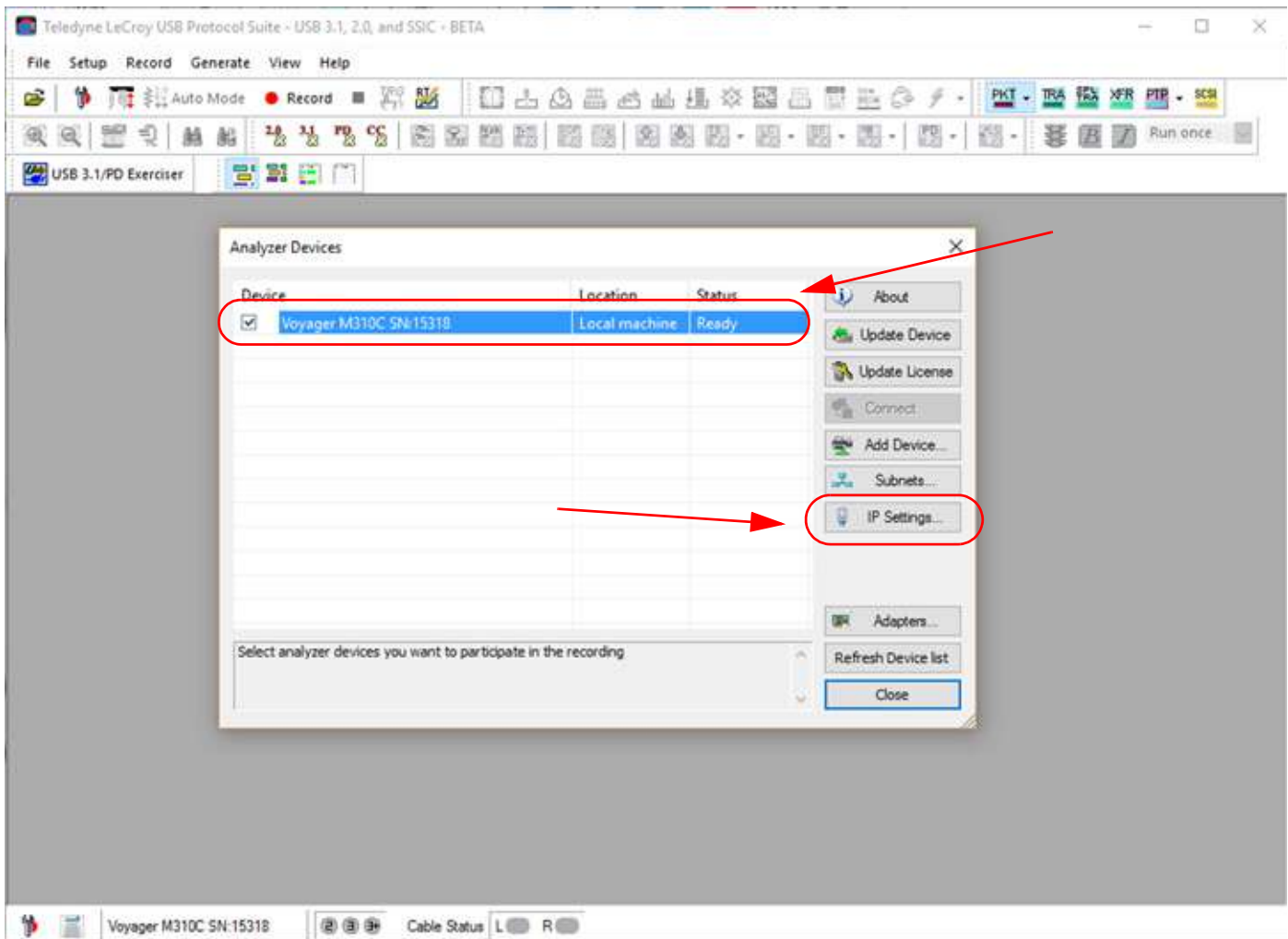


Figure 3.27: All Connected Devices: Analyzer Selected

- Now select the IP Settings tab to configure the analyzer with an appropriate IP address (see [Figure 3.28](#) below). In this case we've used the same subnet settings as our host PC but set the LSBs of the IP Address to "20" so that the analyzer won't interfere with our host PC (that has an IP address of 192.168.1.15). See [Figure 3.25 on page 129](#) for reference.

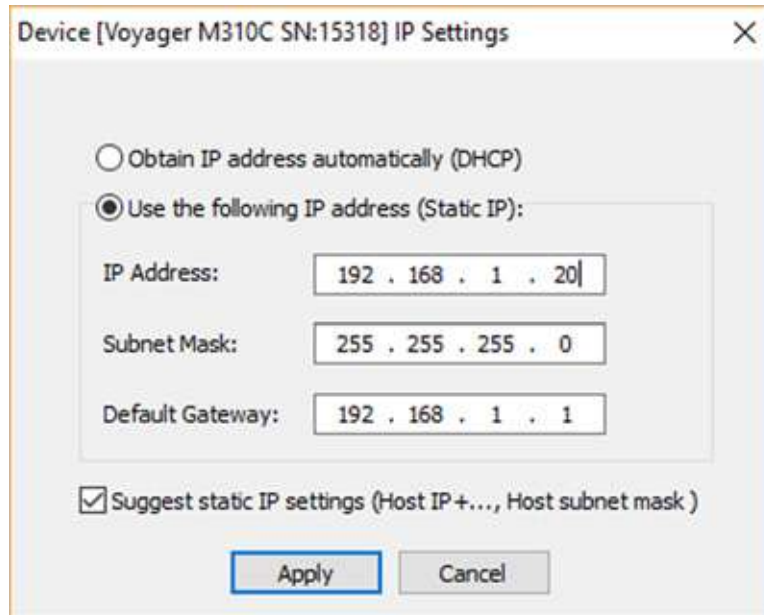


Figure 3.28: Setting Static IP Address for Analyzer

- Click Apply and a window will popup telling you that the new IP Settings have been applied. See [Figure 3.29](#).

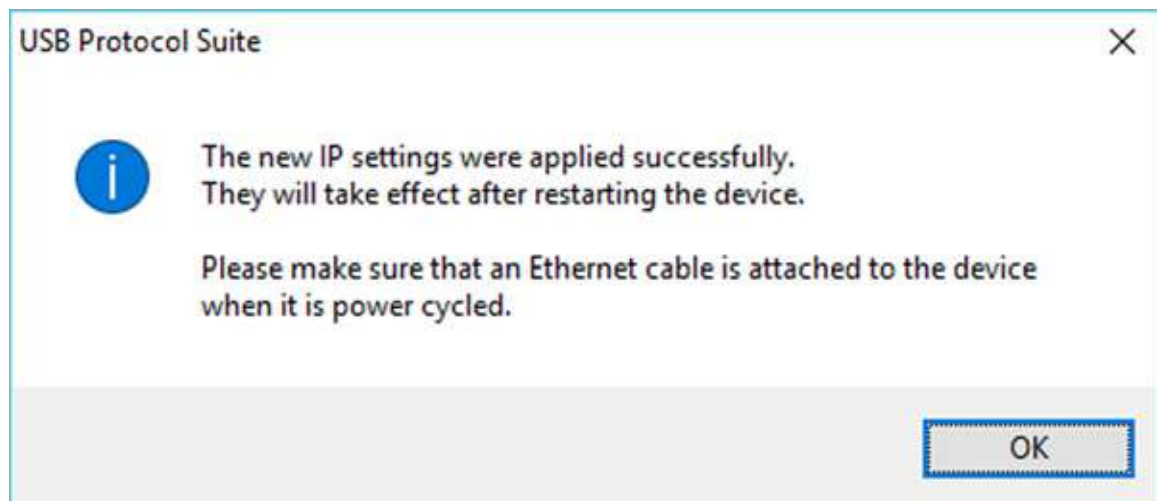


Figure 3.29: New IP Settings Have Been Applied

Ethernet Direct Connection

1. Make sure the USB cable is NOT attached the the USB Analyzer.
2. Now you can attach an ethernet cable from your host PC to the analyzer and power cycle the analyzer.
3. Wait for the analyzer to initialize (the blue LED will come on after initialization) and start up the USB Protocol Suite software.
4. Select "Setup -> All Connected Devices" and then select the analyzer you want to connect to. The Connect tab will be highlighted. See [Figure 3.30](#).

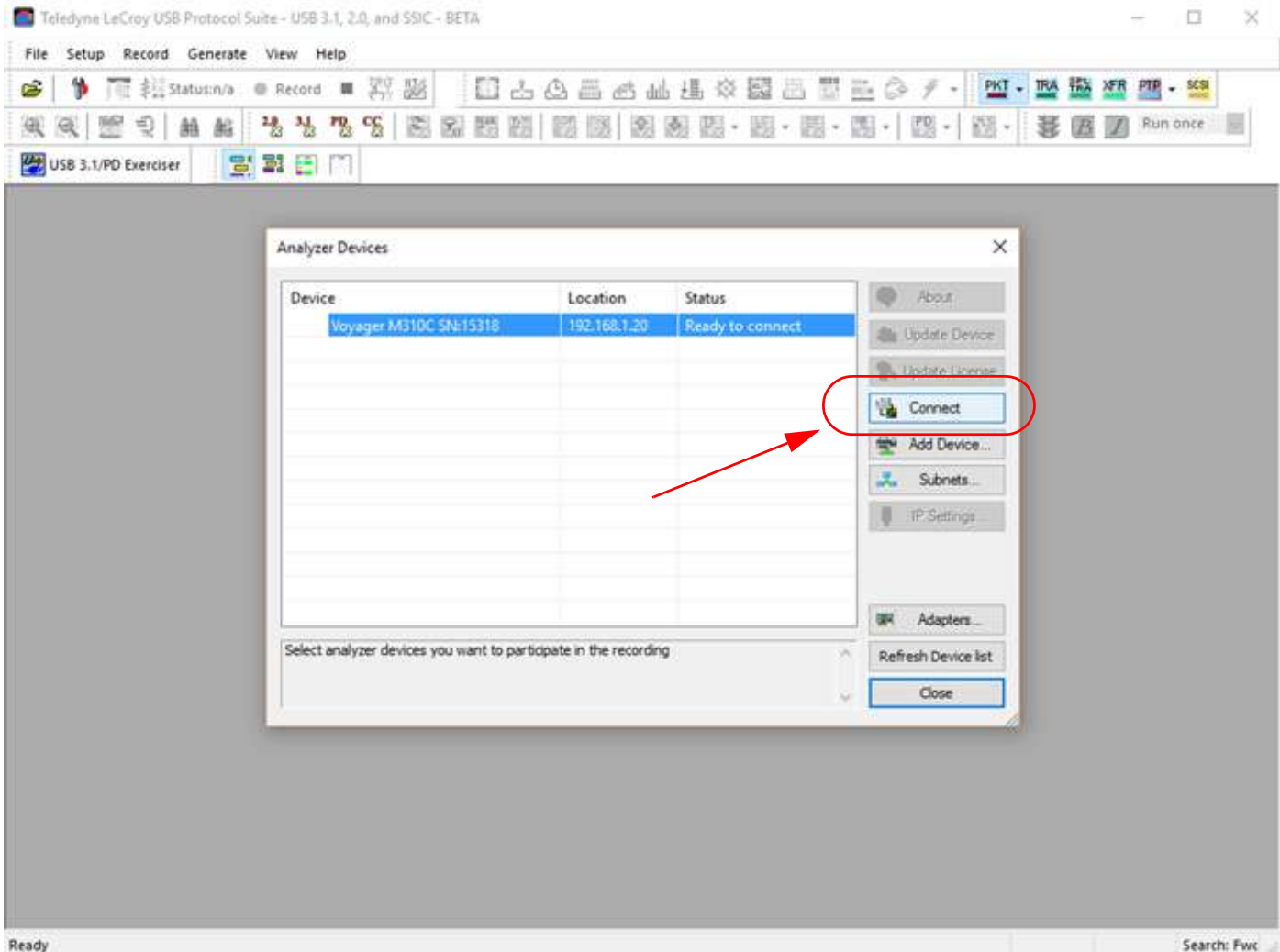


Figure 3.30: USB Analyzer with New IP Address Connected Over an Ethernet bus

5. Now the USB Analyzer Devices Dialog will show the analyzer has been connected and you can close the window and begin recording. See [Figure 3.31](#).

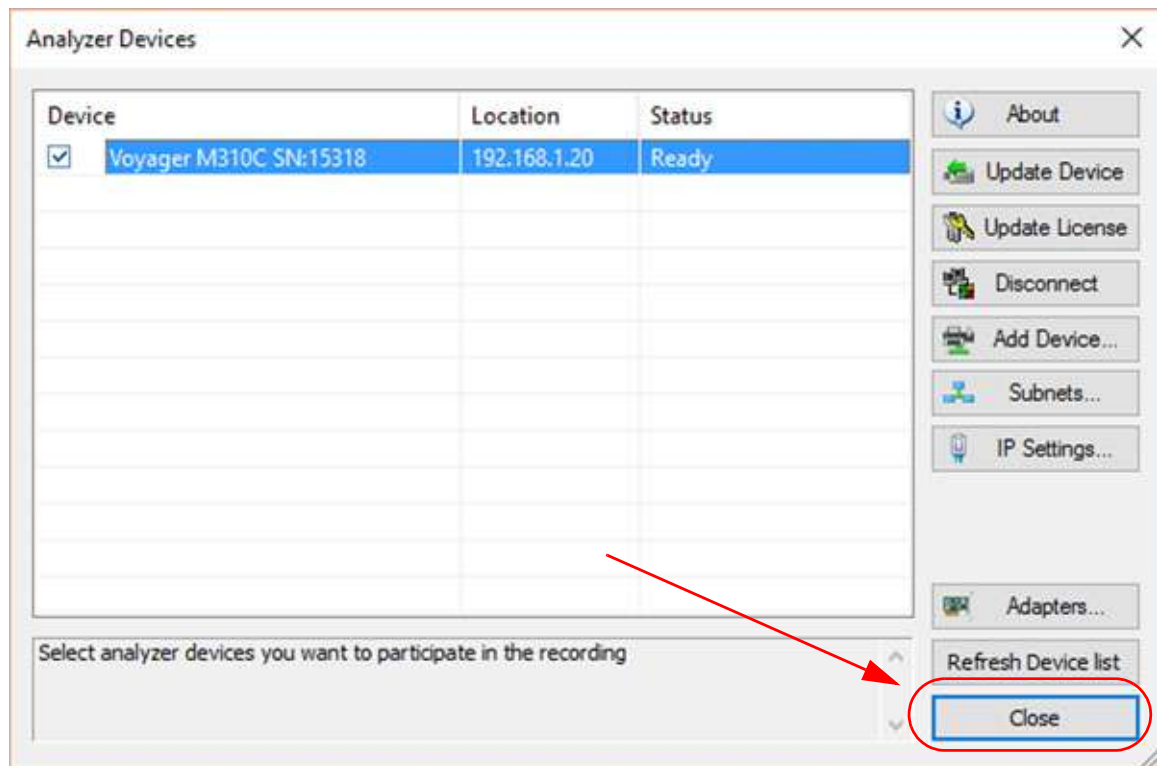


Figure 3.31: Analyzer Connected to Host PC over Ethernet Bus

3.3.2 Using a Dynamic IP Address

1. 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. See [“Allow USB Protocol Suite Through Local Firewall” on page 113](#).

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 141](#).

2. 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.

3. Complete Analyzer setup in the “Application Startup” section (See [“Application Startup” on page 138](#)).

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.

3.3.3 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, M310P, M4x, 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 140](#)).

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 **3.2 Auto-Detect/Termination** mode. Manual control does not work.

3.4.1 Capturing USB 2.0 traffic with CATC Sync or Cross Sync

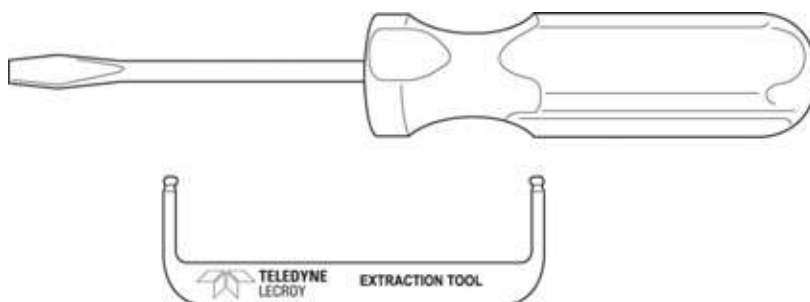
When using Cross Sync or CATC Sync and capturing USB 2.0 traffic, attach the USB 2.0 capturing analyzer device at the OUT connector at the beginning of the CATC SYNC chain. Otherwise, the timestamps will not be synchronized.

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 3.2 traffic on the downstream analyzer(s). In cases of CATC-Syncing with USB analyzers capturing 3.2 traffic, all boxes will have the correct synchronized timestamps.

3.4.2 Removing Expansion Cards

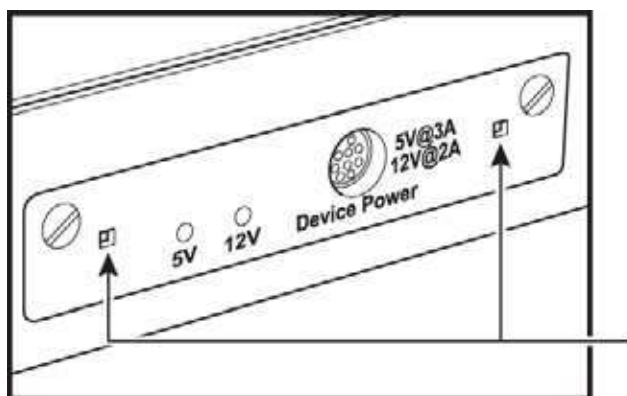
You can remove expansion cards using two tools:

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



To remove an expansion card, follow these steps:

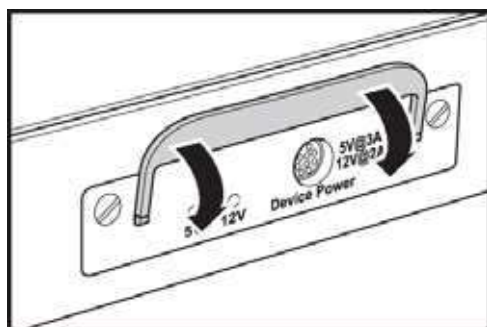
1. Unplug the system from AC power and turn the system so the expansion port is facing you. Note the two retaining screws and the holes for the extraction tool that are located on the panel of the expansion card.



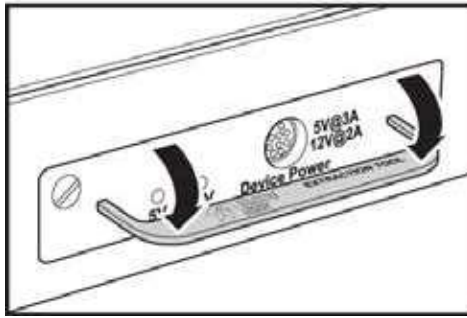
Note: The example shows a different expansion card, but the removal method is the same.

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

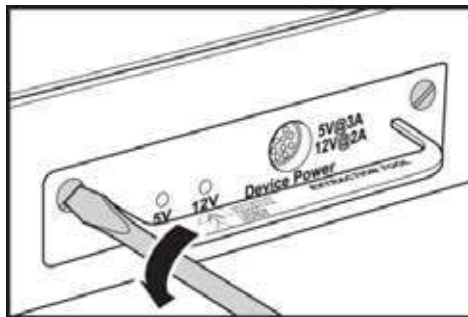
Note: If the prongs do not slip easily into the holes, use a small nail file or similar device to remove paint from the prongs.



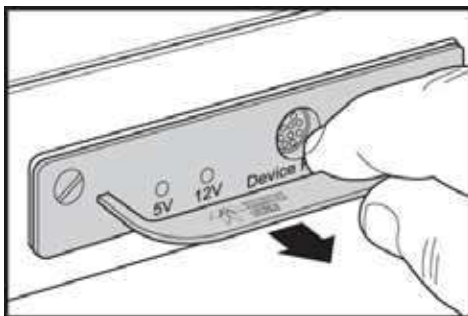
3. Rotate the extraction tool to a horizontal position to lock the prongs into place and make a handle.



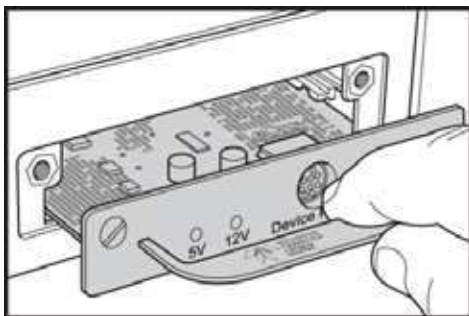
4. Using the screwdriver, loosen both retaining screws by rotating counter-clockwise approximately two full turns, until feeling slight resistance.
Do not force the retaining screws after two turns.



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 3.32 on page 138](#)).

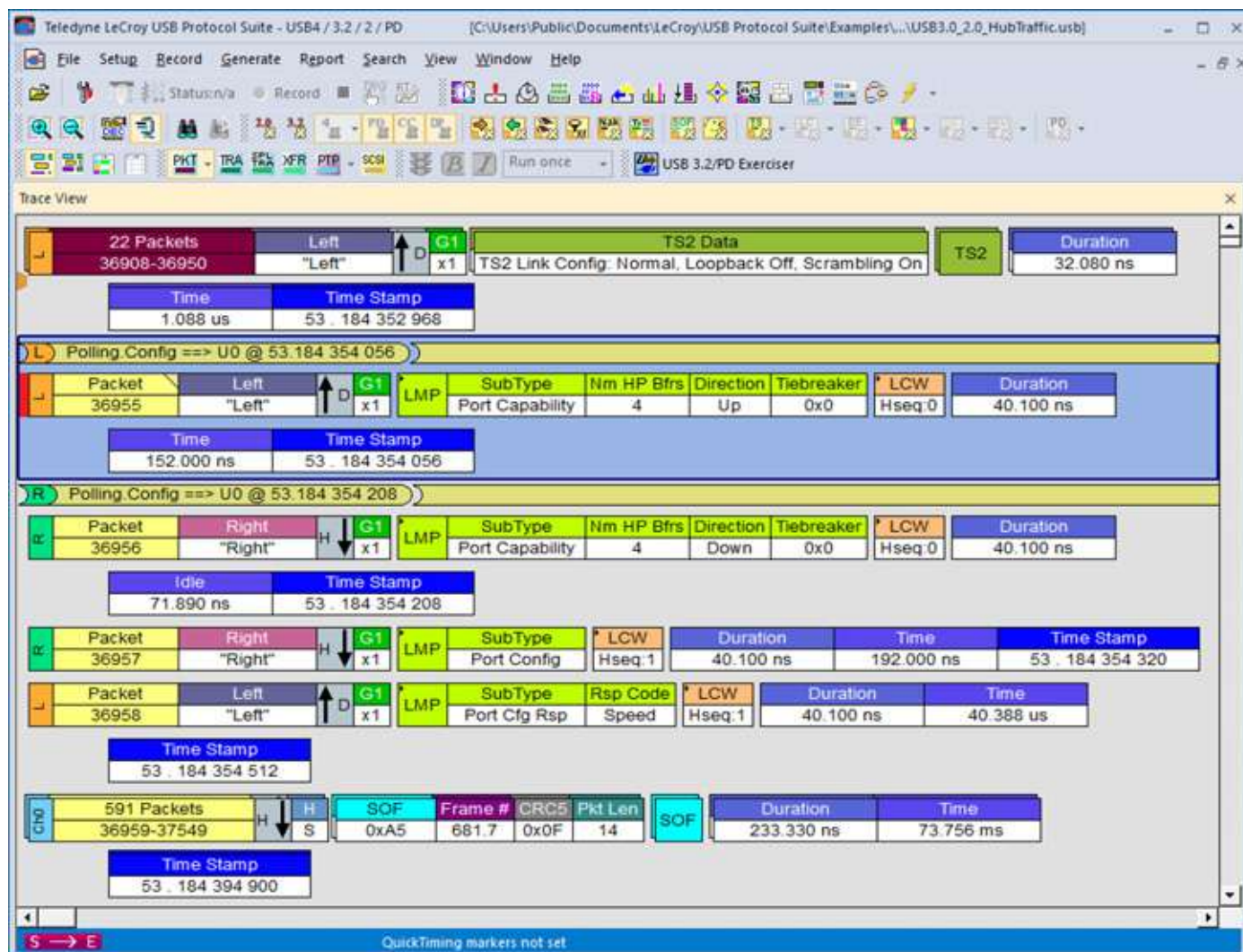


Figure 3.32: Main Window.

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

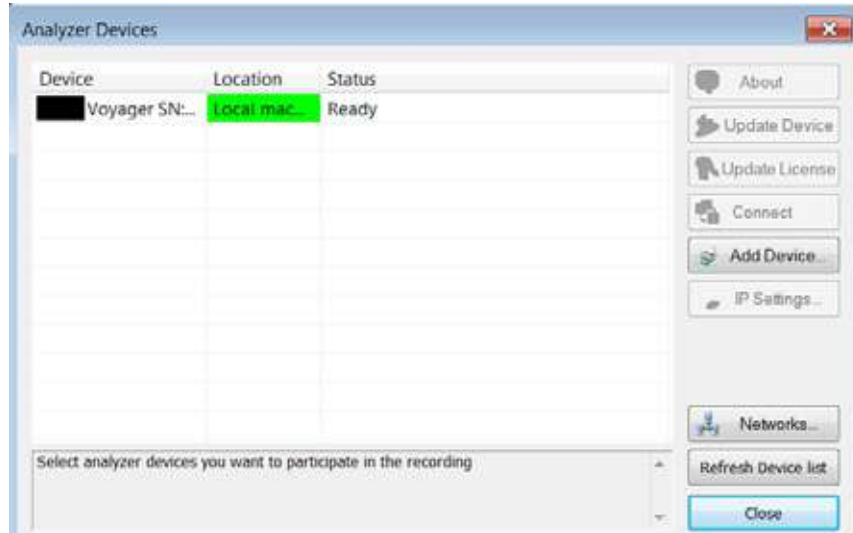
For USB connection, after you open the USB Protocol Suite application, confirm proper installation and USB connection by selecting **About** from the Help menu to view the Software Version, Firmware Version, BusEngine™ Version, and Unit Serial Number in the About window.

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 733).
- ❑ **Update Device** (see [“Manual Updates to Firmware, BusEngine, and Serdes BusEngine”](#) on page 738)
- ❑ **Update License** (see [“Updating the Software License”](#) on page 743)
- ❑ **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.

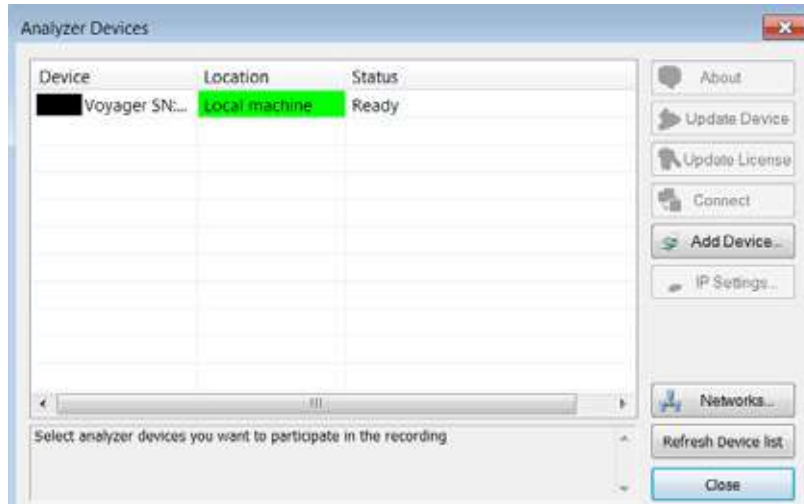


Figure 3.33: Analyzer Devices Dialog.

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

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



Figure 3.34: 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 3.35: 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 Signal Parameters

For USB, to add, remove, edit, load (from a comma-delimited **.csv** file), or save (as a comma-delimited **.csv** file) USB 3.2 devices and to calibrate USB 3.2 connections, select **Setup > Signal Parameters...** (see [Figure 3.36](#)) to display the Signal Settings dialog (see [Figure 3.37](#) on [page 144](#)).

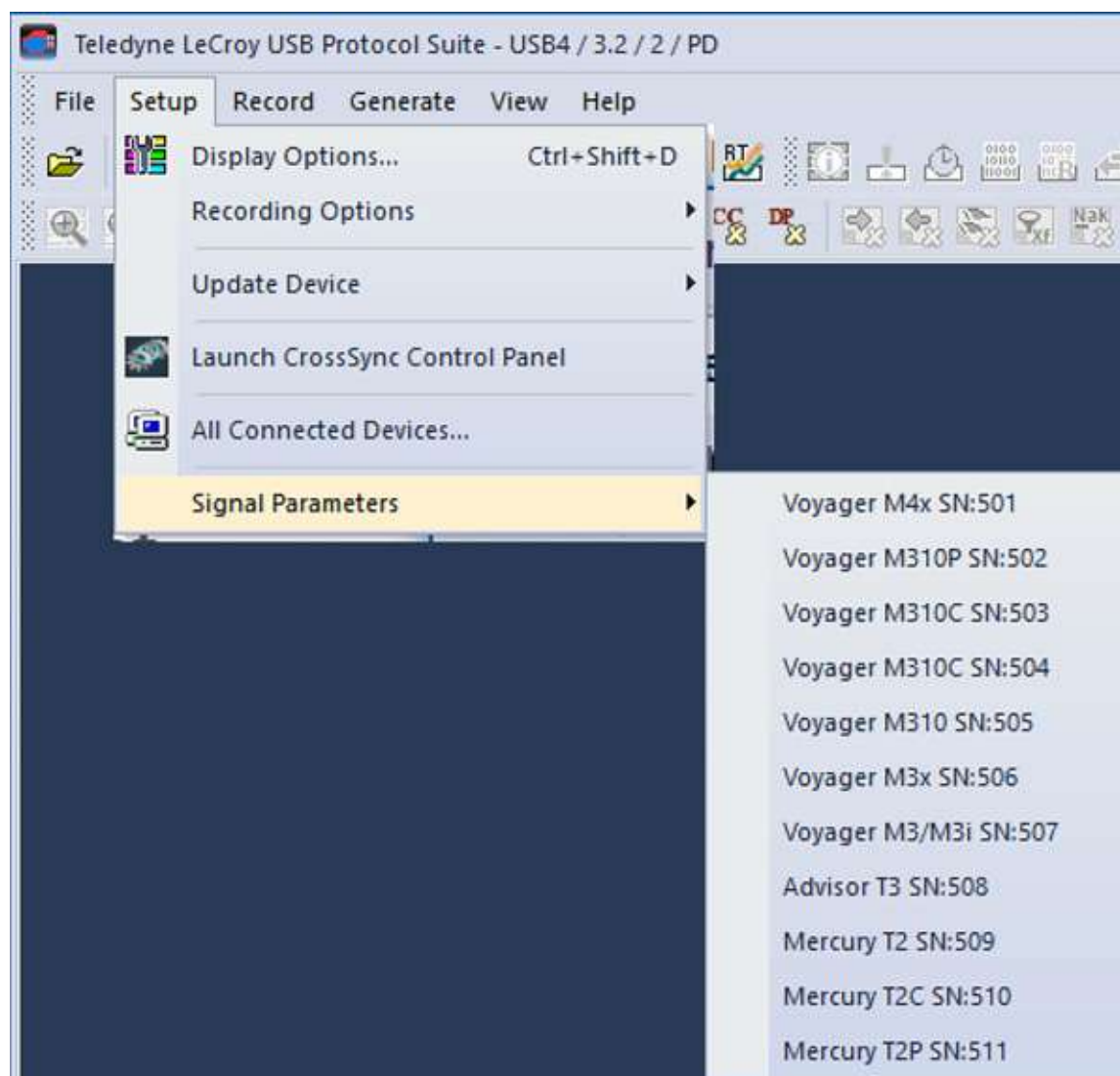


Figure 3.36: Signal Parameters

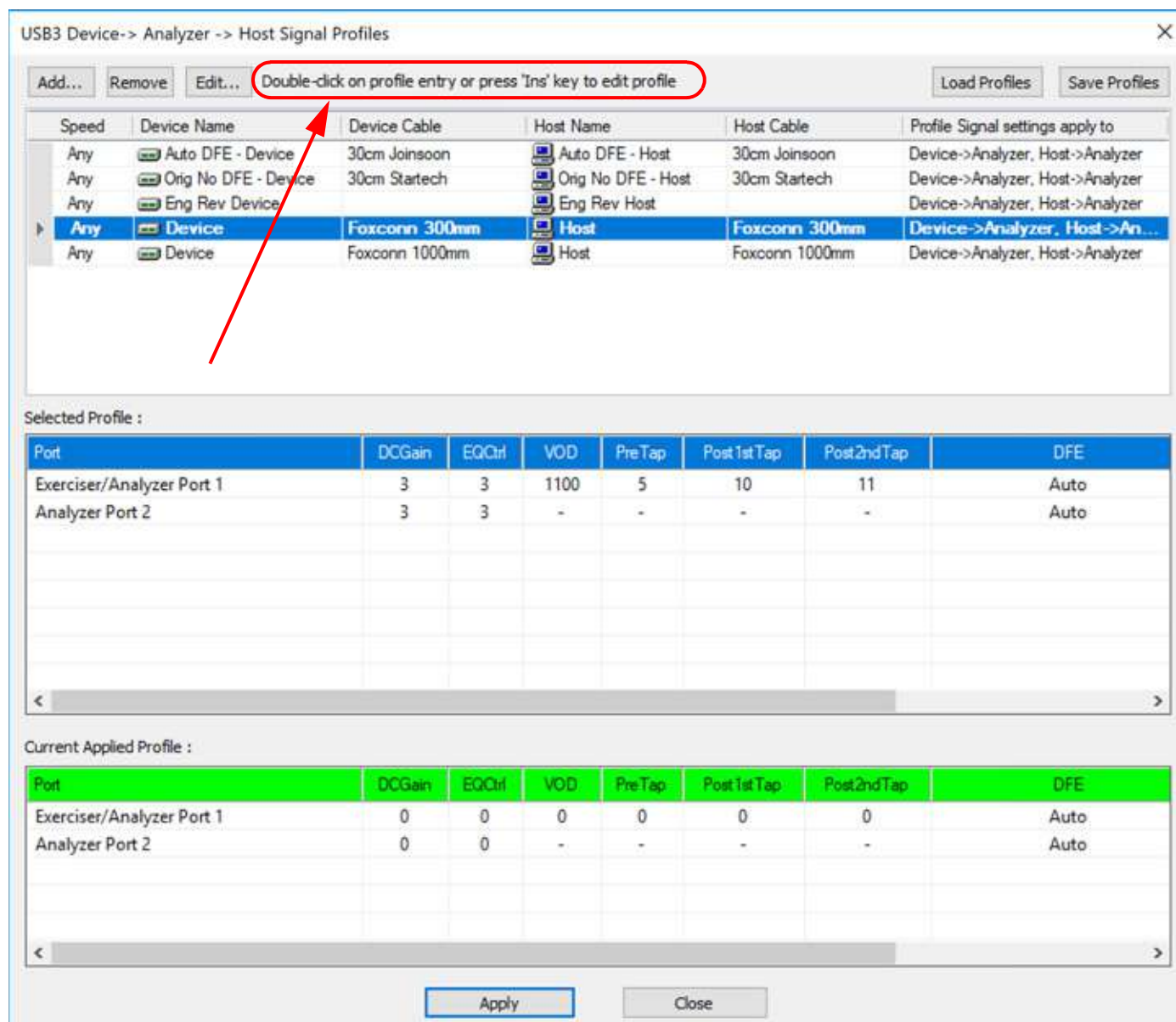


Figure 3.37: USB 3.2 Typical Device Analyzer Host Signal Profiles Dialog

Voyager M310 and M310C

To edit the Host Signal Parameters Profile of a specific profile entry double click on the entry and the following Host Signal Parameters Profile dialog will pop up (see [Figure 3.38](#)).

USB3 Device-> Analyzer -> Host Signal Parameters Profile

☒ One Setting for all Speeds Read from Voyager Apply to Voyager

Voyager is in Analyzer Mode (Auto)

(Device <-> Analyzer 1 / Exerciser) Signal Settings:

Device Name:

Device Cable ID:

Transmit Parameters

Amplitude (0-1260 mv) :

Pre-Tap (-15 to 15) :

Post 1st-Tap (0-31) :

Post 2nd-Tap (-15 to 15) :

Receive Parameters

RX DC Gain (0-4 db) :

EQ Control (0-15 db) :

DFE Settings

Mode:

Tap 1 0-15 db:

Tap 2 -7 to 7 db:

Tap 3 -7 to 7 db:

Tap 4 -7 to 7 db:

Tap 5 -7 to 7 db:

(Host <-> Analyzer 2) Signal Settings:

Host Name:

Host Cable ID:

Transmit Parameters

Amplitude (0-1260 mv) :

Pre-Tap (-15 to 15) :

Post 1st-Tap (0-31) :

Post 2nd-Tap (-15 to 15) :

Receive Parameters

RX DC Gain (0-4 db) :

EQ Control (0-15 db) :

DFE Settings

Mode:

Tap 1 0-15 db:

Tap 2 -7 to 7 db:

Tap 3 -7 to 7 db:

Tap 4 -7 to 7 db:

Tap 5 -7 to 7 db:

Load default settings OK Cancel Load last applied settings

Figure 3.38: USB 3.2 Device Analyzer Host Signal Parameters Profile Dialog Voyager M310 and M310C

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

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

You can enter **Device to Analyzer Signal Settings** and **Host to Analyzer Signal Settings**:

- ☐ **Device Name**
- ☐ **Device Cable ID**
- ☐ **Host Name**
- ☐ **Host Cable ID**
- ☐ **Transmit Parameters**
 - Amplitude (0 - 1260mv)
 - Pre-Tap (-15 to +15)
 - Post 1st-Tap (0 - 31)
 - Post 2nd-Tap (-15 to 15)
- ☐ **Receive Parameters**
 - RX DC Gain (0-4db)
 - EQ Control (0-15db)
- ☐ **DFE Settings**
 - Mode: Auto, Off, Manual, Triggered Adaptation, Continuous Adaptation
 - If in Manual Mode you can set the different tap values:
 - Tap 1 0 - 15 db
 - Tap 2 -7 to 7 db
 - Tap 3 -7 to 7 db
 - Tap 4 -7 to 7 db
 - Tap 5 -7 to 7 db

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

Voyager M3/M3i

To edit the Host Signal Parameters Profile of a specific profile entry double click on the entry and the following Host Signal Parameters Profile dialog will pop up (see [Figure 3.39](#)).

USB3 Device-> Analyzer -> Host Signal Parameters Profile

Read from Analyzer Apply to Analyzer

(Device <-> Analyzer/Exerciser A Port) Signal Settings:

Device Name:

Device Cable ID:

Input Signal Equalization (ISE) Settings:

short time constant:

medium time constant:

long time constant:

Input Eq: ☒ Low ☐ Hi

☐ Enable Both Eq modifications

Pre-Emphasis Settings:

short time Level (0 - 15):

short time Decay (0 - 7):

long time Level (0 - 15):

long time Decay (0 - 7):

Output power level (differential voltage):

(Host <-> Analyzer/Exerciser B Port) Signal Settings:

Host Name:

Host Cable ID:

Input Signal Equalization (ISE) Settings:

short time constant:

medium time constant:

long time constant:

Input Eq: ☒ Low ☐ Hi

Pre-Emphasis Settings:

short time Level (0 - 15):

short time Decay (0 - 7):

long time Level (0 - 15):

long time Decay (0 - 7):

Output power level (differential voltage):

Load default settings OK Cancel Load last applied settings

Figure 3.39: USB 3.2 Device Analyzer Host Signal Parameters Profile Dialog M3/M3i

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

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

You can enter **Device to Analyzer Signal Settings** and **Host to Analyzer Signal Settings**:

- ☐ **Device Name**
- ☐ **Device Cable ID**
- ☐ **Host Name**
- ☐ **Host Cable ID**
- ☐ **Input Signal Equalization (ISE) Settings**
 - short time constant: Maximum, Moderate, Minimum, Off or Current
 - medium time constant: Maximum, Moderate, Minimum, Off or Current
 - long time constant: Maximum, Moderate, Minimum, Off or Current
- ☐ **If you select to Enable Both Equalization Modifiers you can set:**
- ☐ **Input Equalization: Low or High as well as:**
- ☐ **Pre-Emphasis Settings**
 - short time Level (0 - 15)
 - short time Decay (0 - 7)
 - long time Level (0 - 15)
 - short time Decay (0 - 7)
- ☐ **Output power level** (differential voltage): 405 - 890 mv

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

Voyager M3x

To edit the Host Signal Parameters Profile of a specific profile entry double click on the entry and the following Host Signal Parameters Profile dialog will pop up (see [Figure 3.40](#)).

USB3 Device-> Analyzer -> Host Signal Parameters Profile

Read from Voyager Apply to Voyager

(Device <-> Analyzer/Exerciser A Port) Signal Settings:

Device Name: Device

Device Cable ID: Long

Transmit Parameters

VOD (0-7): 4

Pre-Tap (-16 to 15): 0

Post 1st-Tap (0-31): 12

Post 2nd-Tap (0-31): 0

Receive Parameters

RX DC Gain in db (0, 3, 6, 9, 12): 0

EQ Control in db (1-16): 9

(Host <-> Analyzer/Exerciser B Port) Signal Settings:

Host Name: Host

Host Cable ID: Long

Transmit Parameters

VOD (0-7): 5

Pre-Tap (-16 to 15): 0

Post 1st-Tap (0-31): 13

Post 2nd-Tap (0-31): 0

Receive Parameters

RX DC Gain in db (0, 3, 6, 9, 12): 0

EQ Control in db (1-16): 9

Load default settings OK Cancel Load last applied settings

Figure 3.40: USB 3.2 Device Analyzer Host Signal Parameters Profile Dialog M3x.

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

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

You can enter **Device to Analyzer Signal Settings** and **Host to Analyzer Signal Settings**:

- ☐ **Device Name**
- ☐ **Device Cable ID**
- ☐ **Host Name**
- ☐ **Host Cable ID**
- ☐ **Transmit Parameters**
 - VOD (0 - 7)
 - Pre-Tap (-16 to 15)
 - Post 1st-Tap (0 - 31)
 - Post 2nd-Tap (0 - 31)
- ☐ **Receive Parameters**
 - RX DC Gain in db (0, 3, 6, 9, 12)
 - EQ Control in db (0 - 16)

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

Voyager M310P

To edit the Host Signal Parameters Profile of a specific profile entry double click on the entry (see [Figure 3.41](#)) and the following Host Signal Parameters Profile dialog will pop up (see [Figure 3.42](#) on page 152).

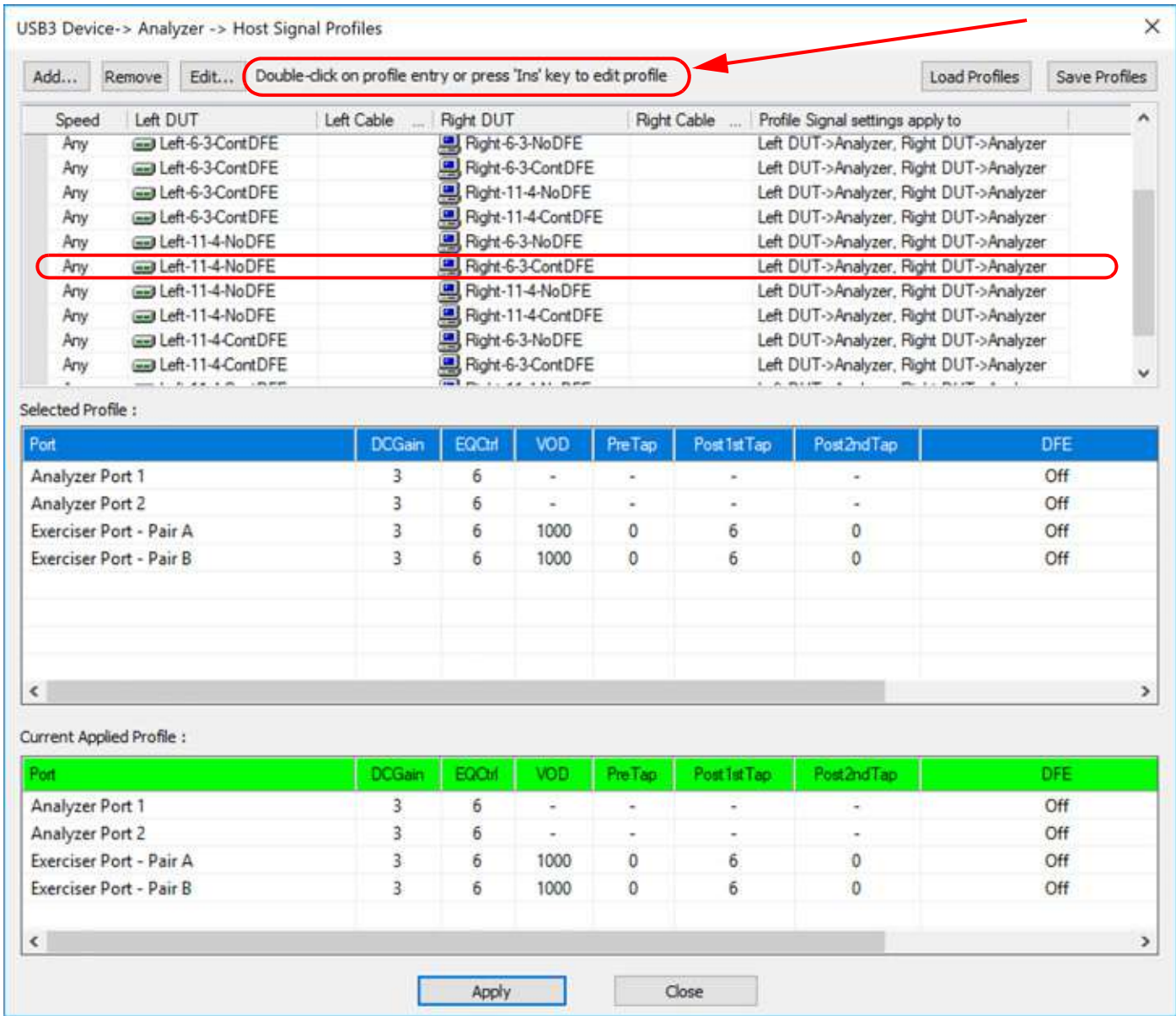


Figure 3.41: USB 3.2 Device Analyzer Host Signal Parameters Profile Dialog M310P.

Voyager M310P

To edit the Host Signal Parameters Profile of a specific profile entry double click on the entry and the following Host Signal Parameters Profile dialog will pop up (see [Figure 3.42](#)).

USB3 Device-> Analyzer -> Host Signal Parameters Profile

☒ One Setting for all Speeds

Read from Voyager Apply to Voyager

Voyager is in Analyzer Mode (Auto)

Analyzer Signal Settings

Port 1

Left DUT (1): Left-11-4-ContDFE

Left (1) Cable:

Receive Parameters

RX DC Gain (0-4 db): 4

EQ Control (0-15 db): 11

DFE Settings

Mode: Continuous adaptatic

Tap 1 (0 to 15 db):

Tap 2 (-7 to 7 db):

Tap 3 (-7 to 7 db):

Tap 4 (-7 to 7 db):

Tap 5 (-7 to 7 db):

Port 2

Right (2) DUT: Right-6-3-NoDFE

Right (2) Cable:

Receive Parameters

RX DC Gain (0-4 db): 3

EQ Control (0-15 db): 6

DFE Settings

Mode: Manual

Tap 1 (0 to 15 db):

Tap 2 (-7 to 7 db):

Tap 3 (-7 to 7 db):

Tap 4 (-7 to 7 db):

Tap 5 (-7 to 7 db):

Exerciser Signal Settings

SS Pair A

DUT Name: Exercise 1 6-3

Cable ID: Normal

Receive Parameters

RX DC Gain (0-4 db): 3

EQ Control (0-15 db): 6

DFE Settings

Mode: Off

Tap 1 (0 to 15 db):

Tap 2 (-7 to 7 db):

Tap 3 (-7 to 7 db):

Tap 4 (-7 to 7 db):

Tap 5 (-7 to 7 db):

Transmit Parameters

Amplitude (0-1260 mv): 1000

Pre-Tap (-15 to 15): 0

Post 1st-Tap (0-31): 6

Post 2nd-Tap (-15 to 15): 0

SS Pair B

DUT Name: Exercise 2 6-3

Cable ID: Flipped

Receive Parameters

RX DC Gain (0-4 db): 3

EQ Control (0-15 db): 6

DFE Settings

Mode: Triggered adaptation

Tap 1 (0 to 15 db):

Tap 2 (-7 to 7 db):

Tap 3 (-7 to 7 db):

Tap 4 (-7 to 7 db):

Tap 5 (-7 to 7 db):

Transmit Parameters

Amplitude (0-1260 mv): 1000

Pre-Tap (-15 to 15): 0

Post 1st-Tap (0-31): 6

Post 2nd-Tap (-15 to 15): 0

Load default settings OK Cancel Load last applied settings

Figure 3.42: USB 3.2 Device Analyzer Host Signal Parameters Profile Dialog M310P

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

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

You can enter **Analyzer Signal Settings for Port 1 and Port 2**:

- ☐ **Left DUT (1) name**
- ☐ **Right (2) DUT name**
- ☐ **Left (1) Cable name**
- ☐ **Right (2) Cable name**
- ☐ **Receive Parameters**
 - RX DC Gain (0 - 4 db)
 - EQ Control (0 - 15 db)
- ☐ **DFE Settings**
 - Mode: Auto, Off, Manual, Triggered Adaptation, Continuous Adaptation
 - If in Manual Mode you can set the different tap values:
 - Tap 1 0 - 15 db
 - Tap 2 -7 to 7 db
 - Tap 3 -7 to 7 db

- Tap 4 -7 to 7 db
- Tap 5 -7 to 7 db

You can enter **Exerciser Signal Settings for SS Pair A and SS Pair B:**

- ☐ **DUT name**
- ☐ **Cable ID**
- ☐ **DUT name**
- ☐ **Cable ID**
- ☐ **Receiver Parameters**
 - RX DC Gain (0 - 4 db)
 - EQ Control (0 - 15 db)
- ☐ **DFE Settings**
 - Mode: Auto, Off, Manual, Triggered Adaptation, Continuous Adaptation
 - If in Manual Mode you can set the different tap values:
 - Tap 1 0 - 15 db
 - Tap 2 -7 to 7 db
 - Tap 3 -7 to 7 db
 - Tap 4 -7 to 7 db
 - Tap 5 -7 to 7 db
- ☐ **Transmit Parameters**
 - Amplitude (0 - 1260mv)
 - Pre-Tap (-15 to +15)
 - Post 1st-Tap (0 - 31)
 - Post 2nd-Tap (-15 to 15)

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

Advisor T3

For the Advisor T3, to add, remove, edit, load (from a comma-delimited **.csv** file), or save (as a comma-delimited **.csv** file) USB 3.2 devices and to calibrate USB 3.2 connections, select **Setup > USB 3.2 Device/Host Signal Parameters**. If the Advisor T3 is in default mode (Automatic) you'll get the following message (see [Figure 3.43](#)).

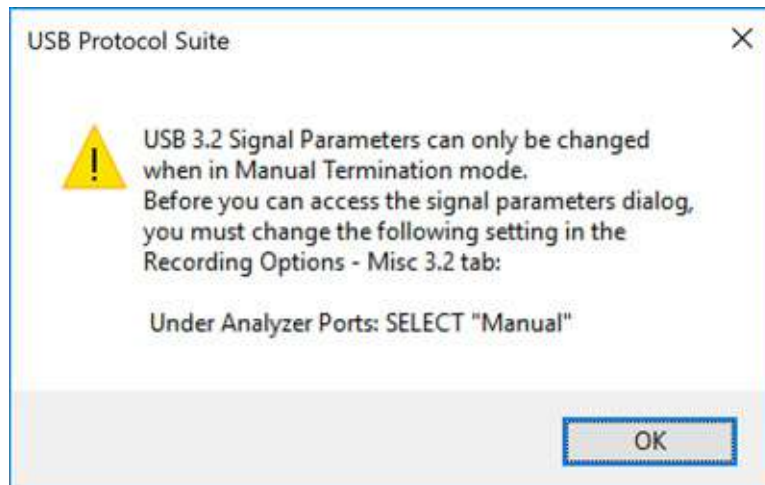


Figure 3.43: Advisor T3: Warning Message

To set the Recording Options to Manual, Open the USB Protocol Suite -> Recording Options.

Select General -> Advisor T3.

Then select the USB 3.2 tab.

Then select Manual (see [Figure 3.44 on page 155](#)).

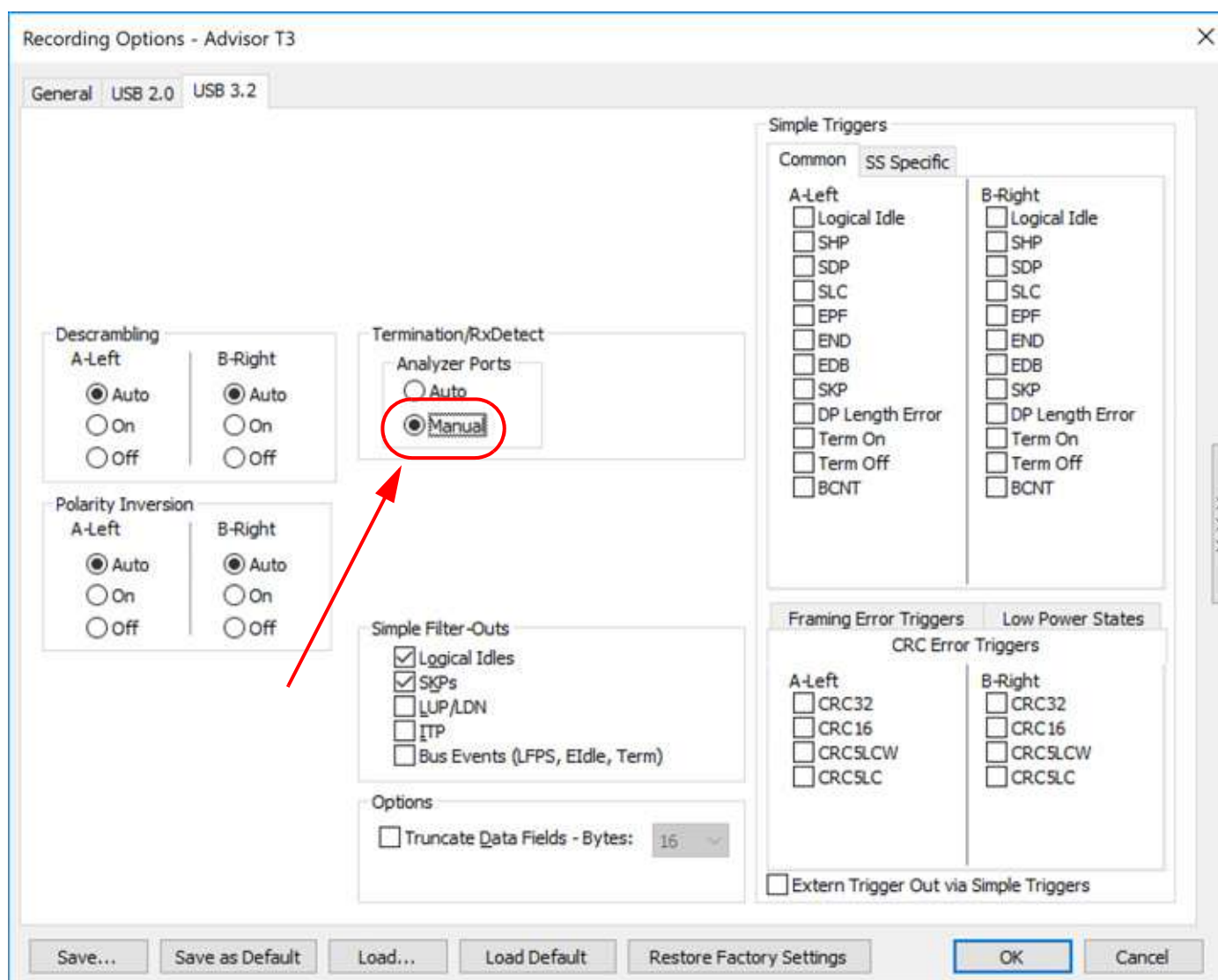


Figure 3.44: Recording Options: Advisor T3

This will allow you to bring up the Host Signal Profiles for the Advisor T3 (see [Figure 3.45 on page 156](#)).

USB3 Device-> Analyzer -> Host Signal Profiles

Add... Remove Edit... Double-click on profile entry or press 'Ins' key to edit profile

Load Profiles Save Profiles

Device Name	Device Cable	Host Name	Host Cable	Profile Signal settings apply to
Device	1 meter	Host	1 meter	Device->Analyzer, Host->Analyzer

Selected Profile :

Port	InputEQ	EQShortTime	EQMediumTime	EQLongTime	PreLongLevel	PreLongDecay
Exerciser A/Device Port	Low	Off	Off	Off	0	0
Exerciser B/Host Port	Low	Off	Off	Off	0	0

Current Applied Profile :

Port	InputEQ	EQShortTime	EQMediumTime	EQLongTime	PreLongLevel	PreLongDecay
Exerciser A/Device Port	Low	Off	Off	Off	0	0
Exerciser B/Host Port	Low	Off	Off	Off	0	0

Apply Close

Figure 3.45: Host Signal Profiles: Advisor T3

Double click on an existing profile and you can update it's parameters (see [Figure 3.46 on page 157](#)).

USB3 Device-> Analyzer -> Host Signal Parameters Profile

Read from Analyzer Apply to Analyzer

(Device <-> Analyzer/Exerciser A Port) Signal Settings:

Device Name: Device

Device Cable ID: 1 meter

Input Signal Equalization (ISE) Settings:

short time constant: Off

medium time constant: Off

long time constant: Off

Input Eq: ☒ Low ☐ Hi

☒ Enable Both Eq modifications

Pre-Emphasis Settings:

short time Level (0 - 15): 2

short time Decay (0 - 7): 2

long time Level (0 - 15): 0

long time Decay (0 - 7): 0

Output power level (differential voltage): 890 mV

(Host <-> Analyzer/Exerciser B Port) Signal Settings:

Host Name: Host

Host Cable ID: 1 meter

Input Signal Equalization (ISE) Settings:

short time constant: Off

medium time constant: Off

long time constant: Off

Input Eq: ☒ Low ☐ Hi

Pre-Emphasis Settings:

short time Level (0 - 15): 2

short time Decay (0 - 7): 2

long time Level (0 - 15): 0

long time Decay (0 - 7): 0

Output power level (differential voltage): 890 mV

Load default settings OK Cancel Load last applied settings

Figure 3.46: Host Signal Profiles: 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** and **Host to Analyzer Signal Settings**:

- ☐ **Device Name**
- ☐ **Device Cable ID**
- ☐ **Host Name**
- ☐ **Host Cable ID**
- ☐ **Input Signal Equalization (ISE) Settings**
 - short time constant: Maximum, Moderate, Minimum, Off or Current
 - medium time constant: Maximum, Moderate, Minimum, Off or Current
 - long time constant: Maximum, Moderate, Minimum, Off or Current
- ☐ **If you select to Enable Both Equalization Modifiers you can set:**
- ☐ **Input Equalization: Low or High as well as:**
- ☐ **Pre-Emphasis Settings**
 - short time Level (0 - 15)
 - short time Decay (0 - 7)
 - long time Level (0 - 15)
 - short time Decay (0 - 7)
- ☐ **Output power level** (differential voltage): 405 - 890 mv

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

3.5.5 M4x Signal Parameters (USB4 and USB3.2)

To select values for the **Rx Equalizer Settings** for the M4x follow the steps outlined below.

Select **Setup -> Signal Parameters -> M4x** and the following dialog box opens: See [Figure 3.47](#).

Figure 3.47: Signal Parameters: M4x

Rx Equalizer Settings:

- ☐ Set All Lanes or Set Lane 0 and Lane 1 to different values.

You can set the values for Left - Analyzer Connector 1:

- ☐ To Analyzer
 - CTLE Values: From 0.0 dB to 6.0 dB in 0.2 dB increments
 - DC Gain Values: From 0.0 dB to 6.0 dB in 0.2 dB increments
 - SigDet Values: From 30 mV to 410 mV in varying increments
- ☐ To Right Connector
 - CTLE Values: From 0.0 dB to 6.0 dB in 0.2 dB increments
 - DC Gain Values: From 0.0 dB to 6.0 dB in 0.2 dB increments
 - SigDet Values: From 30 mV to 410 mV in varying increments

You can set the values for Right - Analyzer Connector 2:

- ☐ To Analyzer
 - CTLE Values: From 0.0 dB to 6.0 dB in 0.2 dB increments
 - DC Gain Values: From 0.0 dB to 6.0 dB in 0.2 dB increments
 - SigDet Values: From 30 mV to 410 mV in varying increments
- ☐ To Left Connector
 - CTLE Values: From 0.0 dB to 6.0 dB in 0.2 dB increments
 - DC Gain Values: From 0.0 dB to 6.0 dB in 0.2 dB increments
 - SigDet Values: From 30 mV to 410 mV in varying increments

If you enter values for the Rx Equalizer Settings and select **“Add”** the following dialog box will open allowing you to save the set of settings. See [Figure 3.48](#).

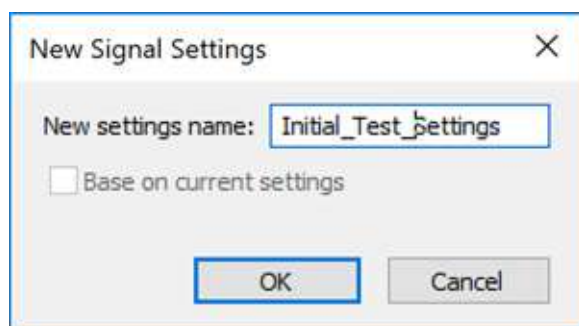


Figure 3.48: New Signal Settings: Name of Set of Settings

Click on **“OK”**.

The Initial_Test_Settings will show up in the M4x Signal Settings dialog box. See [Figure 3.49 on page 161](#).

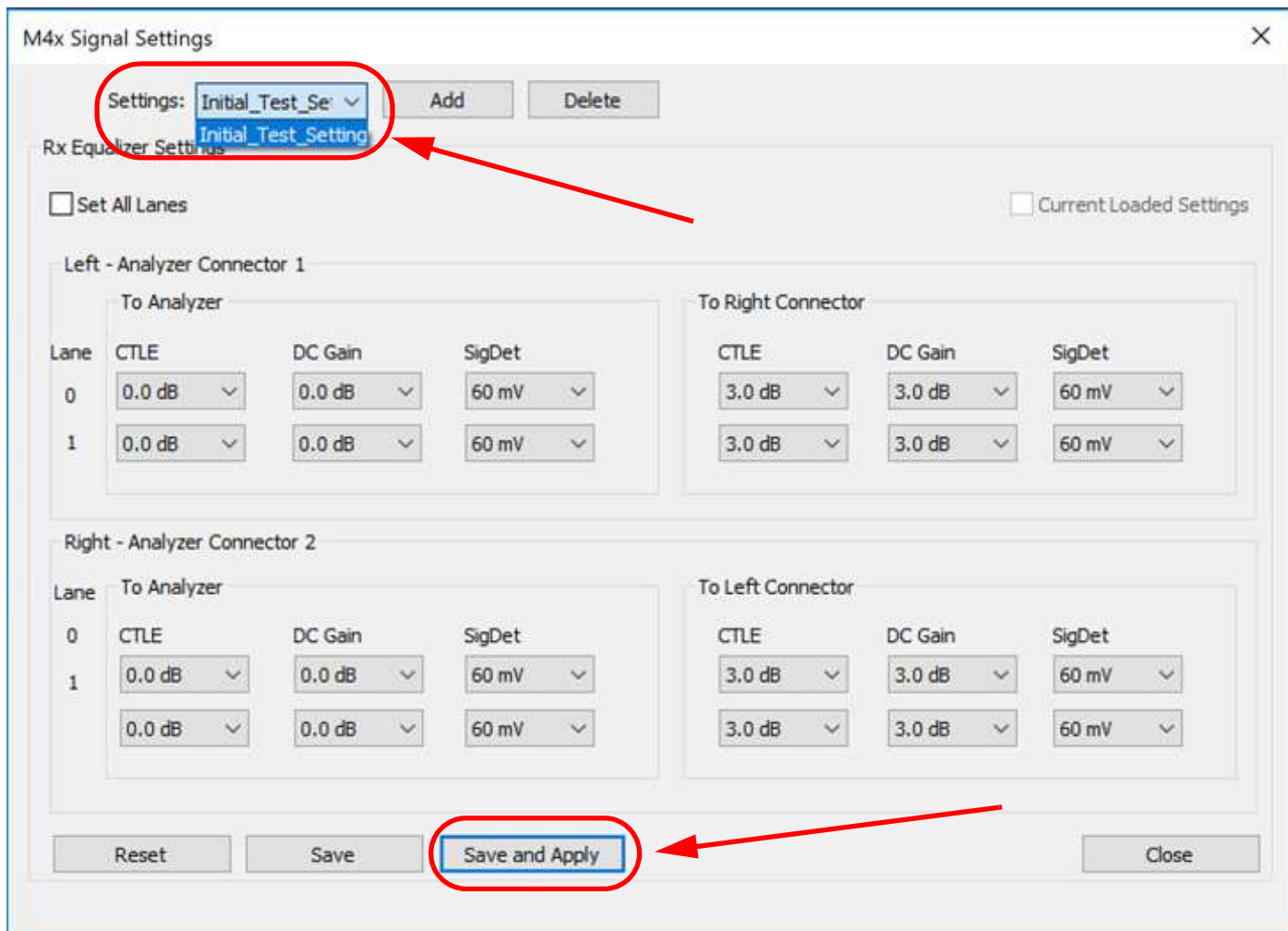


Figure 3.49: M4x Signal Settings: “Initial_Test_Settings” Set of Values Appear in Settings Box

You can also **Save and Apply**, **Reset**, or **Save** the set of Rx Equalizer Settings values you have chosen.

If you have more than one set of values you can **Add** that set or **Delete** it as well.

3.5.5.1 Rx Equalization Settings Detail and Troubleshooting Capture/Link Problems

Figure 3.50 shows how Rx Equalization setting are mapped to different paths in M4x Analyzer front end.

"To Analyzer" settings are designated to tune settings for the path between attached DUTs and "protocol analyzer FPGA" (which is shown with green lines in [Figure 3.50](#)), so if the link between two DUTs are good but analyzer is capturing IPSs, you need to adjust these parameters. If the errors (IPS packets) seen from "Left" in captured trace need to change setting for left connector and if errors seen from "right" in captured trace, you need to change parameters for right connector.

"To Right connector"/"To Left Connector": These settings are designated to tune settings for pass-through the path (path between two DUTs) as highlighted with purple color in [Figure 3.50](#). If the link between DUTs is getting broken by putting the M4x analyzer in the middle of traffic, you need to adjust these parameters to create a successful link between the DUTs attached to both sides of analyzer.

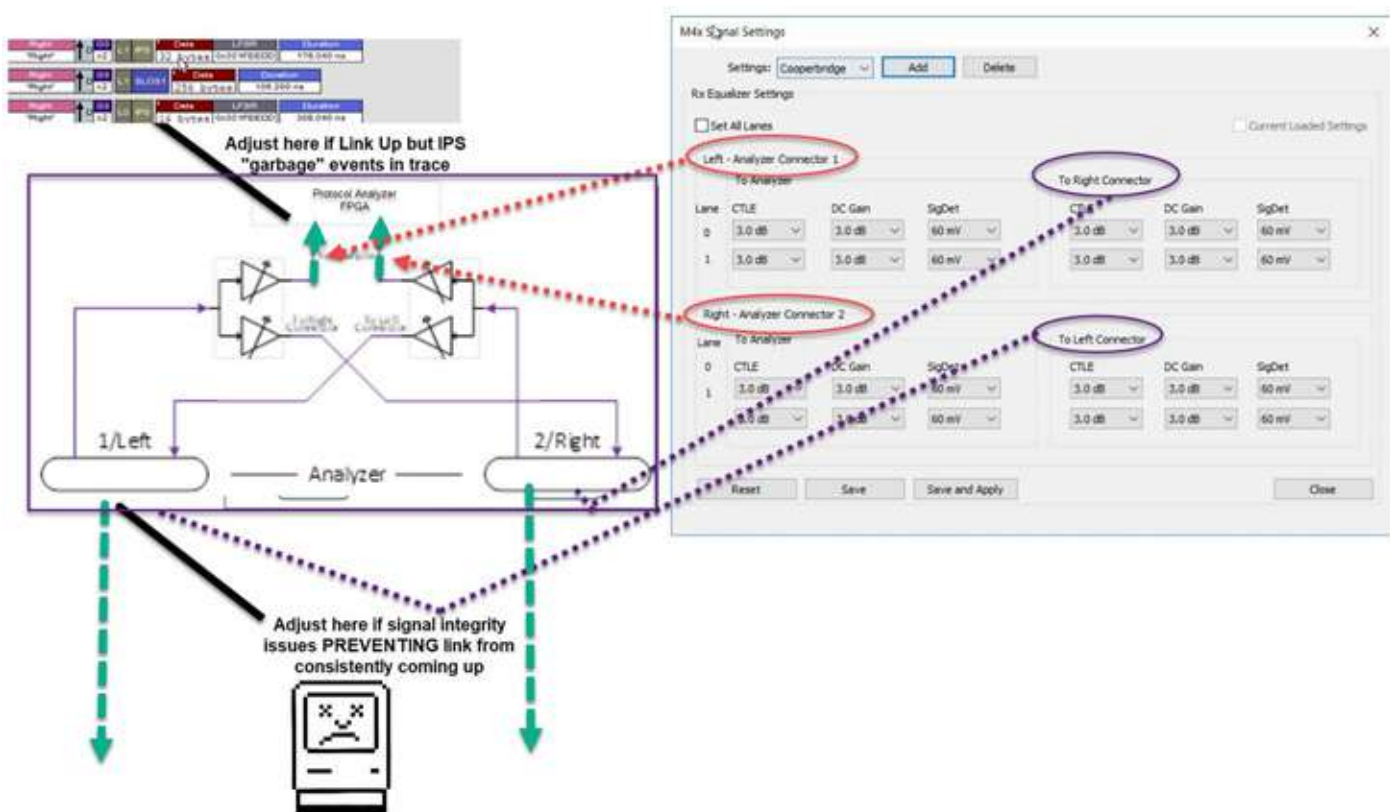


Figure 3.50: Rx Equalization Settings

3.5.5.2 Adding new Rx Equalization Settings set and saving it

After you have updated the equalization settings you can Add or Save and Apply them with the buttons in the signal settings dialog. See [Figure 3.51](#).

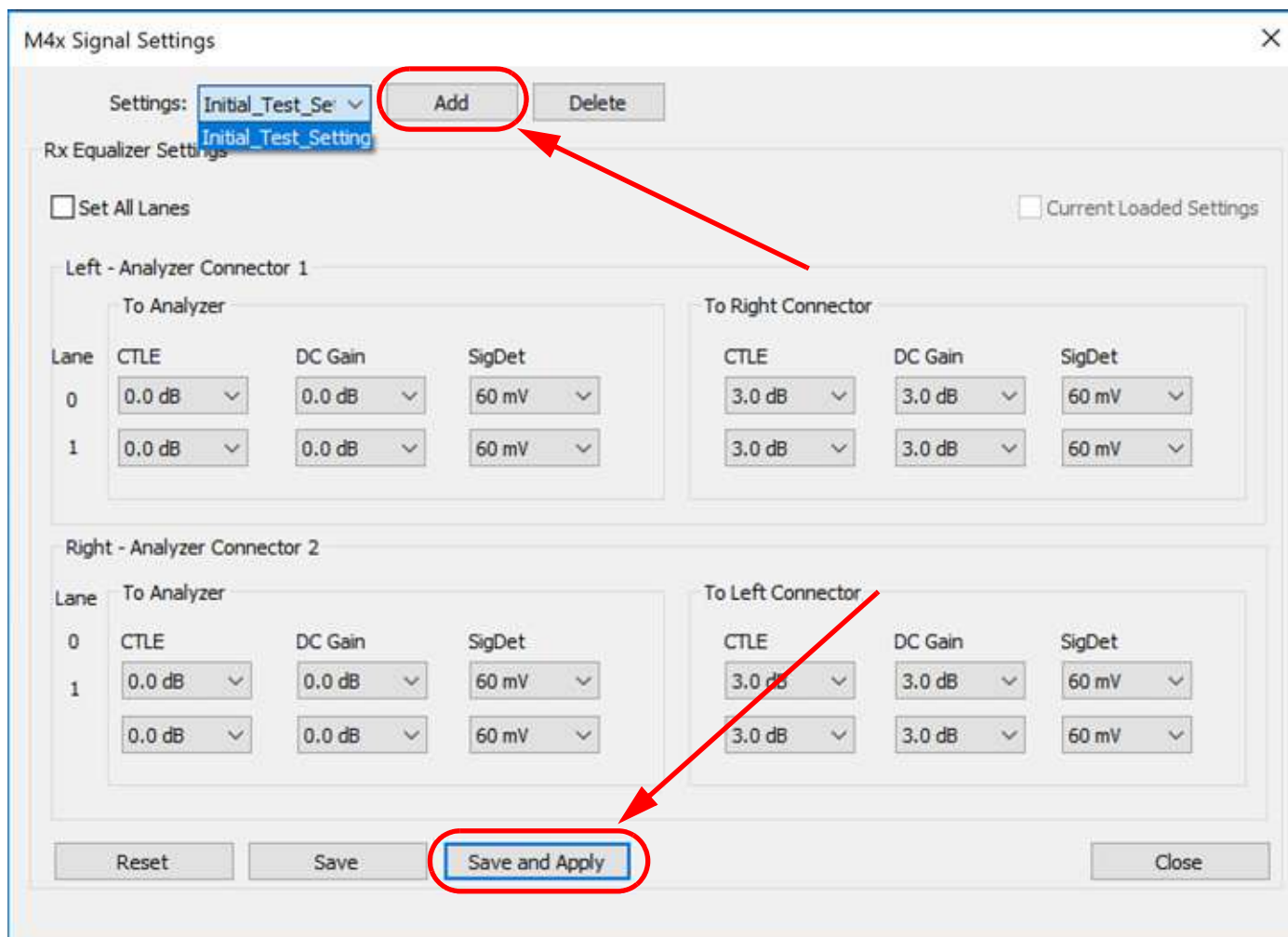


Figure 3.51: Add and Save and Apply Buttons in Equalization Settings Dialog

3.5.6 USB 3.2 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/Right" 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/Left" 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 3.52 on page 165](#)). For the first recording, you can leave these settings unchanged. Under Recording Channels, select **2.0** to record USB 2.0 traffic.

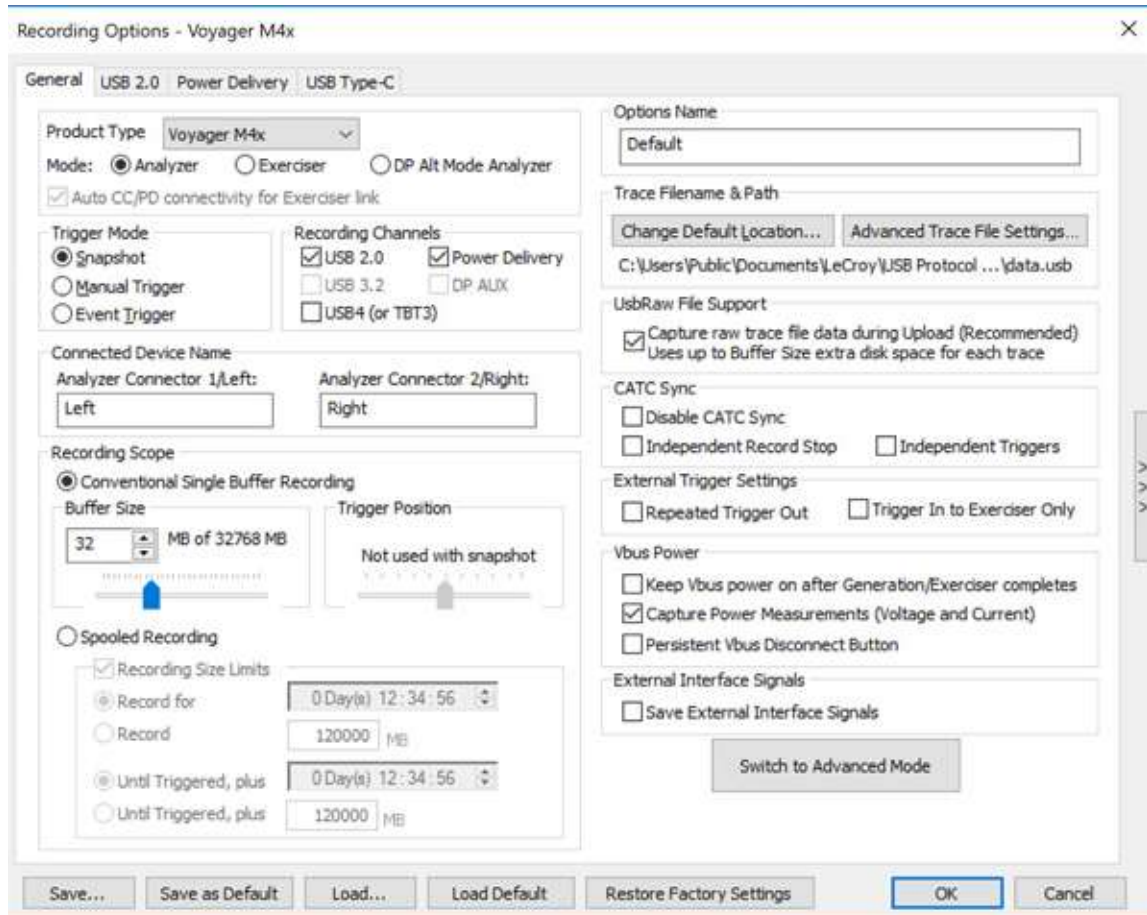


Figure 3.52: Recording Options - Voyager Dialog.

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 3.53 on page 166](#)).

- ❑ 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 3.2 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.

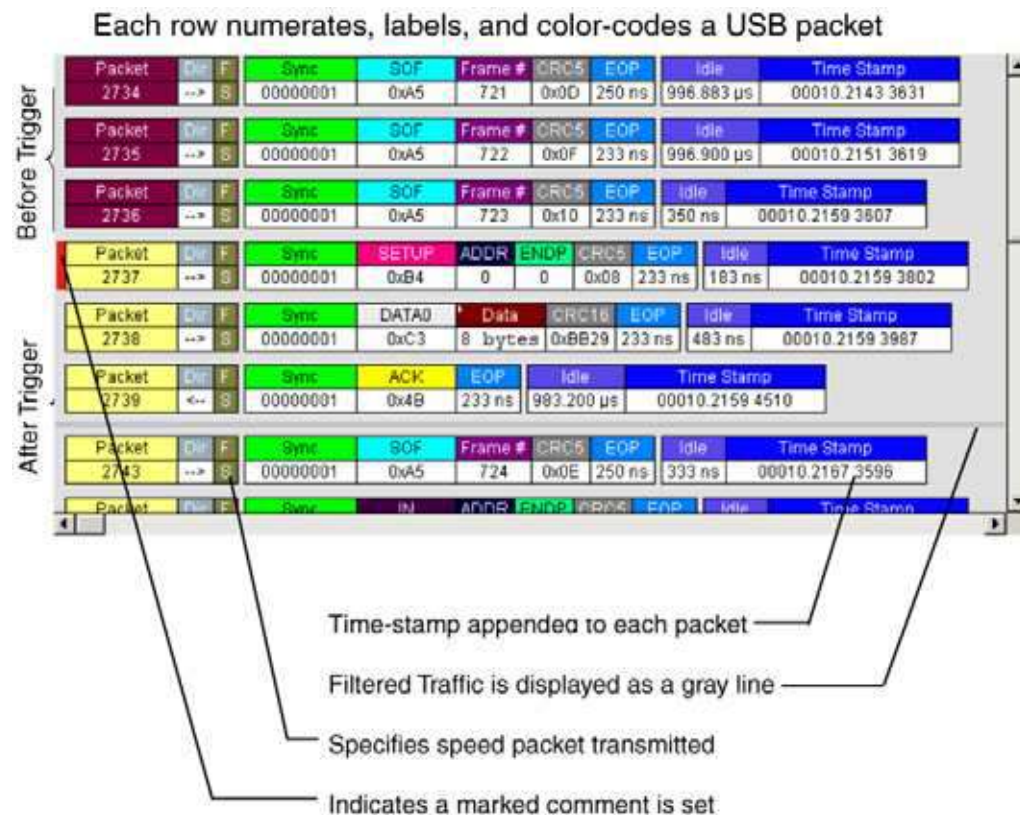


Figure 3.53: Trace View Display

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 10 (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 10 when using Windows 7 and Windows 8, files that were in the **Program Files** path in Windows 10 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 10 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 10 system, trace files will be probably be recorded to a new Windows 10 directory called

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

This is a legitimate path on a Windows 10 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.

To save memory space, the maximum number of traces that can be opened at one time when recording is from 1 to 10. You can also auto-delete traces if your recording session goes beyond the limit set (from 1 to 10). This topic is covered in more detail in [“Recording Options Modes” on page 244](#).

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 170](#)).

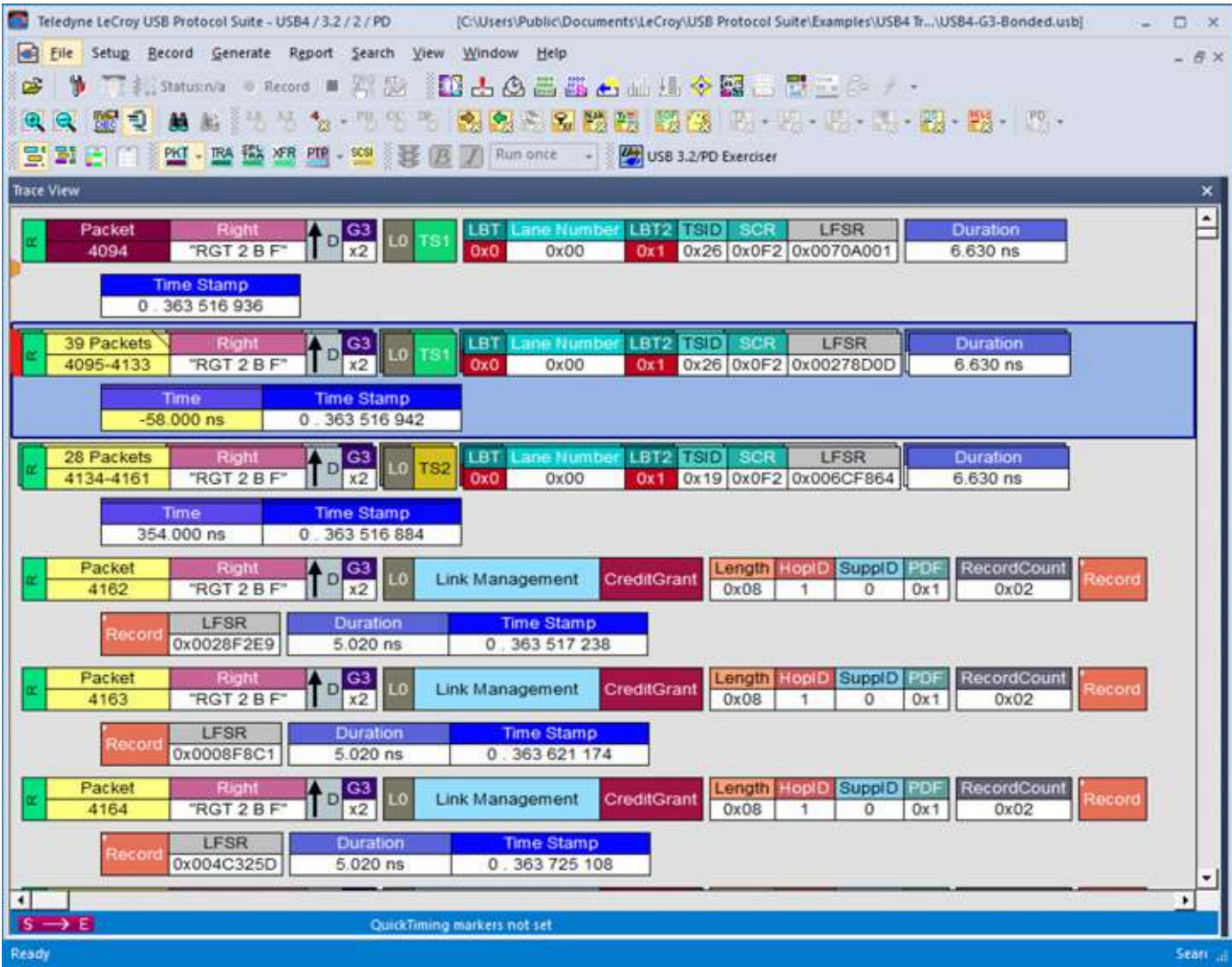


Figure 4.1: Main Window.

4.2 The Main Display Window

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

4.2.1 File Menu

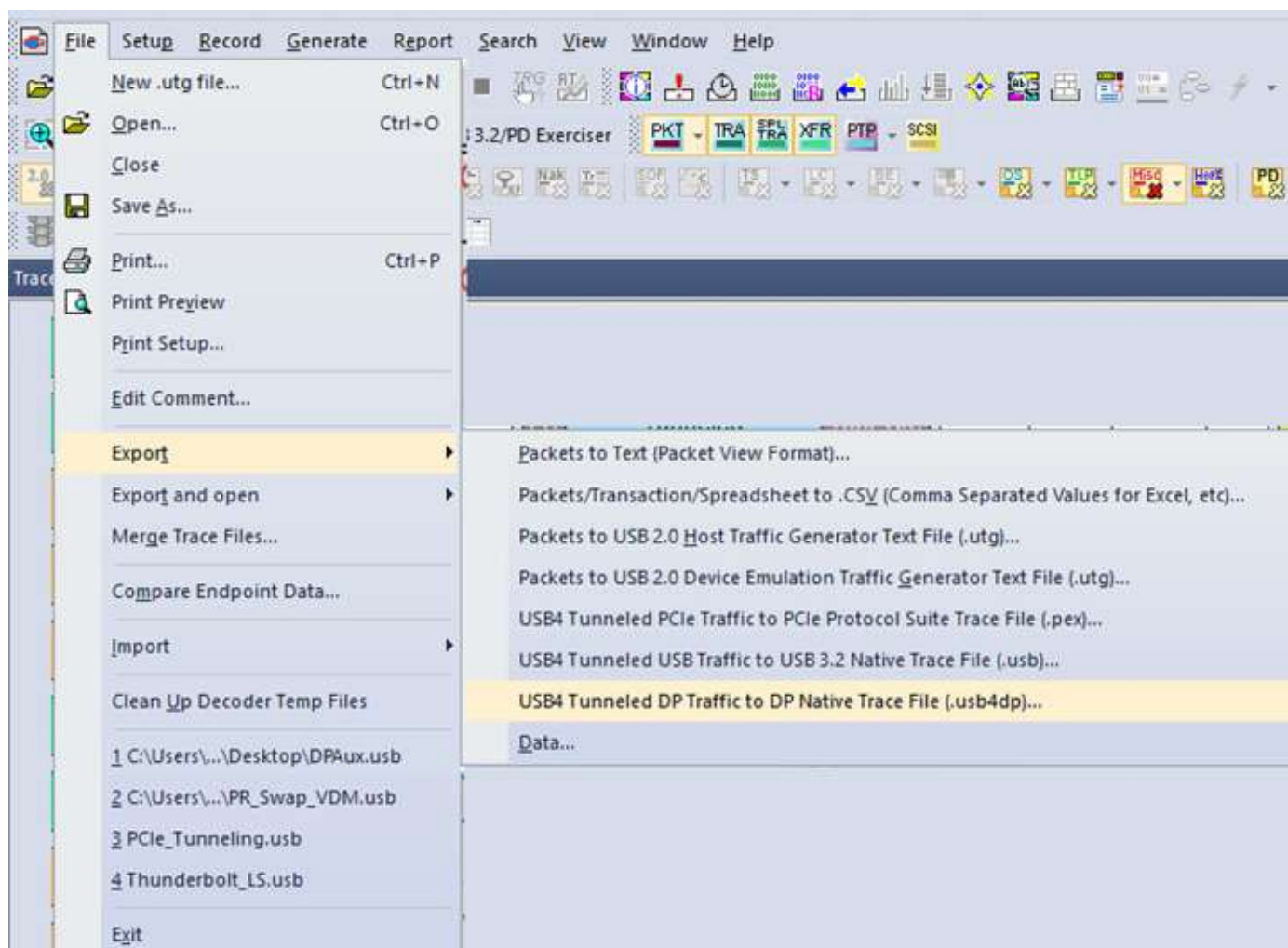


Figure 4.2: File Menu Drop Down Options

TABLE 4.1: File Menu Functions

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.
<u>O</u> pen	Opens a file.
<u>C</u> lose	Closes the current file.
Save <u>A</u> s	Saves all, or a range of, packets from the current file.
<u>P</u> rint	Prints part or all of the current traffic data file.
Print <u>P</u> review	Produces an on-screen preview before printing.
<u>P</u> rint Setup	Sets the options for the current or new printer.
<u>E</u> dit as Text	Opens the Script Editor. Available only when a traffic generation file (.utg) is open. See “Editing a Generation File” on page 650 .
<u>E</u> dit Comment	Creates or edits the Trace file comment field. See “Edit Comment” on page 443 .
Check Syntax of .utg file	Reads open .utg file and checks syntax for errors. Available only when a traffic generation file (.utg) is open.

File menu	Functions
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 191.
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 192.
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 192.
USB4 Tunneled PCIe Traffic to PCIe Protocol Suite Trace File (.pex)	Exports USB4 Tunneled USB traffic to PCIe Protocol Suite Trace File (.pex). This allows you to export ONLY PCIe Protocol Suite Traffic from a USB4 trace. See “Export: USB4 Tunneled PCIe Traffic to PCIe Protocol Suite Trace File” on page 195.
USB4 Tunneled USB Traffic to USB 3.2 Native Trace File (.usb)	Exports USB4 Tunneled USB traffic to USB 3.2 Native Trace file. This allows you to export ONLY USB 3.2 Native Traffic from a USB4 trace. See “Export: USB4 Tunneled USB Traffic to USB 3.2 Native Trace” on page 197.
USB4 Tunneled DP Traffic to DP Native Trace File (.usb4dp)	Exports USB4 Tunneled DP traffic to DP Native Trace file. This allows you to export ONLY DP Native Traffic from a USB4 trace. See “Export: USB4 Tunneled DP Traffic to DP Native Trace” on page 198.
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).

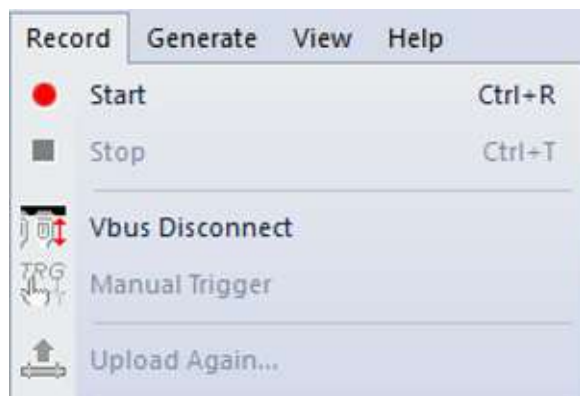
File menu	Functions
Compare Endpoint Data	Allows you to select two endpoints of different directions with the same address and verify that the data OUT/IN is identical to the data IN/OUT from the other endpoint. Used when running echo-types of tests for data integrity. Available only when a trace file (.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. Note: The format of .csv export files is NOT compatible with that of files to be used for these Import functions. The Import .csv file is based on symbol streams at the 10 bit symbol level. The exports are based on decoded delimited packet bytes.
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



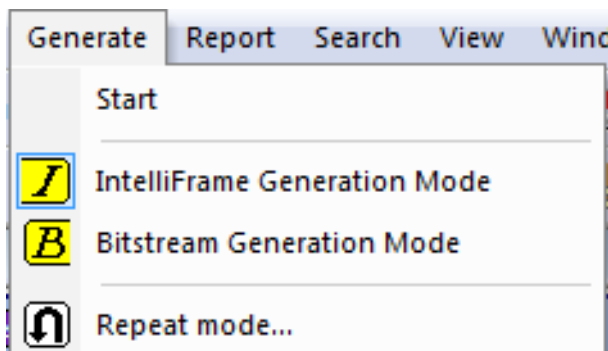
Setup menu	Functions
Display Options	Provides display options such as color, formats, and filters. See “Display Options” on page 513 .
Recording Options	Provides setup options for recording, triggering events and filtering. See “Recording Options” on page 241 .
Update Device	Updates the BusEngine™ and Firmware manually. See “Manual Updates to Firmware, BusEngine, and Serdes BusEngine” on page 738 .
Launch CrossSync Control Panel	Opens the CrossSync multiple-analyzer traffic synchronization software (see CrossSync Control Panel on page 234). For more information, refer to the <i>CrossSync User Manual</i> .
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 140 .
Signal parameters	Adds, removes, edits, loads, and saves USB4 and USB3.2 devices and lists the device name, device cable, host name, host cable, and to what the Profile Signal Settings apply. Used to calibrate 5, 10, and 20 Gbps connections. Also shows custom device-to-analyzer and host-to-analyzer signal settings. See “Signal Parameters” on page 143 .

4.2.3 Record Menu



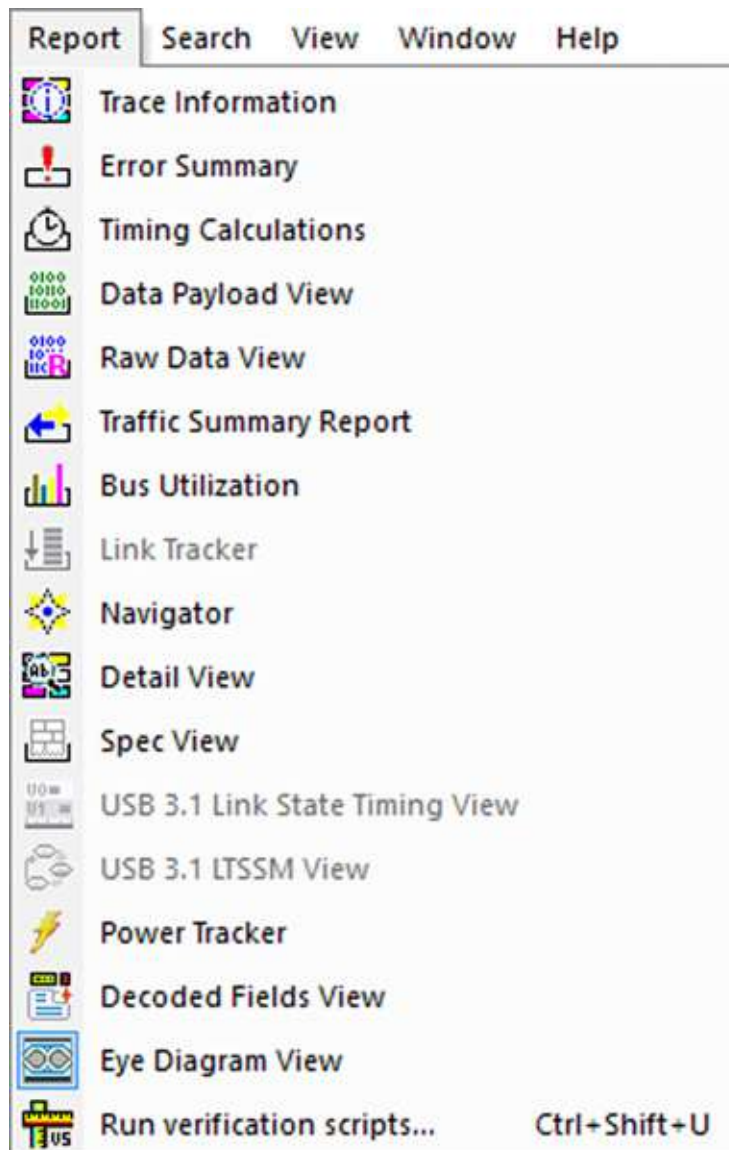
Record menu	Functions
	(see “Recording Status” on page 225.)
<u>S</u> tart	Causes the Analyzer to begin recording USB activity.
<u>S</u> top	Causes the Analyzer to stop recording.
V <u>B</u> us Disconnect	See VBus Disconnect under “Recording” on page 205.
M <u>a</u> nual Trigger	See Manual Trigger under “Recording” on page 205.
<u>U</u> pload Again	Allows you to upload a different portion of the captured trace if the previous upload was only partially uploaded.

4.2.4 Generate Menu



Generate menu	Functions
	(see “Traffic Generation 2.0” on page 643.)
<u>S</u> tart/Stop	Starts traffic generation. After traffic generation has begun, the Start command becomes Stop and lets you stop traffic generation.
<u>I</u> ntelliFrame Generation Mode	Sets the mode of generation to IntelliFrame. Use before Start. (2.0 only)
<u>B</u> itstream Generation Mode	Sets the mode of generation to bitstream. Use before Start. (2.0 only)
<u>R</u> epeat 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
<u>F</u> ile Information	Displays information about the recording, such as the number of packets and triggering setup. See “Trace Information” on page 564.
<u>E</u> rror Summary	Summarizes the errors throughout the recording. Allows for fast navigation to packets with errors. See “Error Summary” on page 567.
<u>T</u> iming <u>C</u> alculations	Calculates timing between two packets and bus utilization. See “Timing Calculations” on page 573.
<u>D</u> ata View	Shows packet information. See “Data View” on page 576.
<u>T</u> raffic 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 580.
<u>B</u> us Utilization	Displays graphs of packet length, bus usage, and bus usage by device. See “Bus Utilization” on page 582.
<u>L</u> ink Tracker	Opens a window for displaying a detailed chronological view of traffic. The window provides view and navigation options. See “Link Tracker (3.2 x1 only)” on page 590.
<u>N</u> avigator	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 595.
<u>D</u> etail View	Displays details of selected packet. See “Detail View” on page 602.
<u>S</u> pec View	Shows packet header information and other items, in a view that matches the USB 3.2 specification. See “Spec View” on page 603.
USB 3.2 Link State Timing View	Graphically shows how much time the link spends in each link state. See “USB (3.2) Link State Timing View” on page 605.
USB 3.2 LTSSM view	Displays the LTSSM diagram depicted in the USB 3.2 specification. See “USB (3.2) LTSSM View” on page 607.
Power Tracker	Displays voltage, current, and power. See “Power Tracker: VBus and Configuration Channel (CC)” on page 608.
Decoded Fields View	Displays the Decoded Fields View. See “Decoded Fields view” on page 632.
Eye Diagram View	Displays the “Eye” diagram for USB traffic. See “Eye Diagram View” on page 632.
Run Verification Scripts	Opens a window to allow you to run verification scripts over the open trace. See “Running Verification Scripts” on page 634.

4.2.6 Search Menu

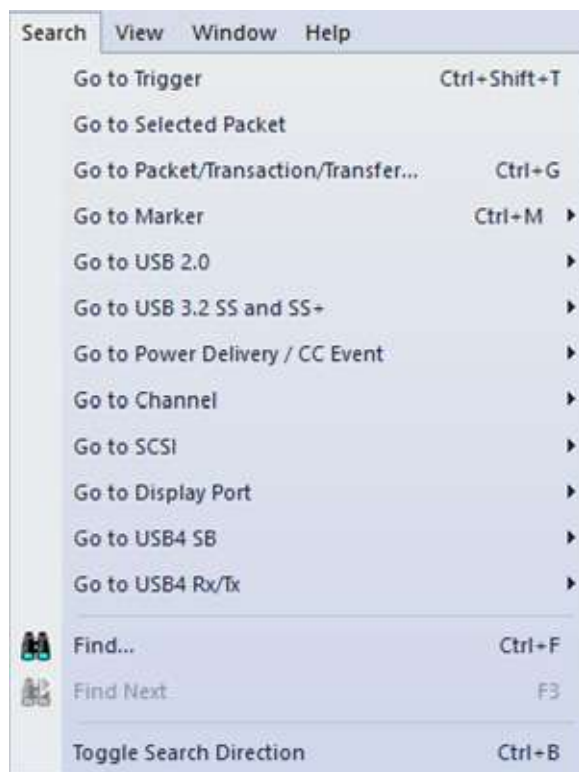
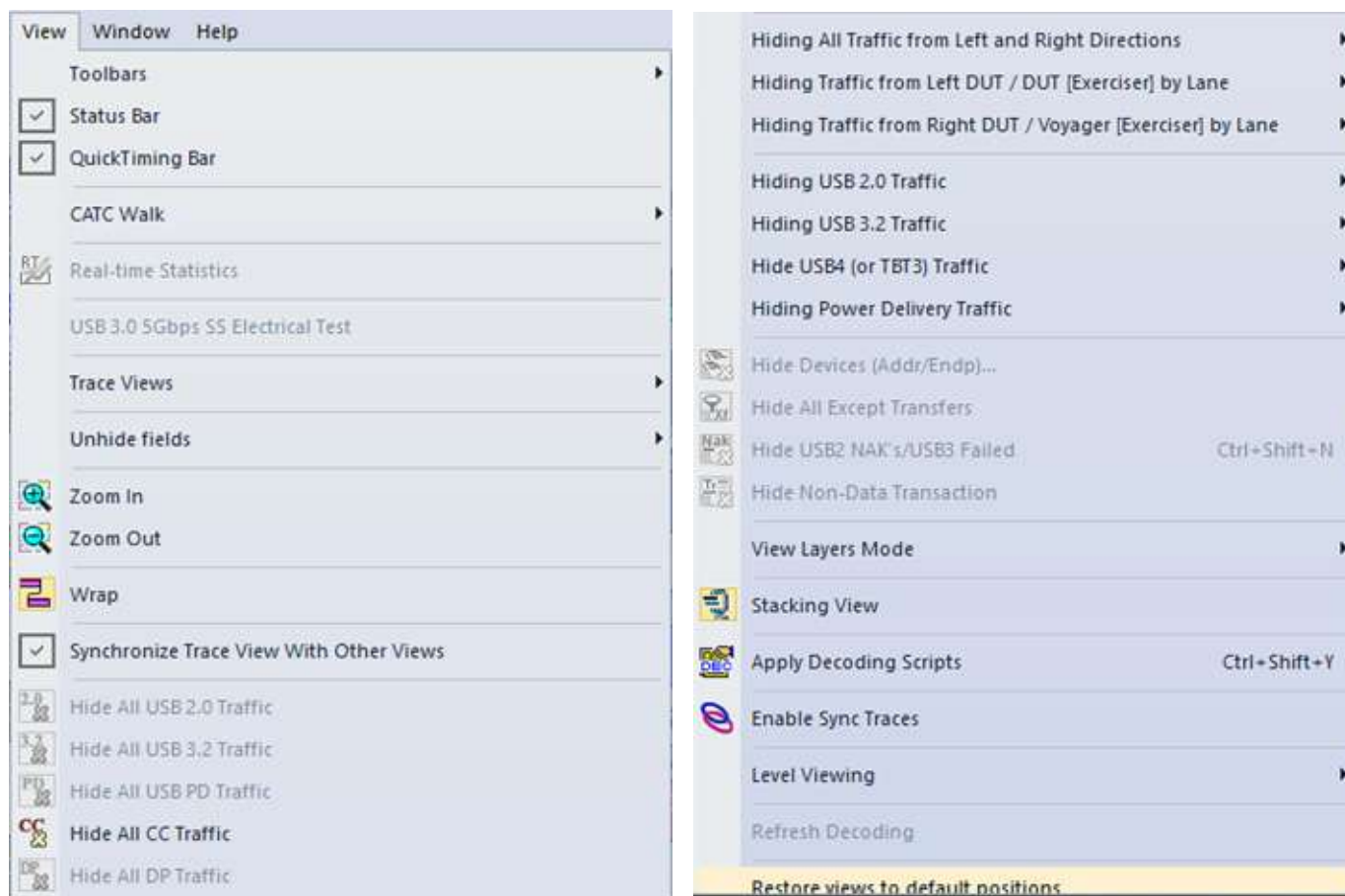


Figure 4.3: Search Menu

Search menu	Functions
	(see “Searching Traces” on page 445.)
Go to <u>T</u> rigger	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 <u>P</u> acket/ Transaction/ Transfer	Positions the display to the packet/transaction/transfer number selected in the Go to <u>P</u> acket/Transaction/Transfer menu.
Go to <u>M</u> arker	Positions the display to the selected marked packet.
<u>G</u> o to USB 2.0	Positions the display to the selected event, condition, value, or type.
Go to <u>U</u> SB 3.2 SS and SS+	Positions the display to the selected event, condition, value, or type.
Go To Power Delivery/ CC Event	Searches for specific Power Delivery and Configuration Channel 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.

Search menu	Functions
Go to Display Port	Positions the display to the selected Display Port Packets, Transaction Type or Transfer Type
Go to USB4 SB	Positions the display to the selected SideBand Transaction Type: AT, RT, LT or Raw
Go to USB4 Rx/Tx	Positions the display to the selected Ordered Set, Control Packets, Line Management Packets, Time Sync Packets, Tunneled Packets or Unidentified Symbol Sequences (USS)
Find	Allows complex searches on multiple criteria. See “Find” on page 502 .
Find <u>N</u> ext	Repeats the previous Find operation.
Toggle <u>S</u> earch Direction	Allows the search direction to be changed from Forward to Backward, or vice versa. The current Search Direction can be found in the lower right hand corner of the Application, in the Status Bar.

4.2.7 View Menu



Top Half

Bottom Half

Figure 4.4: View Menu (top and bottom halves)

View menu	Functions
<u>T</u> oolbars	Displays list of available toolbars. See “Resetting the Toolbar” on page 223 .
<u>S</u> tatus Bar	Switches display of the Status Bar on or off. See “Status Bar” on page 224 .
<u>Q</u> uickTiming 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.

View menu	Functions
Real-time Statistics	Allows you to view traffic statistics as they occur. See “Real Time Monitoring” on page 638.
USB 3.0 5Gbps SS Electrical Test	Tests electrical characteristics. See “USB 3.0 5Gbps SS Electrical Test Modes” on page 718.
Trace Views	Displays CATC Trace, Compressed CATC Trace, Spreadsheet (Color), or Spreadsheet (B/W).
Unhide fields	Unhide previously hidden Traffic, VBus Power, PD Preamble, CC1 Left Power, CC2 Left Power, CC1 Right Power, CC2 Right Power, USB4 SB CRC, USB4 Reserved, USB4 CRC 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 3.2 Traffic	Hides all the SuperSpeed and SuperSpeed+ traffic.
Hide All USB PD Traffic	Hides all the USB power delivery traffic.
Hide All CC Traffic	Hides all Type-C CC1 and CC2 Event Traffic (Configuration Channel)
Hide All DP Traffic	Hides All Data Port Traffic
Hide All Traffic from Left and Right Directions	Hides All Transfers from Left DUT or DUT (Exerciser) when system is in Analyzer Mode
	Hides All Transfers from Right DUT or Voyager (Exerciser) when system is in Exerciser Mode
Hiding Traffic from Left DUT / DUT [Exerciser] by Lane	Hide L0, Hide L1, Hide LB, Hide PD/USB4 SB
Hiding Traffic from Right DUT / Voyager [Exerciser] by Lane	Hide L0, Hide L1, Hide LB, Hide PD/USB4 SB
Hiding USB 2.0 Traffic	Hides. SOE's: Start of Frames Chirps: Chirp-K and Chirp-J Bus conditions (these are recorded only)
Hiding USB 3.2 Traffic	Hides: 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

View menu	Functions
Hide USB4 (or TBT3) Traffic	Hides USB4 Sideband Traffic Hide USB4 Traffic Hide/Show Ordered Sets (Hide SLOS1/SLOS2) (Hide TS1/TS2) (Hide TSN) (Hide Low Power OSs) (Hide CL_WAKES) (Hide DESKEWS) Hide/Show Control Packets (Hide Control Packets) (Read Request) (Read Response) (Write Request) (Write Response) (Notification) (Notification Ack) (Hot Plug Event) (Inter-Domain Request) (Inter-Domain Response) Hide/Show Link Management Packets (Hide Link Management Packets_) (Credit Grant) (Path Credit Sync) (Shared Buffers Credit Sync) Hide/Show Time Sync Packets (Hide Time Sync Packets) (Follow Up) (Inter Domain TS) Hide/Show Miscellaneous Traffic (Hide SKP/Idle/USS/IPS/LFPS) Hide/Show Upstream Hop IDs (Hop ID 0/Hop ID 1/Hop ID3/Hop ID 8) Hide/Show Downstream Hop IDs (Hop ID 0/Hop ID 1/Hop ID3/Hop ID 8) Hide/Show Tunneled PCIe (Show/Hide Update_FC) (see “Hide/Show Tunneled PCIe Traffic” on page 185) Hide/Show Tunneled USB3 Traffic (Hide TS1/TE2 Packets) (Hide Link Commands) (Hide LUP/LDN) (Hide Flow Control) (Hide Power Management) (Hide LFPS Packets) (see “Hide/Show Tunneled USB3 traffic” on page 187) (Miscellaneous) (Hide ISO Time Stamp Packets) (Hide SDS Packet)

View menu	Functions
Hiding Power Delivery Traffic	Hide Unknown Packets Hide Ping Packets Hide GoodCRC Packets
Hide Devices (Addr/Endp)....	Opens the Hiding Devices dialog displaying packets belonging to specified devices by address and endpoint
Hide All Except Transfers	Hide All Except Transfer's Packets
Hide USB2 NAK's/USB3 Failed	Shows/Hides USB2 NAK'd Transactions and USB3 Failed Transactions
Hide Non-Data Transaction	Shows/Hides all Non-Data Traffic
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 407 .
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 527 .
Enable Sync Traces	Synchronizes views between synced traces. See "Enable Sync Traces (used with Hub Compliance)" on page 441 and "Edit Comment" on page 443 .
Level Viewing	Displays Packet Level Displays PHY Transaction Level Displays Transaction Level Displays Split Transaction Level Displays Transfer Level PTP Group PTP Transaction Level displays PTP Transactions PTP Object Transfer Level displays PTP Objects PTP Session Level displays PTP Sessions 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.

4.2.7.1 Hide/Show Tunneled PCIe Traffic

You can Show or Hide different types of Tunneled PCIe traffic. One of the options is to Show or Hide Update_FC traffic as shown in [Figure 4.5](#), [Figure 4.6](#) and [Figure 4.7](#) on page 186.



Figure 4.5: View -> Hide USB4 (or TBT3) traffic -> Hide/Show Tunneled PCIe -> Hide Update_FC

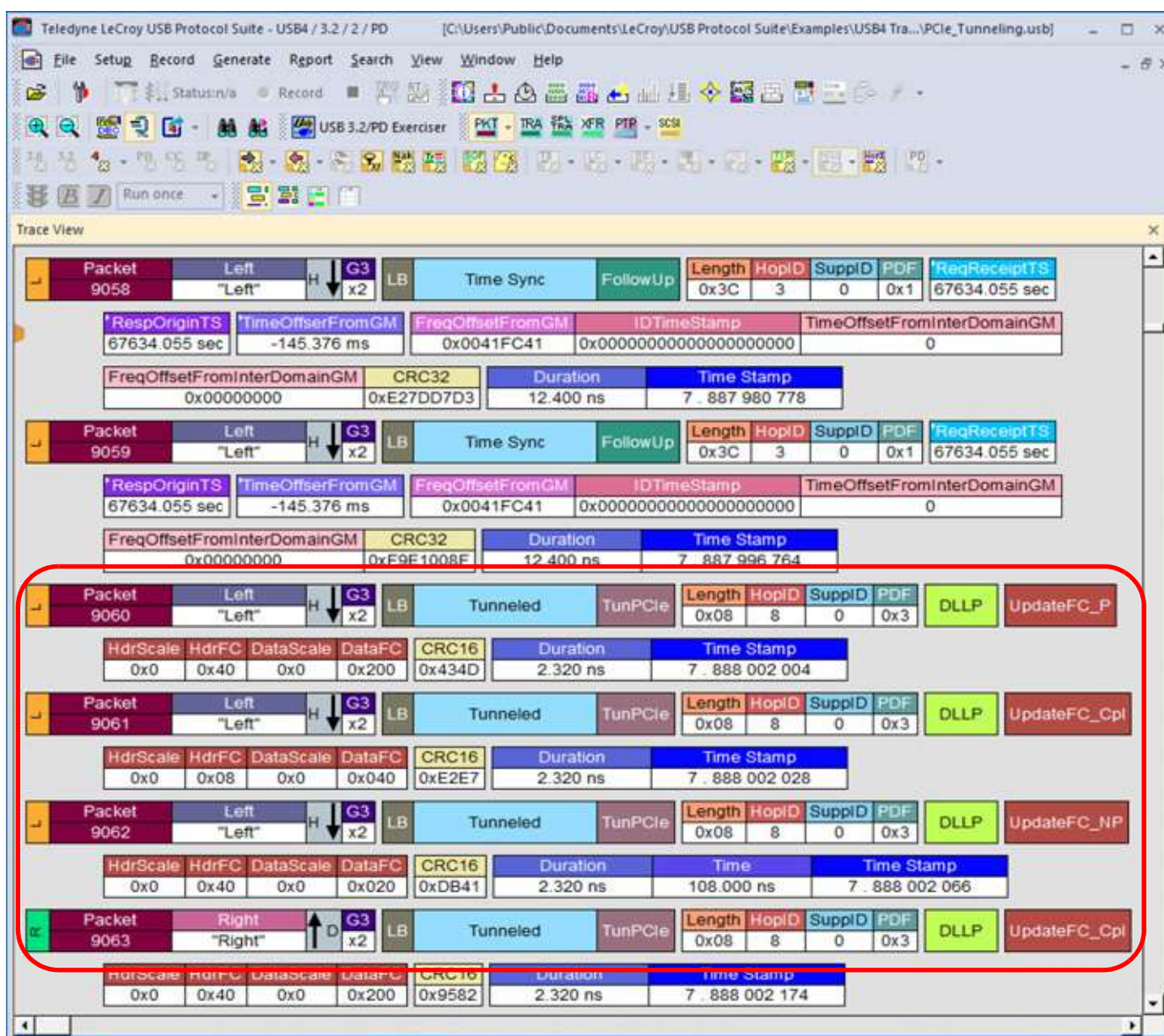


Figure 4.6: Show Update_FC traffic

When you select **View -> Hide USB4 (or TBT3) Traffic -> Hide/Show Tunneled PCIe -> Hide Update_FC traffic** the displayed trace hides the **Update_FC** packets as shown in [Figure 4.7](#).

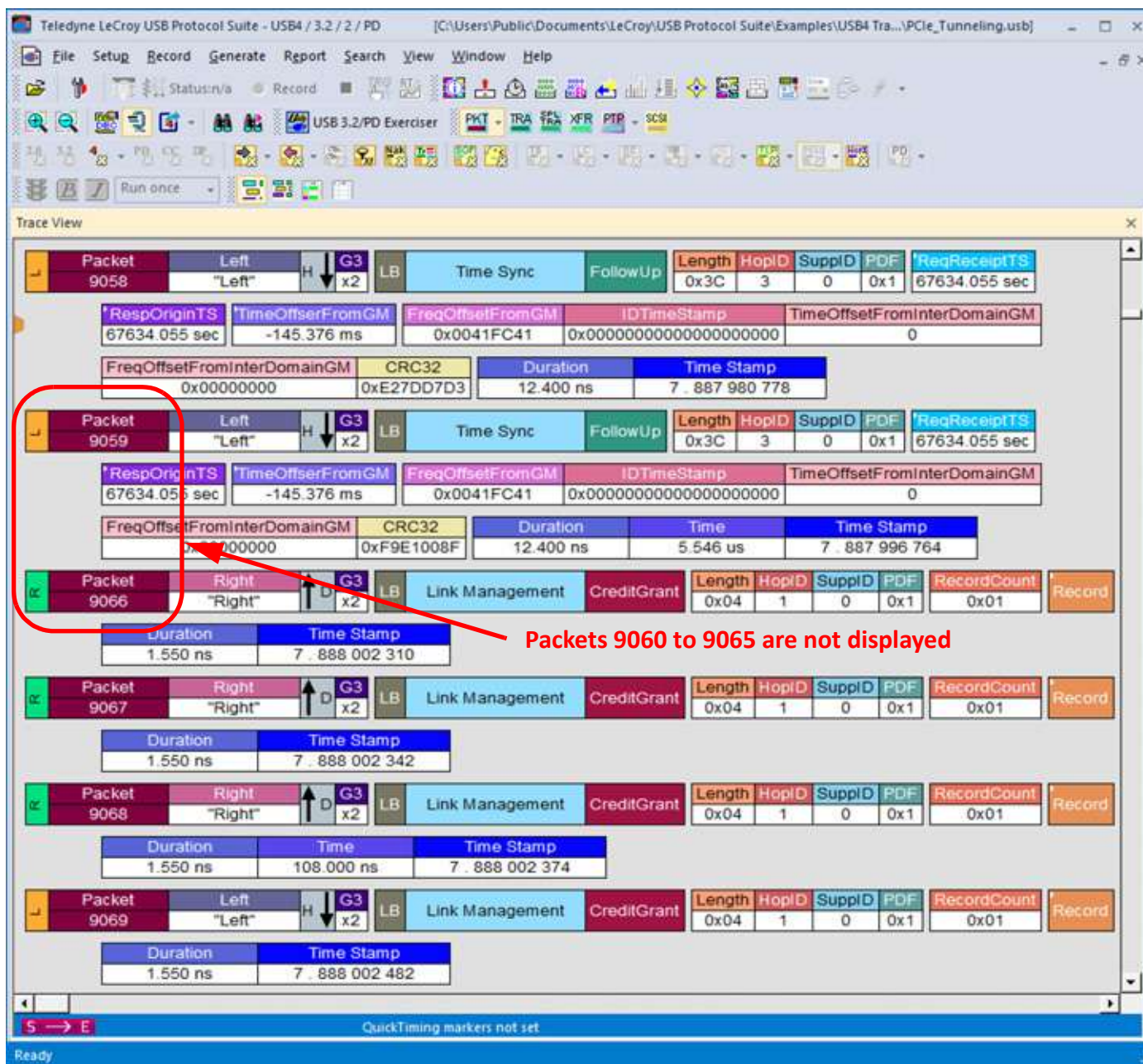


Figure 4.7: Hide Update_FC traffic

4.2.7.2 Hide/Show Tunneled USB3 traffic

You can Show or Hide different types of Tunneled USB3 traffic. One of the options is to Show or Hide LFPS Packets as shown in [Figure 4.8](#), [Figure 4.9](#) and [Figure 4.10](#) on page 188.



Figure 4.8: View -> Hide USB4 (or TBT3) traffic -> Hide/Show Tunneled USB3 traffic -> Hide LFPS Packets

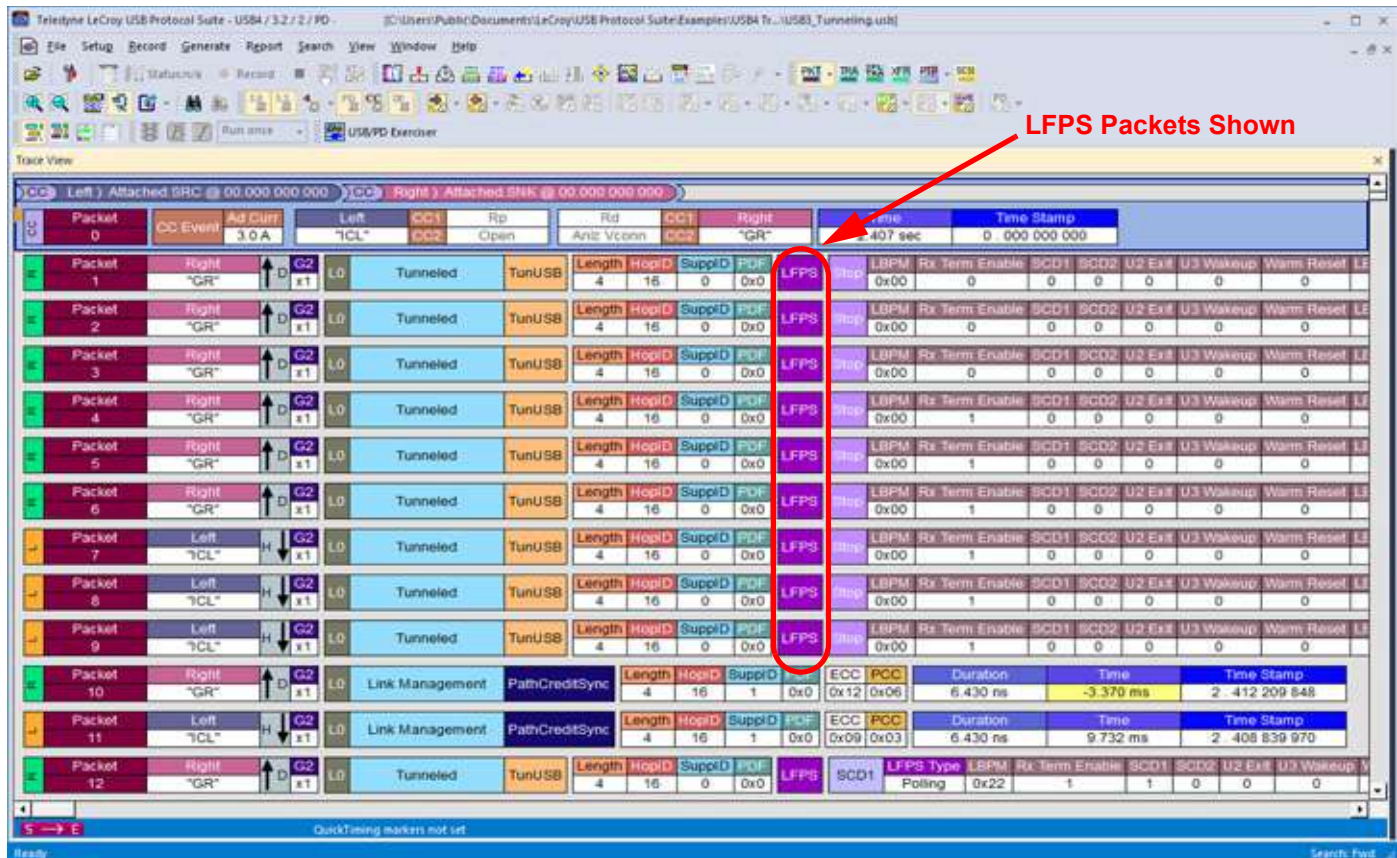


Figure 4.9: Trace Showing Tunneled USB3 Traffic -> LFPS Packets Shown

Now select Hide LFPS Packets. See [Figure 4.10](#) on page 188.

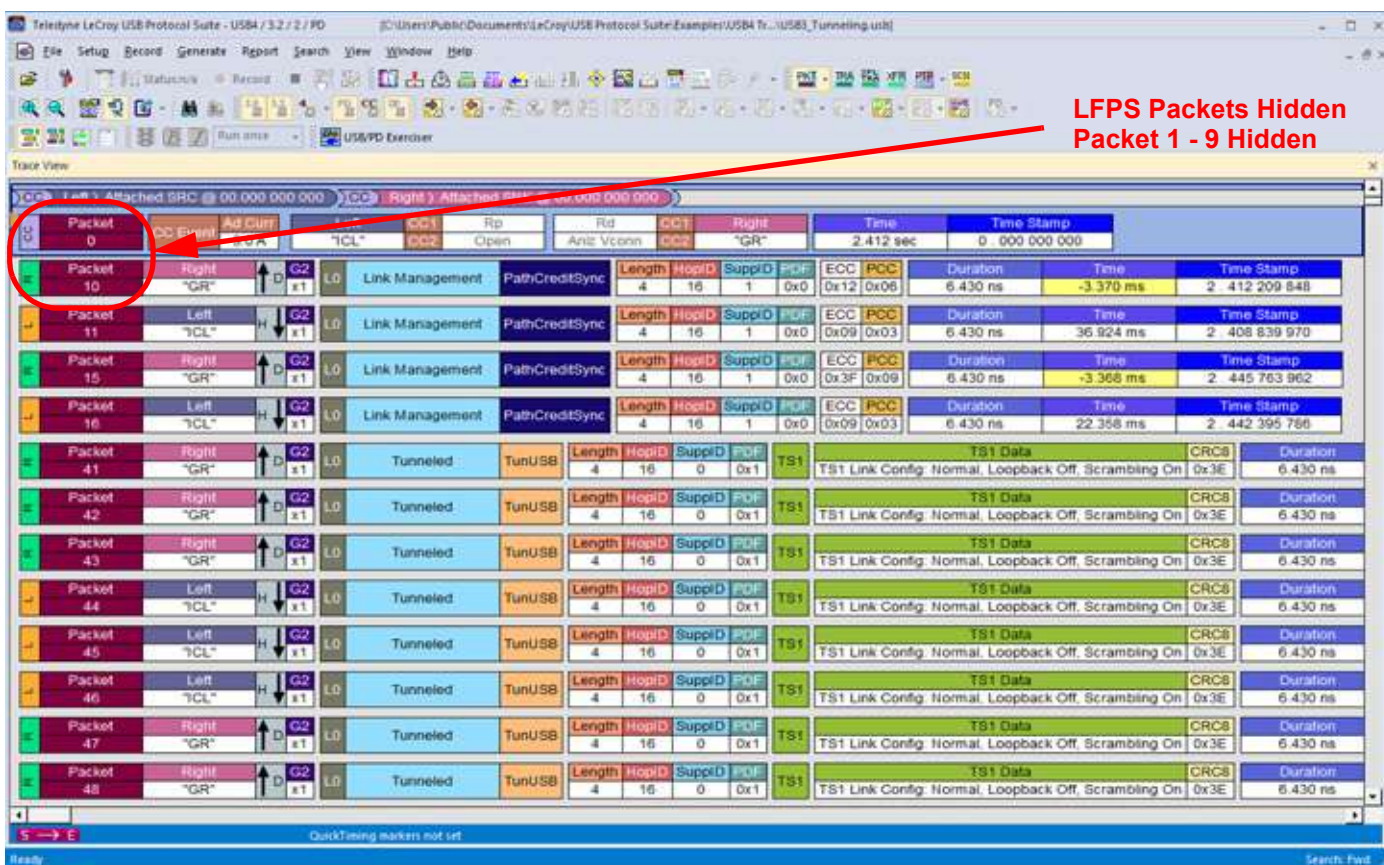
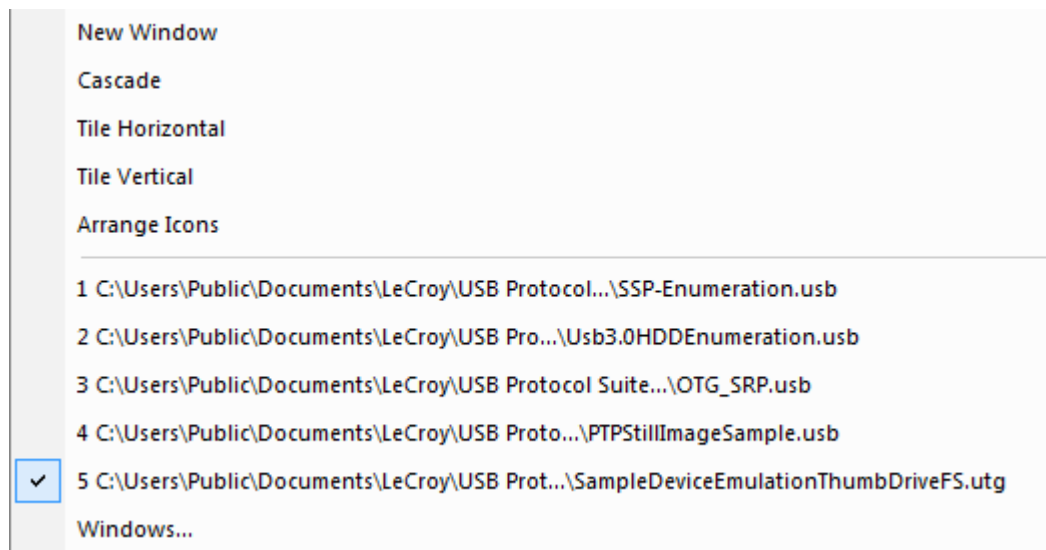


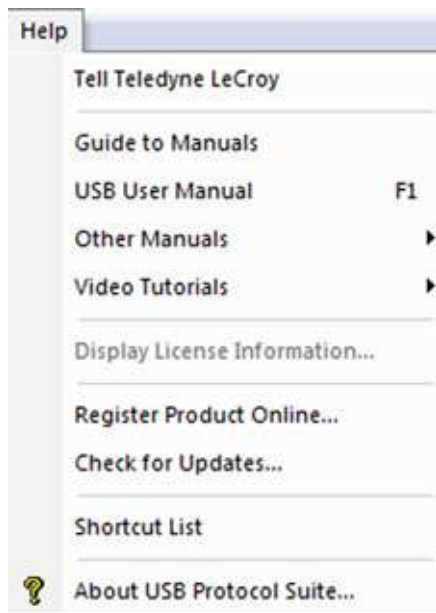
Figure 4.10: Trace with LFPS Packets Hidden

4.2.8 Window Menu



Window menu	Functions
<u>N</u> ew Window	Switches display of the Tool Bar on or off.
<u>C</u> ascade	Displays all open windows in an overlapping arrangement.
Tile <u>H</u> orizontal	Displays all open windows in a above-below arrangement.
Tile <u>V</u> ertical	Displays all open windows in a side-by-side arrangement.
<u>A</u> rrange Icons	Arranges minimized windows at the bottom of the display.
Windows ...	Displays a list of open windows.

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 3.2 Exerciser Manual PDFs. It can be used as on-line help.
Video Tutorials	Has links to YouTube videos that describe Voyager features: Basic USB 3.2 Recording, USB 3.2 Basic Triggering, USB 3.2 Advanced Triggering, Troubleshooting USB 3.2 Connection Issues, USB 3.2 Packet Header Display, USB 3.2 Compliance (Part 1). USB 3.2 Compliance (Part 2)
<u>D</u> isplay License Information	Displays information related to licensing. Also used to update a license key. See “License Information” on page 741 .
<u>R</u> egister Product Online	Register at the Teledyne LeCroy website. See “Registering Online” on page 743 .

Help menu	Functions
<u>C</u> heck 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 734 .
Shortcut List	Displays the Shortcuts List of navigation, common, search, decode levels, and miscellaneous mouse and keyboard shortcuts. See “Analyzer Keyboard Shortcuts” on page 236 .
<u>A</u> bout USB Protocol Suite	Displays version information about the Analyzer and the USB Protocol Suite. See “Software, Firmware, and BusEngine Revisions” on page 733 .

4.3 Exports to .CSV

.CSV files may be created as exports from the contents of 2.0 CATC Trace Packet and Transaction Views, 3.2 CATC Trace Packet views, and any Spreadsheet view. The output is limited to 1 million rows.

Note: The format of Export files is NOT compatible with that of files to be used for the Import functions. The Import .csv file is based on symbol streams at the 10 bit symbol level. The exports are based on decoded delimited packet bytes.

4.3.1 Export Packets to .CSV

When viewing 2.0 or 3.2 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.

4.3.2 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.

4.3.3 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.

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

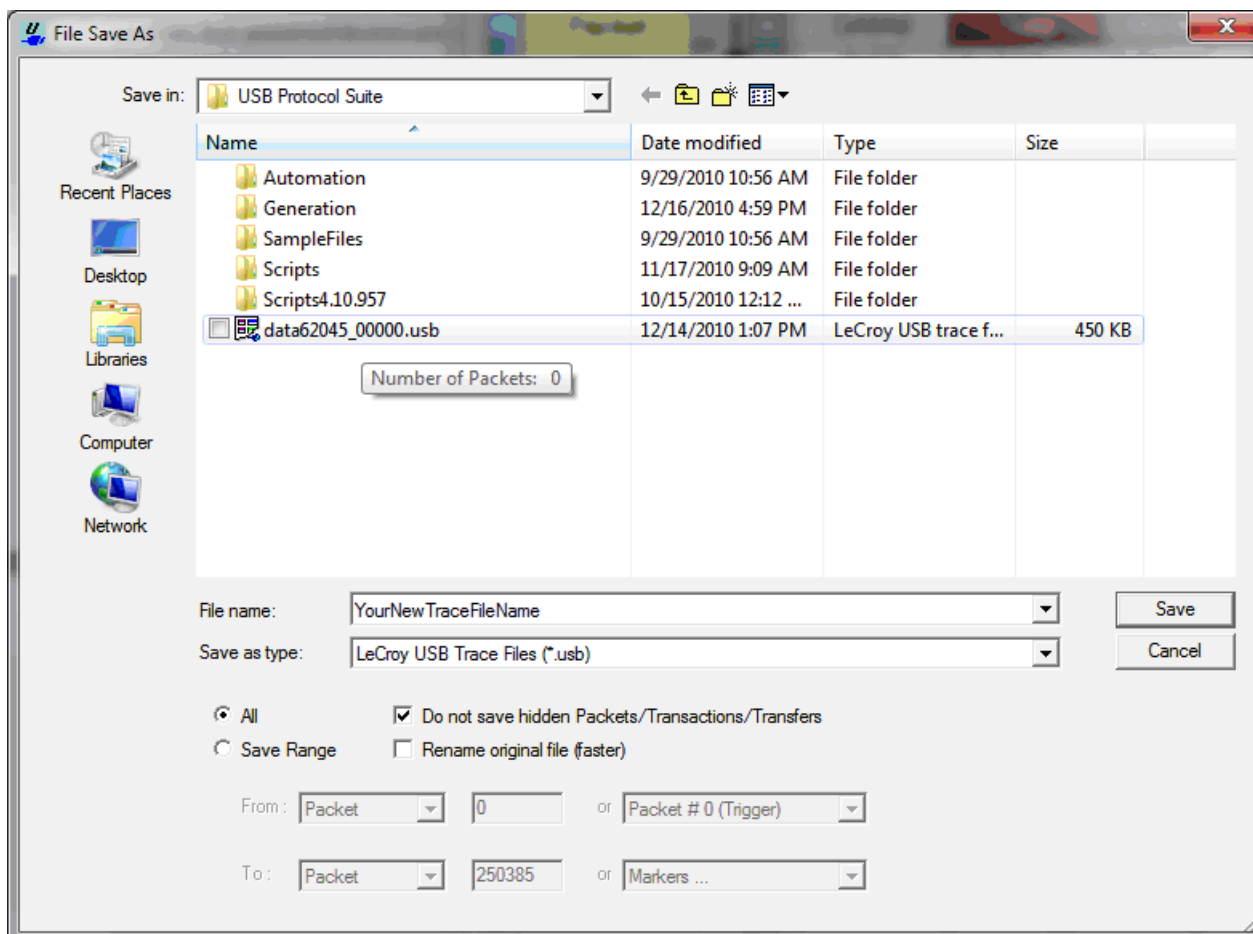
Before exporting to a **.utg** file, first make sure the **.usb** file contains traffic for only one device:

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

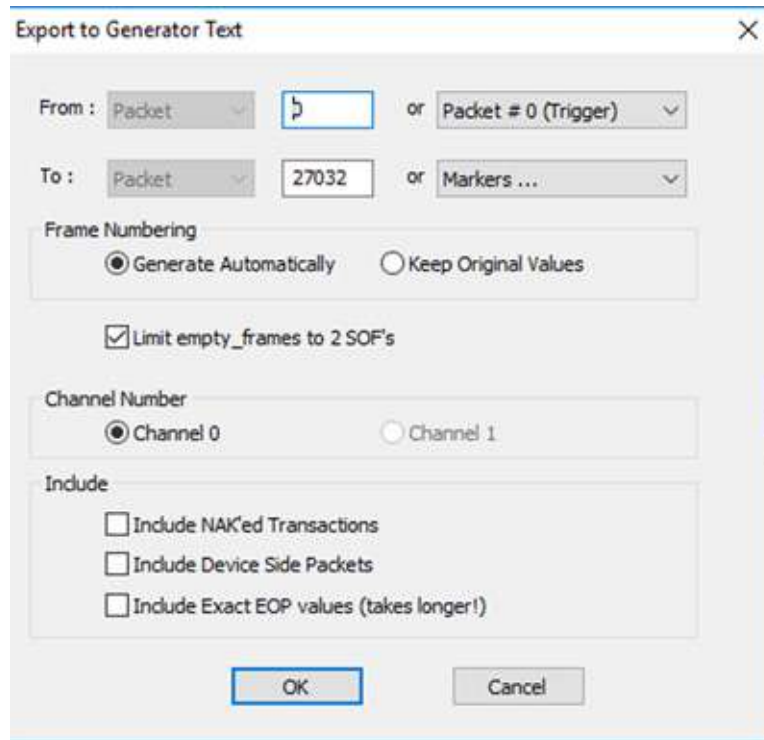
2. Click on the Hide Devices  icon.
The following dialog displays.



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. Take all the default selections unless you have good reason, as this will create the simplest, fastest file:
 - a. Frame Numbering- Letting the frame numbers be generated by the hardware will enable you to edit the .utg file without having to modify all the frame numbers.
 - b. Limit empty_frames to 2 SOF's - This reduces the size of the the generator file image in the hardware memory, allowing the most efficient use of that space. If you need the value to be some number other than 2, you can use a text editor to do a global search & Replace. This might be necessary if you are trying to preserve the number of frames between interrupt or isochronous packets. In that case, it might be better to export without this item checked, and then pare down the size of the file through hand editing the file to reduce large values of "empty_frames".
 - c. Include NAK'ed Transactions - This uses extra generation memory to repeat the original scenario's NAK behavior. This can cause the scenario to fail if the device does not behave EXACTLY the same each run.
 - d. Include Device Side Packets - Used to create a generation file that runs without a device! It just re-creates the original scenario, and requires a termination plug for the analyzer.

- e. Include exact EOP values (LS&FS) - This recreates the same EOP values for the packets as they were seen in the original trace file. This takes much longer to export, and there is little to be gained from it.
6. If the captured file was Hi Speed and was recorded in Auto-Speed Detect mode, you must add a **chirp = 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 "Chirp" sequence is not captured in the trace file.

4.3.5 Export: USB4 Tunneled PCIe Traffic to PCIe Protocol Suite Trace File

If you load a USB4 trace with “Tunneled” PCIe traffic, you can **Export** only the PCIe tunneled traffic to a new PCIe “.pex” trace. If you open the CrossSync tool (see [Figure 4.11](#)) you can see both the Tunneled PCIe traffic in the USB4 “.usb” trace and the PCIe traffic in the PCIe Protocol Analysis software (see [Figure 4.13 on page 196](#)). For more information about CrossSync tool see the *CrossSync User Manual*.

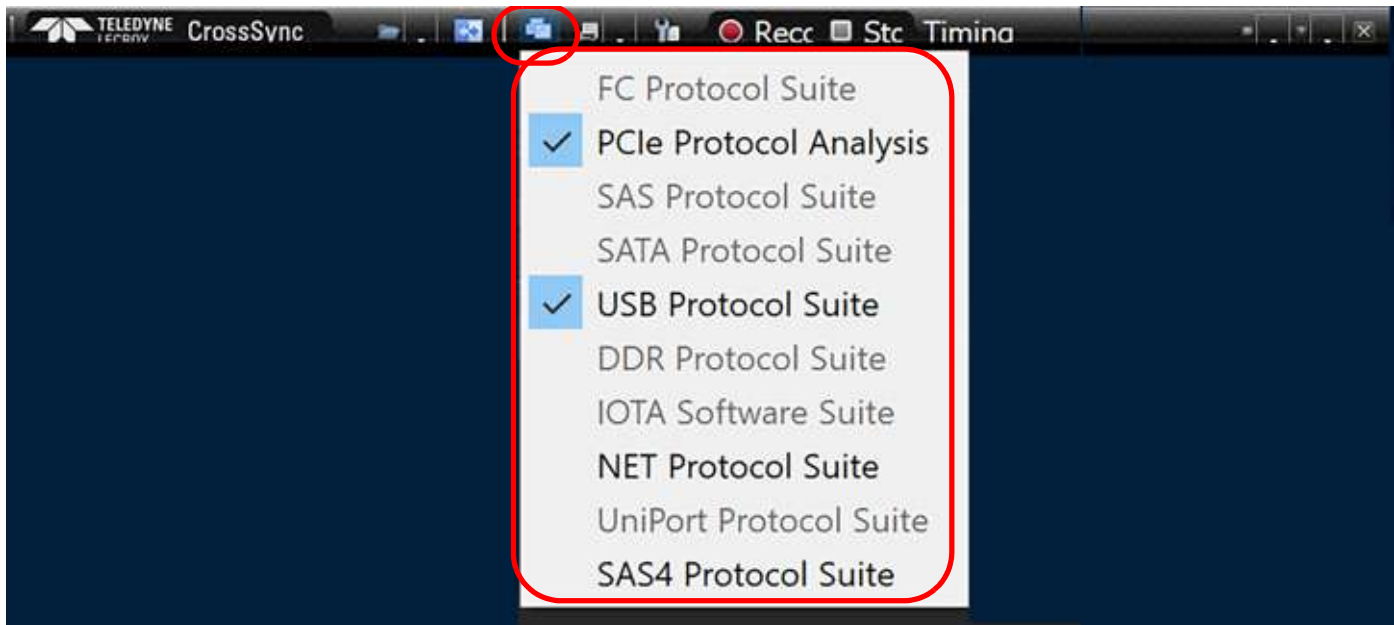


Figure 4.11: USB4 Traffic with Tunneled PCIe traffic -> Shown in CrossSync tool

To make sure than the traces are time synchronized, select the Traces synced icon in the CrossSync Toolbar. See [Figure 4.12](#).

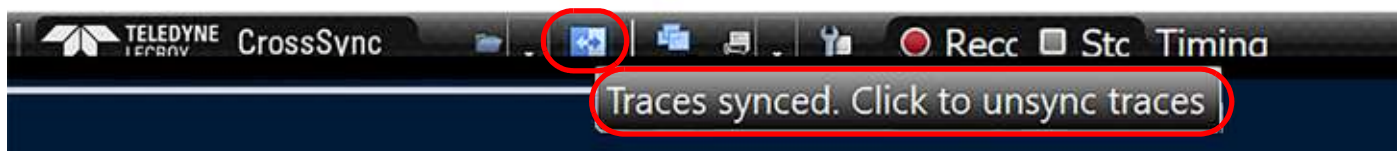
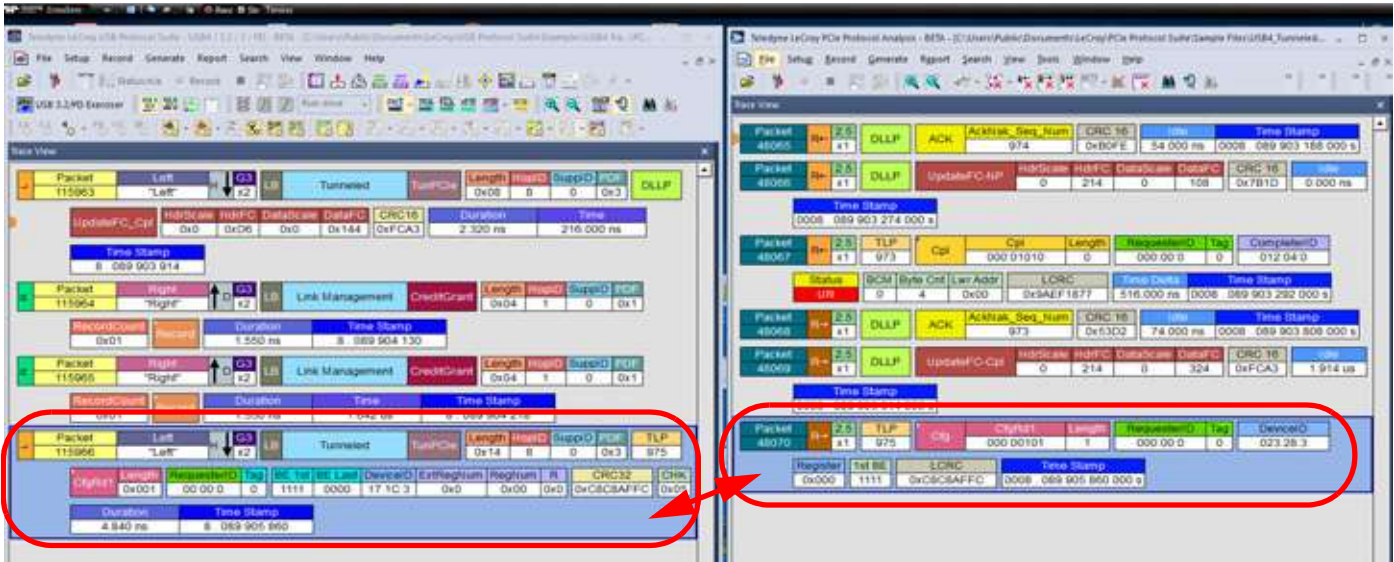


Figure 4.12: Select Traces Synced from Toolbar

The trace with USB4 tunneled PCIe traffic will be time synchronized with the Exported trace with PCIe traffic. See [Figure 4.13 on page 196](#).



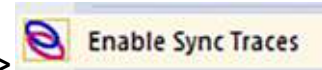
Exported PCIe Trace

USB4 with Tunneled PCIe Trace

Figure 4.13: CrossSync: USB Protocol Suite and PCIe Protocol Suite Enabled

4.3.6 Export: USB4 Tunneled USB Traffic to USB 3.2 Native Trace

If you load a USB4 trace with “Tunneled” USB3.2 traffic, you can **Export** only the USB 3.2 tunneled traffic to a new trace. As shown below in [Figure 4.14](#) shows two traces. The original USB4 traffic with tunneled USB3.2 traffic (left side) and the USB3.2 Native traffic only on right side.



You can also time Synchronize the two traces by selecting **View ->**

Then the USB4 trace with tunneled USB3.2 Native traffic and the trace with tunneled PCIe traffic will be time synchronized. See [Figure 4.14](#).

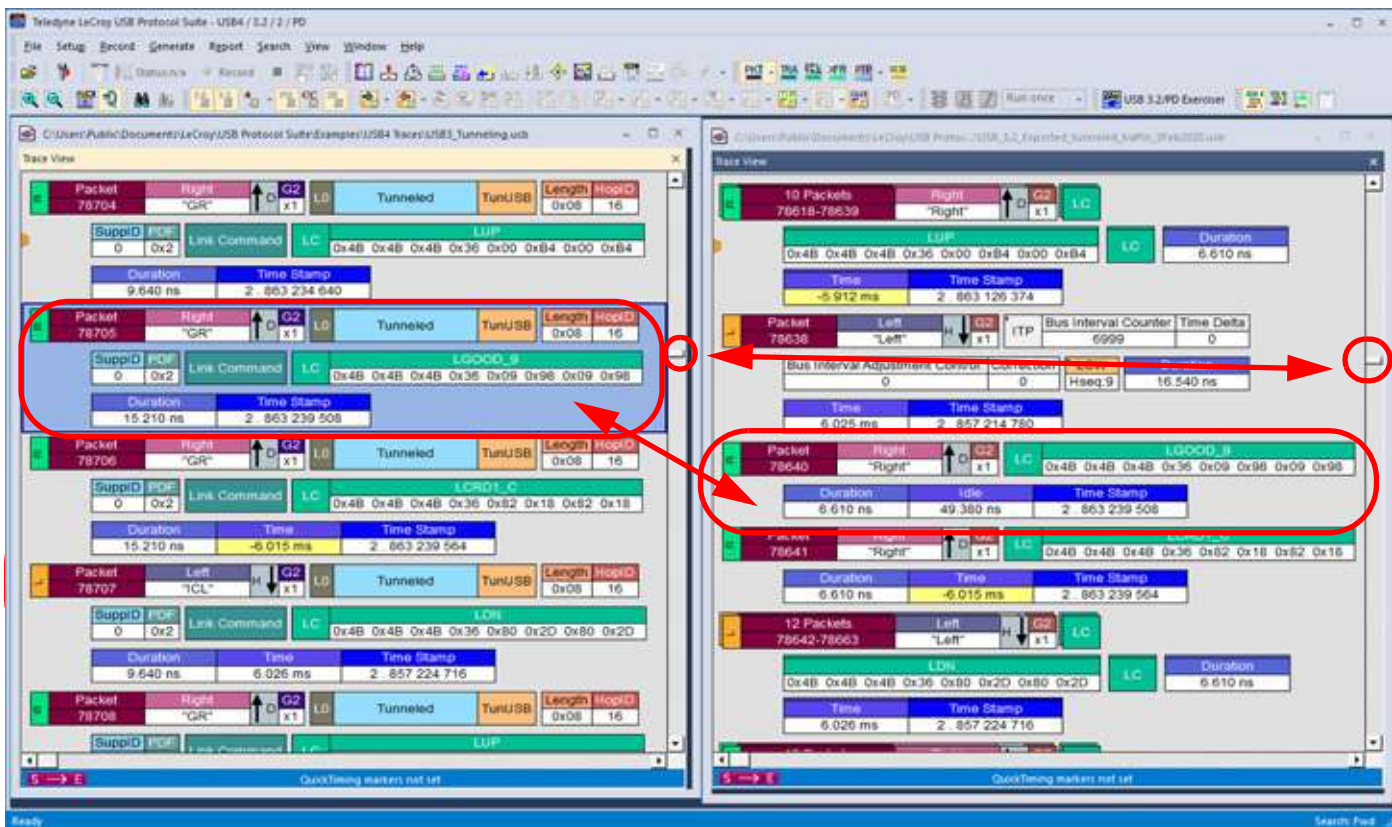


Figure 4.14: Original USB4 Trace with Tunneled USB 3.2 Traffic

4.3.7 Export: USB4 Tunneled DP Traffic to DP Native Trace

If you have captured Data Port (DP) traffic in a USB4 trace, you can export the USB4 tunneled DP traffic to a DP Native Trace using the Export function in the USB Protocol Suite software. See [Figure 4.15](#).

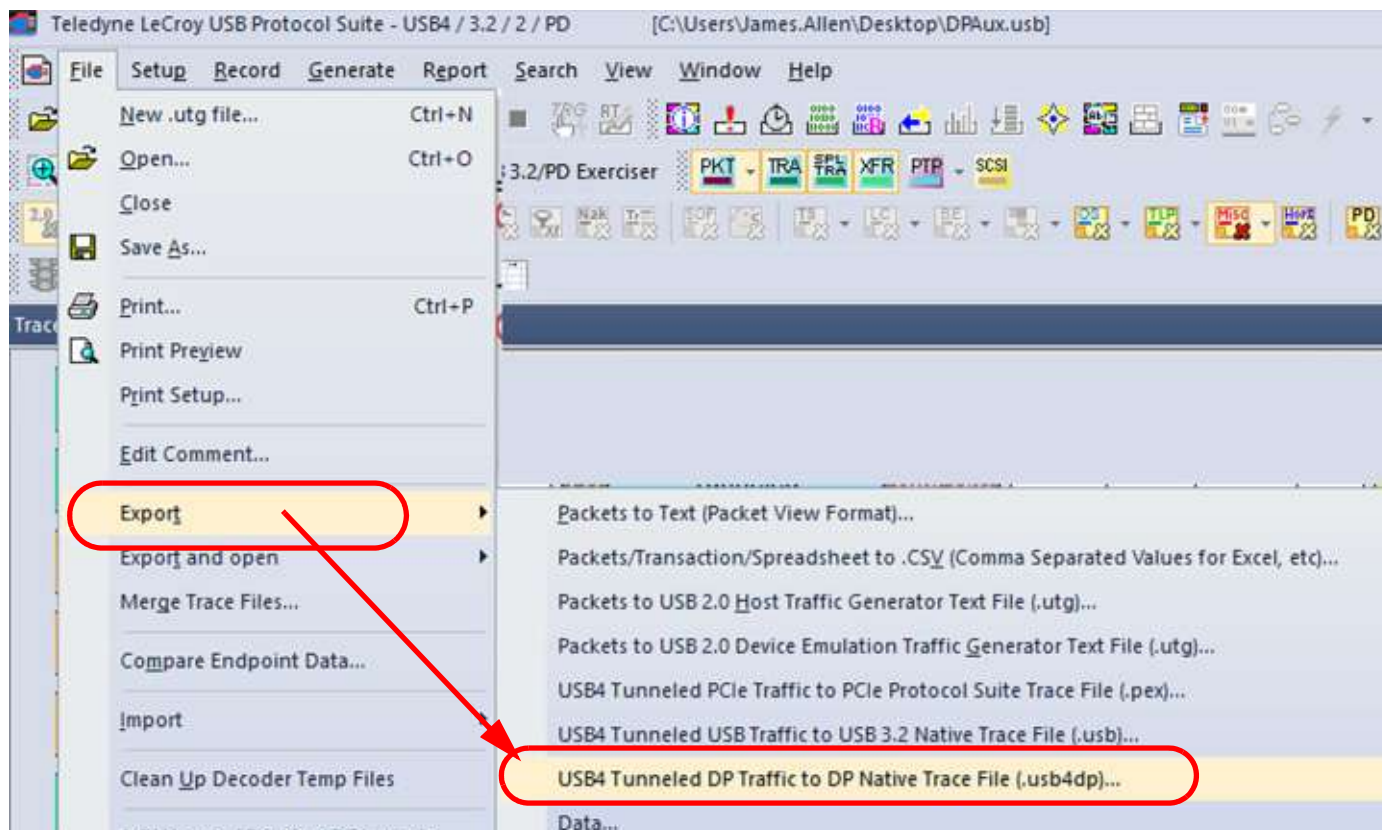


Figure 4.15: Export USB4 Tunneled DP traffic to DP Native Trace

When you select the Export -> USB4 Tunneled DP Traffic to DP Native Trace File another window pops up that shows you the path to the exported trace file and allows you to enter a name for the trace file. See [Figure 4.16 on page 199](#).

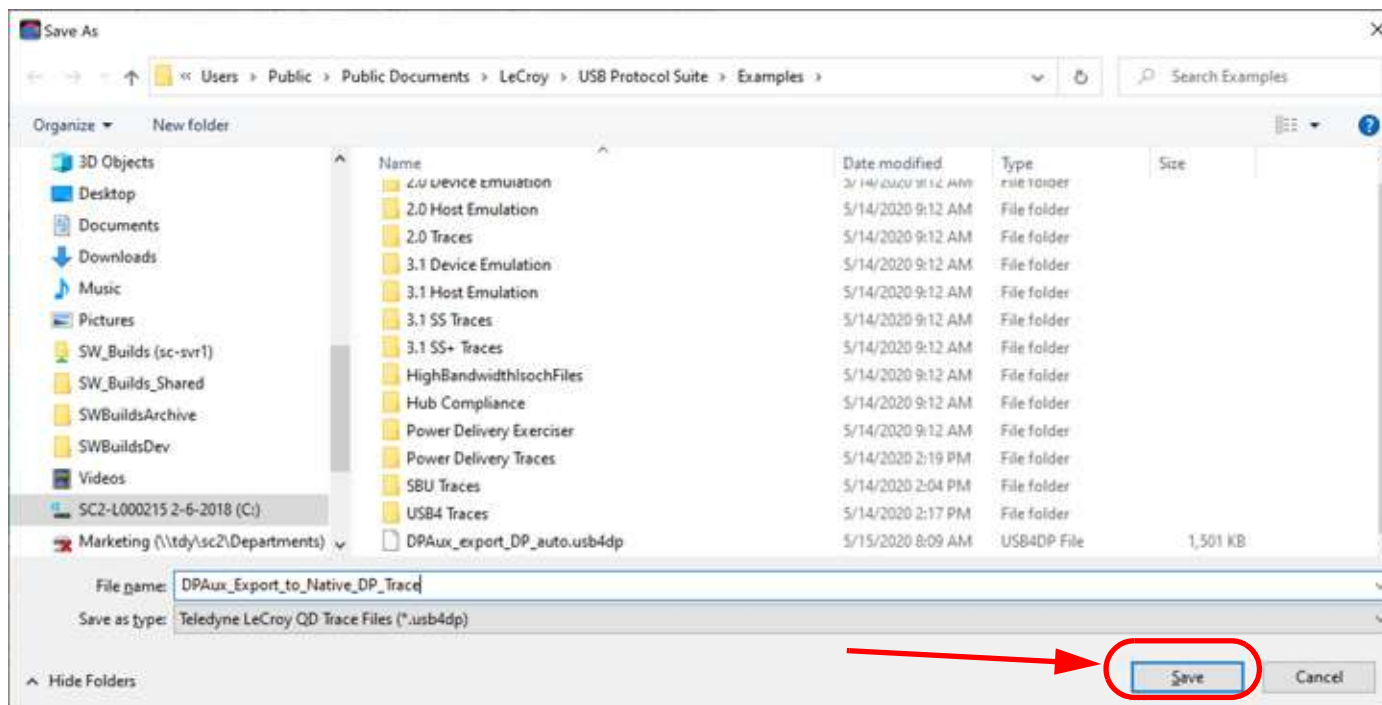


Figure 4.16: Enter a trace File Name

Click on Save to store the newly name DP Trace file.

You now have the ability to open the DP Trace file using the **quantumdata** ATP Manager. This tool must be downloaded and installed separately. See [Figure 4.17](#).

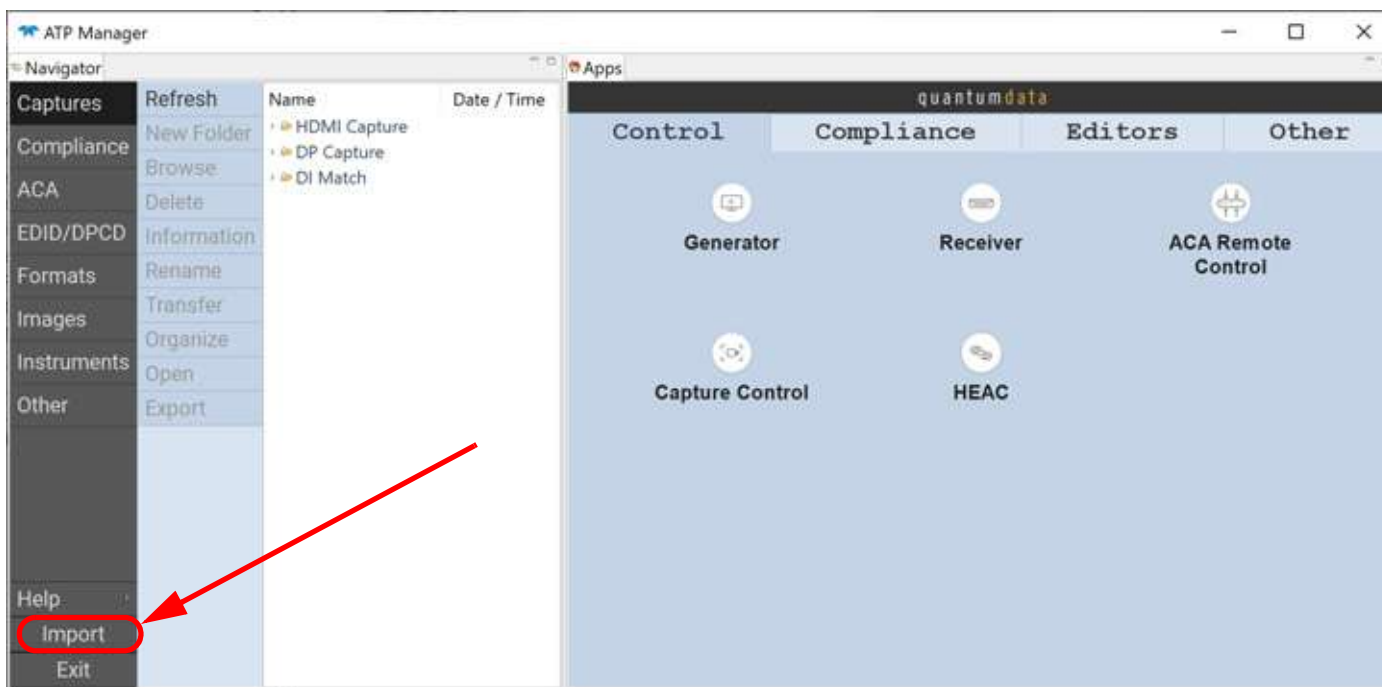


Figure 4.17: **quantamdata** ATP Manager

Select the **Import** function from the lower left side of the window.

Then select the trace your just stored. See [Figure 4.18](#).

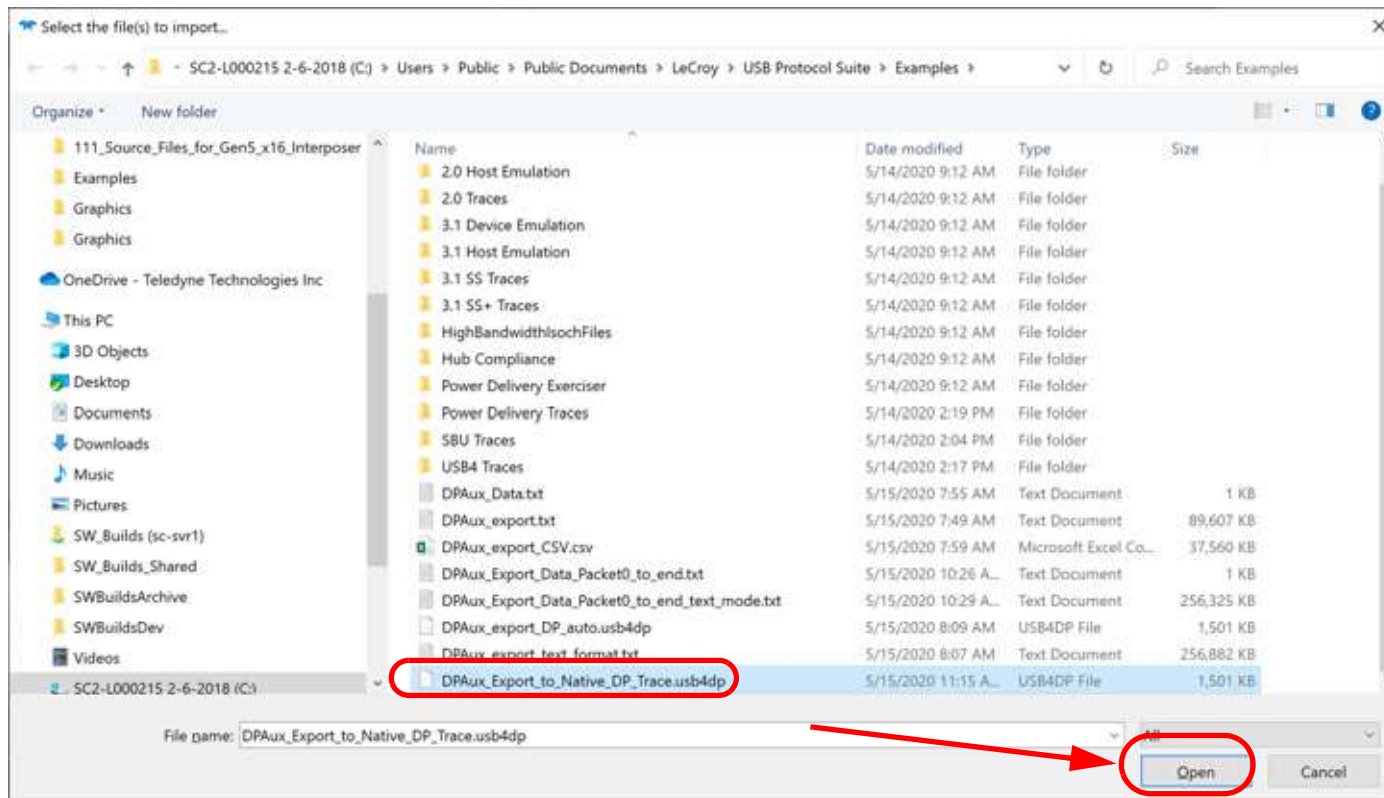


Figure 4.18: Select File to Import

Select Open and the **quantumdata** Import Tunneled DP Trace dialog will pop up. See [Figure 4.19](#) on page 200.

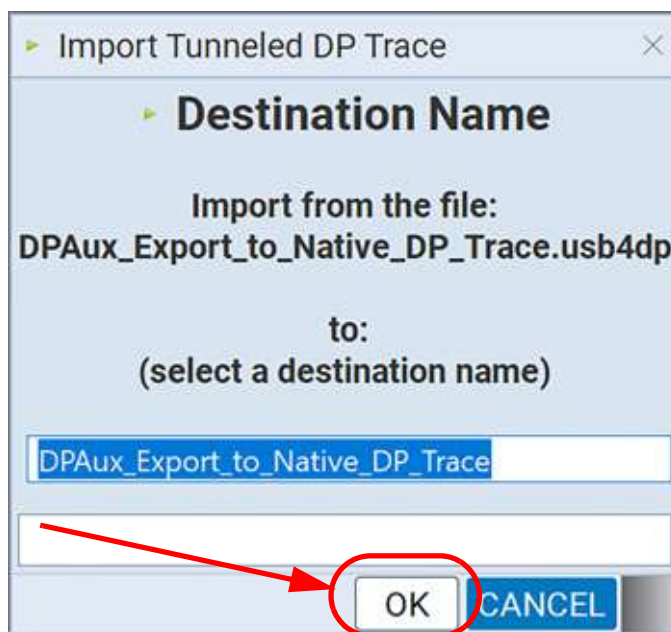


Figure 4.19: **quantumdata** Import Tunneled DP Trace dialog

Select OK to bring up the **quantumdata** USB4 -> DP Import window will show a Processing Events as the trace is import. See [Figure 4.20](#).



Figure 4.20: **quantumdata** USB4 -> DP Import window

When the importing of the trace has finished, the DP Capture Viewer will pop up. See [Figure 4.21](#) on page 201.

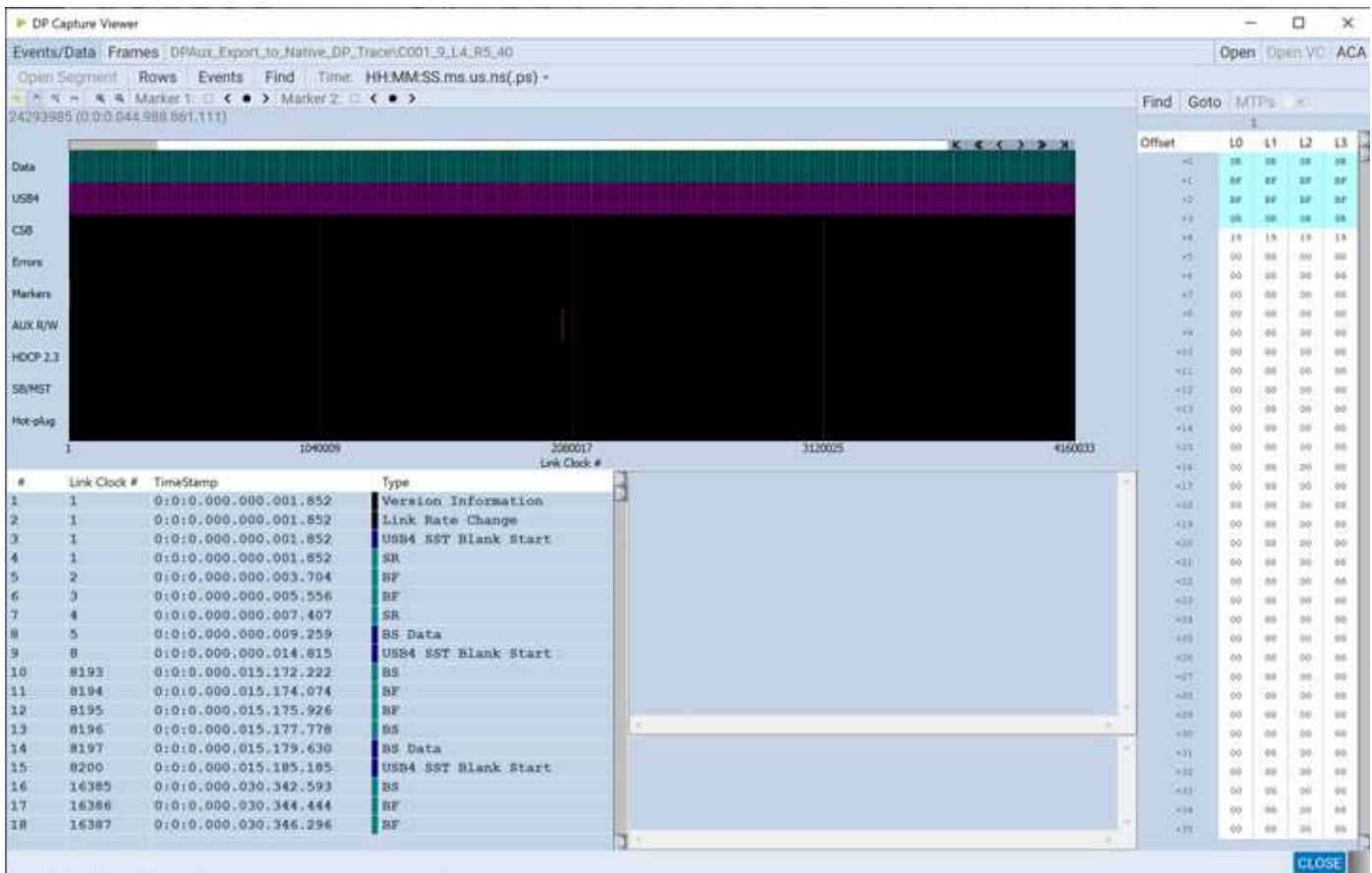


Figure 4.21: **quantumdata** DP Capture Viewer

For more details about **quantumdata** products click on the following link.

<https://www.quantumdata.com>

4.4 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.



4.4.1 Files, Searches, and Options

	Open file		Setup Recording Options. See “Recording Options” on page 241.
	Find (see “Find” on page 502)		Find Next

4.4.2 Zoom In and Zoom Out

	Zoom In		Zoom Out

4.4.3 Miscellaneous

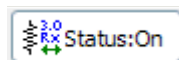
	Display Realtime Statistics. See “Real Time Monitoring” on page 638.		Assign High Level Decodes. See “Decode Requests” on page 527.
	Display Stacking View. See “Stacking” on page 407.		Export Tunneled USB3.0 or Export Tunneled PCIe traffic to new trace. See “Export Tunneled PCIe Traffic, Tunneled USB3 or Tunneled DP traffic” on page 217.

4.4.4 Analysis (Reports)

	Trace Information Report See “Trace Information” on page 564.		Error Report See “Error Summary” on page 567.
	Timing and Bus Usage Calculations See “Timing Calculations” on page 573.		Traffic Summary Report See “Traffic Summary Report” on page 580.
	Data View See “Data View” on page 576.		Raw Data View See “Raw Data View (including Power Delivery and USB4 Sideband Packets)” on page 577.
	Link Tracker See “Link Tracker (3.2 x1 only)” on page 590.		Bus Utilization See “Bus Utilization” on page 582.
	Open the Navigator bar See “Using the Navigator” on page 595.		Spec View See “Spec View” on page 603.
	Decoded Fields View. See “Decoded Fields View” on page 555.		Detail View See “Detail View” on page 602.

	Show USB 3.2 Link State Timing View. See “USB (3.2) Link State Timing View” on page 605.		Show USB 3.2 LTSSM View See “USB (3.2) LTSSM View” on page 607.
			Show Power Tracker. (Power captures are supported only on Voyager M3i, M3x, M310, and M310C.) See “Power Tracker: VBus and Configuration Channel (CC)” on page 608.

4.4.5 Recording



SuperSpeed (USB 3.2) 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 3.2 termination.

M3: This button is always enabled, and Auto mode is not supported. Termination control not available on Voyager M310P, since it uses a passive electrical tap.

	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 packets (Inter-Packet Symbols) see page 380 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.		

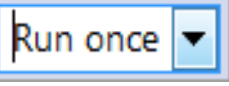
4.4.6 Generator (Traffic Generation for USB 3.2)

Please see [“Traffic Generation USB 3.2/USB4/PD Exerciser”](#) on [page 683](#).

	Go to USB 3.2 Exerciser window.		Manual Trigger

4.4.7 Generator (Traffic Generation for USB 2)

Please see [“Traffic Generation 2.0” on page 643](#).

	Start or Stop Traffic Generation (available if you have the Traffic Generation module).		Bitstream and Intelliframe modes
	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.		

4.4.8 View Level

Please see [“Switch to Transactions View” on page 418](#) and the following.

	Display Packets. See “Trace View Features” on page 377 .		Display PTP Objects. See “Switch to PTP Object Transfers” on page 430 .
	Display Transactions. See “Switch to Transactions View” on page 418 .		Display PTP Sessions. See “Switch to PTP Sessions” on page 431 .
	Display Split Transactions. See “Switch to Transactions View” on page 418 .		Display SCSI Operations See “Switch to SCSI Operations” on page 432 .
	Display Transfers. See “Switch to Transfer View” on page 424 .		Display USB4 Operation Level See “Switch to USB4 Operations” on page 433 .
	Display PTP Transactions See “Switch to PTP Transactions” on page 430 .		PTP Group Click the arrow to display the PTP Levels

4.4.9 Trace Views

Please see [“Compressed CATC Trace View” on page 434](#) and [“Spreadsheet View” on page 434](#).

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

4.4.9.1 Hide Protocols

	Hide all USB 2.0 traffic		Hide all USB 3.2 traffic
	Hide all Power Delivery Traffic		Hide all Configuration Channel (CC) Traffic
	  Sideband  USB4 Rx/Tx		
			
	Hide all DisplayPort Traffic		

4.4.9.2 Hiding Traffic (2.0 & 3.2)

You can Hide Devices and NAK's NRDY's by clicking the buttons in the table below or from the **View** menu.

	Hide Devices (Addr/Endp)		Hide USB2 NAK's/USB3 Failed Transactions
	Hide All Packets Except Transfer's Packets		Hide Non-Data Transactions (All except Setup, In <Out and Status)

Click **View** and select **Hide Devices (Addr/Endp)...** as shown in [Figure 4.22 on page 209](#)



Hiding
Devices

Figure 4.22: Selecting Hide Devices

The **Hiding Devices** dialog is invoked as shown in [Figure 4.23 on page 210](#).

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.

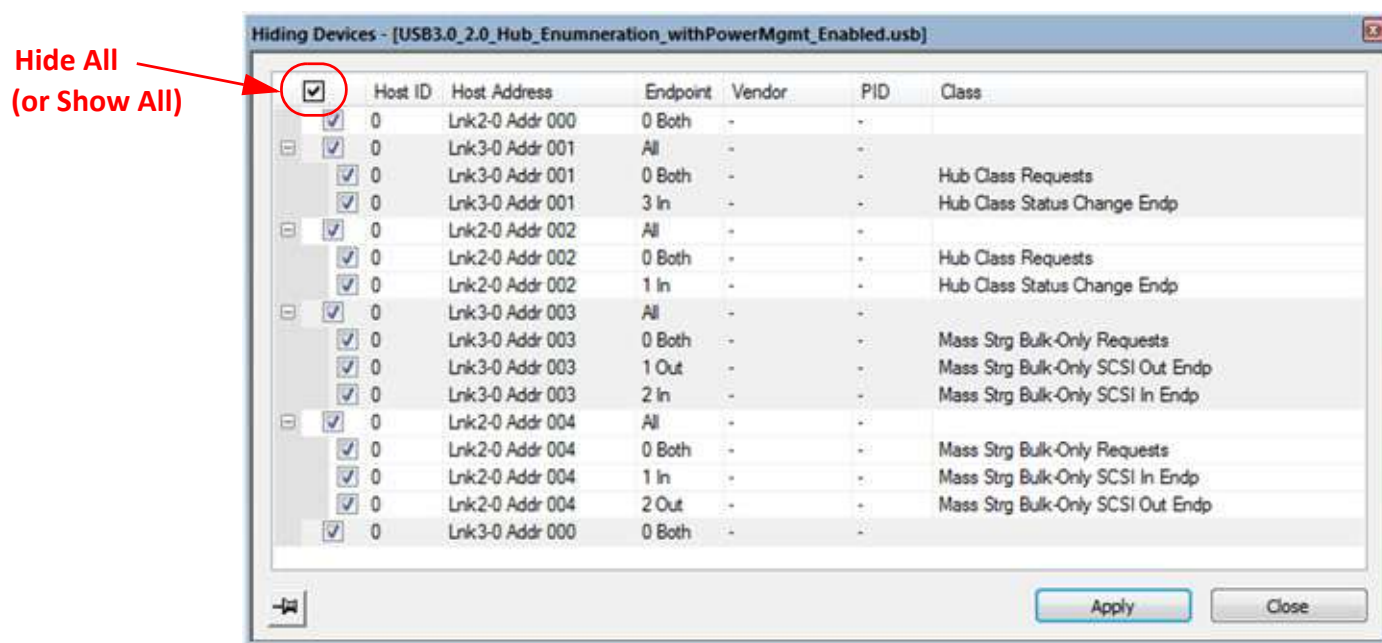


Figure 4.23: Hiding Devices Dialog.

Check the topmost checkbox to Hide or Show All items in the list. This is provided to make it easier to select what you want.

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

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 3.2 Packet Hiding tabs as shown in [Figure 4.24 on page 211](#).

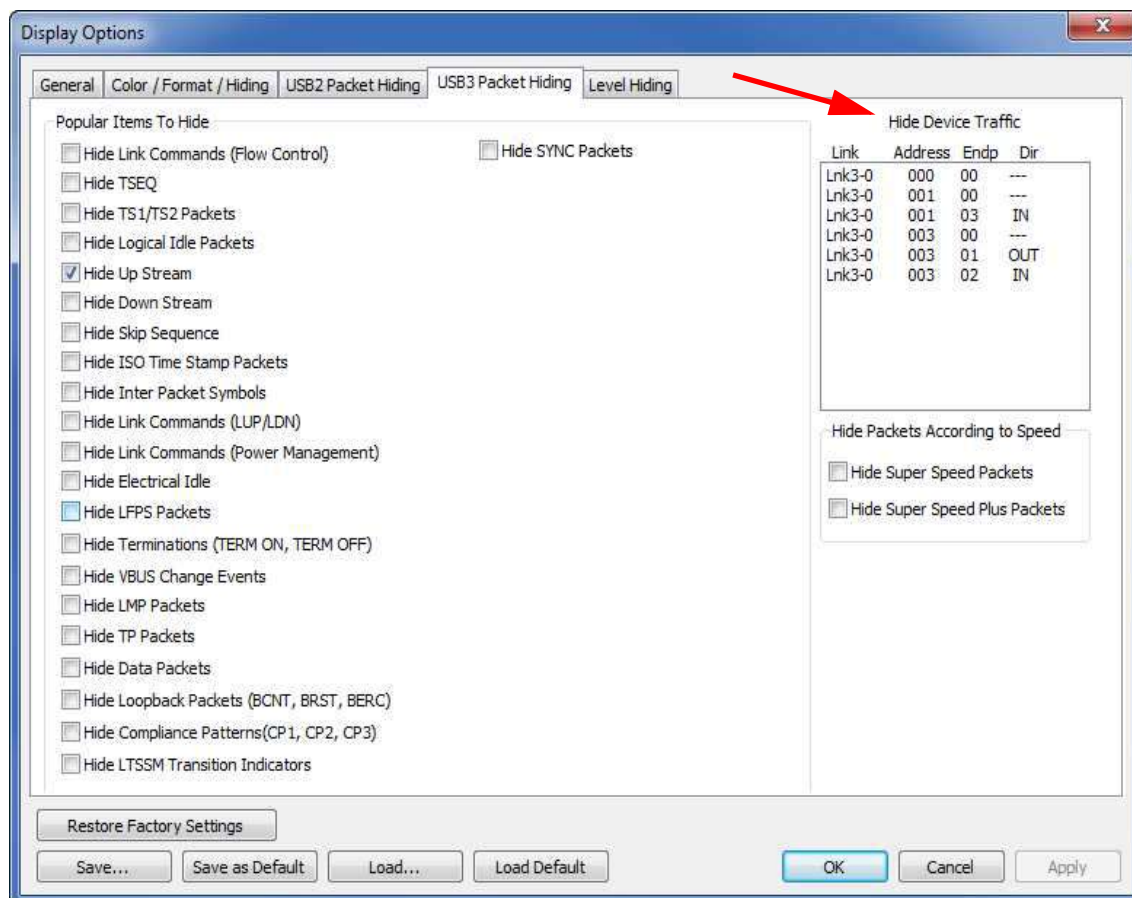


Figure 4.24: Display Option Dialog Showing Hide Device Traffic

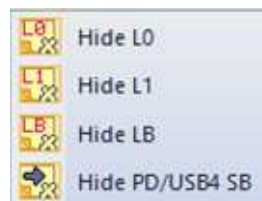
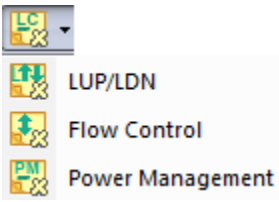
4.4.9.3 USB 2.0 Display/Hide

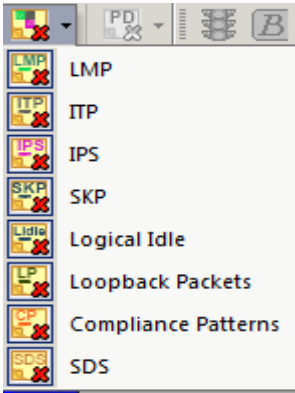
Select from the following options to hide USB 2.0 traffic. Refer to [“Hiding Traffic \(2.0 & 3.2\)” on page 208](#).

4.4.9.4 USB 3.2 Display/Hide

	Hide SOFs.		Hide Chirps

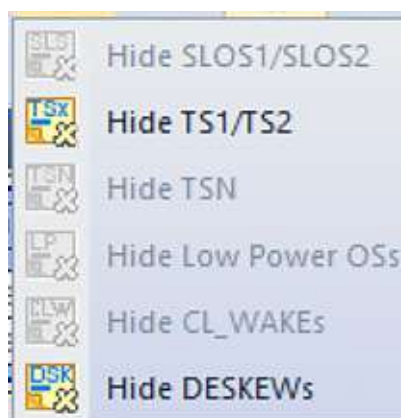
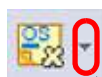
Select from the following options to hide USB 3.2 traffic. For other types of traffic refer to [“Hiding Traffic \(2.0 & 3.2\)” on page 208.](#)

 	Hide Traffic from Left DUT. Hide L0 traffic Hide L1 traffic Hide LB traffic Hide PD/USB4 SB Traffic
 	Hide Traffic from Right DUT. Show L0 traffic Show L1 traffic Show LB traffic Show PD/USB4 SB Traffic
	Hide Link Training Sequences: (TSeq, TS1A/TS1B/TS1/TS2, 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

4.4.9.5 USB 4.0 Display/Hide

Select from the following options to hide USB4 traffic. For other types of traffic refer to [“Hiding Traffic \(2.0 & 3.2\)”](#) on page 208.



Hide Ordered Sets

Hide SLOS1/SLOS2 traffic

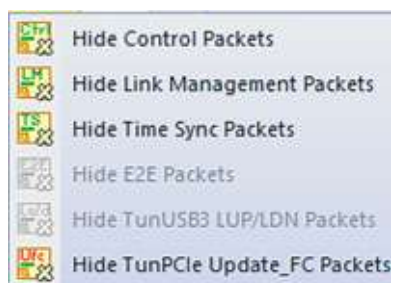
Hide TS1/TS2 traffic

Hide TSN traffic

Hide Low Power Ordered Sets

Hide CL_WAKEs

Hide DESKEWS



Hide TLPs

Hide Control Packets

Hide Link Management Packets

Hide Time Sync Packets

Hide E2E Packets

Hide TunUSB LUP/LDN Packets

Hide TunPCIe Update_FC Packets



Hide Miscellaneous traffic:

Hide SKIP
Hide IDLE
Hide USS
Hide IPS
Hide LFPS



Hide Power Delivery Items:

Hide Unknown
Hide Ping
Hide GoodCRC

4.4.10 Export Tunneled PCIe Traffic, Tunneled USB3 or Tunneled DP traffic

You can use the  icon to quickly export USB3.0 or PCIe tunneled traffic



from a USB4.0 trace by selecting:

- ☐ Tunneled PCIe
- ☐ Tunneled USB3
- ☐ Tunneled DP

4.4.10.1 PCIe Tunneling

If you load a USB4.0 trace with PCIe tunneled traffic (see [Figure 4.25 on page 218](#)) and you

select “Tunneled PCIe” from the drop down tab



you can quickly export

the PCIe tunneled traffic to a new PCIe trace.

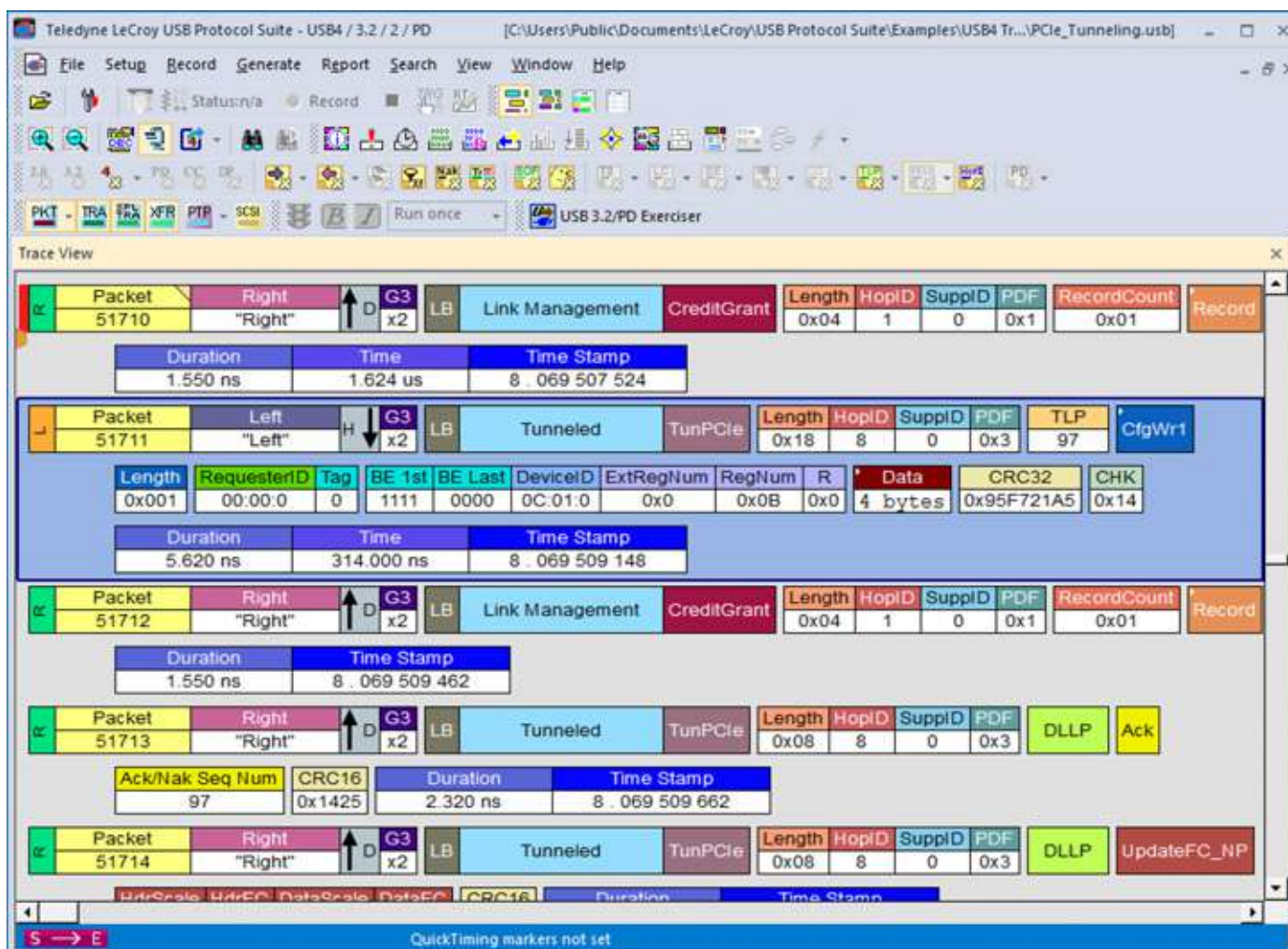


Figure 4.25: USB Trace with PCIe Tunneled Traffic

When you do this Quick Export, you'll get an information message about using the CrossSync Control Panel if you want to see both the USB4 trace and the PCIe trace simultaneously. See [Figure 4.26 on page 219](#).

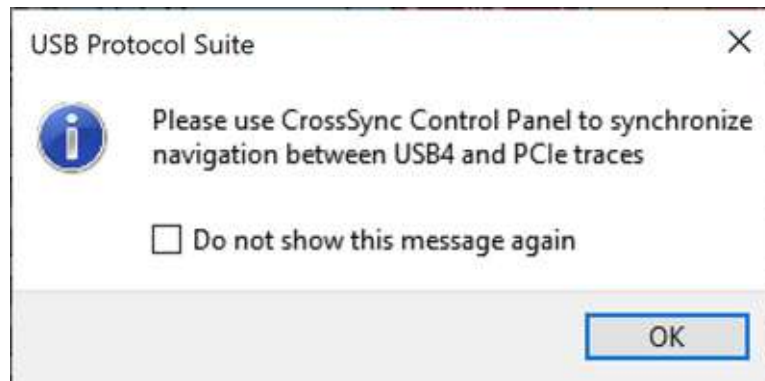


Figure 4.26: Using the CrossSync Control Panel Message

After exporting the tunneled PCIe traffic, the new exported trace will be named as [original_trace_name]_PCIe_Export. This trace is located in same folder as original trace and opened automatically by the PCIe Protocol Analysis software after the export completes. See Figure 4.27.

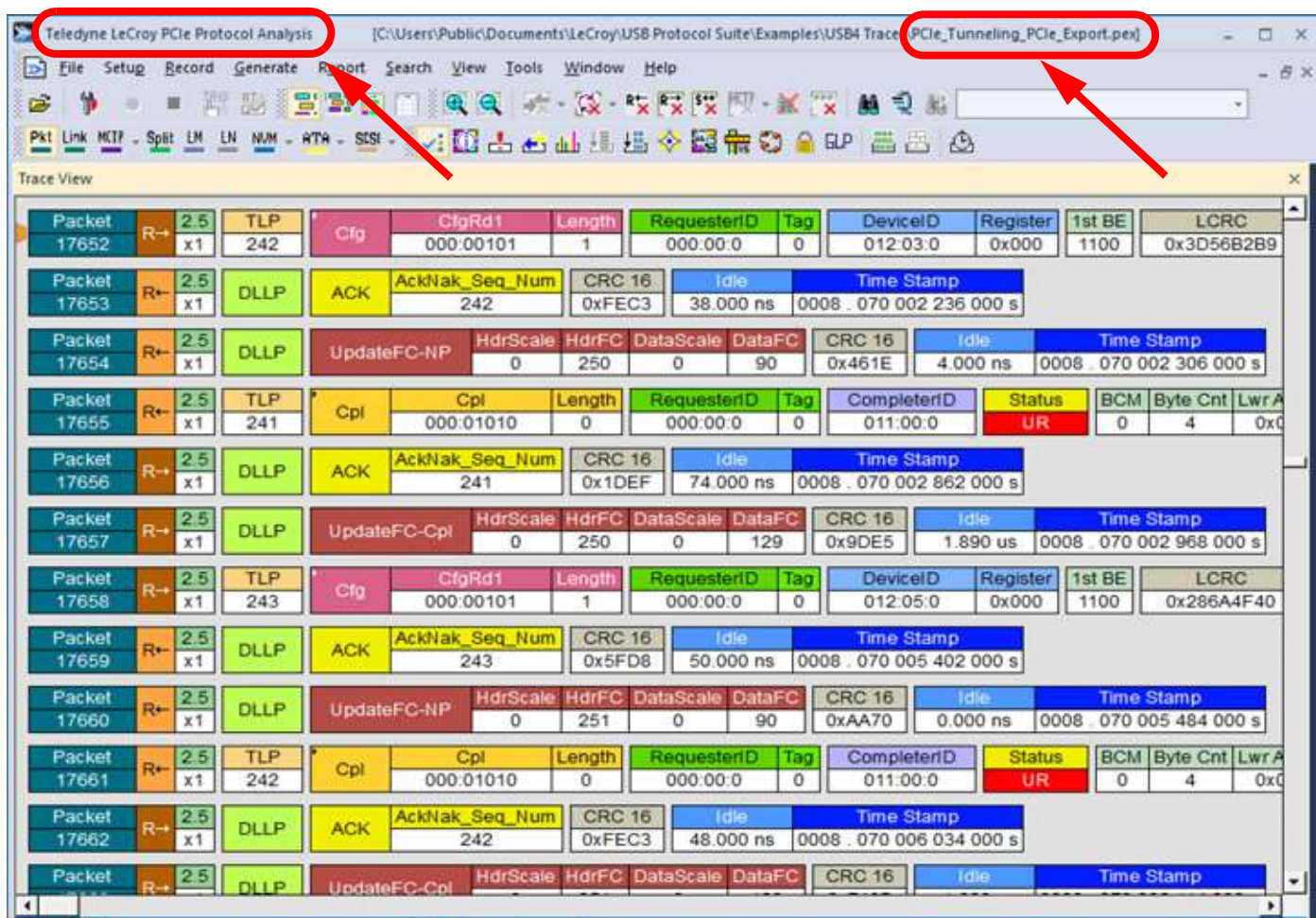


Figure 4.27: Exported Tunneled PCIe Traffic from USB4 Trace Brought Up PCIe Protocol Analysis Software tool

4.4.10.2 Tunneled USB3 traffic

If you load a USB4 trace with USB3 tunneled traffic as shown in the figure below (see [Figure 4.28](#)) you can quickly export the Tunneled USB3 traffic by selecting the “Tunneled USB3” drop down tab.

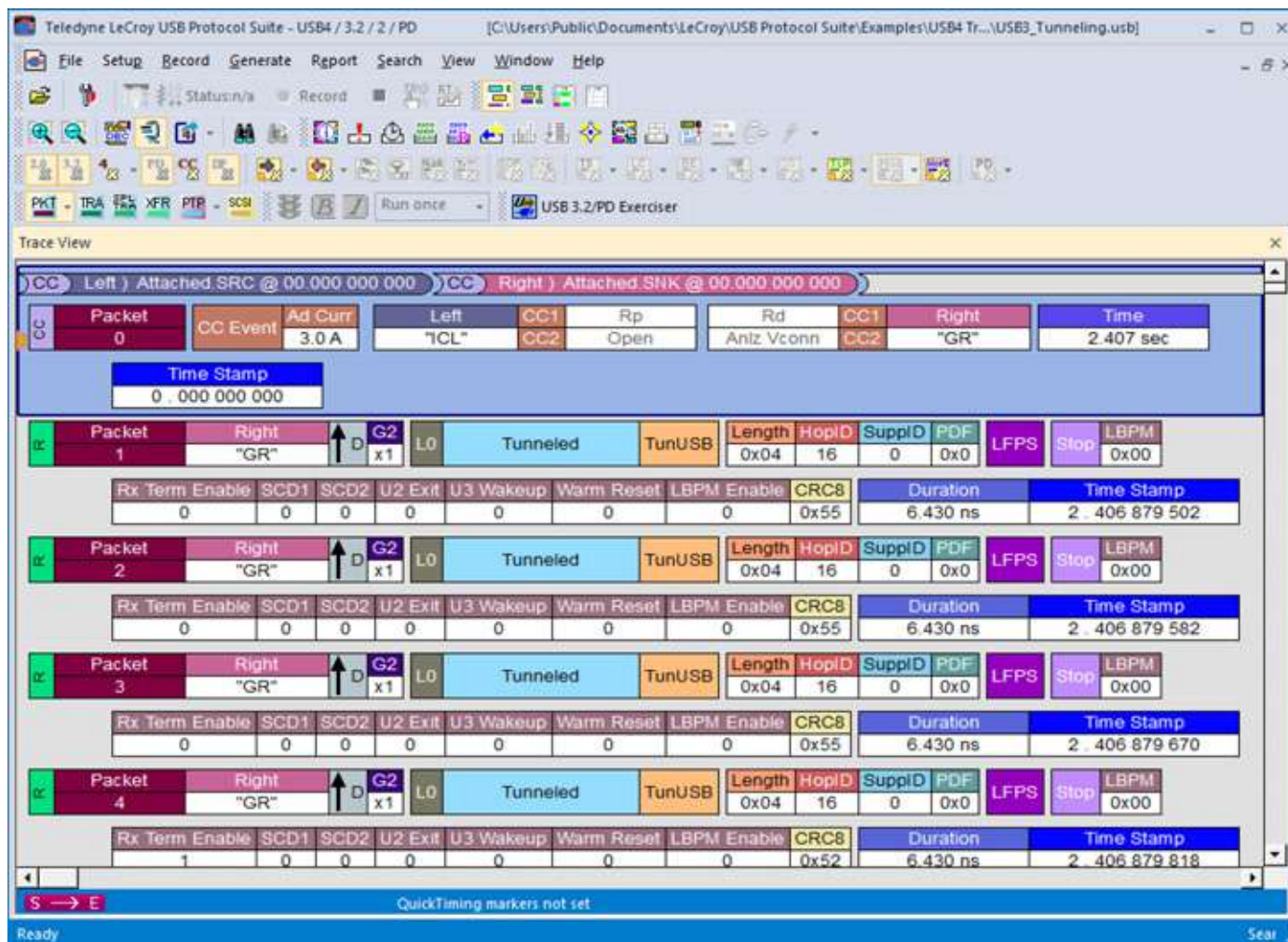


Figure 4.28: Original USB4 Trace with Tunneled USB3 traffic Before Export

After exporting the tunneled USB3 traffic, the new exported trace will be named as [original_trace_name]_USB3_Exported. This trace is located in same folder as original trace and opened automatically after the export completes. See [Figure 4.29](#).

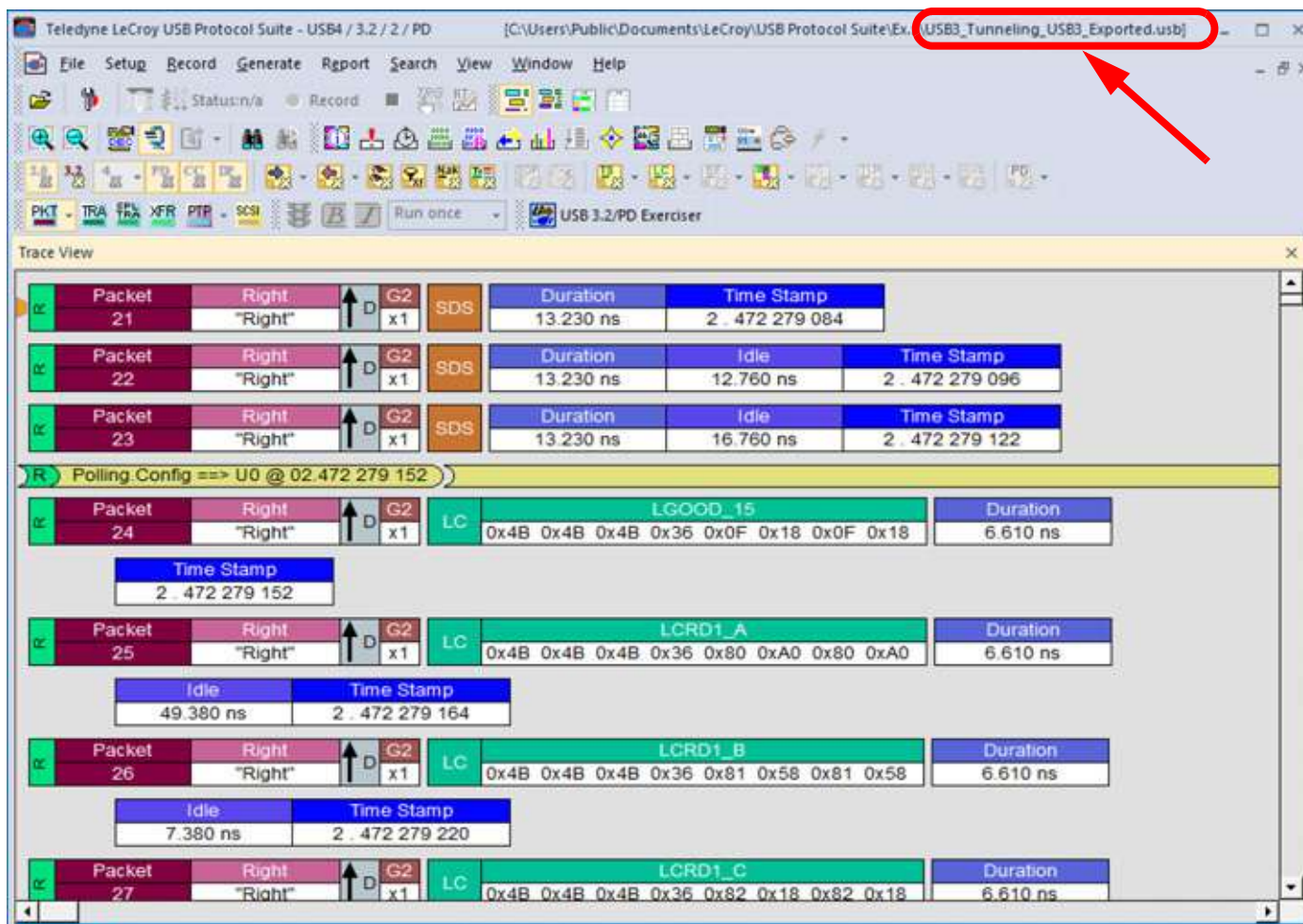
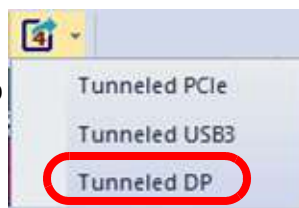


Figure 4.29: Exported USB3 Traffic

4.4.10.3 DP Tunneling

If you load a USB4.0 trace with Tunneled DP traffic (see [Figure 4.30](#)) and you select “Tunneled

DP” from the drop down tab



you can quickly export the DP tunneled

traffic to a new trace.

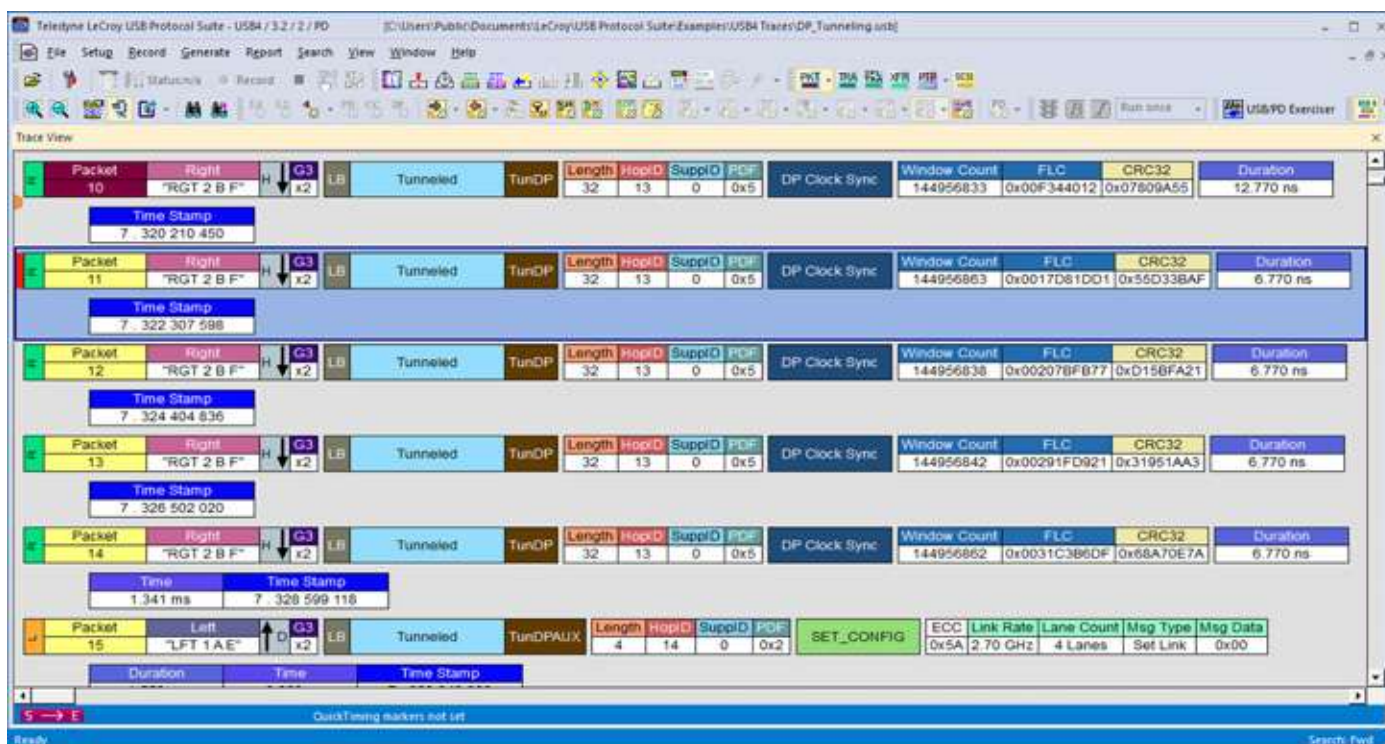


Figure 4.30: USB4.0 Trace with Tunneled DP traffic

To open the trace after Exporting Tunneled DP traffic, see “[Export: USB4 Tunneled DP Traffic to DP Native Trace](#)” on page 198.

4.5 Tooltips

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

4.6 View Options

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

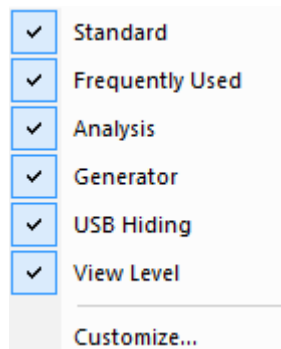


Figure 4.31: View Options Dialog

4.6.1 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.

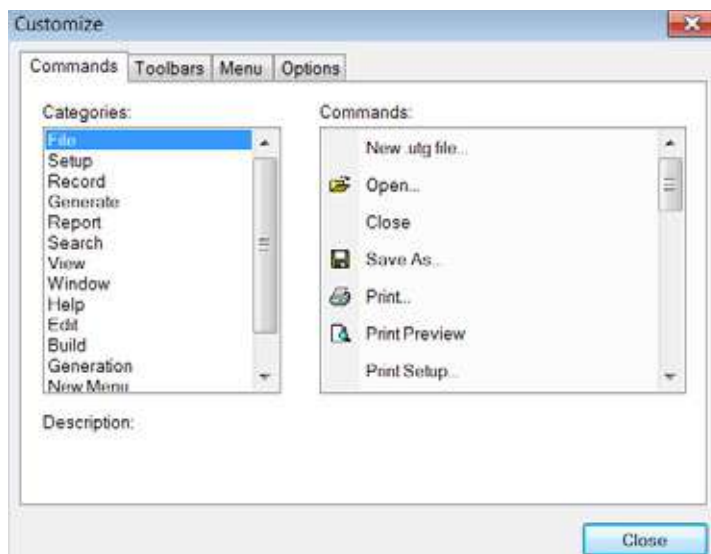


Figure 4.32: Customize Dialog

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

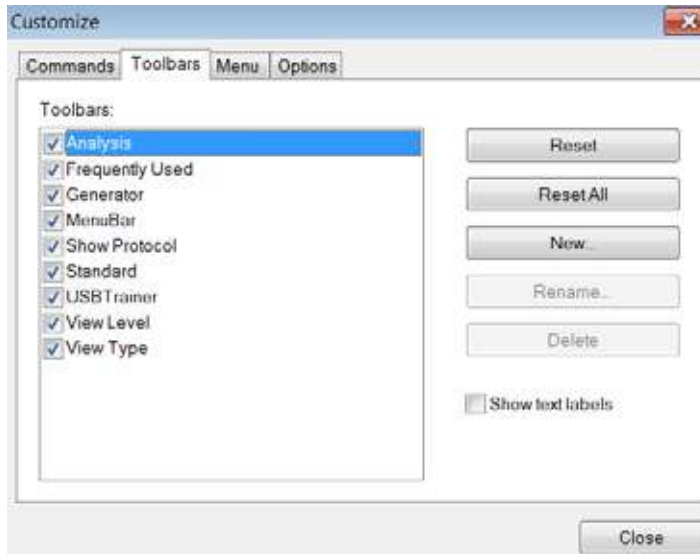


Figure 4.33: Toolbars Dialog

4. Click the **Reset All** button.
The toolbar resets to the factory defaults.

4.7 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: 3.2 SuperSpeed (SS) traffic, 5Gbps
- ❑ 3+: 3.2 SuperSpeedPlus (SS+) traffic, 10Gbps



Figure 4.34: Status Bar

4.7.1 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.

4.7.2 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.

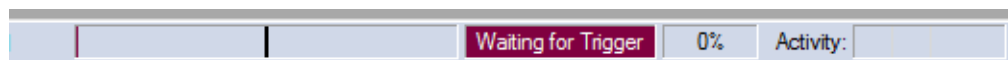


Figure 4.35: Status Bar - Waiting For Trigger

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



Figure 4.36: Status Bar - Uploading

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



Figure 4.37: Status Bar - Rec/Uploading

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

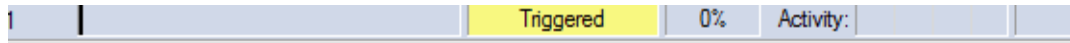


Figure 4.38: Status Bar - Triggered

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).

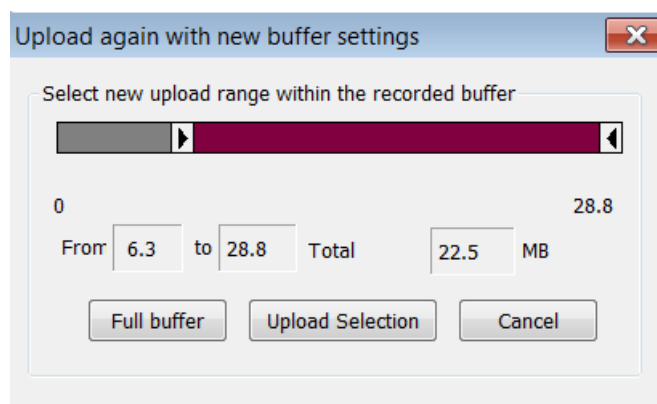


Figure 4.39: Partial Upload Options Dialog

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 trig-

ger (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.

4.7.3 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.

4.7.4 Cable Status

4.7.4.1 Mercury T2C/T2P: Cable Status

The Mercury T2C has cable status LEDs on the front panel. See [Figure 4.40](#).

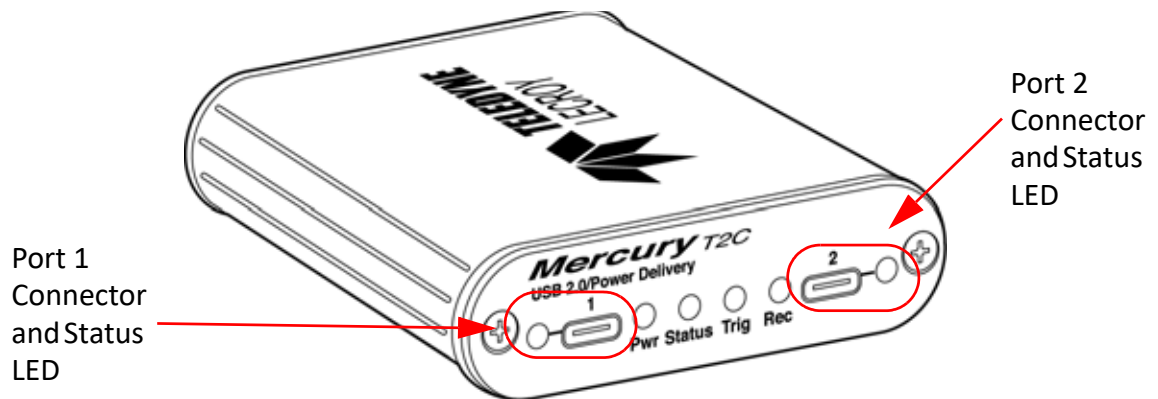
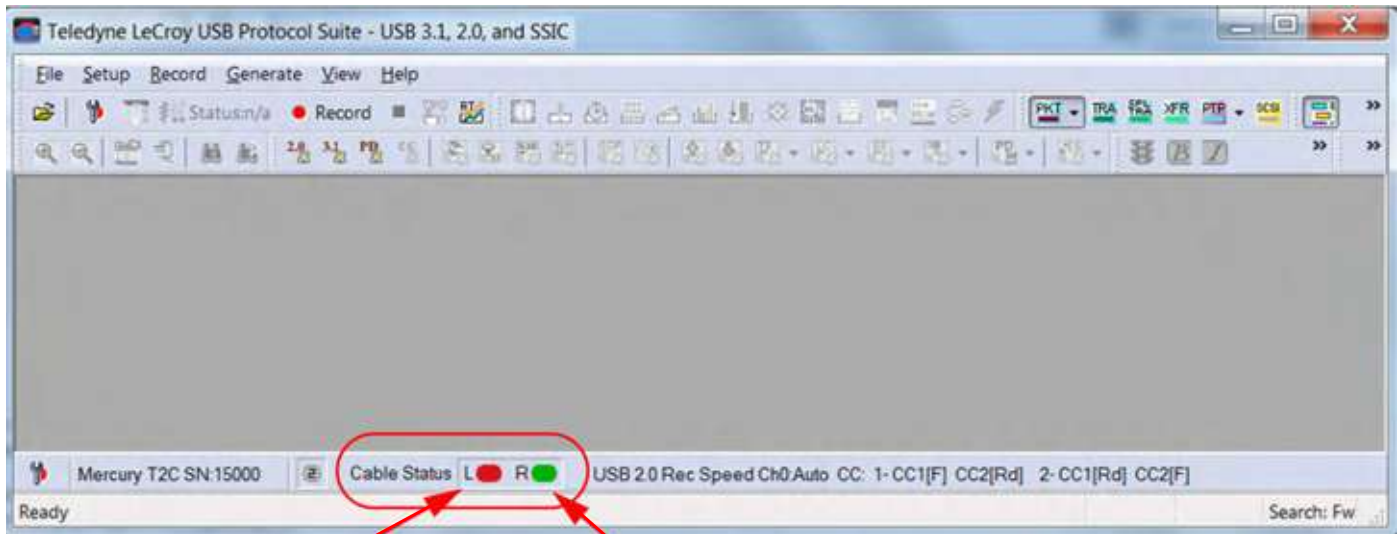


Figure 4.40: Mercury T2C “C” Connectors and LED Status Indicators (same as T2P)

The “C” cable can be inserted into Connectors 1 or 2 on the Mercury T2C/T2P 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 4.41 on page 228](#).



Cable Inserted Upside Down

Cable Inserted Correctly

Figure 4.41: Status Bar in S/W Display Menu

4.7.4.2 Voyager 310C: Cable Status

The Voyager 310C has similar “C” cable connectors and Status LEDs. See [Figure 4.42](#). They work in a similar way as the Status LEDs on the Mercury T2C/T2P. The Status LED operation is also mimicked in the Status Bar, at the bottom of the Teledyne LeCroy USB Protocol Suite software display menu.

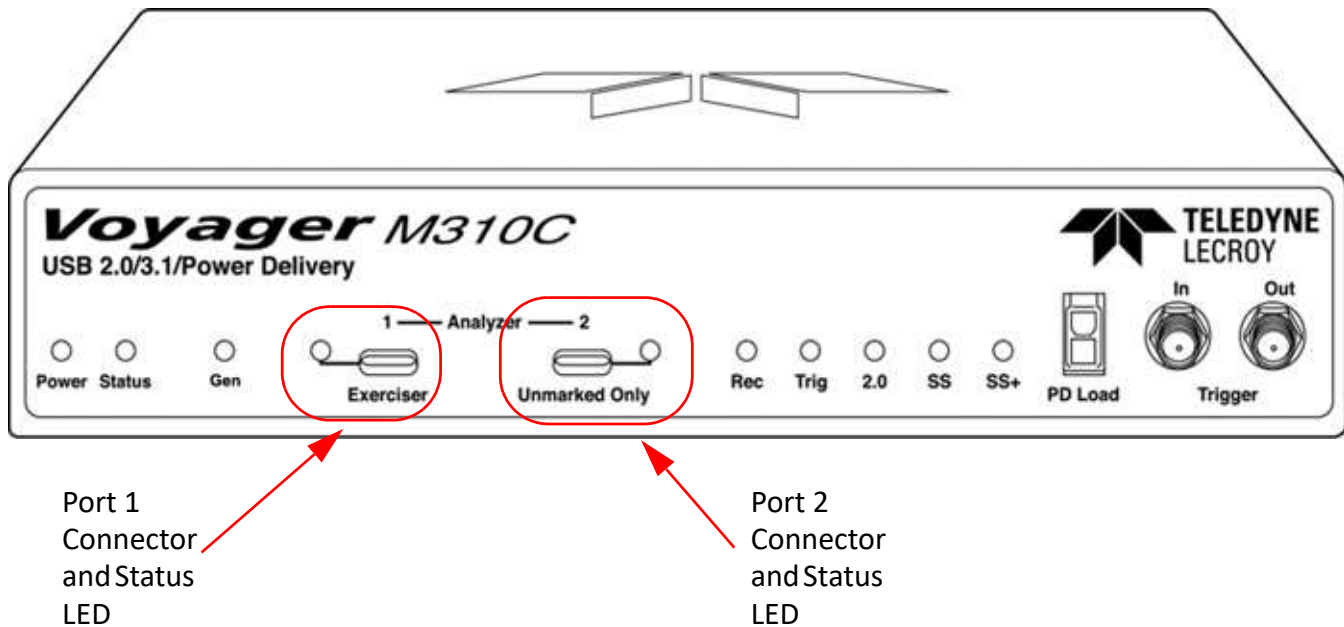
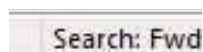


Figure 4.42: Voyager 310C: “C” Connectors and LED Status Indicators

4.7.5 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.



4.8 Device Status

4.8.1 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 4.43](#)) at the bottom of the Main Menu.

Note: This window is not available when using Mercury T2.

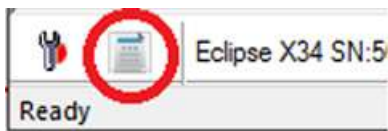


Figure 4.43: Device Status Details Window Button

This will bring up the following Device Status Details Window (see [Figure 4.44](#)).

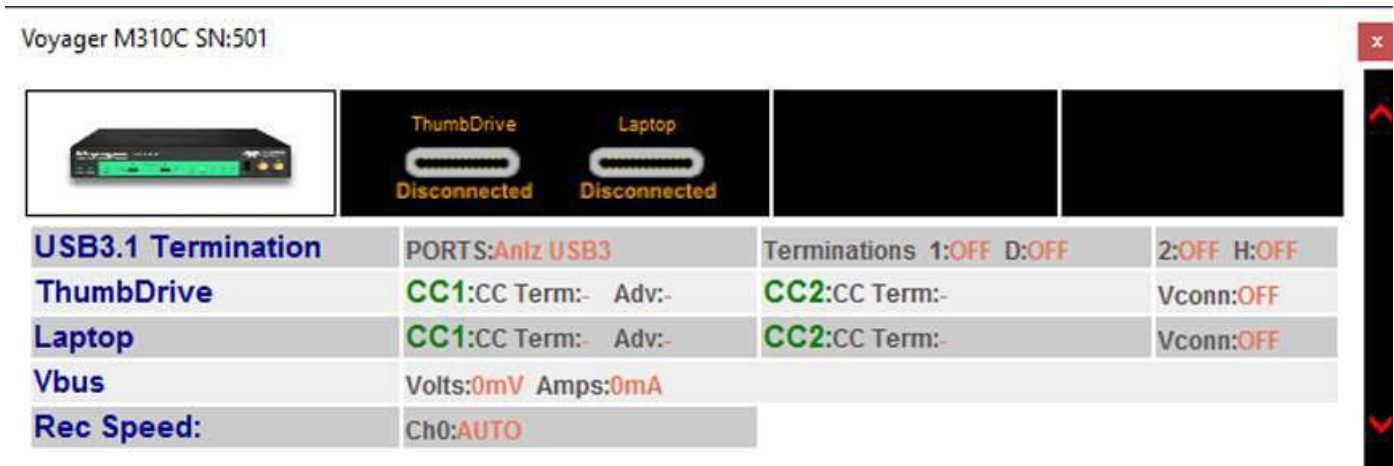


Figure 4.44: Device Status Details Window

4.8.1.1 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, 3.2, 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. 3.2 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 3.2 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.

Note: Terminations do not apply for the M310P Analyzer connectors, since it uses a Passive Electrical Tap.

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

4.8.2 SuperSpeed Termination Status

The lower right middle of the Status Bar shows the SuperSpeed Termination status. (Not applicable to M310P Analyzer Connectors, which use a Passive Electrical Tap.)

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).

Terms A:Off D:Off B:Off H:Off.

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

SS ports: Anlz USB3 | Term A:Off B:Off.

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.

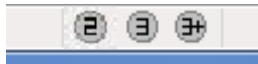
Polling occurs when the Application CPU is not busy.

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 205](#).

4.8.3 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 3.2.



Analyzer

3+	USB 3.2 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 3.2 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	FS SOF's, LS EOP's, or control endpoint traffic
Solid Yellow:	LS Traffic on endpoints other than 0
Slow Flashing Yellow:	(resets activity timer as in 3.2)
Fast Flashing Yellow:	FS Traffic on endpoints other than 0
	(resets activity timer as in 3.2)
Solid Green:	HS SOF's or control endpoint traffic

Flashing Green:	HS traffic on endpoints other than 0 (resets activity timer as in 3.2)
Exerciser	
3+	USB 3.2 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	3.2 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 3.2 LEDs always operate, unless USB 3.2 has been disabled in the Recording Options General Tab.

4.9 Navigation Tools

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

4.9.1 Zoom In

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

- ❑ Click  on the Tool Bar.

4.9.2 Zoom Out

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

- ❑ Click  on the Tool Bar.

4.9.3 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.

4.10 CrossSync Control Panel

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

4.10.1 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.

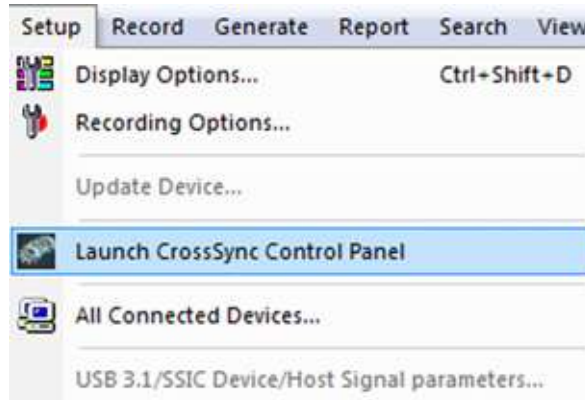


Figure 4.45: Launching CrossSync from the USB Protocol Suite Application

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**.

4.11 Analyzer Keyboard Shortcuts

4.11.1 Shortcuts List

To display the Shortcut List, select **Help > Shortcut List**.

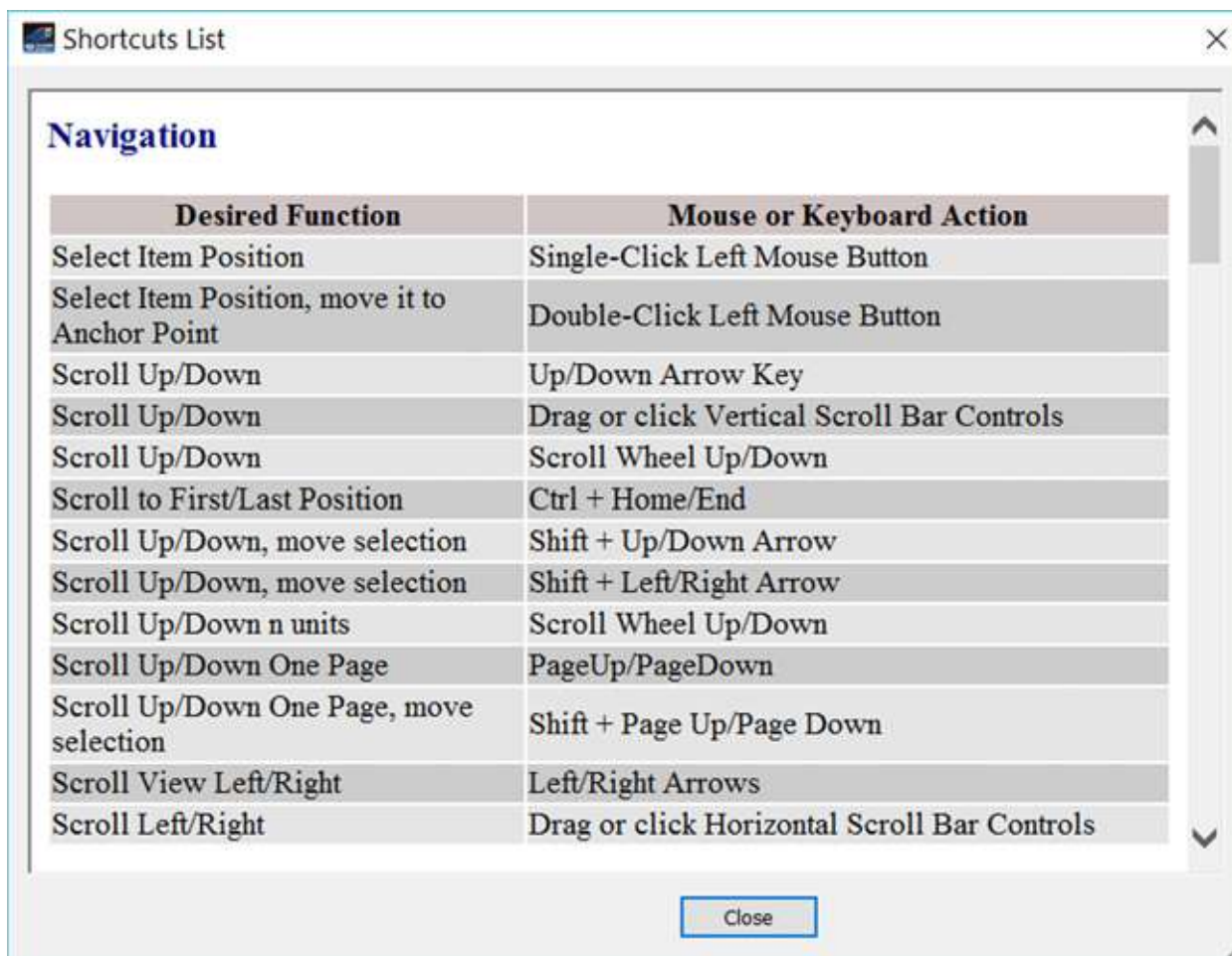


Figure 4.46: Shortcuts List: Navigation

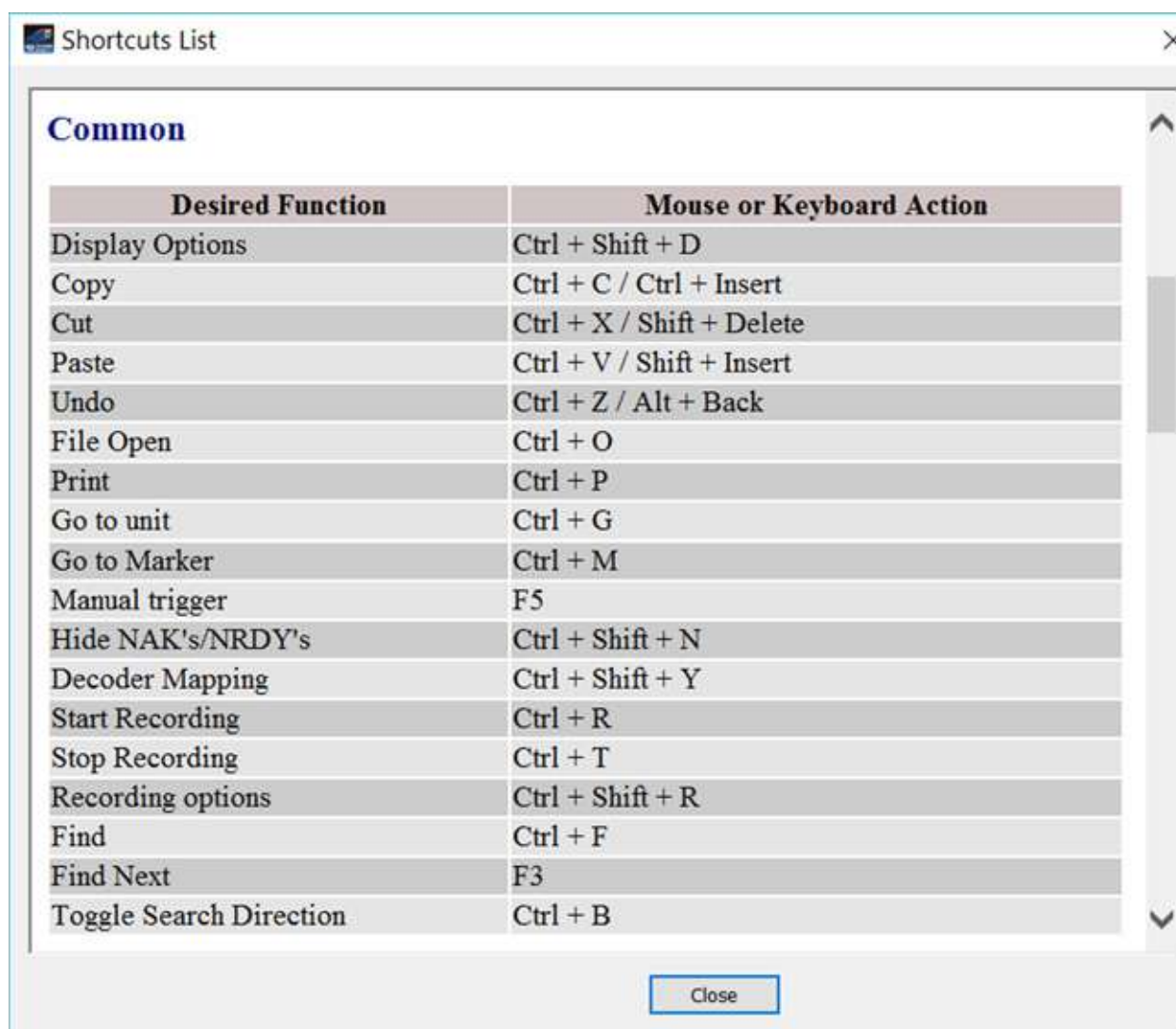


Figure 4.47: Shortcuts List: Common

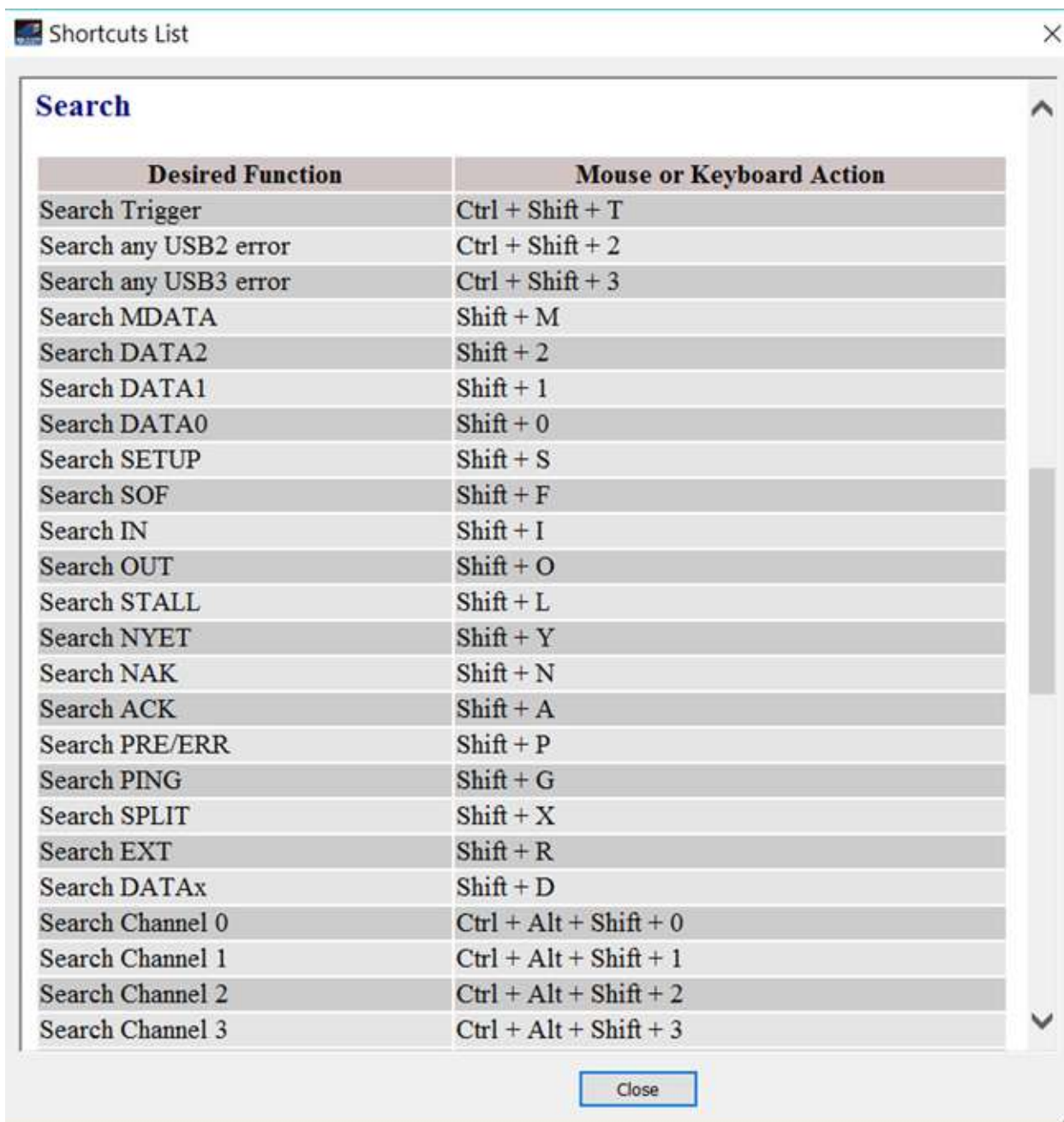


Figure 4.48: Shortcuts List: Search 1

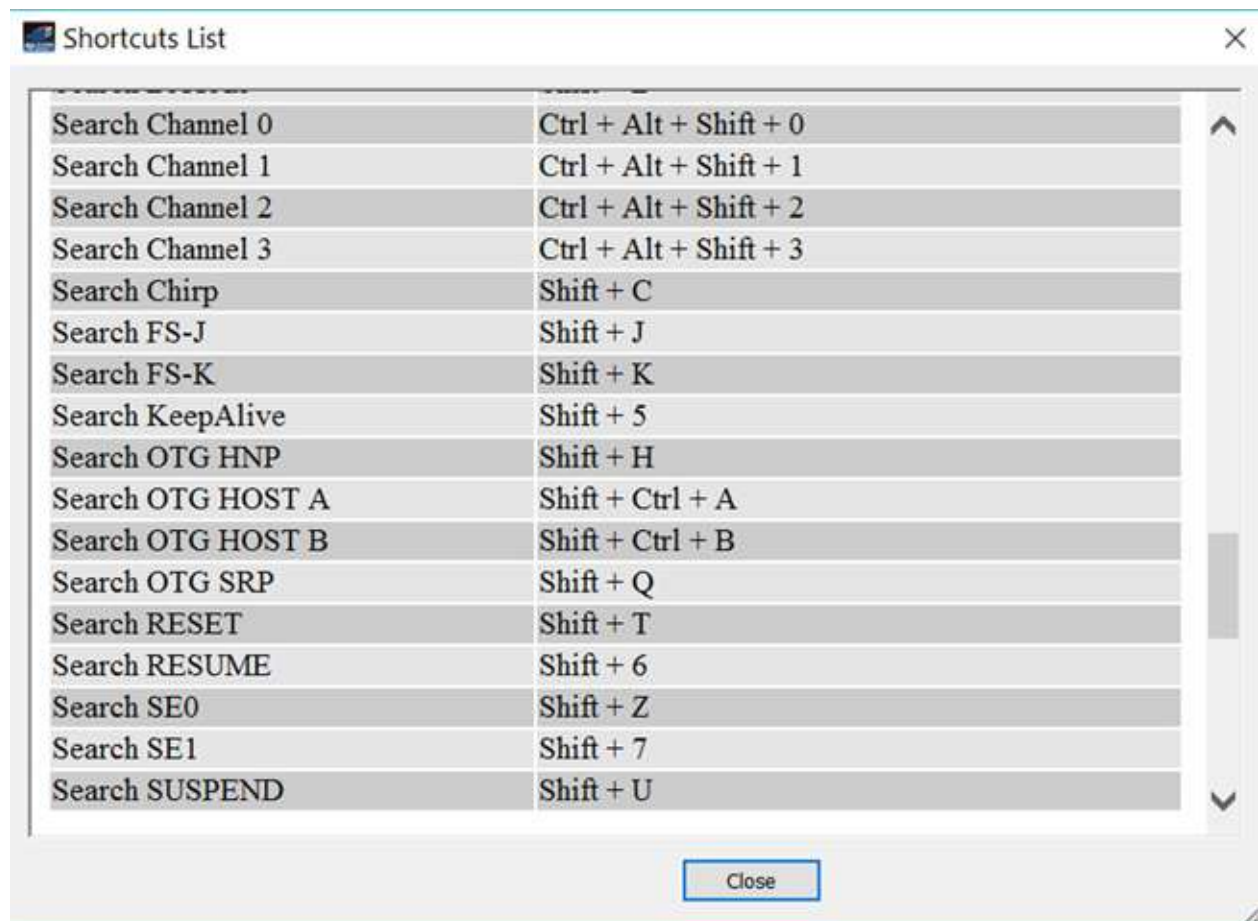


Figure 4.49: Shortcuts List: Search 2

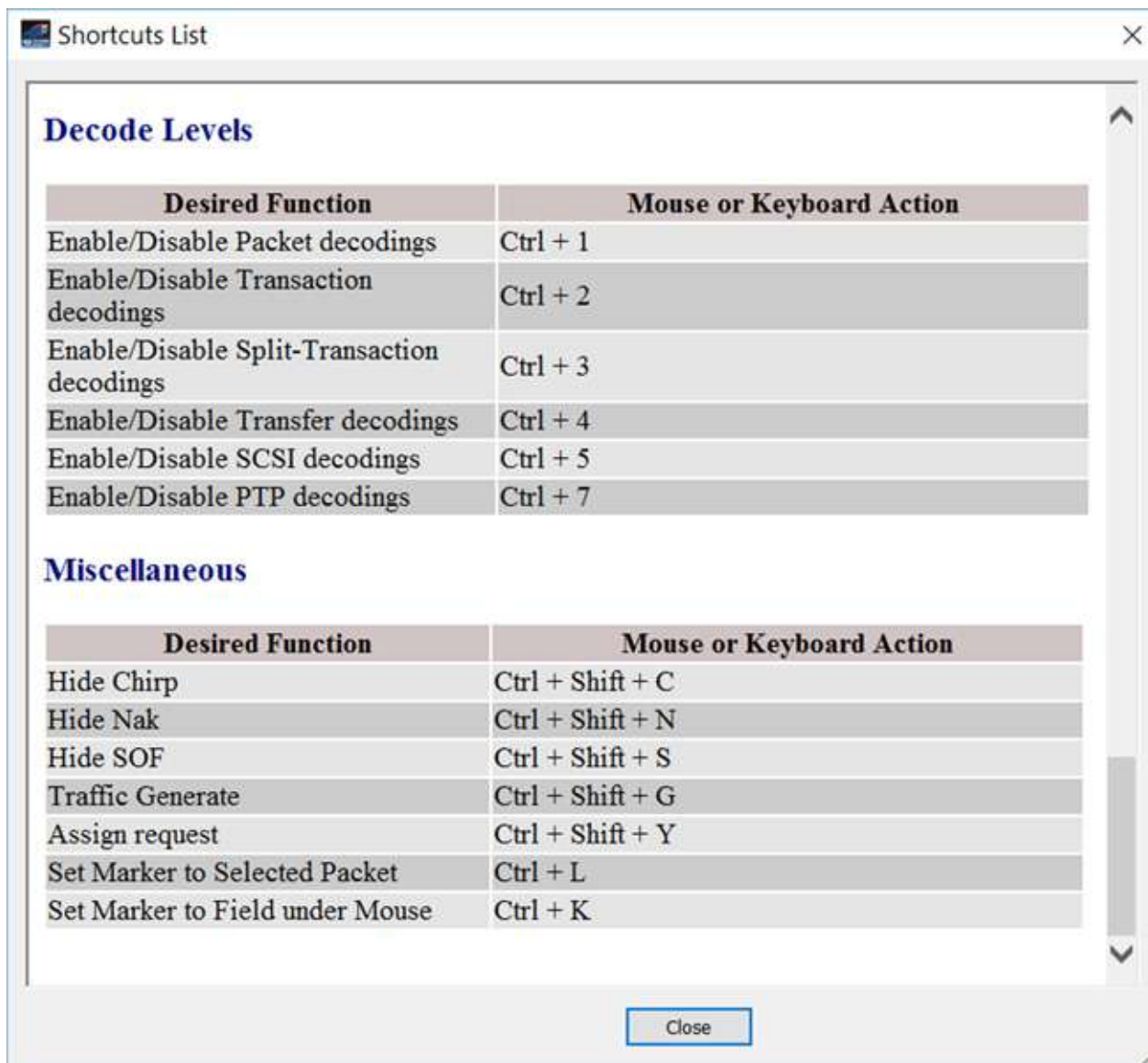


Figure 4.50: Shortcuts: Decode Levels and Miscellaneous

Chapter 5

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.

As an example, you see the **Recording Options** dialog box for the Voyager M310 (analyzer mode), in Simple Mode for recording options (see [Figure 5.1 on page 242.](#))

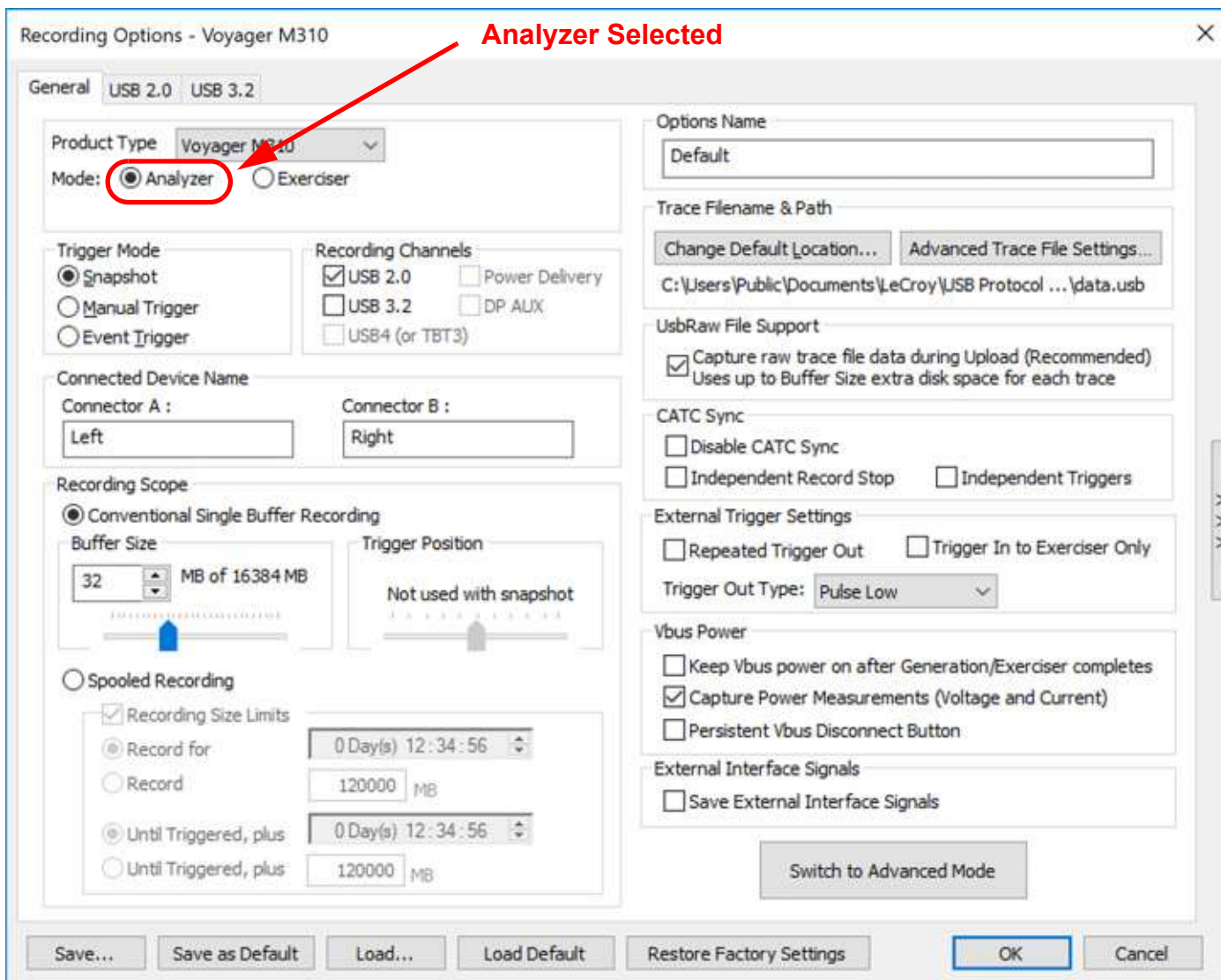


Figure 5.1: Recording Options - General Tab Voyager M310: Simple Mode.

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

The Recording Options for the Voyager 310 in Exerciser mode are shown in [Figure 5.2](#).

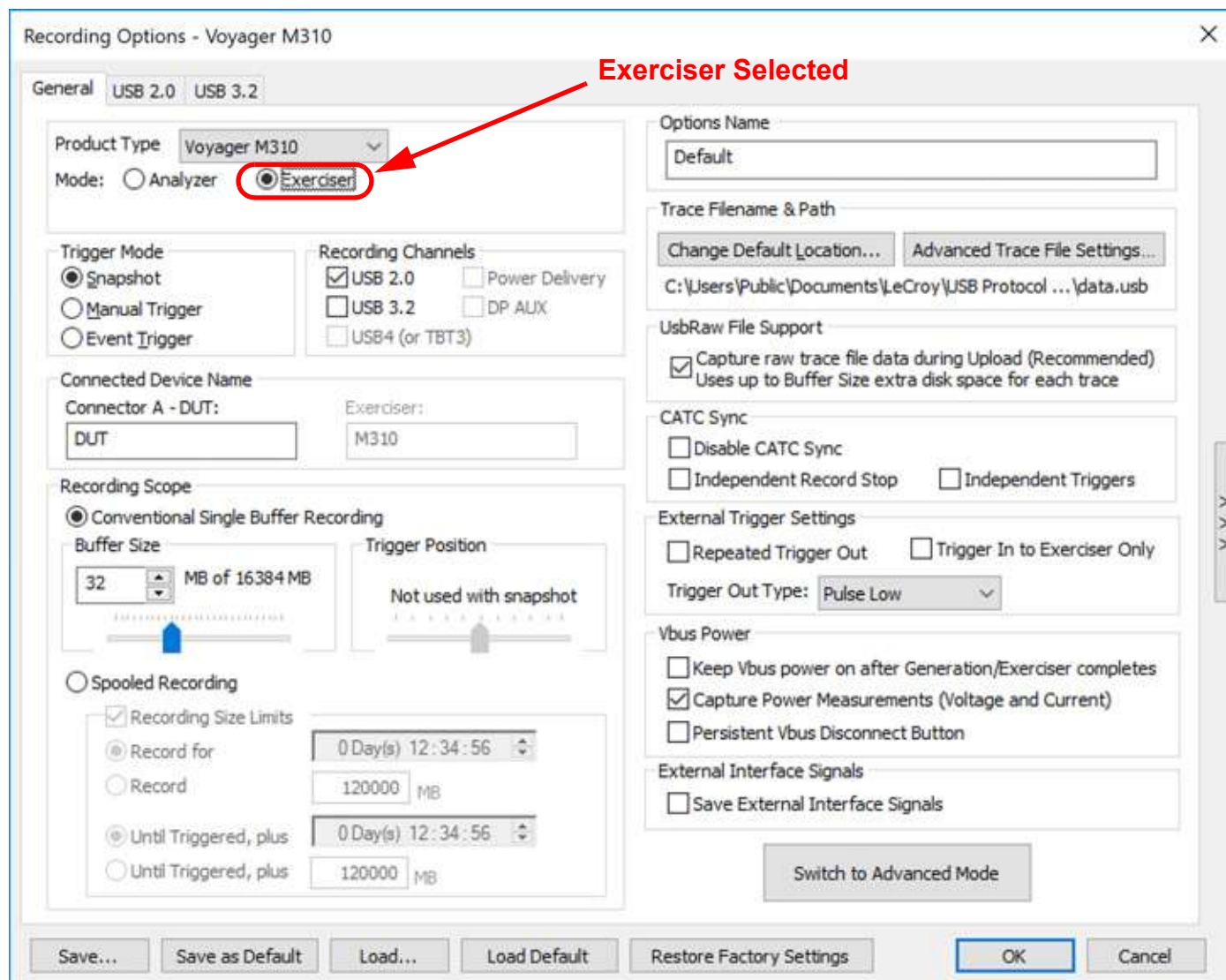


Figure 5.2: M310: Recording Options Simple Mode -> Exerciser selected

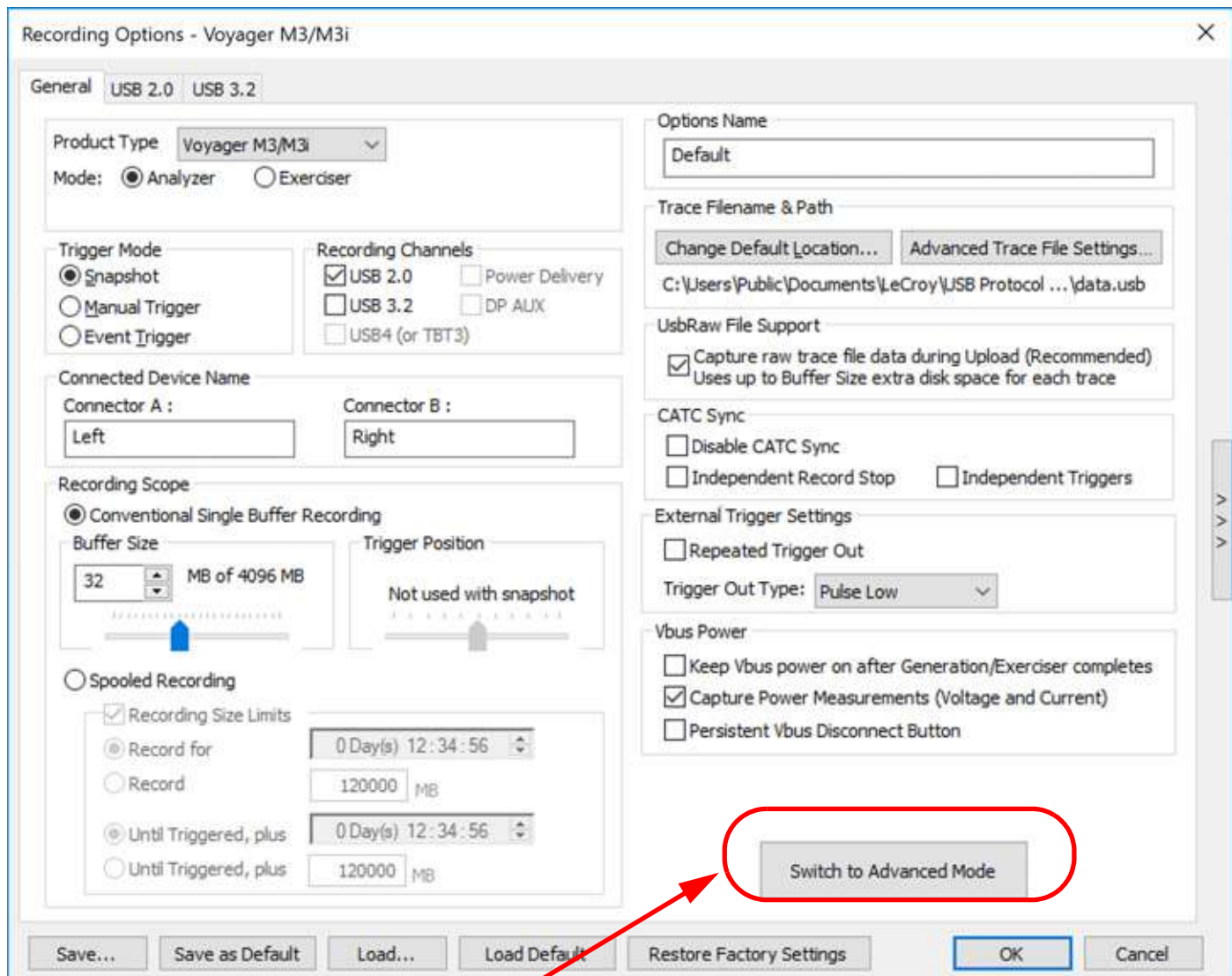
Note: Tabs available differ depending on attached analyzer type. If no analyzer is attached, you can select any product. See [“Recording Option Summary Tab” on page 375](#).

5.1 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 Simple Mode** or **Switch to Advanced Mode** button see [Figure 5.4](#).

5.1.1 Simple Mode: Voyager M3, M3i and M3x

In Simple Mode (Analyzer), the Recording Options dialog box for the Voyager M3, M3i, and M3x is shown below.



Switch to Simple Mode/Switch to Advanced Mode Button

Figure 5.3: Recording Options: Simple Mode Voyager M3, M3i, and M3x

5.1.2 Advanced Mode: Voyager M3, M3i and M3x

In Advanced Mode (Analyzer), the Recording Options dialog box for the Voyager M3, M3i, and M3x is shown below.

The screenshot shows the 'Recording Options - Voyager M3/M3i' dialog box. The 'General' tab is selected. The 'Product Type' is set to 'Voyager M3/M3i'. The 'Mode' is set to 'Analyzer'. The 'Trigger Mode' is set to 'Snapshot'. The 'Recording Channels' are set to 'USB 2.0', 'Power Delivery', 'USB 3.2', 'DP AUX', and 'USB4 (or TBT3)'. The 'Connected Device Name' is set to 'Left' for Connector A and 'Right' for Connector B. The 'Recording Scope' is set to 'Conventional Single Buffer Recording' with a 'Buffer Size' of 32 MB of 4096 MB. The 'Trigger Position' is set to 'Not used with snapshot'. The 'Spooled Recording' section is expanded, showing 'Recording Size Limits' with 'Record for' set to 0 Day(s) 12:34:56, 'Record' set to 120000 MB, 'Until Triggered, plus' set to 0 Day(s) 12:34:56, and 'Until Triggered, plus' set to 120000 MB. The 'Options Name' is set to 'Default'. The 'Trace Filename & Path' is set to 'C:\Users\Public\Documents\LeCroy\USB Protocol ... \data.usb'. The 'UsbRaw File Support' section is expanded, showing 'Capture raw trace file data during Upload (Recommended)' checked. The 'CATC Sync' section is expanded, showing 'Disable CATC Sync' and 'Independent Record Stop' unchecked. The 'External Trigger Settings' section is expanded, showing 'Repeated Trigger Out' unchecked and 'Trigger Out Type' set to 'Pulse Low'. The 'Vbus Power' section is expanded, showing 'Keep Vbus power on after Generation/Exerciser completes' unchecked, 'Capture Power Measurements (Voltage and Current)' checked, and 'Persistent Vbus Disconnect Button' unchecked. A 'Switch to Simple Mode' button is located at the bottom right. The bottom of the dialog has buttons for 'Save...', 'Save as Default', 'Load...', 'Load Default', 'Restore Factory Settings', 'OK', and 'Cancel'.

Figure 5.4: Voyager M3, M3i, and M3x: General Tab in Advanced Mode (Analyzer Mode)

In Advanced Mode (Exerciser), the Recording Options dialog box for the Voyager M3, M3i, and M3x is shown below, see [Figure 5.5](#).

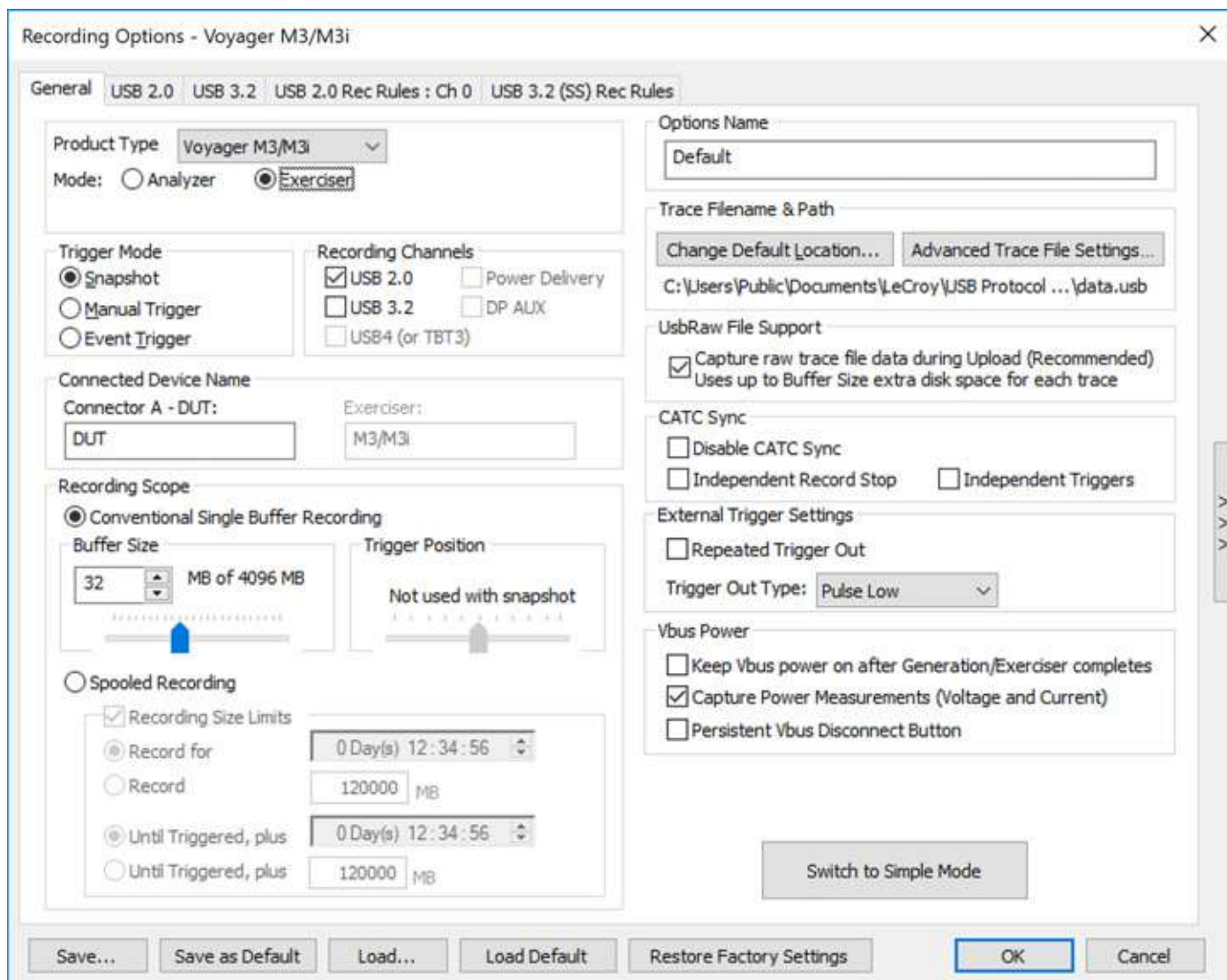


Figure 5.5: Voyager M3, M3i, and M3x: General Tab in Advanced Mode (Exerciser Mode)

5.1.3 Simple Mode: Advisor T3

In Simple Mode for recording options, the Recording Options dialog box for the Advisor T3 is shown below, see [Figure 5.6](#).

Recording Options - Advisor T3

General USB 2.0 USB 3.2

Product Type: Advisor T3

☒ Analyzer ☐ Exerciser

Trigger Mode: ☒ Snapshot ☐ Manual Trigger ☐ Event Trigger

Recording Channels: ☒ USB 2.0 ☐ USB 3.2

Connected Device Name: Connector A: Left Connector B: Right

Recording Scope: ☒ Conventional Single Buffer Recording

Buffer Size: 32 MB of 2048 MB

Trigger Position: Not used with snapshot

☐ Spooled Recording

☒ Recording Size Limits

☒ Record for: 0 Day(s) 12:34:56

☐ Record: 120000 MB

☒ Until Triggered, plus: 0 Day(s) 12:34:56

☐ Until Triggered, plus: 120000 MB

Options Name: Default

Trace Filename & Path: Change Default Location... Advanced Trace File Settings...
C:\Users\Public\Documents\LeCroy\USB Protocol ... \data.usb

Vbus Power: ☐ Persistent Vbus Disconnect Button

UsbRaw File Support: ☒ Capture raw trace file data during Upload (Recommended)
Uses up to Buffer Size extra disk space for each trace

CATC Sync: ☐ Disable CATC Sync ☐ Independent Record Stop ☐ Independent Triggers

External Trigger Out Settings: ☐ Repeated Triggering
Trigger Out Type: Pulse Low

Switch to Advanced Mode

Save... Save as Default Load... Load Default Restore Factory Settings OK Cancel

Figure 5.6: Advisor T3: General Tab in Simple Mode for Recording Options

5.1.4 Advanced Mode: Advisor T3

In Advanced Mode, the Recording Options dialog box for the Advisor T3 is shown below, see [Figure 5.7](#).

Recording Options - Advisor T3

General | USB 2.0 | USB 3.2 | USB 2.0 Rec Rules : Ch 0 | USB 3.2 (SS) Rec Rules

Product Type: **Advisor T3** (v)

☒ Analyzer ☐ Exerciser

Trigger Mode:
☒ Snapshot
☐ Manual Trigger
☐ Event Trigger

Recording Channels:
☒ USB 2.0
☐ USB 3.2

Options Name: Default

Trace Filename & Path:
 Change Default Location... Advanced Trace File Settings...
 C:\Users\Public\Documents\LeCroy\USB Protocol ... \data.usb

Connected Device Name:
 Connector A: left Connector B: Right

Vbus Power:
☐ Persistent Vbus Disconnect Button

Recording Scope:
☒ Conventional Single Buffer Recording
 Buffer Size: 32 MB of 2048 MB
 Trigger Position: Not used with snapshot

UsbRaw File Support:
☒ Capture raw trace file data during Upload (Recommended)
 Uses up to Buffer Size extra disk space for each trace

CATC Sync:
☐ Disable CATC Sync
☐ Independent Record Stop ☐ Independent Triggers

Spooled Recording:
☒ Recording Size Limits
☒ Record for 0 Day(s) 12 : 34 : 56
☐ Record 120000 MB
☒ Until Triggered, plus 0 Day(s) 12 : 34 : 56
☐ Until Triggered, plus 120000 MB

External Trigger Out Settings:
☐ Repeated Triggering
 Trigger Out Type: Pulse Low (v)

Switch to Simple Mode

Save... Save as Default Load... Load Default Restore Factory Settings OK Cancel

Figure 5.7: Advisor T3: Recording Options - General Tab in Advanced Mode (Analyzer)

5.1.5 Simple Mode: Mercury T2

In Simple Mode for recording options, the Recording Options dialog box for Mercury T2 has the General and USB 2.0 tabs. See [Figure 5.8](#).

Recording Options - Mercury T2

General USB 2.0

Product Type: Mercury T2

☒ Analyzer ☐ Exerciser

Trigger Mode: ☒ Snapshot ☐ Manual Trigger ☐ Event Trigger

Recording Channels: ☒ USB 2.0 ☐ Power Delivery ☐ USB 3.2 ☐ DP AUX ☐ USB4 SB

Connected Device Name: Connector A: Left Connector B: Right

Recording Scope: ☒ Conventional Single Buffer Recording

Buffer Size: 32 MB of 256 MB

Trigger Position: Not used with snapshot

☐ Spooled Recording

☒ Recording Size Limits

☒ Record for: 0 Day(s) 12:34:56

☐ Record: 120000 MB

☒ Until Triggered, plus: 0 Day(s) 12:34:56

☐ Until Triggered, plus: 120000 MB

Options Name: Default

Trace Filename & Path: Change Default Location... Advanced Trace File Settings...
C:\Users\Public\Documents\LeCroy\USB Protocol ... \data.usb

UsbRaw File Support: ☒ Capture raw trace file data during Upload (Recommended)
Uses up to Buffer Size extra disk space for each trace

External Trigger Out Settings: ☐ Repeated Triggering
Trigger Out Type: Pulse Low

Switch to Advanced Mode

Save... Save as Default Load... Load Default Restore Factory Settings OK Cancel

Figure 5.8: Mercury T2: Recording Options - General Tab in Simple Mode

5.1.6 Advanced Mode: Mercury T2

In Advanced Mode, the Recording Options dialog box for Mercury T2 has the General, USB 2.0 and USB 2.0 Rec Rules: Ch 0 tabs. See [Figure 5.9](#).

The screenshot shows the 'Recording Options - Mercury T2' dialog box with the 'General' tab selected. The dialog is divided into several sections:

- Product Type:** A dropdown menu set to 'Mercury T2'.
- Analyzer/Exerciser:** Radio buttons for 'Analyzer' (selected) and 'Exerciser'.
- Trigger Mode:** Radio buttons for 'Snapshot' (selected), 'Manual Trigger', and 'Event Trigger'.
- Recording Channels:** Checkboxes for 'USB 2.0' (checked), 'Power Delivery', 'USB 3.2', 'DP AUX', and 'USB4 SB'.
- Connected Device Name:** Text boxes for 'Connector A' (containing 'Left') and 'Connector B' (containing 'Right').
- Options Name:** A text box containing 'Default'.
- Trace Filename & Path:** Includes buttons for 'Change Default Location...' and 'Advanced Trace File Settings...', and a text box showing the path 'C:\Users\Public\Documents\LeCroy\USB Protocol ...\data.usb'.
- UsbRaw File Support:** A checkbox for 'Capture raw trace file data during Upload (Recommended)' which is checked, with a note 'Uses up to Buffer Size extra disk space for each trace'.
- External Trigger Out Settings:** A checkbox for 'Repeated Triggering' (unchecked) and a dropdown for 'Trigger Out Type' set to 'Pulse Low'.
- Recording Scope:**
 - Conventional Single Buffer Recording:** Selected. Includes a 'Buffer Size' slider set to 32 MB of 256 MB and a 'Trigger Position' slider set to 'Not used with snapshot'.
 - Spoiled Recording:** Unselected. Includes a 'Recording Size Limits' section with radio buttons for 'Record for', 'Record', 'Until Triggered, plus', and 'Until Triggered, plus'. The 'Record for' option is selected, with a time limit of '0 Day(s) 12:34:56'.
- Buttons:** 'Save...', 'Save as Default', 'Load...', 'Load Default', 'Restore Factory Settings', 'Switch to Simple Mode', 'OK', and 'Cancel'.

Figure 5.9: Mercury T2: Recording Options - General Tab in Advanced Mode

5.1.7 Simple Mode: Mercury T2C

In Simple Mode for recording options, the Recording Options dialog box for Mercury T2C has the General, USB 2.0, Power Delivery and USB Type-C tabs. See [Figure 5.12](#).

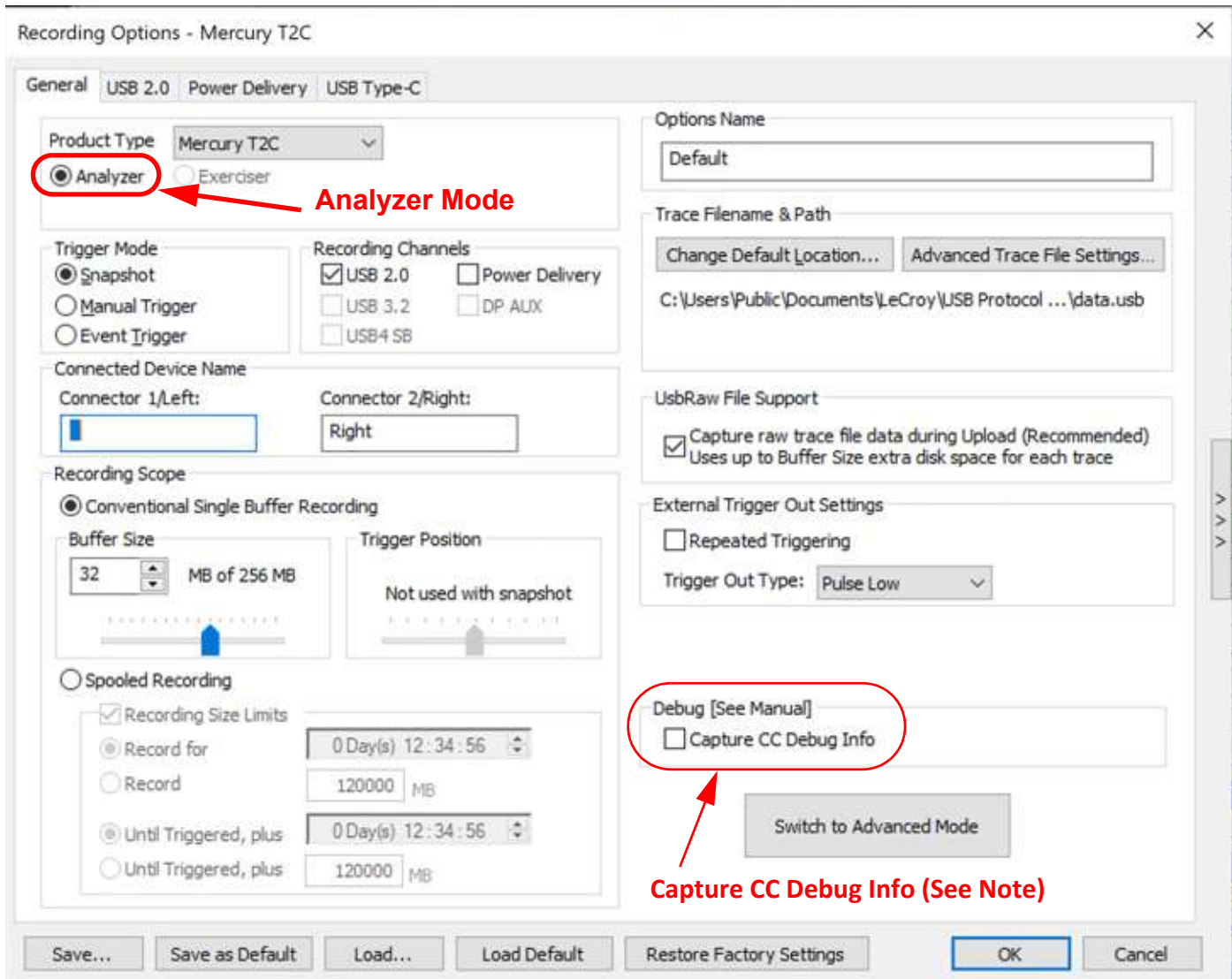


Figure 5.10: Mercury T2C: Recording Options - General Tab in Simple Mode

Note: The Capture CC Debug Info checkbox enables capturing of specific debug information used by Teledyne LeCroy to investigate issues with the Type-C Termination detection. This should only be checked at the direction of Teledyne LeCroy Technical Support, as it alters the normal contents of the trace data. If directed to use this, the trace should be captured, then this box unchecked for normal trace acquisitions.

The Trigger options for Power Delivery and USB Type-C events are the same in both Simple and Advanced Mode.

The Simple Trigger Options for Power Delivery are shown below:

- ❑ Analyzer Mode: [Figure 5.72 on page 325](#)

The Simple Trigger Options for USB Type-C events are shown below:

- ❑ Analyzer Mode: [Figure 5.74 on page 328](#)

5.1.8 Advanced Mode: Mercury T2C

In Advanced Mode, the Recording Options in Analyzer Mode dialog box for Mercury T2C has the General, USB 2.0, Power Delivery, USB Type-C and USB 2.0 Rec Rules: Ch 0 tabs. See [Figure 5.13](#).

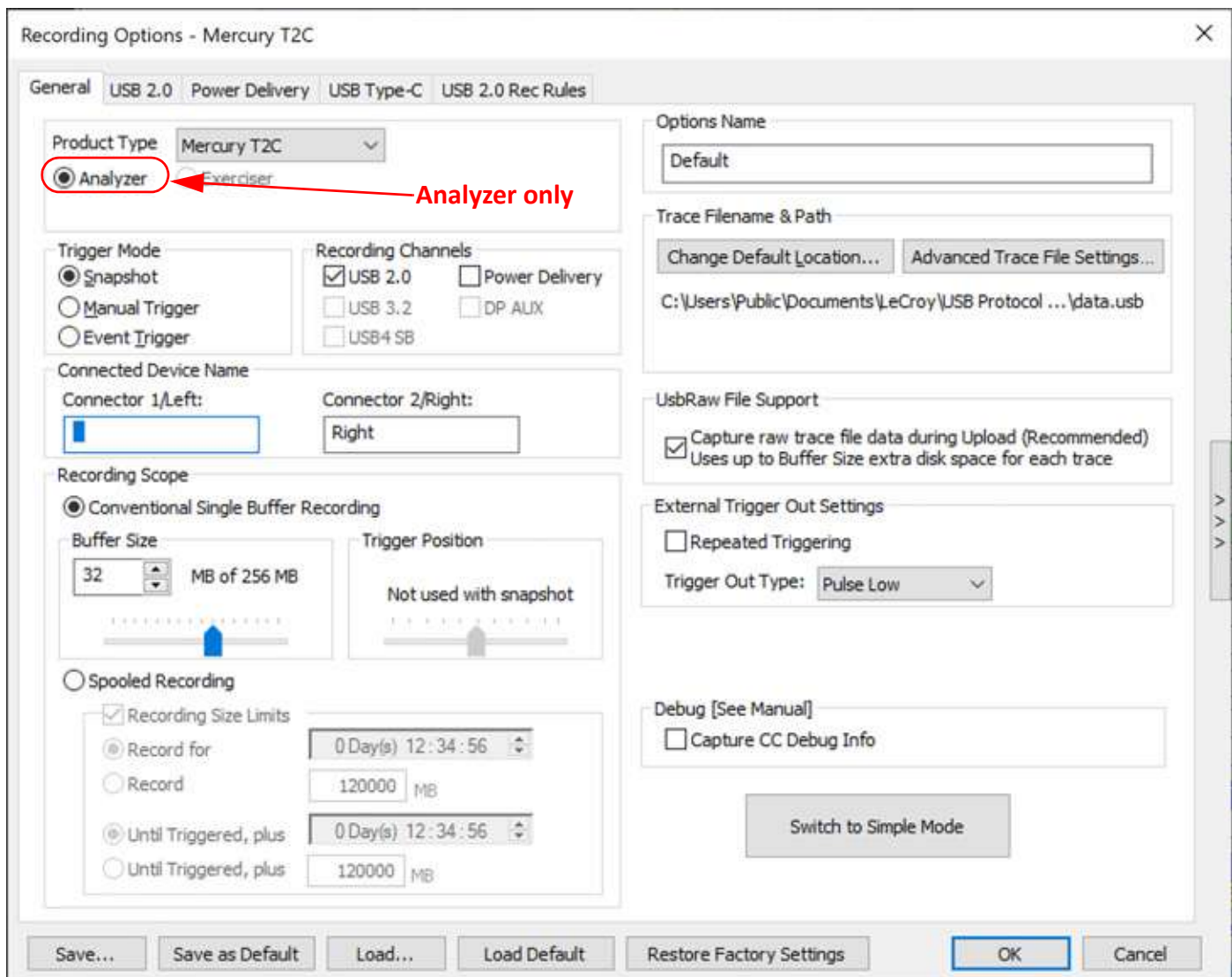


Figure 5.11: Mercury T2C: Recording Options General Tab in Advanced Mode

5.1.9 Simple Mode: Mercury T2P

In Simple Mode for Analyzer recording options, the Recording Options dialog box for Mercury T2P has the General, USB 2.0, Power Delivery and USB Type-C tabs. See [Figure 5.12](#).

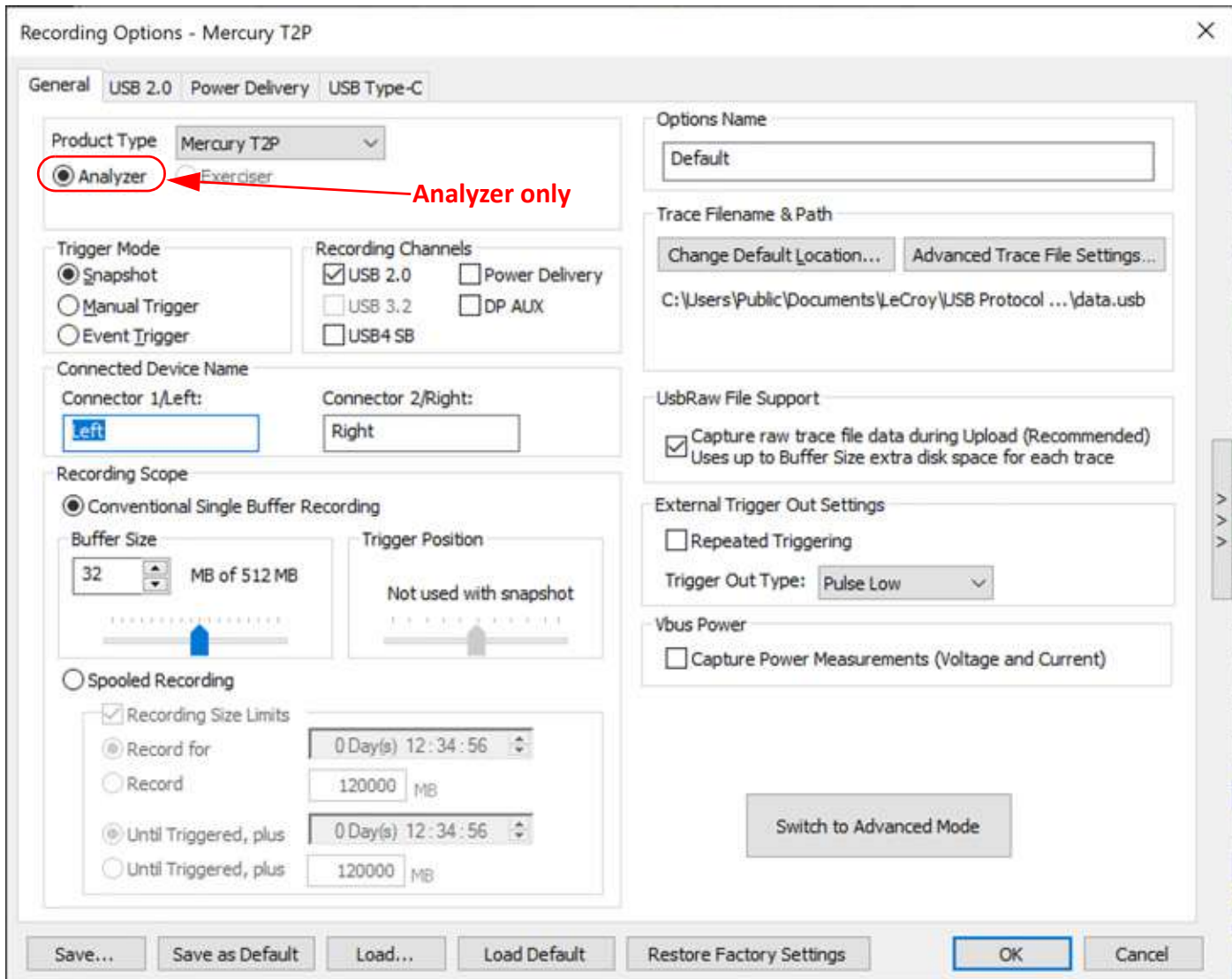


Figure 5.12: Mercury T2P: Recording Options - General Tab in Simple Mode

Note: The Capture CC Debug Info checkbox enables capturing of specific debug information used by Teledyne LeCroy to investigate issues with the Type-C Termination detection. This should only be checked at the direction of Teledyne LeCroy Technical Support, as it alters the normal contents of the trace data. If directed to use this, the trace should be captured, then this box unchecked for normal trace acquisitions.

The Trigger options for Power Delivery and USB Type-C events are the same in both Simple and Advanced Mode.

The Simple Trigger Options for Power Delivery are shown below:

- ❑ Analyzer Mode: [Figure 5.72 on page 325](#)

The Simple Trigger Options for USB Type-C events are shown below:

- ❑ Analyzer Mode: [Figure 5.74 on page 328](#)

5.1.10 Advanced Mode: Mercury T2P

In Advanced Mode, the Recording Options dialog box for Mercury T2P has the General, USB 2.0, Power Delivery, USC Type-C and USB 2.0 Rec Rules: Ch 0 tabs. See [Figure 5.13](#).

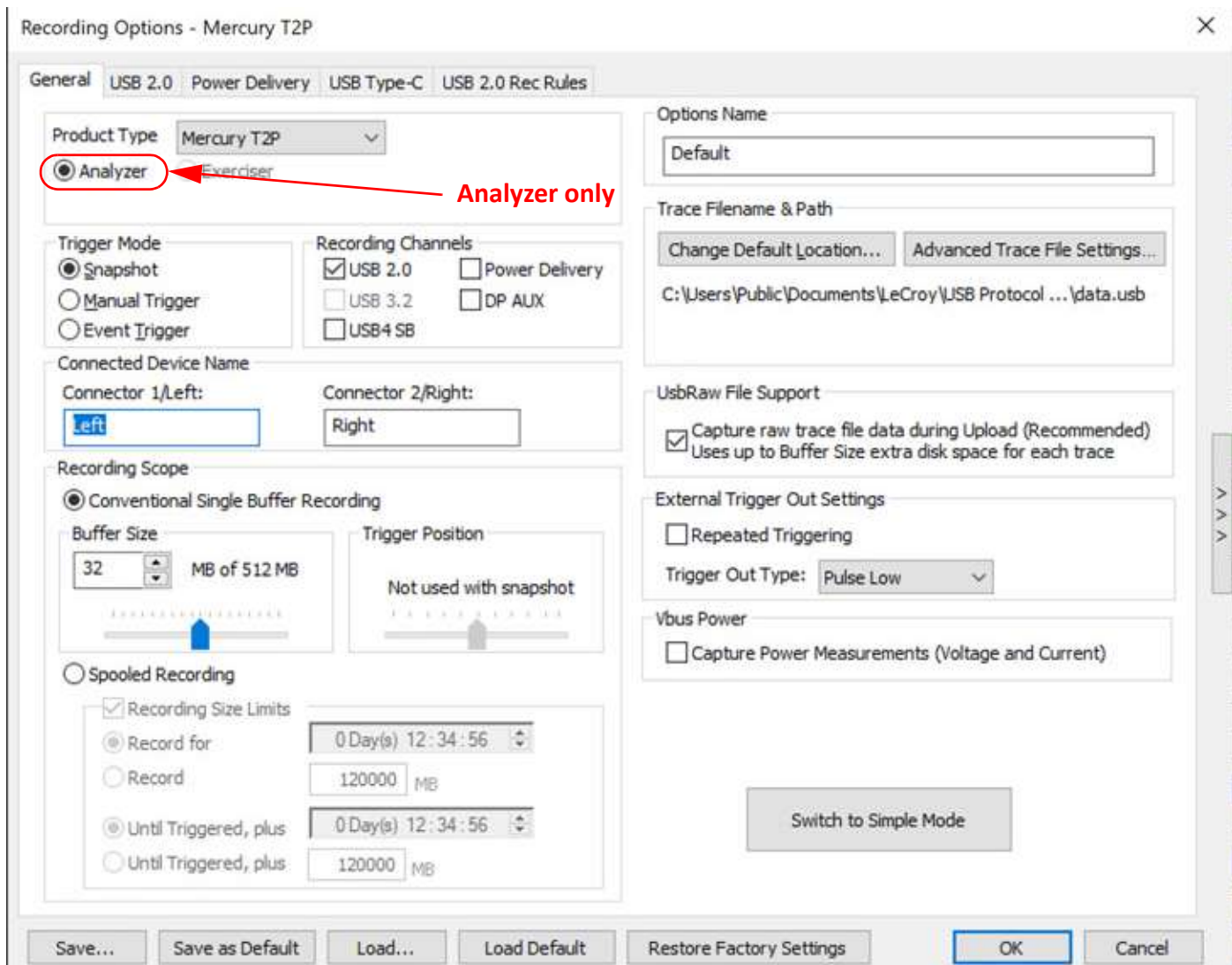


Figure 5.13: Mercury T2P: Recording Options General Tab in Advanced Mode

Advanced Settings: Recording Settings: USB Type-C

Select the USB Type-C tab and the following dialog box pops up with an Advanced Setting tab. See [Figure 5.14](#).

Note: This dialog gives the user the ability to change some of the Mercury's or Voyager's internal voltage thresholds and debounce timing values used to evaluate Type-C states and behaviors. **THIS SHOULD ONLY BE USED BY ADVANCED USERS WHO KNOW WHAT THEY ARE DOING.** Changing these values may break the operation between the partners.

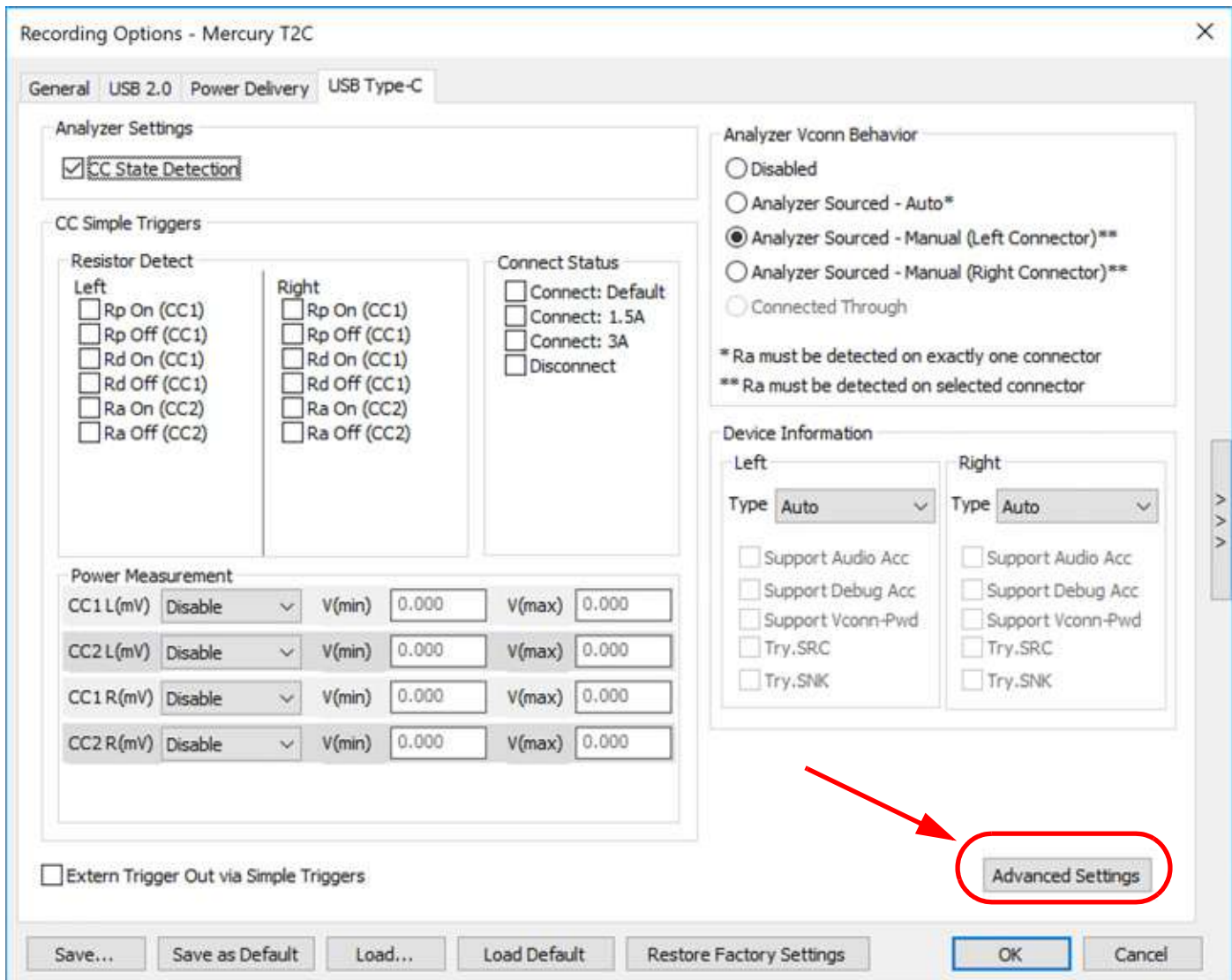


Figure 5.14: T2C: Recording Mode -> Advanced Settings for USB Type C

5.1.11 Select Advanced Settings

These options allow you to set the Voltage Settings and Debounce Times used by the Analyzer or Exerciser for detecting different Type-C states. These have been calibrated by Teledyne LeCroy for each analyzer to provide the best results, but may need to be fine-tuned by the customer for specific devices during the development stages. Note that changing these values COULD cause improper captures of Type-C state changes as viewed in the Trace Files. These should only be modified by users who understand the implications.

If you select the User Defined checkbox, you can set your own voltage thresholds. If you want to use the default values you can un-check the checkbox and the values will be grayed out. See [Figure 5.15](#).

Type C Advanced Settings

Voltage Threshold | **Debounce Threshold**

☒ **User Defined** ← **User Defined**

Analyzer

- vConnect- 3A Max (mV) : **1000** <4000 ← **Value Set by User (green box)**
- vConnect- 1.5A Max (mV) : 1230 <4000
- vConnect- Def Max (mV) : 660 <4000
- vConnect- Def Min (mV) : 410 <4000
- vOpen Max (mV) : 1970 <4000
- vOpen Min (mV) : 1250 <4000

Vbus On/Off Threshold

- Analyzer (mV) : 4000 <21000
- Exerciser as SRC (mV) : 4750 <21000
- Exerciser as SNK (mV) : 4750 <21000

Exerciser

Rp-3A Term

- vConnect (mV) : 2600 <4000
- vRa (mV) : 800 <4000

Rp-1.5A Term

- vConnect (mV) : 1600 <4000
- vRa (mV) : 400 <4000

Rp-Def Term

- vConnect (mV) : 1600 <4000
- vRa (mV) : 200 <4000

Rd Term

- vConnect- 3A (mV) : 2040 <4000
- vConnect- 1.5A (mV) : 1230 <4000
- vConnect- Def (mV) : 660 <4000
- vOpen (mV) : 250 <4000

Ra Term

- vRp (mV) : 3000 <4000
- vOpen (mV) : 70 <4000

No Term

- vOpen Max (mV) : 1970 <4000
- vOpen Min (mV) : 225 <4000

OK **Cancel**

Figure 5.15: Advanced Recording Options -> USB Type-C Voltage Thresholds

You can also select the Debounce Threshold tab (see [Figure 5.16](#)). If you select the User Defined checkbox, you can set your own voltage thresholds. If you want to use the default values you can un-check the checkbox and the values will be grayed out.

These options allow you to set the Debounce Threshold Settings used by the Analyzer or Exerciser.

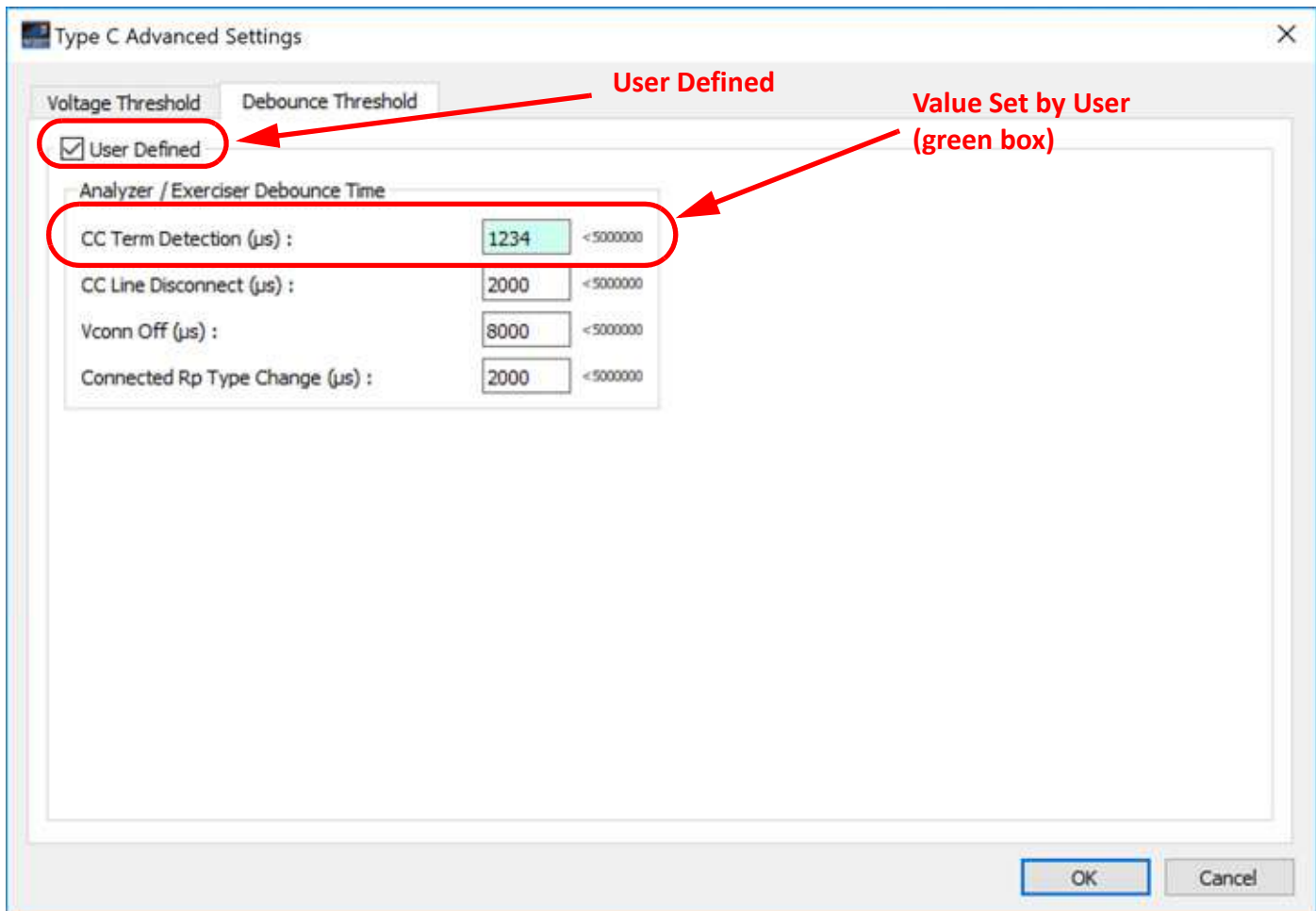


Figure 5.16: USB Type-C Debounce Thresholds tab

5.1.12 Simple Mode: Voyager M3x

In Simple Mode for Analyzer recording options, the Recording Options dialog box for the Voyager M3x is:

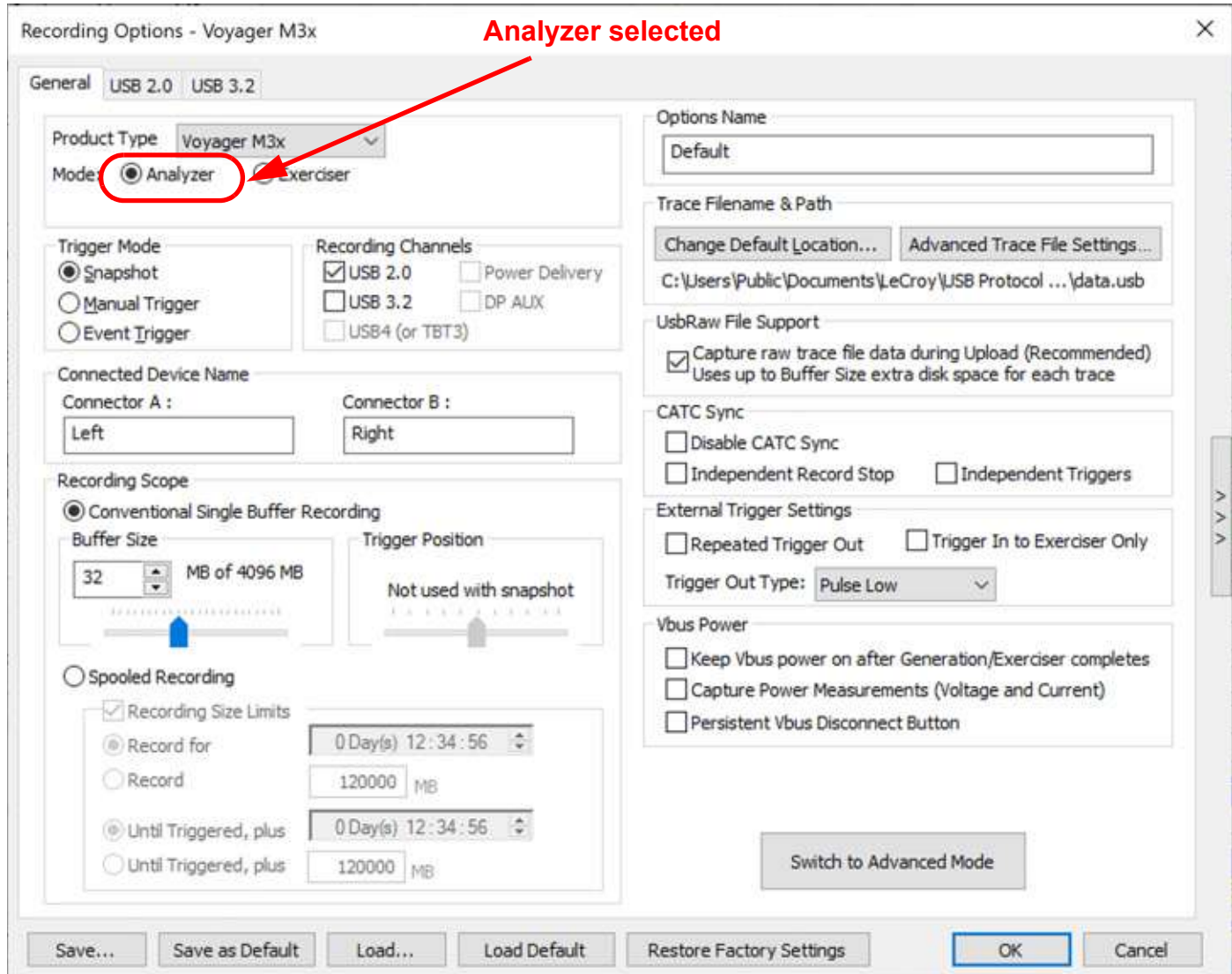


Figure 5.17: Voyager M3x: Recording Options General Tab in Simple Mode

For the recording option for the M3x in simple Exerciser Mode see [Figure 5.18 on page 259](#).

Recording Options - Voyager M3x

General USB 2.0 USB 3.2

Product Type: Voyager M3x

Mode: ☐ Analyzer ☒ Exerciser

Trigger Mode:
☒ Snapshot
☐ Manual Trigger
☐ Event Trigger

Recording Channels:
☒ USB 2.0 ☐ Power Delivery
☐ USB 3.2 ☐ DP AUX
☐ USB4 (or TBT3)

Connected Device Name:
 Connector A - DUT: DUT
 Exerciser: M3x

Recording Scope:
☒ Conventional Single Buffer Recording
 Buffer Size: 32 MB of 4096 MB
 Trigger Position: Not used with snapshot
☐ Spooled Recording
☒ Recording Size Limits
☒ Record for: 0 Day(s) 12:34:56
☐ Record: 120000 MB
☒ Until Triggered, plus: 0 Day(s) 12:34:56
☐ Until Triggered, plus: 120000 MB

Options Name: Default

Trace Filename & Path:
 Change Default Location... Advanced Trace File Settings...
 C:\Users\Public\Documents\LeCroy\USB Protocol ... \data.usb

UsbRaw File Support:
☒ Capture raw trace file data during Upload (Recommended)
 Uses up to Buffer Size extra disk space for each trace

CATC Sync:
☐ Disable CATC Sync
☐ Independent Record Stop ☐ Independent Triggers

External Trigger Settings:
☐ Repeated Trigger Out ☐ Trigger In to Exerciser Only
 Trigger Out Type: Pulse Low

Vbus Power:
☐ Keep Vbus power on after Generation/Exerciser completes
☐ Capture Power Measurements (Voltage and Current)
☐ Persistent Vbus Disconnect Button

Switch to Advanced Mode

Save... Save as Default Load... Load Default Restore Factory Settings OK Cancel

Figure 5.18: M3x: Recording Options -> Exerciser Selected, Simple Mode

5.1.13 Advanced Mode: Voyager M3x

In Advanced Mode, the Recording Options dialog box for the Voyager M3x (Analyzer Mode) is shown below with USB2.0, USB3.2, USB 2.0 Rec Rules: CHO and USB3.2 (SS) Rec Rules see [Figure 5.19](#).

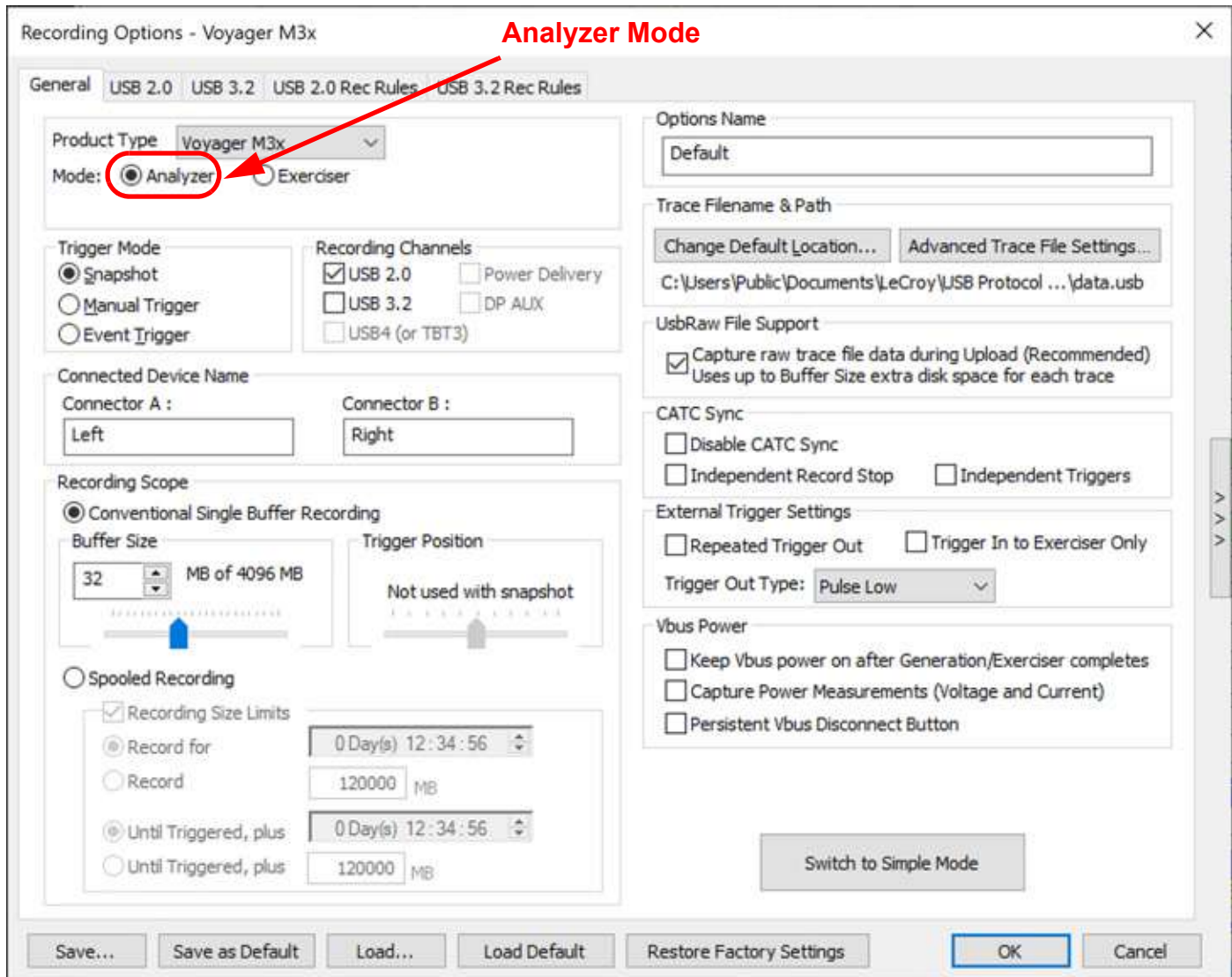


Figure 5.19: Voyager M3x: Recording Options General Tab in Advanced Mode

5.1.13.1 Advanced Mode: M3x Recording Options Exerciser Mode

In Advanced Mode, the Recording Options dialog box for the Voyager M3x (Exerciser Mode) is shown below with USB2.0, USB3.2, USB 2.0 Rec Rules: CHO and USB3.2 (SS) Rec Rules tabs see [Figure 5.20](#).

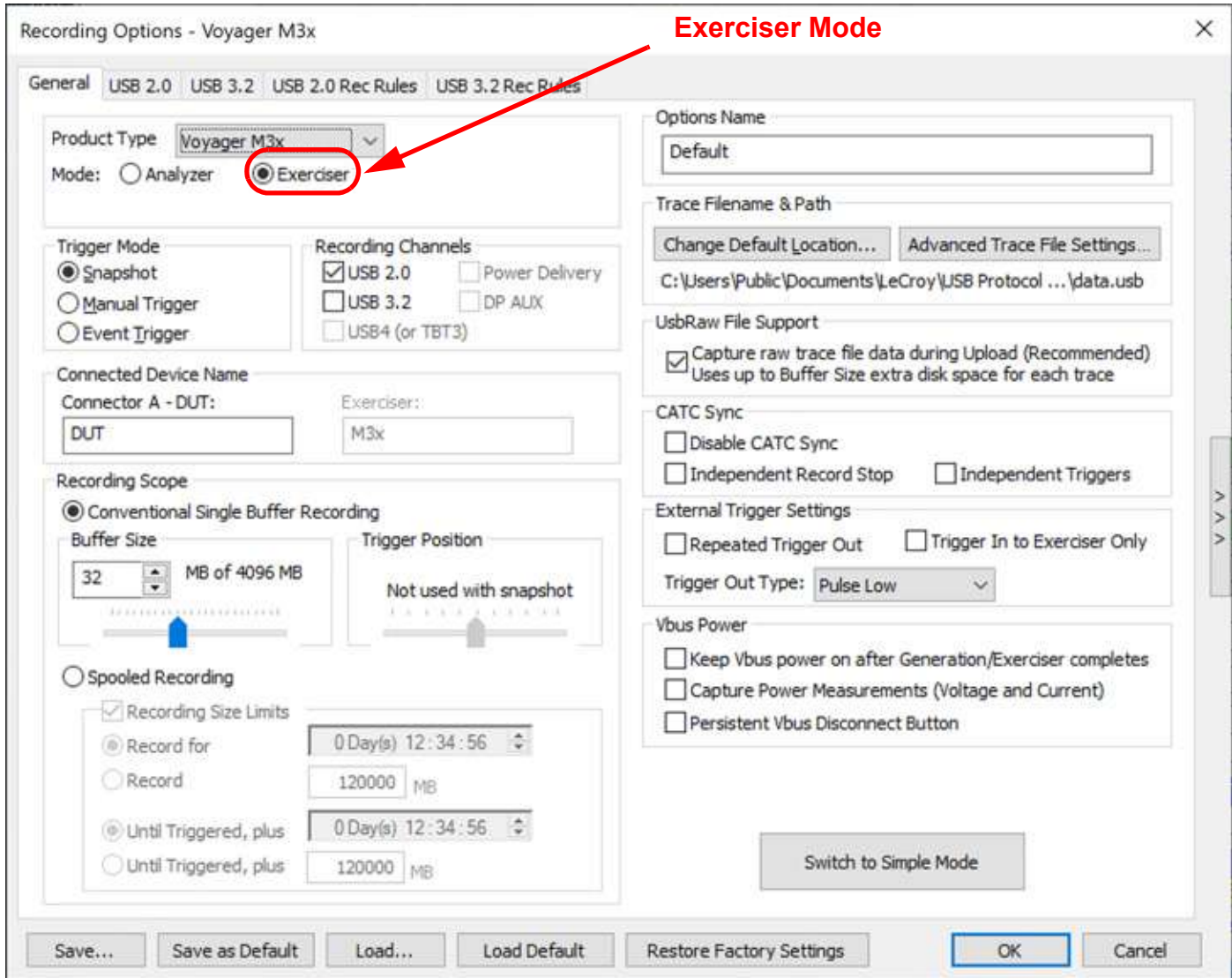


Figure 5.20: M3x: Advanced Mode -> Recording Options Exerciser Mode

5.1.14 Simple Mode: Voyager M310C (Analyzer Mode)

In Simple Mode (Analyzer) the Voyager M310C has options for USB2.0, USB3.2, Power Delivery and USB Type-C. See [Figure 5.21](#).

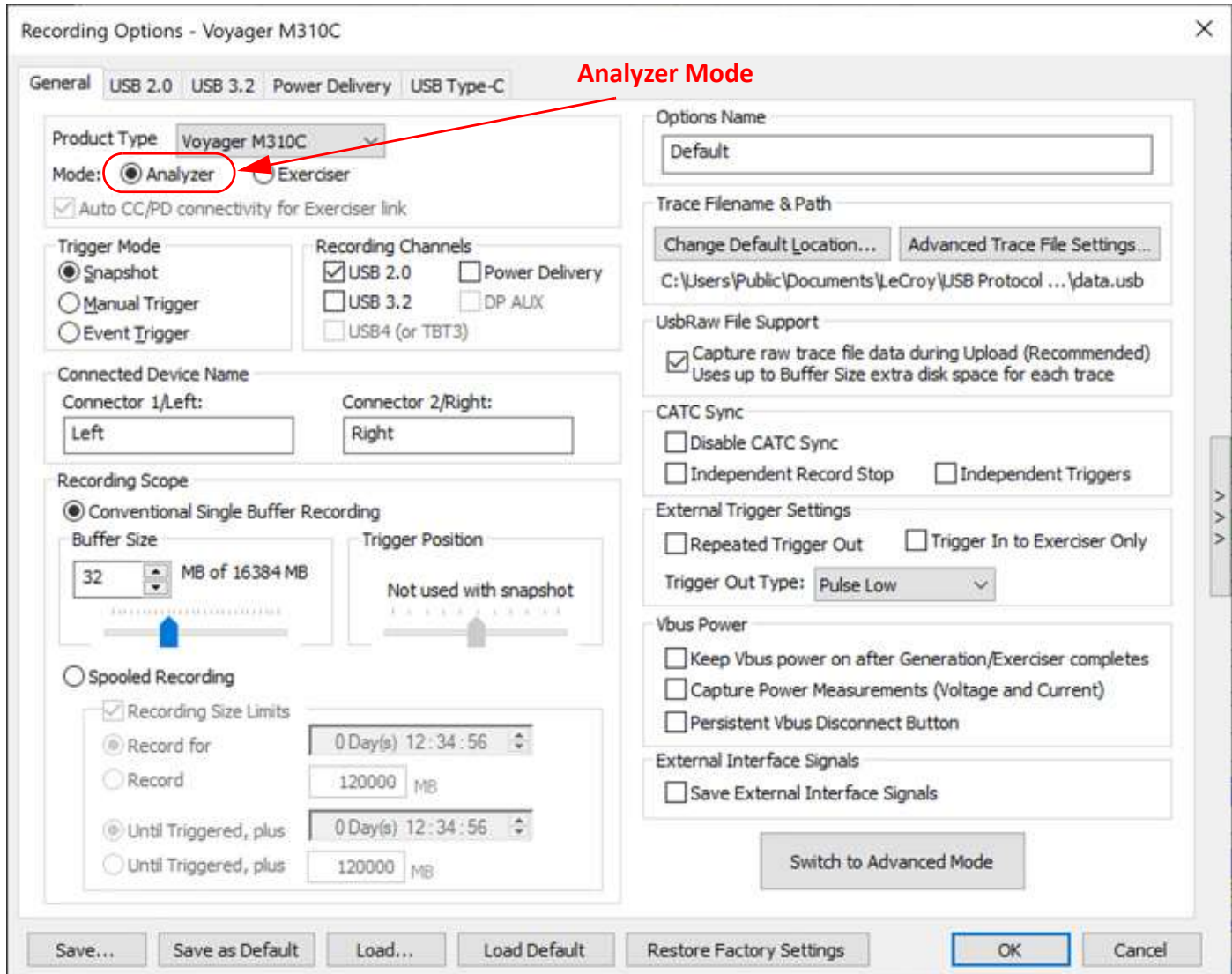


Figure 5.21: Voyager M310C: Simple Mode Recording Options

5.1.14.1 Simple Mode: Voyager M310C (Exerciser Mode)

In Simple Mode (Exerciser) the Voyager M310C has options for USB 2.0, USB 3.2, Power Delivery and USB Type-C. It also has an option for Auto CC/PD connectivity for Exerciser Link and a single connection to the DUT. See [Figure 5.22](#).

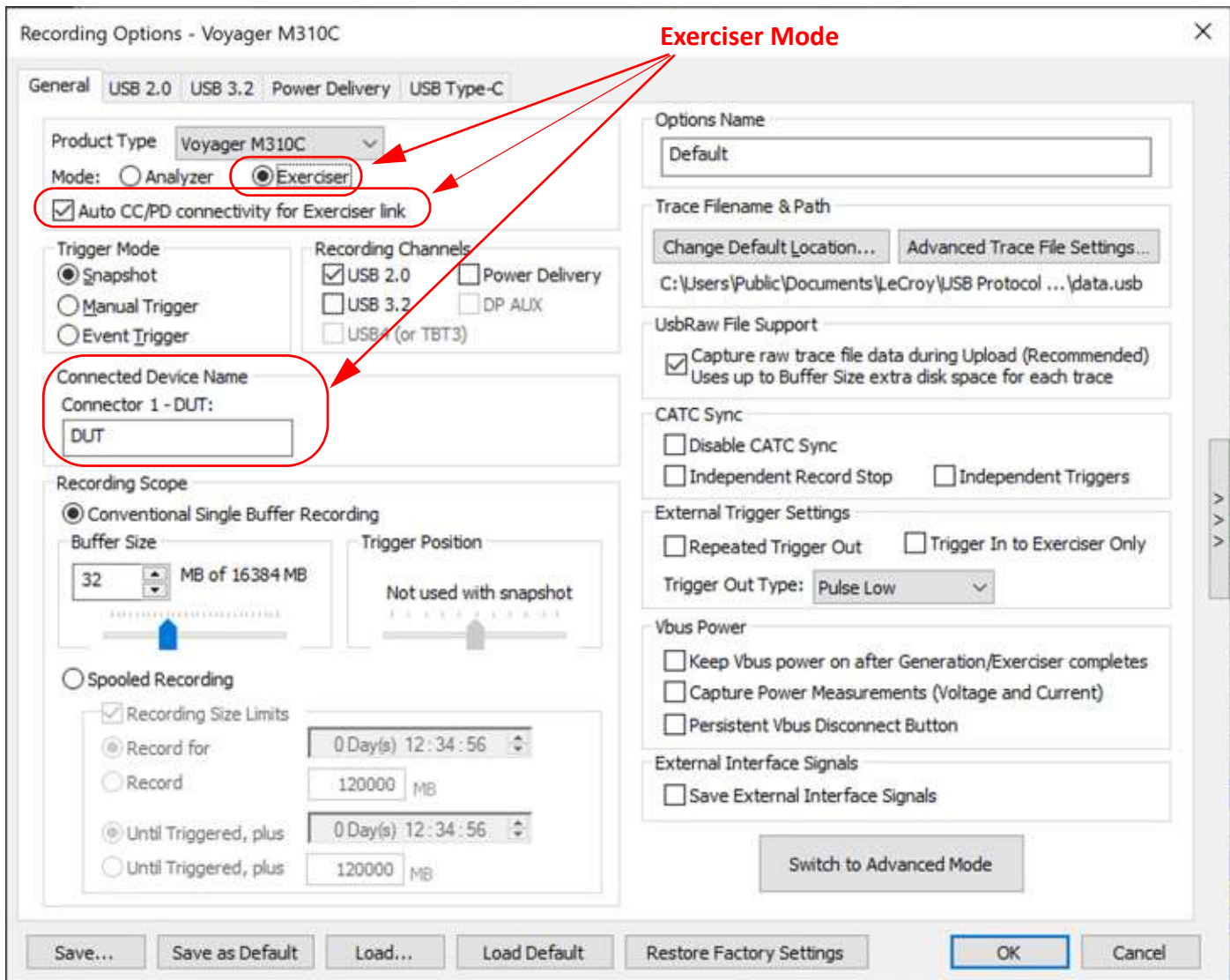


Figure 5.22: Voyager M310C: Simple Mode (Exerciser) Recording Options

The Trigger options for Power Delivery and USB Type-C events are the same in both Simple and Advanced Mode.

The Simple Trigger Options for Power Delivery are shown below:

- ☐ Analyzer Mode: [Figure 5.72 on page 325](#)
- ☐ Exerciser Mode: [Figure 5.73 on page 326](#)

The Simple Trigger Options for USB Type-C events are shown below:

- ☐ Analyzer Mode: [Figure 5.74 on page 328](#)
- ☐ Exerciser Mode: [Figure 5.75 on page 330](#)

5.1.14.2 Advanced Mode: Voyager M310C (Analyzer Mode)

In Advanced Mode the Voyager M310C has options for USB2.0, USB3.2, Power Delivery, USB Type-C, USB 2.0 Rec Rules: CH0 and USB3.2 (SS) Rec Rules. See [Figure 5.23](#).

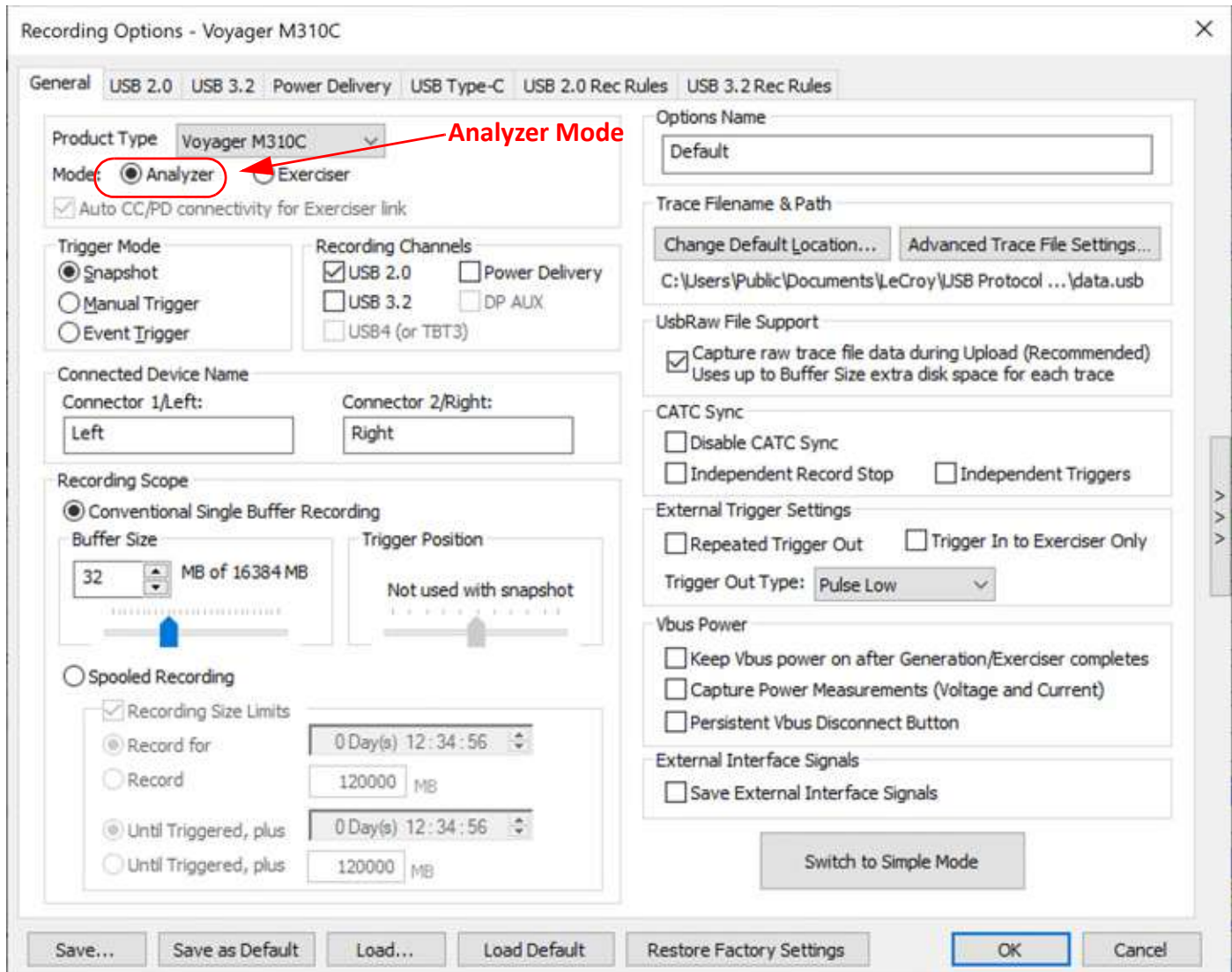


Figure 5.23: Voyager M310C: Advanced Mode Recording Options -> Analyzer Mode

5.1.14.3 Advanced Mode: Voyager M310C (Exerciser Mode)

In Advanced Mode (Exerciser) the Voyager M310C has options for USB2.0, USB3.2, Power Delivery, USB Type-C, USB 2.0 Rec Rules: CH0 and USB3.2 (SS) Rec Rules. It also has an option for Auto CC/PD connectivity for Exerciser Link and a single connection to the DUT. See [Figure 5.24](#).

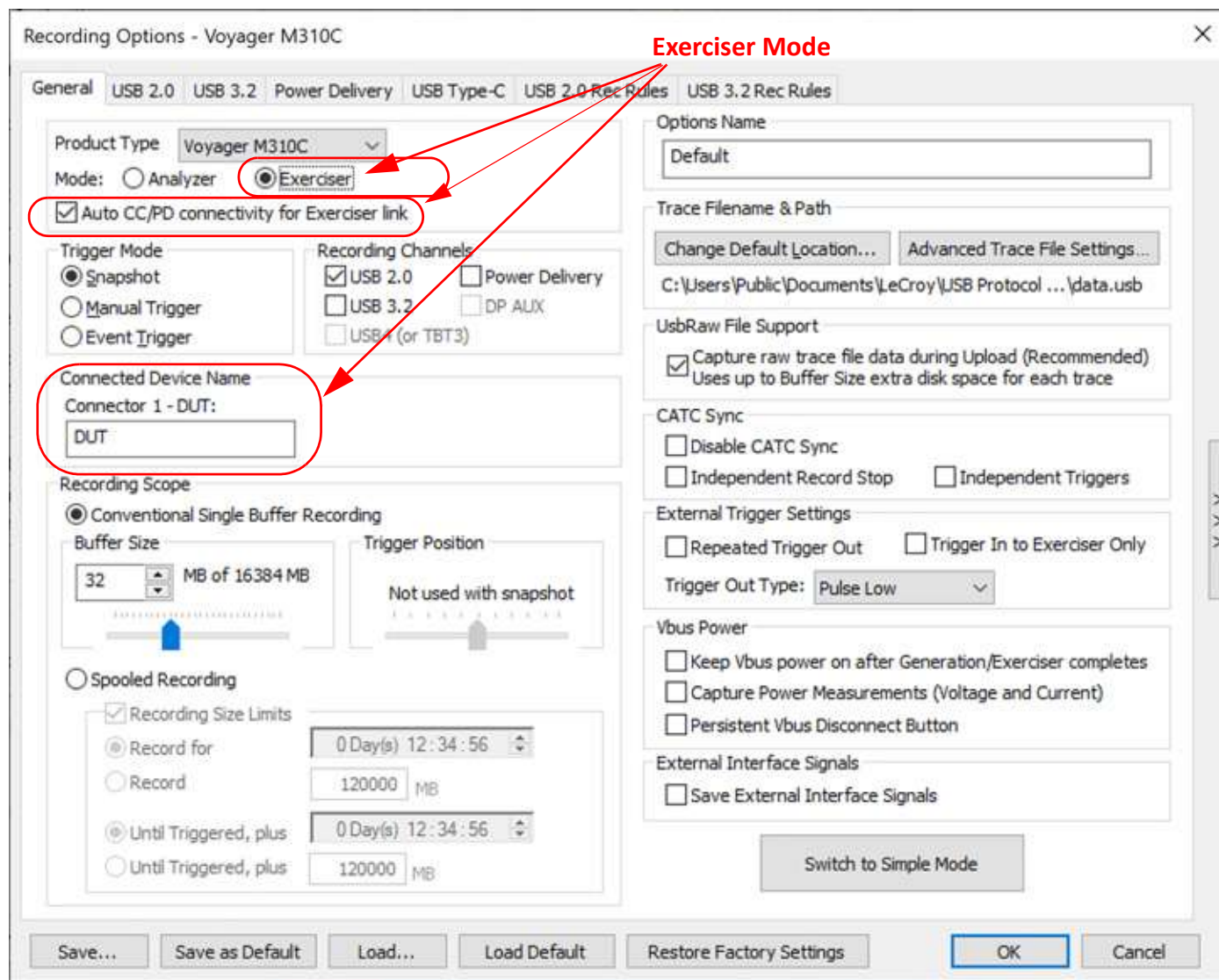


Figure 5.24: Voyager M310C: Advanced Mode Recording Options -> Exerciser Mode

5.1.15 Simple Mode: Voyager M310P (Analyzer)

In Simple Mode the Voyager M310P has options for USB2.0, USB3.2, Power Delivery and USB Type-C. See [Figure 5.25](#).

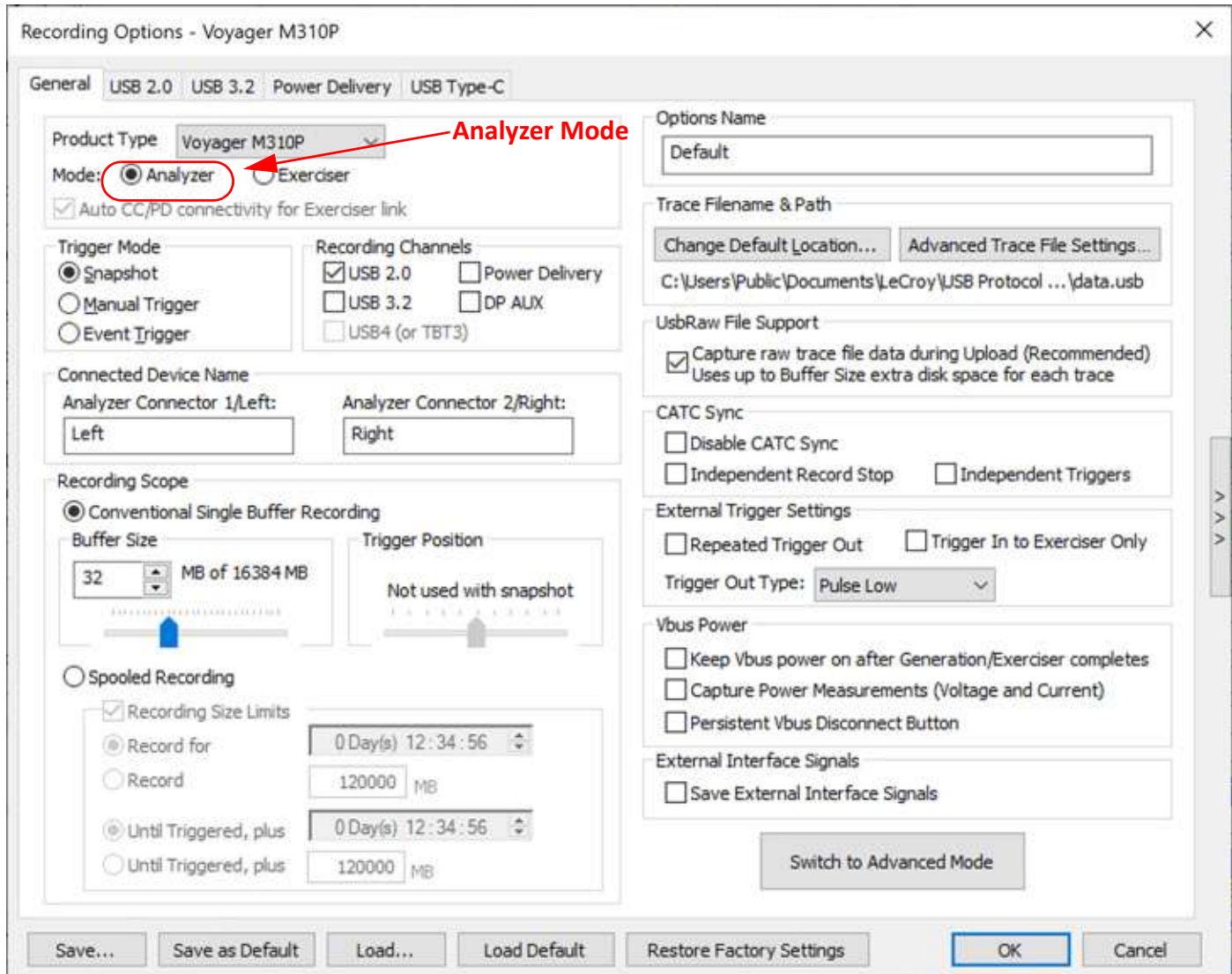


Figure 5.25: Voyager M310P: Simple Mode Recording Options (Analyzer)

5.1.15.1 Simple Mode: Voyager M310P (Exerciser)

In Simple Mode (Exerciser) the Voyager M310P has options for USB2.0, USB3.2, Power Delivery and USB Type-C. It also has an option for Auto CC/PD connectivity for Exerciser Link and a single connection to the DUT. See [Figure 5.26](#).

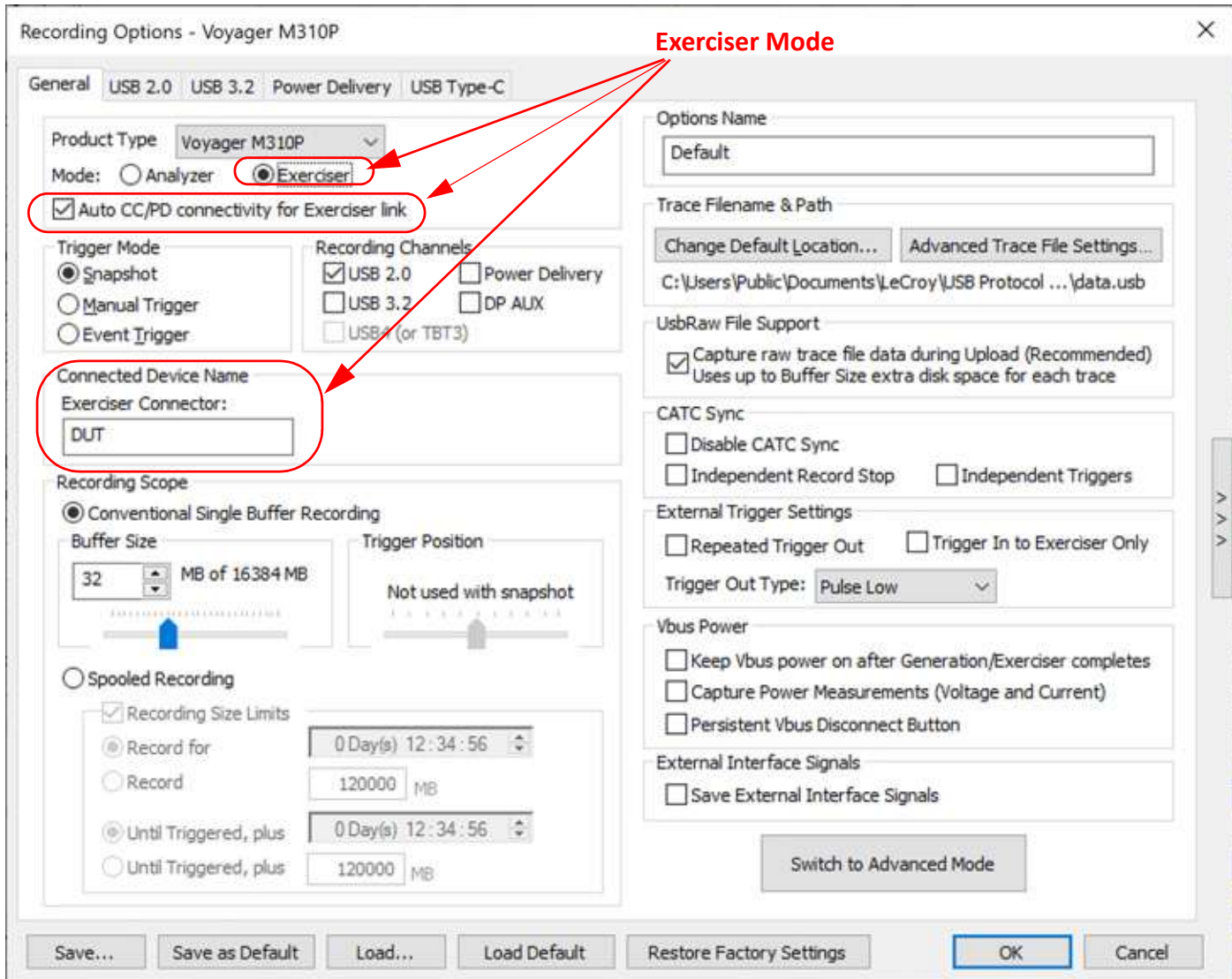


Figure 5.26: Voyager M310P: Simple Mode Recording Options (Exerciser)

The Power Delivery and USB Type-C Recording Options are the same for both Simple and Advanced Modes.

The Simple Trigger Options for Power Delivery are shown below:

- ☐ Analyzer Mode: [Figure 5.72 on page 325](#)
- ☐ Exerciser Mode: [Figure 5.73 on page 326](#)

The Simple Trigger Options for USB Type-C events are shown below:

- ☐ Analyzer Mode: [Figure 5.74 on page 328](#)
- ☐ Exerciser Mode: [Figure 5.75 on page 330](#)

5.1.16 Advanced Mode: Voyager M310P (Analyzer)

In Advanced Mode the Voyager M310P analyzer has options for USB2.0, USB3.2, Power Delivery, USB Type-C, USB 2.0 Rec Rules: CH0 and USB3.2 (SS) Rec Rules. See [Figure 5.27](#).

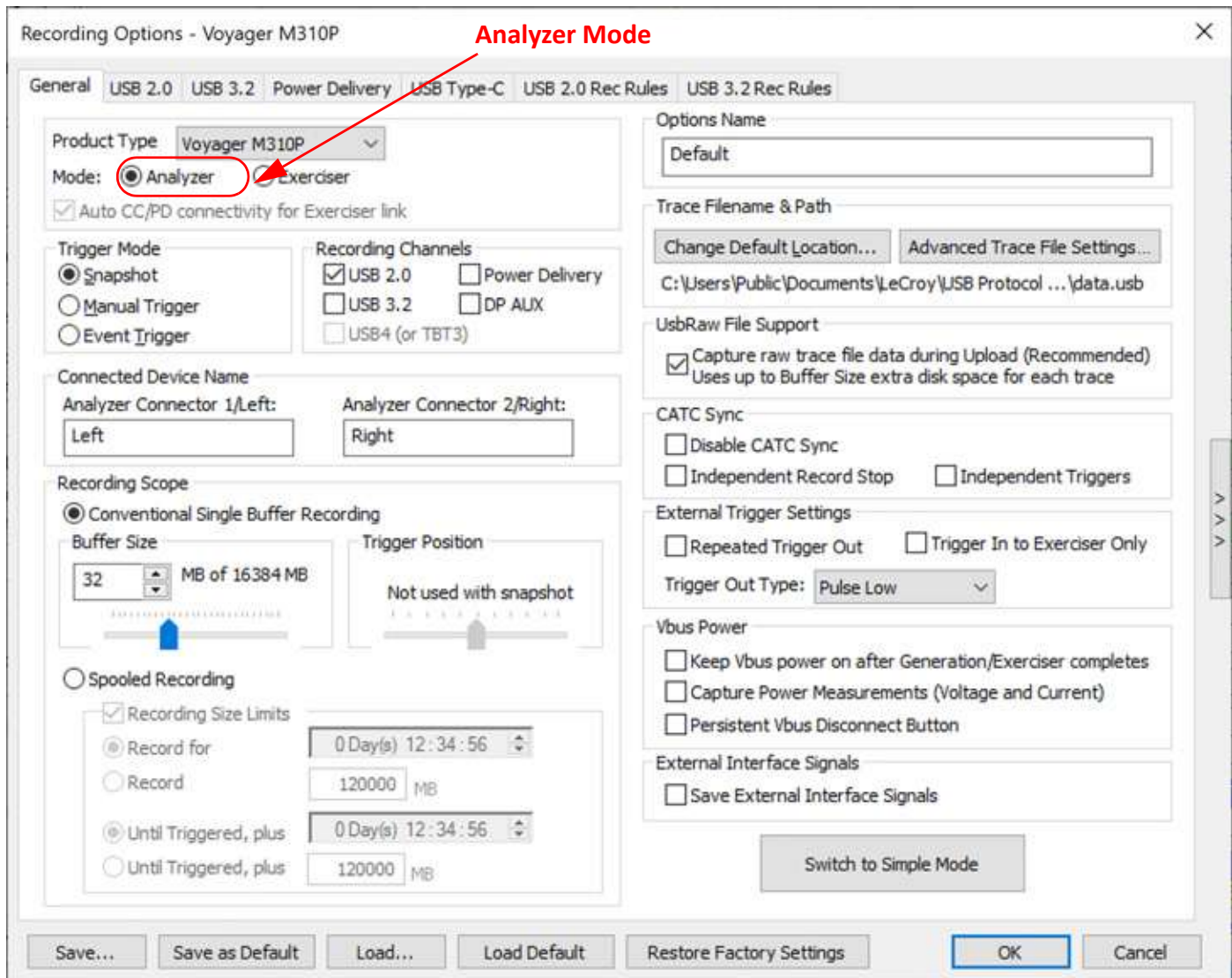


Figure 5.27: Voyager M310P: Advanced Mode Recording Options (Analyzer)

5.1.16.1 Advanced Mode: Voyager M310P (Exerciser)

In Advanced Mode (Exerciser) the Voyager M310P has options for USB2.0, USB3.2, Power Delivery, USB Type-C, USB 2.0 Rec Rules: CH0 and USB3.2 (SS) Rec Rules. It also has an option for Auto CC/PD connectivity for Exerciser Link and a single connection to the DUT. See [Figure 5.28](#).

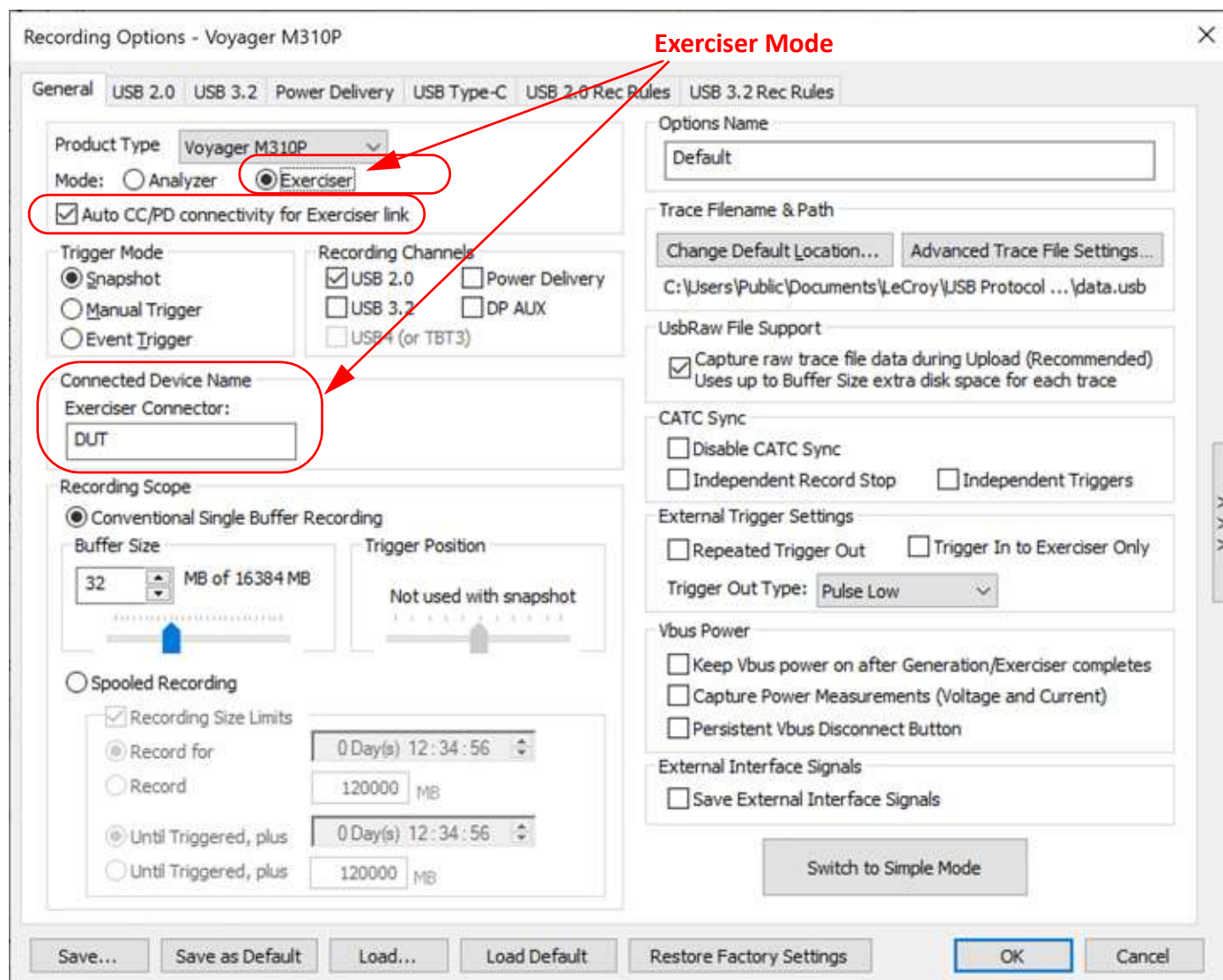


Figure 5.28: Voyager M310P: Advanced Mode Recording Options (Exerciser)

5.1.17 Simple Mode: Voyager M4x (Analyzer)

The usage modes for Voyager M4x are selected from the following choices:

- ❑ Analyzer Mode: The "Analyzer" Mode enables the top pair of Type-C Connectors on the front of the M4x that are labeled "Analyzer". These are used to capture USB 2.0, USB 3.2 (x1 and x2, 5 Gbps and 10Gbps), USB4, Power Delivery, Type-C signals, and USB4 SideBand signals.
- ❑ Exerciser Mode The "Exerciser" Mode enables the Exerciser connector on the front of the M4x, but is not enabled for use at this time.
- ❑ DP Alt Mode Analyzer: The "DP Alt Mode Analyzer" Mode enables the lower 2 Type-C Connectors. These are used to capture USB 2.0, Power Delivery, Type-C signals, and Display Port Aux Channel packets. The Gb speed signals are wired directly from Connector 1 to Connector 2 and are not analyzed.

In Simple Mode the Voyager M4x has options for USB2.0, Power Delivery, USB Type-C and USB4. See [Figure 5.29](#).

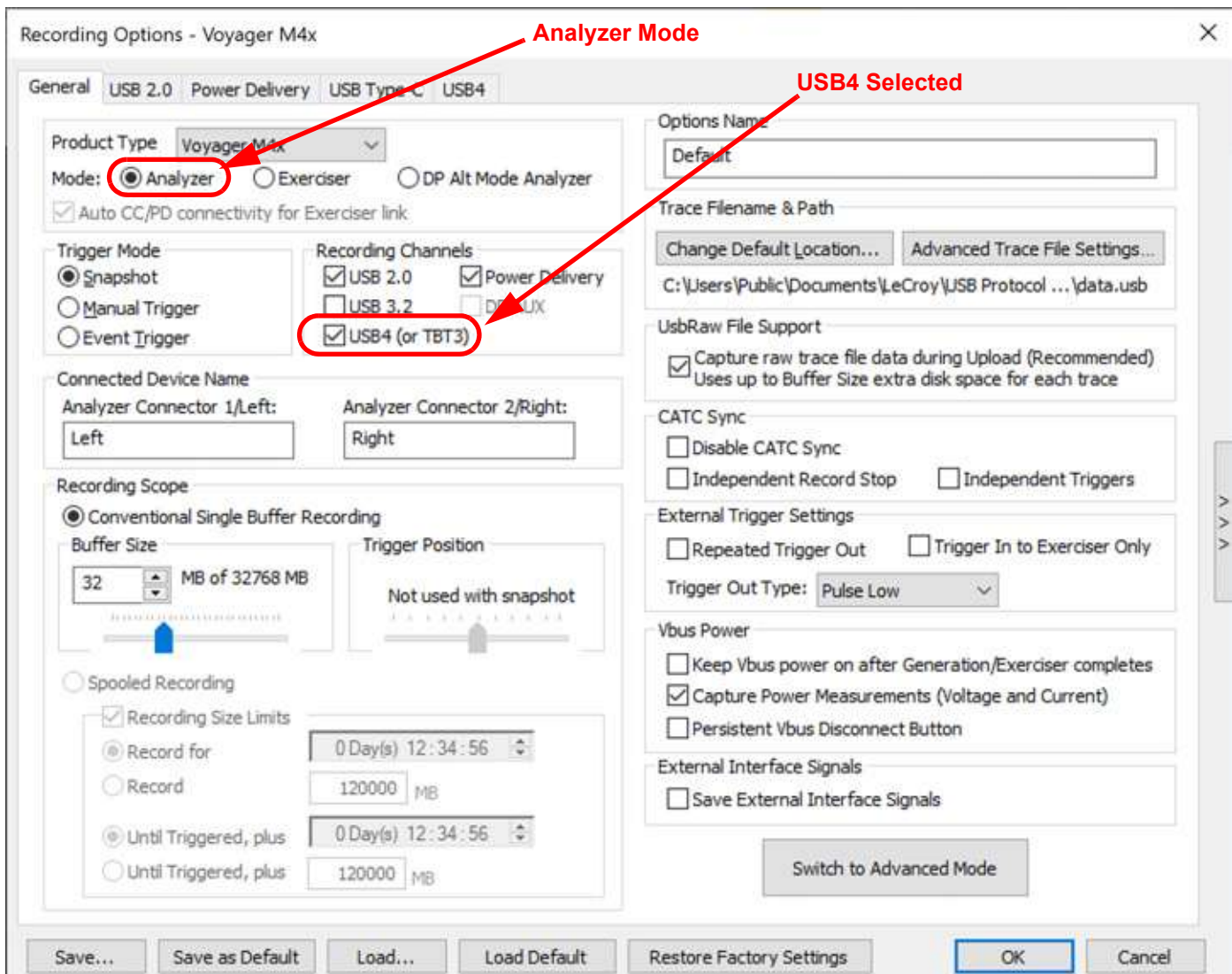


Figure 5.29: Voyager M4x: Simple Mode Recording Options

5.1.17.1 Simple Mode: Voyager M4x (Exerciser)

In Simple Mode (Exerciser) the Voyager M4x has options for USB2.0, Power Delivery, USB Type-C and USB4. It also has an option for Auto CC/PD connectivity for Exerciser Link and a single connection to the DUT See [Figure 5.30](#).

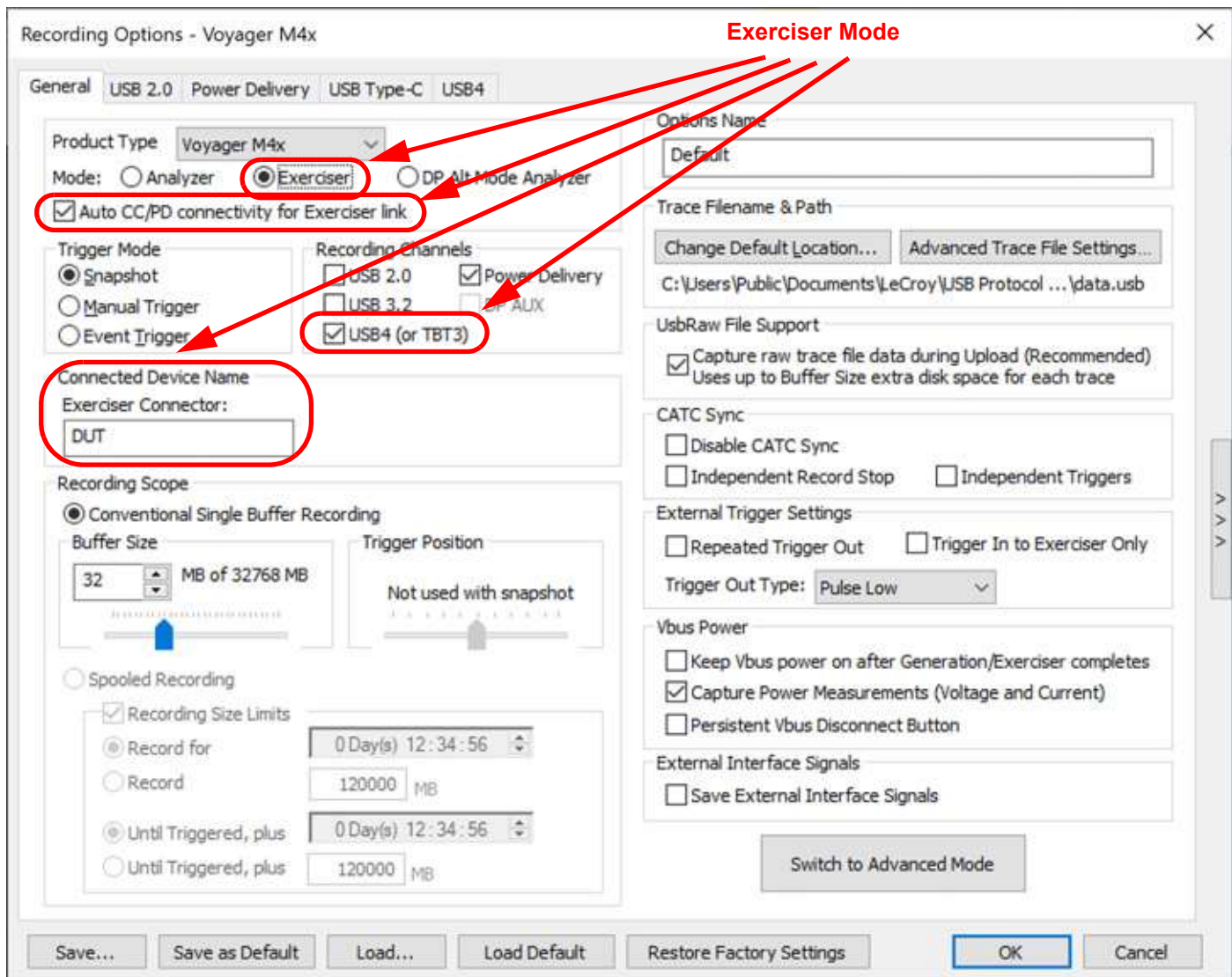


Figure 5.30: Voyager M4x: Simple Recording Options (Exerciser)

5.1.17.2 Simple Mode: Voyager M4x (DP Alt Mode Analyzer)

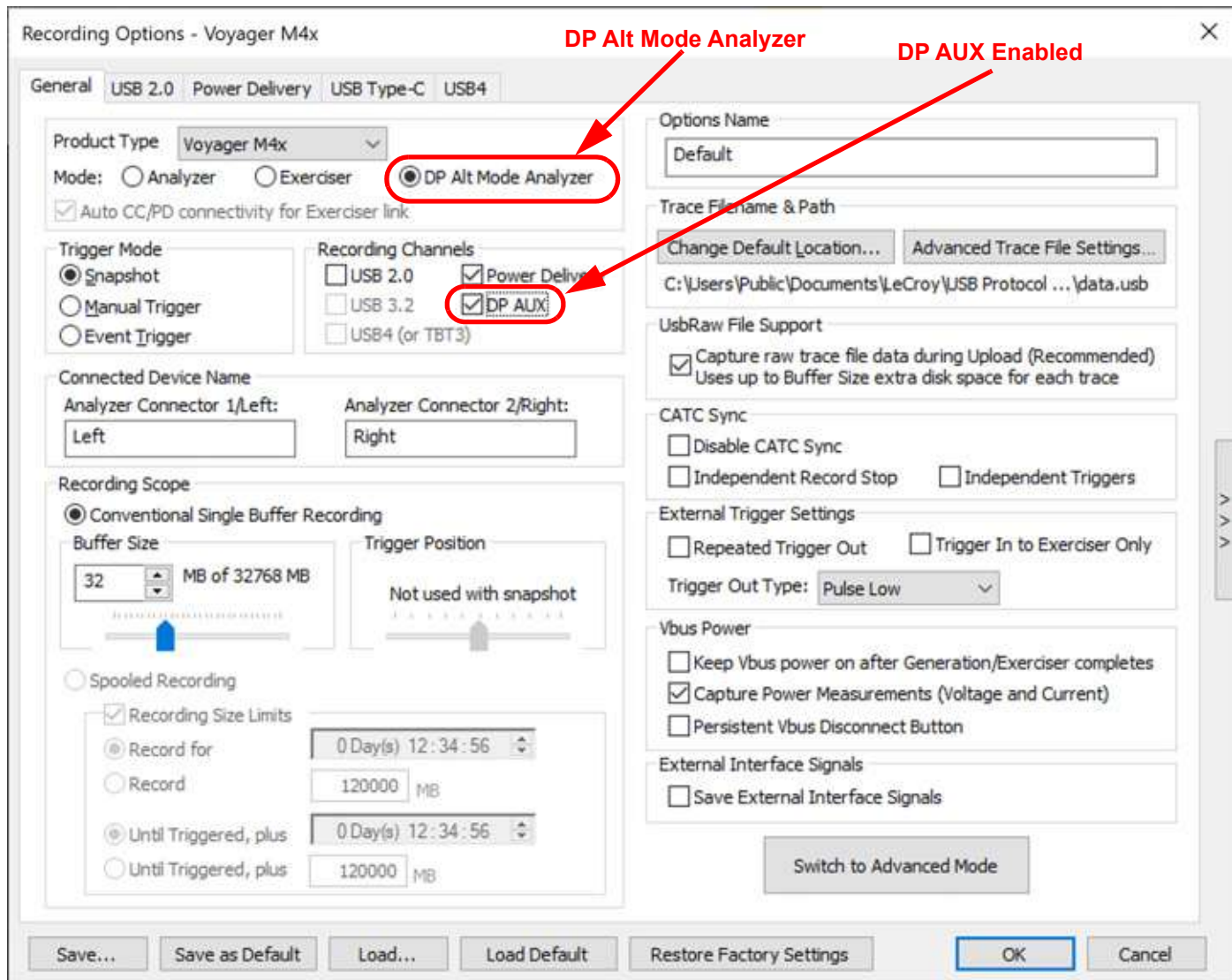


Figure 5.31: Voyager M4x: Simple Recording Options (DP Alt Mode Analyzer)

The Power Delivery and USB Type-C Recording Options are the same for both Simple and Advanced Modes.

The Simple Trigger Options for Power Delivery are shown below:

- ❑ Analyzer Mode: [Figure 5.72 on page 325](#)
- ❑ Exerciser Mode: [Figure 5.73 on page 326](#)

The Simple Trigger Options for USB Type-C events are shown below:

- ❑ Analyzer Mode: [Figure 5.74 on page 328](#)
- ❑ Exerciser Mode: [Figure 5.75 on page 330](#)

5.1.17.3 M4x Recording Options (Simple Mode): USB4

The Link Settings, Spread Spectrum Clock, Filter Out and Simple Trigger recording options for the M4x in Analyzer Simple Mode USB4 are shown below:

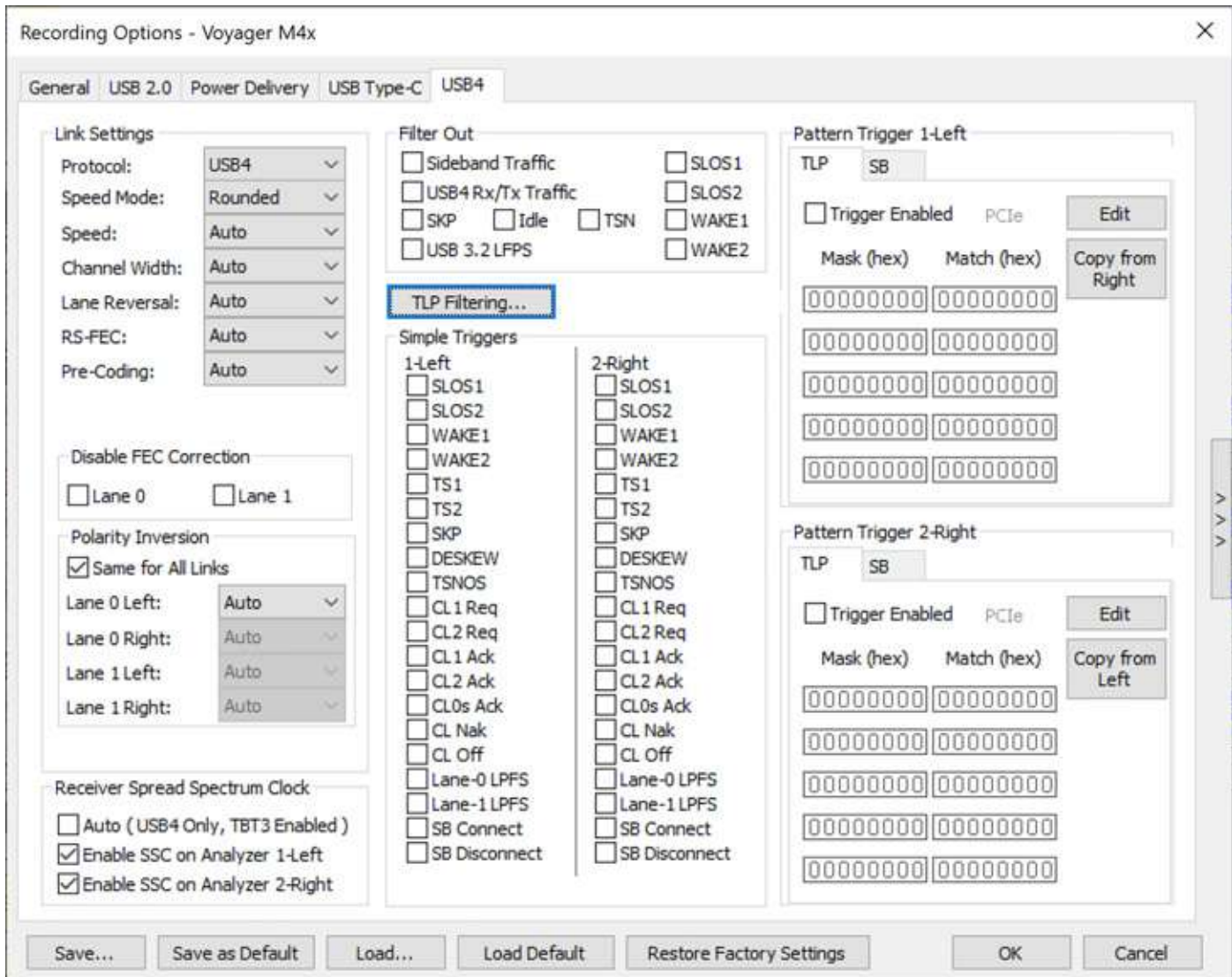


Figure 5.32: Voyager M4x: Recording Options USB4 -> Triggers and Filters

5.1.17.4 Link Settings

Protocol

- ☐ TBT3 - This will cause the software to interpret the packets and behavior according to the TBT3 specification. For example, if a new field is used in USB4 that was Reserved in TBT3, it will be shown as an error.
- ☐ USB4 - Interprets all packets and behavior according to the USB4 specification.

Speed Mode

- ☐ Rounded - USB4 clock rate of 20.000 Gbps (Gen 3) or 10.000 Gbps (Gen 2)
- ☐ Legacy (Non-Rounded) - TBT3 clock rate of 20.625 Gbps (Gen 3) or 10.3125 Gbps (Gen 2)

Speed

- ☐ Auto
 - Gen 2
 - Gen 3

Channel Width

- ☐ Auto
 - x1
 - x2

Lane Reversal

- ☐ Auto
 - No
 - Yes

RS-FEC

- ☐ Auto
 - FEC Encoded (Forward Error Correction)
 - Non-FEC Mode (128/130 Encoding)

PreCoding

- ☐ Auto
 - Enabled
 - Disabled

Disable FEC Correction

- ☐ Lane 0
- ☐ Lane 1
 - This controls whether the Analyzer tries to apply FEC correction to its capture data, or ignores it.
 - Default is to apply the corrections (Unchecked)

Polarity Inversion

- ☐ Same for All Links
 - Used to force a polarity regardless of that indicated in the training.

Note: Seldom needed, so it is normally set to Auto.

- Lane 0 Left
 - Auto Off/On
- Lane 0 Right
 - Auto Off/On
- Lane 1 Left
 - Auto Off/On
- Lane 1 Right
 - Auto Off/On

Spread Spectrum Clock

- ☐ Receive
- ☐ Transmit (Exerciser)

5.1.17.5 Filter Out

Select the checkbox of items you do not want captured in the trace file. This will reduce the size of the trace file and/or reduce the amount of capture memory used.

Note: USB3.2 LFPs filter option is smart filtering option that keeps "USB4 LFPs" in trace and only filters USB3.2 LFPs that happens before entering USB4 mode.

5.1.17.6 Simple Triggers

Select any number of the items listed to cause a trigger to occur when the event is seen by the Analyzer.

5.1.17.7 Pattern Triggers

Pattern triggers are applied the first few DWORDS of a packet to force a Software Trigger when a specific pattern is seen, defined by match/mask constructs.

TLP Tab (USB4 Transport Layer Packet)

These are packets on the High Speed USB4 lanes. The first word denotes the USB4 Header which is one DWORD, followed by 4 DWORDS of untyped traffic.

SB Tab (SideBand)

This is used on the SideBand traffic, to trigger on up to 4 DWORDS of pattern matching.

■ Trigger Enabled

This turns off or on the triggering based on the defined pattern. The pattern can be preserved in either the triggering mode or with it turned off.

■ Edit

See "Edit" below on editing the patterns.

■ Copy from Right / Copy from Left

To simplify setting patterns that you want to match from either transmitter, you can click on this button to copy the pattern from the OTHER side to the current one:

Before: (See [Figure 5.33 on page 276](#))

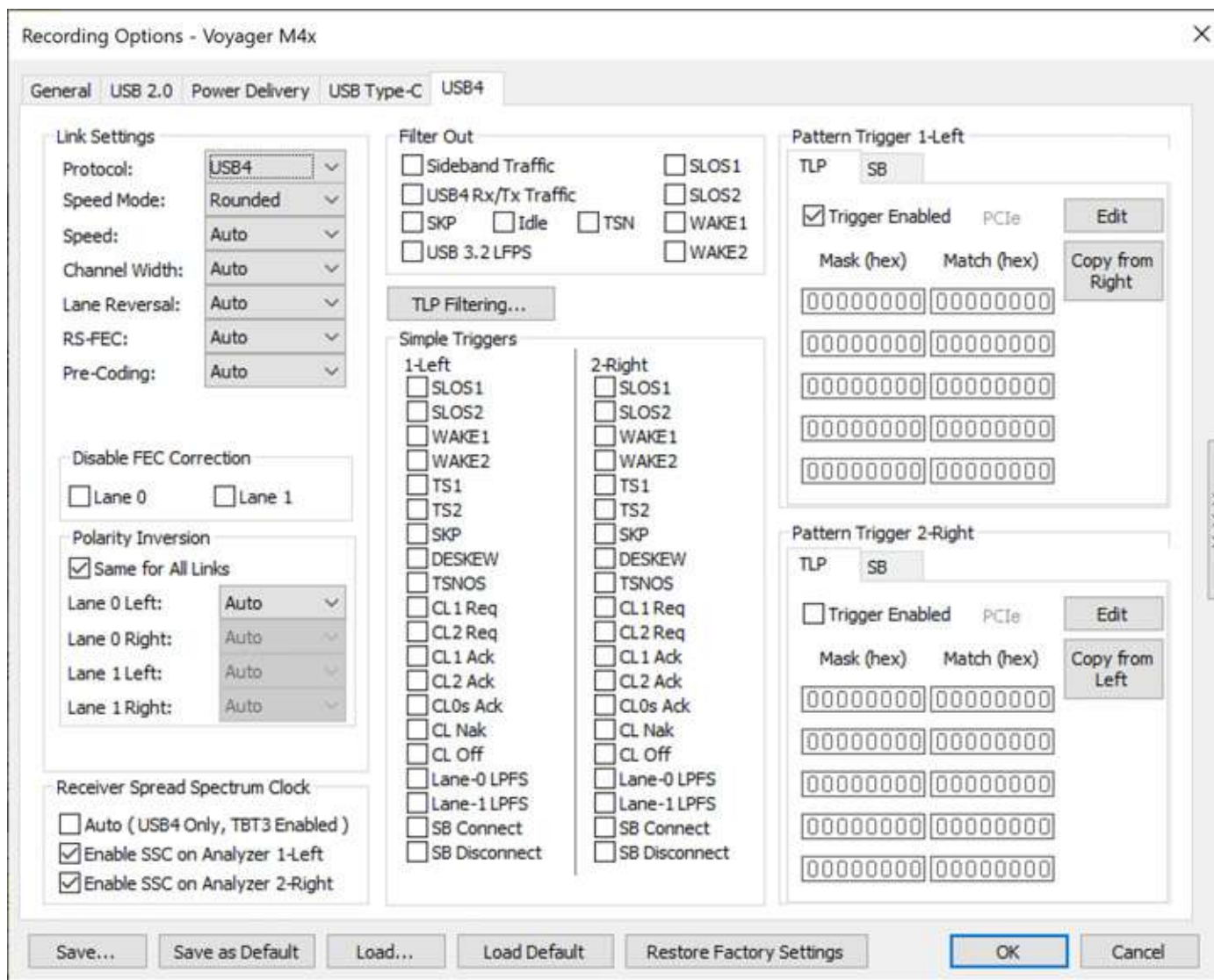


Figure 5.33: Triggering: Before clicking on “Copy from Left”

After hitting "Copy from Left": See [Figure 5.34 on page 277](#).

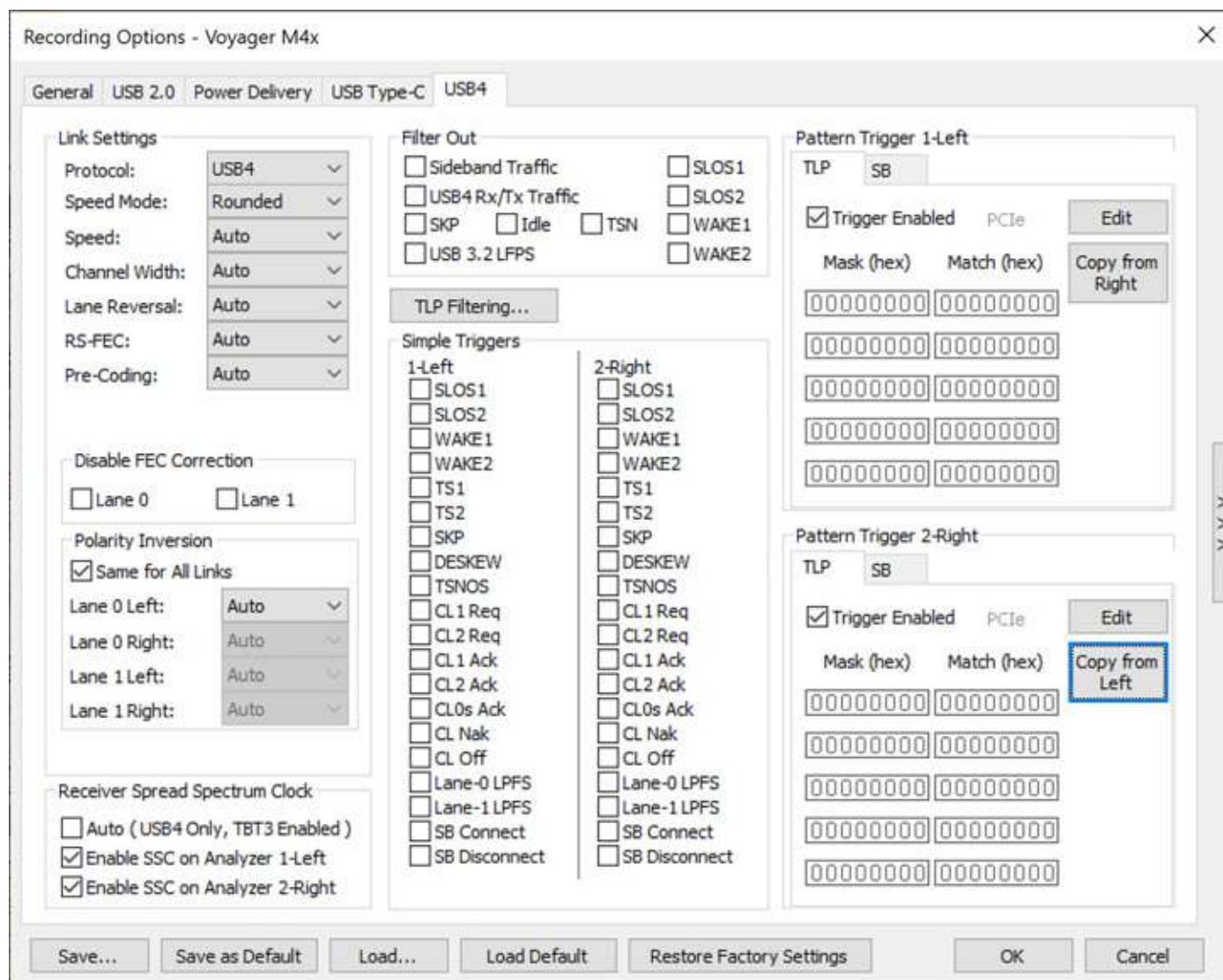


Figure 5.34: Triggering: After clicking on “Copy from Left”

5.1.17.8 Edit TLP Mask Match Pattern Options

If you select the Edit button in the Recording Options -> Pattern Trigger (see [Figure 5.35](#)) this will bring up a dialog box for editing the TLP. See [Figure 5.36 on page 279](#).

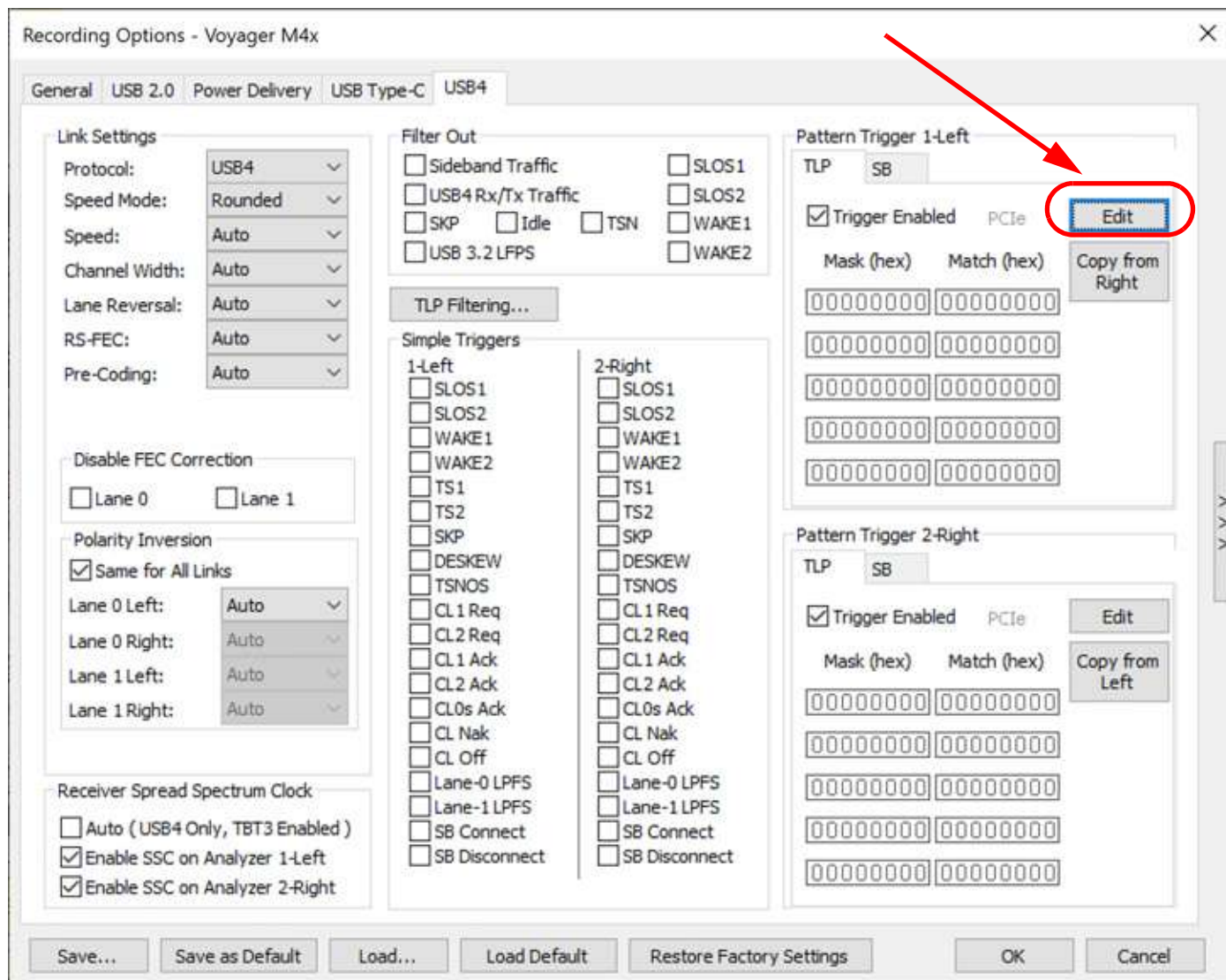


Figure 5.35: Recording Options: Select Edit Button in Pattern Trigger Options

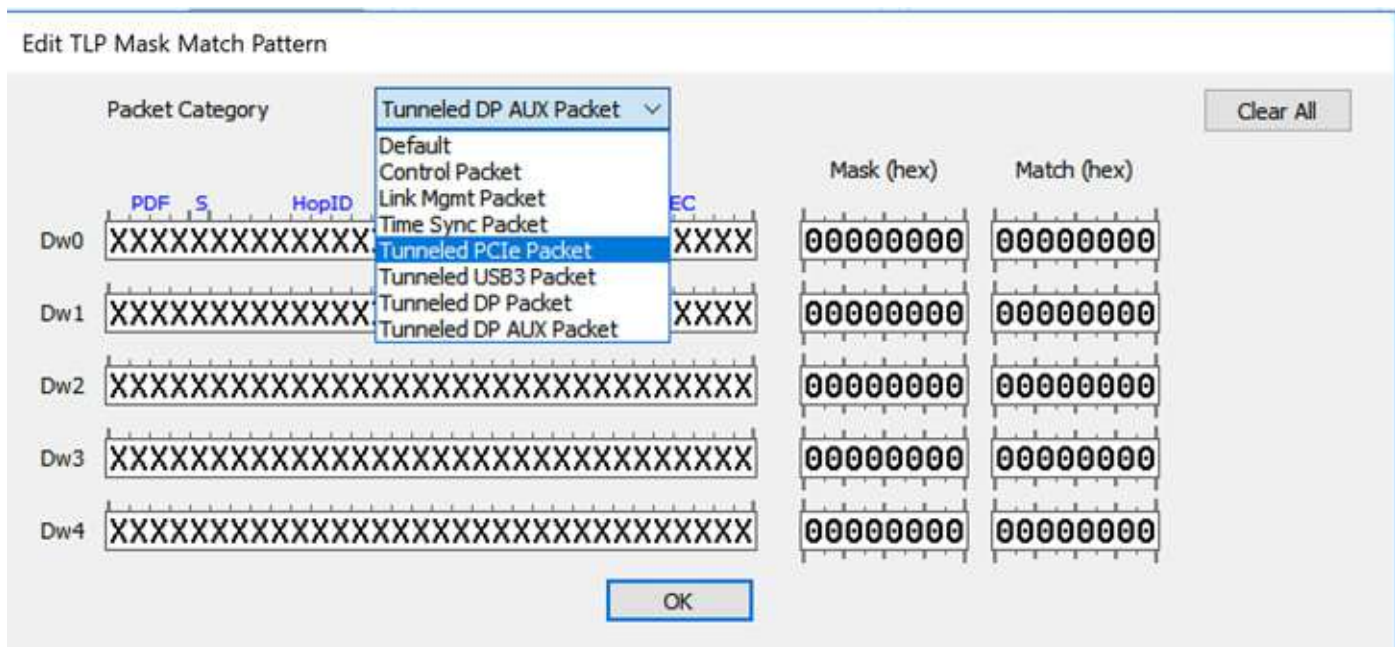


Figure 5.36: Edit TLP Mask Match Pattern Dialog Box

The Packet Category produces a drop menu where you can choose the type of packet you want to trigger on including:

- ☐ Control Packet
- ☐ Link Mgmt Packet
- ☐ Time Sync Packet
- ☐ Tunneled PCIe Packet
- ☐ Tunneled USB3 Packet
- ☐ Tunneled DP Packet
- ☐ Tunneled DP AUX Packet

As an example, if you chose Tunneled PCIe Packet the following options are available in DW0:

- ☐ PDF
- ☐ S
- ☐ HopID
- ☐ Length
- ☐ HEC

See [Figure 5.37 on page 280](#).

Edit TLP Mask Match Pattern

Packet Category: Tunneled PCIe Packet Clear All

	PDF	S	HopID	Length	HEC	Mask (hex)	Match (hex)
Dw0	0x0	▼	XXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXX	XXXXXXXXXX	00000000	00000000
Dw1	Ordered Set - 0001b Electric Idle State - 0010b TLP/DLLP - 0011b PERST Active - 0101b PERST Inactive - 0110b					XXXXXXXXXXXX	00000000
Dw2	XXXXXXXXXXXXXXXXXXXXXXXXXXXX					XXXXXXXXXXXX	00000000
Dw3	XXXXXXXXXXXXXXXXXXXXXXXXXXXX					XXXXXXXXXXXX	00000000
Dw4	XXXXXXXXXXXXXXXXXXXXXXXXXXXX					XXXXXXXXXXXX	00000000

OK

Figure 5.37: Tunneled PCIe Packet Options: PDF

For PDF you can choose from the following options:

- ☐ Ordered Set
- ☐ Electrical Idle State
- ☐ TLP/DLLP
- ☐ PERST Active
- ☐ PERST Inactive

An example with each option selected is shown in [Figure 5.38](#).

Edit TLP Mask Match Pattern

Packet Category: Tunneled PCIe Packet Clear All

	PDF	S	HopID	Length	HEC	Mask (hex)	Match (hex)
Dw0	00110000001100100011001000110010	Type	XXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXX	XXXXXXXXXX	FFFFFFFF	30323232
Dw1	XXXXXXXXXXXXXXXXXXXXXXXXXXXX					XXXXXXXXXXXX	00000000
Dw2	XXXXXXXXXXXXXXXXXXXXXXXXXXXX					XXXXXXXXXXXX	00000000
Dw3	XXXXXXXXXXXXXXXXXXXXXXXXXXXX					XXXXXXXXXXXX	00000000
Dw4	XXXXXXXXXXXXXXXXXXXXXXXXXXXX					XXXXXXXXXXXX	00000000

OK

Figure 5.38: Tunneled PCIe Packet Options Selected

After you click on “OK” the Trigger Pattern you selected will be shown in the Recording Options dialog box (see [Figure 5.39](#)). In this case since we chose Tunneled PCIe Packet the PCIe text in the Pattern Trigger area will be highlighted.

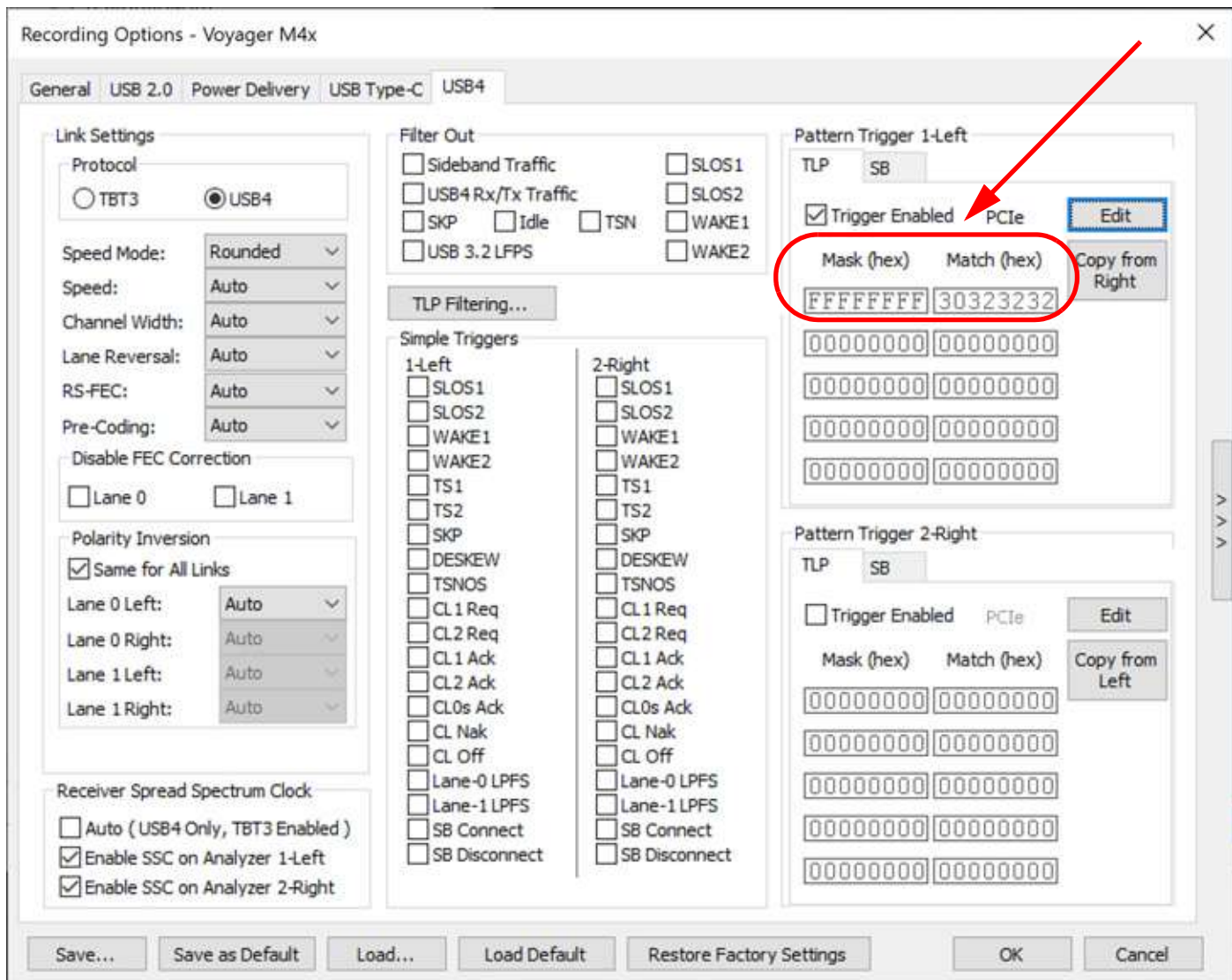


Figure 5.39: Recording Options -> Pattern Trigger Set

Another example of a more complex trigger pattern is shown in [Figure 5.40 on page 282](#).

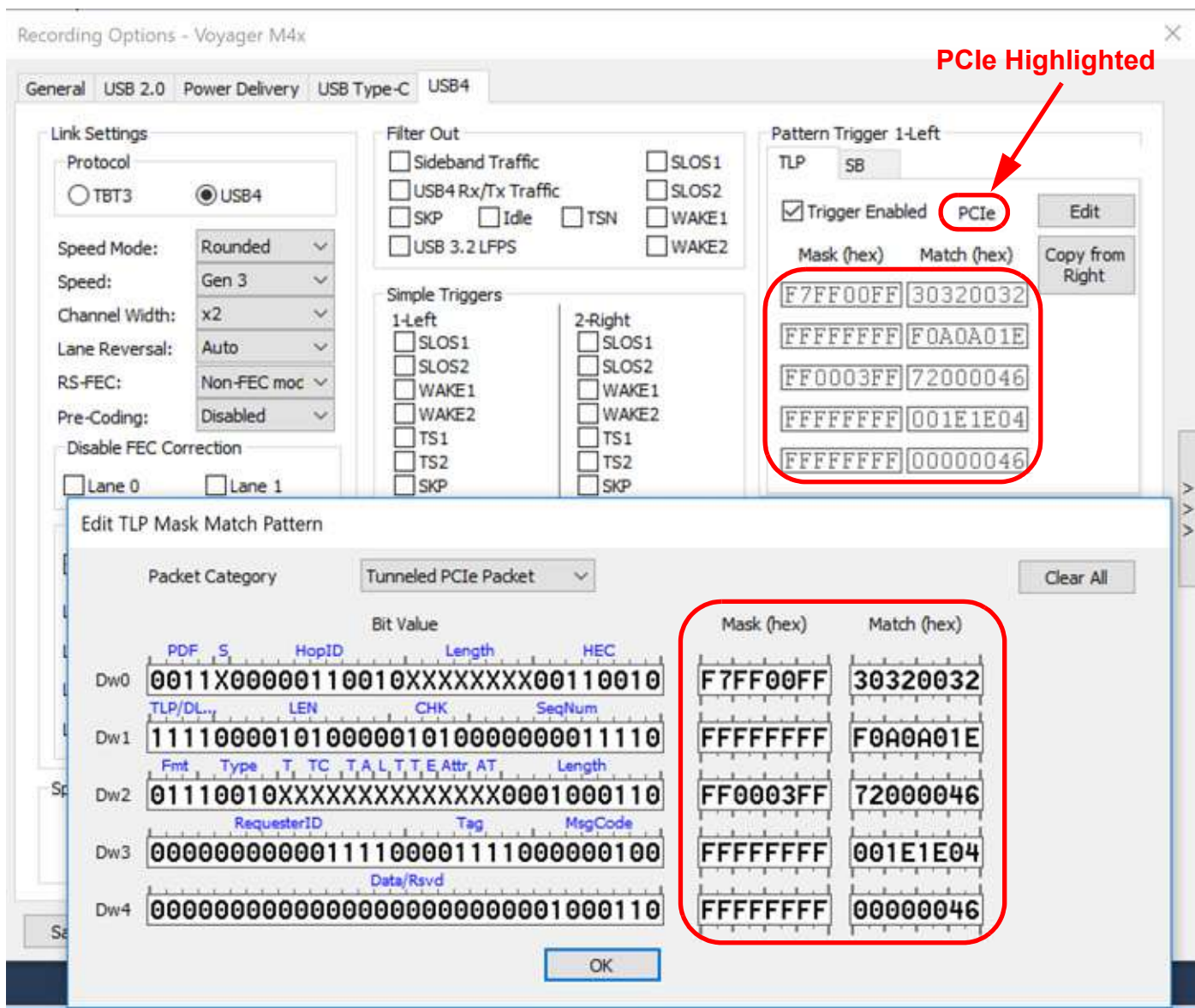


Figure 5.40: Edit TLP Mask match Pattern: Tunneled PCIe Packet

5.1.17.9 Tunneled PCIe Packet

(TLP Only) Check this option if you are trying to trigger on a PCIe TLP. In the special case of PCIe tunneling, the pattern being set for matching is applied simultaneously to the following DWORDS:

- ❑ DWORD0-DWORD1- DWORD2-DWORD3-DWORD4

And

- ❑ DWORD0 -DWORD3-DWORD4 DWORD5- DWORD6

The above compensates for the fact the PCIe can insert a 2-DWORD DLP at the beginning of a tunneled packet, causing the PCIe TLP to start at DWORD 3.

The other Packet Types chosen from the drop down menu function in a similar manner.

5.1.17.10 SideBand (SB)

- ❑ Example => SideBand Mask and Match Cleared: See [Figure 5.41](#).

Bit Value

Mask (hex)

Match (hex)

Clear All

OK

	Bit Value	Mask (hex)	Match (hex)
Dw0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	00000000	00000000
Dw1	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	00000000	00000000
Dw2	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	00000000	00000000
Dw3	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	00000000	00000000

Figure 5.41: Side Band: SB Cleared

- ❑ Example => SB Edited: See [Figure 5.42](#).

Bit Value

Mask (hex)

Match (hex)

Clear All

OK

	Bit Value	Mask (hex)	Match (hex)
Dw0	XXXX1011XXXXXXXXXXXXXXXXXXXXXXXXXXXX	0F000000	0B000000
Dw1	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	00000000	00000000
Dw2	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	00000000	00000000
Dw3	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	00000000	00000000

Figure 5.42: Side Band: SB Edited

5.1.17.11 Spread Spectrum Settings (SSC)

Note: In legacy platforms, the Receiver SSC settings are the same for both ports.

Receiver:

When operating in Analyzer mode, it may necessary to manually adjust the SSC settings to be more tolerant to Spread Spectrum Clocking from the Device-under-test. This recording option adjusts the "Receiver" logic on the left and right analyzer ports independently to improve lock performance. When either side is checked, the analyzer Reference Clock will apply "down-spread" to its own internal Receiver Reference Clock to better track SSC signaling. When un-checked, the analyzer Receiver Reference Clock will be set to the nominal data rate.

Important notes:

- ❑ USB 3.2 & USB4: The SSC setting can be adjusted per port for the analyzer (left/right connector) allowing users to independently tune SSC tolerance for the host and device (TX) signal.
- ❑ Users are advised to experiment with different settings as the advertised SSC settings may not always correlate to the signal reaching the analyzer.
- ❑ USB4: if an analyzer port receives the data from a re-timer, the Receiver SSC setting needs to be unchecked (left or right connector) as the re-timer initially transmits without SSC.

Transmitter:

This setting is applicable only in "Exerciser mode". Check "Transmitter" to apply Spread Spectrum Clocking on exerciser transmitter path.

Note: The Transmitter and Receive commands are independent of each other.

5.1.17.12 TLP filtering: Filter Options

If you select the TLP Filtering tab, the following options dialog box will pop up. See [Figure 5.43](#).

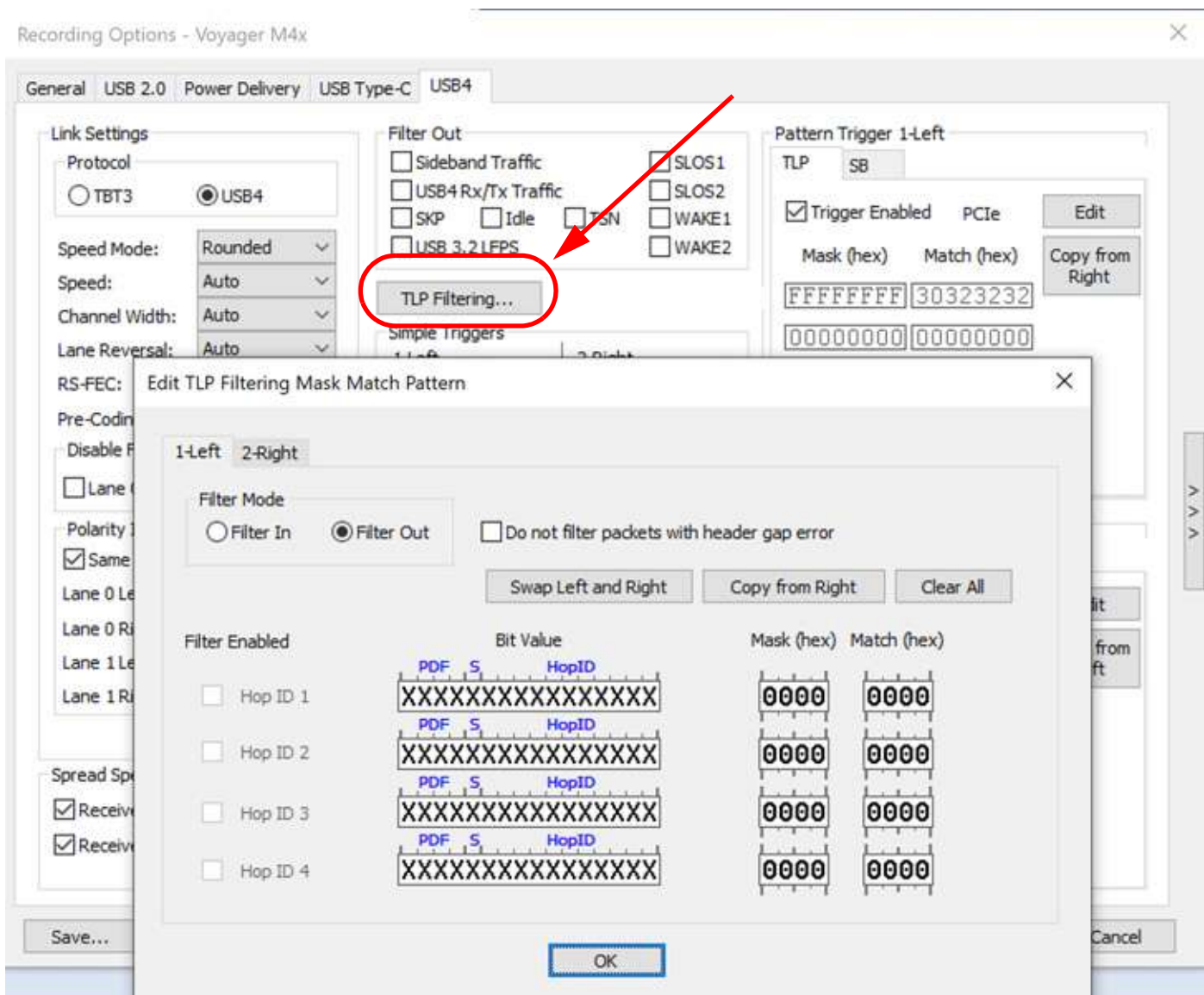


Figure 5.43: TLP filtering Options

Using this dialog users are able to define "Filter IN" (capture only TLP traffic with associated HOP ID[s]) criteria or "Filter Out" (do not capture TLP traffic with associated HOP ID[s]) criteria separately for left/right port. There are options to swap left/right patterns or copy pattern from other side for quicker pattern definition.

A simple example is shown below. See [Figure 5.44 on page 286](#).

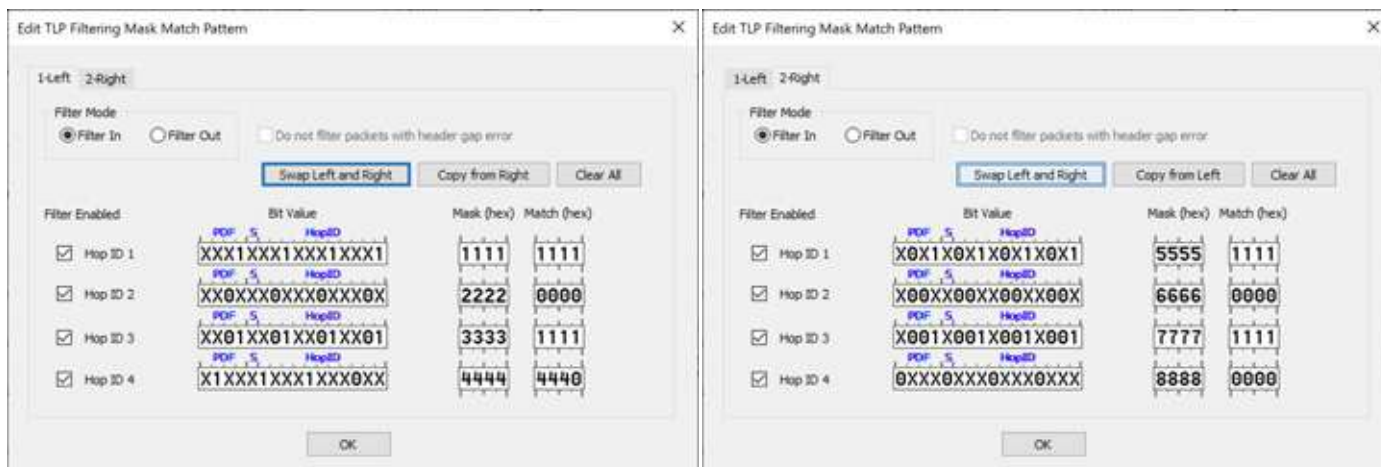


Figure 5.44: Swap Left and Right (before Swap)

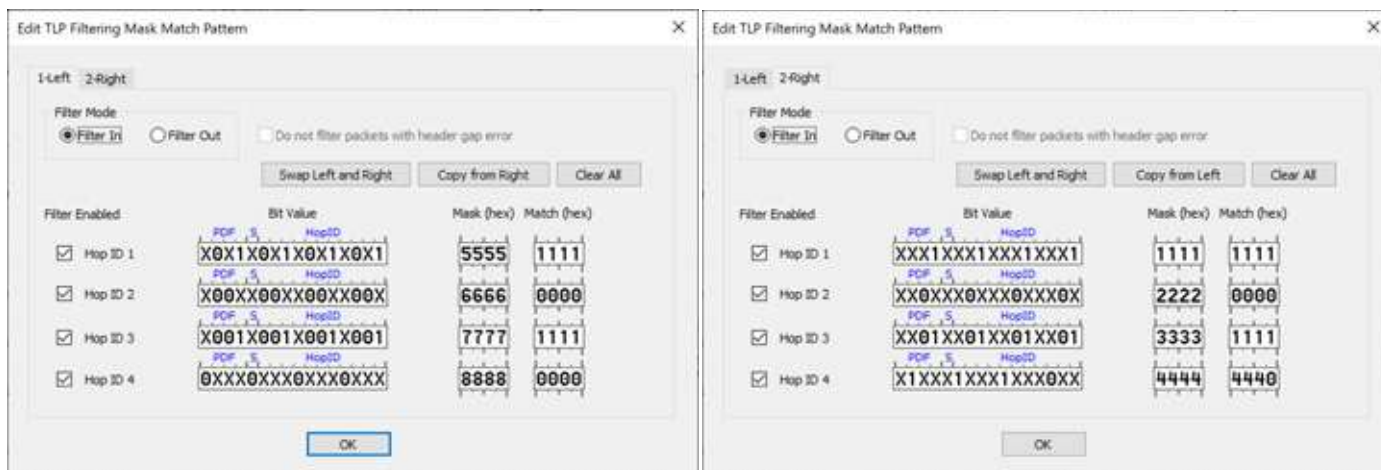


Figure 5.45: Swap Left and Right (after Swap)

You can also use the Copy from Right or Copy from Left button to simplify editing this dialog box. See [Figure 5.46](#) and [Figure 5.47](#).

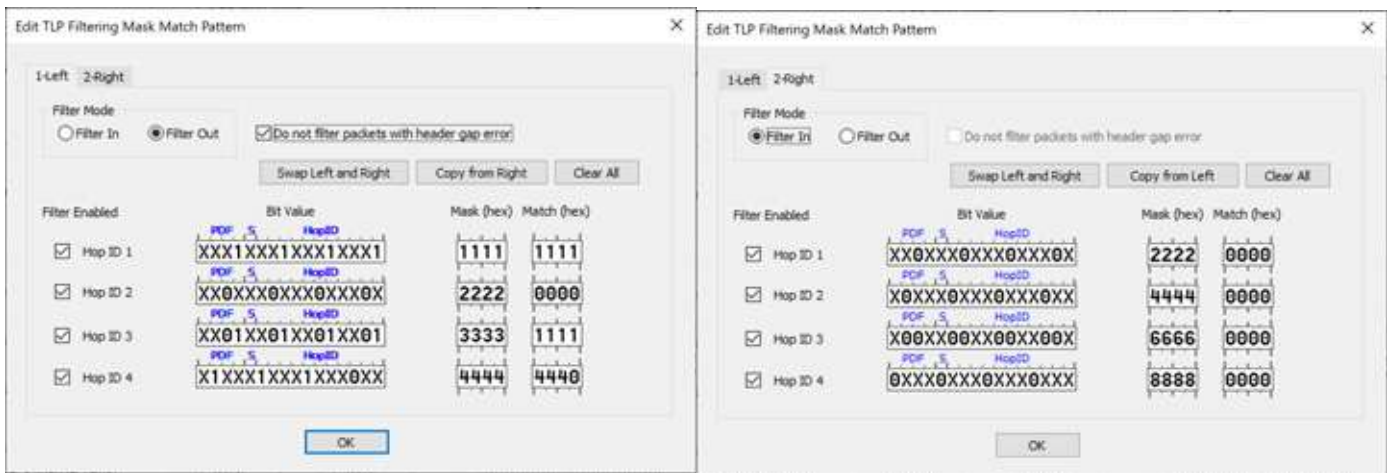


Figure 5.46: Copy from Left/Copy from Right (before Copy to Left)

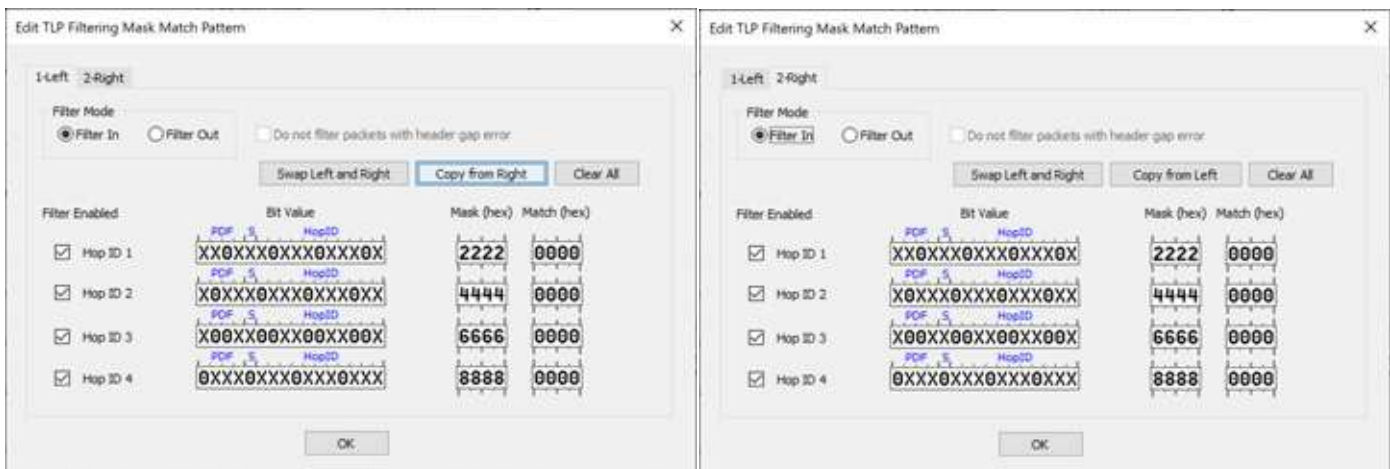


Figure 5.47: Copy from Left/Copy from Right

In filter out mode, if "Do not filter packets with header gap error" option checked, it keeps TLP packets in trace with header GAP violation. See [Figure 5.48 on page 288](#)

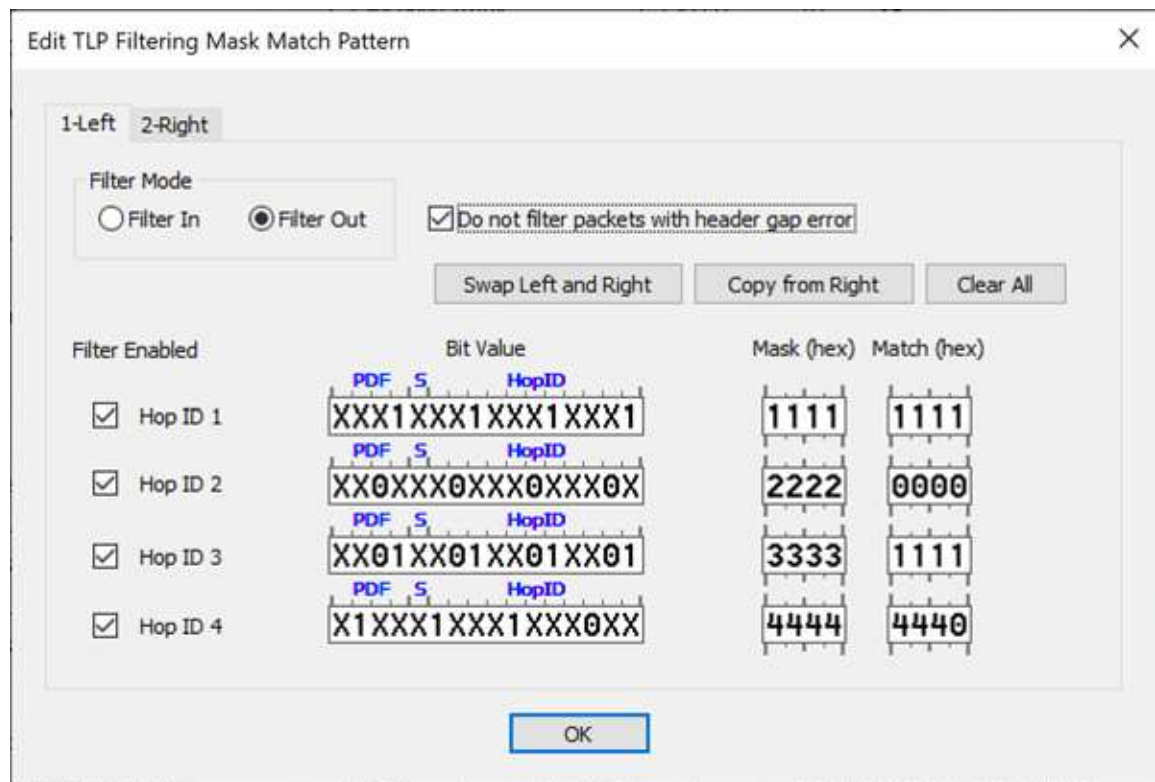


Figure 5.48: Do not filter packets with header gap error

5.1.17.13 USB4 Analyzer mode: Either AutoDetect or Two independent settings for SSC setting for analyzer left/right port.

See [Figure 5.49](#).

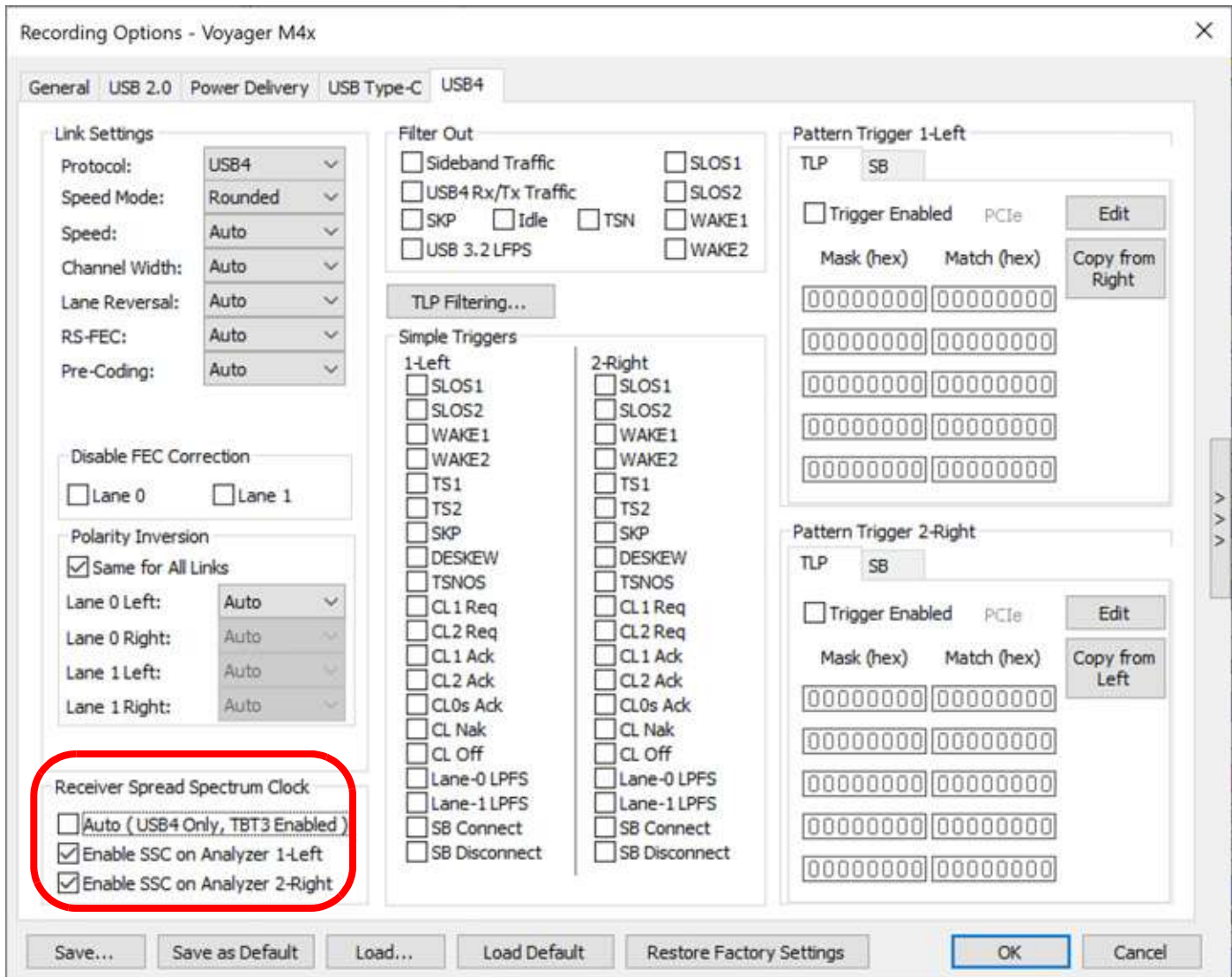


Figure 5.49: Voyager M4x: Recording Options -> Spread Spectrum Clock (Two Independent Clocks)

5.1.17.14 USB4 Exerciser mode: Either AutoDetect or Enable Receiver Spread Spectrum Clock (SSC)

See [Figure 5.50](#).

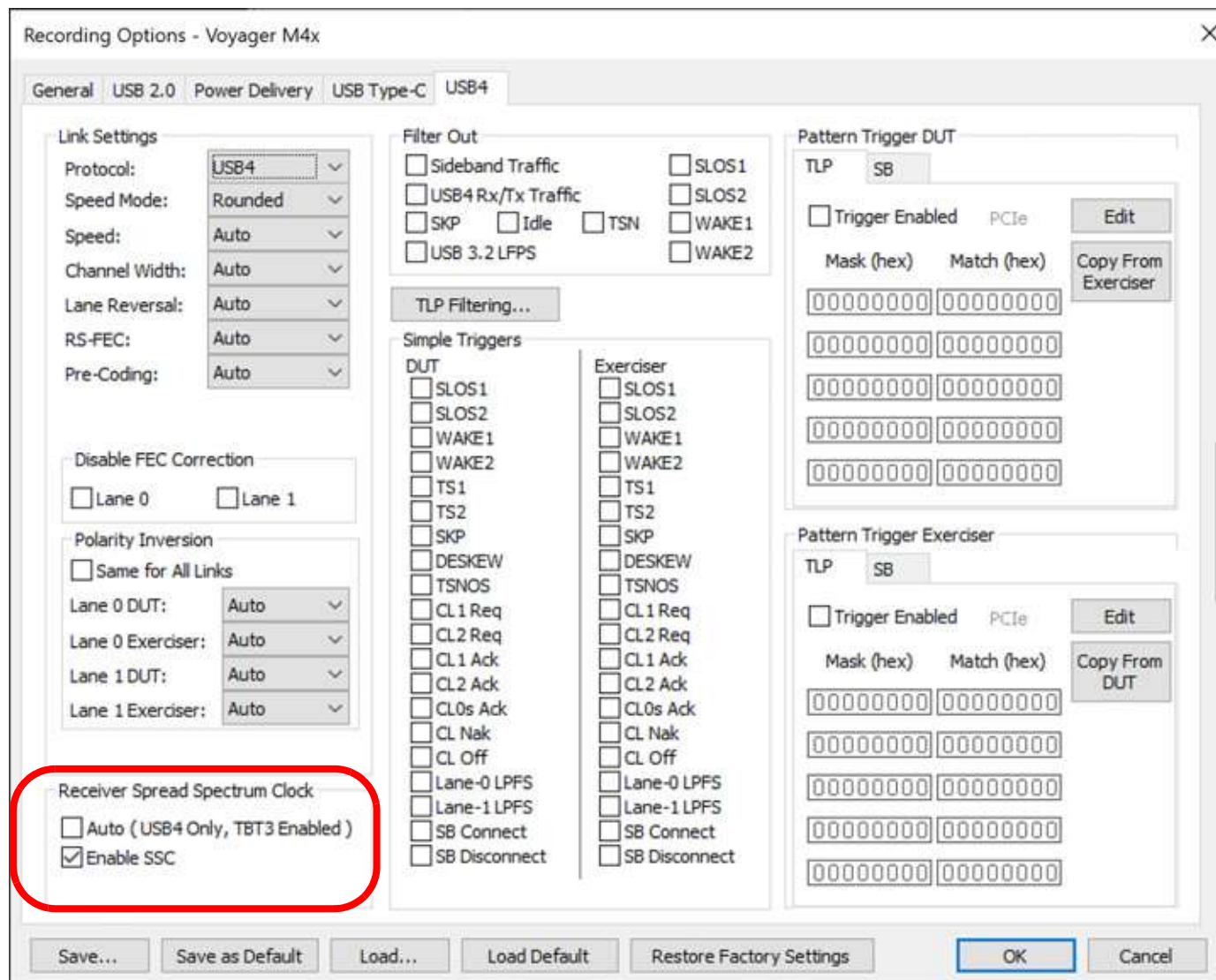


Figure 5.50: Voyager M4x: Recording Options -> Exerciser Mode SSC

5.1.17.15 USB 3.2 analyzer mode: Two independent settings for SSC setting for analyzer left/right port

See [Figure 5.51](#).

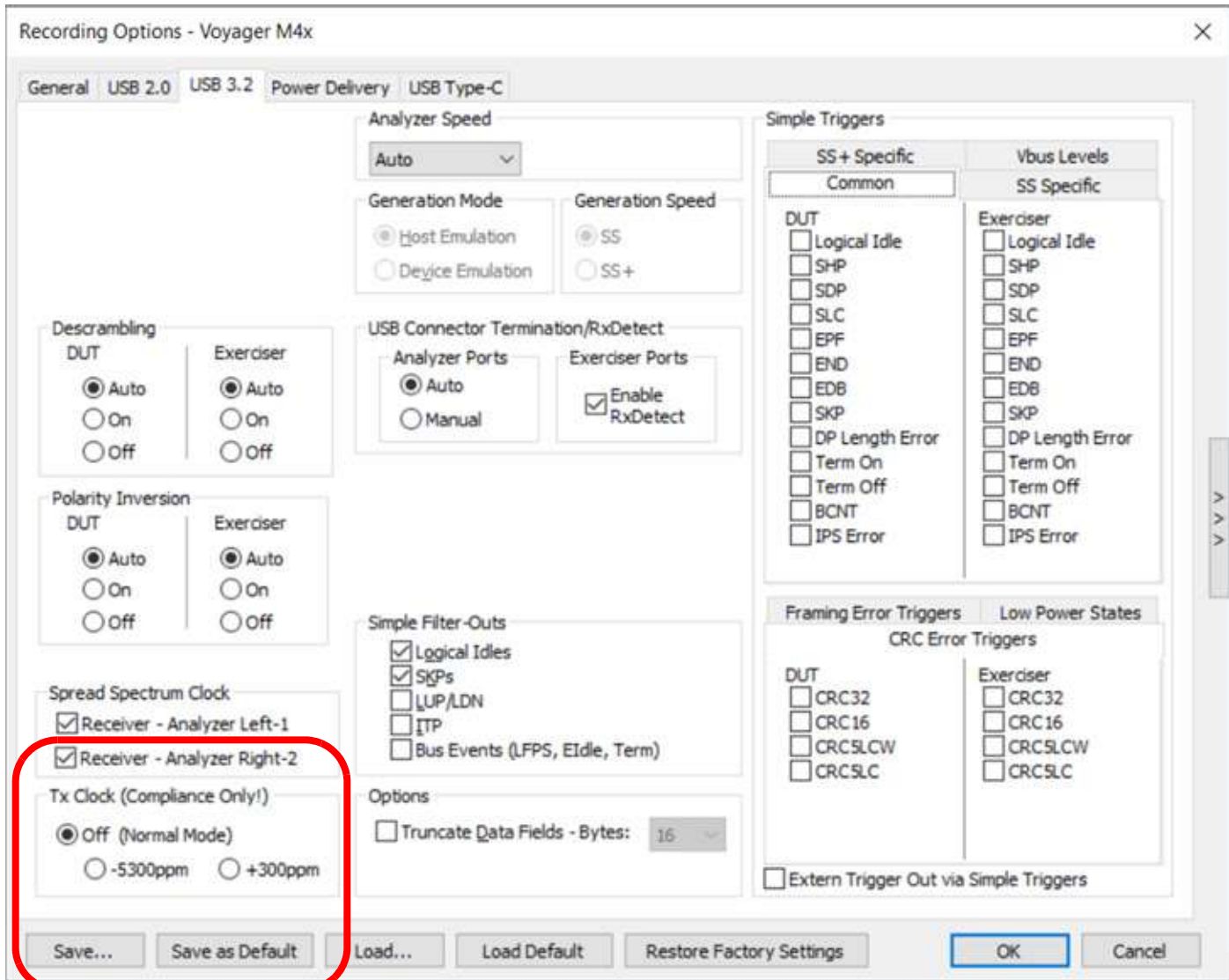


Figure 5.51: Voyager M4x: Recording Options USB 3.2 Analyzer Mode

5.1.17.16 USB 3.2 exerciser mode: One setting for receiver and one setting for transmitter

See [Figure 5.52](#).

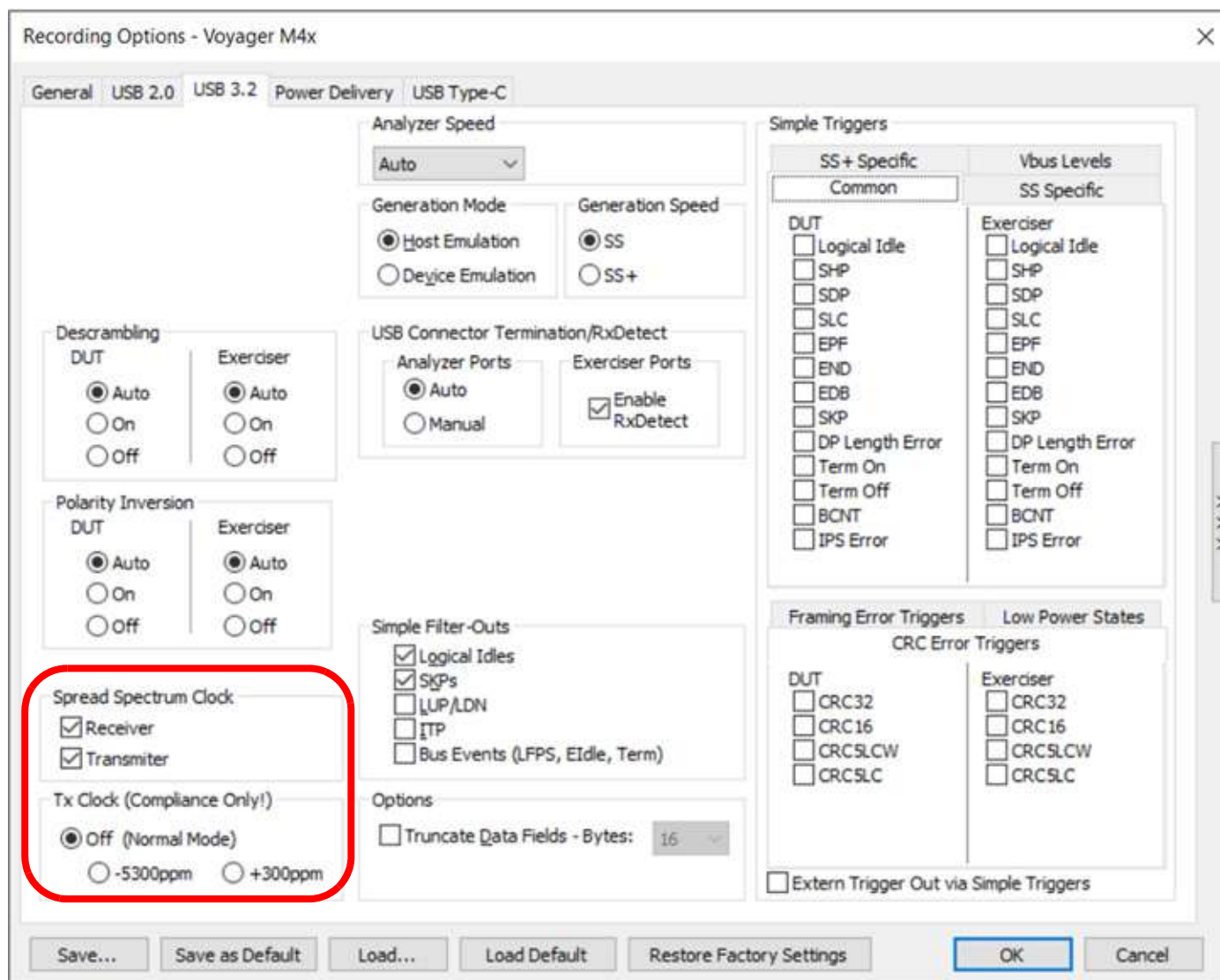


Figure 5.52: Voyager M4x: Recording Options: USB3.2 Exerciser Mode

5.1.18 Advanced Mode: Voyager M4x (Analyzer)

The Recording Options for the M4x (Advanced Mode) are shown below:

The screenshot shows the 'Recording Options - Voyager M4x' dialog box. The 'General' tab is selected. The 'Product Type' is 'Voyager M4x'. The 'Mode' is 'Analyzer'. The 'Trigger Mode' is 'Snapshot'. The 'Recording Channels' are 'USB 2.0', 'USB 3.2', 'USB 4 (or TBT3)', 'Power Delivery', and 'DP AUX'. The 'Connected Device Name' is 'Left' and 'Right'. The 'Recording Scope' is 'Conventional Single Buffer Recording'. The 'Buffer Size' is '32 MB of 32768 MB'. The 'Trigger Position' is 'Not used with snapshot'. The 'Spooled Recording' section is expanded, showing 'Recording Size Limits' with 'Record for' set to '0 Day(s) 12:34:56' and 'Record' set to '120000 MB'. The 'Until Triggered, plus' is set to '0 Day(s) 12:34:56' and '120000 MB'. The 'Options Name' is 'Default'. The 'Trace Filename & Path' is 'C:\Users\Public\Documents\LeCroy\USB Protocol ...\data.usb'. The 'UsbRaw File Support' is checked. The 'CATC Sync' is unchecked. The 'Independent Record Stop' and 'Independent Triggers' are unchecked. The 'External Trigger Settings' are unchecked. The 'Trigger Out Type' is 'Pulse Low'. The 'Vbus Power' is unchecked. The 'Capture Power Measurements (Voltage and Current)' is checked. The 'Persistent Vbus Disconnect Button' is unchecked. The 'External Interface Signals' are unchecked. The 'Save External Interface Signals' is unchecked. The 'Switch to Simple Mode' button is visible. The 'OK' button is highlighted.

Figure 5.53: Voyager M4x Recording Options: Advanced Mode

All the recording options for Advanced Mode are the same as Simple Mode except that you also have the USB2.0 Recording Rules : Ch 0 as shown below:

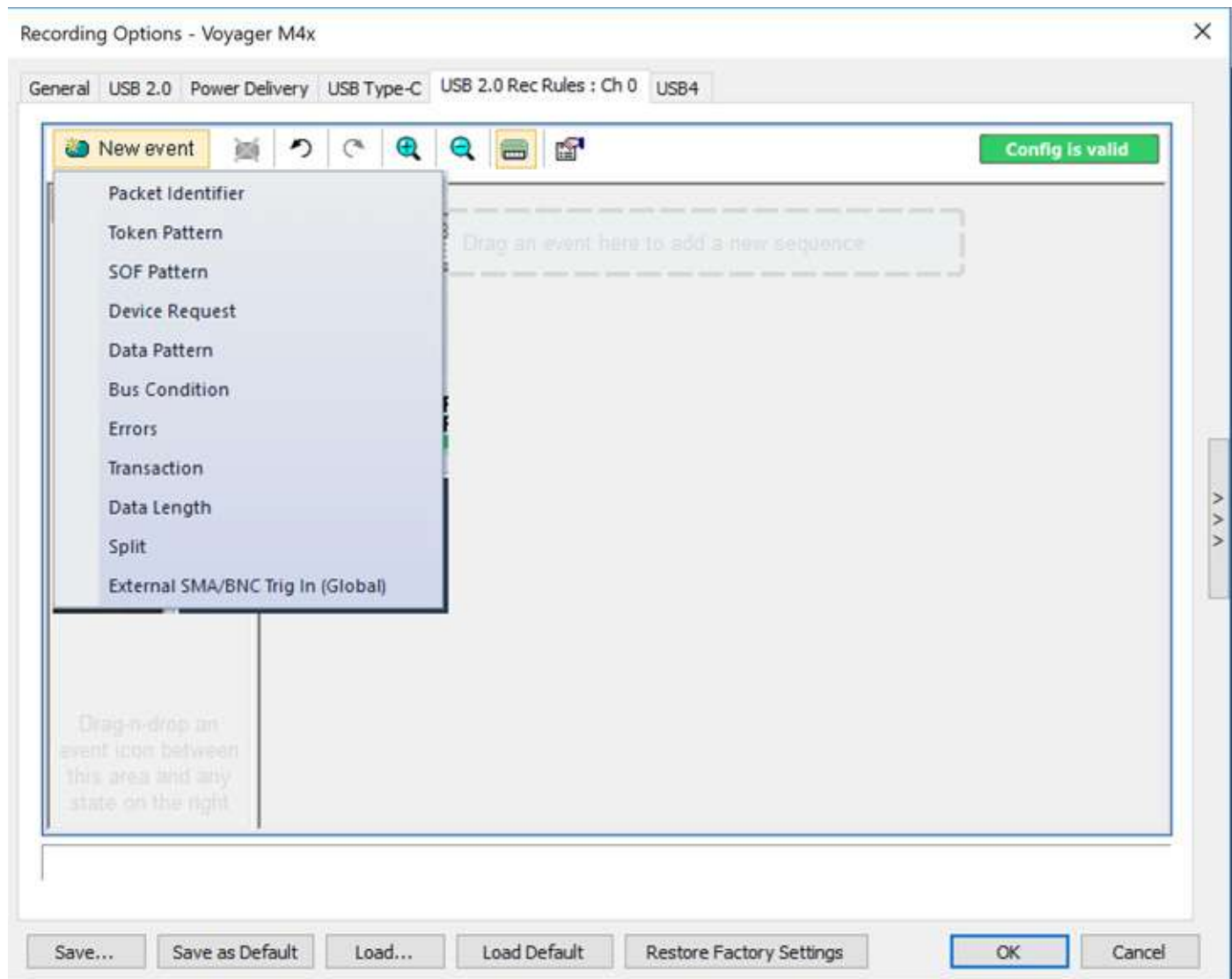


Figure 5.54: Voyager M4x Advanced Recording Options: USB 2.0 Recording Rules: Ch 0

The use of the Advanced Recording Rules is covered in great detail in section [“Recording Rules - USB 2.0”](#) on page 334.

5.2 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.

5.2.1 Product

You can select one of the following products:

- ☐ Voyager M4x
- ☐ Voyager M310P
- ☐ Voyager M310C
- ☐ Voyager M3i
- ☐ Voyager M3x
- ☐ Voyager M310
- ☐ Advisor T3
- ☐ Mercury T2
- ☐ Mercury T2C
- ☐ Mercury T2P
- ☐ USBTracer/Trainer*
- ☐ USB Advisor*

* These analyzers are no longer supported. See [“USBTracer/Trainer, USB Advisor, USBMobile HS and USBMobile T2” on page 101](#) for more information.

5.2.2 Analyzer vs. Exerciser vs. DP Alt Mode Analyzer

This selects the overall mode of operation of the Voyager product. (Mercury and Advisor products only run in Analyzer mode.) The Voyager products can be put into the Exerciser mode, where they will behave as a Host or Device based on scripts provided. They can simultaneously capture these sessions for display in a trace file. See [Chapter 11, “Traffic Generation 2.0,” on page 643](#) and [Chapter 12, “Traffic Generation USB 3.2/USB4/PD Exerciser,” on page 683](#) for more information on the Exerciser capabilities. Voyager M4x supports the selection of DP Alt Mode Analyzer, which uses the bottom 2 Type-C connectors on the front of the M4x to capture the Display Port sideband signaling on it's Aux channel. There is no support for capturing Display Port high speed traffic.

5.2.3 Trigger Mode

The **Trigger Mode** box presents three options that allow you to set how the Analyzer begins and ends a recording.

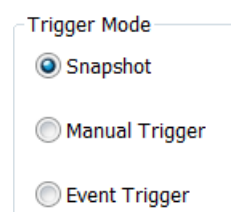


Figure 5.55: Trigger Mode Dialog

The options are: *Snapshot*, *Manual Trigger*, and *Event Trigger*.

5.2.3.1 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.

5.2.3.2 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.

5.2.3.3 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.

5.2.4 Recording Channels USB4, USB 3.2, USB 2.0, Power Delivery and SBU

You can select **USB 2.0** and/or **USB 3.2** and/or **Power Delivery** and/or **SBU** as the recording channel. All can be captured simultaneously.

If user selects different external trigger modes in the Recording Rules when doing simultaneous USB 2.0/USB 3.2 captures, the trigger mode for USB 3.2 will be applied.

3.2 Channel is used to record SuperSpeed 5Gbps Gen 1 traffic and SuperSpeed+ 10Gbps Gen 2 traffic. SuperSpeed+ captures are only supported on Voyager M310 ,M310C and M310P.

The SBU Channel (SideBand Use) is used for Alternate Mode Type-C Devices. The M310P (only) supports the capture and display of the Display Port Aux channel Protocol which runs on the SBU wires. The Mercury T2P and Voyager M4x support Thunderbolt 3 Low Speed packet capture as well as Display Port Aux channel.

The Power Delivery Recording channel is explained in the next section.

5.2.5 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/M310P and Mercury T2C/T2P.

TABLE 5.2: Recording Modes Summary

Model	USB2.0	USB3.2	Power Delivery	SBU
Voyager M4x	Yes	Yes*x2	Yes**	Yes, DP and USB4
Voyager M310	Yes	Yes*	N/A	N/A
Voyager M310P	Yes	Yes*	Yes**	Yes, DP
Voyager M310C	Yes	Yes*	Yes**	N/A
Voyager M3x	Yes	Yes	N/A	N/A
Voyager M3i	Yes	Yes	N/A	N/A
Advisor T3	Yes	Yes	N/A	N/A
Mercury T2	Yes	N/A	N/A	N/A
Mercury T2C	Yes	N/A	Yes**	N/A
Mercury T2P	Yes	N/A	Yes**	Yes, DP and USB4

Note: * Includes SuperSpeed+ 10Gbps Gen 2 captures.

Note: ** The Voyager M310C / M310P / M4x can also record Vbus On and Vbus Off events when in Power Delivery Capture mode. The Mercury T2C /T2P does not capture those events.

Note: The Analyzers may capture initial state events such as Vbus state, Term states, and the states of CC signals when Type-C Cables are used. Because of this, it is possible for the Recording session to capture a trace even if no cables are attached to the box: The analyzer just records the initial conditions.

5.2.6 Connected Device Name

Enter a user-friendly name for the DUT and/or HUT so that it makes reading the Trace easier. For example, the DUT could be "Acme HD", and the HUT could be "Cherry PC".

5.2.7 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 USB4, 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 3.2 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.

5.2.8 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 maximum values selected may be slightly smaller than the entire buffer size due to a very small amount of overhead (like you see in Hard Disk sizing).

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 USB 2.0 tab of the Recording Options dialog (M3i Only).

5.2.9 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.

5.2.10 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.

5.2.11 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\...** to 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 a Windows 10 system. See [“Notes on Windows 7 and Windows 8 Directory Protections” on page 167](#) 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.

5.2.12 Advanced Trace File Settings

The application will automatically generate a unique file name for newly recorded trace files, and the traces will be stored in a user-configurable directory.

- ❑ The unique file name will be based on a file-creation-date-time-stamp and possibly a unique index to guarantee uniqueness in the target directory.

To avoid having new traces fill up memory opened in the application, the application will limit open traces to a user-configurable maximum. After that, the application will close the least recently used new trace before creating another one. This limit won't apply to pre-saved traces that might be opened.

- ❑ The default max limit is 5. This can be changed by the user from 1 to 10.
- ❑ There will be a related user-configurable option to automatically delete the files that exceed the limit. Default is OFF.
- ❑ Though the new default behavior would be different than previous behavior, these options enable a user get back to the old behavior (max limit 1 + auto-delete ON).

See [Figure 5.56](#) and [Figure 5.57 on page 301](#).

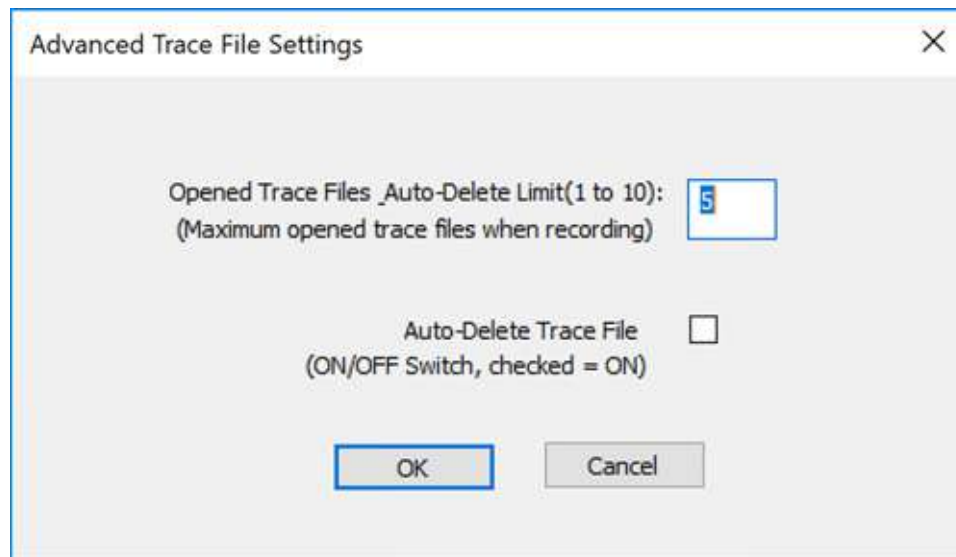


Figure 5.56: Advanced Trace File Settings: 5 Open Traces at a time

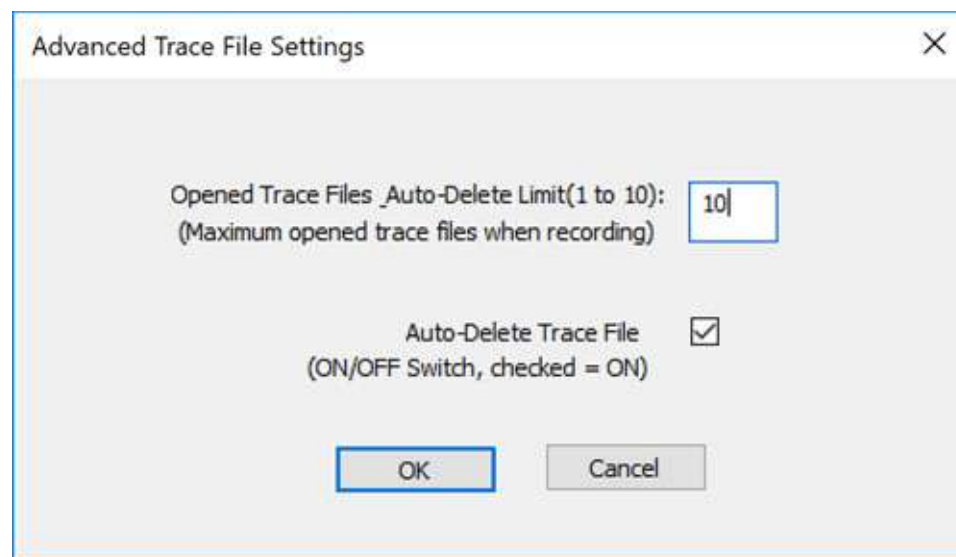


Figure 5.57: Advanced Trace File Settings: 10 Open Traces at a time, Auto-Delete when maximum number reached (10)

Note: None of this applies to automation cases. Behavior in automation will remain the same as before.

5.2.13 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 3.2 Trainer/Exerciser script.
- ☐ **Capture Power Measurements (Voltage and Current):** Record voltage and current.
- ☐ **Persistent VBus Disconnect Button:** Check if you want to 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.

5.2.14 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.

5.2.15 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.

5.2.16 External Trigger Settings

5.2.16.1 Repeated Trigger Out

In some circumstances, you will want to issue a pulse on the external trigger connection(s) whenever you see an event. By checking this box, this pulse will occur every time the event is seen, as long as it is set up as a trigger in the trigger definition dialogs. It will only be indicated once in the captured software, at the point where the first instance occurred. Events must be spaced far enough apart for the pulse to be reset by hardware, or it will not be visible on external equipment. It is safest to choose events which will occur no more frequently than once per microframe (125 uSec) Repeated Triggering.

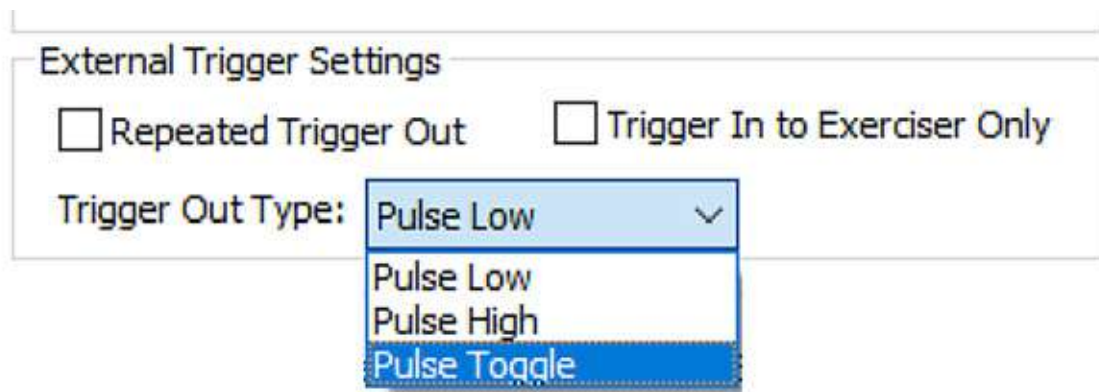


Figure 5.58: External Trigger Settings: Low/High/Toggle

5.2.16.2 Trigger In to Exerciser Only

Trigger In connects to Exerciser only (no connection to analyzer).

5.2.16.3 Trigger Output Type

You can set the external trigger to be one of the following:

- ☐ Pulse Low
- ☐ Pulse High
- ☐ Pulse Toggle

5.3 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.

5.4 Recording Options-USB 2.0

The **USB 2.0** page presents options for setting (see [Figure 5.59 on page 304](#)):

- ☐ **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

The image shows the 'Recording Options - Voyager M310' dialog box with the 'USB 2.0' tab selected. The dialog is divided into several sections:

- General:** Includes tabs for 'General', 'USB 2.0', 'USB 3.2', 'USB 2.0 Rec Rules : Ch 0', and 'USB 3.2 (SS) Rec Rules'.
- Analyzer Trace Speed:** A group box containing 'Channel 0' with three radio buttons: 'Auto-Detect' (selected), 'Low', 'Full', and 'High'.
- USB On-The-Go:** A group box containing:
 - 'On-The-Go SRP' checkbox (unchecked).
 - 'Dual Role Devices' group box containing:
 - '2 DRD's' checkbox (unchecked).
 - 'A Dev Name' text box with 'A'.
 - 'B Dev Name' text box with 'B'.
 - 'Assume B is 1st Host' checkbox (unchecked).
- Generator-related Parameters:** A large group box containing:
 - 'Default to IntelliFrame Mode' checkbox (checked).
 - 'Device Emulation Mode (Tracing limited to Channel 0 only)' checkbox (unchecked).
 - 'Device Resumes:' section with:
 - 'Delay Time Before Resume in msec (1-65535)' text box with '1'.
 - 'Resume Time in usec (1-65535)' text box with '20000'.
 - 'Device Address' group box with:
 - 'Use Address in .utg file' radio button (selected).
 - 'Emulated Device's Hex Address (01-7F)' radio button (unchecked), with 'Match:' text box containing '01' and 'Mask:' text box containing '7F'.
 - 'Host Chirp Reset Length, msec (1-69)' text box with '50'.
- Options:** A group box containing:
 - 'Truncate Data Fields (1-245)' checkbox (unchecked), with 'Bytes:' text box containing '1'.

At the bottom of the dialog are buttons: 'Save...', 'Save as Default', 'Load...', 'Load Default', 'Restore Factory Settings', 'OK' (highlighted with a blue border), and 'Cancel'.

Figure 5.59: Recording Options USB 2.0.

5.4.1 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.

One side effect of using Auto-Detect Speed selection is that the first set of High Speed Chirps that occur prior to the first packet is not recorded. The Auto-Detection mechanism is looking for a match on a packet pattern, so it does not see the Chirp signaling (which is only visible to the High Speed Detection circuitry).

Note: In General, if you already know the speed of the device you are working with, it is better to set the speed explicitly!

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)

5.4.1.1 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.

5.4.2 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 **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.

5.4.3 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.

5.4.4 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/M310P/M4x.
- ☐ **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).

5.4.5 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.

5.5 Recording Options - USB 3.2 for Voyager

The **USB 3.2** 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 USB Connector Termination/RxDetect.

Note: Voyager M3x/M310/M310C do not support Port Configurations.

Note: For details about using a Spread Spectrum Clock see [“Spread Spectrum Settings \(SSC\)”](#) on page 284.

You can see the Simple Triggers Common Settings in [Figure 5.60](#) below.

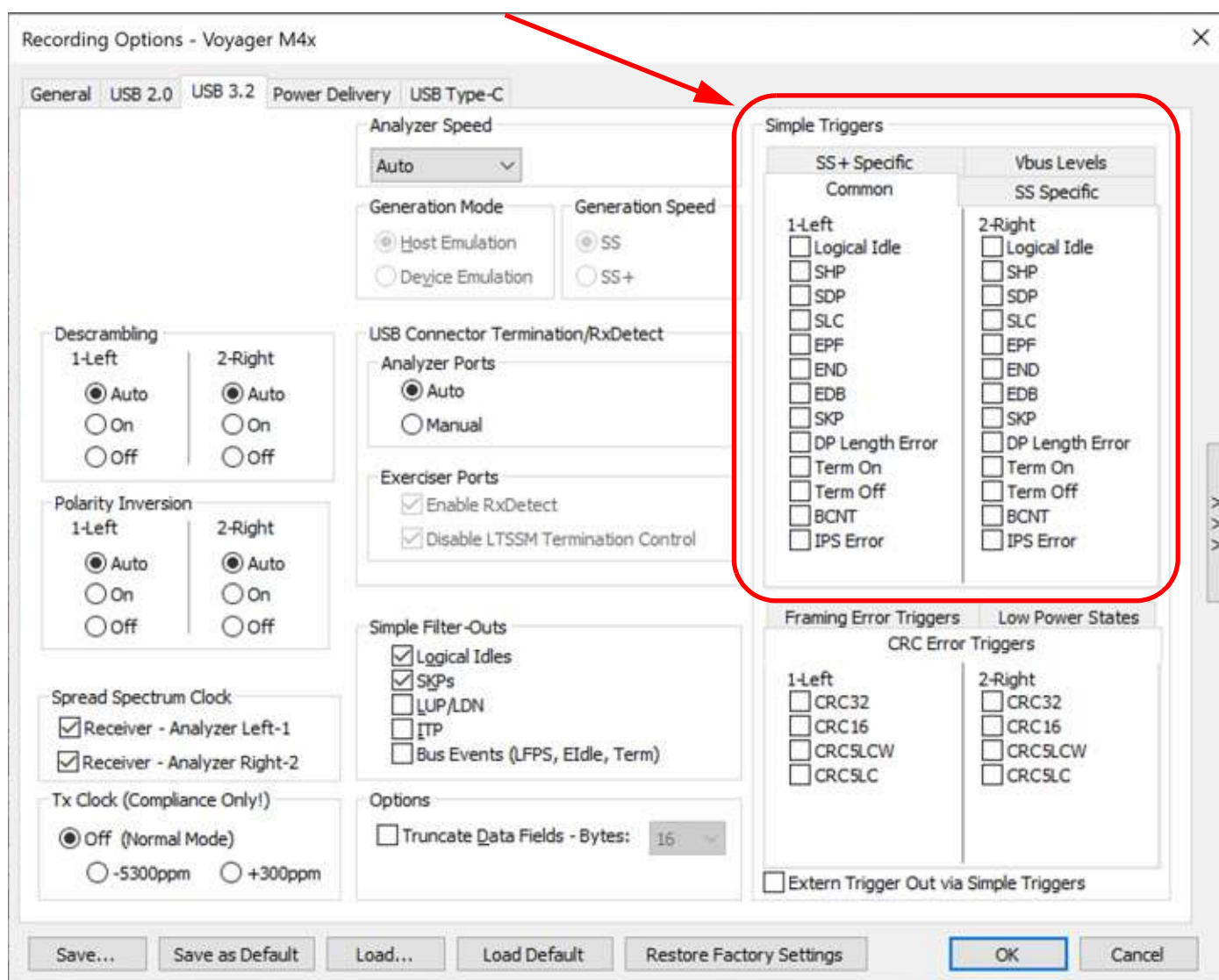


Figure 5.60: M4x Recording Options for USB3.2

The other categories of Simple Triggers are:

- ☐ SS Specific
- ☐ SS+ Specific (SYNC packets can be used as simple triggers)
- ☐ VBus Levels

These other simple triggers can be seen in [Figure 5.61](#).

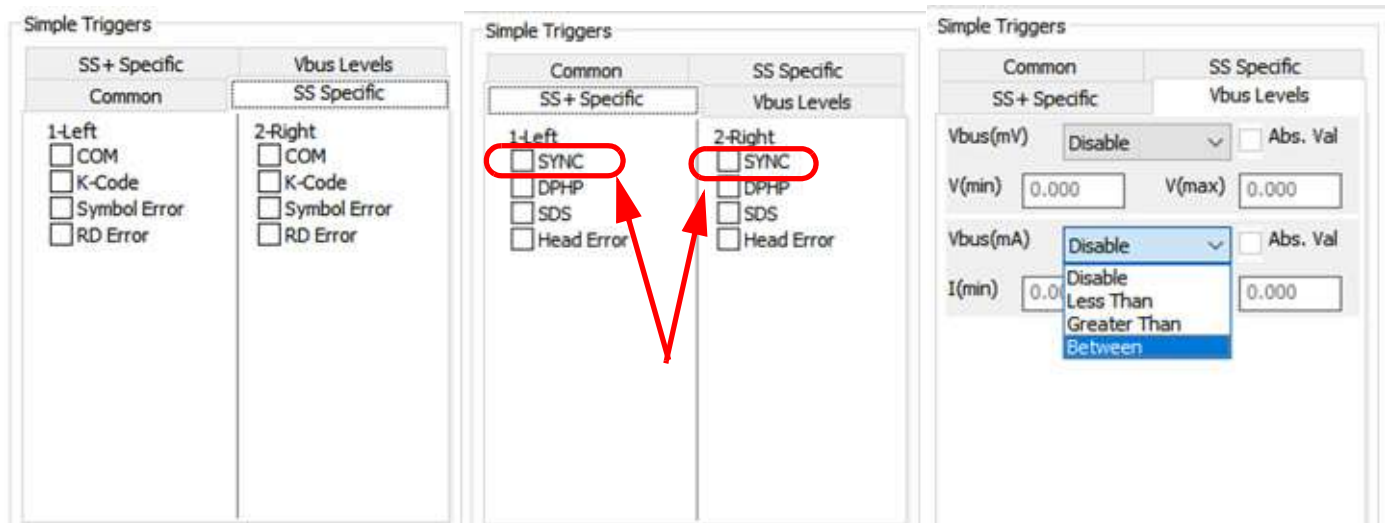


Figure 5.61: Simple Triggers: SS Specific / SS+ Specific / Vbus Levels

Note: Filtering LUP/LDN will apply to both channels on Power Delivery Systems, since the Data Roles can be swapped. See [Figure 5.62 on page 310](#).

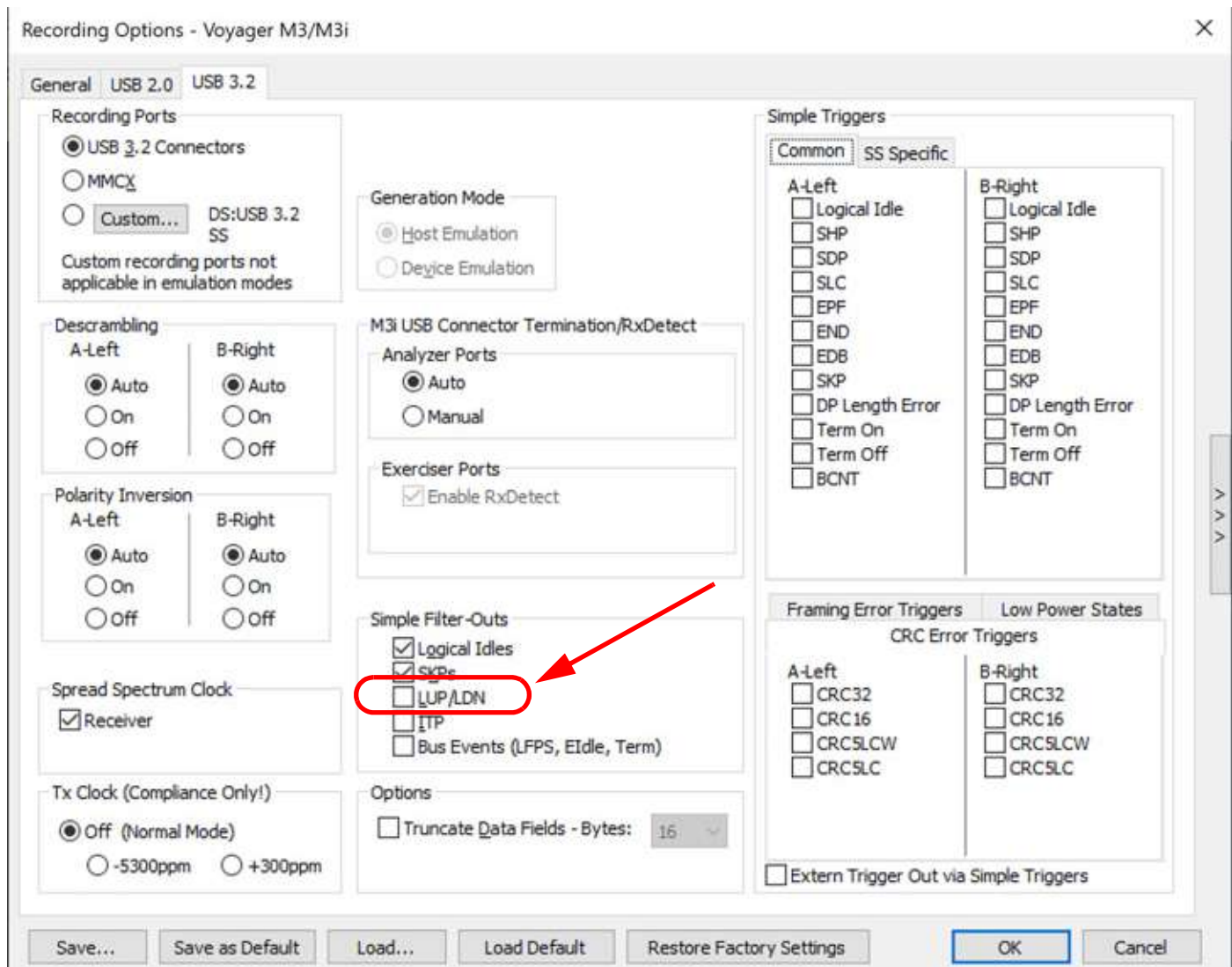


Figure 5.62: Recording Options - USB 3.2 for Voyager M3 and M3i.

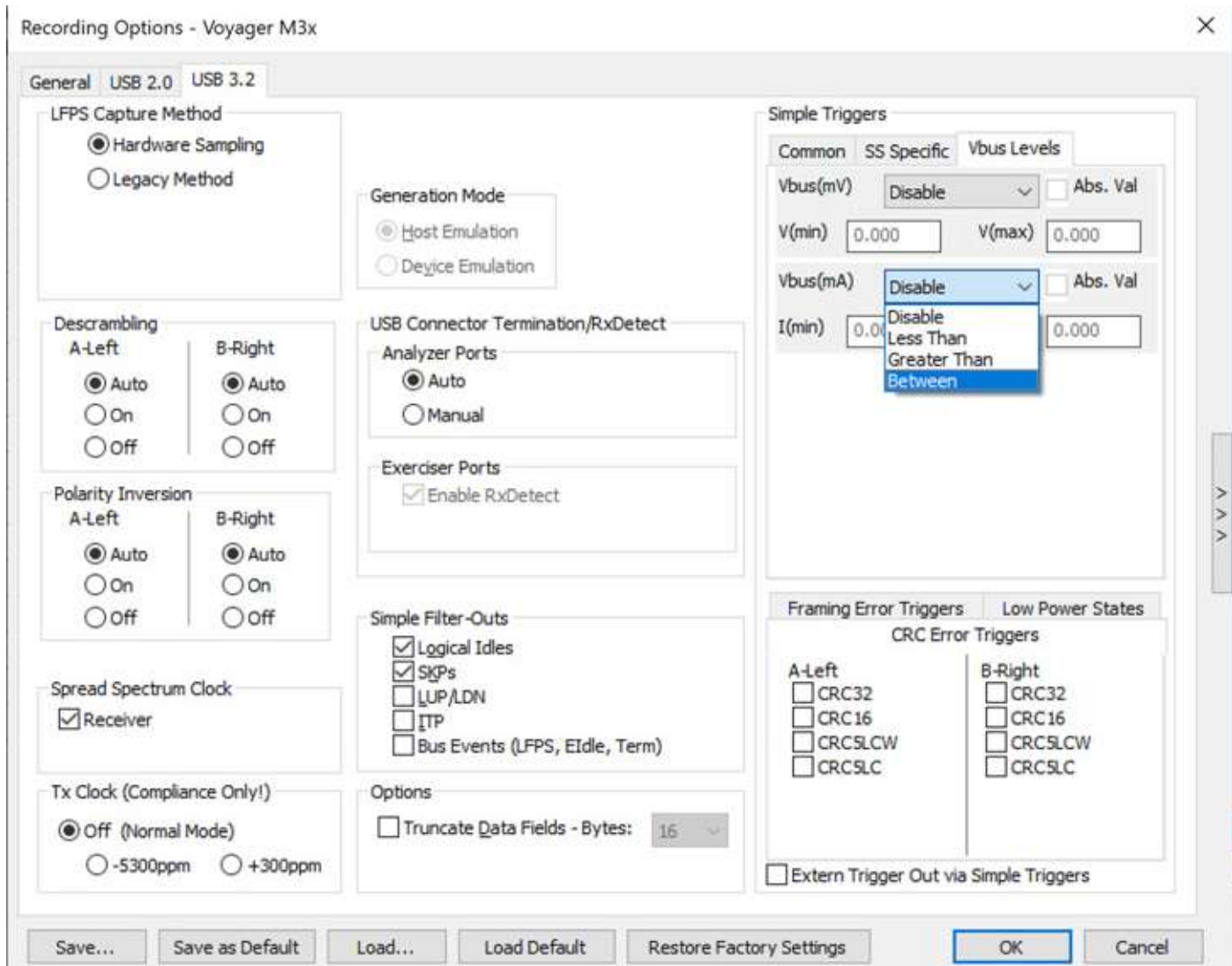


Figure 5.63: Recording Options - USB 3.2 for Voyager M3x.

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 3.2 analyzers (Voyager M3x only).

For Recording Ports, select **USB 3.2 Connectors, MMCX**, or **Custom (DS:USB 3.2, US:USB 3.2)**. The custom option allows you to change the recording channels to use a mix of MMCX and USB 3.2 connectors (Voyager M3i only).

5.5.1 Descrambling

In Analyzer Mode, Select **Auto** to have the analyzer determine the Scrambling state of the incoming data stream on the connector examining the TS1 Packets. You can force the analyzer to either Descramble or not regardless of what is seen in the TS1 packets by selecting **On** or **Off**, respectively.

In Exerciser mode, you can chose the Exerciser Transmit Scrambling mode by selecting **On** or **Off**. **On** sends Scrambled data, so the DUT would need to Descramble it. **Off** sends data without being Scrambled. **Auto** defaults to sending Scrambled data, just like **On**. For the DUT side, it works like the Analyzer settings, above.

5.5.2 Polarity Inversion

In Analyzer Mode, Select **Auto** to have the analyzer determine the Polarity state of the incoming data stream on the connector examining the TSEQ Packets. You can force the analyzer to either Invert Polarity or not regardless of what is seen in the TSEQ packets by selecting **On** or **Off**, respectively.

In Exerciser mode, you can chose the Exerciser Polarity Inversion mode by selecting **On** or **Off**. **On** sends the data Inverted, and **Off** does not. It is up to the device to handle these cases. **Auto** defaults to sending uninverted data just like **Off**. For the DUT side, it works like the Analyzer settings, above.

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, Eldle, 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.

5.5.3 USB Connector Termination/RxDetect settings

Analyzer Ports:

This setting identifies the SS Rx termination approach on the analyzer ports. The Auto mode [default] has been designed to recognize USB 3 hosts and devices attached to one port of the analyzer, and then present terminations to DUT attached to other port. (Termination proxying) However, some cases have timing that can cause the Host and Device not to connect or fall back to USB 2.0. In this case we need to use Manual mode. After selecting Manual, the "Status: on/off" button will be enabled in toolbar to allow toggling of the termination state. The Momentary Disconnect button is also available to cycle Vbus off and then back on.

Note: Note: The Analyzer Ports settings do not apply for the M310P Analyzer connectors, since it uses a Passive Electrical Tap. Termination is therefore passed through directly.

Exerciser ports:

Two settings for exerciser ports:

- ☐ Enable RxDetect

The RxDetect mode has been designed to recognize USB 3 hosts and devices and present a SS termination to them when they are plugged in.

- ☐ LTSSM Controlled Termination

If this feature is Enabled, the Exerciser will automatically present SuperSpeed receiver termination in accordance with the Type-C specification and the USB 3 Link Training Status State Machine.

Disabling the feature will allow complete control of the termination state through an Exerciser script (.usb3g) file, which may be desirable for testing compliance scenarios. The Disabled setting further allows the user to select whether termination will be enabled (Start with TERM ON), disabled (Start with TERM OFF), or unmodified (Keep TERM state) when the recording options are initially applied.

See [Figure 5.64 on page 314](#) for USB Connector Termination/RxDetect and Common Simple Triggers when the unit is in Analyzer mode. For the same recording options in Exerciser mode see [Figure 5.65 on page 315](#).

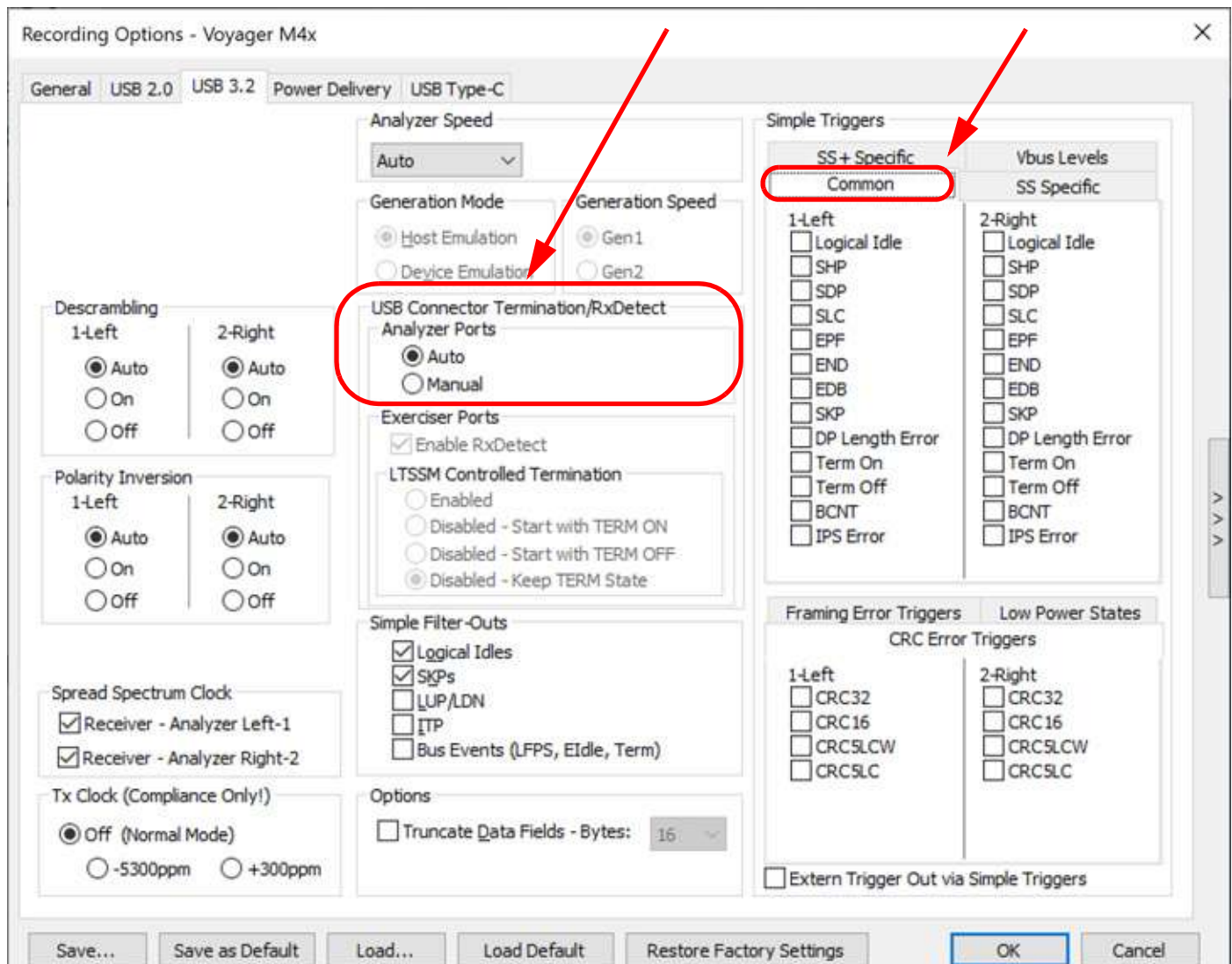


Figure 5.64: Recording Options - USB 3.2 for Voyager M310C/M310P/M4x in Analyzer Mode

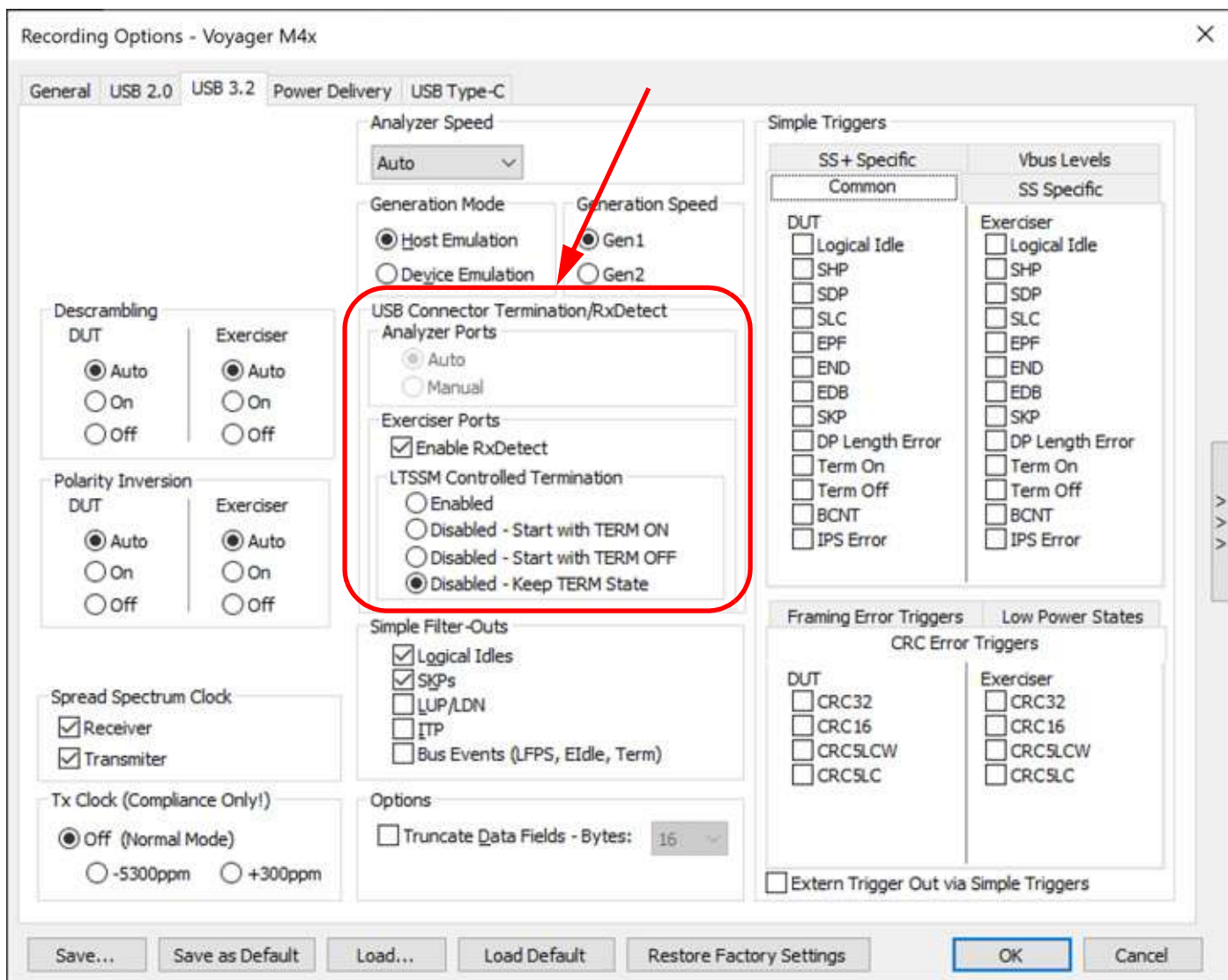


Figure 5.65: Recording Options - USB 3.2 for Voyager M310C/M310P/M4x in Exerciser Mode

5.5.4 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.

5.6 Recording Options - USB 3.2 for Advisor T3

The **USB 3.2** tab presents options for setting Descrambling, Termination/RxDetect, Polarity Inversion, Simple Filters, and Truncate Data Fields.

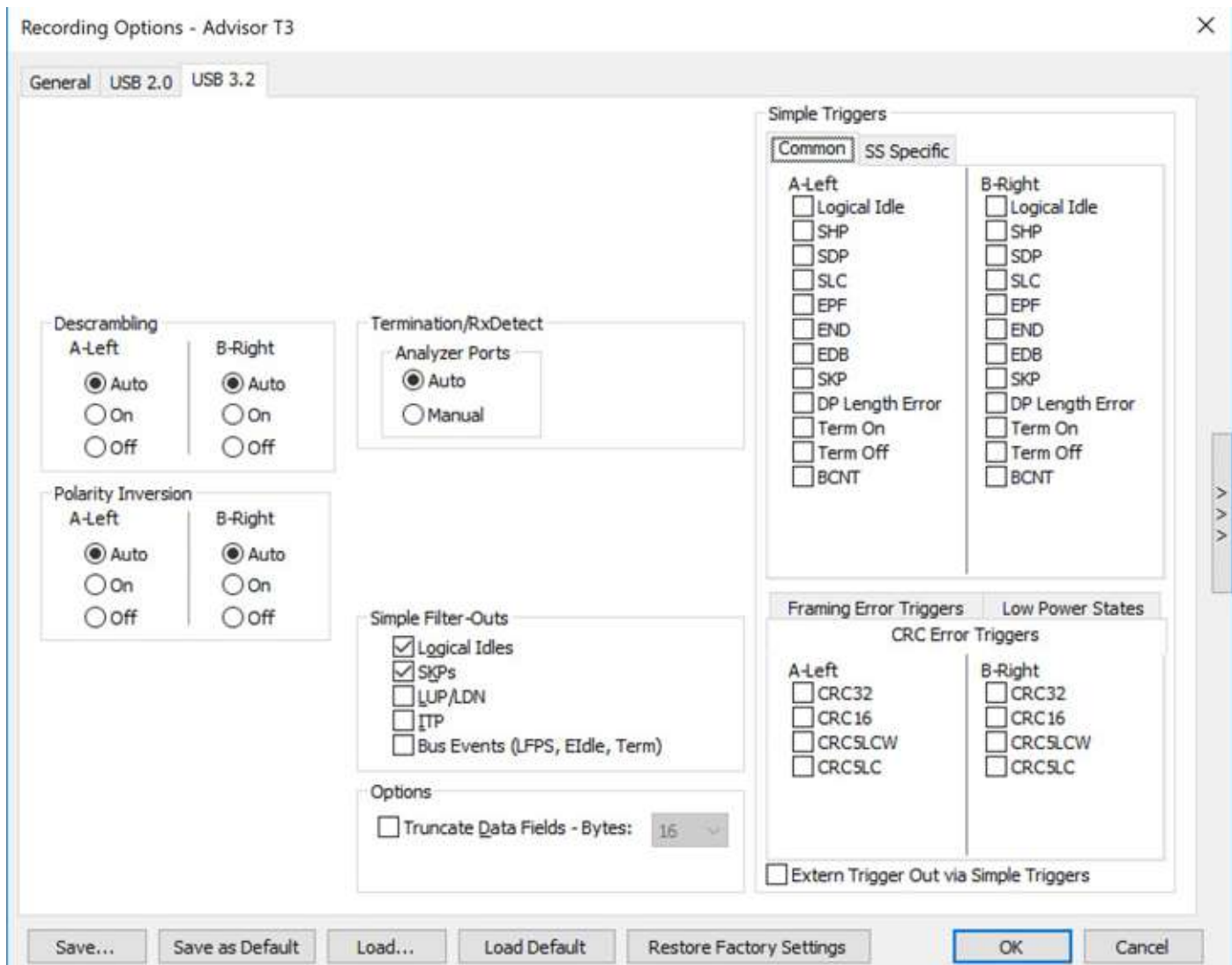


Figure 5.66: For Descrambling, on A or B connectors, select On, Off, or Auto.

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 205](#).

Note: The **Auto RxDetect** mode has been designed to recognize 3.2 hosts and devices and present 3.2 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, Eldle, 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).

5.7 Recording Rules Actions and Action Properties

Note: For both USB 2.0 and USB 3.2 (except as noted).

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 3.2 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 three Trigger 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. (USB 2.0 only)
Restart Sequence	Restart this sequence. (USB 3.2 only)
Reset Timeout	Reset the Timeout value to 0, so it starts again. (USB3.2 only)

Action	Description
External Trigger Setting:	See “External Trigger Settings” on page 303 .”.
External Trigger Pulse LOW	Send LOW pulse on external trigger output.
External Trigger Pulse HIGH	Send HIGH pulse on external trigger output.
External Trigger Pulse Toggle	Send toggling signal (LOW/HIGH/LOW etc.) 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 3.2 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

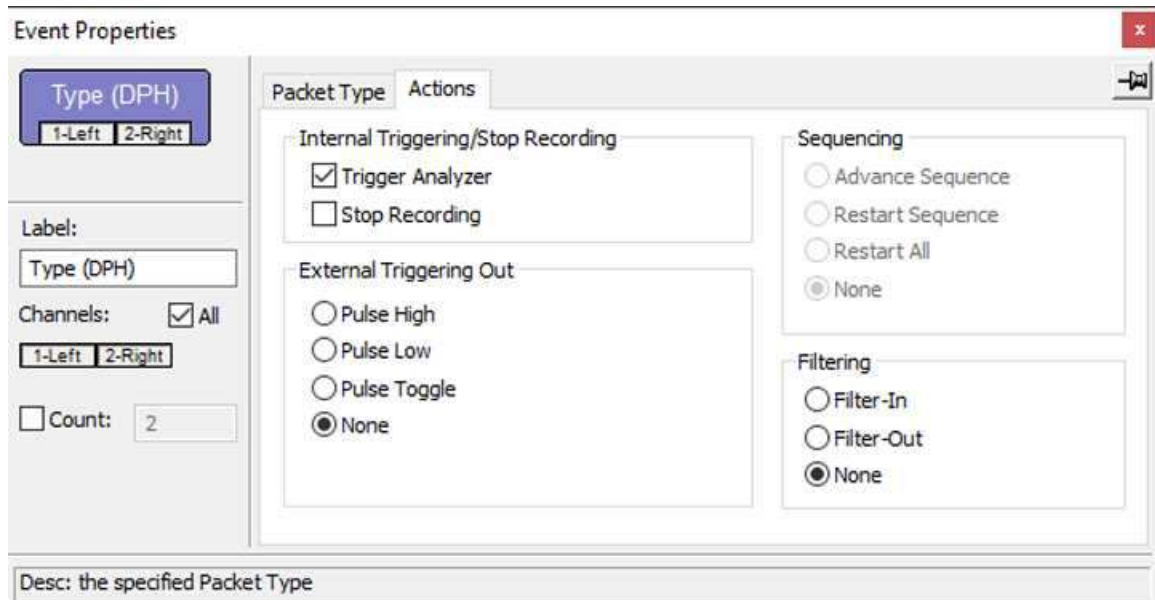


Figure 5.67: Event Properties: Actions Dialog.

You can set External Triggering Out based on the setting in Recording Options -> General -> External Trigger Settings (see [“External Trigger Settings” on page 303](#)), Sequencing, and Filtering.

Note: Due to analyzer limitations in USB 3.2 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 3.2 packets by the analyzer software.

5.8 Power Delivery/CC Recording options

The Voyager M310C/M310P/M4x and the Mercury T2C/T2P have the following Channel Configuration (CC) Simple Triggers:

- ☐ Resistor Detect
- ☐ Connect Status
- ☐ Power Measurement

5.8.1 Resistor Detect

Select a Resistor Detect checkbox (Left or Right) to trigger recording. See [Figure 5.68](#).

CC Simple Triggers

Resistor Detect

Left

- ☐ Rp On (CC1)
- ☐ Rp Off (CC1)
- ☐ Rd On (CC1)
- ☐ Rd Off (CC1)
- ☐ Ra On (CC2)
- ☐ Ra Off (CC2)

Right

- ☐ Rp On (CC1)
- ☐ Rp Off (CC1)
- ☐ Rd On (CC1)
- ☐ Rd Off (CC1)
- ☐ Ra On (CC2)
- ☐ Ra Off (CC2)

Connect Status

- ☐ Connect: Default
- ☐ Connect: 1.5A
- ☐ Connect: 3A
- ☐ Disconnect

Figure 5.68: CC Simple Triggers: Resistor Detect

5.8.1.1 Connect Status

Select one of the following Connect Status checkboxes to trigger the analyzer (see [Figure 5.69](#)):

- ☐ Default
- ☐ 1.5A
- ☐ 3A
- ☐ Disconnect

CC Simple Triggers

Resistor Detect

Left

- ☐ Rp On (CC1)
- ☐ Rp Off (CC1)
- ☐ Rd On (CC1)
- ☐ Rd Off (CC1)
- ☐ Ra On (CC2)
- ☐ Ra Off (CC2)

Right

- ☐ Rp On (CC1)
- ☐ Rp Off (CC1)
- ☐ Rd On (CC1)
- ☐ Rd Off (CC1)
- ☐ Ra On (CC2)
- ☐ Ra Off (CC2)

Connect Status

- ☐ Connect: Default
- ☐ Connect: 1.5A
- ☐ Connect: 3A
- ☐ Disconnect

Figure 5.69: CC Simple Triggers: Connection Status

5.8.1.2 Power Measurement

Select one of the following Power Measurement checkboxes to trigger the analyzer (see [Figure 5.69](#)):

- ☐ CC1 L: Set V(min) and V(max) values
- ☐ CC2 L: Set V(min) and V(max) values
- ☐ CC1 R: Set V(min) and V(max) values
- ☐ CC2 R: Set V(min) and V(max) values

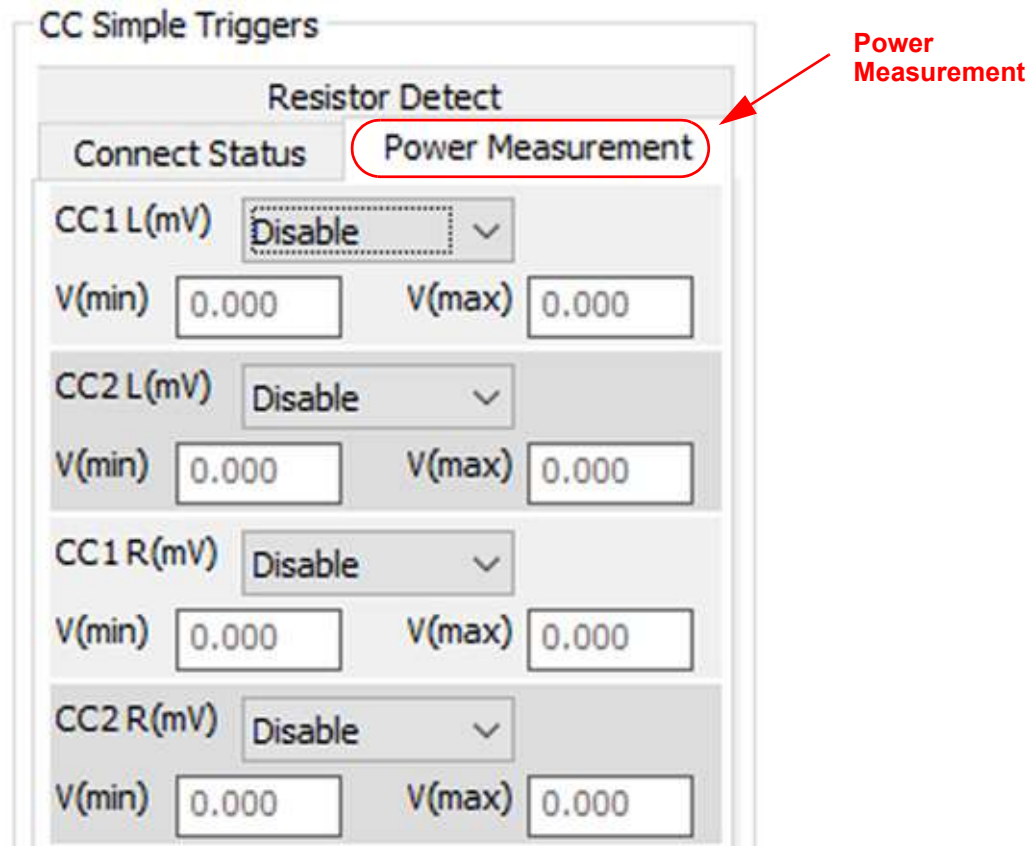


Figure 5.70: CC Simple Triggers: Power Measurement

You can also select from the following conditions (see [Figure 5.71 on page 324](#)) to trigger the analyzer:

- ☐ Disable
- ☐ Less Than
- ☐ Greater Than
- ☐ Between

CC Simple Triggers

Resistor Detect

Connect Status | Power Measurement

CC1 L(mV) Disable ▾

V(min) Disable

CC2 L(mV) Less Than

V(min) Greater Than

CC1 R(mV) Between

V(min) Disable

CC2 R(mV) Disable ▾

V(min) Less Than

V(max)

Figure 5.71: CC Simple Triggers: Power Measurement

5.8.1.3 Power Delivery/USB Type-C Recording Options (Simple Mode)

Note: The images below show the M310P but the Power Delivery and USB Type-C Recording Options for the M4x, M310C, T2P and T2C analyzers are identical.

Note: Exerciser options are not applicable in Mercury T2C or Mercury T2P.

The Simple Trigger Options for Power Delivery are shown below:

- ❑ Analyzer Mode: [Figure 5.72](#)
- ❑ Exerciser Mode: [Figure 5.73 on page 326](#)

The Simple Trigger Options for USB Type-C events are shown below:

- ❑ Analyzer Mode: [Figure 5.74 on page 328](#)
- ❑ Exerciser Mode: [Figure 5.75 on page 330](#)

5.8.1.4 M310P: Power Delivery Analyzer Mode Recording Options (simple)

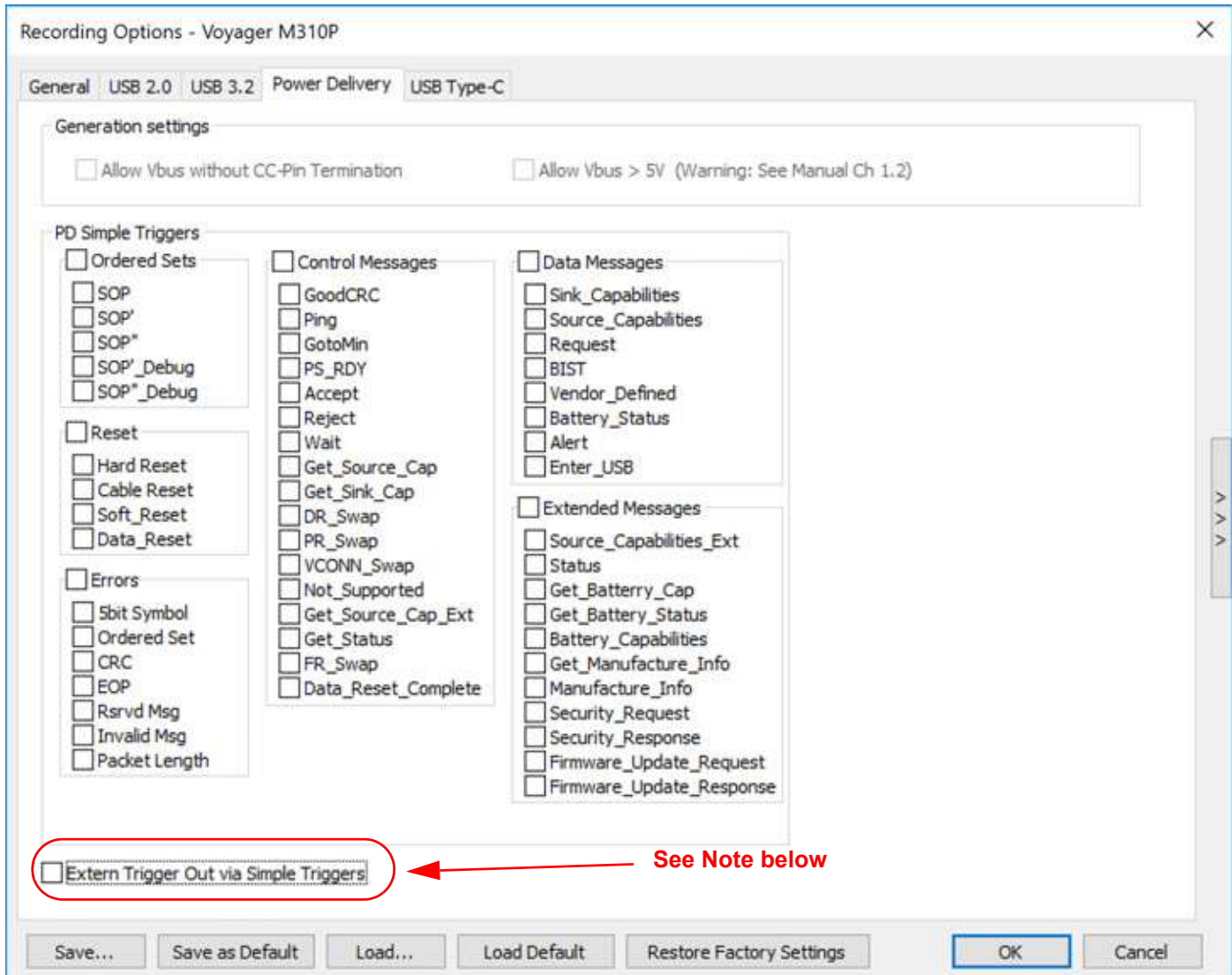


Figure 5.72: Power Delivery Recording Options -> Analyzer (Simple Mode) for M4x, M310P, M310C, T2P and T2C

Note: Selecting the “Extern Trigger Out via Simple Triggers” checkbox will cause a Trigger Pulse on the external Trigger Out Cable when the External Trigger Cable AC032XXA-X is attached.

5.8.1.5 M310P: Power Delivery Exerciser Mode Recording Options (simple)

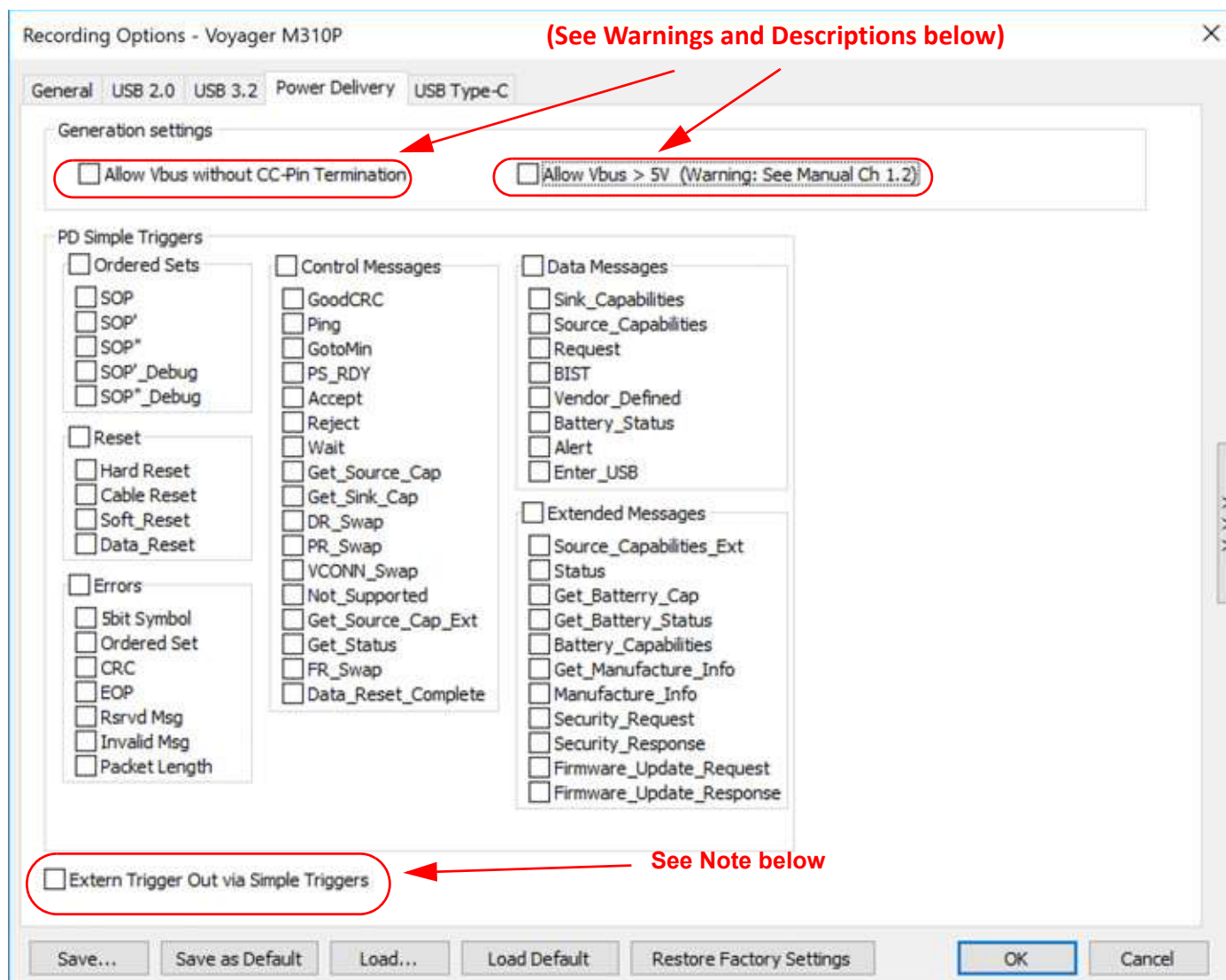


Figure 5.73: Power Delivery Recording Options -> Exerciser (Simple Mode) for M4x, M310P, M310C, T2P and T2C

Note: Selecting the “Extern Trigger Out via Simple Triggers” checkbox will cause a Trigger Pulse on the external Trigger Out Cable when the External Trigger Cable AC032XXA-X is attached.

WARNING: **Exerciser:** This checkbox changes the mode from analyzing two connected Power Delivery partners to one where the M310P 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: **Allow Vbus without CC-Pin Termination:** This checkbox allows you to override the Type-C/PD protocol. This features was added so that during development you can test the SS+ protocol without requiring the Type-C/PD Protocols to establish Vbus.

WARNING: **Allow Vbus > 5V:** This checkbox allows you to generate voltages on VBus as high as 20 Volts. See “[Voyager M310C Analyzer](#)” on page 17. 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 Delivery Exerciser scenarios.

5.8.1.6 M310P: USB Type-C Analyzer Mode Recording Options (simple)

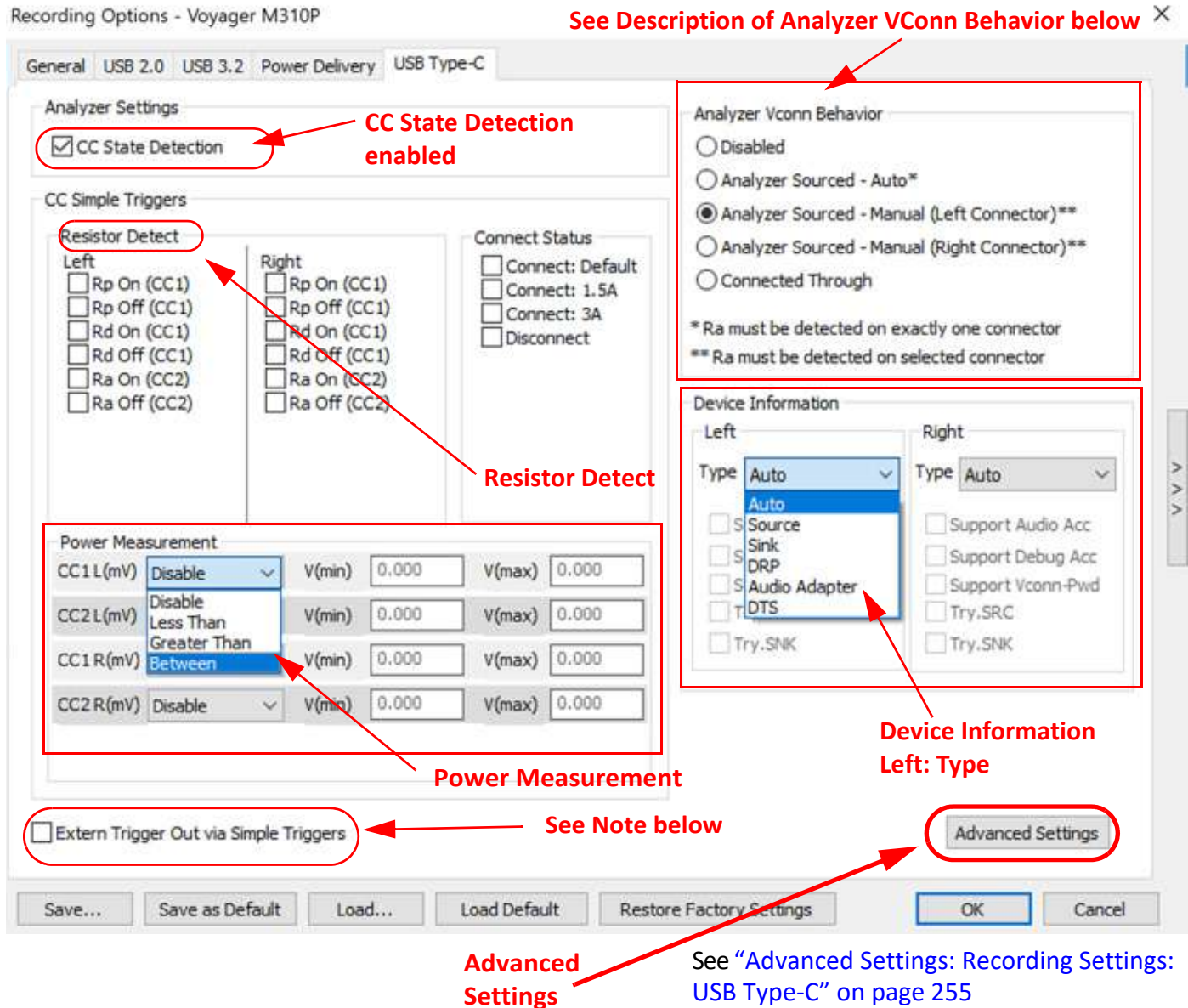


Figure 5.74: USB Type-C Recording Options -> Analyzer (Simple Mode) for M4x, M310P, M310C, T2P and T2C

Note: Selecting the "Extern Trigger Out via Simple Triggers" checkbox will cause a Trigger Pulse on the external Trigger Out Cable when the External Trigger Cable AC032XXA-X is attached.

5.8.2 CC (Configuration Channel) State Detection: Voyager M310P

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.

5.8.2.1 Analyzer VConn Behavior

Certain devices with a captured Type-C plug require VConn on CC2 to drive their electronics. An example would be an HDMI Adapter or a device that is fully powered by VConn (known as a VConn Powered Device, or VPD). This selection box allows you to configure how you would like the Vconn power to be treated, depending on the analyzer product being used.

- ☐ Disabled - Vconn is not connected through nor is any voltage applied to either connector.
- ☐ Analyzer Sourced - Auto: The analyzer looks for the proper identifiers of the cables and supplies Vconn to one of the 2 connectors as needed.
- ☐ Analyzer Sourced - Manual (Left Connector): The analyzer supplies Vconn to the Left Connector
- ☐ Analyzer Sourced - Manual (Right Connector): The analyzer supplies Vconn to the Right Connector
- ☐ Connected Through - On the M310P, it is possible to connect the Vconn signal directly between the two connectors. This selection does that.

5.8.2.2 M310P: USB Type-C Exerciser Mode Recording Options (simple)

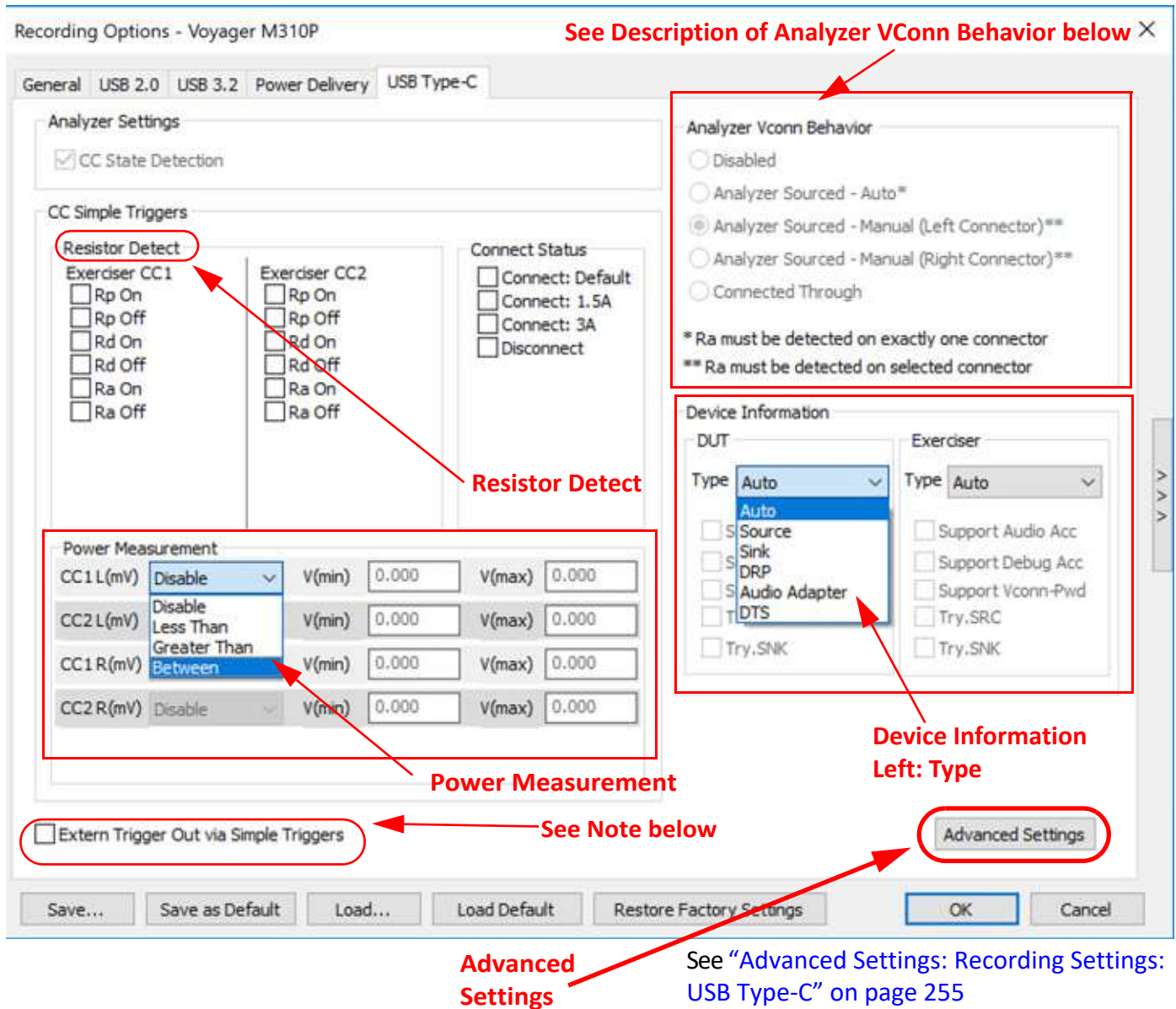


Figure 5.75: USB Type-C Recording Options -> Exerciser (Simple Mode) for M4x, M310P, M310C, T2P and T2C

Note: Selecting the “Extern Trigger Out via Simple Triggers” checkbox will cause a Trigger Pulse on the external Trigger Out Cable when the External Trigger Cable AC032XXA-X is attached.

WARNING: This checkbox changes the mode from analyzing two connected Power Delivery partners to one where the M310P 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

5.8.2.3 Analyzer VConn Behavior

Does not apply.

5.9 VBUS Power Measurement Trigger Options

The Voyager M3x, M310, M310C and M310P have the following Simple Triggers (see Figure 5.76):

- ☐ Vbus Voltage
- ☐ Vbus Current

Figure 5.76: USB3.2: Simple Triggers -> Vbus Levels

You can specify V(min) and V(max) or I(min) and I(max) with the following conditions (see Figure 5.77):

- ☐ Disable
- ☐ Less Than
- ☐ Greater Than
- ☐ Between

Figure 5.77: USB3.2: Simple Triggers -> Vbus Levels

5.9.1 Absolute Value

If you don't know which direction the power is coming from (whether it's being sourced or sunk) you can select the Abs. Value and then set the voltage and current (min) and (max) and the select conditions will trigger the analyzer. See [Figure 5.78](#).

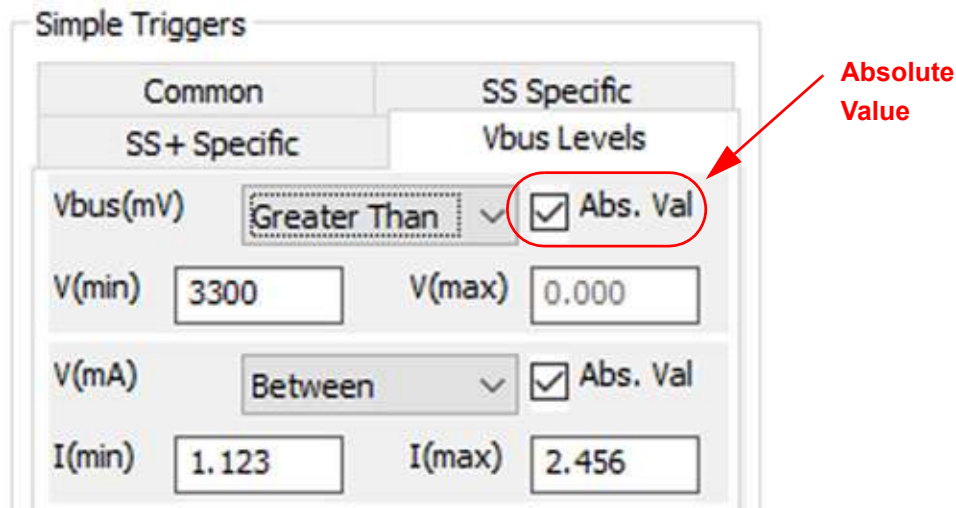


Figure 5.78: USB3.2: Simple Triggers -> Vbus Levels -> Absolute Value

In the case shown above the analyzer will trigger if the magnitude (positive or negative) of the Vbus is greater than 3300 mV and the magnitude of the current (positive or negative) is between 1.123 mA and 2.456 mA.

5.10 Recording Rules - USB 2.0

Use the Recording Rules to set triggers and filters for USB 2.0.

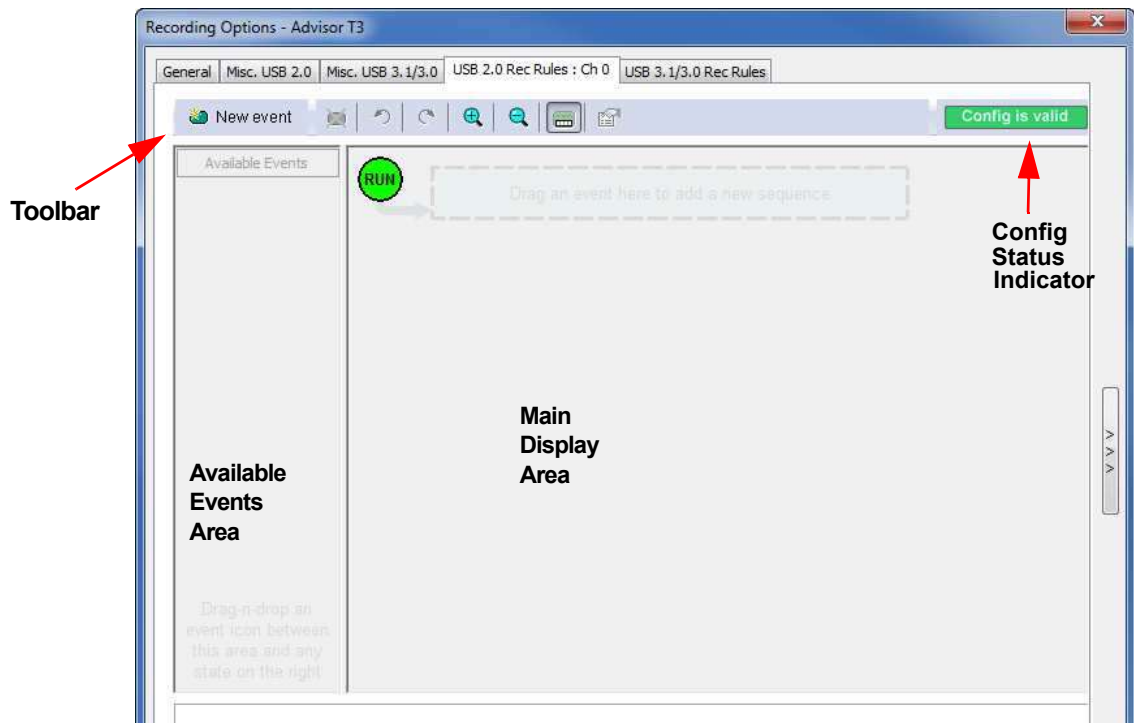


Figure 5.79: Recording Rules USB 2.0 Dialog.

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.

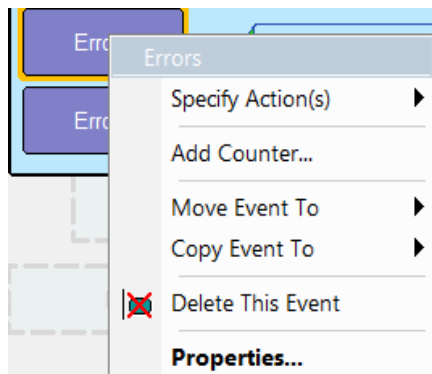


Figure 5.80: PO-Up Menu.

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.

5.10.1 Recording Rules Toolbar

The Recording Rules toolbar buttons control the Recording Rules page.



Figure 5.81: Recording Rules Toolbar.

TABLE 5.3: 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.

5.10.2 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.

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.

5.10.3 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:

1. Click the **New Event** button at the left side of the toolbar to display the New Event pop-up menu (see [Figure 5.82](#)).

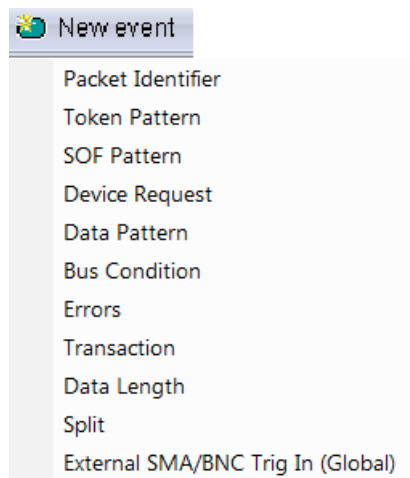


Figure 5.82: New Event Pop-up Menu.

2. Select an event, such as Errors. The event appears in the Available Events area. See [Figure 5.83](#).

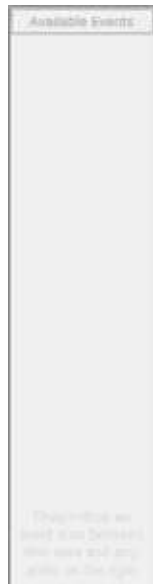


Figure 5.83: Available Events Area.

5.10.4 SMA External Trigger In

The example below shows the options available for the M310P after the External SMA/BNC Trigger In Event occur (as defined in [“M310P Features” on page 62](#)).

Although this example shows the options for a Voyager M310P they are typical for all analyzers that have an SMA External Trigger In.

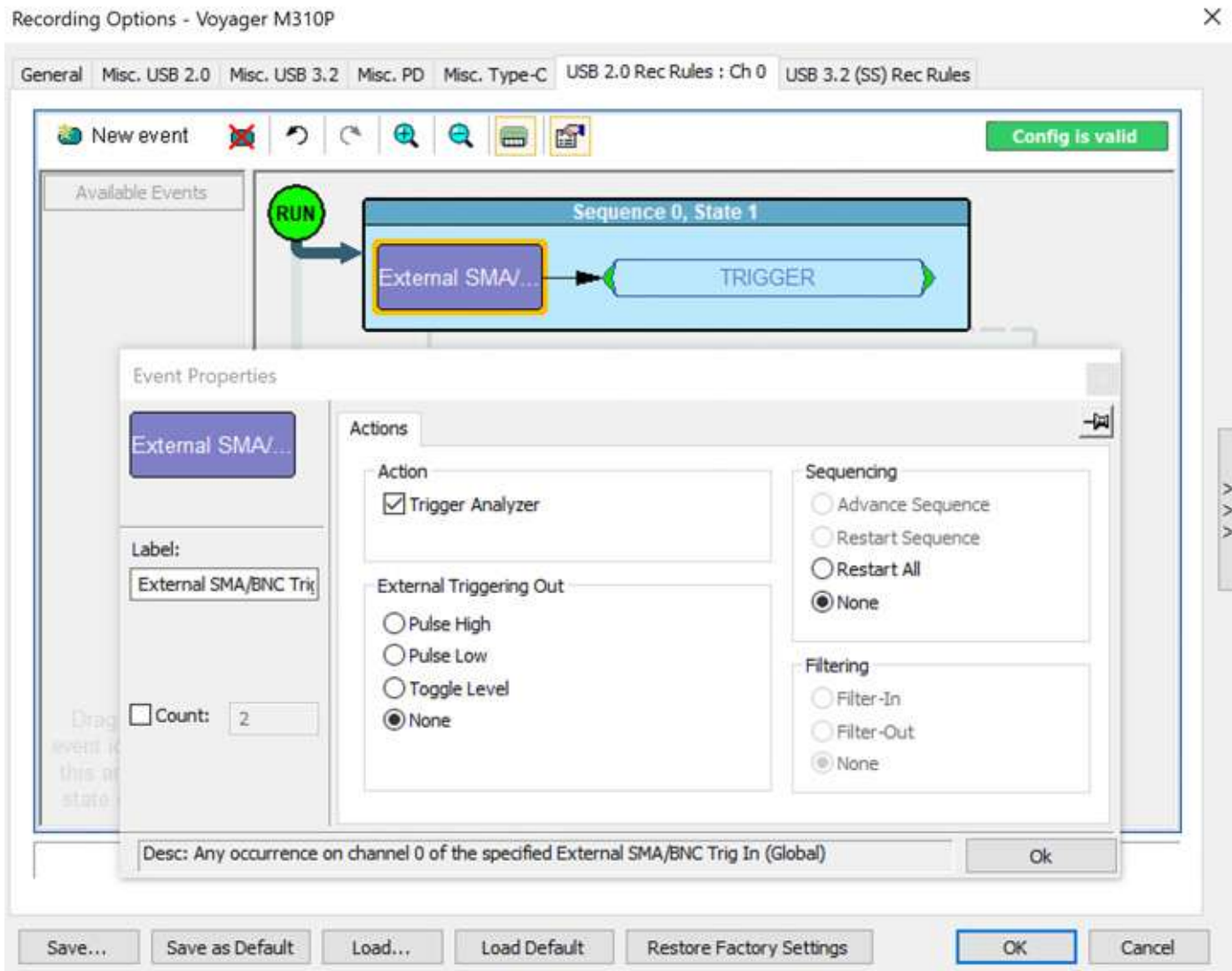


Figure 5.84: Advanced Mode Recording: External Trigger In

5.10.5 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 labeled 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.

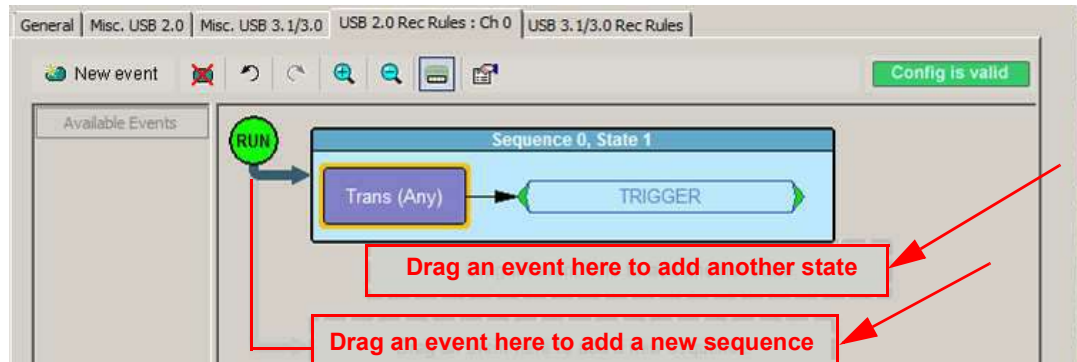


Figure 5.85: Events Button in Cell.

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: Sequence 0 State 1 and Sequence 0 State 2). You can have up to 7 states in one sequence.

See [Figure 5.86 on page 340](#).

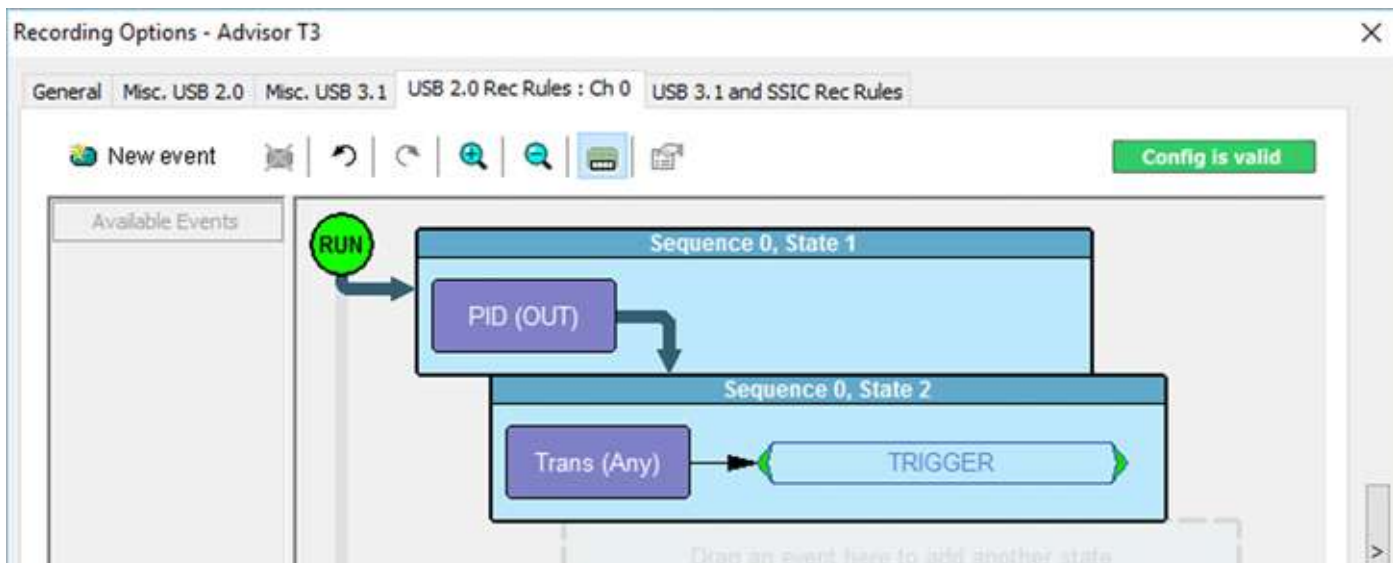


Figure 5.86: Recording Options: Adding a New State to Sequence 0

The second of the new cells is to create a separate sequence, which would be labeled Sequence 1 (Errors). See [Figure 5.87](#).

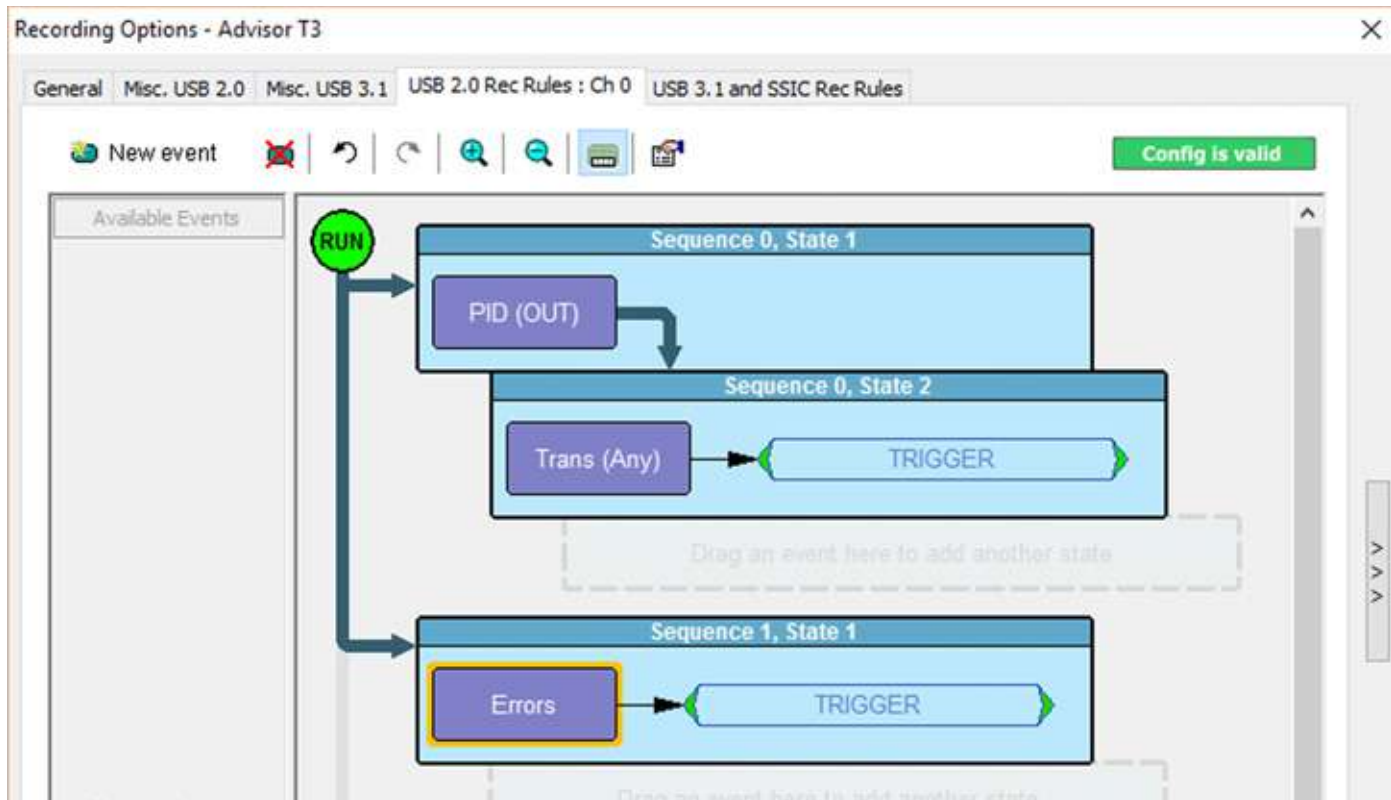


Figure 5.87: Recording Options: Adding a New Sequence

You can define up to 8 sequences.

5.10.6 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 5.88 on page 342](#).)

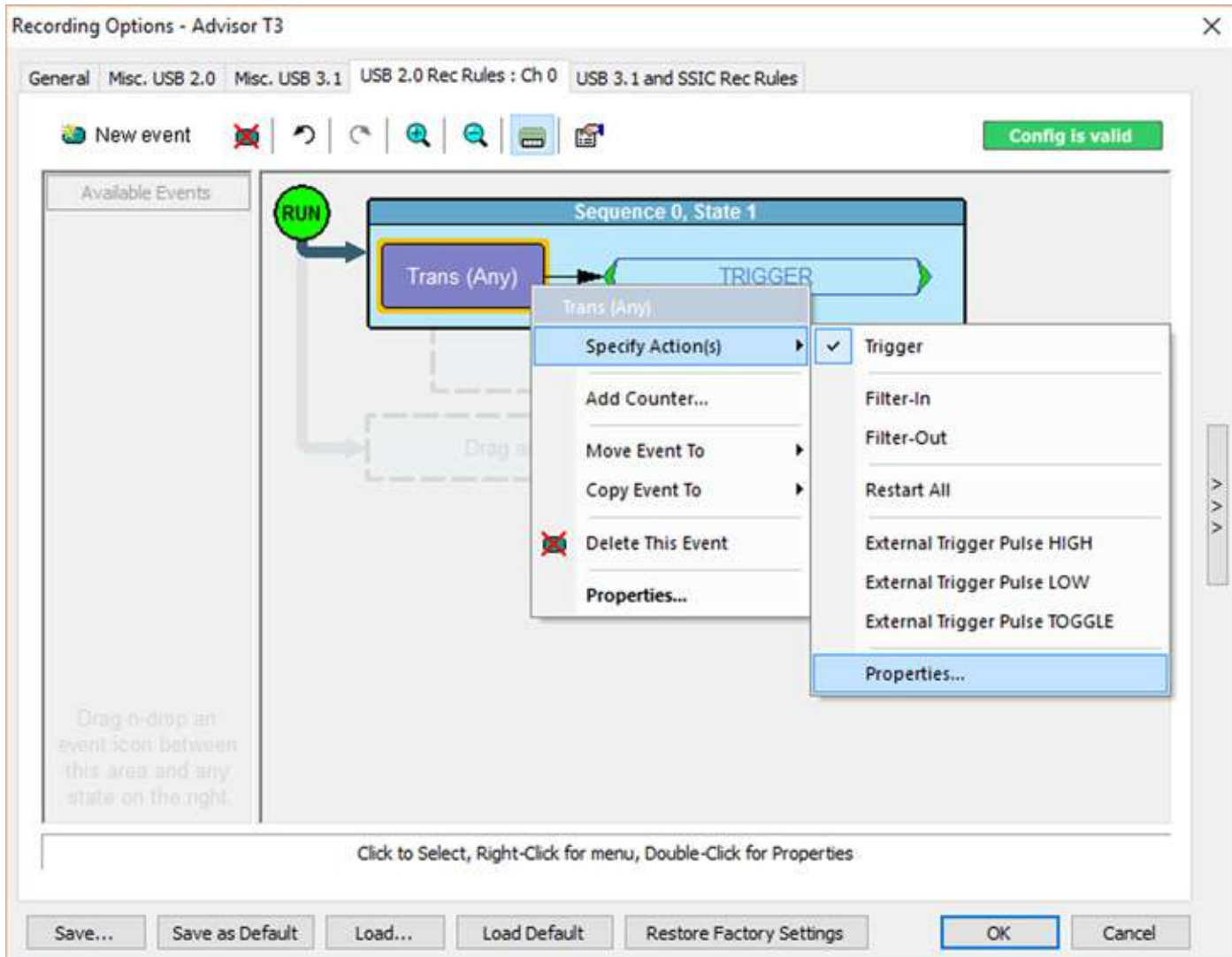


Figure 5.88: Assigning Action to Event Button.

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 5.89](#).

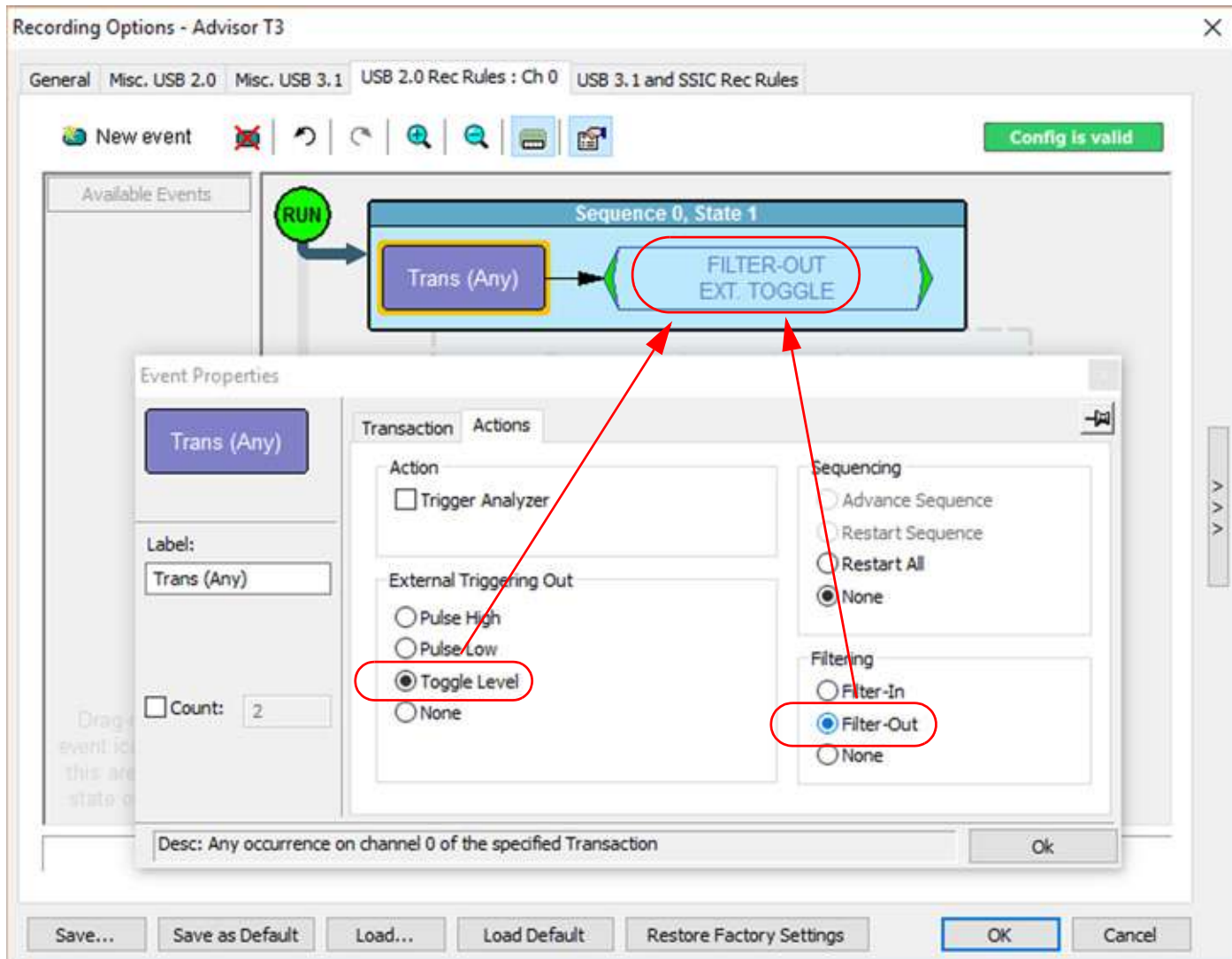


Figure 5.89: Action Assigned.

5.10.7 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.

5.10.7.1 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.

5.10.7.2 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 Stray-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).
- ❑ **Stop Recording:** Stops recording and uploads the captured data.
- ❑ **Reset Timeout:** Resets the Timeout back to 0.

5.10.7.3 Advance the Sequence to Another State

To create 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 5.90 on page 345](#).

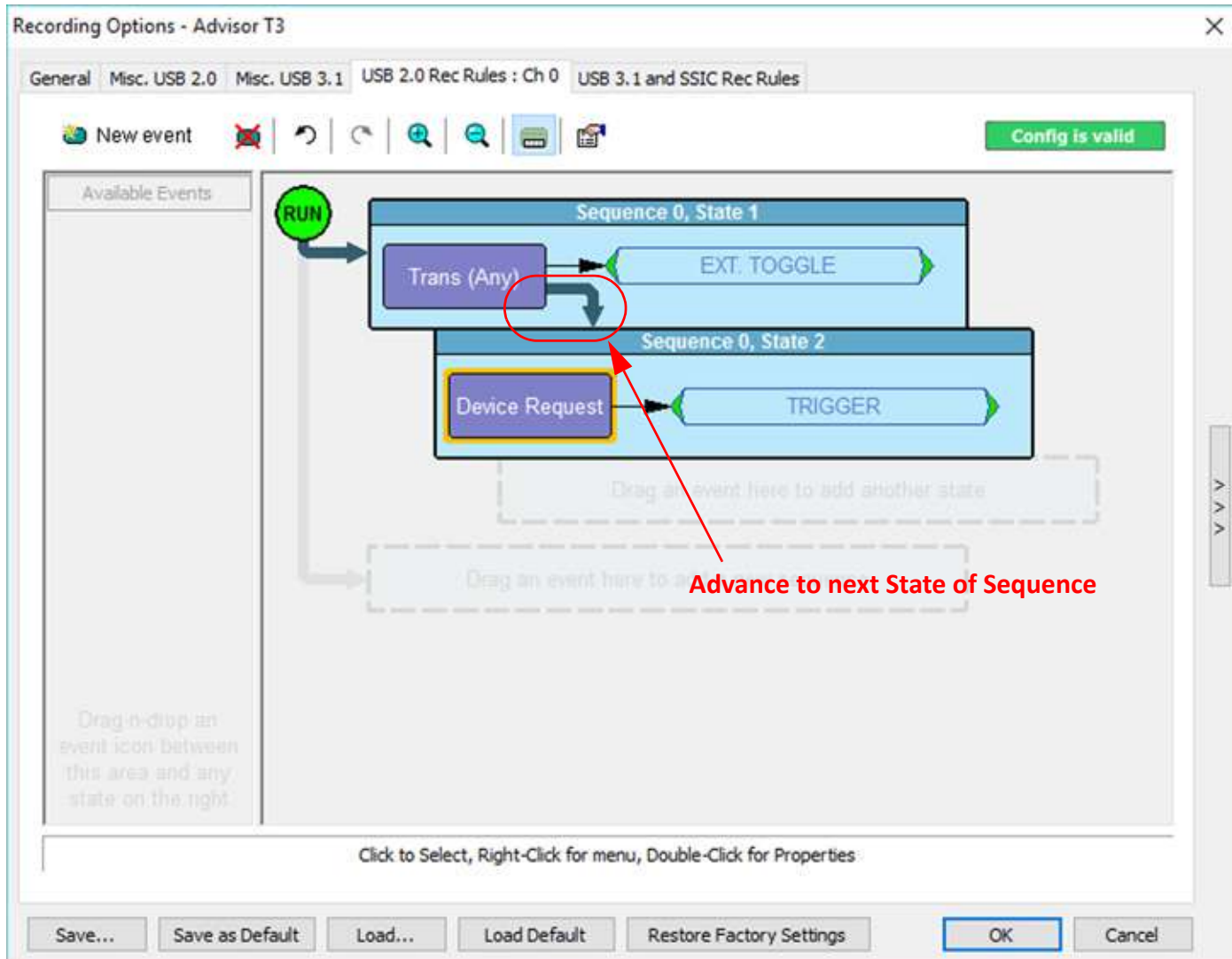


Figure 5.90: Advancing the Sequence.

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 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. USB 2.0 only.
- ❑ **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.

5.10.7.4 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.

5.10.8 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.

5.10.8.1 Event Properties (of the Error Event)

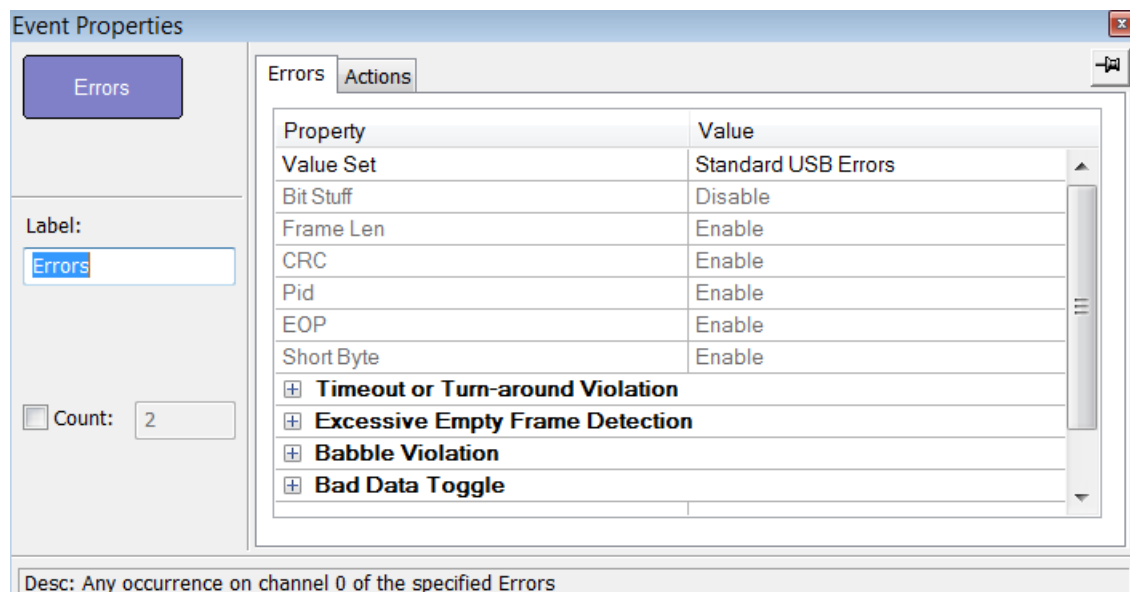


Figure 5.91: Event Properties Dialog.

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.

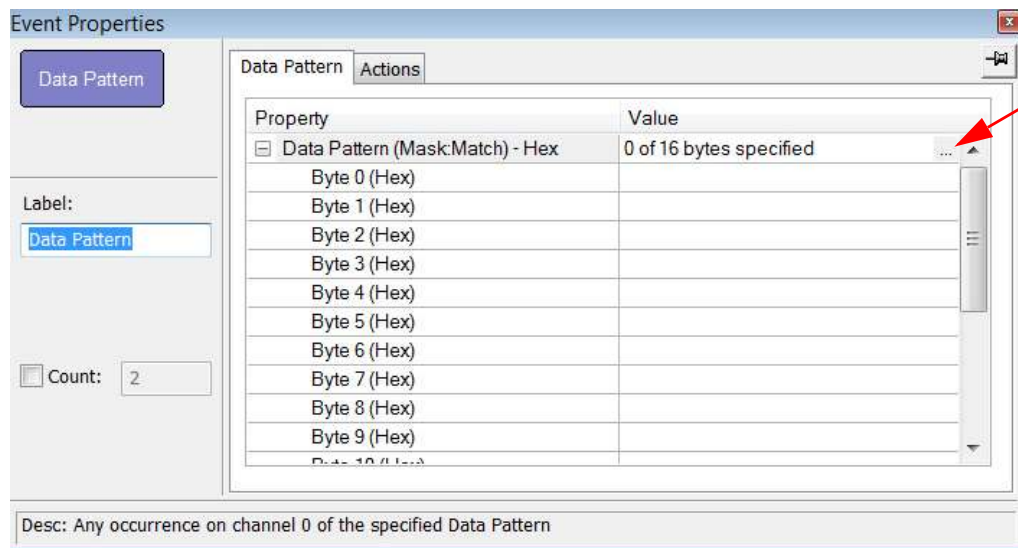
Therefore, to ensure Babble and Turnaround triggers have the correct default values, you should follow this procedure:

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.

5.10.8.2 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 5.92 on page 350](#)).

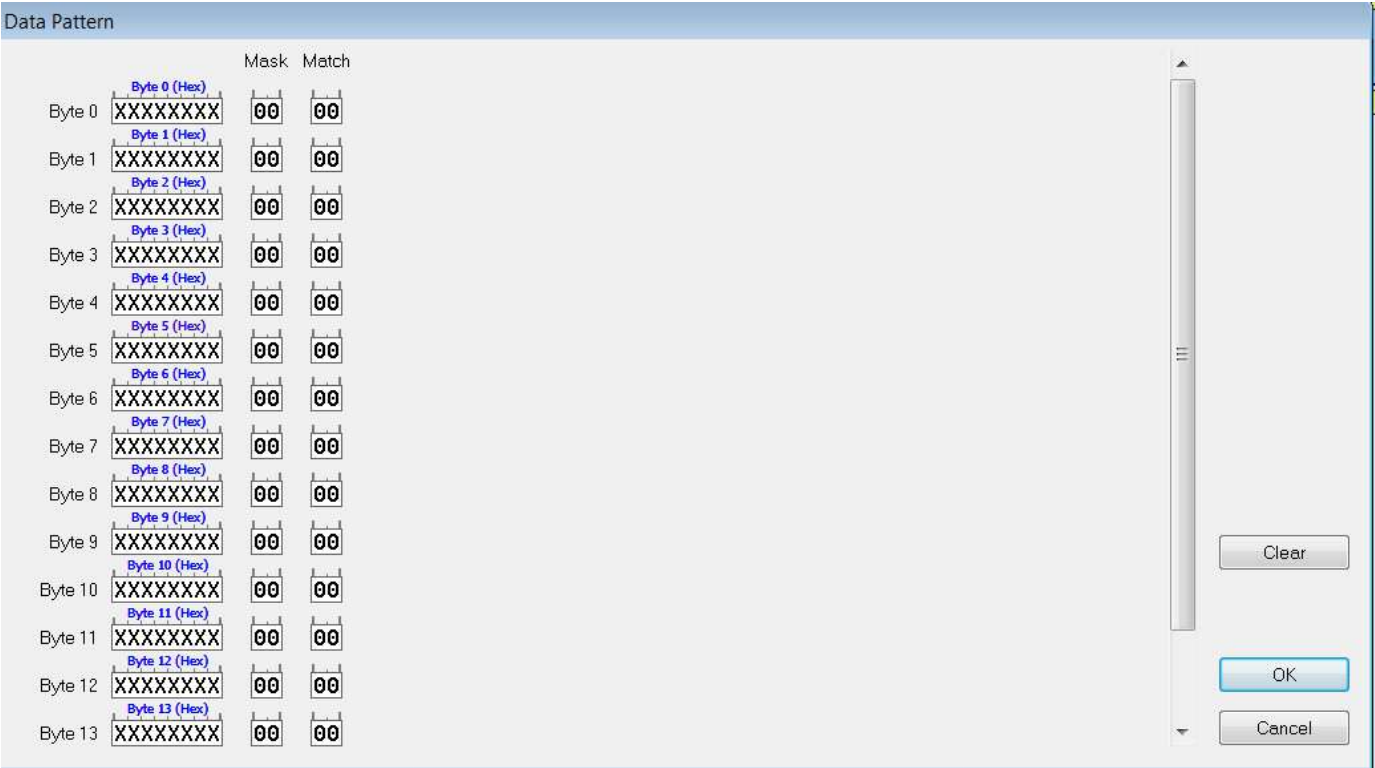


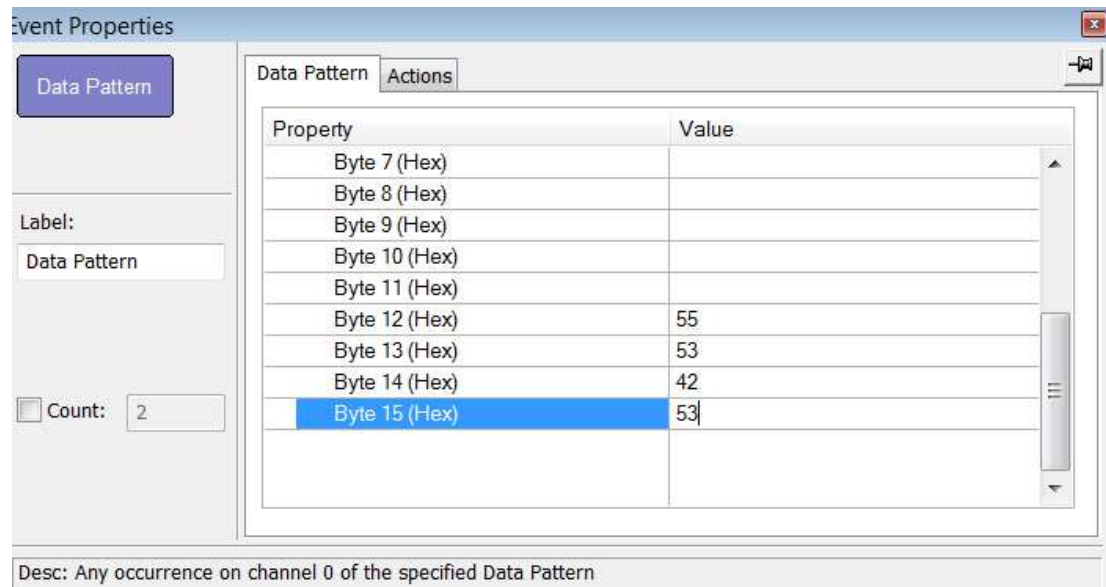
Figure 5.92: Data Pattern Dialog.

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.

5.10.9 Actions for USB2.0

After an Event has been assigned to a Sequence, an Action can be assigned to that Event. See [Figure 5.93](#).

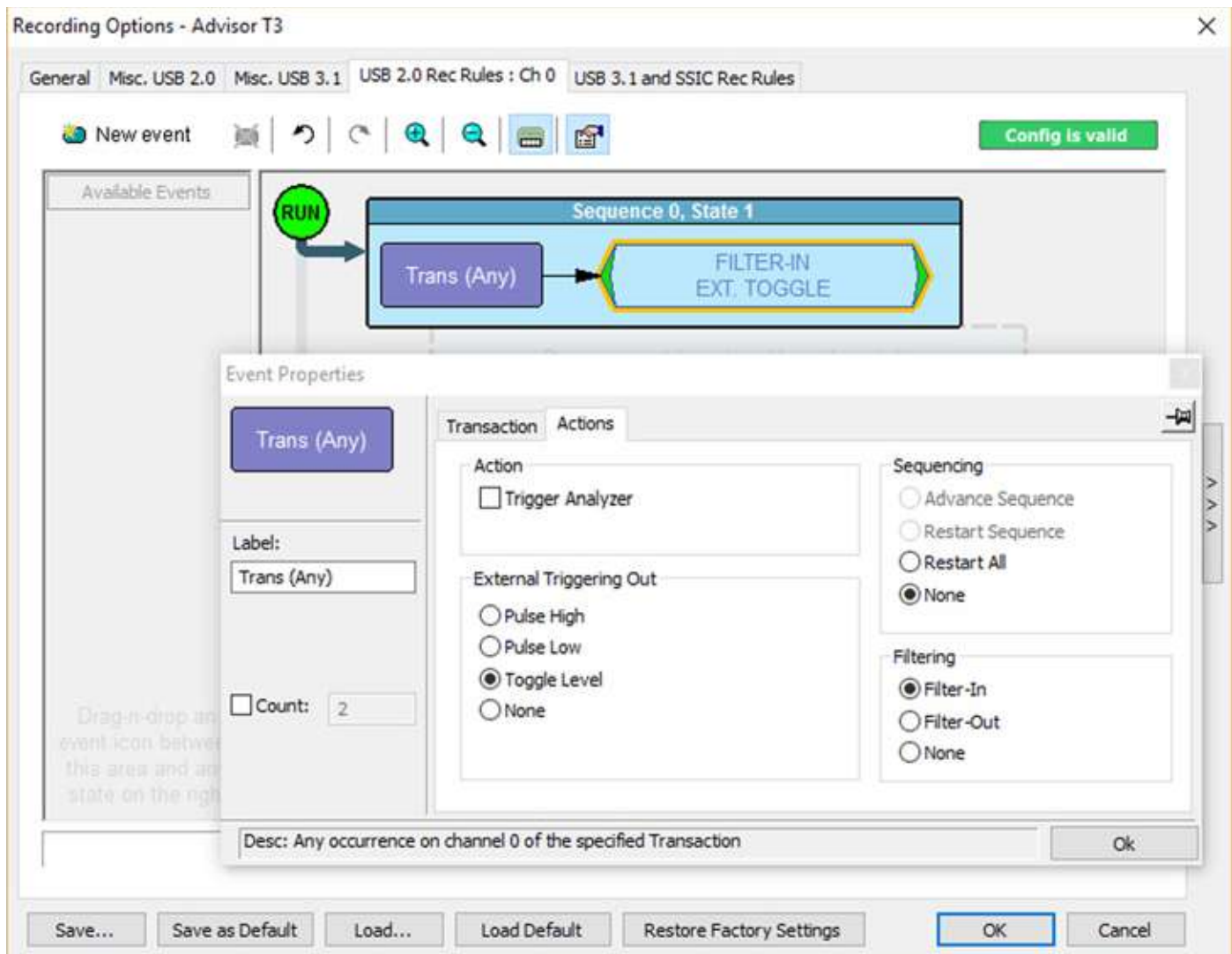


Figure 5.93: Recording Options: Actions Available for USB2.0

Actions are context sensitive (they depend on the type of Event selected). In the case above when Any Transaction is detected the External Trigger Out will toggle and only transactions will be displayed in the captured trace because the Filter-In button was selected. If Filter-Out was selected the captured trace will not contain any transactions, but it will contain all other types of traffic.

5.10.10 Example: Filter-In and Filter-Out

You can set the Recording Options to Filter-In Any Transactions. See [Figure 5.94](#).

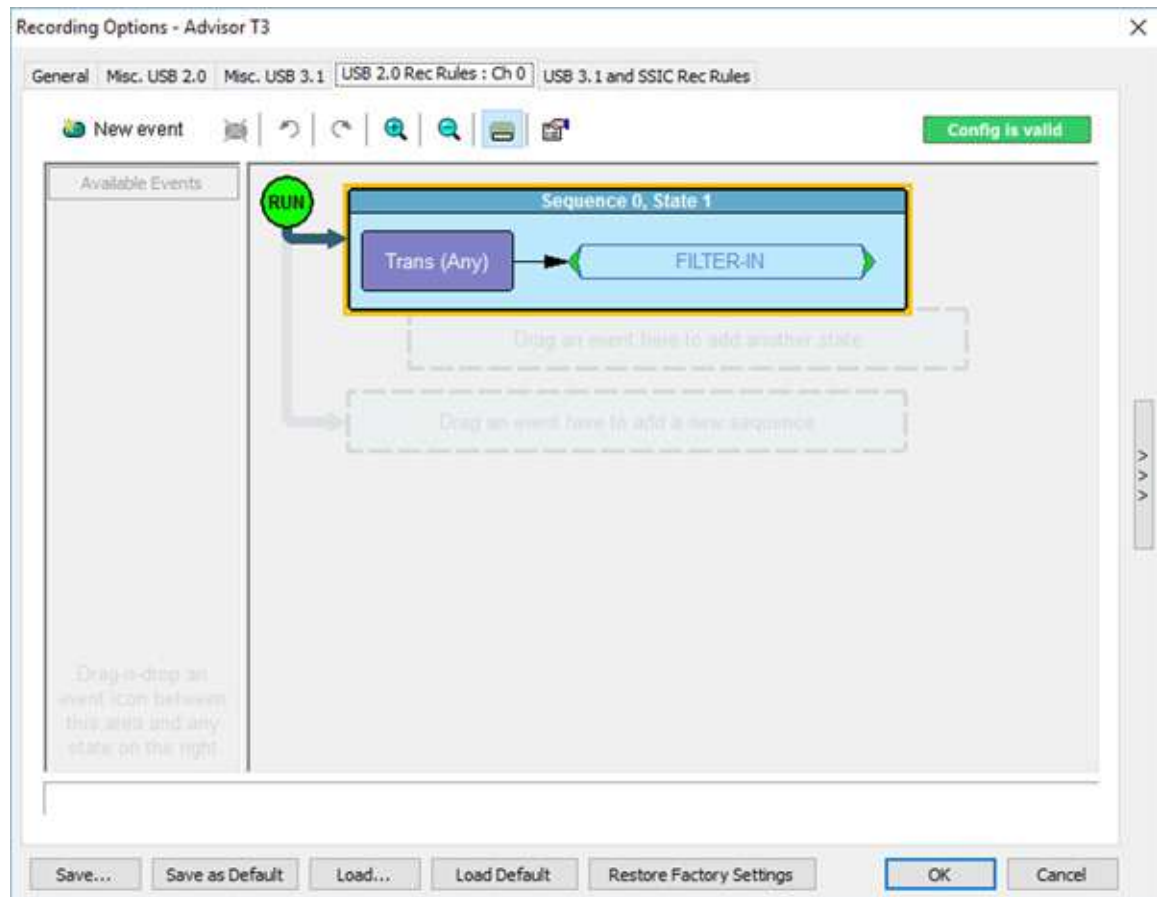


Figure 5.94: Recording Options: Transactions -> FILTER-IN

After you make a recording, the traffic shown in the Trace view will look something like [Figure 5.95 on page 354](#), depending on the type of data traffic occurring on the bus.

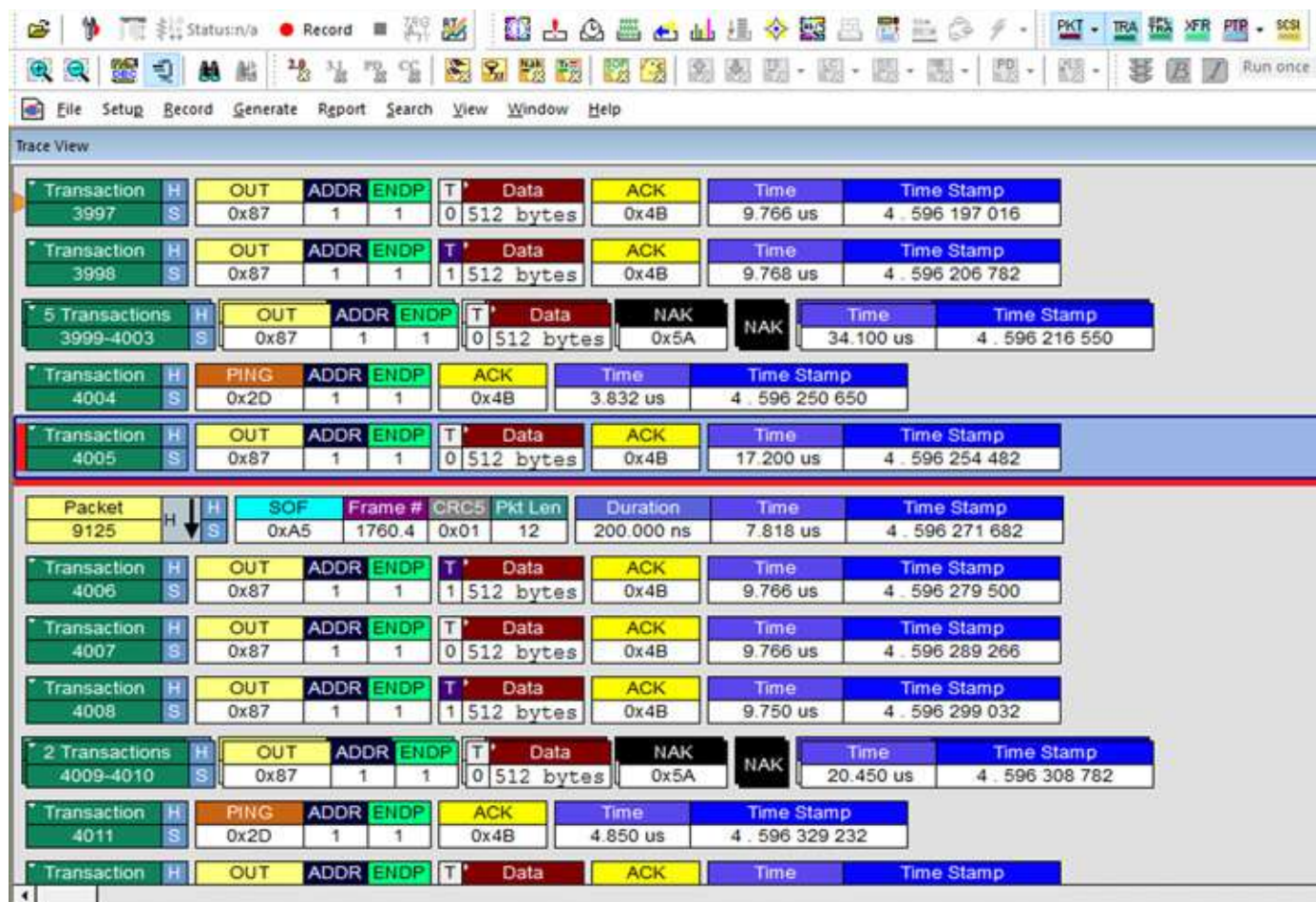


Figure 5.95: Transactions: FILTER-IN -> Data Traffic with Transactions

You can set the Recording Options to FILTER-OUT Any Transactions. See [Figure 5.96](#).

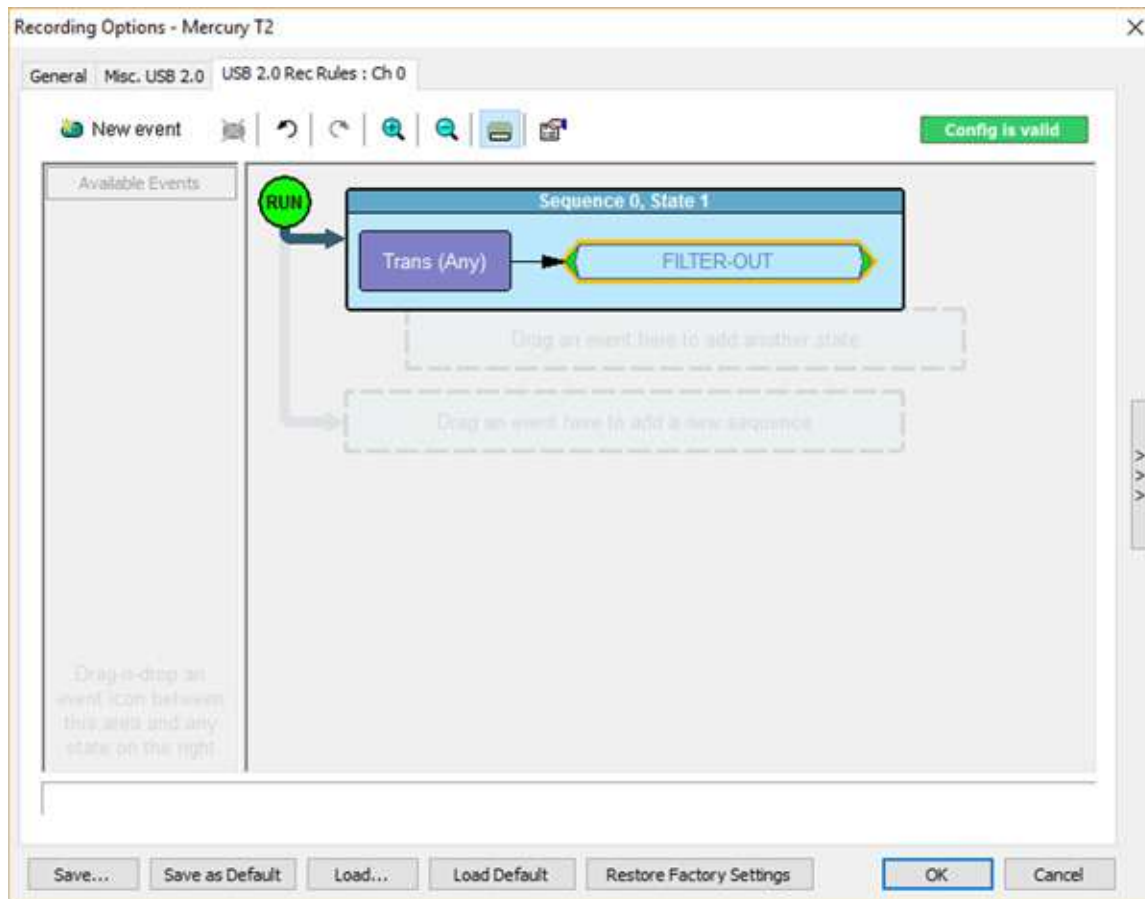


Figure 5.96: Recording Options: Transactions -> FILTER-OUT

After you make a recording, the traffic shown in the Trace view will look something like [Figure 5.97](#), depending on the type of data traffic occurring on the bus. You'll see lots of Start of Frame (SOF) packets but no Transactions because they have been filtered-out.

Packet	H	S	SOF	Frame #	CRC5	Pkt Len	Duration	Idle	Time Stamp
41622	H	S	0xA5	1441.6	0x1A	12	200.000 ns	124.800 us	5 . 202 777 582
41623	H	S	0xA5	1441.7	0x1A	12	200.000 ns	124.800 us	5 . 202 902 582
41624	H	S	0xA5	1442.0	0x18	12	200.000 ns	124.800 us	5 . 203 027 582
41625	H	S	0xA5	1442.1	0x18	12	200.000 ns	124.784 us	5 . 203 152 582
41626	H	S	0xA5	1442.2	0x18	12	200.000 ns	124.800 us	5 . 203 277 566
41627	H	S	0xA5	1442.3	0x18	12	200.000 ns	124.800 us	5 . 203 402 566
41628	H	S	0xA5	1442.4	0x18	12	200.000 ns	124.800 us	5 . 203 527 566
41629	H	S	0xA5	1442.5	0x18	12	200.000 ns	124.800 us	5 . 203 652 566
41630	H	S	0xA5	1442.6	0x18	12	200.000 ns	124.800 us	5 . 203 777 566
41631	H	S	0xA5	1442.7	0x18	12	200.000 ns	124.800 us	5 . 203 902 566
41632	H	S	0xA5	1443.0	0x07	12	200.000 ns	124.800 us	5 . 204 027 566
41633	H	S	0xA5	1443.1	0x07	12	200.000 ns	124.800 us	5 . 204 152 566

Figure 5.97: Transactions: FILTER-OUT -> Data Traffic without Transactions

5.10.11 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.

5.10.11.1 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.

5.10.11.2 Number of Analyzer Counters

This analyzer includes two USB 2.0 counters. If you try to assign more, you will get a warning.

5.10.11.3 Packets

You must assign a packet, event, or logical expression to a counter and/or timer.

5.10.11.4 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.

5.10.11.5 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.

5.10.11.6 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.

5.10.12 Performance Considerations

There are various USB 2.0 scenarios which can have a heavy impact on performance both of uploading and decoding/viewing of a trace.

It is recommended that (if you can) you filter out data that is not necessary for debugging your scenario. Here are couple of examples:

- ❑ 1. Filter out traffic from devices you are not debugging. Some devices traffic will fill the buffer with their data preventing you from getting the data from the device you want. To prevent this , you can filter out all the traffic from an address using the Transaction Filter and setting the address to the one you don't want.
- ❑ 2. Some devices "NAK Forever" (or what seems like forever). These fill the buffer with minimally usable information (unless it is the NAK's you are interested in). Having millions of NAK transactions will adversely effect decoding and scrolling through your trace file. This can be prevented by filtering out NAK transactions using the transaction filter.

5.11 Using Sequences

5.11.1 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).

5.11.2 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.

5.11.3 Using Independent Sequences (USB 2.0 only)

You can use up to eight independent sequences. By default, they are labeled Sequence 0 through Sequence 7.

The sequences operate in parallel and have no effect on each other with the following exception:

- ❑ Any of the sequences can contain the action Restart All. This action restarts all sequences in the Main Display area.

5.12 Recording Rules - USB 3.2 SS+ (Voyager M310/M310C/M310P/M4x only), USB 3.2 SS (Voyager/Advisor T3 only)

Note: USB 3.2: Only one sequence is supported.

Note: Use the Recording Rules to set triggers for USB 3.2.

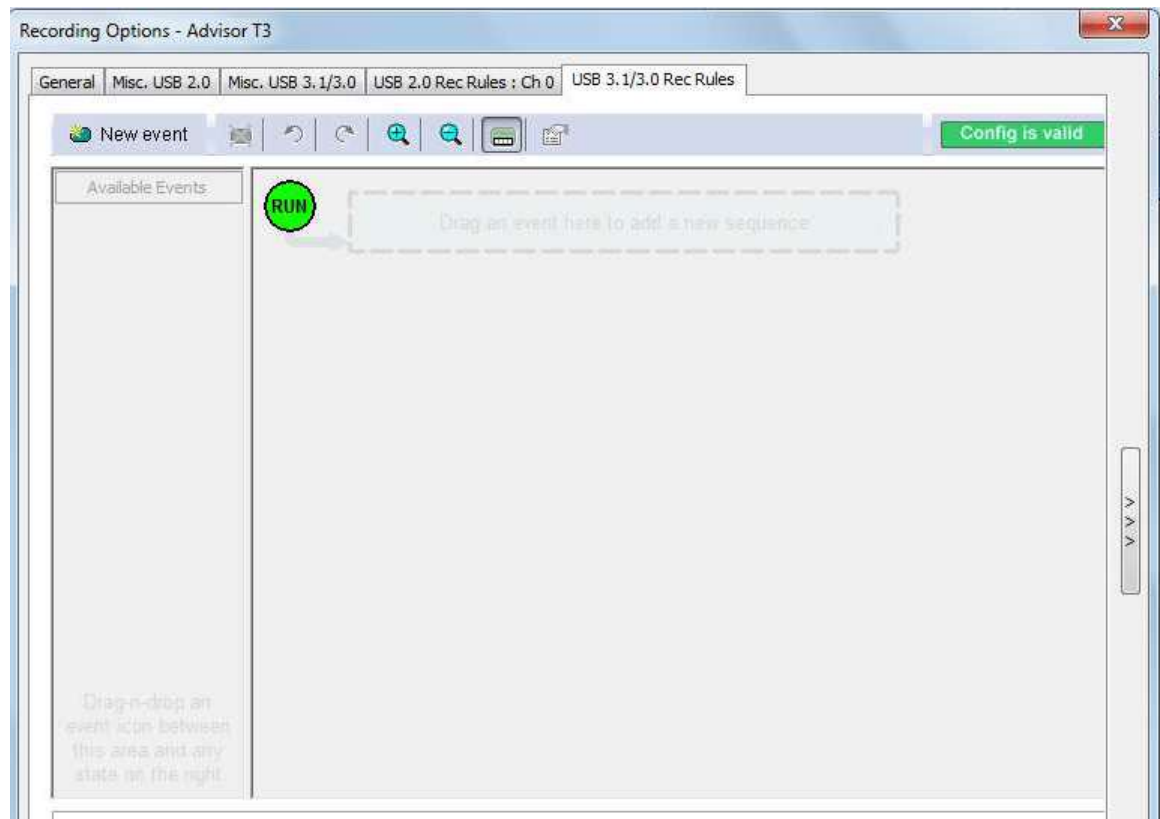


Figure 5.98: Recording Rules USB 3.2.

The page has the same areas as the USB 2.0 Recording Rules (see [“Recording Options - USB 3.2 for Advisor T3” on page 317](#)):

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.

5.12.1 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 335](#)).

Note: If you have a wheel on the mouse, you can zoom by holding down the CTRL key and rolling the mouse wheel.

5.12.2 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 336](#).

Note: Recording Rules for USB 3.2 currently do not support more than two independent states.

5.12.3 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 337](#). The following events are available for USB 3.2 recording rules (see [Figure 5.99 on page 362](#)):

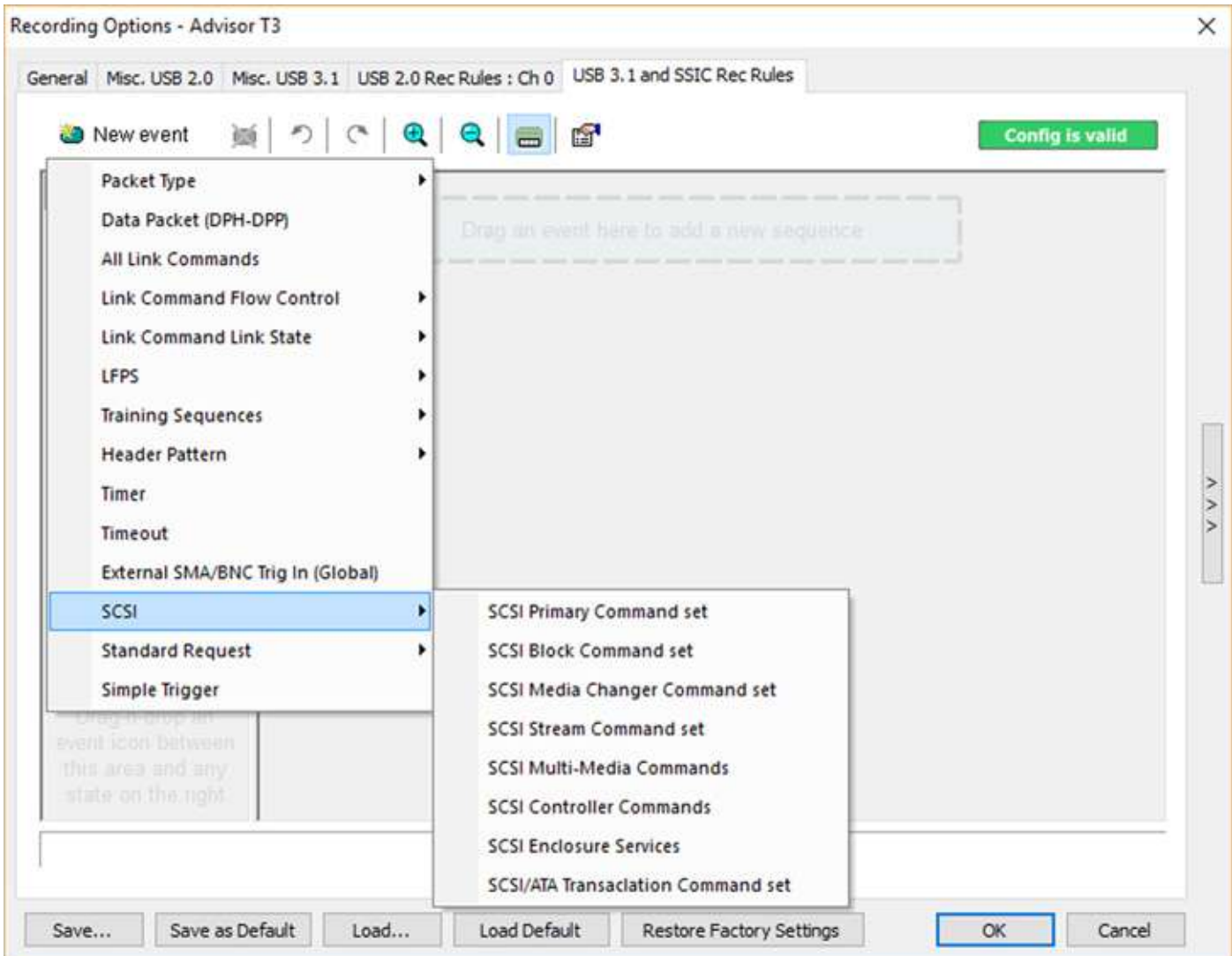


Figure 5.99: Events for USB 3.2.

5.12.4 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 5.100 on page 363.](#))

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 3.2 currently do not support more than two independent states.

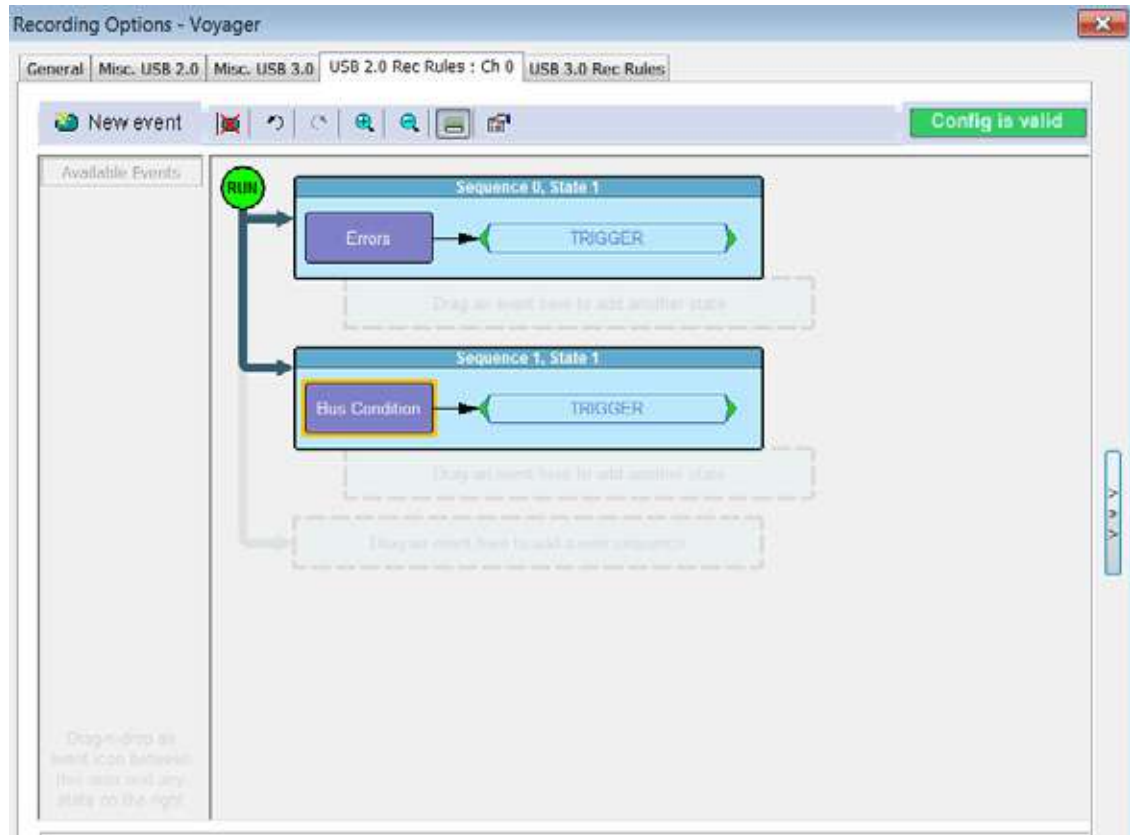


Figure 5.100: Sequence and State Cells.

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 339](#)

5.12.5 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 341](#).

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.

5.12.6 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.

5.12.6.1 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.

5.12.6.2 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 346](#)).

5.12.6.3 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 344](#)):

Note: Recording Rules for USB 3.2 currently do not support more than two independent states. The Advance Sequence option is not currently available for USB 3.2 recording rules.

5.12.7 Actions and Action Properties

For the available Actions and Action Properties, see [“Recording Rules Actions and Action Properties” on page 318](#).

5.12.7.1 Action Properties

For the Action Properties, you can set Internal Triggering and External Triggering.

Recording Rules for USB 3.2 currently do not support more than two independent states. The Advance Sequence option is not currently available for USB 3.2 recording rules.

5.12.8 Events and Event Properties for USB 3.2

Recording rules are associations between events and actions. These associations determine how trace recording occurs. The supported events for USB 3.2 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
 - TS1A
 - TS1B
 - TS1 All
 - 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

- ❑ Timeout
- ❑ 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 (Not applicable to M310P Analyzer Connectors)
 - Term Off (Not applicable to M310P Analyzer Connectors)
 - BCNT
 - CRC32
 - CRC16
 - CRC5LCW
 - CRC5LC

- Framing Error Triggers
 - SLC
 - SDP
 - SHP
 - END
- Low Power States
 - U1
 - U2
 - U3

Note: Data Pattern Matching - For USB 3.2, 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 346](#)).

Note: The Header Pattern tab is different for the USB 3.2 recording rules.

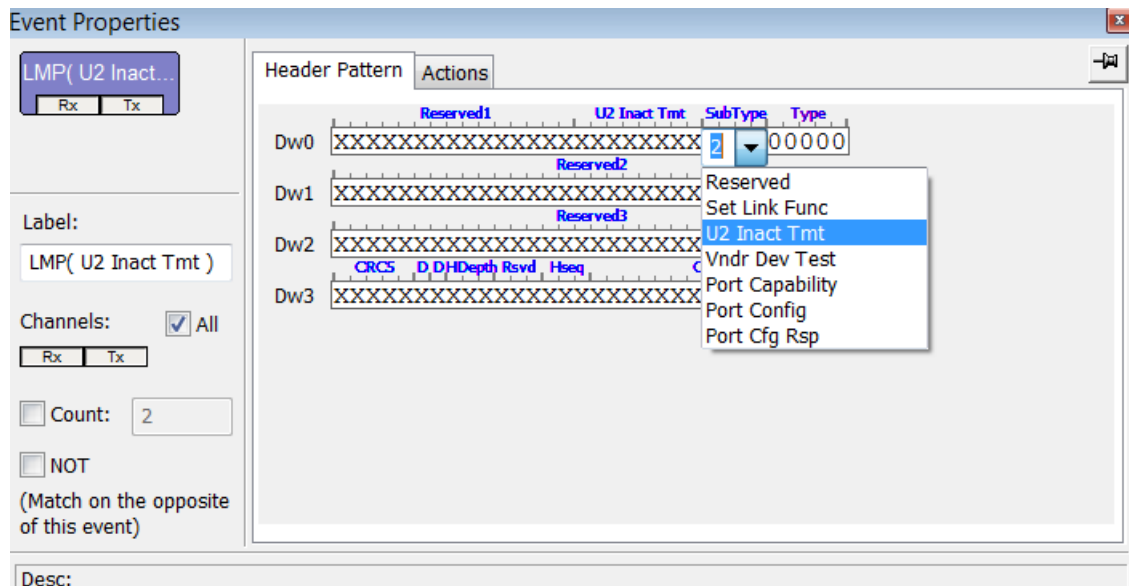


Figure 5.101: Event Properties - Header Pattern Dialog.

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

5.12.9 Counters and Timers for USB 3.2

Timer: A timer counts the time from a starting event to a final event. For example, if you enter **10** in the milliseconds field, the Analyzer counts 10 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 around 75 seconds.

Timeout: The timeout allows you to look for the absence of some event(s) within a time period. The event of interest should be programmed to have an action to reset the timeout. If the timeout occurs before the reset happens, then the Timeout may be used to cause a trigger or to stop recording. The maximum value is around 75 seconds.

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, Timers, and Timeouts

The Analyzer includes one event counter per event. If you try to assign more, you get a warning. There is one Timeout and one Timer allowed per state, and it can be reset along with any other actions. Counters, Timeouts, and Timers are all reset whenever a state transitions.

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.

5.12.10 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.



5.13 Saving Recording Options

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

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

5.14 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.

5.15 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 5.102 on page 373](#)).

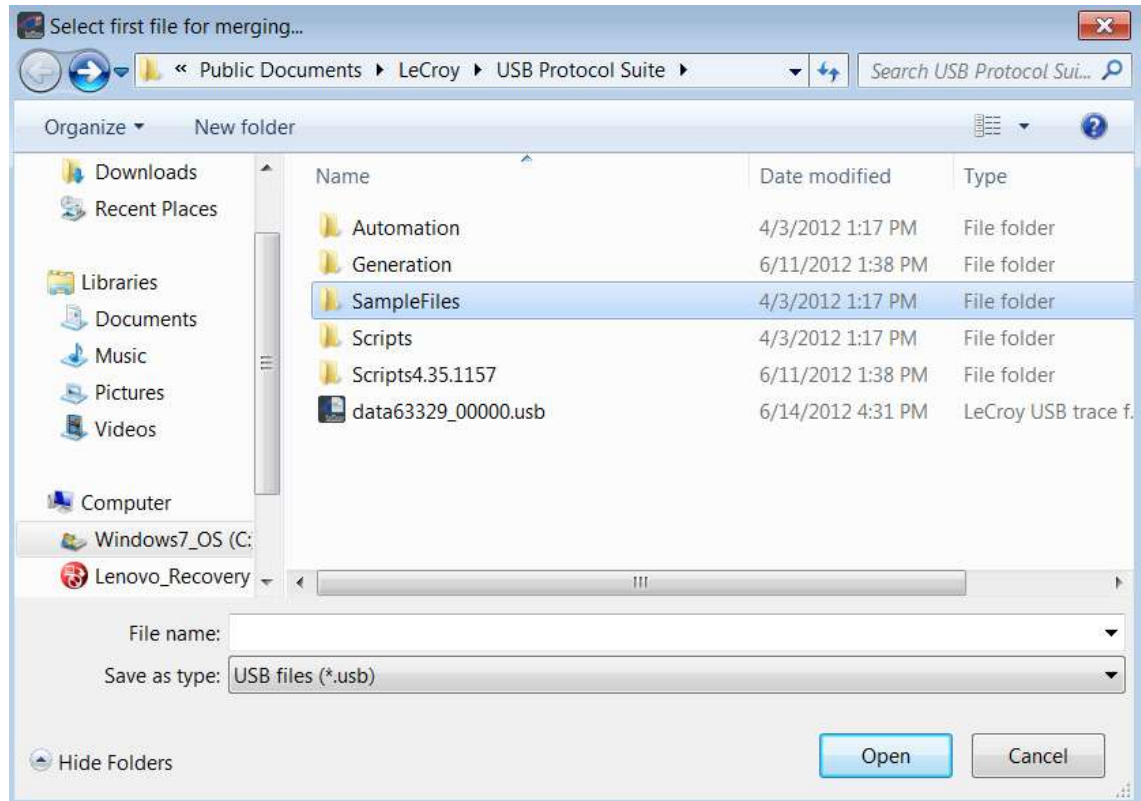


Figure 5.102: Select First File For merging Dialog.

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 5.103 on page 374](#).

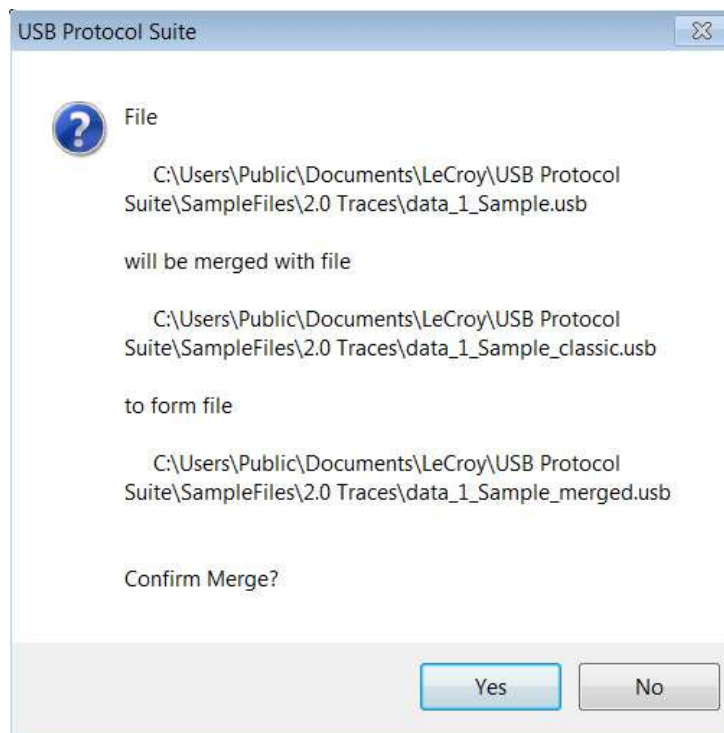


Figure 5.103: Confirm Choice.

4. Click **Yes**.

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

5.16 Recording Option Summary Tab

Click the vertical triple less-than (<) symbols on the right to display the Recording Options Summary tab:

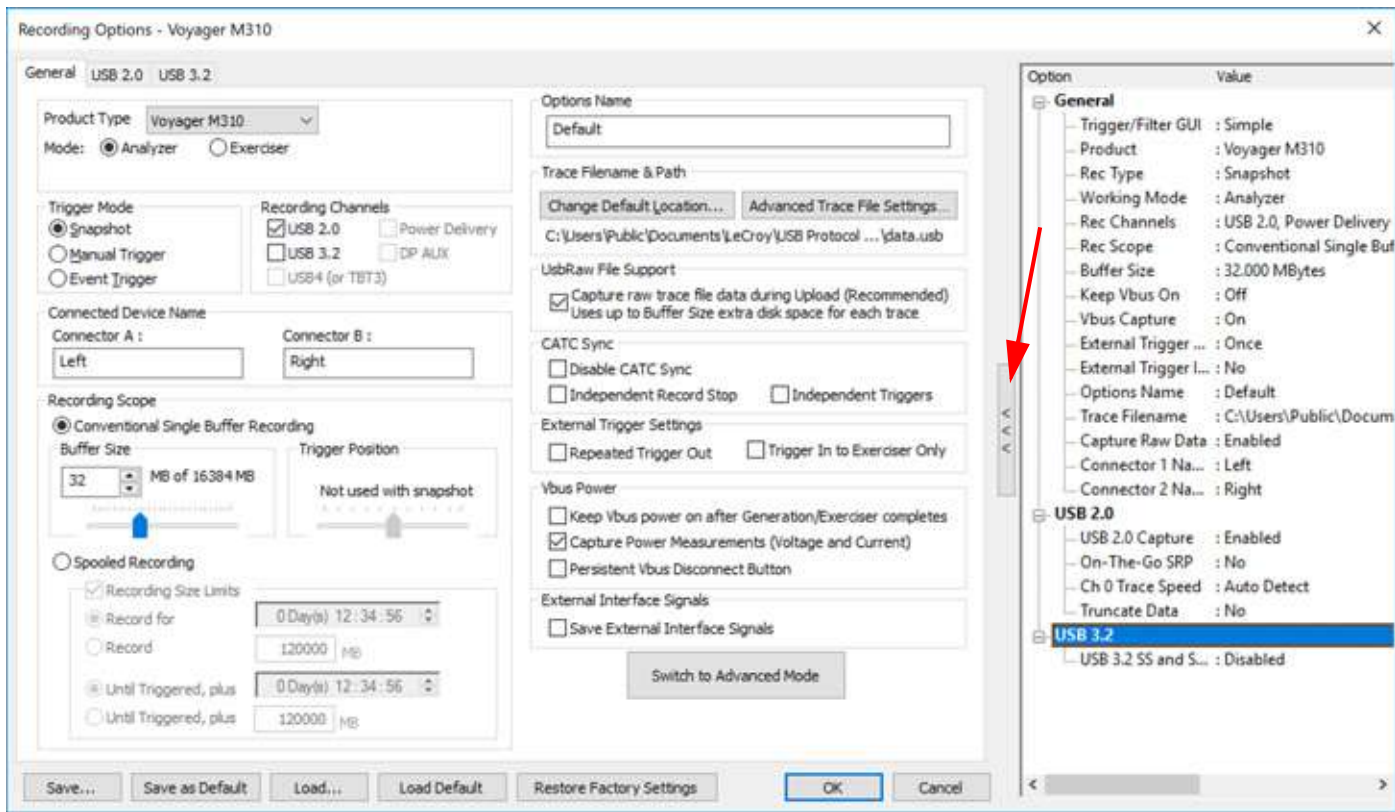


Figure 5.104: Recording Options - Summary Tab.

The Summary tab provides an easy-to-read summary of the currently selected options.

5.17 Yellow LED Connector Indications: Vconn Behavior

5.17.1 M310P / M4x: Yellow LED

If one connector shows a Yellow LED:

The orientation is indeterminate. This may occur when the "Vconn thru" cable (926762-00 or 930705-00) is used, as the analyzer will detect both Rp/Rp or Rd/Rd on the two CC pins.

If both connectors show a Yellow LED, one of the following 3 situations applies:

1. Cables presenting Ra are attached to both connectors.
 - ❑ If both cables contain eMarkers, this is not a valid configuration.
 - ❑ If one cable is an "unmarked Ra" cable, this is a valid scenario. Source Vconn to the side that does contain the eMarker in **Recording Options -> USB Type-C -> Analyzer Vconn Behavior**.
2. A cable presenting Ra is attached to one connector, and the orientation on the other connector is indeterminate (such as with a "Vconn thru" cable). You may allow Vconn to be connected through the analyzer in **Recording Options -> USB Type-C -> Analyzer Vconn Behavior**.
3. The orientation on both connectors is indeterminate. This may occur when two pass-through cables are used, which is not a valid configuration.

5.17.2 M310C, Mercury T2C, Mercury T2P: Yellow LED

If one connector shows a Yellow LED:

The orientation is indeterminate. This may occur when the "Vconn thru" cable (926762-00) is used, as the analyzer will detect both Rp/Rp or Rd/Rd on the two CC pins.

If both connectors show a Yellow LED, one of the following 3 situations applies:

1. Cables presenting Ra are attached to both connectors.
 - ❑ If both cables contain eMarkers, this is not a valid configuration.
 - ❑ If one cable is an "unmarked Ra" cable, this is a valid scenario. Source Vconn to the side that does contain the eMarker in **Recording Options -> USB Type-C -> Analyzer Vconn Behavior**.
2. A cable presenting Ra is attached to one connector, and the orientation on the other connector is indeterminate (such as with a "Vconn thru" cable). Using a "Vconn thru" cable for an Analyzer capture is invalid.
3. The orientation on both connectors is indeterminate. This may occur when two pass-through cables are used, which is not a valid configuration.

Chapter 6

Reading a Trace

6.1 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.

Packet	Host : A	?	Reset	Time	Time Stamp
0	laptop		2.100 ms	2.164 ms	2 . 553 991 466
Packet	Host : A	?	VBus Voltage		Time Stamp
1	laptop		Rising above 4.40 Volts		2 . 556 155 182
Packet	Host : A	H ↓	Suspend	Time Stamp	
2	laptop		202.801 ms	2 . 559 091 466	

- ❑ 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.)

SOF	Frame #	CRC5	Pkt Len	Idle	Time Stamp
0xA5	1156.?	0x1C	12	124.767 μ s	00000.4056 3910
SOF	Frame #	CRC5	Pkt Len	Idle	Time Stamp
0xA5	1156.?	0x1C	14	124.767 μ s	00000.4057 3908

↑
Microframes

6.1.1 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 6.26](#) through [Figure 6.3](#).

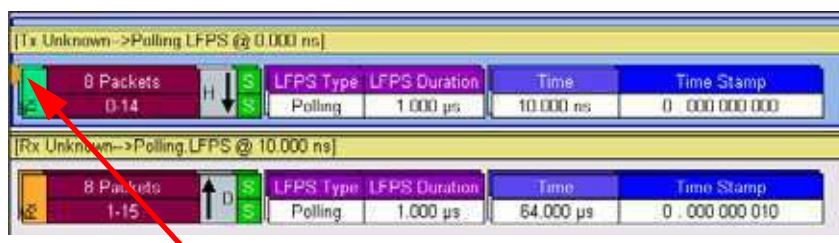


Figure 6.1: Anchor Point in the CATC Trace View

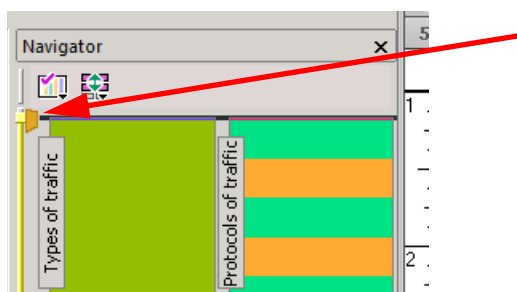


Figure 6.2: Anchor Point in the Navigator Panel

Time Stamp	Item	Pkt Dir	Addr/Enap/Dir	Type	Subtype	Data	Error	Miscellaneous
0.000 000 000	8 Pkts 0-14	H		LFPS				LFPS Duration: 1.000 μ s
0.000 000 010	8 Pkts 1-15	H		LFPS				LFPS Duration: 1.000 μ s
0.000 064 010	Pkt 16	H		TS00				TS00 Count: 55536
0.000 064 020	Pkt 17	H		TS00				TS00 Count: 55536
0.000 258 314	Pkt 18	H		TS1				TS1 Repeat Count: 8
0.000 258 324	Pkt 19	H		TS1				TS1 Repeat Count: 8
0.000 258 330	2 Pkts 20...	H		TS2				TS2 Repeat Count: 16

Figure 6.3: 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).

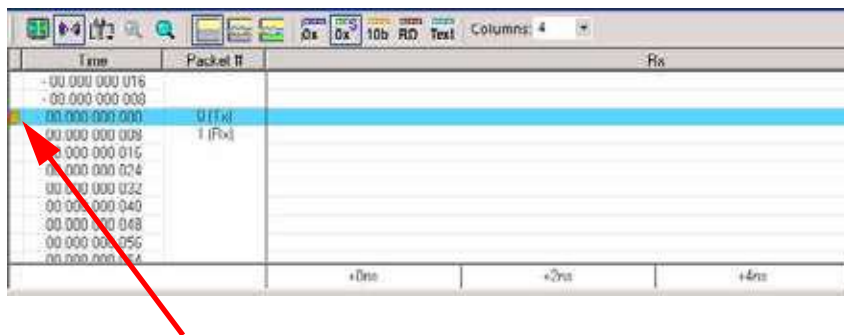


Figure 6.4: Anchor Point in the Link Tracker View

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.

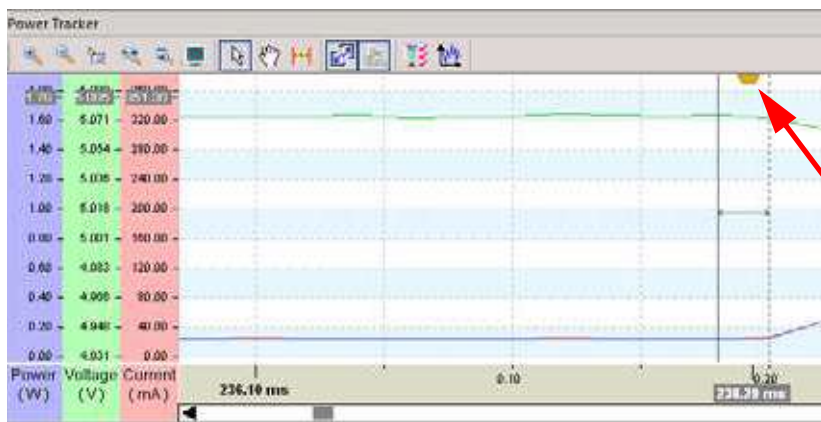


Figure 6.5: Anchor Point in the Power Tracker View

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.

6.1.2 USB 3.2 Packets

USB 3.2 has the following packet types:

- ☐ Link Training Sequences
 - TSeq
 - TS1
 - TS1A
 - TS1B
 - TS2
- ☐ LFPS Packets
- ☐ Electrical Idles
- ☐ Link Commands
- ☐ SKP
- ☐ Header Packets
- ☐ Payload Packets
- ☐ Data packets
- ☐ Logical Idle Packets
- ☐ BRST
- ☐ BERC
- ☐ BCNT
- ☐ Termination Packets (Time stamped when termination is detected by Analyzer)
- ☐ CP
- ☐ VBus Change (On/Off)
- ☐ SYNC
- ☐ SDS

Note: Term On and Term Off are not applicable to M310P Analyzer Connectors.

In addition, there are two packet types provided which show symbol traffic which cannot be assembled into a known USB 3.2 packet types:

- ☐ IPS (Inter-Packet Symbols) - These can occur when the link is in U0 but there are symbols seen which do not form a packet. This can be caused by a bad USB cable or some other signal integrity issue. Since these cannot be decoded, this is considered to be an "Error".
- ☐ USS (Unidentified Symbol Sequence) - These often occur during the transition into and out of U0. Since they are found during this transition period and normally do not interfere with the link coming up or going down, they are classified as a "Warning". They can generally be ignored.

6.1.3 USB4 Packets - Assigning Protocols using HopID

Since USB4 Packets can contain tunneled protocols, this mapping of HopID to Protocol type can be done manually by doing the following:

1. Find a tunneled packet you wish to map to a protocol (see [Figure 6.6](#)).

Packet	Left	Right	Length	HopID	SuppID	PCID	Unknown	Data	Duration	Time Stamp
43499	TCL	G2 x1	5 bytes	16	0	0x2	Unknown	5 bytes	9.640 ns	2.681226620

Figure 6.6: Tunneling Packet

2. Right click on the HopID Field of the Tunneled Packet. Choose one of the Protocol types from the drop-down list. See [Figure 6.7](#).

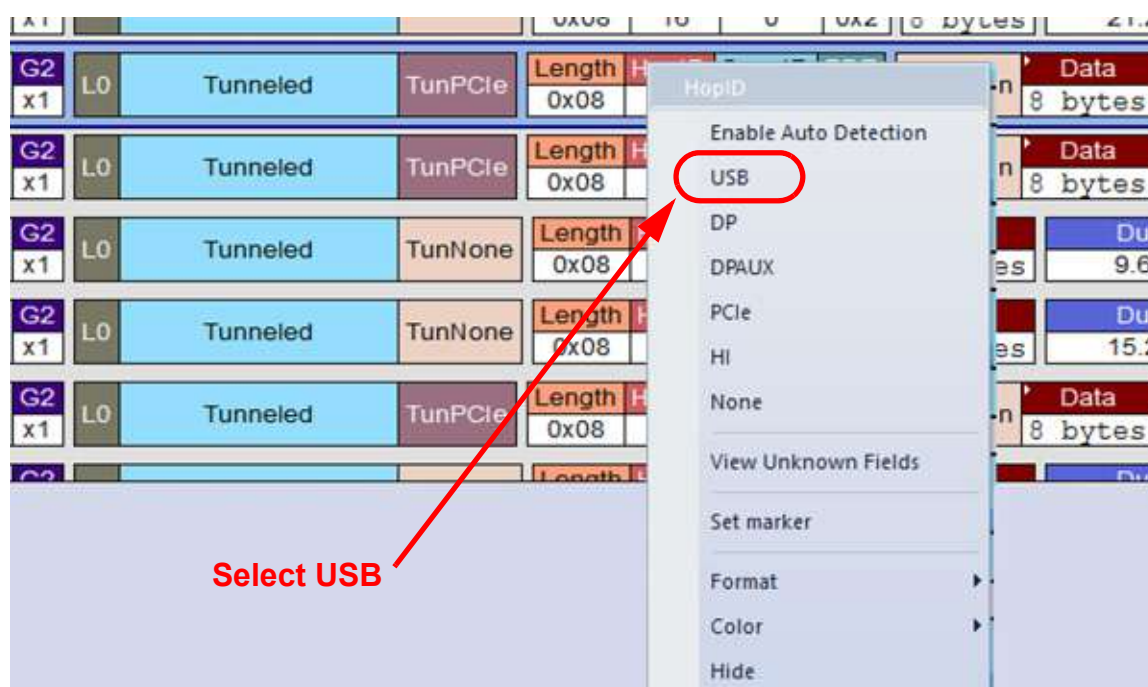


Figure 6.7: Selecting HopID

3. That HopID will now use the decoder type selected wherever that Hop ID occurs in the same direction. See [Figure 6.8](#)

Packet	Left	Right	Length	HopID	SuppID	PCID	Link Command	Link	Duration	Time Stamp
43499	TCL	G2 x1	5 bytes	USB	0	0x2	Link Command	0x36 0x4B 0x4B 0x4B 0x2D 0x80 0x2D 0x80	9.640 ns	2.681226620

Figure 6.8: Selected USB HopID

4. Do the same for the other direction, since the HopID values are qualified by the direction.

Hiding/Showing HopID Packets



You can selectively Show or Hide HopIDs with the following toolbar icon . See [Figure 6.9](#).



Figure 6.9: Toolbar Showing HopID Icon

You can see the effect of clicking on the HopID Hiding icon in the following two figures.

The first figure has several instances of upstream (US) HopID of 8. from Packet 196485 to Packet 196496. See [Figure 6.10](#)

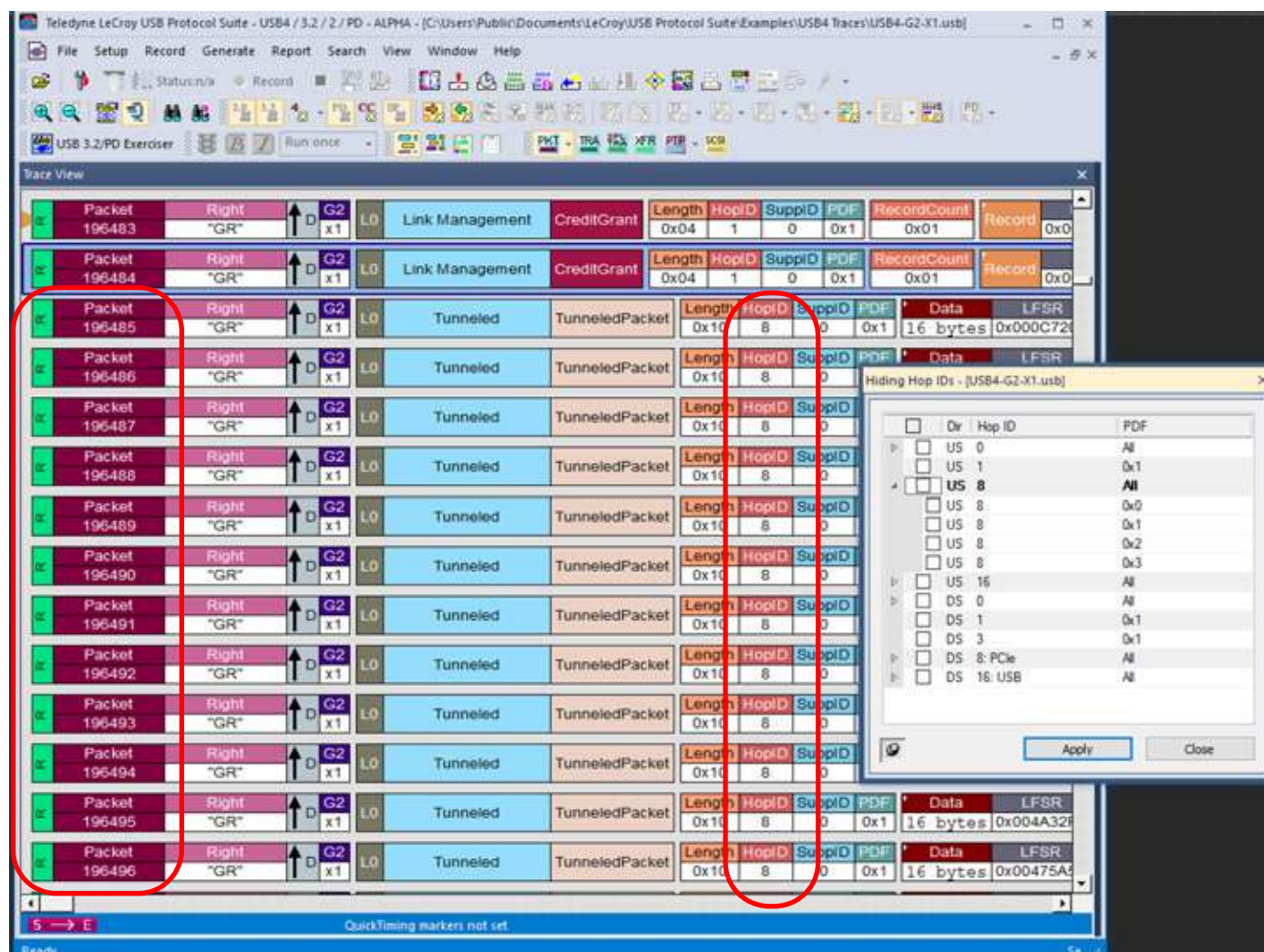


Figure 6.10: Toolbar Showing Upstream HopID = 8

If you want to hide those HopID Packets, simply select them in the drop down box and click apply. The Packets from 196485 through 196498 are hidden. See [Figure 6.11](#).

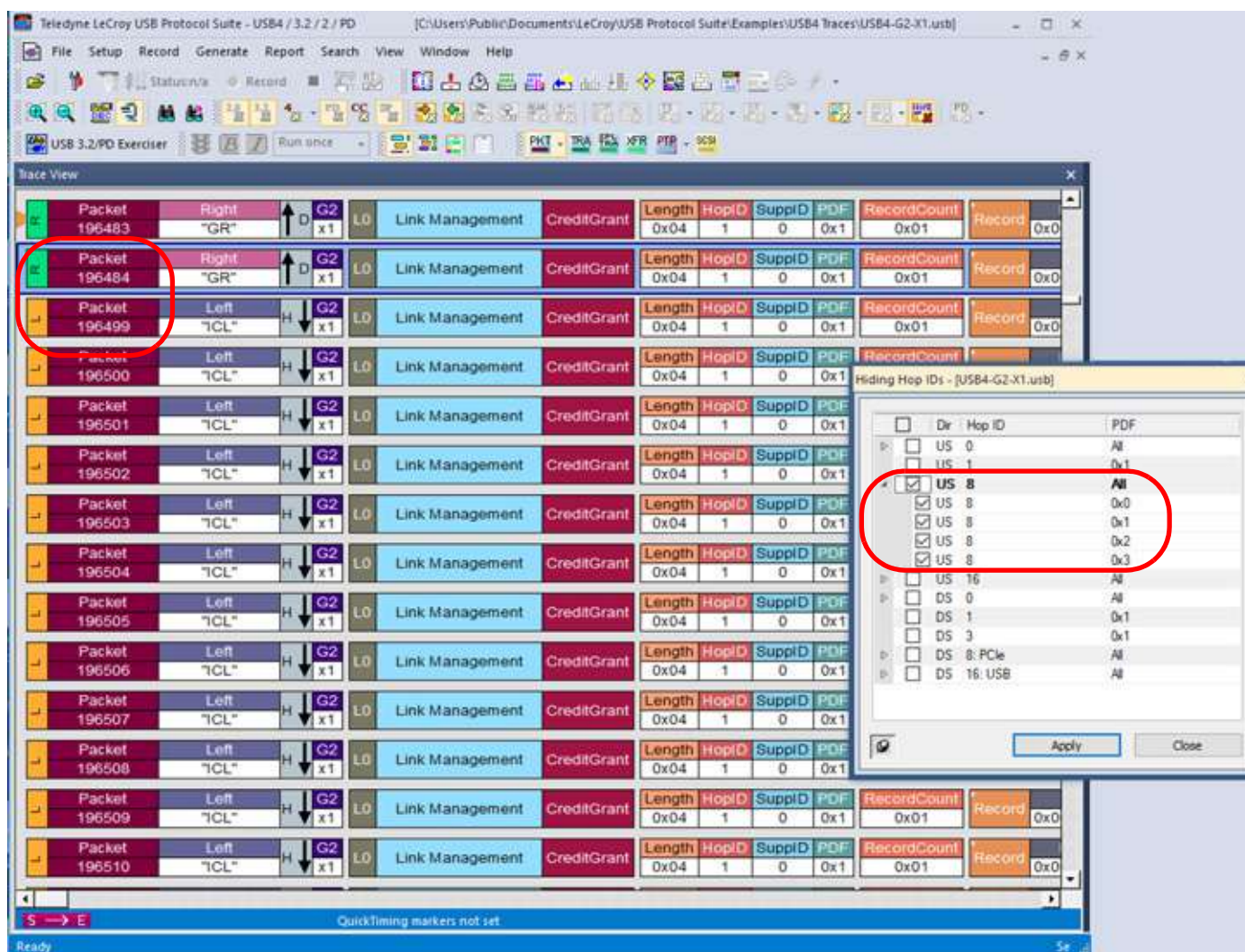


Figure 6.11: Packets defined as Upstream with HopID = 8 are Hidden

6.1.4 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.

6.1.5 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 6.12:](#) .

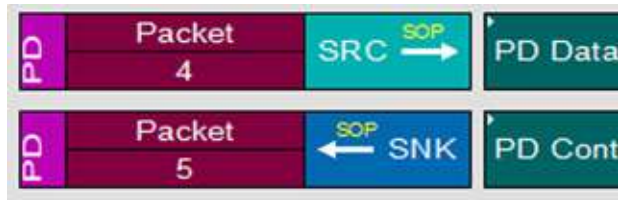


Figure 6.12: Power Delivery Packet Direction

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

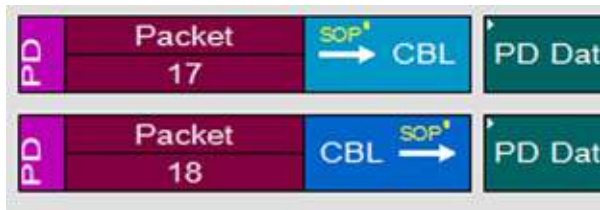


Figure 6.13: Cable Packet Power Delivery

6.2 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.

6.2.1 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.

6.2.2 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 6.14 on page 385](#)).

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

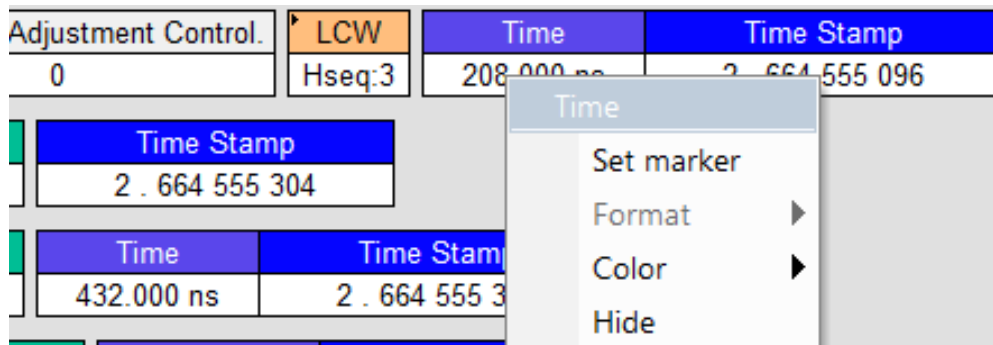


Figure 6.14: Time Dialog

The Create Marker dialog displays.

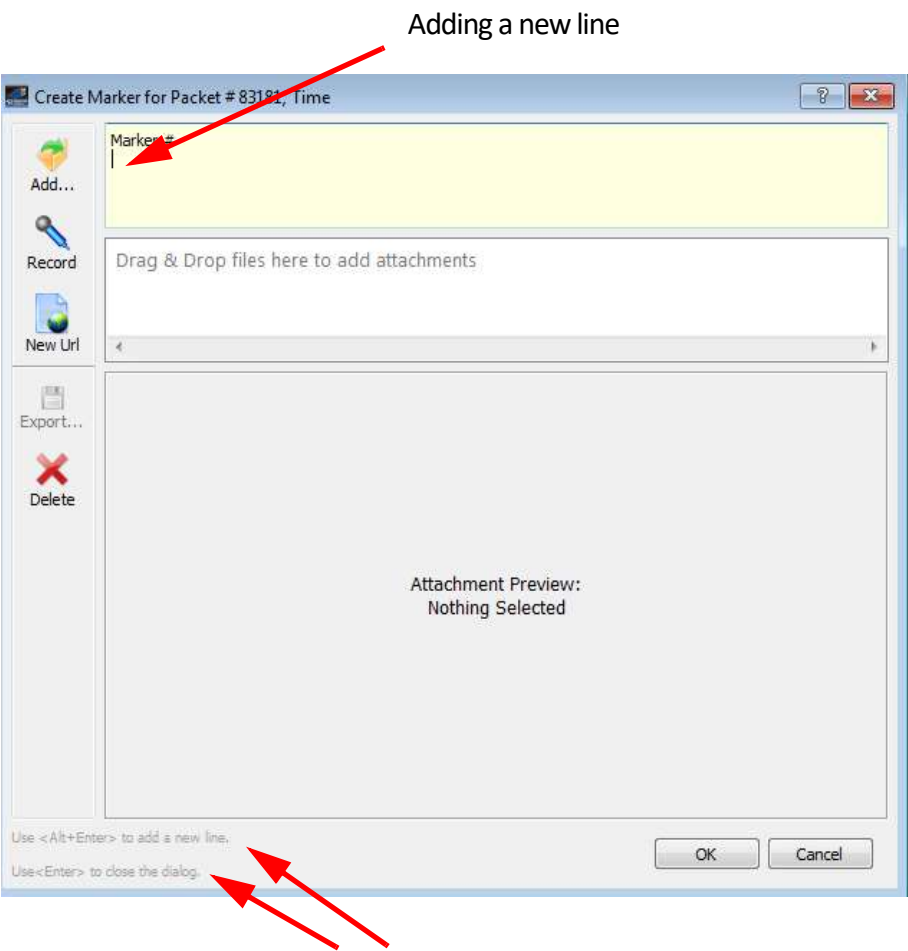


Figure 6.15: Create Marker for Packet Dialog

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 387.		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 388.		Delete icon. Click on this icon to delete an attachment
	New URL icon. Click on this icon to add any URL.		

6.2.3 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.

6.2.4 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 6.16 on page 387](#)). 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.

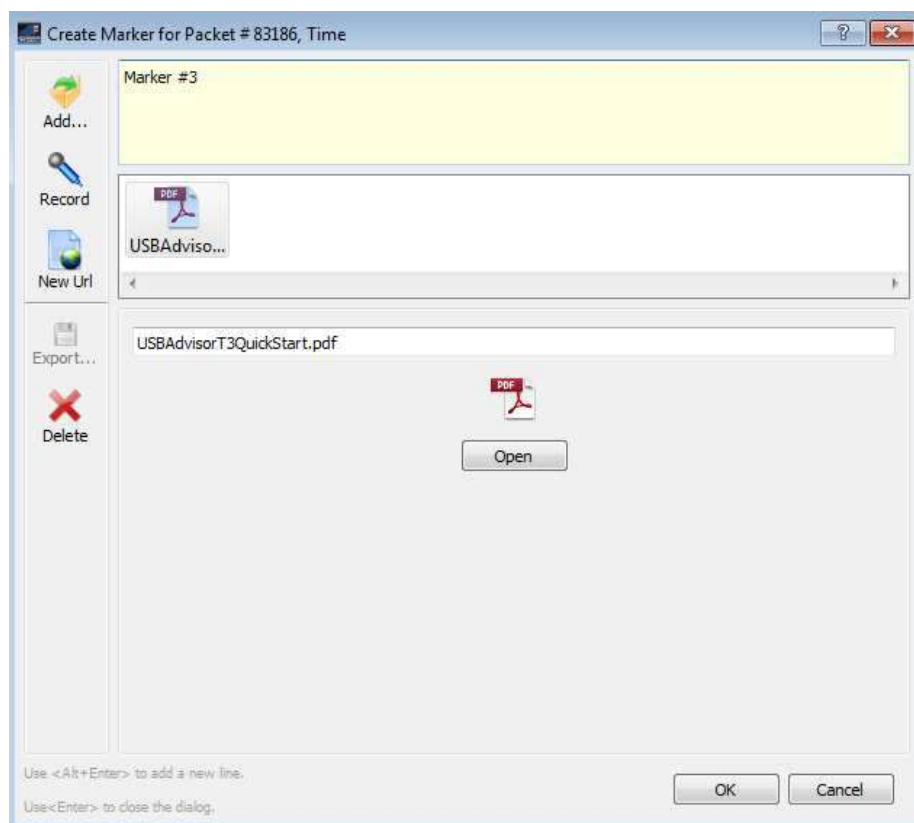


Figure 6.16: Create Marker for Transfer Dialog

6.2.5 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.

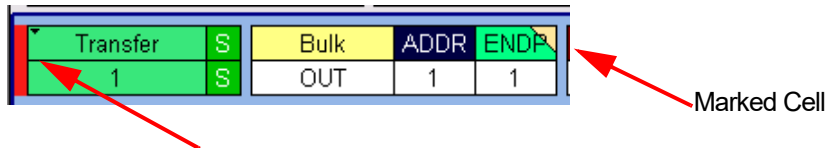
Note: This functionality is disabled if a microphone is not installed.

6.2.6 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.

6.2.7 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.

6.2.8 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.

6.2.9 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 389](#), a window pops up displaying the contents of the marked cell (see [Figure 6.17 on page 390](#)).

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.

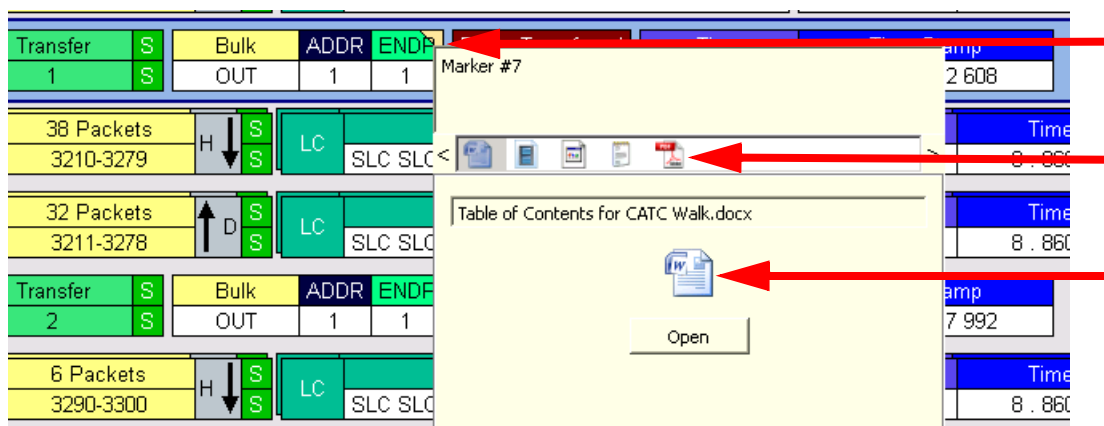


Figure 6.17: Pop-up Displaying Marker Contents

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.

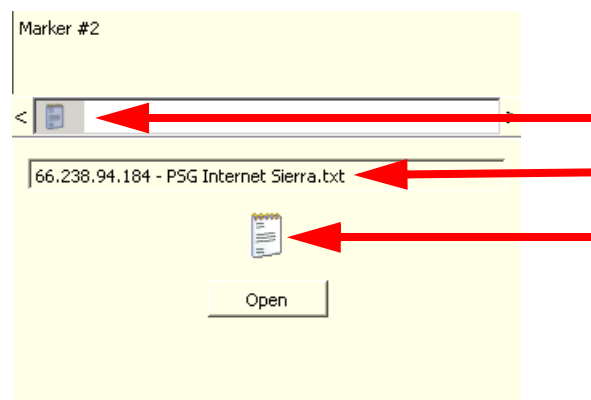


Figure 6.18: Text Attachment Pop-up Window

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

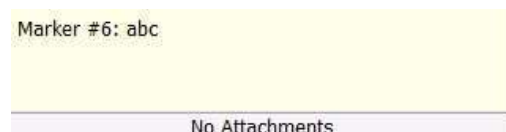


Figure 6.19: No Attachments Pop-up Window

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.

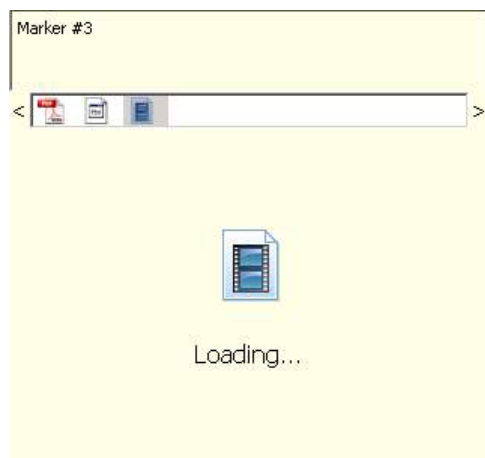
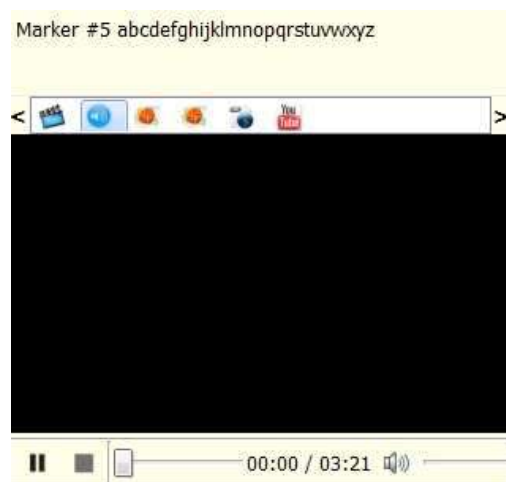


Figure 6.20: Preview Attachments Pop-up Window

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.



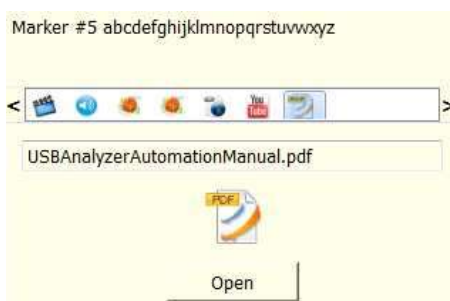
Images

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.



6.2.10 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.

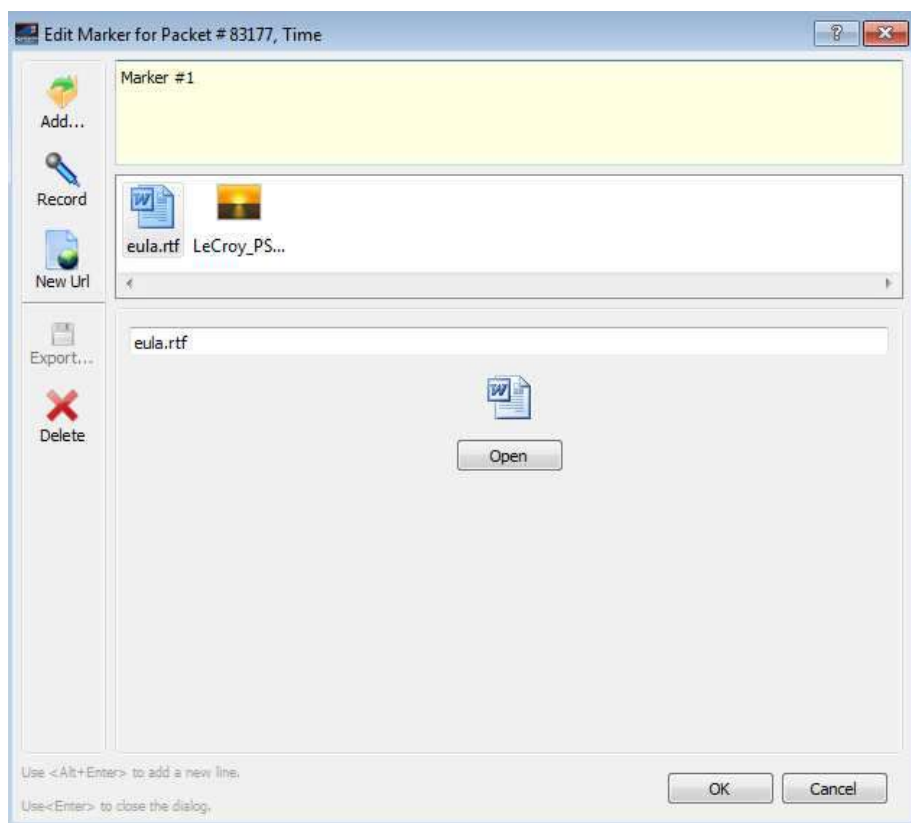


Figure 6.21: EDIT Marker for Packet Dialog

6.2.11 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 (see [Figure 6.22](#)).

- ☐ All Markers are displayed
- ☐ You can Search For/Filter the type of Markers you are looking for
- ☐ 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

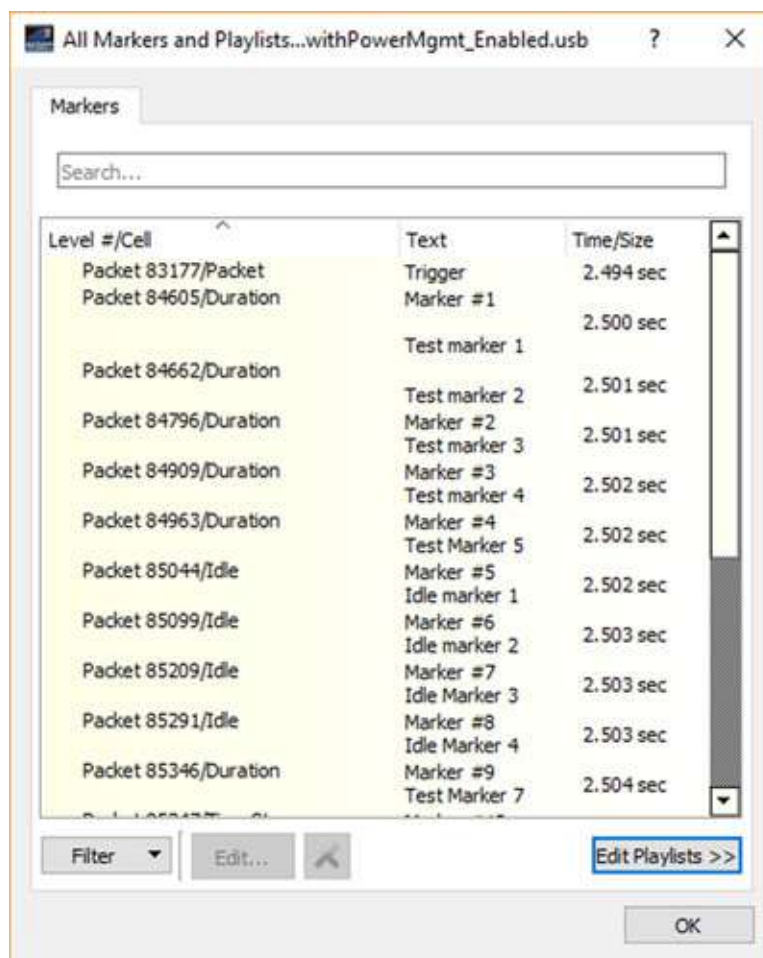


Figure 6.22: Search/Filter/Edit Marker Dialog

Search Markers

You can search for a specific set of markers by simply entering the type of marker you're looking for into the "Search" window at the top of the dialog. Then you'll see only the markers with that characteristic. See [Figure 6.23](#).

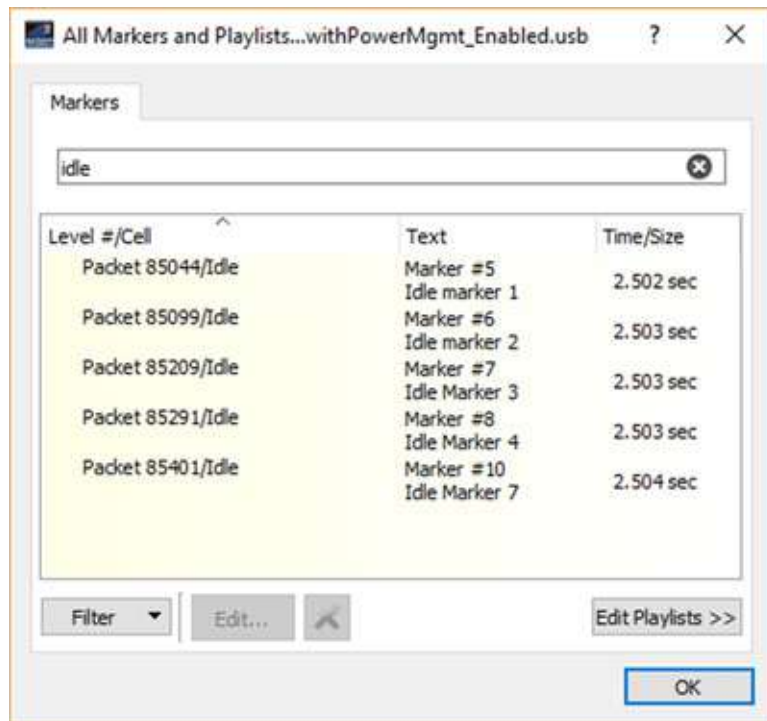


Figure 6.23: Search on Idle Marker

Delete Markers

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 6.24 on page 396](#)).

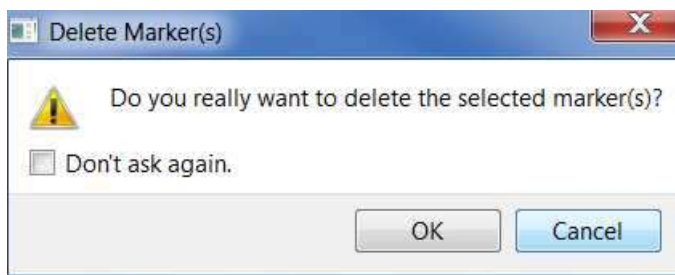


Figure 6.24: Confirmation Dialog

Filter Markers

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



Figure 6.25: Filter Dialog

6.3 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 6.26 on page 397](#)).

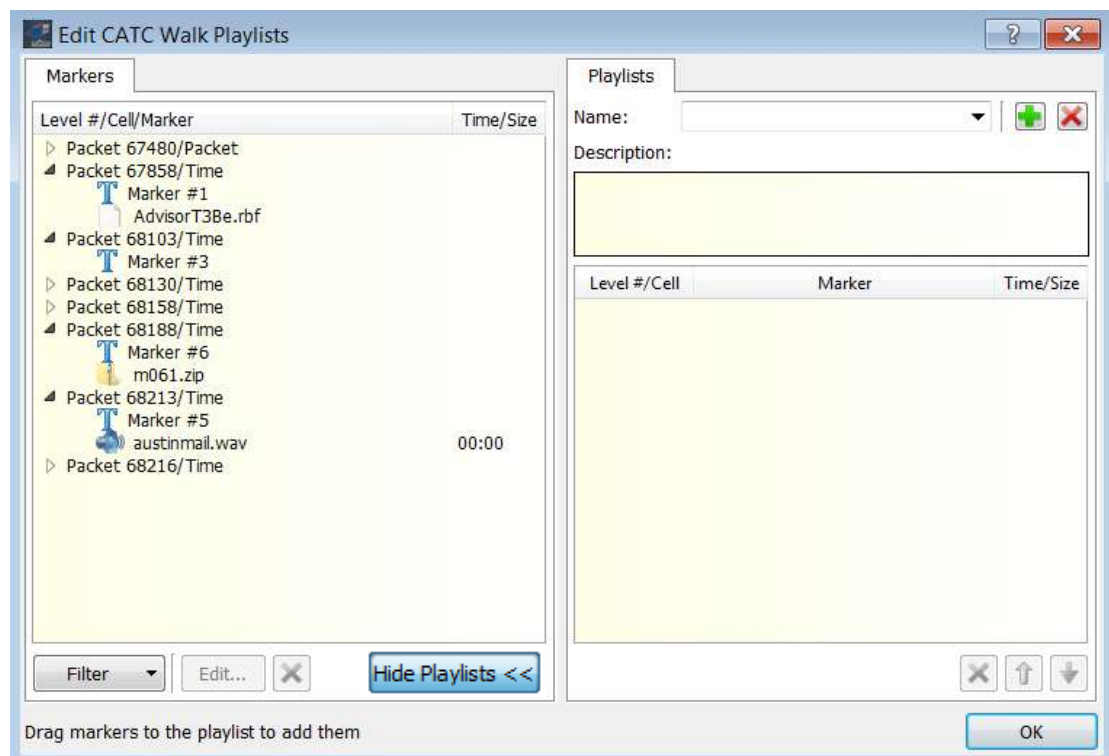


Figure 6.26: Edit CATC Walk Playlists Dialog

6.3.1 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 6.27 on page 398](#)).

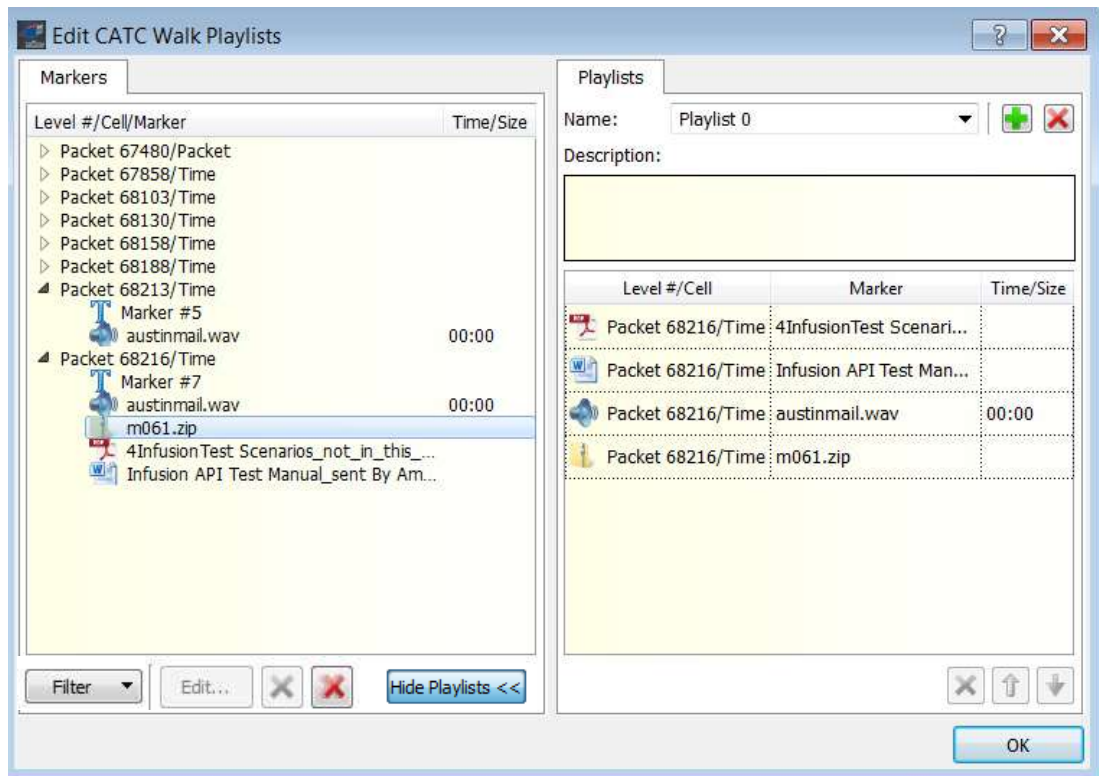


Figure 6.27: Edit CATC Walk Playlists Dialog

You can drag and drop an 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

6.3.2 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.

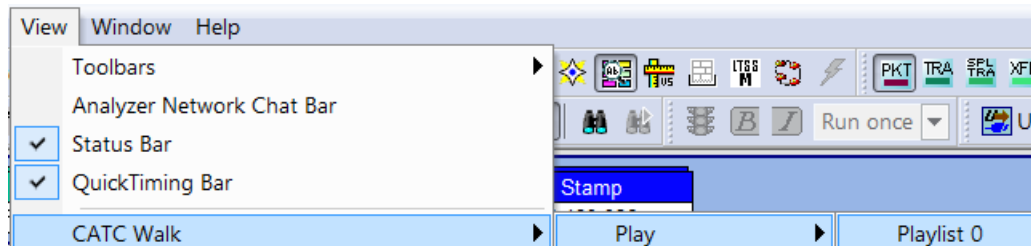


Figure 6.28: View Dialog

The attachment item starts to play in the playback window (see [Figure 6.29 on page 399](#)).



Figure 6.29: 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 6.30 on page 400](#)).

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 colored.



Figure 6.30: Playlist Playback View

6.4 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 514](#). This only effects where the timestamp is shown in the CATC View, it does not change the point in time in the packet that the timestamp represents

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

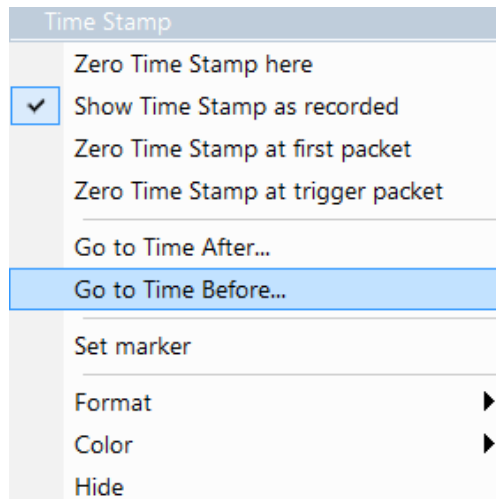


Figure 6.31: Time Stamp Dialog

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.

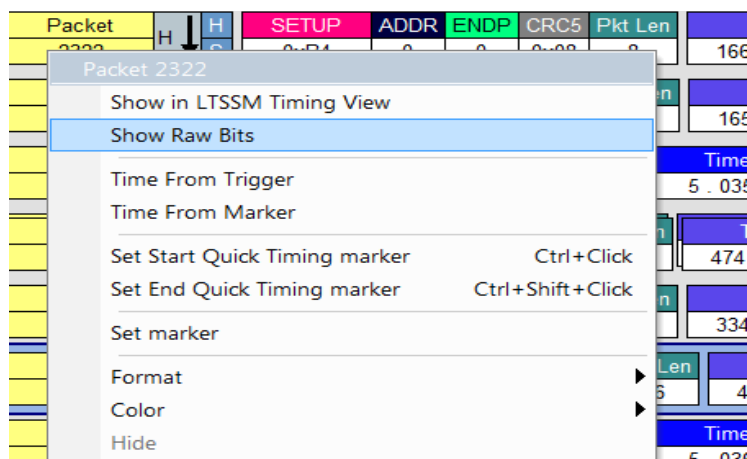
You can also create a new marker by selecting **Set marker**.

6.5 View Raw Bits (2.0)

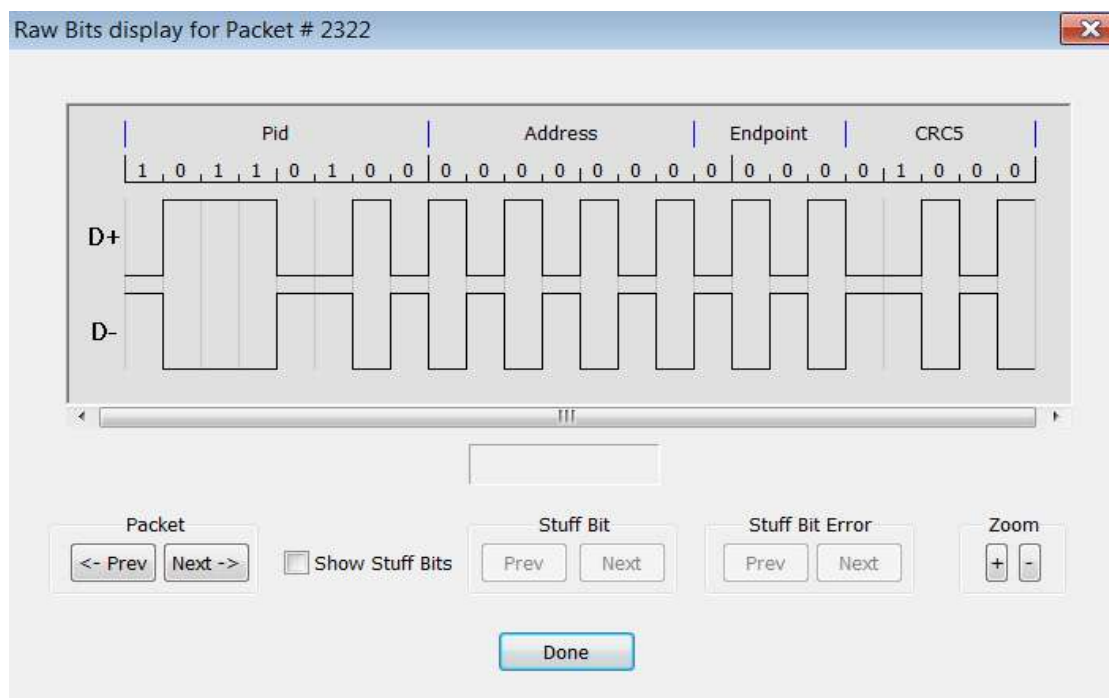
You can expand a specific packet to view the raw bits in detail.

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.

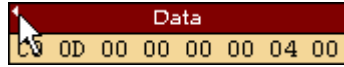
6.6 Expanding and Collapsing Data Fields

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.

6.6.1 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.



6.6.2 Double-Clicking to Expand/Collapse Data Fields

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

6.6.3 Expanding or Collapsing All Data Fields

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

6.6.4 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:

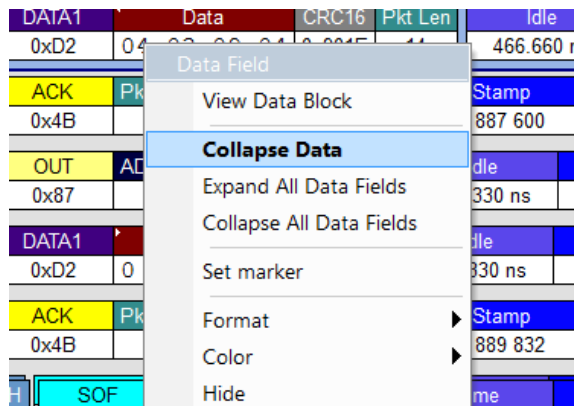


Figure 6.32: Data Field menu

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

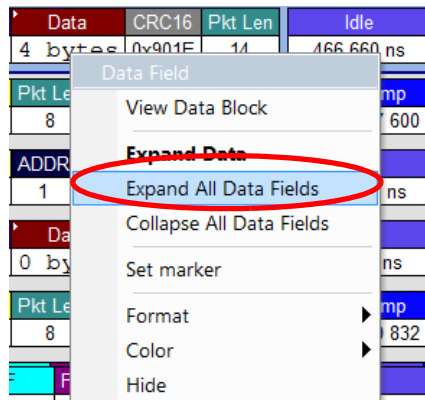


Figure 6.33: Data Field menu

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

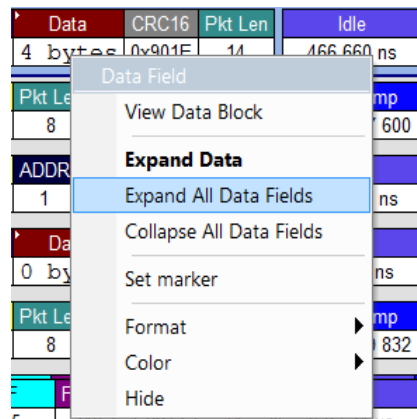
The Trace View repositions, with the selected packet(s) in the format that you specified.

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.

6.7 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 516](#)).

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 516](#)).

6.7.1 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 402).

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.

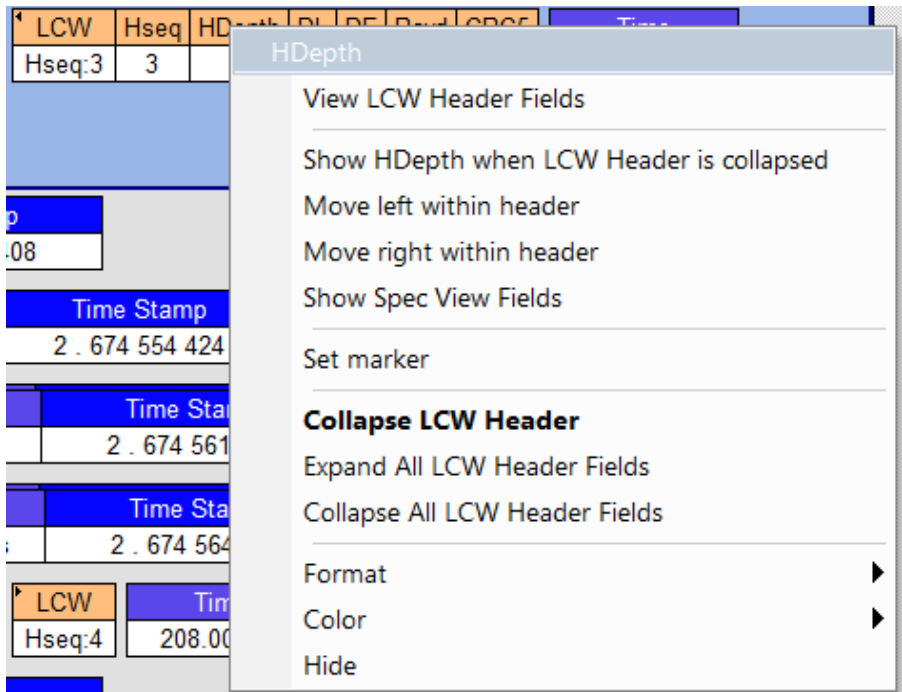


Figure 6.34: Hide/Show Field

6.8 View Data Block

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

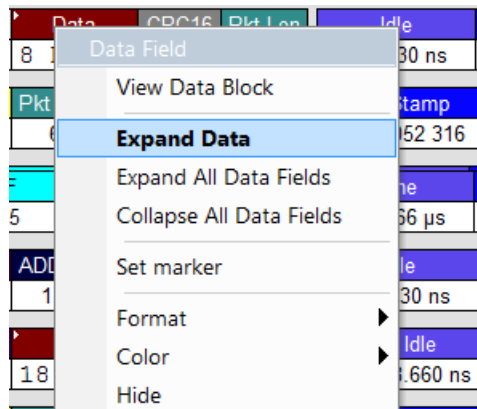


Figure 6.35: View Data Block Pop-up Menu

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 6.36 on page 406](#)).

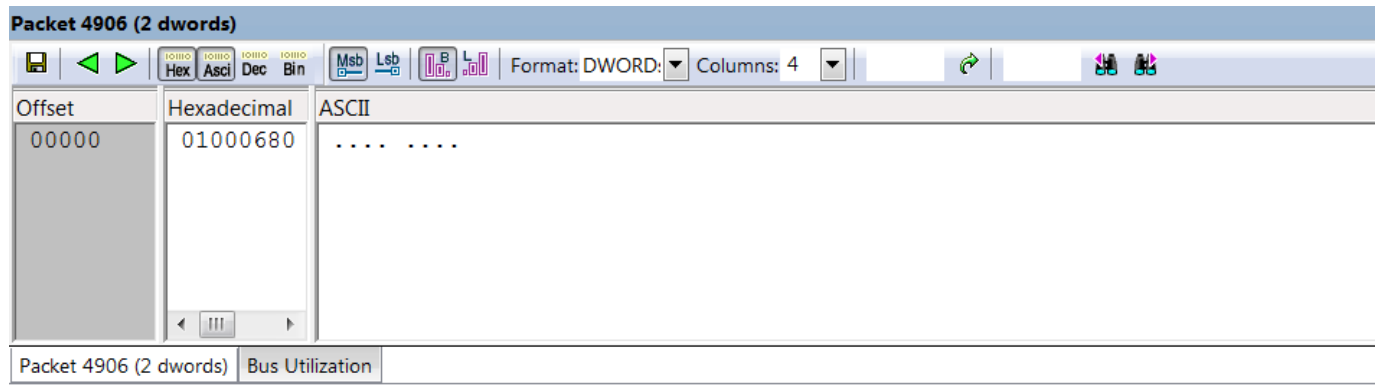


Figure 6.36: Data Block Dialog

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

6.9 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.

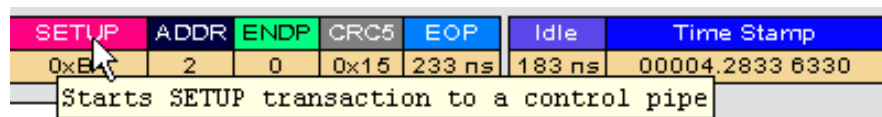


Figure 6.37: Pop-up Tool-tips

6.10 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 6.39 on page 407](#)).

- ❑ 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 3.2, 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 6.40 on page 408](#) and [Figure 6.41 on page 408](#).

Packet	Direction	LC	Fields	Time	Time Stamp
83189	D	LC	SLC SLC SLC EPF D26.5 D00.7 D03.6 D05.5	184.000 ns	2 . 493 873 376
83190	H	LC	SLC SLC SLC EPF D09.6 D05.6 D06.0 D01.2	9.888 us	2 . 493 873 560
83191	D	LC	SLC SLC SLC EPF D26.1 D29.2 D07.6 D01.7	144.000 ns	2 . 493 883 448
83192	H	LC	SLC SLC SLC EPF D09.3 D02.5 D21.0 D07.7	9.912 us	2 . 493 883 592
83193	D	LC	SLC SLC SLC EPF D26.7 D29.7 D04.7 D09.3	120.000 ns	2 . 493 883 594

Figure 6.38: Un-stacked View

Item	Direction	LC	Fields	Time	Time Stamp
7 Packets (83190-83201)	H	LC	SLC SLC SLC EPF D09.6 D05.6 D06.0 D01.2	64.344 us	2 . 493 873 560
Packet 83203	H	ITP	Bus Interval Counter: 10921, Time Delta: 6, Bus Interval Adjustment Control: 0	256.000 ns	2 . 493 937 904
Packet 83204	D	LC	SLC SLC SLC EPF D25.0 D17.4 D03.3 D12.5	16.000 ns	2 . 493 938 160
Packet 83205	D	LC	SLC SLC SLC EPF D17.6 D24.0 D28.6 D08.6	5.552 us	2 . 493 938 192
12 Packets (83206-83228)	H	LC	SLC SLC SLC EPF D18.3 D31.0 D20.4 D27.3	4.504 us	2 . 493 943 744
12 Packets (83207-83229)	D	LC	SLC SLC SLC EPF D14.3 D06.1 D22.4 D09.1	114.648 us	2 . 493 948 248
Packet 83230	H	ITP	Bus Interval Counter: 10922, Time Delta: 6, Bus Interval Adjustment Control: 0	256.000 ns	2 . 494 062 896
Packet 83231	D	LC	SLC SLC SLC EPF D17.6 D03.2 D08.0 D08.6	16.000 ns	2 . 494 063 152

Figure 6.39: Stacked View

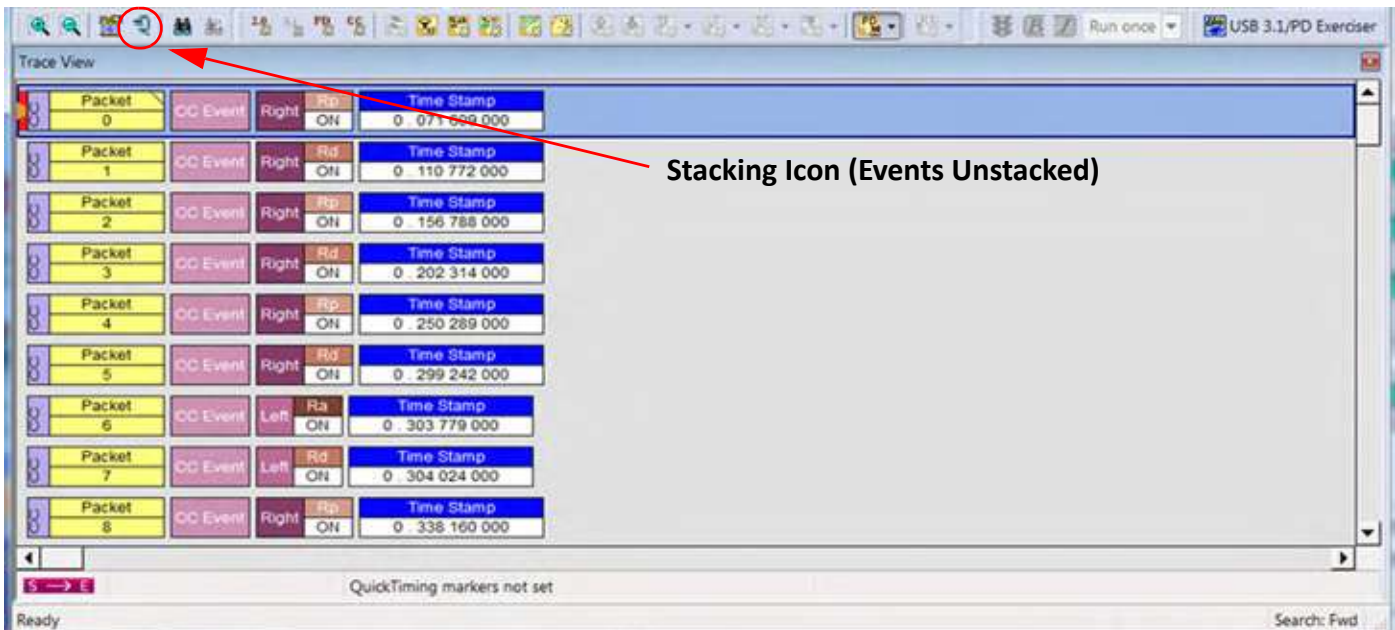


Figure 6.40: Unstacked CC Events

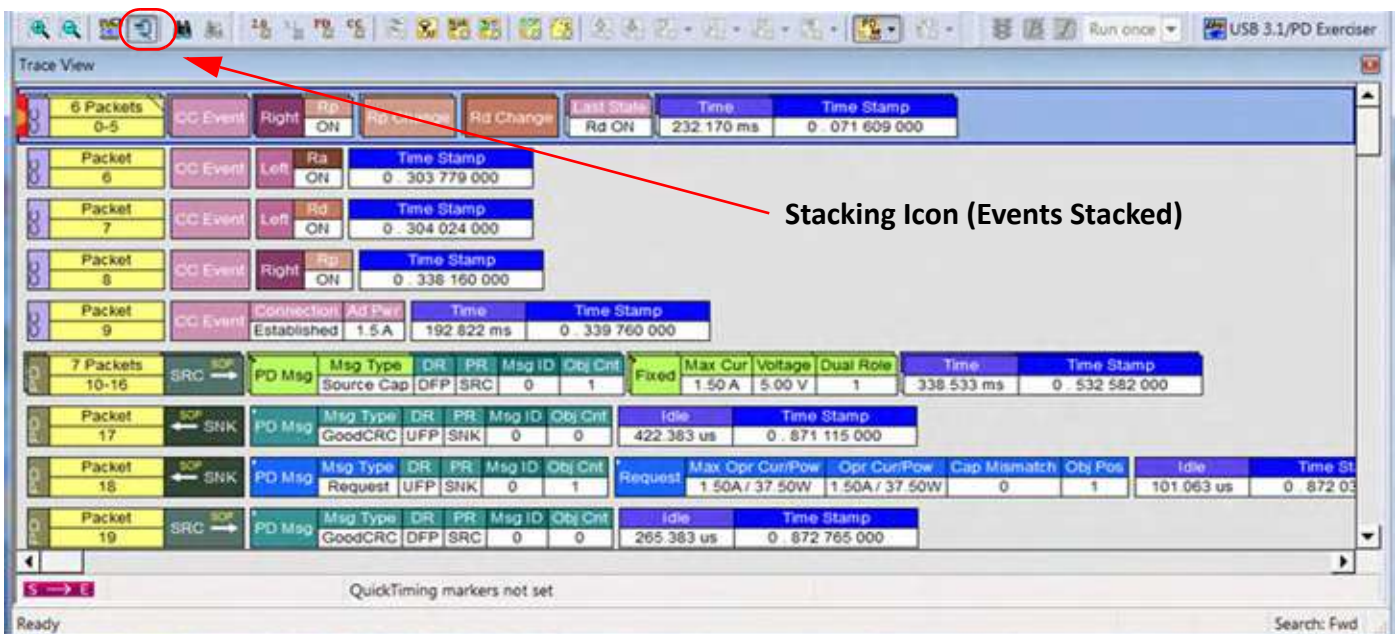


Figure 6.41: Stacked CC Events

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 3.2 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.

6.11 Hide Traffic Toolbar

The Hide toolbar allows you to selectively hide data traffic that you're not interested in. See [Figure 6.42](#). The highlighted buttons indicate the loaded trace contains that type of data traffic.



Figure 6.42: Hide Traffic Toolbar

6.11.1 Hide All USB 2.0 Traffic

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

6.11.2 Hide All USB 3.2 Traffic

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

6.11.3 Hide All

Click the  button to hide all USB4 traffic. Hit the carat on the right side if you want to individually hide the Rx/Tx traffic or the Sideband Traffic.

6.11.4 Hide All Power Delivery Traffic

Click the  button to hide all Power Delivery Traffic.

6.11.5 Hide Configuration Channel Traffic

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

6.11.6 Hide All DisplayPort Traffic

Click on the  button to hide all Display Port Traffic.

6.11.7 Hide Traffic from Left DUT / DUT (Exerciser)

Click on the  button to hide Traffic from Left DUT / DUT (Exerciser).

There are four types of traffic you can hide:

- ☐ L0
- ☐ L1
- ☐ LB
- ☐ PD/USB4 SB



Figure 6.43: Types of Traffic that can be Hidden from Left DUT / DUT (Exerciser)

6.11.8 Hide Traffic from Right DUT / Voyager (Exerciser)

Click on the  button to Hide Traffic from Right DUT / Voyager (Exerciser).

There are four types of traffic you can hide:

- ☐ L0
- ☐ L1
- ☐ LB
- ☐ PD/USB4 SB

See [Figure 6.44 on page 411](#).



Figure 6.44: Types of Traffic that can be Hidden from Right DUT / Voyager (Exerciser)

6.11.9 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.

6.11.10 Hide All Packets Except Transfers Packets.

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

6.11.11 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 3.2 NRDY transactions, if they are virtual equivalents of a 2.0 NAK situation.

6.11.12 Hide Non Data Transactions

Click on the  to hide all Non Data Transactions.

6.11.13 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.

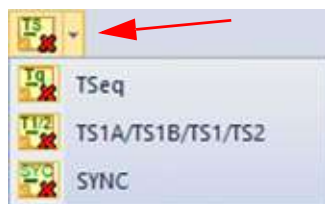
Note: This also hides low-speed EOPs.

6.11.14 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.

6.11.15 Hide Link Training Sequences (3.2)

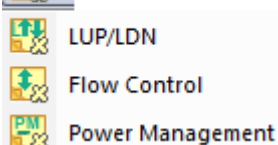
Click the  button to Hide Link Training Sequences and select from the



options to show/hide TSeq TS1A/TS1B/TS1/TS2. For 3.2 SS+ traces, you can hide the SYNC packets.

6.11.16 Hide Link Commands (Flow Control) (3.2)

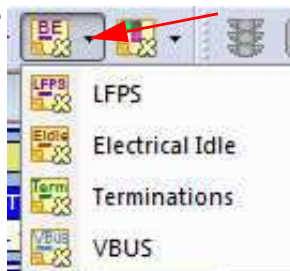
Click the  button and select from the options to show/hide Link



Commands (LUP/LDN, Flow Control or Power Management).

6.11.17 Hide Bus Events (3.2)

Click the  button and select from the options to show/hide Bus Events



(LFPS, Electrical Idle, Termination or VBus On/Off).

6.11.18 Hide Miscellaneous Packets (3.2)

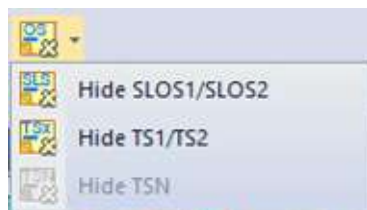
Click the  button and select from the options to show/hide:



- ☐ LMP
- ☐ ISO Time Stamp
- ☐ IPS-Inter-Packet Symbols (Unrecognizable Symbols while in U0)
- ☐ USS (Unrecognizable Symbol Stream while NOT in U0)
- ☐ Skip Sequences
- ☐ Logical Idle
- ☐ Loopback (BCNT, BRST, BERC)
- ☐ Compliance Pattern
- ☐ SDS - Start Data Stream

6.11.19 Hide USB4 HS Ordered Sets

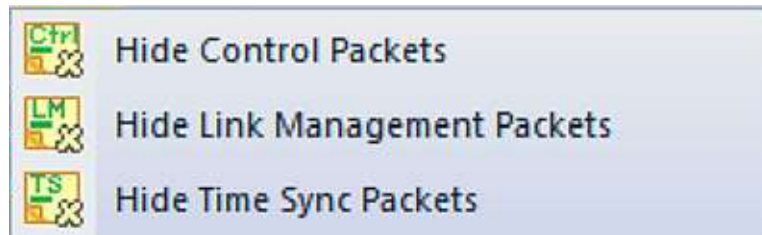
Click on the  to hide USB4 HS Ordered Sets.



- ☐ Hide SLOS1/SLOS2
- ☐ Hide TS1/TS2
- ☐ Hide TSN

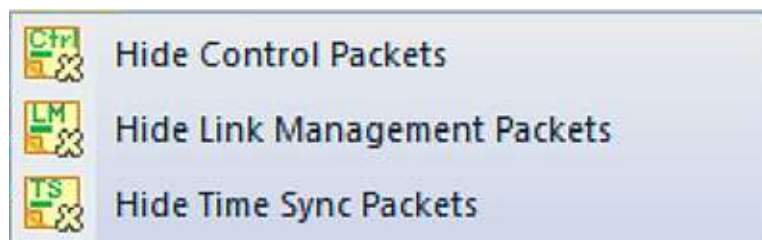
6.11.20 Hide USB4 HS Transport Layer Packets

Click on the  to hide different types of USB4 HS TLPs.



6.11.21 Hide USB4 HS Miscellaneous Packets

Click on the  to hide USB4 HS Miscellaneous Packet types



6.11.22 Hide HopID/PDF Packets

Click on the  to hide HopID/PDF types. Then select the HopID/PDF packets you want to hide.

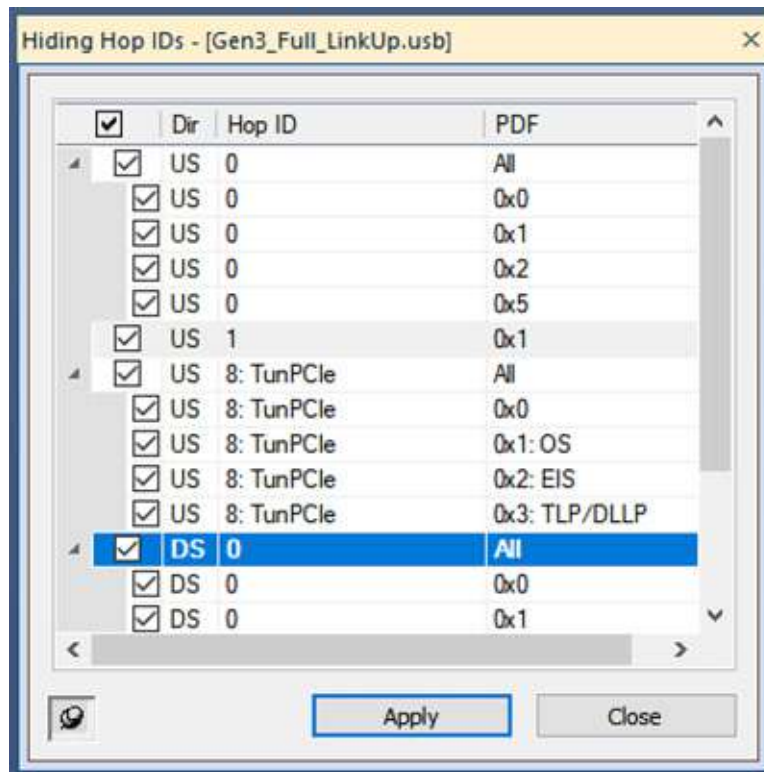


Figure 6.45: HopID Pop Up Menu

6.11.23 Hide Power Delivery Packets

Click  to hide:

- ☐ Unknown
- ☐ PING
- ☐ GoodCRC

6.11.24 Hide All Transactions Except Stream Id Numbers

This selection found when clicking on the Stream Id field of a USB 3.2 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 6.46 on page 416](#)).

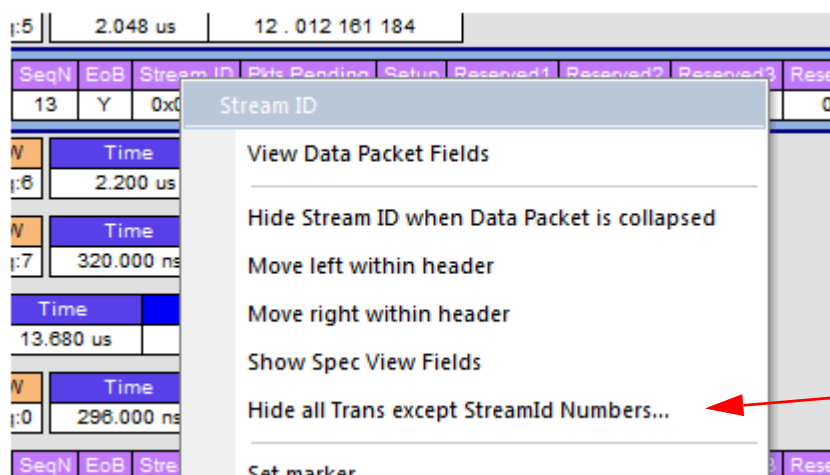


Figure 6.46: Right-clicking on the Stream Id field of a USB 3.2 Data Packet

Right-click on the Stream Id field of a USB 3.2 Data Packet and select Hide all Trans except StreamID Numbers.... to display the Hide Packets dialog (see [Figure 6.47](#)).

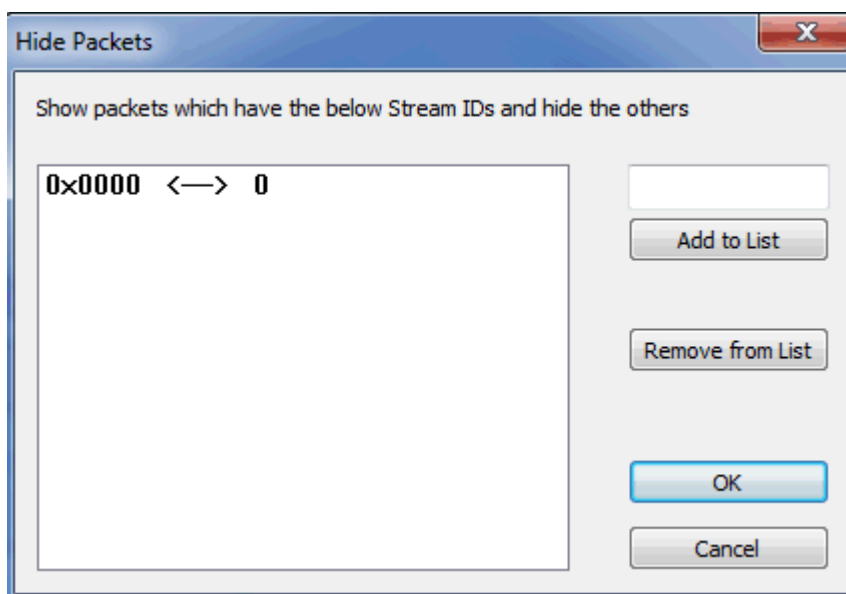
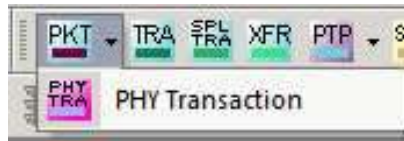


Figure 6.47: Hide Packets Dialog

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.

6.11.25 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.

6.12 Switch to Transactions View

6.12.1 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 6.48: 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 6.49: Link Power Management View

6.12.2 Transaction View from the Display Options Dialog

You can also switch to Transaction View from the Display Options Dialog

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

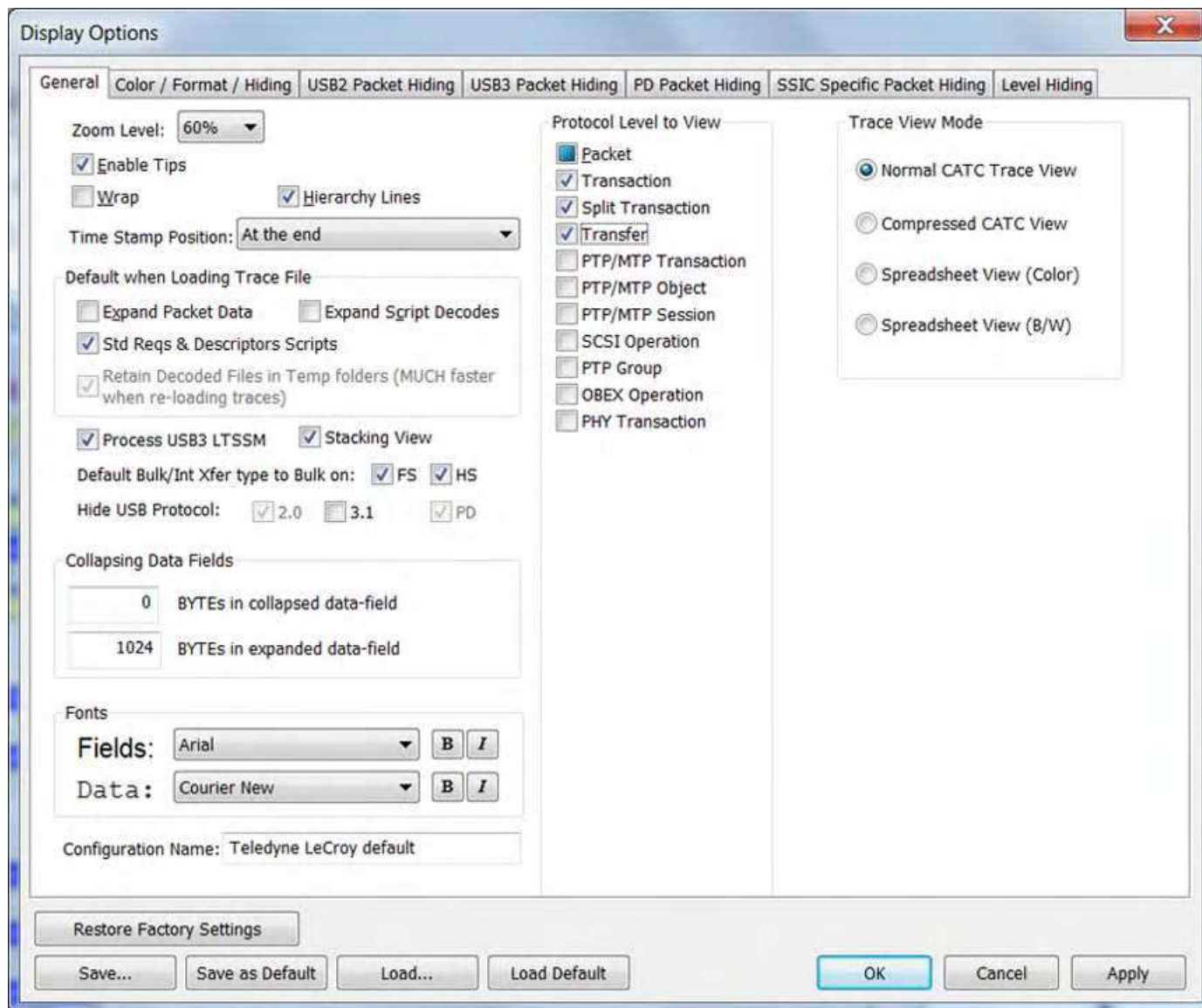


Figure 6.50: Display Options General Dialog

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

6.12.3 Power Delivery Transactions

Power Delivery Transactions are also viewable at this level. See [Figure 6.51](#).

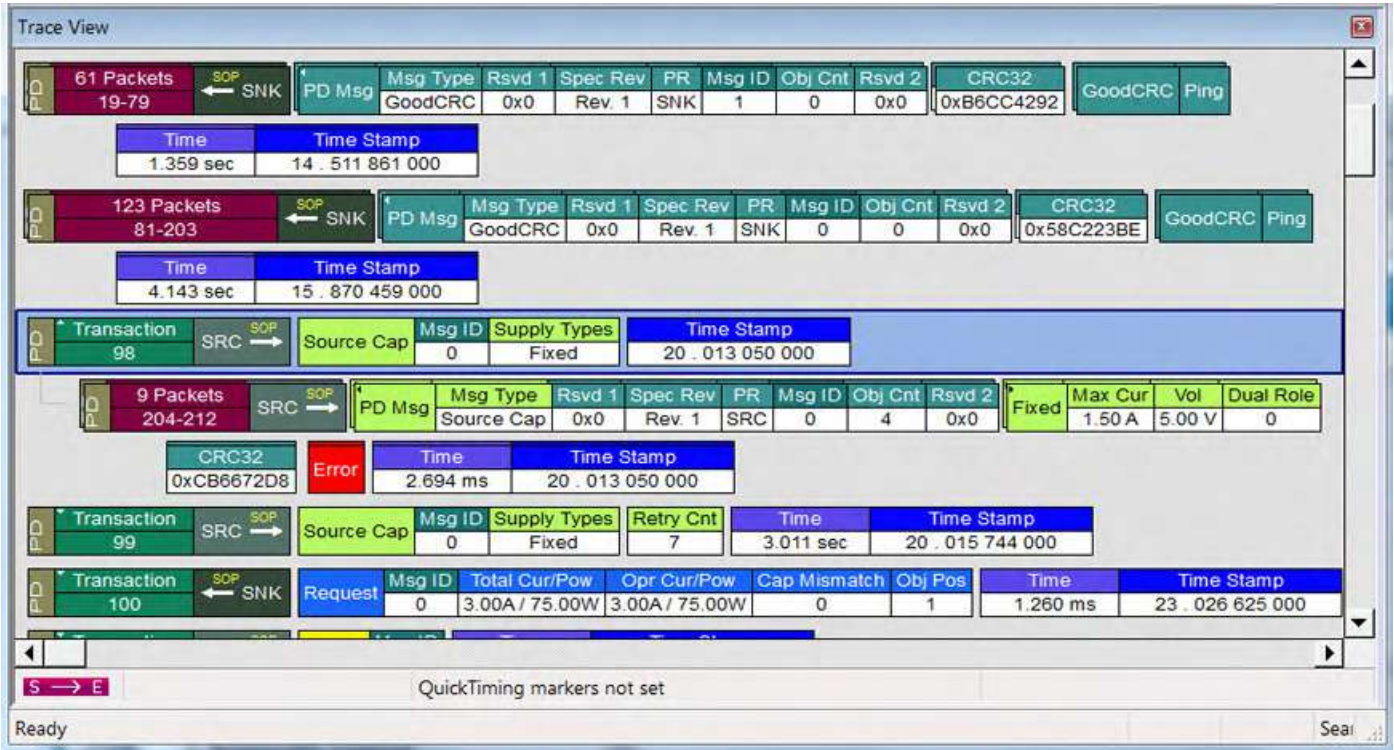


Figure 6.51: Power Delivery Transactions

6.12.4 Power Delivery Packets

If you right click in a Power Delivery Packet the following menus pops up. See [Figure 6.52](#).

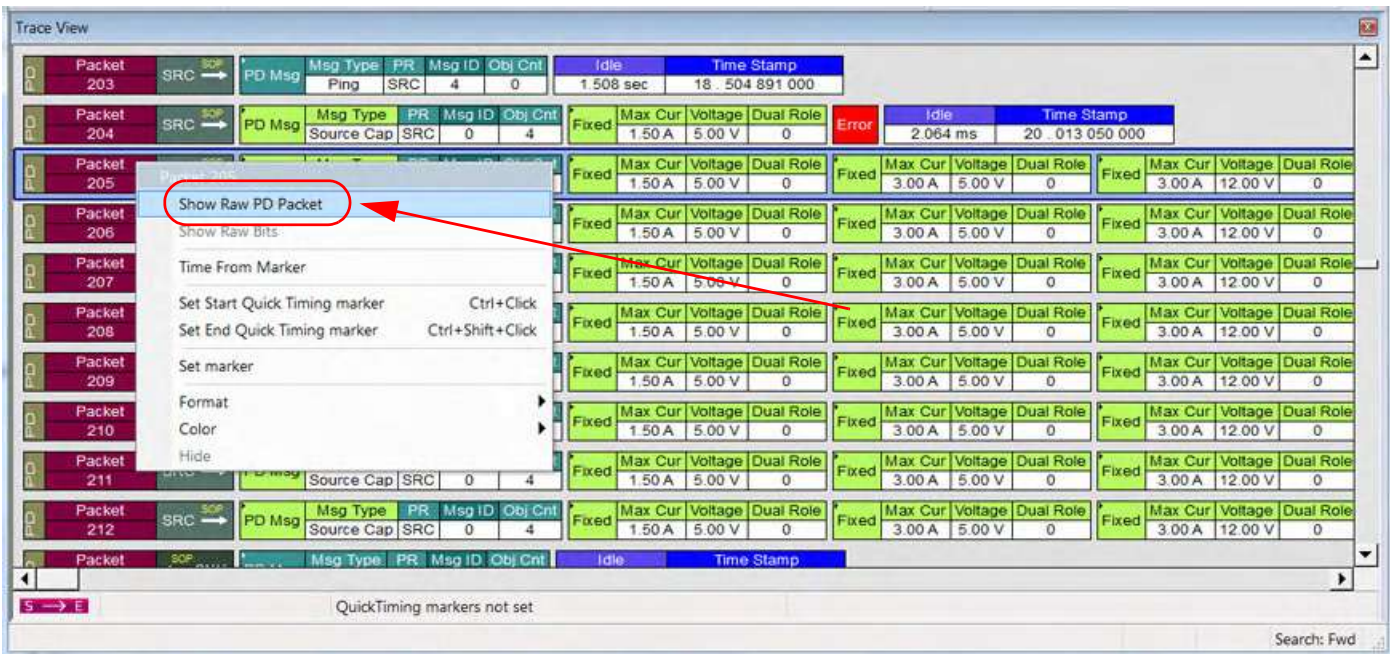


Figure 6.52: Power Delivery Packet: Right Click

From the pop up menu you can choose to view the Raw PD data by clicking on Show Raw PD Packet. See [Figure 6.53](#).

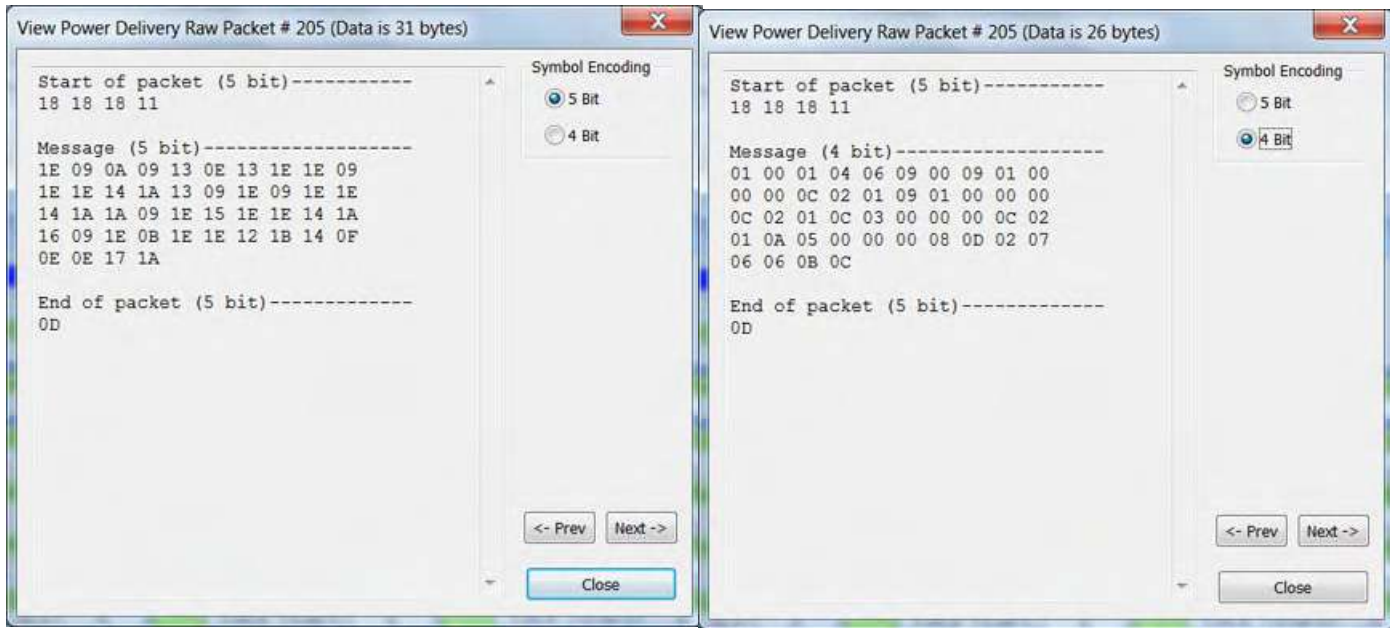


Figure 6.53: Show Raw PD Packet: 5b vs. 4b Encoding

6.13 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 6.54 on page 422](#)).



Figure 6.54: 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 (3.2) 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.

6.13.1 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 6.55 on page 423](#).)



Figure 6.55: 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.

6.14 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.

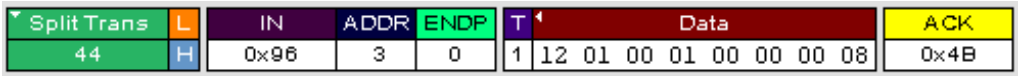


Figure 6.56: Split Transaction View

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**.

6.15 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**.

6.15.1 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 6.57: 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 (3.2) 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.

6.15.2 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:

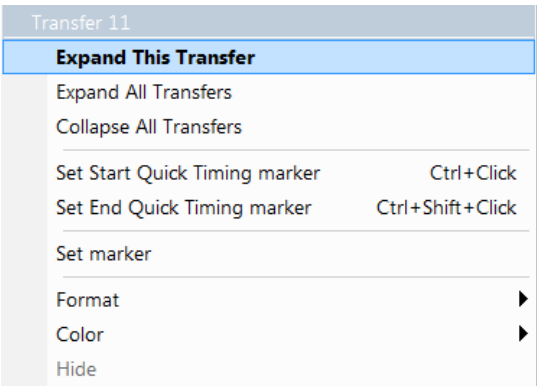


Figure 6.58: Expand This Transfer Menu Option

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



Figure 6.59: 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.

6.15.3 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.

6.15.4 USB4 Transfer View

USB4 transfer view combines configuration layer request/responses as a new layer and provides decoding of data transferred. To be able to see USB4 transfers you should select Transfer Level view from toolbar.

Click  on the toolbar.

Transfer level decoding shows transfer target configuration space including "Router", "Adapter", "Path" and "counters", and decode register fields in space based on CS type and address.

See [Figure 6.60 on page 427](#), which shows how a USB4 packet was collected and the transfer layer decoding has been provided.

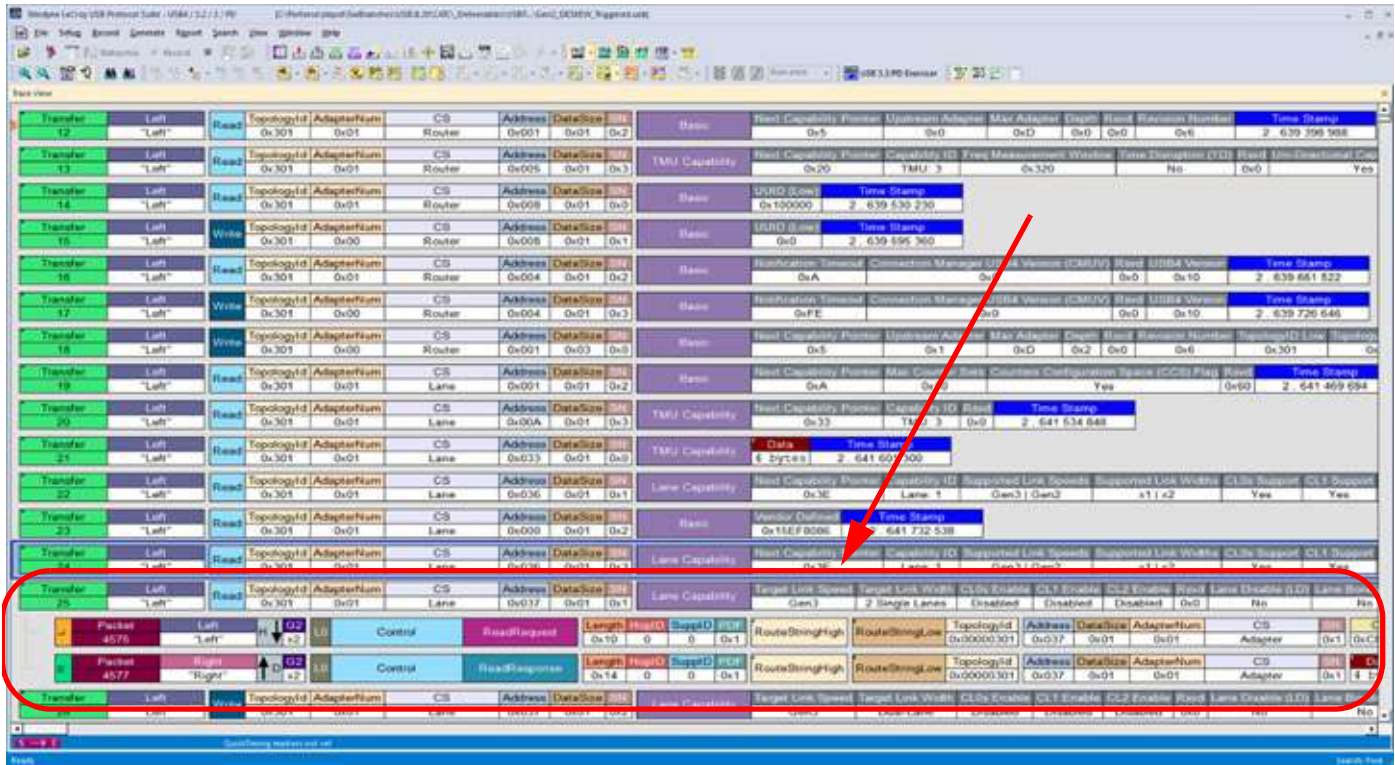


Figure 6.60: USB4 Transfer View of Trace

USB Protocol Suite software is able to automatically assign correct configuration space type of transfers, however if required information for this is not available, software will provide a feature that user can assign CS type to transfer to see fields decoded base on assigned type.

See [Figure 6.61 on page 428](#) , which shows available options for assigning CS Type.

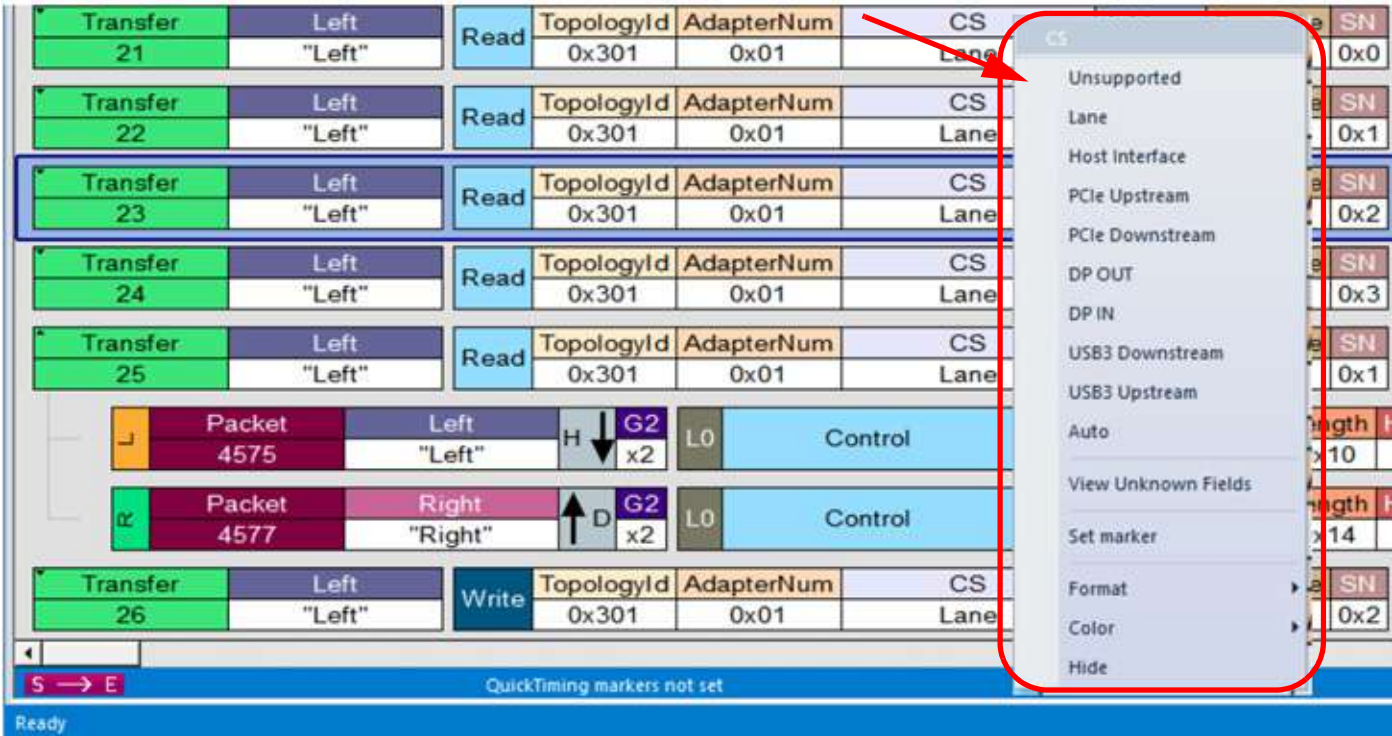


Figure 6.61: USB4 Configuration Space: Options

6.15.5 Decoding Power Delivery Transfers

You can also use the Transfer  icon on the toolbar to find Power Delivery Transfers. See [Figure 6.52 on page 421](#)

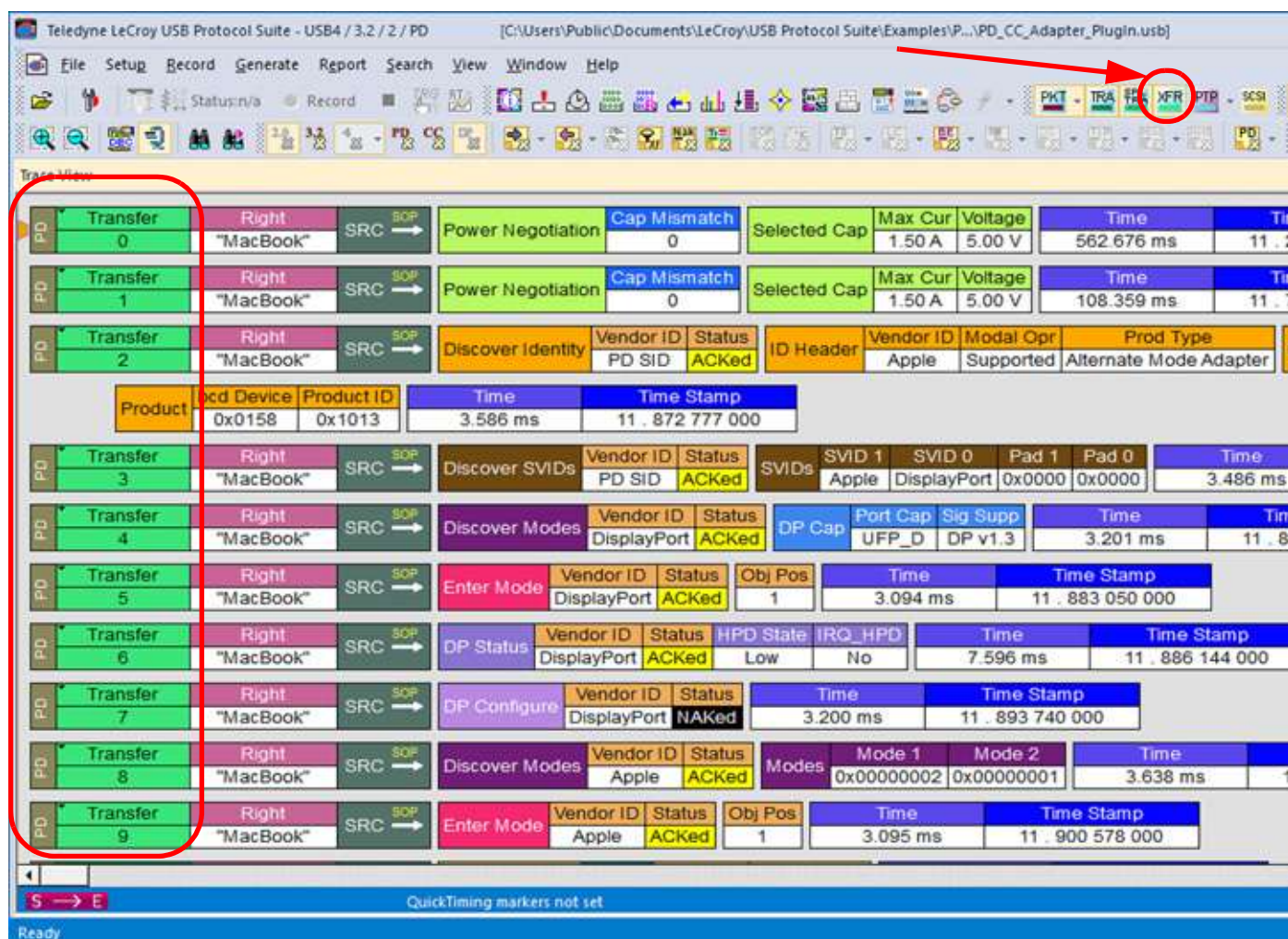


Figure 6.62: Power Delivery Transfers

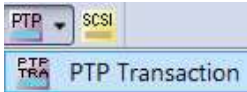
6.16 Switch to PTP Transactions

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**.

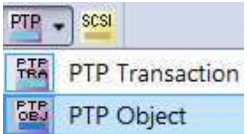
6.17 Switch to PTP Object Transfers

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**.

6.18 Switch to PTP Sessions

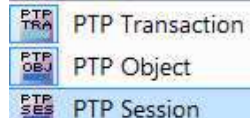
A **session** is a state of persisting communication between a device and a host during which the connection is continuous and the login and other communication parameters do not change. A session begins with an **OpenSession** operation, which establishes the communications connection and parameters,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

6.19 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**.

6.19.1 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

6.20 Switch to USB4 Operations

This view provides a new layer to combine related USB4 transfers for a router/port operation and decode operation layer fields based on combined payload from USB4 transfers.

To view USB4 operations, switch to USB4 Operations viewing level:

- ☐ Click  on the toolbar.
- OR
- ☐ Select **View > Level Viewing > USB4 Operation Level**.
- OR
- ☐ Select **Setup > Display Options** to display the Display Options window, check **USB4 Operation**, and then click **OK**.

Note: In this release of software only 'DROM Read' operation decoding is supported.

A sample trace with USB4 Operations with DROM READ decoded is shown in [Figure 6.63](#).

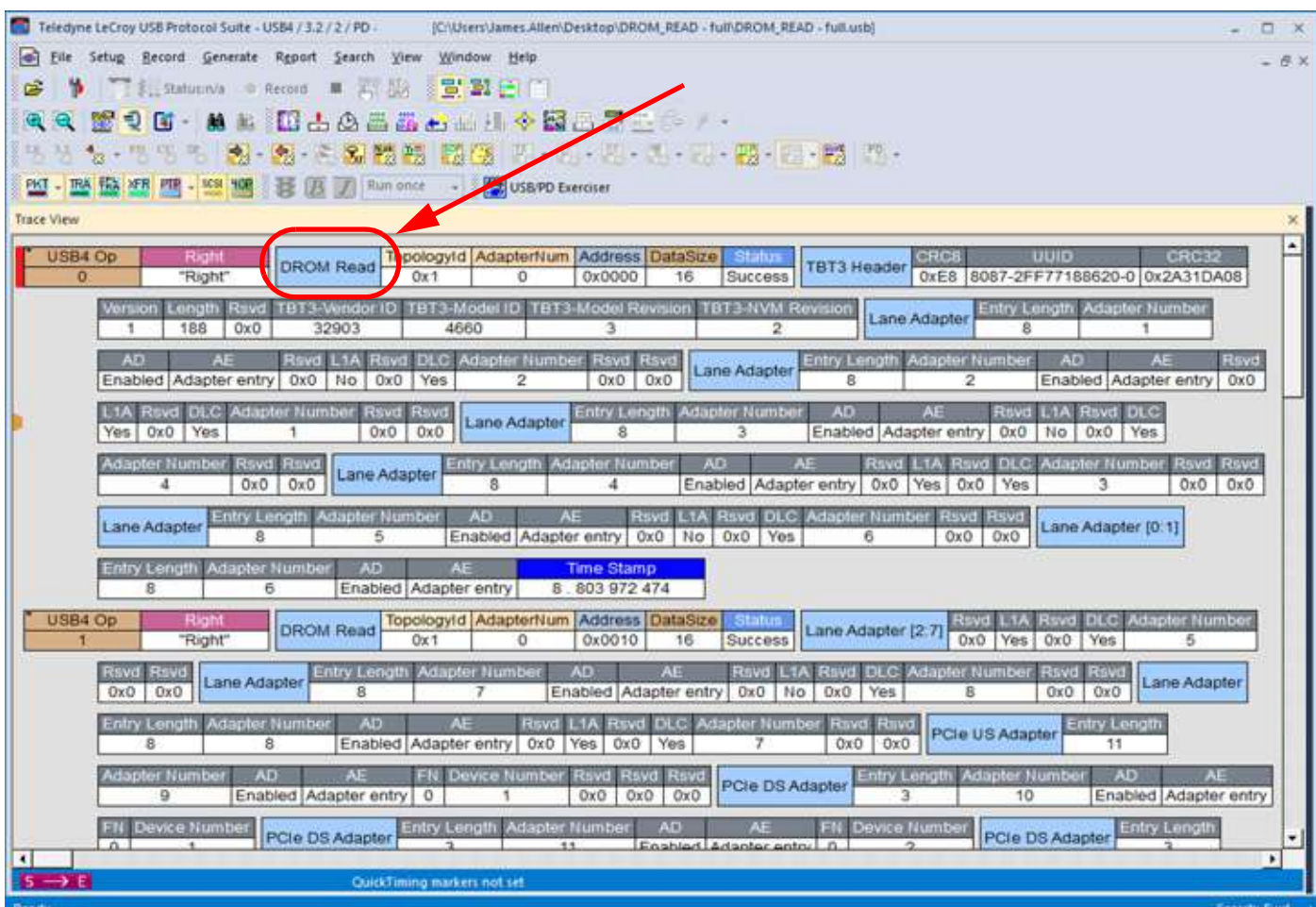


Figure 6.63: USB4 Operations: DROM Read

6.21 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 6.64 on page 434](#)).

To compress the CATC Trace:

- ☐ Click  on the toolbar.
- OR
- ☐ Select **View > Trace Views > Compressed CATC Trace**.

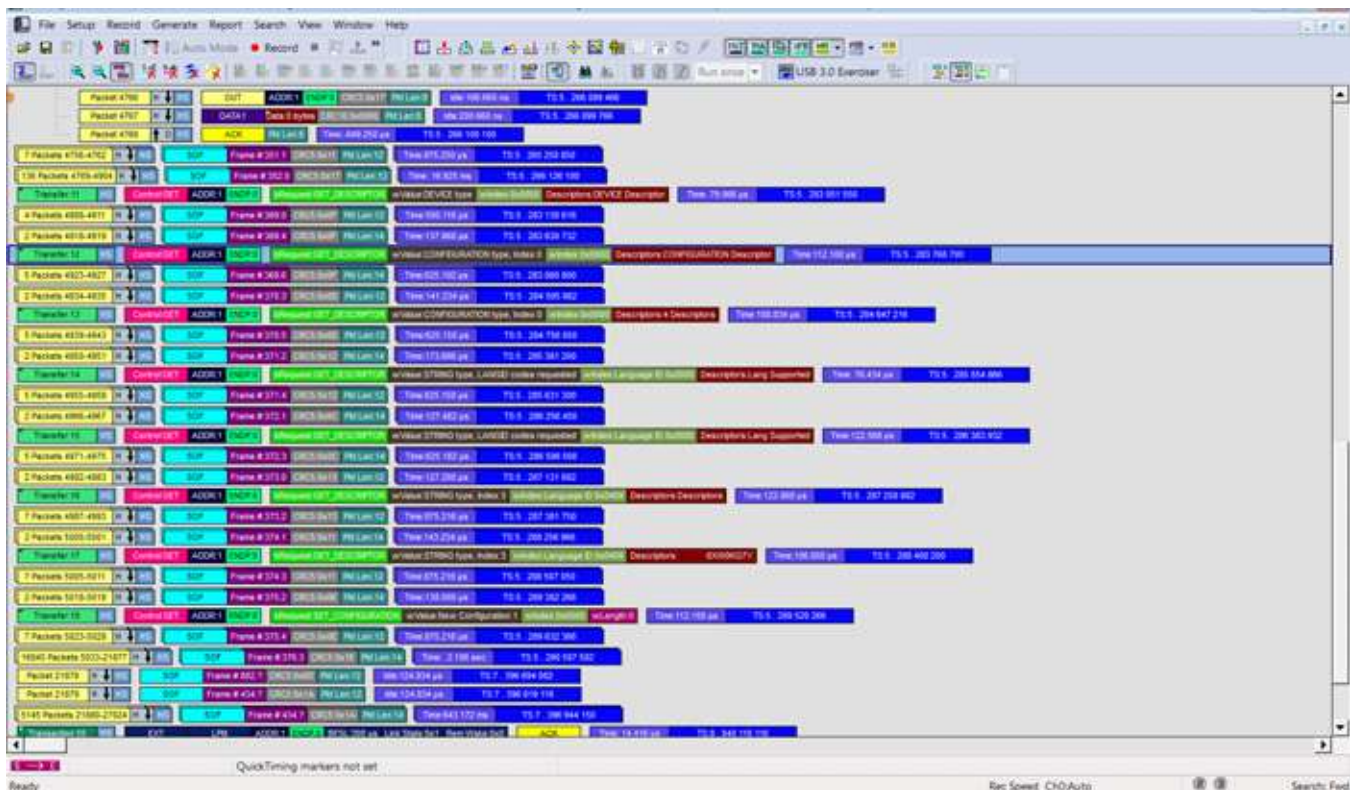


Figure 6.64: Compressed CATC Trace

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

6.22 Spreadsheet View

You can view the CATC Trace as a spreadsheet in color or black and white (see [Figure 6.65 on page 435](#)).

- ☐ Click  on the toolbar, or

- ❑ Select **View > Trace Views > Spreadsheet (Color)**.

Time Stamp	Item	Pkt Dir	Addr/Endpoint	Type	Subtype	Data	Error	Miscellaneous	Channel/Link
5.260 000 488	Pkt ...	H ↓	1.0	OUT				Pkt Len: 8	
5.260 000 786	Pkt ...	H ↓		DATA1		0 bytes		Pkt Len: 8	
5.260 100 100	Pkt ...	H ↓		ACK				Pkt Len: 8	
5.265 250 050	7 Pkts 47	H ↓		SDF		Frame # 351.1		Pkt Len: 12	
5.265 128 100	156 Pkts	H ↓		SDF		Frame # 352.0		Pkt Len: 12	
5.263 081 550	Xfr 11	H ↓	1.0	Control GET	GET_DESCRIPTOR	Frame # 369.0		wValue DEVICE type	
5.263 130 616	4 Pkts 49	H ↓		SDF		Frame # 369.0		Pkt Len: 12	
5.263 630 732	2 Pkts 49	H ↓		SDF		Frame # 369.4		Pkt Len: 14	
5.263 788 700	Xfr 12	H ↓	1.0	Control GET	GET_DESCRIPTOR			wValue CONFIGURATION type, index	
5.263 880 800	5 Pkts 49	H ↓		SDF		Frame # 369.6		Pkt Len: 14	
5.264 505 902	2 Pkts 49	H ↓		SDF		Frame # 370.3		Pkt Len: 12	
5.264 647 216	Xfr 13	H ↓	1.0	Control GET	GET_DESCRIPTOR			wValue CONFIGURATION type, index	
5.264 750 050	5 Pkts 49	H ↓		SDF		Frame # 370.5		Pkt Len: 12	
5.265 301 200	2 Pkts 49	H ↓		SDF		Frame # 371.2		Pkt Len: 14	
5.265 554 066	Xfr 14	H ↓	1.0	Control GET	GET_DESCRIPTOR			wValue STRING type, LANGID code	
5.265 631 300	5 Pkts 49	H ↓		SDF		Frame # 371.4		Pkt Len: 12	
5.266 256 450	2 Pkts 49	H ↓		SDF		Frame # 372.1		Pkt Len: 14	
5.266 363 932	Xfr 15	H ↓	1.0	Control GET	GET_DESCRIPTOR			wValue STRING type, LANGID code	
5.266 500 500	5 Pkts 49	H ↓		SDF		Frame # 372.3		Pkt Len: 14	
5.267 131 682	2 Pkts 49	H ↓		SDF		Frame # 373.0		Pkt Len: 12	
5.267 250 050	Xfr 16	H ↓	1.0	Control GET	GET_DESCRIPTOR			wValue STRING type, index 3	
5.267 381 750	7 Pkts 49	H ↓		SDF		Frame # 373.2		Pkt Len: 12	
5.268 256 966	2 Pkts 50	H ↓		SDF		Frame # 374.1		Pkt Len: 14	
5.268 400 200	Xfr 17	H ↓	1.0	Control GET	GET_DESCRIPTOR			wValue STRING type, index 3	
5.268 507 050	7 Pkts 50	H ↓		SDF		Frame # 374.3		Pkt Len: 12	
5.269 302 266	2 Pkts 50	H ↓		SDF		Frame # 375.2		Pkt Len: 14	
5.269 520 266	Xfr 18	H ↓	1.0	Control SET	SET_CONFIGURATION			wValue New Configuration 1	
5.269 632 366	7 Pkts 50	H ↓		SDF		Frame # 375.4		Pkt Len: 12	

Figure 6.65: Spreadsheet View (Color)

- ❑ Click  on the toolbar, or
- ❑ Select **View > Trace Views > Spreadsheet (B/W)**. See [Figure 6.66 on page 435](#).

Time Stamp	Item	Pkt Dir	Addr/Endpoint	Type	Subtype	Data	Error	Miscellaneous	Channel/Link
5.260 000 488	Pkt ...	H ↓	1.0	OUT				Pkt Len: 8	
5.260 000 786	Pkt ...	H ↓		DATA1		0 bytes		Pkt Len: 8	
5.260 100 100	Pkt ...	H ↓		ACK				Pkt Len: 8	
5.265 250 050	7 Pkts 47	H ↓		SDF		Frame # 351.1		Pkt Len: 12	
5.265 128 100	156 Pkts	H ↓		SDF		Frame # 352.0		Pkt Len: 12	
5.263 081 550	Xfr 11	H ↓	1.0	Control GET	GET_DESCRIPTOR	Frame # 369.0		wValue DEVICE type	
5.263 130 616	4 Pkts 49	H ↓		SDF		Frame # 369.0		Pkt Len: 12	
5.263 630 732	2 Pkts 49	H ↓		SDF		Frame # 369.4		Pkt Len: 14	
5.263 788 700	Xfr 12	H ↓	1.0	Control GET	GET_DESCRIPTOR			wValue CONFIGURATION type, index	
5.263 880 800	5 Pkts 49	H ↓		SDF		Frame # 369.6		Pkt Len: 14	
5.264 505 902	2 Pkts 49	H ↓		SDF		Frame # 370.3		Pkt Len: 12	
5.264 647 216	Xfr 13	H ↓	1.0	Control GET	GET_DESCRIPTOR			wValue CONFIGURATION type, index	
5.264 750 050	5 Pkts 49	H ↓		SDF		Frame # 370.5		Pkt Len: 12	
5.265 301 200	2 Pkts 49	H ↓		SDF		Frame # 371.2		Pkt Len: 14	
5.265 554 066	Xfr 14	H ↓	1.0	Control GET	GET_DESCRIPTOR			wValue STRING type, LANGID code	
5.265 631 300	5 Pkts 49	H ↓		SDF		Frame # 371.4		Pkt Len: 12	
5.266 256 450	2 Pkts 49	H ↓		SDF		Frame # 372.1		Pkt Len: 14	
5.266 363 932	Xfr 15	H ↓	1.0	Control GET	GET_DESCRIPTOR			wValue STRING type, LANGID code	
5.266 500 500	5 Pkts 49	H ↓		SDF		Frame # 372.3		Pkt Len: 14	
5.267 131 682	2 Pkts 49	H ↓		SDF		Frame # 373.0		Pkt Len: 12	
5.267 250 050	Xfr 16	H ↓	1.0	Control GET	GET_DESCRIPTOR			wValue STRING type, index 3	
5.267 381 750	7 Pkts 49	H ↓		SDF		Frame # 373.2		Pkt Len: 12	
5.268 256 966	2 Pkts 50	H ↓		SDF		Frame # 374.1		Pkt Len: 14	
5.268 400 200	Xfr 17	H ↓	1.0	Control GET	GET_DESCRIPTOR			wValue STRING type, index 3	
5.268 507 050	7 Pkts 50	H ↓		SDF		Frame # 374.3		Pkt Len: 12	
5.269 302 266	2 Pkts 50	H ↓		SDF		Frame # 375.2		Pkt Len: 14	
5.269 520 266	Xfr 18	H ↓	1.0	Control SET	SET_CONFIGURATION			wValue New Configuration 1	
5.269 632 366	7 Pkts 50	H ↓		SDF		Frame # 375.4		Pkt Len: 12	
5.269 507 502	18045 Pkts	H ↓		SDF		Frame # 376.3		Pkt Len: 14	
7.260 894 082	Pkt 21878	H ↓		SDF		Frame # 382.7		Pkt Len: 12	
7.260 819 116	Pkt 21879	H ↓		SDF		Frame # 434.7		Pkt Len: 12	
7.260 944 150	5145 Pkts	H ↓		SDF		Frame # 434.7		Pkt Len: 14	
8.040 116 116	Xfr 19	H ↓	1.0	EXT	ACK				
8.040 130 532	Pkt 27028	H ↓		Full Speed J (Suspend)					
11.040 116 700	Pkt 27029	H ↓		Full Speed K (Resume?)					
11.045 547 200	Pkt 27030	H ↓		Full Speed J (Suspend)					
11.250 120 032	2 Pkts 27	H ↓		Chap J					

Figure 6.66: Spreadsheet View (Black And White)

6.22.1 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.

6.22.2 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 513).
CATC Walk	See and manage playlists. (see “CATC Walk Playlist” on page 397).
Real-time Statistics	Allows you to view traffic statistics as they occur. See “Real Time Monitoring” on page 638 .
USB 3.0 5Gbps Electrical Test	Displays the USB3 Electrical Test dialog. (see “USB 3.0 5Gbps SS Electrical Test Modes” on page 718).
Trace Views	Displays CATC Trace, Compressed CATC Trace, Spreadsheet (Color), or Spreadsheet (B/W).
Unhide fields	Unhide previously hidden Traffic, VBus Power, PD Preamble, CC1 Left Power, CC2 Left Power, CC1 Right Power, CC2 Right Power, USB4 SB CRC, USB4 Reserved, USB4 CRC 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 3.2 Traffic	Hides all the SuperSpeed and SuperSpeed+ traffic.
Hide All USB PD Traffic	Hides all the USB power delivery traffic.
Hide All CC Traffic	Hides all Type-C CC1 and CC2 Event Traffic (Configuration Channel)
Hide All DP Traffic	Hides All Data Port Traffic
Hide All Traffic from Left and Right Directions	Hides All Transfers from Left DUT or DUT (Exerciser) when system is in Analyzer Mode
	Hides All Transfers from Right DUT or Voyager (Exerciser) when system is in Exerciser Mode
Hiding Traffic from Left DUT / DUT [Exerciser] by Lane	Hide L0, Hide L1, Hide LB, Hide PD/USB4 SB

Hiding Traffic from Right DUT / Voyager [Exerciser] by Lane	Hide L0, Hide L1, Hide LB, Hide PD/USB4 SB
Hiding USB 2.0 Traffic	Hides: SOE's: Start of Frames Chirps: Chirp-K and Chirp-J Bus conditions (these are recorded only)
Hiding USB 3.2 Traffic	Hides: 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 USB4 (or TBT) Traffic	Hides USB4 Sideband Traffic Hide USB4 Traffic Hide/Show Ordered Sets (Hide SLOS1/SLOS2) (Hide TS1/TS2) Hide/Show Control Packets (Hide Control Packets) (Read Request) (Read Response) (Write Request) (Write Response) (Notification) (Notification Ack) (Hot Plug Event) (Inter-Domain Request) (Inter-Domain Response) (Hide/Show Link Management Packets (Hide Link Management Packets_) (Credit Grant) (Path Credit Sync) (Shared Buffers Credit Sync) Hide/Show Time Sync Packets (Hide Time Sync Packets) (Follow Up) (Inter Domain TS) Hide/Show Miscellaneous Traffic (Hide SKP/Idle/USS/IPS/LFPS) Hide/Show Upstream Hop IDs (Hop ID 0/Hop ID 1/Hop ID3/Hop ID 8) Hide/Show Downstream Hop IDs (Hop ID 0/Hop ID 1/Hop ID3/Hop ID 8) Hide/Show Tunneled PCIe (Show/Hide Update_FC) See “Export: USB4 Tunneled DP Traffic to DP Native Trace” on page 198.
Hiding Power Delivery Traffic	Hide Unknown Packets Hide Ping Packets Hide GoodCRC Packets
Hide Devices (Addr/Endp)....	Opens the Hiding Devices dialog displaying packets belonging to specified devices by address and endpoint
Hide All Except Transfers	Hide All Except Transfer's Packets

Hide USB2 NAK's/USB3 Failed	Shows/Hides USB2 NAK'd Transactions and USB3 Failed Transactions
Hide Non-Data Transaction	Shows/Hides all Non-Data Traffic
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 407 .
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 527 .
Enable Sync Traces	Synchronizes views between synced traces. See "Enable Sync Traces (used with Hub Compliance)" on page 441 .
Level Viewing	Displays Packet Level Displays PHY Transaction Level Displays Transaction Level Displays Split Transaction Level Displays Transfer Level PTP Group PTP Transaction Level displays PTP Transactions PTP Object Transfer Level displays PTP Objects PTP Session Level displays PTP Sessions 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.

6.22.3 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 6.67 on page 440](#)).

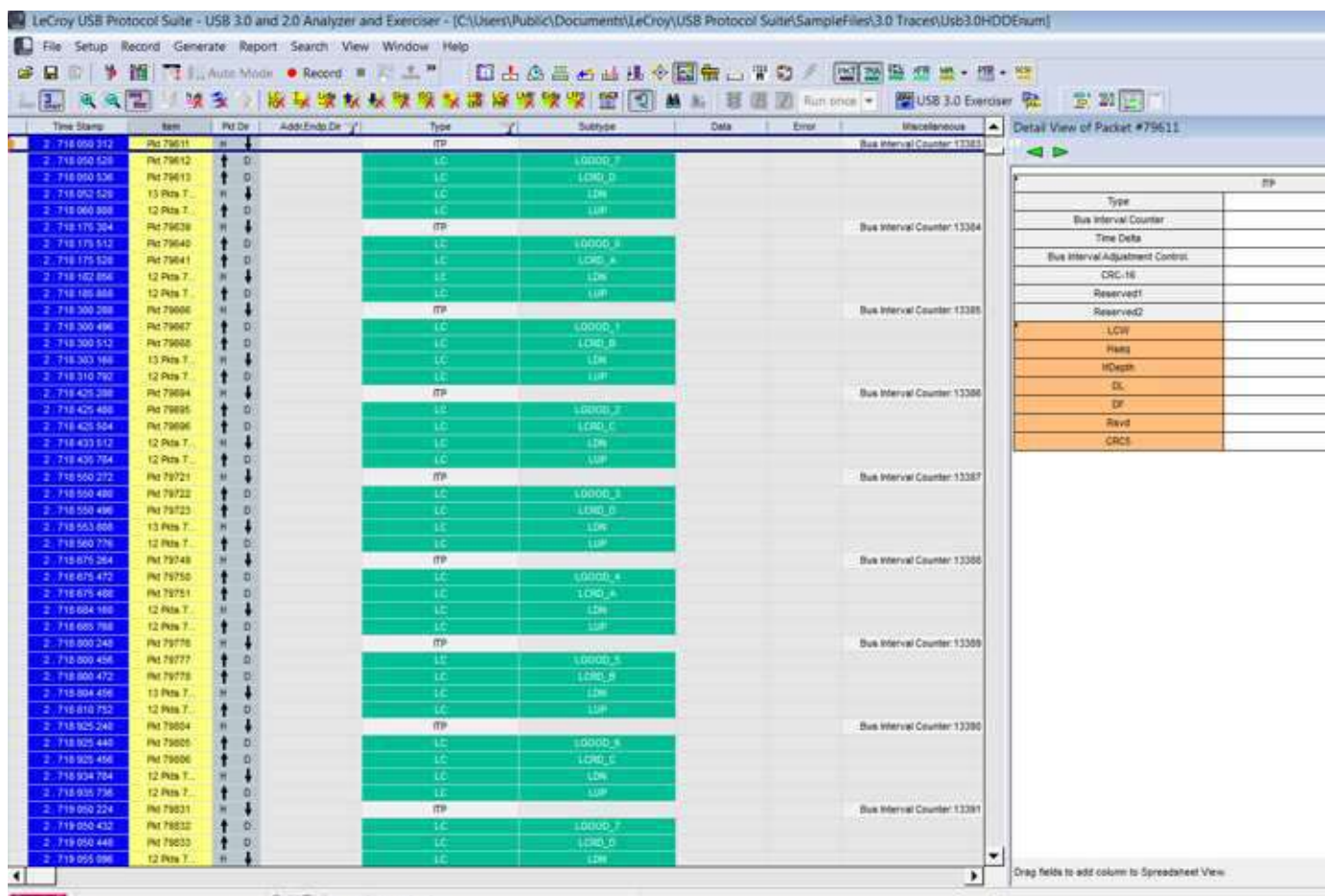
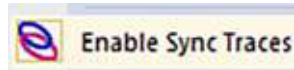


Figure 6.67: Detail View in Spreadsheet View

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

6.23 Enable Sync Traces (used with Hub Compliance)



This button will cause the upstream and downstream traces to be time synchronized for scrolling, etc. This will only work on traces which are recorded at the same time by two Analyzers during Hub Compliance testing, as the Compliance program identifies and marks both traces as being recorded simultaneously during a particular test scenario.

In the first example two traces have been loaded but “Enable Sync Traces” is not turned on. See [Figure 6.68](#).

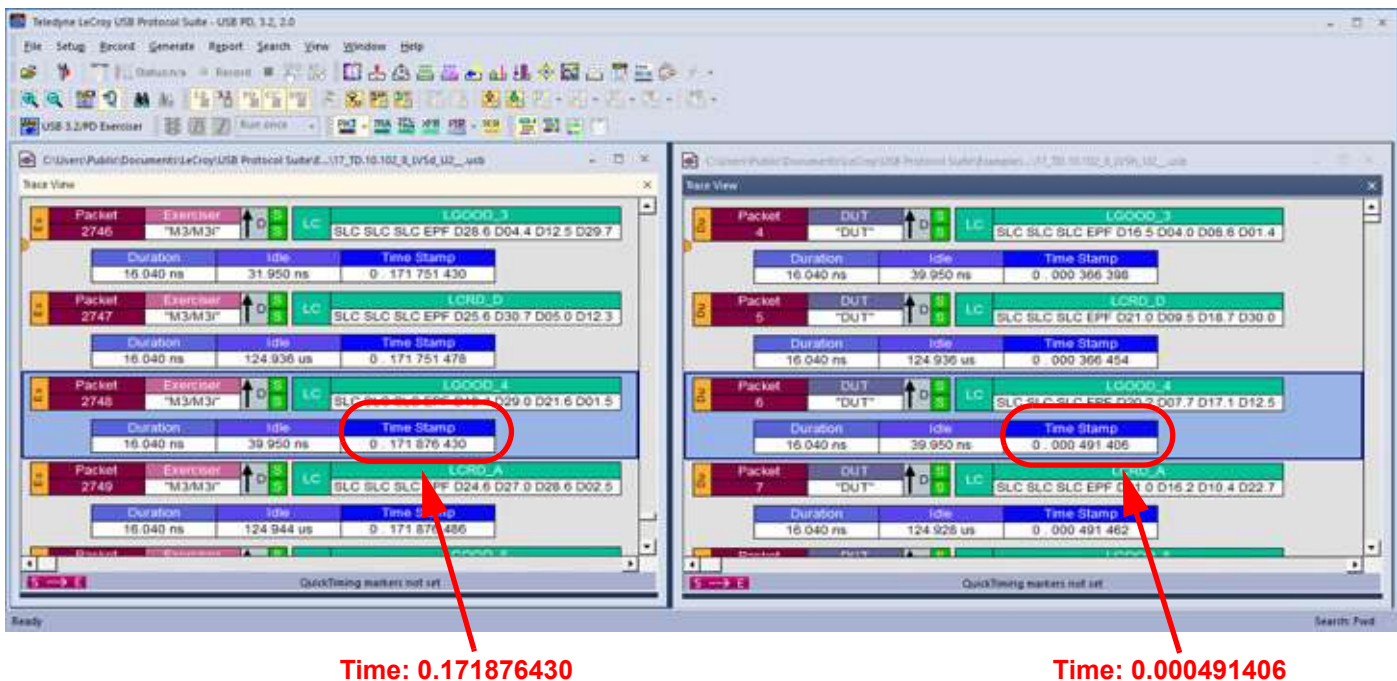
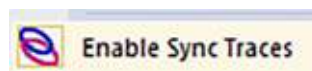
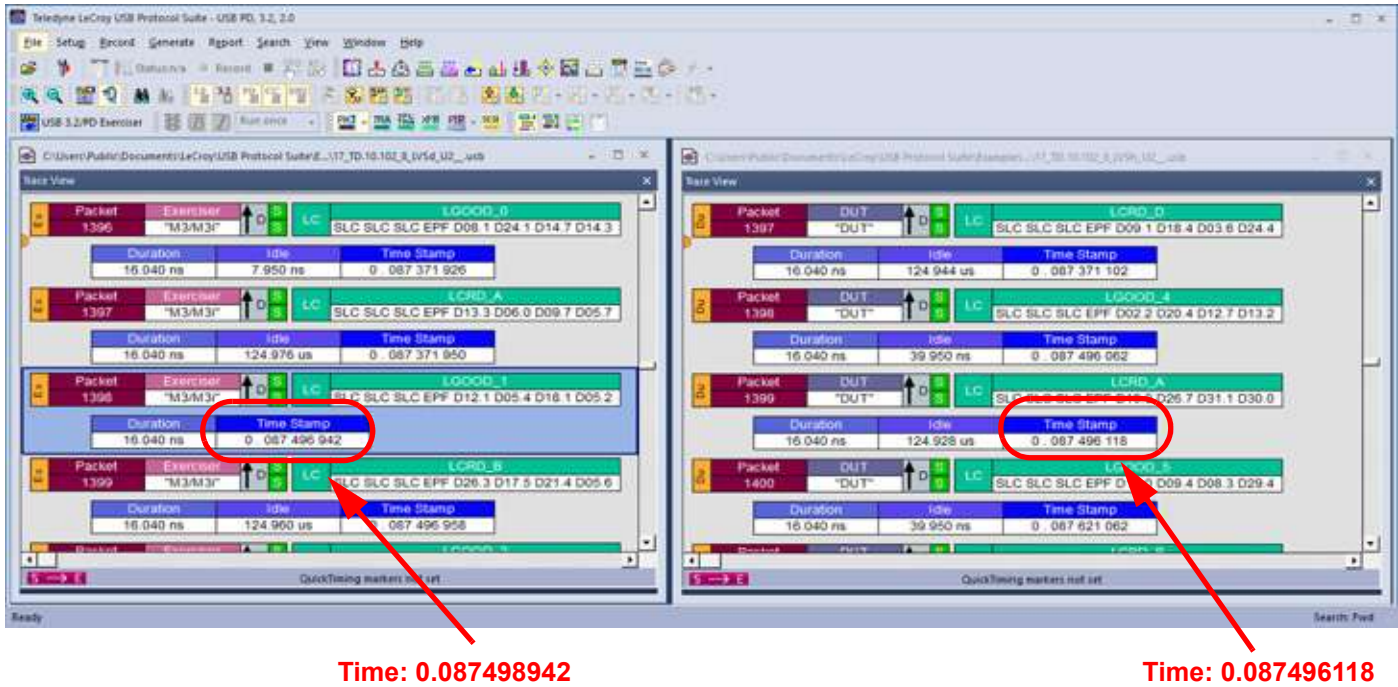


Figure 6.68: Two Traces Loaded “Enable Sync Traces” is not turned on



Now select the button on the View Menu (“View Menu” on [page 181](#)). The result can be seen below in [Figure 6.69 on page 442](#). The two views will remain time-synchronized when scrolling or when moving to a different packet via selection or searching.

Note: This feature is limited to packets which are captured close to each other in time.



6.24 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:

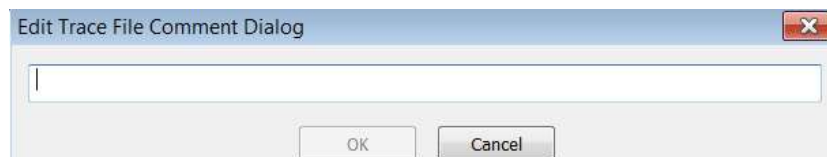


Figure 6.70: Edit Comments For Trace File Dialog

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

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

Chapter 7

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:

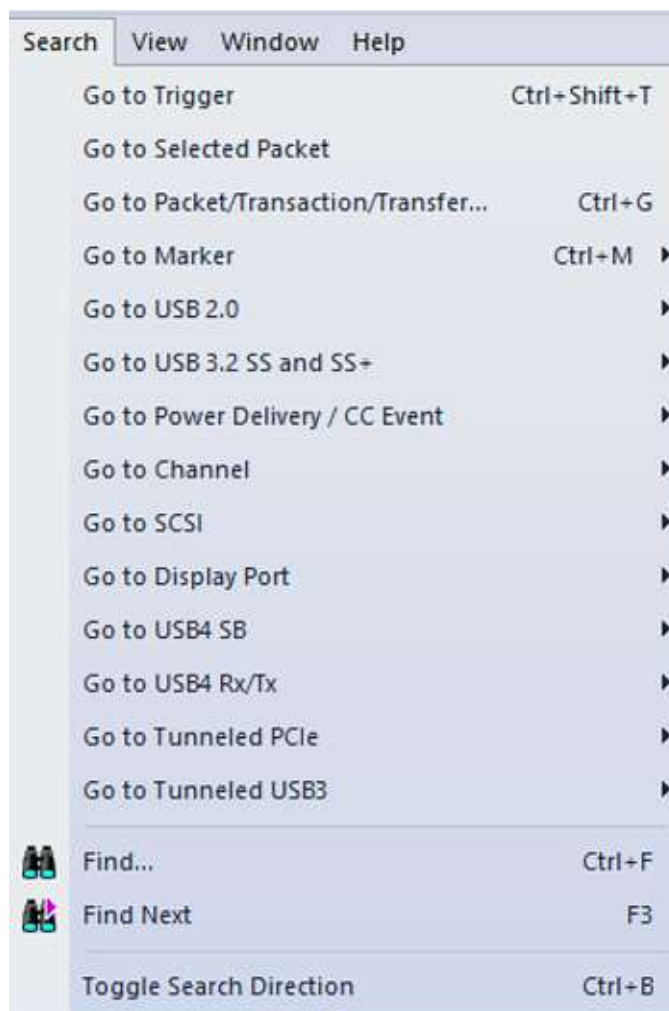


Figure 7.1: Search Drop-down Menu

7.1 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.

7.2 Go to Selected Packet

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

7.3 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:

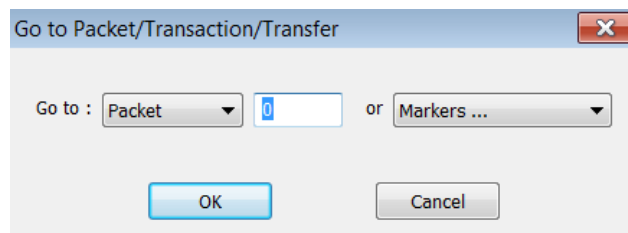


Figure 7.2: Go To Packet/Transaction/Transfer Dialog

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.

7.4 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:

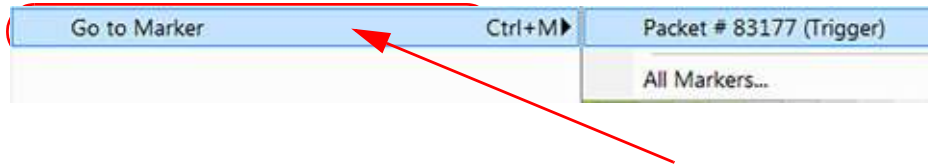


Figure 7.3: Go To Marker Menu Option

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 385](#).

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

Packet Selection works with Go to Marker.

7.5 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:

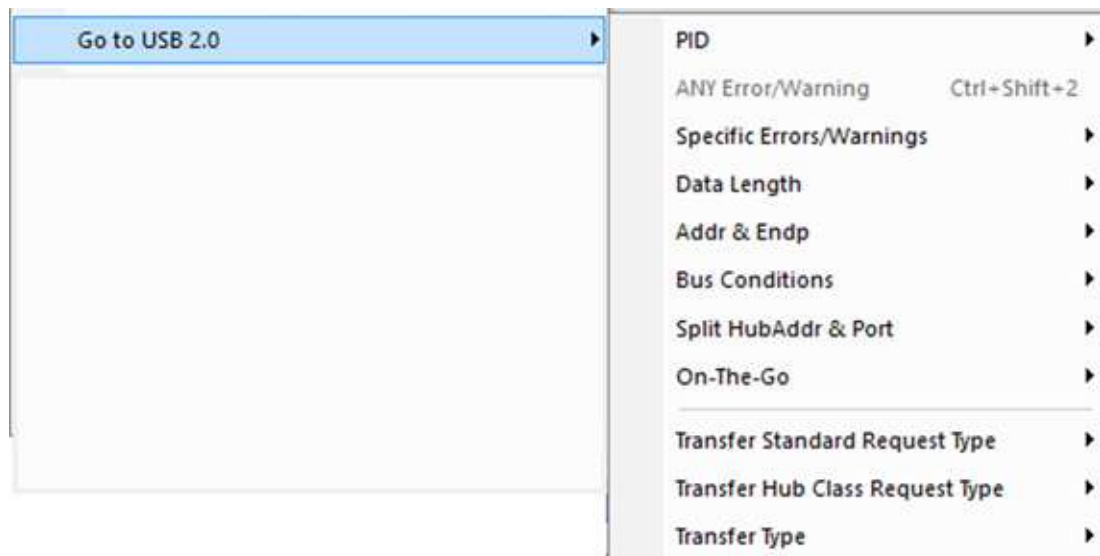


Figure 7.4: Go To USB 2.0 Menu Option

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.

7.5.1 Packet IDs (PIDs)

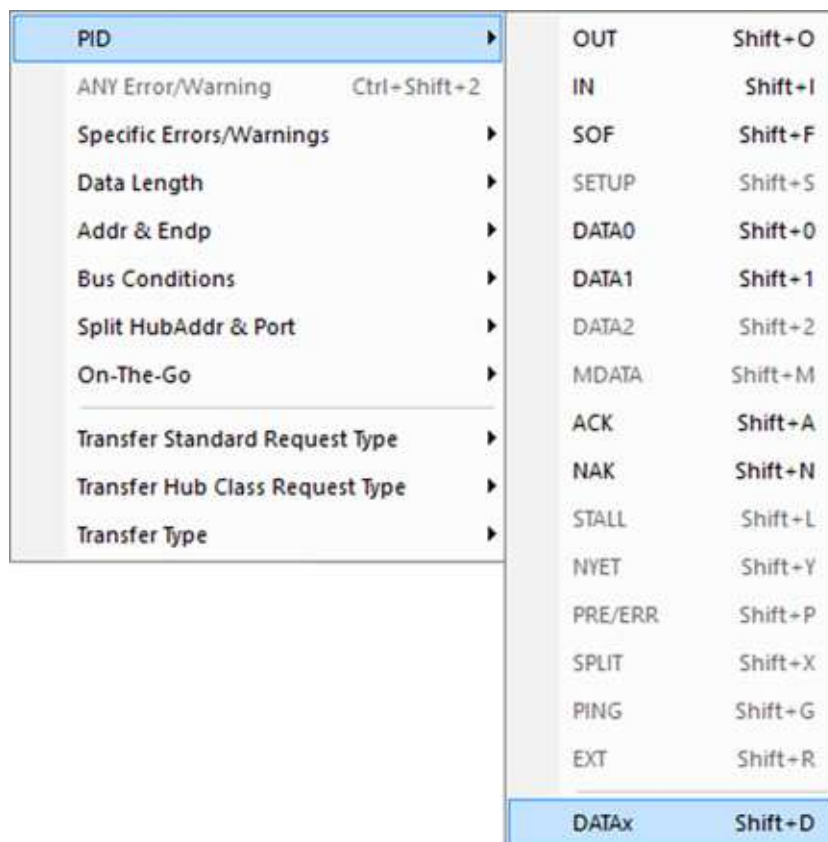


Figure 7.5: Packet IDs

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

7.5.2 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.

7.5.3 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 7.6 on page 449](#)).

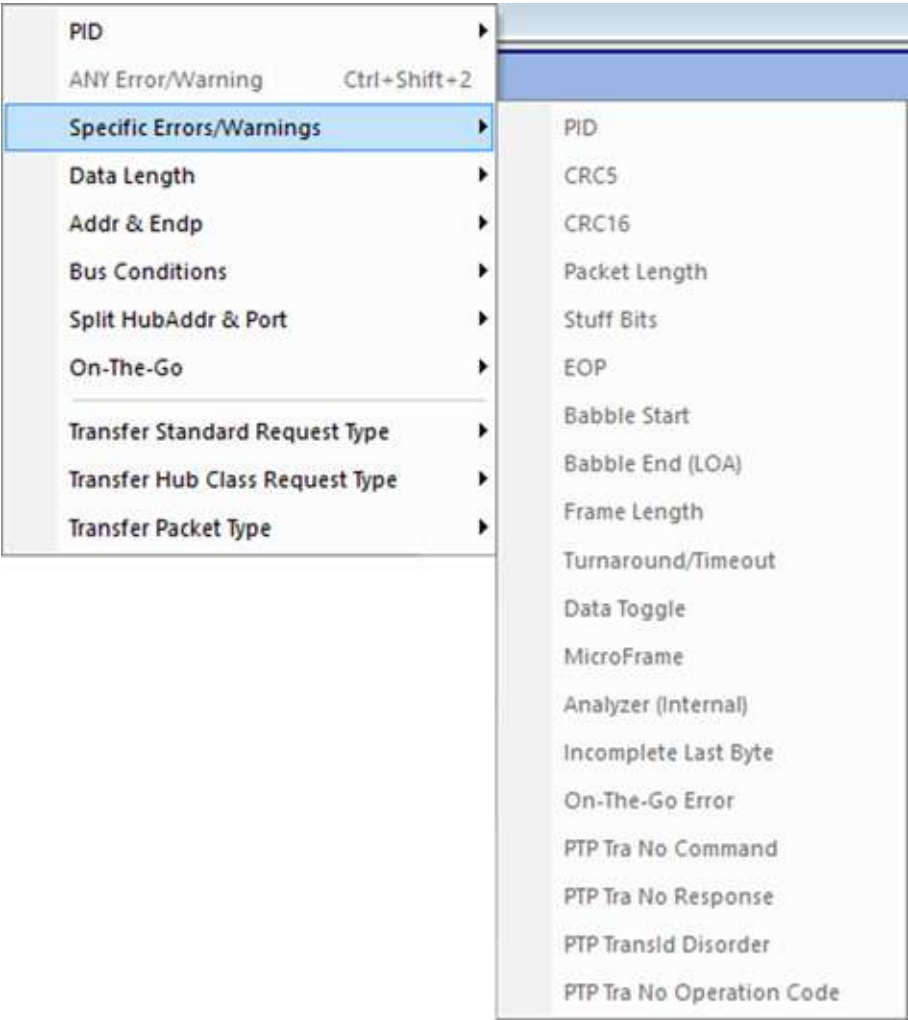


Figure 7.6: Errors Menu Option

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

7.5.4 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.

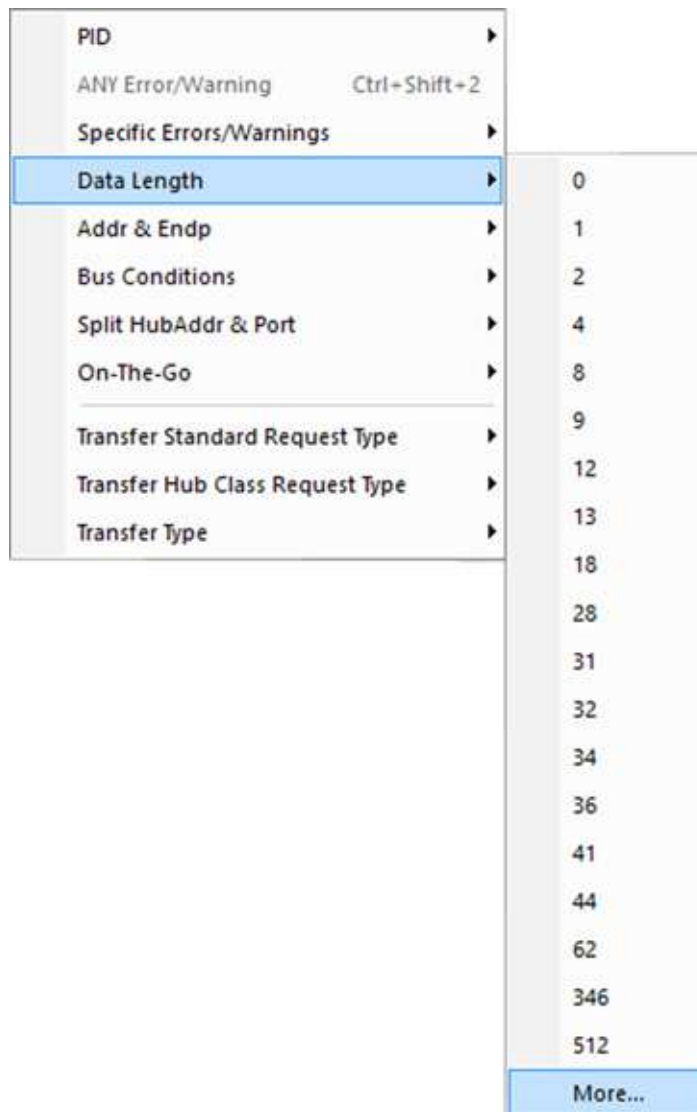


Figure 7.7: Data Length Menu Option

7.5.5 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.

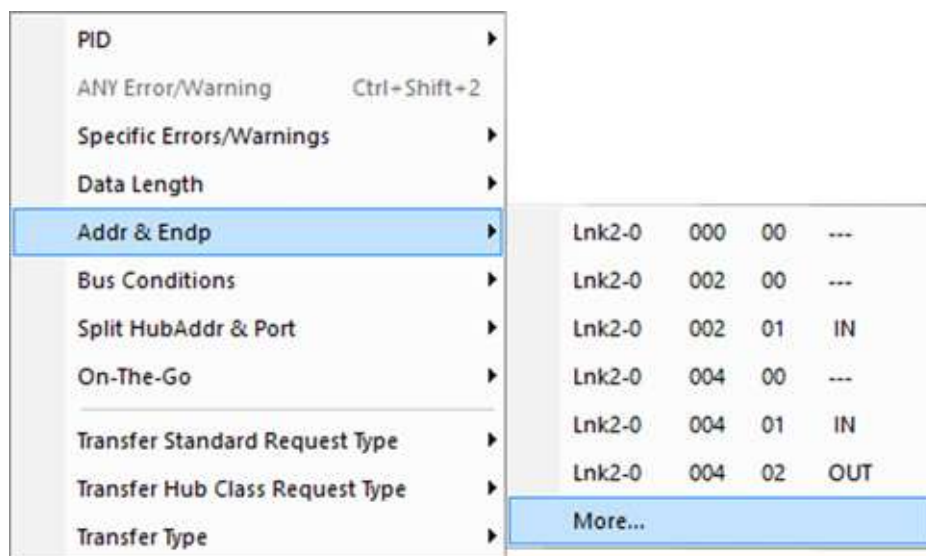


Figure 7.8: Addr & Endp Menu Option

7.5.6 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.

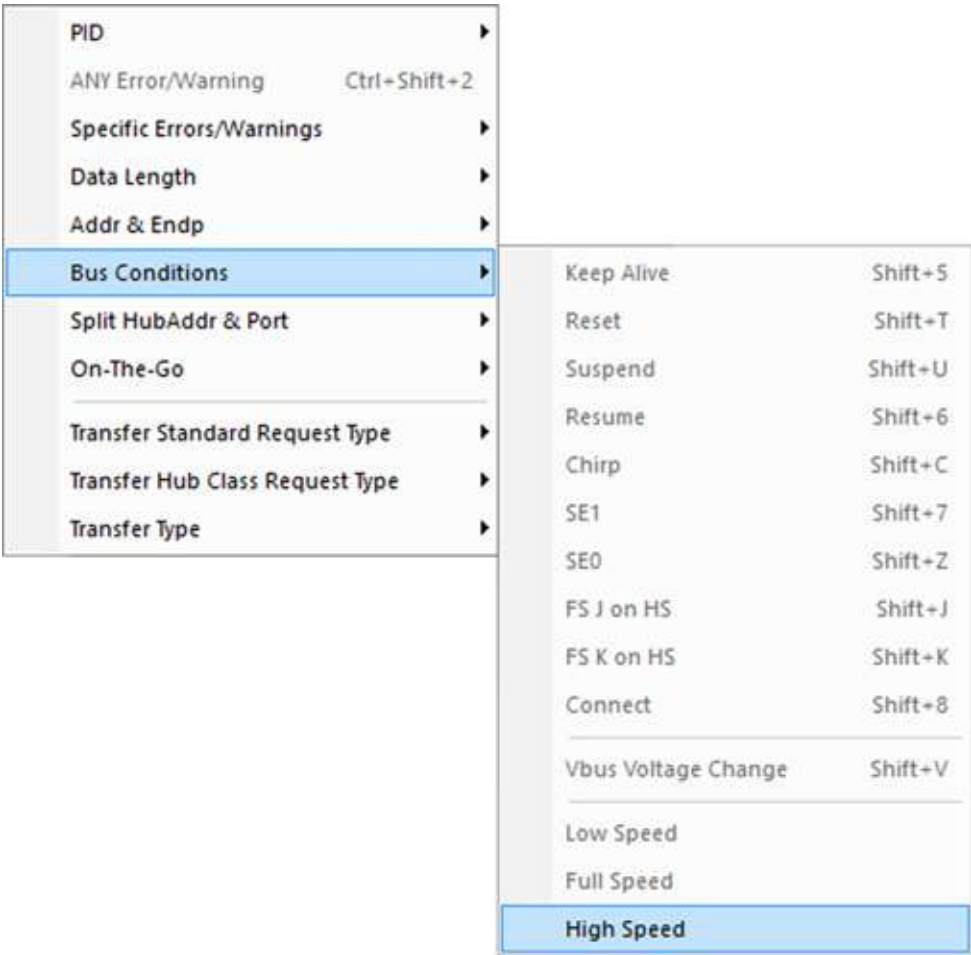


Figure 7.9: Bus Conditions Menu Option

7.5.7 Split HubAddr & Port

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

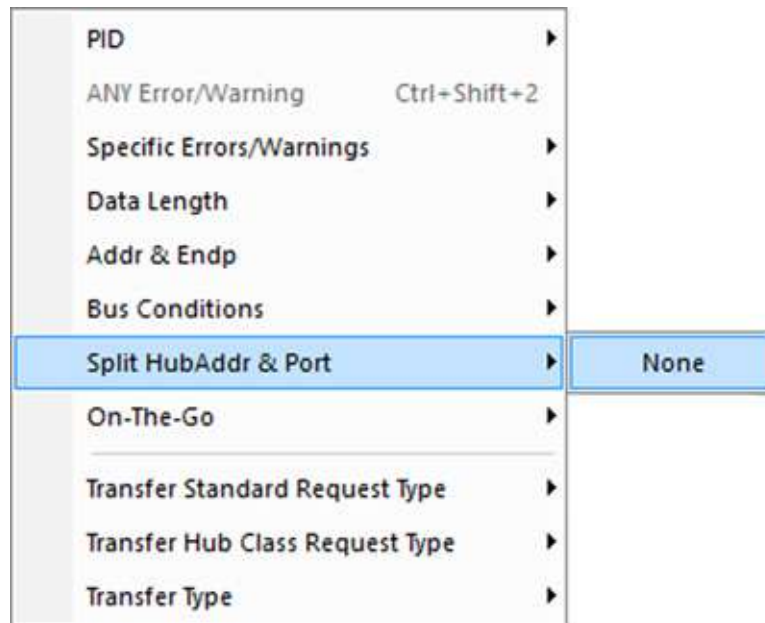


Figure 7.10: Split HubAddr & Port Menu Option

7.5.8 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

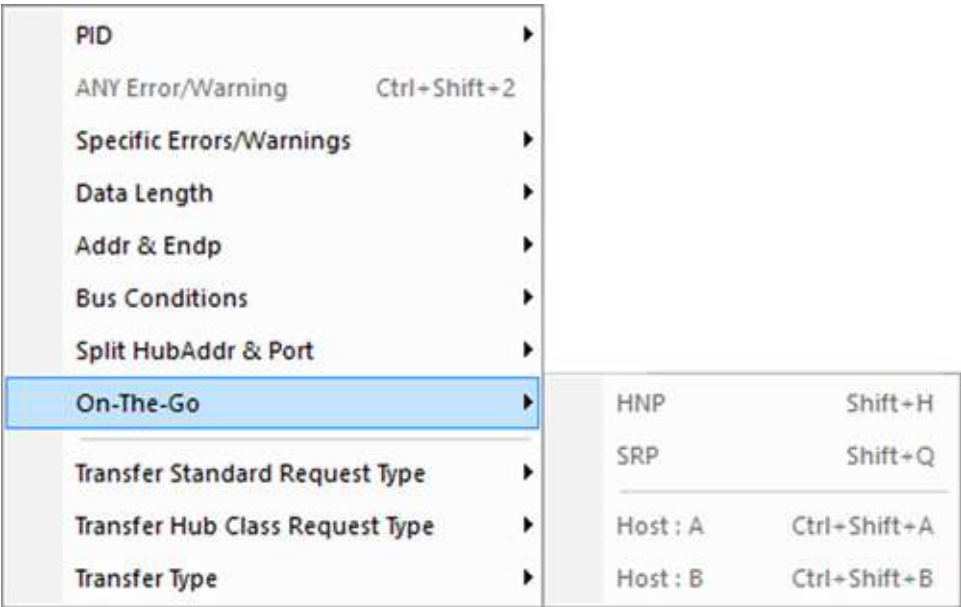


Figure 7.11: On-the-Go Menu Option

7.5.9 Transfer Standard Request Type

Allows you to search for Transfer Standard Request Type attributes.

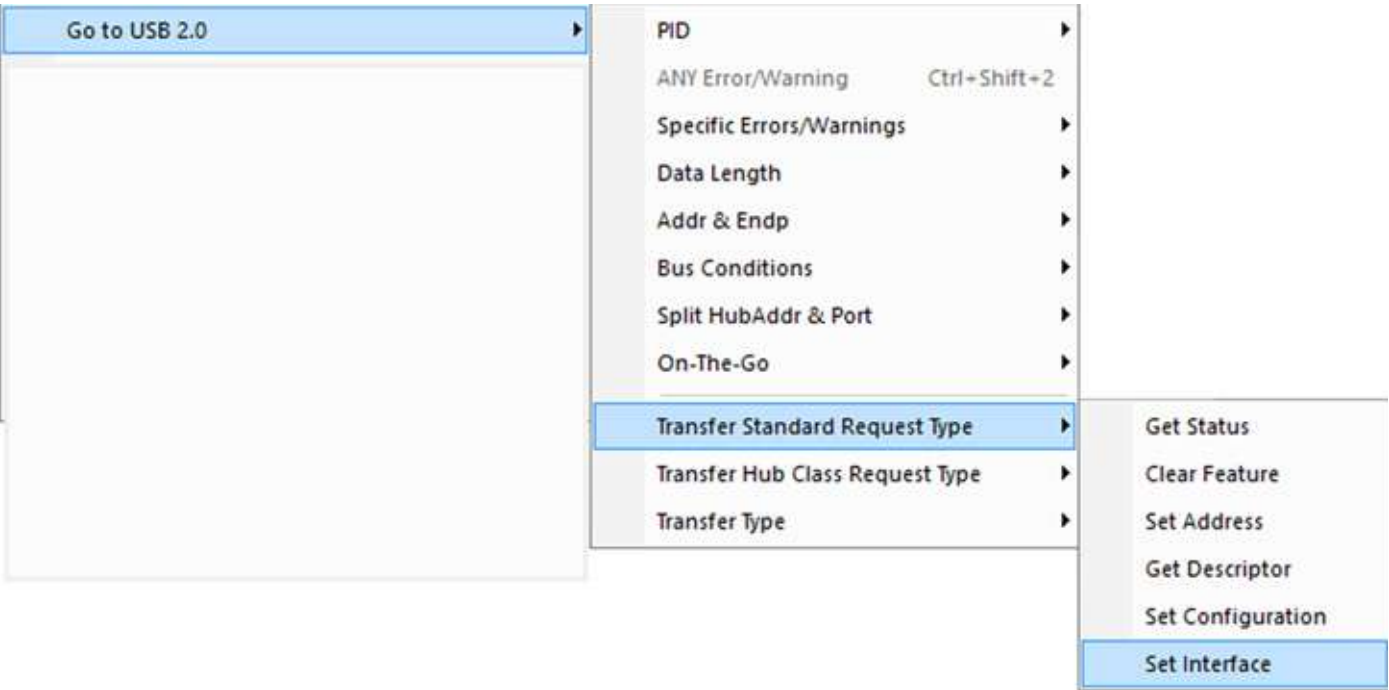


Figure 7.12: Transfer Standard Request Type Option

7.5.10 Transfer Hub Class Request Type

Allows you to search for Transfer Hub Class Request Type attributes.

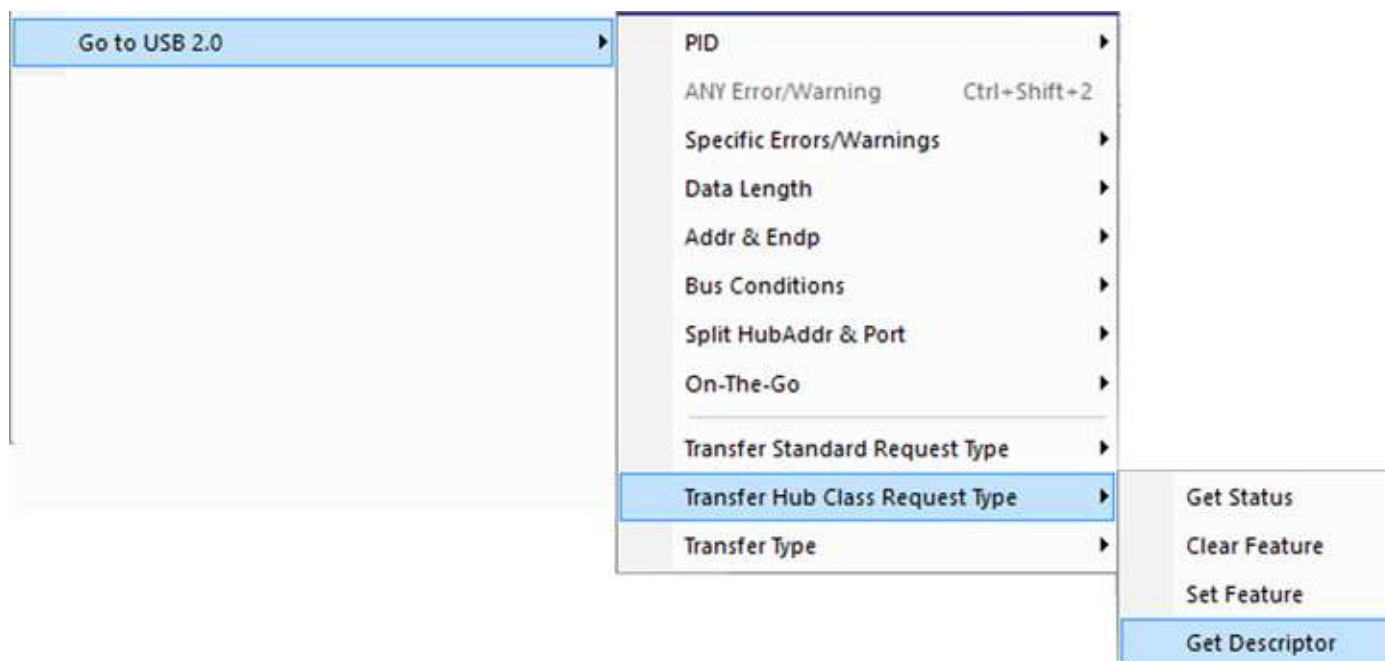


Figure 7.13: Transfer Hub Class Request Type Option

7.5.11 Transfer Type

Allows you to search for Transfer Type attributes.

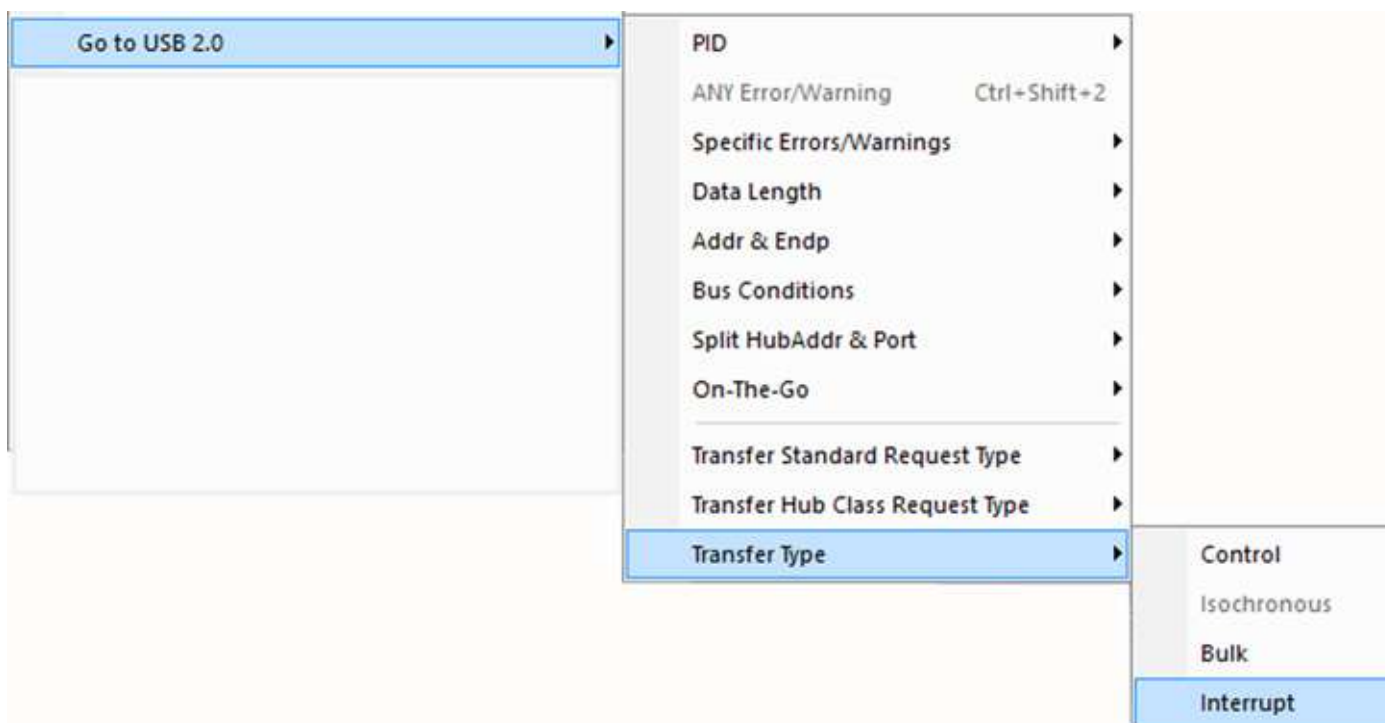


Figure 7.14: Transfer Type Option

7.6 Go To USB 3.2

The Go To USB 3.2 feature takes you directly to an event in a Trace.

1. Select **Go To USB 3.2** under Search on the Menu Bar to display the Go To USB 3.2 drop-down menu. For 3.2 data, the menu is:

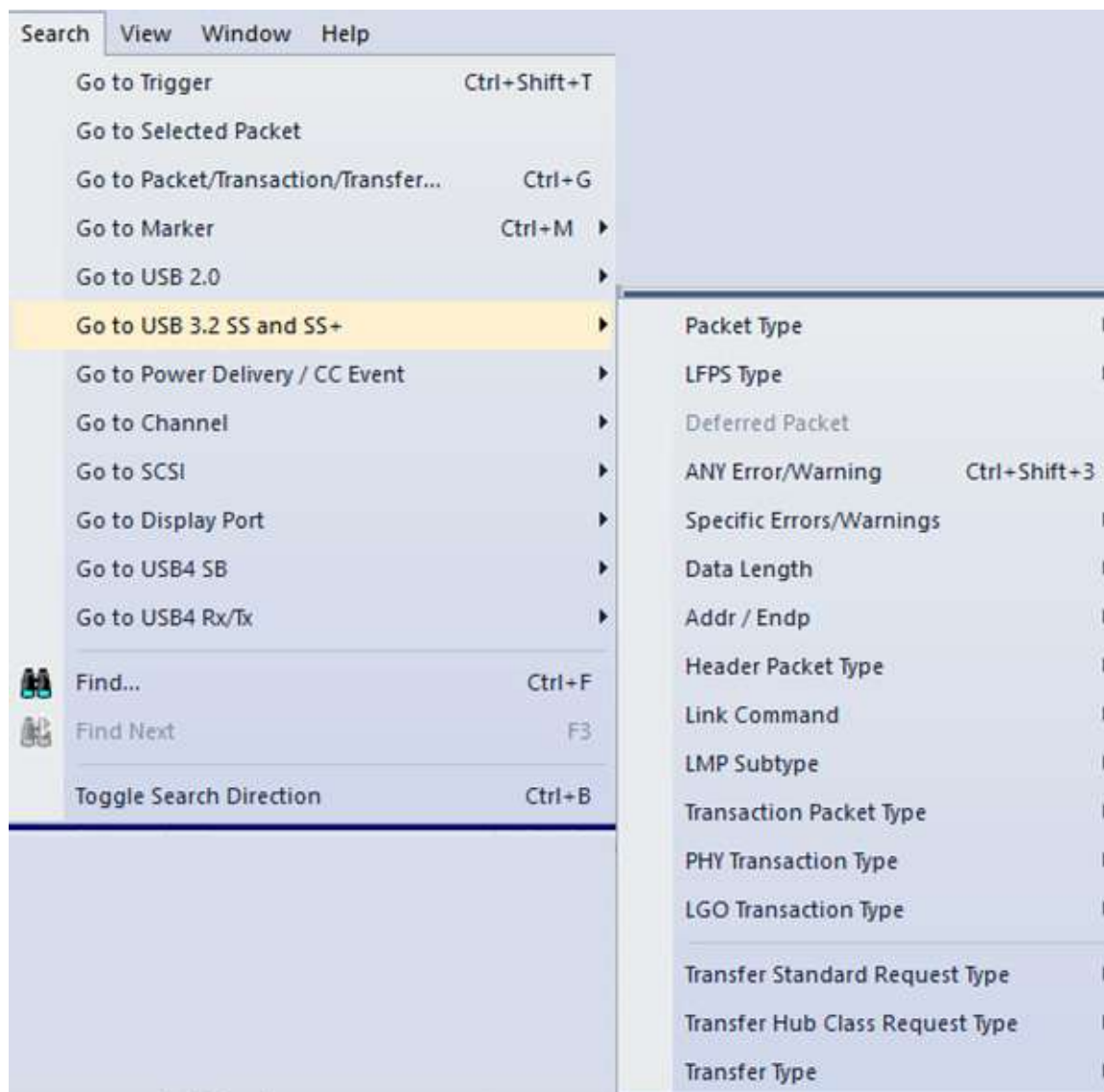


Figure 7.15: Go To USB 3.2 Menu Option

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.

7.6.1 Packet Type

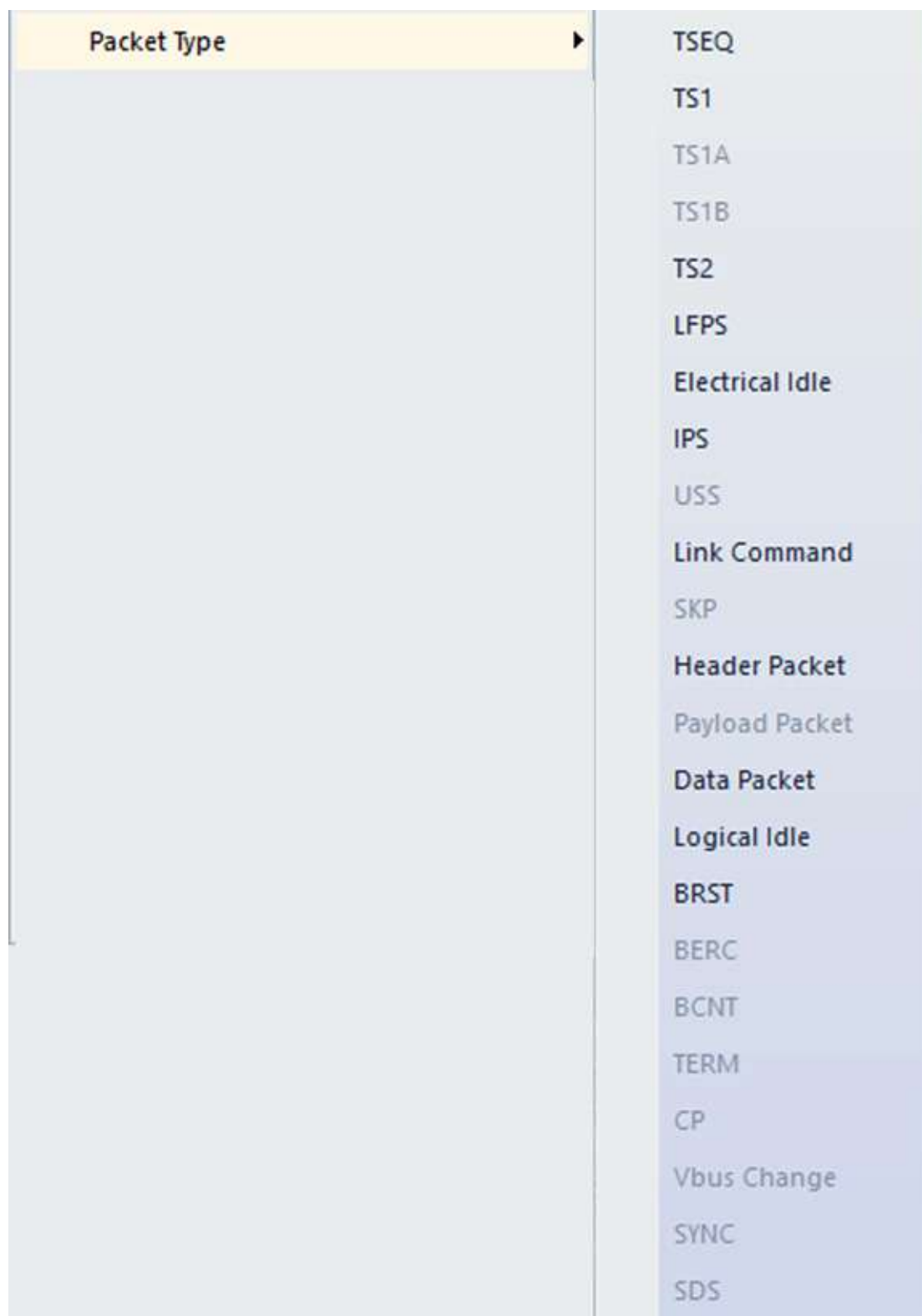


Figure 7.16: Packet Type Menu Option

Select the Packet Type to which you want to go.

7.6.2 LFPS Type

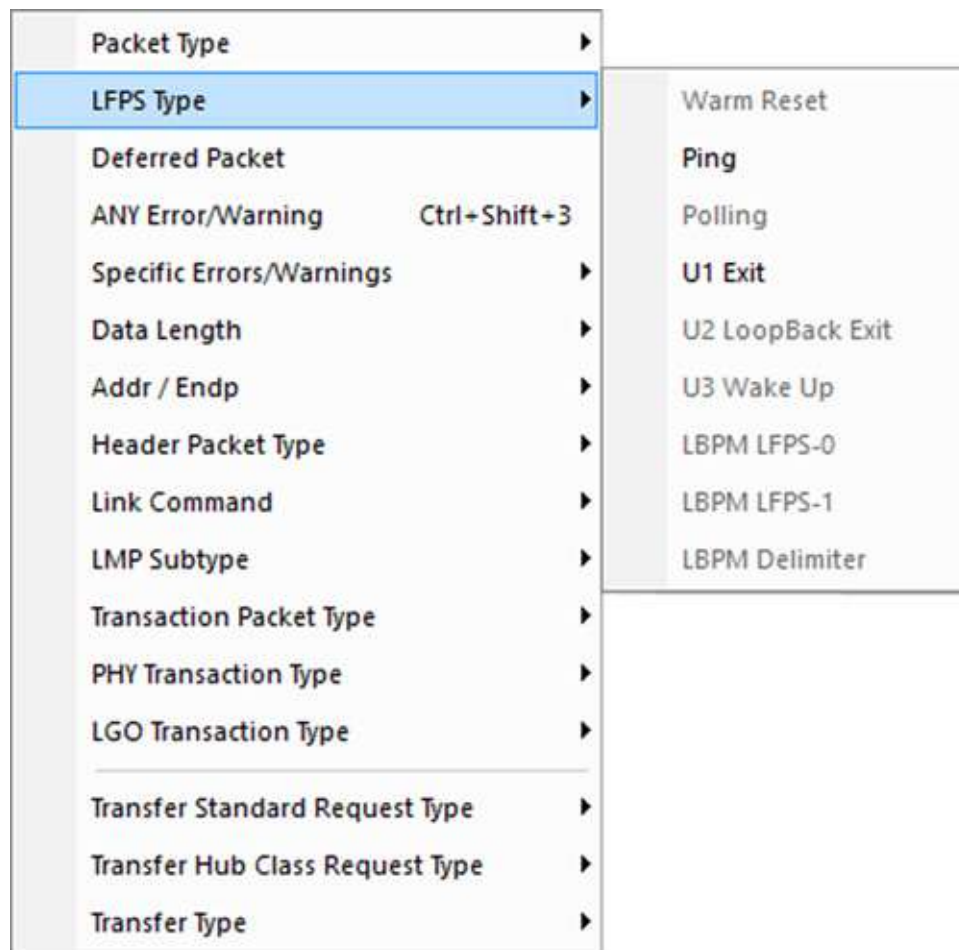


Figure 7.17: LFPS Type Menu Option

Select the LFPS Subtype to which you want to go.

7.6.3 Deferred Packet

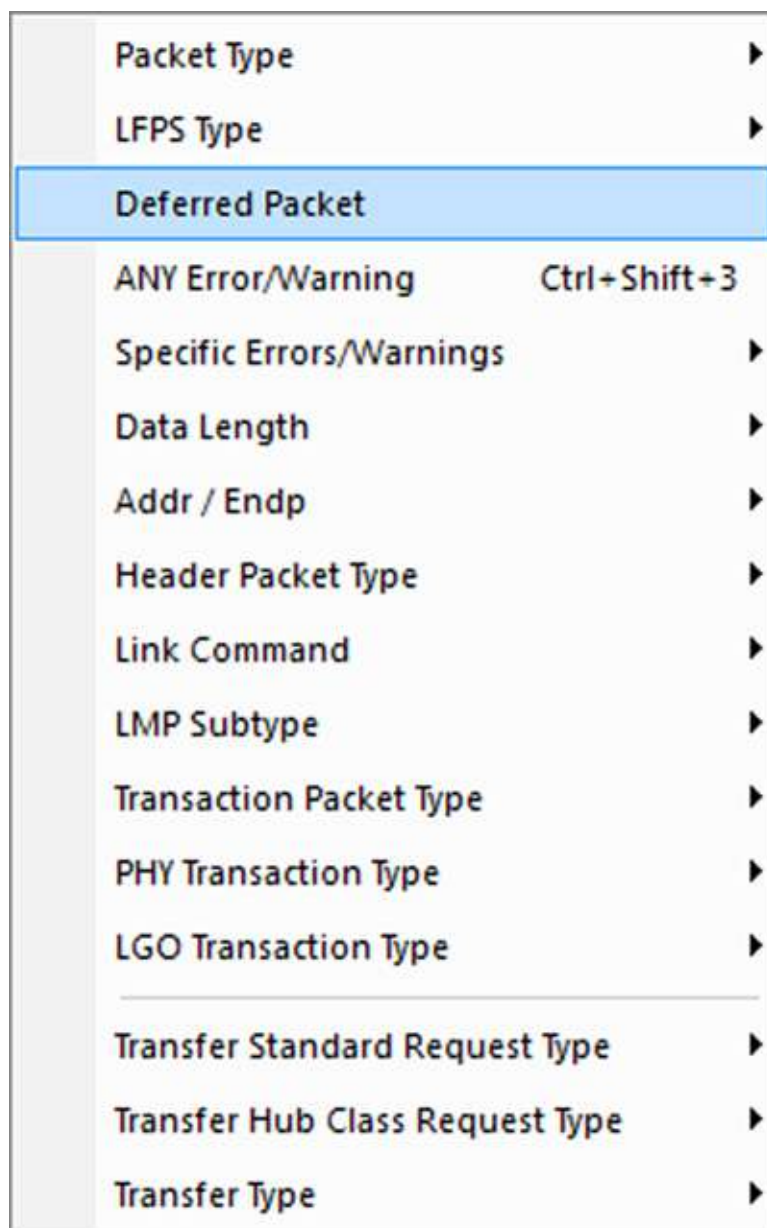


Figure 7.18: Deferred Packet Menu Option

7.6.4 ANY Error/Warning

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

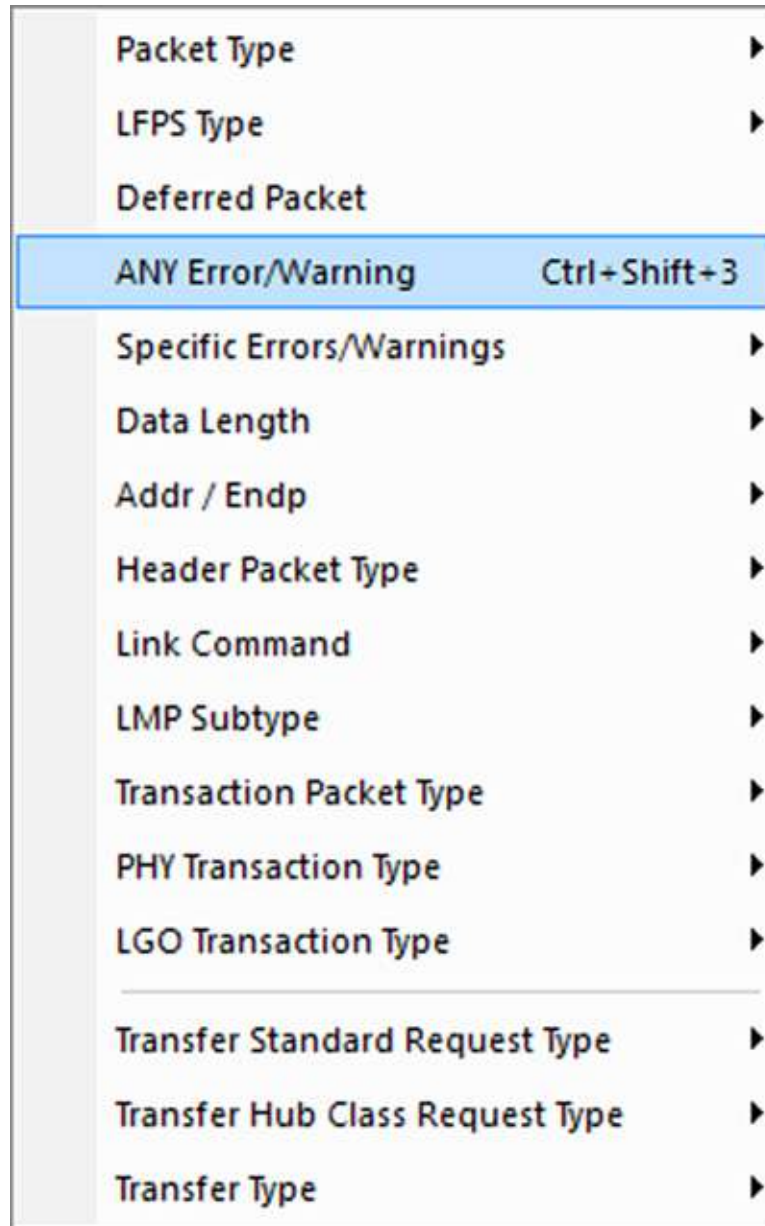


Figure 7.19: Any Error /Warning Menu Option

7.6.5 Specific Errors/Warnings

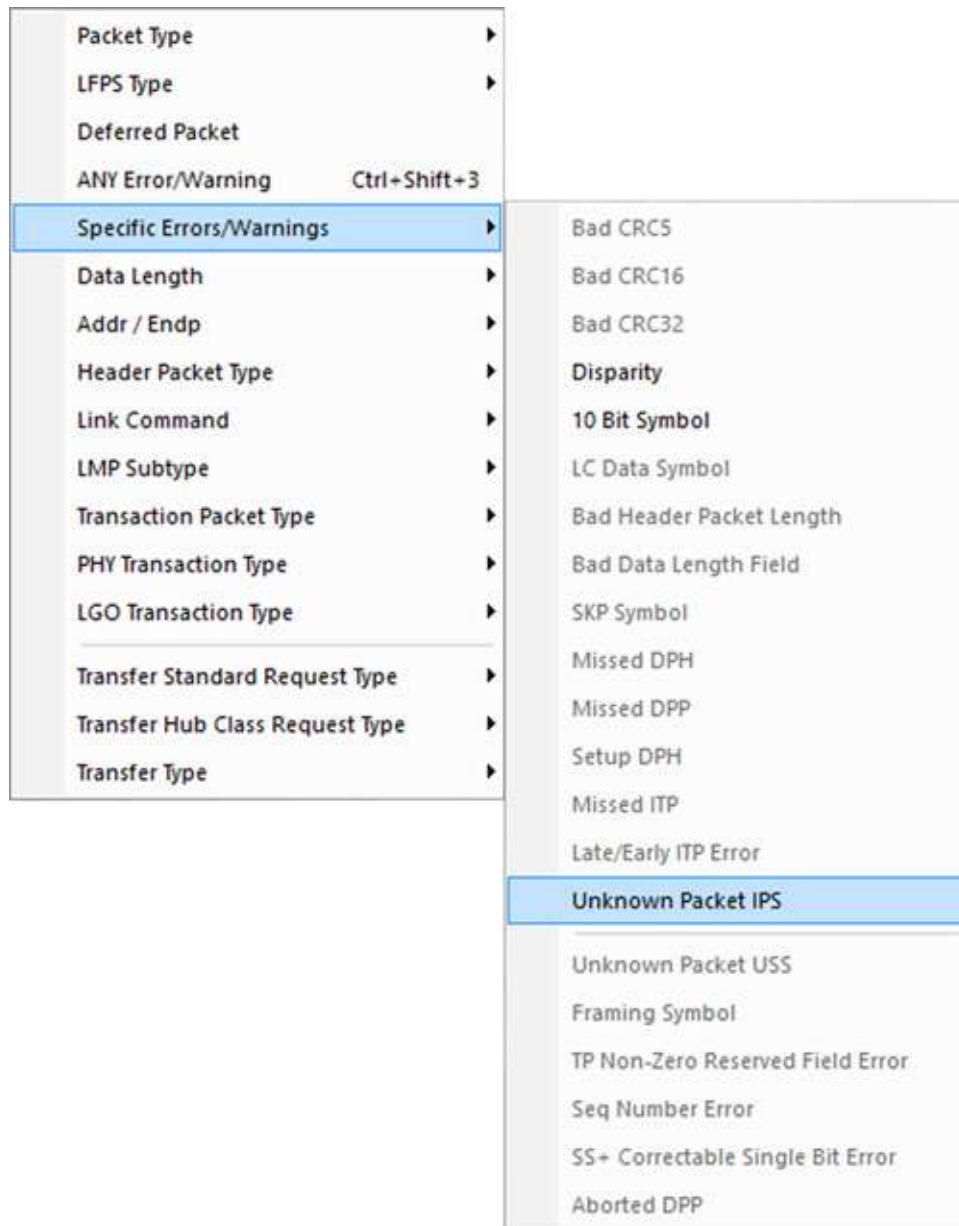


Figure 7.20: Specific Errors/Warnings Menu Option

Select the specific error or warning 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.

7.6.6 Data Length

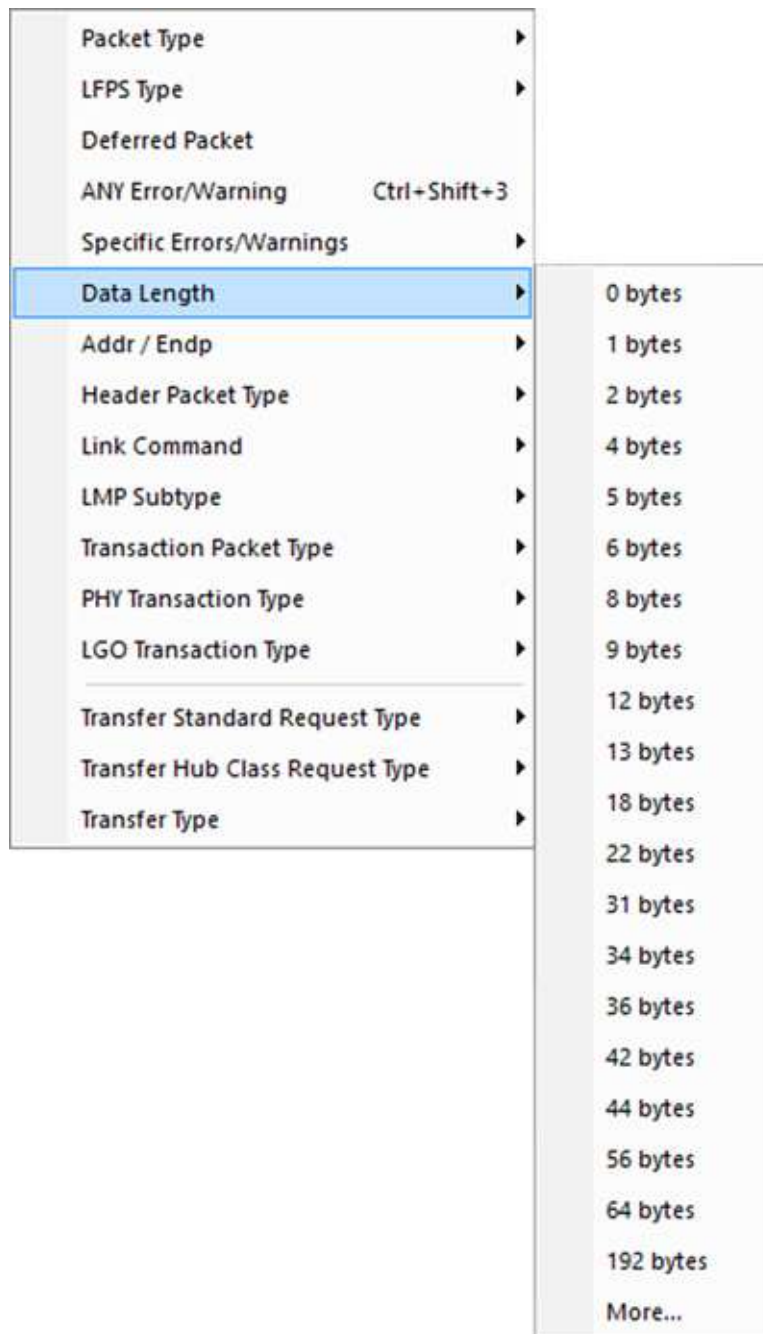


Figure 7.21: Data Length Menu Option

Select the data length to which you want to go.

7.6.7 Address and Endpoint

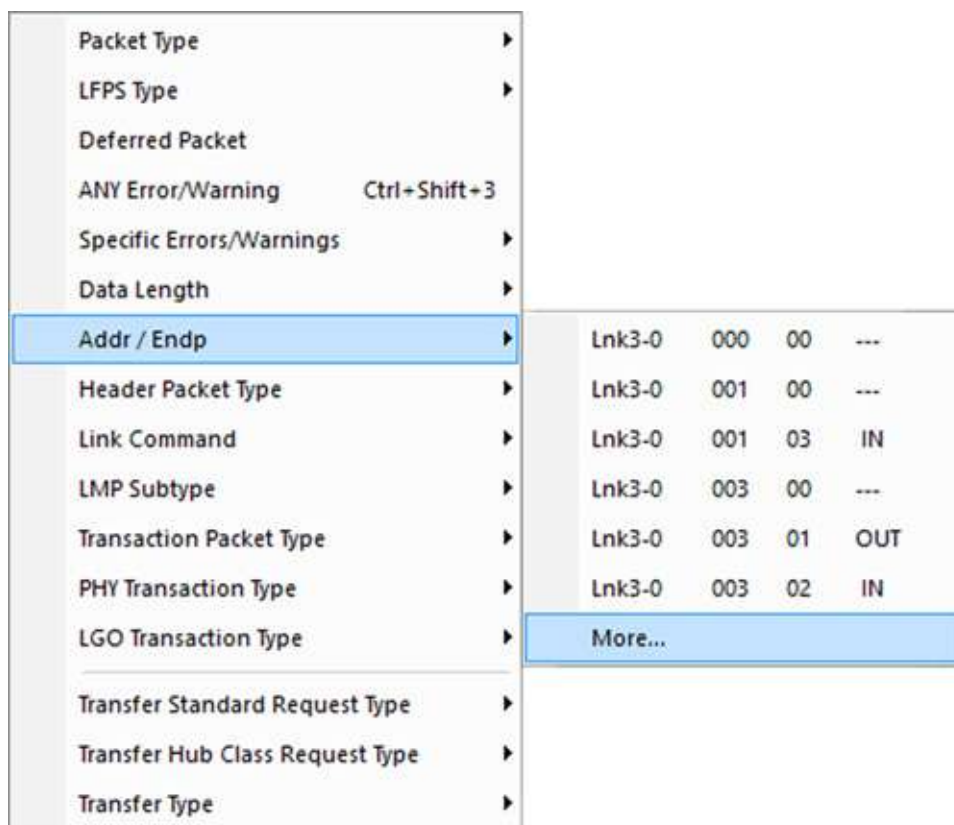


Figure 7.22: Address and Endpoint Menu Option

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

7.6.8 Header Packet Type

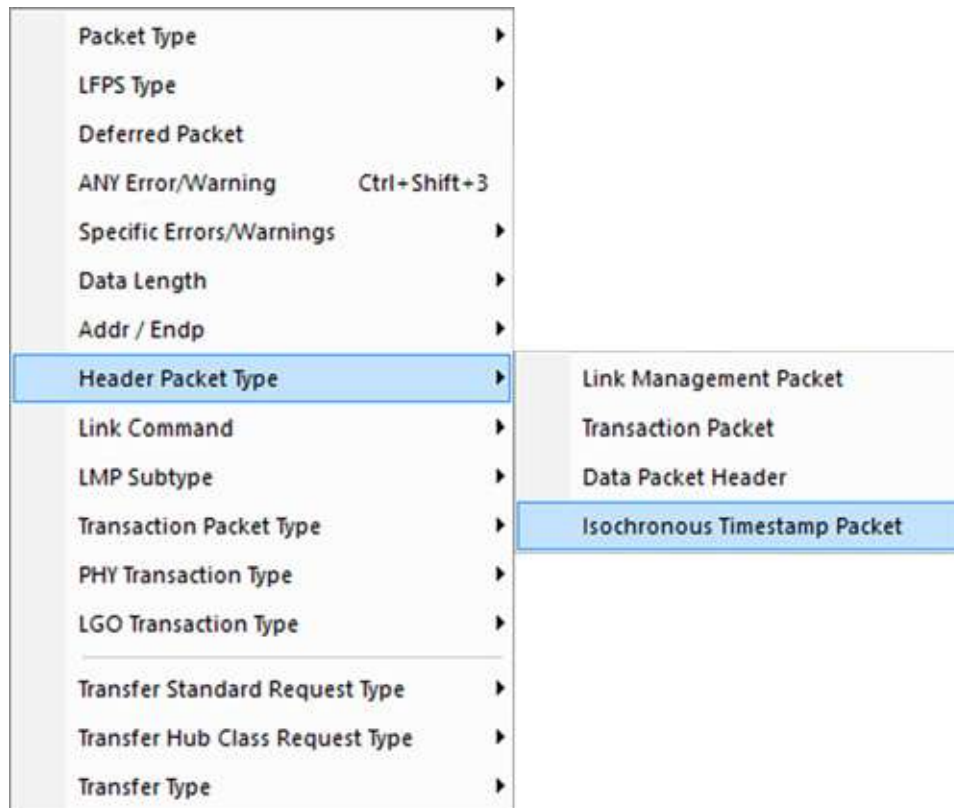


Figure 7.23: Header Packet Type Menu Option

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

7.6.9 Link Command

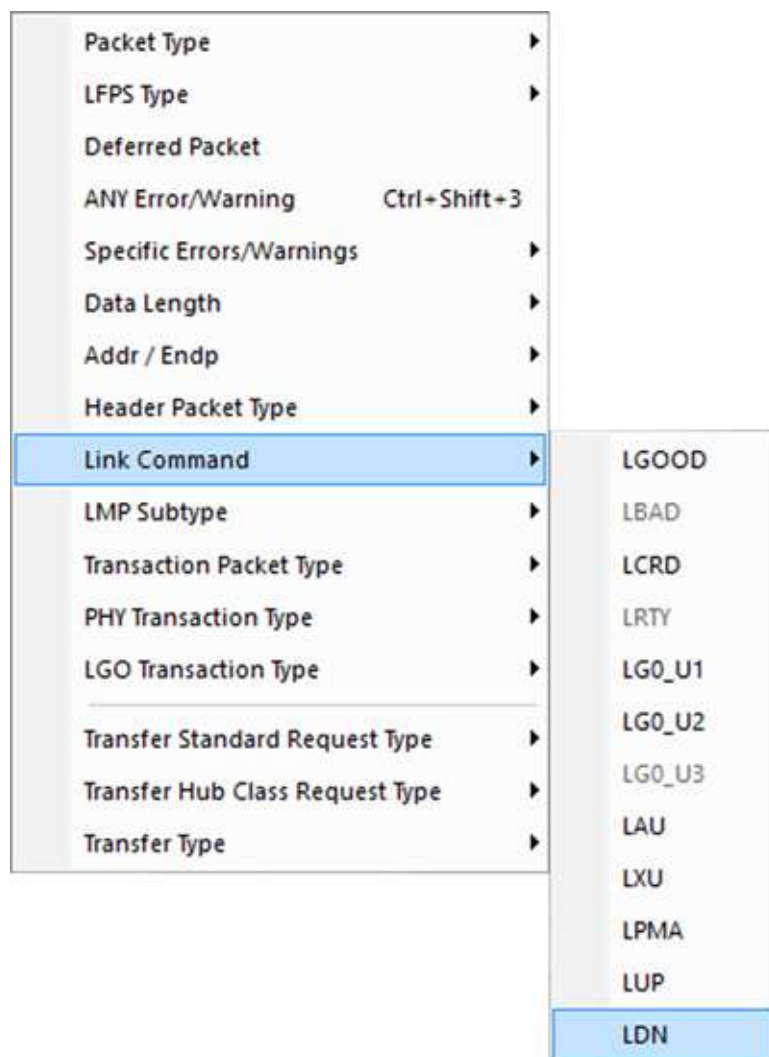


Figure 7.24: Link Command Menu Option

Select the link command to which you want to go.

7.6.10 LMP Subtype

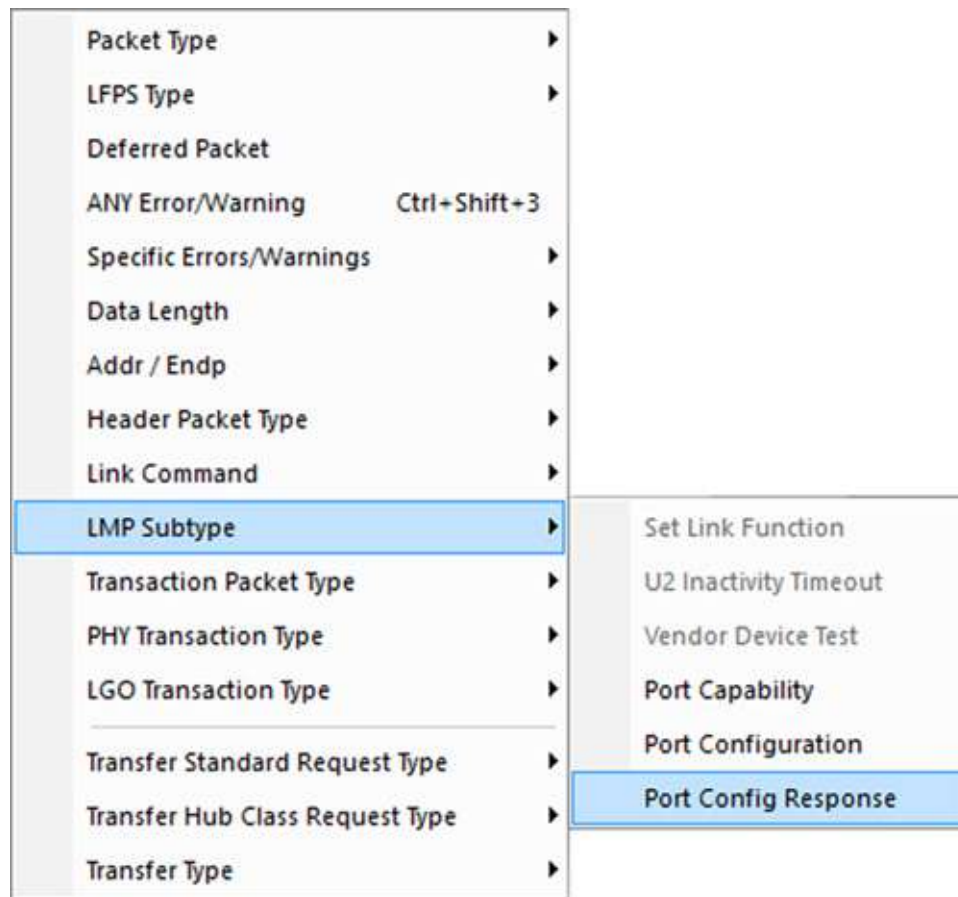


Figure 7.25: LMP Subtype Menu Option

Select the LMP Subtype to which you want to go.

7.6.11 Transaction Packet Type

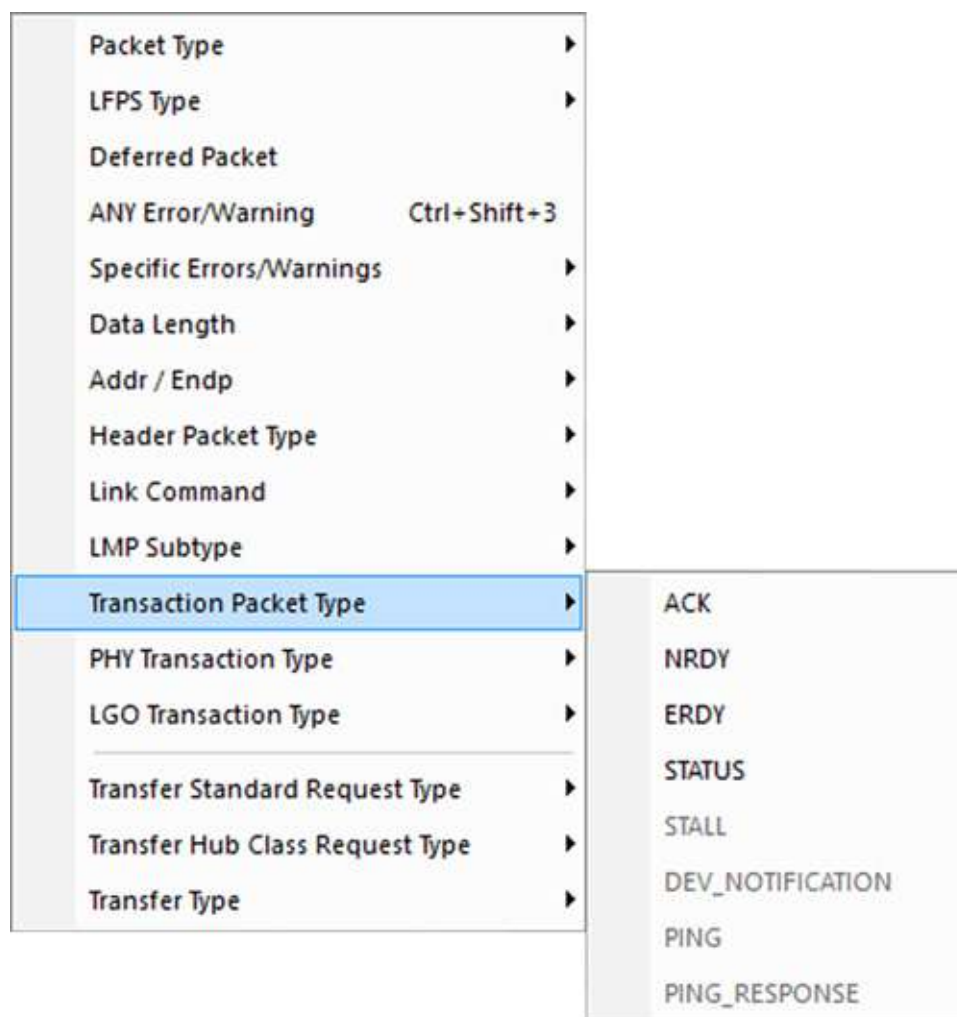


Figure 7.26: Transaction Packet Type Menu Option

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

7.6.12 PHY Transaction Type

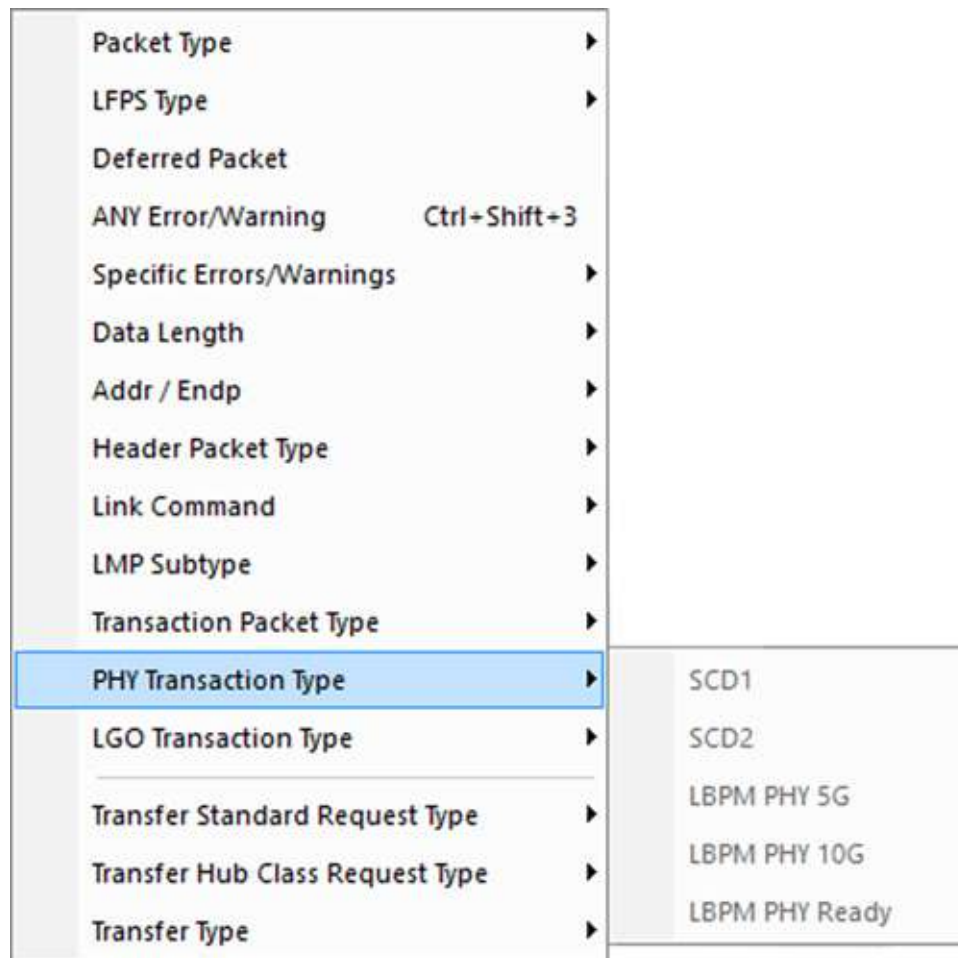


Figure 7.27: PHY Transaction Type

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

7.6.13 LGO Transaction Type

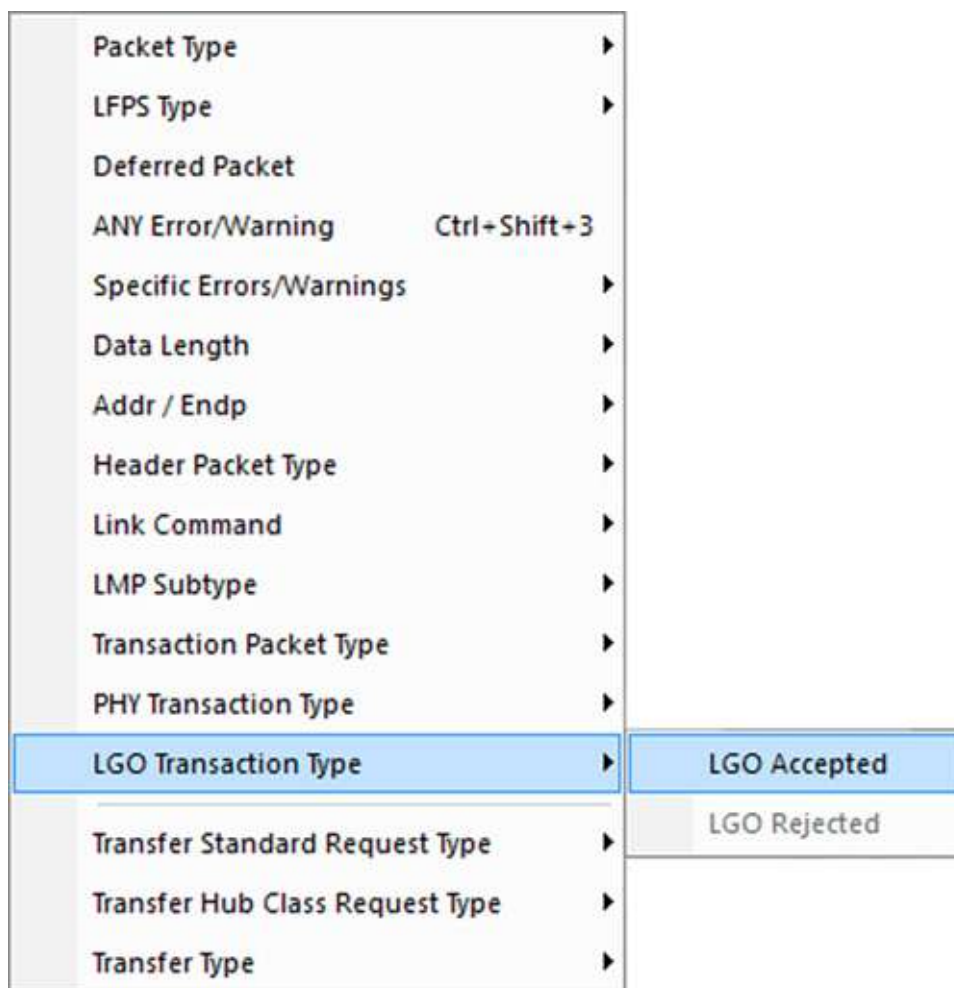


Figure 7.28: LGO Transaction Type Options

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

7.6.14 Transfer Standard Request Type

Allows you to search for Transfer Standard Request Type attributes.

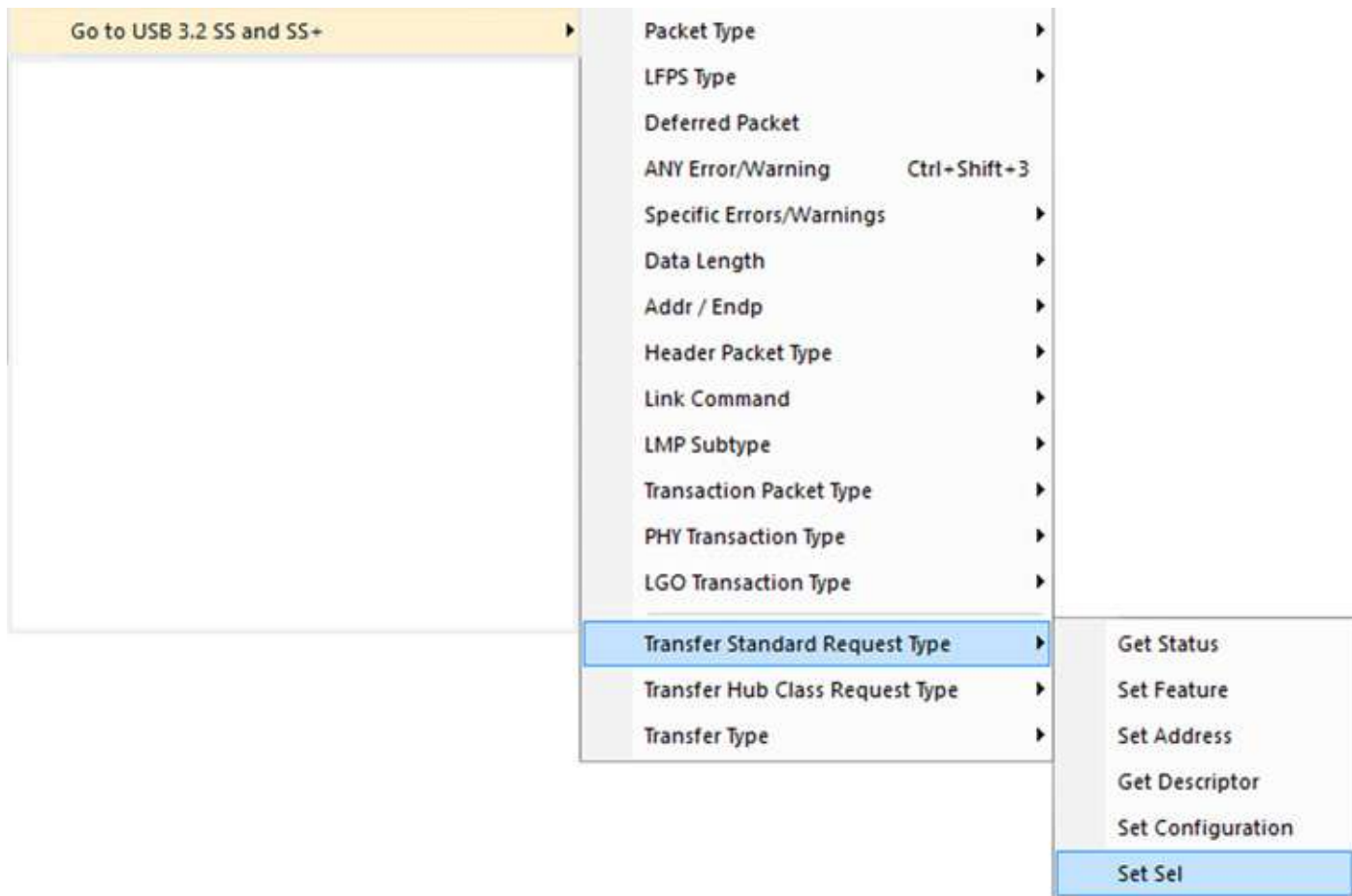


Figure 7.29: Transfer Standard Request Type Option

7.6.15 Transfer Hub Class Request Type

Allows you to search for Transfer Hub Class Request Type attributes.

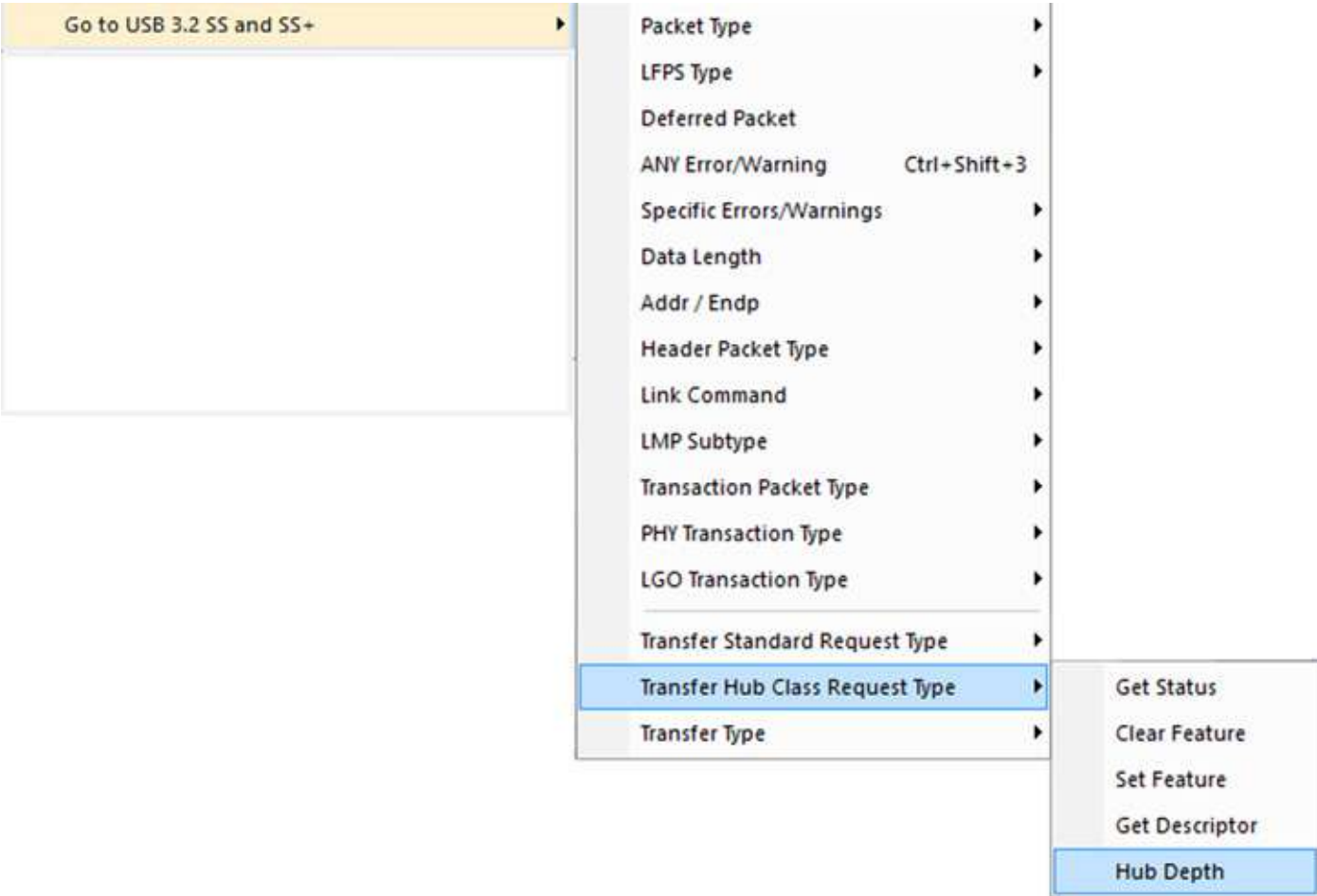


Figure 7.30: Transfer Hub Class Request Type Options

7.6.16 Transfer Type

Allows you to search for Transfer Type attributes.

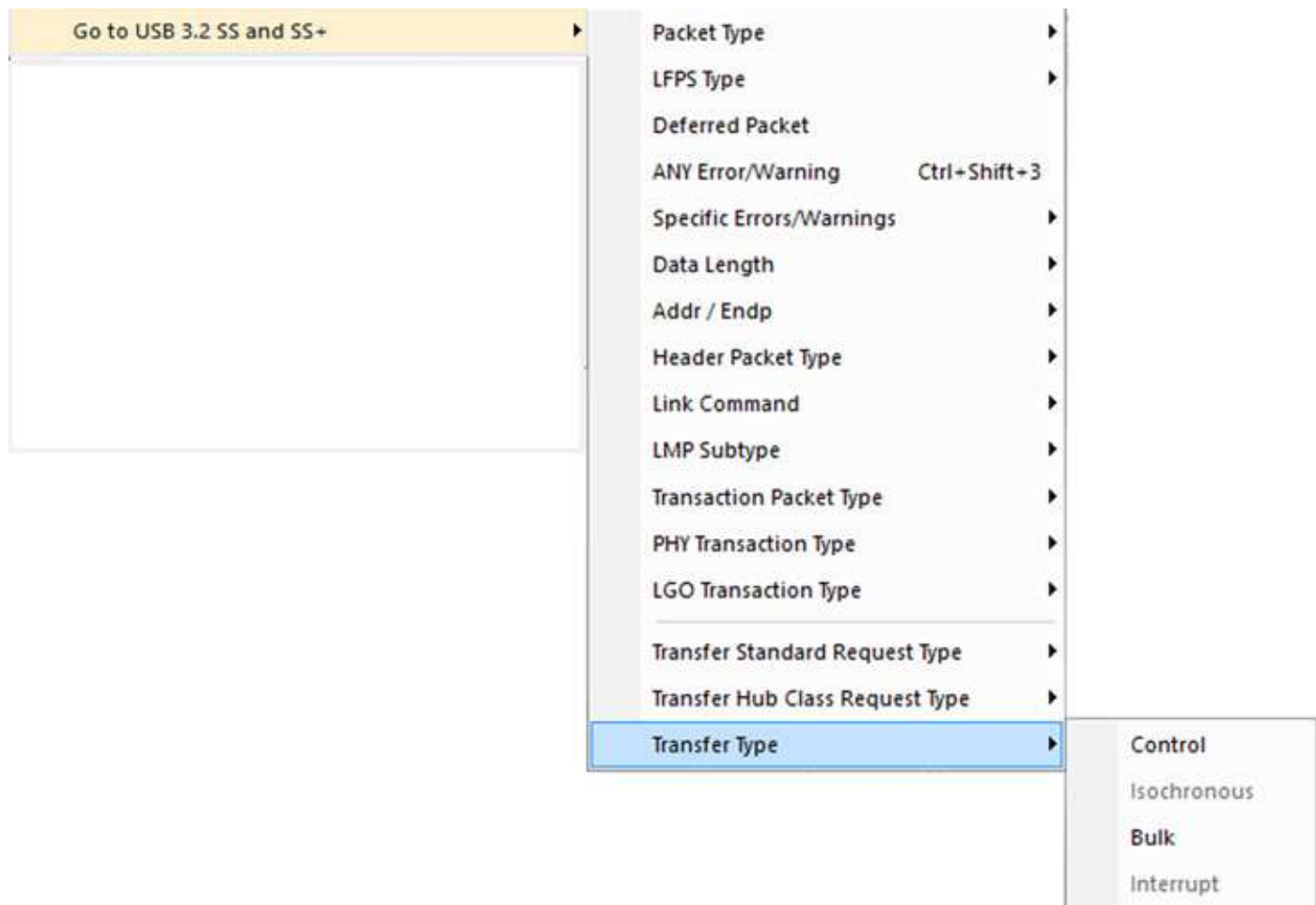


Figure 7.31: Transfer Type Option

7.7 Go To Power Delivery

The following types of packets can be searched for by the USB Protocol Suite software.

7.7.1 Power Delivery: Control Message

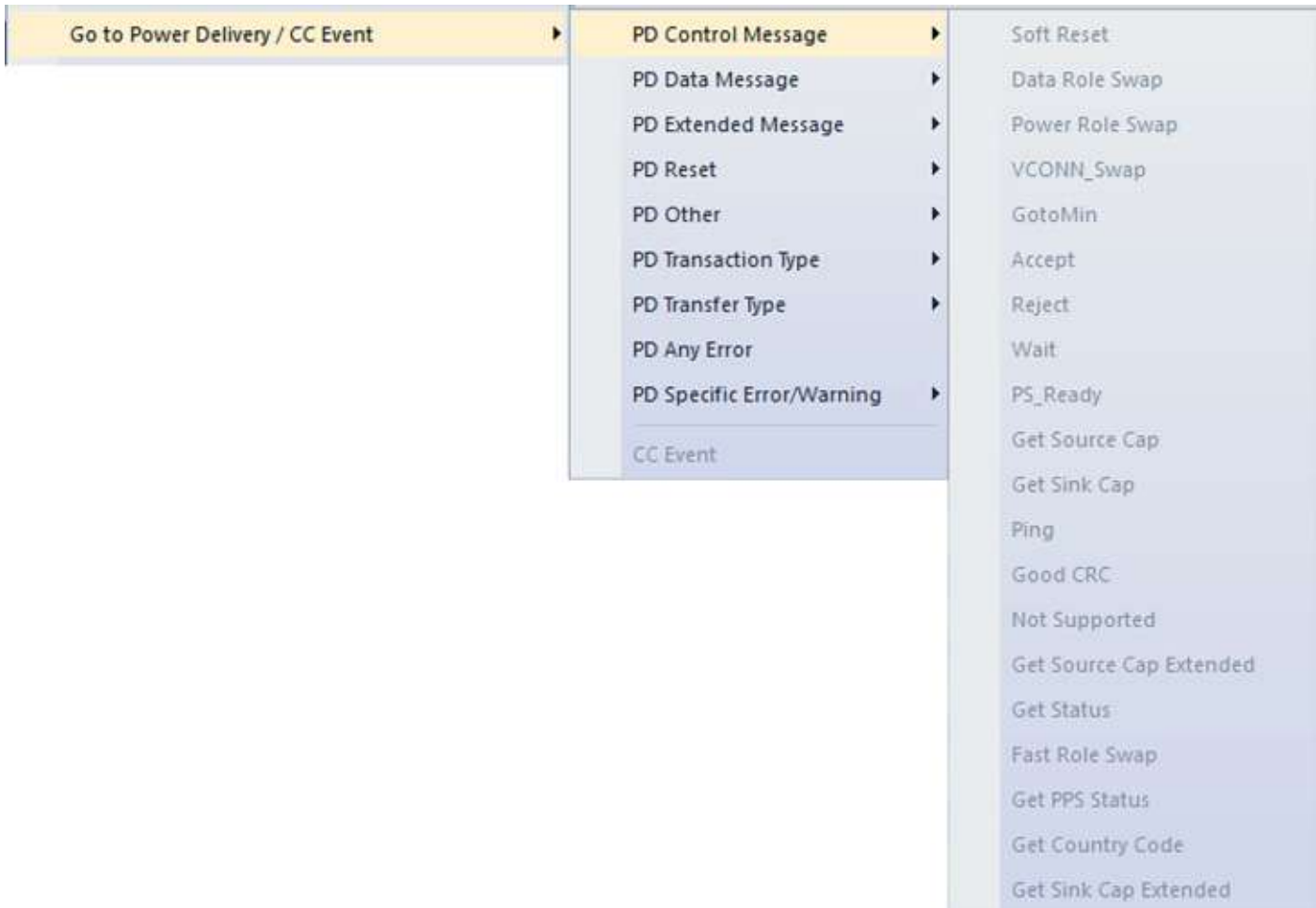


Figure 7.32: Power Delivery: Control Message

You can search for specific types of power delivery control messages.

7.7.2 Power Delivery: Data Message

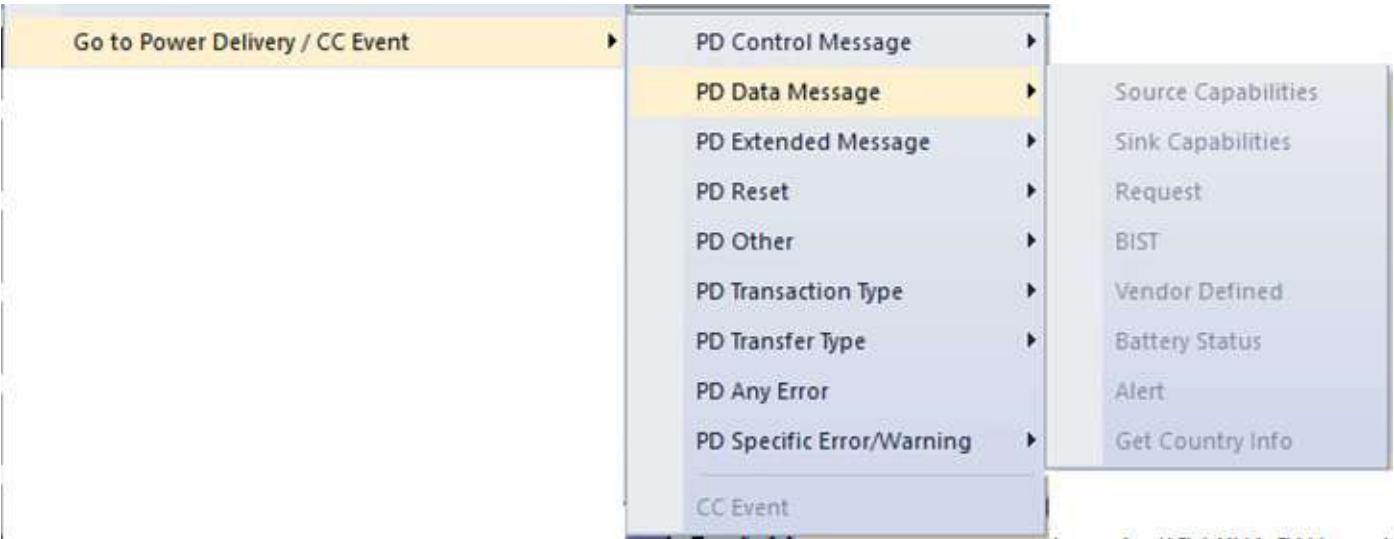


Figure 7.33: Power Delivery: Data Message

You can search on specific types of power delivery data messages.

7.7.3 Power Delivery: Reset

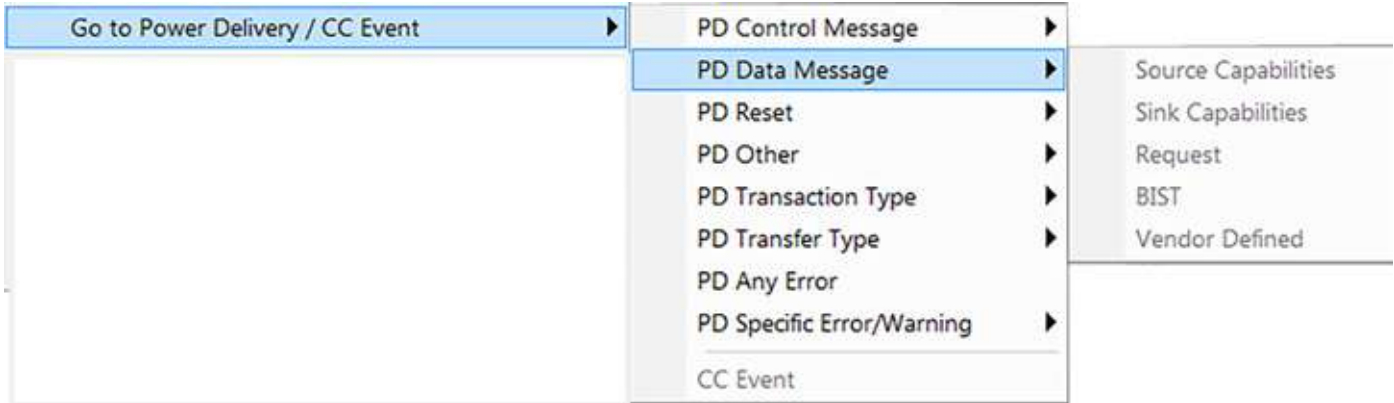


Figure 7.34: Power Delivery: Reset

You can search on specific types of power delivery resets.

7.7.4 Power Delivery: Other

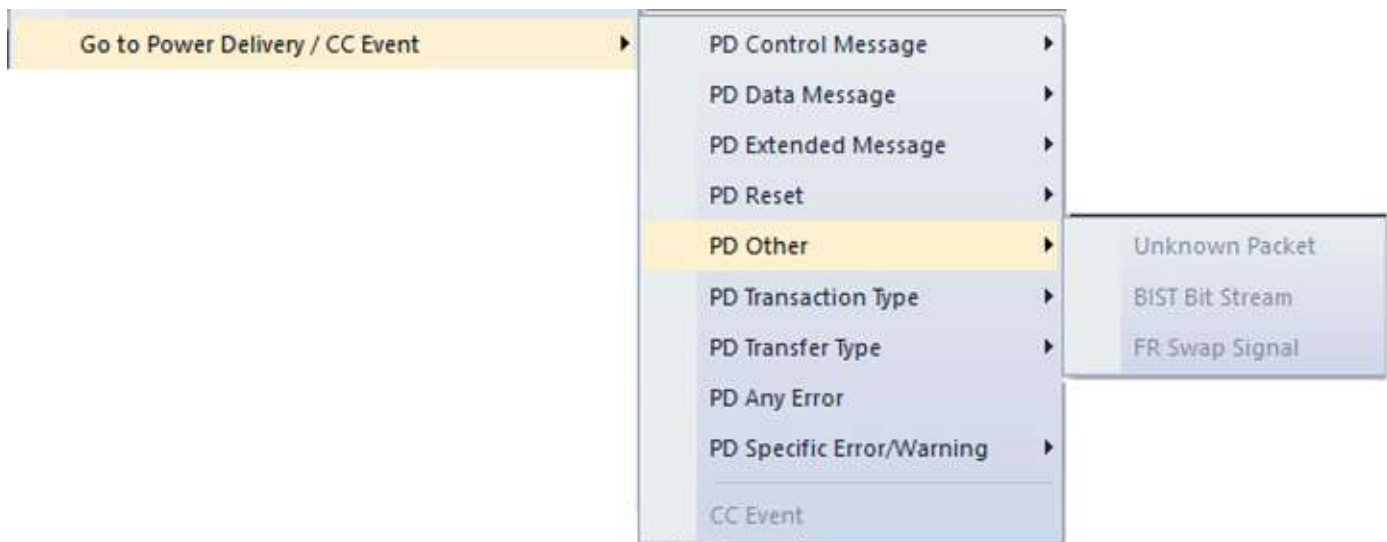


Figure 7.35: Power Delivery: Other Types of Events

You can search on other types of power delivery events.

7.7.5 Power Delivery: Transaction Type

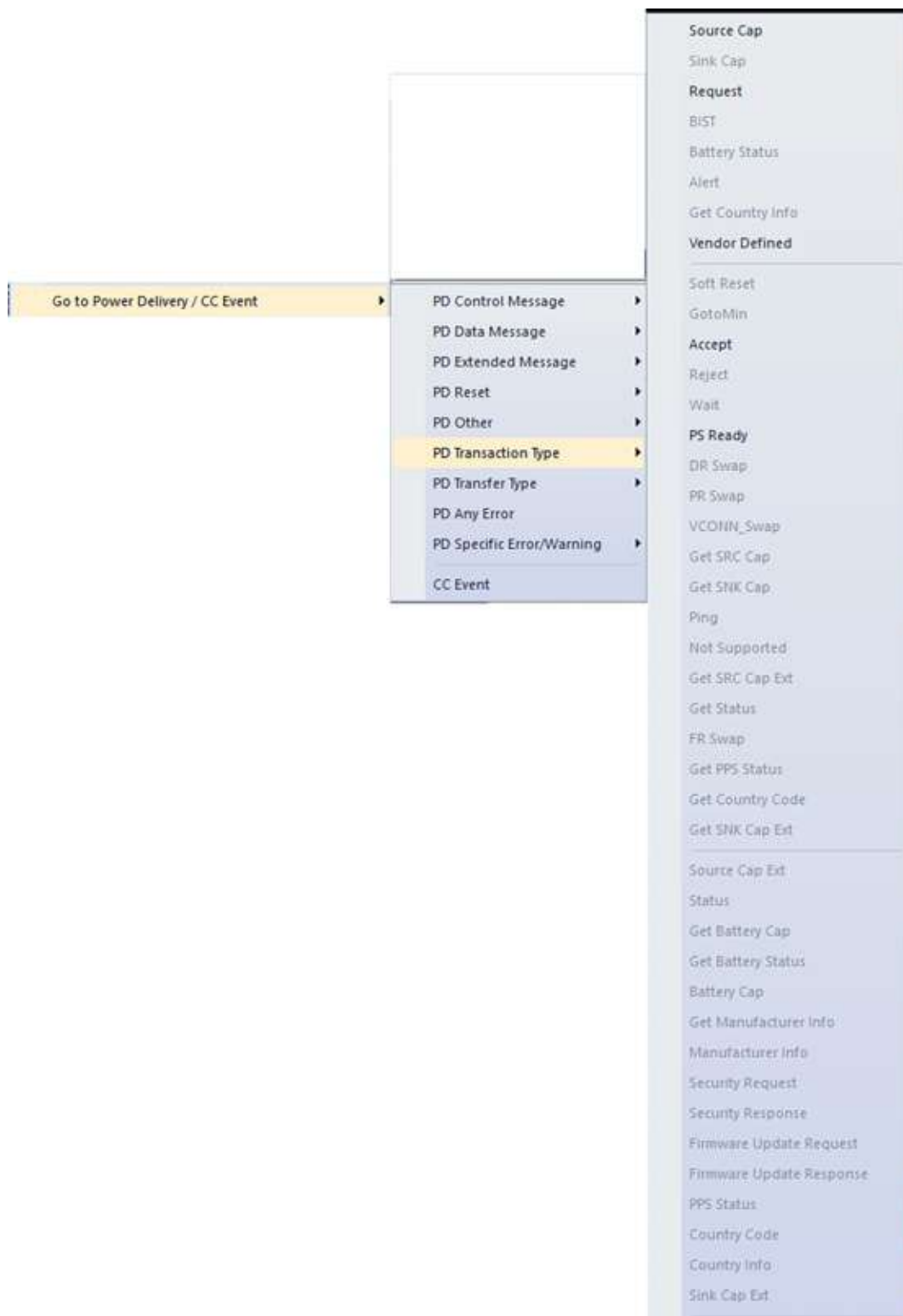


Figure 7.36: Power Delivery: Transaction Types

You can search on specific types of power delivery transaction types.

7.7.6 Power Delivery: Transfer Types

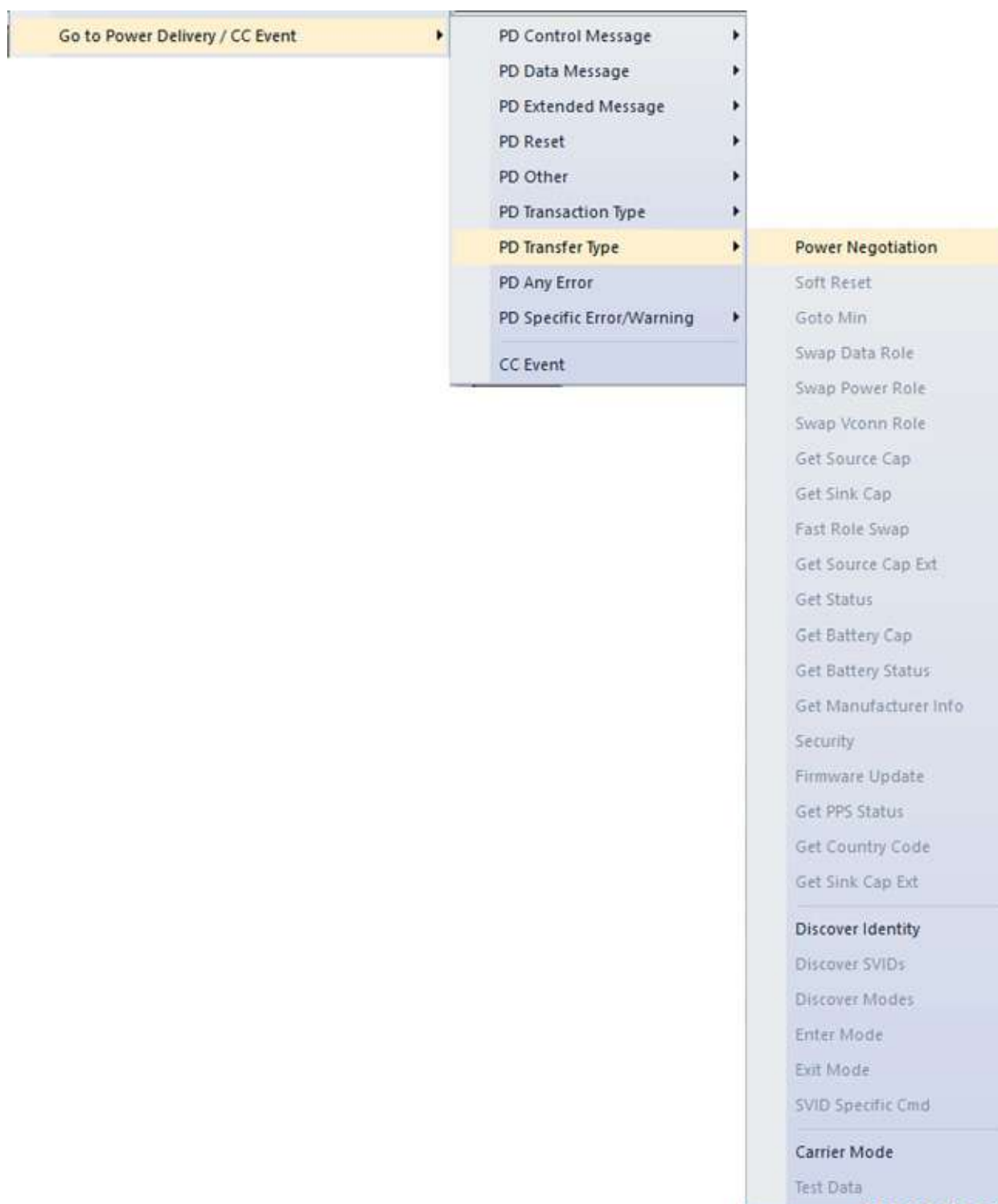


Figure 7.37: Power Delivery: Transfer Types

You can search on a wide variety of power delivery transfer types.

7.7.7 Power Delivery: Any Error

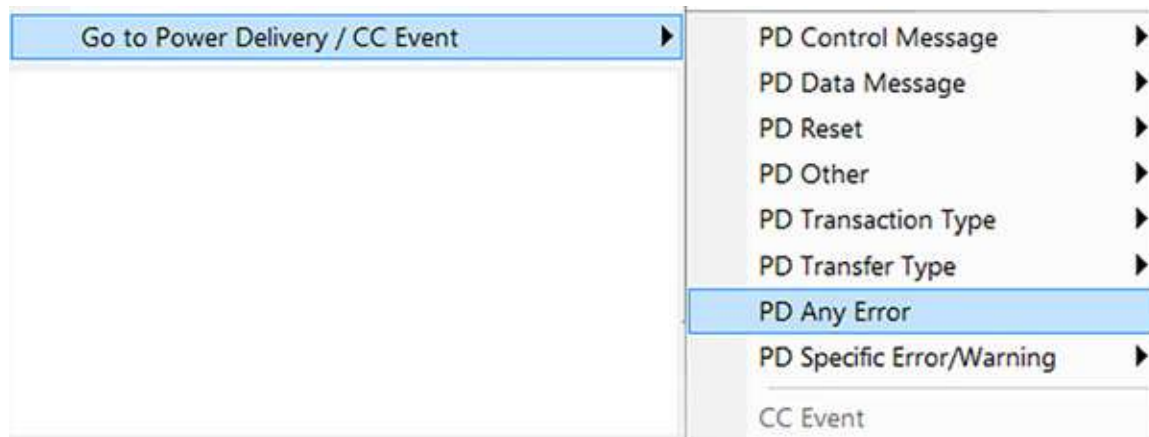


Figure 7.38: Power Delivery: Any Error

You can search on any type of power delivery error.

7.7.8 Power Delivery: Specific Error or Warning

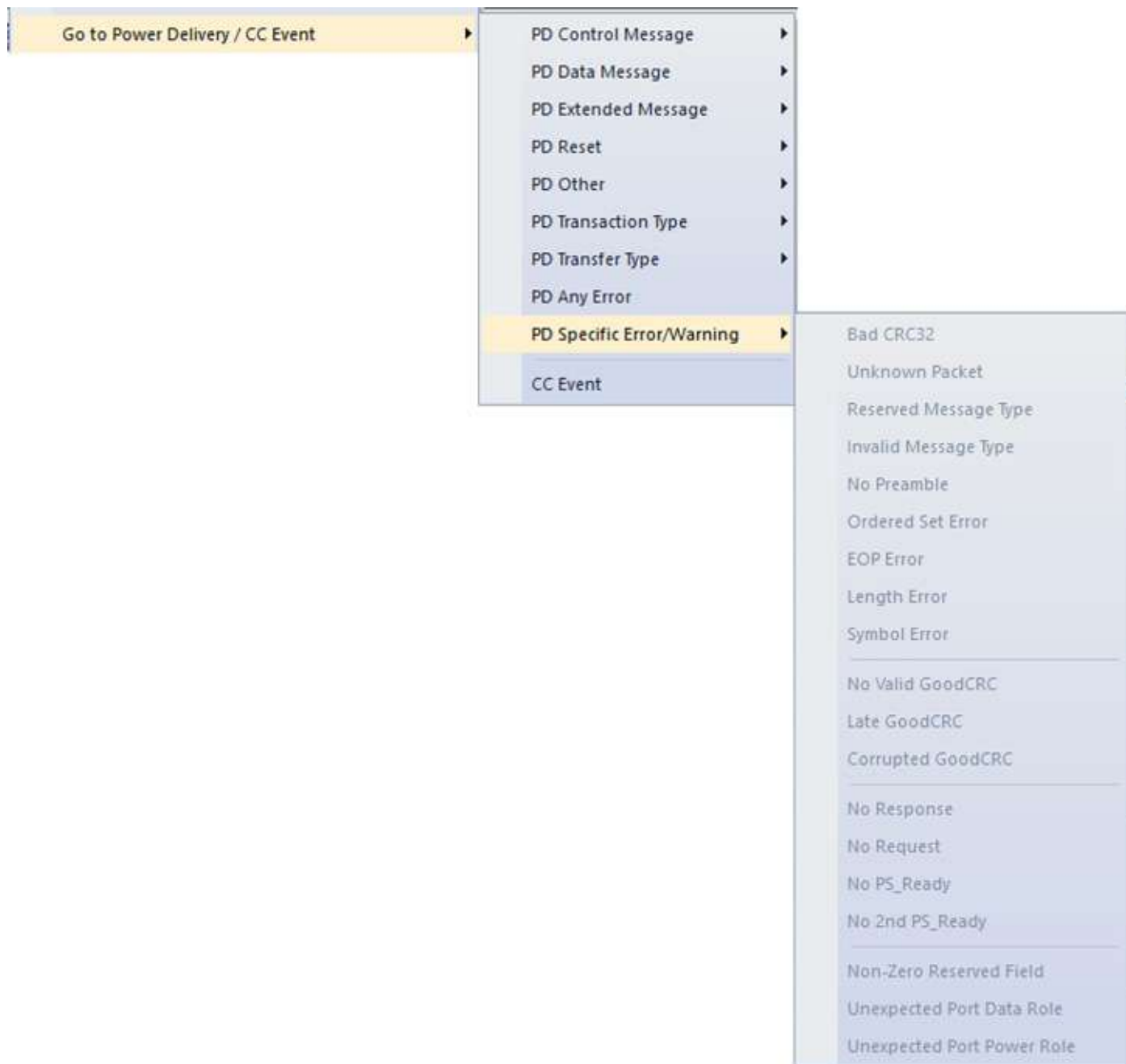


Figure 7.39: Power Delivery: Specific Error or Warning

You can search on a specific type of power delivery error or warning.

7.7.9 Power Delivery: CC (Configuration Channel) Event

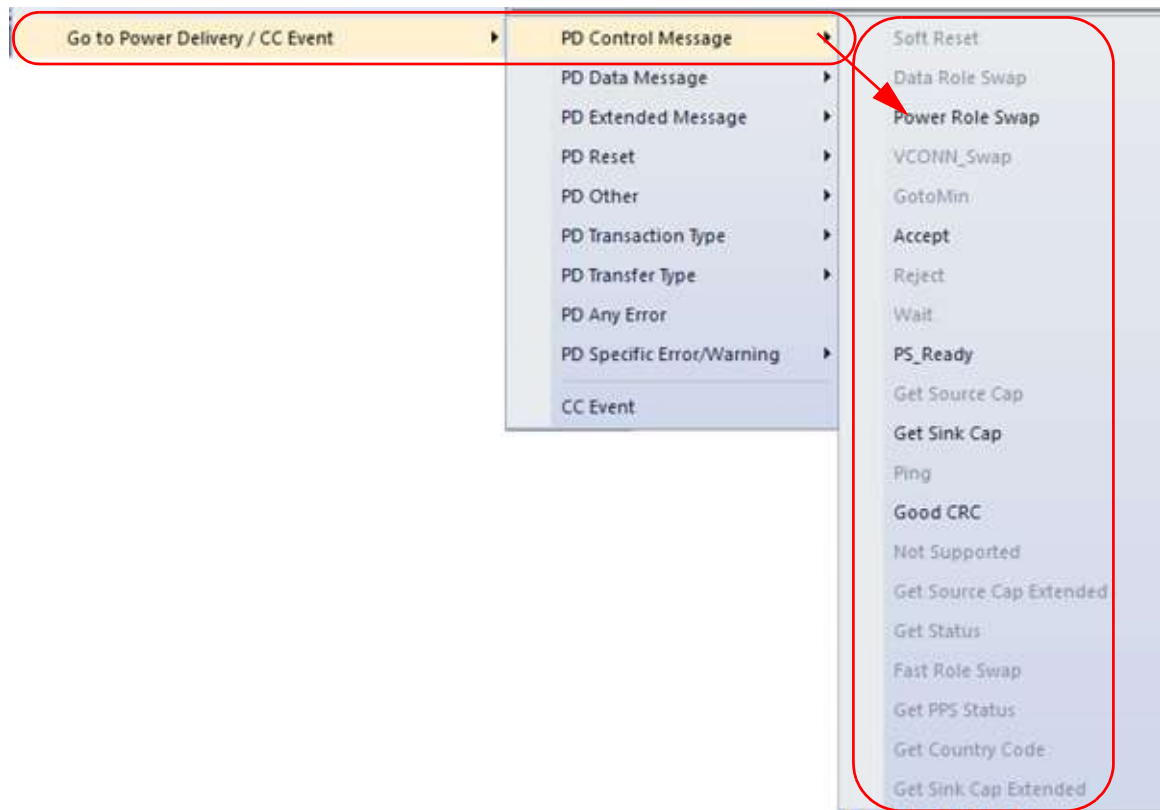


Figure 7.40: Power Delivery: Configuration Channel (CC) Events

You can search for a specific configuration channel event:

- ☐ PD Control Message
- ☐ PD Data Message
- ☐ PD Reset
- ☐ PD Other
- ☐ PD Transaction Type
- ☐ PD Transfer Type
- ☐ PD Any Error
- ☐ PD Specific Error/Warning
- ☐ CC Event

7.8 Go To Channel

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

The following types of packets can be searched for by the USB Protocol Suite software.

Go to Channel	0	Ctrl+Alt+Shift+0
	1	Ctrl+Alt+Shift+1
	2	Ctrl+Alt+Shift+2
	3	Ctrl+Alt+Shift+3

Figure 7.41: Channel Menu Option

7.9 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.

The following types of packets can be searched for by the USB Protocol Suite software.

7.9.1 Go To SCSI Menu Selection Example

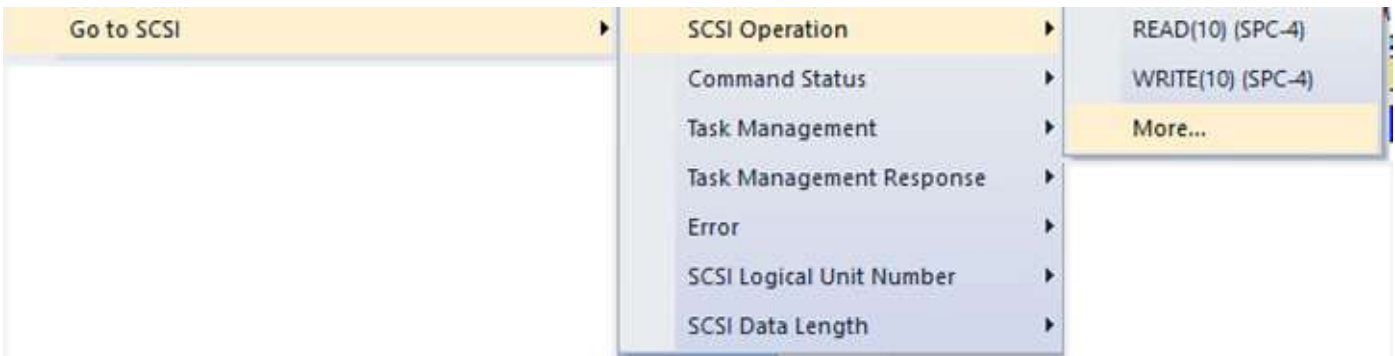


Figure 7.42: Go To SCSI Menu Selection Example

7.9.2 SCSI Command Status

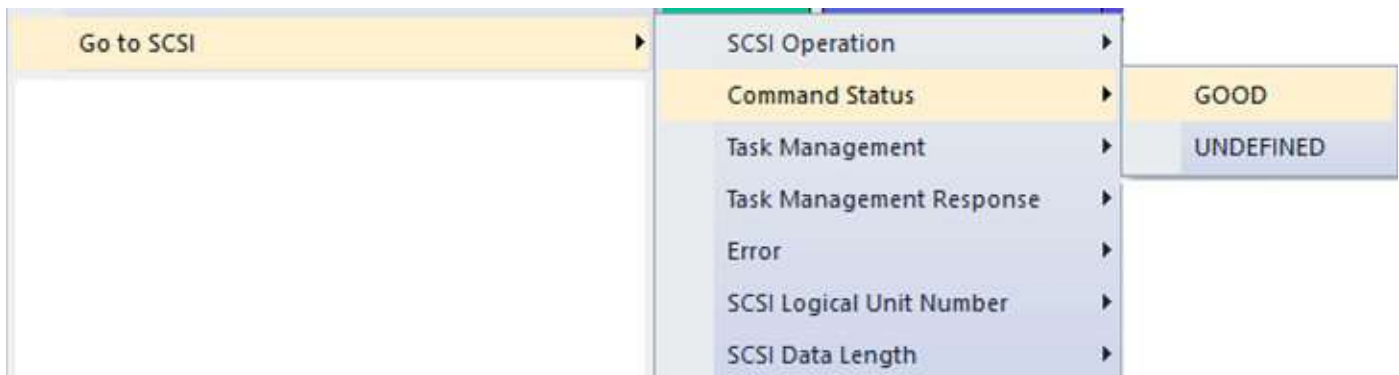


Figure 7.43: SCSI: Command Status

7.9.3 SCSI Error

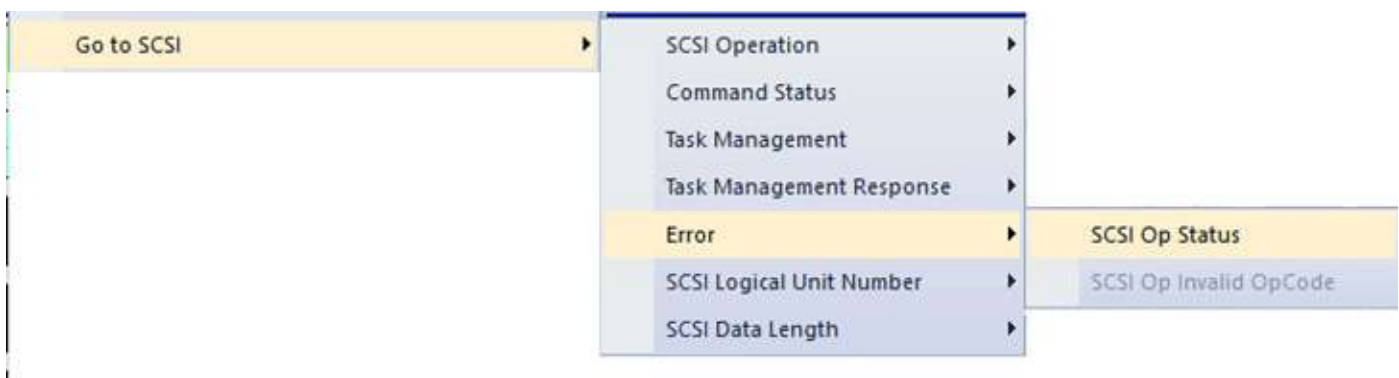


Figure 7.44: SCSI: Error -> SCSI Op Status

7.9.4 SCSI Logical Unit

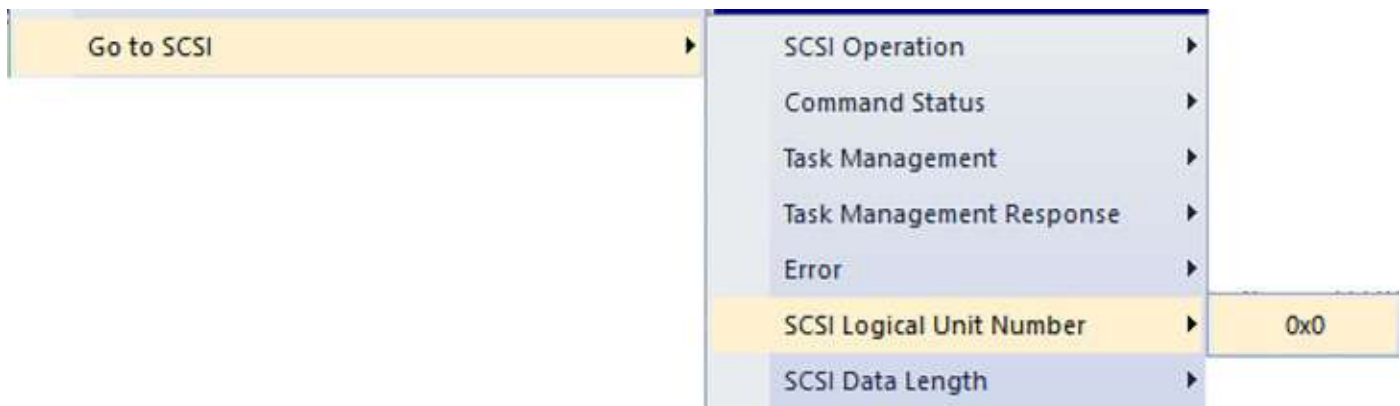


Figure 7.45: SCSI: Error -> SCSI Op Status

7.9.5 SCSI Data Length

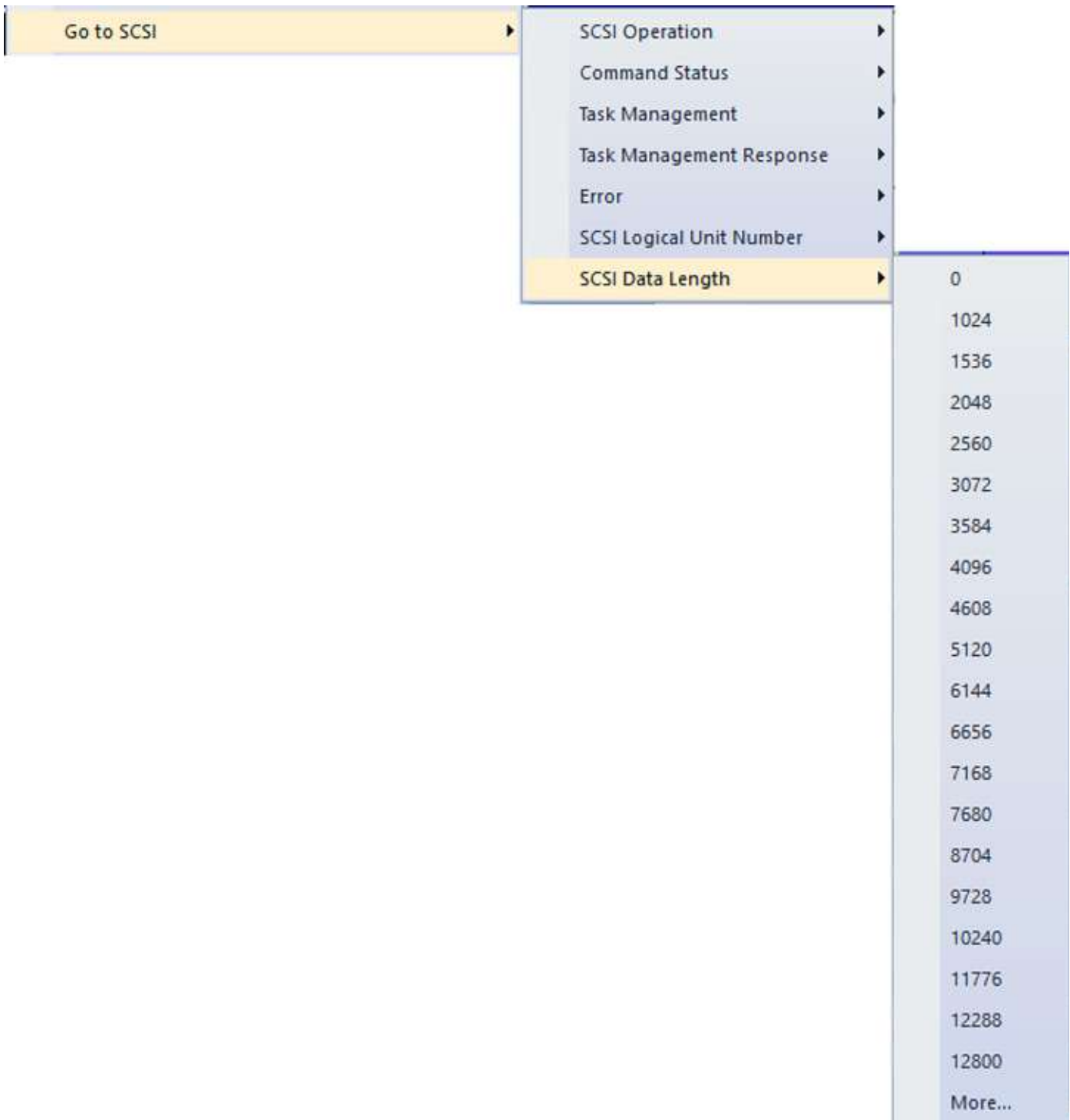


Figure 7.46: SCSI: SCSI Data Length

7.10 Go to Display Port

The following types of packets can be searched for by the USB Protocol Suite software.

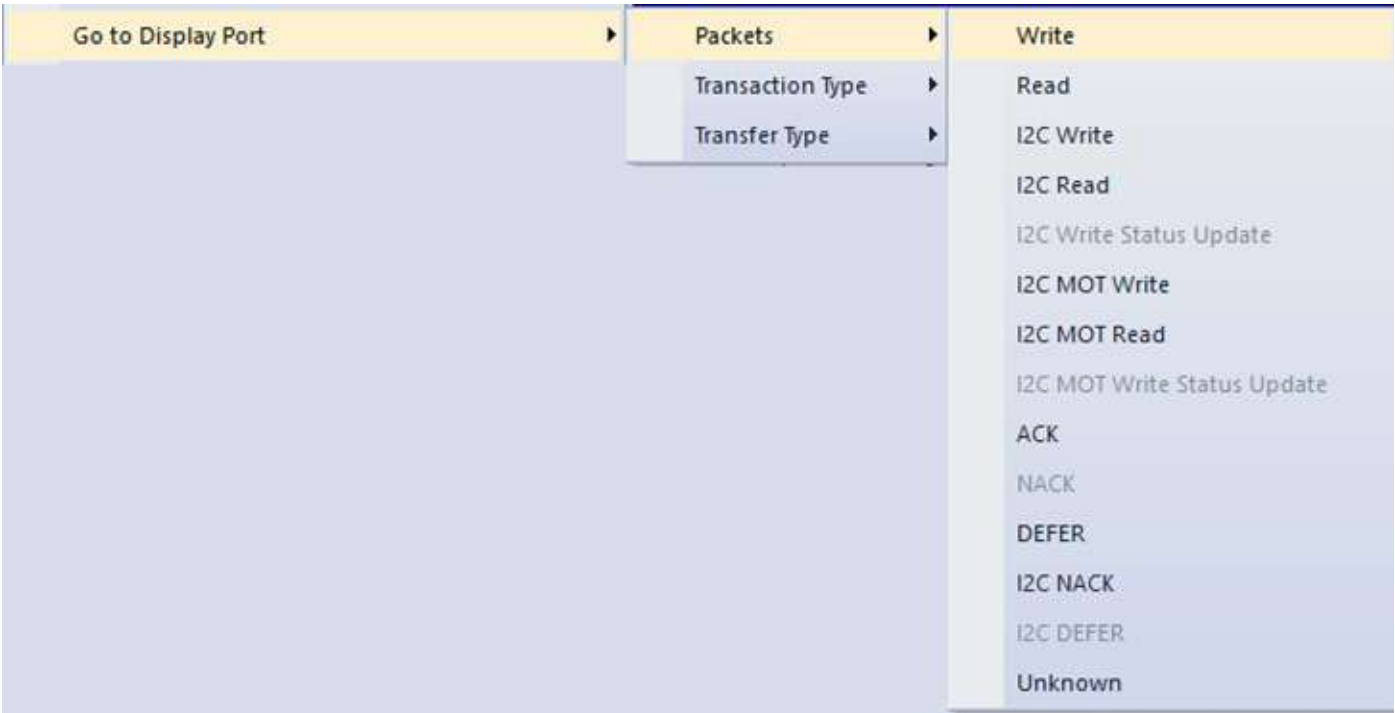


Figure 7.47: Go to Display Port: Packets

7.10.1 Display Port: Transaction Type

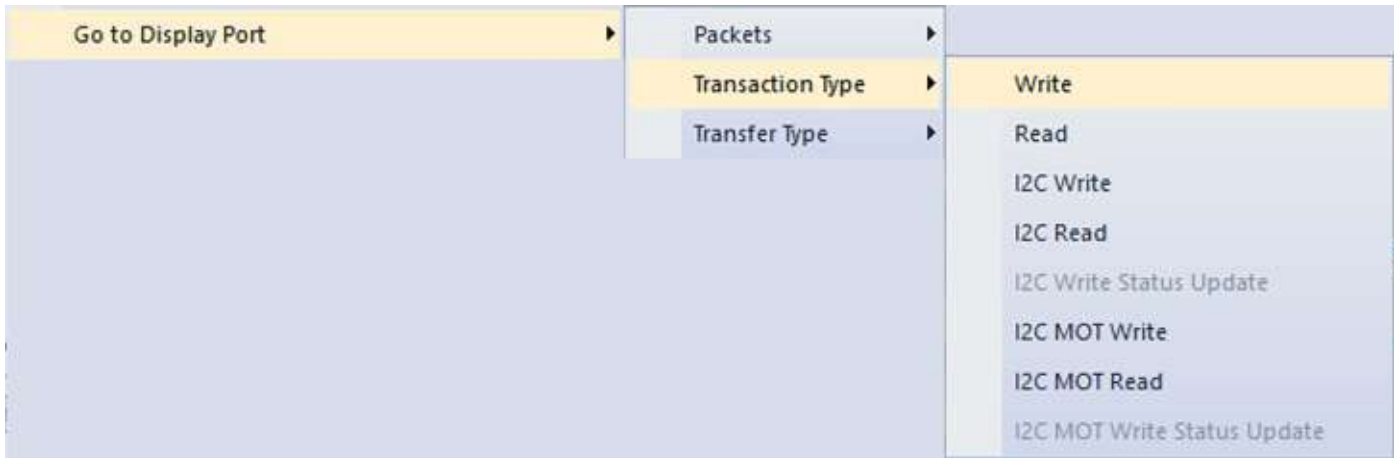


Figure 7.48: Go to Display Port: Transaction Type

7.10.2 Display Port: Transfer Type

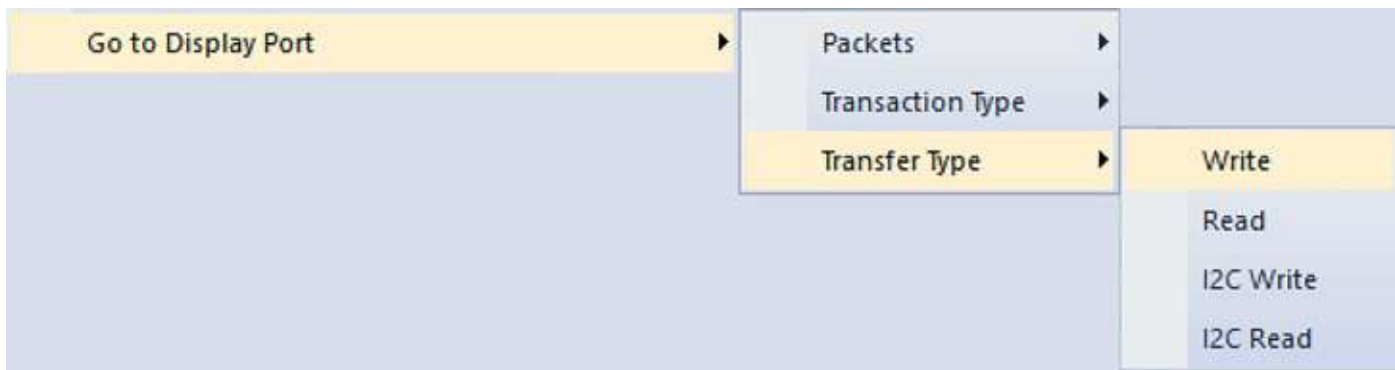


Figure 7.49: Go to Display Port: Transfer Type

7.11 Go to USB4 SB

The following types of packets can be searched for by the USB Protocol Suite software.



Figure 7.50: Go to USB4 SB

You can search for several types of USB3 Sideband (SB) Packets:

- ☐ AT: See [Figure 7.51 on page 487](#).
- ☐ RT: See [Figure 7.52 on page 487](#).
- ☐ LT: See [Figure 7.53 on page 488](#).
- ☐ Events: See [Figure 7.54 on page 488](#).

7.11.1 Go to USB4 SB: AT

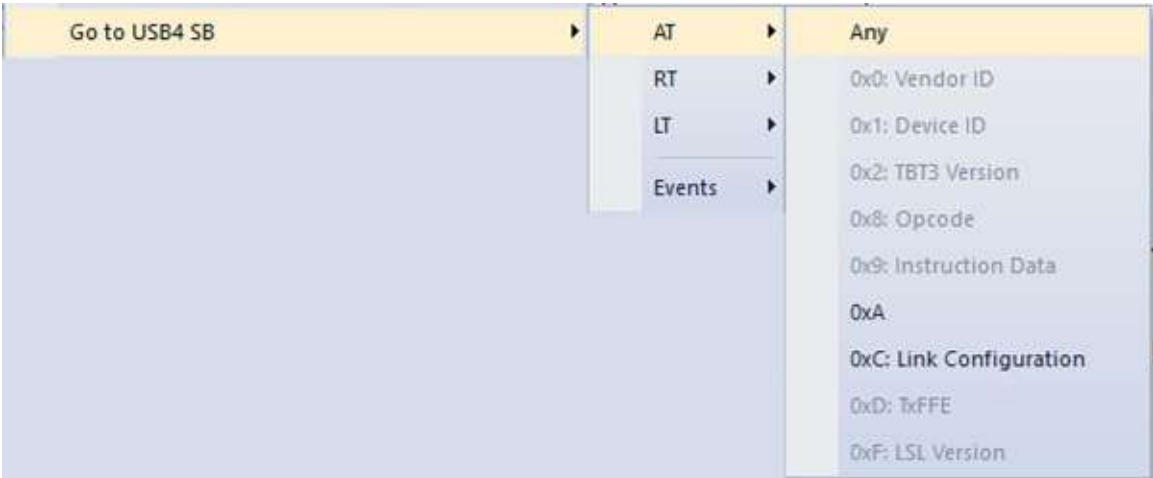


Figure 7.51: Go to USB4: AT

7.11.2 Go to USB4 SB: RT

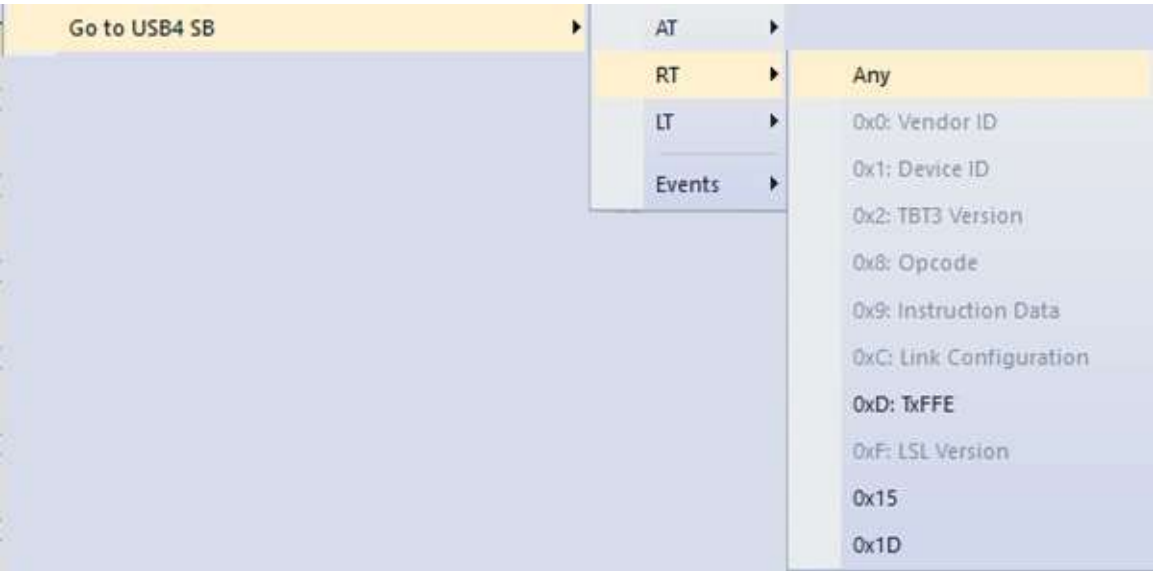


Figure 7.52: Go to USB4: RT

7.11.3 Go to USB4 SB: LT

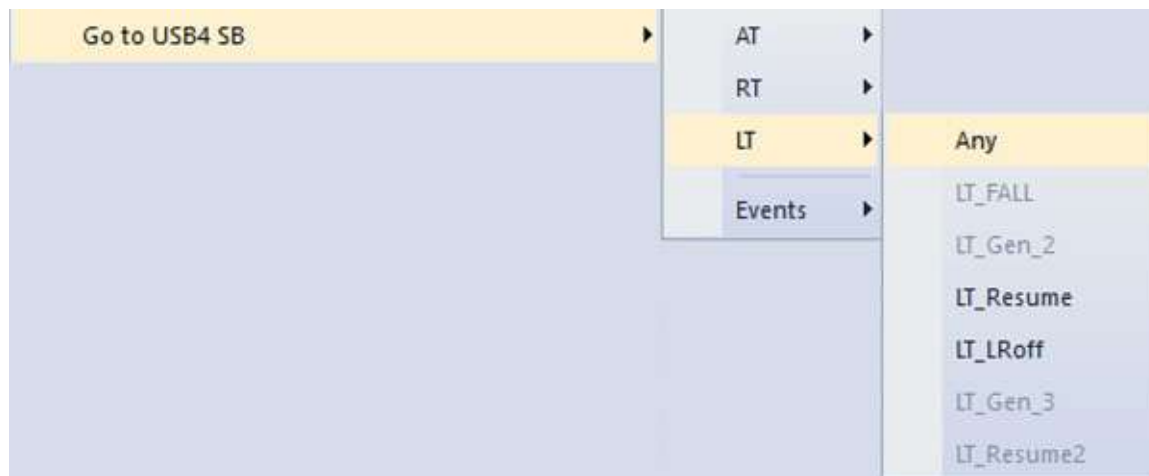


Figure 7.53: Go to USB4: LT

7.11.4 Go to USB4 SB: Events



Figure 7.54: Go to USB4: Events

7.12 Go to USB4 Rx/Tx

The following types of packets can be searched for by the USB Protocol Suite software.

7.12.1 Ordered Sets

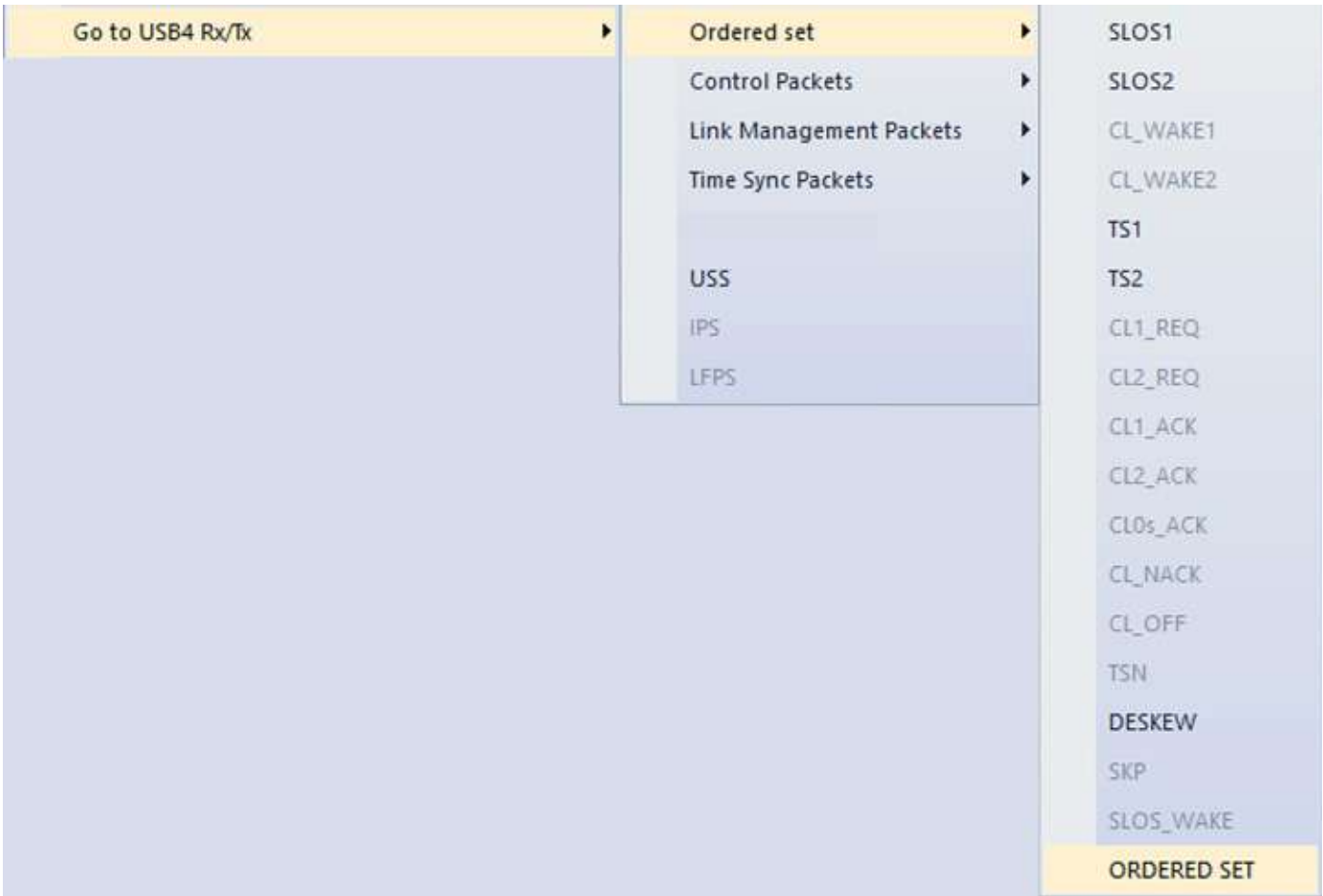


Figure 7.55: Go to USB4 Rx/Tx

7.12.2 Control Packets

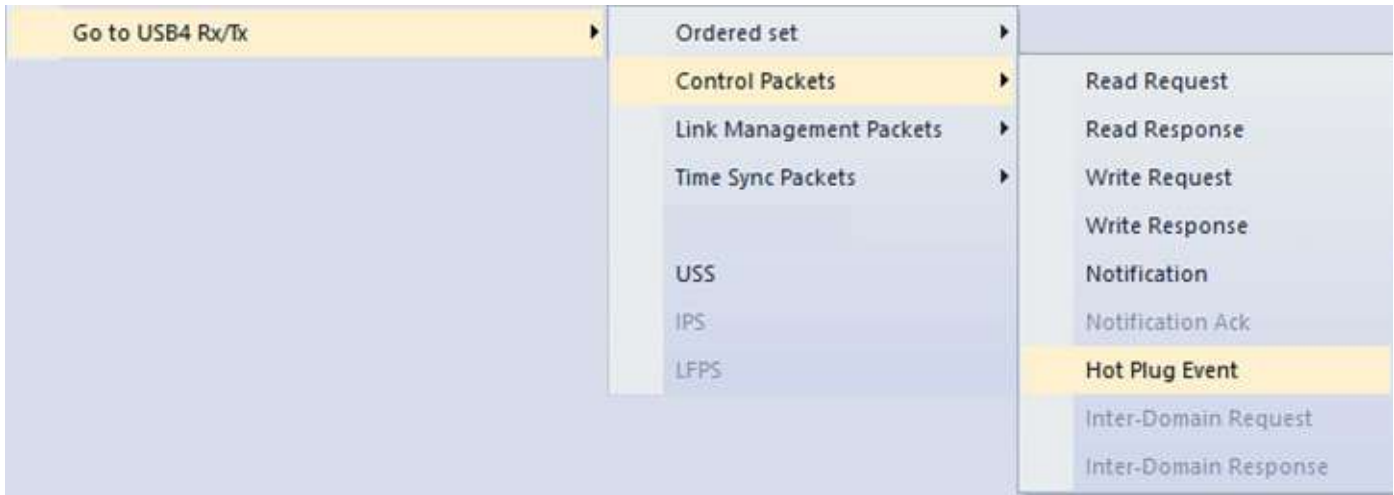


Figure 7.56: Go to USB4 Rx/Tx: Control Packets

7.12.3 Link Management Packets

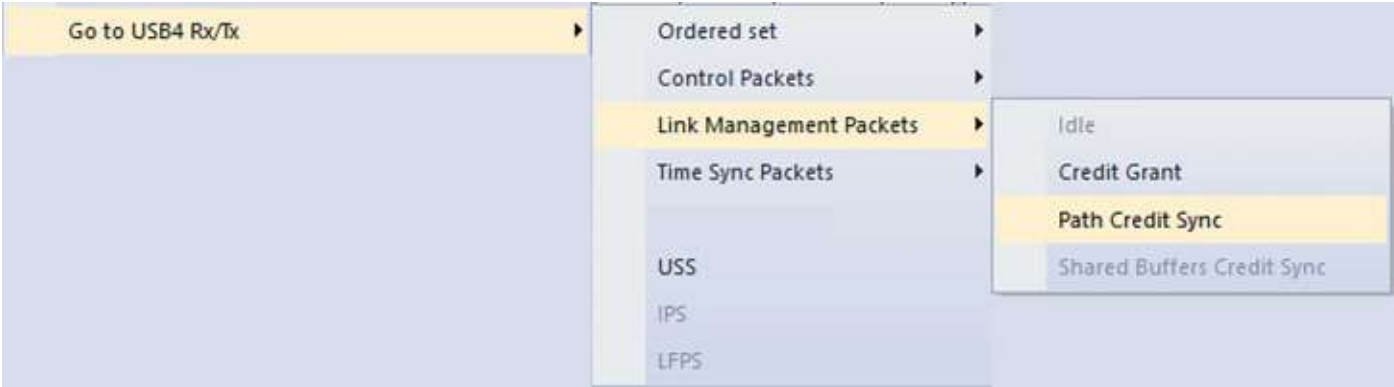


Figure 7.57: Go to USB4 Rx/Tx: Link Management Packets

7.12.4 Time Sync Packets

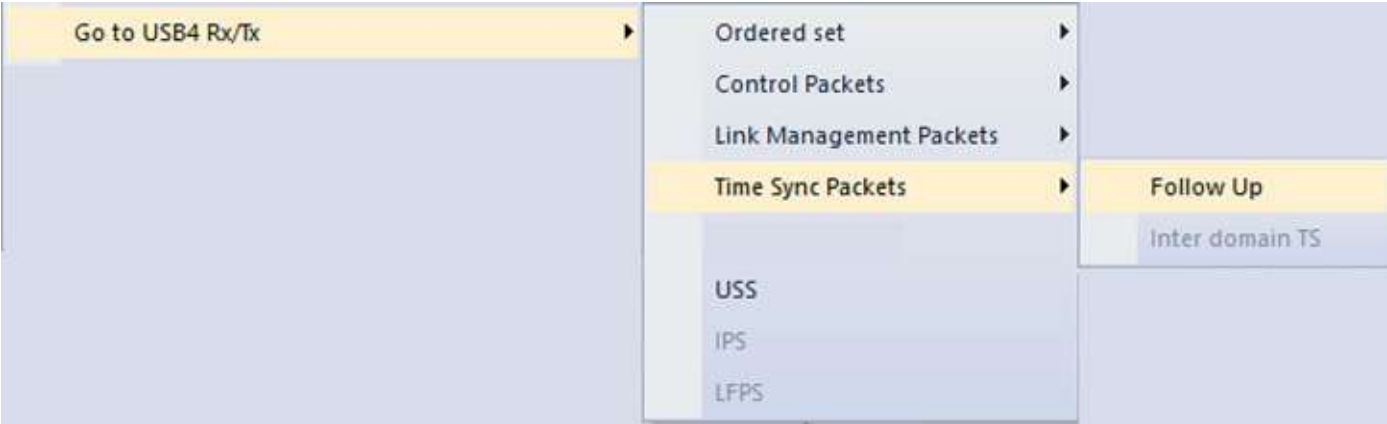


Figure 7.58: Go to USB4 Rx/Tx: Time Sync Packets

7.12.5 USS (USB Smooth Stepper)



Figure 7.59: Go to USB4 Rx/Tx: USS

7.12.6 IPS (In Plane Switching)

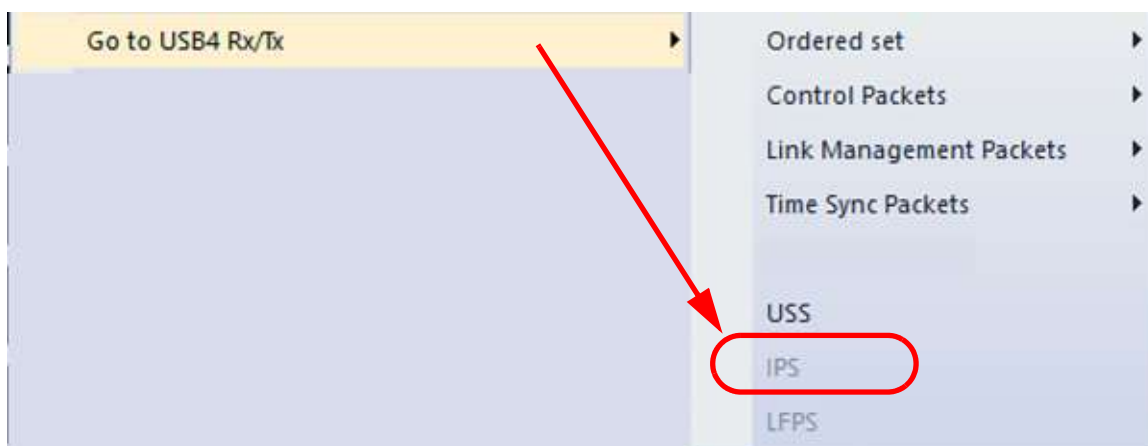


Figure 7.60: Go to USB4 Rx/Tx: IPS

7.12.7 LFPS (Low Frequency Periodic Signaling)

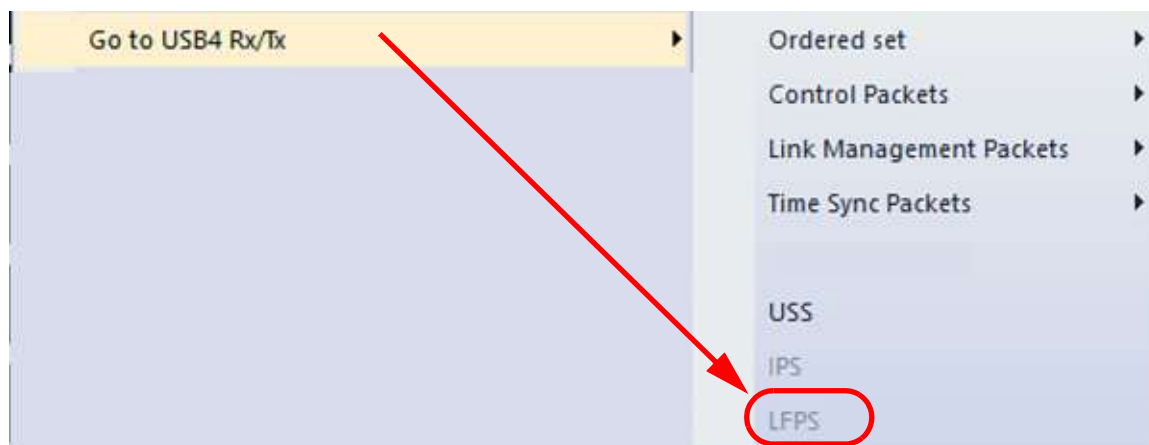


Figure 7.61: Go to USB4 Rx/Tx: LFPS

7.13 Go to Tunneled PCIe



Figure 7.62: Go to Tunneled PCIe: TLP, DLLP or Ordered Sets

7.13.1 TLP

Go to Tunneled PCIe

TLP

Memory Read (32 bit)

Memory Read (32 bit) - Locked

Memory Write (32 bit)

Memory Read (64 bit)

Memory Read (64 bit) - Locked

Memory Write (64 bit)

I/O Read Request

I/O Write Request

Configuration Read Type 0

Configuration Write Type 0

Configuration Read Type 1

Configuration Write Type 1

Deprecated Config Read Type

Deprecated Config Write Type

Message

Message with Data

Completion

Completion with Data

Completion for Locked Memory Read

Completion for Locked Memory Read with Data

AtomicOp Fetch and Add (32 bit)

AtomicOp Unconditional Swap (32 bit)

AtomicOp Compare and Swap (32 bit)

AtomicOp Fetch and Add (64 bit)

AtomicOp Unconditional Swap (64 bit)

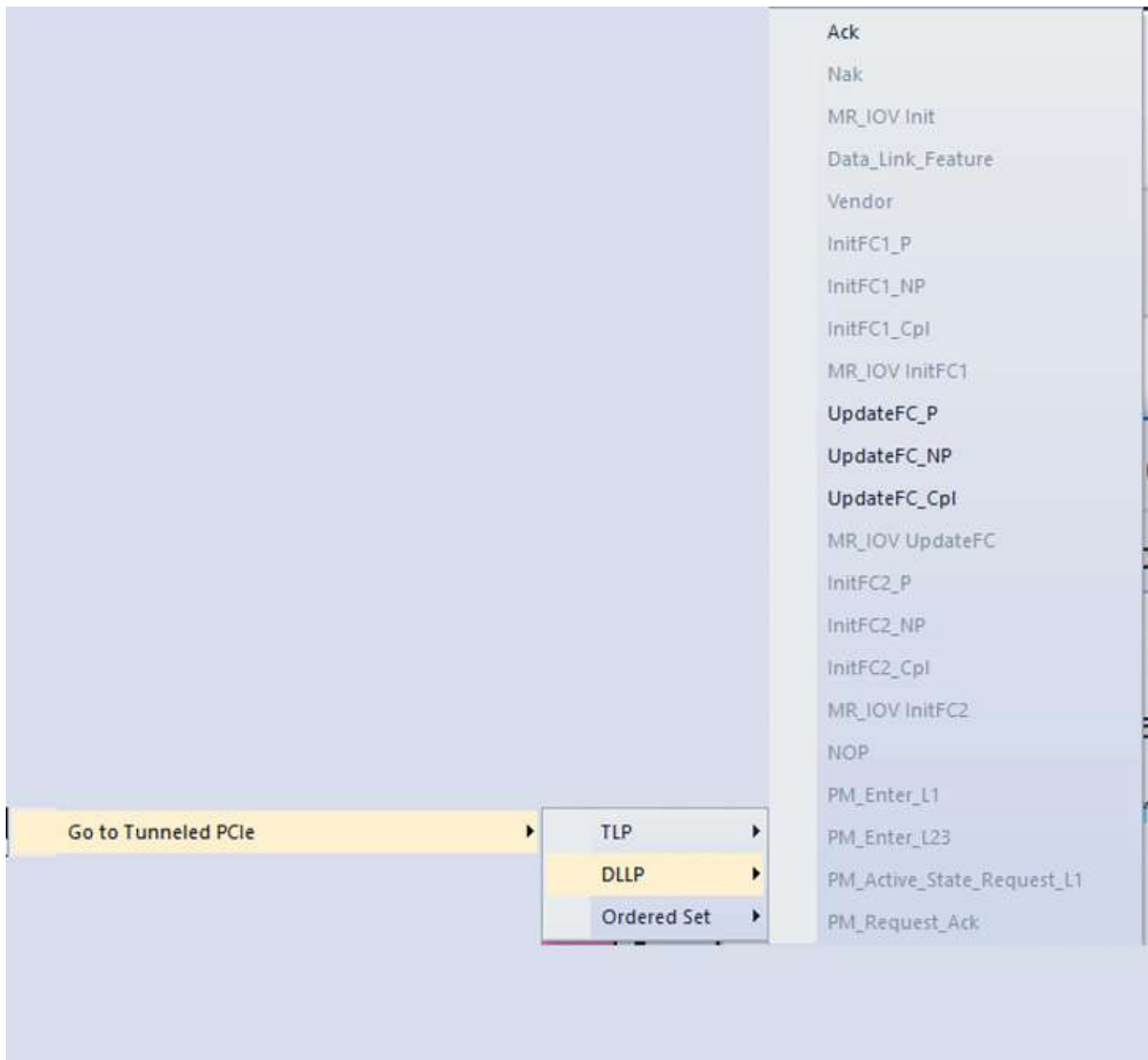
AtomicOp Compare and Swap (64 bit)

Local TLP Prefix

End-end TLP Prefix

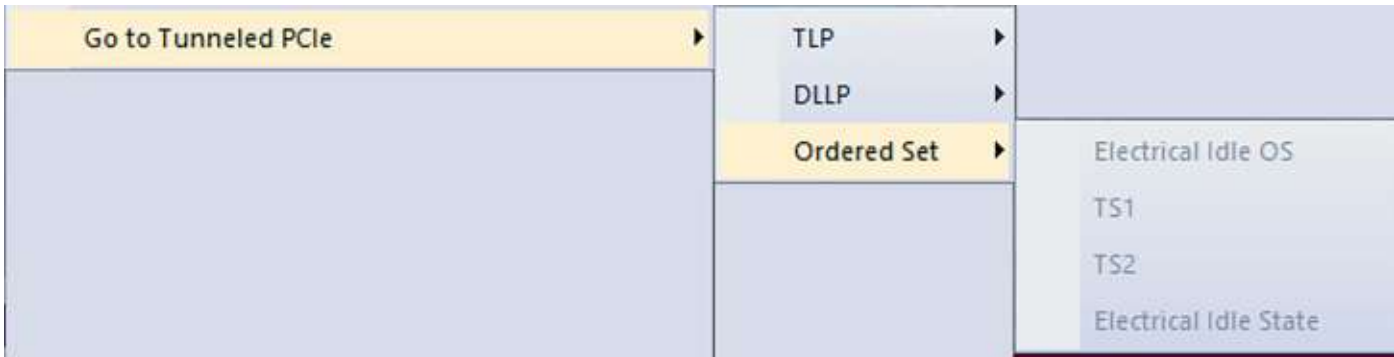
Go to Tunneled PCIe: TLPs

7.13.2 DLLPs



Go to Tunneled PCIe: DLLPs

7.13.3 Ordered Set



Go to Tunneled PCIe: Ordered Set

7.14 Go to Tunneled USB3

7.14.1 Packet Types

There are a wide variety of Tunneled USB3 Packets Types you can search for. See [Figure 7.63](#).

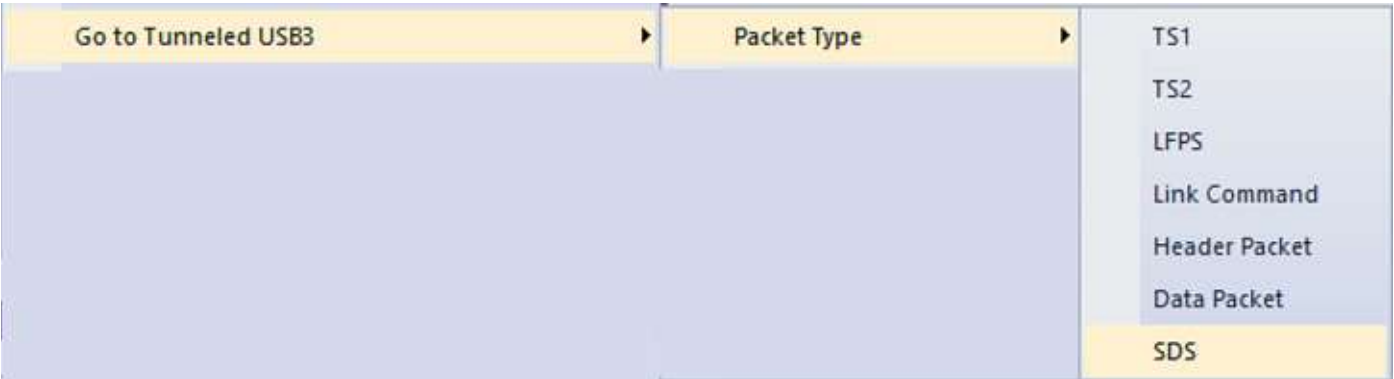


Figure 7.63: Go to Tunneled USB3: Packet Type

You can select from the following types of Packets to search for:

- ☐ TS1
- ☐ TS2
- ☐ LFPS
- ☐ Link Command
- ☐ Header Packet
- ☐ Data Packet
- ☐ SDS

7.14.2 LFPS Type Traffic

There are a wide variety of Tunneled USB3 LFPS Type traffic you can search for. See [Figure 7.64](#).

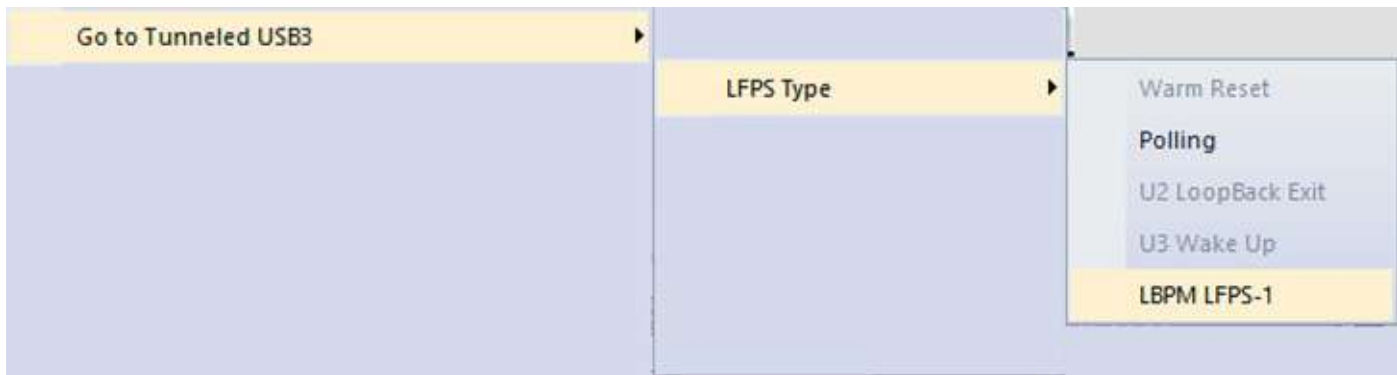


Figure 7.64: Go to Tunneled USB3: LFPS Type traffic

You can select from the following types of LFPS traffic to search for:

- ☐ Warm Reset
- ☐ Polling
- ☐ U2 LoopBack Exit
- ☐ U3 Wake Up
- ☐ LBPM LFPS-1

7.14.3 Header Packet Type Traffic

There are a wide variety of Tunneled USB3 Header Packet Type traffic you can search for. See [Figure 7.65](#).

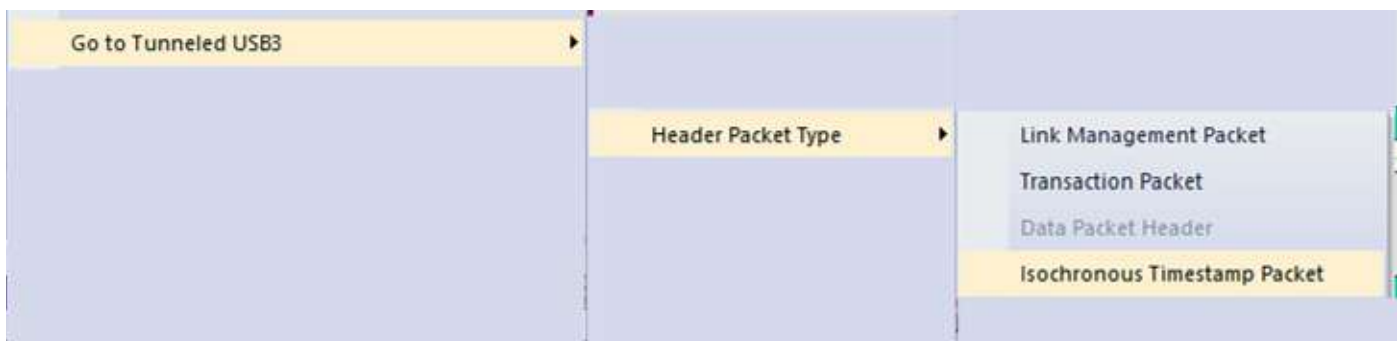


Figure 7.65: Go to Tunneled USB3:Header Packet Type traffic

You can select from the following types of LFPS traffic to search for:

- ☐ Link Management Packet
- ☐ Transaction Packet
- ☐ Data Packet Header
- ☐ Isochronous Timestamp Packet

7.14.4 Link Command Traffic

There are a wide variety of Tunneled USB3 Link Command traffic you can search for. See [Figure 7.66 on page 498](#).

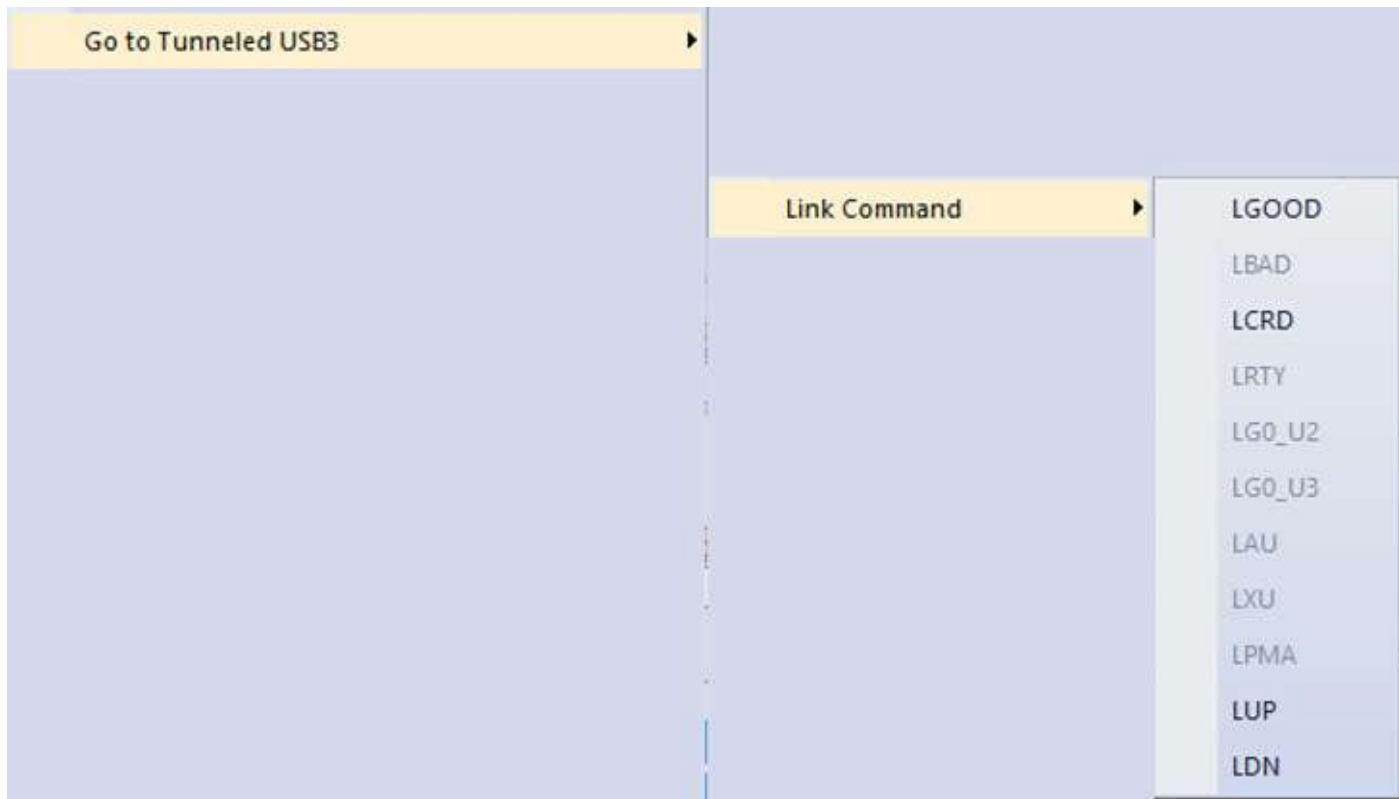


Figure 7.66: Go to Tunneled USB3: Link Command traffic

You can select from the following types of Link Command traffic to search for:

- ☐ LGOOD
- ☐ LBAD
- ☐ LCRD
- ☐ LRTY
- ☐ LG0_U2
- ☐ LG0_U3
- ☐ LAU
- ☐ LXU
- ☐ LPMA
- ☐ LUP
- ☐ LDN

7.14.5 LMP Subtype Traffic

There are a wide variety of Tunneled USB3 LMP Subtype traffic you can search for. See [Figure 7.67 on page 499](#).

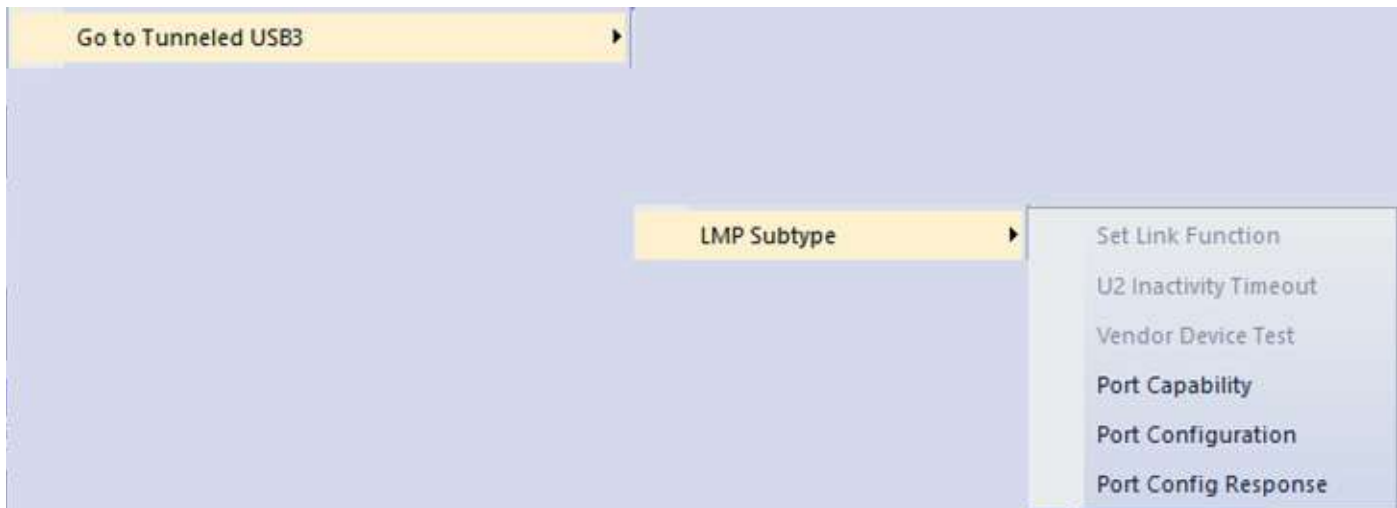


Figure 7.67: Go to Tunneled USB: LMP Subtype traffic

You can select from the following types of LMP Subtype traffic to search for:

- ☐ Set Link Function
- ☐ U2 Inactivity Timeout
- ☐ Vendor Device Test
- ☐ Port Capability
- ☐ Port Configuration
- ☐ Port Config Response

7.14.6 Transaction Packet Type Traffic

There are a wide variety of Tunneled USB3 Transaction Packet Type traffic you can search for. See [Figure 7.68 on page 500](#).

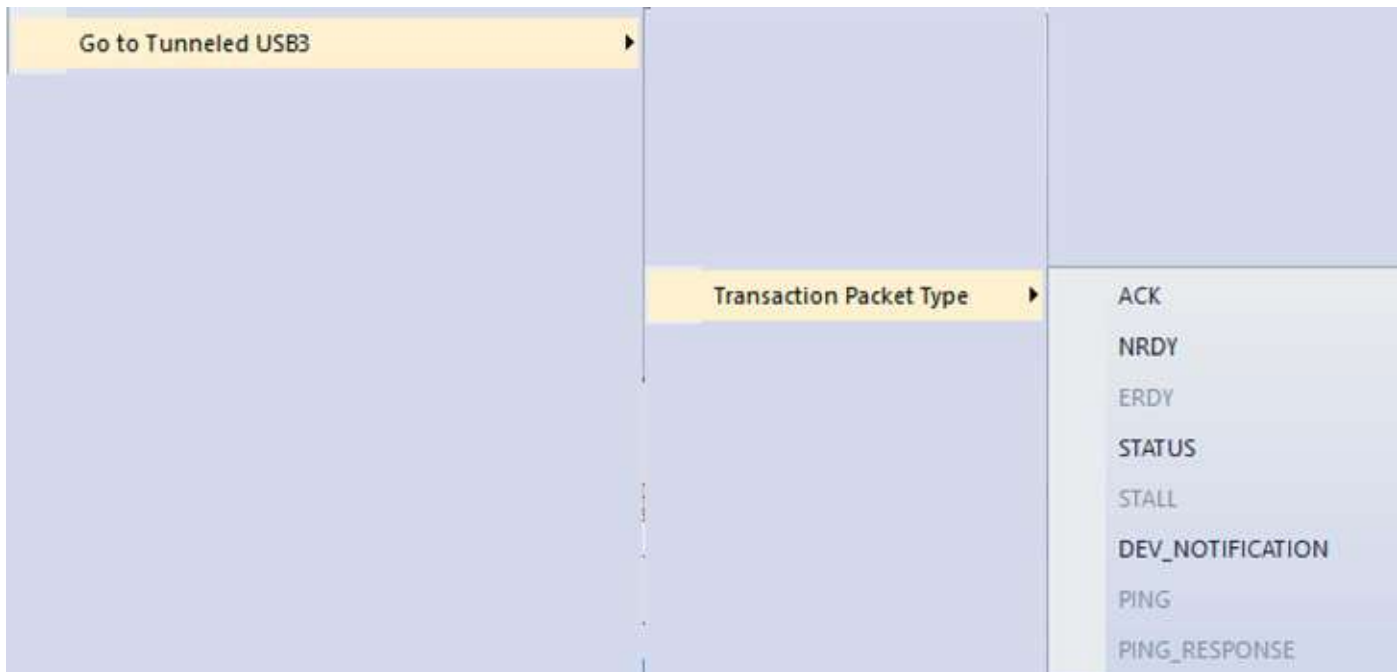


Figure 7.68: Go to Tunneled USB: Transaction Packet Type traffic

You can select from the following types of Transaction Packet Type traffic to search for:

- ☐ ACK
- ☐ NRDY
- ☐ ERDY
- ☐ STATUS
- ☐ STALL
- ☐ DEV_NOTIFICATION
- ☐ PING
- ☐ PING_RESPONSE

7.14.7 Data Packet Type Traffic

There are a wide variety of Tunneled USB3 Data Packet Type traffic you can search for. See [Figure 7.69 on page 501](#).

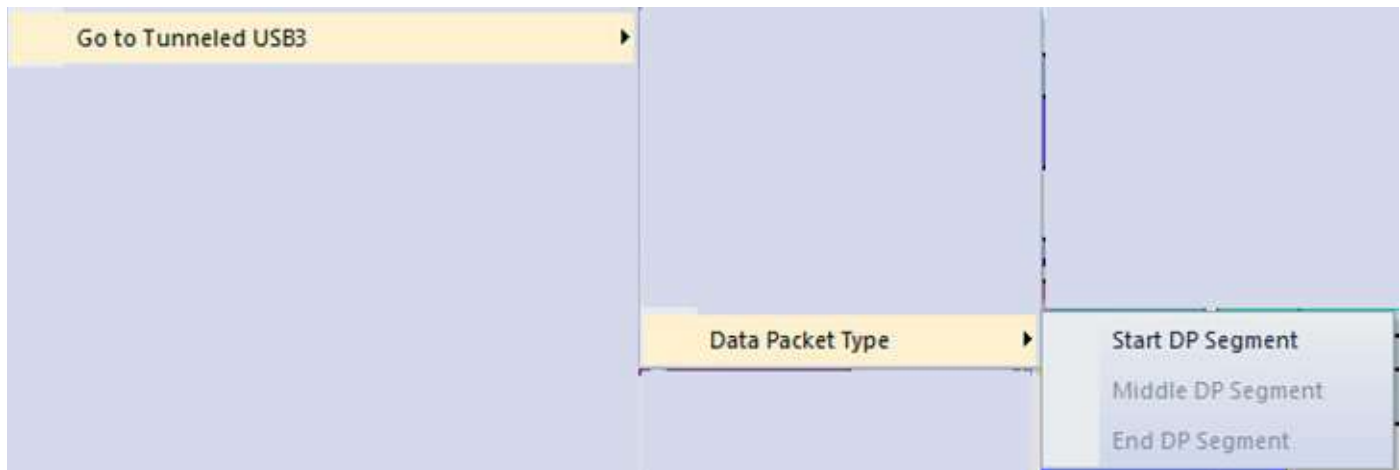


Figure 7.69: Go to Tunneled USB: Data Packet Type traffic

You can select from the following types of Data Packet Type traffic to search for:

- ☐ Start DP Segment
- ☐ Middle DP Segment
- ☐ End DP Segment

7.15 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. You can also search for Standard and Hub Request Types.

7.15.1 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:

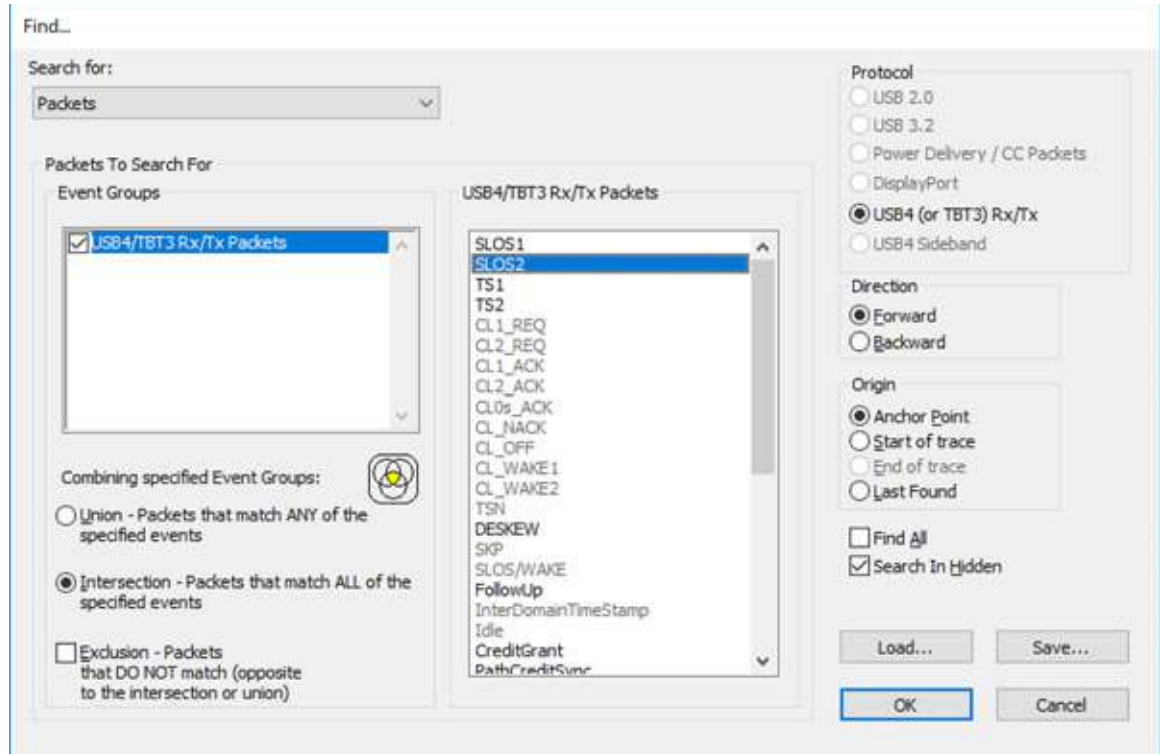


Figure 7.70: Find Dialog.

2. If the file has both USB 2.0 and USB 3.2 traffic, select either of these technologies in the Protocol area (upper right): **USB 2.0**, **USB 3.2** 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.

7.15.2 Power Delivery and Configuration Channel (CC) Elements

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

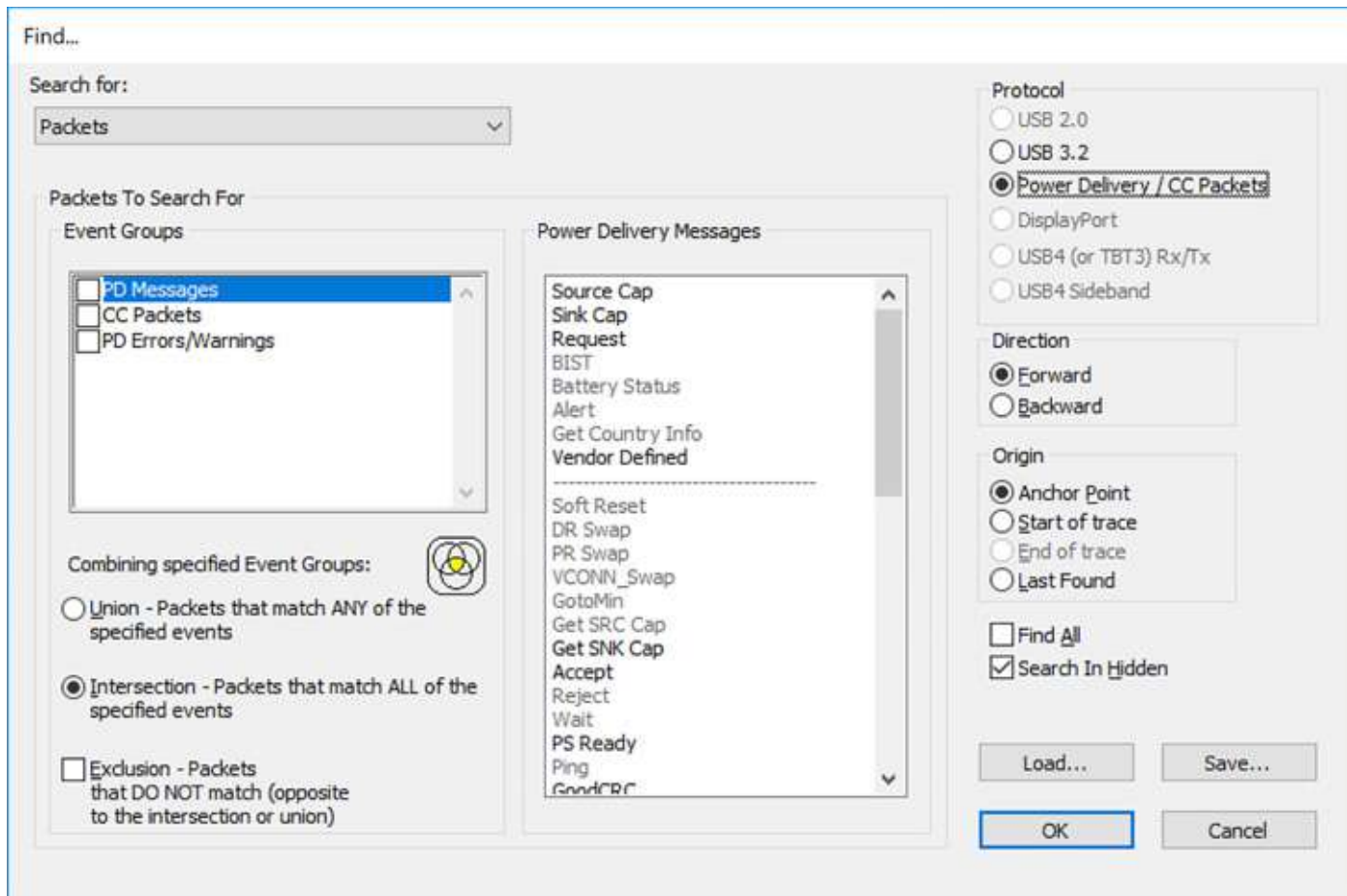


Figure 7.71: Power Delivery and CC Elements

7.15.3 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.

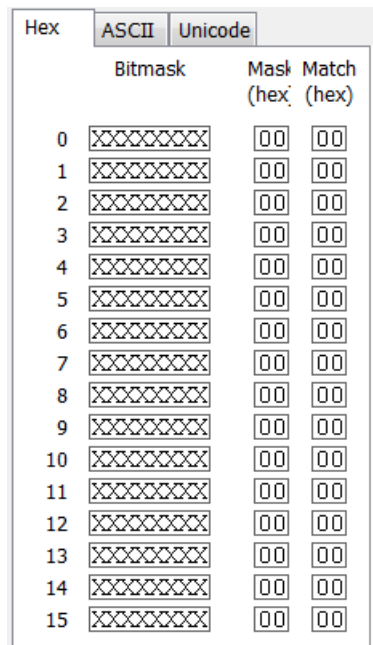


Figure 7.72: Data Pattern Mask and Match Dialog

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.

7.15.4 Find USB4 Configuration Space Transfers

Open a trace with Transfer Layer traffic and click on the View Transfer Level icon .

Note: All the configuration space register accesses in traffic listed in different categories is based on the configuration space type (Router/Adapter/Path/Counters).

In the case shown below, the Transfer layer traffic will be displayed (see [Figure 7.73](#)).

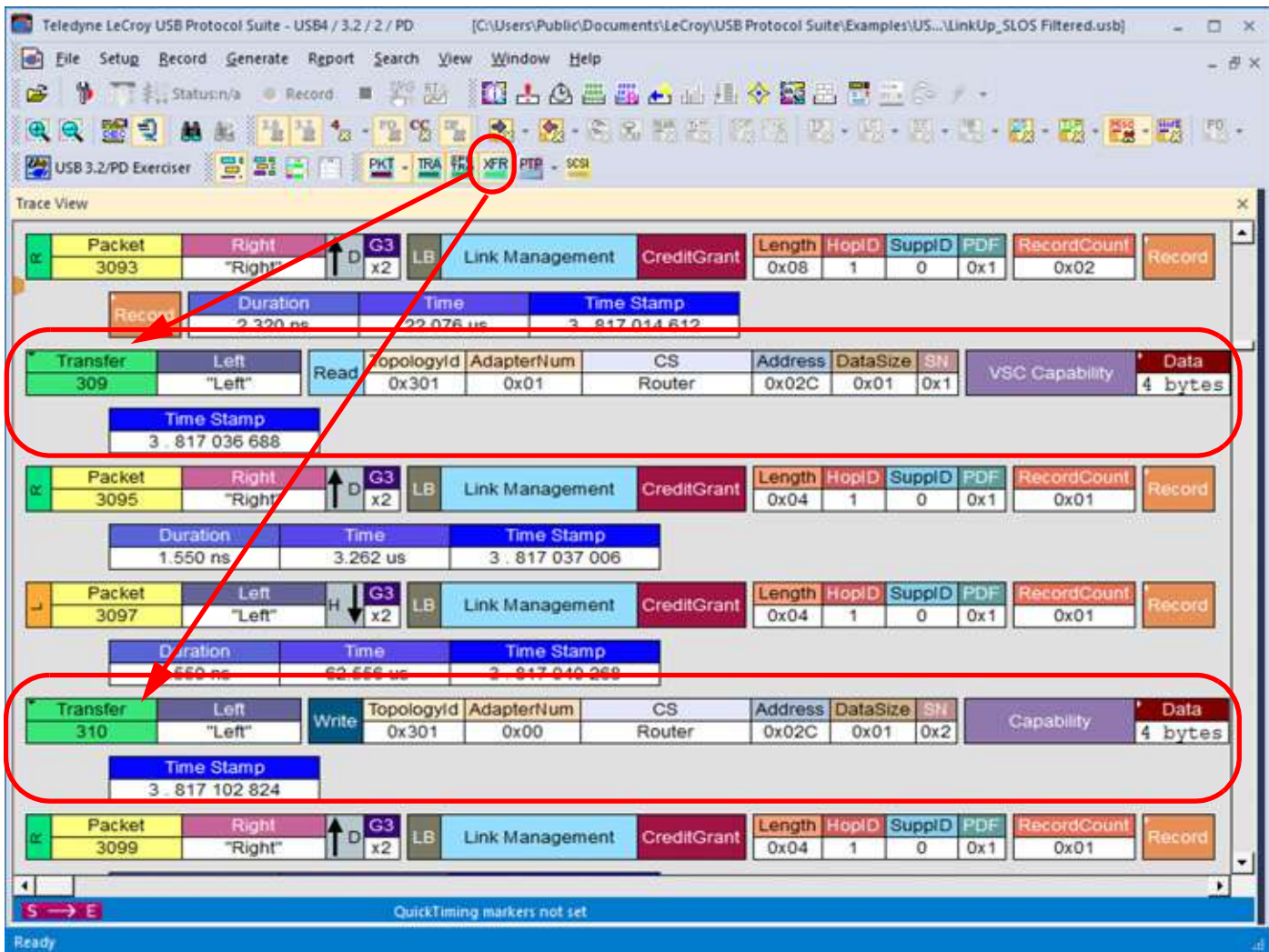


Figure 7.73: Transfer Level Traffic Displayed

You can then select the Find icon , which will bring up the Find dialog box, see [Figure 7.74 on page 508](#).

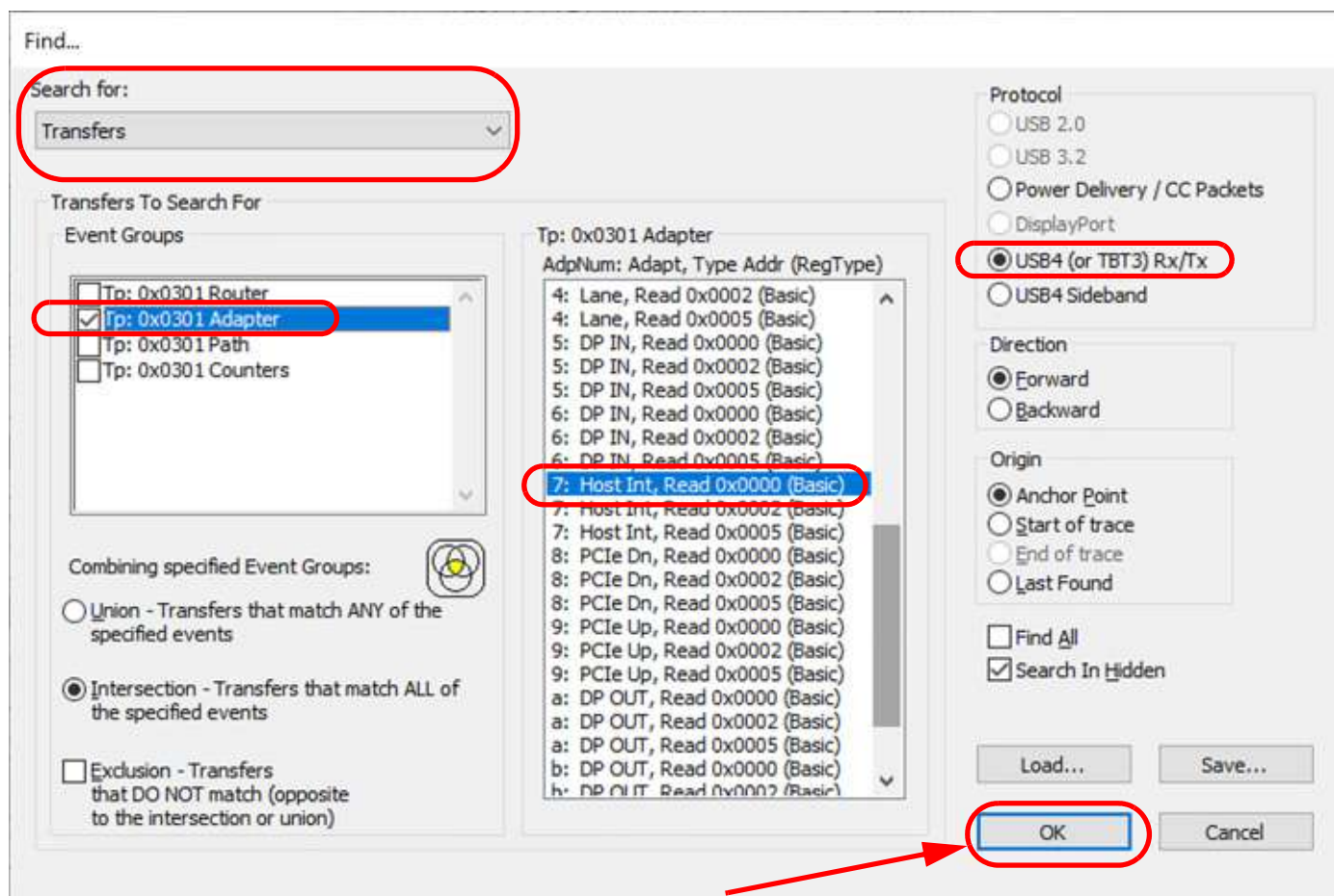


Figure 7.74: Find Dialog Box

As an example select:

- ☐ Transfers
- ☐ Event Groups -> Adapter and Register Type
- ☐ Host Int, Read: 7: Host Int, Read
- ☐ USB4 (or TBT3) Rx/Tx

Then click on "OK".

Transfer #784 with READ, TopologyId, AdapterNum and Configuration Space will be highlighted. See [Figure 7.75 on page 509](#).

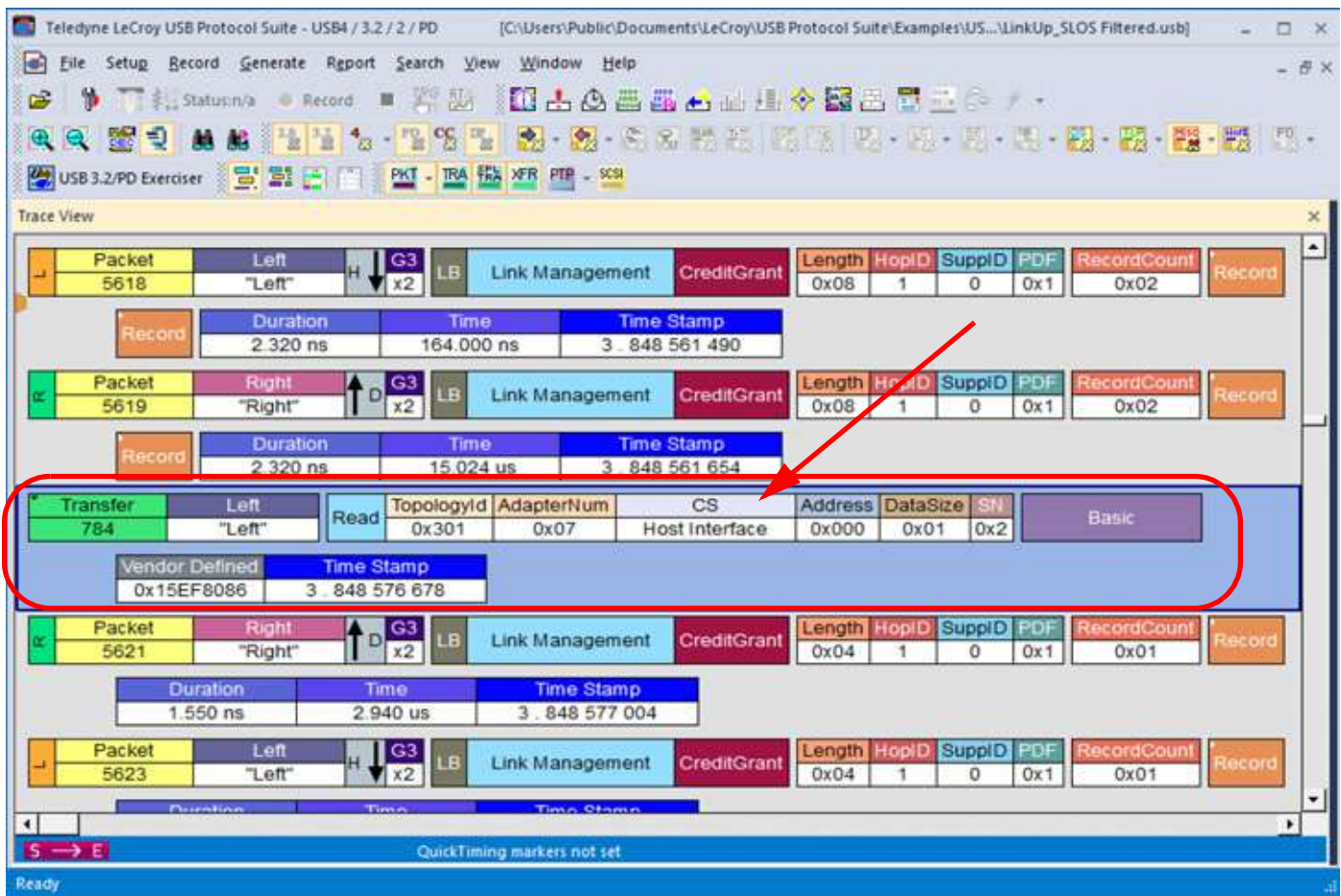


Figure 7.75: Transfer #784 Highlighted: Configuration Space -> Host Interface

7.15.5 Find USB4 Operations: DROM

You can then select the **Find** icon  , which will bring up the Find dialog box. Then you can then search for USB4 Operations: DROM see [Figure 7.76 on page 510](#).

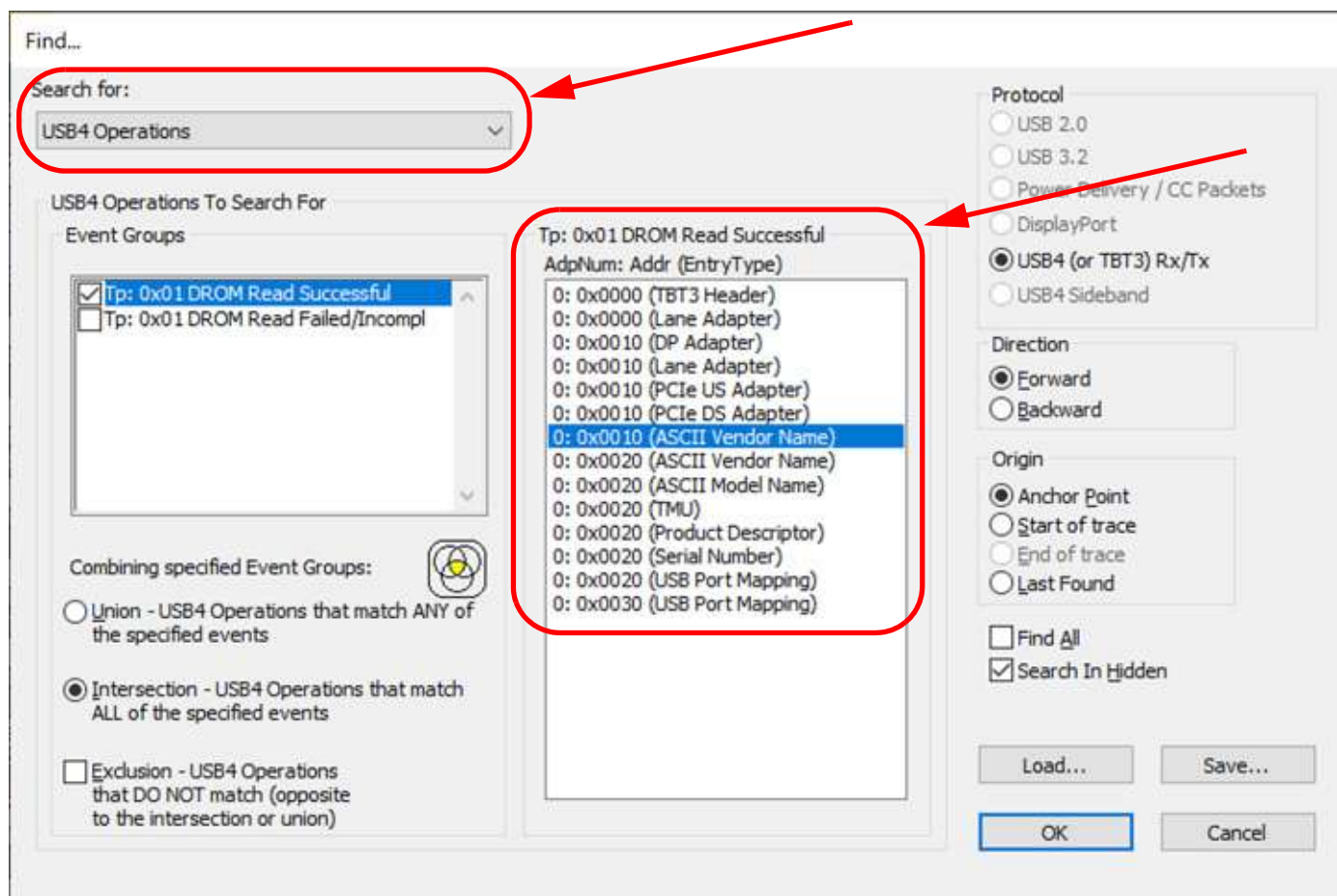


Figure 7.76: Find: USB4 Operations => DROM Read => ASCII Vendor Name

When you click on **OK** the operation with the DROM Read & ASCII Vendor Name will be highlighted in the loaded trace. See [Figure 7.77 on page 511](#).

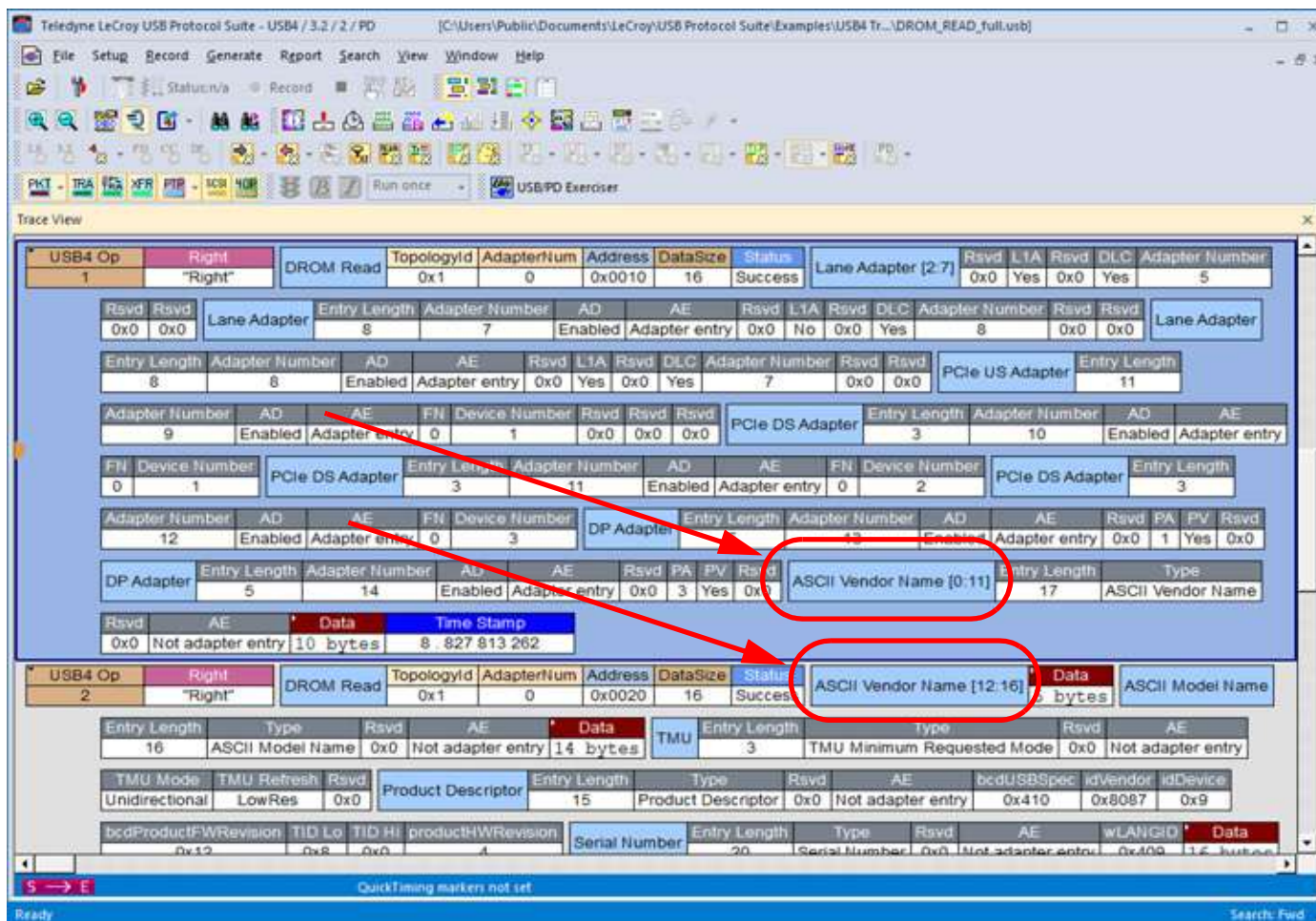


Figure 7.77: Trace with DROM Read => ASCII Vendor Name highlighted

7.16 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.

7.17 Search Direction

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

Chapter 8

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:

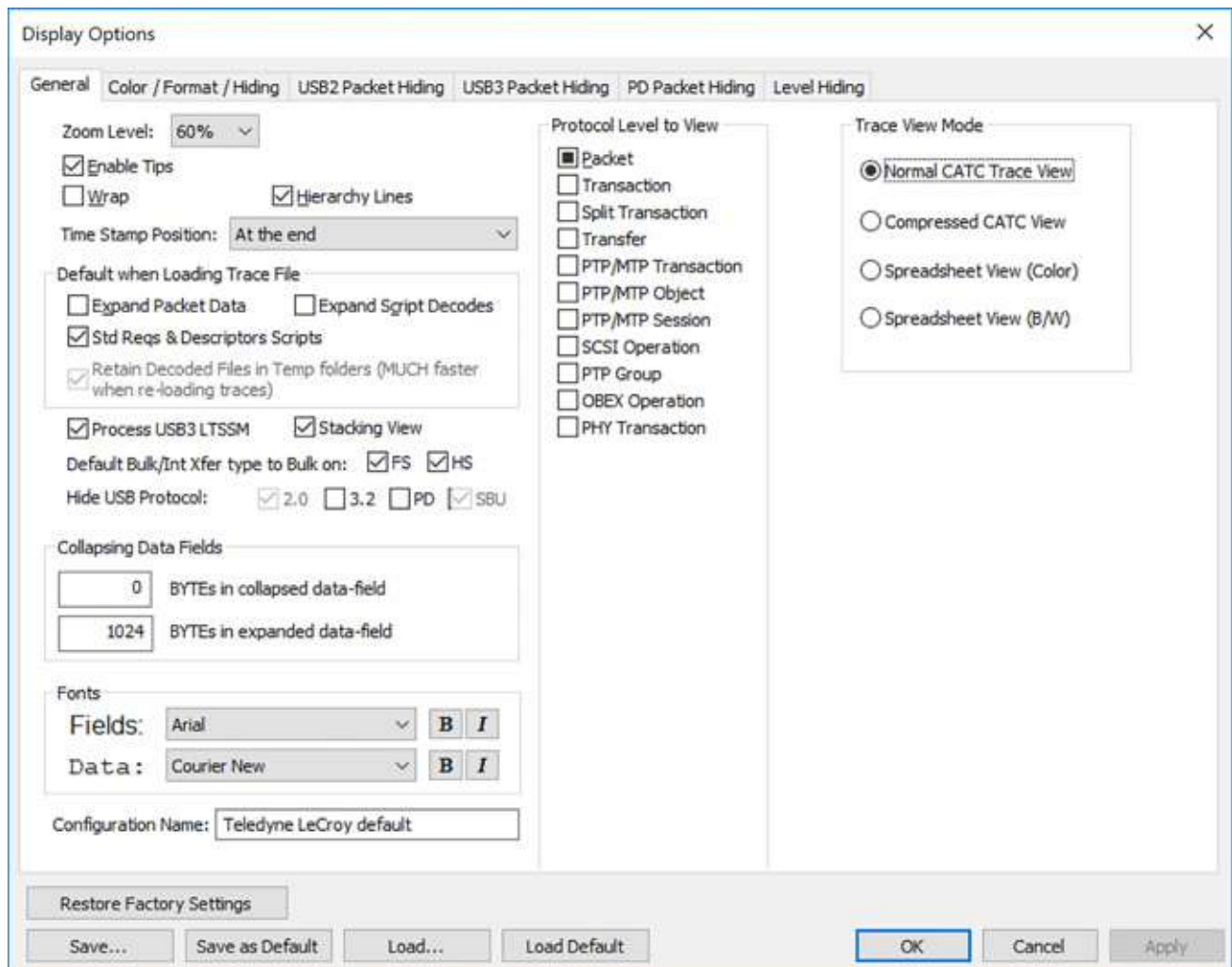


Figure 8.1: Display Options General Dialog

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

8.1 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 a trace file is loaded. It does not do anything to a trace that is already open in the application. You **MUST** hit the "Save as Default" button at the bottom of the Display Options dialog to make this selection persistent, so that it will apply it to all subsequently loaded trace files.
 - **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 407](#).
- ☐ **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 3.2 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 8.2 on page 515](#)).

Data		Time	Time Stamp
40 03 55 00 53 00 42 00 ...		464.000 ns	2.681184200
64 bytes (first 8 shown)			
40 03 55 00 53 00 42 00 ...			

Figure 8.2: 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.

Data		Time	Time Stamp
0: 40 03 55 00 53 00 42 00 33 00 2E 00 30 00 20 00		464.000 ns	2.681184200
16: 48 00 75 00 62 00 00 00 00 00 00 00 00 00 00 ...			
64 bytes (first 30 shown)			
40 03 55 00 53 00 42 00 33 00 2E 00 30 00 20 001...			

Figure 8.3: 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.

8.2 Color/Format/Hiding Display Options

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

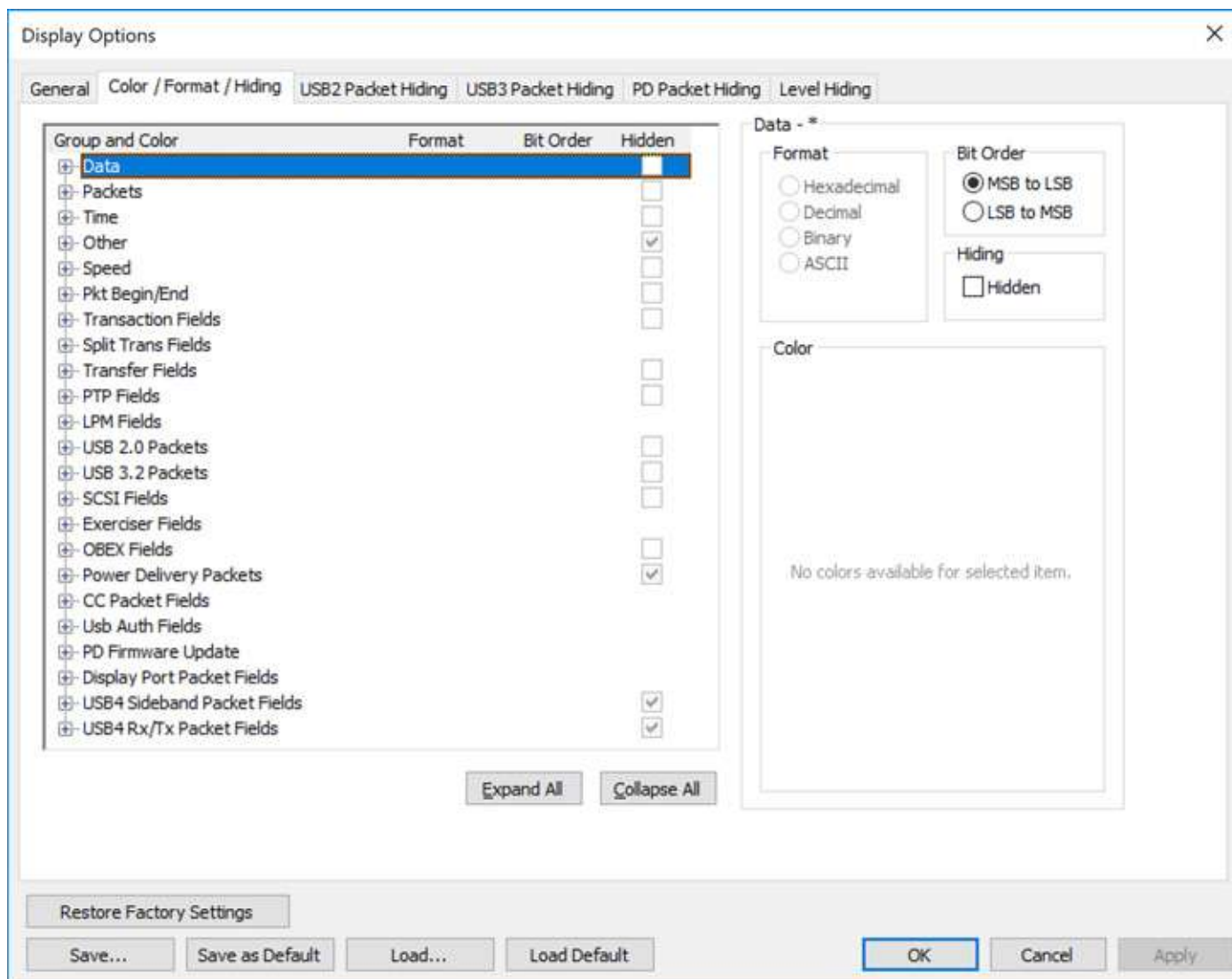


Figure 8.4: Display Options Color/Format/Hiding Dialog.

8.2.1 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.

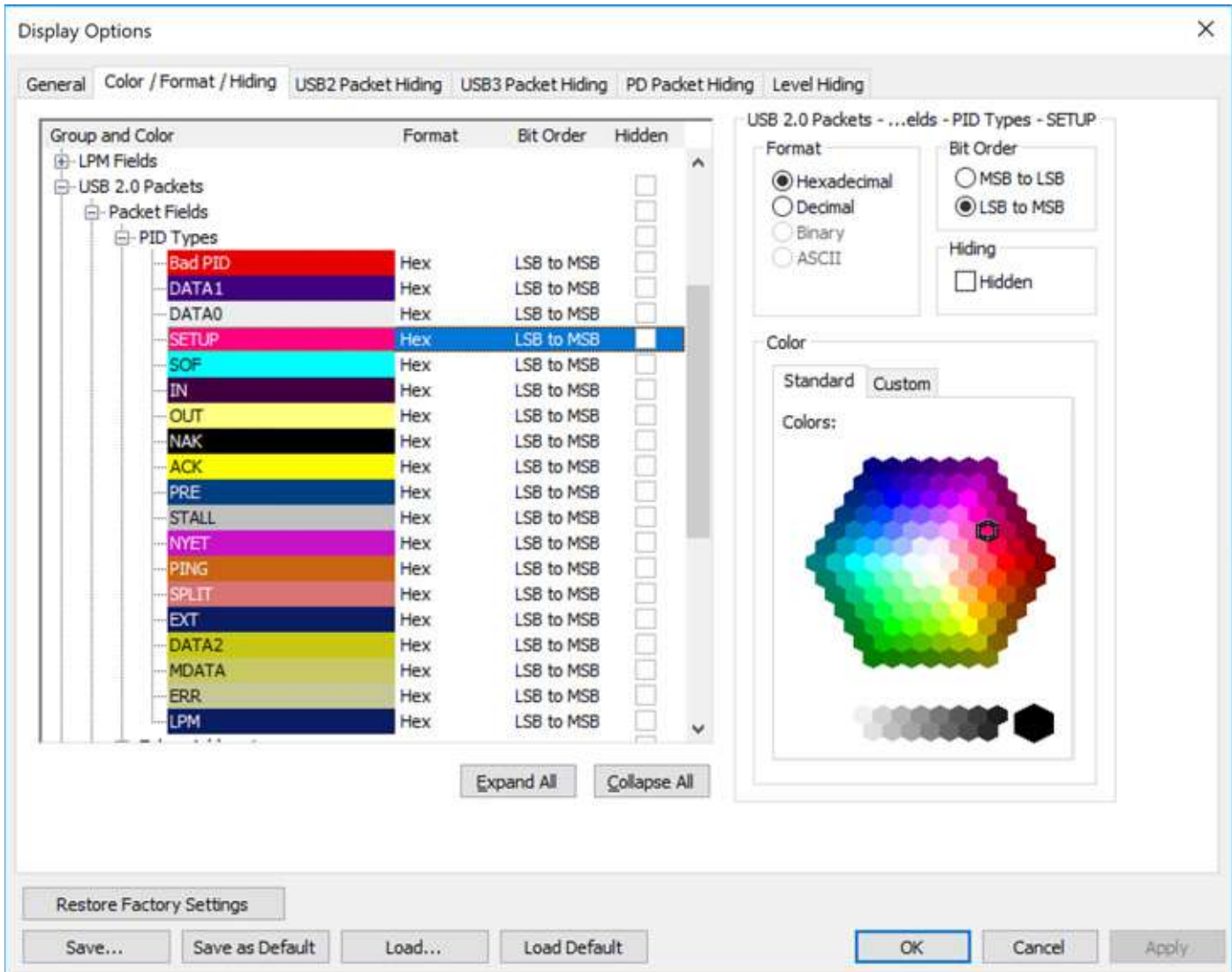
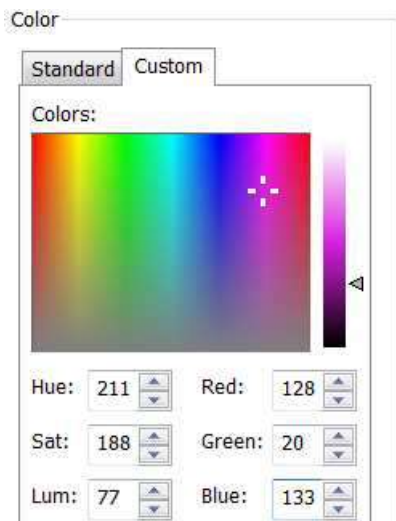


Figure 8.5: Display Options Color/Format/Hiding Dialog Group and Color Pane.

To customize colors, use the Custom tab.



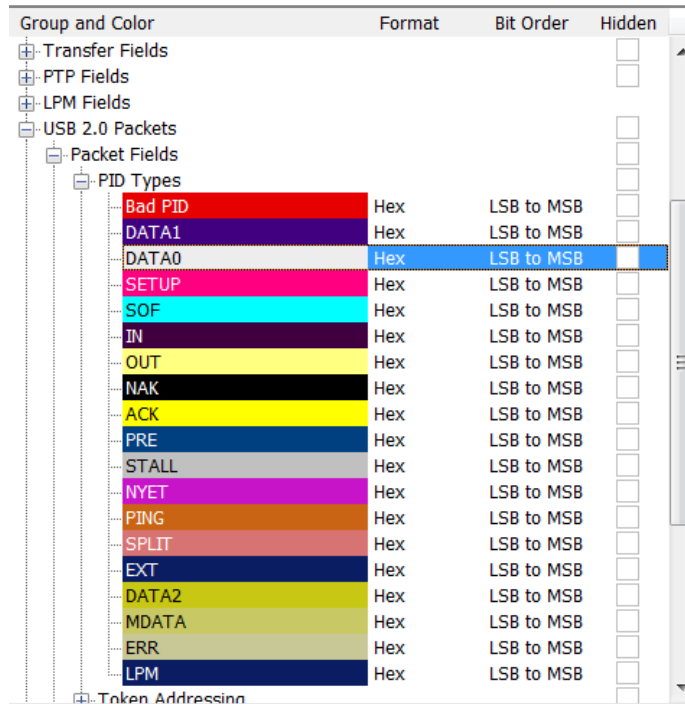
Note: You cannot change the color of an Invalid Data (packet error) field. It is permanently set to red.

8.2.2 Format Display Options

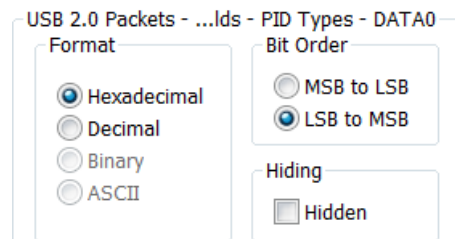
For each type of data in each group of data, the program has a default data format. Examples of number data formats are Bin (binary), Dec (decimal), and Hex (hexadecimal). Examples of date and time data formats are Hex uFrame, Dec uFrame, Date & Time, Time, Bit Time, seconds, microseconds, and nanoseconds. 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:

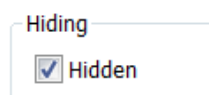


If available, select Bit Order in the Format section. The options are MSB to LSB or LSB to MSB.

8.2.3 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.



8.3 USB2 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
- ☐ Reset 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 **USB2 Packet Hiding** tab, then select the data types to hide (see [Figure 8.6 on page 521.](#))

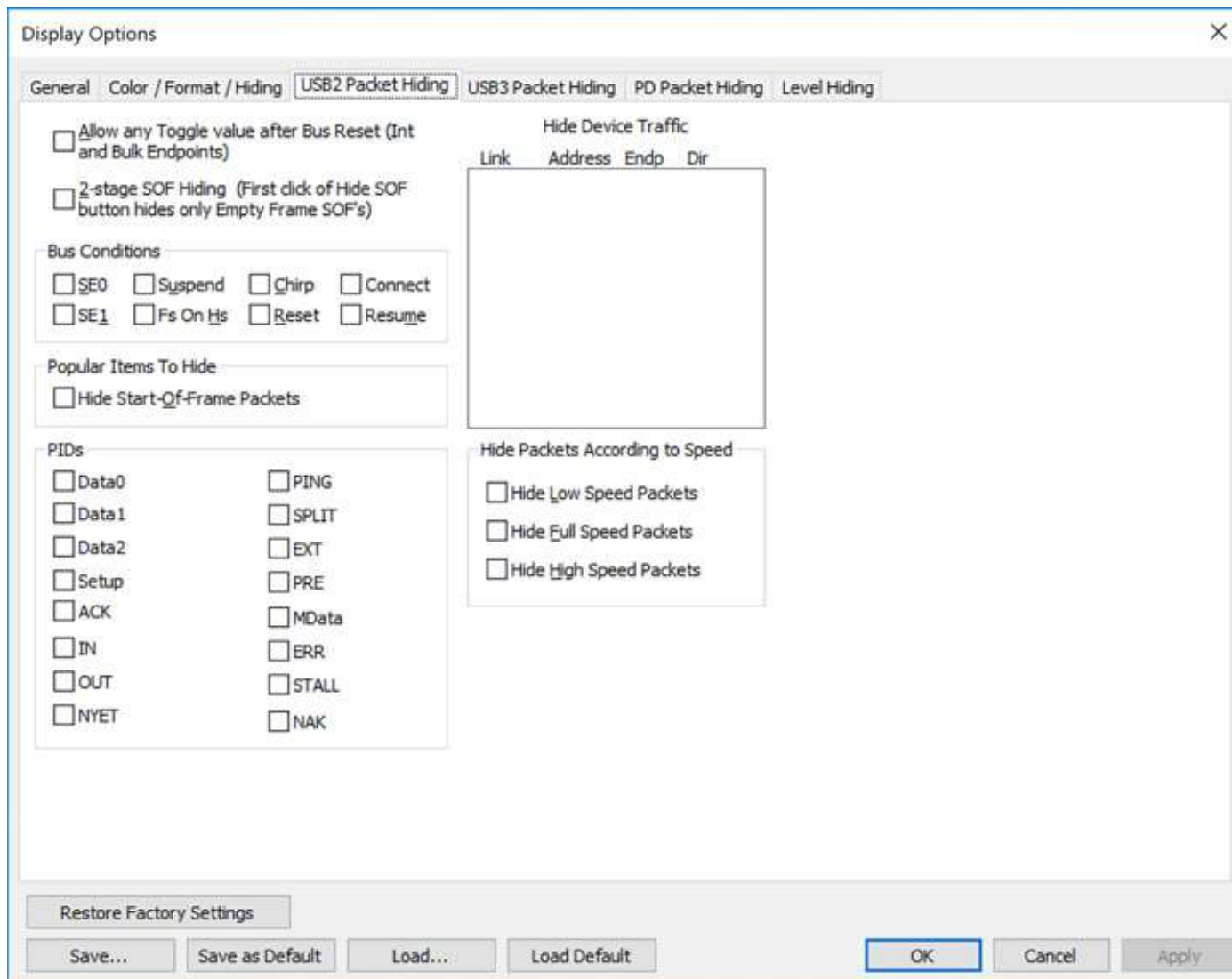


Figure 8.6: Display Options USB2 Packet Hiding Dialog.

8.4 USB3 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, TS1A, TS1B, 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 (CP3)
- ☐ LTSSM Transition Indicators
- ☐ SYNC Packets

Select the **USB3 Packet Hiding** tab, then select the data types to hide (see [Figure 8.7 on page 523.](#))

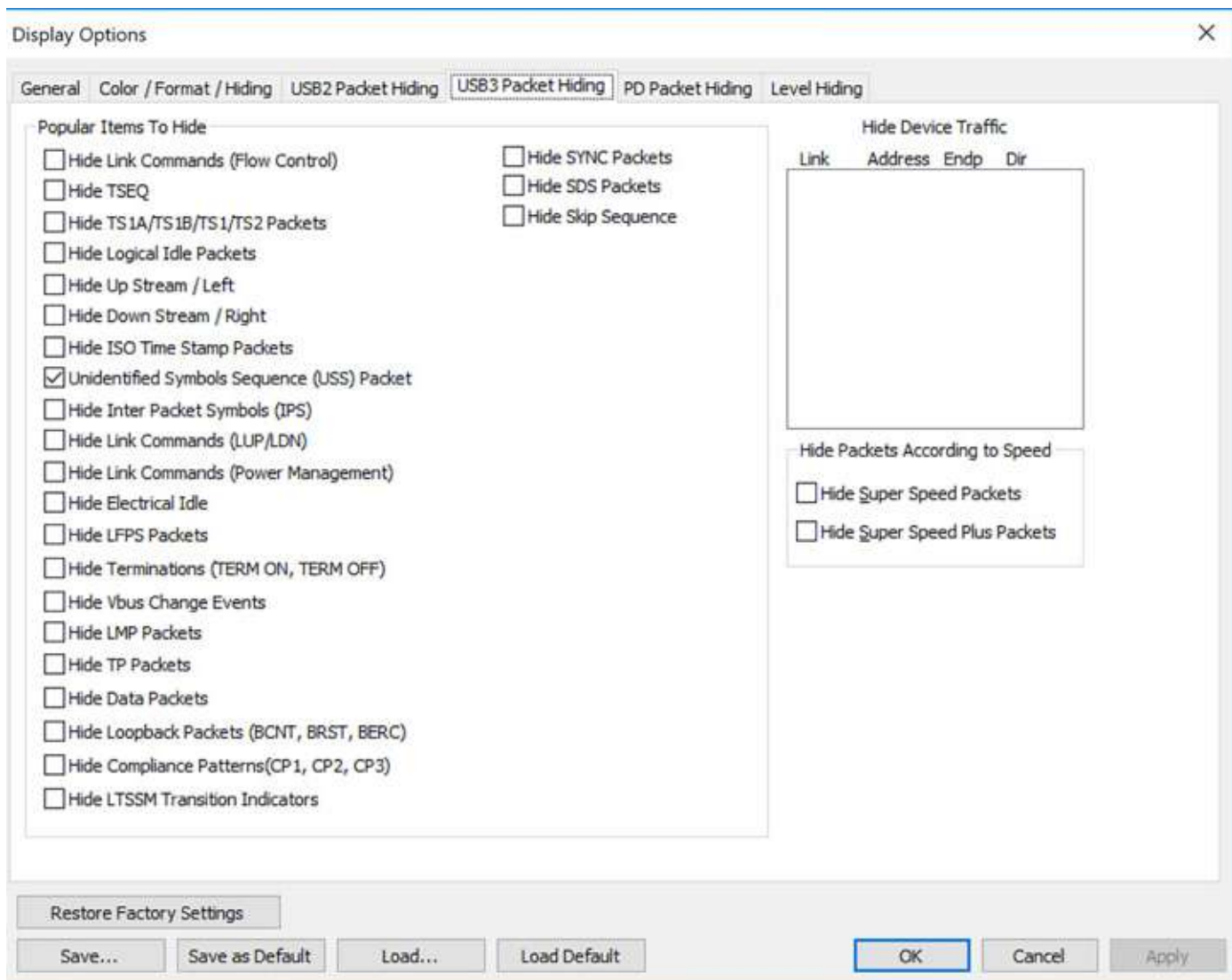


Figure 8.7: Display Options USB3 Packet Hiding Dialog.

8.5 PD Packet Hiding

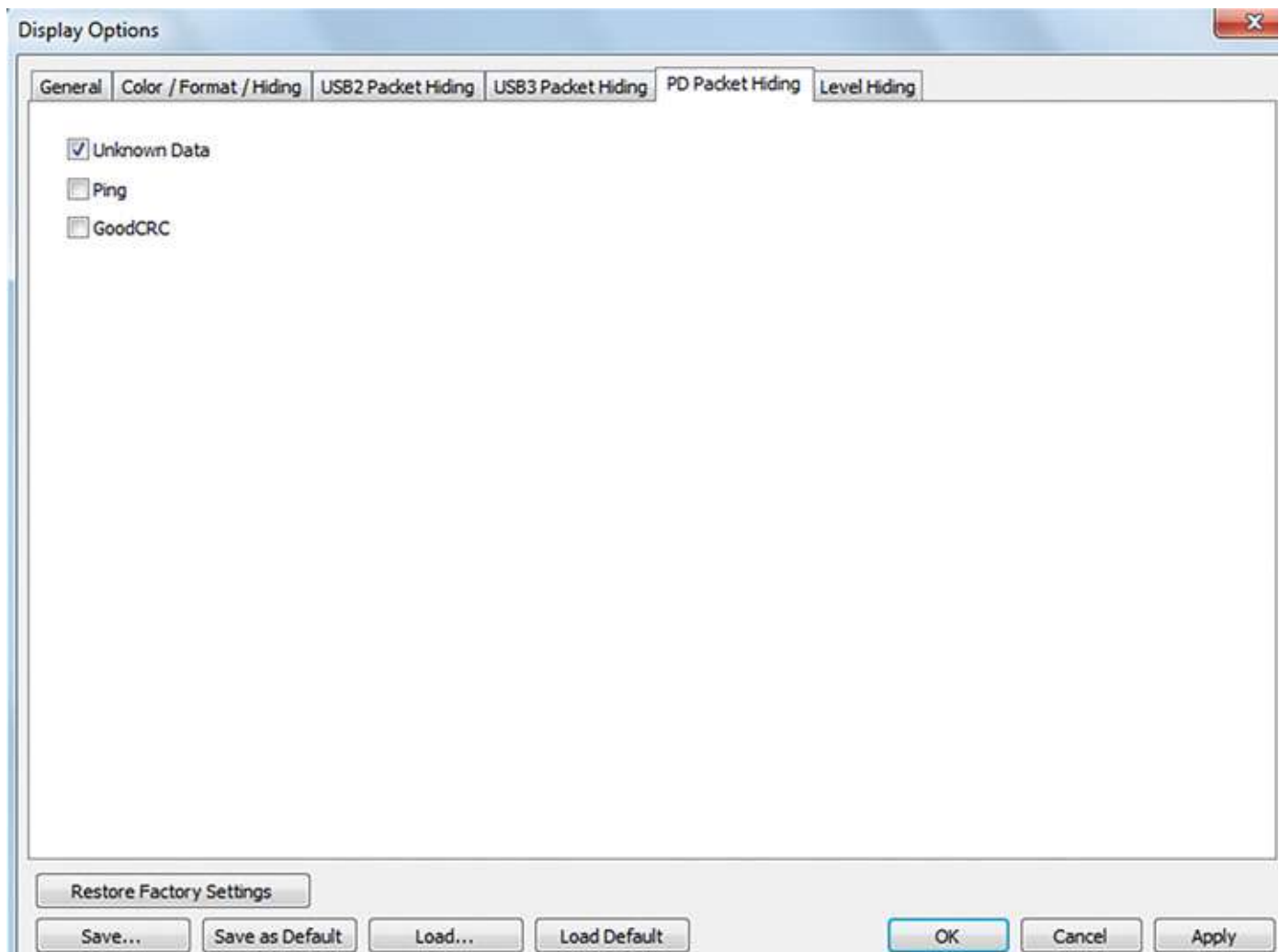


Figure 8.8: PD Packet Hiding

8.6 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 8.9.](#))

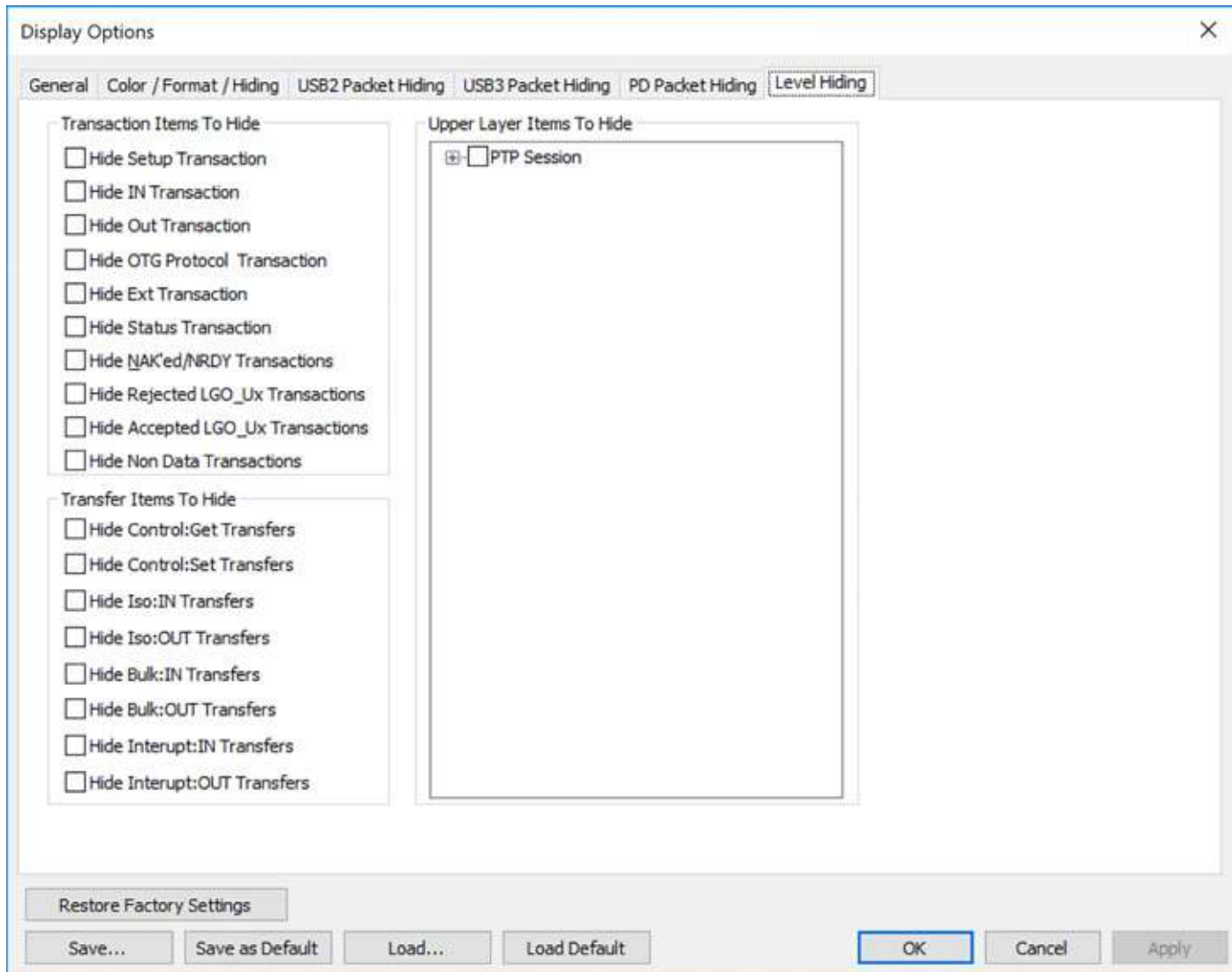


Figure 8.9: Level Hiding Dialog

8.7 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**.

8.8 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 9

Decode Requests

9.1 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	Protocol ID
Audio Class (See “Audio Decoders” on page 533) AudioClass\Audio1.0Requests.dec AudioClass\Audio2.0Requests.dec AudioClass\Audio3.0Requests.dec AudioClass\Audio1.0Interrupt.dec AudioClass\Audio2.0Interrupt.dec AudioClass\Audio3.0Interrupt.dec	Audio	0x01	0x00	0x00 0x20 0x30 0x00 0x20 0x30
Communications and CDC* Control Direct Line Control Model Abstract Control Model Telephone Control Model Multi-Channel Control Model CAPI Control Model Ethernet Networking Control Model ATM Networking Control Model Wireless Handset Control Model Device Management Model Mobile Direct Line Model OBEX Model Communication Device Subclass/EEM Communications\CommRequests.dec Communications\CommInterrupt.dec Communications\CommCDCEEM.dec	Communication Communication Communication Communication Communication Communication Communication Communication Communication Communication Communication Communication Communication Communication Communication	0x02 0x02 0x02 0x02 0x02 0x02 0x02 0x02 0x02 0x02 0x02 0x02 0x02 0x02	0x01 0x02 0x03 0x04 0x05 0x06 0x07 0x08 0x09 0x0A 0x0B 0x0C	
Device Firmware Update	DevFirmwareUpdate	0xFE	0x01	0x02
HID (Human Interface Device, see “HID Decoders” on page 533) HUT (HID extension) Monitor (HID extension) Physical Interface (force-feedback extension to HID) Point of Sale Devices (HID extension) Power (HID extension) Hid\Hid_InterruptIN.dec Hid\Hid_InterruptOUT.dec Hid\Hid_Req.dec	HID HID HID HID HID HID HID	0x03 Extension Extension Extension Extension Extension Extension		
*: 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	0x06	0x01	0x01
Printer Printer\Printer_req.dec	Printer	0x07	0x01	0xXX
Mass Storage SCSI/Bulk Protocol MassStorageClass\MS_BulkOnly_Requests.dec MassStorageClass\MS_BulkOnlySCSIInEndpoint. dec MassStorageClass\MS_BulkOnlySCSIOutEndpoint. dec MassStorageClass\MS_BulkOnlySCSIOutEndpoint. dec	Mass Storage Mass Storage SCSI Bulk	0x08 0x08	0x06	0x50
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	0x08	0x04	0x00
Hub support HubClass\HubClassRequests.dec HubClass\HubClassStatusEndpoint.dec	Hub Class	0x09		
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	Protocol 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*	0x0A	0xXX	
*: The CDC Decoder includes the ECM class decoding				
Smart Card (CCID) SmartCard\CCIDBulkIn.dec SmartCard\CCIDBulkOut.dec SmartCard\CCIDInterrupt.dec SmartCard\CCID_req.dec SmartCard\ICCIDBulkIn.dec SmartCard\ICCIDBulkOut.dec SmartCard\ICCIDInterrupt.dec SmartCard\ICCID_req_Ver.A.dec SmartCard\ICCID_req_Ver.B.dec	CCID and ICCD	0x0B	0x00	0x01 0x02
Content Security ContentSecurityRequests.dec ContentSecurityInterruptIN.dec ContentSecurityInterruptOUT.dec	Content Security	0x0D 0x0D 0x0D	0x00 0x00 0x00	0x01 0x01 0x01

USB Decode	USB Decoder Name	USB-IF Base Class	Codes Sub Class	Protocol ID
Video Class (UVC)				
VIDEO CONTROL 1.0	Video	0x0E	0x01	0x00
VIDEO STREAMING 1.0	Video	0x0E	0x02	0x00
VIDEO INTERFACE COLLECTION 1.0	Video	0x0E	0x03	0x00
VIDEO CONTROL 1.1	Video	0x0E	0x01	0x20
VIDEO STREAMING 1.1	Video	0x0E	0x02	0x20
VIDEO INTERFACE COLLECTION 1.1	Video	0x0E	0x03	0x20
VIDEO CONTROL 1.5	Video	0x0E	0x01	0x30
VIDEO STREAMING 1.5	Video	0x0E	0x02	0x30
VIDEO INTERFACE COLLECTION 1.5	Video	0x0E	0x03	0x30
VideoClass\VideoBulkIn.dec VideoClass\VideoBulkOut.dec VideoClass\VideoInterrupt.dec VideoClass\VideoIsochIn.dec VideoClass\VideoIsochOut.dec VideoClass\Video1.0Requests.dec VideoClass\Video1.1Requests.dec VideoClass\Video1.5Requests.dec				
Wireless Controller				
Bluetooth	HCI	0xE0 0xE0 0xE0	0x01 0x01	0x01 0x02
USB Type-C Bridge				
TypeC_BridgeRequests.dec TypeC_BridgeNotifications.dec	USB Type-C Bridge	0x12 0x12	0x00 0x00	0x00 0x00
Remote Network Driver Interface Specification (RNDIS)	Remote NDIS	0xEF	0x02	0x02
USB3 Vision				
USB3 Vision VisionControl.dec VisionEvent.dec VisionStream.dec	USB3 Vision	0xEF	0x05	0x00

USB Decode	USB Decoder Name	USB-IF Base Class	Codes Sub Class	Protocol ID
Miscellaneous Device Class Interface Association Descriptor	Standard, so no decoder method needed	0xEF 0xEF	0x02	0x01
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	0xEF	0x03	0x01
Device Firmware Update USBDFU_req.dec USBDFU_BulkInEndpoint.dec USBDFU_BulkOutEndpoint.dec		0xFE 0xFE 0xFE	0x01 0x01 0x01	0x02 0x02 0x02
IrDA Bridge	IrDA Bridge	0xFE	0x02	0x00
ATAPI	ATAPI	0x08	0x02	0x50
IP	IP	0xFF		
HTTP	HTTP	0xFF		
Personal Healthcare Devices PersonalHealthcare\PersonalHealthcareRequest. dec PersonalHealthcare\PersonalHealthcareDescriptors .inc PersonalHealthcare\PersonalHealthcareDataBulkIn .dec PersonalHealthcare\PersonalHealthcareDataBulk Out.dec PersonalHealthcare\PersonalHealthcareDataBulk. inc	Personal Healthcare	0x0F		

9.1.1 Audio Decoders

Due to Entity ID mapping issues with this class, it works best if the descriptors are captured in the trace file. Then, the software can map the Entity Id's to the correct functions. It is also possible to hand-edit the Audio1.0CurrentEntityIdMap_EditMe.inc or Audio2.0CurrentEntityIdMap_EditMe.inc

files to explicitly apply this mapping. These files are found in:

\Users\Public\Documents\LeCroy\USB Protocol Suite\Scripts\AudioClass

Setting the value in that file UseCurrentEntityIdMap =1;

will cause it to use the mapping that you provide, otherwise it depends on the mapping found in the descriptors.

If the automatic mapping has occurred on a trace, then the default mapping in subsequent traces will use those values, as long as the application session remains.

Hitting the "Reset Decoding" button will apply the decoding to a trace if it was not already done automatically.

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

9.1.2 HID Decoders

The HID class is based on HUT tables. If the trace captured does not contain the report descriptor, then you must edit the file supplied in the

\Users\Public\Documents\LeCroy\USB Protocol Suite\Scripts\Hid

folder called "HIDReportDescriptor_EditMe.inc". You will need to define the report layout in this file [there are some examples and templates]. Also, you must set the variable in that file "UseHIDReportDescriptorItems" to "1" to be able to use report layout defined in this file. If this flag is "0", software will try to find report from descriptor in trace, and if the descriptor is not found in the trace, it uses the most recently used report layout.

You may need to select the "Reset Decoding" button in decoding assignment for old traces.

9.2 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.

9.2.1 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:

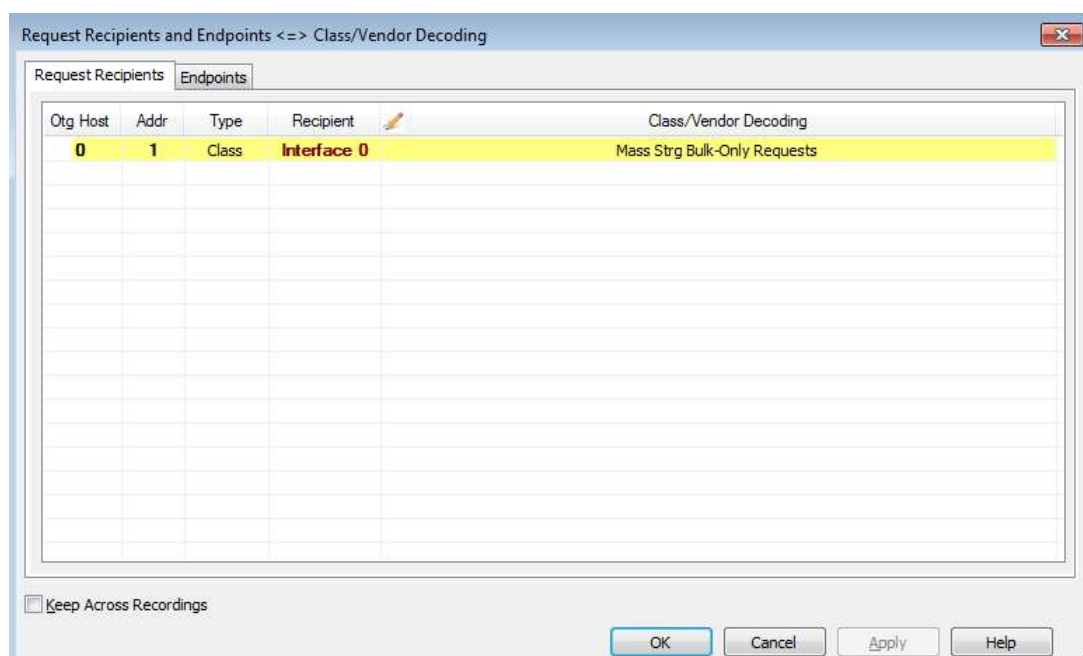


Figure 9.1: Request Recipients and Endpoints - Class/Vendor Decoding Request Recipients Tab

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.

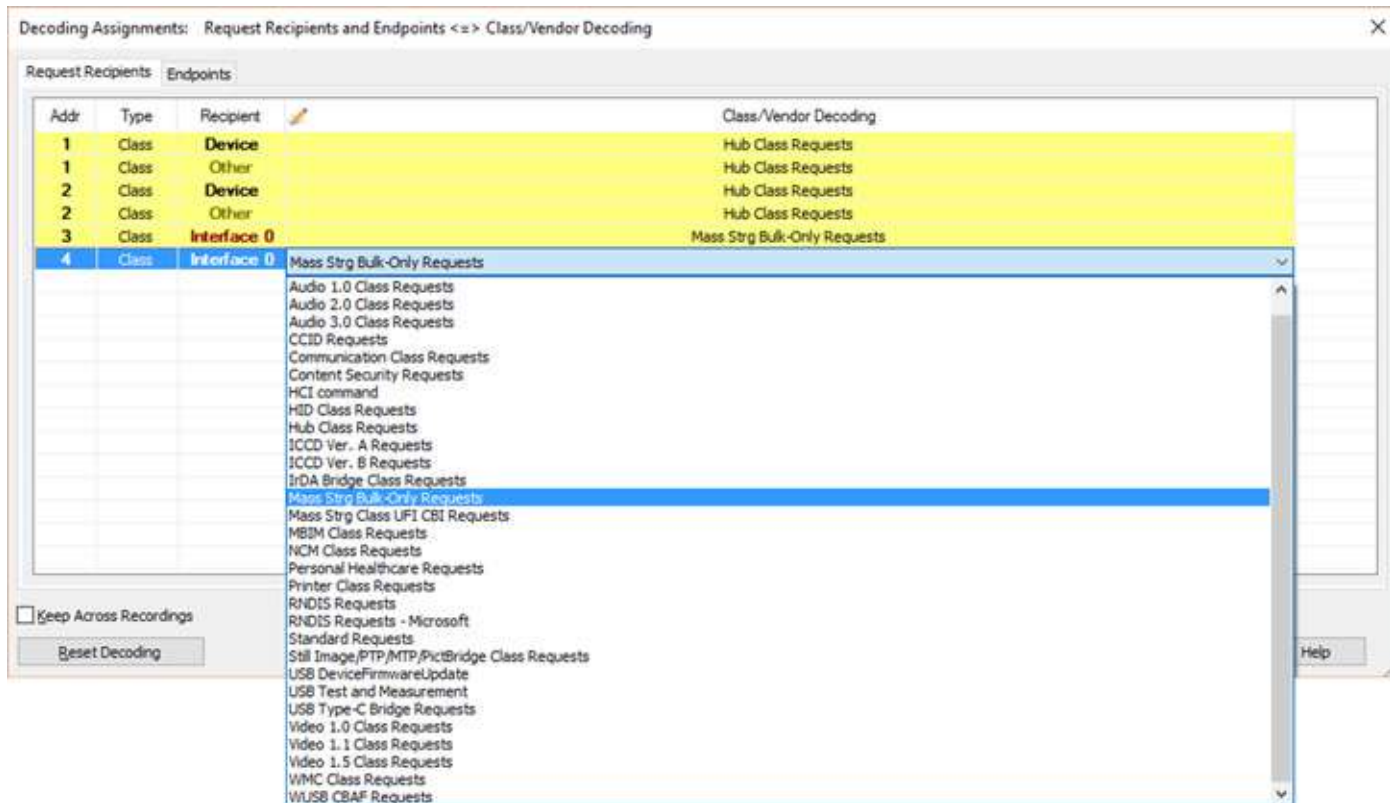


Figure 9.2: Class/Vendor Decoding Groups Drop-down Menu.

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
- ☐ Audio 3.0 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 DeviceFirmwareUpdate
 - ☐ USB Test and Measurement
 - ☐ USB Type-C Bridge Requests
 - ☐ Video 1.0 Class Requests
 - ☐ Video 1.1 Class Requests
 - ☐ Video 1.5 Class Requests
 - ☐ 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**.

9.2.2 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. See [Figure 9.3 on page 537](#).

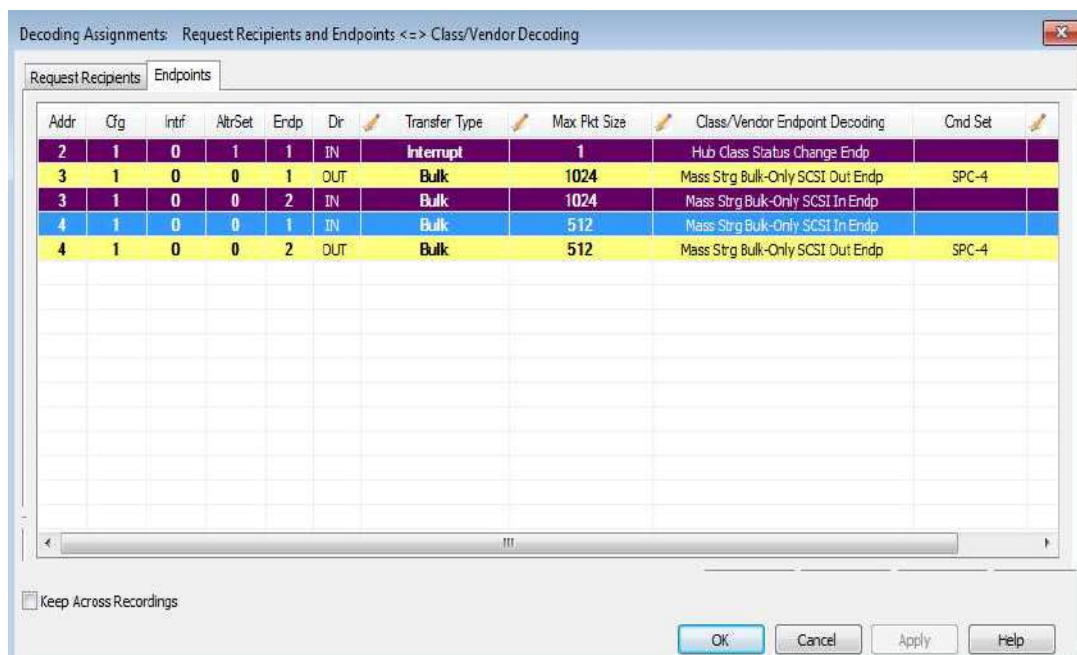


Figure 9.3: Request Recipients and Endpoints - Class/Vendor Decoding Endpoints Tab

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 in [Figure 9.4](#):

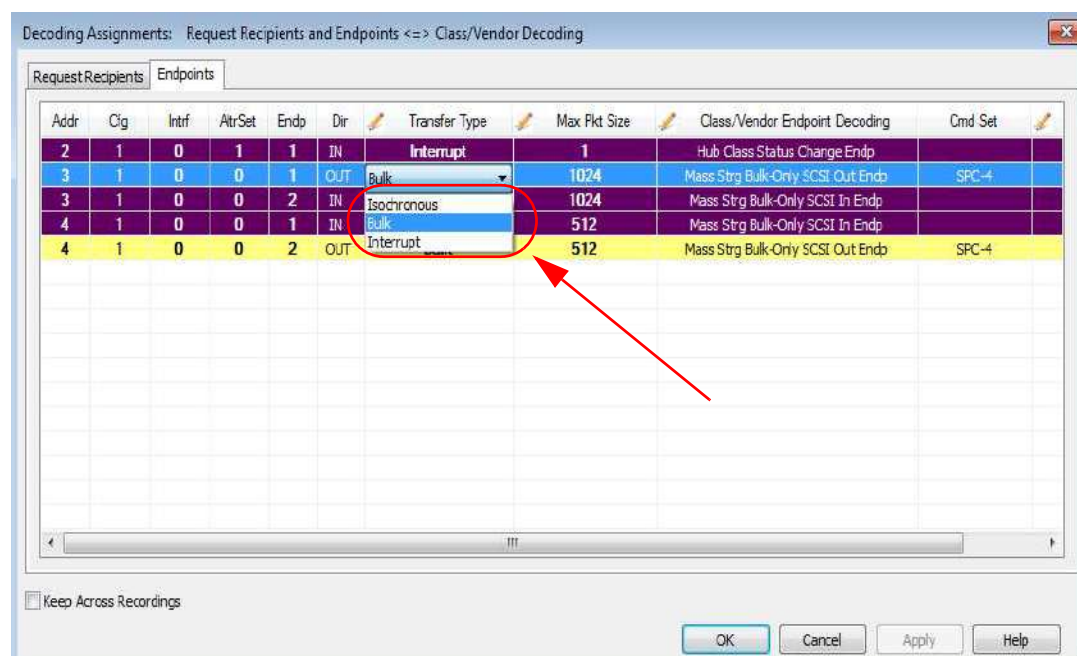


Figure 9.4: Transfer Type Drop-down Menu.

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 for Isochronous IN or OUT Transfers (see [Figure 9.5](#)):

Isochronous Transfer Type: IN or OUT Class/Vendor Endpoint Decoding

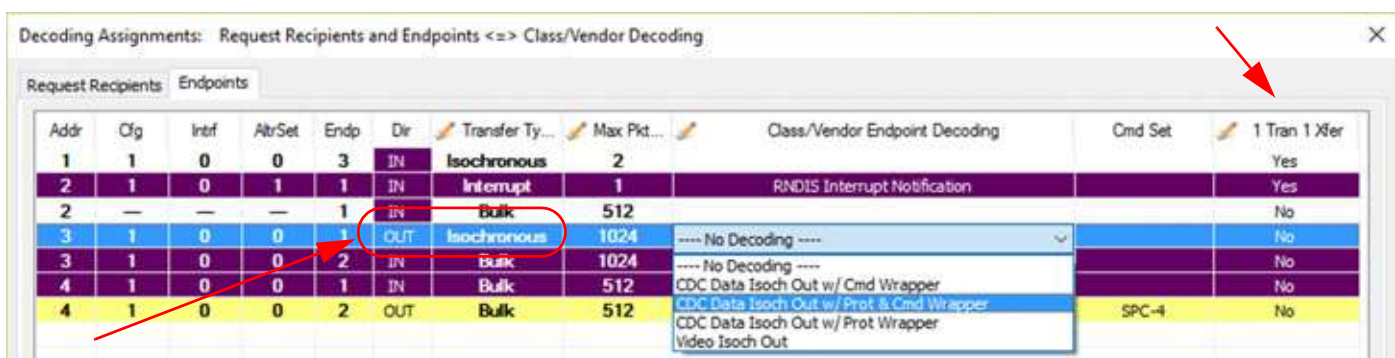


Figure 9.5: Endpoint Decoding Options: IN or OUT Isochronous Transfer Type

The Isochronous Transfer Type Class/Vendor Endpoint Decoding options for an IN or OUT transfer (as shown above) 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

9. Display the **Class/Vendor Endpoint Decoding** drop-down menu for Bulk IN or OUT transfers (see [Figure 9.6](#)):

Bulk Transfer Type: IN or OUT Class/Vendor Endpoints Decoding

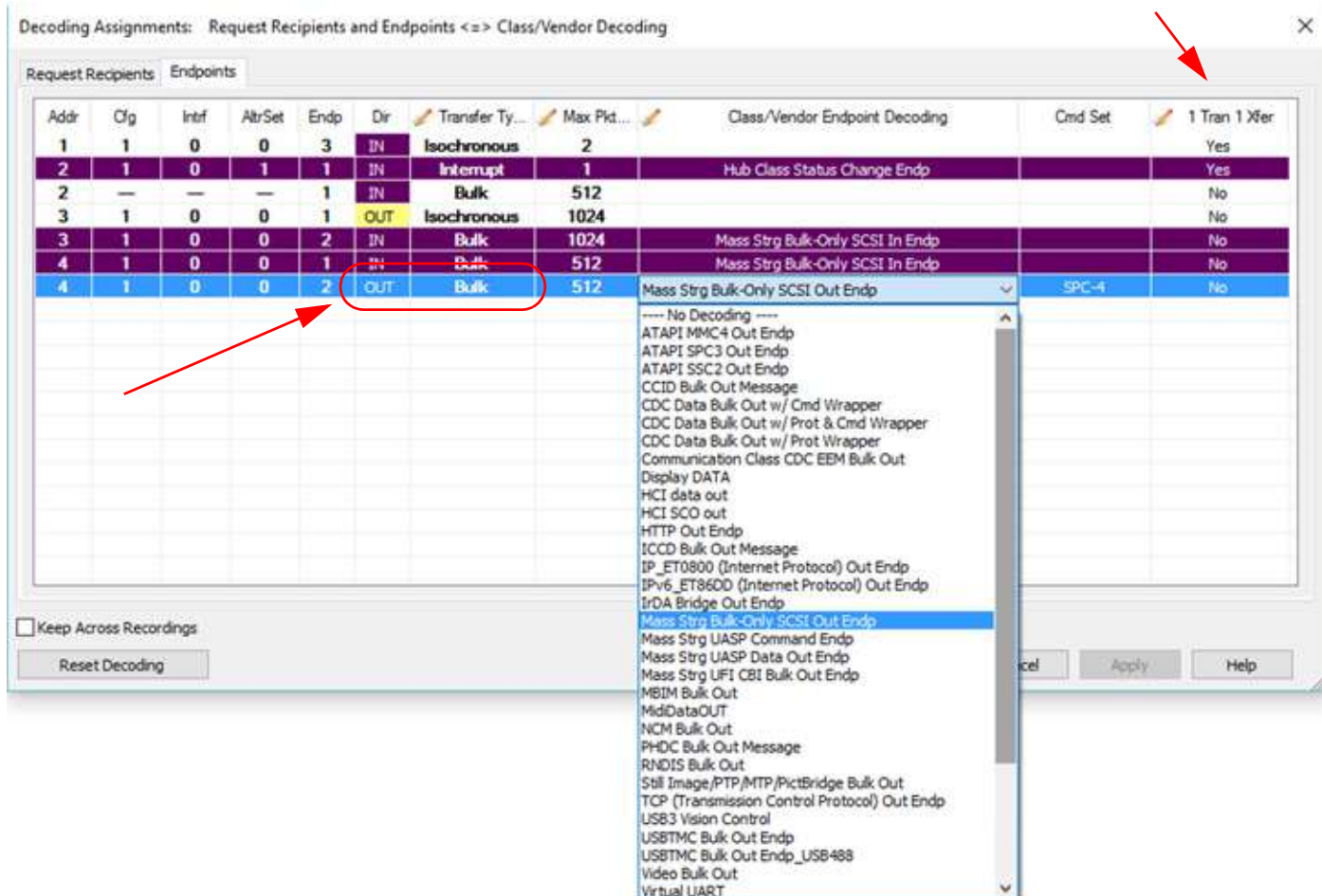


Figure 9.6: Endpoint Decoding Options: IN or OUT Bulk Transfer Type

The Class/Vendor Endpoint Decoding options for an IN or OUT transfer for Bulk Transfer Type (as shown in above) 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_ET86DD (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
- ☐ MidiDataOUT
- ☐ NCM Bulk Out
- ☐ PHDC Bulk Out Message
- ☐ RNDIS Bulk Out
- ☐ Still Image/PTP/MTP/PictBridge Bulk Out
- ☐ TCP (Transmission Control Protocol) Out Endp
- ☐ USB3 Vision Control
- ☐ USBTMC Bulk Out Endp
- ☐ USBTMC Bulk Out Endp_USB488
- ☐ 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**.

10. Display the **Class/Vendor Endpoint Decoding** drop-down menu for Interrupt IN transfers (see [Figure 9.7](#)):

Interrupt Transfer Type: IN Class/Vendor Endpoint Decoding

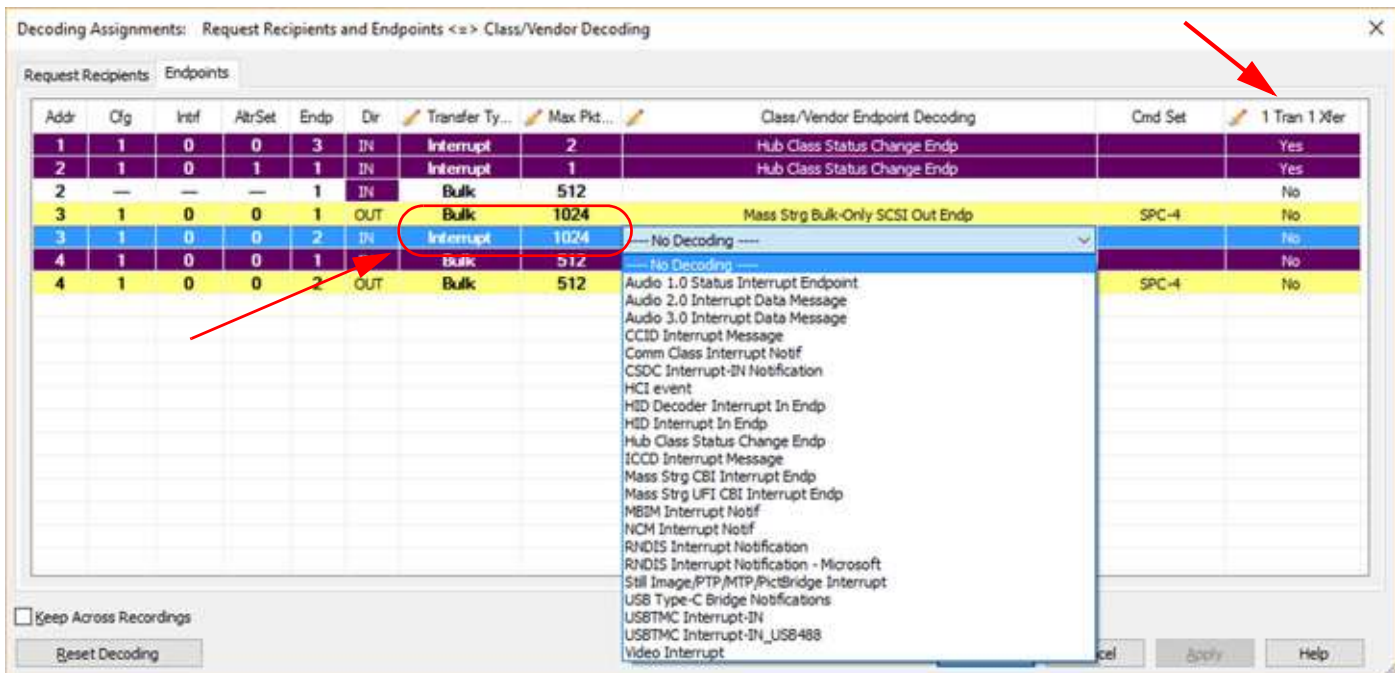


Figure 9.7: 1 Tran 1 Xfer column -> HID Interrupt In Endpoint Decoding

The IN Interrupt Transfer Type options for a Class/Vendor Endpoint Decoding (as shown above) are:

- ☐ No Decoding
- ☐ Audio 1.0 Status Interrupt Endpoint
- ☐ Audio 2.0 Interrupt Data Message
- ☐ Audio 3.0 Interrupt Data Message
- ☐ CCID Interrupt Message
- ☐ Comm Class Interrupt Notif
- ☐ CSDC Interrupt-IN Notification
- ☐ HCI event
- ☐ HID Decoder Interrupt in Endp
- ☐ 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
- ☐ USB Type-C Bridge Notifications

- ☐ USBTMC Interrupt-IN
- ☐ USBTMC Interrupt-IN_USB488
- ☐ Video Interrupt

11. Display the **Class/Vendor Endpoint Decoding** drop-down menu for Interrupt OUT Transfers (see [Figure 9.8](#)):

Interrupt Transfer Type: OUT Class/Vendor Endpoint Decoding

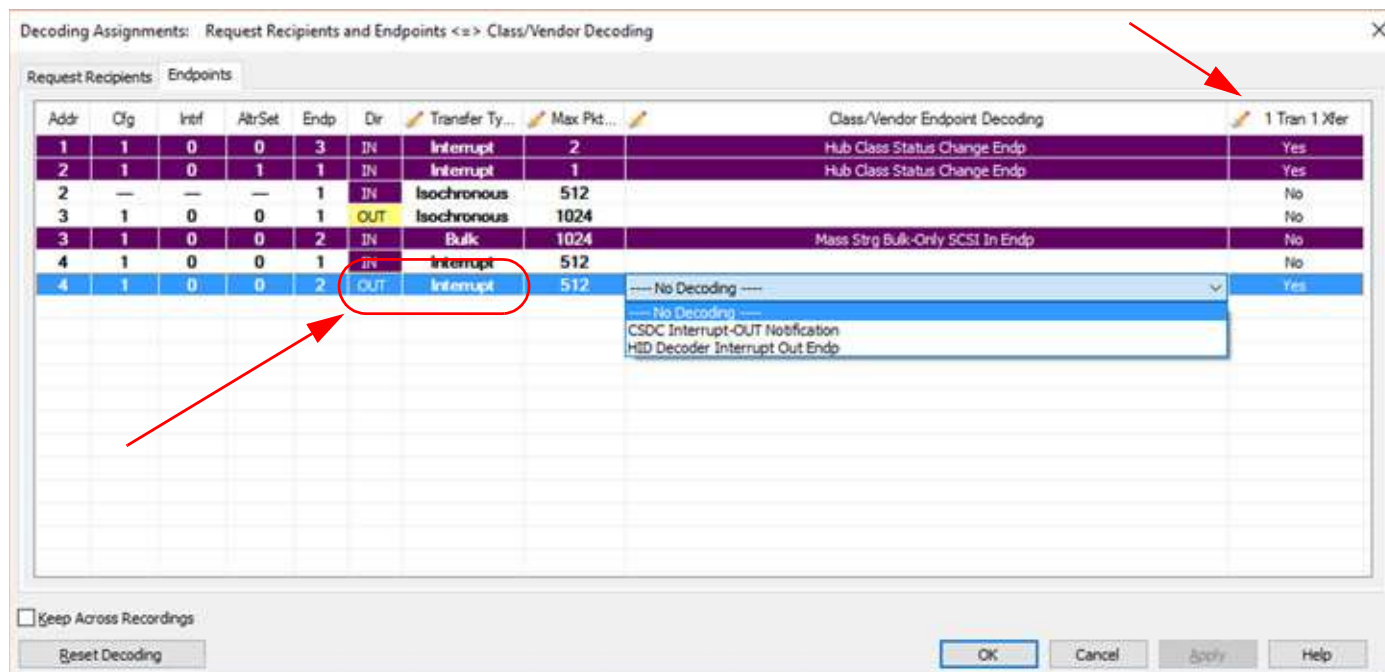


Figure 9.8: 1 Tran 1 Xfer column -> HID Interrupt OUT Endpoint Decoding

The OUT Interrupt Transfer Type options for a Class/Vendor Endpoint Decoding (as shown above) are:

- ☐ No Decoding
- ☐ CSDC Interrupt-OUT Notification
- ☐ HID Decoder Interrupt Out Endp

12. Select the type of decoding.

OR

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

13. 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 9.7 on page 541](#)).

14. Repeat the previous steps for any additional endpoints you would like to map.
15. To retain a mapping from trace to trace DURING an application session, select the **Keep Across Recordings** checkbox.
16. Click **OK**.

9.2.3 Selecting Number of Transactions per Transfer

In the Decoding Assignments dialog (see [Figure 9.9](#)), after selecting the Endpoints tab you can select either:

- ☐ 1 Transaction per 1 Transfer (see [Figure 9.10 on page 545](#))

or

- ☐ NAK Separated Transfers (see [Figure 9.13 on page 547](#))

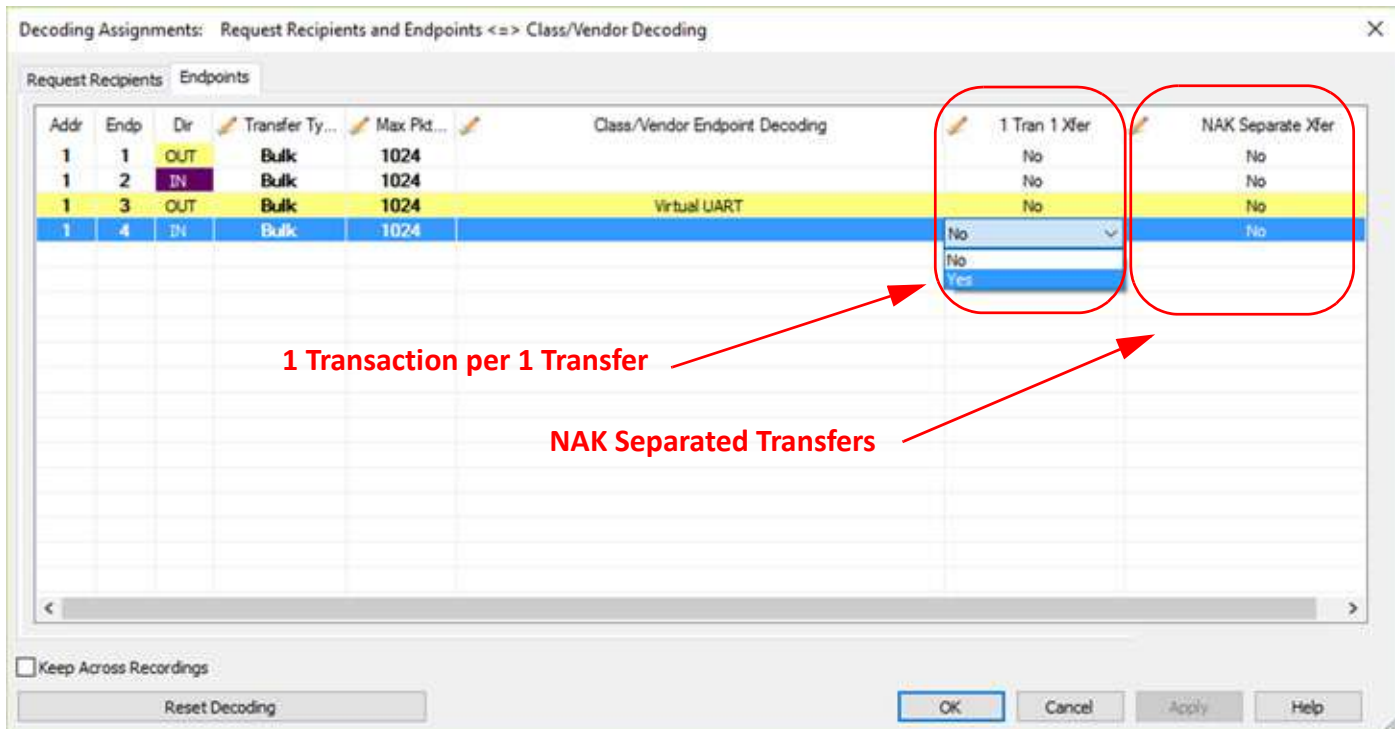


Figure 9.9: Decoding Assignments: Main Dialog

Single Transaction per Transfer

If you select the option: “1 Transaction per 1 Transfer” (see [Figure 9.10](#)), the data traffic in Trace View will change from several transactions per transfer (see [Figure 9.11 on page 545](#)) to one transaction per transfer (see [Figure 9.12 on page 546](#)).

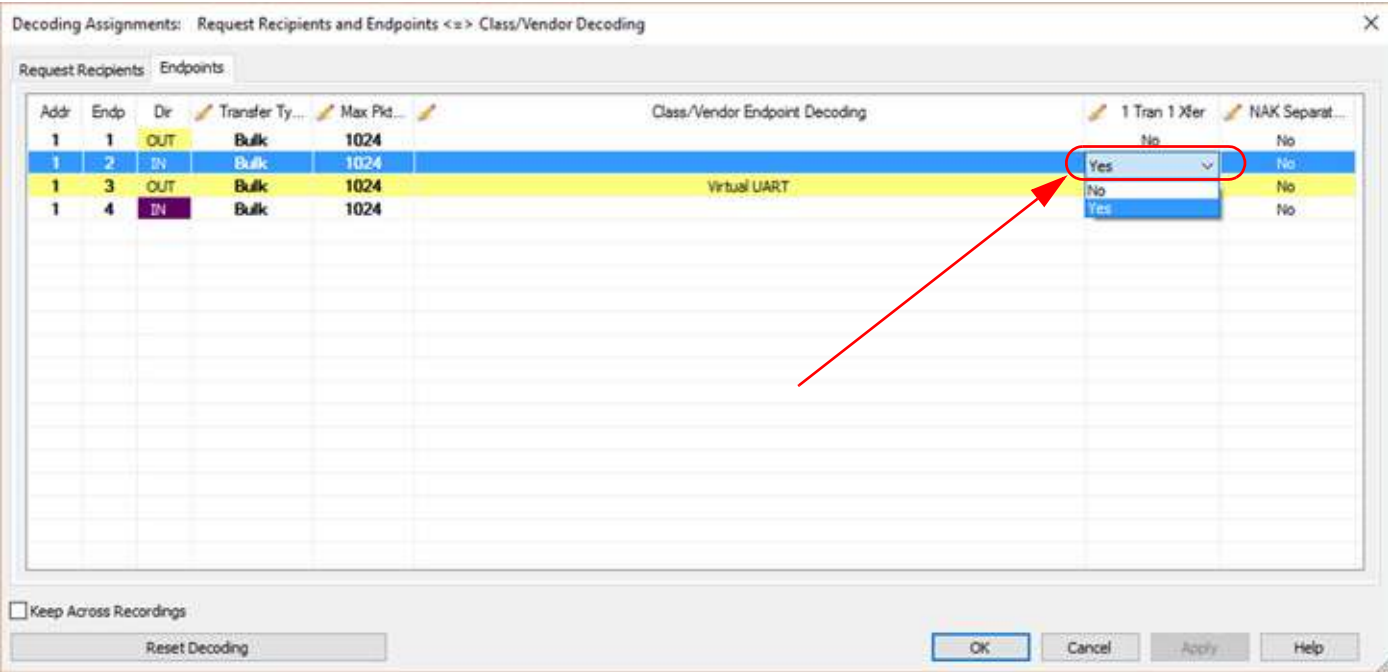


Figure 9.10: Decoding Assignments: 1 Transaction per Transfer

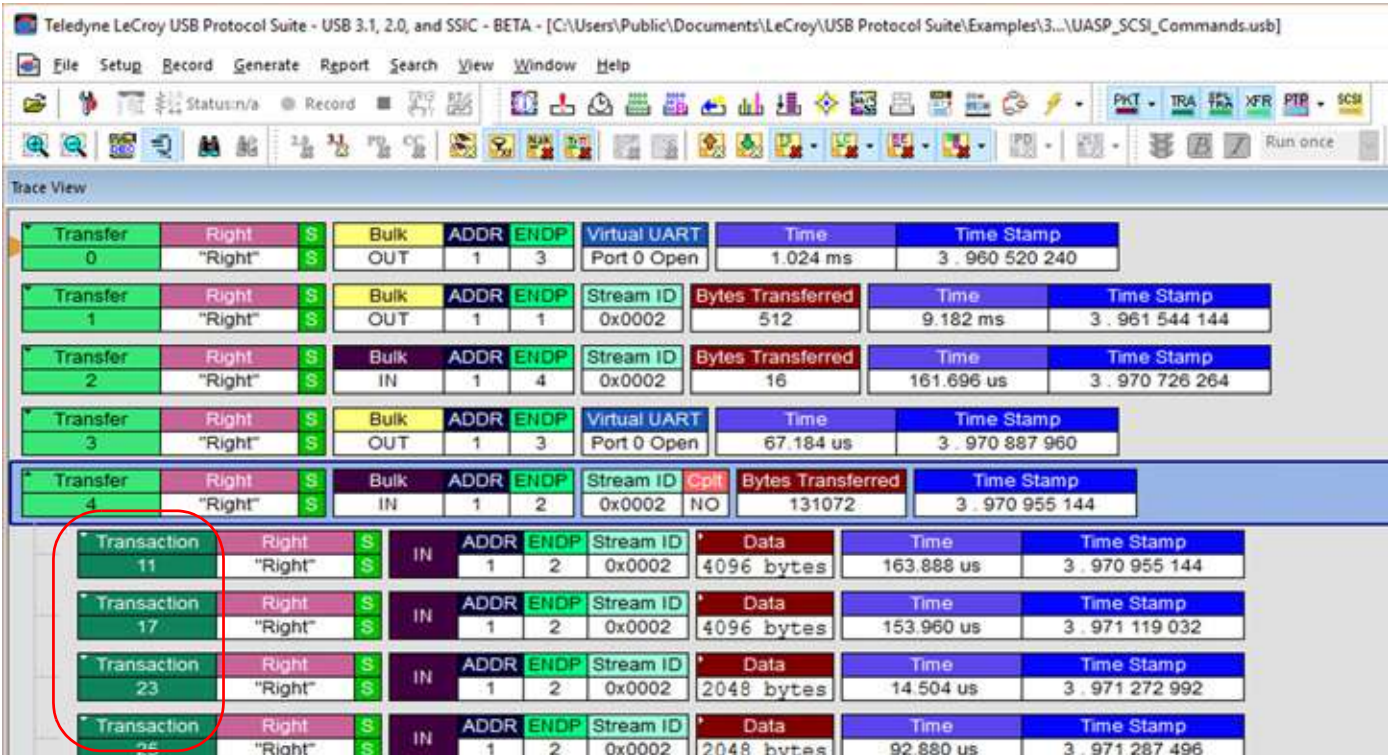


Figure 9.11: Trace View: Several Transactions per Transfer

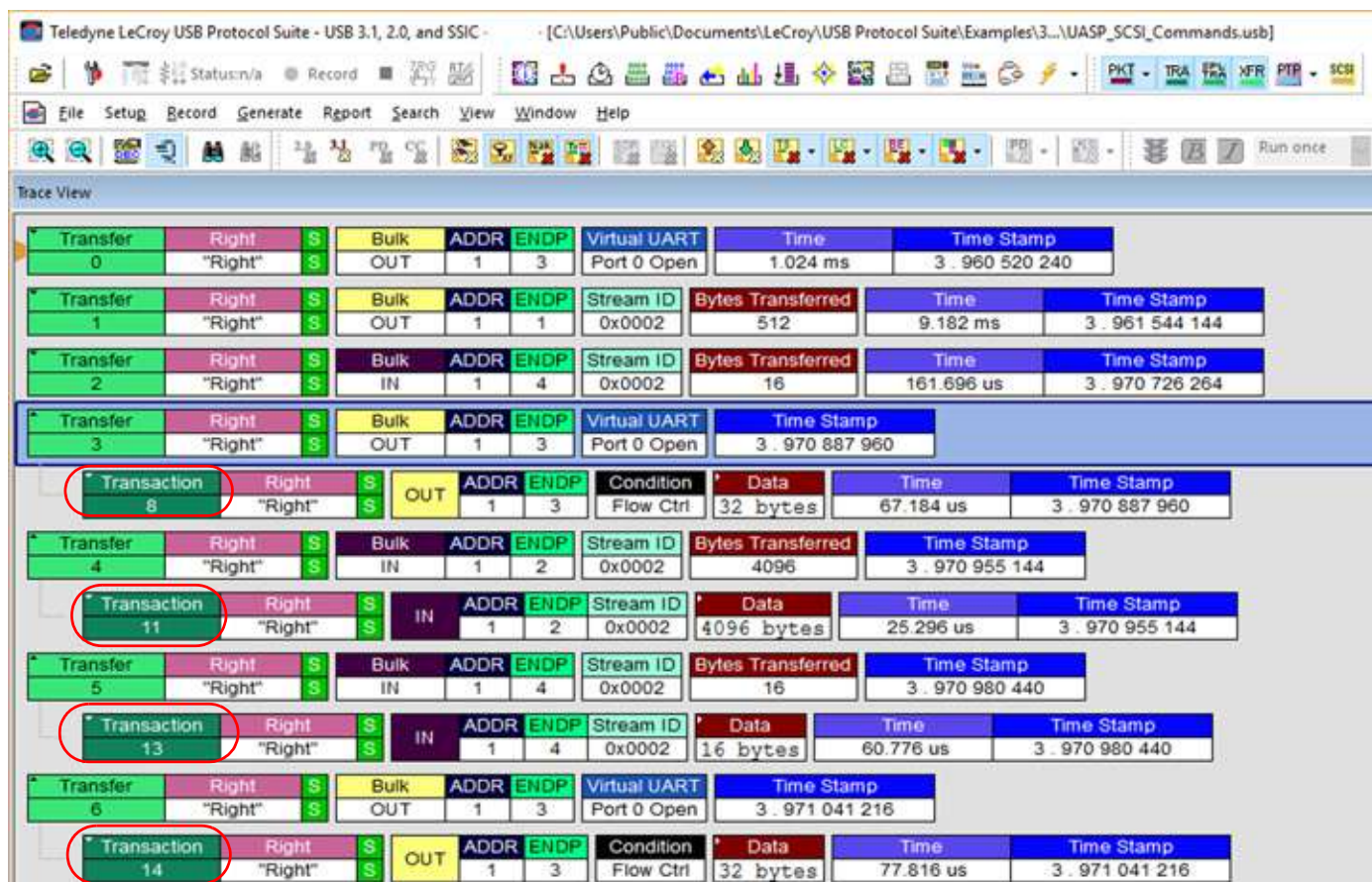


Figure 9.12: Trace View: 1 Transaction per 1 Transfer

NAK Separated Transfer

If you select NAK Separate Transfer (see [Figure 9.13](#)) the Trace Data Traffic will be converted from several (3) Transactions per Transfer (see [Figure 9.14](#)) to NAK Separate Transfer (see [Figure 9.15](#) on page 548).

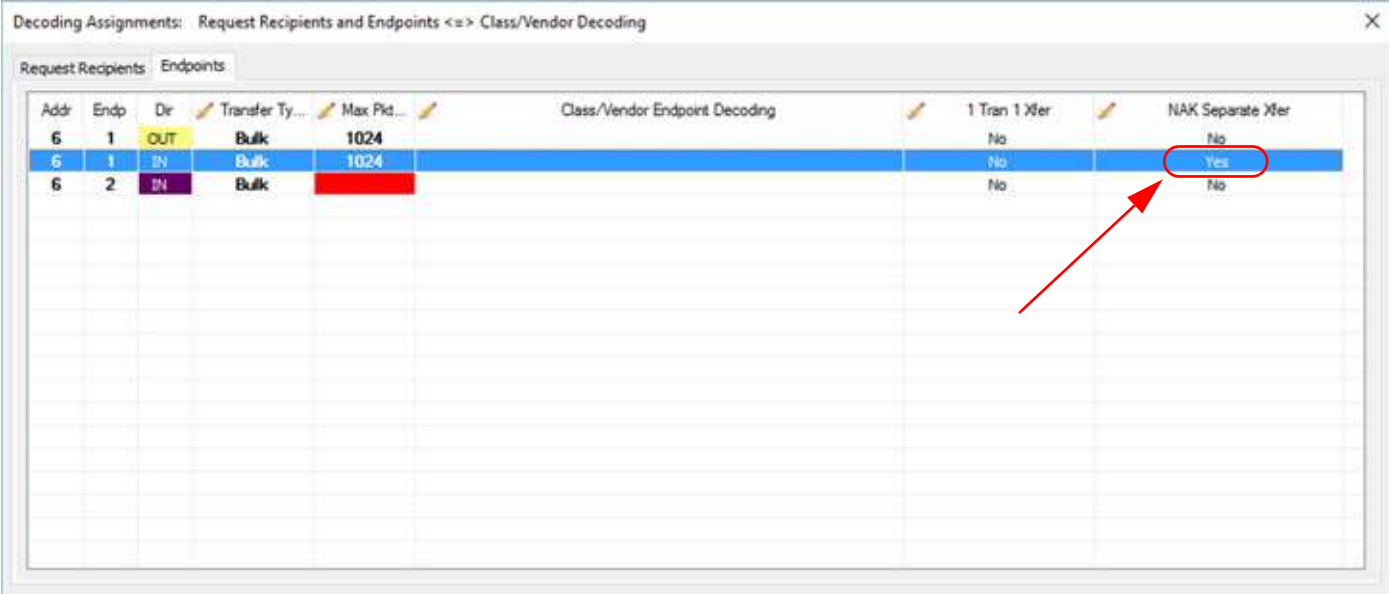


Figure 9.13: Decoding Assignments: NAK Separated Transfer

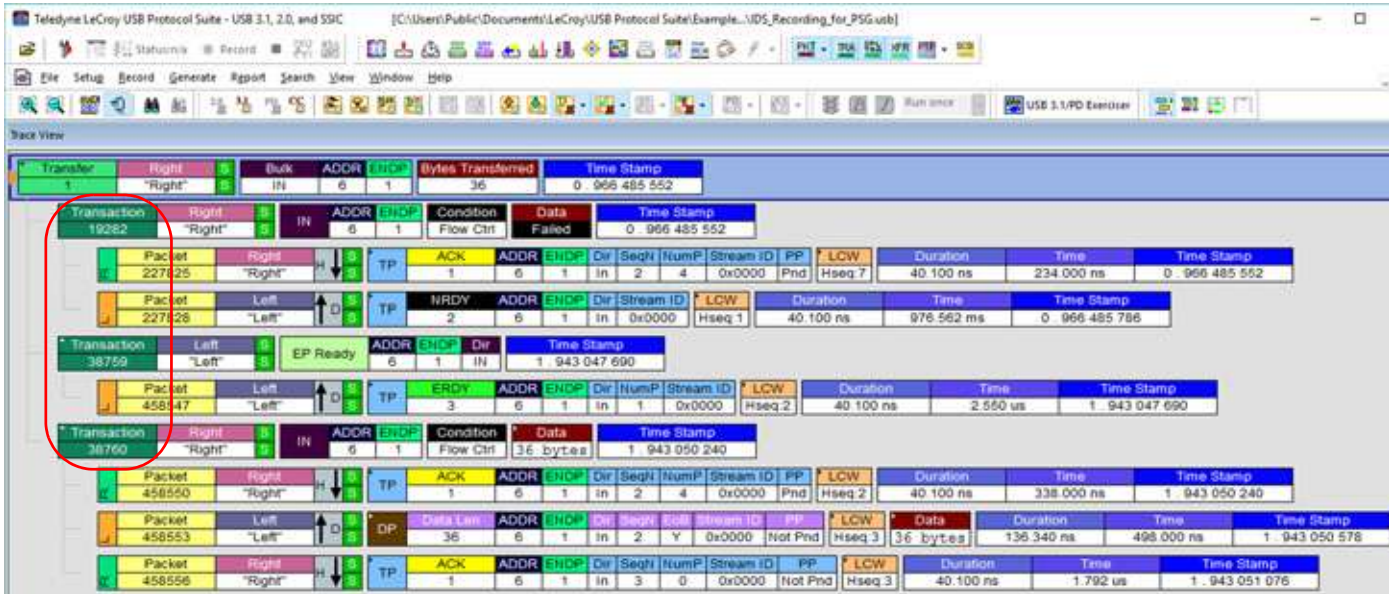


Figure 9.14: Trace View: Several Transactions per Transfer

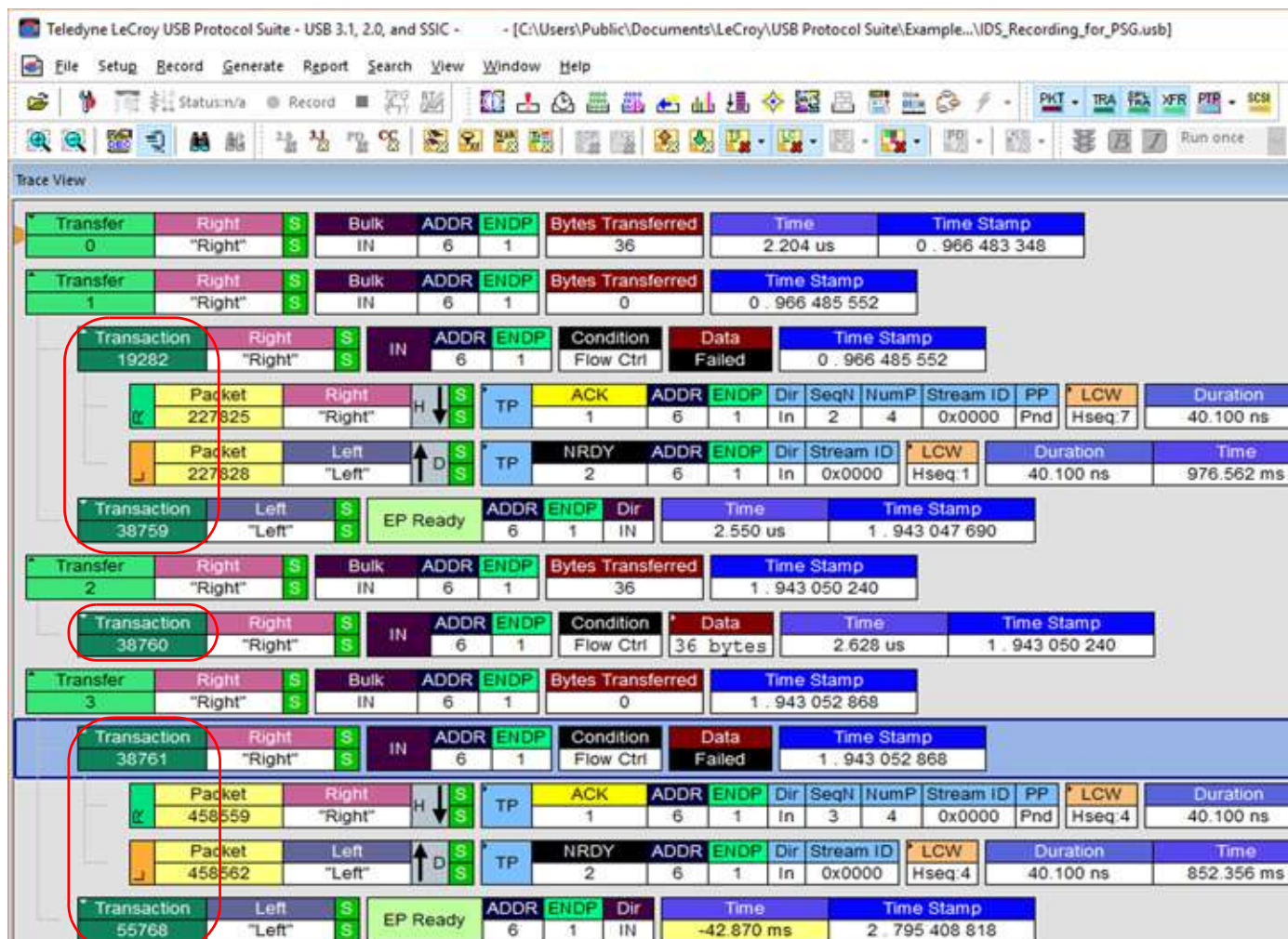


Figure 9.15: Trace View: NAK Separated Transfers

9.3 General Options

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

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

9.3.1 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:

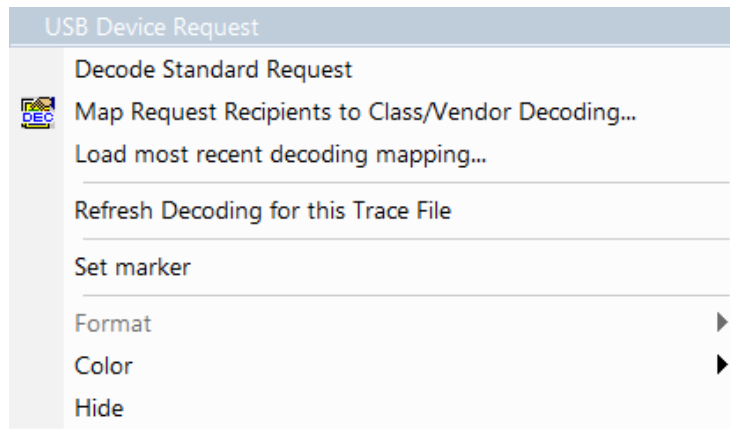


Figure 9.16: USB Device Request Dialog

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 8, "Display Options," on page 513](#))

9.3.2 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:

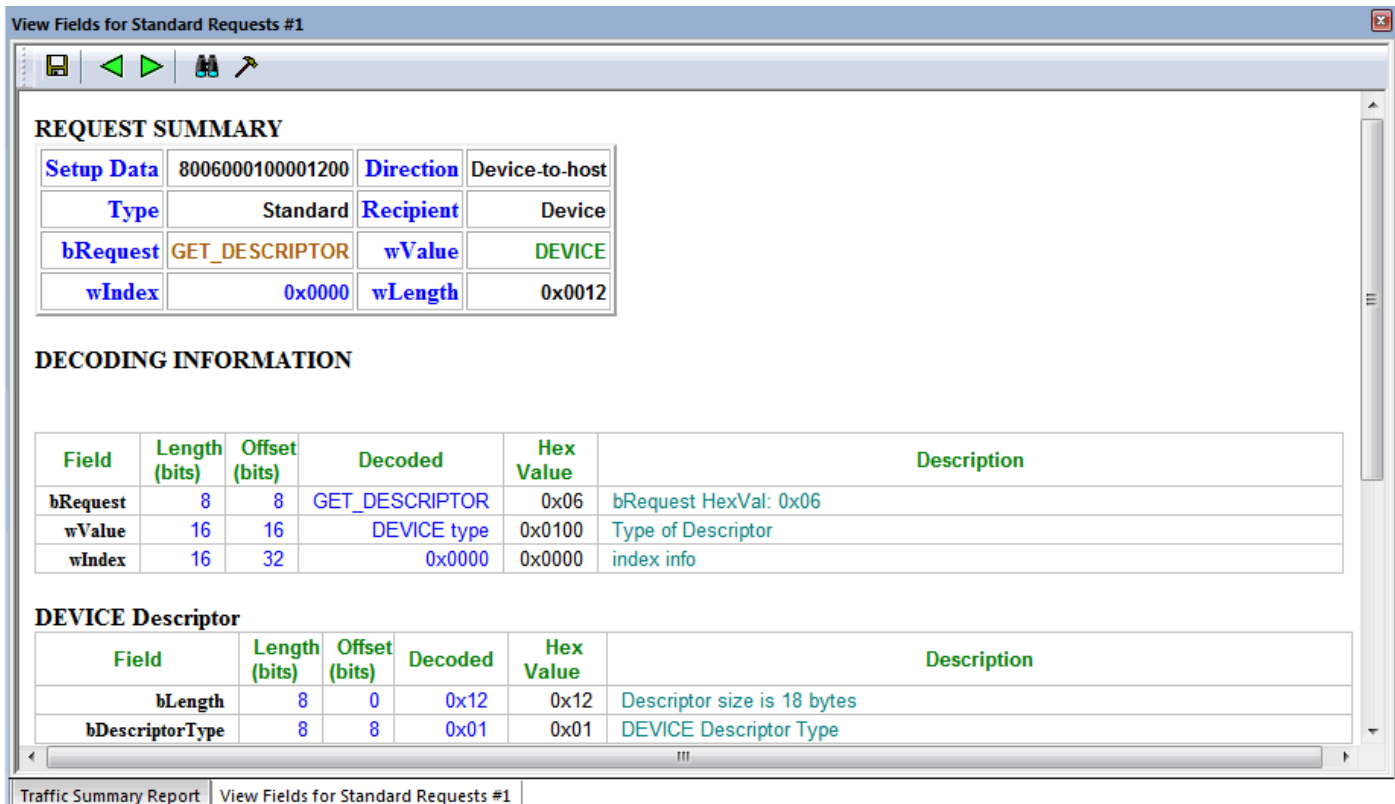


Figure 9.17: View Fields for Standard Requests Dialog

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/

9.3.3 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 9.18 on page 551](#)).

The following figure shows a View Fields for Hub Class Requests decoding:

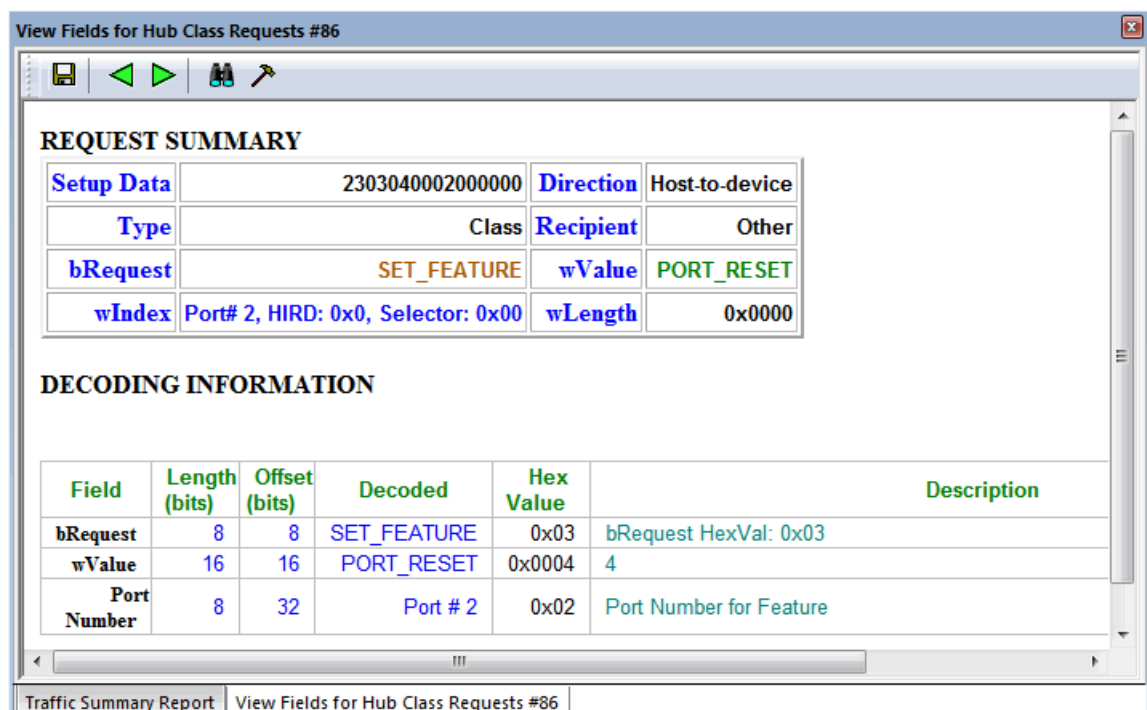


Figure 9.18: View Fields for Hub Class Requests Dialog

9.3.4 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.

9.3.5 Decoding Undefined USB/WUSB Device Requests

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

9.3.6 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:

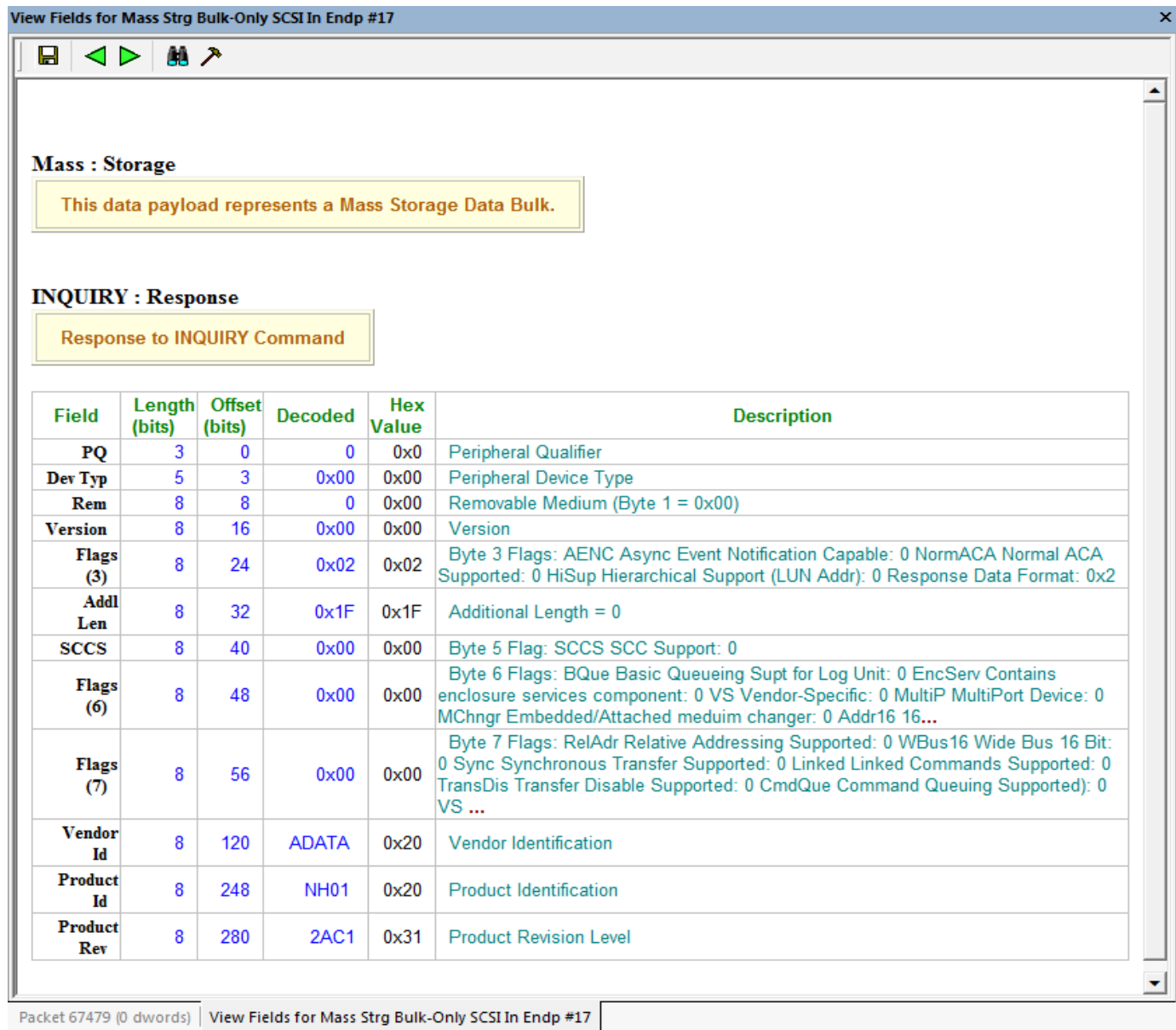


Figure 9.19: View Fields for Mass Strg Bulk-Only SCSI IN Endp Dialog

9.3.7 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.

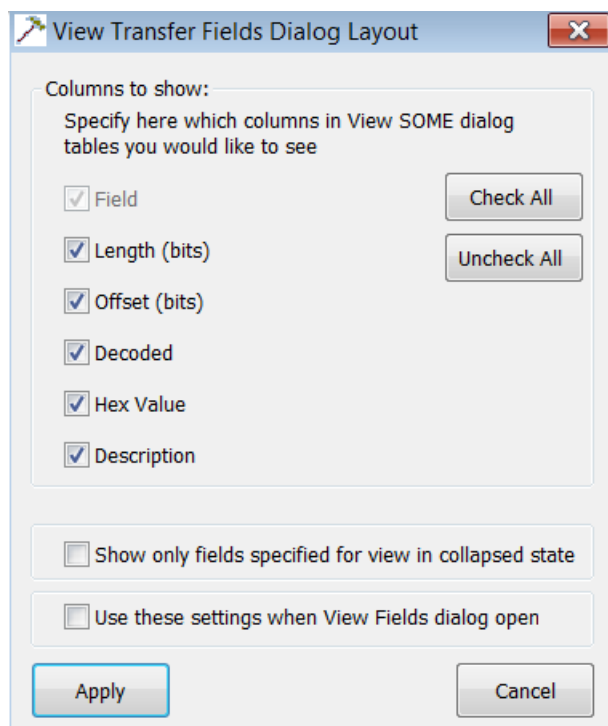


Figure 9.20: View Transfer Fields Dialog Layout

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**.

9.3.8 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.

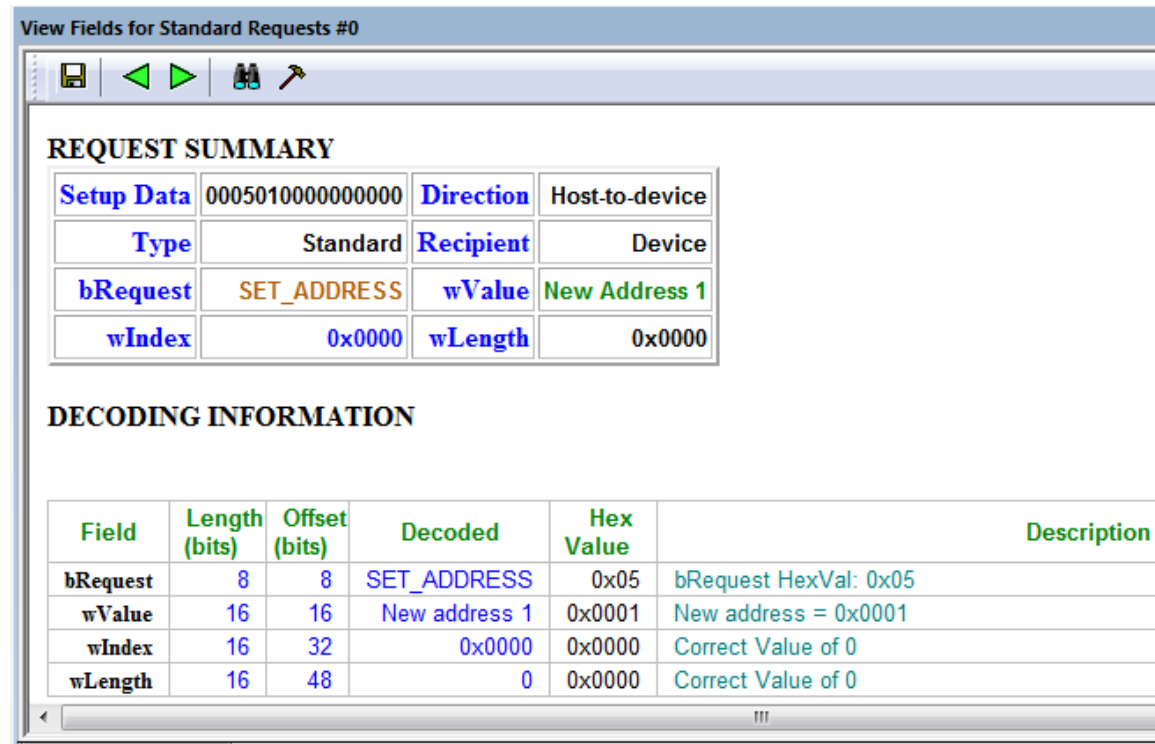


Figure 9.21: Decoded Fields View

	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 9.22 on page 556) allowing you to specify different kinds of presentation formats for the View Fields dialog.

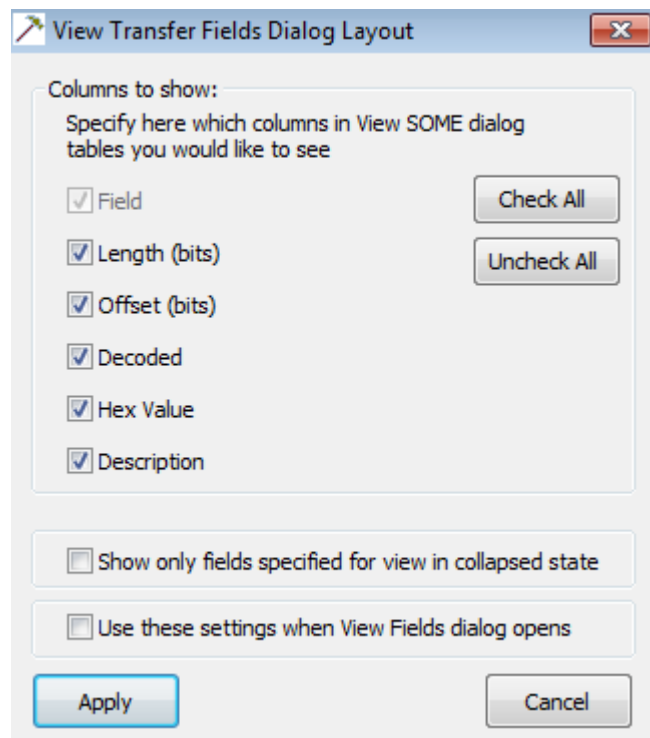


Figure 9.22: View Transfer Fields Dialog Layout Dialog

9.4 USB4 Decoding Assignments Dialog

9.4.1 General Information about USB4 Decoding Assignments

USB4 Decoding Assignments Dialog helps the user set decoding parameters manually when automatic decoding is insufficient or incomplete. There are three groups of decoding parameters which can be set manually:

- ☐ Tunneled Hop ID Protocols
- ☐ Adapter Types
- ☐ Display Port Adapter Parameters
- ☐ Host Interface Adapter Parameters

USB4 Decoding Assignments dialog shows all parameters successfully set when automatic decoding is complete. See [Figure 9.23](#), [Figure 9.24 on page 558](#), [Figure 9.25 on page 558](#) and [Figure 9.26 on page 559](#).

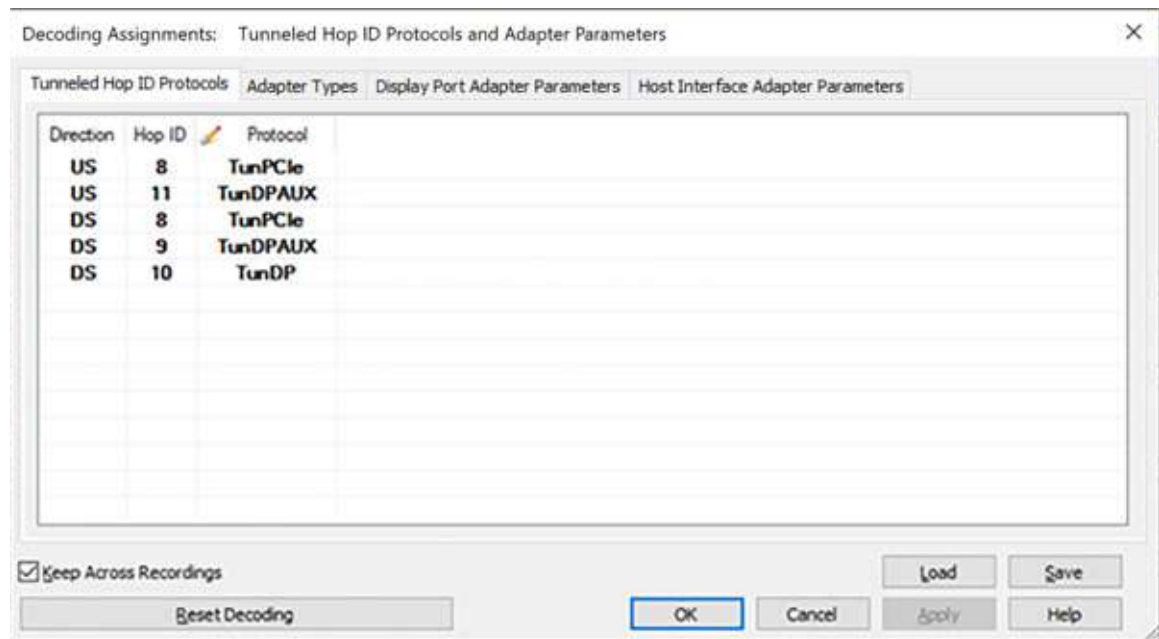


Figure 9.23: Automatically detected Tunneled Protocols

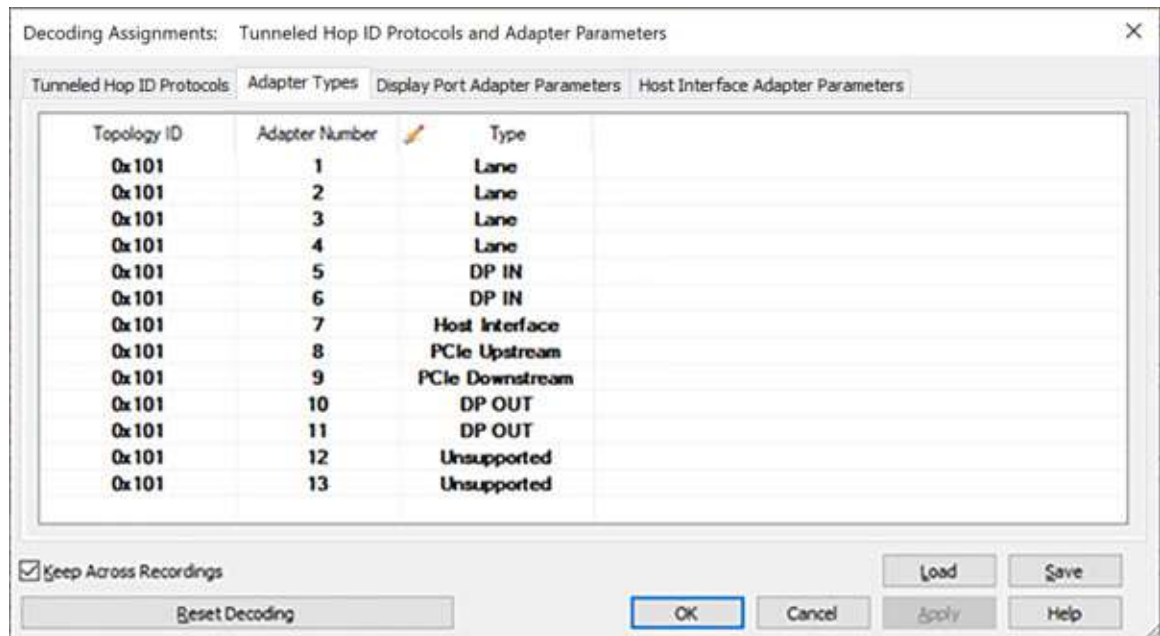


Figure 9.24: Automatically detected Adapter Types

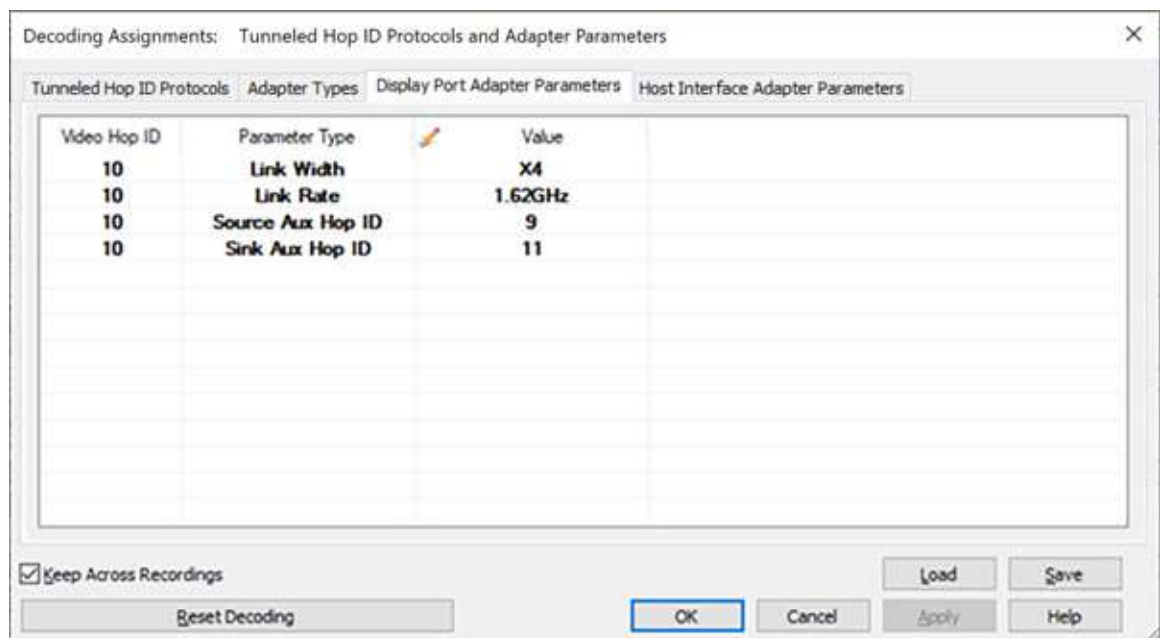


Figure 9.25: Automatically detected Display Port Adapter Parameters

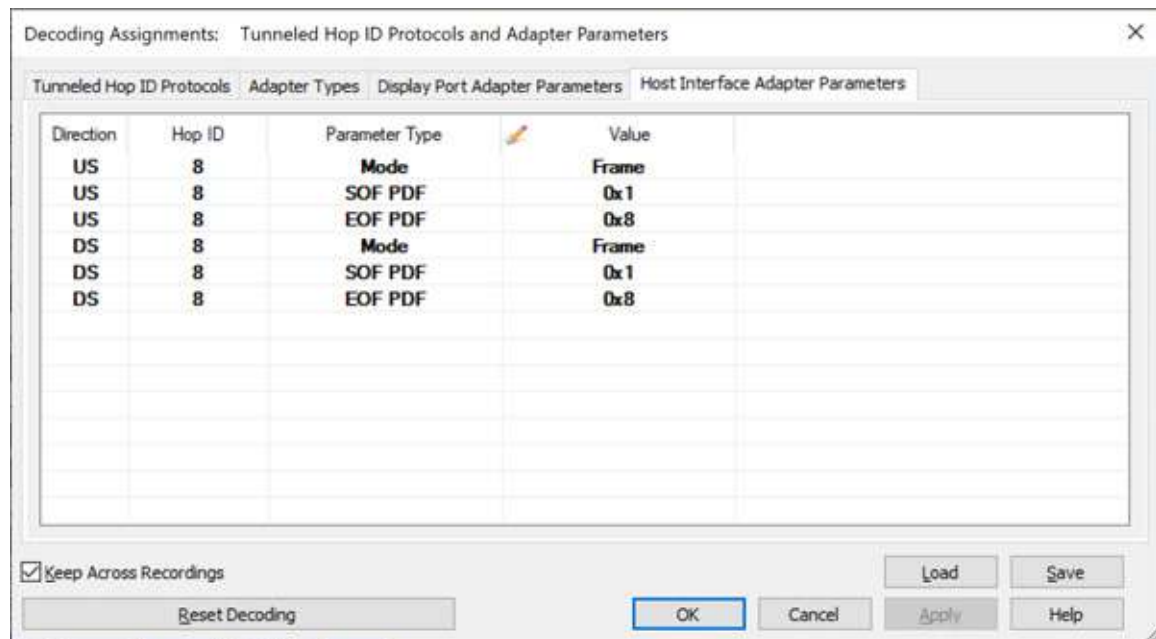


Figure 9.26: Automatically detected Host Interface Adapter Parameters

There are different things that the user can do with USB4 Decoding Assignments Dialog:

- ❑ The user can change any value in the most right column (marked with Pen icon in a header) and apply manually adjusted decoding by pressing OK button. If “Keep Across Recording” checkbox is checked and OK button is pressed, the decoding assignments will be preserved in the current USBSuite application session. Decoding assignments will also be applied to new recordings with a lower priority than automatically detected decoding assignments.
- ❑ The user can press the Save button to save decoding parameters to external file for future use
- ❑ The user can press Load button to load a file with previously saved decoding parameters and apply them by pressing OK button
- ❑ The user can reset manual decoding to automatically decoded parameters by pressing the “Reset Decoding” button.
- ❑ The user can exit from the USB4 Decoding Assignments dialog without applying modified parameters by pressing the Cancel button

Note: OK/Load/Save/Cancel/Reset operations are related only to currently selected trace for which USB4 Decoding Assignments is opened, other opened traces are not affected by these operations;

Note: OK/Load/Save/Cancel/Reset operations are applied to all three groups of settings (Tunneled Hop ID Protocols, Adapter Types, Display Port Adapter Parameters);

Note: After pressing OK modified parameters are stored permanently in a trace.

9.4.2 Tunneled Hop ID Protocols

If tunneled protocols are auto detected successfully, the user will see Hop IDs assigned to one of the corresponding protocols “PCIe/USB3/DP/DPAUX/HI” in USB4 Decoding Assignments Dialog.

If some tunneled protocols are not auto detected, the user will see corresponding Hop IDs assigned to “None”. The user can change “None” to the appropriate protocol and press OK to see the result of decoding.

9.4.3 Adapter Types

If there is configuration traffic with access to the Protocol Adapter’s configuration space, the user can change the protocol for the adapter specified by Topology ID and Adapter number.

9.4.4 Display Port Adapter Parameters

If there is Display Port Main Link traffic, the user can modify Display Port decoding parameters for Display Port Adapter specified by Hop ID. These parameters include:

- ☐ Link Width of the Display Port Main Link
- ☐ Link Rate of the Display Port Main Link
- ☐ Source/Sink Aux Hop IDs of the Display Port Aux links associated with the specified Video Hop ID (Main Link)

Chapter 10

Reports

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

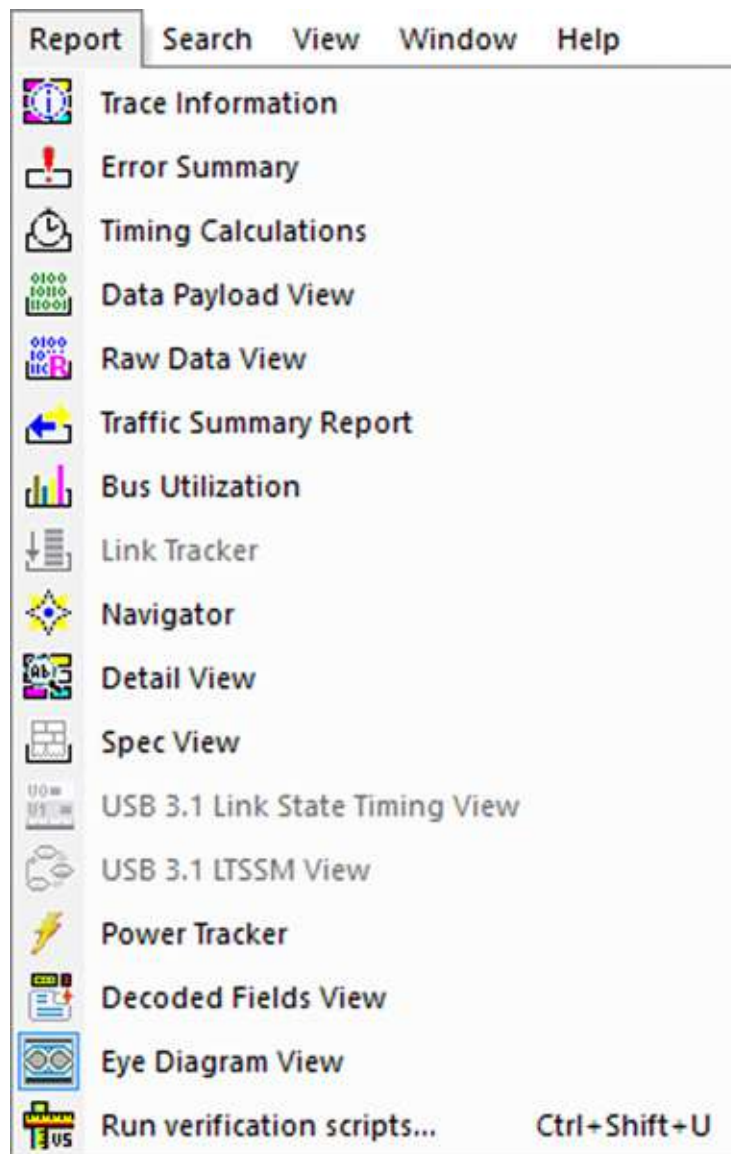


Figure 10.1: Report Menu

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.
- ❑ **Raw Data View:** Allows you to see the raw values of the entire packet as they were seen in the PHY layer. See [“Raw Data View \(including Power Delivery and USB4 Sideband Packets\)” on page 577.](#)
- ❑ **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 (3.2):** 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:** Shows packet header information and other items, in a view that matches the USB 3.2, USB 2.0, Power Deliver/Thunderbolt 3 Low Speed and Display Port specifications. See [“Spec View” on page 603.](#)
- ❑ **USB 3.2 Link State Timing View:** Graphically shows how much time the link spends in each link state.
- ❑ **USB 3.2 LTSSM View:** Displays the LTSSM diagram depicted in the USB 3.2 specification.
- ❑ **Power Tracker:** Displays voltage, current, and power. You can select Hide, Full Screen, Sync by Time, or Real Time Monitor. See [“Power Tracker: VBus and Configuration Channel \(CC\)” on page 608.](#)
- ❑ **Decoded Fields View:** See [“Decoded Fields View” on page 555.](#)
- ❑ **Eye Diagram View:** See [“Eye Diagram View” on page 632.](#)
- ❑ **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.

10.1 View Docking and Floating Windows.

Similar to the windows in most Windows™ programs, most report views are dockable and tabable. 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 10.2](#) and [Figure 10.3 on page 563.](#)



Figure 10.2: Drop Target

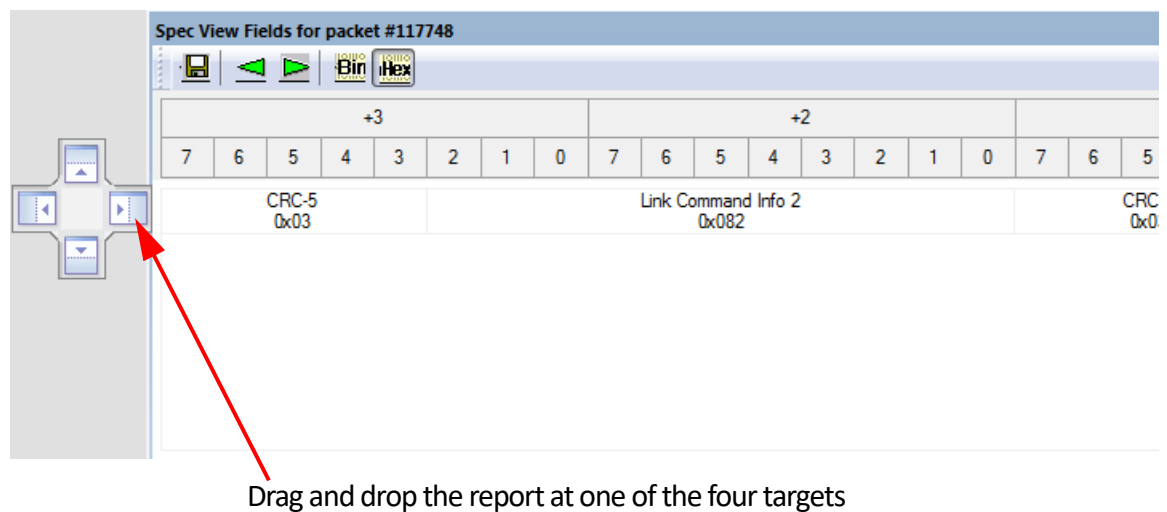


Figure 10.3: Drag and Drop Report in Target

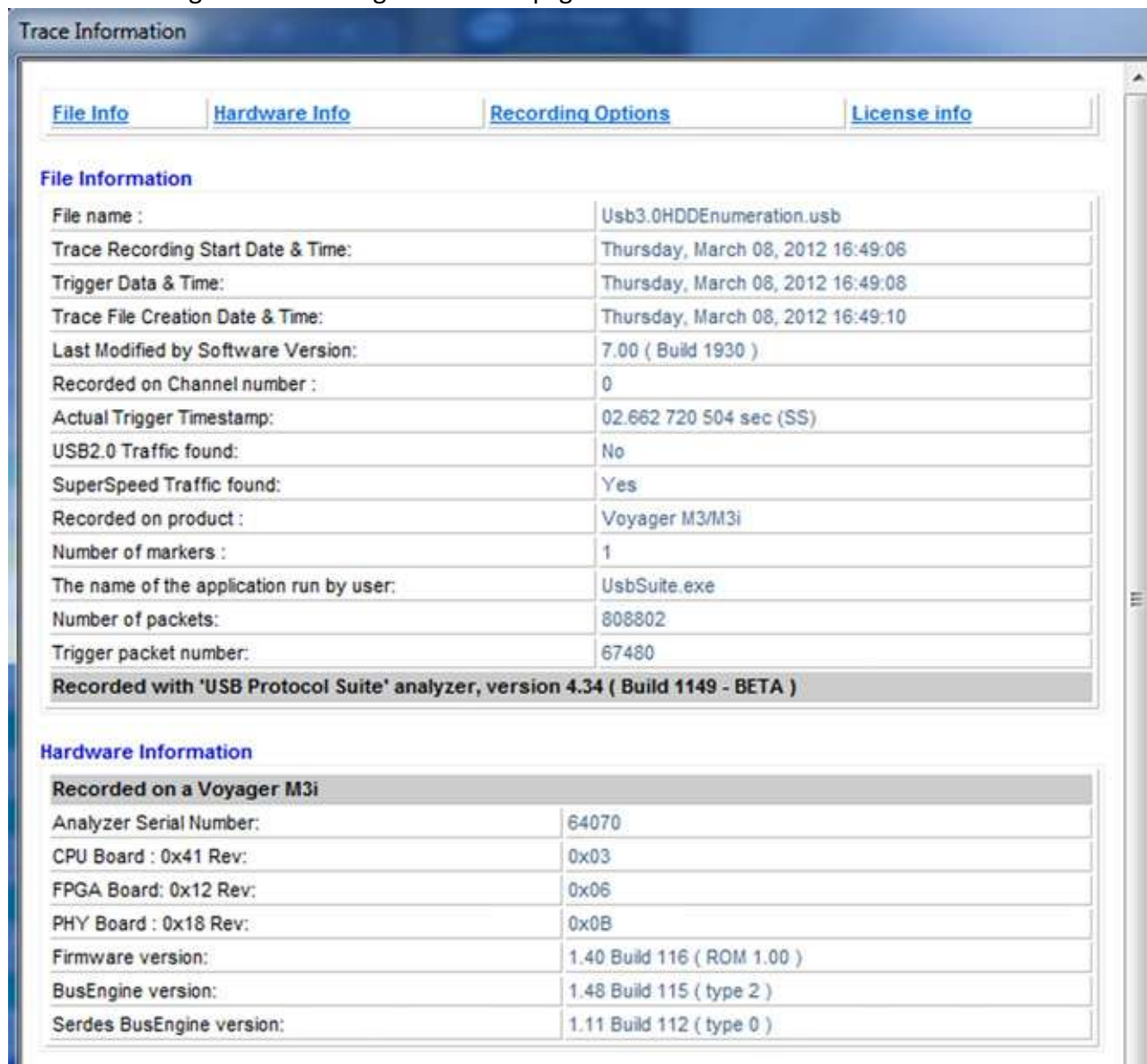
Note: When you open a report view, the software attempts to apply the user preferences used when you most recently viewed the report.

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.

10.2 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 10.4: and Figure 10.5: on page 565.



The screenshot shows the 'Trace Information' window with four tabs: 'File Info', 'Hardware Info', 'Recording Options', and 'License info'. The 'File Info' tab is active, displaying a table of file details. Below this, the 'Hardware Information' section is visible, showing details for a Voyager M3i analyzer.

File Information	
File name :	Usb3.0HDDenumeration.usb
Trace Recording Start Date & Time:	Thursday, March 08, 2012 16:49:06
Trigger Data & Time:	Thursday, March 08, 2012 16:49:08
Trace File Creation Date & Time:	Thursday, March 08, 2012 16:49:10
Last Modified by Software Version:	7.00 (Build 1930)
Recorded on Channel number :	0
Actual Trigger Timestamp:	02.662 720 504 sec (SS)
USB2.0 Traffic found:	No
SuperSpeed Traffic found:	Yes
Recorded on product :	Voyager M3/M3i
Number of markers :	1
The name of the application run by user:	UsbSuite.exe
Number of packets:	808802
Trigger packet number:	67480
Recorded with 'USB Protocol Suite' analyzer, version 4.34 (Build 1149 - BETA)	

Hardware Information	
Recorded on a Voyager M3i	
Analyzer Serial Number:	64070
CPU Board : 0x41 Rev:	0x03
FPGA Board: 0x12 Rev:	0x06
PHY Board : 0x18 Rev:	0x0B
Firmware version:	1.40 Build 116 (ROM 1.00)
BusEngine version:	1.48 Build 115 (type 2)
Serdes BusEngine version:	1.11 Build 112 (type 0)

Figure 10.4: 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

[Save As...](#) [Close](#)

Figure 10.5: 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 3.2 captures, click on the hyperlink Show/Hide details to expand the information.

10.3 Error Summary

The Error Summary details all errors analyzed throughout the recording. After the report displays, click USB 2.0 Errors (see Figure 10.6) or USB 3.2 Errors (see Figure 10.7 on page 569) 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:

10.3.1 USB 2.0 Errors

The figure below and the table following it list and describe the USB 2.0 errors.

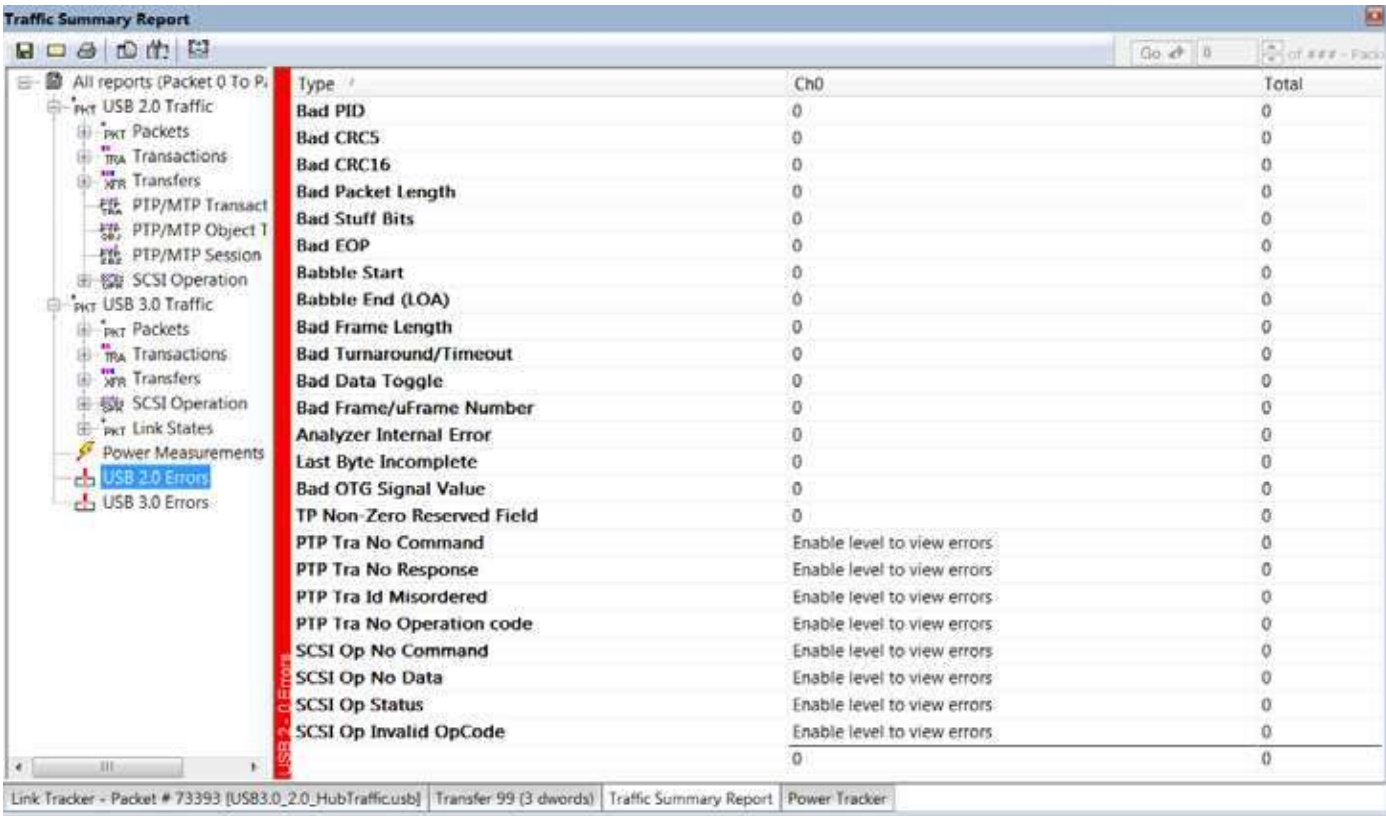


Figure 10.6: Traffic Summary Report (USB 2.0)

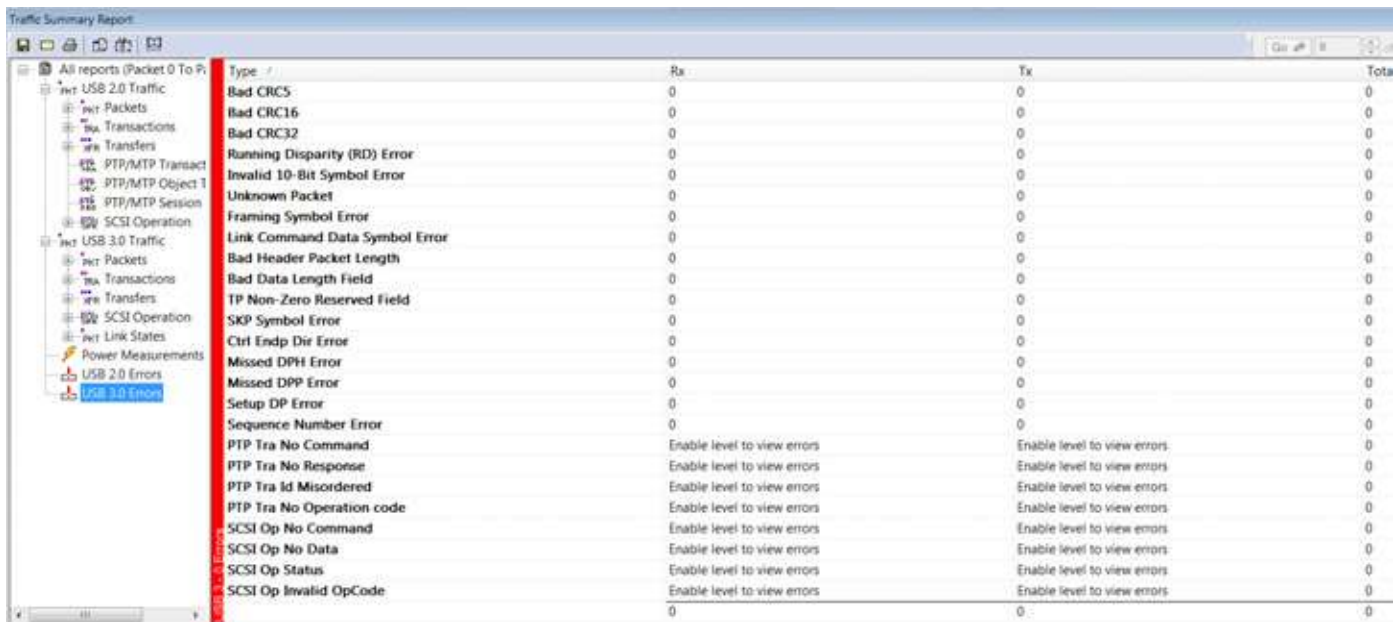
The following table lists each USB 2.0 error type and its description.

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 too late in the Frame or Microframe.
Bad Frame Length	The Frame or Microframe time was out of spec. (expected ~1 ms or ~125 μ Sec)
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.

10.3.2 USB 3.2 Errors

The figure below and the table following it list and describe the USB 2.0 and 3.2 errors.



Type	Rx	Tx	Total
Bad CRC5	0	0	0
Bad CRC16	0	0	0
Bad CRC32	0	0	0
Running Disparity (RD) Error	0	0	0
Invalid 10-Bit Symbol Error	0	0	0
Unknown Packet	0	0	0
Framing Symbol Error	0	0	0
Link Command Data Symbol Error	0	0	0
Bad Header Packet Length	0	0	0
Bad Data Length Field	0	0	0
TP Non-Zero Reserved Field	0	0	0
SKP Symbol Error	0	0	0
Ctrl Endp Dir Error	0	0	0
Missed DPH Error	0	0	0
Missed DPP Error	0	0	0
Setup DP Error	0	0	0
Sequence Number Error	0	0	0
PTP Tra No Command	Enable level to view errors	Enable level to view errors	0
PTP Tra No Response	Enable level to view errors	Enable level to view errors	0
PTP Tra Id Misordered	Enable level to view errors	Enable level to view errors	0
PTP Tra No Operation code	Enable level to view errors	Enable level to view errors	0
SCSI Op No Command	Enable level to view errors	Enable level to view errors	0
SCSI Op No Data	Enable level to view errors	Enable level to view errors	0
SCSI Op Status	Enable level to view errors	Enable level to view errors	0
SCSI Op Invalid OpCode	Enable level to view errors	Enable level to view errors	0
	0	0	0

Figure 10.7: Traffic Summary Report (USB 3.2)

The following table lists each USB 3.2 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 3.2 Specification.
Framing Symbol Error	The sequence of framing symbols found is not supported by the USB 3.2 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 3.2 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 3.2 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 3.2 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.

10.3.3 USB4 Sideband Errors

The figure below shows USB4 Sideband errors traffic and the table following it lists and describes the USB4 Sideband errors.

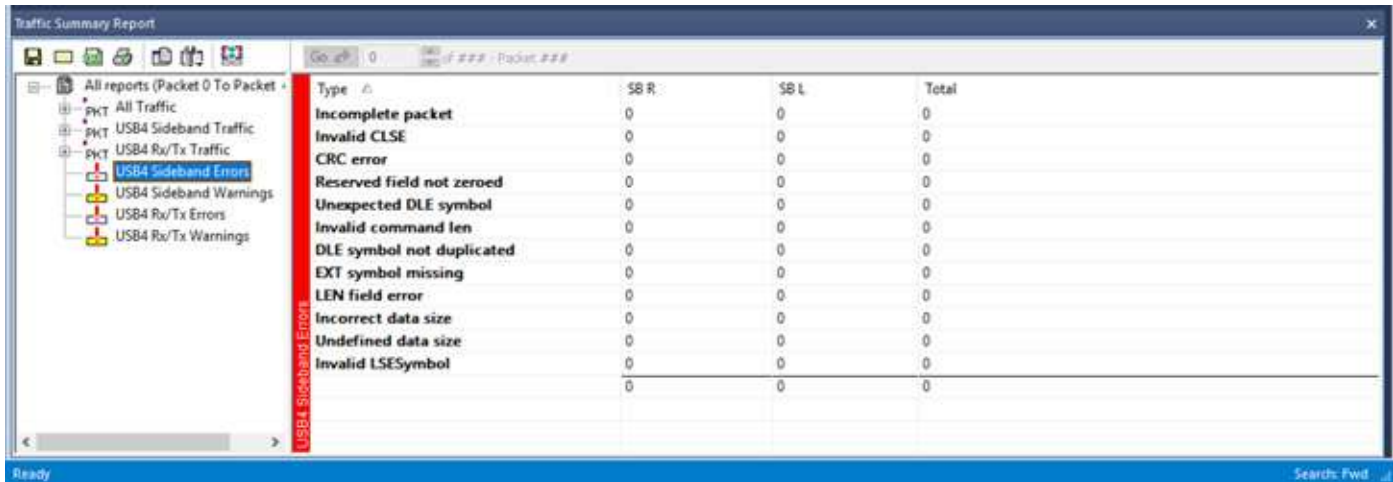


Figure 10.8: USD4 Traffic Summary Report

The following table lists each USB4 Sideband error type and its description.

Error Type	Error Description
Incomplete packet	Packet appears to have terminated before reaching its prescribed length
Invalid CLSE	In SBU LT packet: CLSE is not a complement of LSE field
CRC error	CRC Calculated does not match the one captured
Reserved field not zeroed	Non-zero value found in a Reserved field
Unexpected DLE symbol	In SBU LT packet: LT packet is started, but mistakenly interrupted by DLE symbol
Invalid Command len	Command length is not a valid value
DLE symbol not duplicated	DLE symbol inside SBU AT or RT packet's payload is not duplicated
EXT symbol missing	ETX (End Of Transaction) symbol is missing in SBU AT/RT packet
LEN field error	Actual length of SBU AT/RT packet doesn't match LEN field
Incorrect data size	In SBU AT/RT packets: - Cmd Data Len is bigger than maximum; - Cmd Data Len of Write packet is not 1; - Cmd Data Len of Request packet is not 0
Undefined data size	In SBU AT/RT packets: actual Cmd Data Len doesn't match expected one
Invalid LSESymbol	In SBU LT packets: unspecified value of LSE field

10.3.4 USB4 Rx/Tx Errors

The figure below shows USB4 Rx/Tx errors traffic and the table following it lists and describes the USB4 Rx/Tx errors.

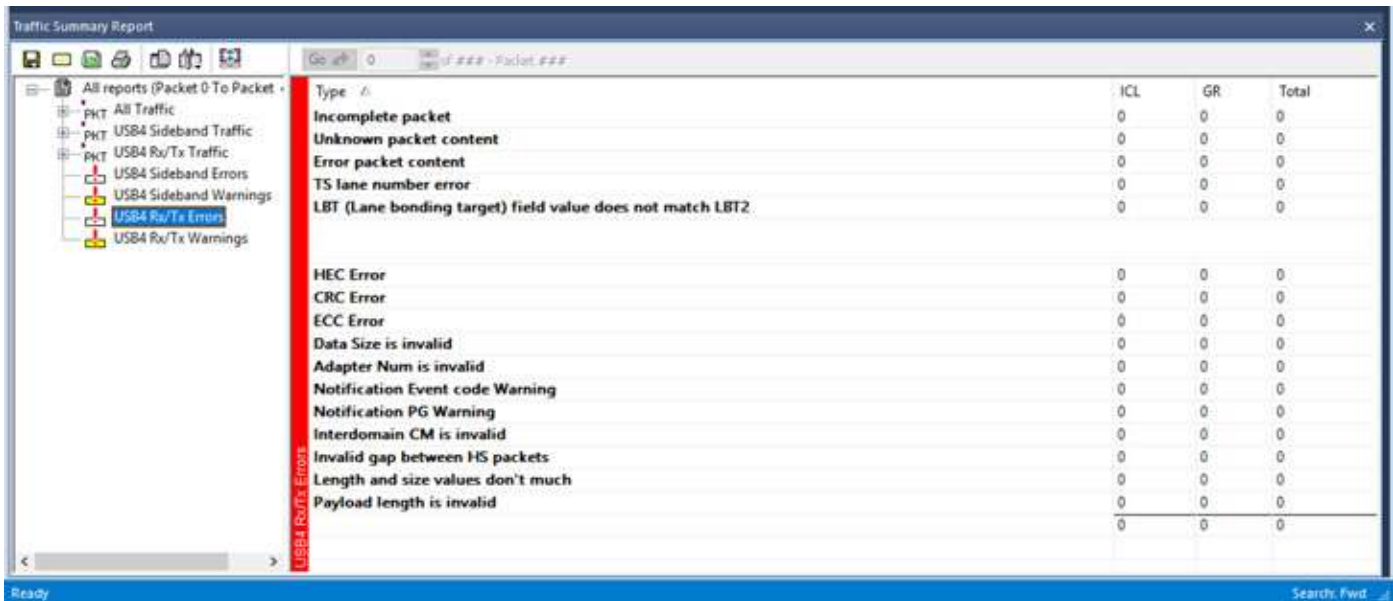


Figure 10.9: Traffic Summary: USB Rx/Tx Errors

The following table lists each USB4 Rx/Tx error type and its description.

Error Type	Error Description
Incomplete packet	Packet is incomplete (interrupted, didn't come in complete form)
Unknown packet content	Packet type cannot be detected
Error packet content	OS packet type is detected, but content has errors
TS lane number error	In TS1 and TS2: LaneNumber field is not 0 or 1
LBT (Lane bonding target) field value does not match LBT2	In TS1 and TS2: LaneBondingTarget2 doesn't match LaneBondingTarget
HEC Error	HEC Calculated does not match the one captured.
CRC Error	CRC Calculated does not match the one captured.
ECC Error	ECC Calculated does not match the one captured.
Data size is invalid	Invalid Length in TLP Header for specific Control packet types
Adapter Num is invalid	Adapter number is not within the allowable range
Notification Event code Warning	Invalid EventCode in Notification Control Packet
Notification PG Warning	Invalid value of PG field of Notification Control Packet
Interdomain CM is invalid	CM is not 0 in InterDomain Packets
Invalid gap between HS packets	More than one TLP Header within Gen2/Gen3 symbol
Length and size values don't match	Lengths in TLP Header and Control Packet's Data don't match
Payload length is invalid	Actual TLP Packet length doesn't match expected one (from TLP Header)

10.4 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:

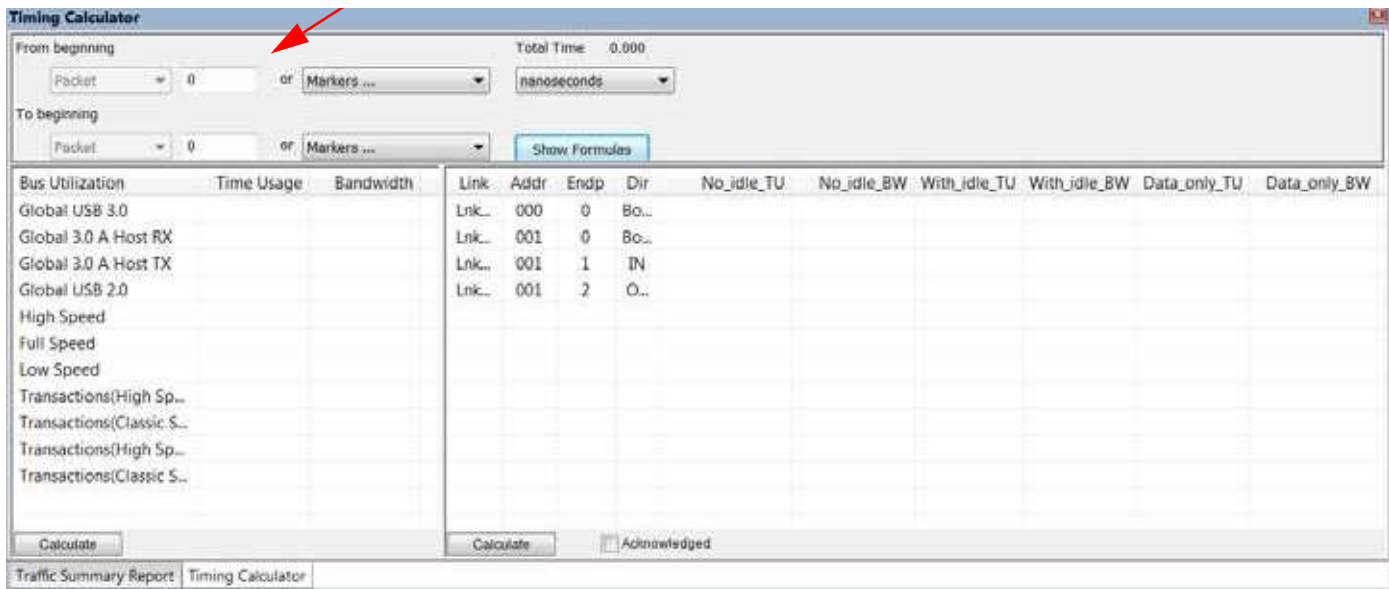


Figure 10.10: Timing Calculations Report

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 10.11 on page 574](#), 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.)

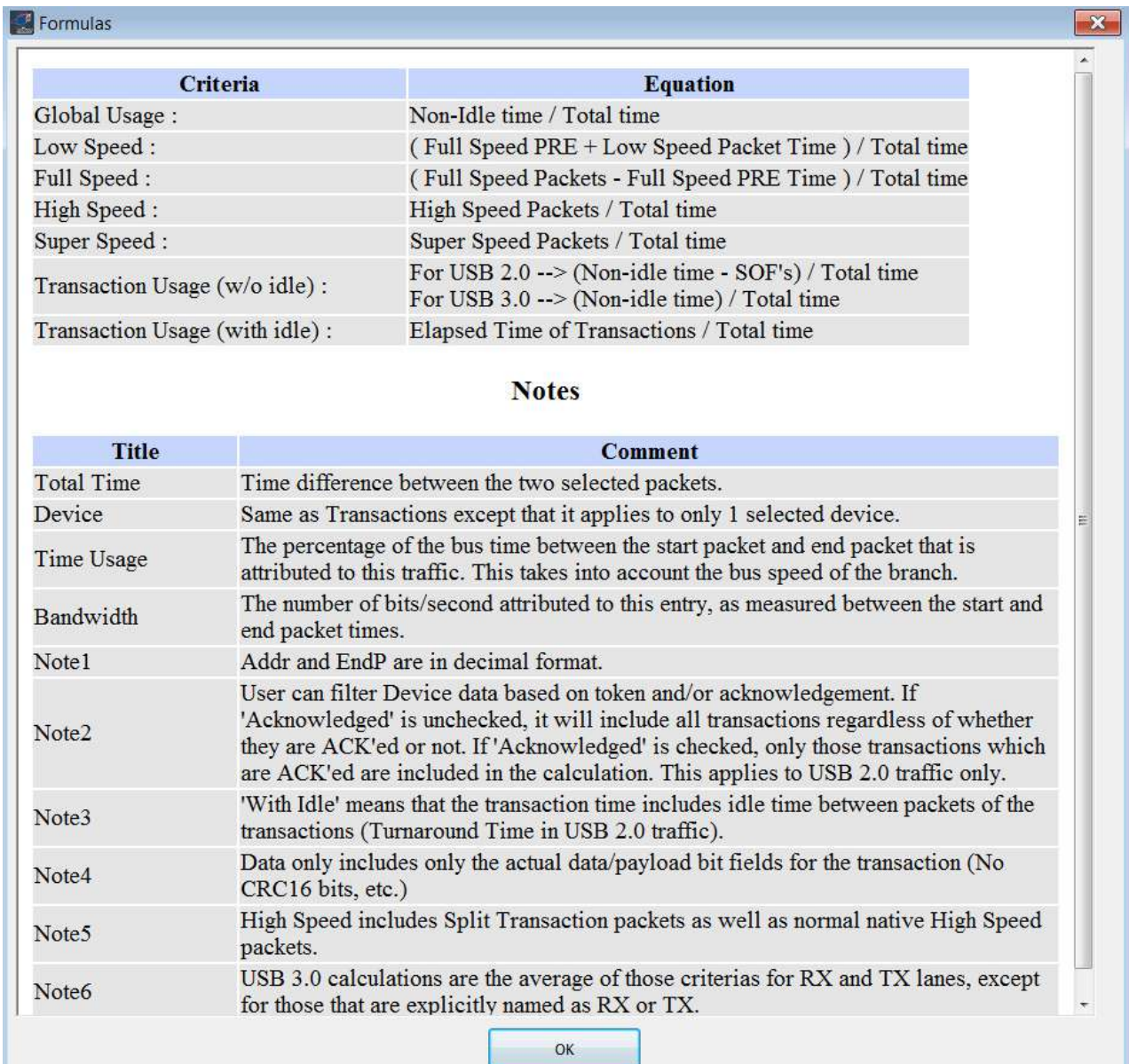


Figure 10.11: Formulas Window

6. Click **Calculate** (see red arrow in [Figure 10.10 on page 573](#)) in the left side to display the Bus Utilization, Time Usage, and Bandwidth. Bus Utilization is:
 - ☐ Global USB 3.2
 - ☐ Global 3.2 A Host RX
 - ☐ Global 3.2 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)

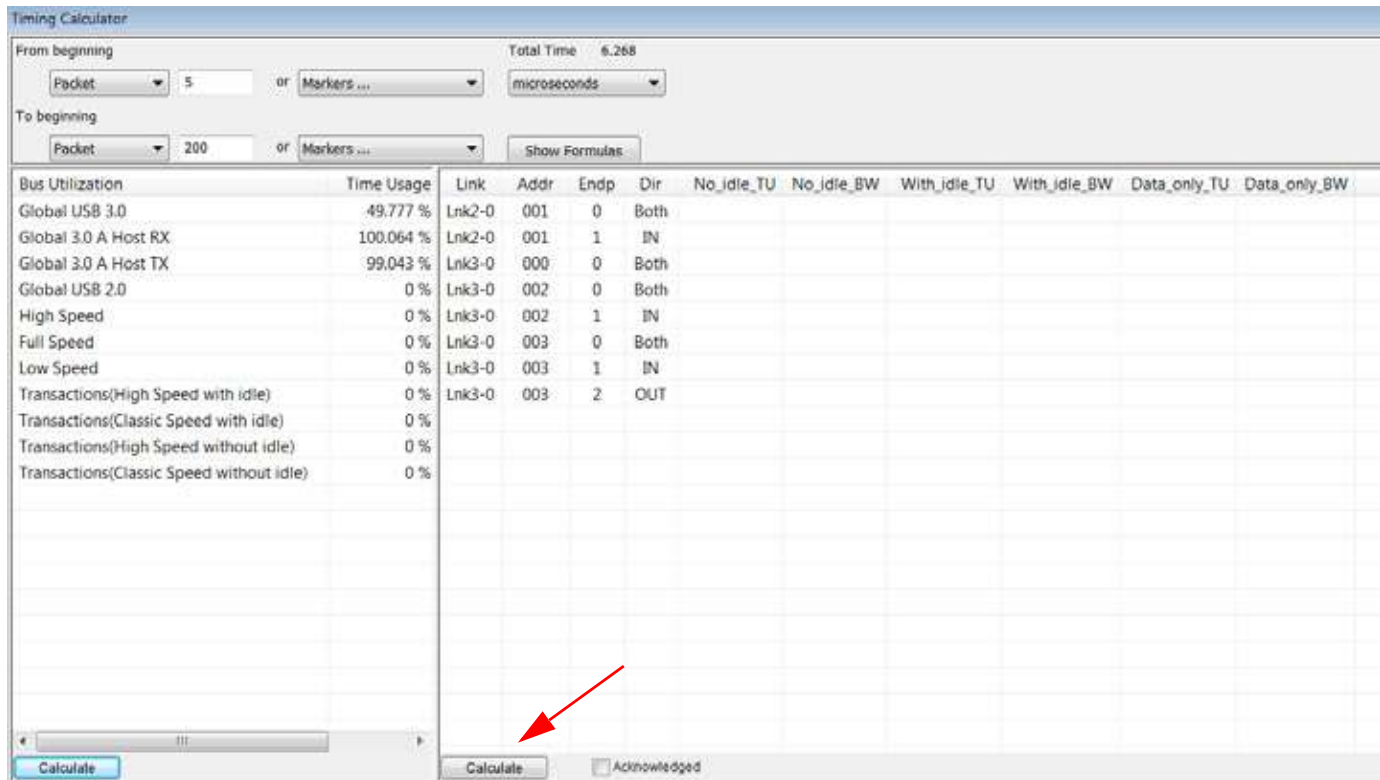


Figure 10.12: Timing Calculator Report

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.

10.5 Data View

The Data View window shows packet information.

To obtain the Data View window, select **Report > Data View**

or click the  toolbar icon.

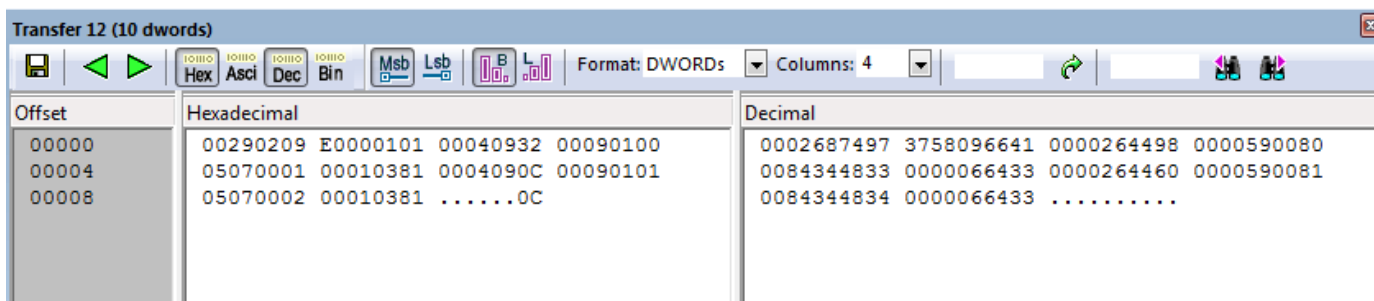


Figure 10.13: Data View Report

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

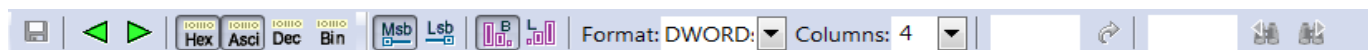


Figure 10.14: Data View Toolbar

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.

10.6 Raw Data View (including Power Delivery and USB4 Sideband Packets)

This Dockable view allows you to see the raw values of the entire packet as they were seen in the PHY layer. Note that the Bit Stuffing used for NRZI encoding on USB 2.0 is not shown here, you will need to right click on the 2.0 packet and select "Show Raw Bits" to see that. This view enables you to switch from 4-bit to 5-bit encoding values of Power Delivery, and to see the Preamble and SOP values. For USB 2.0 traffic, you can change the display to show Least significant bit (Lsb) Mode, which is how the bits travel over the wire, or Most significant bit (Msb) Mode, which presents byte values that we are familiar with. See [Figure 10.16 on page 578](#).

To bring up the Raw Data View select the  or choose the Raw Data View from the Report tab on the main Toolbar. See [Figure 10.15](#).

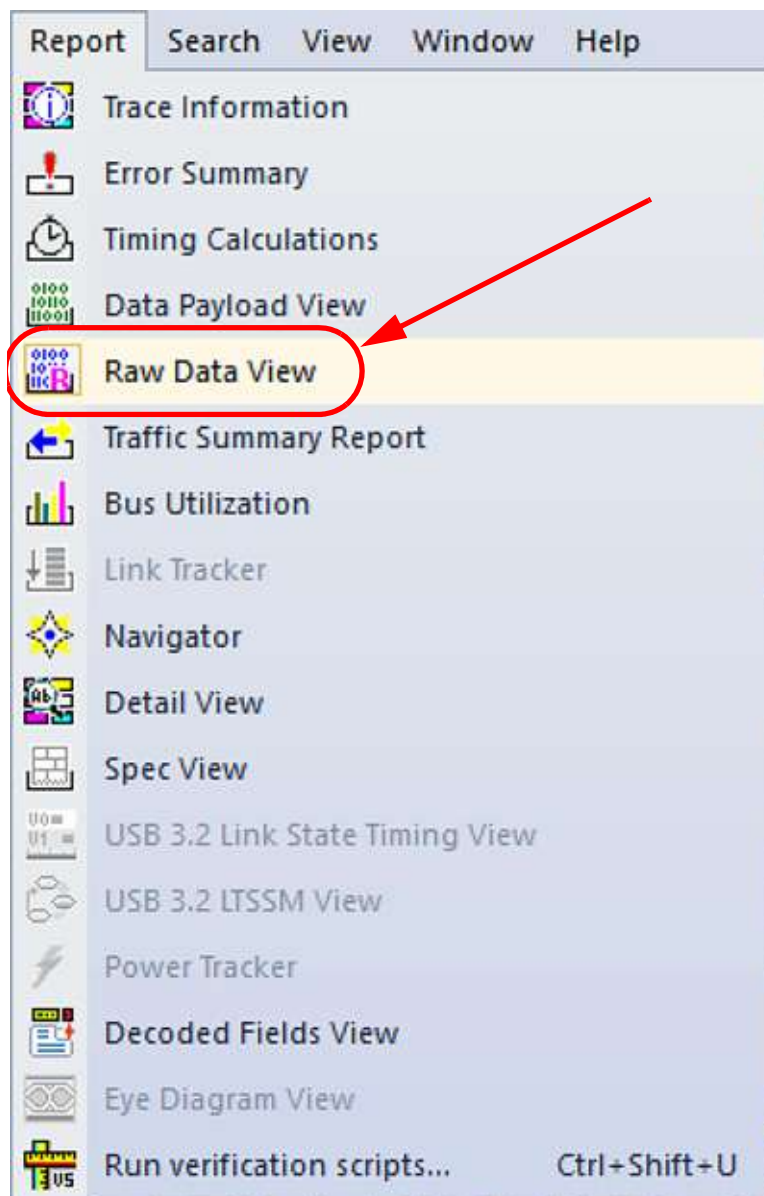


Figure 10.15: Report -> Raw Data View

The Raw Data View toolbar buttons allow you to:

- ☐ Save
- ☐ Go to Previous or Next packet in the trace
- ☐ Display Hexadecimal or Binary
- ☐ Display data in 4 or 5 bits
- ☐ Use Msb Format or Lsb Format
- ☐ Hide Escape Symbols
- ☐ Arrange the Data in 1, 2, 4, 8, 16, 32 or 64 columns
- ☐ Type in a value and then Search Previous or Search Next



Search Box

Figure 10.16: Raw Data Toolbar

An example of Raw Data from a packet in a trace is shown below:

Search Box

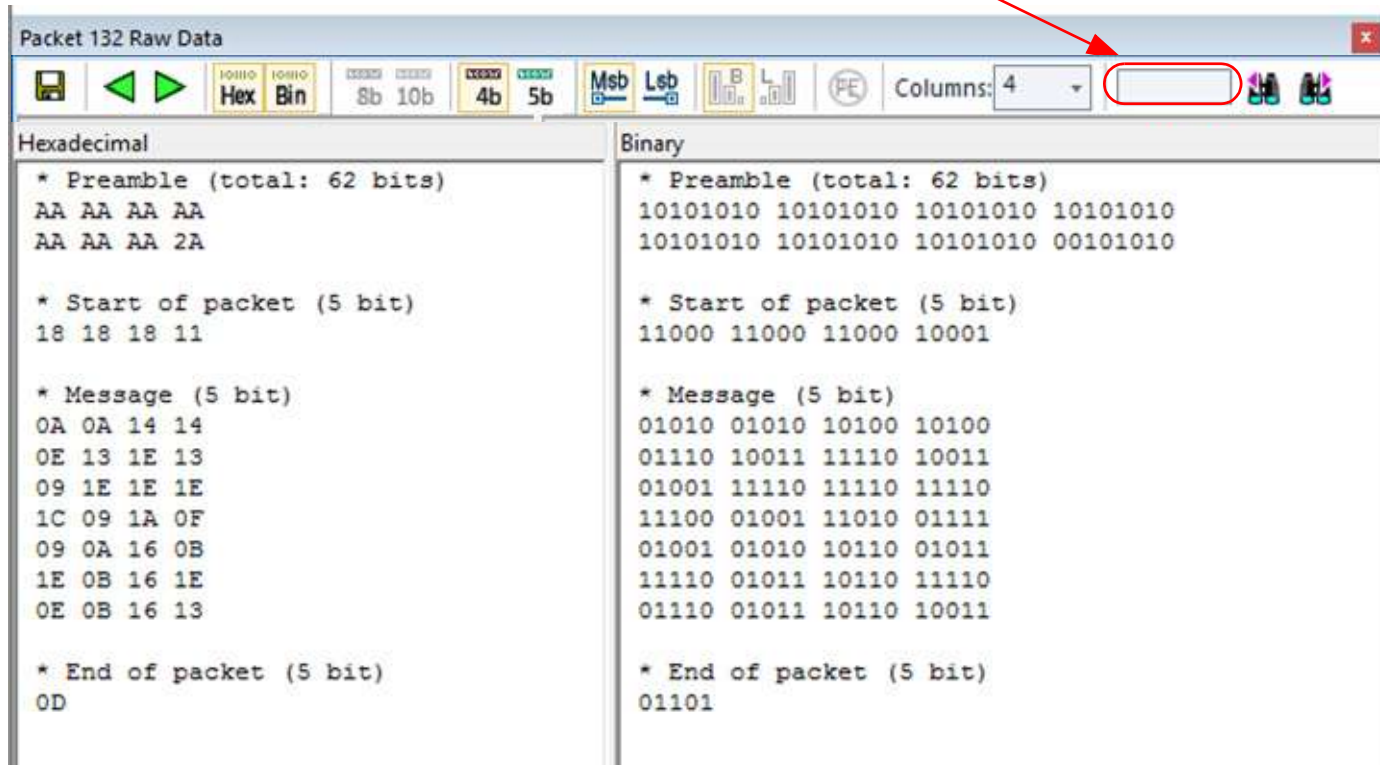


Figure 10.17: Raw Data View: Hex and Binary Formats

10.6.1 Hide Escape Symbols

If you have a transaction with multiple Escape Symbols, you can Show or Hide the Escape Symbols with the “Hide Escape Symbols” icon . The Raw Data View without Hiding Escape Symbols and with Hiding Escape Symbols are shown in [Figure 10.18](#) and [Figure 10.19](#).

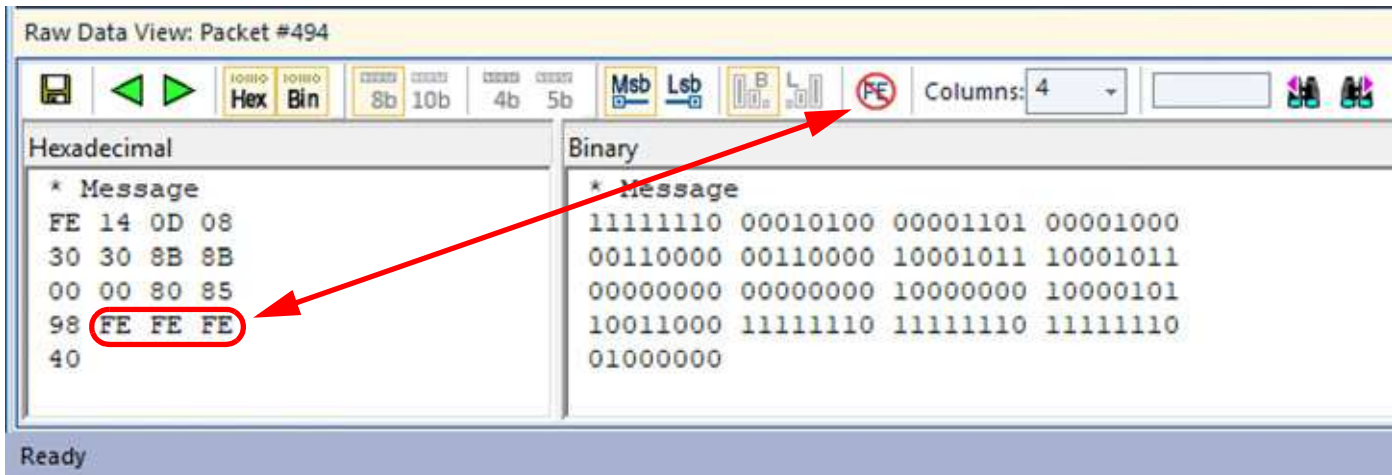


Figure 10.18: Raw Data: Escape Symbols Shown

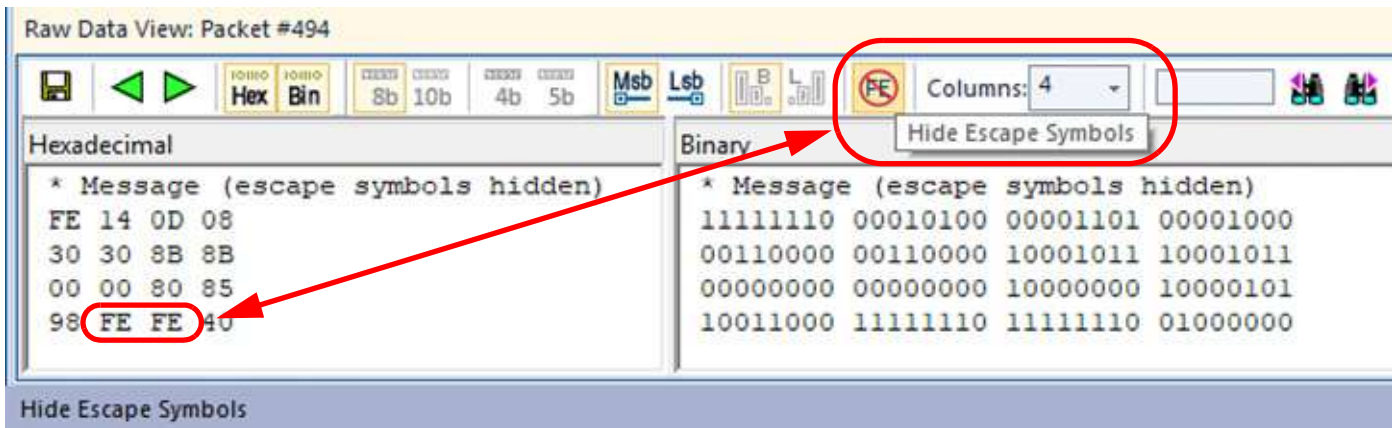


Figure 10.19: Raw Data: Escape Symbols Hidden

10.7 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:

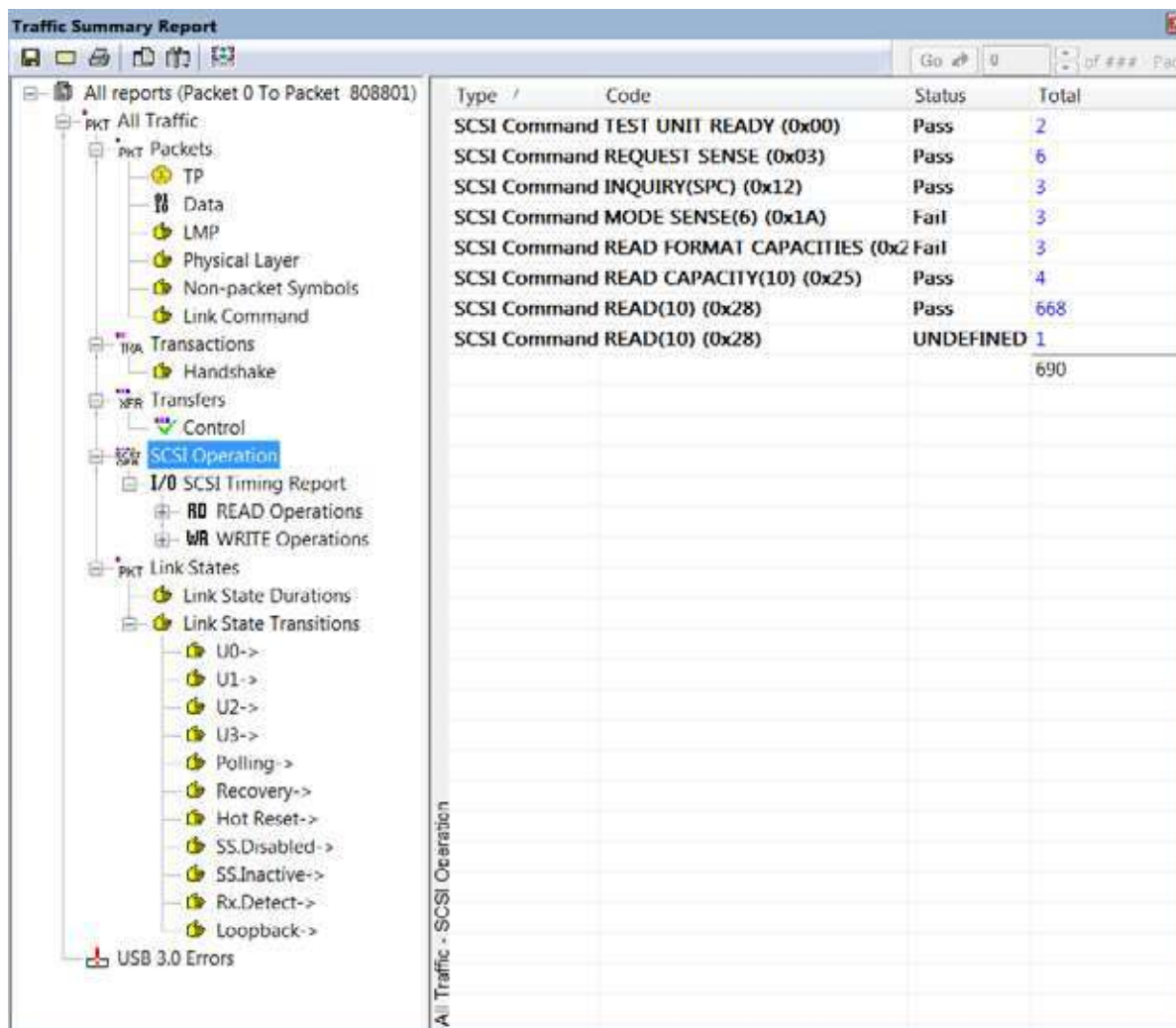


Figure 10.20: Traffic Summary Report

Click the Options button (see red arrow above) to display the Options menu (see [Figure 10.21 on page 581](#)) which allows you to show Grid lines, Row selection, and Tight columns.

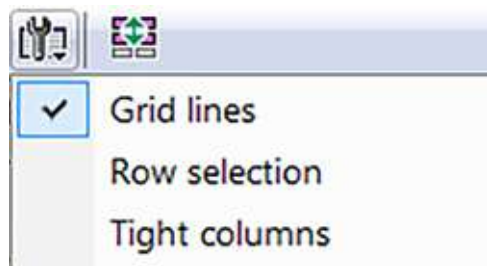


Figure 10.21: Options Menu

Click  to display the Select Range dialog.

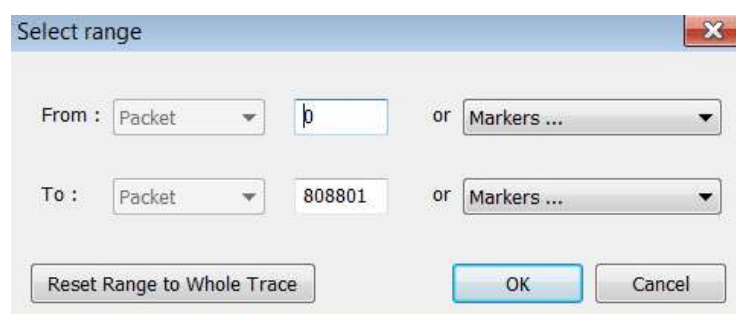


Figure 10.22: Select Range Dialog

Enter a number **From** and a number **To**.

You can **Reset Range to Whole Trace**.

10.7.1 SCSI Metrics

The SCSI Metrics are:

A screenshot of the 'Traffic Summary Report' window. The left sidebar shows a tree view with 'All reports (Packet 67858 To Packet 67859)' expanded, and 'SCSI Operation' selected. The main area displays a table with the following columns: 'Address', '#Xfers (Min)', '#Xfers (Avg)', '#Xfers (Max)', 'Resp. time (Min)', 'Resp. time (Avg)', 'Resp. time (Max)', and 'Total'. The table is currently empty, showing only the header row and a 'Total' row with the value '0'. The status bar at the bottom indicates 'All Traffic - SCSI Operation - SCSI Timing Report'.

Figure 10.23: 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

10.7.2 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 10.24](#).

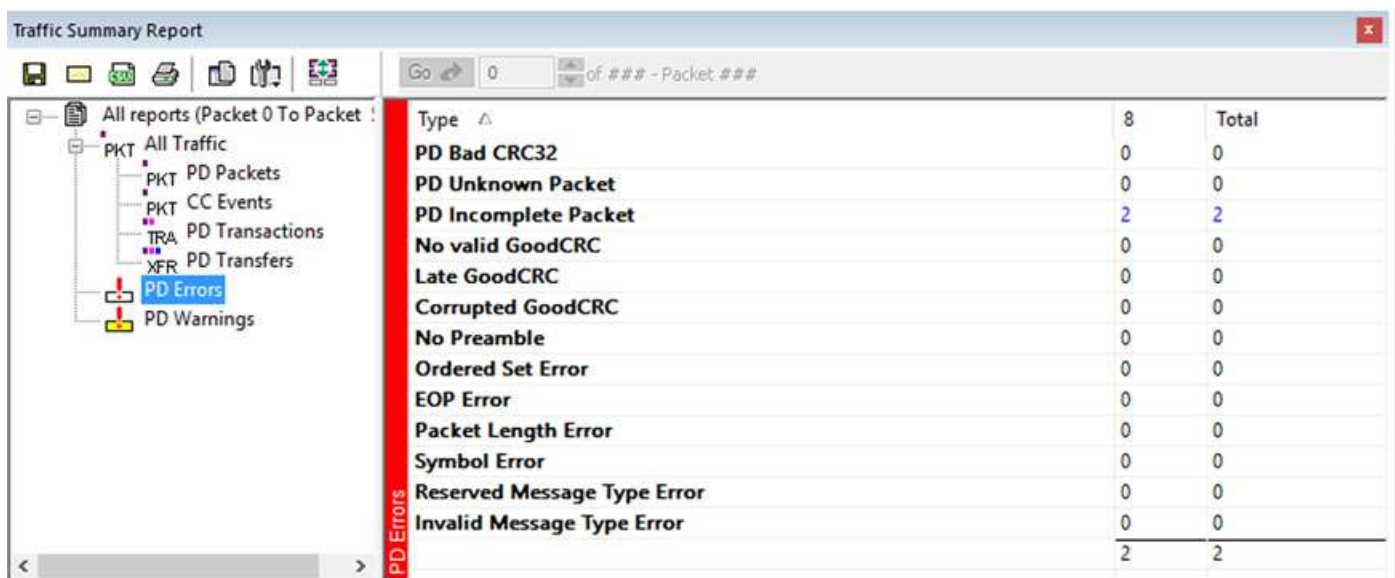


Figure 10.24: Power Delivery Traffic Summary

10.8 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:

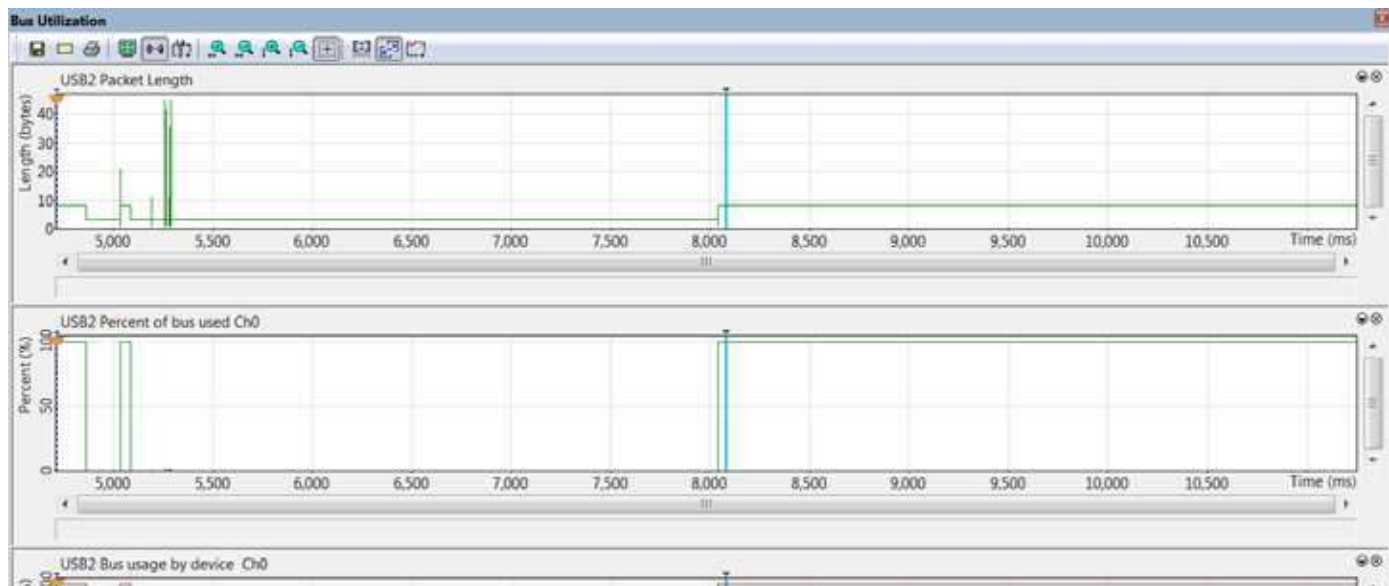


Figure 10.25: Bus Utilization Window

For USB 3.2, the display is similar to the following:

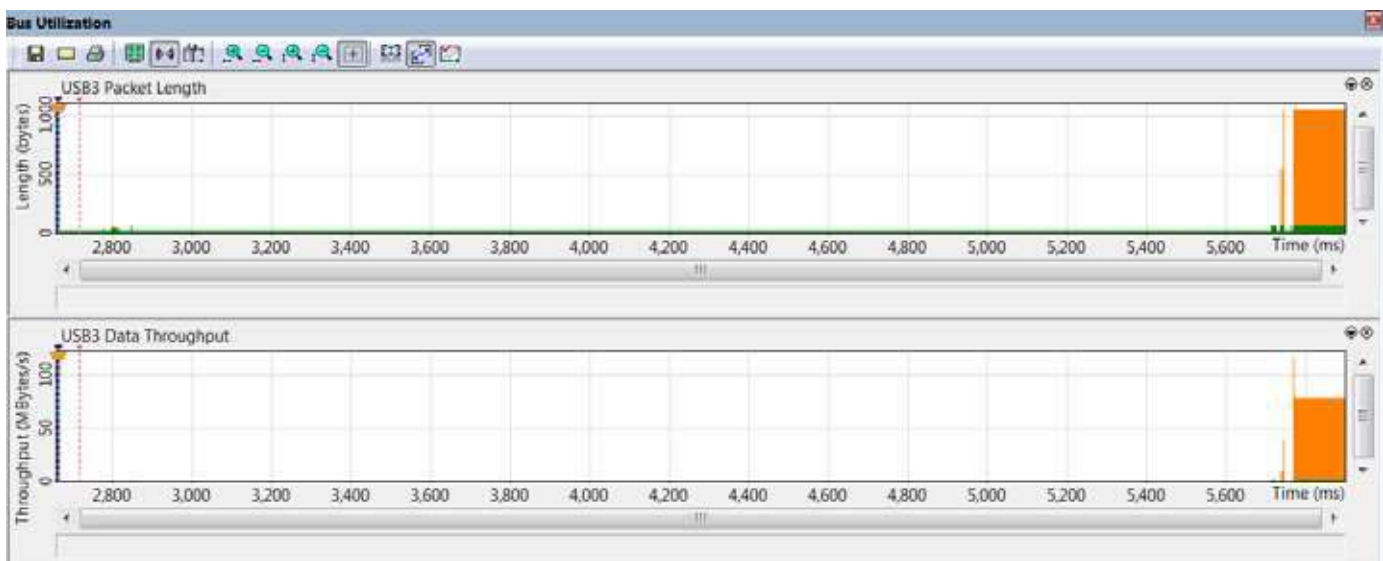


Figure 10.26: Bus Utilization Window

10.8.1 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 594.		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.

10.8.2 View Settings Menu

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

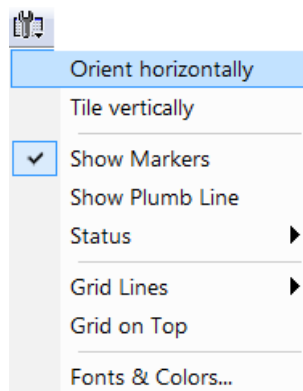


Figure 10.27: View Settings Menu

- ☐ **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:

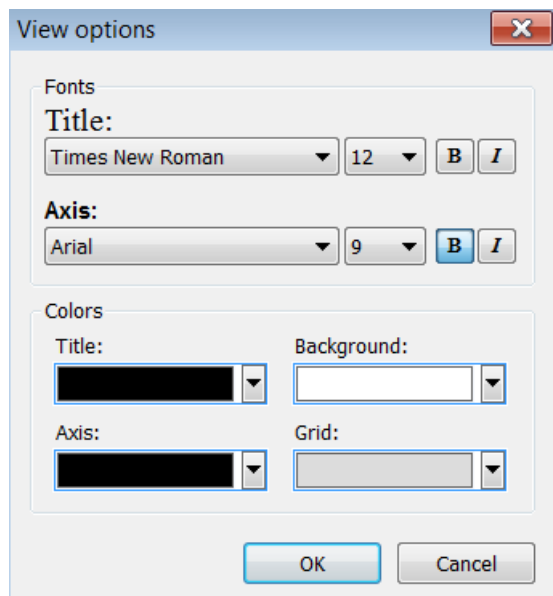


Figure 10.28: View Options Menu

10.8.3 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:

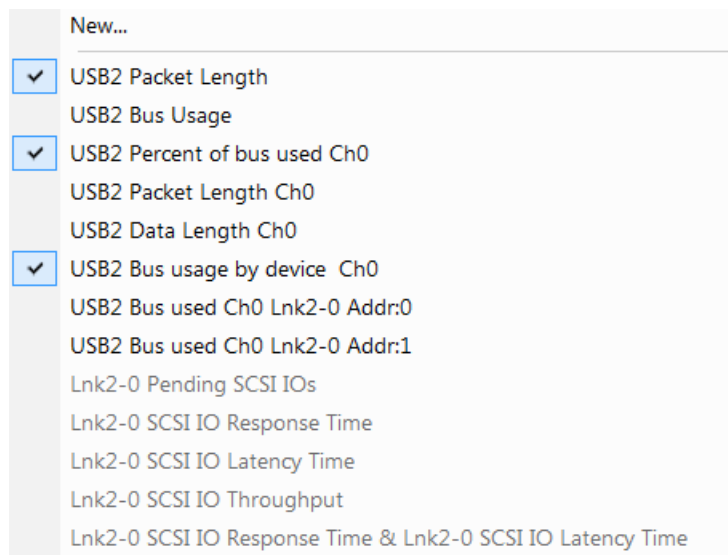


Figure 10.29: Graph Areas Menu USB 2.0

For USB 3.2, the display is similar to the following:

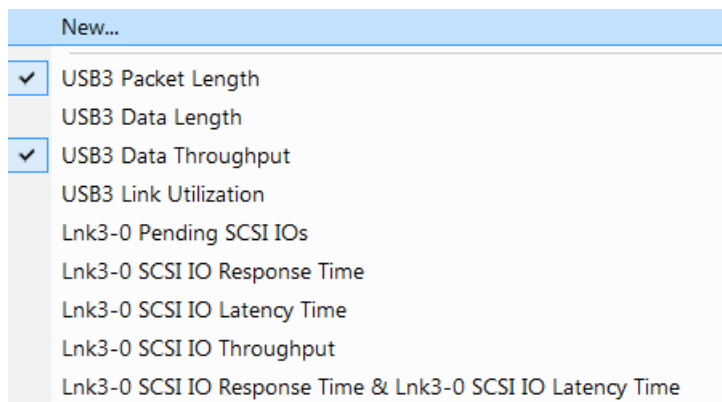


Figure 10.30: Graph Areas Menu USB 3.2

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 10.31 on page 589](#)), 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 10.31 on page 589](#)), select the options to display in the graph.
3. Enter a Title for the new graph, then click **OK**.

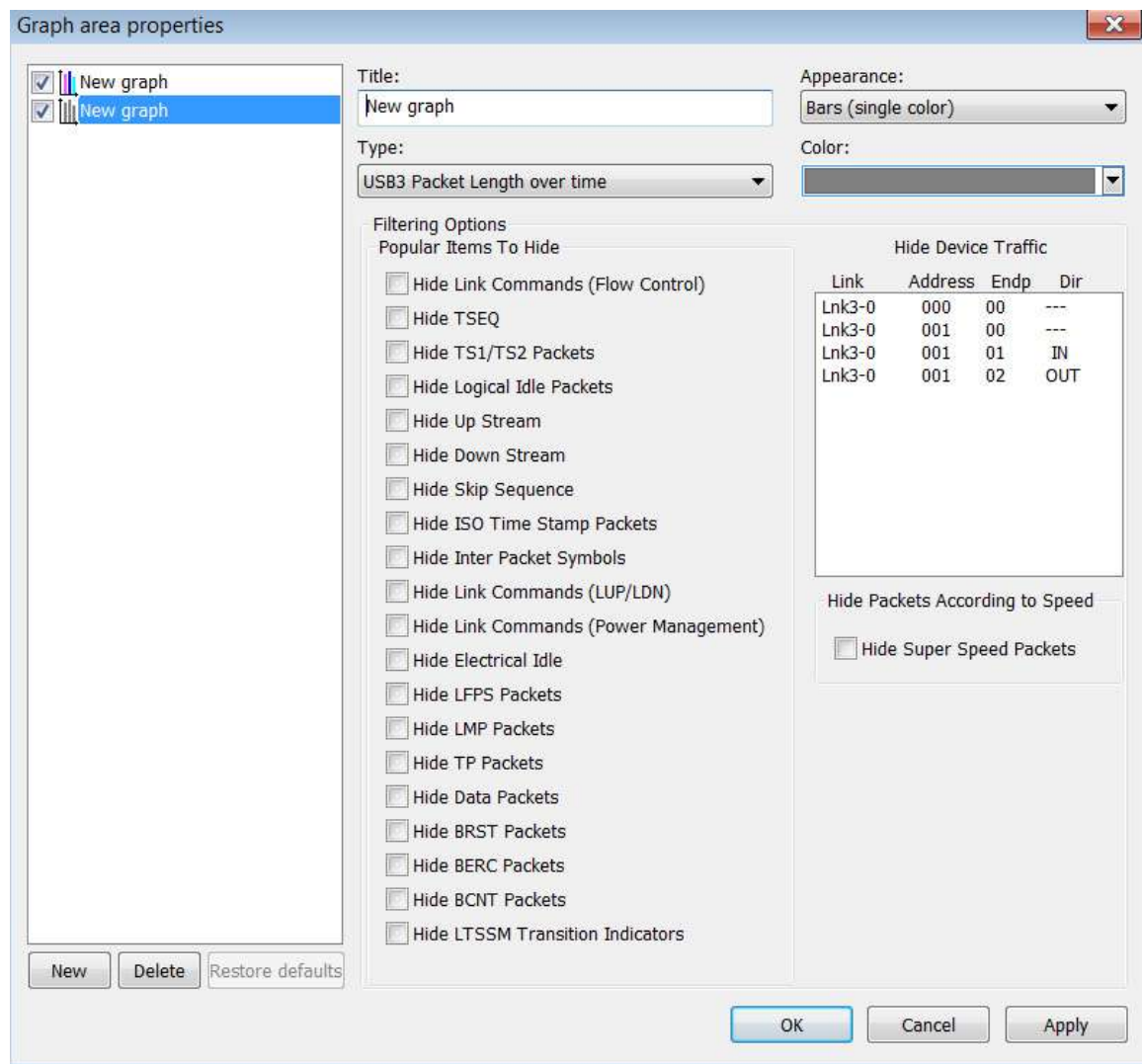


Figure 10.31: Graph Area Properties Dialog

10.9.1 Time Overlap Indicator

Due to the sampling error of the nominal symbol time vs the granularity of our precision (~3ppm) timestamps, it can sometimes occur that 2 or more symbols seem to belong in the same time location of this view.

This is denoted by the yellow circle next to the symbol. See [Figure 10.33](#).

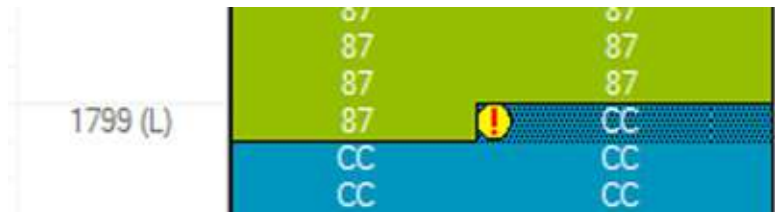


Figure 10.33: Linetracker: Yellow Circle -> Multiple Symbols

If you hover your timestamp over the yellow circle, a tooltip will show the symbols that occur in this location. See [Figure 10.34](#).

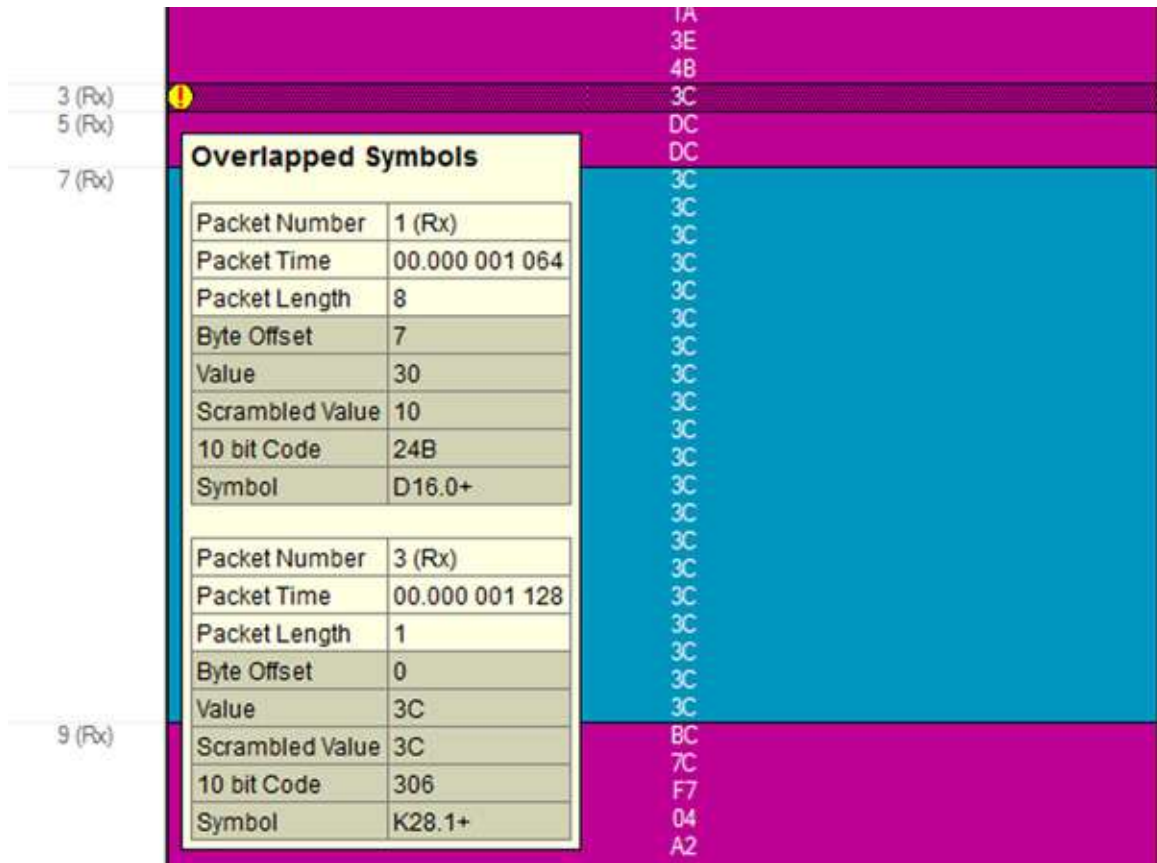


Figure 10.34: Linktracker: Tooltip

The top one occurred first, followed by the bottom one, etc. This artifact can occur occasionally throughout the LinkTracker view.

10.9.2 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.

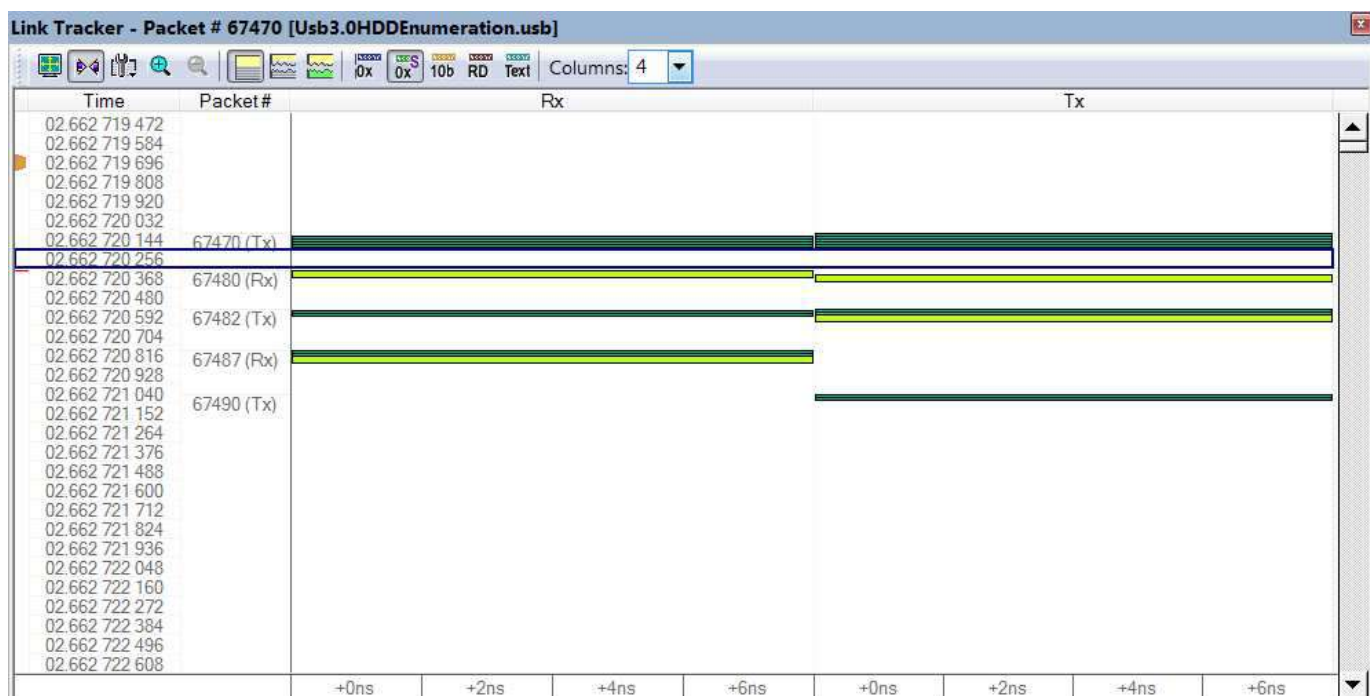


Figure 10.35: Link Tracker Window Zoomed Out

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.

10.9.3 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 592 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 3.2 Super Speed 5Gbps Gen 1 packets. Link tracker cannot simultaneously display SS and SS+ traffic.
	Show USB 3.2 Super Speed + 10Gbps Gen 2 packets. Link tracker cannot simultaneously display SS and SS+ traffic.
Columns: 4 	Columns to view

10.10 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.

10.10.1 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 10.36 on page 596](#)).

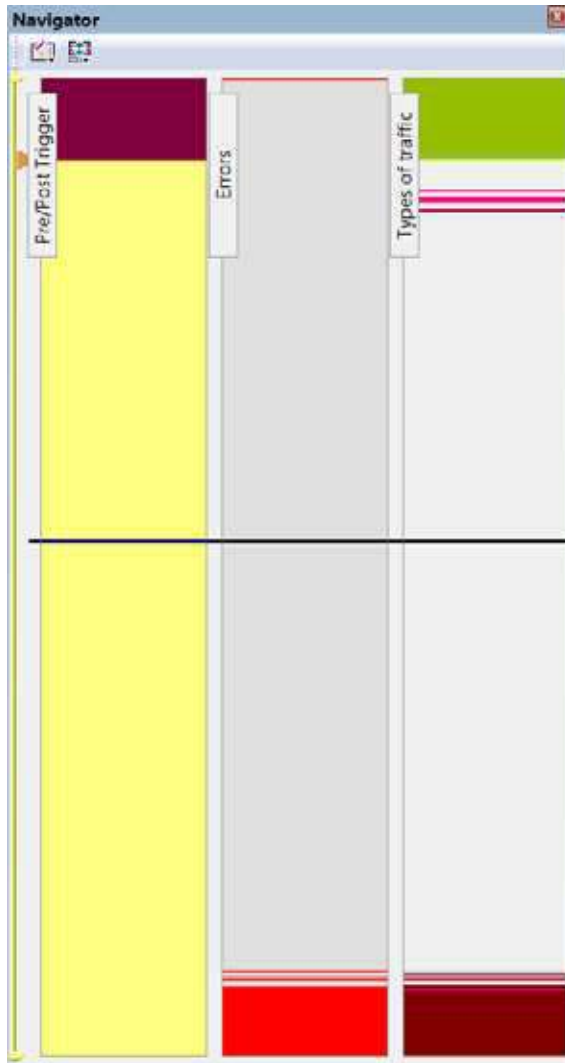


Figure 10.36: Navigator Window

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.

10.10.2 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.

10.10.3 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.

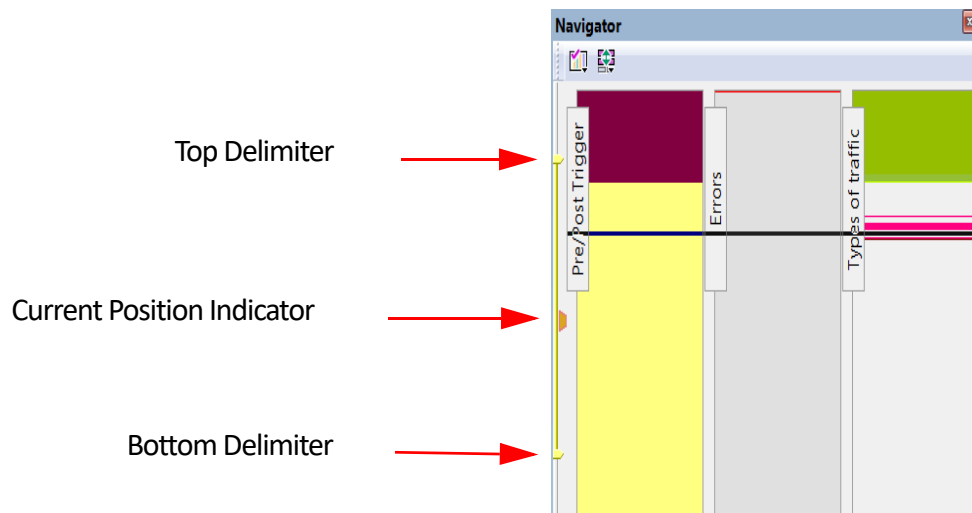


Figure 10.37: Navigator Delimiter

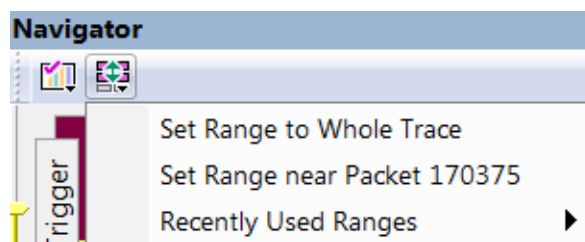
To Determine Current Position

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.

10.10.4 Navigator Panes

You can display any combination of trace Navigator panes.



Figure 10.38: 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 3.2 Host Tx, or USB 3.2 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 10.37 on page 598](#)).

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.

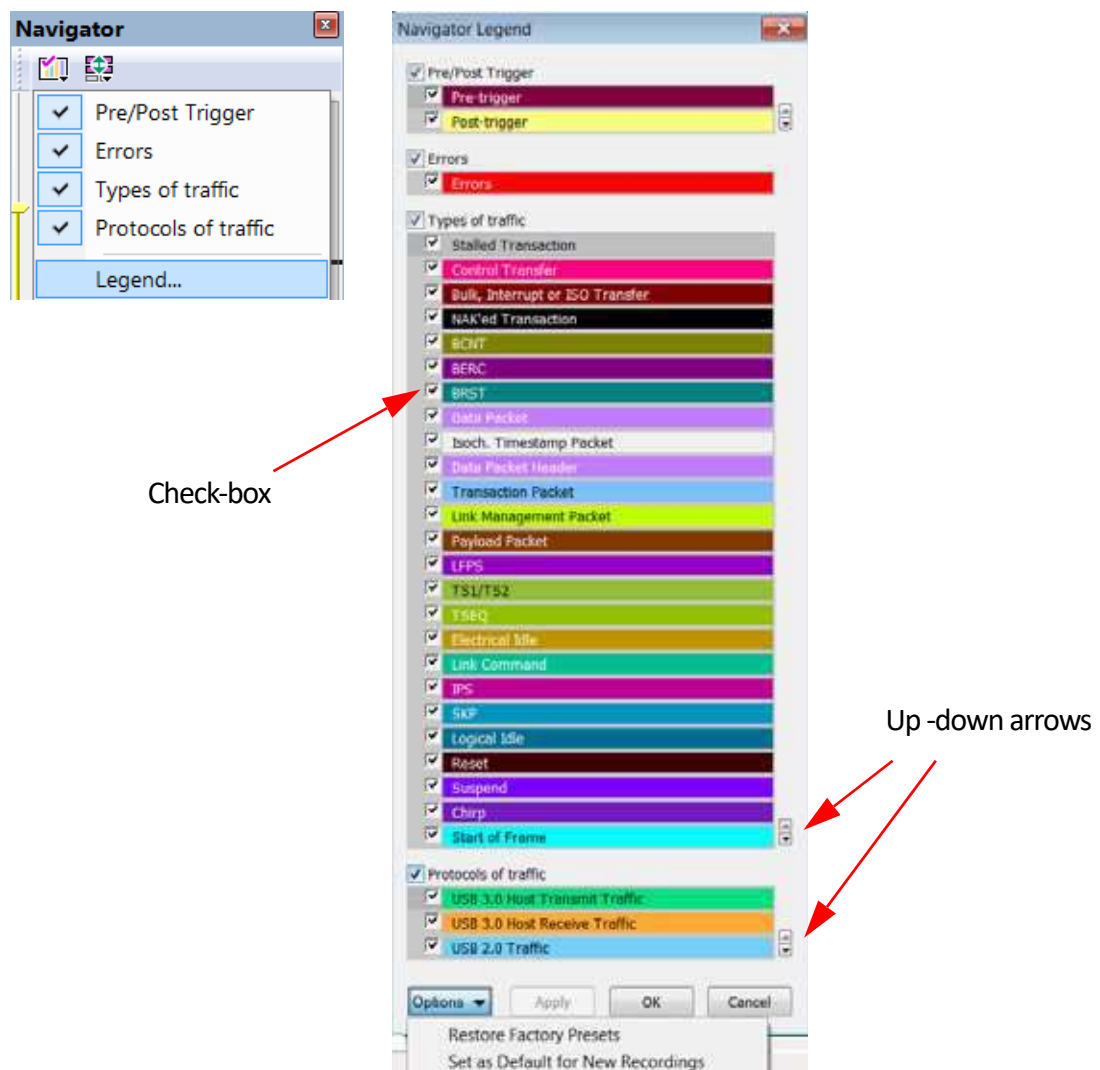


Figure 10.39: Navigator Legend Dialog

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.

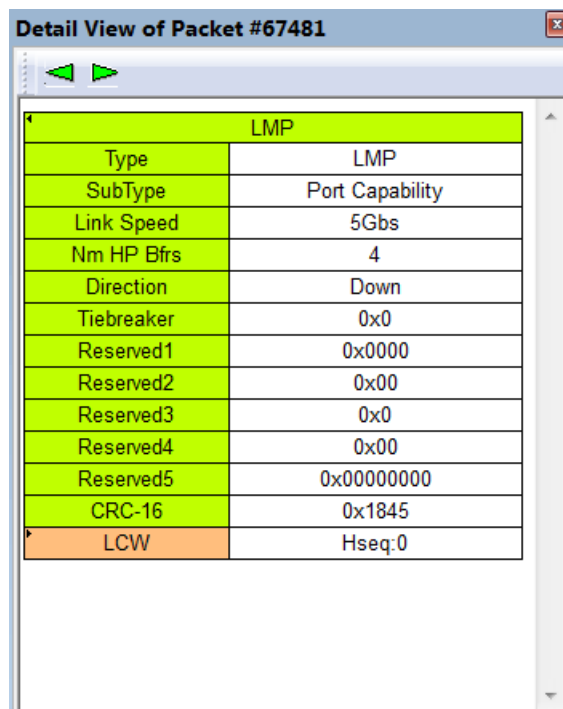
In the case of the Traffic Type pane, priority determines display priority of each packet type. For portions of the trace that are dominated by a particular packet type, this setting no effect: only the color corresponding to that packet type is displayed in that portion of the pane. Suppose, however, 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.

10.11 Detail View

The Detail View window shows packet details.

To obtain the Detail View window, select **Report > Detail View**

or click the  toolbar icon.



LMP	
Type	LMP
SubType	Port Capability
Link Speed	5Gbs
Nm HP Bfrs	4
Direction	Down
Tiebreaker	0x0
Reserved1	0x0000
Reserved2	0x00
Reserved3	0x0
Reserved4	0x00
Reserved5	0x00000000
CRC-16	0x1845
LCW	Hseq:0

Figure 10.40: Detail View Window

The Data View toolbar buttons allow you to Go to Previous or Next.

Expanding a data field displays the Data View.

10.11.1 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.

10.12 Spec View

The Spec View shows packet header information for USB 3.2, USB 2.0, Power Delivery, USB4 Sideband and Display Port traffic.

To obtain the Spec View, select **Report > Spec View**

or click the  Spec View toolbar icon.

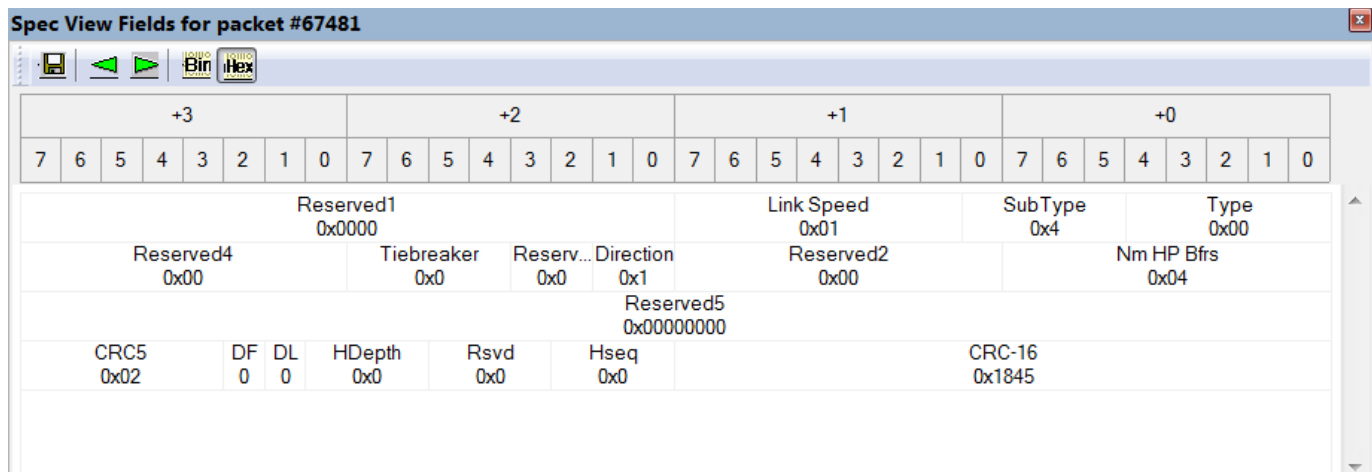


Figure 10.41: Spec View

The toolbar allows you to Save, go to Previous or Next and display Binary or Hexadecimal. See [Figure 10.42](#).



Figure 10.42: Spec View Toolbar

Display Port: Spec View

For an example of the Spec View of Display Port traffic see [Figure 10.43 on page 604](#).

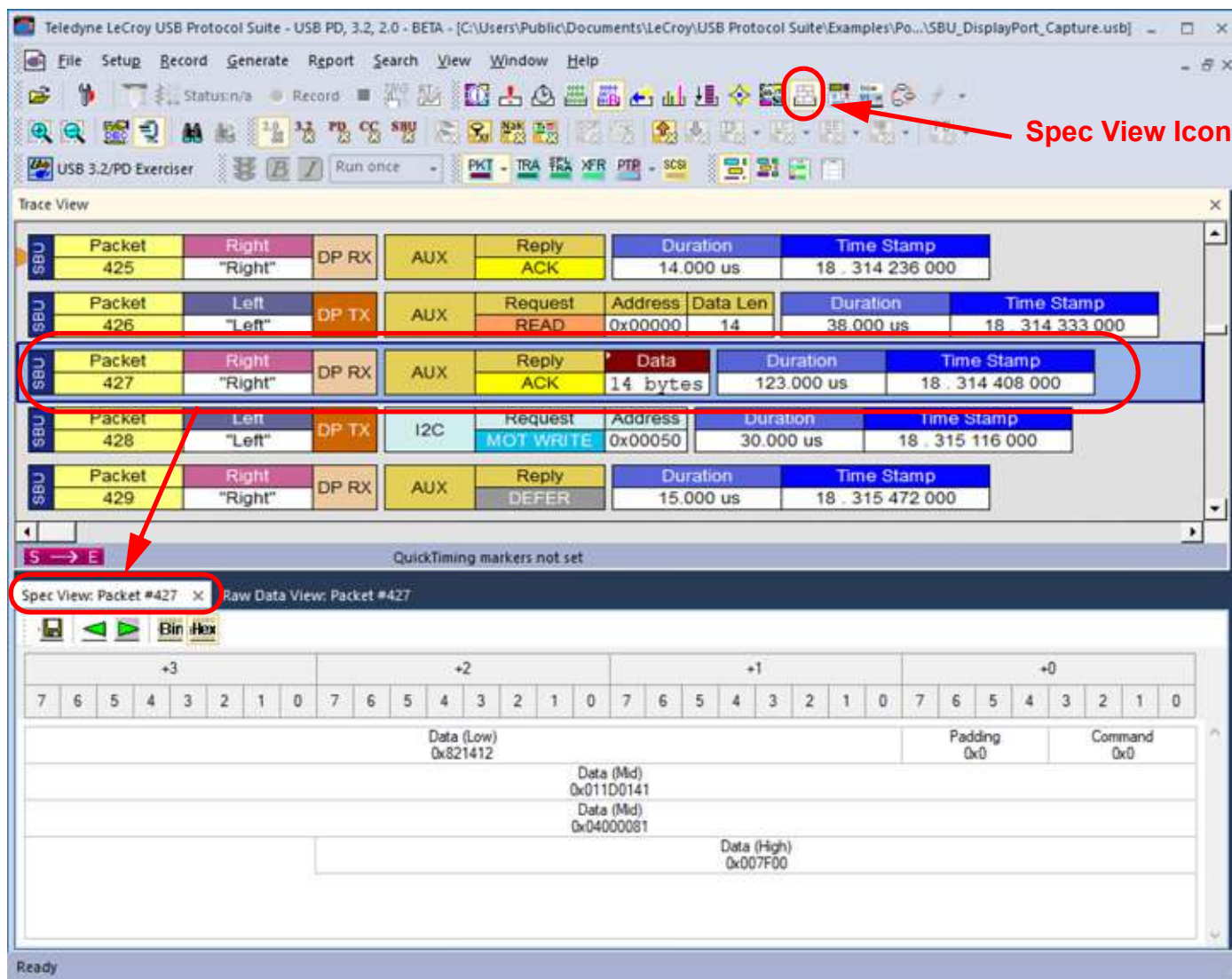


Figure 10.43: Display Port: Spec View

10.13 USB (3.2) 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 3.2 Link State Timing View (see [Figure 10.44 on page 605](#)).

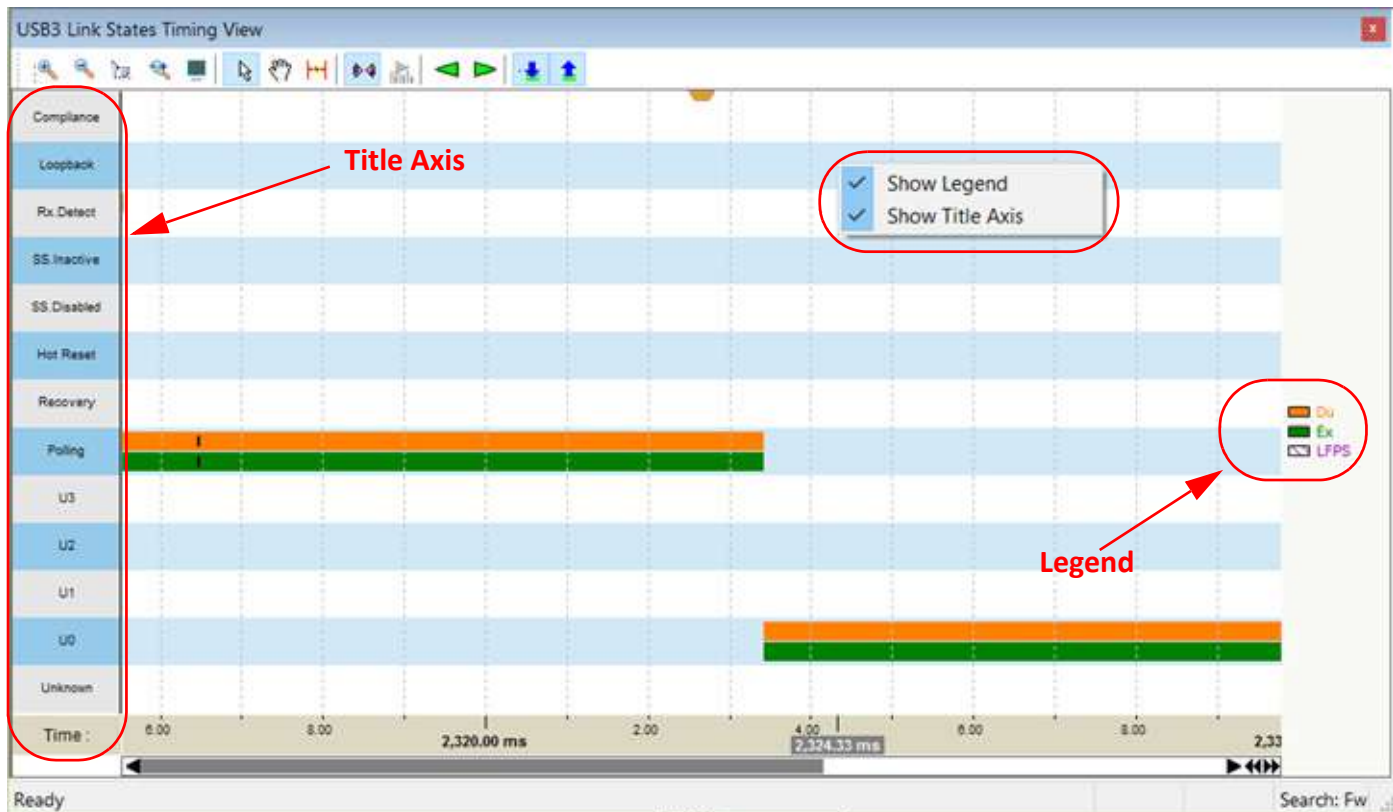


Figure 10.44: USB 3.2 Link State Timing View

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.

If you right-click in the graph area a small dialog box will popup. You can turn on or turn off the following attributes to the graph:

- ☐ Show Legend
- ☐ Show Title Axis

10.13.1 USB (3.2) 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 3.2 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.

10.13.2 USB (3.2) LTSSM View

The LTSSM View displays the LTSSM diagram depicted in the USB 3.2 specification.

Click  to display the USB 3.2 LTSSM View.

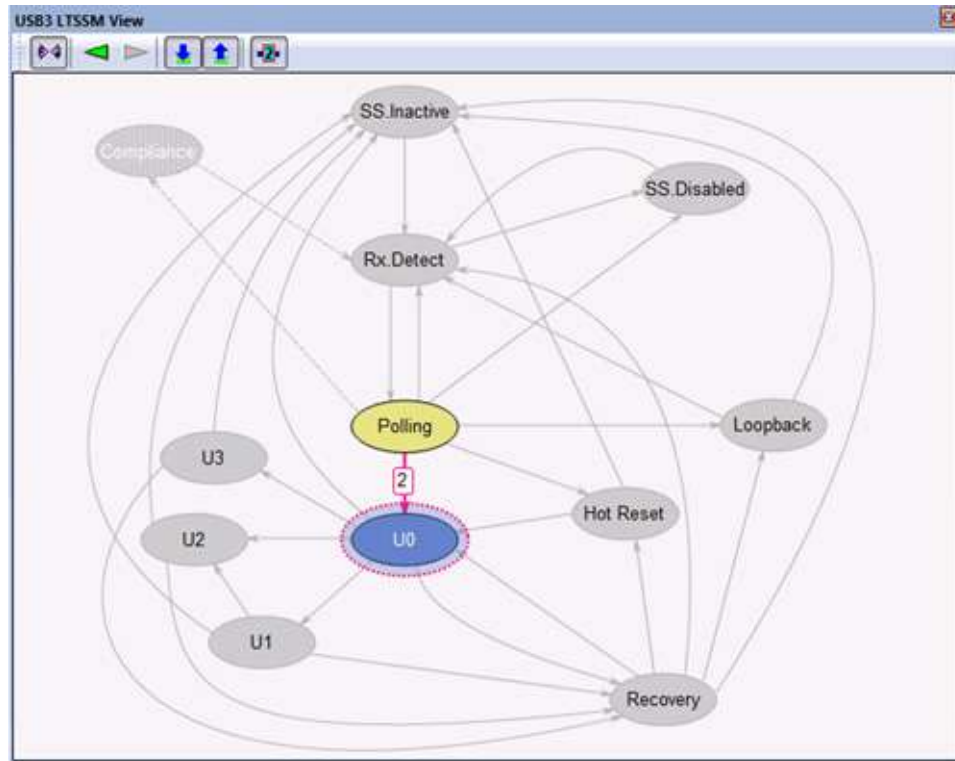


Figure 10.45: USB 3.2 LTSSM View

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 3.2 LTSSM** checkbox. Click **Save As Default**. Reopen the trace file.

10.14 Power Tracker: VBus and Configuration Channel (CC)

Note: Power Capture can only be enabled on licensed versions of Voyager M3i, M3x, M310, M310C, M310P and Mercury T2P.

10.14.1 VBus Power Tracker

The Power Tracker displays the power, voltage and current at each point in time. Power Tracker assumes the direction of current flow is from the Right connector ("2") to the Left connector ("1") which is the behavior if a normal USB Device was connected to the Left connector, and the Host was connected to the Right connector. If the direction of current flow is going the OTHER way, it is shown as a Negative value. With Power Delivery and Type-C, there are many situations where current can flow in either direction, so we just use this orientation as our standard. For the Exerciser port, we use the Voyager supplying current as the Positive value, and the Voyager sinking current as the Negative value.

Note: "Current direction or direction of current flow" can be used to search for this section.

Select **Report > Power Tracker**, or click  to display the VBus Power Tracker, CC Power Tracker and Exerciser VConn Tracker. See [Figure 10.47](#).

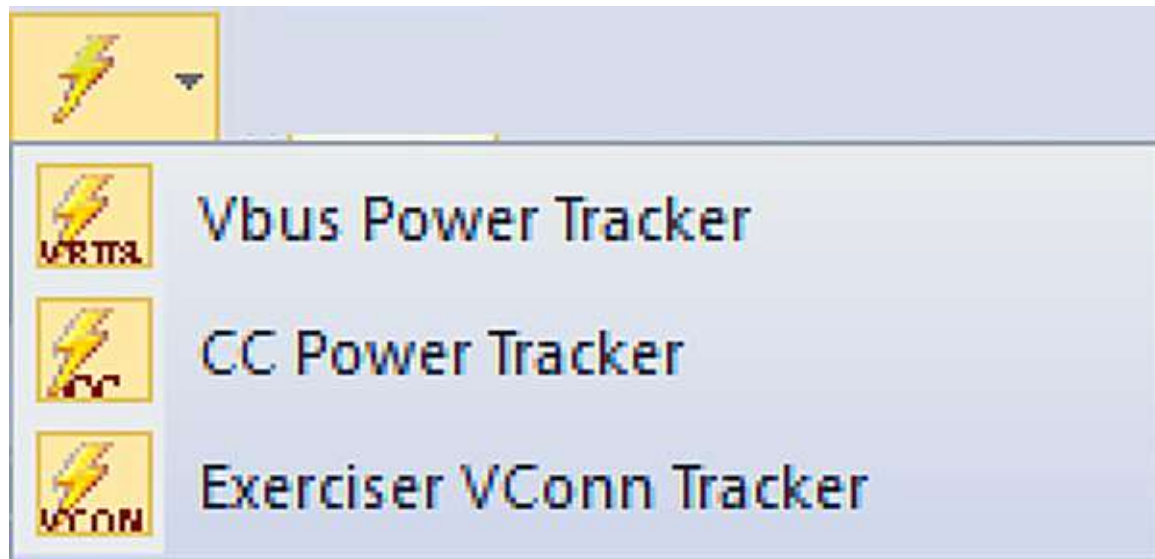


Figure 10.46: Power Tracker: VBus and CC Events

If you select VBus Power Tracker you'll see the Power, Voltage and Current waveforms displayed. See [Figure 10.47](#). If you select CC Power Tracker the Configuration Channel voltage will be displayed. If you select VConn Tracker, you will see the power used on the VConn connection. On the M310P, this will apply to the Exerciser port. On the Mercury T2P, this will apply to whatever analyzer connector was selected in the Recording Options. See "[Configuration Channel \(CC\) Power Tracker](#)" on page 626.

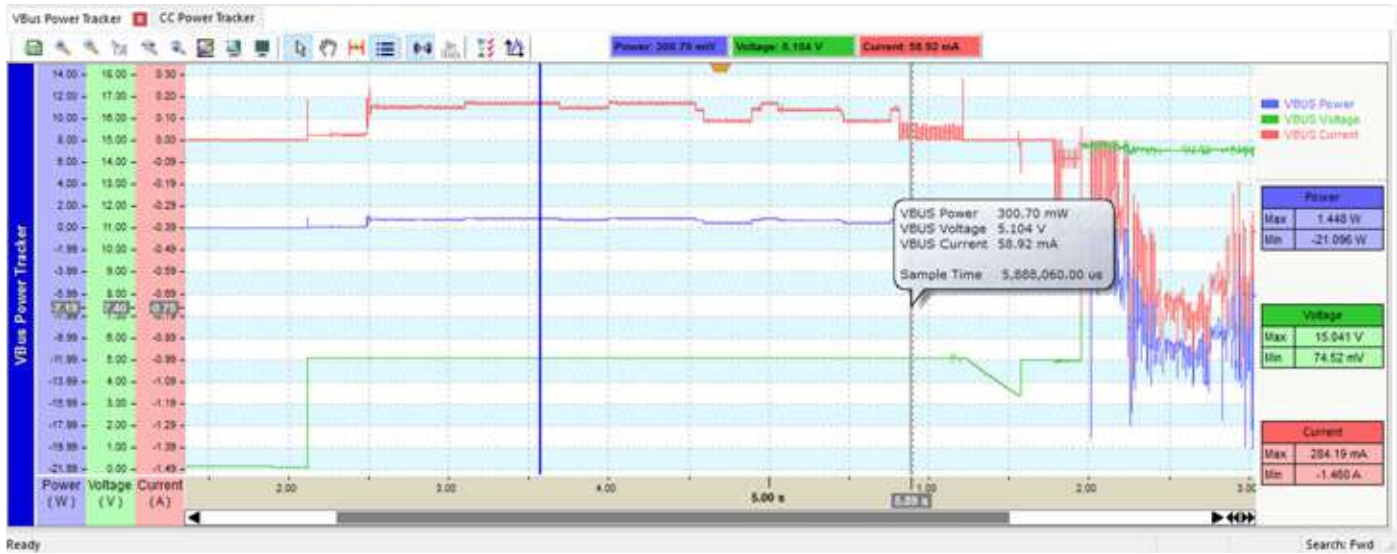


Figure 10.47: Power Tracker: VBus

If you right click within the display, the following window will pop up: See [Figure 10.48](#).

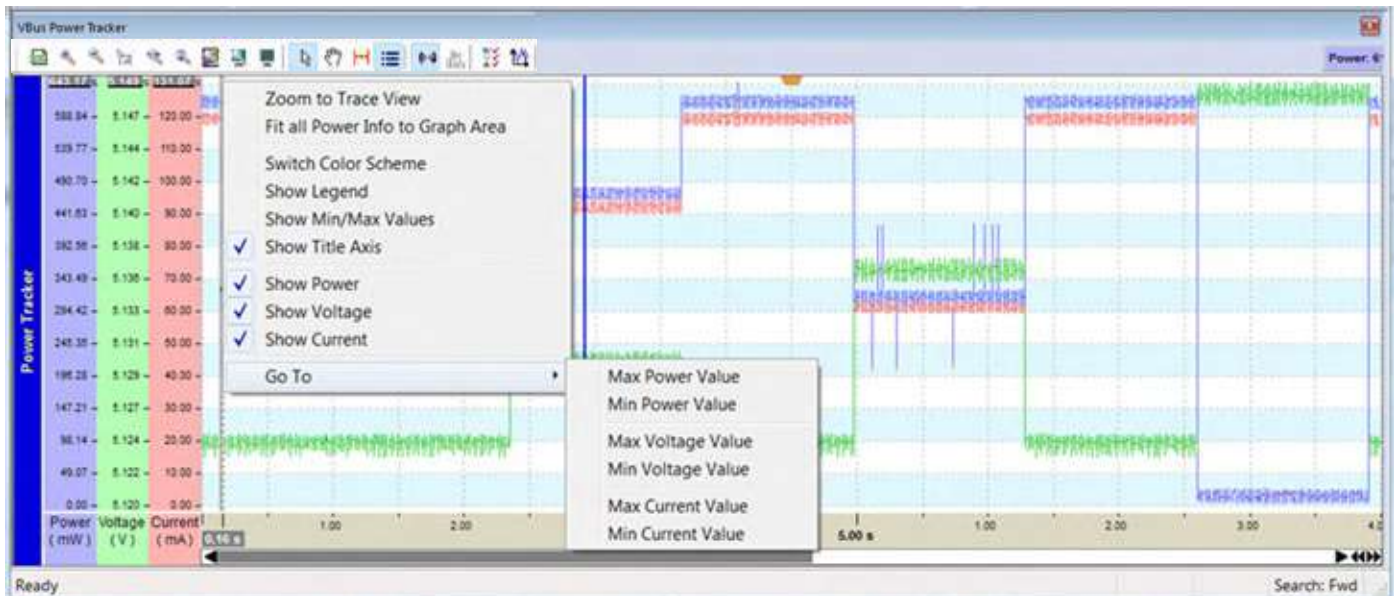


Figure 10.48: Right Click in Display Menus

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 10.49](#)

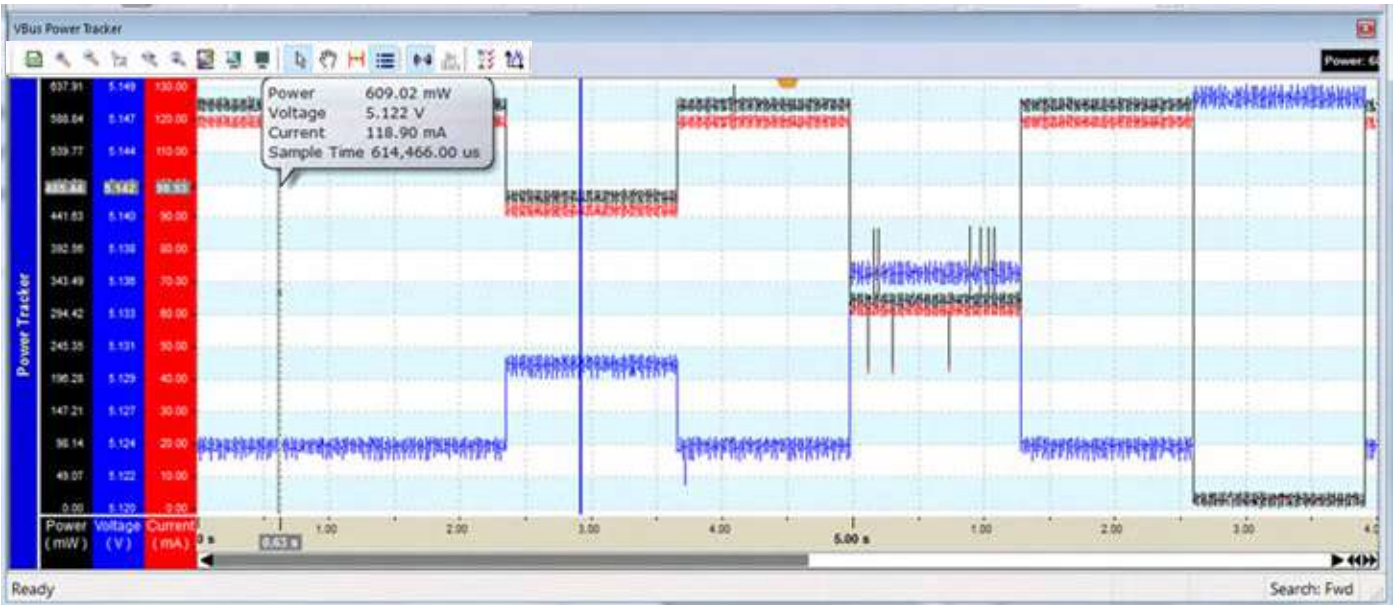


Figure 10.49: Update Color Scheme of Legend

If you select Show Legend and Show Min/Max Values, they will show up in the display. See [Figure 10.50 on page 610](#).

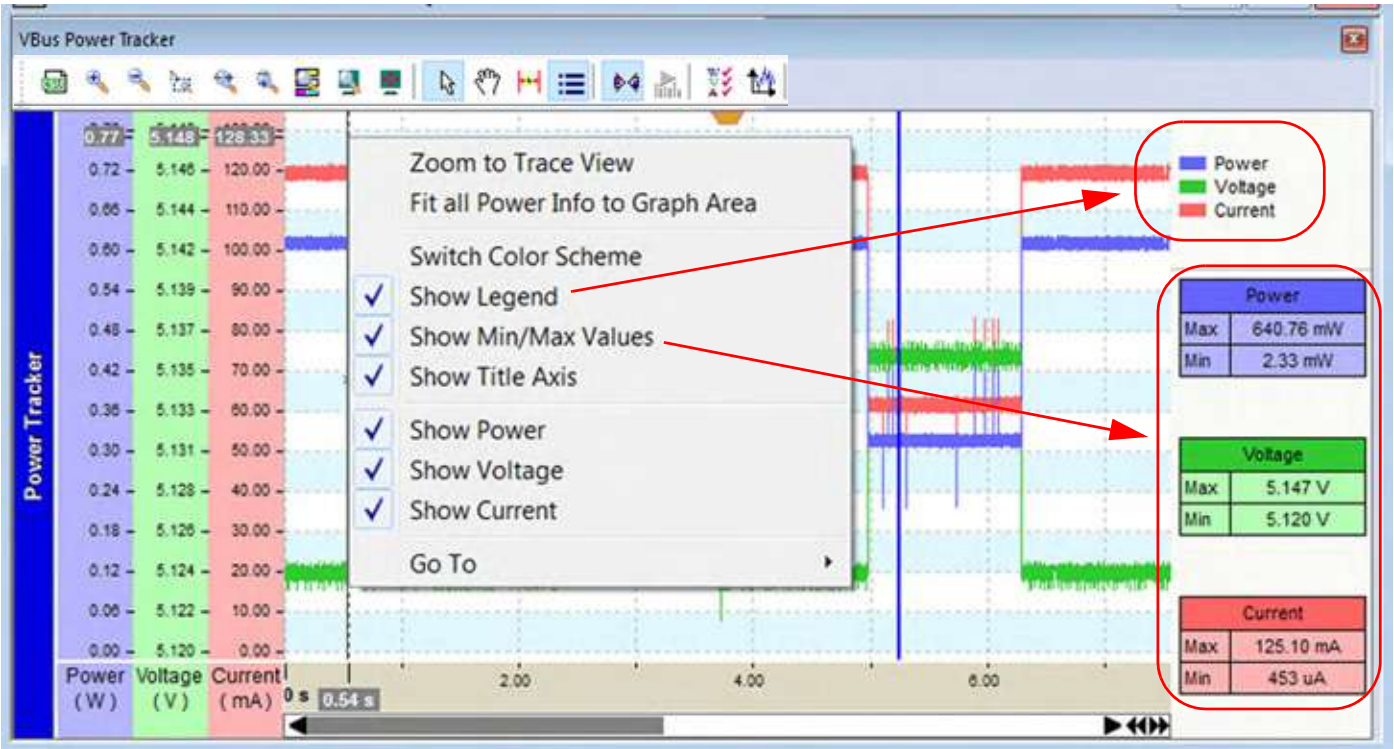


Figure 10.50: Show Legend, Show Min/Max Values

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 612](#)).

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.

On the M310P and Mercury T2P, the current sense device has high hysteresis, so current measurements can take a few hundred milliseconds to settle. The byproduct of this hysteresis is that it reduces the noise and gets a more accurate value at low currents after this period of time.

Power Tracker Toolbar



Figure 10.51: Power Tracker Toolbar

Note: Vbus Voltage Values shown when running Power Delivery 2.0 Load Tests use built-in compensation factors to adjust for the voltage drop across the required cable: USB18CAB-X (926763-00). The voltage drop across this cable due to the current is added to each sample so that the voltage captured and displayed represents the value at the user's connector. This compensation is ONLY done during these Load tests, so all other Voltage values captured and shown are measured at the Voyager Connector and are unaware of cable voltage drops.

The buttons have the following functions:

	Export Trace to CSV file (see “VBus Power Tracker Export to CSV File” on page 624).		
	Zoom in (see Figure 10.52 on page 614).		Pointer Mode (see Figure 10.60 on page 618).
	Zoom out (see Figure 10.53 on page 614).		Hand Panning (see Figure 10.61 on page 618).
	Zoom by Selection (see Figure 10.54 on page 615).		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 10.62 on page 619 .
	Zoom by Horizontal Drag (see Figure 10.55 on page 615).		Show detailed information on the marker. Displays voltage and current slew rates between markers. See Figure 10.63 on page 619 .
	Zoom by Vertical Drag (see Figure 10.56 on page 616).		Sync by Time. Synchronize the USB 3.2 Link State Timing States View and the Trace View, see Figure 10.64 on page 620 .

	Zoom to Visible part of Trace (Power Tracker Info close to Packet of interest, see Figure 10.57 on page 616).		Monitor during capture (Power Tracker Data Displayed in Real Time).
	Fit All Power Info to Graph Area (Power Info for Entire Trace Visible, see Figure 10.58 on page 617).		Show/Hide Power Tracker Types: Power, Voltage, and/or Current (see Figure 10.65 on page 620).
	Full Screen (see Figure 10.59 on page 617).		Change Power Tracker graph type: Bar, Line, and/or Point (see Figure 10.66 on page 621).
			Drop Compensation: When running USB PD 2.0 Compliance Load tests, the software can automatically compensate for the voltage drop across the Type-C cable being used during the test. This button toggles between the value we captured and the value that takes into account this extra cable voltage drop.

The effects of the ToolBar Buttons are shown below:

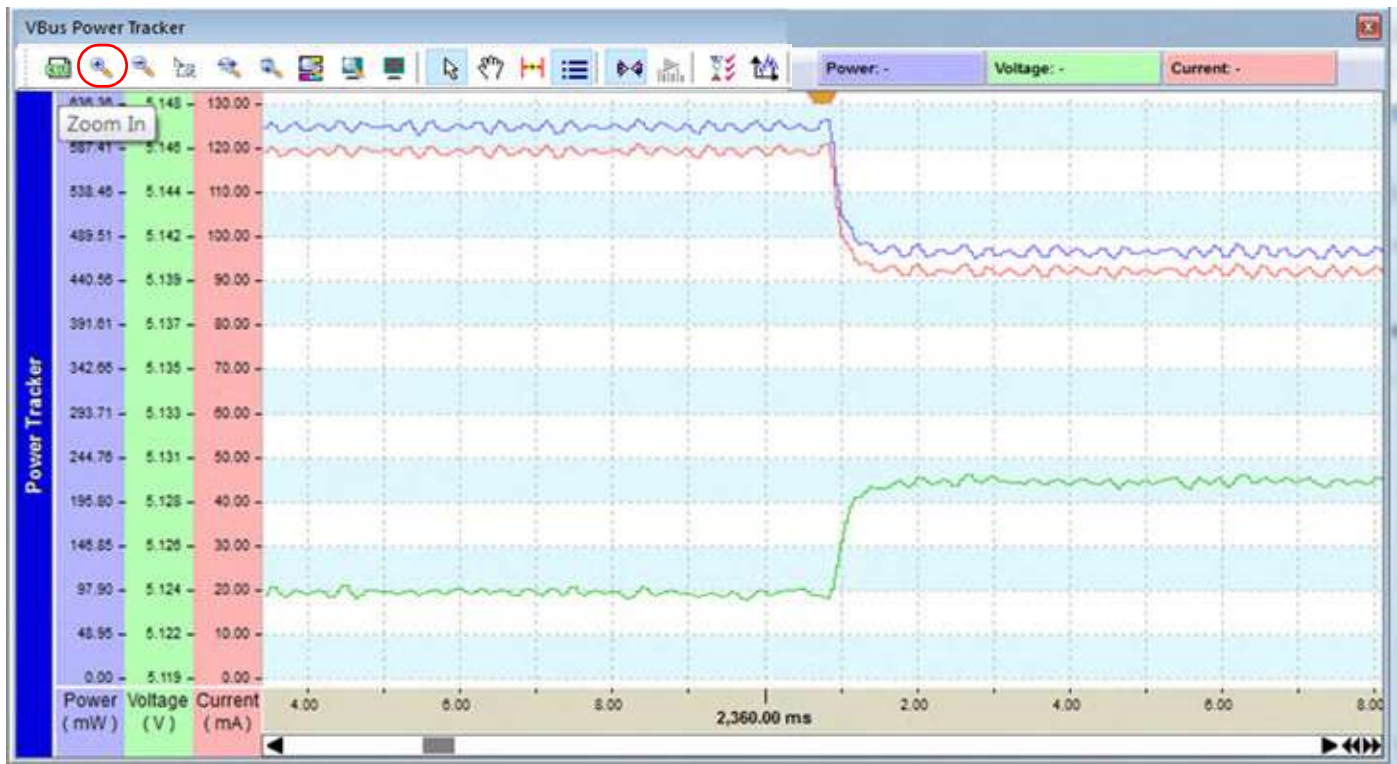


Figure 10.52: Power Tracker ToolBar Button: Zoom In

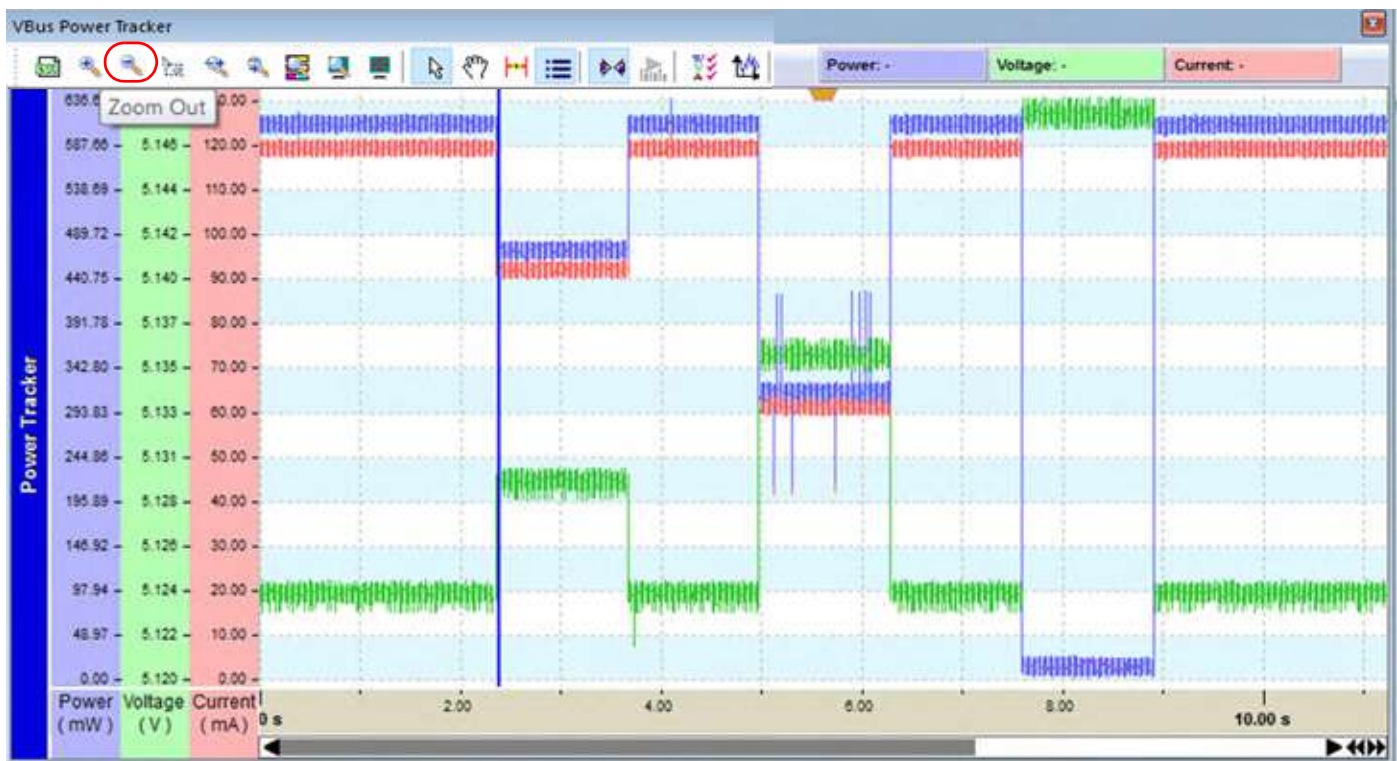


Figure 10.53: Power Tracker ToolBar Button: Zoom Out

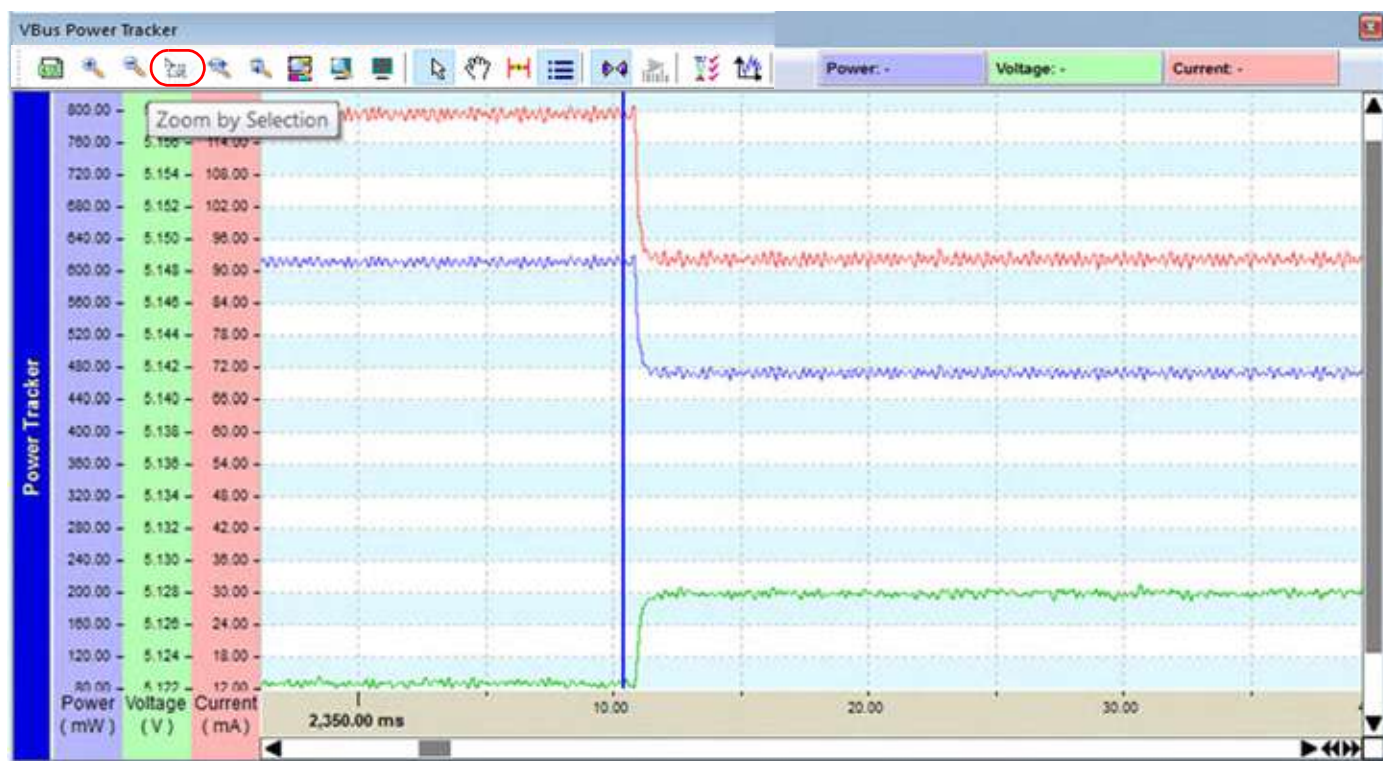


Figure 10.54: Power Tracker ToolBar Button: Zoom By Selection

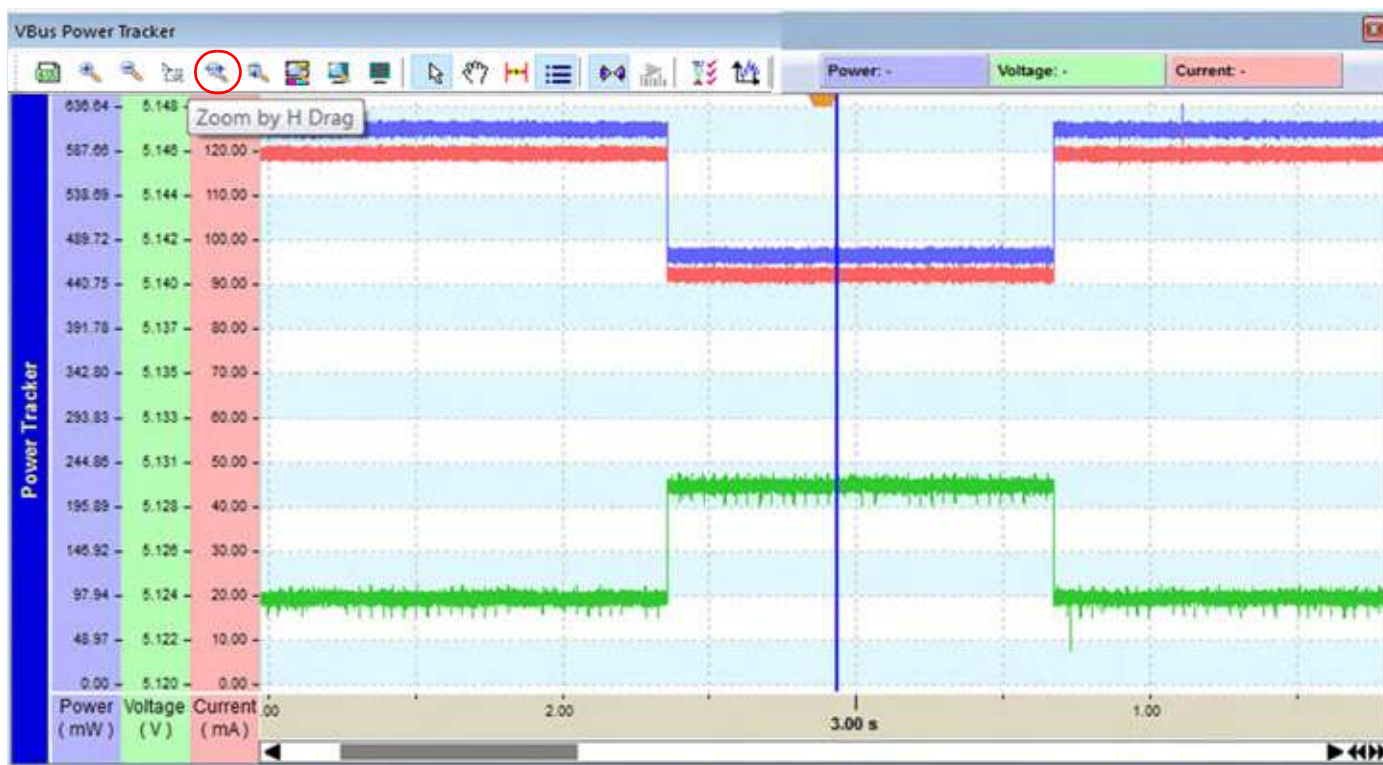


Figure 10.55: Power Tracker ToolBar Button: Zoom by Horizontal Drag

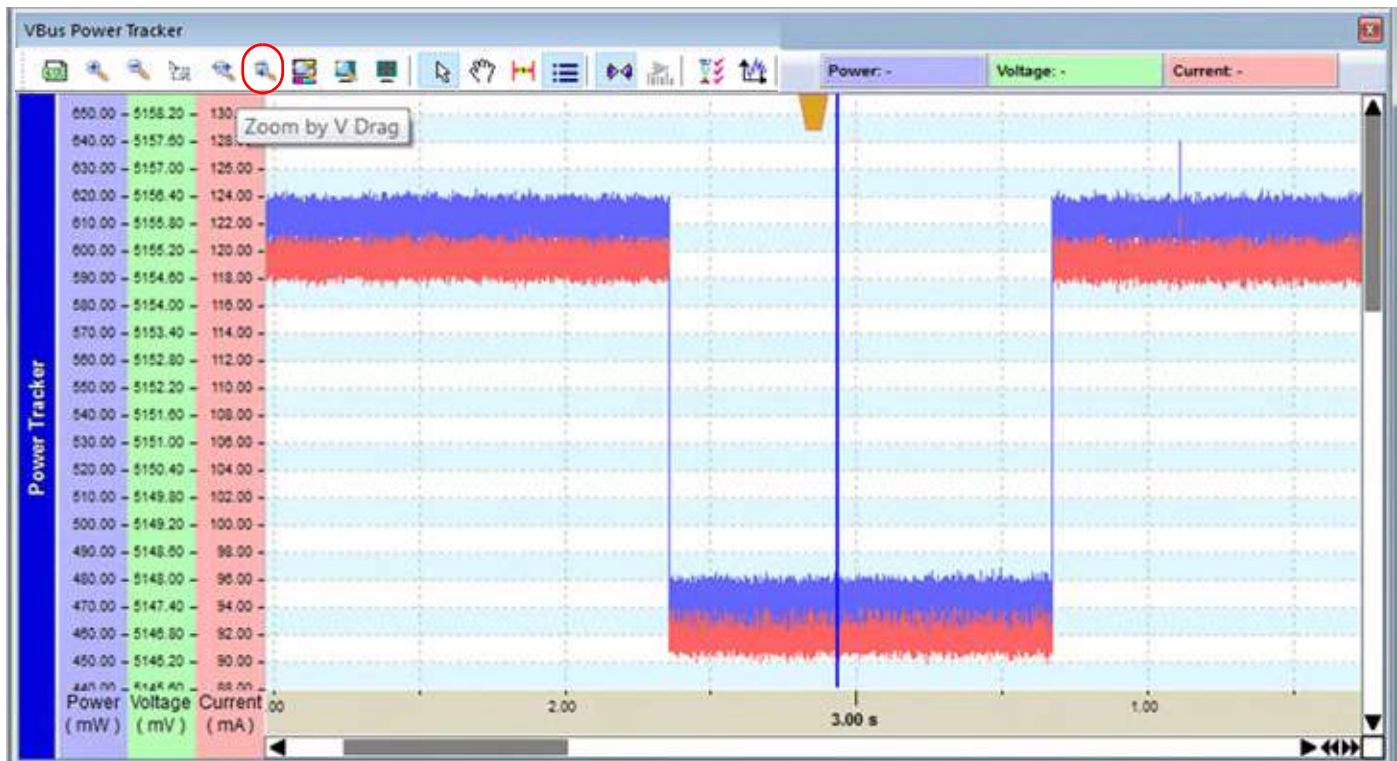


Figure 10.56: Power Tracker ToolBar Button: Zoom by Vertical Drag

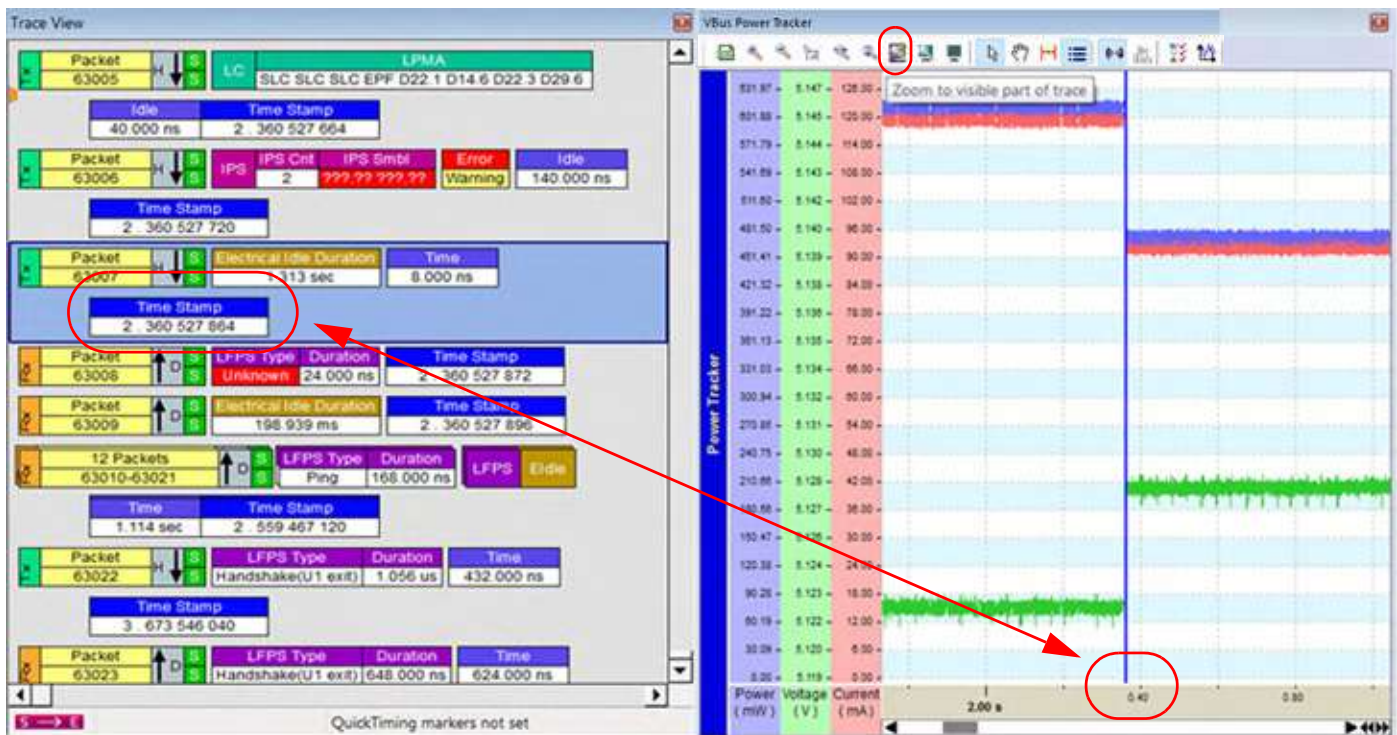


Figure 10.57: Power Tracker ToolBar Button: Zoom to Visible Part of Trace

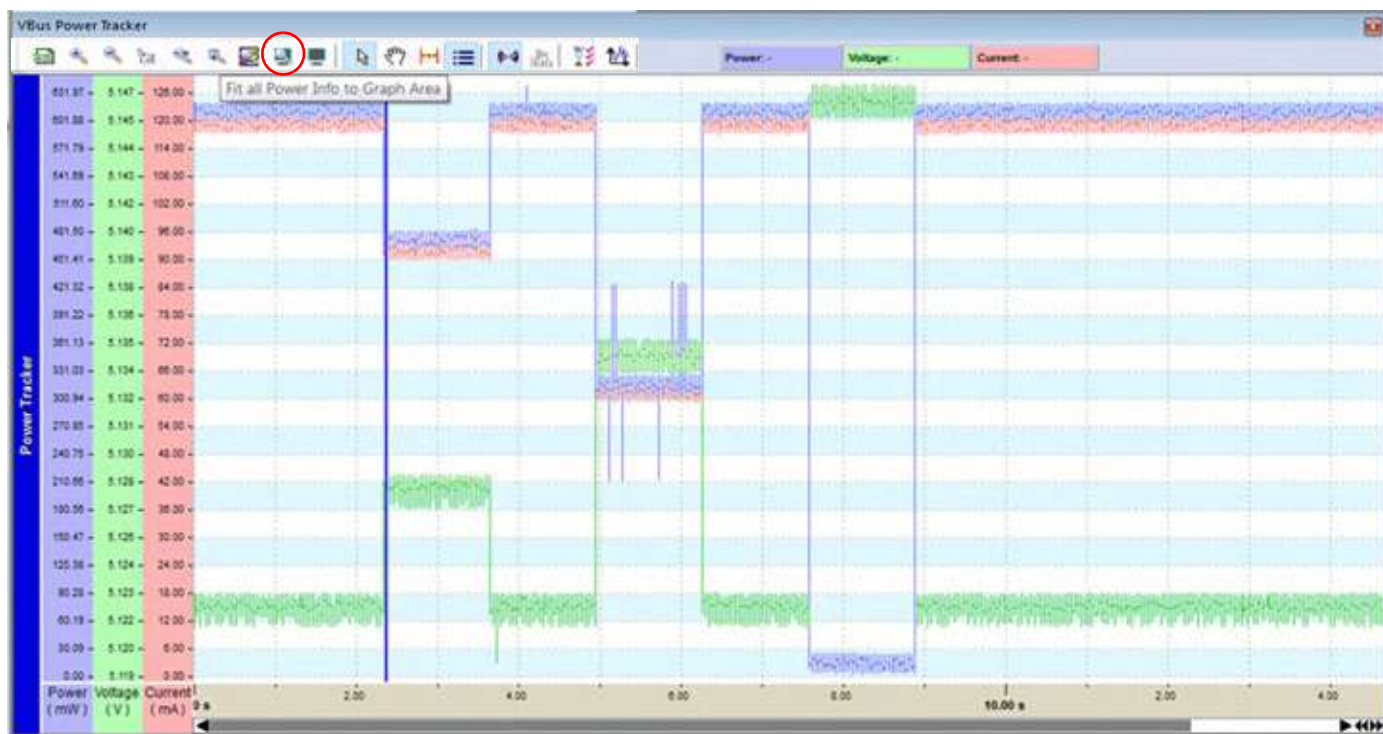


Figure 10.58: Power Tracker ToolBar Button: Fit All Power Info to Graph Area

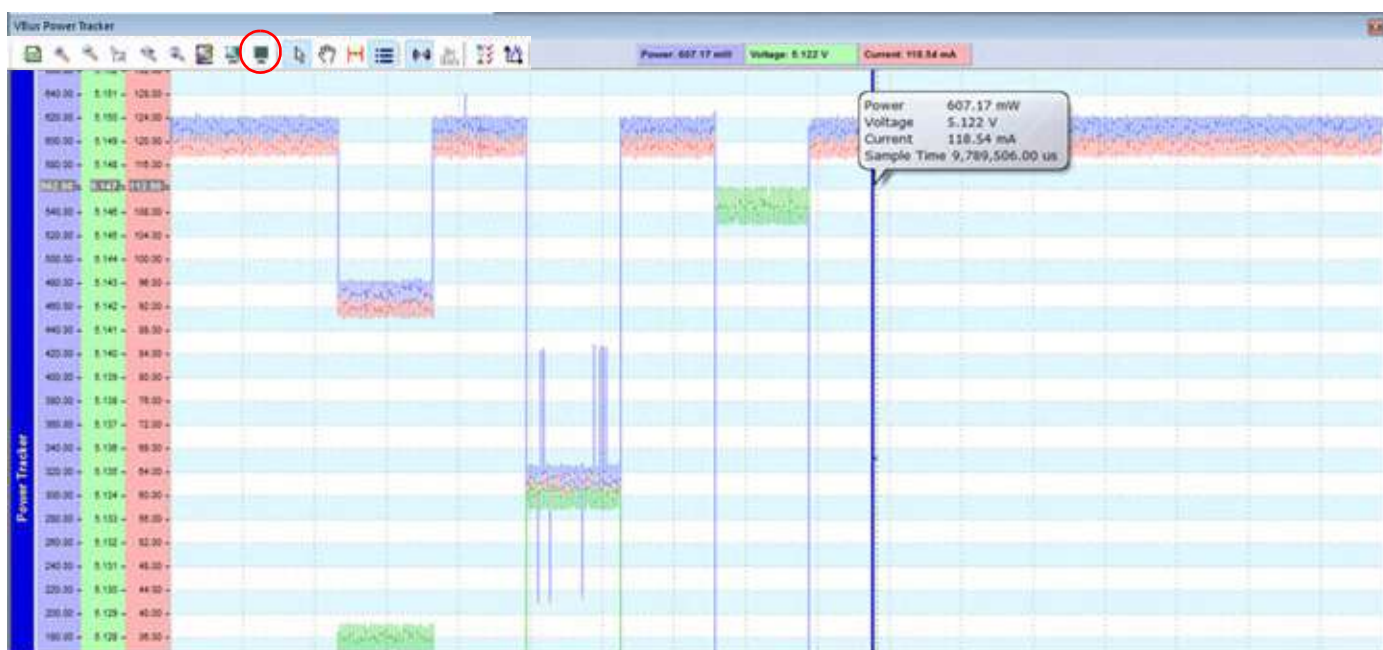


Figure 10.59: Power Tracker ToolBar Button: Full Screen

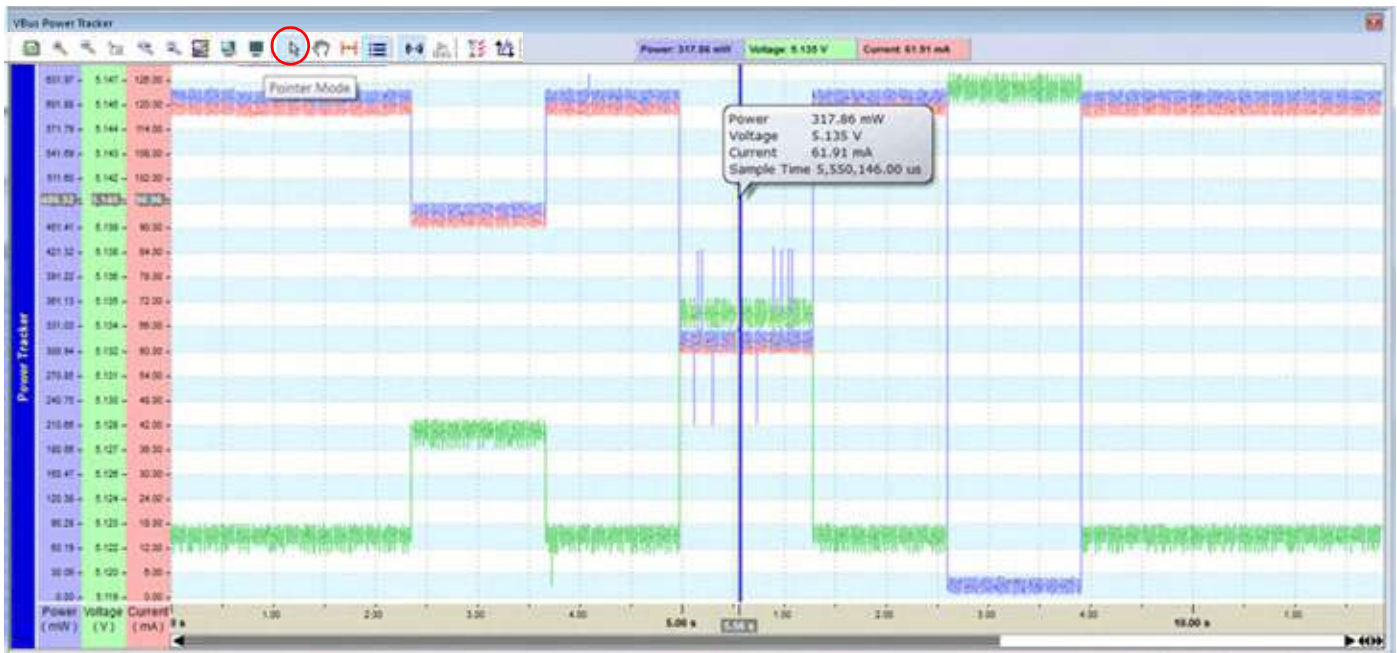


Figure 10.60: Power Tracker ToolBar Button: Pointer Mode

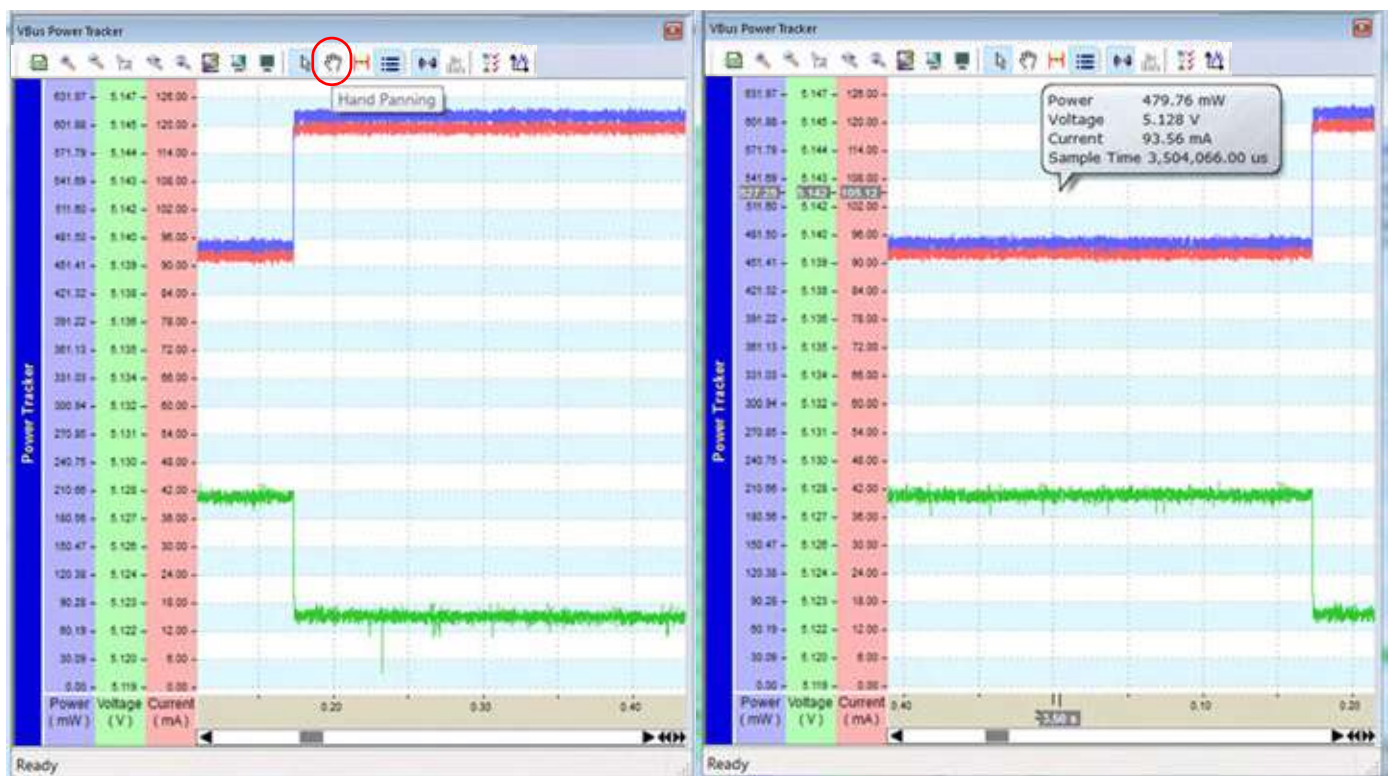


Figure 10.61: Power Tracker ToolBar Button: Hand Panning

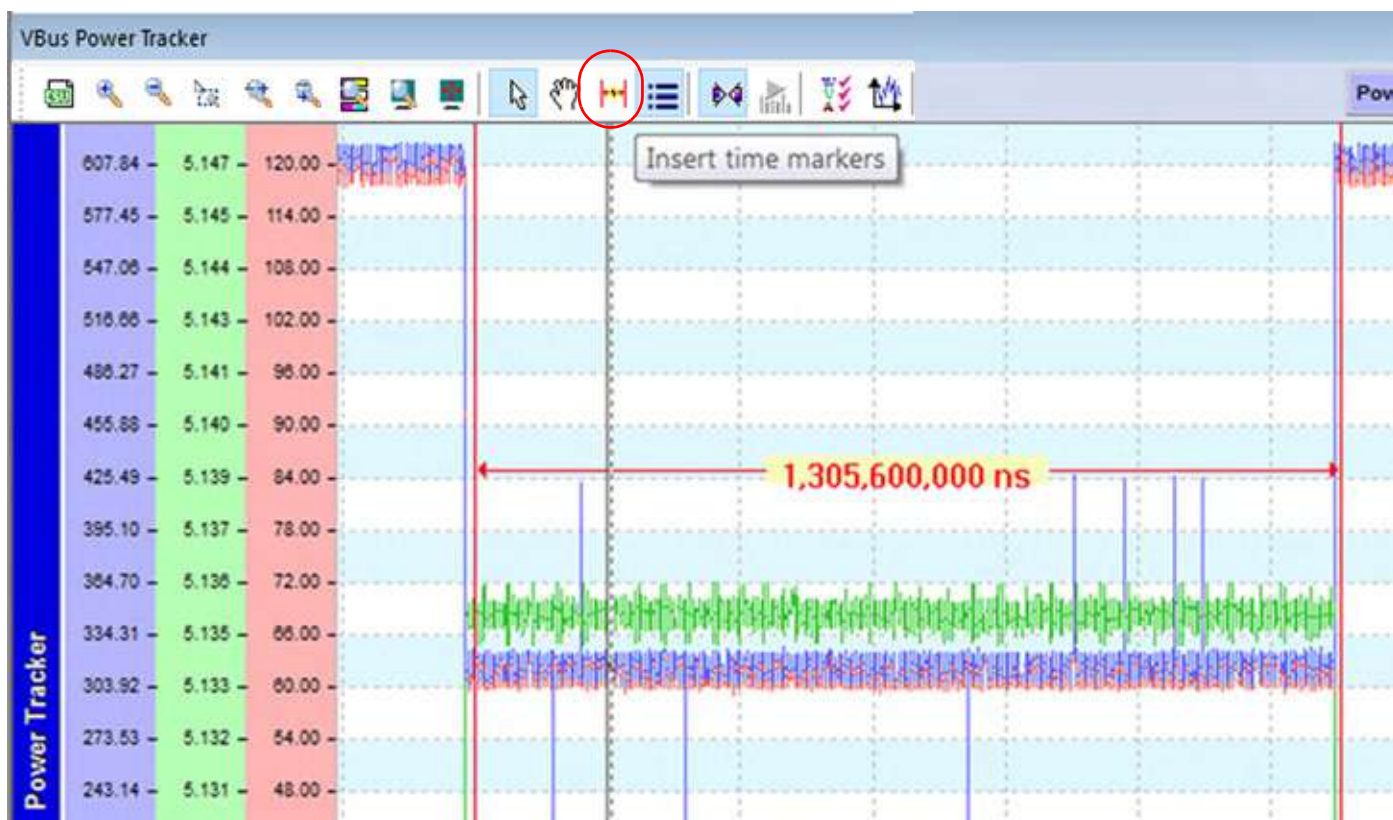


Figure 10.62: Power Tracker ToolBar Button: Insert Time Markers



Figure 10.63: Power Tracker ToolBar Button: Insert Time Markers -> Slew Rate Information

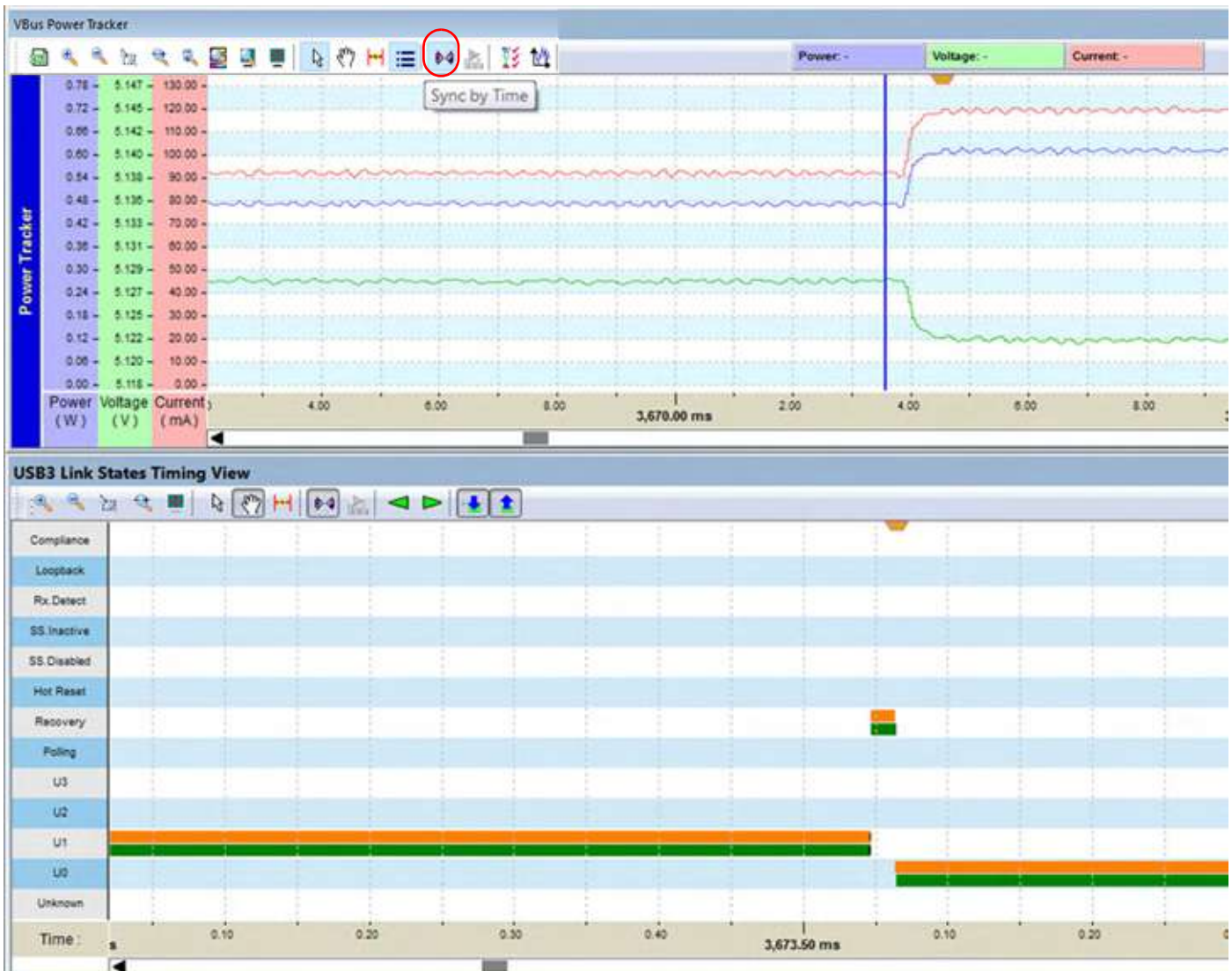


Figure 10.64: Power Tracker ToolBar Button: Sync by Time

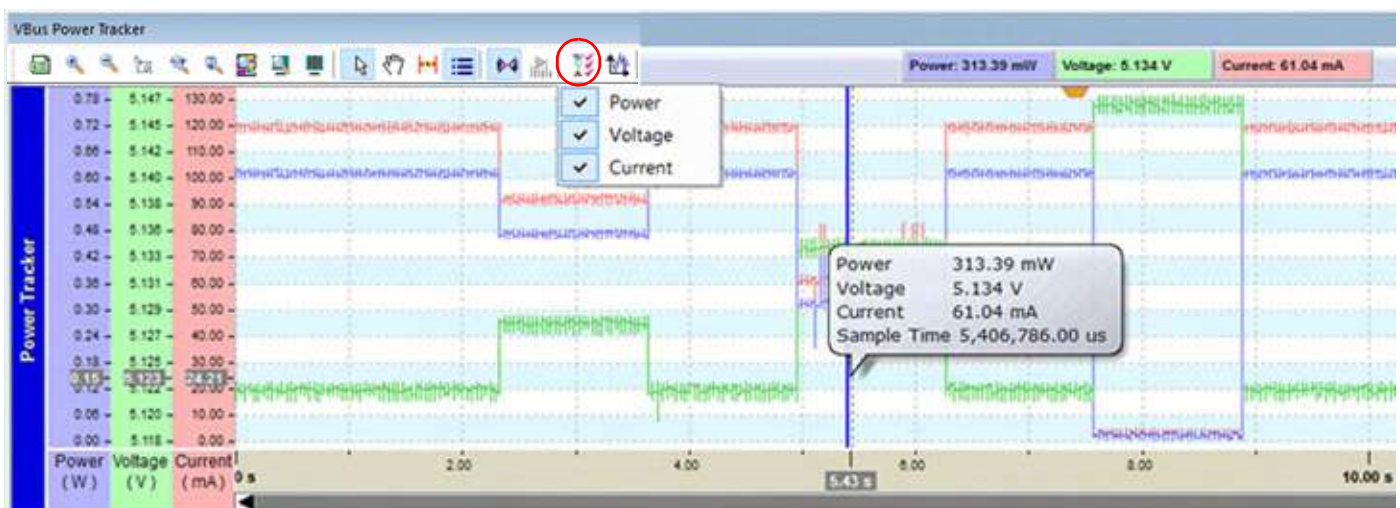


Figure 10.65: Power Tracker ToolBar Button: Show/Hide Power Tracker Types

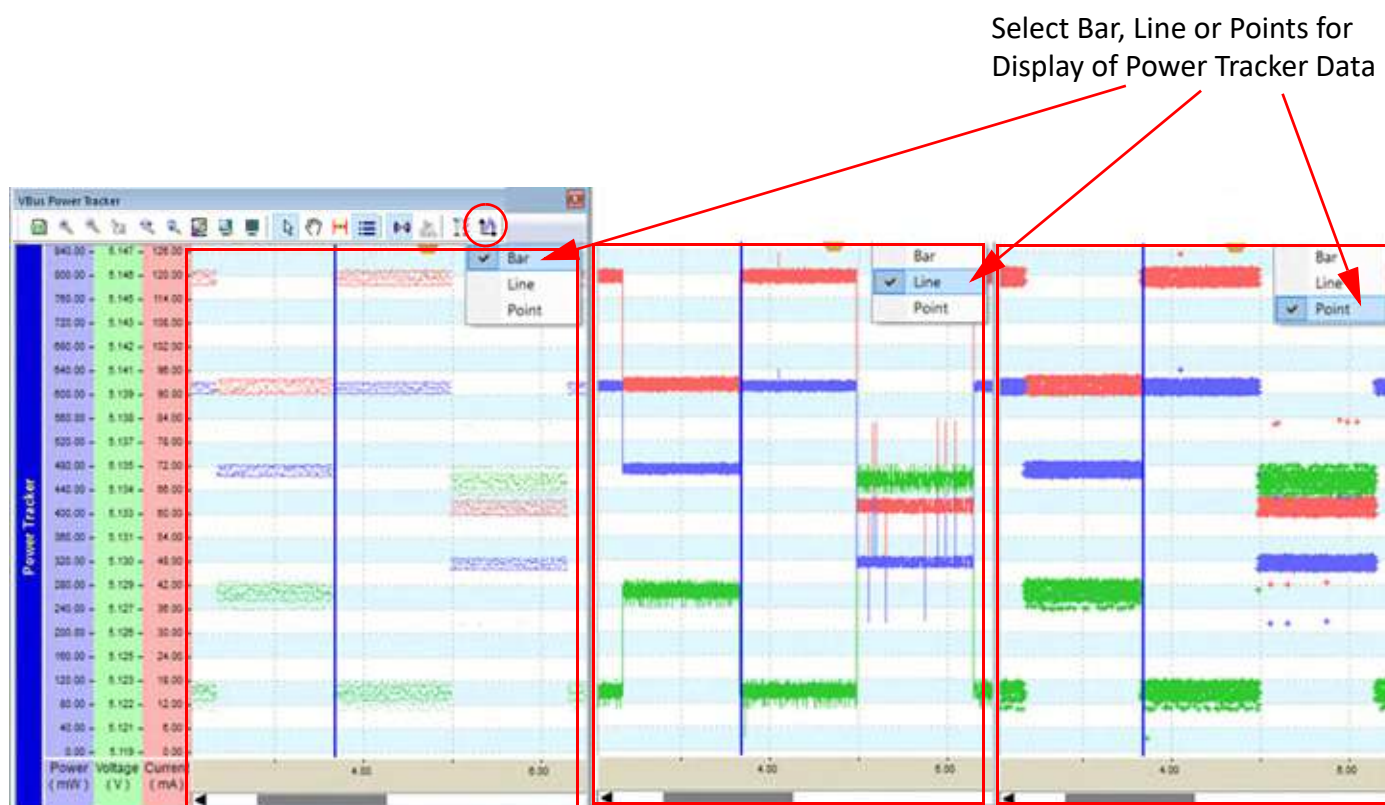


Figure 10.66: Power Tracker ToolBar Button: Change Power Tracker Graph Type

10.14.2 Power Tracker: CC Power Tracker/Vbus Power Tracker Sync'ed (Beta)

You can display both the CC Power Tracker view synchronized with the Vbus Power Tracker view by opening an appropriate trace. In this case the trace PR_Swap_VDM.usb has been selected below. See [Figure 10.67](#).

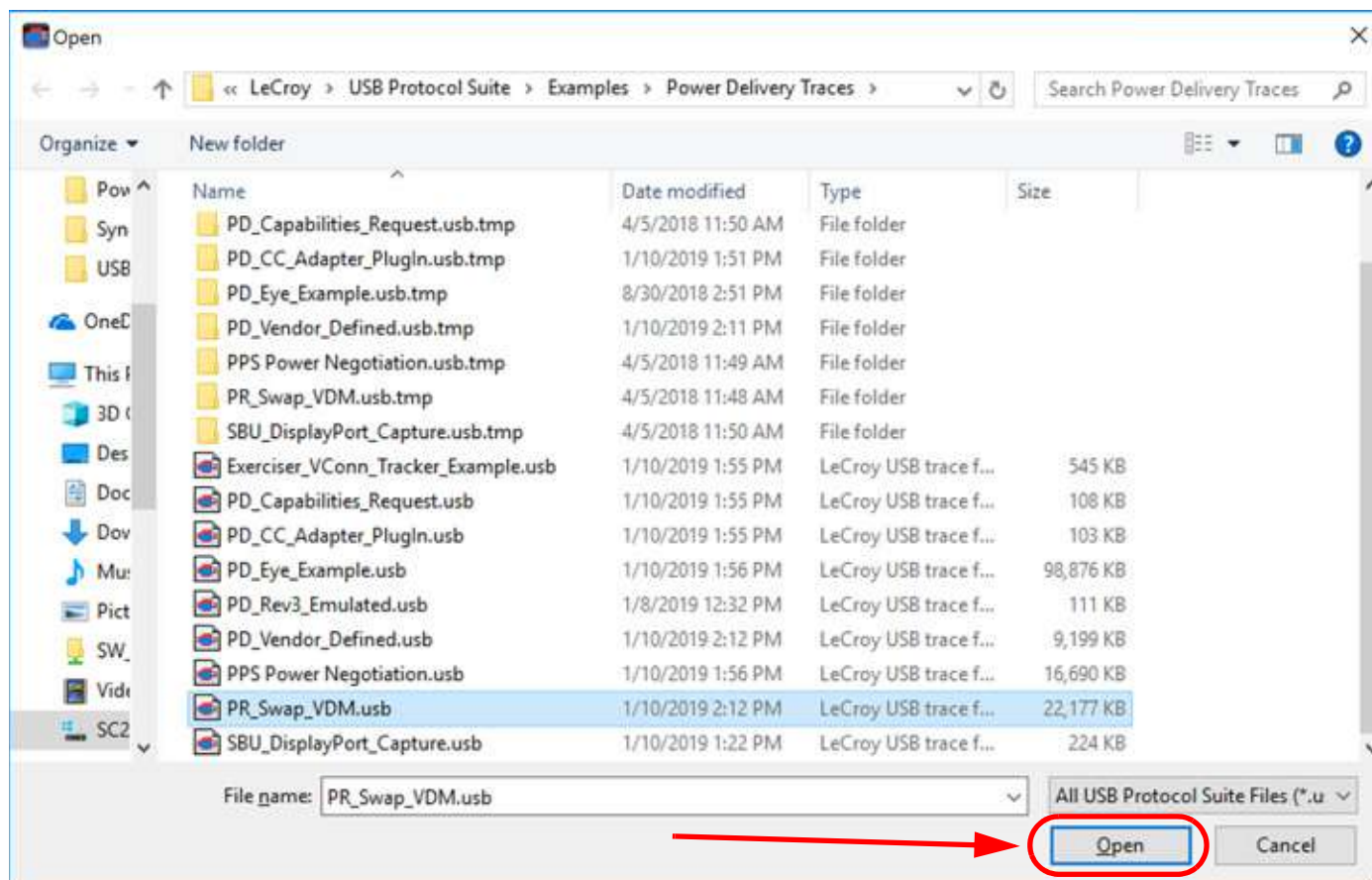


Figure 10.67: Trace Opened: PR_Swap_VDM

Ensure both Vbus Power Tracker and CC Power Tracker are enabled. See [Figure 10.68](#).



Figure 10.68: Vbus Power Tracker and CC Power Tracker are Enabled

To use this feature, you must dock the two views so they lie above and below each other, as shown in [Figure 10.69 on page 623](#). This is not done automatically. By pressing the Sync by Time and Zoom button, both views will track any subsequent zooms and time scrolling, so that the

relationship between the events is visually consistent. In addition, the blue selection line is kept aligned as much as possible.

This feature will be improved on in the future, and is presented as a Beta version at this time. See figure below.

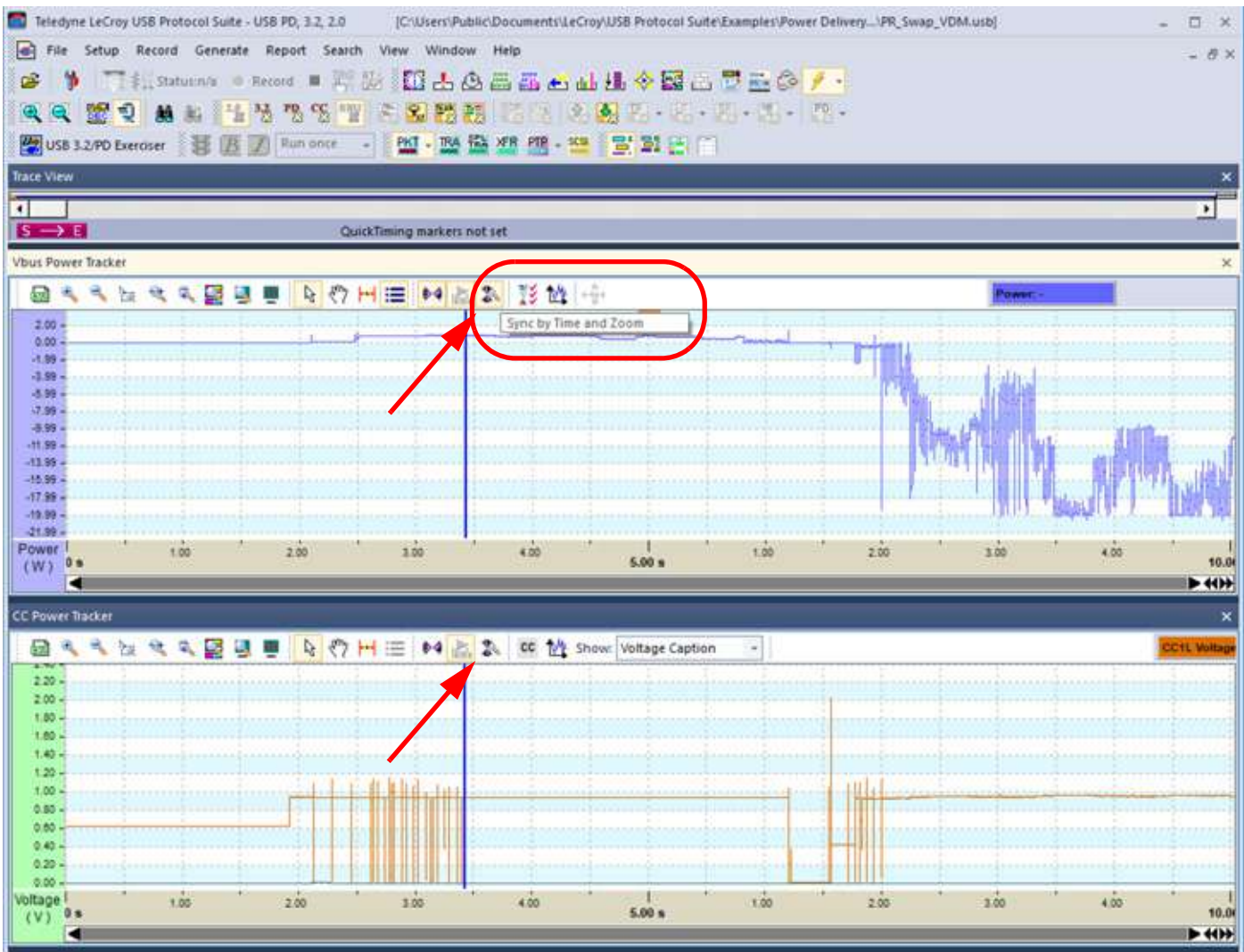


Figure 10.69: CC Power Tracker view and the Vbus Power Tracker view: Time and Zoom Synchronized

10.14.3 VBus Power Tracker Export to CSV File

If you select the CSV icon on the toolbar (see [Figure 10.70](#)).

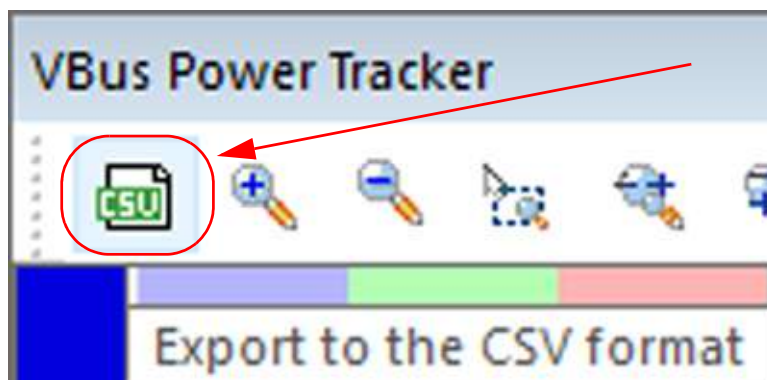


Figure 10.70: VBus Power Tracker: CSV Icon

A dialog box will popup in the directory path where the USB Protocol Suite Software was installed:
C:\Users\Public\Documents\LeCroy\USB Protocol Suite\Examples\Power Delivery Traces

You can choose an appropriate file title for the CSV file. In this case we have chosen:

VBus_Power_Tracker_Info_from_Trace.csv

See [Figure 10.71](#).

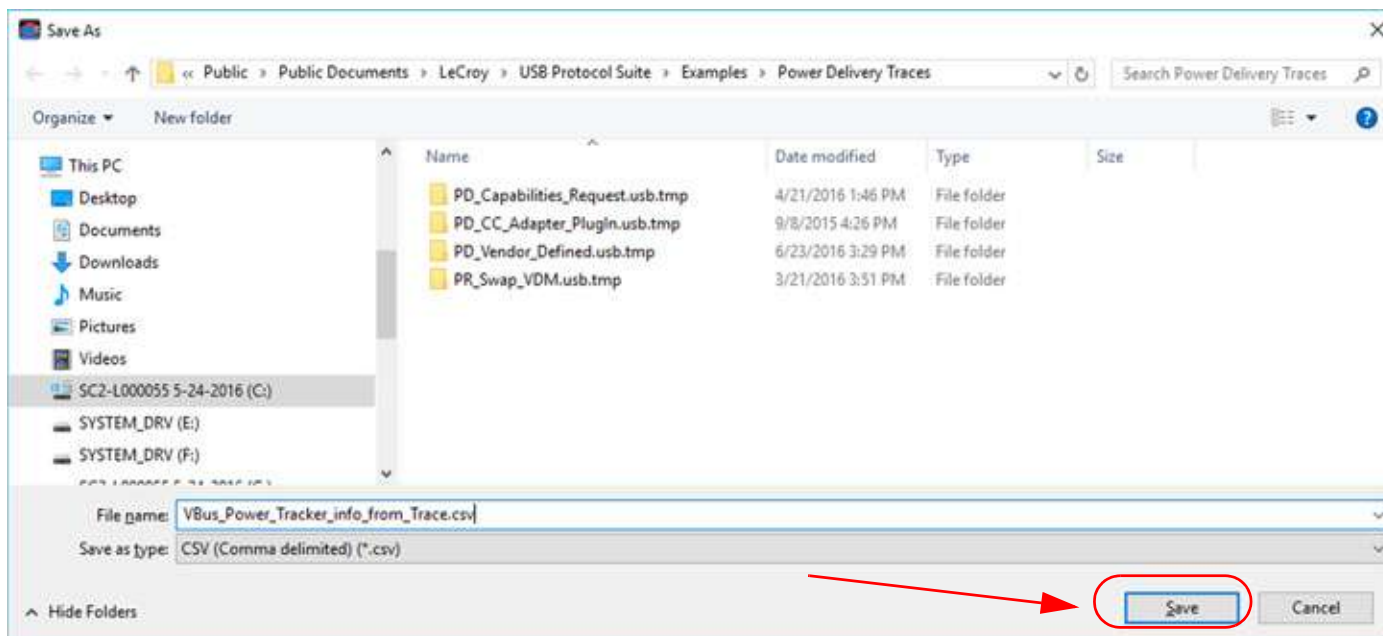


Figure 10.71: Popup Dialog Box with Path to Save CSV File

Select "Save" and the CSV file will be saved to the chosen directory.

You can then open the file with Excel. See [Figure 10.72 on page 625](#).

	A	B	C	D
1	VBUS Power Tracker Report			
2				
3	time(ns)	Voltage(micro volts)	Amperage(micro amperes)	Power(micro watts)
4	0	143837	2142	308.098854
5	20000	145950	1916	279.6402
6	40000	143546	1894	271.876124
7	60000	143659	2296	329.841064
8	80000	145371	2142	311.384682
9	100000	144434	1697	245.104498
10	120000	142828	1664	237.665792
11	140000	143796	2070	297.65772
12	160000	144781	2437	352.831297
13	180000	144428	2409	347.927052
14	200000	144618	2125	307.31325
15	220000	143993	1505	216.709465
16	240000	142800	1861	265.7508
17	260000	144518	2605	376.46939
18	280000	146425	2267	331.945475
19	300000	144618	1794	259.444692
20	320000	142050	2004	284.6682
21	340000	143875	2043	293.936625
22	360000	145987	2080	303.65296
23	380000	143987	2312	332.897944
24	400000	142353	2012	286.414236
25	420000	144040	1250	180.05
26	440000	145075	1787	259.249025

Figure 10.72: CVS File of VBus_Power_Tracker_Info_From_Trace

10.14.4 Configuration Channel (CC) Power Tracker

The USB Type C cable supports two Configuration Channel (CC) pins: CC1 and CC2. The Voyager M310C/M310P/M4x has two Type C connections: one on the left of the front panel (Connector 1) and one to the right (Connector 2). See [Figure 10.73](#).

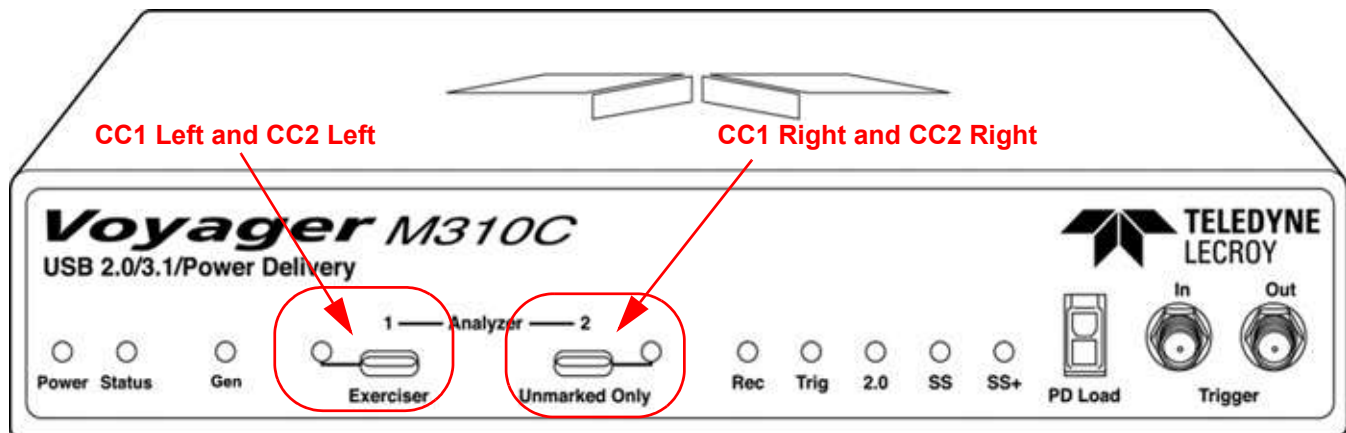


Figure 10.73: Voyager M310C: Front Panel View

When setting Recording Options, the Left and Right Analyzer connectors can be labeled and those labels will show up in the trace file. See [Figure 10.74](#) and [Figure 10.75 on page 627](#).

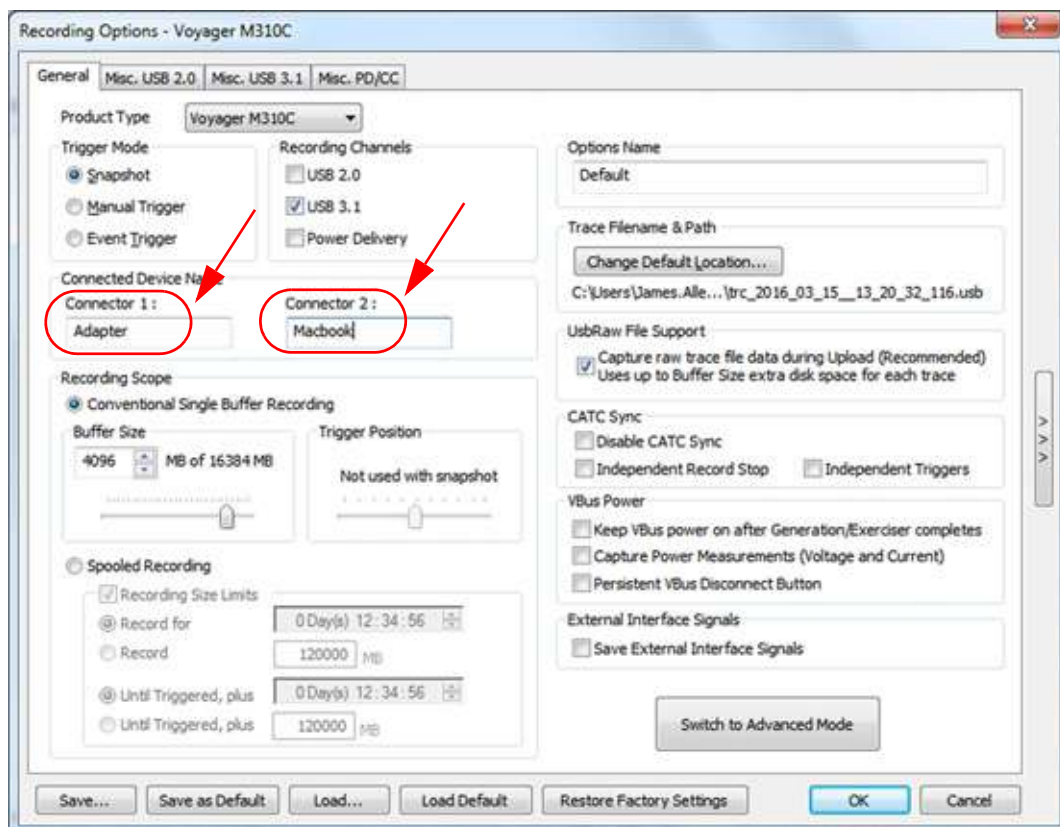


Figure 10.74: Voyager M310C: Recording Features for Left and Right Connectors

Configuration Channel (CC) Pins

Voyager also provides the voltages of the Configuration Channel (CC) pins in a separate window (CC Power Tracker View). Left “Adapter” is for Connector 1 (CC1L, CC2L) and Right “MacBook” is for Connector 2 (CC1R, CC2R). See [Figure 10.75](#).

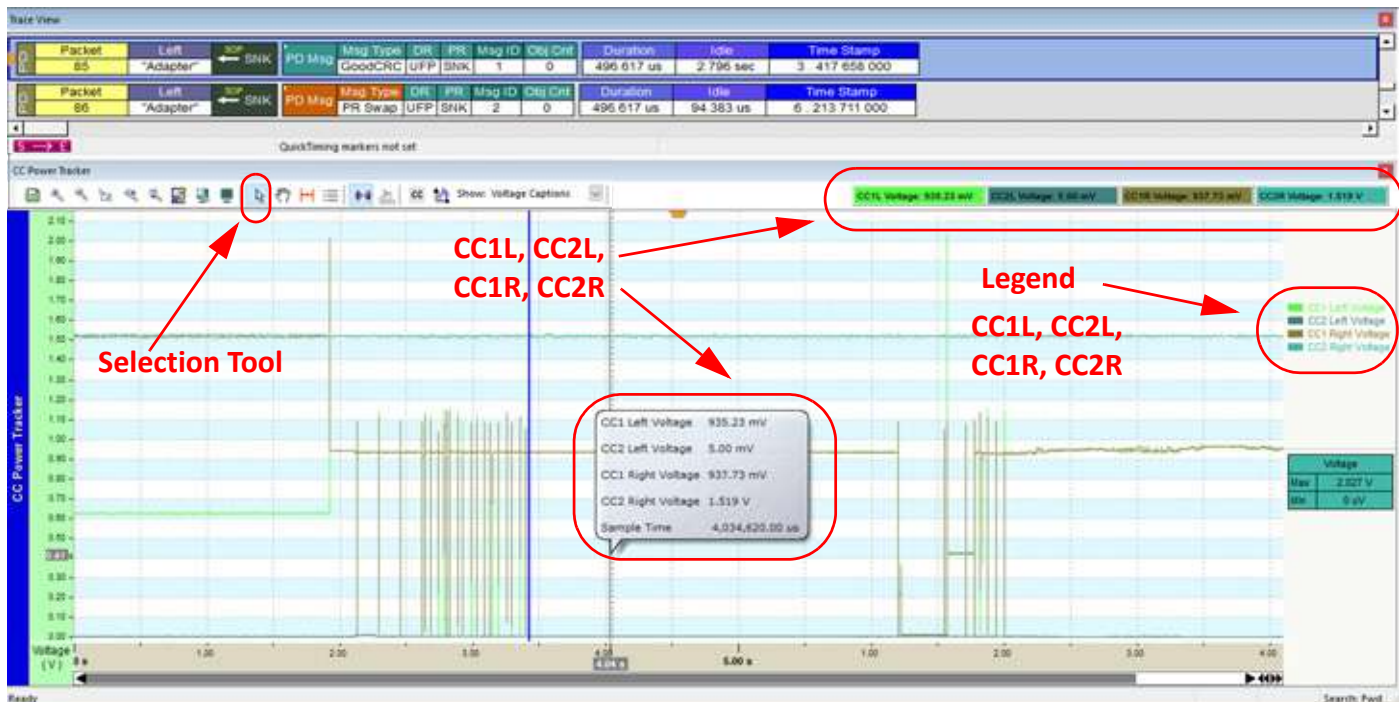


Figure 10.75: Configuration Channel (CC) Power Tracker Display: Packet 107

The Configuration Channel pins in a Type C connector can be used to determine a variety of functions:

- ☐ Attachment of USB Port Detection
- ☐ Cable Orientation Detection
- ☐ Role Detection
- ☐ Current Mode Advertisement and Detection (Default, Medium and High)

The analyzer monitors the CC1 and CC2 pins for pullup or pulldown resistances to determine when a USB Port has been attached, the orientation of the cable and the role detected. Rd means the Port is configured to sink current. Rp means that the Port is configured to source current. Ra means that the Port has been configured to high impedance. Open means that the cable is unattached.

Packet 107 displays the voltages on the CC pins are as follows:

- ☐ CC1 Left = 008.750 mV
- ☐ CC2 Left = 001.250 mV
- ☐ CC1 Right = 692.670 mV
- ☐ CC2 Right = 001.528 mV

The voltages values can be read in the colored tabs ([Figure 10.76 on page 628](#)) or in the gray window that pops up. See [Figure 10.77 on page 628](#).



Figure 10.76: Configuration Channel (CC) 1 and 2 Voltages Shown in Colored Tabs

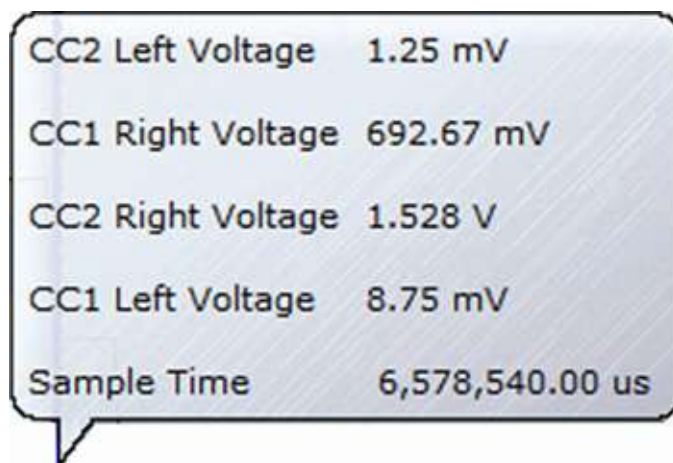


Figure 10.77: Configuration Channel Voltage Values in Gray Box

Packet 107 is highlighted below, which shows that the Left cable is attached and is a Source. The Right cable is attached and is a Sink. See [Figure 10.78](#).



Figure 10.78: Packet Information from Trace View

Packet 000 through Packet 003 show the stages the CC1 and CC2 pins on the left and right analyzer connectors go through as the unit powers up. See [Figure 10.79](#).

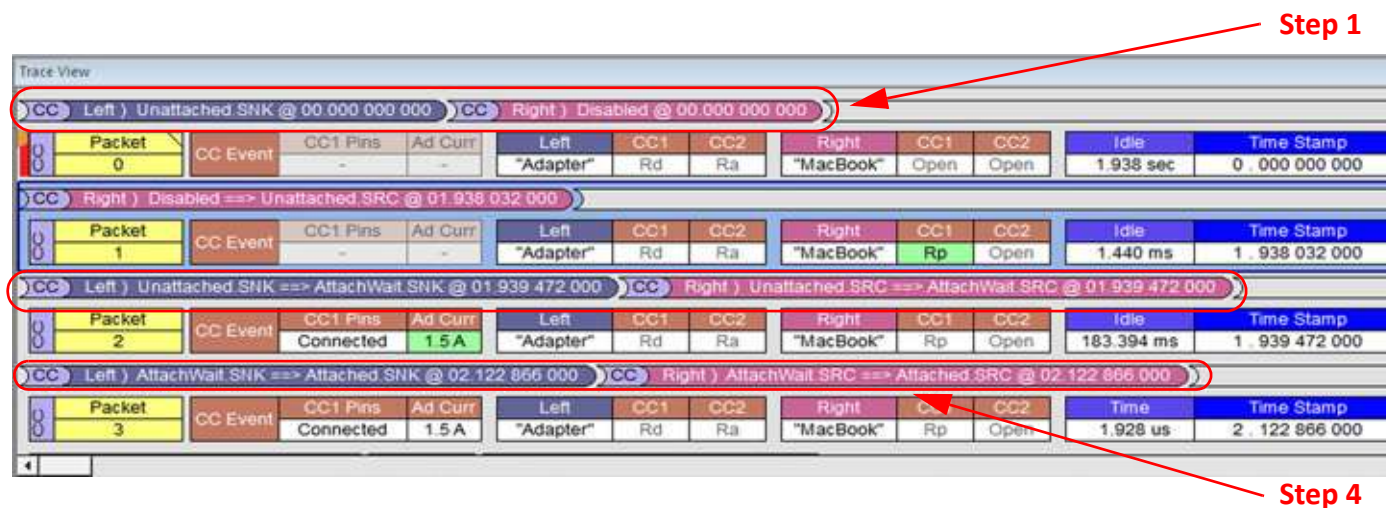


Figure 10.79: Configuration Channel Information as Units Power Up

Both units start out Unattached/Disabled in Packet 000 and by Packet 003 the left unit (labeled “Adapter”) is Attached as a current Sink and the right unit (labeled “MacBook”) is Attached as a source.

CC Icon and Voltage Captions

In the CC Power Tracker View you can selectively turn-on or turn-off each of the voltages: CC1L,

CC1R, CC2L or CC2R by selecting the  icon in the toolbar and selecting or de-selecting the CC voltages you are interested in. In the example below only the CC1 Right voltage is shown in the display. See [Figure 10.80](#).

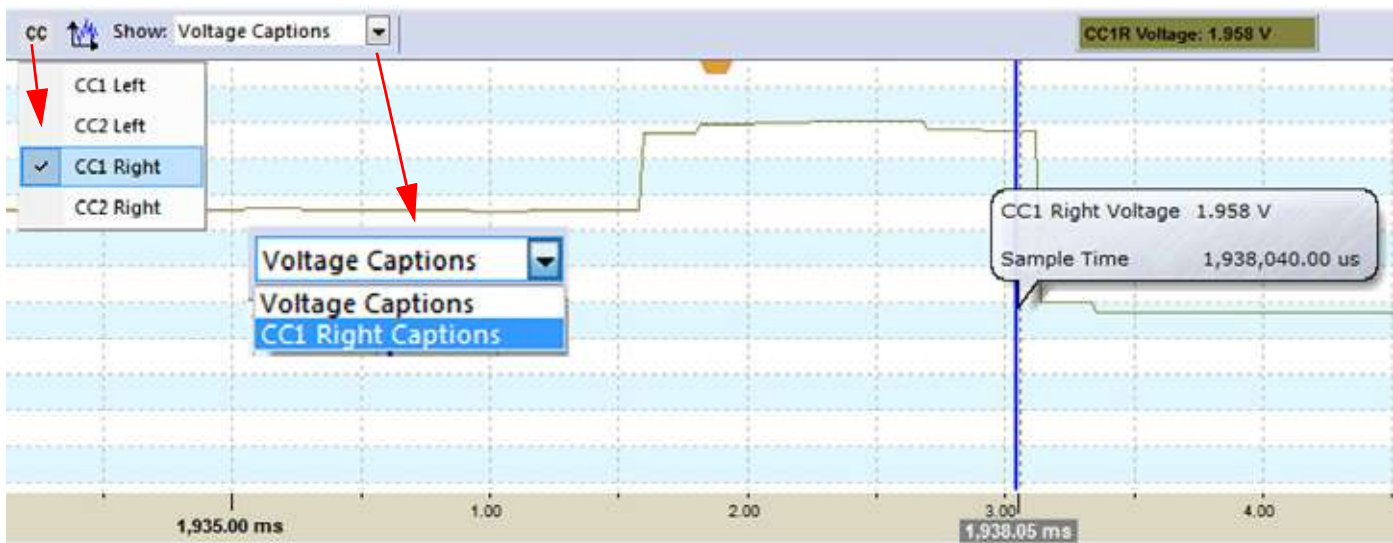


Figure 10.80: Selecting CC Voltages or to View

If you leave all the CC voltages on for display the CC Tracker View would be more congested. See [Figure 10.81](#).

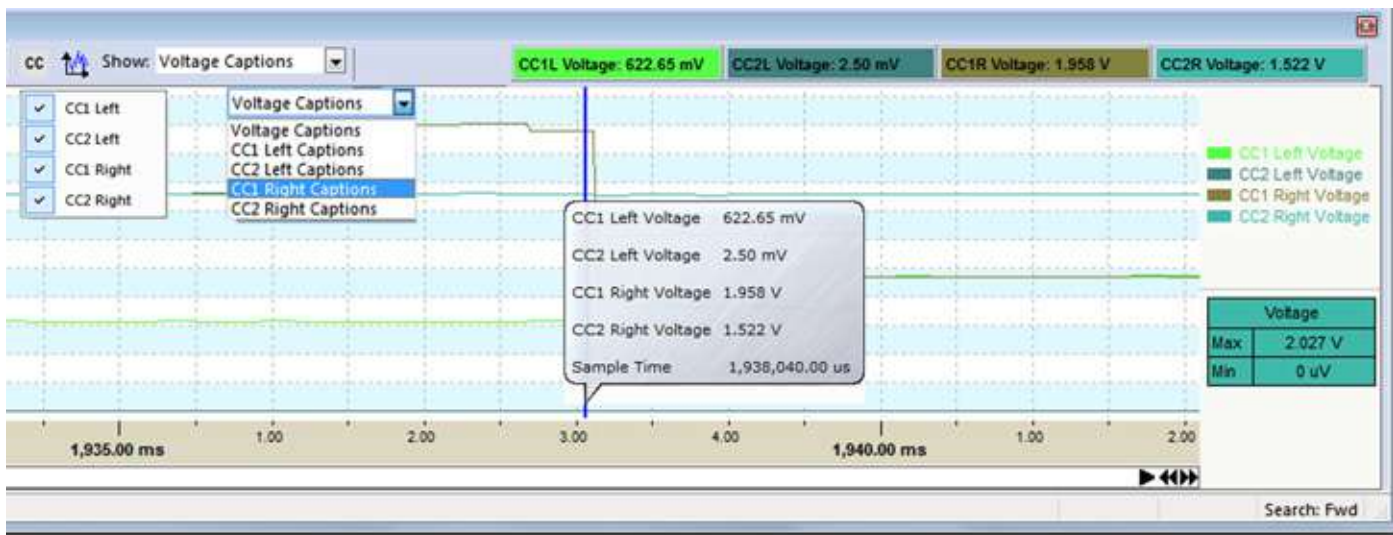


Figure 10.81: CC Tracker: All Options Shown

CC Power Tracker Export to CSV File

If you select the CSV icon on the CC Power Tracker toolbar (see [Figure 10.70](#)).

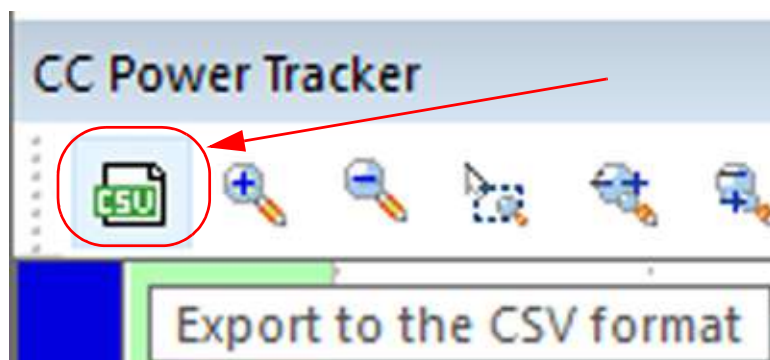


Figure 10.82: CC Power Tracker: CSV Icon

A dialog box will popup in the directory path where the USB Protocol Suite Software was installed:
C:\Users\Public\Documents\LeCroy\USB Protocol Suite\Examples\Power Delivery Traces.

You can choose an appropriate file title for the CSV file. In this case we have chosen:

CC_Power_Tracker_Info_from_Trace.csv

See [Figure 10.83](#).

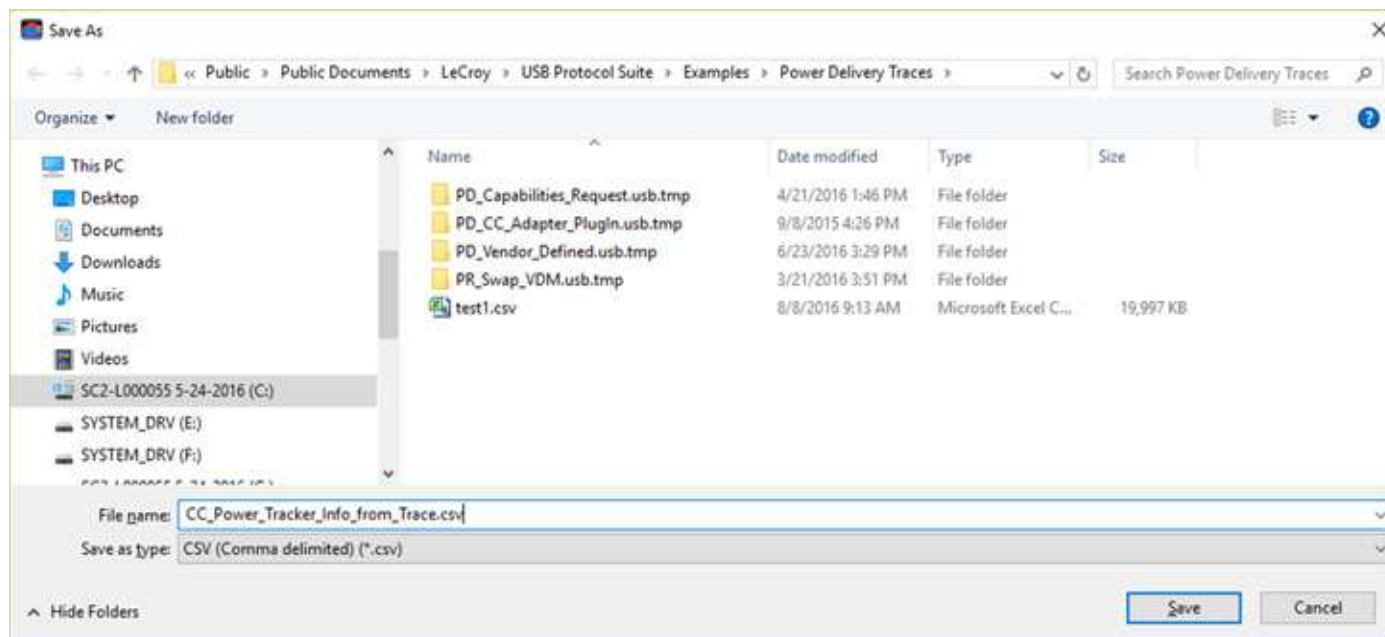
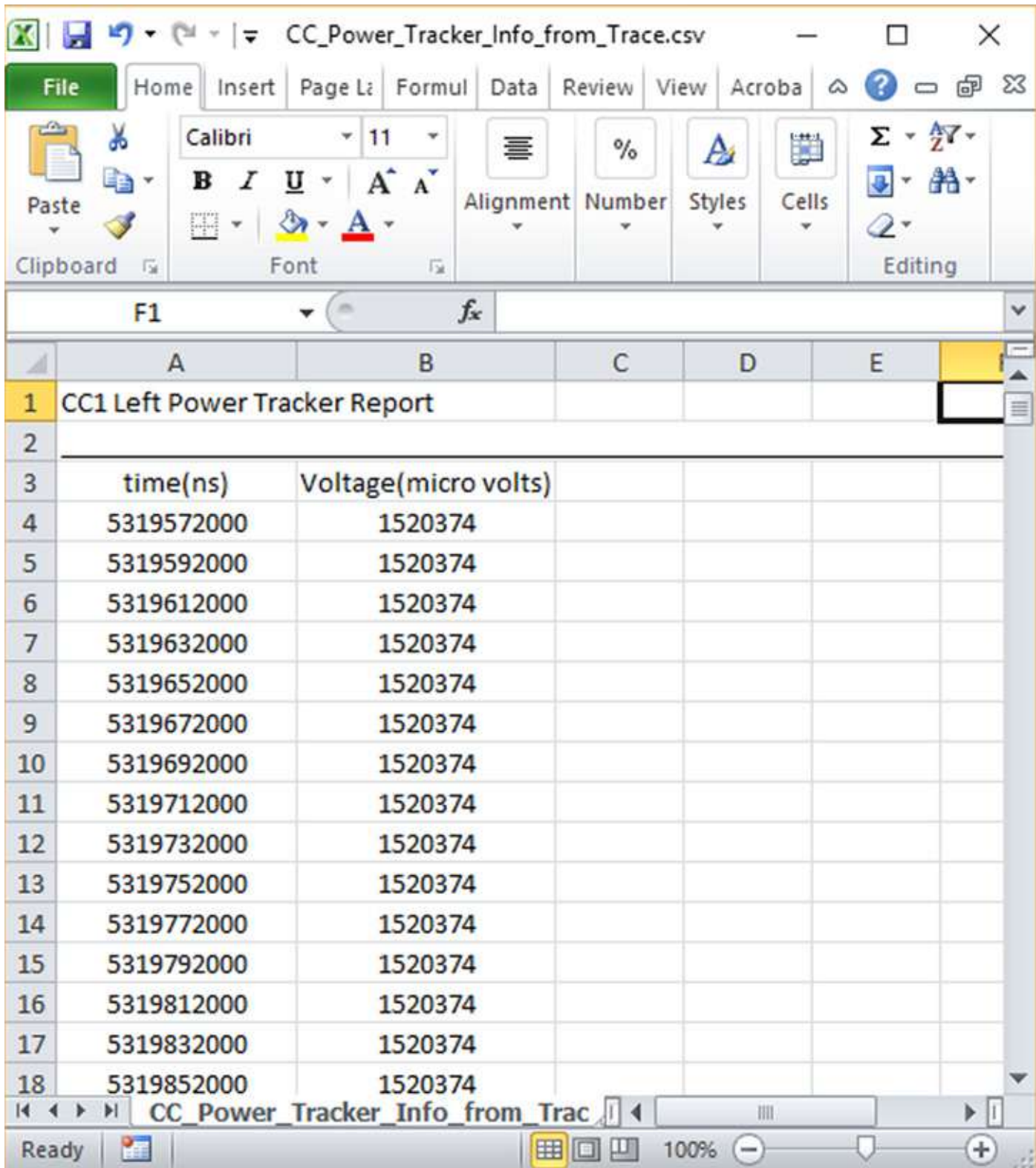


Figure 10.83: Popup Dialog Box with Path to Save CSV File

Select "Save" and the CSV file will be saved to the chosen directory.

You can then open the file with Excel. See [Figure 10.84 on page 631](#).



	A	B	C	D	E
1	CC1 Left Power Tracker Report				
2					
3	time(ns)	Voltage(micro volts)			
4	5319572000	1520374			
5	5319592000	1520374			
6	5319612000	1520374			
7	5319632000	1520374			
8	5319652000	1520374			
9	5319672000	1520374			
10	5319692000	1520374			
11	5319712000	1520374			
12	5319732000	1520374			
13	5319752000	1520374			
14	5319772000	1520374			
15	5319792000	1520374			
16	5319812000	1520374			
17	5319832000	1520374			
18	5319852000	1520374			

Figure 10.84: CVS File of CC_Power_Tracker_Info_From_Trace

10.15 Decoded Fields view

See [“Decoded Fields View” on page 555](#) for information.

10.16 Eye Diagram View

An eye diagram is a display in which a digital signal from a receiver is repetitively sampled and applied to the vertical input, while the data rate is used to trigger the horizontal sweep. It is a tool for the evaluation of the combined effects of channel noise and inter-symbol interference on the performance of a baseband pulse-transmission system. It is the synchronized superposition of all possible realizations of the signal of interest viewed within a particular signaling interval.

In Voyager M310P, The Power Delivery Compliance test includes capturing an Eye Diagram of a sequence of bits transmitted by the device under test. The only way to capture this Eye is to run the USB PD Compliance test, which requires a License Key. A trace which is captured as a result of an eye test will contain the data that is displayed below. See [Figure 10.85](#).

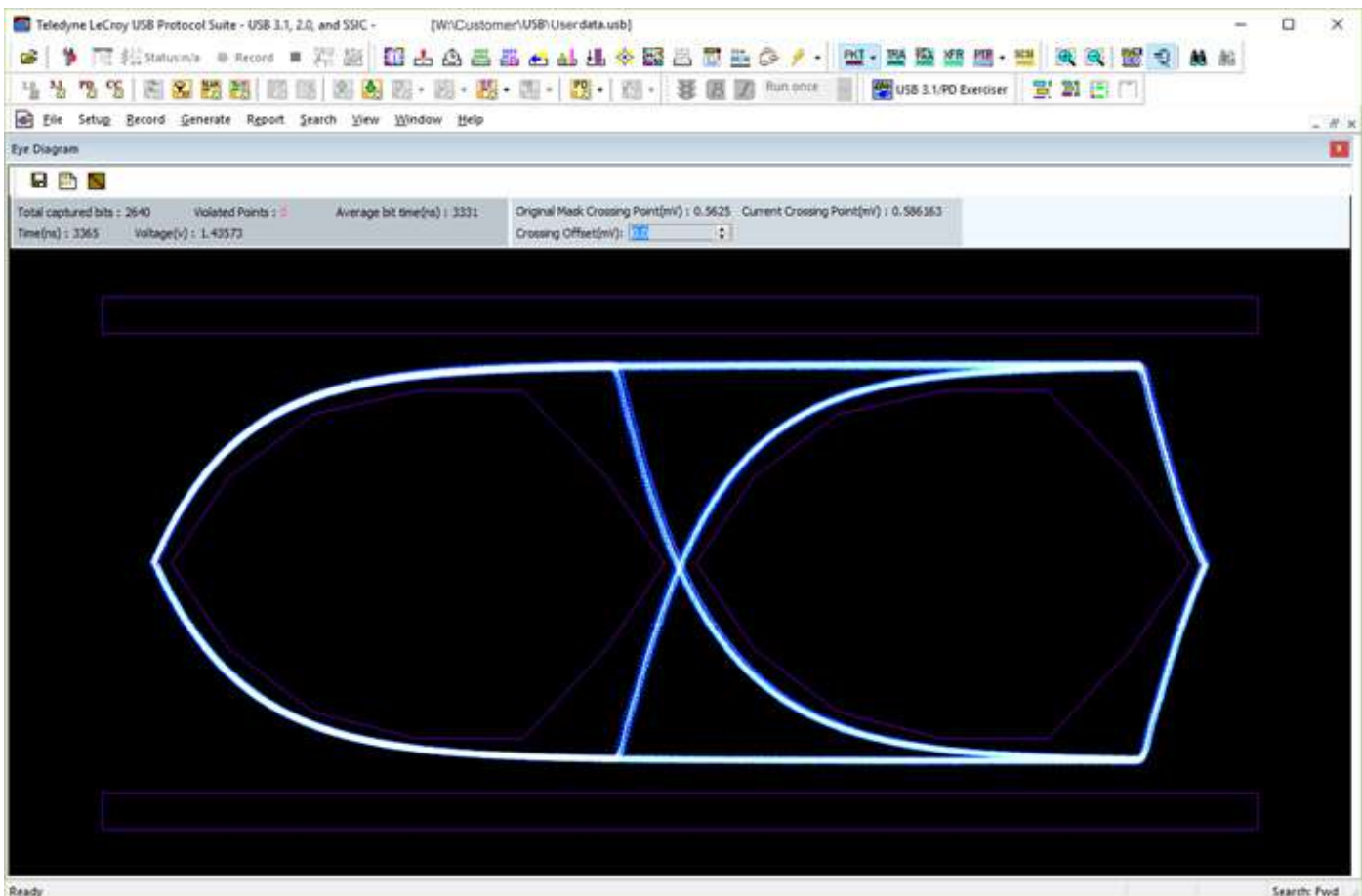


Figure 10.85: Eye Diagram View

Eye Diagram Information/Options

- ❑ Total captured Power Deliver Unit Intervals (UIs) or bits: 2640
(Number of bits sampled to produce the eye)
- ❑ Violated Points: 0
(Number of instances of samples which are found outside of the mask limits)
- ❑ Average bit time (ns): 3331
- ❑ Time (ns): 3365
(Time from the start of the UI to the User's Cursor)
- ❑ Voltage (V): 1.43573
(Voltage value at the User's Cursor)
- ❑ Original Mask Crossing Point (mV): 0.585163
(Value found during capture)
- ❑ Current Crossing Point (mV): 0.586163
(Value found after modifying Crossing Offset)
- ❑ Crossing Offset (mV): 0.0
User can change the crossing offset by changing this millivolt value.
 - Limits: +100 (mV) to -100 (mV)

Effect of Offset

If you change the Crossing Offset you can see the effect on Violated Points. Set the Crossing Offset to 100 mV and this will produce 1023870 violated points, which show up as purple. See [Figure 10.86](#).

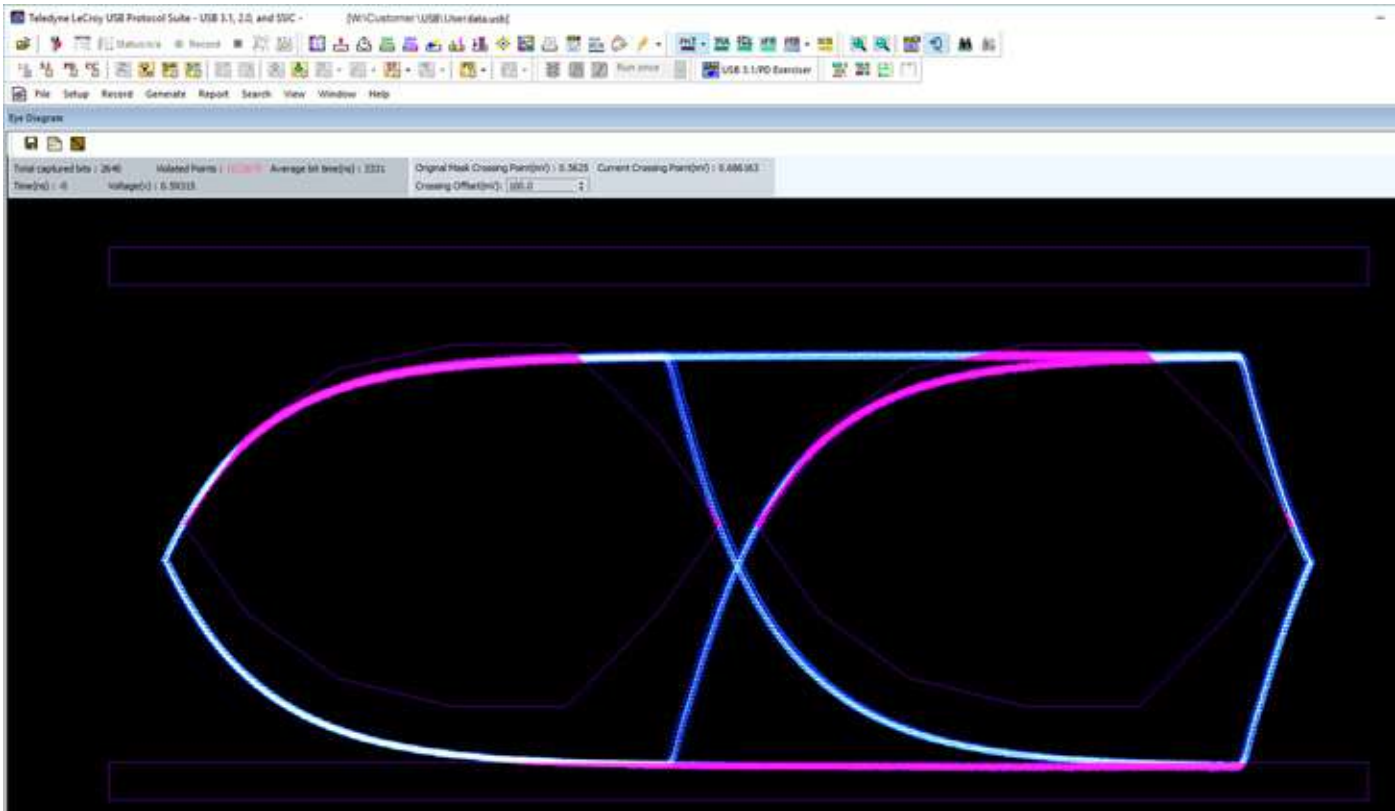


Figure 10.86: Eye Diagram: Effect of Offset on Violated Points

Eye Diagram Toolbar

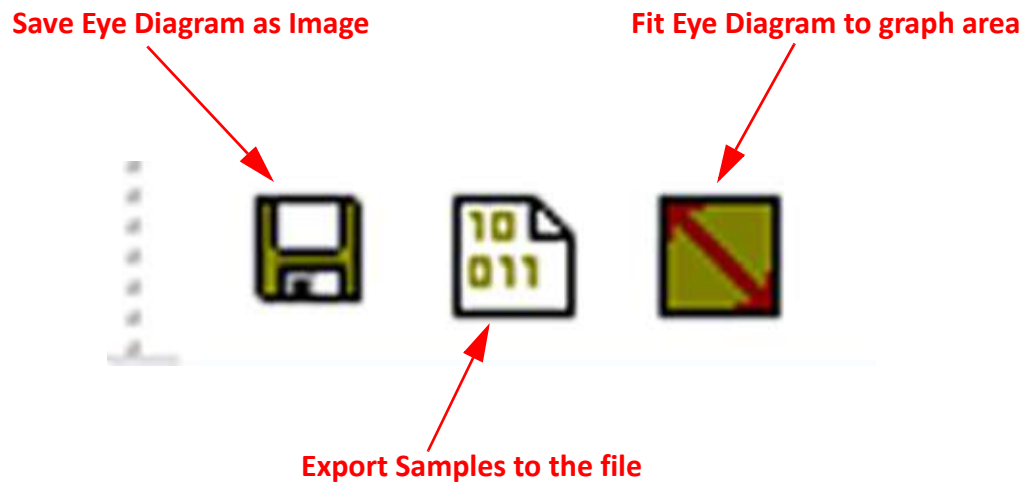


Figure 10.87: Eye Diagram Toolbar

Eye Diagram Toolbar Functions:

- ☐ Save Eye Diagram as Image: Opens Windows Explorer Folder to save image
- ☐ Export Samples to file: Opens Folder to save image as CSV file
- ☐ Fit Eye Diagram to graph area: Expands image to fill window

10.17 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 10.88 on page 635](#)), from which you choose, then run, one or several verification scripts:

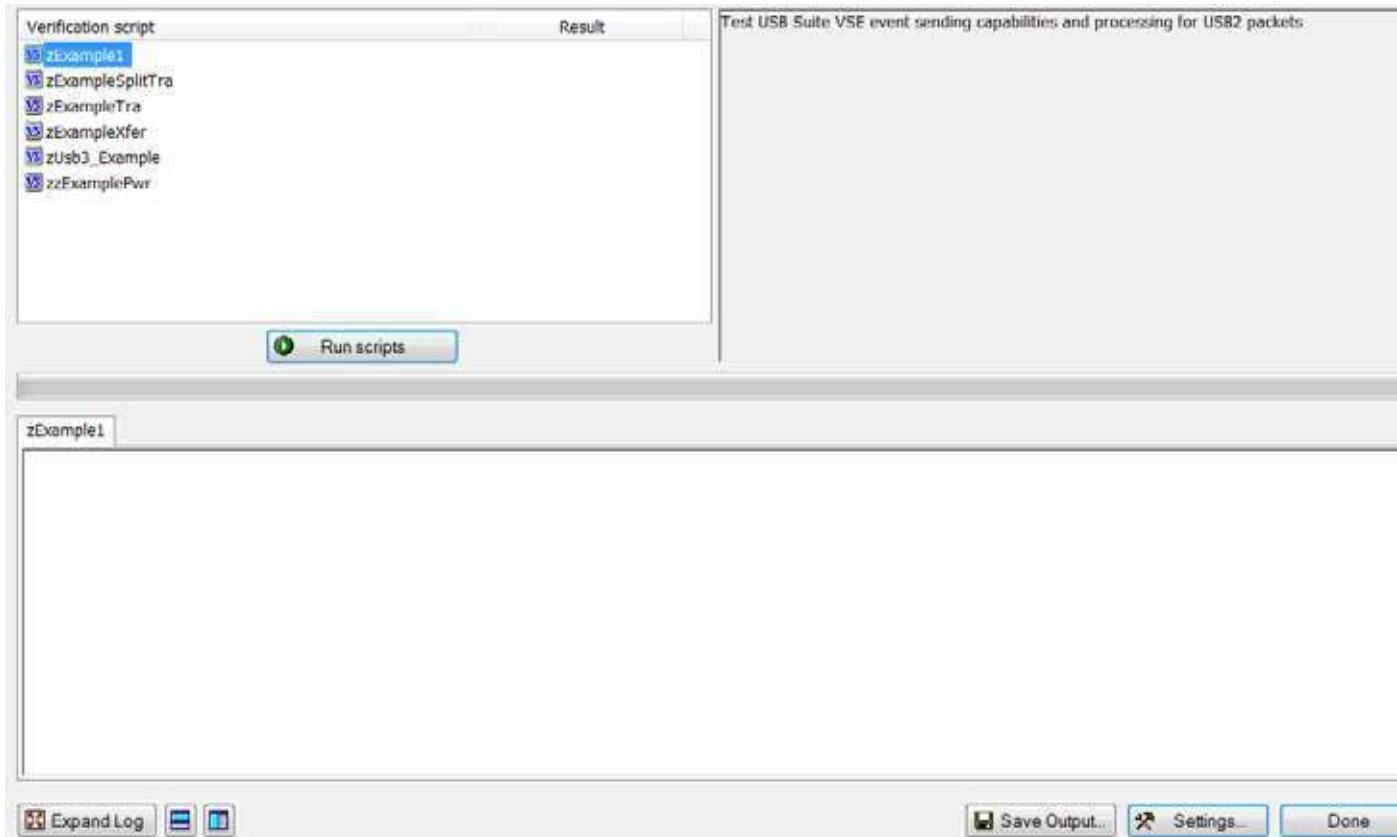


Figure 10.88: Run Verification Scripts Dialog

To expand log, click the Expand Log button  **Expand Log**.

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 10.89 on page 636](#)).

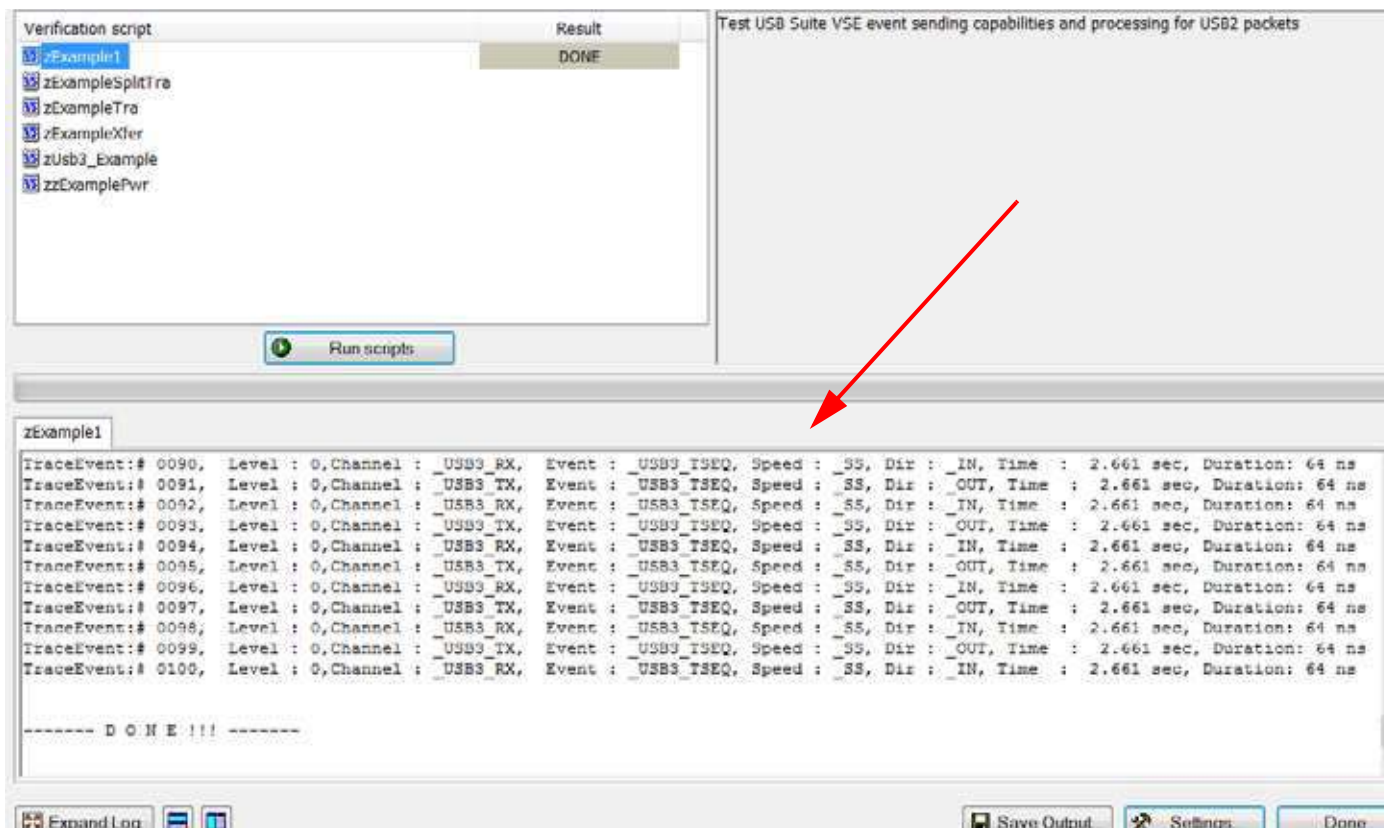


Figure 10.89: Verification Script Results

3. Right-clicking in the script list displays some additional operations over selected scripts.

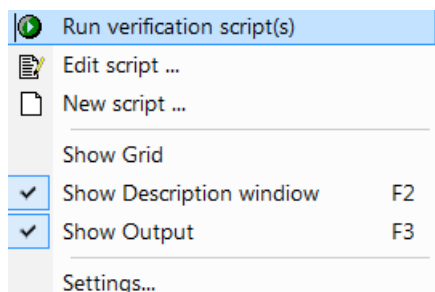


Figure 10.90: Right-click Options

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 10.91 on page 637](#).)

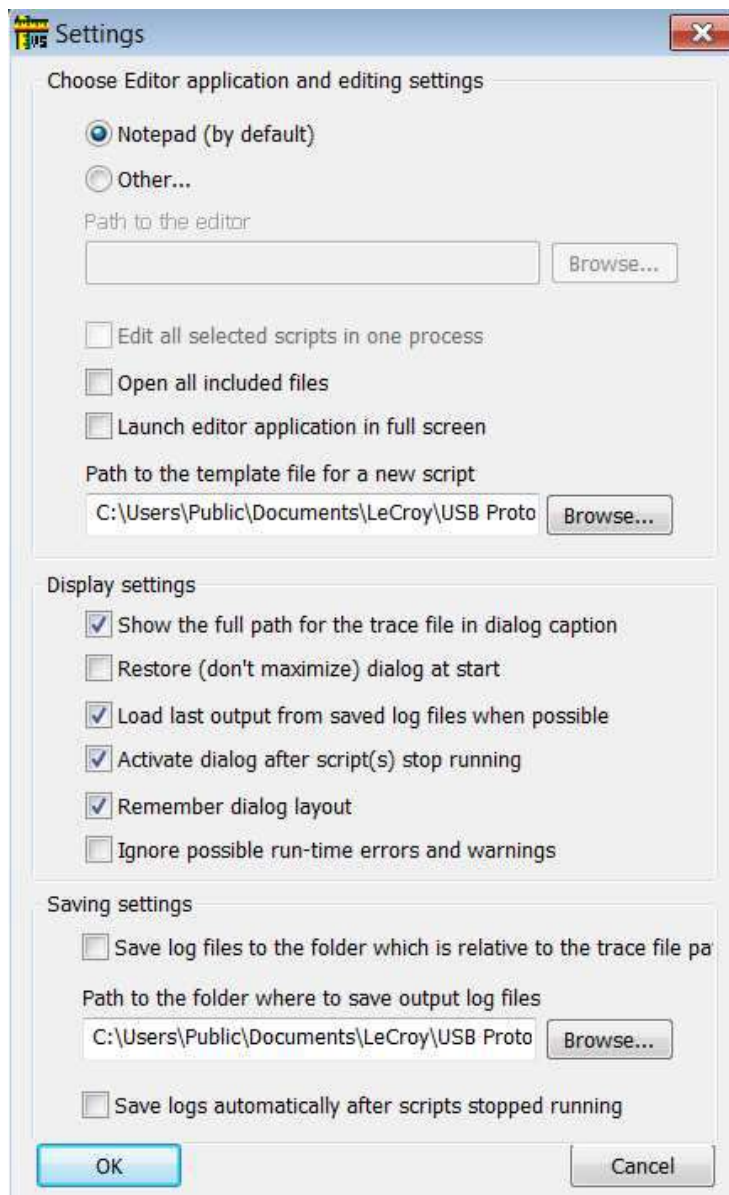


Figure 10.91: Settings Dialog

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.

10.18 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 10.92 on page 638](#).

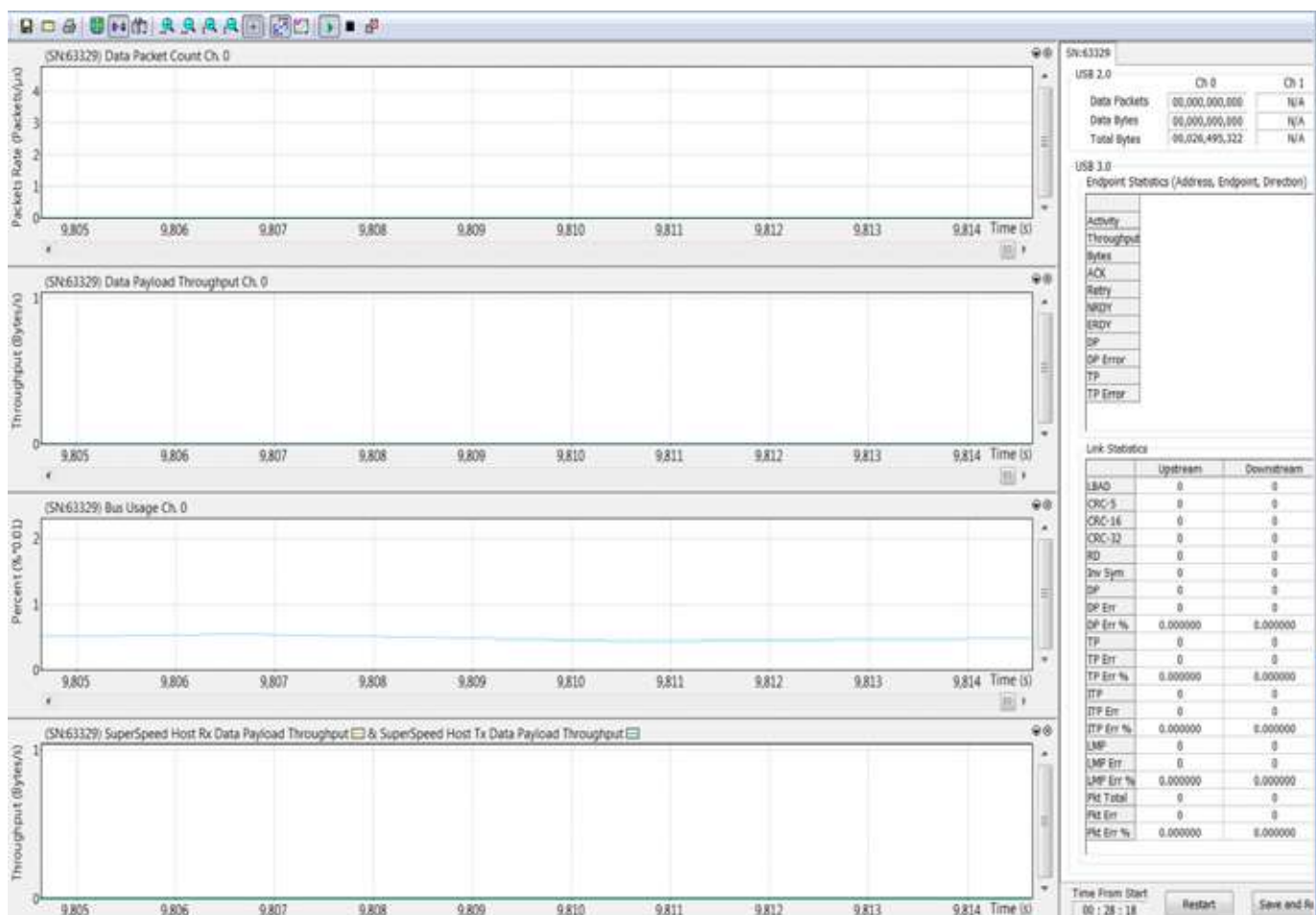


Figure 10.92: Real Time Statistics window

For USB 3.2, 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 567](#) 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  .

10.18.1 Real-Time Statistics Buttons

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

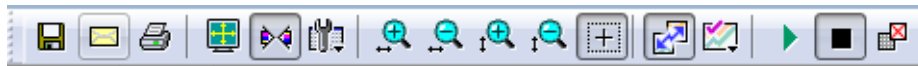


Figure 10.93: Real time Statistics Buttons

The buttons have the following functions:

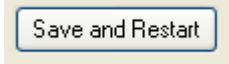
	Save As - Saves Real-Time graphs as bitmap files (*.bmp)		Vertical zoom in
	Email - Creates an email with a *.bmp file attachment of the graphs		Vertical zoom out
	Print		Click and Drag zoom - Click diagonally to select and zoom in on part of the graph
	Full Screen		
	Synchronize with other Views. Synchronizes the View windows so that a move in one window repositions the other. See “Link Tracker Buttons” on page 594 .		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.

10.18.2 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:

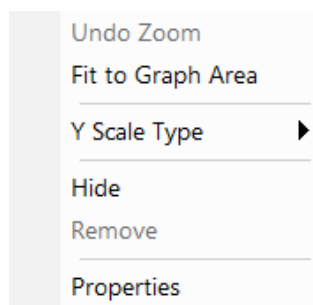


Figure 10.94: Real-Time Statistical Monitor Pop-up Menu

- ☐ **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.

10.18.3 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.

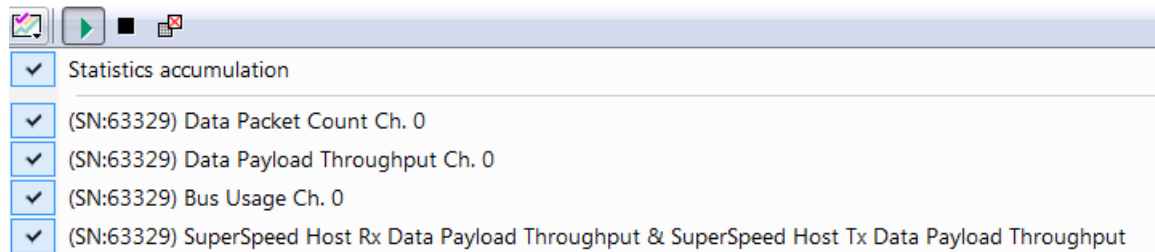


Figure 10.95: Graph Areas Menu Options

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 3.2, the Real-Time Statistics window can display a SuperSpeed graph of real-time link activity.

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 its 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 3.2, see [“Traffic Generation USB 3.2/USB4/PD Exerciser” on page 683](#).

11.1 Connecting to Voyager 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 M3i according to the following diagram (see [Figure 11.1 on page 644](#)).

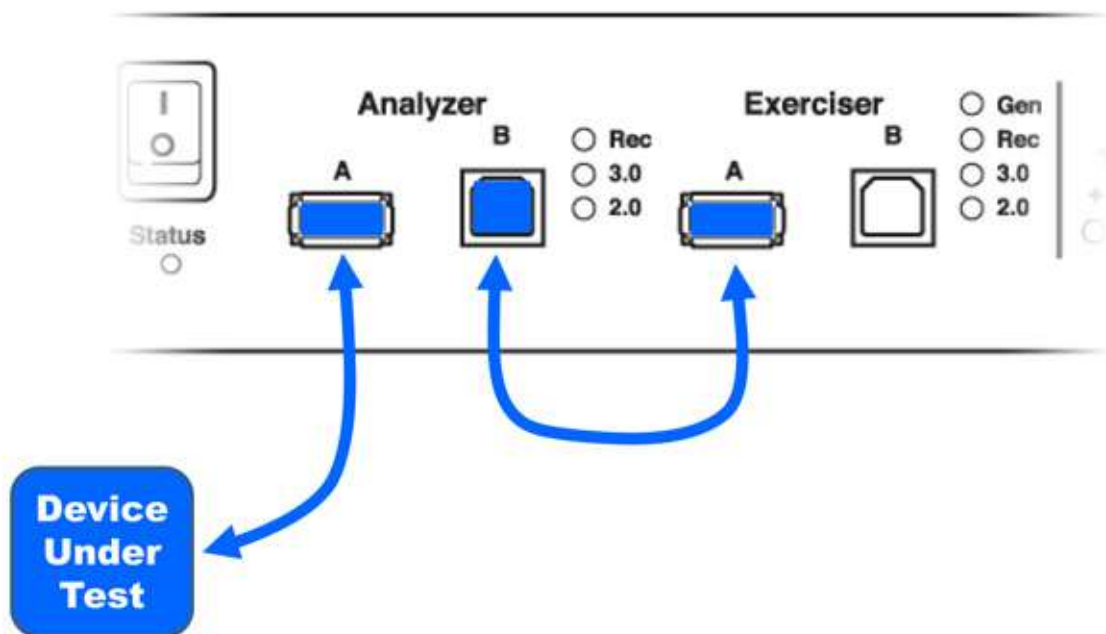


Figure 11.1: Connections to the Voyager M3i.

Hi/Full/Low Speed Device Emulation

For Device Emulation Hi, Full, or Low Speed, connect to the Voyager according to the following diagram.

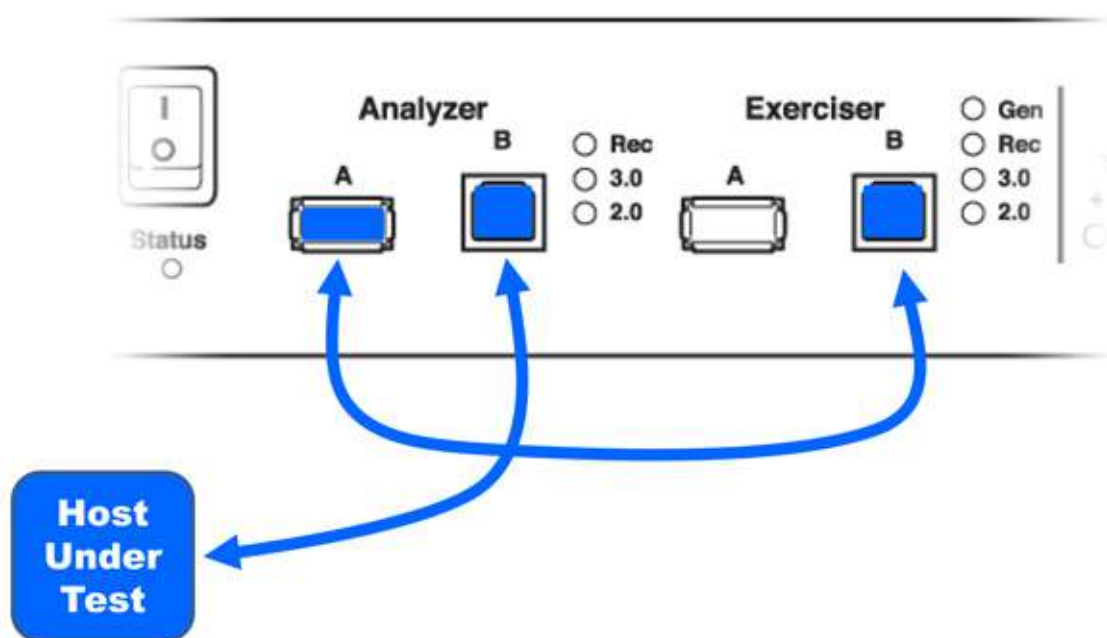


Figure 11.2: Connections to the Voyager M3i.

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 644](#)).

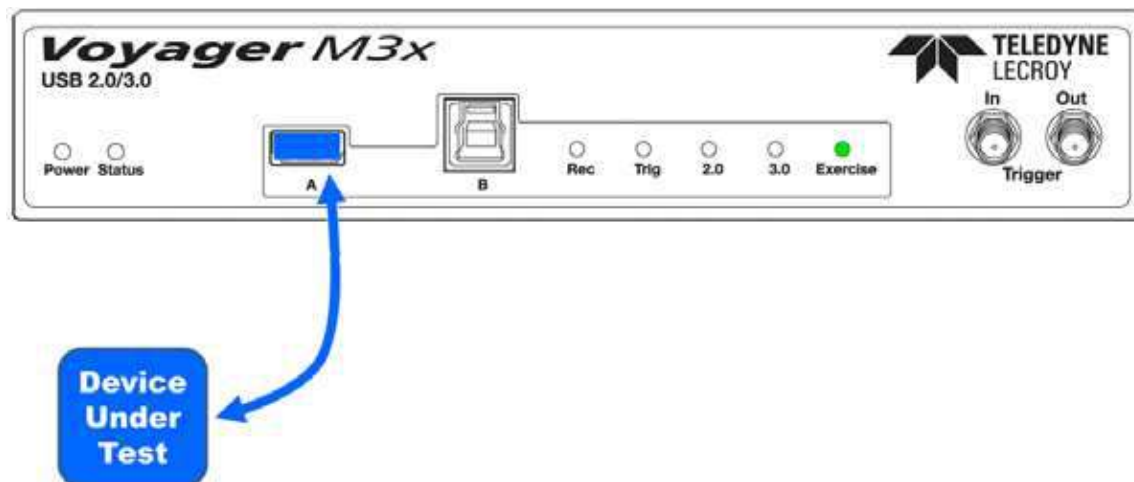


Figure 11.3: Connections to the Voyager M3x.

Hi/Full/Low Speed Device Emulation

For Device Emulation Hi, Full, or Low Speed, connect to the Voyager according to the following diagram.

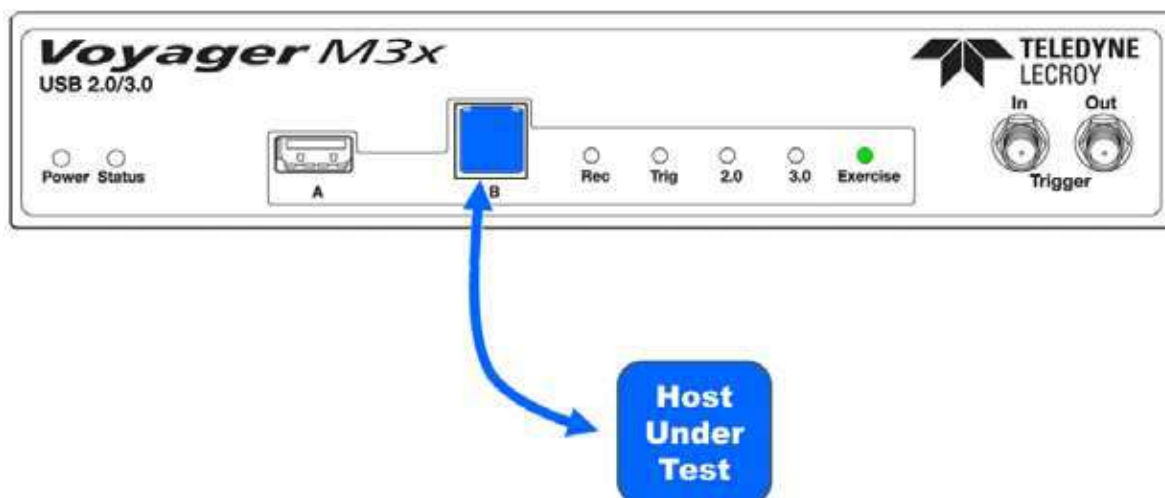


Figure 11.4: Connections to the Voyager M3x.

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 644](#)).

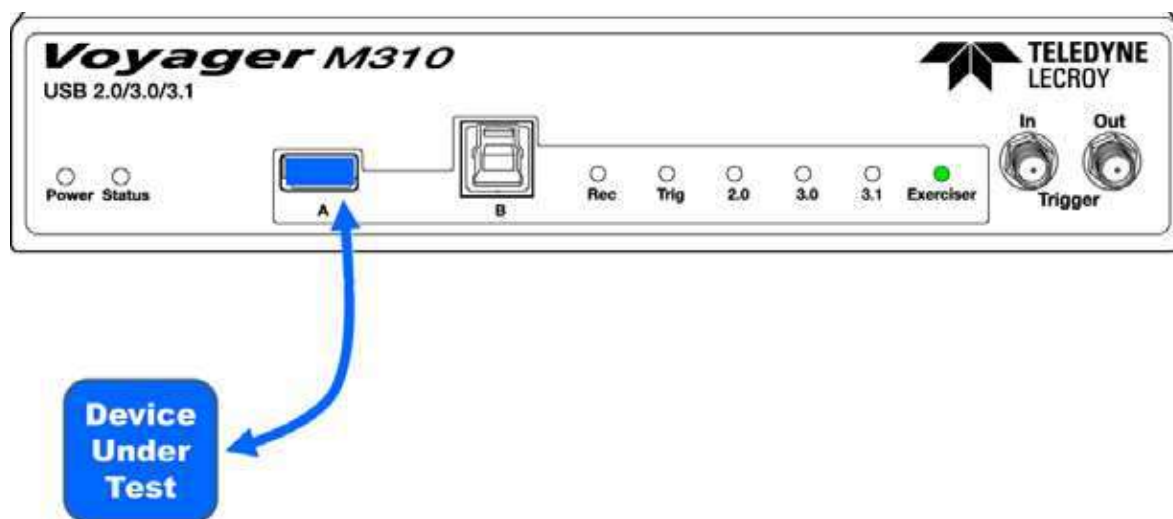


Figure 11.5: Connections to the Voyager M310.

Hi/Full/Low Speed Device Emulation

For Device Emulation Hi, Full, or Low Speed, connect to the Voyager according to the following diagram.

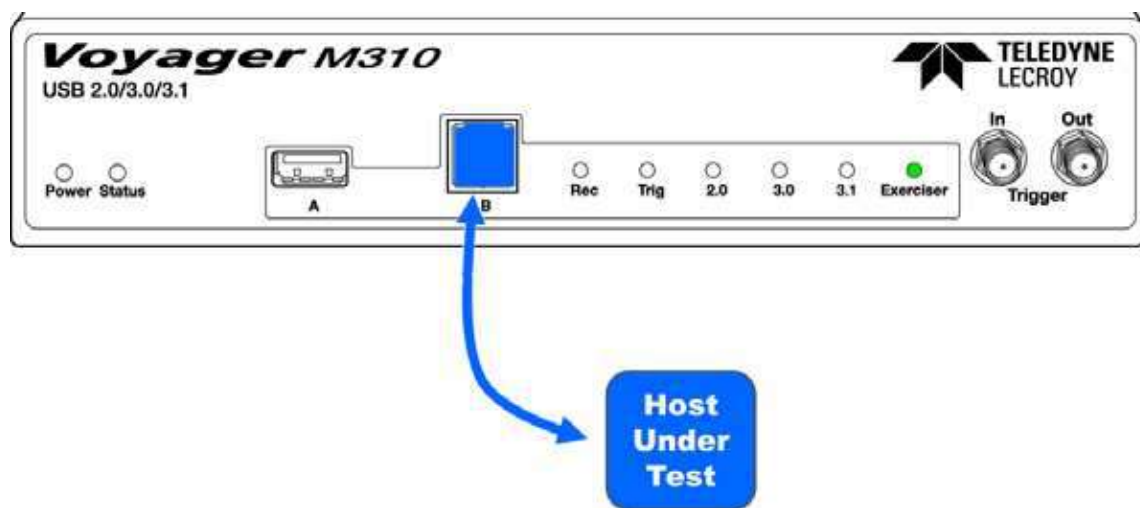


Figure 11.6: Connections to the Voyager M310.

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 644](#)).

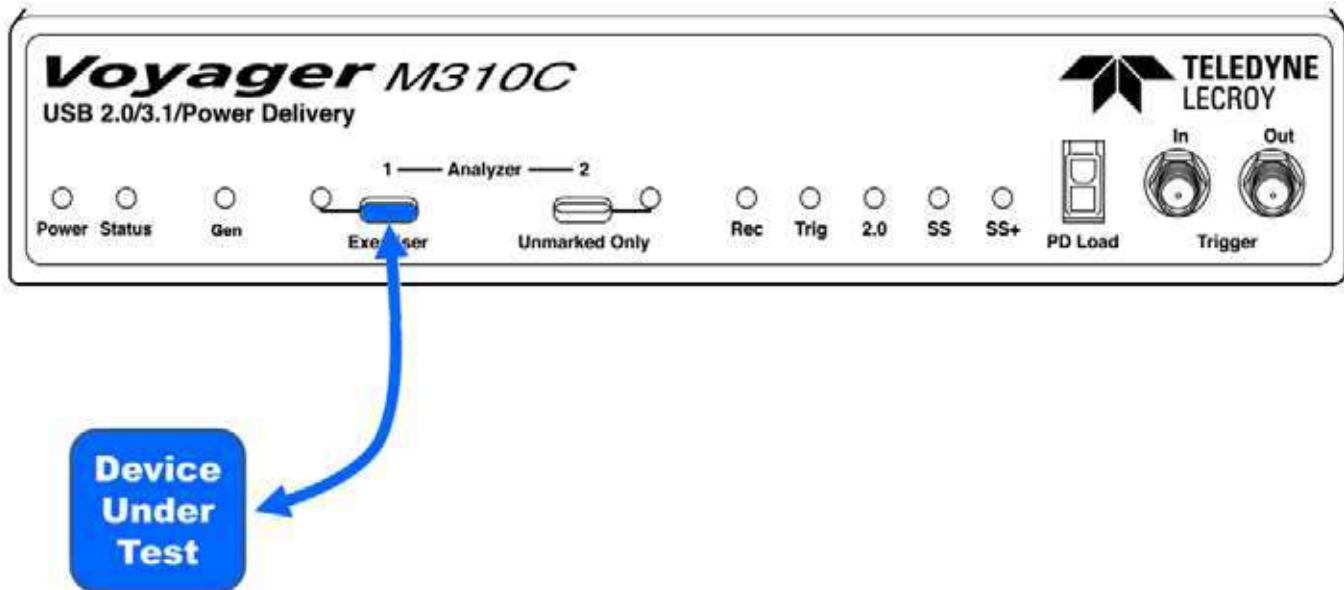


Figure 11.7: Connections to the Voyager M310C: Device Under Test.

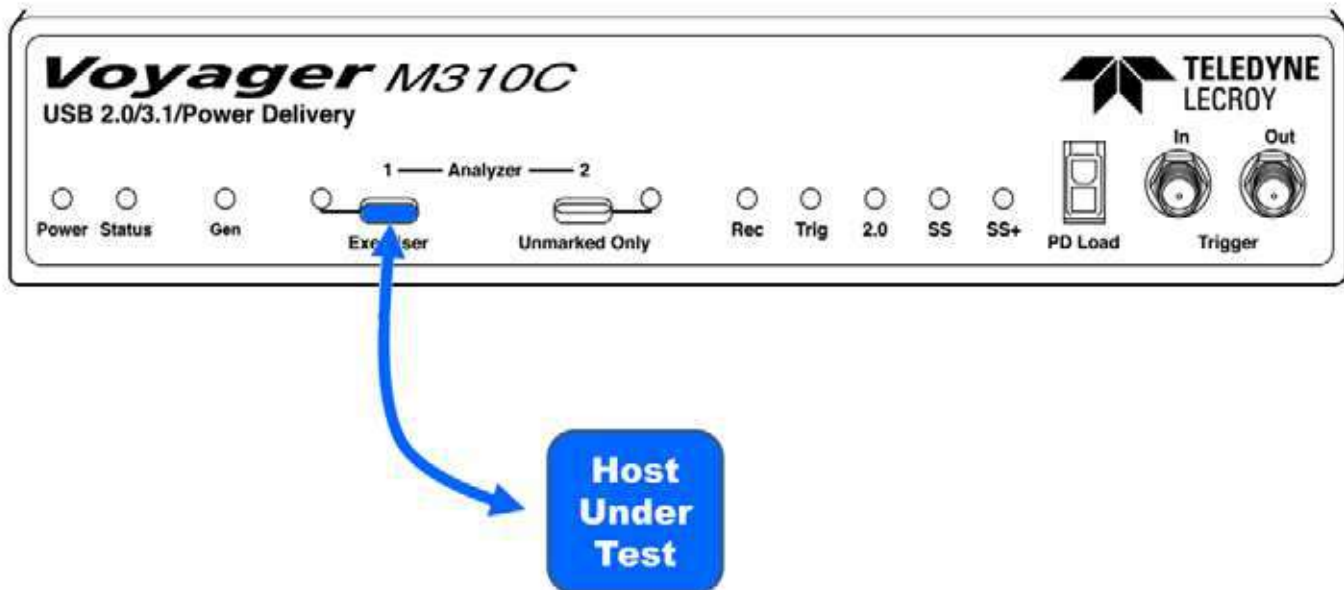


Figure 11.8: Connections to the Voyager M310C: Host Under Test.

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\enumeration\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=T0_EOF
frame=auto idle=T0_EOF
frame=auto idle=T0_EOF
frame=auto idle=T0_EOF
frame=auto idle=T0_EOF
frame=auto idle=T0_EOF
frame=auto idle=T0_EOF
frame=auto idle=T0_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 658](#) 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 10, 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:

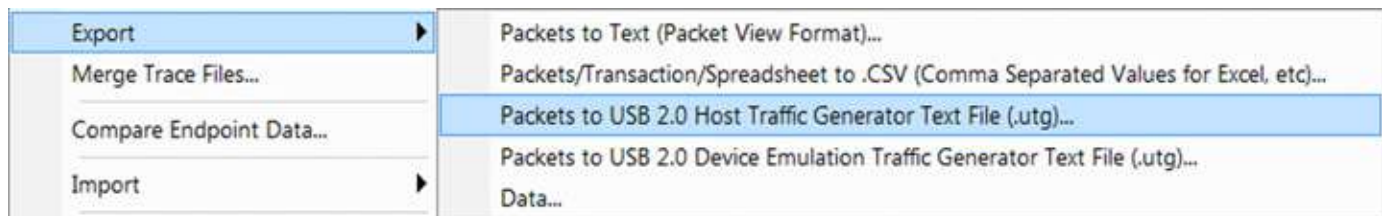


Figure 11.10: File Export Menu

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 649](#)).

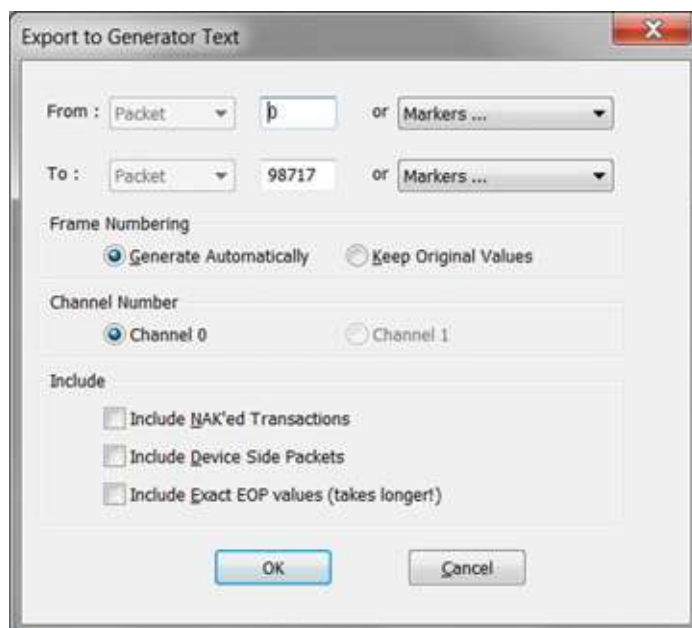


Figure 11.11: Export to Generator Text Window

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. Since there is limited memory for generating traffic, the export function will look to see if space is "wasted" on Empty Frames. These are USB Frames which contain no host or device traffic. If the source file had locations where lots of empty frames occurred, the software will inform you so they can be reduced by editing the .utg output file once export is complete. You would search for `empty_frames = nnn` and look for any location where where `nnn` is 102 or greater. In most cases, this value can be reduced to a very small value. See the documentation for the `empty_frames` key later in this chapter. See [Table 11.3 on page 674](#).

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 651](#)).

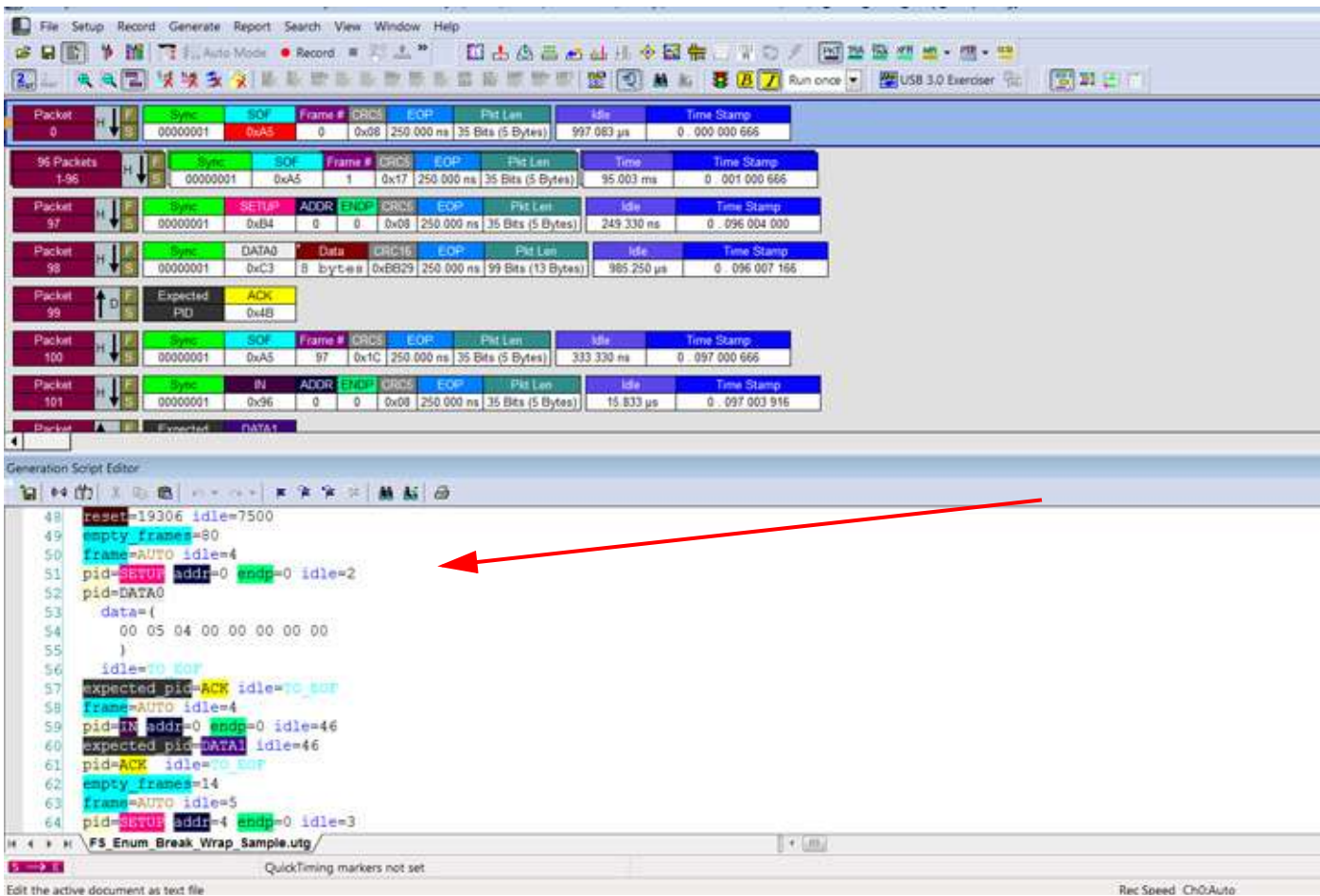


Figure 11.12: Script Editor

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:

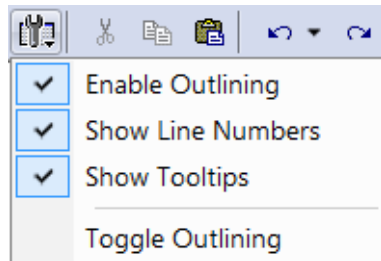


Figure 11.13: View Options Menu

- ☐ **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:

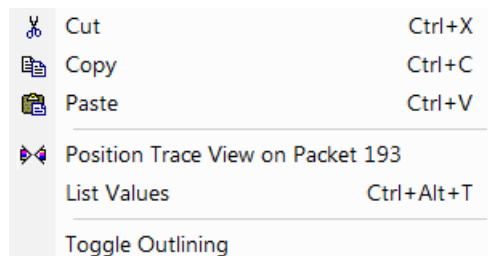


Figure 11.14: Pop-up Menu

- ☐ 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.

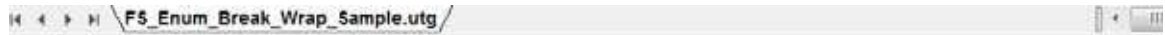


Figure 11.15: File Tabs

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 655](#)):

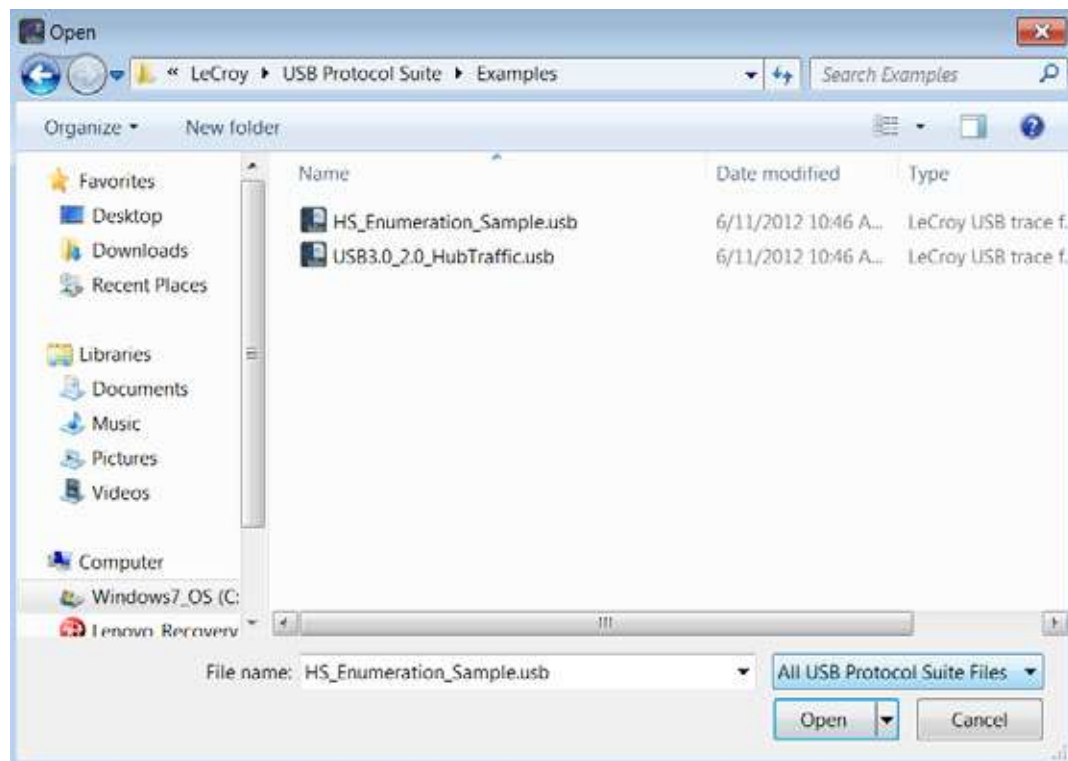


Figure 11.16: Open Dialog

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 656.](#))

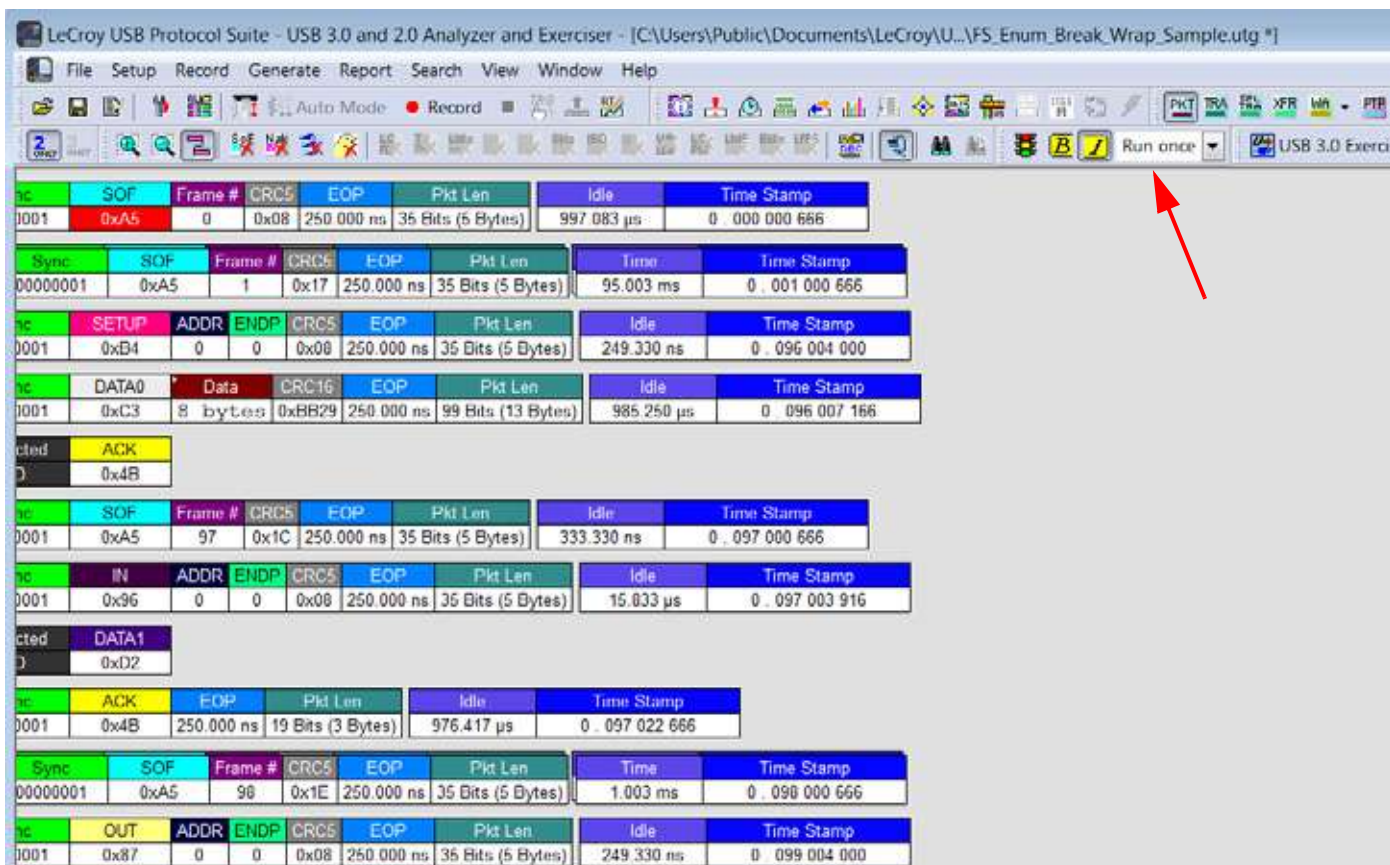


Figure 11.17: Traffic Generation File

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

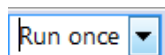


Figure 11.18: Repeat Drop-down Menu

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 SEO'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. This first parses the .utg file and downloads the resulting binary generation file to the Voyager. Since the memory is limited, it also checks to see if generator memory space is wasted by excessive numbers of empty frames, where no traffic occurs between Start-Of-Frame packets. If this is found, a dialog will notify you of it so you can edit the .utg file and fix it. See "empty_frames" key explanation later in this chapter. See [Table 11.3 on page 674](#).

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/M310/M310C design, some features previously available on USBTracer and Voyager 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/M310C, 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)

chirp = HERE      ; This is necessary for Hi Speed scenarios to establish
running at Hi Speed

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 11.4: 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 4. Usage: file_version=4
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 11.4: 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 11.4: 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 11.4: 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 11.4: 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 11.4: 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 11.4: 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 11.4: 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 11.4: 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. Additional Data is not required. In general, whatever number you put in here will show up as a "Bad PID", since all the nibble values are defined in the specification.
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 11.4: 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 11.4: Support Keys for Defining Fields within a packet. (Continued)

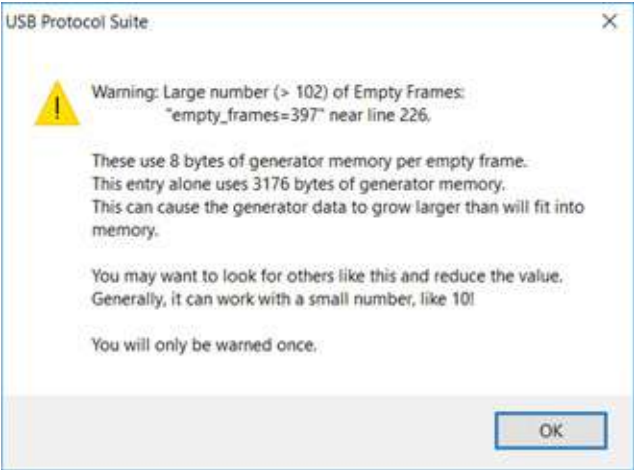
Key Code	Format	Description
empty_frame	integer	Host Generation Only. This key creates a sequence of start of frame packets with idle=TO_EOF values for the idle time. This results in N empty frames, where N is the integer value specified. If the branch speed is LOW, the frames contain only the keep-alive 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. Since generator memory space is limited, the software will warn you when too many empty frames might be generated. It will show a warning such as this:  The empty_frames large value may have occurred due to the original trace file having such behavior, which is due to the actual Host taking a long time to process data it receives from the device. The Voyager Trainer has no such processing time, and can therefore use a much smaller value (like 10!) in these locations. Usage: empty_frames=23; insert 23 empty frames here.

TABLE 11.4: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
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 11.4: 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 .

TABLE 11.4: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
chirp	HERE	Used to create a chirp sequence for a High Speed generation. This MUST be used to switch from the default Full Speed behavior to Hi Speed signalling! This should be placed prior to any packet traffic like Start of Frames, etc. Usage: chirp=HERE
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.

TABLE 11.4: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
crc	5 bits (0x0-0x1F) or 16 bits (0x0-0xFFFF)	Assign a value for the crc field. The default value is the correct crc calculated for the packet.
s	0 or 1	Host Generation Only. Assign a value for the s (High Speed SPLIT Start/Speed) field.
sc	0 or 1	Host Generation Only. Assign a value for the sc (High Speed SPLIT Start/Complete) field.
e	0 or 1	Host Generation Only. Assign a value for the e (High Speed SPLIT End) field.
et	0 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 <i>Link Power Management Specification</i> .
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.

TABLE 11.4: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
hi_eop	(AB CD) Hex	Used to generate a high speed EOP pattern. The bytes are in the order they come across the bus, and the bits within the bytes are in LSB to MSB order. Maximum number of bytes allowed is 13.
idle	positive integer or TO_EOP	Defines the length of idle after the current packet. Assign a positive integer or string to this key. The positive integer indicates the number of full-speed or low-speed bit times. The default value is around 4 bits for Classic speeds and around 150 bits for High speeds. When this keyword is assigned a string TO_EOF, USB Chief automatically calculates the amount of idle remaining in the frame. When handshaking with a device, you can use this keyword to add idle where you anticipate a packet being returned from the device. The idle= key is always associated with the proceeding packet or bus condition, so you should not put file control keys between the packet or bus condition statement and the idle= statement.
marker	string	Assign a string in quotation marks to be put in the marker for the defined packet.

TABLE 11.4: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
raw_data Supported in Hi Speed Mode only on Voyager M3i.	(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.)
raw_data_bits Supported in Hi Speed Mode only on Voyager M3i.	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 Supported in Hi Speed Mode only on Voyager M3i.	OFF ON	Assign the string OFF to disable bit stuffing within the current packet. The default value is ON.

TABLE 11.4: Support Keys for Defining Fields within a packet. (Continued)

Key Code	Format	Description
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		
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 USB 3.2/USB4/PD Exerciser

The USB 3.2 Exerciser allows you to generate USB 3.2 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 PD Exerciser is supported in Voyager M310C/M10P/M4x.

The USB4 Exerciser is supported in Voyager M4x.

Note: For traffic generation for USB 2.0, see [“Traffic Generation 2.0” on page 643](#).

12.1 Connecting to Voyager 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.

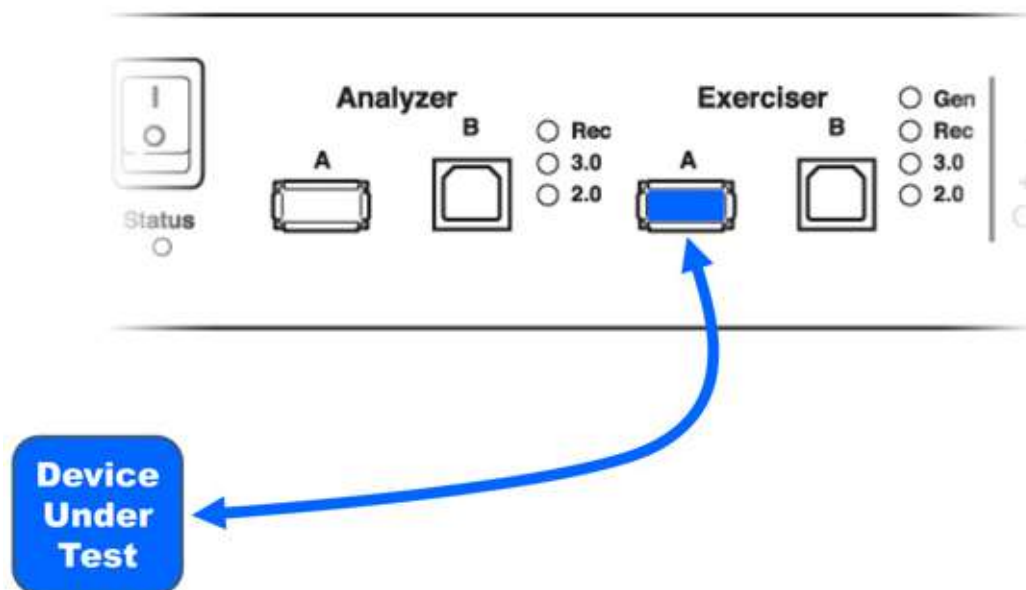


Figure 12.1: Connecting a Cable from Device under Test to Exerciser “A” Port.

12.1.2 Device Emulation

For Device Emulation, connect a cable from Host under Test to Exerciser “B” port.

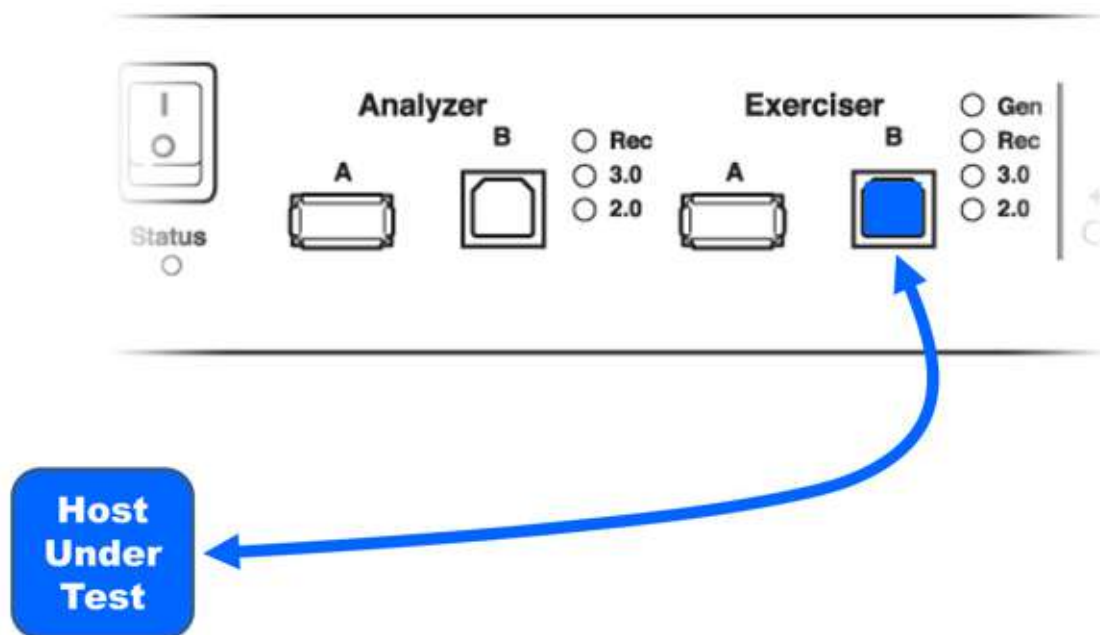


Figure 12.2: Connecting a Cable from Host under Test to Exerciser “B” Port.

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.

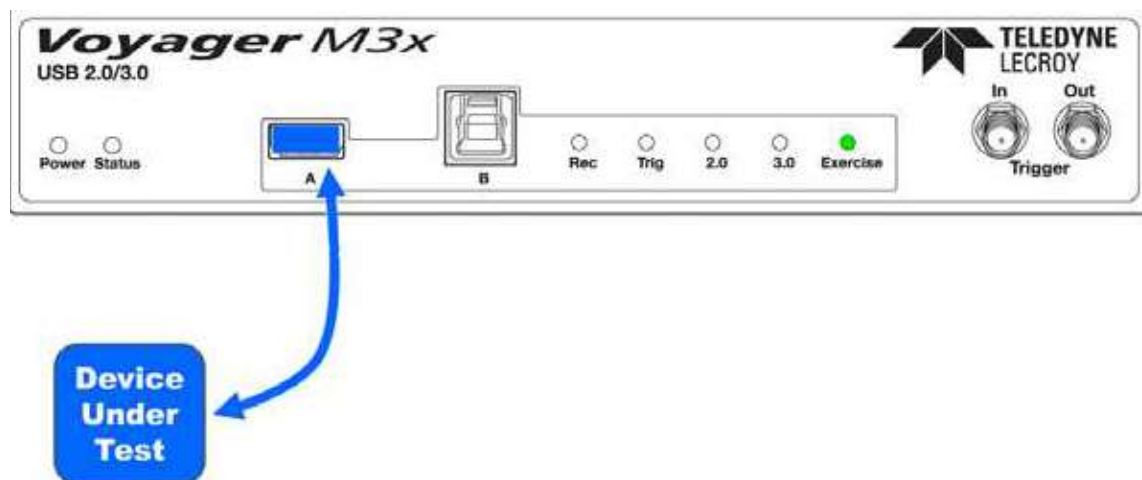


Figure 12.3: Connecting a Cable from Device under Test to “A” Port.

12.2.2 Device Emulation

For Device Emulation, connect a cable from Host under Test to “B” port.

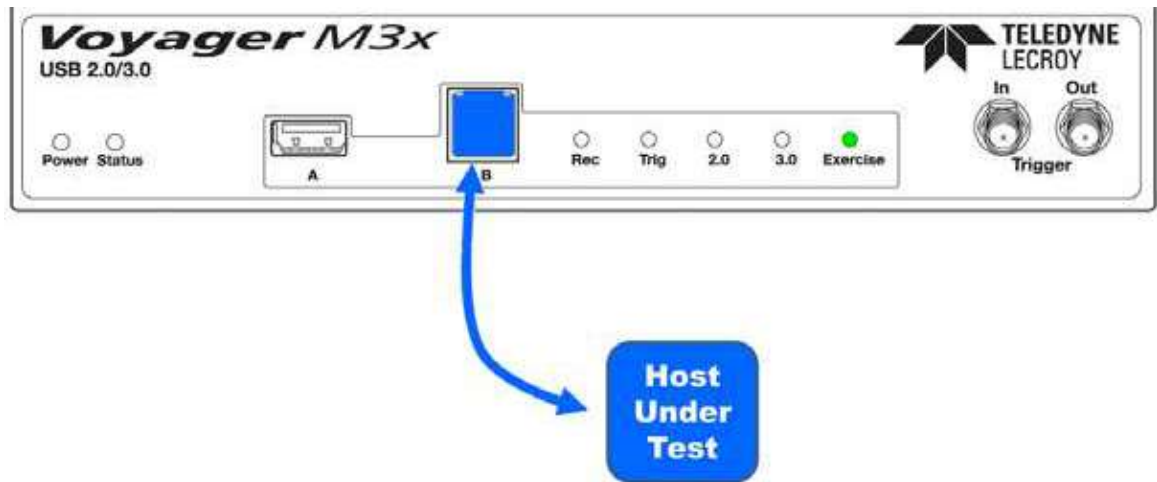


Figure 12.4: Connecting a Cable from Host under Test to “B” Port.

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.

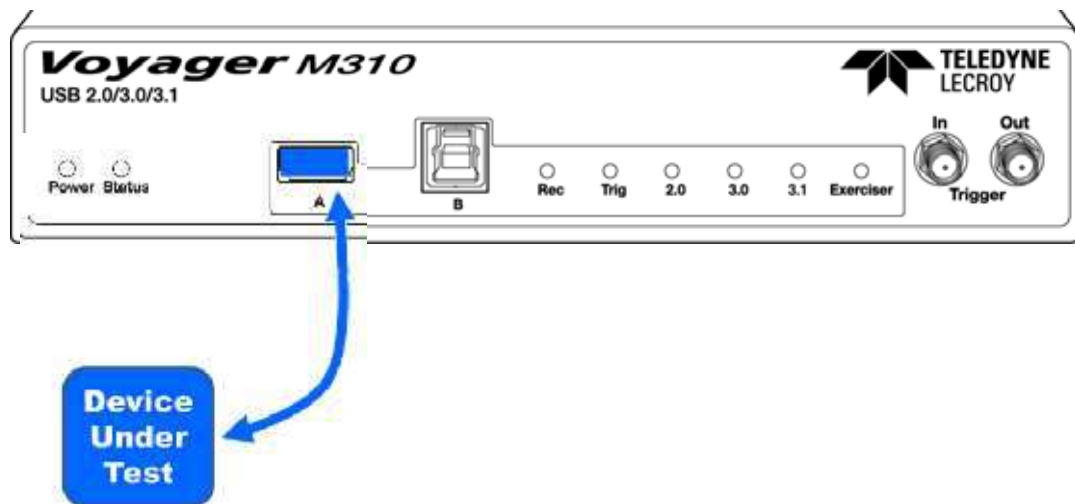


Figure 12.5: Connecting a Cable from Device under Test to Exerciser “A” Port.

12.3.2 Device Emulation

For Device Emulation, connect a cable from Host under Test to Exerciser “B” port.

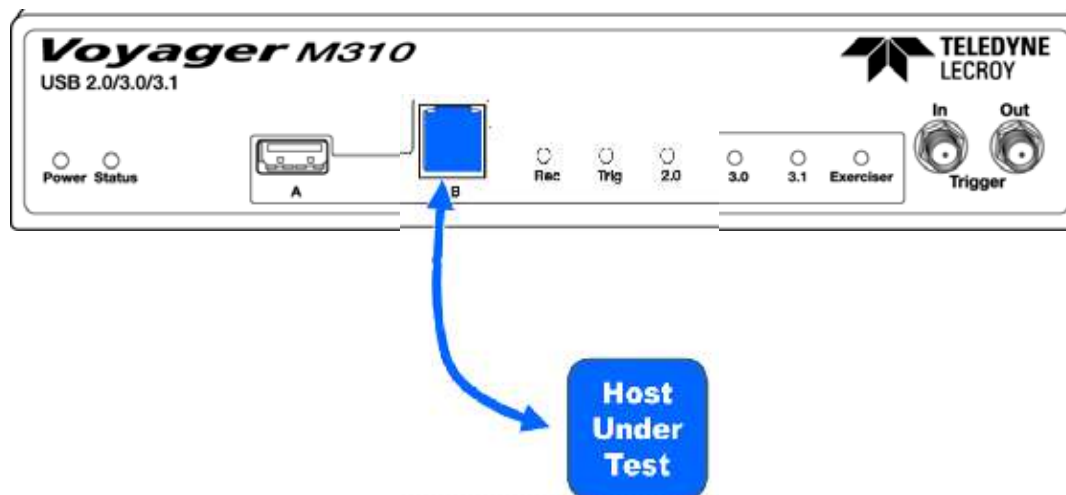


Figure 12.6: Connecting a Cable from Host under Test to Exerciser “B” Port.

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.

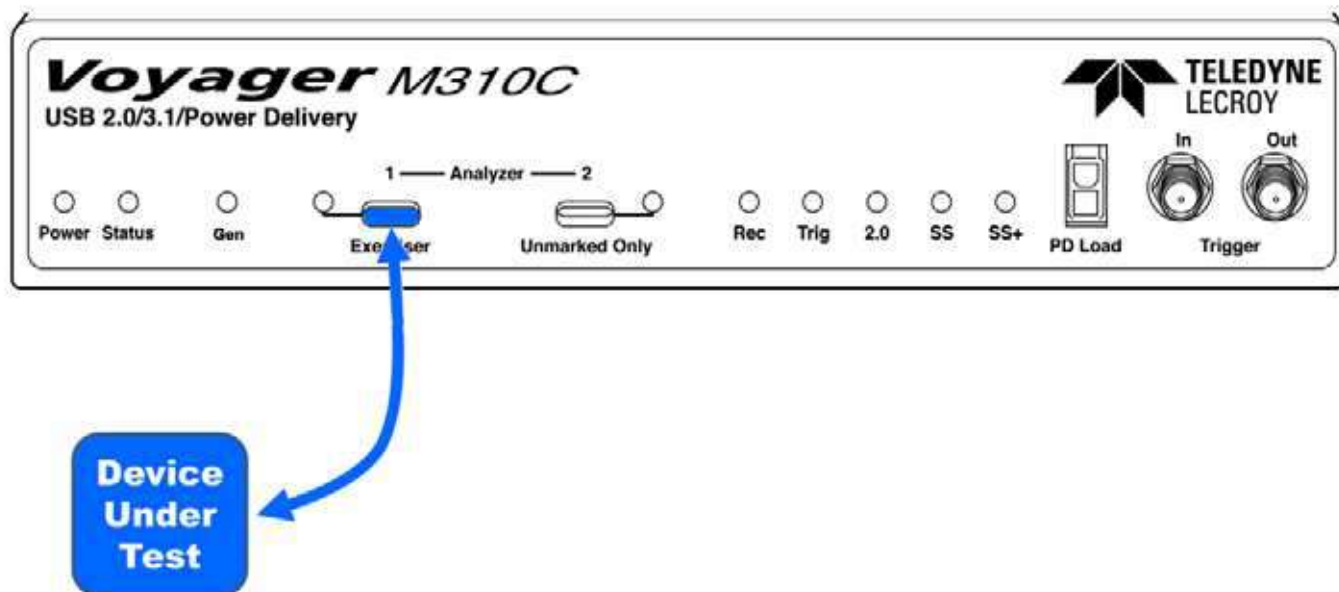


Figure 12.7: Connecting a Cable from Device under Test to Exerciser "A" Port.

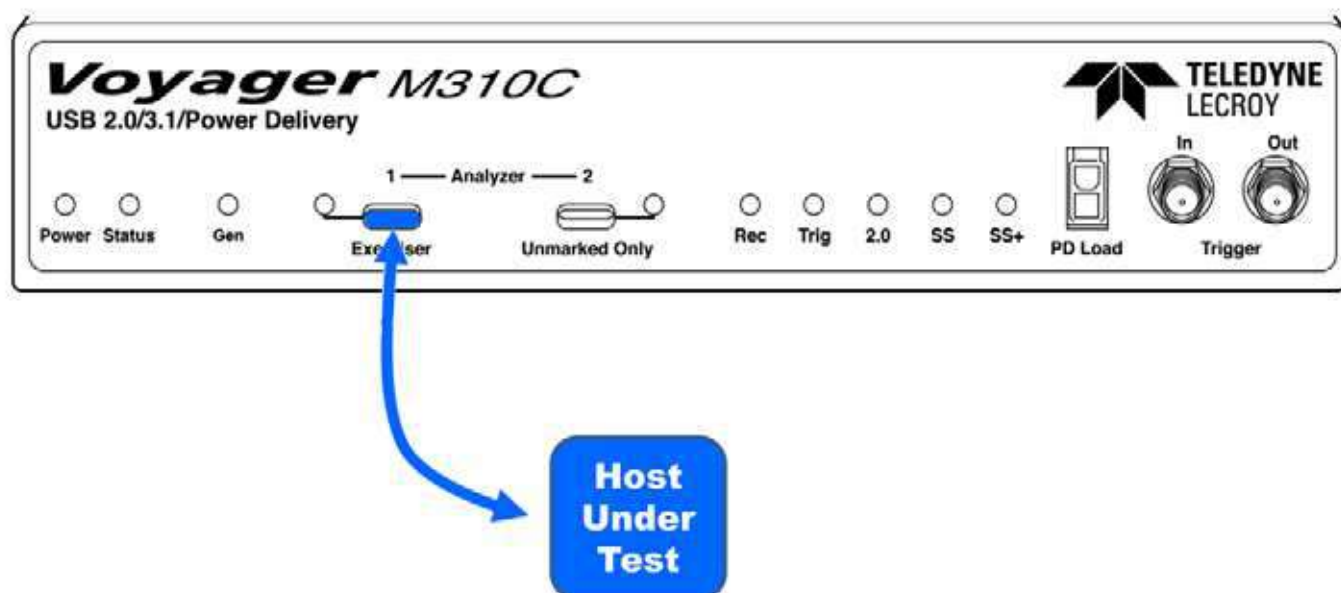


Figure 12.8: Connecting a Cable from Host under Test to Exerciser "A" Port.

12.5 Connecting to Voyager M310P

In all cases you attach to the USB Type-C™ connector (the one with "Exerciser" written above it). Selection between Host and Device emulation is done in the Recording Options dialog.

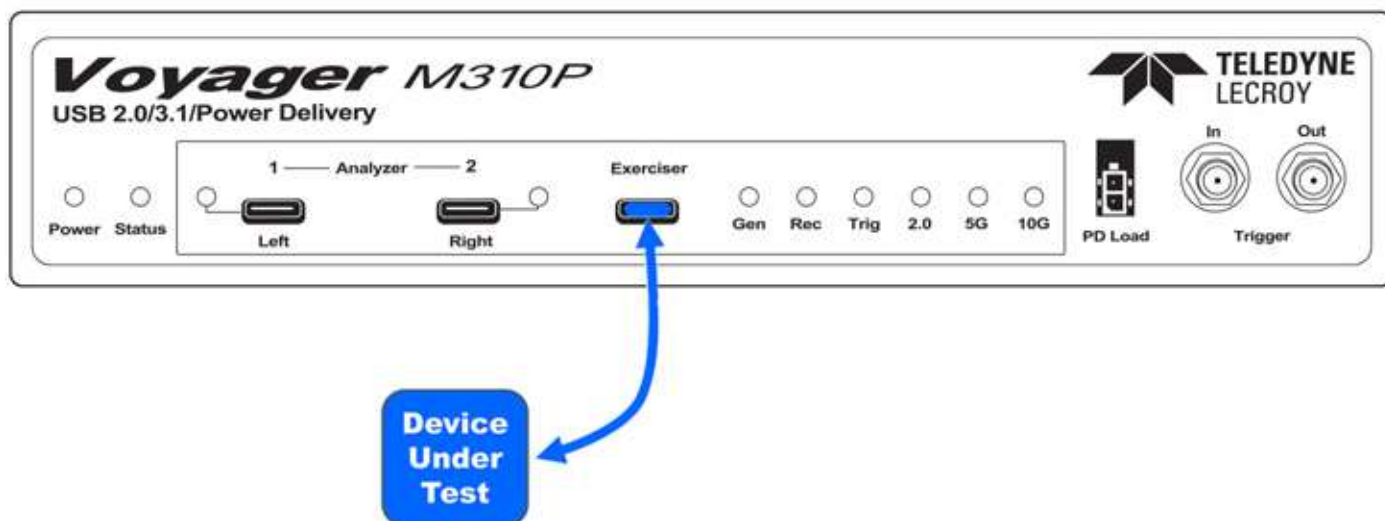


Figure 12.9: Connecting a Cable from Device under Test to Exerciser Port

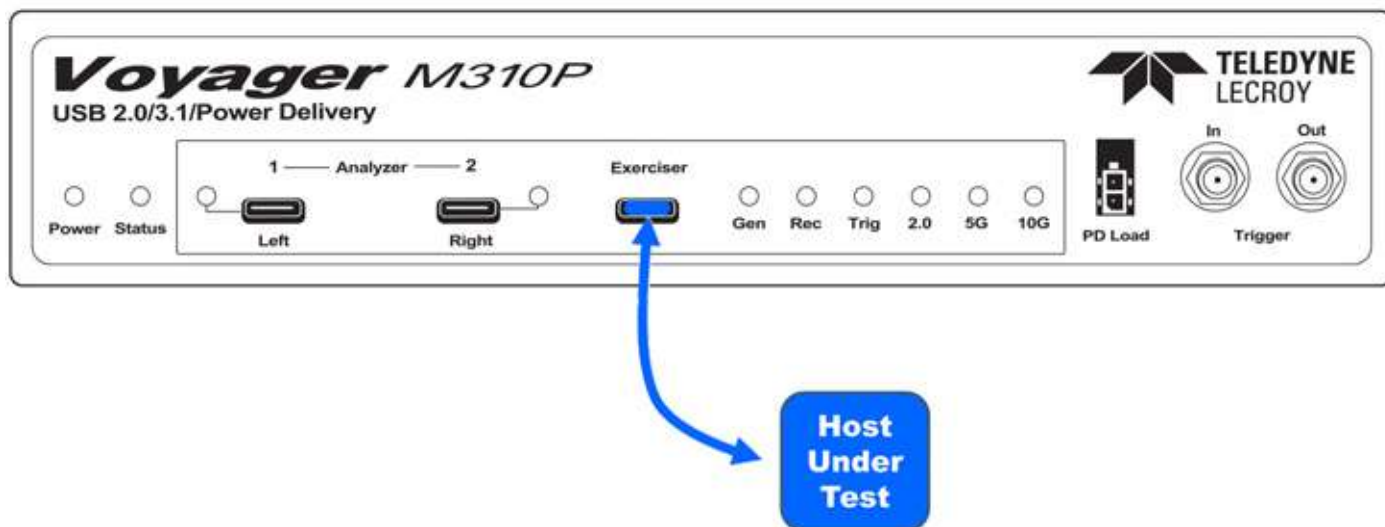


Figure 12.10: Connecting a Cable from Host under Test to Exerciser Port.

12.6 Connecting to Voyager M4x

In all cases you attach to the USB Type-C™ connector (the one with "Exerciser" written above it.) Selection between Host and Device emulation is done in the Recording Options dialog.

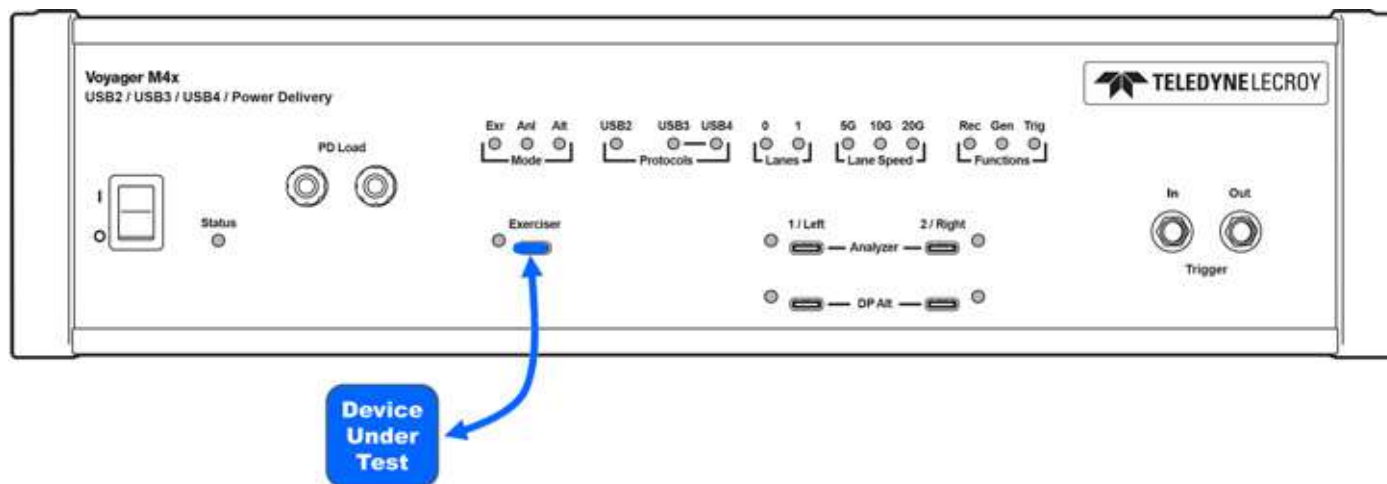


Figure 12.11: Connecting a Cable from Device under Test to Exerciser Port

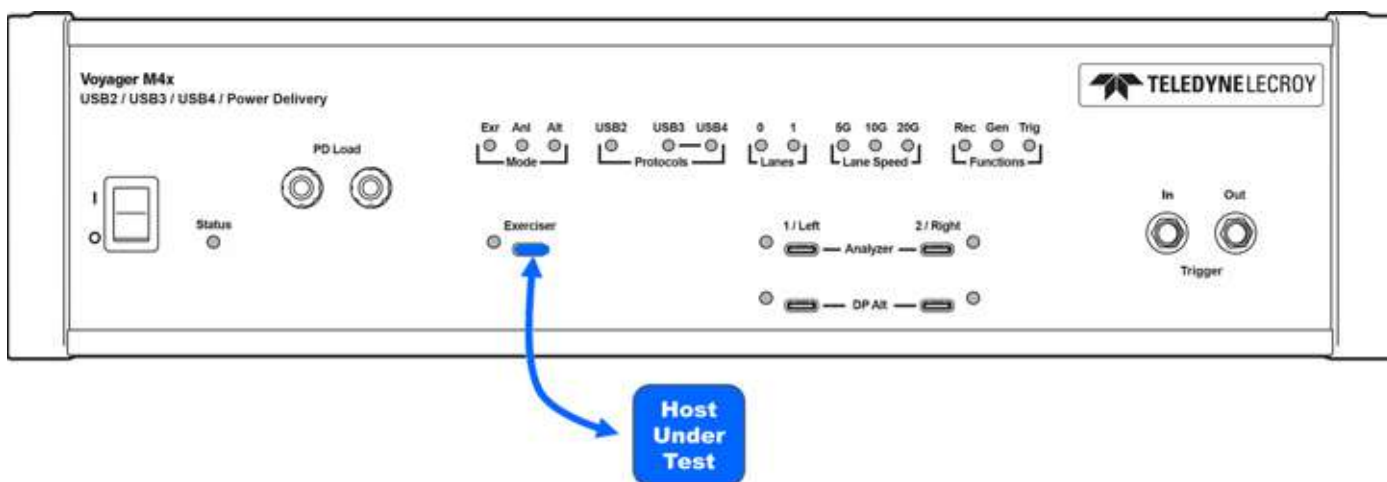


Figure 12.12: Connecting a Cable from Host under Test to Exerciser Port

12.7 USB 3.2 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 3.2 Exerciser Generation Script Language Reference Manual.

12.8 Exerciser Files

The system generates the following types of traffic:

- ❑ USB 3.2 traffic: Utilizing *.usb3g traffic generation files
- ❑ USB 4.0 traffic: Utilizing *.usb4g traffic generation files
- ❑ PD traffic: Utilizing *.updg traffic generation files

The system generates USB 3.2/USB4.0/PD traffic from traffic generation files, which are text-based script files that instruct the Exerciser how to generate USB 3.2/USB4.0/PD 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.

12.9 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\3.2 Host Emulation\LowLevelScripts**.

For Windows 10, an example such as: **MassStorageEnumeration.USB3g**, **SampleEnumHostTx.usb3g**, or **SampleMassStorageHostTx.usb3g**, in the directory **C:\Program Files\LeCroy\USB Protocol Suite\Examples\3.2 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.

12.10 Exerciser Window

Click the **USB/PD Exerciser**  button on the toolbar to open the USB/PD Exerciser window.

12.10.1 USB/PD Exerciser Menus

The Exerciser menus are:

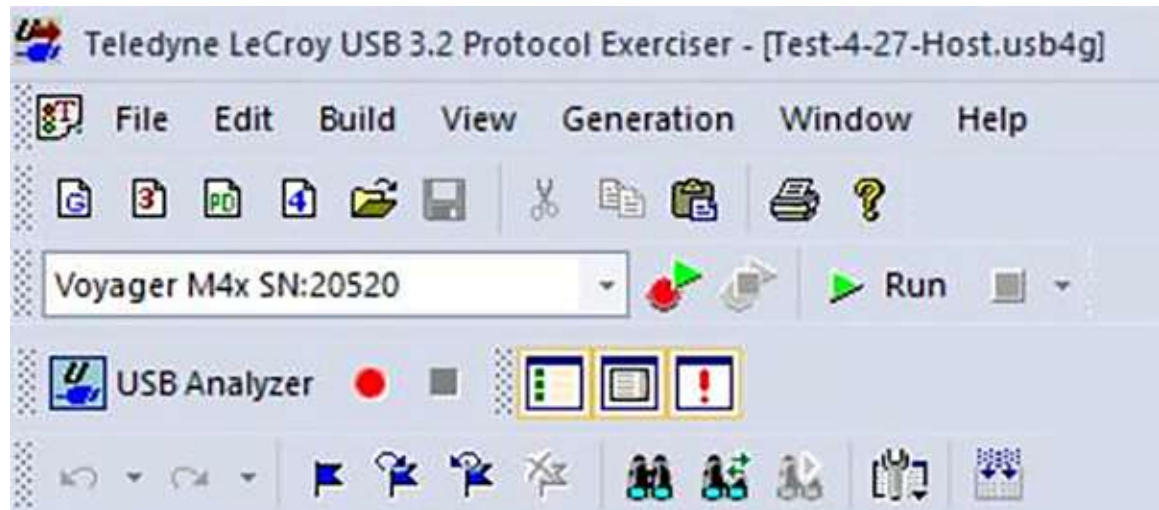
Menu	Sub Topic	Function
<u>F</u> ile		
	<u>N</u> ew USB3 Graphic Scenario	Creates a new, empty, graphic traffic generation file.
	New USB3 Text Scenario	Creates a new, empty, text traffic generation file.
	New PD Text Scenario	Creates a new, empty, text traffic generation file.
	New USB4 TextScenario	Creates a new, empty, text traffic generation file.
	<u>O</u> pen	Opens a file.
	<u>S</u> ave	Saves the current file.
	Save <u>A</u> s	Saves all or a range of packets from the current file.
	<u>C</u> lose	Closes the current file.
	<u>P</u> rint	Prints part or all of the current traffic data file.
	Print Pre <u>u</u> iew	Produces an on-screen preview before printing.
	Print Setup	Sets the options for the current or new printer.
	<u>E</u> xit	Exits the program.

Menu	Sub Topic	Function
Edit		
	<u>U</u> ndo	Undoes previous command.
	<u>R</u> edo	Redoes undone command.
	<u>C</u> ut	Deletes selected text.
	<u>C</u> opy	Copies selected text
	<u>P</u> aste	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).
	Select All	Select all text in the current file (scripts only).
Generation		
	<u>R</u> un Scenario	Starts traffic generation.
	<u>S</u> top Scenario	Stops traffic generation.
	<u>P</u> review Trace	Checks script for errors and displays trace.
Build (scripts only)		
	<u>C</u> ompile	Starts traffic generation (scripts only).
<u>V</u>iew		
	Main <u>T</u> oolbars	Switches display of the Main toolbar on or off.
	Graphical Toolbar	Switches display of the Graphical toolbar on or off (graphics only).
	<u>V</u> iews Toolbar	Switches display of the Views toolbar on or off (scripts only).
	<u>S</u> cript Toolbar	Switches display of the Script toolbar on or off (scripts only).
	<u>S</u> tatus 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).

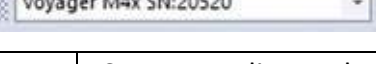
Menu	Sub Topic	Function
<u>W</u>indow		
	<u>C</u> ascade	Displays all open windows in an overlapping arrangement.
	T <u>i</u> le	Displays all open windows in a above-below arrangement.
	<u>A</u> rrange Icons	Arranges minimized windows at the bottom of the display.
	C <u>l</u> ose All	Closes all open windows.
<u>H</u>elp		
	<u>A</u> bout	Displays version information about the Voyager M3i and the USB Protocol Suite. See “Software, Firmware, and BusEngine Revisions” on page 733.

12.10.2 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 USB3 Graphic Scenario		New USB3 Text Scenario
	Creates a new PD exerciser script		Creates a new USB4 exercise script
	Open file.		Save. Saves your edits and immediately updates the setting bars and Frames shown in the trace window.
	Cut.		Copy.
	Paste.		Print.
	About		
	List all connected units and allows user to choose target unit for running exerciser.		
	Start recording and exerciser generation with one click		Stop recording and exerciser generation with one click
	Run Scenario.		Stop Scenario.

	View Toolbox		View Output
	View Error Output		
 USB Analyzer	Go to USB Analyzer window.		Start Recording.
	Stop Recording.		

12.11 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.

There are three script editors:

- ☐ USB3: New Text Generation Scenario (see [Figure 12.13 on page 697](#))
- ☐ PD: New PD Text Generation Scenario (see [Figure 12.15 on page 699](#))
- ☐ USB4: New USB4 Text Generation Scenario (see [Figure 12.17 on page 701](#))

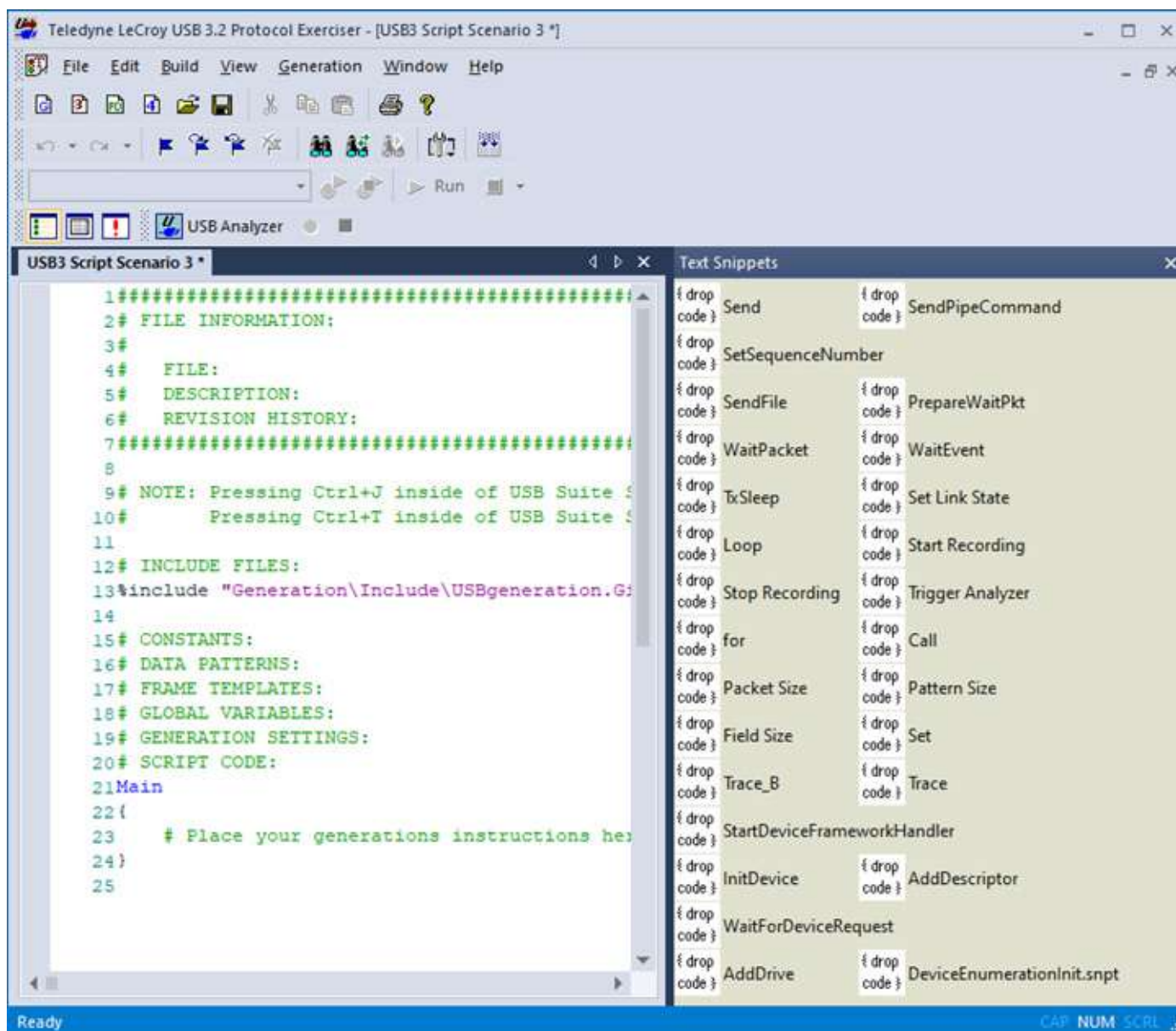


Figure 12.13: New Text Generation Scenario

For details on the generation of a USB3.2 Script, consult the Voyager™ USB 3.2 Exerciser SS (5Gbps) and SS+ (10Gbps) Generation Script Language Reference Manual.

This and other manuals can be found by selecting
Help -> Other Manuals -> USB3.2 Exerciser Manual

See [Figure 12.14 on page 698](#).

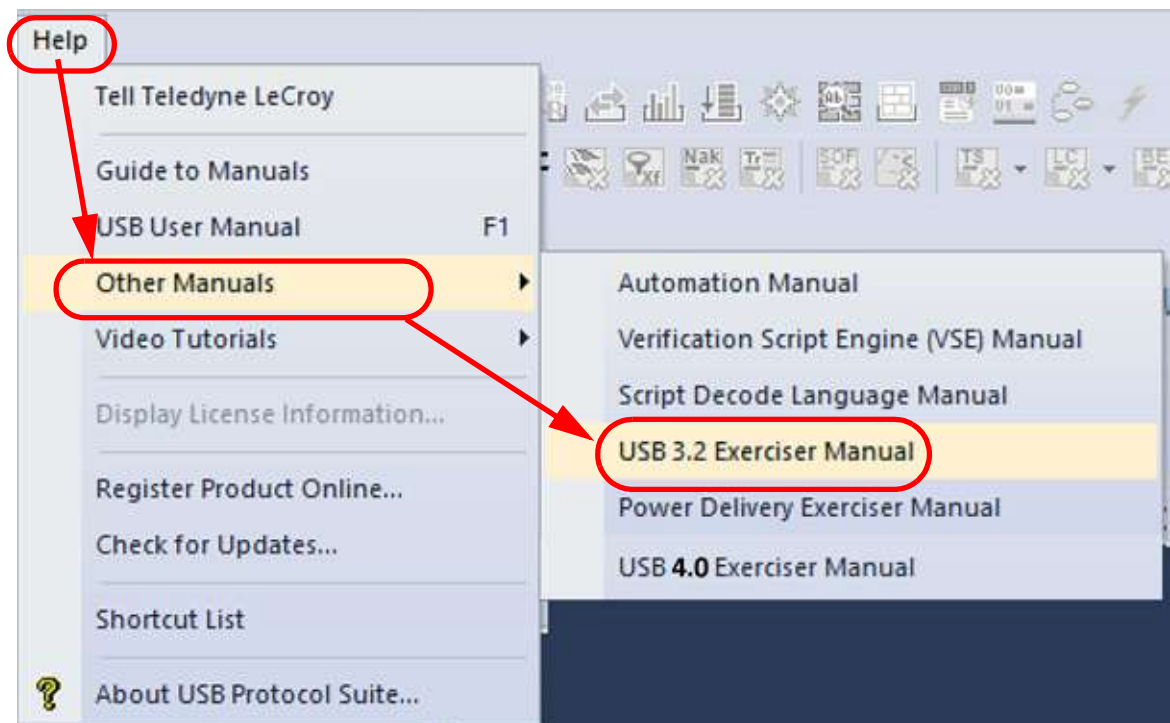


Figure 12.14: USB 3.2 Exerciser Manual

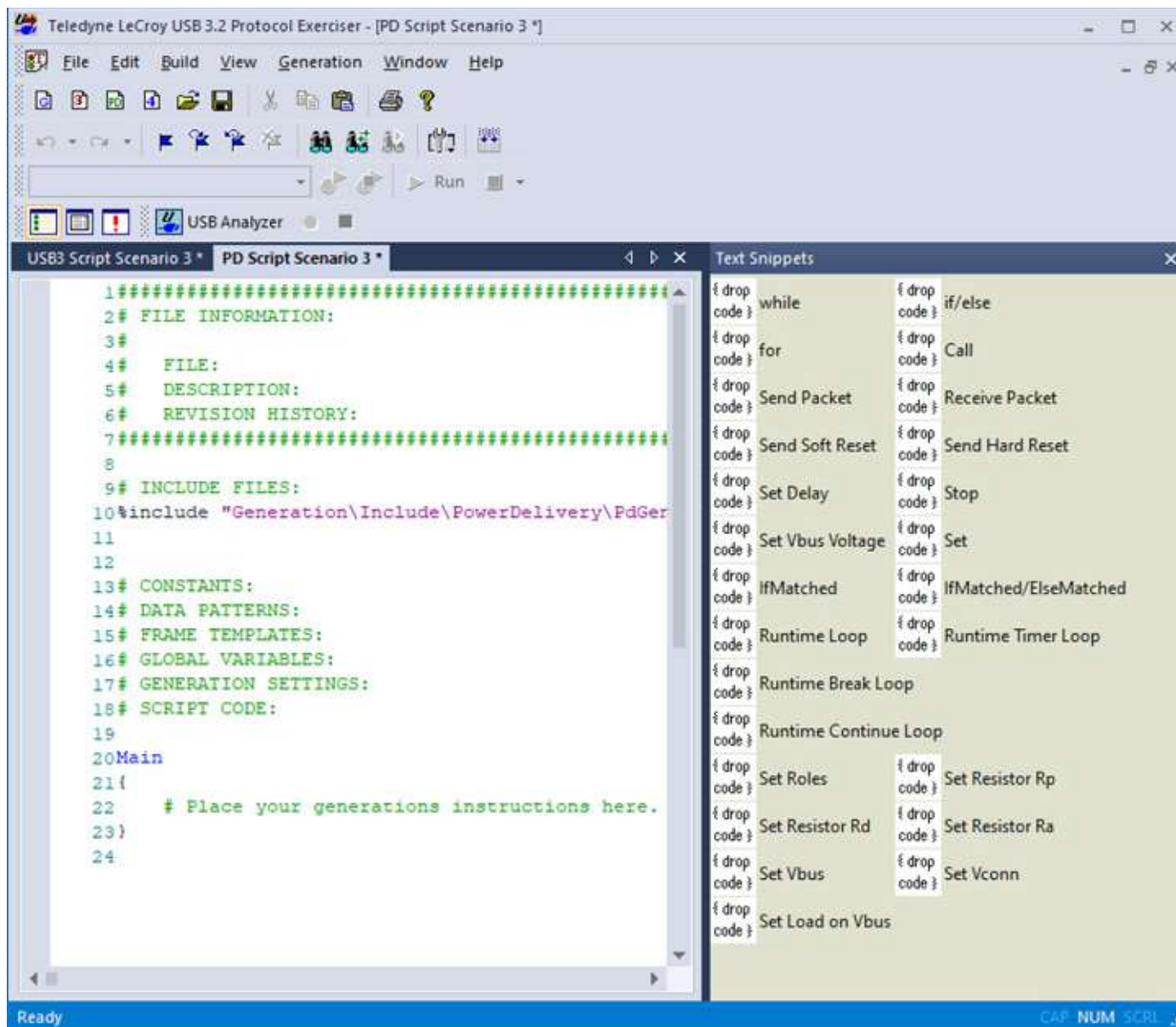


Figure 12.15: New PD Text Generation Scenario

For details on the generation of a Power Delivery (PD) Script, consult the Voyager™ Power Delivery Generation Script Language Reference Manual.

This and other manuals can be found by selecting
Help -> Other Manuals -> Power Delivery Exerciser Manual

See [Figure 12.14 on page 698](#).

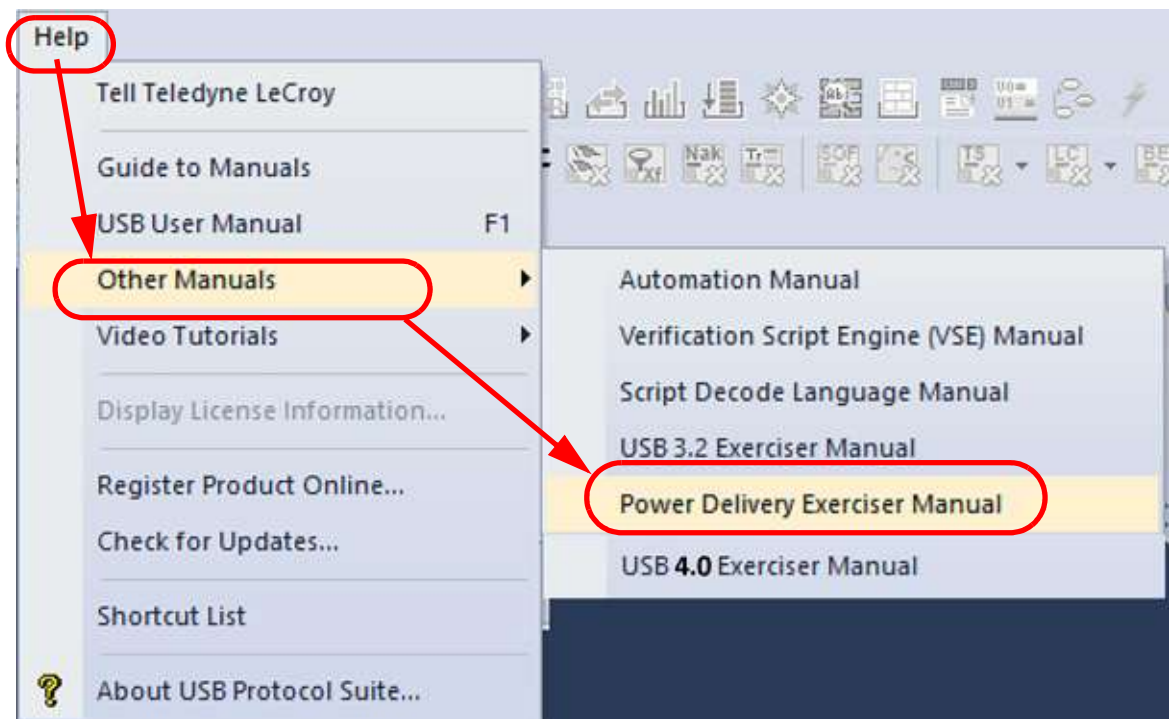


Figure 12.16: Power Delivery Exerciser Manual

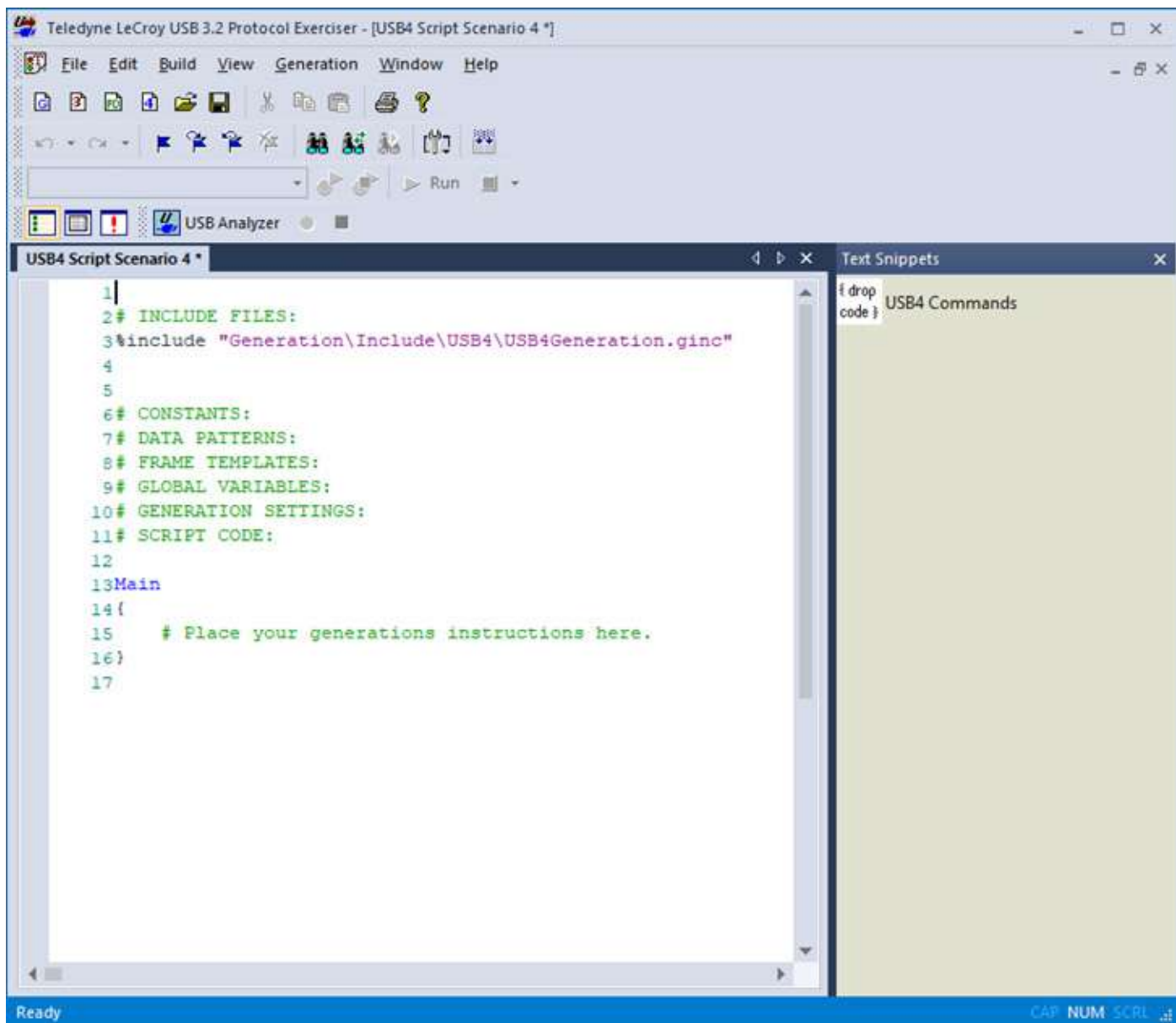


Figure 12.17: New USB4 Text Generation Scenario

For details on the generation of a USB 4.0 Script, consult the Voyager™ USB 4.0 Exerciser Generation Script Language Reference Manual.

This and other manuals can be found by selecting **Help -> Other Manuals -> USB4.0 Exerciser Manual**

See [Figure 12.18 on page 702](#).

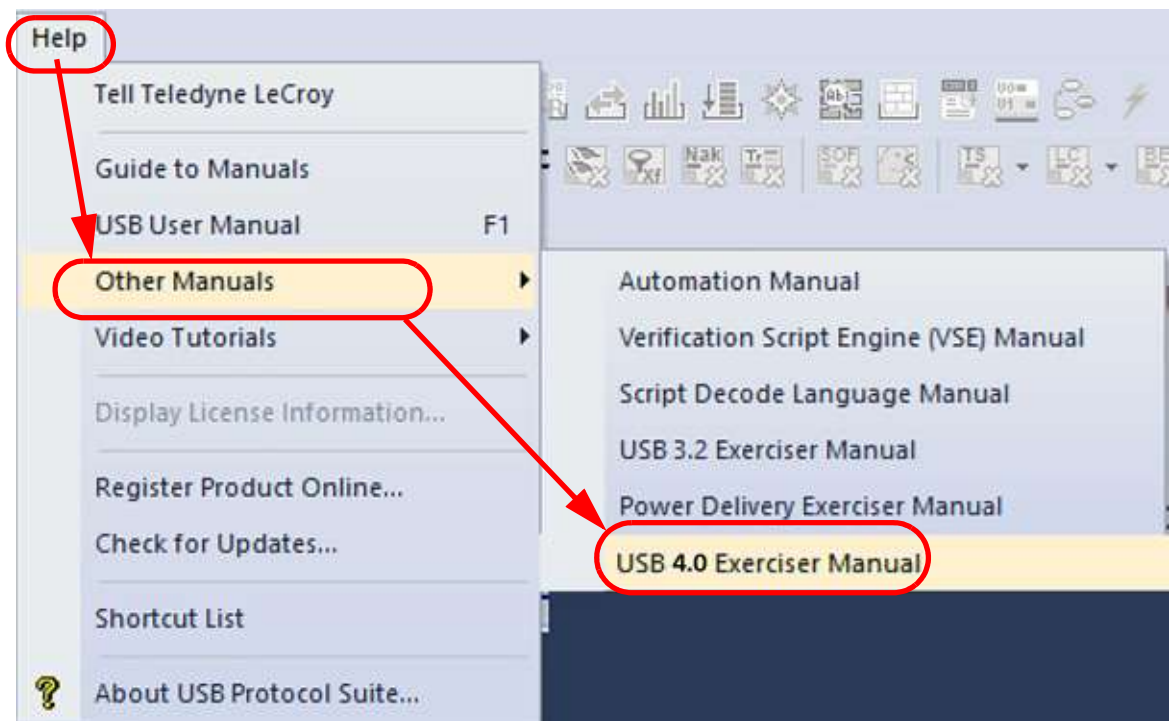


Figure 12.18: USB 4.0Exerciser Manual

12.11.1 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**.

12.11.2 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

12.11.3 Help

Right-click a command to display a menu from which you can choose Help.

12.11.4 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.

12.11.5 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.

12.11.6 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.

12.11.7 Output

When you compile a script that generates output or when the application sends you a message, the information appears in the Output tab.

12.11.8 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.

12.11.9 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.

12.11.10 Line Numbers

If you enable line numbers at the Options button, each line has a line number.

12.11.11 Tooltips

If you show tooltips at the Options button, tooltips appear when you place the cursor over a button or command.

12.11.12 USB 3.2 Text Snippets

Text snippets appear in the Text Snippets window (see [Figure 12.19 on page 705](#).) 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

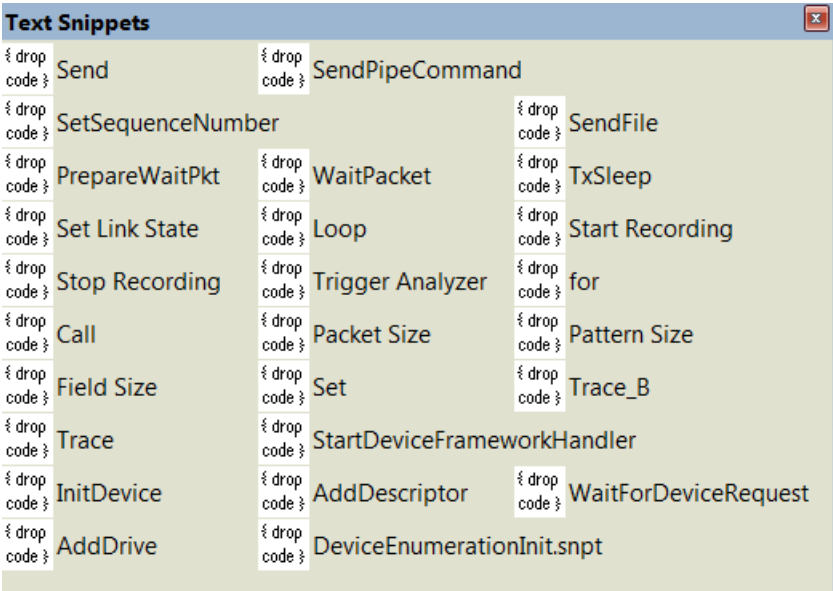


Figure 12.19: Text Snippets Window

Note: For information about each command, see the *Voyager USB 3.2 Exerciser - Generation Script Language Reference Manual*.

12.11.13 Views Toolbar

The Views toolbar contains buttons for viewing text snippets, Output window, and Error Output window.



Figure 12.20: Views Toolbar

The buttons have the following functions:

	View Toolbox Text Snippets.		View Output window
	View Error Output window.		

12.11.14 Script Toolbar

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



Figure 12.21: 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

12.11.15 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.

12.11.16 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.

12.11.17 Tooltips

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

12.12 Creating a Script using the Script Editor

Before creating a script, read the *Voyager USB 3.2/USB4/PD Exerciser Generation Script Language Reference Manuals* 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 3.2, Protocol Exerciser window:

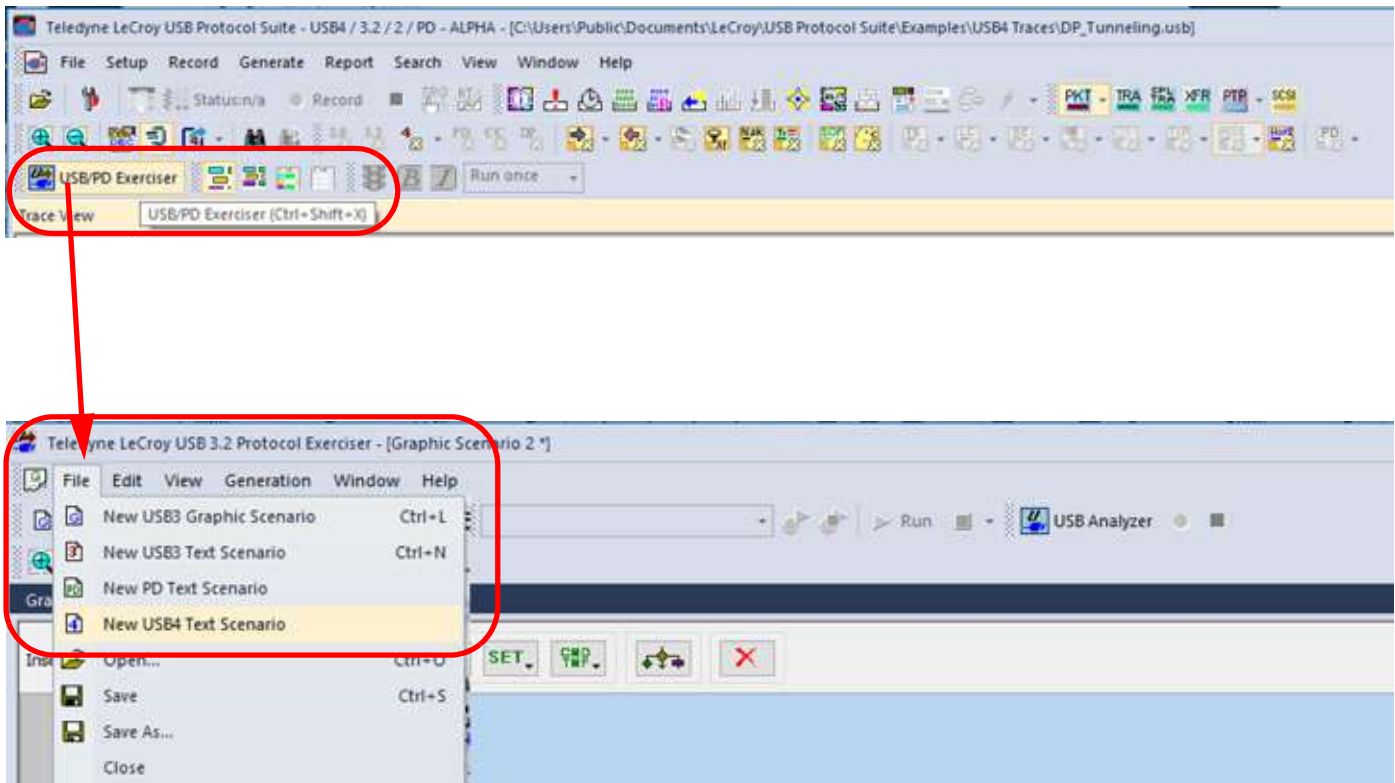


Figure 12.22: Select USB/PD Exerciser icon, then chose the type of Scenario

1. Click the  **New USB3 Graphic Scenario** button or select **File > :**

- ☐ **New USB3 Text Scenario**
- ☐ **New PD Text Scenario**
- ☐ **New USB4 text Scenaio**

to display a blank script.

An example of a blank USB3 Script Scenario is shown below. See [Figure 12.23](#)

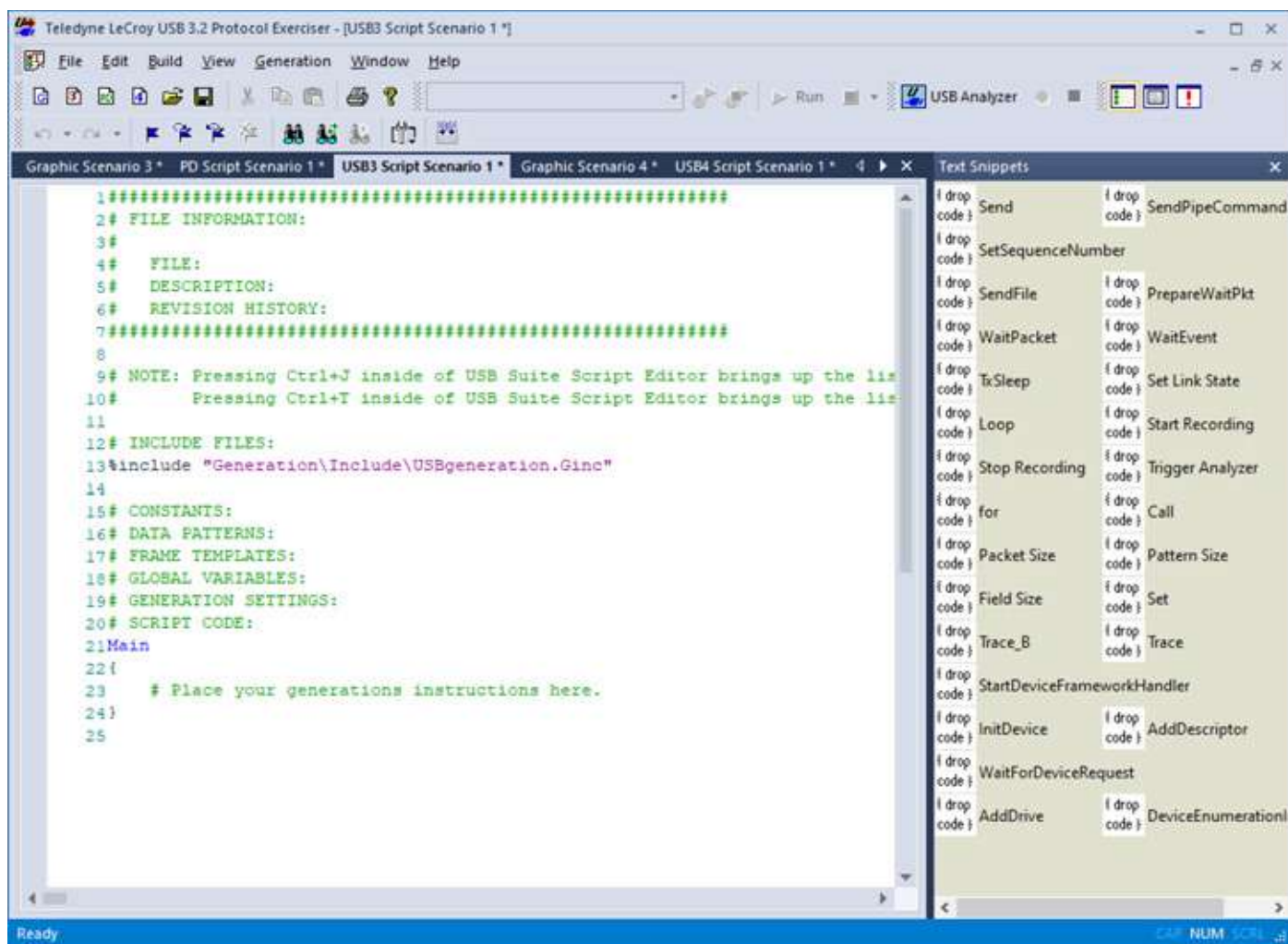


Figure 12.23: Script Scenario

The file name appears on the tab for the file.

```

tempusb3g Script Scenario 8.usb3g
1 #####
2 # FILE INFORMATION:
3 #
4 # FILE:
5 # DESCRIPTION:
6 # REVISION HISTORY:
7 #####
8
9 # NOTE: Pressing Ctrl+J inside of USB Suite Script Editor brings up the list of available instructions/directives."
10 # Pressing Ctrl+T inside of USB Suite Script Editor brings up the list of available packet templates."
11
12 # INCLUDE FILES:
13 #include "Include\FrameworkLib.ginc"
14
15 # CONSTANTS:
16 const EndpointNum = 1
17 const DeviceNumber = 1
18
19 const WaitTPSleep = 200
20 const WaitDPSleep = 200
21 set Mode = HOST
22 # DATA PATTERNS:
23 # FRAME TEMPLATES:
24 # GLOBAL VARIABLES:
25 # GENERATION SETTINGS:
26 # SCRIPT CODE:
27 Main
28 {
29     # Place your generations instructions here.
30
31     SetLinkState (LinkState = U0
32
33     Call GetDescriptor(EndpointNum,0, DEVICE_DESC,0x00,0x00,0x1200,WaitTPSleep,WaitDPSleep
34
35     Call SetAddress(EndpointNum, DeviceNumber * 256,WaitTPSleep, WaitDPSleep)
36 }
  
```

Figure 12.24: Script Scenario

2. (optional) You can use the Text Snippets on the left Text Snippets panel to add commands and their parameters.
3. Click the **Compile** button or select **Build > Compile** to check the file for errors. The application lists any errors in the Errors tab.
4. Click the **Save** button or select **File > Save** to save the file.

Note: Saving the file automatically compiles it.

12.13 Graphical Scenario Editor

Note: This graphical editor supports USB 3.2 exerciser but is not currently available for PD/USB4.

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.

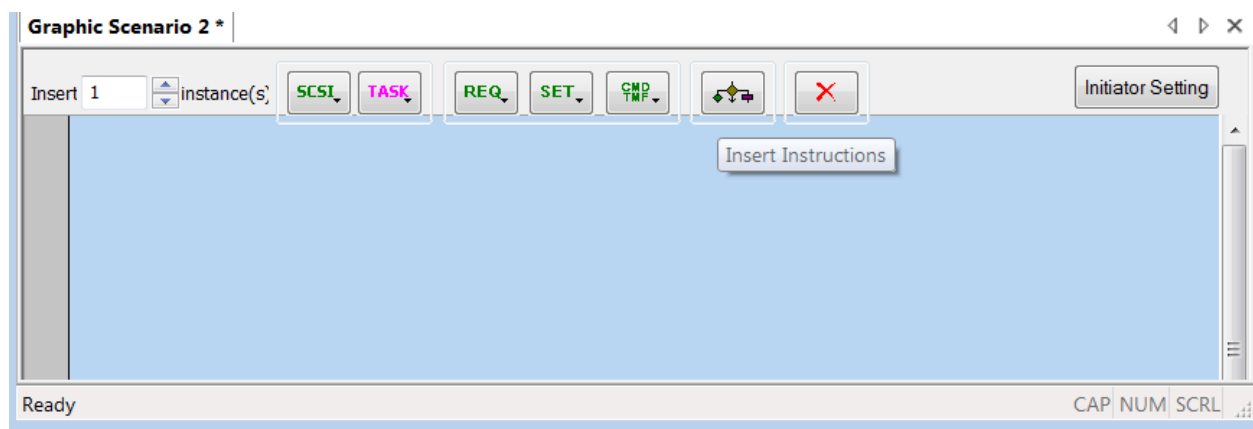


Figure 12.25: Graphical Scenario Editor

12.13.1 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

12.13.2 Initiator Setting

Initiator Setting

The Initiator Settings button displays the Initiator Settings dialog.

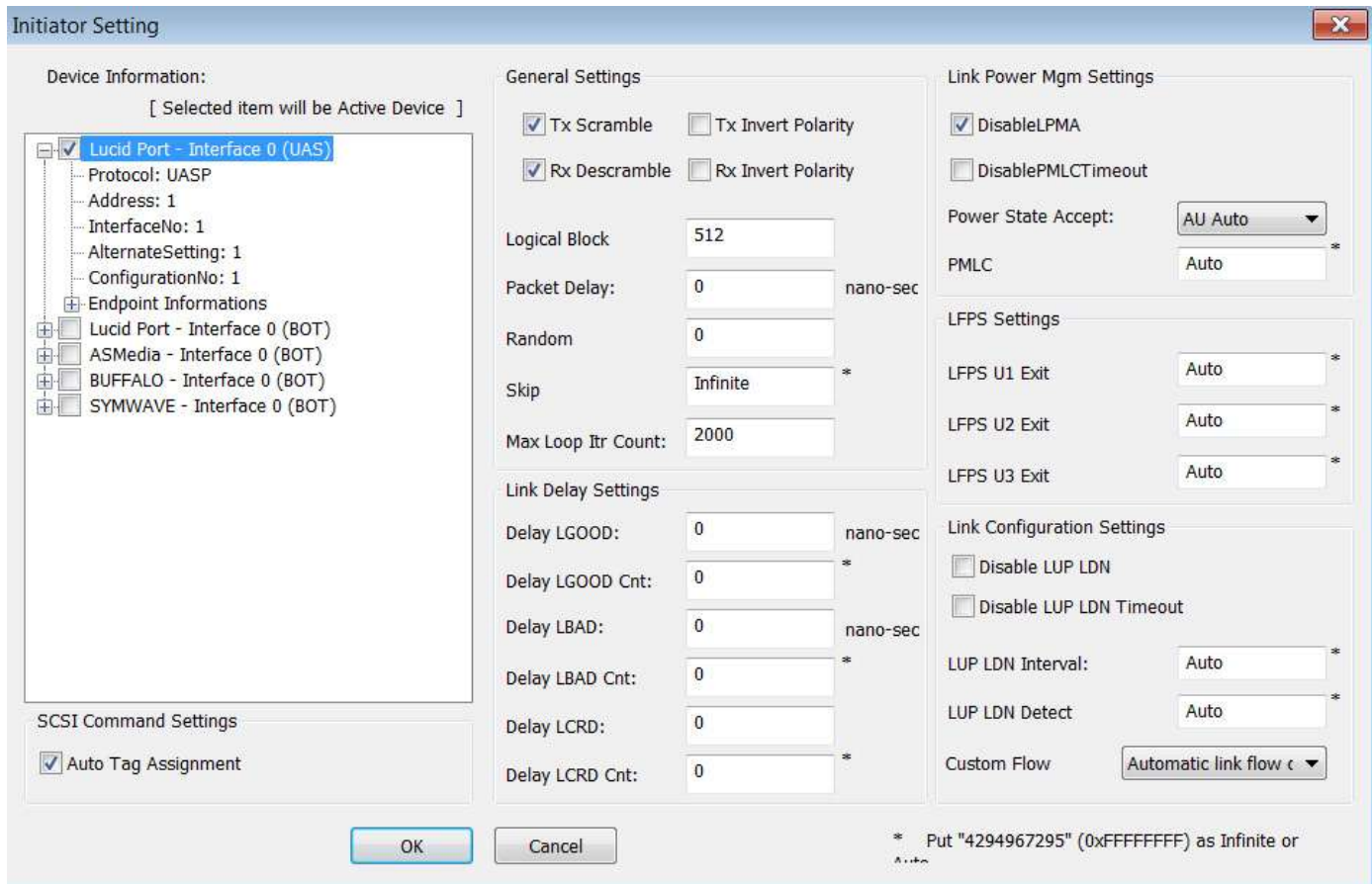


Figure 12.26: Initiator Setting Dialog

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
- PipeUsageld
- 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.

Note: If your scenario enumerates a device, you will have to issue a "SetLinkState" at the end of it to bring the link back to its initial state before running it again.

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).

12.13.3 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

Tag	Device LUN	Option
Auto	0x0000000000000000	...

 displays. Click this button, to set some protocol errors and command settings for that item.

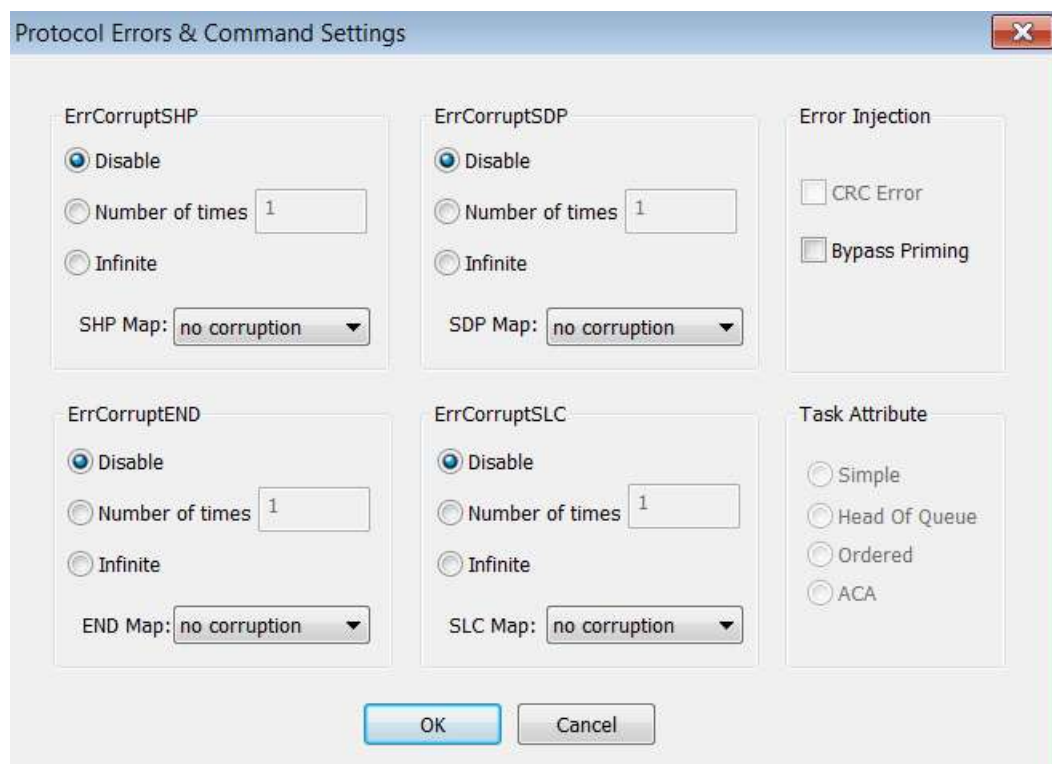


Figure 12.27: Protocol Errors and Command Settings

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

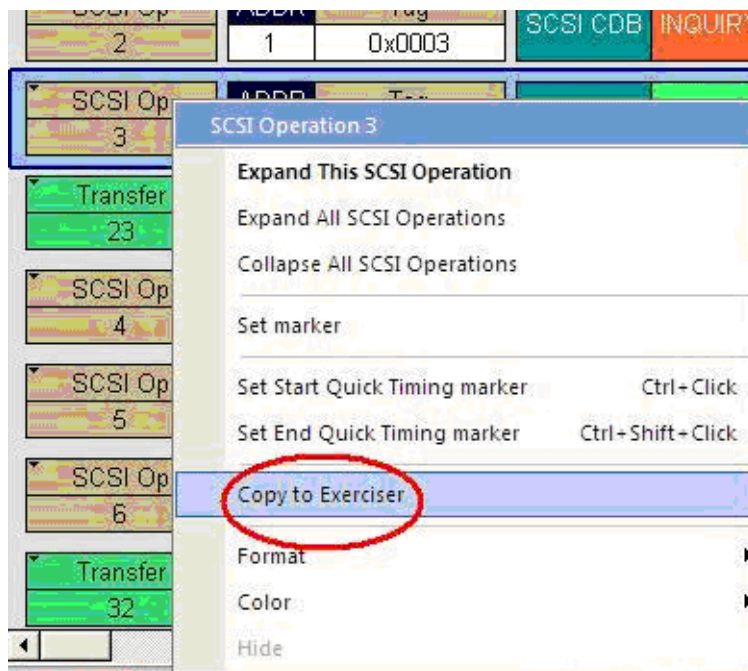
You can save a created project by selecting **File > Save**.

You can run a saved project by selecting **Generation > Run Scenario** or using the Run Toolbar.

12.13.4 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.

12.13.5 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.

12.14 Loading and Running the Generation File

The USB 3.2 Traffic Generation files are scripts that instruct the Analyzer how to generate USB 3.2 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 3.2 Traffic Generation files.
3. Select a Traffic Generation file (*.usb3g).
4. Click **Open**.

12.14.1 Starting Traffic Generation

To start traffic generation, click  **Run** on the Tool Bar.

Click the **Trace Preview**  button to check the file.

12.14.2 Stop Traffic Generation

To instruct the Analyzer to halt traffic generation, click  on the Tool Bar.

12.15 USB 3.0 5Gbps SS 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.

12.15.1 Loopback Mode

The Voyager USB 3.0 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!**

Note: Speeds above 5 Gbps are not supported.

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 3.0 tab, uncheck the **Filter-Out Logical Idles and Filter-Out SKPs** option.

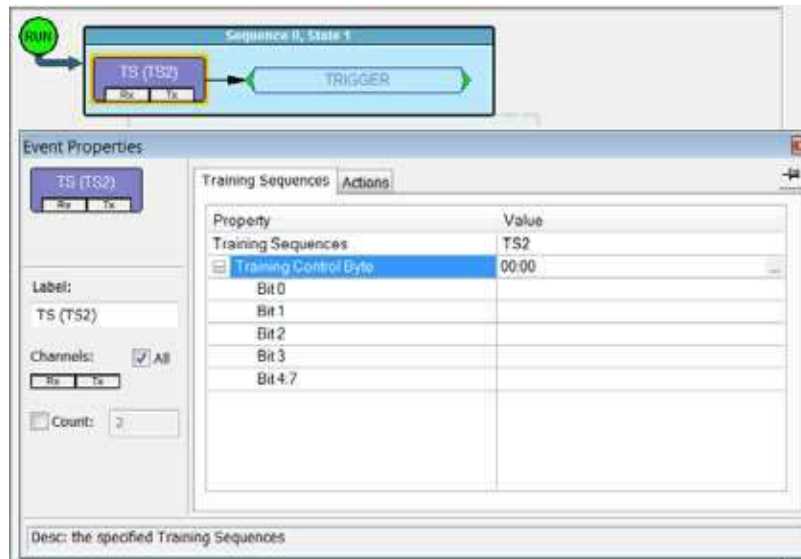
Simple Filters

☐ Filter Out Logical Idles & SKPs

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.

Packet 305217	LC	LDN	Time	Time Stamp
		SLC SLC SLC EPF D07.7 D27.1 D30.7 D08.7	9.664 µs	26 : 820 229 464
Packet 305218	LC	LUP	Time	Time Stamp
		SLC SLC SLC EPF D25.5 D11.6 D08.2 D00.0	360.000 ns	26 : 820 239 128
Packet 305219	LC	LDN	Idle	Time Stamp
		SLC SLC SLC EPF D05.2 D14.0 D31.0 D01.7	10.024 µs	26 : 820 239 488
Packet 305220	LC	LDN	Time	Time Stamp
		SLC SLC SLC EPF D06.4 D03.1 D22.6 D18.1	1.600 µs	26 : 820 249 528

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.

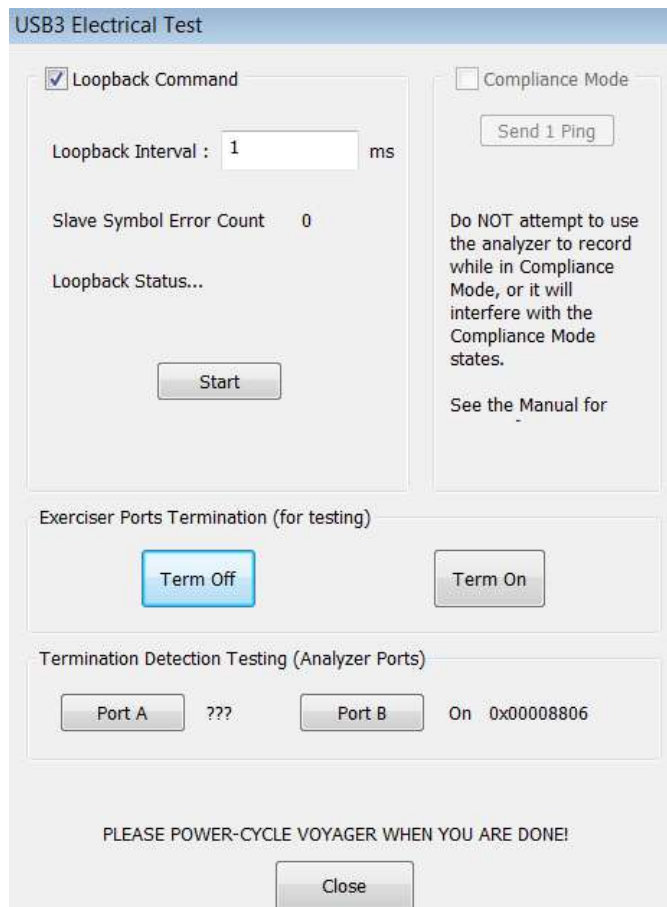


Figure 12.28: USB 3.0 Electrical Test

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.

- 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.
- 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 12.29 on page 720](#))

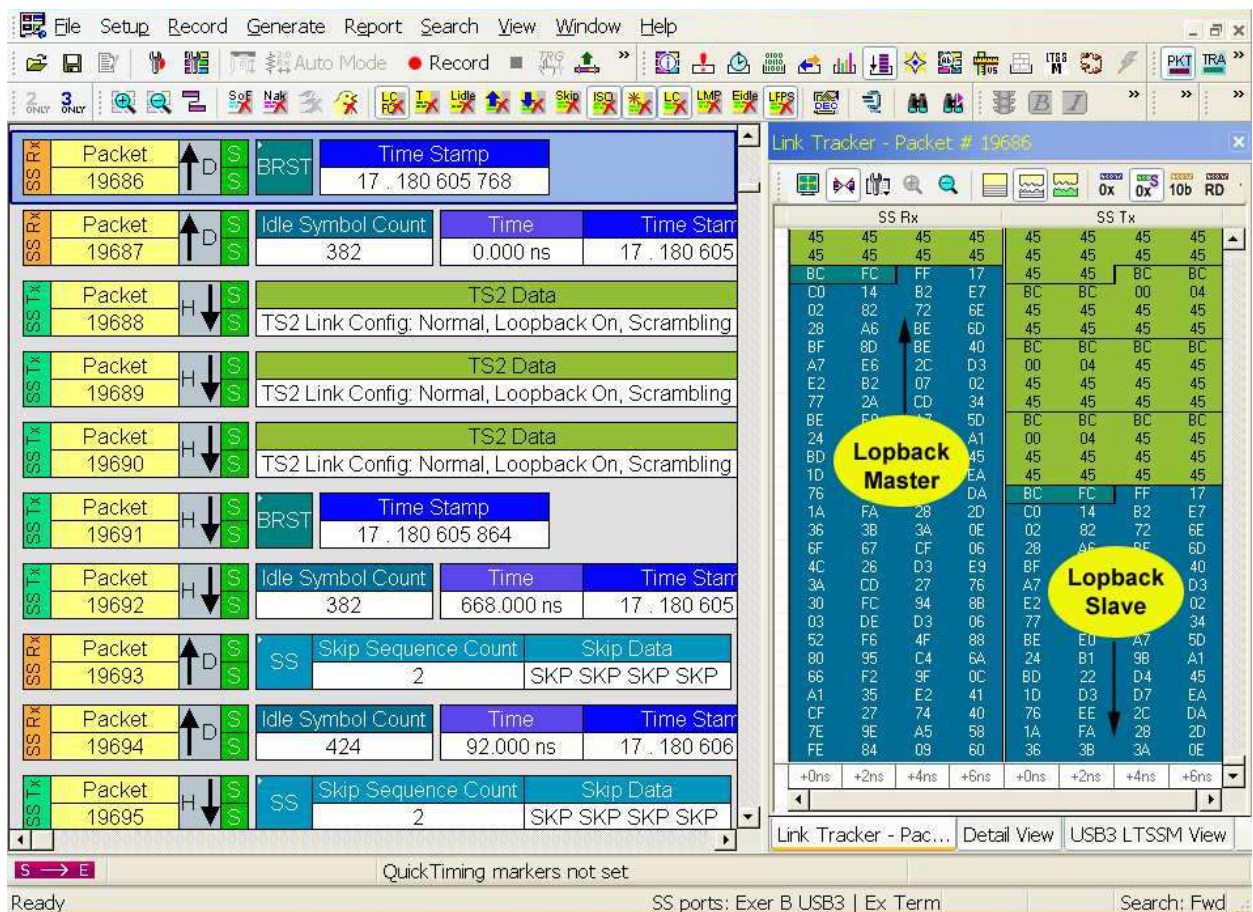


Figure 12.29: Device Initiates Loopback Mode with SuperSpeed Host.

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.

12.15.2 Compliance Mode

The Voyager USB 3.0 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 3.0 Electrical Test window can initiate the required test modes, while an attached oscilloscope is used to measure the transmitted compliance patterns.

Note: Speeds above 5 Gbps are not supported.

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 only 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.

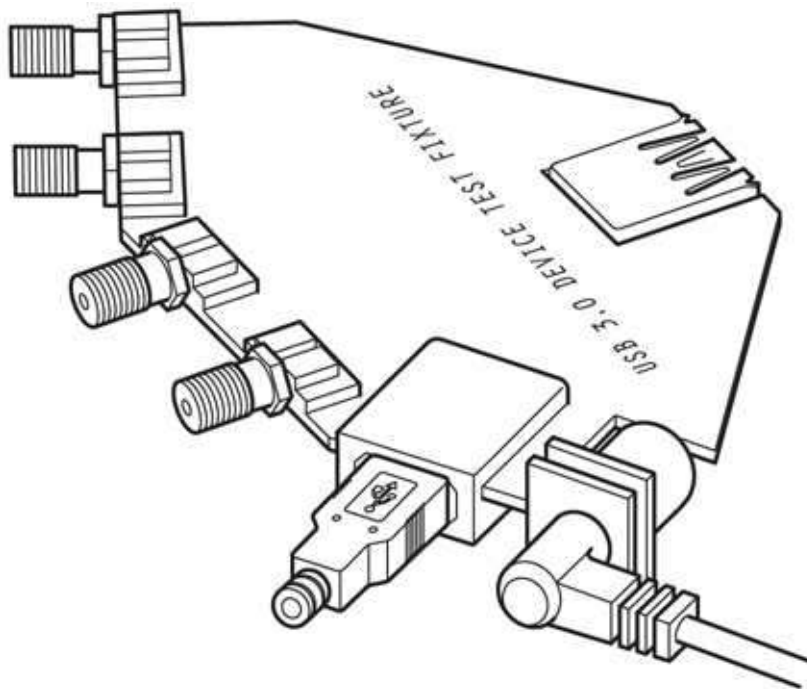


Figure 12.30: Intel Test Fixture

The following two photos show an example connection.

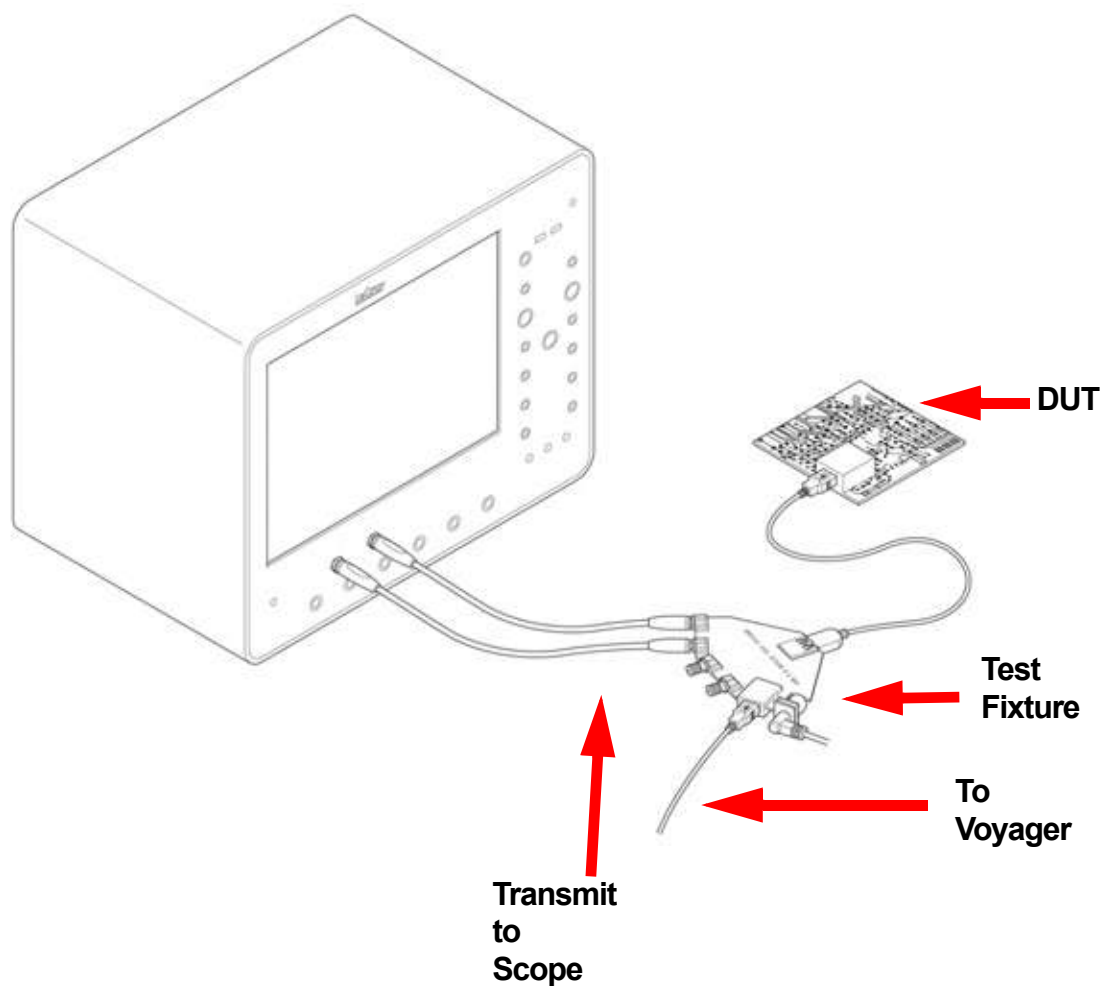


Figure 12.31: Test Fixture to DUT and Oscilloscope Connections

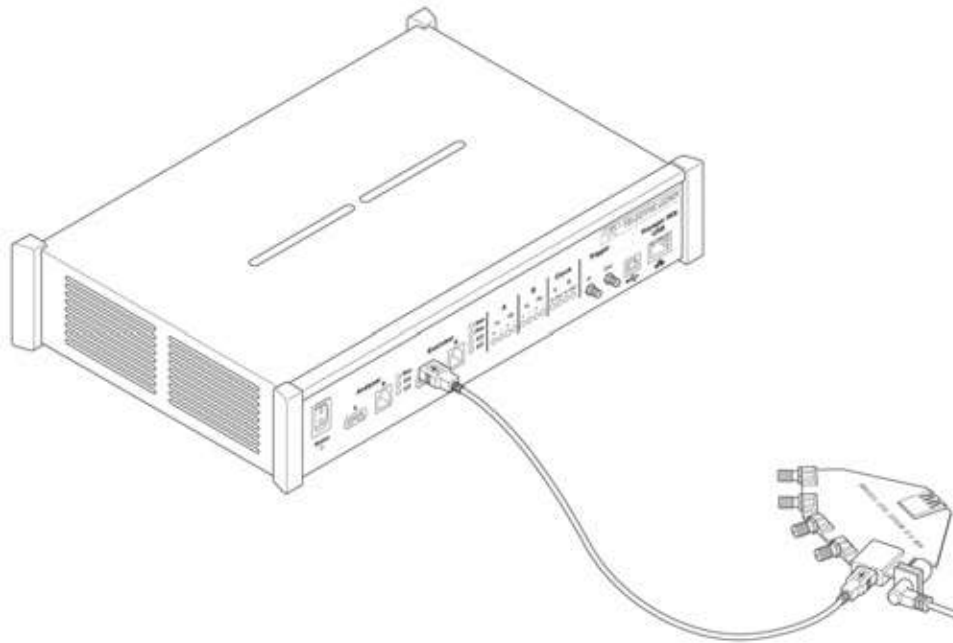


Figure 12.32: Test Fixture to Voyager Connection

2. Set the Recording Options, in the USB 3.2 tab, to run the Electrical tests.

Recording Options - Voyager M3/M3i

General USB 2.0 **USB 3.2** USB 2.0 Rec Rules : Ch 0 USB 3.2 (SS) Rec Rules

Recording Ports

☒ USB 3.2 Connectors

☐ MMCX

☐ Custom... DS:USB 3.2 SS

Custom recording ports not applicable in emulation modes

Generation Mode

☒ Host Emulation

☐ Device Emulation

Descrambling

A-Left B-Right

☒ Auto ☒ Auto

☐ On ☐ On

☐ Off ☐ Off

Polarity Inversion

A-Left B-Right

☒ Auto ☒ Auto

☐ On ☐ On

☐ Off ☐ Off

Spread Spectrum Clock

☒ Receive

☒ Transmit (Exerciser)

Tx Clock (Compliance Only!)

☒ Off (Normal Mode)

☐ -5300ppm ☐ +300ppm

M3i USB Connector Termination/RxDetect

Analyzer Ports

☒ Auto

☐ Manual

Exerciser Ports

☒ Enable RxDetect

Simple Filter-Outs

☒ Logical Idles

☒ SKPs

☐ LUP/LDN

☐ ITP

☐ Bus Events (LFPS, EIdle, Term)

Options

☐ Truncate Data Fields - Bytes: 16

Figure 12.33: Recording Options - USB 3.2 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.

- After you set up the system, make sure that the USB cable is NOT plugged into Voyager, and then select **USB 3.0 Electrical Test** from the View menu.

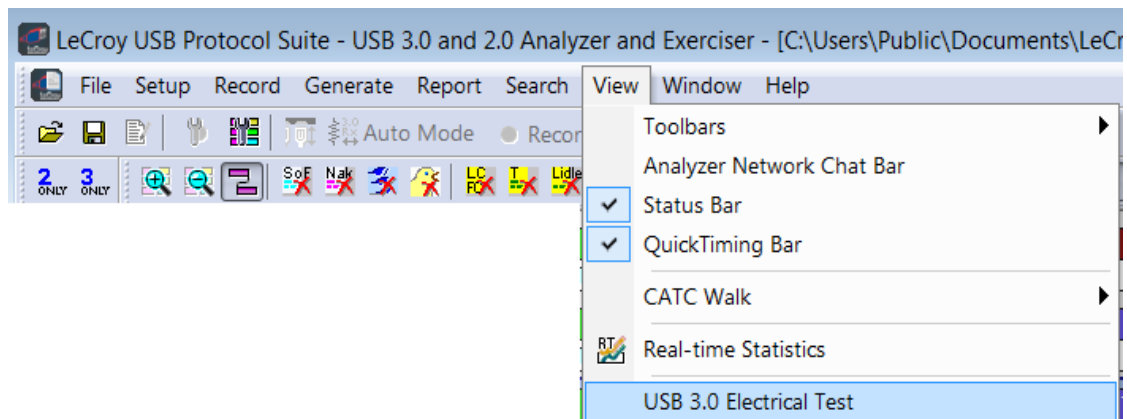


Figure 12.34: View Menu

4. In the USB 3.0 Electrical Test dialog, check the **Compliance Mode** box (see [Figure 12.35 on page 726.](#))

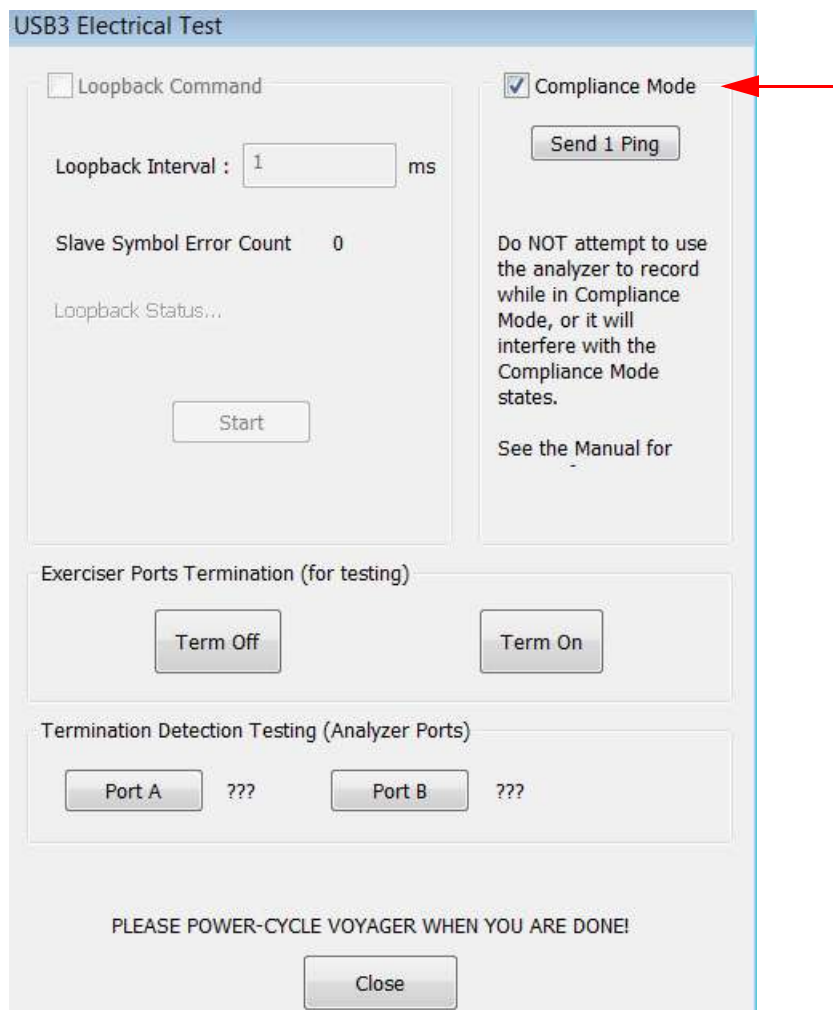


Figure 12.35: USB 3.0 Electrical Test Dialog

- 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.

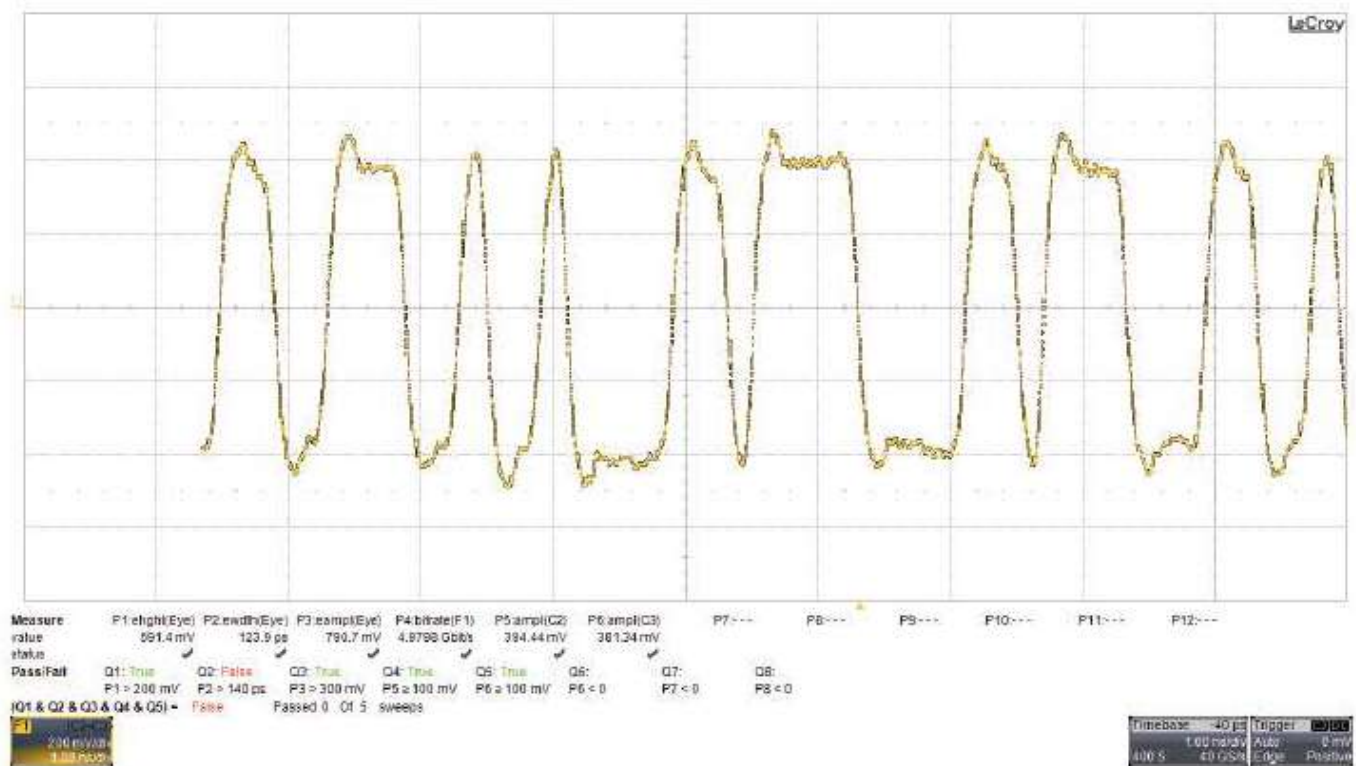


Figure 12.36: Typical CP0 Pattern

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.

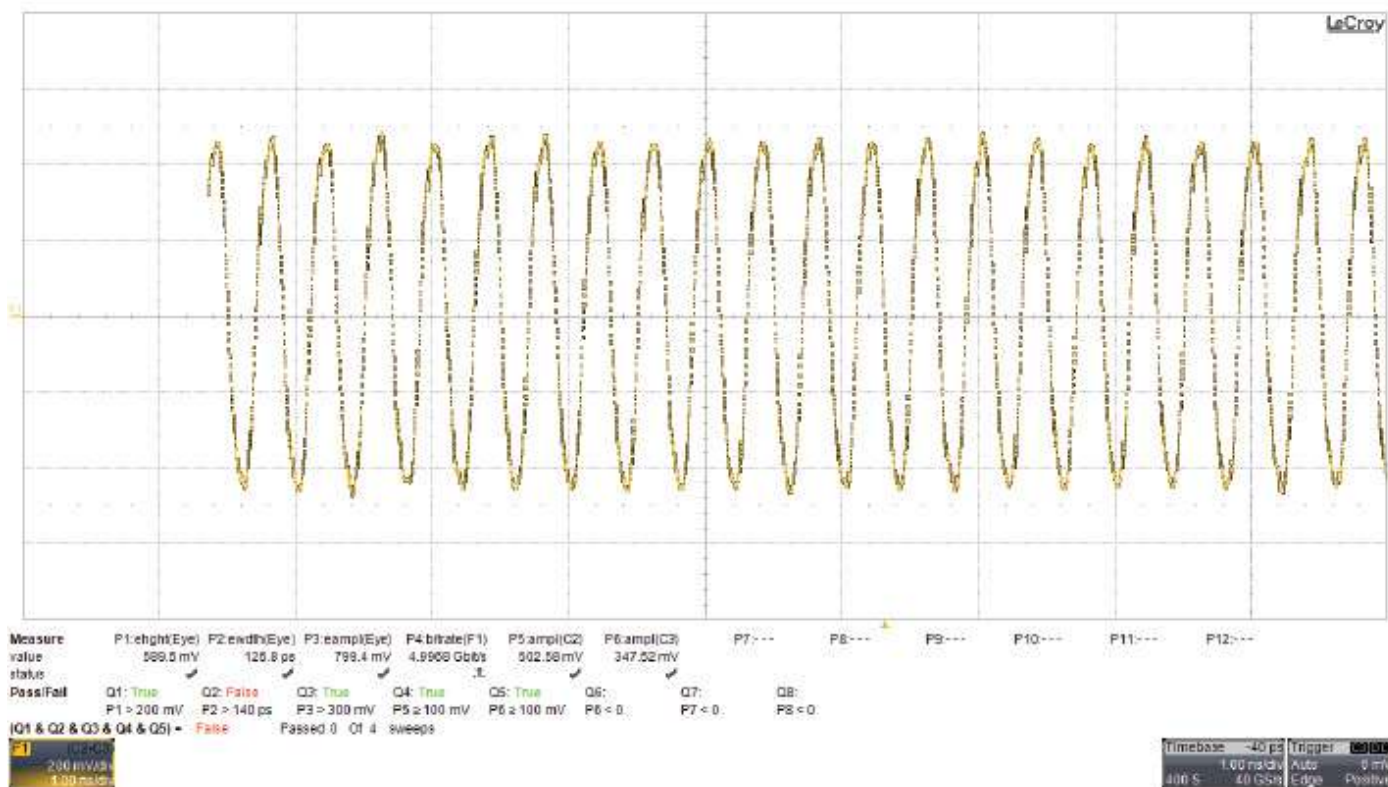


Figure 12.37: Typical CP1 Pattern

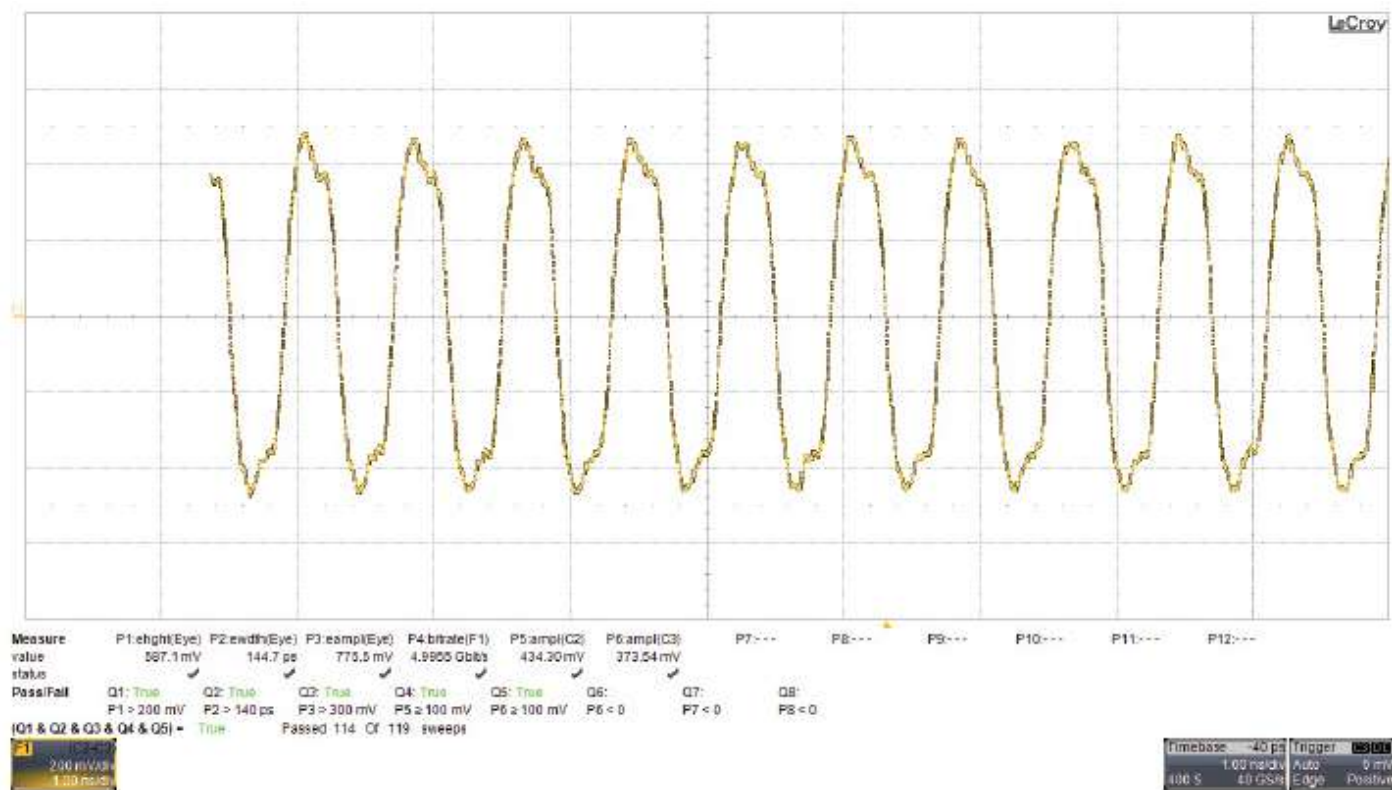


Figure 12.38: Typical CP2 Pattern

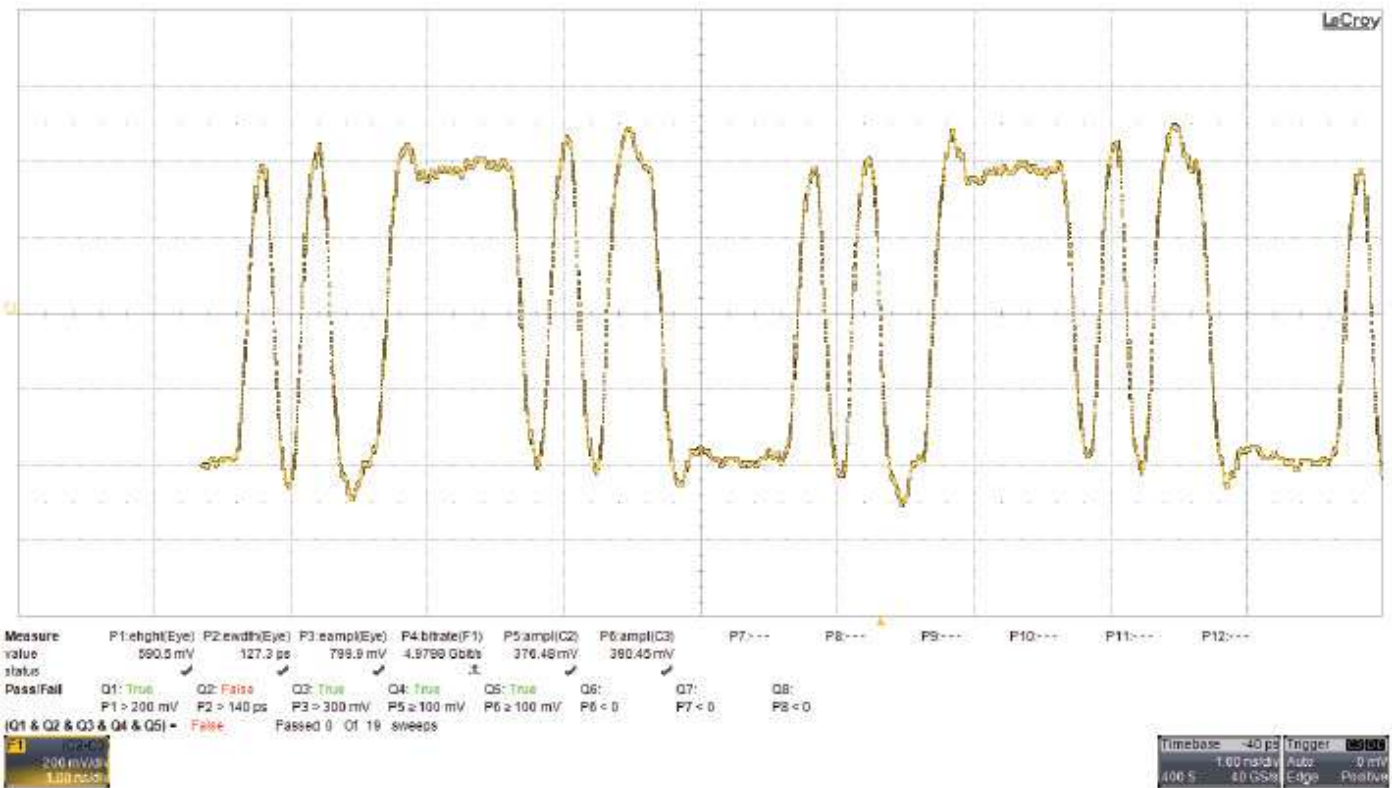


Figure 12.39: Typical CP3 Pattern

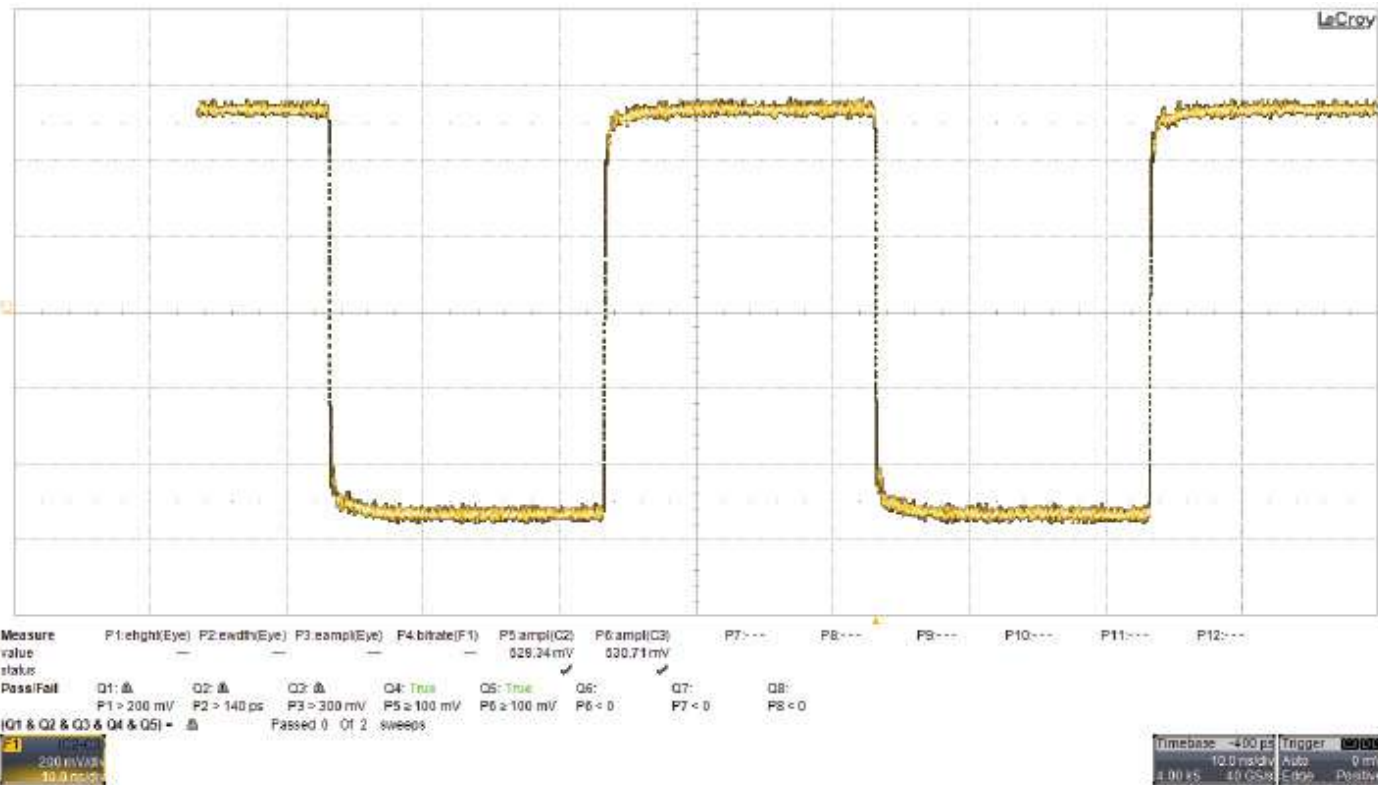


Figure 12.40: Typical CP5 Pattern

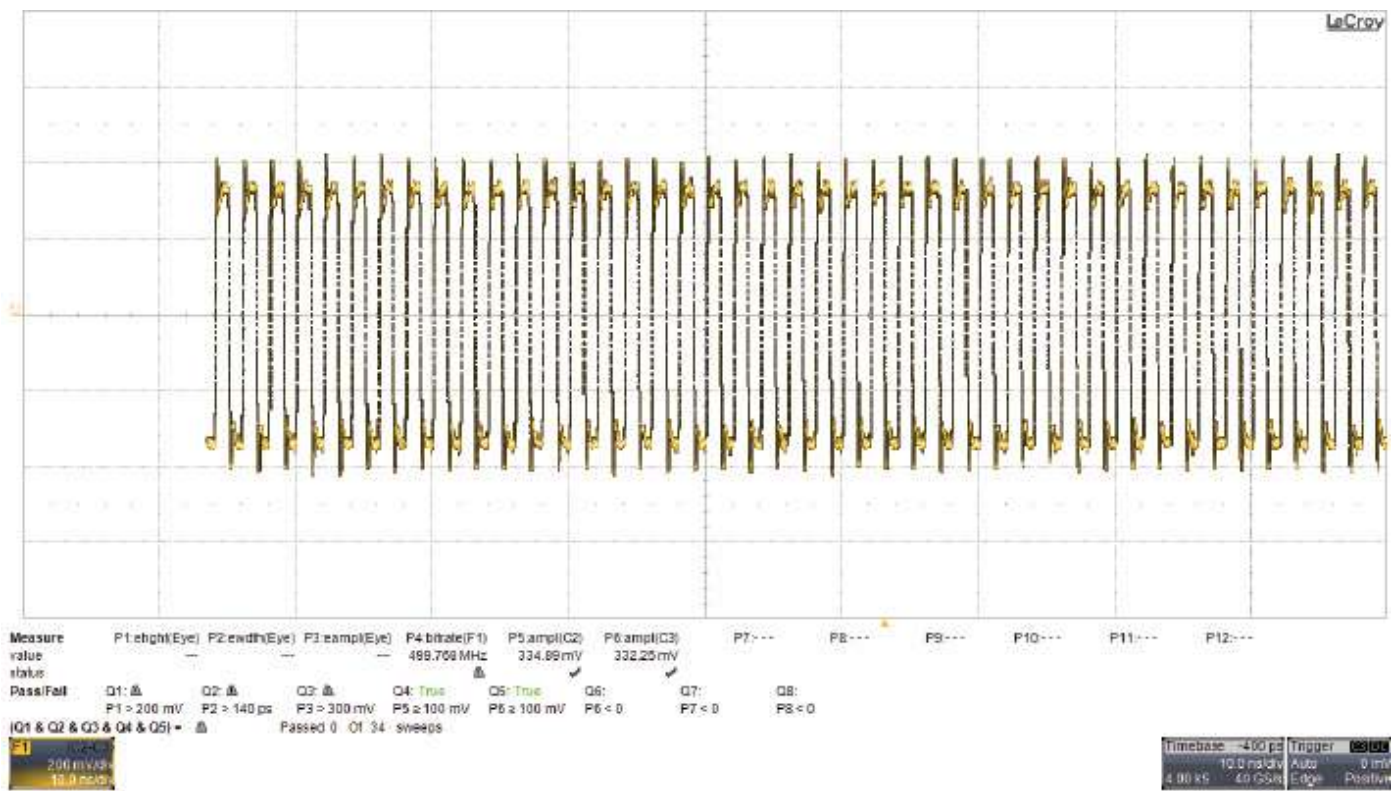


Figure 12.41: Typical CP6 Pattern

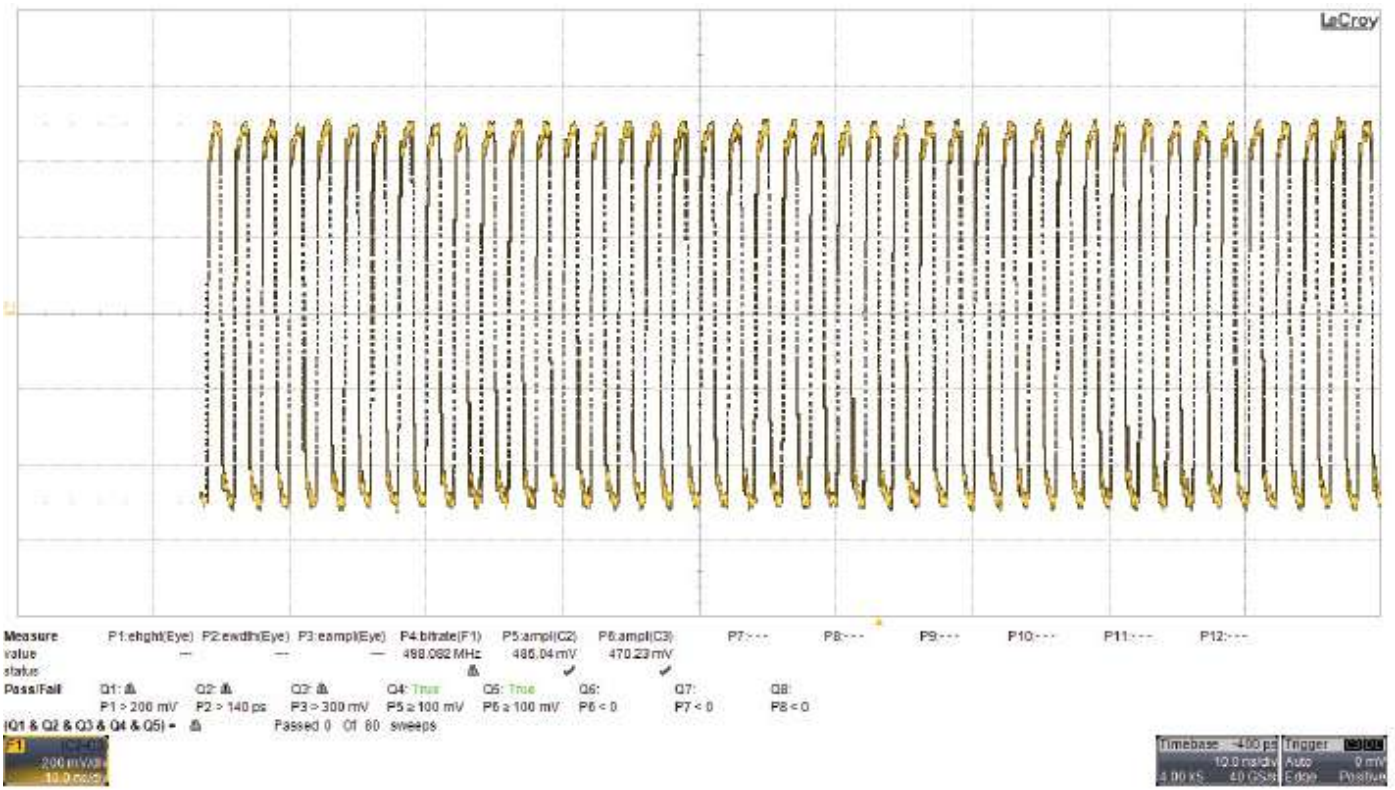


Figure 12.42: Typical CP7 Pattern

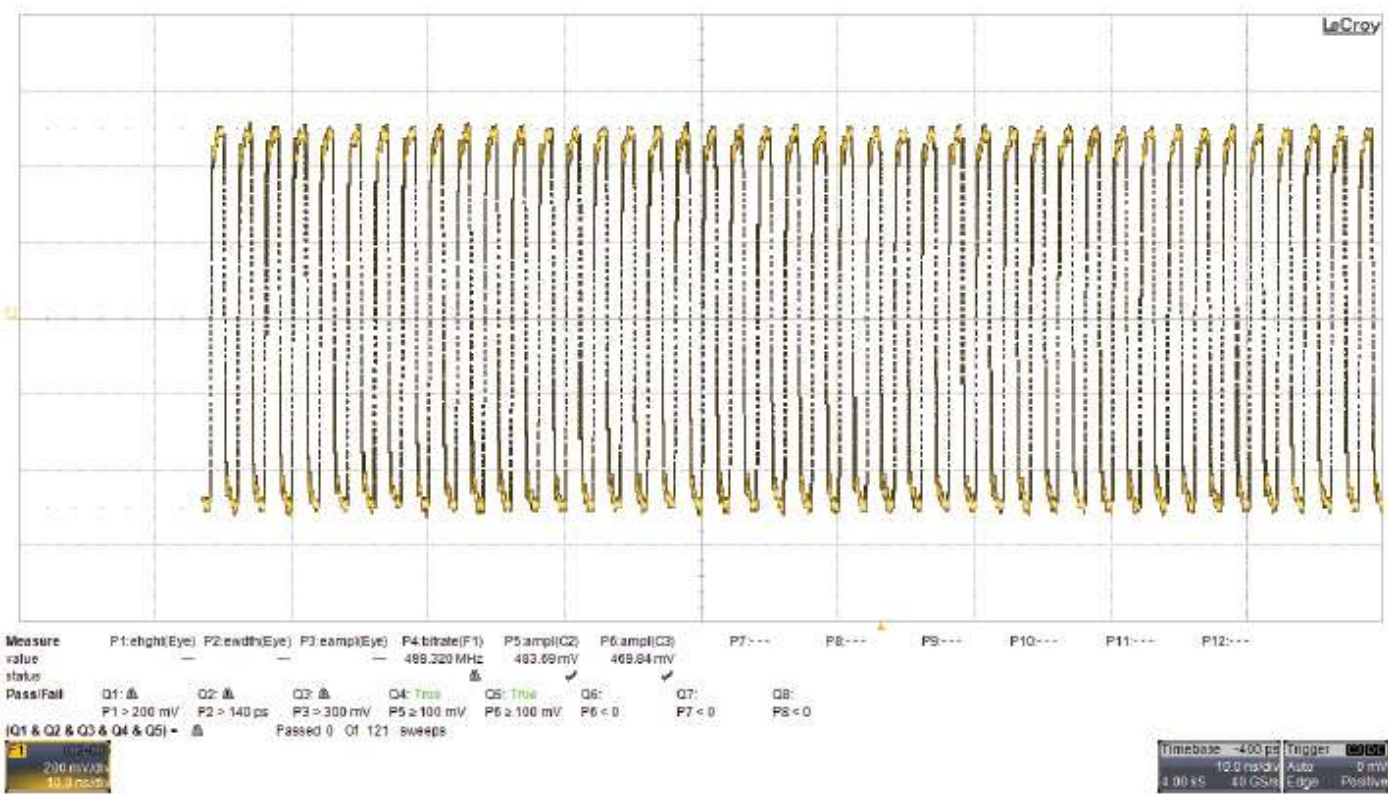


Figure 12.43: Typical CP8 Pattern

Note: CP patterns for 3.2 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.

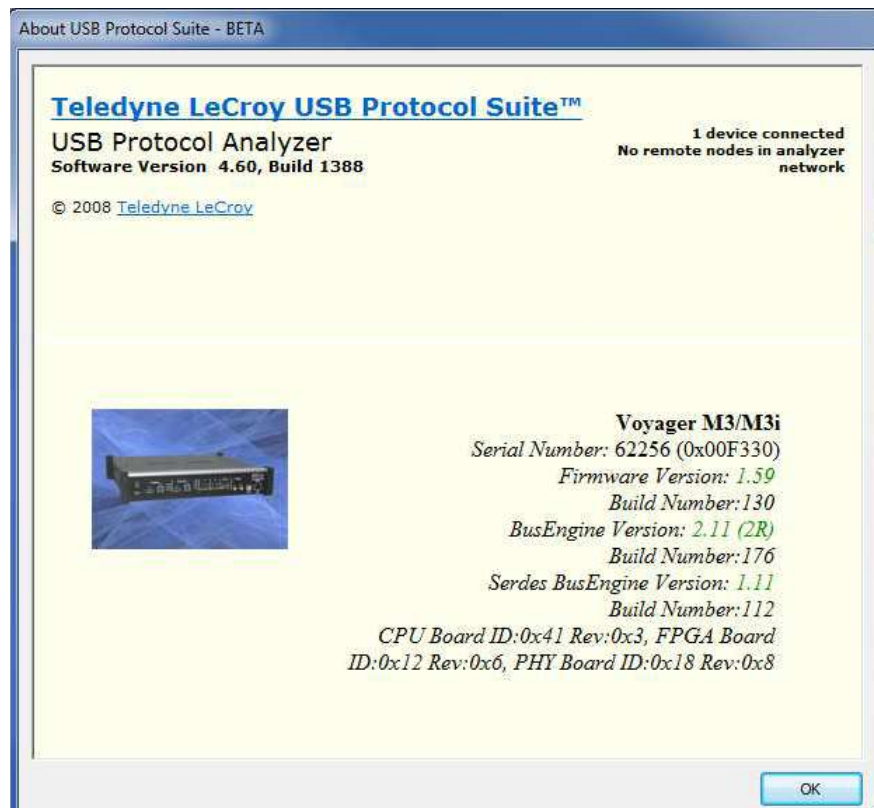


Figure 13.44: About Window

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. You can download the latest version of the USB Protocol Suite software from the following site:

<https://teledynelecroy.com/sw/usb/>

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:

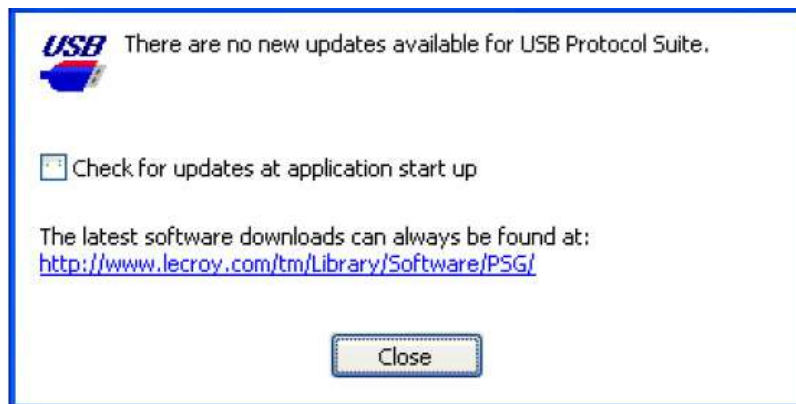


Figure 13.1: No Update Available Window

If an update is available, the window is:

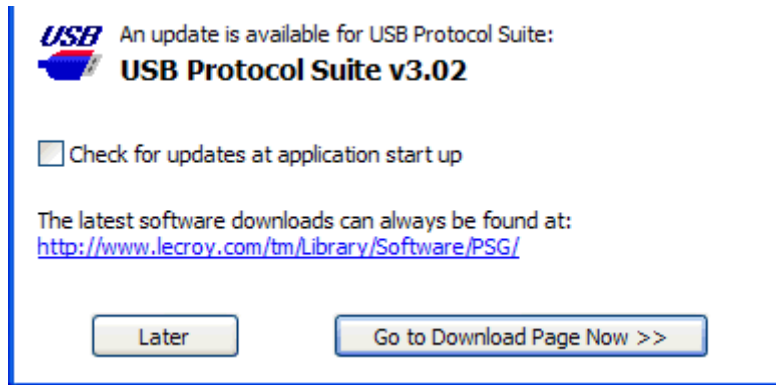


Figure 13.2: Update is Available Window

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.

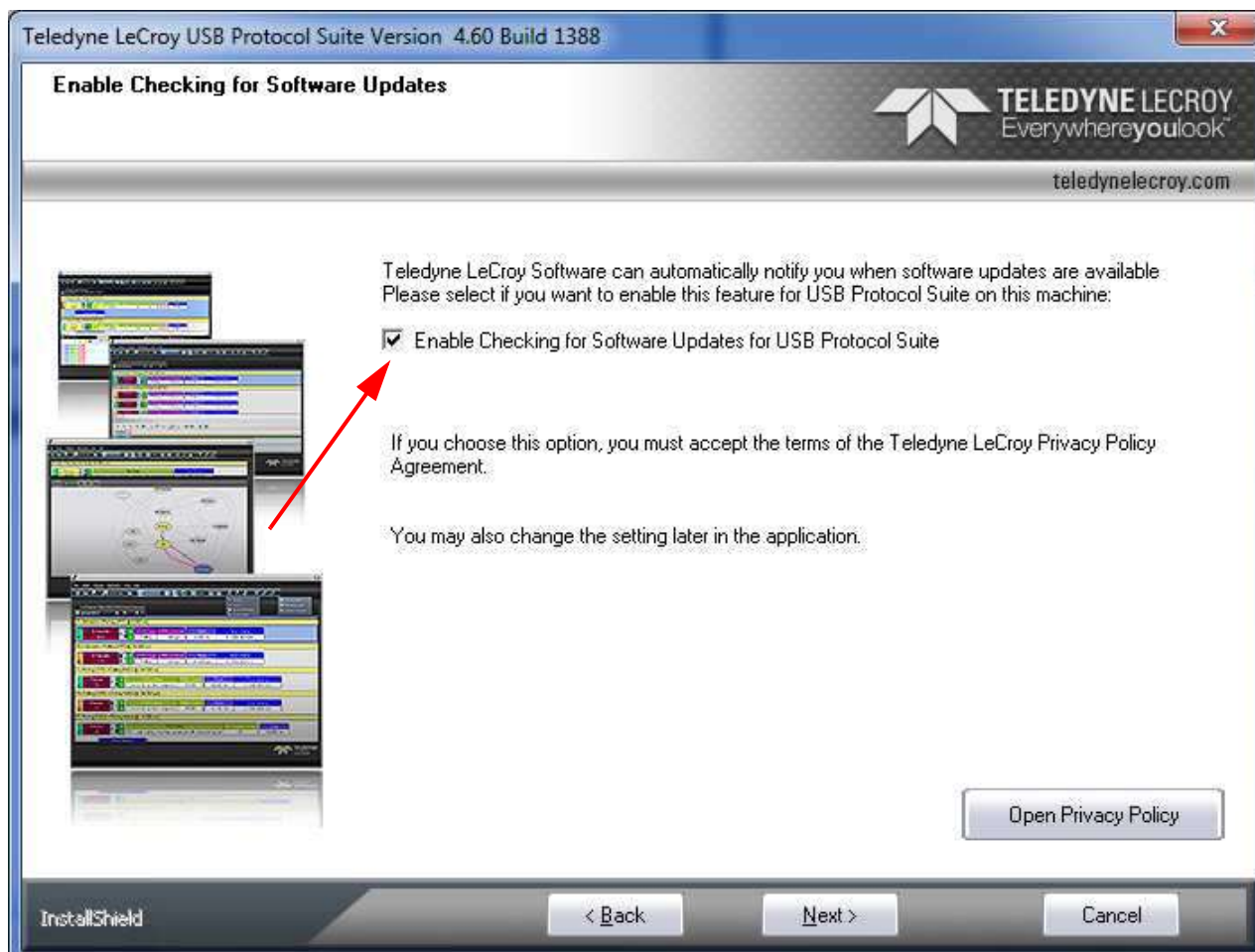


Figure 13.3: Checkbox for Automatic Updates

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:

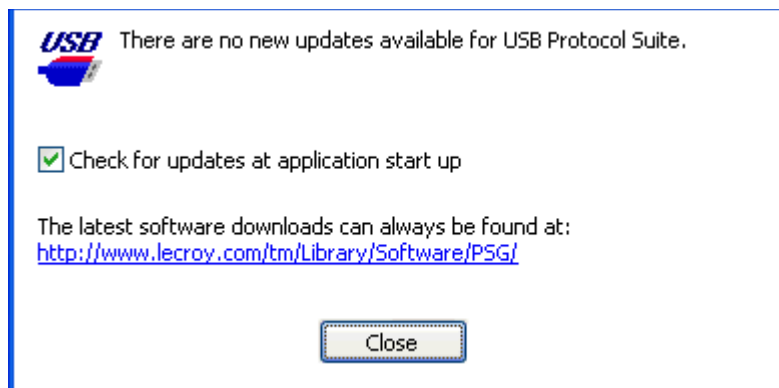


Figure 13.4: No Update Available Window

If an update is available, the window is:

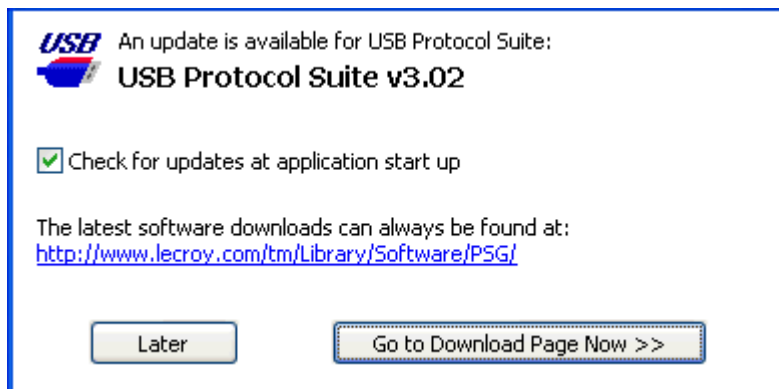


Figure 13.5: Update is Available Window

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):

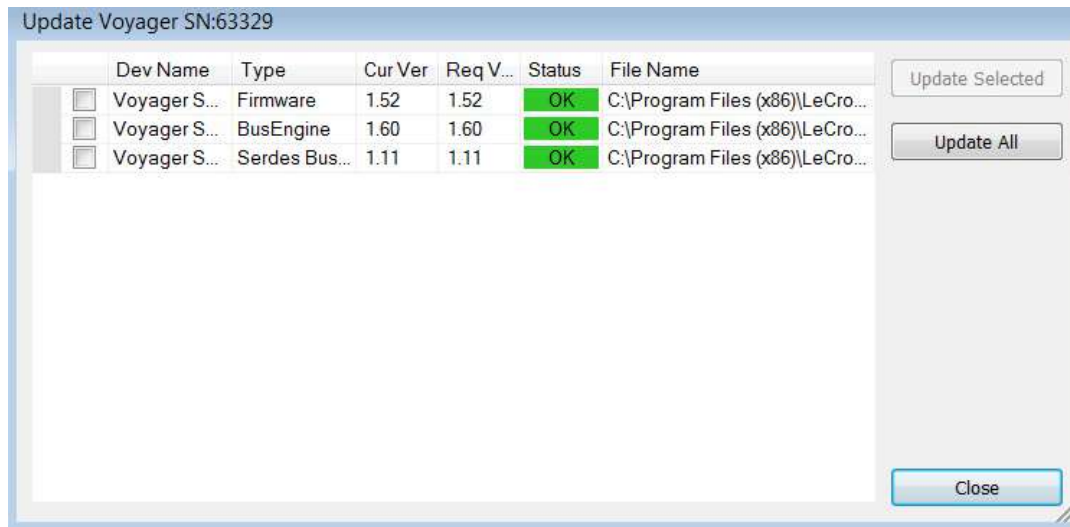


Figure 13.6: Update Device Dialog

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 Purchased and Trial Licenses

Teledyne LeCroy offers a single license with features in it for all USB analyzers (Voyager M4x, Voyager M3x, Voyager M310, Voyager M310C, Voyager M310P, Advisor T3, Mercury T2P, Mercury T2C and Mercury T2).

There are purchased and trial features.

Purchased features are permanent (or optionally subject to SW maintenance if any).

Trial features expire on a set date which is programmed at Teledyne LeCroy. It is valid till the end of the expiration date.

Both features may co-exist on an analyzer. The union of selected features will be enabled.

A one-time activation process may need to be completed on an analyzer in order to use trial features.

All new analyzers mentioned above will be activated at Teledyne LeCroy facility before shipping. In this case customers don't have to activate them.

13.4.1 Activation process

It is done automatically for the analyzer in most cases. User needs manually activate an analyzer only if it has trial features on non-activated analyzer and there is no internet connection. In this case user should connect the host PC with connected analyzer to the internet and press "Activate trial" button on License Information dialog. SW will explain particular steps user needs to do. Otherwise user can contact Teledyne LeCroy for help.

13.4.2 Downloading trial features

The same way as purchased features. Teledyne LeCroy will provide a file with trial features which user needs to download into the analyzer. Then activate it if needed. SW will indicate the status of trial features.

13.4.3 Popups

SW will check trial licenses available on the device automatically upon connection and shows popup window with license related information if needed. There are some cases when such a notifications are shown, like trial is about to expire, trial expires tomorrow, trial has recently expired and activation required.

13.4.4 License Information dialog

Purchased and trial features could always be seen in License Information dialog (**Help --> Display License information... menu**).

13.4.5 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). See [Figure 13.7](#).

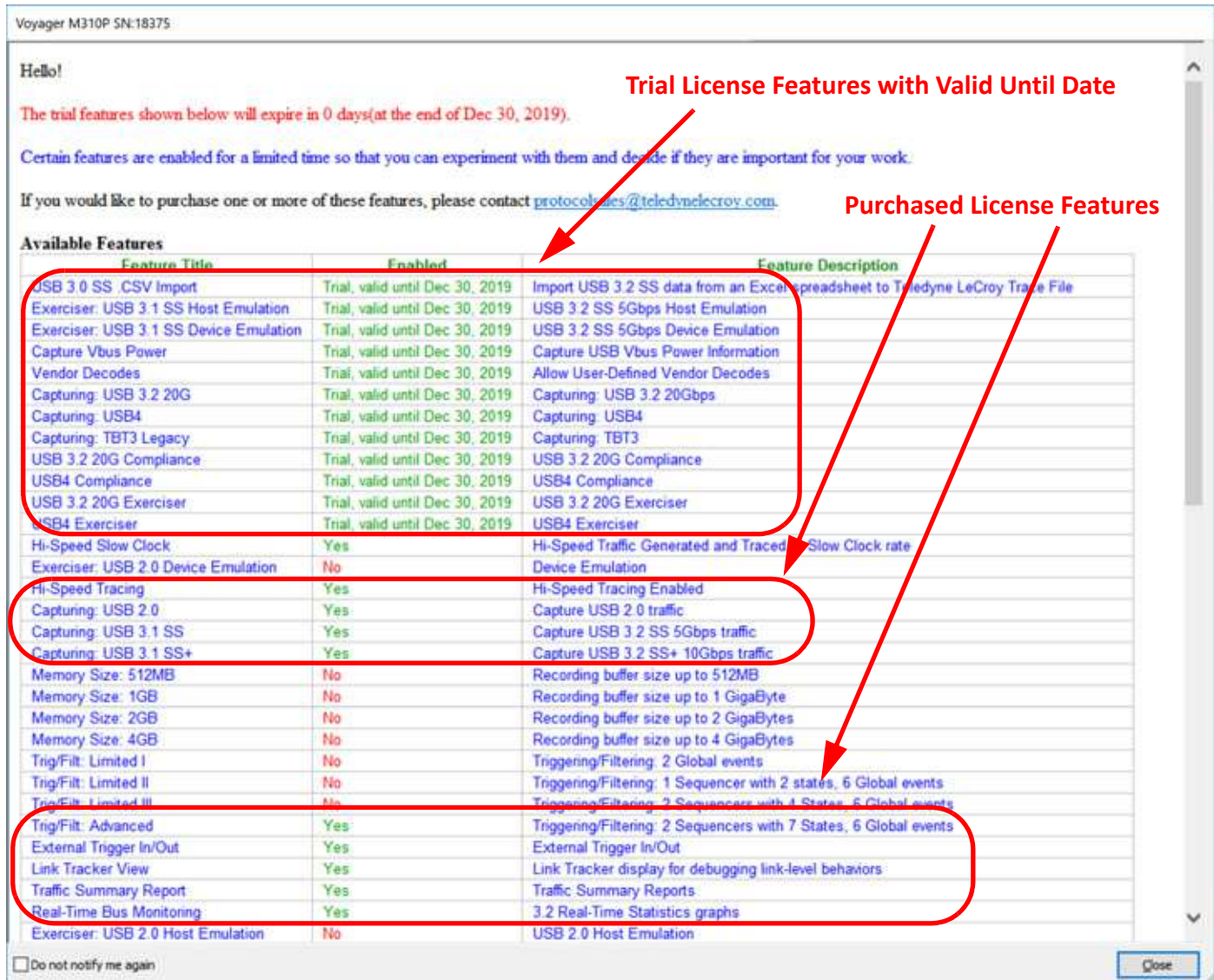


Figure 13.7: License File Showing Both Trial and Purchased Features

Named features enabled on your host machine are indicated by **Yes** in the Purchased column. Names features enabled on your host machine for a Trial period are indicated by "Trial valid until DATE". Named features that are not enabled on your host machine are indicated by **No** in the Enabled 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.

13.4.6 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 13.8](#)).
1. Select **Install License File** to display the Select License Key File dialog.

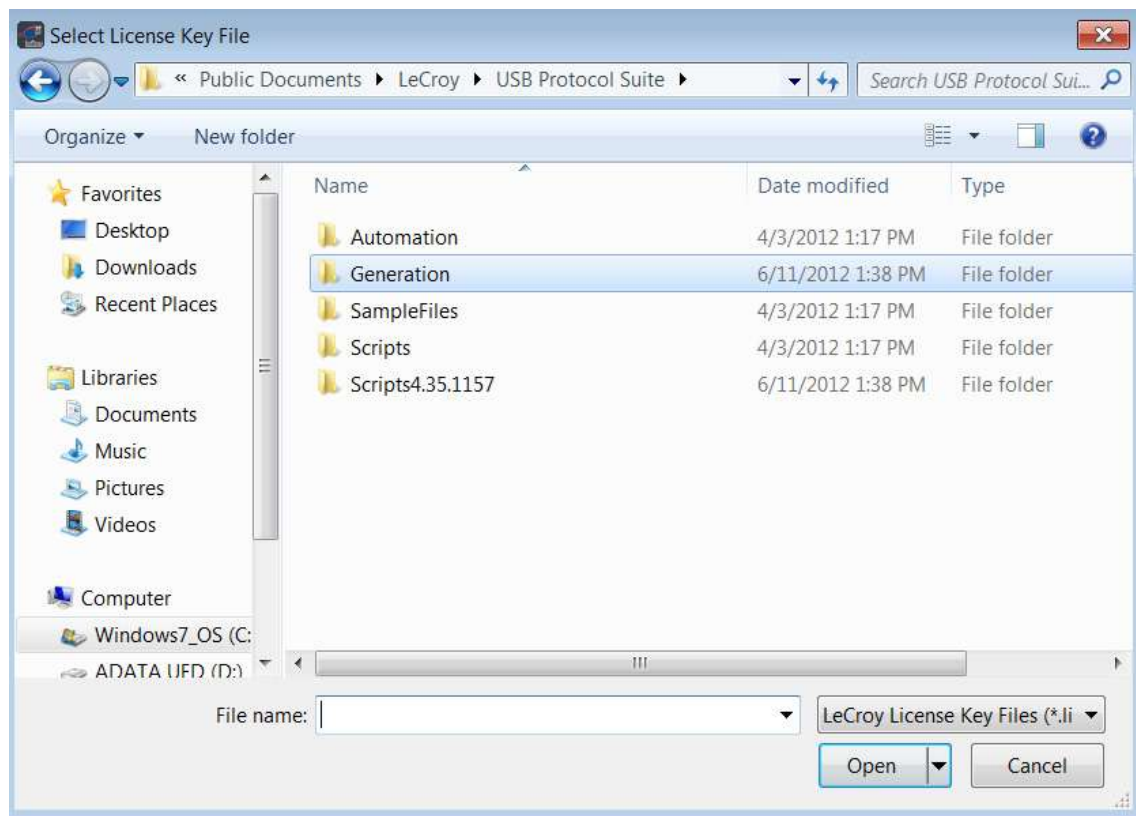


Figure 13.8: Select License Key File Dialog

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**.

13.5 Registering Online

To register the product online, select **Help > Register Product Online**.

Appendix A

How to Contact Teledyne LeCroy

Send e-mail to Support	psgsupport@teledyne.com
Contact support	teledynelecroy.com/support/contact
Visit Teledyne LeCroy's web site	teledynelecroy.com
Tell Teledyne LeCroy	Report a problem to Teledyne LeCroy Support via e-mail by selecting Help > Tell Teledyne LeCroy from the application toolbar. This requires that an e-mail client be installed and configured on the host machine.

Appendix B

China Restriction of Hazardous Substances Table

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

部件名称	有毒有害物质和元素					
	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

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

EFUP (Environmental Friendly Use Period) Use Conditions:

Temperature 5C to 40C

Humidity 5% to 95% max RH (non-condensing)

Altitude Up to 2000 meters

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