USB Protocol Suite User Manual



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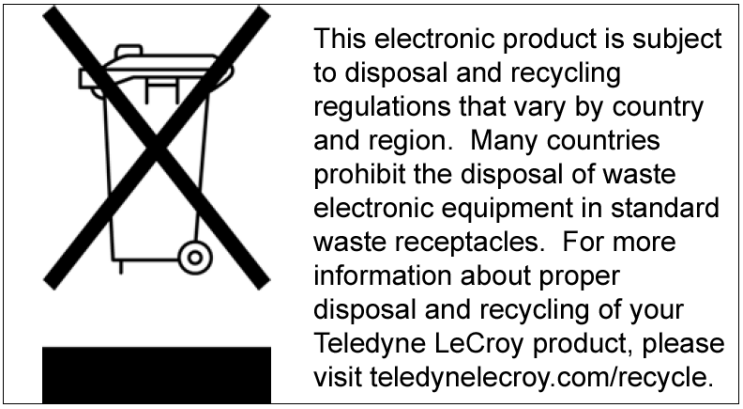
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WEEE Program



Teledyne LeCroy
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Chapter 1

Overview

1.1 About USB Protocol analyzers

Teledyne LeCroy USB protocol analyzers connect to portable or desktop host machines. analyzers are configured and controlled by USB Protocol Suite software, which installs onto host machines running 64-bit versions of Microsoft® Windows® Server 2019, Windows Server 2016, Windows 11, or Windows 10.

analyzers provide 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 (see *Real-Time Event Triggering and Capture Filtering*). Filtering also allows you to preserve recording memory, for extended recording time.

The trace viewer application (see *Graphical Bus Traffic Display*) 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 provides on-the-fly detection of, and triggering on, events like Tokens and Errors (see *Comprehensive Error Detection and Analysis*). Whether recording manually or with a specified trigger condition, the system continuously records the link data, in a wraparound 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 search to investigate 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.

NOTE:	Voyager M480x and M4x analyzers support both USB4 and Thunderbolt 3 (TBT3) capture and analysis. The term **USB4** is used throughout this manual to denote the features involving capturing both USB4 traffic *and* legacy TBT3 traffic. Where differences exist, a note will provide explanation.

1.1.1 USB Protocol Specifications

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

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

1.2 Common Features

While there are some differences between the range of Teledyne LeCroy analyzers, there are also many shared features.

1.2.1 Graphical Bus Traffic Display

In the Trace Viewer, bus traffic displays use color and graphics to show captured transactions (Figure 1.1). Packets appear on separate rows, and receive timestamps and sequential numbers as the system records them. Fields have labels and color codes. When the system automatically detects protocol errors, they are highlighted in red. The display color scheme and field formats are customizable.

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. The display software operates independently of the hardware, allowing it to function as a standalone "trace viewer" that you can freely distribute.

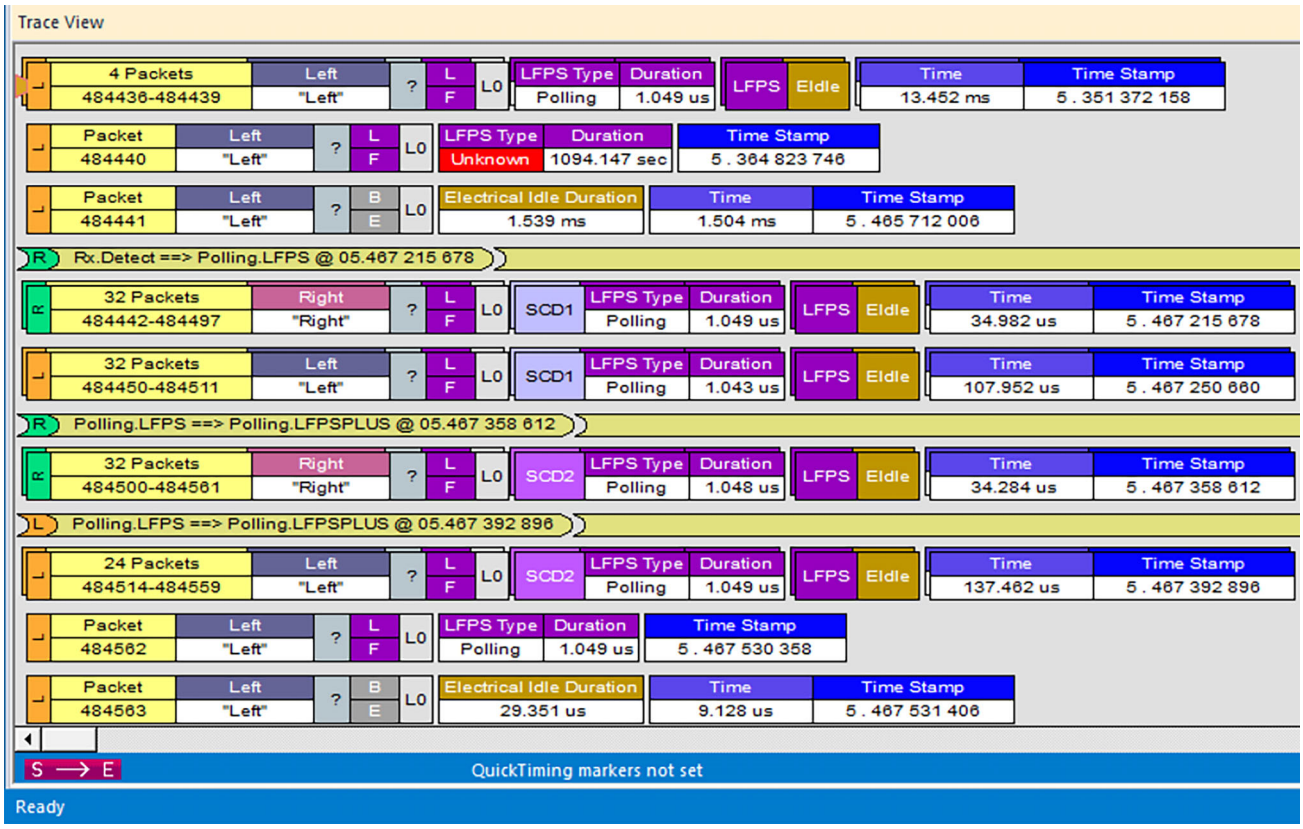


Figure 1.1: Trace Viewer

1.2.2 Accurate Time Measurement

The internal counter/timer circuitry enables reliable, accurate time-stamping of recorded bus traffic. Traces and measurement and analysis functions display this timing information. Time fields are timestamps, 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 technology, the system can make accurate timing calculations while still preserving valuable recording memory for important bus traffic.

1.2.3 CrossSync Control Panel

The CrossSync Control Panel allows you to select analyzers for synchronization and manage the recording process. It supports a wide combination of Teledyne LeCroy 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 buses. 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 4.12.4 *CrossSync Control Panel*).

1.2.4 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.

1.2.5 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.

1.2.5.1 Advanced Event Counting and Sequencing

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

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.

1.2.6 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.

1.2.7 General Analyzer Specifications

- Fully complies with USB specification revisions
- Uses field-upgradeable firmware and recording engine
- 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 (M480x, M4x, M310e, M310P, M310C, T2C, T2P)
- 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 an online manual
- Self-diagnoses at power on
- Uses software-upgradeable Exerciser function (M480x, M4x, M310e, M310P, M310C, M310, M3x)
- Allows remote control of USB analyzers from a local PC or on a network

1.2.8 Common Physical Components

Teledyne LeCroy USB analyzer families share many components:

- Plug-and-play USB installation
- USB 3.2 Super-Speed connection to desktop or portable host machine (M480x, M4x, M310e, M310P, M310C, M310, M3x)
- USB 2.0 Hi-Speed connection to desktop or portable host machine (T3, T2C, T2P, T2)
- USB 3.2 USB Type-C™ type connectors for capture and generation USB 3.2 Super-Speed connection to desktop or portable host machine (M480x, M4x, M310e, M310P, M310C)

- Integrated CATC Sync ports to support cascading analyzers or Cross-Sync configurations USB 3.2 Super-Speed connection to desktop or portable host machine (M480x, M4x, M310e, M310P, M310C, M310, M3x)

1.2.9 Recording Options

Teledyne LeCroy USB analyzers share 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) (USB 2.0)
- CATC Trace display and enumeration of High-Speed Micro Frames (USB 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) (USB 2.0)
- Advanced triggering with event counting and sequencing
- Dedicated trigger for recording input and output used to interface to external test equipment (Optional purchase item for T2P, T2C, T2)
- 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 (USB 2.0)
- Real-time traffic capture filtering and data packet truncation variable up to 256 bytes (USB 2.0)
- Adjustable buffer size
  - Up to 32 GB (M480x, M4x)
  - Up to 16 GB (M310, M310e M310P, M310C)
  - Up to 4 GB (M3x)
  - Up to 2 GB (T3)
  - Up to 512 MB (T2P)
  - Up to 256 MB (T2C, T2)
- Idle filtering

1.2.10 Display Options

Many display options are the same for analyzers.

- 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 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 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 (USB 2.0 and USB 3.2)
- Uses Link Tracker to view symbols of traffic (not available on Mercury-series analyzers)
- Uses a Spec View to show packets in the same format as the USB 3.2 specification (not available on Mercury-series analyzers)
- Uses Quick Timing Markers to immediately show time deltas and bandwidth use
- Power Tracker view shows Current and Voltage samples coordinated with Packet timestamps.

1.2.11 LFPS Signals

1.2.11.1 Voyager M480x, M4x, M310e, M310P, M310C, M310

Voyager **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.

1.2.11.2 Voyager M3x

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.

1.2.12 Traffic Generation (M480x, M4x, M310e, M310P, M310C, M310, M3x)

USB 2.0 and USB 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.

1.2.12.1 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 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.

1.2.12.2 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 Voyager M480x Analyzer



Warning: The Voyager M480x 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 can cause damage to the devices under test and their cables. Use caution when writing scripts so that these limitations are not exceeded.**
- **Power-cycle the M480x unit after PD usage to insure that the go back to their default Voltage and Current states.**

The Teledyne LeCroy Voyager M480x is the first protocol analyzer for testing next-generation USB4 80Gb/s systems. The new platform leverages Teledyne LeCroy probe technology to support Gen-4 (PAM-3) signaling as well as USB4 Gen-3, Gen-2, Thunderbolt™ in addition to

legacy USB 3.2 speeds. Based on the Voyager platform, the M480x captures asymmetric link operation and tunneled DisplayPort 2.1 with complete decoding of USB4 protocol.



Figure 1.2: Voyager M480x Analyzer Exerciser System

See the ReadMe file from the software installation site for the latest on host machine requirements and supported operating systems: https://teledynelecroy.com/sw/usb/

1.3.1 USB4, USB 3.2, and USB 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. Analysis of 80 Gbps traffic requires the use of short, low-loss, high quality cables, as provided by Teledyne LeCroy with your M480x product. Use of other cables may compromise the signal quality and prevent capturing of the traffic. Electronically Marked cables may be used in either of 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.

1.3.2 Features

In addition to the features it has in common with other analyzers, the M480x also has the following specifications.

1.3.2.1 General

- Supports the following USB speeds: USB4 80/40/20 Gb/s, USB 3.2 20Gb/s, 10Gb/s, 5Gb/s, USB 2.0, 480 Mb/s, 12 Mb/s, and 1.5 Mb/s

1.3.2.2 Physical Components

- 32 GB of physical data-recording memory

1.4 Voyager M4x Analyzer



Warning: The Voyager M4x 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 can cause damage to the devices under test and their cables. Use caution when writing scripts so that these limitations are not exceeded.**
- **Power-cycle the M4x unit after PD usage to insure that the go back to their default Voltage and Current states.**

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 connects to a laptop or desktop via its USB or Gigabit Ethernet port.

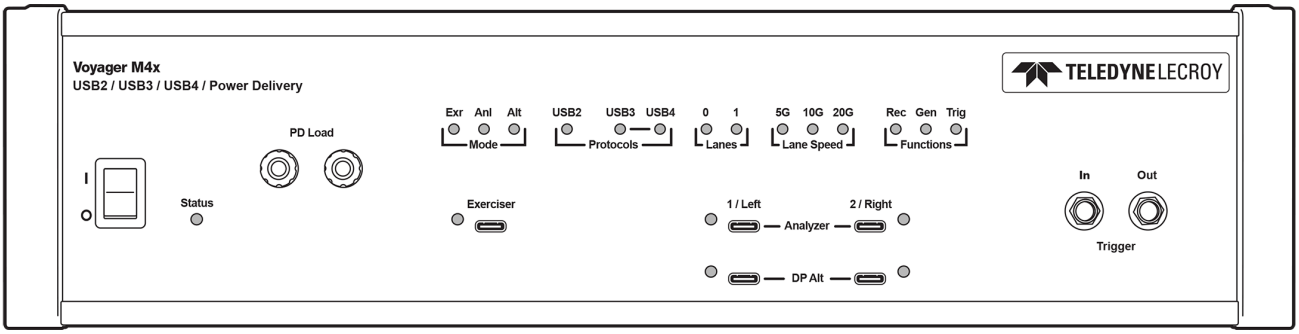


Figure 1.3: Voyager M4x Analyzer Exerciser System

See the ReadMe file from the software installation site for the latest on host machine requirements and supported operating systems: https://teledynelecroy.com/sw/usb/

1.4.1 USB4, USB 3.2, and USB 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 (Figure 1.4). 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. Electronically Marked cables may be used in either of 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.

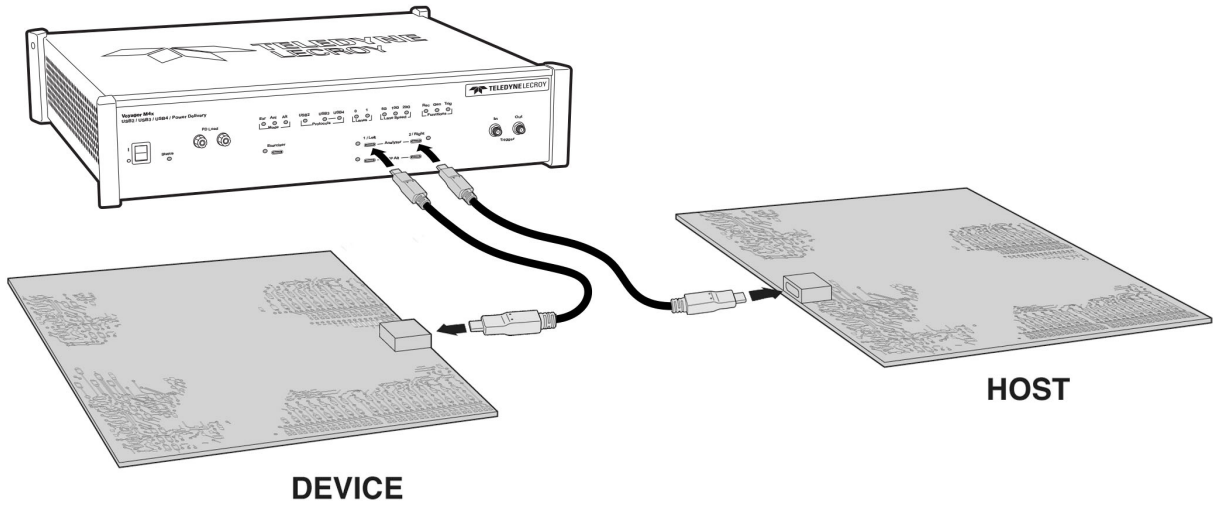


Figure 1.4: Typical Direct Connection using USB 3.2 Cables

1.4.2 Features

In addition to the features it has in common with other analyzers, the M4x also has the following specifications.

1.4.2.1 General

- Supports the following USB speeds: USB4 40/20 Gb/s, USB 3.2 20Gb/s, 10Gb/s, 5Gb/s, USB 2.0, 480 Mb/s, 12 Mb/s, and 1.5 Mb/s

1.4.2.2 Physical Components

- 32 GB of physical data-recording memory

1.5 Voyager M310e Analyzer



Warning: The Voyager M310e 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 can cause damage to the devices under test and their cables. Use caution when writing scripts so that these limitations are not exceeded.**
- **Power-cycle the M310e unit after PD usage to insure that the go back to their default Voltage and Current states.**

The Teledyne LeCroy Voyager M310e™ Protocol Analyzer/Exerciser is a multifunction verification system for USB development and testing. It supports USB 3.2 Gen 1 (5 Gbps) and Gen 2 (10 Gbps), as well as USB 2.0, Power Delivery (PD) 2.0 and 3.1 (with EPR) and USB Type-C™ event data over the “C” connector cables. Power Delivery capture is available for SOP, SOP’ and SOP’’ traffic. PD packets can be captured and displayed in an Eye Diagram for use in

USB-IF PD Compliance, which is fully supported on M310e. The M310e is built to support the latest PD exerciser capability, with the ability to sink or source up to 240 Watts. The M310e can sink or source voltages from 5 to 48 VDC (with an attached programmable power supply or electronic load) and currents from 0 to 5 Amps. It can also verify and display the configuration channel (CC) data coming from connected ports and cables. The Voyager M310e is designed to record USB traffic and graphically present the logical transactions and events. It can also be configured to generate USB Gen 1 (5 Gbps) and Gen 2 (10 Gbps), as well as USB 2.0 traffic. The Voyager M310e connects to a laptop or desktop host machine via its SuperSpeed USB or Gigabit Ethernet port.

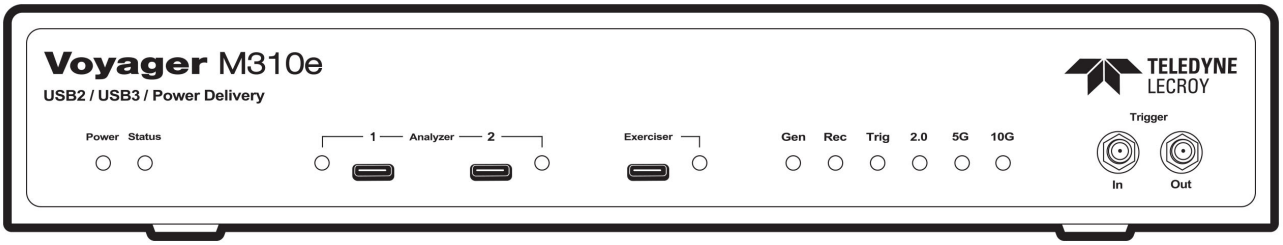


Figure 1.5: Voyager M310e Analyzer Exerciser System

See the ReadMe file from the software installation site for the latest on host machine requirements and supported operating systems: https://teledynelecroy.com/sw/usb/

1.5.1 USB 3.2 and USB 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 (Figure 1.6). 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 M310e product. Use of other cables may compromise the signal quality and prevent capturing of the traffic. Electronically Marked cables may be used in either of the connectors marked “Left” and “Right”.

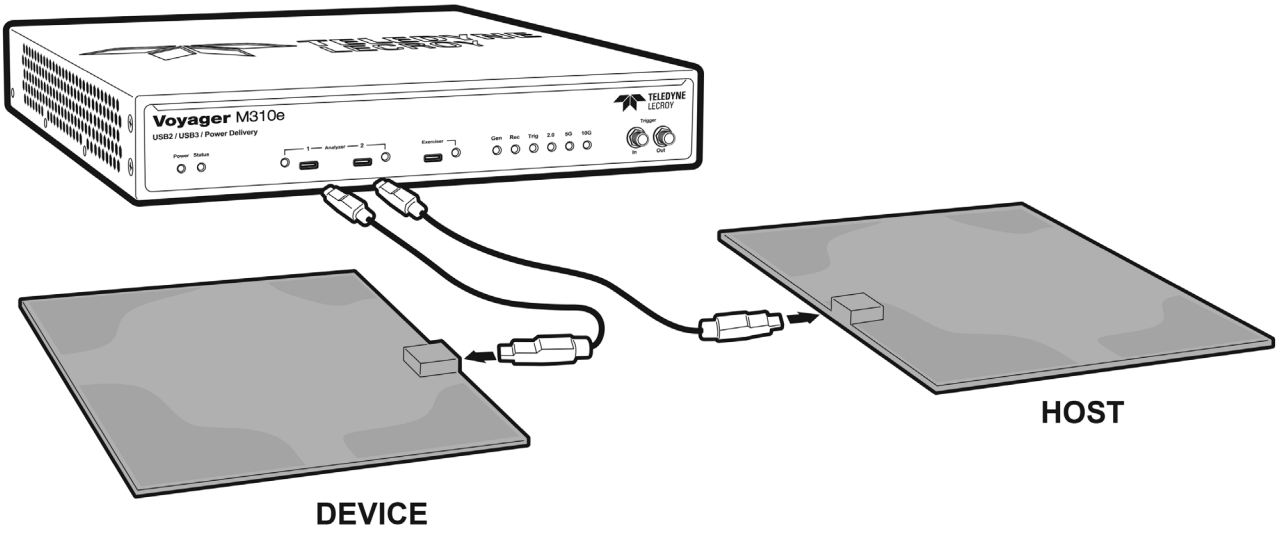


Figure 1.6: Typical Direct Connection using USB 3.2 Cables

1.5.2 Features

In addition to the features it has in common with other analyzers, the M310e also has the following specifications.

1.5.2.1 General

- Supports latest PD exerciser capability for EPR with the ability to sink or source up to 240 Watts
- Supports the following USB speeds: 10GB/s, 5 Gb/s, 480 Mb/s, 12 Mb/s, and 1.5 Mb/s
- Passive Tapping of the SuperSpeed Signals is the least intrusive method of capturing packets and events: No Termination Proxies necessary

1.5.2.2 Physical Components

- 16 GB of physical data-recording memory

1.6 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 can cause damage to the devices under test and their cables. Use caution when writing scripts so that these limitations are not exceeded.**
- **Power-cycle the M310P unit after PD usage to insure that the 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 connects to a laptop or desktop via its USB or Gigabit Ethernet port.

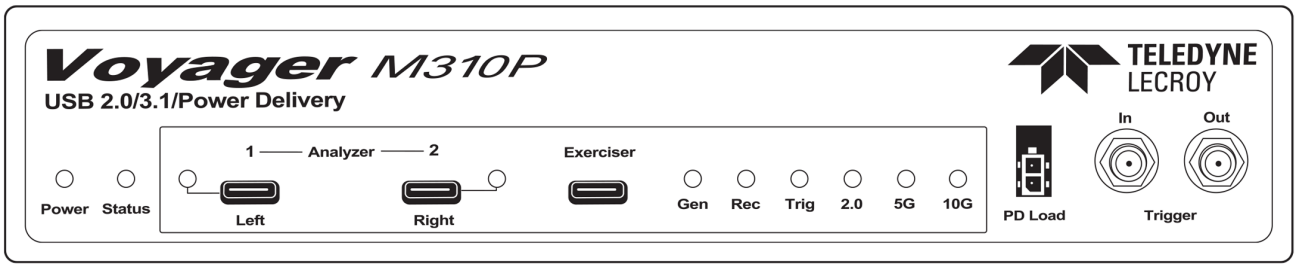


Figure 1.7: Voyager M310P Analyzer Exerciser System

See the ReadMe file from the software installation site for the latest on host machine requirements and supported operating systems: https://teledynelecroy.com/sw/usb/

1.6.1 USB 3.2 and USB 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 (Figure 1.8). 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. Electronically Marked cables may be used in either of the connectors marked “Left” and “Right”.

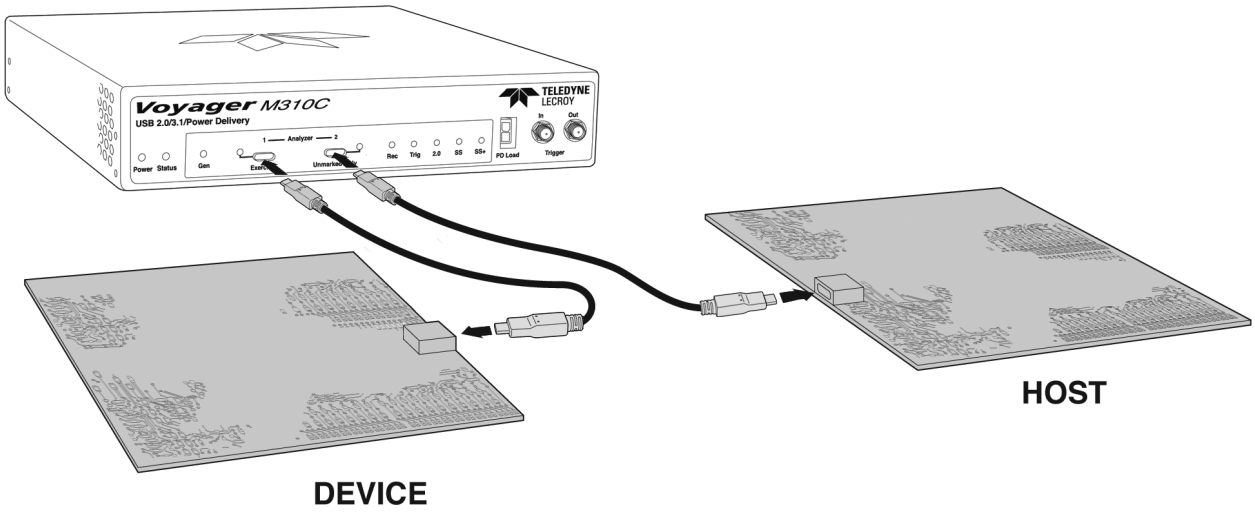


Figure 1.8: Typical Direct Connection using USB 3.2 Cables

1.6.2 Features

In addition to the features it has in common with other analyzers, the M310C has the following specifications.

1.6.2.1 General

- Supports the following USB speeds: 10GB/s, 5 Gb/s, 480 Mb/s, 12 Mb/s, and 1.5 Mb/s
- Passive Tapping of the SuperSpeed Signals is the least intrusive method of capturing packets and events: No Termination Proxies necessary

1.6.2.2 Physical Components

- 16 GB of physical data-recording memory

1.7 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 can cause damage to the devices under test and their cables. Use caution when writing scripts so that these limitations are not exceeded.**
- **Power-cycle the M310C unit after PD usage to insure that the 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 connects to a laptop or desktop via its USB or Gigabit Ethernet port.

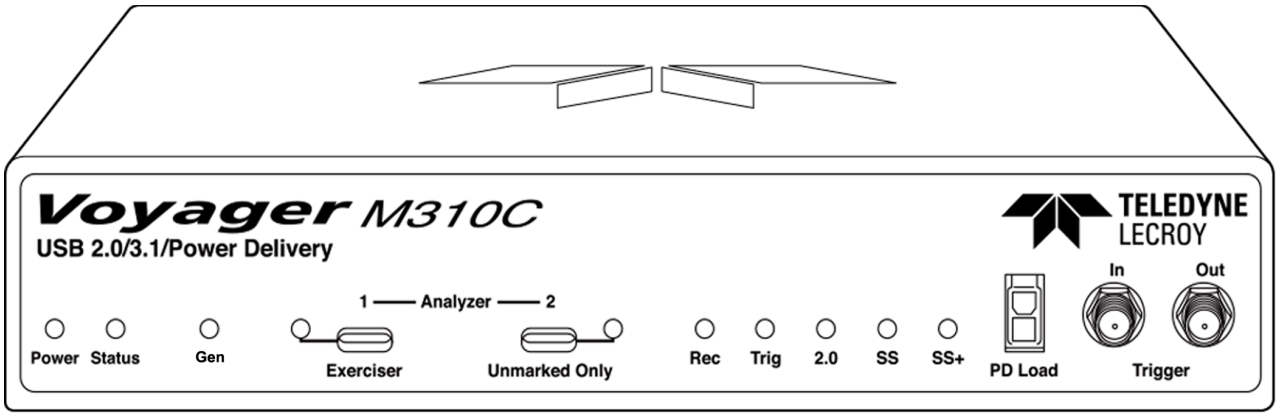


Figure 1.9: Voyager M310C Analyzer Exerciser System

See the ReadMe file from the software installation site for the latest on host machine requirements and supported operating systems: https://teledynelecroy.com/sw/usb/

1.7.1 USB 3.2 and USB 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 (Figure 1.10). 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".

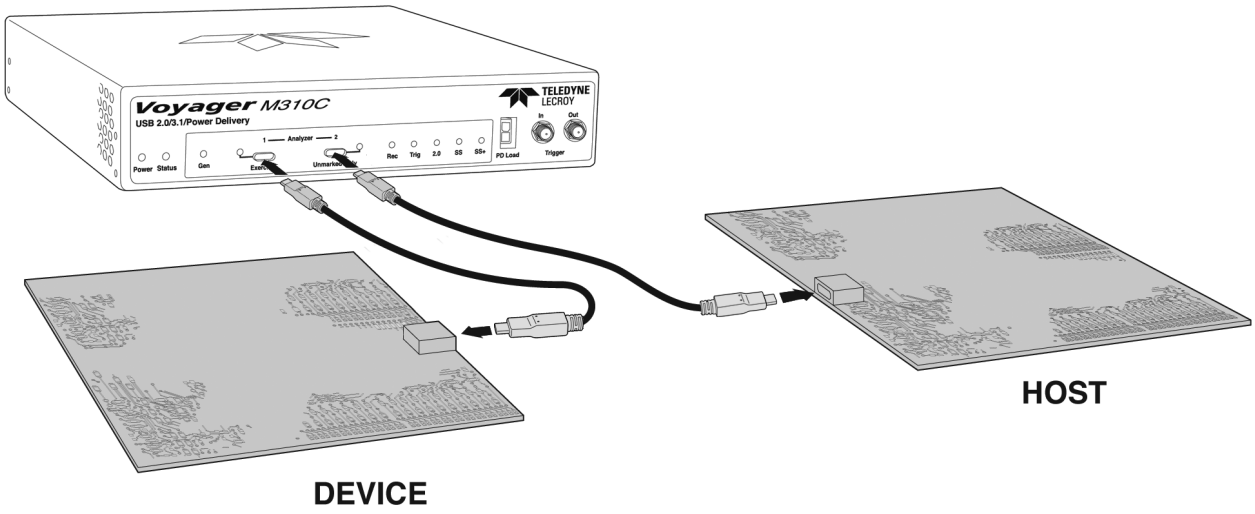


Figure 1.10: Typical Direct Connection using USB 3.2 Cables

1.7.2 Features

In addition to the features it has in common with other analyzers, the M310C:

1.7.2.1 General

- Supports the following USB speeds: 10GB/s, 5 Gb/s, 480 Mb/s, 12 Mb/s, and 1.5 Mb/s

1.7.2.2 Physical Components

- 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

1.8 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 connects to a laptop or desktop via its USB or Gigabit Ethernet port.

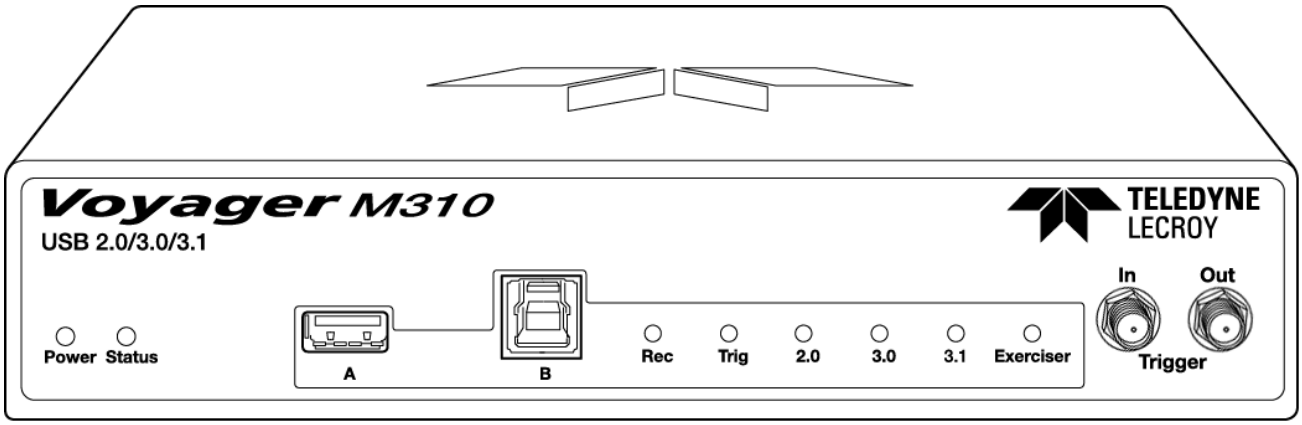


Figure 1.11: Voyager M310 Analyzer Exerciser System

See the ReadMe file from the software installation site for the latest on host machine requirements and supported operating systems: https://teledynelecroy.com/sw/usb/

1.8.1 USB 3.2 and USB 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 (Figure 1.12).

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. 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.

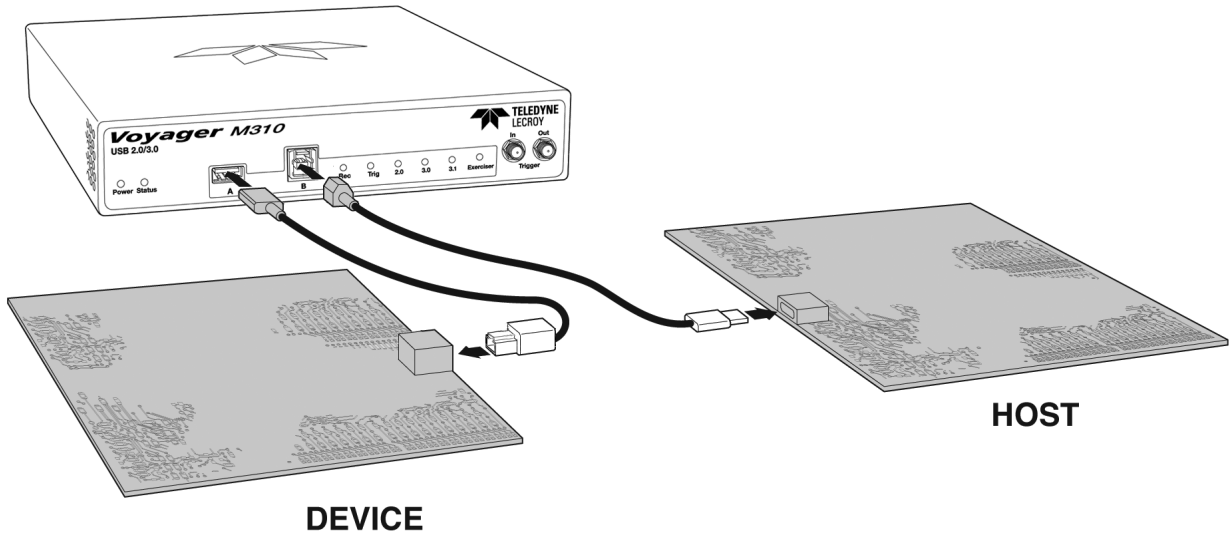


Figure 1.12: Direct Connection using USB 3.2 Cables

1.8.2 Features

In addition to the features it has in common with other analyzers, the M310 has the following specifications.

1.8.2.1 General

- Supports the following USB speeds: 10GB/s, 5 Gb/s, 480 Mb/s, 12 Mb/s, and 1.5 Mb/s

1.8.2.2 Physical Components

- 16 GB of physical data-recording memory

1.9 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 connects to a laptop or desktop via its USB or Gigabit Ethernet port.

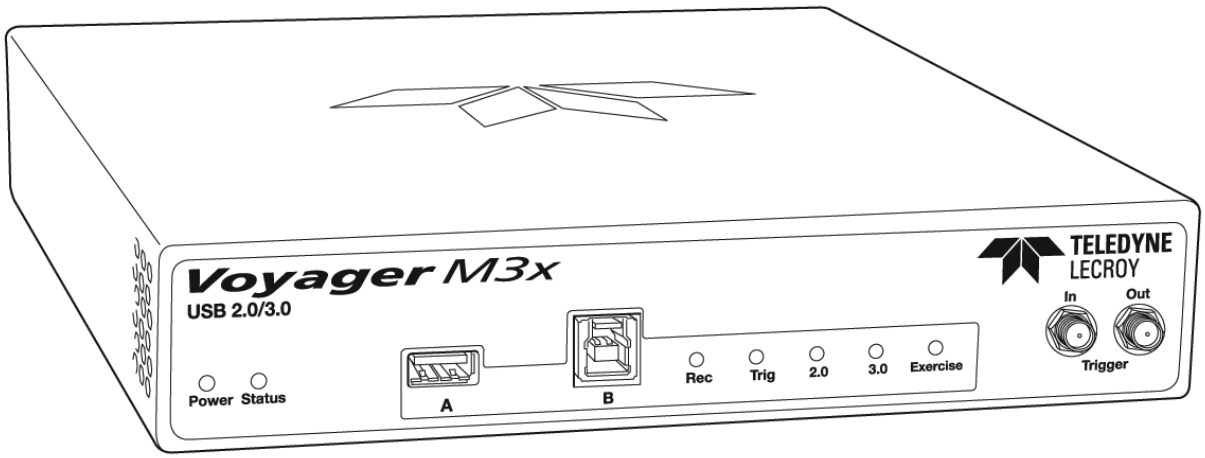


Figure 1.13: Voyager M3x Analyzer Exerciser System

See the ReadMe file from the software installation site for the latest on host machine requirements and supported operating systems: https://teledynelecroy.com/sw/usb/

1.9.1 USB 3.2 and USB 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 cables (Figure 1.14).

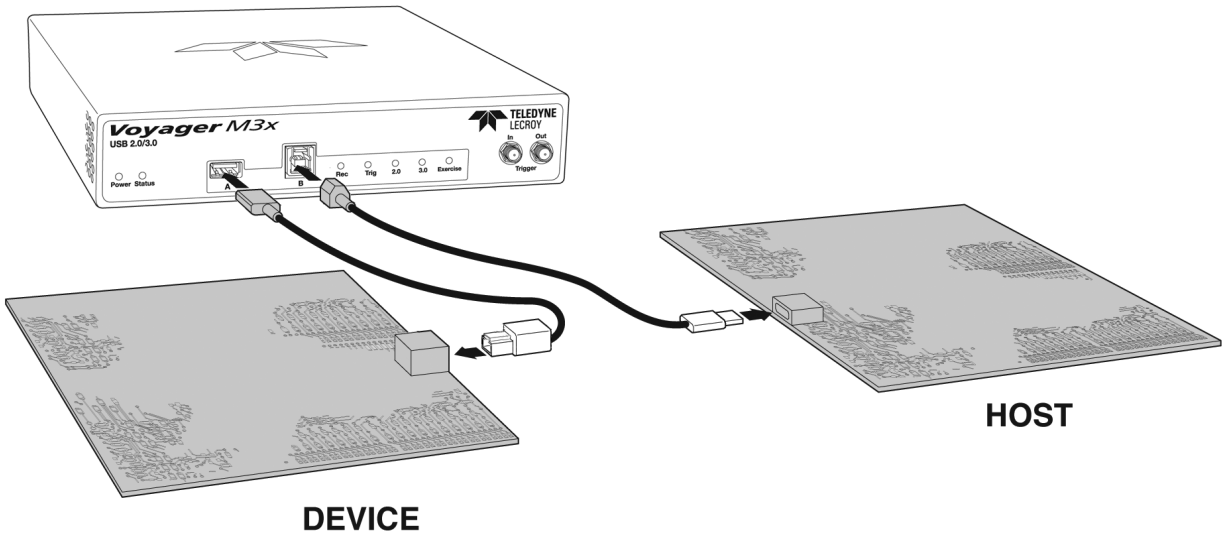


Figure 1.14: Direct Connection using USB 3.2 Cables

1.9.2 Features

In addition to the features it has in common with other analyzers, the M3x has the following specifications.

1.9.2.1 General

- Supports the following USB speeds: 5 Gb/s, 480 Mb/s, 12 Mb/s, and 1.5 Mb/s

1.9.2.2 Flexible 3.2 Calibration

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

1.9.2.3 Physical Components

- 4 GB of physical data-recording memory

1.10 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.

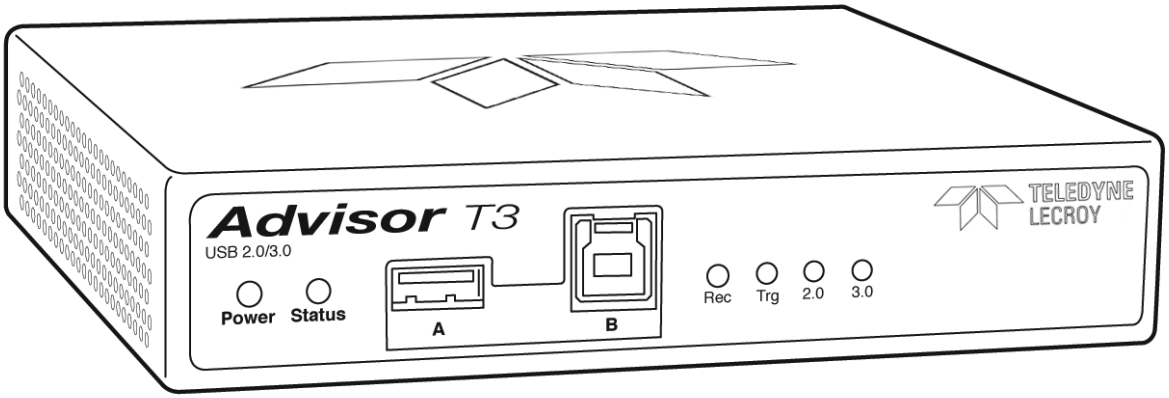


Figure 1.15: Advisor T3

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.

See the ReadMe file from the software installation site for the latest on host machine requirements and supported operating systems: https://teledynelecroy.com/sw/usb/

1.10.1 Features

In addition to the features it has in common with other analyzers, the Advisor T3 has the following specifications:

1.10.1.1 General

- Supports the following USB speeds: 5 GB/s, 480 MB/s, 12 MB/s, and 1.5 MB/s

1.10.1.2 Flexible 3.2 Calibration

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

1.10.1.3 Physical Components

- Plug-and-Play USB installation
- 2 GB of physical data-recording memory
- 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

1.11 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.

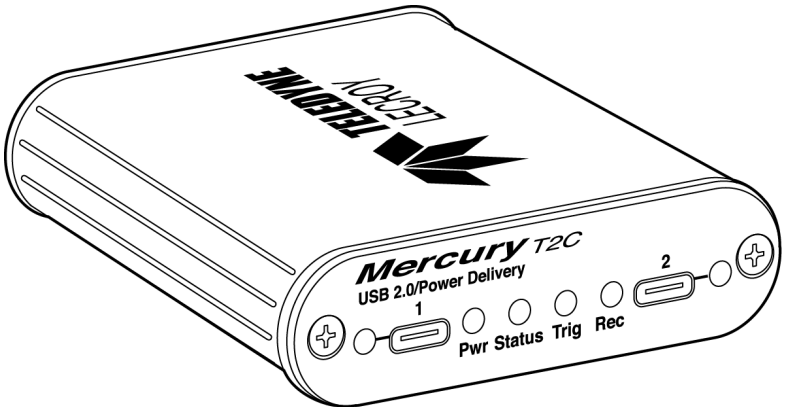


Figure 1.16: Mercury T2C

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 less than 4 feet.

See the ReadMe file from the software installation site for the latest on host machine requirements and supported operating systems: https://teledynelecroy.com/sw/usb/

1.11.1 Features

In addition to the features it has in common with other analyzers, the Mercury T2C has the following specifications.

1.11.1.1 General

- Supports the following USB speeds: 480 Mb/s, 12 Mb/s, and 1.5 Mb/s
- Supports Power Delivery 2.0 and 3.0 over 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 V_{BUS}, with negligible voltage drop

1.11.1.2 Physical Components

- 256 MB of physical data-recording memory
- Expansion port for optional External Trigger In/Out cable

1.12 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.

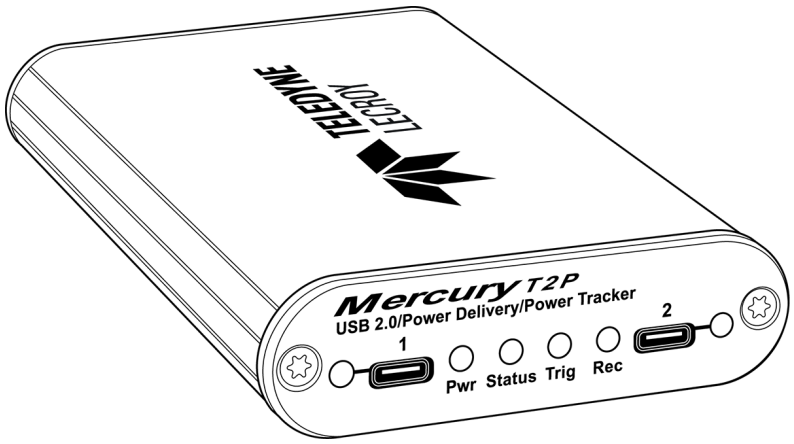


Figure 1.17: Mercury T2P

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 less than 4 feet.

See the ReadMe file from the software installation site for the latest on host machine requirements and supported operating systems: https://teledynelecroy.com/sw/usb/

1.12.1 Features

In addition to the features it has in common with other analyzers, the Mercury T2P has the following specifications.

1.12.1.1 General

- Supports the following USB speeds: 480 Mb/s, 12 Mb/s, and 1.5 Mb/s
- Supports Power Delivery 2.0 and 3.0 over 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 V_{BUS}, with negligible voltage drop
- Captures Current and Voltage on V_{BUS} and V_{CONN} 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

1.12.1.2 Physical Components

- 512 MB of physical data-recording memory
- Expansion port for optional External Trigger In/Out cable

1.13 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.

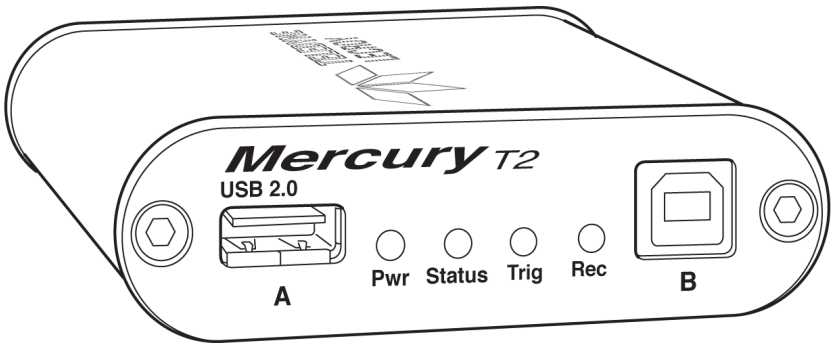


Figure 1.18: Mercury T2

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 less than 4 feet.

See the ReadMe file on the installation DVD for the latest information on host machine requirements and supported operating systems: https://teledynelecroy.com/sw/usb/

1.13.1 Features

In addition to the features it has in common with other analyzers, the Mercury T2 has the following specifications.

1.13.1.1 General

- Supports the following USB speeds: 480 Mb/s, 12 Mb/s, and 1.5 Mb/s

1.13.1.2 Physical Components

- 256 MB of physical data-recording memory
- Expansion port for optional External Trigger In/Out cable

1.14 Deprecated Products

The M3, M3i, USBTracer/Trainer, USB Advisor, USBMobile HS and USBMobile T2 CATC analyzers are no longer supported.

To use these older analyzers, you will have to uninstall the newer software and install an older release from the Teledyne LeCroy website.

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

Chapter 2

General Description

This chapter describes the general features of Teledyne LeCroy USB protocol analyzers and the requirements for their use.

2.1 Voyager M480x Analyzer

2.1.1 System Components and Packing List

The Teledyne LeCroy Voyager M480x analyzer package includes the following:

- Voyager M480x protocol analyzer/exerciser system
- AC power cord
- 12 USB cables
  - Type-C to C 0.3m 40Gbps EPR
  - Type-C to C 0.3m 40Gbps V_{CONN}-thru
  - Type-C to C 0.3m 40Gbps unmarked (2x)
  - Type-C to C 0.2m
  - Type-C to A 1m
  - Type-C to A 0.3m
  - Type-C to A receptacle 0.15m
  - Type-C to B 0.3m
  - Type-C to Micro-B 0.3m
  - Type-C to B 1m USB2
  - Type-C to Micro-B 1m USB2
- Quick Start Guide

2.1.2 Host Machine Requirements

Refer to the USBProtocolSuite_Readme.pdf 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.



Figure 2.1: Voyager M480x Analyzer Front



Figure 2.2: Voyager M480x Analyzer Rear

2.1.3.1 M480x Features

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

Table 2.1: M480x Analyzer Features (Sheet 1 of 3)

Feature	Function
Front Panel	
Power Switch	(⏻/1) Off/On
Power LED	Green: If plugged in and powered on
Status LED	Blue: If system successfully initializes
	Red: If hardware failure
	Green: While initializing
Mode	
Exerciser	**Solid green:** Exerciser Mode is enabled
Analyzer	**Solid green:** Analyzer Mode is enabled
Protocols	
USB4	**Solid blue:** USB4 BE is loaded
USB3	**Solid blue:** USB3 BE is loaded

Table 2.1: M480x Analyzer Features (Sheet 2 of 3)

Feature	Function
USB2	**Solid yellow:** FS SOFs, LS EOPs, or control endpoint traffic **Slow flashing yellow:** LS Traffic on endpoints other than 0 **Fast flashing yellow:** FS Traffic on endpoints other than 0 **Solid green:** HS SOFs or control endpoint traffic **Flashing green:** HS traffic on endpoints other than 0
Exerciser / Left (Lane configuration): These LEDs indicate whether traffic is being transmitted or received on each lane, from the perspective of the Exerciser (in Exerciser Mode) or the product connected on the Left (in Analyzer Mode).	
LED 1	**Off:** Electrical idle **Solid green:** Exerciser/Left is transmitting on Tx0
LED 2	**Off:** Electrical idle **Solid green:** Exerciser/Left is transmitting on Tx1
LED 3	**Off:** Electrical idle **Solid blue:** Exerciser/Left is receiving on Rx1
LED 4	**Off:** Electrical idle **Solid blue:** Exerciser/Left is receiving on Rx0
Lane Speed (USB4 Mode)	
Gen 2	**Solid green:** Gen 2 negotiated through SB
Gen 3	**Solid green:** Gen 3 negotiated through SB
Gen 4	**Solid green:** Gen 4 negotiated through SB
Lane Speed (USB 3 Mode)	
Gen 1	**Solid yellow:** LFPS **Slow flashing yellow:** Gen 1 link is in a low power state (Ux) **Fast flashing yellow:** Gen 1 link training **Solid green:** Gen 1 link traffic (U0) **Flashing green:** Gen 1 data traffic (TP, DP)
Gen 2	**Slow flashing yellow:** Gen 2 link is in a low power state (Ux) **Fast flashing yellow:** Gen 2 link training **Solid green:** Gen 2 link traffic (U0) **Flashing green:** Gen 2 data traffic (TP, DP)
Functions	
Rec	**Solid green:** Recording is occurring
Gen	**Solid green:** Exerciser is generating traffic
Trig	**Solid yellow:** Trigger has occurred
Analyzer Connectors Left and Right	**LEDs Off:** No cable attached **Solid Red:** Plug is upside-down; invert and re-insert **Solid Green:** Plug is correctly oriented
Trigger	

Table 2.1: M480x Analyzer Features (Sheet 3 of 3)

Feature	Function
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 Advanced Recording Options (if applicable).
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, as well as 8-bit Data Capture and external Trig In/Out, with Cable (P/N AC061XXA-X) (sold separately) (see Figure 2.20). 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 SuperSpeed Type-C Connector to host machine.
AC IN	100-240V AC, 500 Watt max

WARNING: Do not open the Voyager M480x enclosure. No operator-serviceable parts are inside. Refer servicing to Teledyne LeCroy Customer Care.

2.1.4 Specifications

The analyzer specifications are shown in Table 2.4, below.

Table 2.2: Voyager M480x Analyzer Specification

Tool/Utility	Specification
Power Requirements	100-250V AC, 225 Watts
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% RH, non-condensing
Operating Altitude	Up to 6560 feet (2000 meters)
Probing Characteristics	

Table 2.2: Voyager M480x Analyzer Specification

Tool/Utility	Specification
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 M480x 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 Figure 2.13 below.

NOTE: Analysis of traffic requires the use of short, low-loss, high quality cables. The cables provided, 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 M4x Analyzer

2.2.1 System Components and Packing List

The Teledyne LeCroy Voyager M4x analyzer package includes the following:

- Voyager M4x protocol analyzer/exerciser system
- AC power cord
- 11 USB cables
  - USB4/USB 3.2: C-C unmarked 40Gbps (X2), C-C eMarked 40Gpbs, C-C V_{CONN}-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

2.2.2 Host Machine Requirements

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.

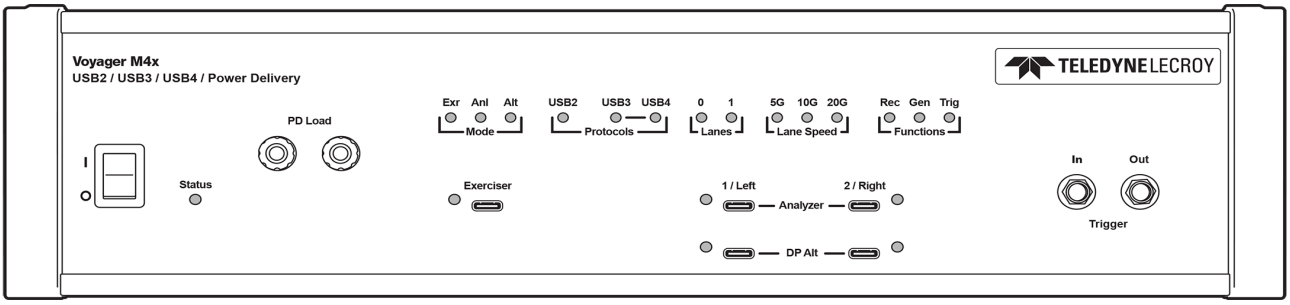


Figure 2.3: Voyager M4x Analyzer Front



Figure 2.4: Voyager M4x Analyzer Rear

2.2.3.1 M4x Features

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

Table 2.3: M4x Analyzer Features (Sheet 1 of 3)

Feature	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

Table 2.3: M4x Analyzer Features (Sheet 2 of 3)

Feature	Function
• 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. 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. 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 Advanced Recording Options (if applicable).

Table 2.3: M4x Analyzer Features (Sheet 3 of 3)

Feature	Function
• 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 2.20). 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.

2.2.4 Specifications

The analyzer specifications are shown in Table 2.4, below.

Table 2.4: Voyager M4x Analyzer Specification

Tool/Utility	Specification
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%).

Table 2.4: Voyager M4x Analyzer Specification

Tool/Utility	Specification
Switches	Power On/Off
Recording Memory Size	32 GB for traffic data capture, timing, state and other data

2.2.5 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 Figure 2.13 below. Note that it will work the "other way" (Host on Left, Device on Right); however, 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, which our traces will track.

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.

2.3 Voyager M310e Analyzer

2.3.1 System Components and Packing List

The Teledyne LeCroy Voyager M310e analyzer package includes the following:

- Voyager M310e 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

2.3.2 Host Machine Requirements

Refer to the USBProtocolSuite_Readme.pdf 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.

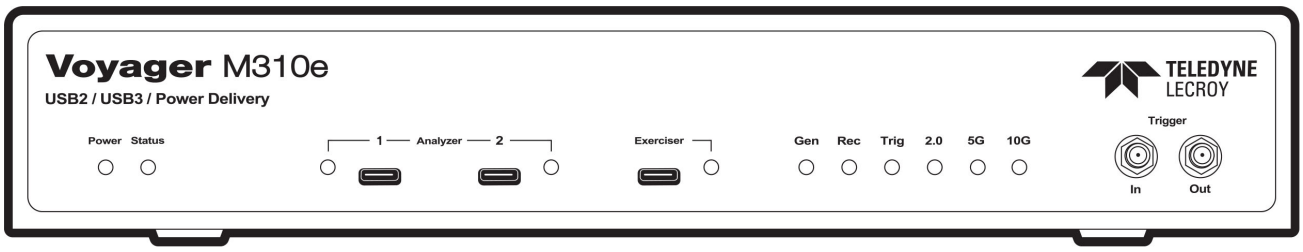


Figure 2.5: Voyager M310e Analyzer Front

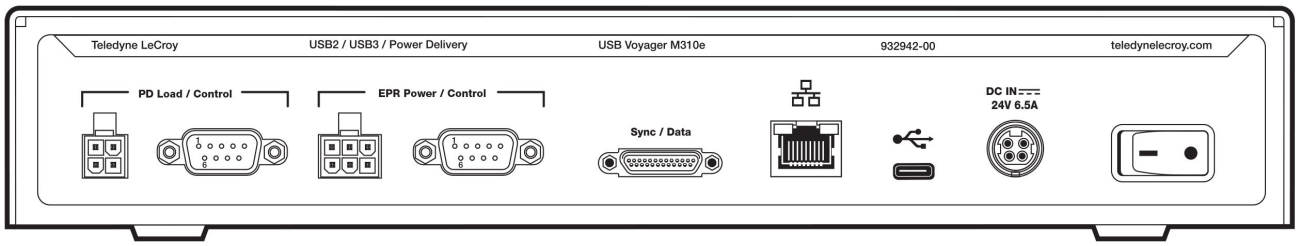


Figure 2.6: Voyager M310e Analyzer Rear

2.3.3.1 M310e Features

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

Table 2.5: M310e Analyzer Features (Sheet 1 of 3)

Feature	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
Exerciser Connector LEDs Off	No cable attached
Solid Red	Plug is Upside Down. Invert and re-insert.
Solid Green	Plug is correctly oriented
Solid Yellow	Special Condition

Table 2.5: M310e Analyzer Features (Sheet 2 of 3)

Feature	Function
Solid Purple	Cable with eMarker is attached to both ports.
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 SOFs, LS EOPs, 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 SOFs 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	TPs and DPs (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	TPs and DPs (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 Advanced Recording Options (if applicable).

Table 2.5: M310e Analyzer Features (Sheet 3 of 3)

Feature	Function
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	
PD Load/Control	Connectors for power and RS-232 communication with a compatible programmable electronic load.
EPR Power/Control	Connectors for power and RS-232 communication with a compatible programmable power supply.
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 2.20). 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 M310e enclosure. No operator serviceable parts are inside. Refer servicing to Teledyne LeCroy Customer Care.

2.3.4 Specifications

The analyzer specifications are shown in Table 2.6. below.

Table 2.6: Voyager M310e Analyzer Specification

Tool/Utility	Specification
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	

Table 2.6: Voyager M310e Analyzer Specification

Tool/Utility	Specification
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 M310e 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 2.13 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.

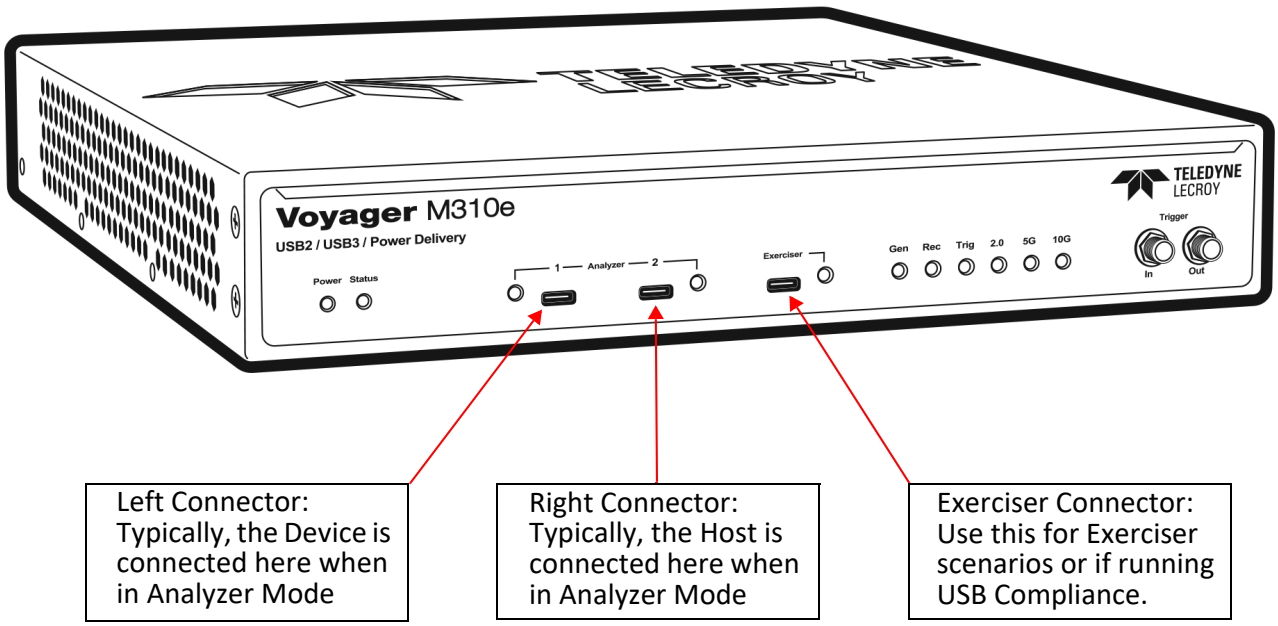


Figure 2.7: Voyager M310e Preferred Connection Method

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.

2.4 Voyager M310P Analyzer

2.4.1 System Components and Packing List

The Teledyne LeCroy Voyager M310P analyzer package includes the following:

- 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

2.4.2 Host Machine Requirements

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.

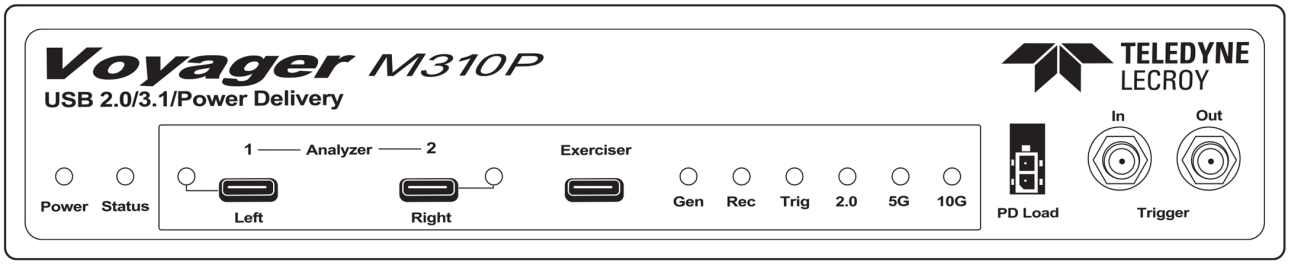


Figure 2.8: Voyager M310P Analyzer Front

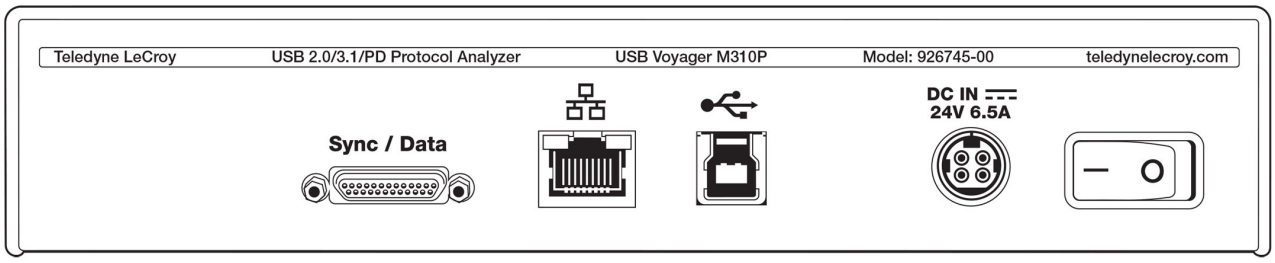


Figure 2.9: Voyager M310P Analyzer Rear

2.4.3.1 M310P Features

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

Table 2.7: M310P Analyzer Features (Sheet 1 of 3)

Feature	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. Invert and re-insert.

Table 2.7: M310P Analyzer Features (Sheet 2 of 3)

Feature	Function
• Solid Green	Plug is correctly oriented
• Solid Yellow	Special Condition
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 SOFs, LS EOPs, 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 SOFs 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	TPs and DPs (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	TPs and DPs (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 Advanced Recording Options.

Table 2.7: M310P Analyzer Features (Sheet 3 of 3)

Feature	Function
• Out	SMA external trigger output. Pulse Width = 280 ns. Pulse Voltage = 3.3 Volts into 1 Meg-Ohms. 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 2.20). 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.

2.4.4 Specifications

The analyzer has the following specifications.

Table 2.8: Voyager M310P Analyzer Specification

Tool/Utility	Specification
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	

Table 2.8: Voyager M310P Analyzer Specification

Tool/Utility	Specification
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

2.4.5 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 2.13 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.

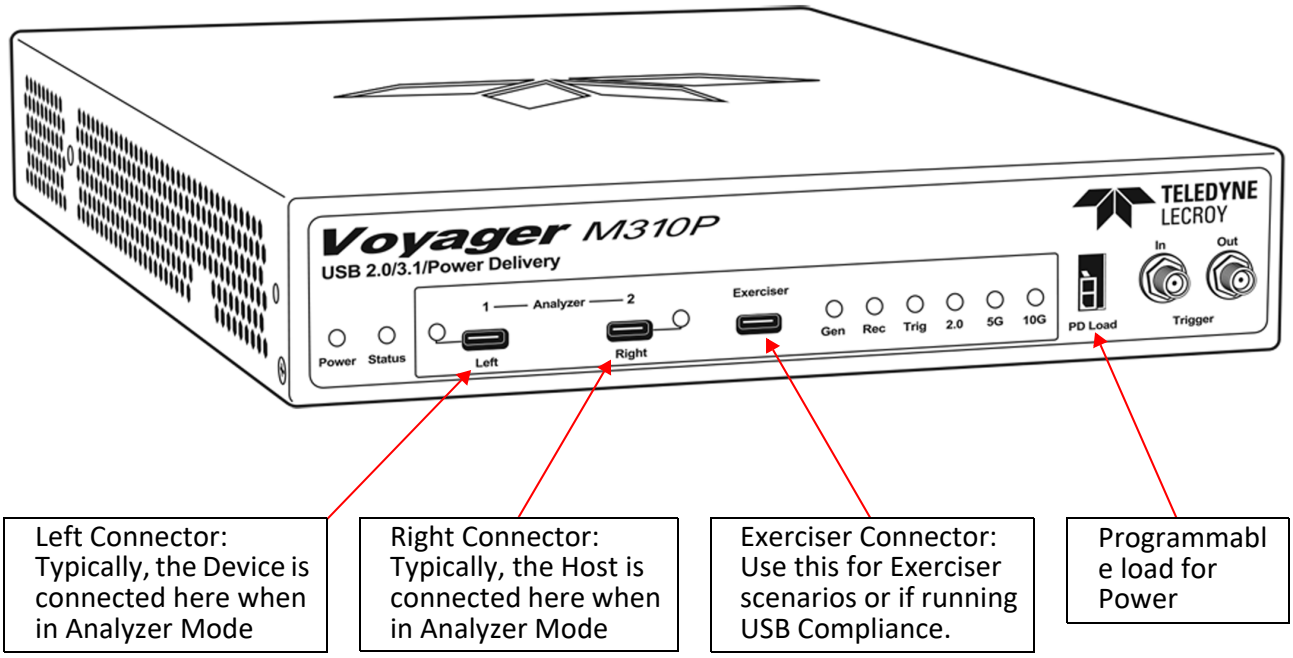


Figure 2.10: Voyager M310P Preferred Connection Method

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.

2.5 Voyager M310C Analyzer

2.5.1 System Components and Packing List

The Teledyne LeCroy Voyager M310C analyzer package includes the following:

- 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

2.5.2 Host Machine Requirements

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 figures 2.11 and 2.12.

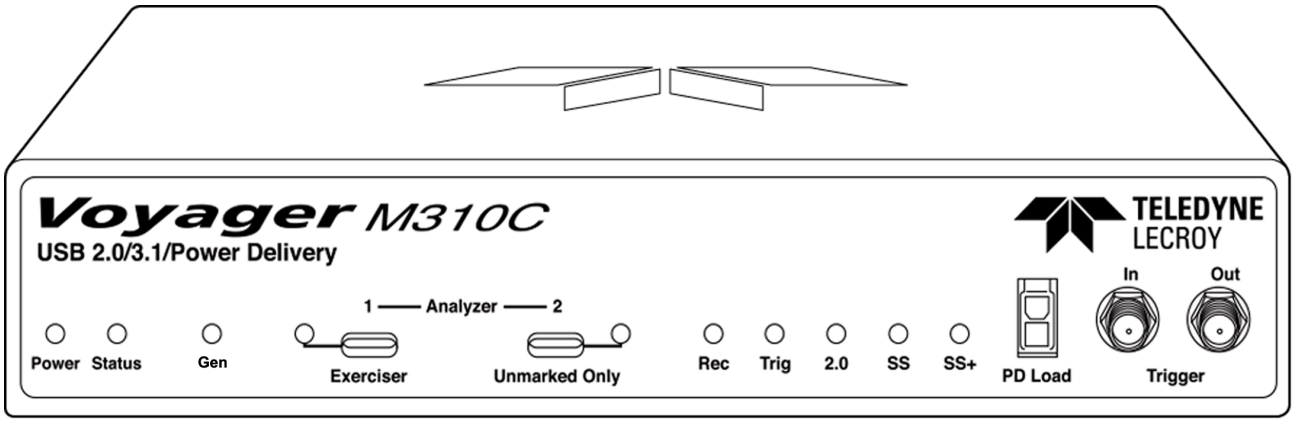


Figure 2.11: Voyager M310C Analyzer Front

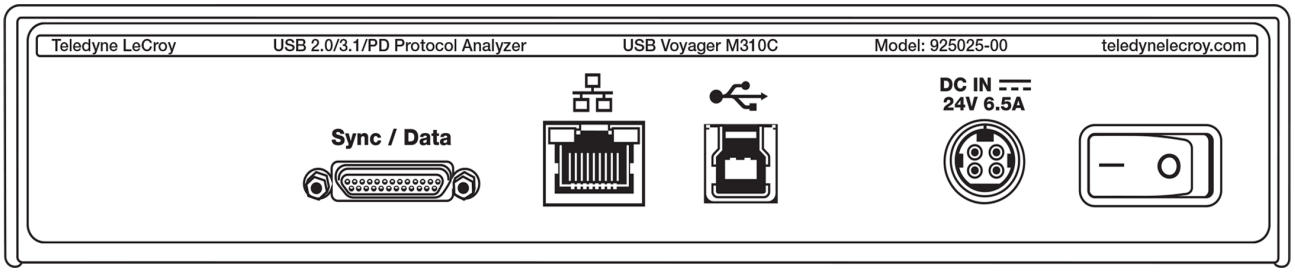


Figure 2.12: Voyager M310C Analyzer Rear

2.5.3.1 M310C Features

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

Table 2.9: M310C Analyzer Features (Sheet 1 of 2)

Feature	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 Q–LEDs	
• Off	No cable attached
• Solid Red	Plug is Upside Down. Invert and re-insert.
• Solid Green	Plug is correctly oriented
• Solid Yellow	Special Condition
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 SOFs, LS EOPs, 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 SOFs 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	TPs and DPs (actual traffic)
• SS+	USB 3.2 SuperSpeed Plus (10Gbps)
• Off	No traffic or LFPS
• Solid Yellow	Only Polling LFPS with LBPM/SCDx messages

Table 2.9: M310C Analyzer Features (Sheet 2 of 2)

Feature	Function
• Slow Flashing Yellow	Low Power States
• Fast Flashing Yellow	Symbol Traffic, Training (TS1/TS2/TSEQ)
• Solid Green	Link Traffic (U0) LUP, LDN
• Blinking Green	TPs and DPs (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 Advanced Recording Options.
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 2.20). 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) are 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.

2.5.4 Specifications

The M310C analyzer specifications are shown in Table 2.10, below.

Table 2.10: Voyager M310C Analyzer Specification

Tool/Utility	Specification
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

2.5.5 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 2.13.

Note that the connection can be reversed (Host on Left, Device on Right), but it is preferred to connect as indicated so that the default setup is similar to Teledyne LeCroy's 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 the Support Team, and reduces the number of setup diagrams to follow. The data roles *can* swap via USB protocol, and the traces will track that.

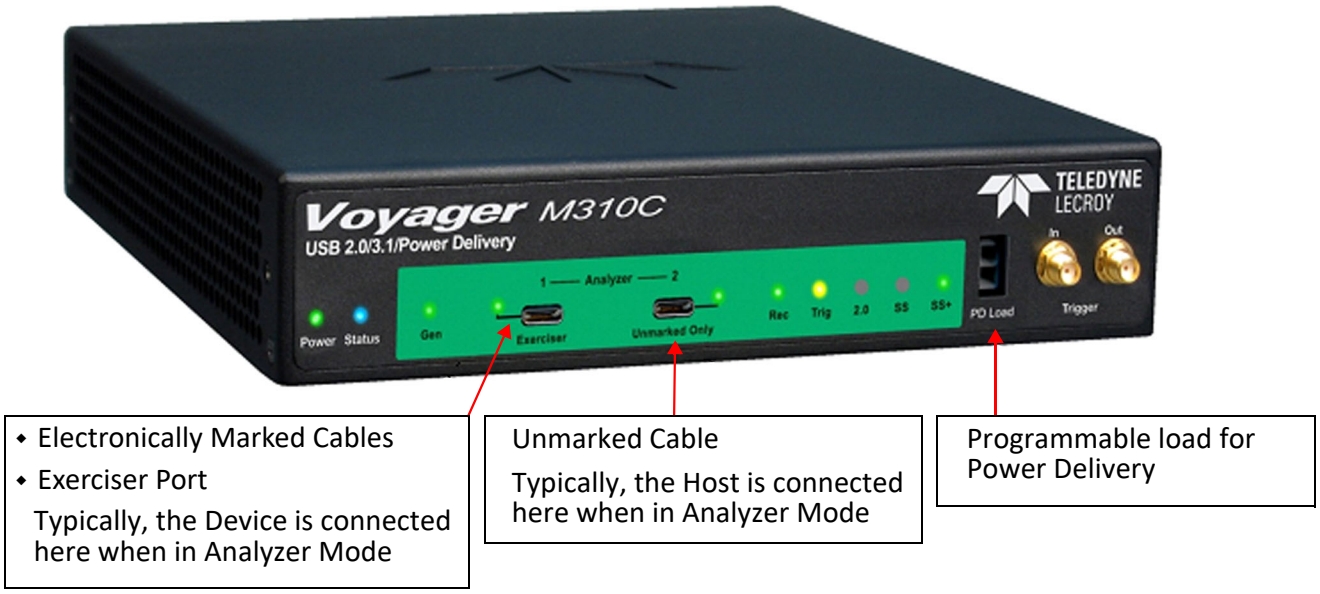


Figure 2.13: Voyager M310C Preferred Connection Method

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.

2.6 Voyager M310 Analyzer

2.6.1 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

2.6.2 Host Machine Requirements

Refer to the USBProtocolSuite_Readme.html file from the software installation site for the current host machine and operating system requirements.

2.6.3 Analyzer

The analyzer is shown in figures 2.14 and 2.15, below.

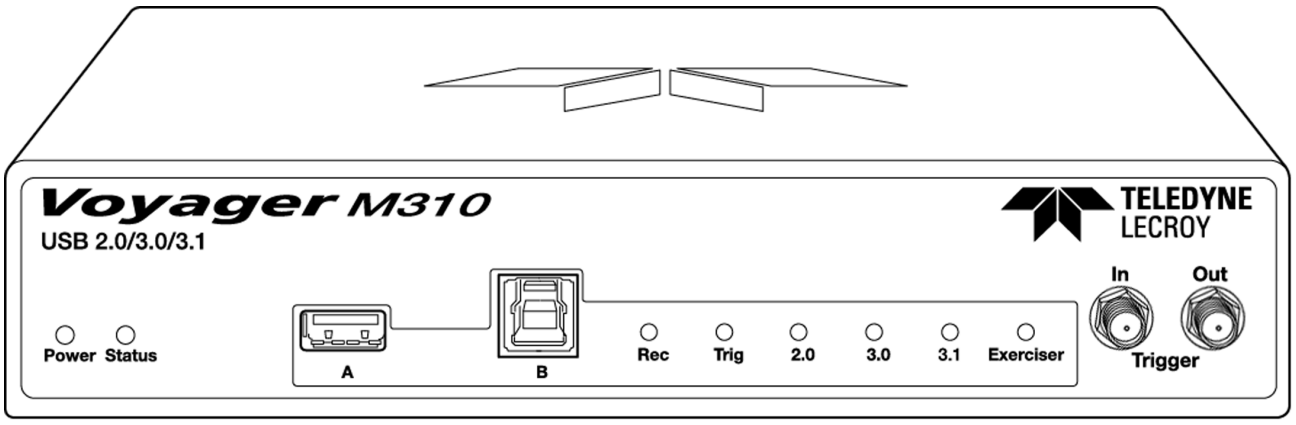


Figure 2.14: Voyager M310 Analyzer Front

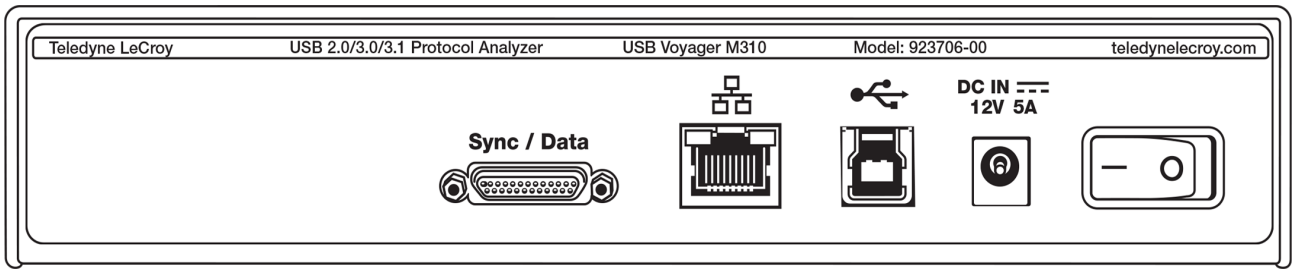


Figure 2.15: Voyager M310 Analyzer Rear

2.6.3.1 M310 Features

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

Table 2.11: M310 Analyzer Features (Sheet 1 of 3)

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	

Table 2.11: M310 Analyzer Features (Sheet 2 of 3)

Features	Function
Rec	Recording Green if 3.2 recording enabled in Analyzer mode
Trig	Yellow when triggered
2.0	USB 2.0
Solid Yellow	FS SOFs, LS EOPs, 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 SOFs 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	TPs and DPs (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	TPs and DPs (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 Advanced Recording Options.

Table 2.11: M310 Analyzer Features (Sheet 3 of 3)

Features	Function
• Out	SMA external trigger output. Pulse Width = 280 ns. Pulse Voltage = 3.3 Volts into 1 Meg-Ohms. 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 2.20). 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.

2.6.4 Specifications

The Voyager M310 analyzer has the following specifications:

Table 2.12: Voyager M310 Analyzer Specification

Tool/Utility	Specification
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

2.7 Voyager M3x Analyzer

2.7.1 System Components and Packing List

The Teledyne LeCroy Voyager M3x analyzer package includes the following:

- 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

2.7.2 Host Machine Requirements

Refer to the USBProtocolSuite_Readme.html file from the software installation site for the current host machine and operating system requirements.

2.7.3 Analyzer

The analyzer is shown in the figures 2.16 and 2.17, below.

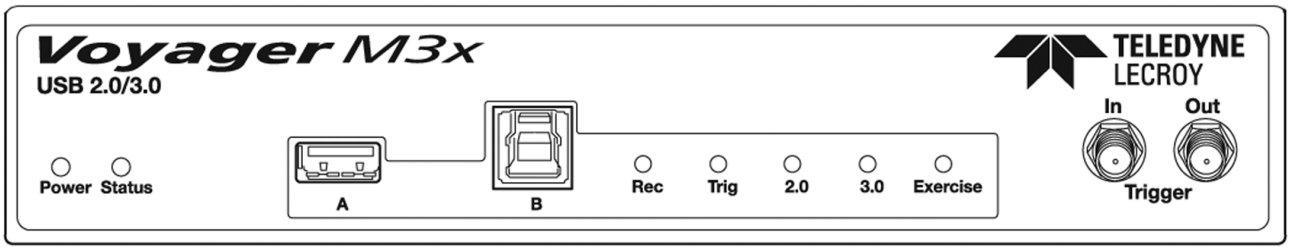


Figure 2.16: Voyager M3x Analyzer Front

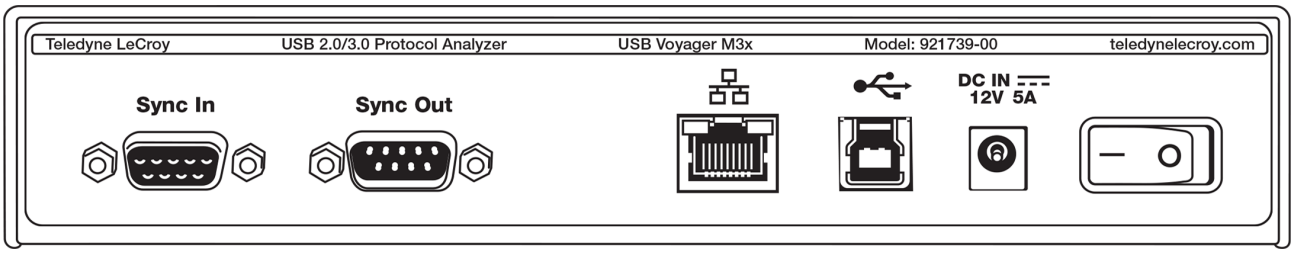


Figure 2.17: Voyager M3x Analyzer Rear

2.7.3.1 M3x Features

The features of the analyzer are listed in the following table:

Table 2.13: M3x Analyzer Features (Sheet 1 of 2)

Feature	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

Table 2.13: M3x Analyzer Features (Sheet 2 of 2)

Feature	Function
Solid Yellow	FS SOFs, LS EOPs, 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 SOFs 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	TPs and DPs (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 Advanced Recording Options.
Out	SMA external trigger output. Pulse Width = 280 ns. Pulse Voltage = 3.3 Volts into 1 Meg-Ohms. 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.

2.7.4 Specifications

The analyzer has the following specifications.

Table 2.14: Voyager M3x Analyzer Specification

Tool/Utility	Specification
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

2.8 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.

2.8.1 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

2.8.2 Front Panel

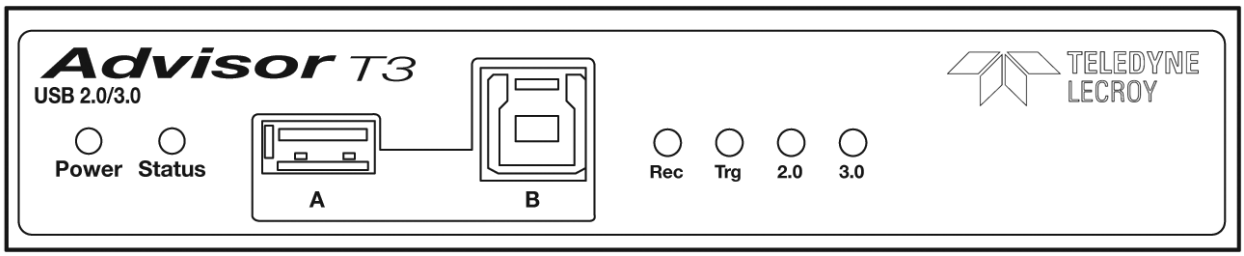


Figure 2.18: Advisor T3 Front Panel

The front panel has the following indicators and connectors:

Table 2.15: Advisor T3 Front Panel

Indicator/Connector	Description
Power LED	Green when On
Status LED	• Blue if system successfully initializes • Red if 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	USB 2.0 (yellow for Low and Full Speed)
• 3.0 USB 3.0	USB 3.2 SS (green if link is up; flashes green while data transfers; yellow if polling)

2.8.3 Rear Panel

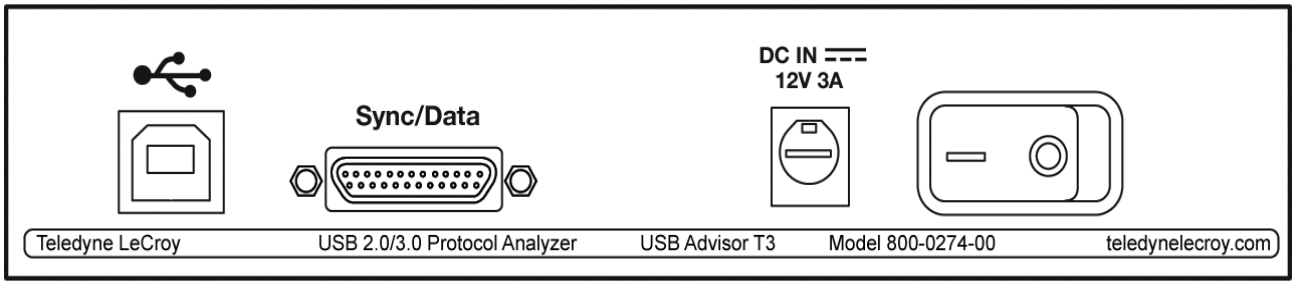


Figure 2.19: Advisor T3 Rear Panel

Table 2.16: Advisor T3 Rear Panel (Sheet 1 of 2)

Indicator/Connector	Description
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)
• Sync/External	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 Cable	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.

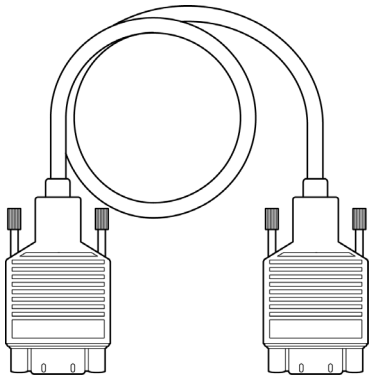
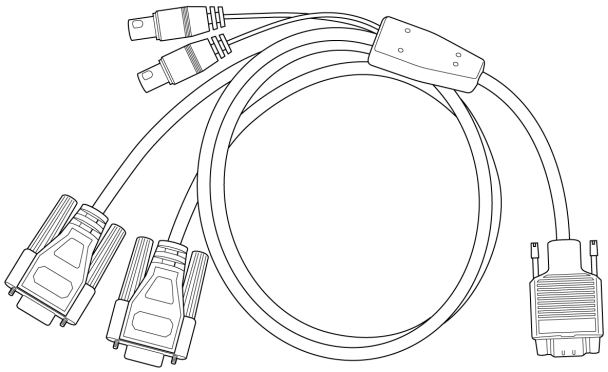


Figure 2.20: Micro DB-25 to Micro DB-25 External Interface Cable

Table 2.16: Advisor T3 Rear Panel (Sheet 2 of 2)

Indicator/Connector	Description
Sync/Data (continued)	
Trigger Out Cable	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.  Figure 2.21: 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.

2.8.4 Specifications

Specifications for the Advisor T3 are shown in the table below.

Table 2.17: Advisor T3 Specification (Sheet 1 of 2)

Tool/Utility	Specification
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)

Table 2.17: Advisor T3 Specification (Sheet 2 of 2)

Tool/Utility	Specification
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

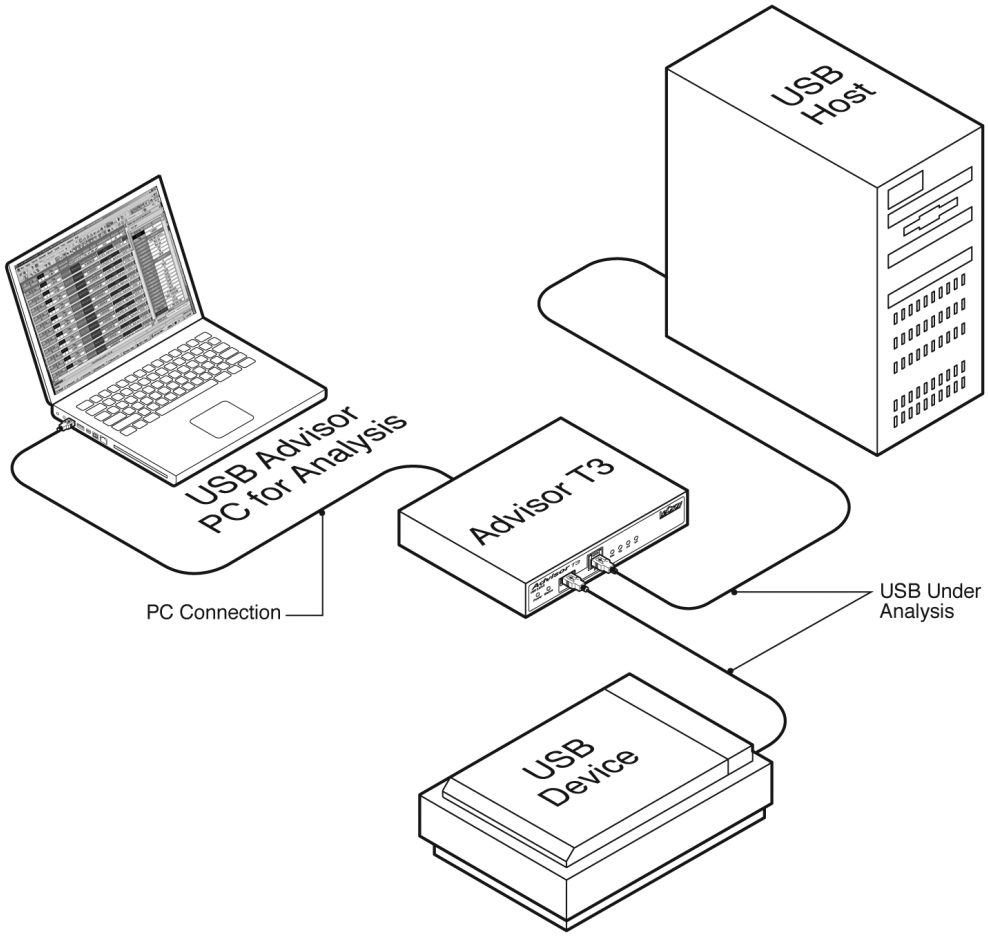


Figure 2.22: Advisor T3 Setup

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

2.9 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.

2.9.1 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

2.9.2 Front Panel

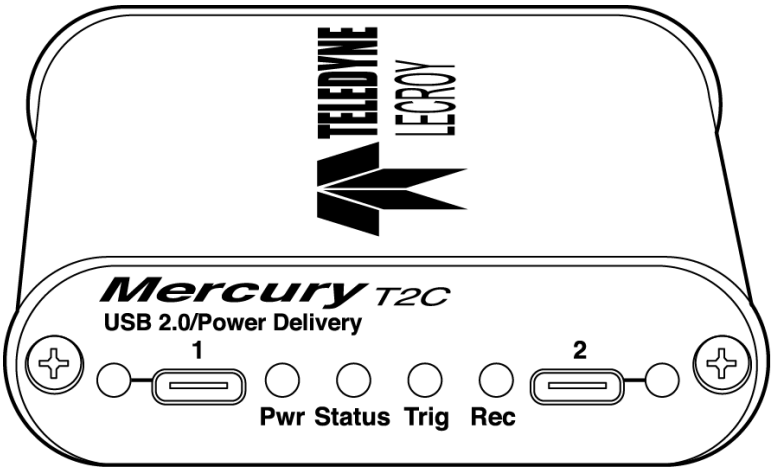


Figure 2.23: Mercury T2C Front Panel

The front panel has the following indicators and connectors:

Table 2.18: Mercury T2C Front Panel

Indicator/Connector	Description
Connector 1 LED	• Green – Good • Red – Flip it over! • Solid Yellow – Special Condition.
Analyzer Connector 1 (downstream)	Connects to Device under test (UFP)
Power LED	Green when 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 • Rec – Recording	 • Green when triggering • Red when recording is enabled
Analyzer Connector 2 (upstream)	Connects to Host under test (DFP)
Connector 2 LED	• Green – Good • Red – Flip it over • Solid Yellow – Special Condition

2.9.3 Rear Panel

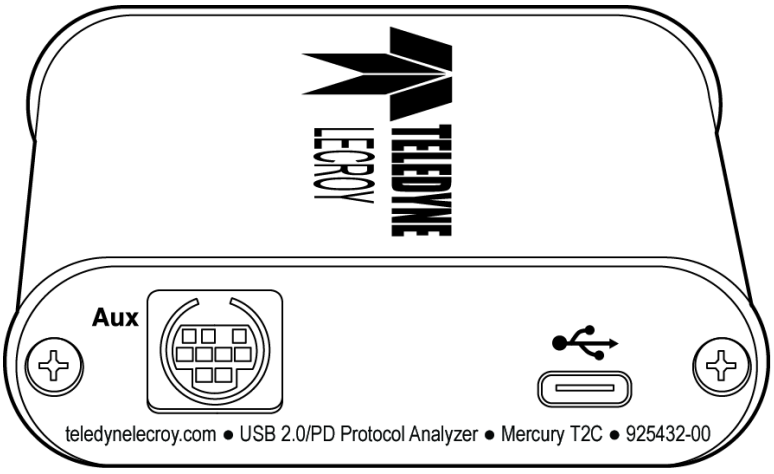
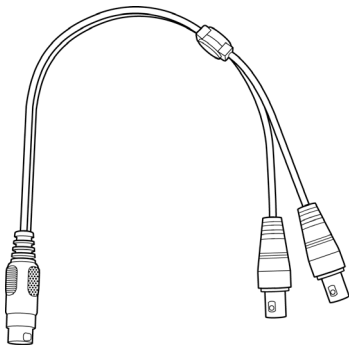


Figure 2.24: Mercury T2C Rear Panel

The rear panel has the following indicators and connectors:

Table 2.19: Mercury T2C Rear Panel

Indicator/Connector	Description
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) 
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.

Table 2.20: Mercury T2C Analyzer Specification

Tool/Utility	Specification
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)

Table 2.20: Mercury T2C Analyzer Specification

Tool/Utility	Specification
Probing Characteristics	
Connection	• USB 2.0 USB Type-C™ connector cables • High Speed USB Connectors • Standard cables
Switches	Power On/Off
Recording Memory Size	256 MB for traffic data capture, timing, state and other data

2.9.5 Mercury T2C System Setup

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

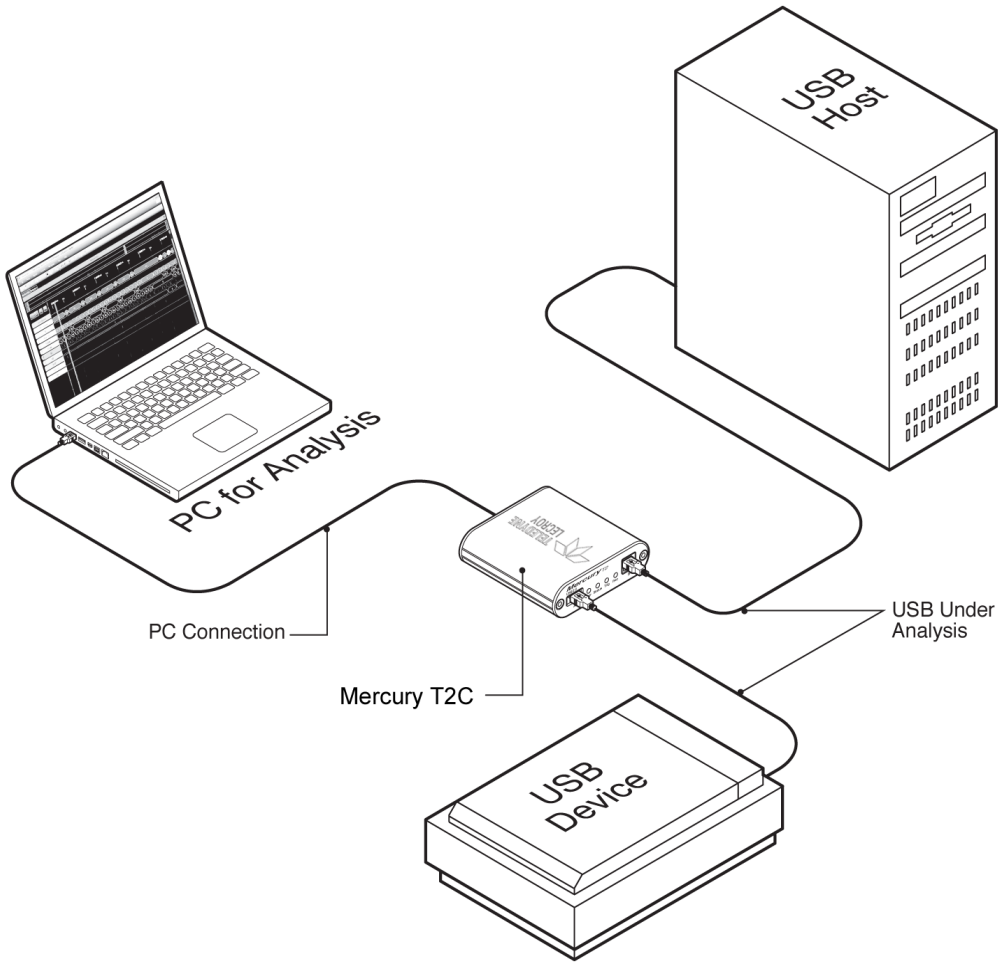


Figure 2.25: Mercury T2C Setup

1. The Device (UFP) should be reconnected to the Connector 1 (Left side), whereas the Host (DFP) should be connected to Connector 2 (Right side).

2. 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.
3. The cables can then be connected to the Mercury T2C.
4. If the LED associated with the Connector shows Red, you need to flip the connector over so it shows Green. The will enable the analyzer to connect all the other signals in a 3.2 cable correctly, allowing the other SS, SS+, or Alternate Modes to work without interruption.

2.10 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.

2.10.1 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

2.10.2 Front Panel

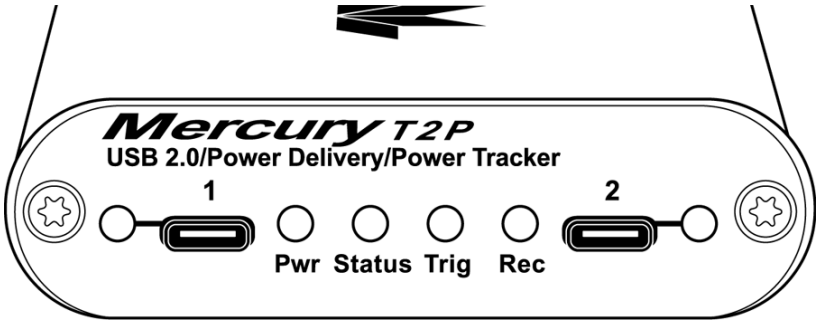


Figure 2.26: Mercury T2P Front Panel

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

Table 2.21: Mercury T2P Front Panel

Indicator/Connector	Description
Connector 1 LED	• Green – Good • Red – Flip it over! • Solid Yellow – Special Condition
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 • Rec– Recording	• Green if triggering • 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

2.10.3 Rear Panel

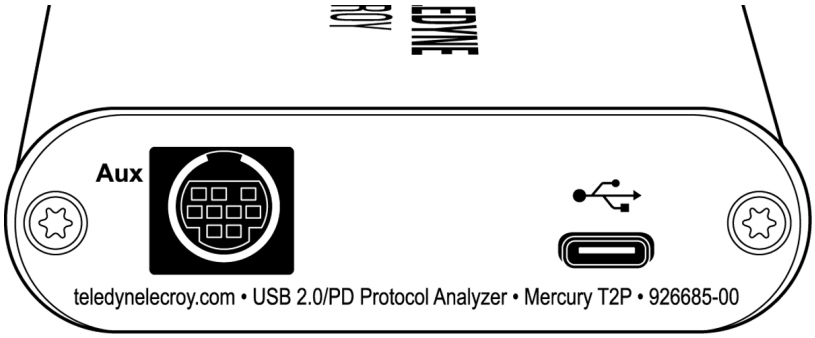


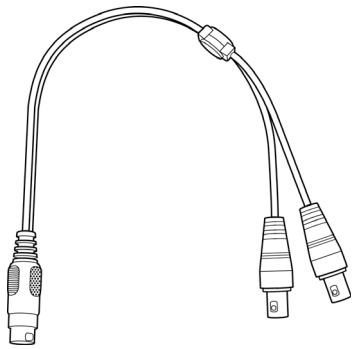
Figure 2.27: Mercury T2P Rear Panel

The rear panel has the following indicators and connectors:

Table 2.22: Mercury T2P Rear Panel

Indicator/Connector	Description
USB	Type C connector for connection to host machine

Table 2.22: Mercury T2P Rear Panel

Indicator/Connector	Description
Aux	9-pin Mini DIN connector, used for External Trigger In and Out BNC connections (Cable sold separately, part # AC032XXA-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

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

2.10.4 Specifications

The analyzer has the following specifications.

Table 2.23: Mercury T2P PD Analyzer Specification

Tool/Utility	Specification
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	

Table 2.23: Mercury T2P PD Analyzer Specification

Tool/Utility	Specification
Connection	• USB 2.0 USB Type-CTM connector cables • High Speed USB Connectors • Standard cables
Recording Memory Size	512 MB for traffic data capture, timing, state and other data.

2.10.5 Mercury T2P System Setup

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

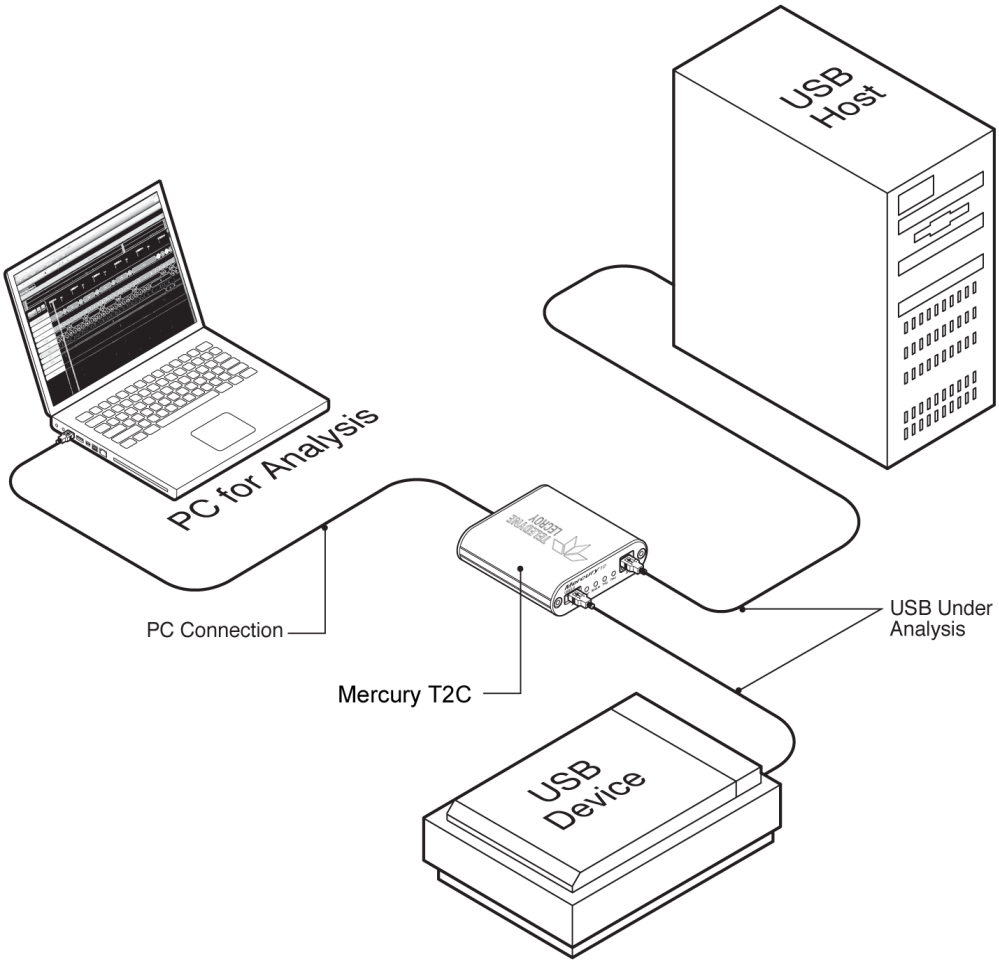


Figure 2.28: Mercury T2P Setup

1. The Device (UFP) should be reconnected to the Connector 1 (Left side), whereas the Host (DFP) should be connected to Connector 2 (Right side).
2. 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.

3. The cables can then 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. The 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.

2.11 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.

2.11.1 Components

The Teledyne LeCroy Mercury T2 analyzer package includes the following:

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

2.11.2 Front Panel

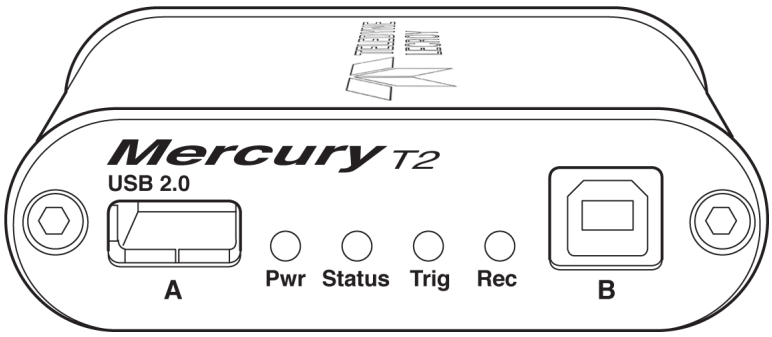


Figure 2.29: Mercury T2 Front Panel

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

Table 2.24: Mercury T2 Front Panel

Indicator/Connector	Description
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.

Table 2.24: Mercury T2 Front Panel

Indicator/Connector	Description
Analyzer Port A (downstream)	Connects to Device under test
Analyzer Port B (upstream)	Connects to Host under test
Analyzer LEDs • **Rec** • **Trig**	 Recording (red if recording enabled Trigger (green if triggering)

2.11.3 Rear Panel

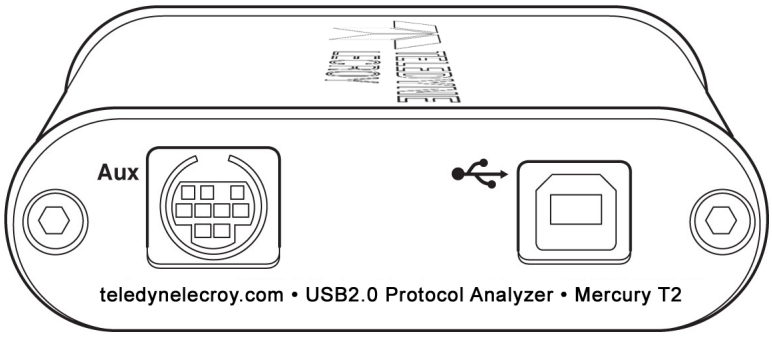


Figure 2.30: Mercury T2 Rear Panel

The rear panel has the following indicators and connectors:

Table 2.25: Mercury T2 Rear Panel

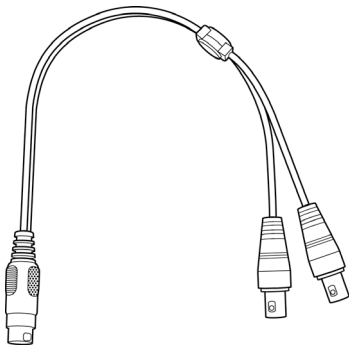
Indicator/Connector	Description
USB	Type B connector for connection to host machine
Aux	9-pin Mini DIN connector, used for External Trigger In and Out BNC connections. (Cable sold separately, part # AC032XXA-X) 

Table 2.25: Mercury T2 Rear Panel

Indicator/Connector	Description
• **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.

2.11.4 Specifications

The analyzer has the following specifications.

Table 2.26: Mercury T2 Analyzer Specification

Tool/Utility	Specification
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
Switches	Power On/Off
Recording Memory Size	256 MB for traffic data capture, timing, state, and other data.

2.11.5 Mercury T2 System Setup

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

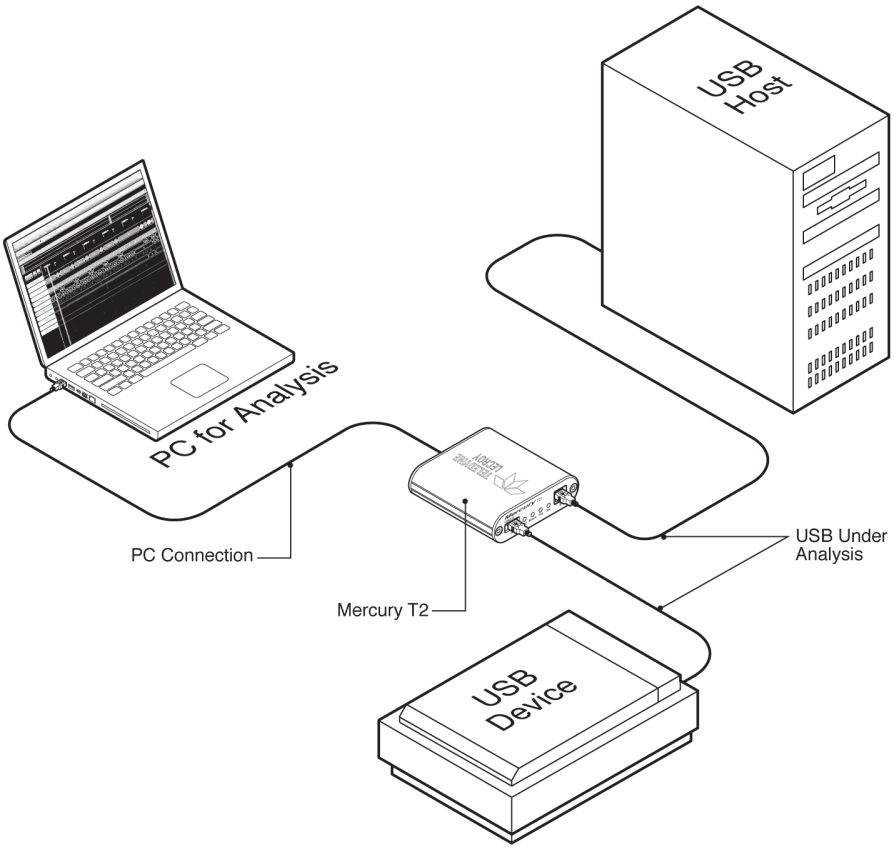


Figure 2.31: Mercury T2 Setup

2.12 Yellow LED Connector Indications

2.12.1 M310P/M310e/M4x/M480x

If one connector shows a Yellow LED:

The orientation is indeterminate. This may occur when the "V_{CONN} 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 V_{CONN} to the side that does contain the eMarker in **Recording Options > USB Type-C > Analyzer V_{CONN} Behavior**.
2. A cable presenting Ra is attached to one connector, and the orientation on the other connector is indeterminate (such as with a "V_{CONN} thru" cable). You may allow V_{CONN} to be connected through the analyzer in **Recording Options > USB Type-C > Analyzer V_{CONN} 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.

2.12.2 M310C, Mercury T2C, Mercury T2P

If one connector shows a Yellow LED:

The orientation is indeterminate. This may occur when the "V_{CONN} 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 V_{CONN} to the side that does contain the eMarker in **Recording Options > USB Type-C > Analyzer V_{CONN} Behavior**.
2. A cable presenting Ra is attached to one connector, and the orientation on the other connector is indeterminate (such as with a "V_{CONN} thru" cable). Using a "V_{CONN} 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 3

Installation

The USB Protocol Suite analyzer software installs onto a Microsoft® Windows® host machine using the Windows Server 2019, Windows Server 2016, Windows 11, or Windows 10 64-bit operating system.

WARNING:	You must 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

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

Download the latest version of the USB Protocol Suite software from this website:

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

You'll need to register as a user the first time you access the site.

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 Windows Control Panel.
2. Select **System and Security.**
3. Under Windows Defender Firewall, select **Allow an app through Windows Firewall**. A window listing allowed applications and features opens (Figure 3.1).

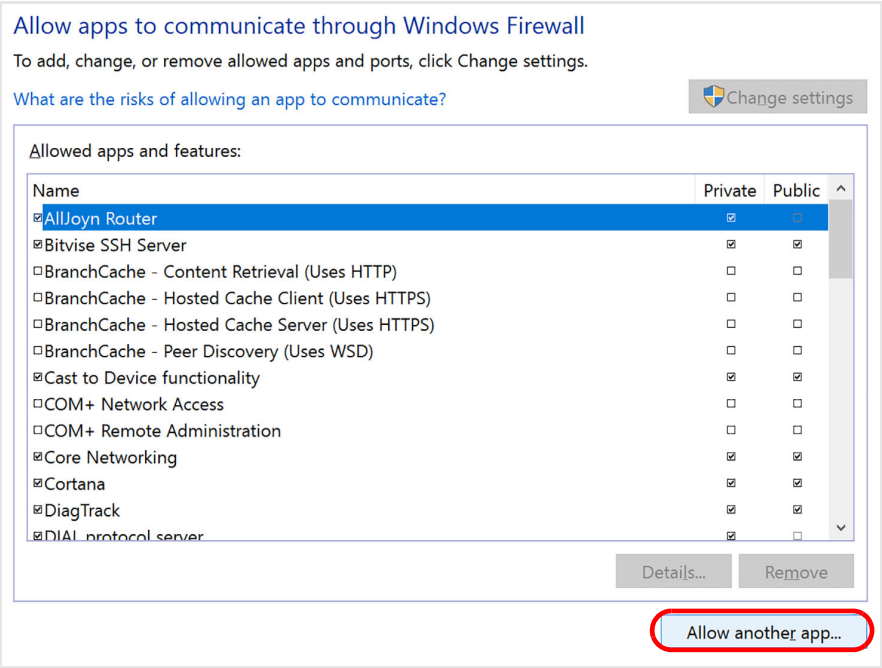


Figure 3.1: Allowed Apps and Features Window

4. Click **Allow another app**. The **Add an app** window opens (Figure 3.2).

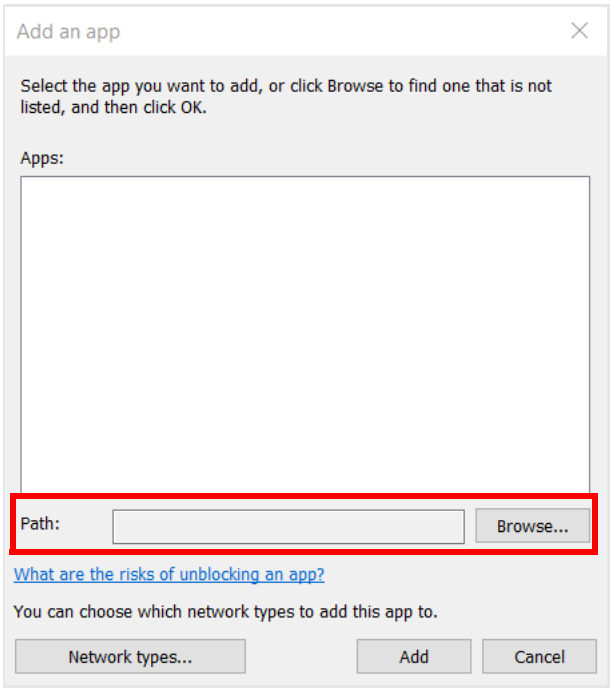


Figure 3.2: Add an App Window

5. Enter the path for the USB Protocol Suite or click **Browse** to locate the application file.

The default installation location for the Teledyne LeCroy USB Protocol Suite is C:\Program Files\LeCroy\USB Protocol Suite.

6. Select the USB Protocol Suite executable (.exe extension) and click **Open**. The application is added to “Allowed apps and features” (Figure 3.3).

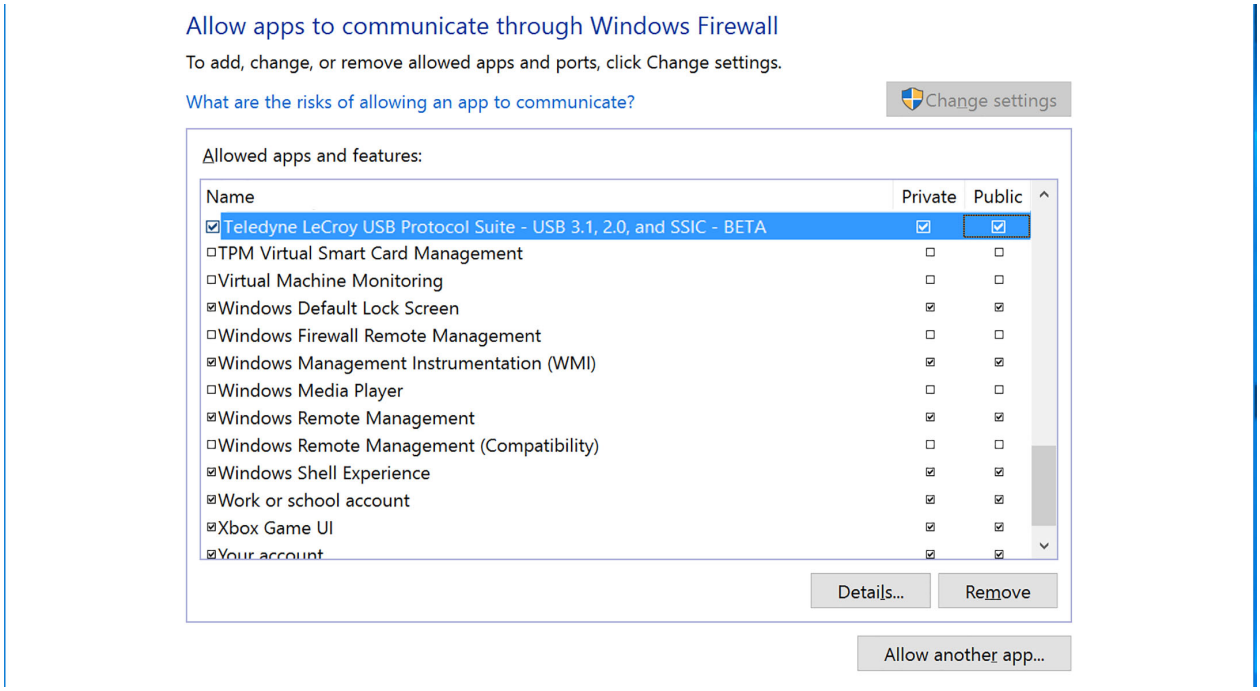


Figure 3.3: Add Teledyne LeCroy USB Protocol Suite to Allowed Applications

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**.
2. From the Control Panel, open **Systems and Security**.
3. Under Windows Firewall, select **Allow an app through Windows Firewall**. The Allowed apps screen appears.
4. Click **Change settings** > **Allow another app**.
5. If the **User Account Control** pop-up appears (Figure 3.4), click **Yes**.

NOTE:	This prompt might not appear if you have already allowed Microsoft Windows to make changes to your computer.

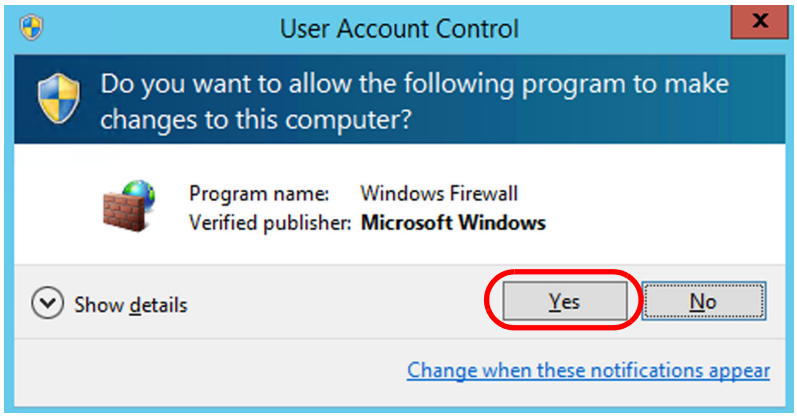


Figure 3.4: Windows 10 User Account Control Dialog Box

6. From the **Add an app** window, click **Browse**, and navigate to the location of the USB Protocol Suite you want to install.

NOTE:	The default installation location for the Teledyne LeCroy USB Protocol Suite is C:\Program Files\LeCroy\USB Protocol Suite.

7. Select the USB Protocol Suite executable file (Type=Application (.exe extension)) and click **Open**. The **Add an app** window reappears with the selected application.
8. If necessary, select **USB Protocol Suite\UsbSuite.exe**, then click **Add**. The Teledyne LeCroy USB Protocol Suite is added to the Apps allowed through the firewall.
9. After the Application has been added, you can see it in the **Allow apps to communicate through Windows Firewall** screen. An updated list of **Allowed apps and features** appears.
10. Verify that **Teledyne LeCroy USB Protocol Suite** was added, then click **OK**.

3.2 Command Line Interface

Install the USB Protocol Suite silently from the command line using this syntax:

```
[installer.exe] in --accept-licenses --accept-messages --confirm-command
```

To obtain a list of the available components:

```
[installer.exe] se
```

To install specific components:

```
[installer.exe] in component.Usb component.Example component.UsbM4xSupport --no-default-installations
```

To uninstall:

```
<installation directory>\maintenancetool.exe pr --am
```

NOTE: For a full list of commands, refer to: *https://doc.qt.io/qtinstallerframework/ifw-cli.html*

3.3 Setting Up the Analyzer: USB Connection

To set up an analyzer using a USB connection:

1. Connect the USB port on the analyzer 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.
2. Download and install the most current software for your analyzer from https://teledynelecroy.com/sw/usb/ (required USB driver files are included with the software).
3. Power on the analyzer.

NOTE: At power-on, the analyzer initializes itself in approximately ten seconds and performs a self-diagnostic that can last a few minutes. If the diagnostics fail, contact Teledyne LeCroy Customer Support for assistance.

4. When **Add New Hardware Wizard** opens on the host machine, click **Next**.
5. 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.
6. 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.
7. Check analyzer setup in the “Application Startup” section (See 3.6 *Application Startup*).

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 could cause the software to malfunction.

3.4 Setting Up the Analyzer: Ethernet Connection

When connected to a network, the analyzer can communicate with the DHCP server in order to obtain its IP address configuration. The client needs to send a request to the DHCP server to obtain an IP. The server sends only one reply. The server does not necessarily send the available IP address.

The Voyager products use the following ports:

- TCP Ports: 3999 – 4003
- UDP Ports: 4018 – 4020

NOTE: If your PC and the analyzer are not on the same subnet, you might have to set appropriate subnet and gateway settings. Also, it is best if TCP ports 4000 to 4003 and UDP ports 4018 to 4020 are available on the network, but even if they are not you might be able to force a connection by selecting the “Force add/connect attempt” box.

To set up an analyzer using an Ethernet connection:

1. Download the most current software for your analyzer from: https://teledynelecroy.com/sw/usb/.
2. Connect your host machine to the analyzer using either a Static IP Address or a Dynamic IP address if you are on a network.

NOTE: 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.

The steps for each method are described in the following section.

3.4.1 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.

3.4.1.1 Setting a Static IP Address on your PC

1. To use a Static IP address, first set your computer’s IP address to a Static IP Address:
   - Open the Control Panel: **Start > Windows System > Control Panel**.
   - Select **Network and Sharing Center**. The Network and Sharing Center Menu appears.
2. From the **Network and Sharing Center menu**, select **Change adapter settings**. The **Local Area Connection** option appears in the Network Connections window.
3. Click **Local Area Connection**. The **Local Area Connection Properties** window opens (Figure 3.5).

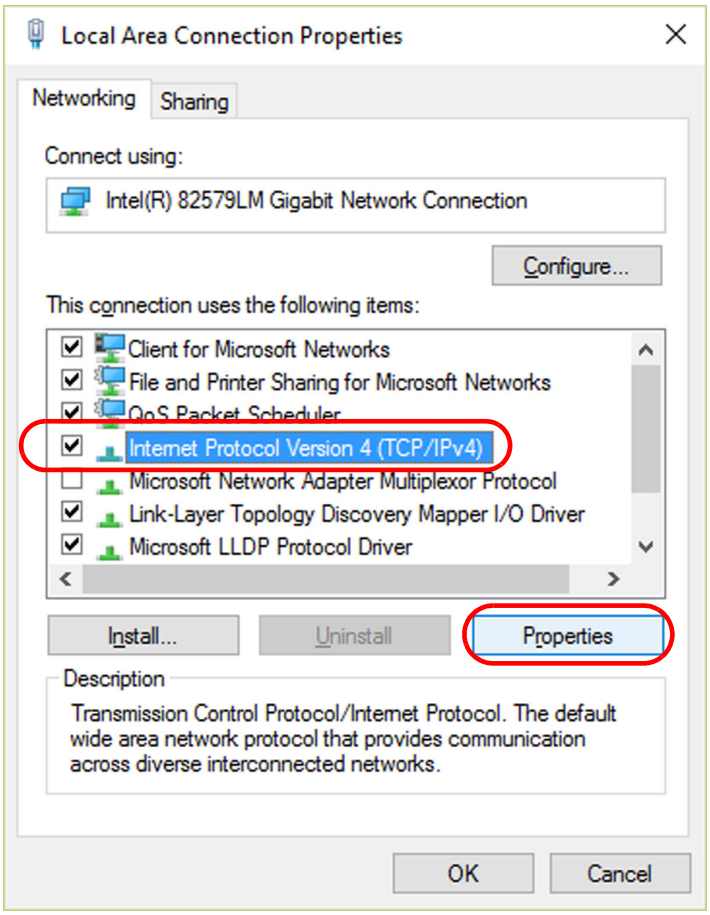


Figure 3.5: Pv4: Properties

4. Highlight **Internet Protocol Version 4 (TCP/IPv4)**, then click **Properties**. The dialog box for TCP/IPv4 properties opens (Figure 3.6).

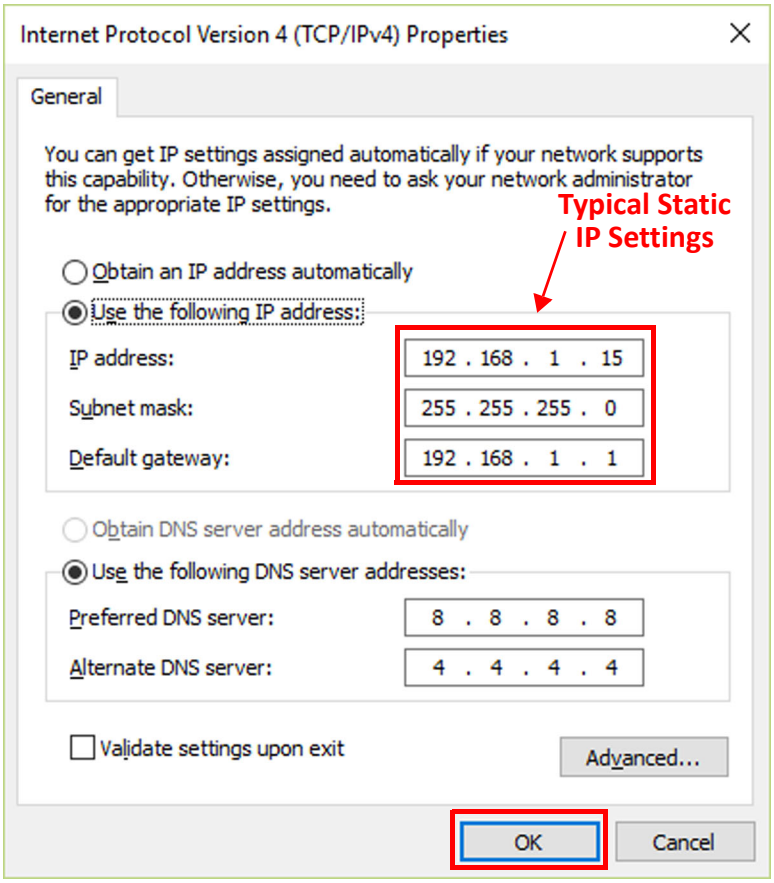


Figure 3.6: Setting Static IP Address

5. Enter your local static IP settings in the appropriate fields, then click **OK**. These are the settings that will be used by the host computer.
6. To verify that your IP address has been changed, open a Command Prompt window (Figure 3.7).

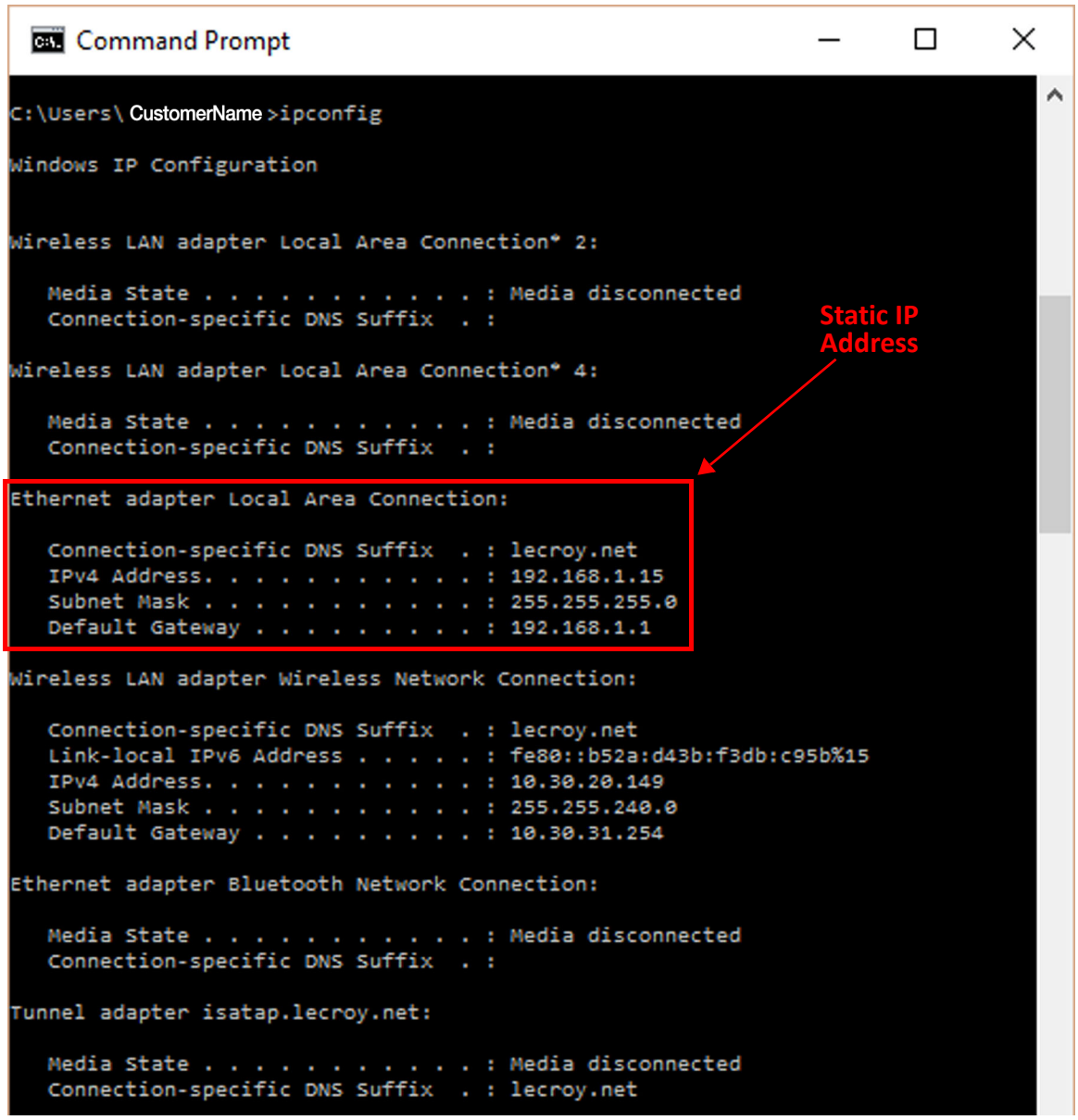


Figure 3.7: Command Prompt Window for **`ipconfig`**

3.4.1.2 Setting a Static IP Address on Your USB analyzer

1. Connect your PC to the analyzer with a USB cable.
2. Power on your analyzer (with the USB cable attached).
3. After the analyzer has initialized, launch the USB Protocol Suite software and select **Setup > All Connected Devices**. See Figure 3.8.

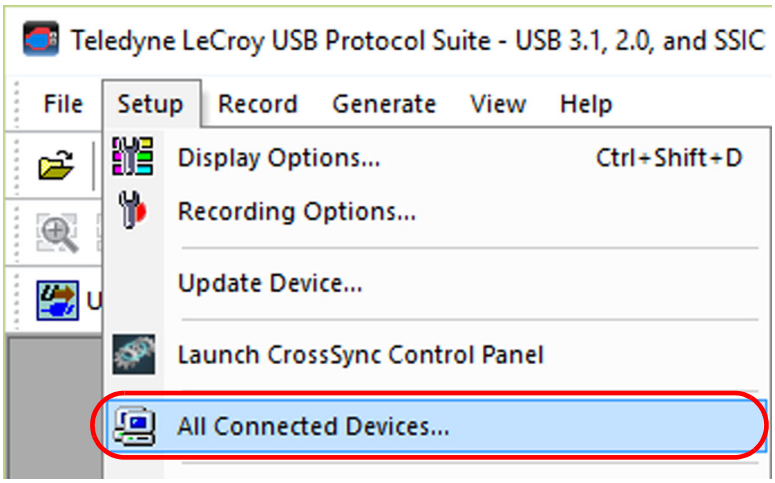


Figure 3.8: Command Prompt Window for **`ipconfig`**

4. Select **All Connected Devices**. The analyzer Devices window opens and shows the connected USB analyzer and its status (Figure 3.9).

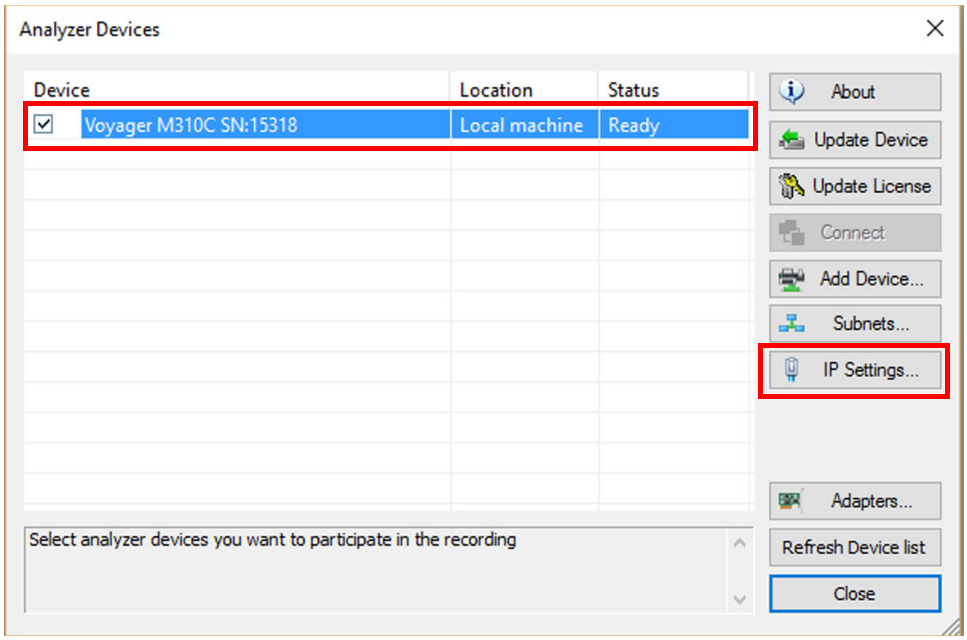


Figure 3.9: All Connected Devices: analyzer Selected

5. To configure the analyzer with an appropriate IP address, select the **IP Settings** tab (see Figure 3.10 below).

In this example (Figure 3.10), the same subnet settings as the host PC are used, but the LSBs of the IP Address are set to “20” so that the analyzer won’t interfere with the host PC (which has an IP address of 192.168.1.15).

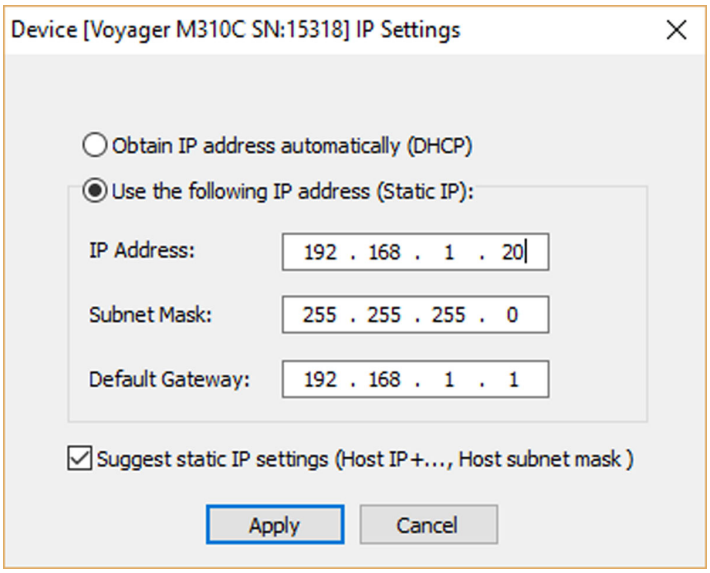


Figure 3.10: Setting Static IP Address for analyzer

6. Click **Apply**. A confirmation message appears telling you that the new IP Settings have been applied.

3.4.1.3 Ethernet Direct Connection

1. Ensure the USB cable is NOT attached the USB analyzer, then attach an Ethernet cable from the host PC to the analyzer.
2. Power cycle the analyzer.
3. Wait for the analyzer to initialize (the blue LED comes on after initialization), then start the USB Protocol Suite software.
4. Select **Setup > All Connected Devices**, then select the analyzer you want to connect. The **Connect** button will be active (Figure 3.11).

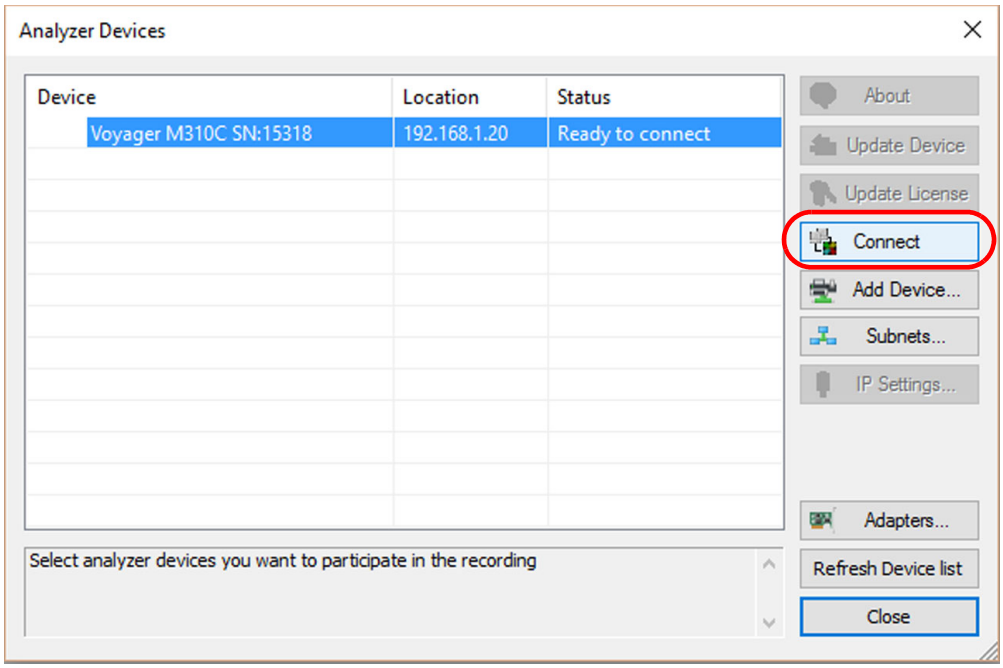


Figure 3.11: USB analyzer with New IP Address Connected Over an Ethernet Bus

The USB analyzer Devices window shows the analyzer has been connected.

5. Close the window and begin recording (Figure 3.12).

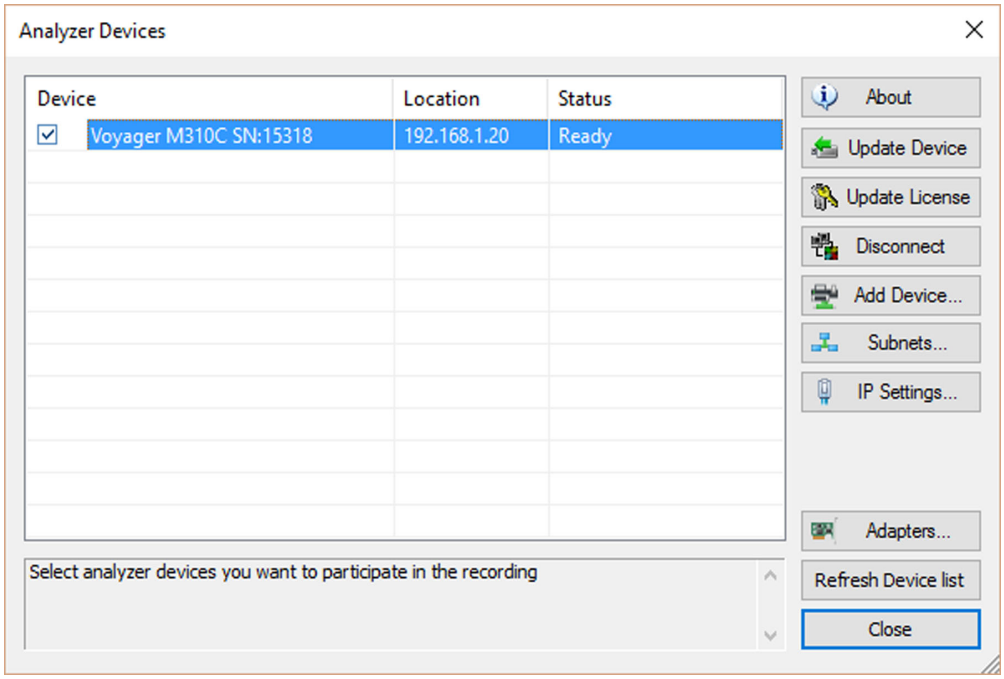


Figure 3.12: analyzer Connected to Host PC over Ethernet Bus

3.4.2 Using a Dynamic IP (DHCP) 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 3.1.3 *Allow USB Protocol Suite Through Local Firewall*.
- Direct connection from the Ethernet port on the host machine to the Ethernet port on the analyzer is supported in this release. See 3.6.3 *IP Settings (Voyager only)*.

2. Turn on the power switch.

NOTE: At power-on, the analyzer initializes itself in approximately ten seconds and performs a self-diagnostic that can last a few minutes. If the diagnostics fail, call Teledyne LeCroy.

3. Complete analyzer setup described in 3.6 *Application Startup*.

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

NOTE: Disconnecting USB or Ethernet during capture or uploading of trace data is not supported, and might cause the software to malfunction or crash.

3.4.3 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.

3.5 Cascading with CATC SYNC Expansion Card

You can daisy-chain two analyzers if they both have a CATC SYNC port. Voyager M3x, M310, M310C, M310P/M310e, M4x, M480x, and Advisor T3 have built-in CATC SYNC ports and only require a cross-connect or octopus cable accessory kit.

After the analyzers are connected, recording starts simultaneously and triggers 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 (see 3.6.2 *Analyzer Devices*).

WARNING: If you are using other types of analyzers (NOT USB!) in your daisy-chain (including PCIe, DDR, SAS, SAS, FC, net) and do not want 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.

3.5.1 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 T3s, 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.

3.5.2 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)

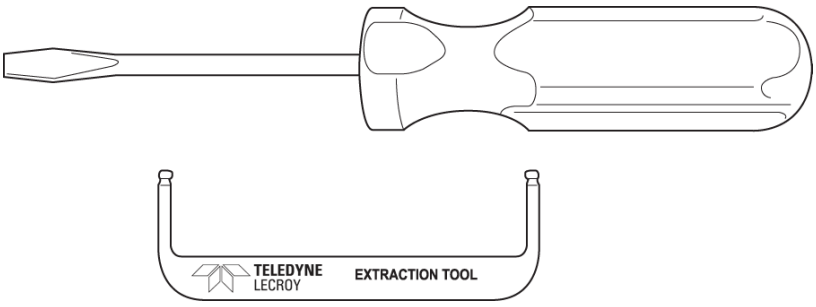


Figure 3.13: Required Tools for Removing Expansion Card

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 (Figure 3.14), which are located on the panel of the expansion card.

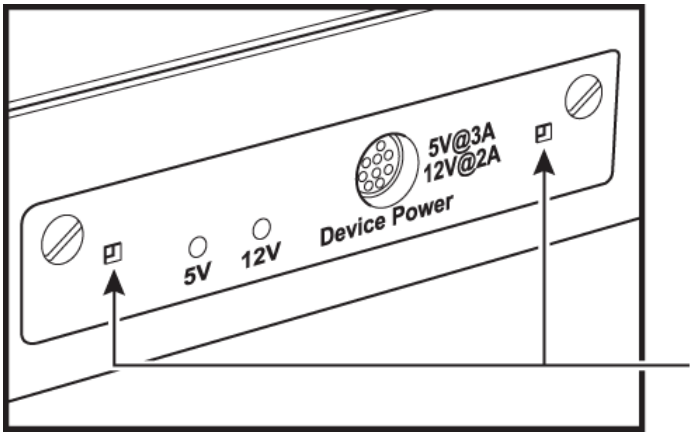


Figure 3.14: Retaining Screws and the Holes

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

2. Insert the prongs of the extraction tool into the holes in the expansion card panel (Figure 3.15).

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.

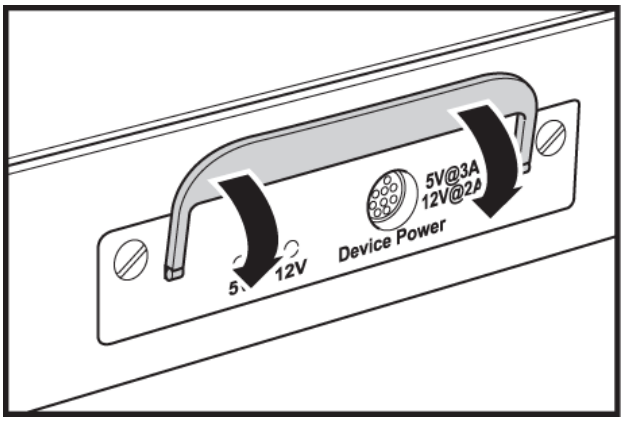


Figure 3.15: Insert Extraction Tool

3. Rotate the extraction tool to a horizontal position (Figure 3.16) to lock the prongs into place and make a handle.

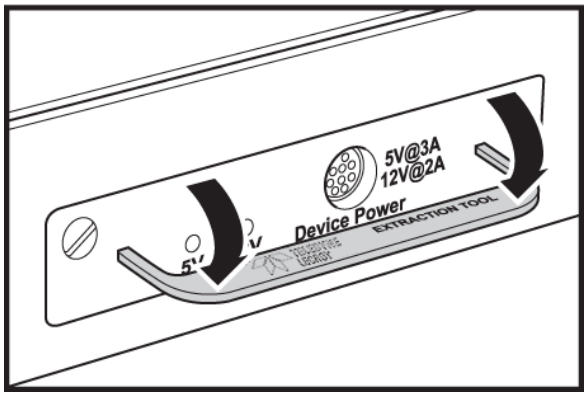


Figure 3.16: Rotate Extraction Tool

4. Using the screwdriver, turn both retaining screws counter-clockwise approximately two full turns, until you feel a slight resistance (Figure 3.17).

DO NOT FORCE THE RETAINING SCREWS after two turns.

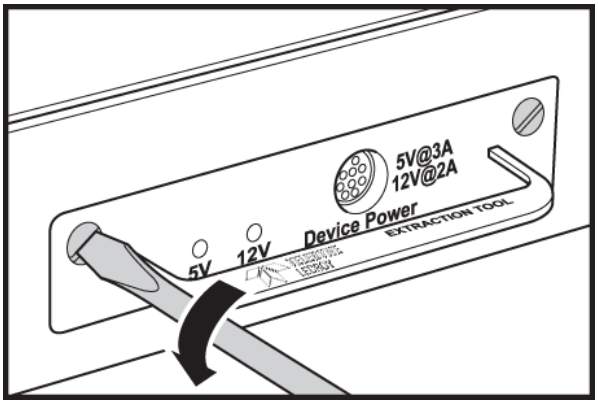


Figure 3.17: Turn Screws Counter-Clockwise Approximately Two Full Turns

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

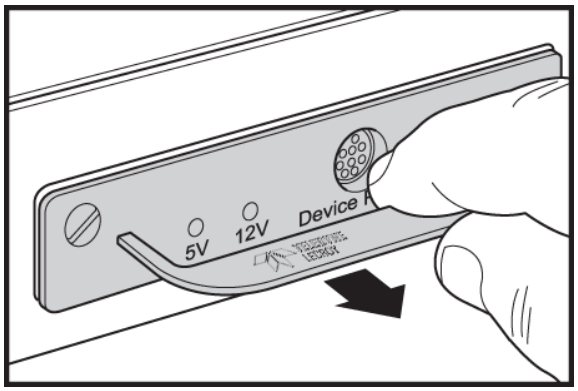


Figure 3.18: Gently Wriggle Handle Forward

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.

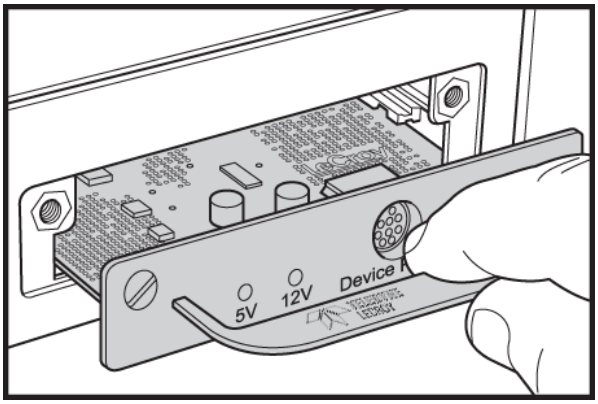


Figure 3.19: Remove Card

3.6 Application Startup

Select **Start > All Programs > LeCroy > USB Protocol Suite > USB Protocol Suite** to open the main window (see Figure 3.20).

NOTE: The installer adds a service that helps keep your software up-to-date. If you see a message from your antivirus software, you can:

Disable your antivirus software until installation is complete

Opt out of automatic updates during installation

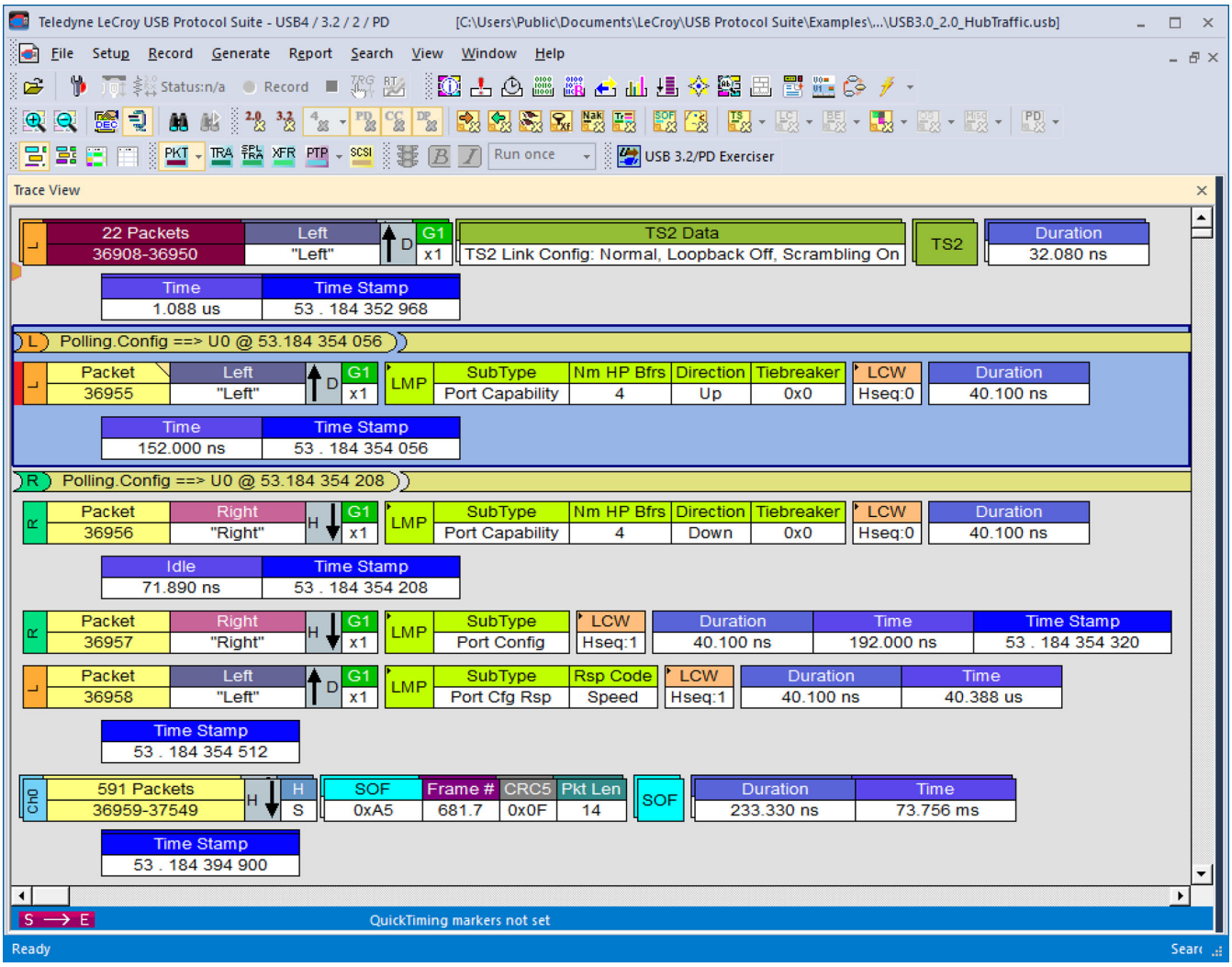


Figure 3.20: Main Window

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.

3.6.1 Confirm Proper Hardware Installation & USB or Ethernet Connection

3.6.1.1 USB Connection

To confirm proper installation and USB connection:

1. Open the USB Protocol Suite application.
2. From the main menu, select **Help > About**. The Software Version, Firmware Version, BusEngine™ Version, and Unit Serial Number are displayed in the About window.

3.6.1.2 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 and the About windows.

3.6.2 Analyzer Devices

1. To show the available analyzer Devices, select **Setup > All Connected Devices**. The Analyzer Devices window appears (Figure 3.21).

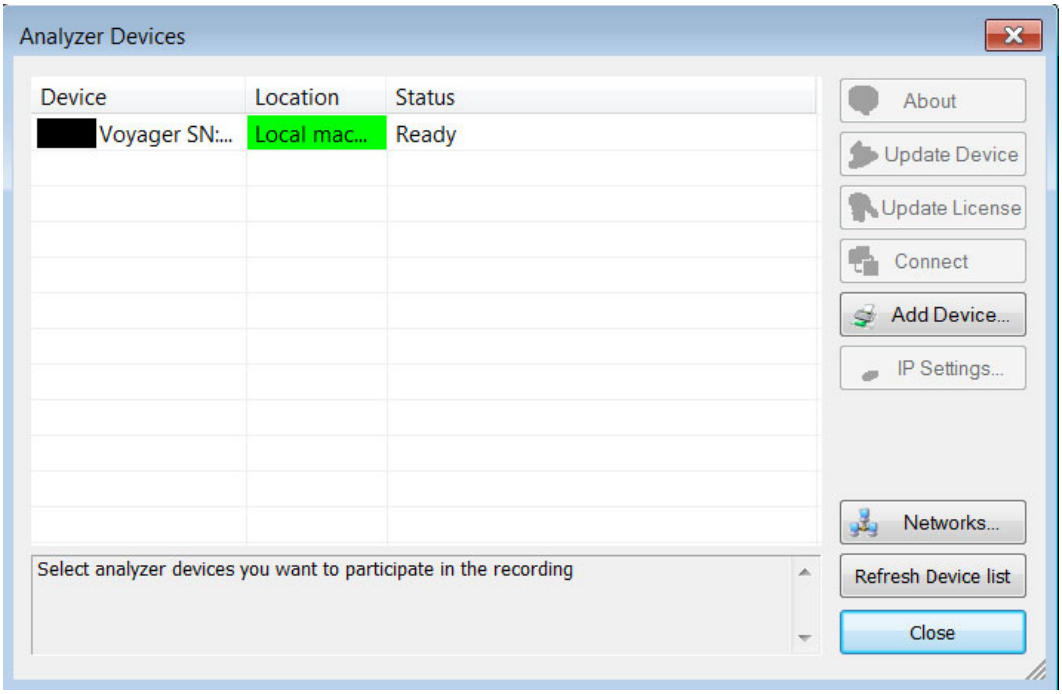


Figure 3.21: Device, Location, and Status

2. You can click:

   - **About** to display device information (see 13.1 *Software, Firmware, and BusEngine Revisions*).
   - **Update Device** (see 13.3.4 *Manual Updates to Firmware, BusEngine, and Serdes BusEngine*)
   - **Update License** (see 13.4.5 *Updating the Software License*)
   - **Connect** to display the Connection Properties window, in which you can set the system to the following:
     - Automatically connect to the device
     - Ask to connect to the device
     - Take no action
     - **Add Device** to display the Add Ethernet Attached Device window, in which you can enter an IP Address

- **IP Settings** to use a DHCP or Static IP address

3. To refresh the list of devices, click **Refresh Device List**.
4. Before starting a recording, select the analyzer you want to use.

3.6.3 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. The *analyzer Devices* window (Figure 3.22) appears.

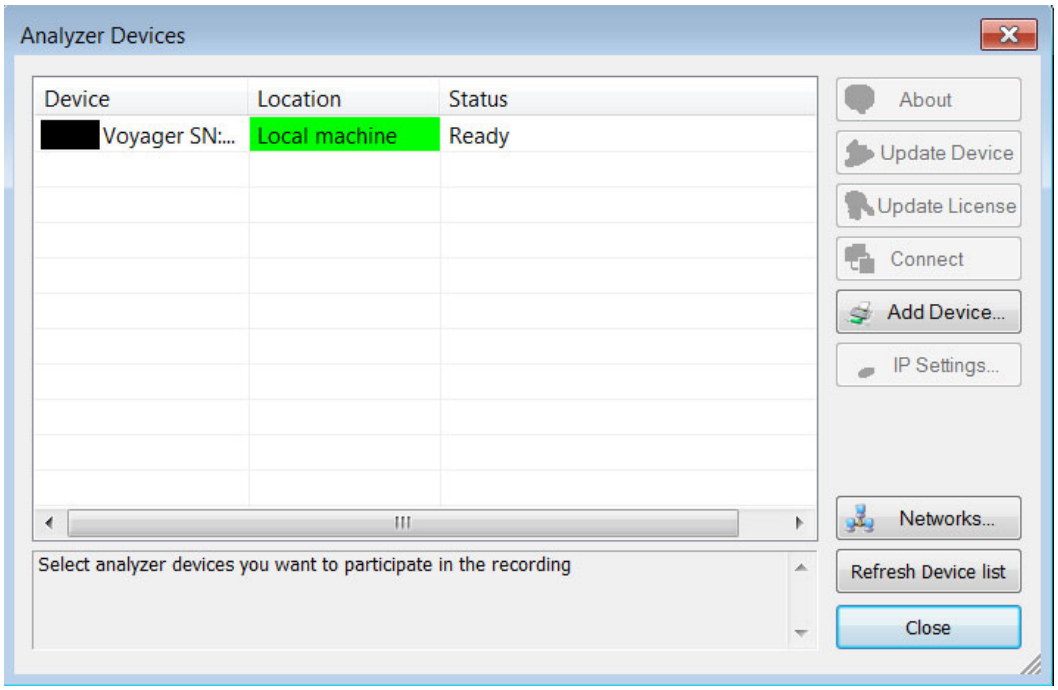


Figure 3.22: analyzer Devices Window

NOTE: If you are not connected to a device, the IP Settings command is inactive.

2. Select the device to use in the recording, then click the **IP Settings** button to display the Device IP Settings dialog box (Figure 3.23).

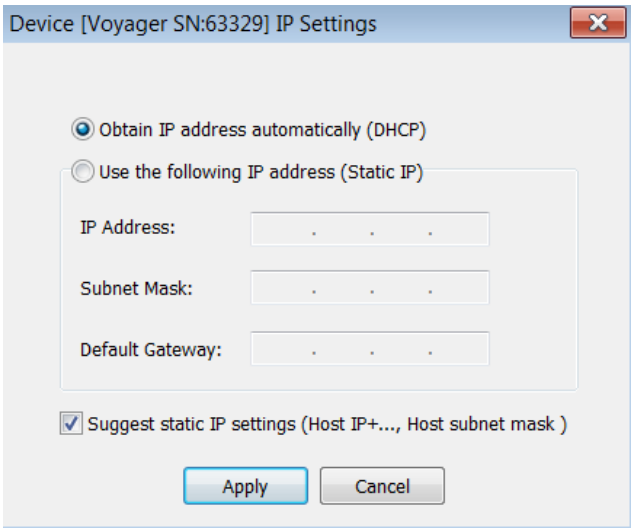


Figure 3.23: Device IP Settings Dialog Box

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, then:
   a. Enter the **IP Address**.
   b. Enter the **Subnet Mask**.
   c. Enter the **Default Gateway**.

The system can also **Suggest static IP settings** (IP address and subnet mask).

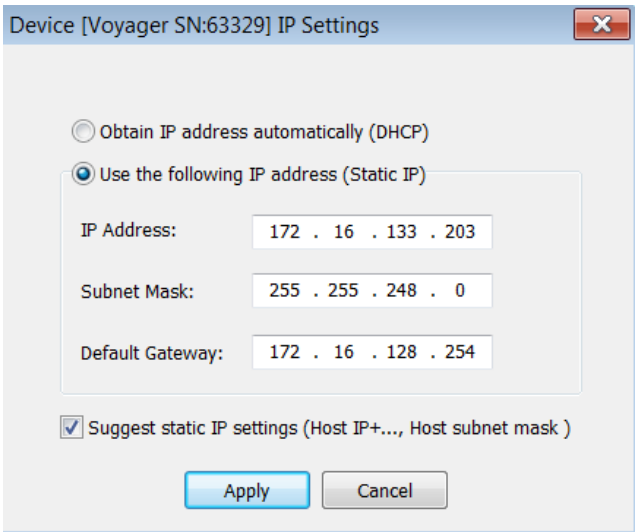


Figure 3.24: Device IP Settings Dialog

4. Click **Apply**. A success message appears and you are returned to the analyzer Devices window.

5. Click **Close** to close the window and use the device with a Static IP address.

3.6.4 Signal Parameters

The methods and interfaces for setting signal parameters vary based on the particular analyzer you're using.

3.6.4.1 Voyager M480x

3.6.4.1.1 Auto Calibration

Before capturing USB4 Gen 4 traffic, it's essential to calibrate the Voyager M480x. This involves tuning the equalizer to properly receive PAM3 signaling, so both the Host and Device must enter and remain in CL0 for the duration of the process. Since the receiver is dynamically adapting, calibration can take anywhere from several minutes to over an hour, depending on the signal quality.

NOTE: Calibration only affects the signal received by the analyzer and does not impact the signal path between the Host and Device. If any component in the setup changes (including the Host, Device, cabling, and Tx parameters), calibration should be repeated to maintain the lowest possible error rate.

1. In the status bar, select the target icon next to the unit you'd like to calibrate.

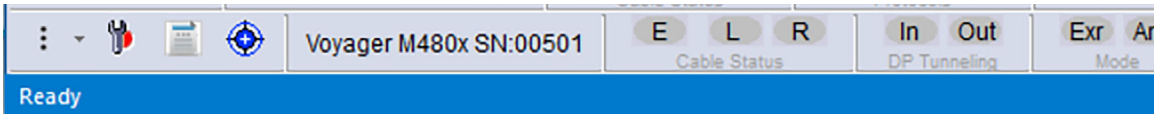


Figure 3.25: USB Protocol Suite Status Bar

2. The Auto Calibration wizard opens. From the Configuration stage, select the lanes you want to perform calibration on, then click Next.

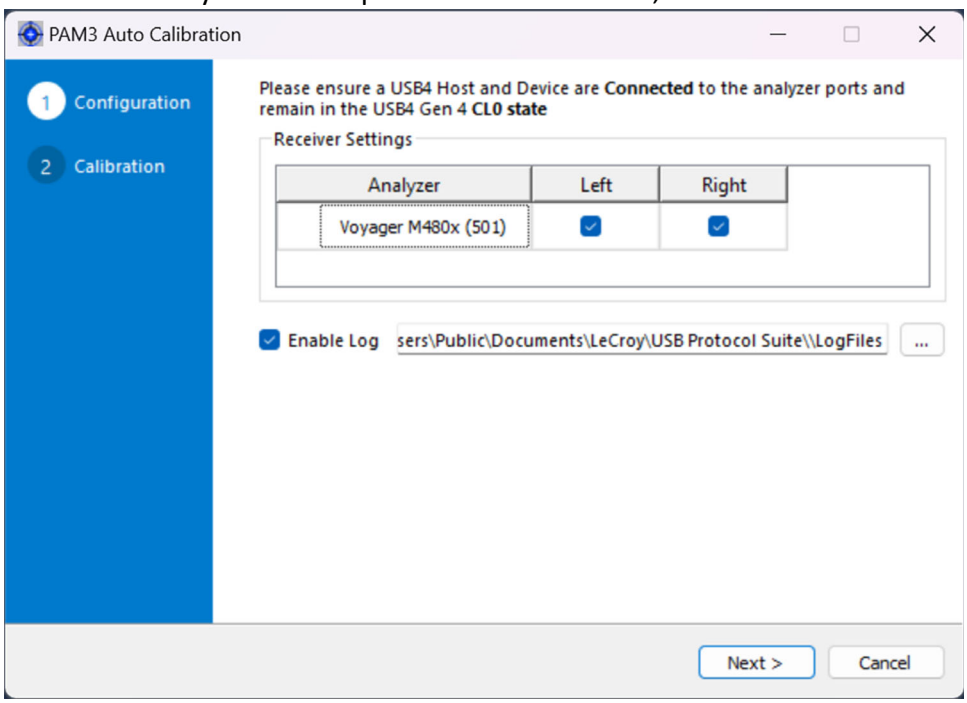


Figure 3.26: Auto Calibration Setup Window

3. The Calibration stage appears and shows the progress of the calibration (Figure 3.27). When it's complete, you can save the results in a Profile that will be available in the Signal Parameters window (see *Profiles*).

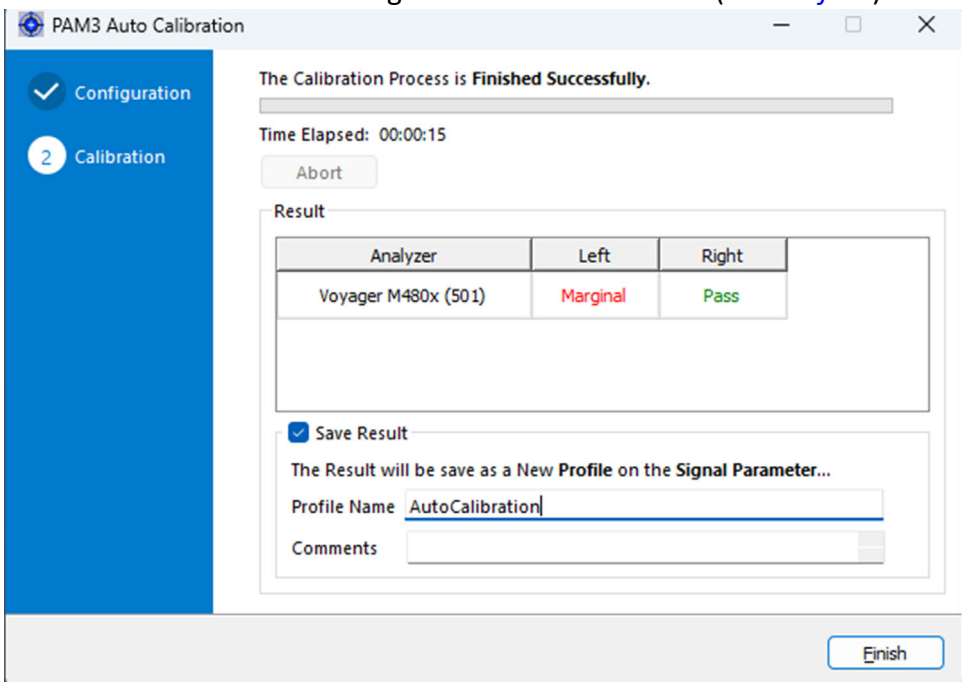


Figure 3.27: Auto Calibration Success Message

3.6.4.1.2 Profiles

1. Select **Setup > Signal Parameters** to access the **M480x Signal Settings** window (Figure 3.28).

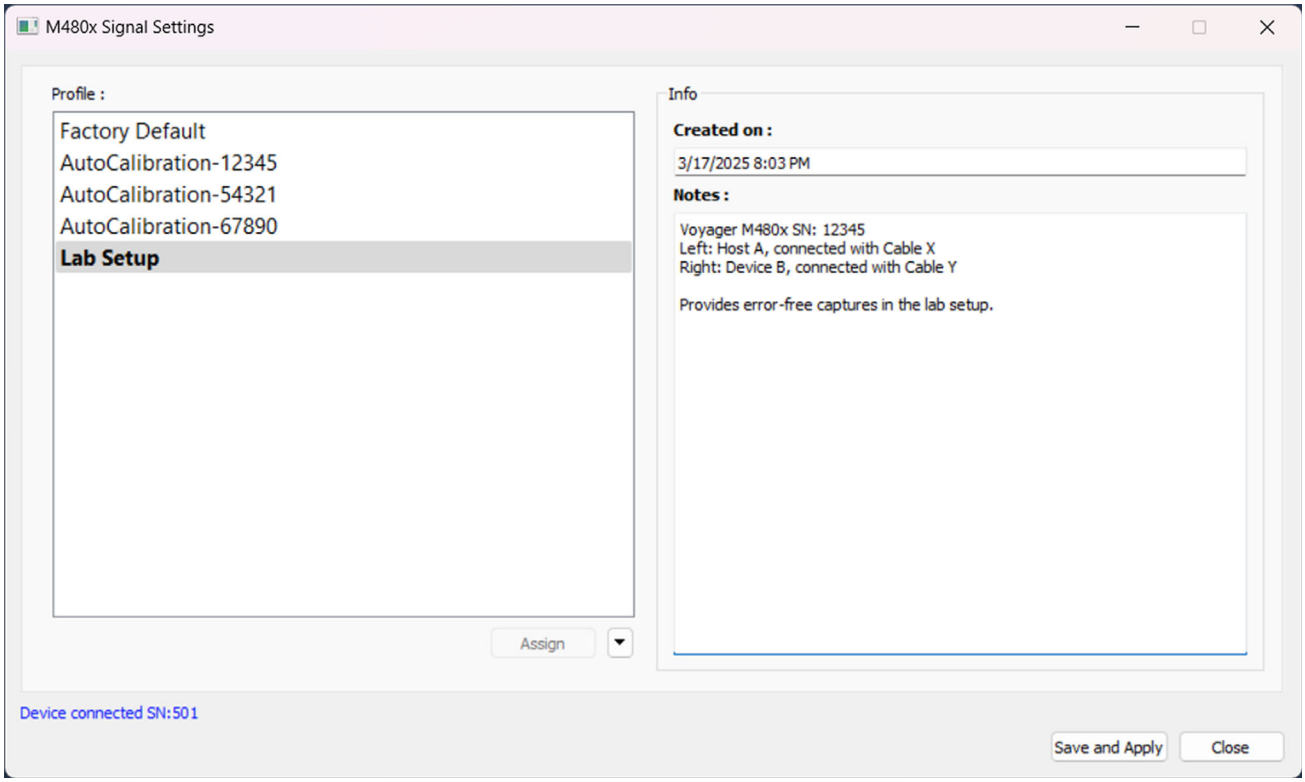


Figure 3.28: M480x Signal Settings Window

2. Select the Profile from the list, then click **Save and Apply** to apply the settings.

NOTE:
- Use the Notes field to save details about your configurations and to record information about testing performance.
- Right-click in the Profiles list to open menus with more options (i.e., Delete, Rename, Assign).

3.6.4.2 Voyager M4x (USB4 and USB 3.2)

To select values for the **Rx Equalizer Settings** for the M4x do the following:

1. Select **Setup > Signal Parameters > M4x**. The **M4x Signal Settings** window opens (Figure 3.29).

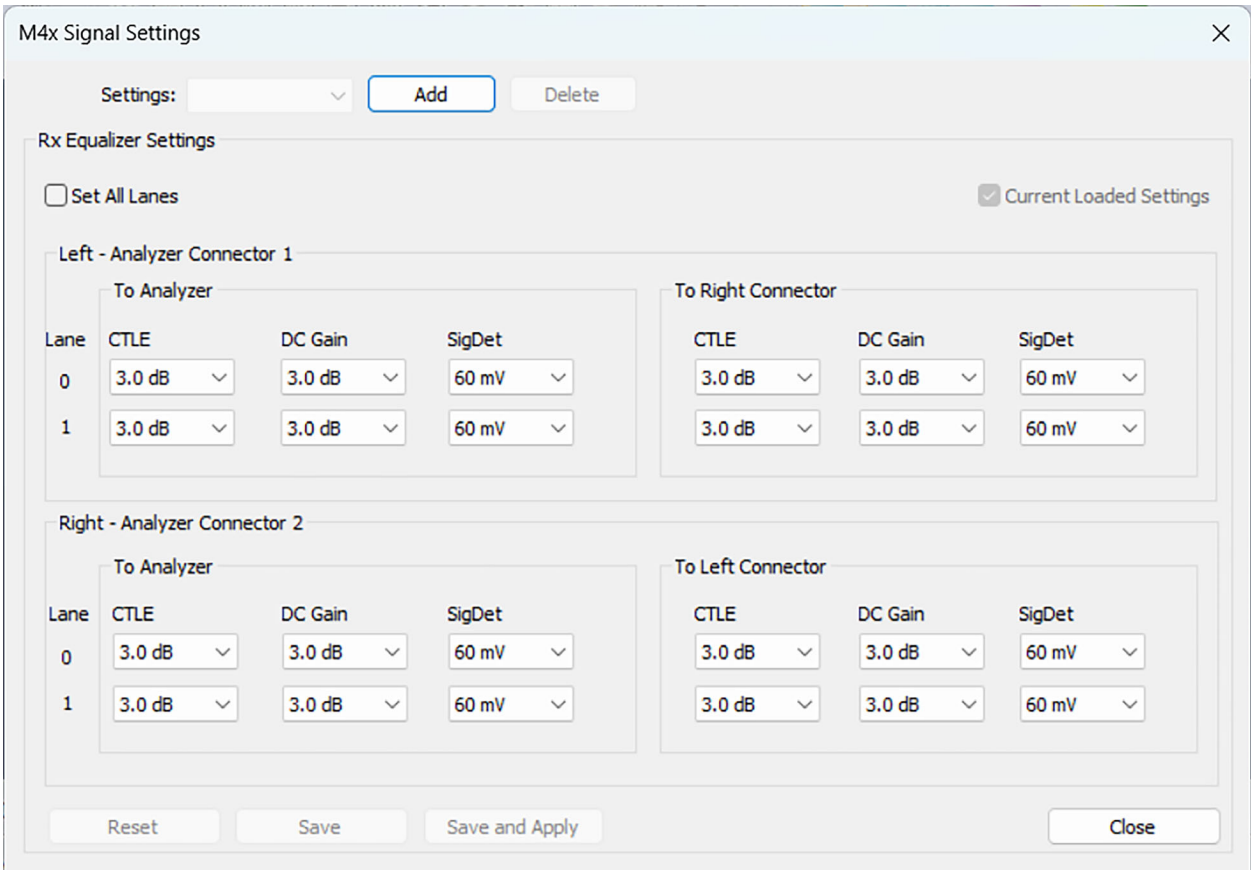


Figure 3.29: Signal Parameters: M4x

- Rx Equalizer Settings: Set All Lanes or Set Lane 0 and Lane 1 to different values.
- 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
- 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

2. If you enter values for the Rx Equalizer Settings and select **Add,** the New Signal Settings box opens (Figure 3.30).

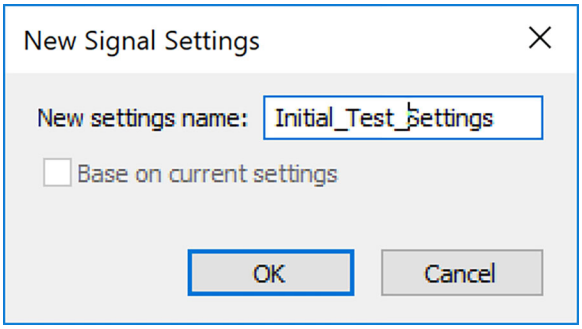


Figure 3.30: New Signal Settings: Name of Set of Settings

3. Click **OK**. The Initial Test Settings appear in the M4x Signal Settings window (Figure 3.31).

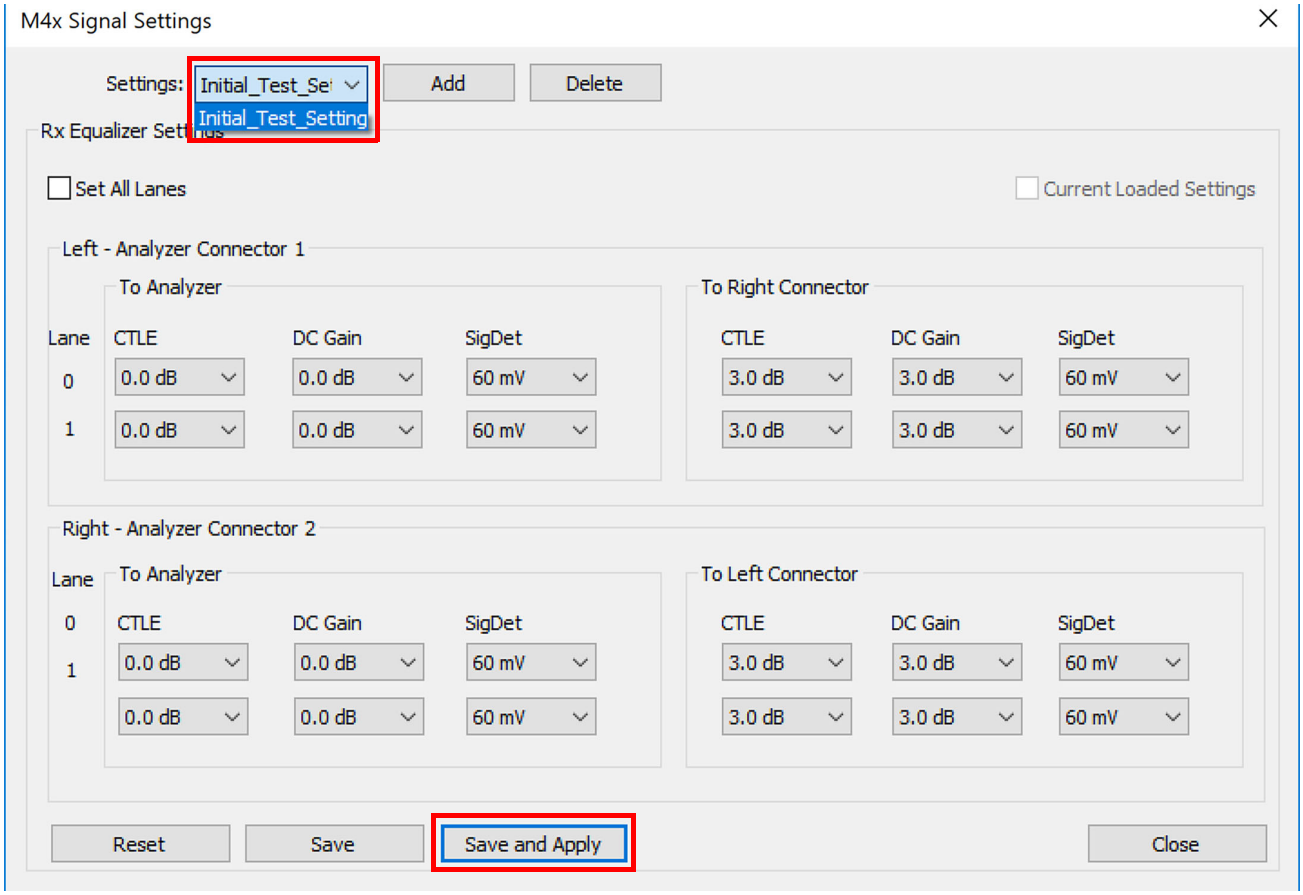


Figure 3.31: M4x Initial Test Signal Settings

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.

3.6.4.2.1 Rx Equalization Settings Detail & Troubleshooting Capture/Link Problems

Figure 3.32 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" (green arrows in Figure 3.32). Therefore, if the link between two DUTs are good but analyzer is capturing IPSs, you need to adjust these parameters:

- If errors (IPS packets) are seen from "Left" in the captured trace, you need to change the settings for the left connector.
- If errors are seen from "Right" in the captured trace, you need to change parameters for the right connector.

To Right Connector and **To Left Connector** settings are designated to tune settings for pass-through the path (between two DUTs), highlighted purple in Figure 3.32. 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.

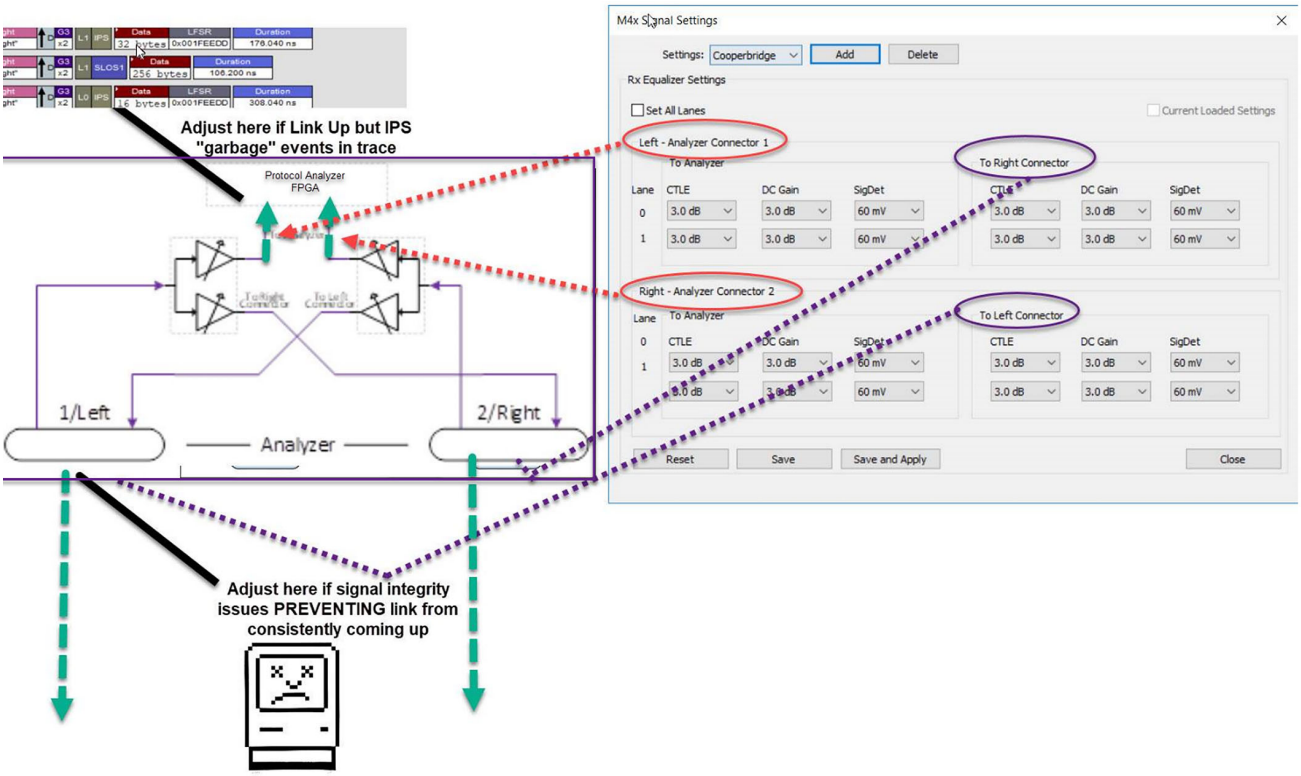


Figure 3.32: Rx Equalization Settings

3.6.4.2.2 Adding and Saving New Rx Equalization Settings

After you have updated the equalization settings you can Add or Save and Apply them with the buttons in the signal settings window. See Figure 3.33.

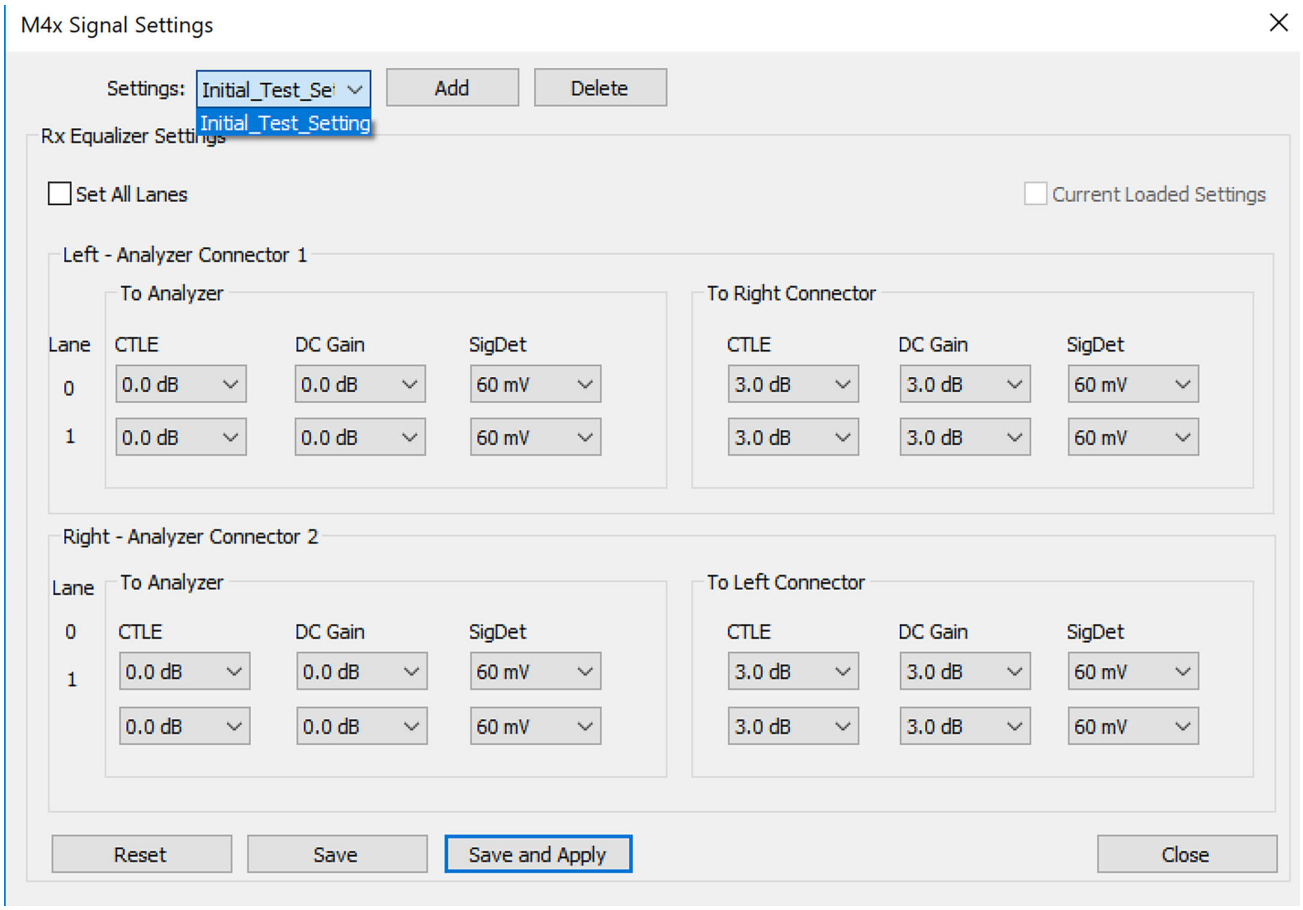


Figure 3.33: Add and Save and Apply Buttons in Equalization Settings Dialog

3.6.4.3 Using .csv Files (USB 3.2)

You can 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:

1. Select **Setup > Signal Parameters** (Figure 3.34).

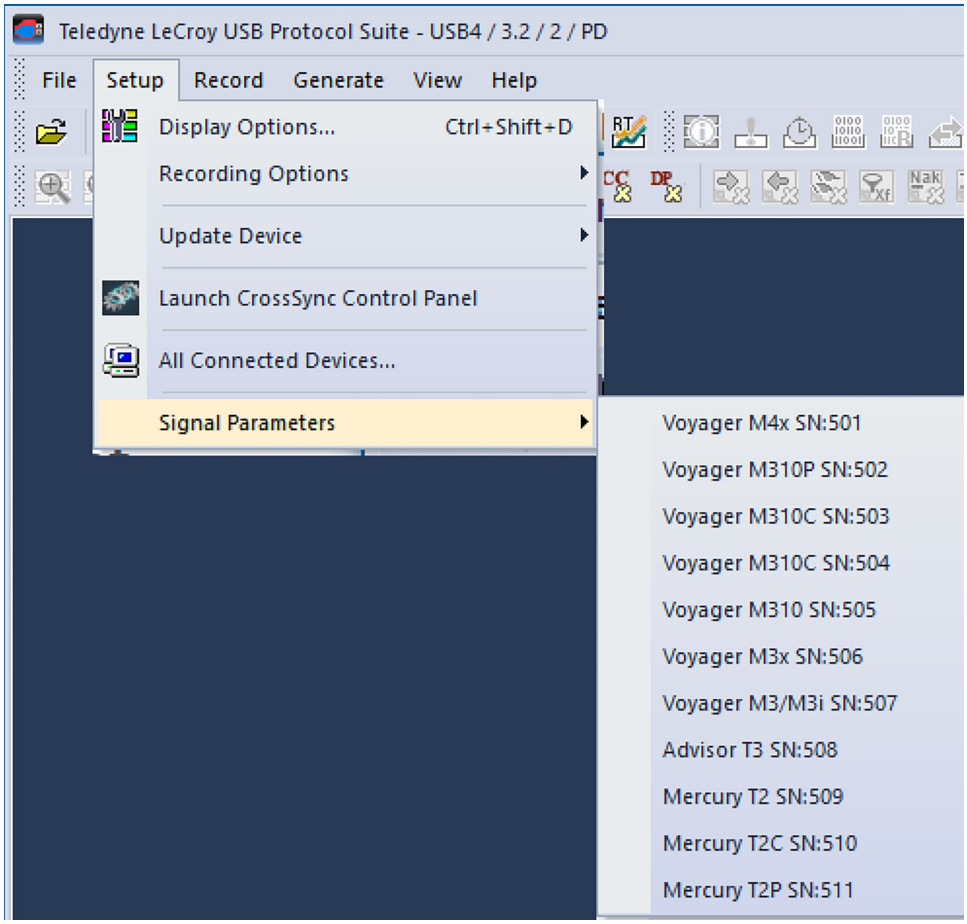


Figure 3.34: Signal Parameters

2. Select the USB 3.2 device you want to modify and/or for which to calibrate USB 3.2 connections.

The Host Signal Profiles window appears for the selected device (Figure 3.35).

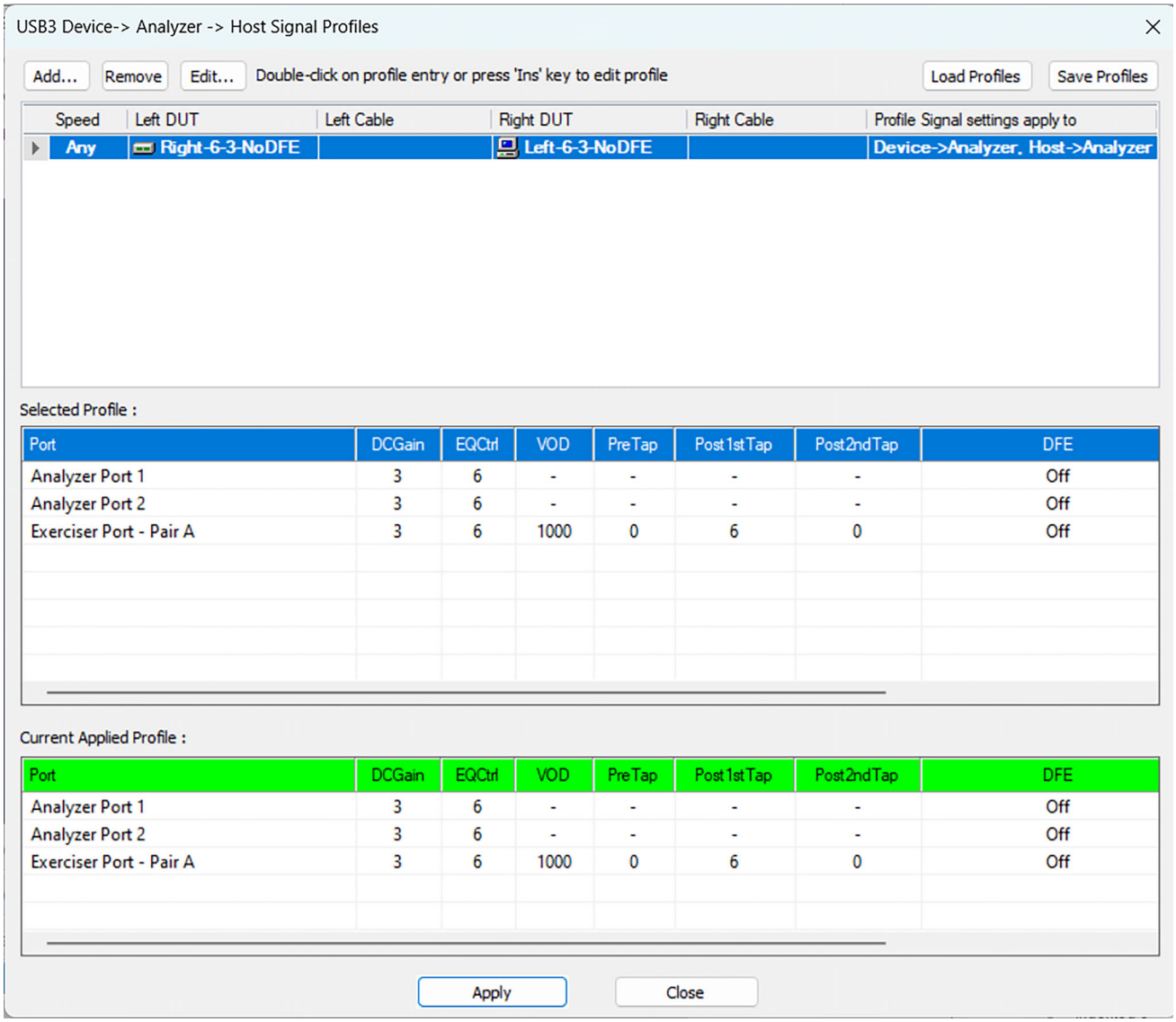


Figure 3.35: USB 3.2 Analyzer Host Signal Profiles Window

3. Choose Load Profiles, then select the .csv file for the profile you want to use.

3.6.4.4 Voyager M310 and M310C

1. To edit the Host Signal Parameters Profile of a specific profile entry, double click on the entry. The **Host Signal Parameters Profile** window appears (Figure 3.36).

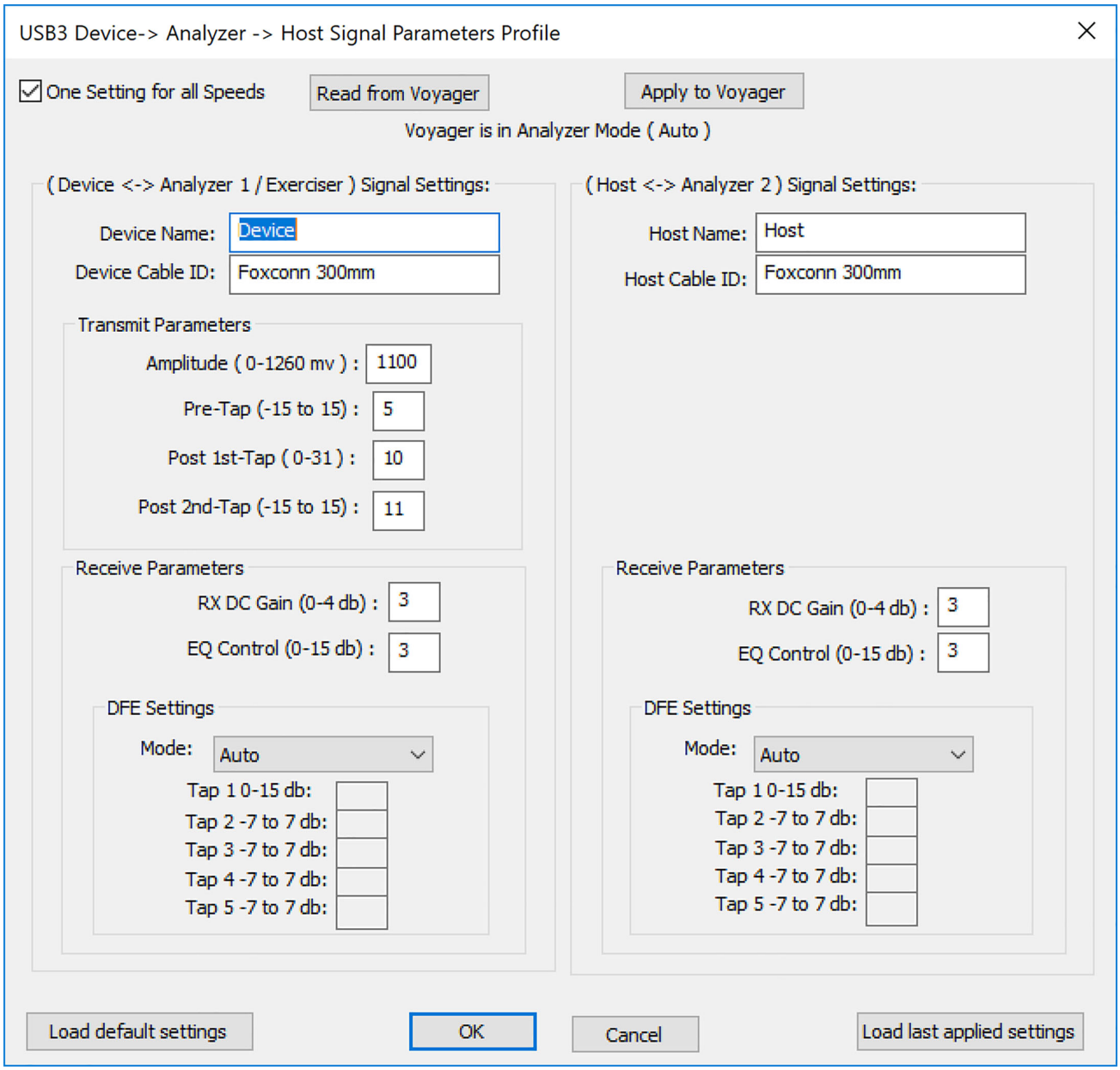


Figure 3.36: Example Host Signal Parameters Profile for Voyager M310 and M310C

This window allows you to do the following:

- Read from [*analyzer*]
- Apply to [*analyzer*]
- 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 to 1260mv)
            - Pre-Tap (-15 to +15)
            - Post 1st-Tap (0 to 31)
            - Post 2nd-Tap (-15 to 15)
    - Receive Parameters
        - RX DC Gain (0 to 4db)
        - EQ Control (0 to 15db)
    - DFE Settings
        - Mode: Auto, Off, Manual, Triggered Adaptation, Continuous Adaptation
        - If in Manual Mode, you can set different tap values:
            - 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
2. You can also **Load default settings** or **Load last applied settings**.

3.6.4.5 Voyager M3x

1. To edit the Host Signal Parameters of a specific Profile entry, double click the entry. The **Host Signal Parameters Profile** window opens (Figure 3.37).

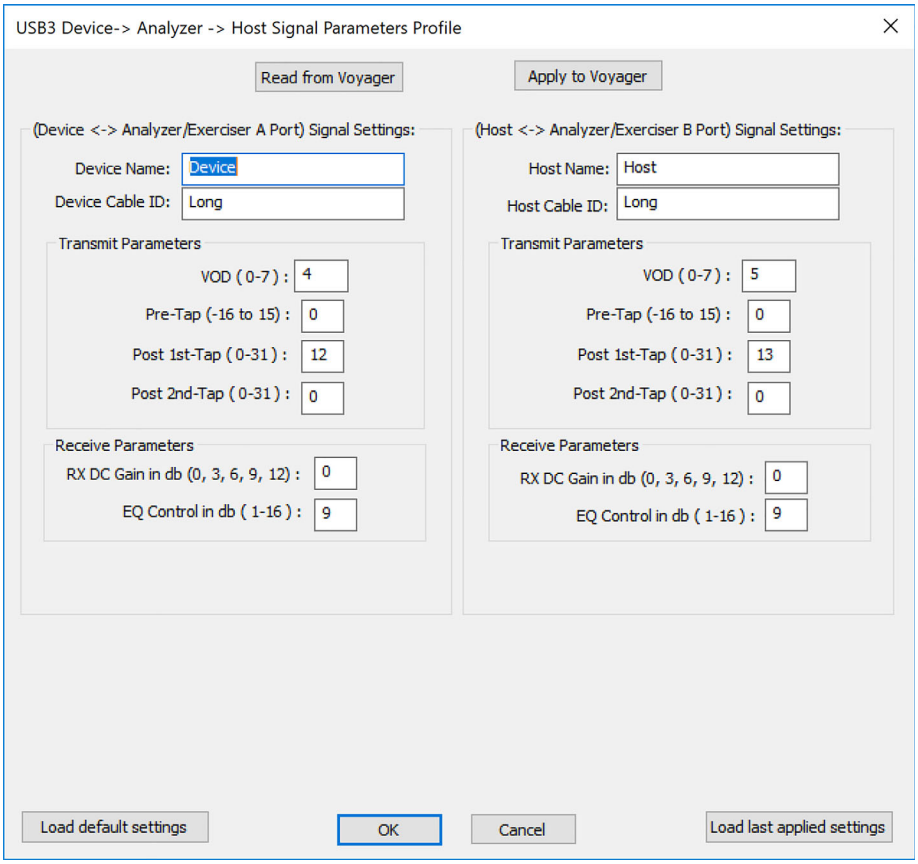


Figure 3.37: USB 3.2 Device analyzer Host Signal Parameters Profile for M3x

- Read from [*analyzer*]
- Apply to [*analyzer*]
- 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 to 7)
    - Pre-Tap (-16 to 15)
    - Post 1st-Tap (0 to 31)
    - Post 2nd-Tap (0 to 31)
  - Receive Parameters

- RX DC Gain in db (0, 3, 6, 9, 12)
- EQ Control in db (0 to 16)

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

3.6.4.6 Voyager M310P

To edit the Host Signal Parameters Profile of a specific entry, double click on the entry. The **Host Signal Parameters Profile** window opens (Figure 3.38).

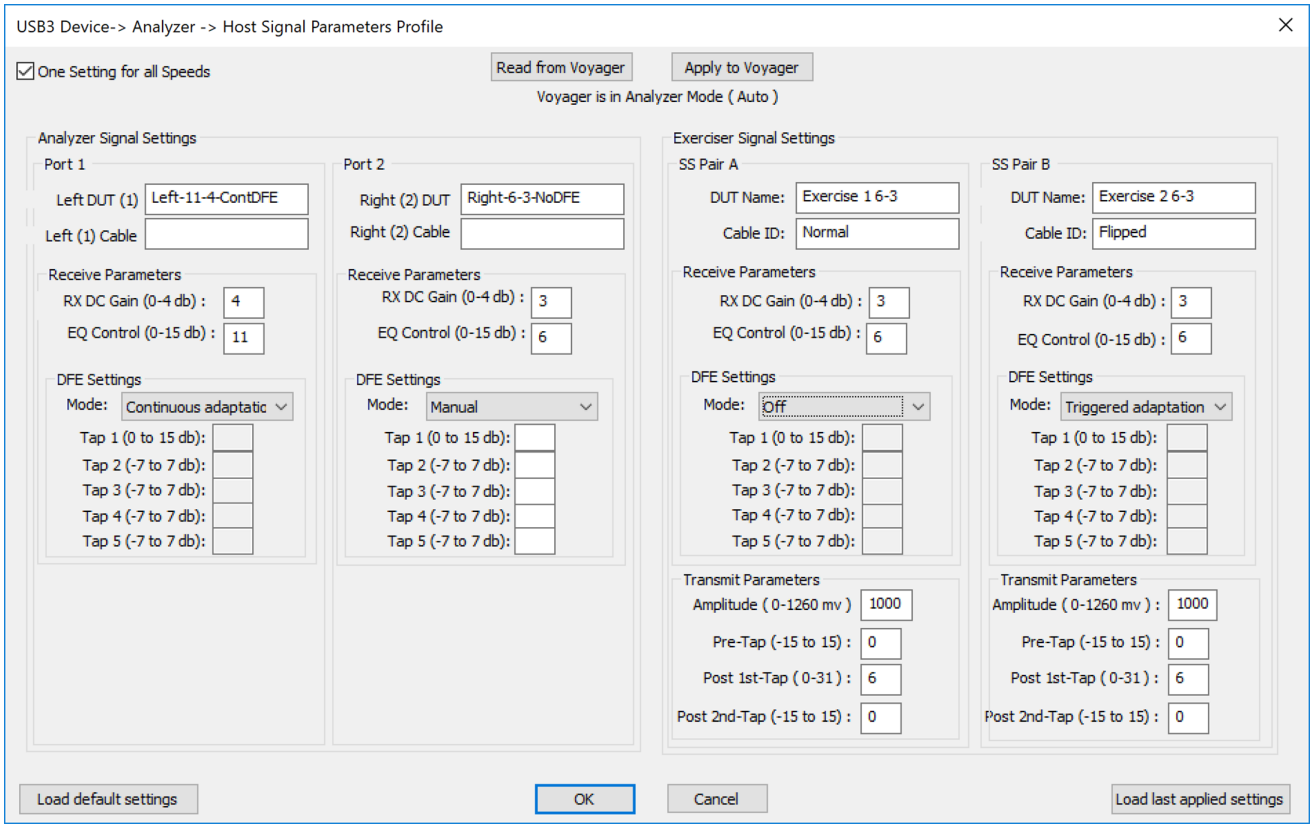


Figure 3.38: Device analyzer Host Signal Parameters Profile for Selected M310P Entry

This window has the following functions:

- Read from [*analyzer*]
- Apply to [*analyzer*]
- 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 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

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 to 4 db)
    - EQ Control (0 to 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 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 to 1260mv)
    - Pre-Tap (-15 to +15)
    - Post 1st-Tap (0 to 31)
    - Post 2nd-Tap (-15 to 15)

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

3.6.4.7 Voyager M310e

To edit the Host Signal Parameters Profile of a specific profile, double click on the entry. The **Host Signal Parameters Profile** window appears (Figure 3.39).

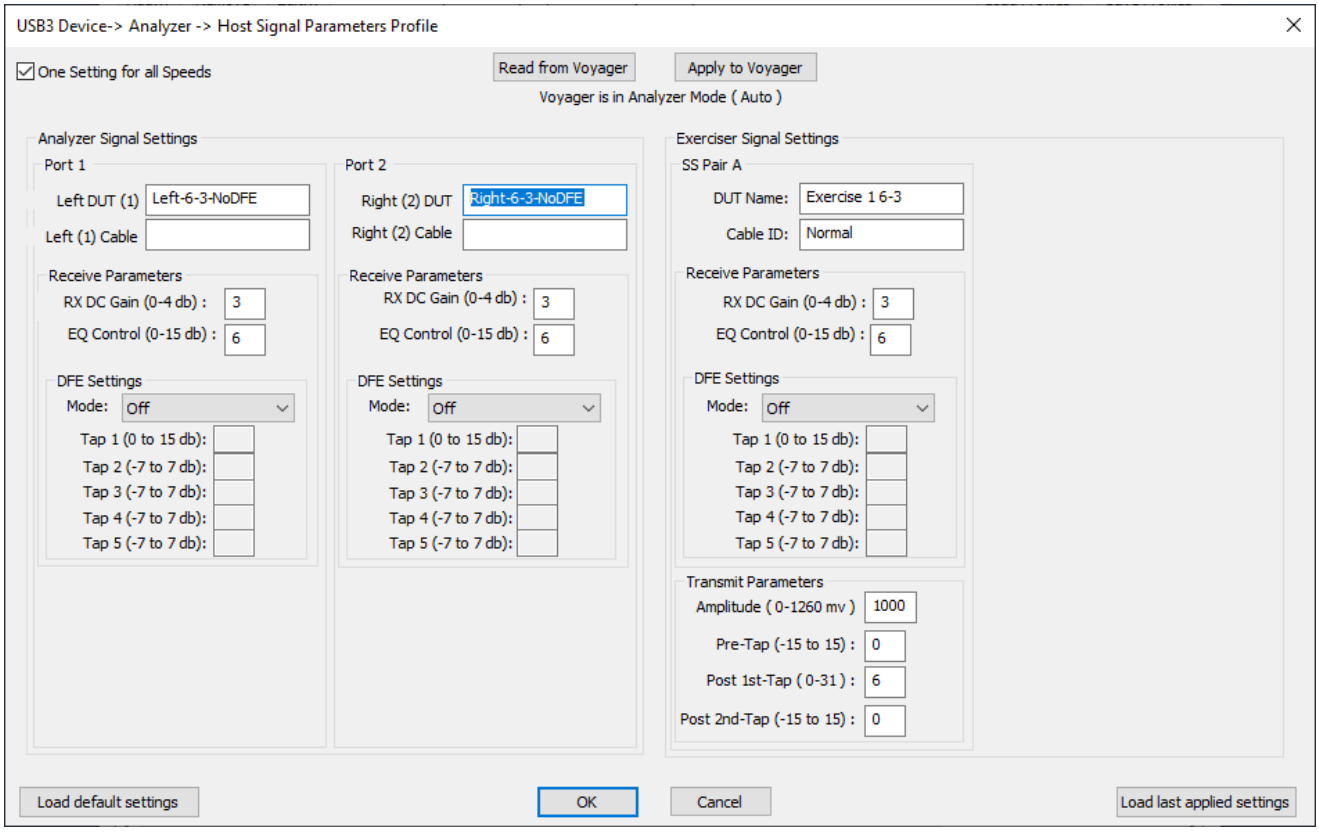


Figure 3.39: USB 3.2 Device analyzer Host Signal Parameters Profile Dialog M310e

Use this window to:

- Read from [*analyzer*]
- Apply to [*analyzer*]
- 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 to 4 db)
    - EQ Control (0 to 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 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

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

- DUT name
- Cable ID
- DUT name
- Cable ID
- Receiver Parameters
  - RX DC Gain (0 to 4 db)
  - EQ Control (0 to15 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 to 1260mv)
  - Pre-Tap (-15 to +15)
  - Post 1st-Tap (0 to 31)
  - Post 2nd-Tap (-15 to 15)

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

3.6.4.8 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:

1. Select **Setup > USB 3.2 Device/Signal Parameters**. If the Advisor T3 is in default mode (Proxied from other port), the following message appears (Figure 3.40).

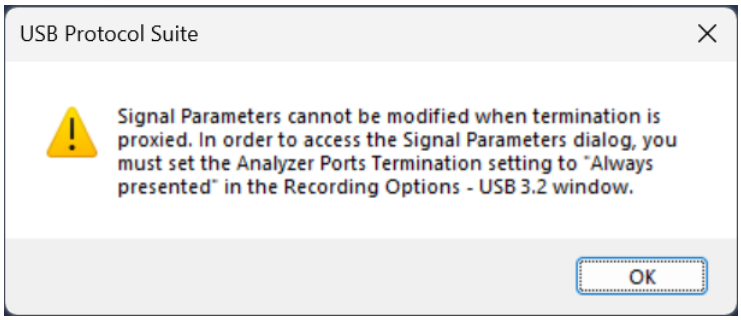


Figure 3.40: Advisor T3: Warning Message

2. To set the Recording Options to Always presented, Open the USB Protocol Suite and select **Recording Options**.

a. Select **General > Advisor T3**.

b. Select the USB 3.2 tab.

c. Click the **Always presented** radio button (Figure 3.41).

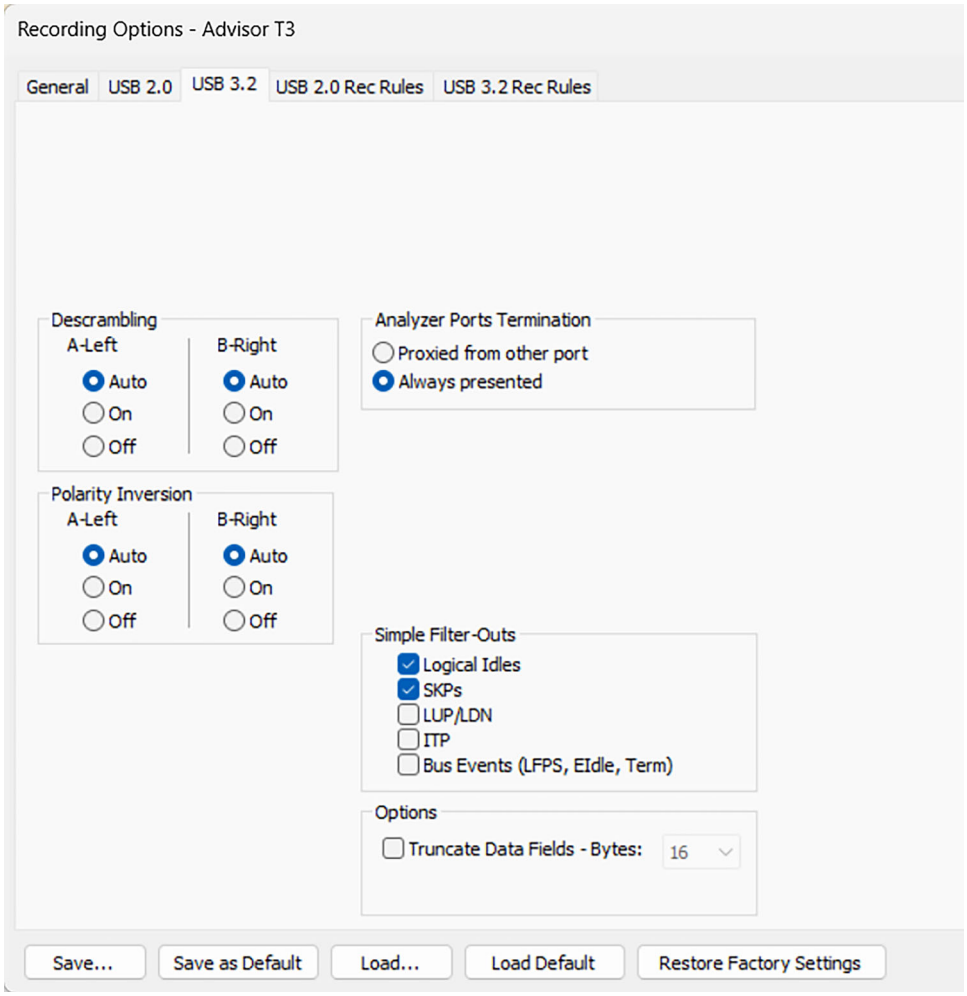


Figure 3.41: Recording Options: Advisor T3

This allows you to bring up the Host Signal Profiles for the Advisor T3 (Figure 3.42).

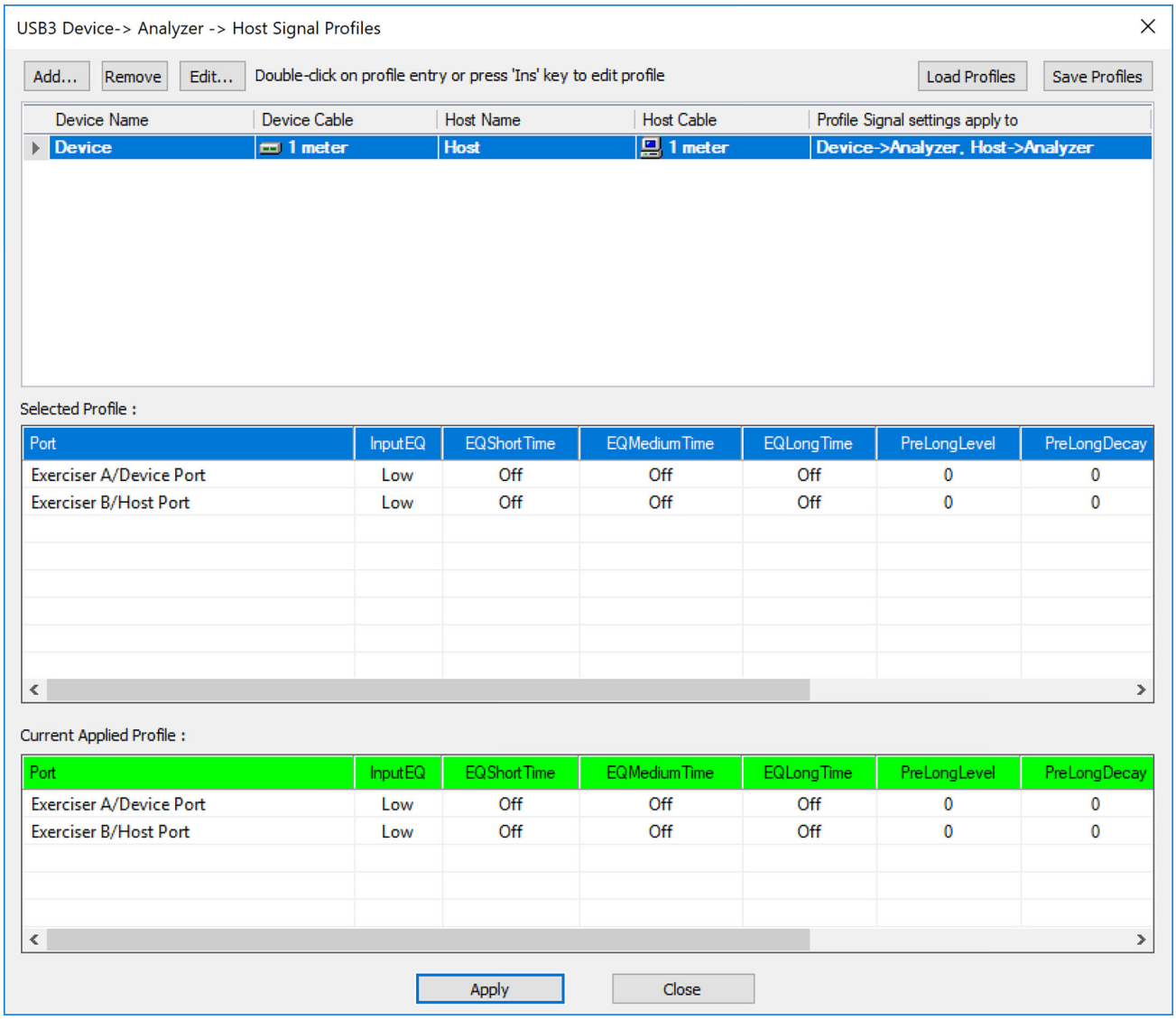


Figure 3.42: Host Signal Profiles: Advisor T3

4. Double click on an existing profile to update its parameters (Figure 3.43).

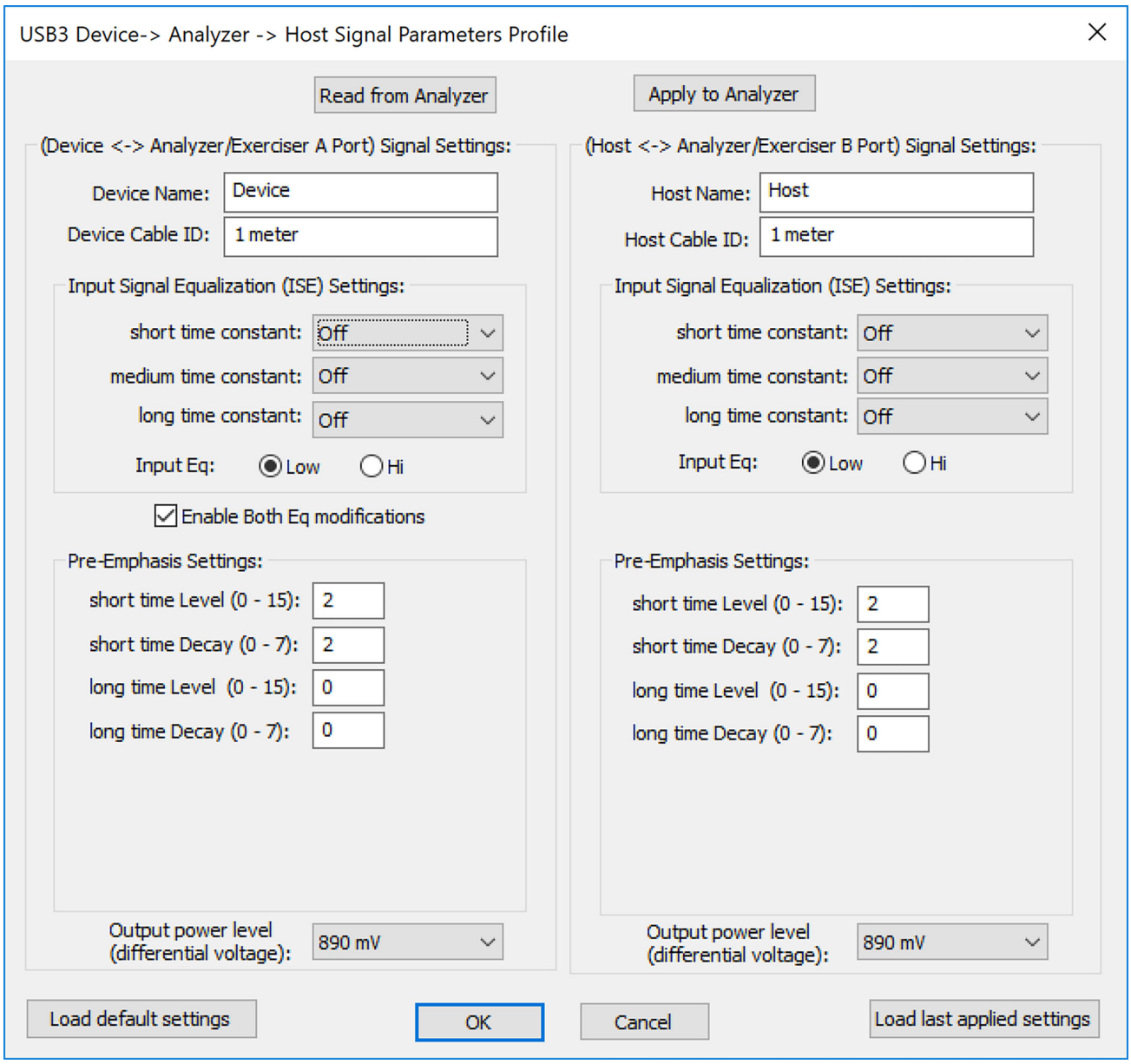


Figure 3.43: Host Signal Profiles: Advisor T3

From this window, you can:

- **Read from analyzer** and **Apply to analyzer**
  - 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 to 15)
- short time Decay (0 to 7)
- long time Level (0 to 15)
- short time Decay (0 to 7)
  - **Output power level** (differential voltage): 405 - 890 mv

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

3.6.5 USB 3.2 Cabling and Signal Integrity

The analyzer requires two connector discontinuities. In addition, bus-powered devices are susceptible to voltage drops on V_{BUS}.

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.

3.7 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, then connect the other ends to the USB device under test and USB host.

NOTE:	During connect/disconnect testing, always plug/unplug the “**B**” or “2/Right” connector on the analyzer (connected 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 (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 window showing factory default settings, such as Snapshot and 4 MB buffer size (Figure 3.44).
   - For the first recording, you can leave these settings unchanged.
   - Under Recording Channels, select **2.0** to record USB 2.0 traffic.

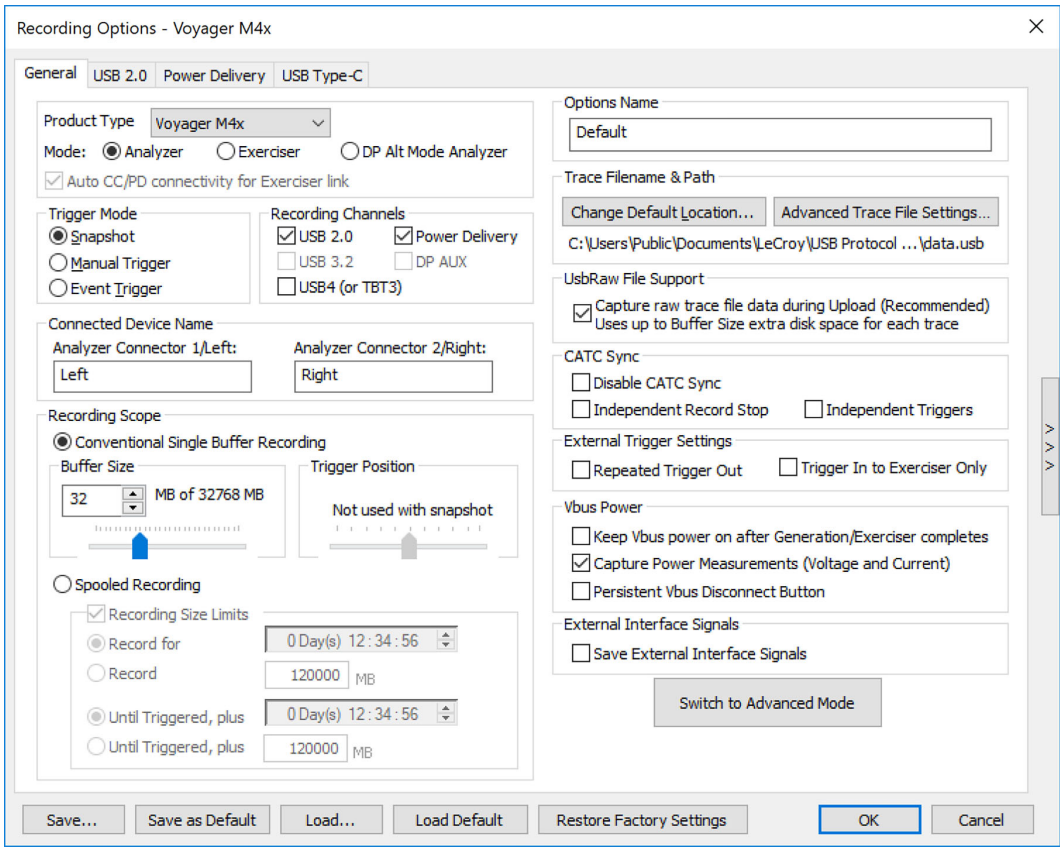


Figure 3.44: Recording Options: Voyager M4x

NOTE: Items not supported by your hardware are either inactive or not shown.

4. Click **OK** to activate the selected recording options.
5. Turn on the USB devices that are to be tested and have them generate USB traffic.
6. Click Record 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, do one of the following:
    - Select **File > Save As** on the Menu Bar, enter a unique name for the recording, and save it to the appropriate directory.
    - Click  on the Tool Bar to display the standard **Save As** window, enter a unique name for the recording, and save it to the appropriate directory.

3.7.1 Trace View Features

After the recording terminates, the results display (Figure 3.45).

- The packet view uses color and graphics to document captured traffic.
- Packets are on separate rows; individual fields are labeled and color-coded.
- Packets are numbered sequentially (as recorded), time-stamped (with a resolution of 2ns 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.

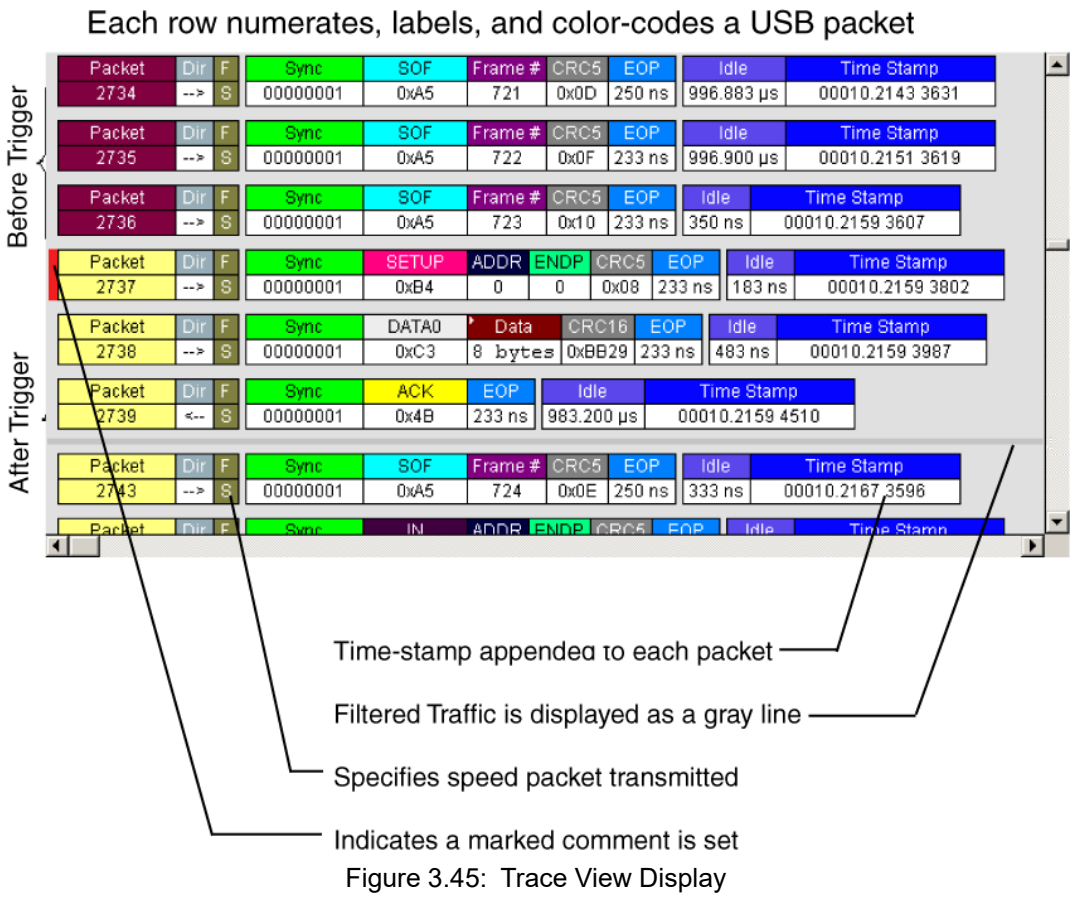


Figure 3.45: Trace View Display

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.

3.8 Trace File Structure

The captured trace file are saved in .usb format. When a trace file is loaded, additional decoding and data reduction is done that results in additional data files that are placed in a folder of the same name as the trace file (as .tmp files). 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 do not 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).

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.

3.11 Connecting EPR Mode-Enabled Devices to Analyzer Ports

NOTE: For Voyager M310C/M310P/M4x and Mercury T2C/T2P ONLY.

USB Protocol Suite version 8.60 and later includes a feature to protect legacy analyzers (Voyager M310C/M310P/M4x and Mercury T2C/T2P) from any damage that could be caused by the extended voltage range (> 20 V) introduced in PD 3.1. The Software will monitor the PD negotiation and break the connection when EPR Mode is entered to protect the analyzer.

When breaking the PD negotiation, the software displays a warning message as shown in Figure 3.46. This warning message continues to prompt until the devices connected to the analyzer port are physically disconnected.

If a recording is in progress, the captured trace will include a specific event called “Unsupported EPR Entry” and show the sequence for breaking the connection. Figure 3.46 illustrates this event.

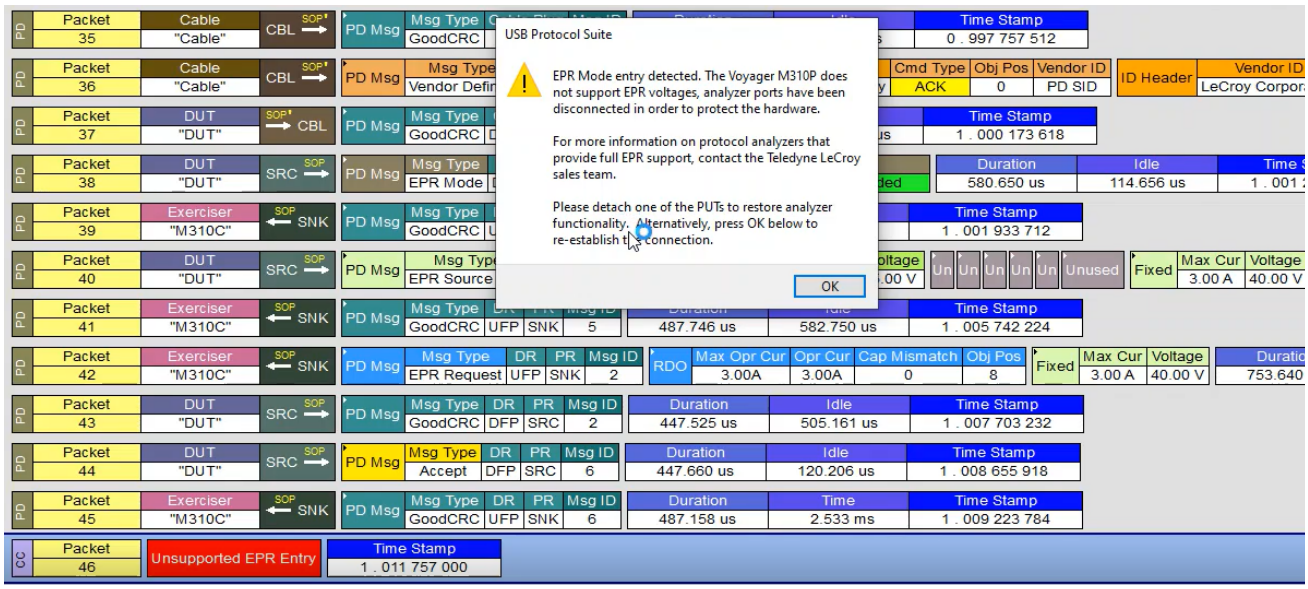


Figure 3.46: Breaking the EPR Link in analyzer Platforms without EPR Mode

NOTE: For EPR testing, consider the Voyager M310e. It provides full support of PD 3.1 and the expanded voltage range, up to 51 V.

WARNING: **Any downgrade of software to a version lower than 8.60 is not recommended.**

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:

Select **Start** > **All Programs** > **LeCroy** > **USB Protocol Suite** > **USB Protocol Suite**. The main window appears (Figure 4.1).

4.2 USB Protocol Suite Menus

This section describes the menus and their functions.

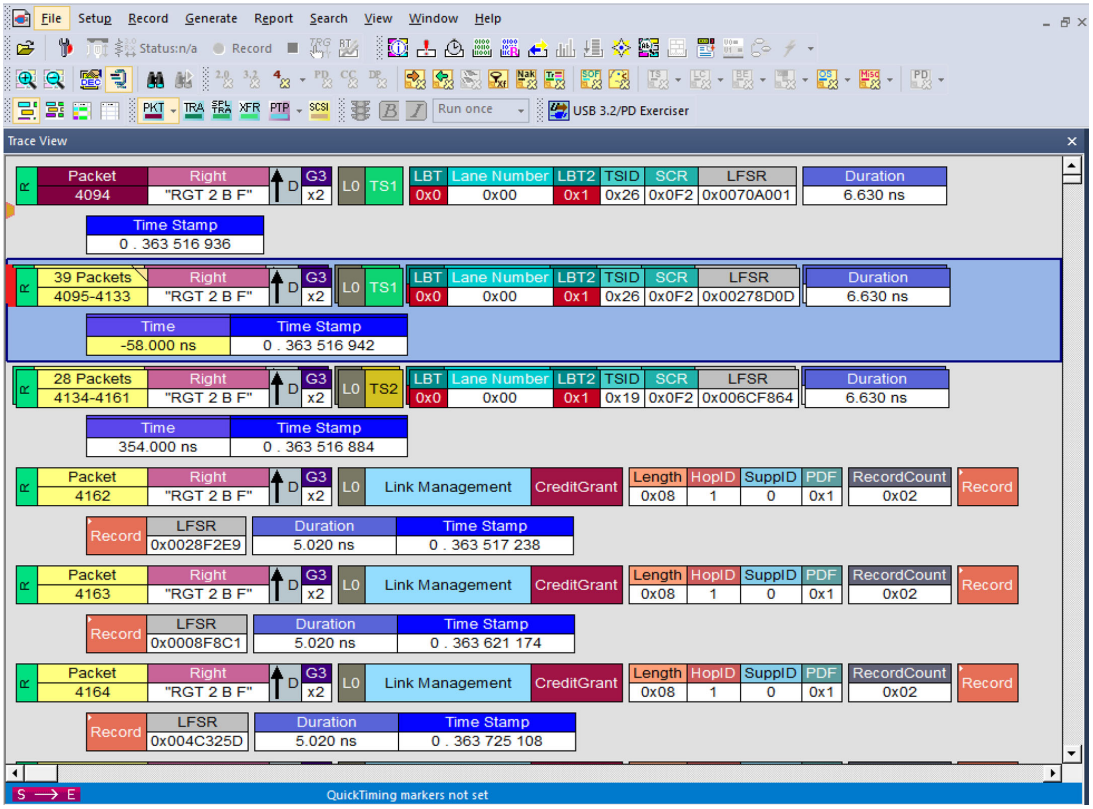


Figure 4.1: File Menu Drop-Down Options

Table 4.1: File Menu Options & Functions (Sheet 1 of 3)

Option	Function
New **.utg** file.	Creates a new, empty traffic generation file. Available only if a trace file (.usb) is open. To edit a .utg file, click Edit as Text in the toolbar.
Open	Opens a file.
Open Examples Folder	Opens a folder containing example traces and scripts.
Close	Closes the current file.
Save As	Saves all, or a range of, packets from the current file.
Print	Prints part or all of the current traffic data file.
Print Preview	Produces an on-screen preview before printing.
Print Setup	Sets the options for the current or new printer.
Edit as Text	Opens the Script Editor. Available only when a traffic generation file (.utg) is open. See 11.8 *Editing a Generation File*.
Edit Comment	Creates or edits the Trace file comment field. See 6.23 *Edit Comment*.
Check Syntax of **.utg** file	Reads open **.utg** file and checks syntax for errors. Available only when a traffic generation file (**.utg**) is open.

Table 4.1: File Menu Options & Functions (Sheet 2 of 3)

Option	Function
Export >> Packets to Text (Packet View Format)	Saves all or part of a trace to a text file or generator file. Saves trace as a text file in Packet View Format.
Packets / Transaction /Spread-sheet to. CSV (Comma Separated Values for Excel, etc.) Format)	Saves trace as a comma-separated-values text file for use with Microsoft® Excel. See 4.3 *Exports to .CSV*.
Packets to USB 2.0 Host Traffic Genera-tor Text File (**.utg**)	Saves trace as a script file that can be used by a Generator to generate a trace. See 4.3.4 *Exporting Packets to USB 2.0 Host Traffic Generator Text File (.utg files)*.
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 4.3.4 *Exporting Packets to USB 2.0 Host Traffic Generator Text File (.utg files)*.
USB4 Tunneled PCIe Traffic to PCIe Proto-col Suite Trace File (.pex)	Exports USB4 Tunneled USB traffic to PCIe Protocol Suite Trace File (.pex). This allows you to export ONLY PCIe Protocol SuiteTraffic from a USB4 trace. See 4.3.5 *Export USB4 Tunneled PCIe Traffic to PCIe Protocol Suite Trace File*.
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 4.3.6 *Export USB4 Tunneled USB Traffic to USB 3.2 Native Trace*.
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 4.3.7 *Export USB4 Tunneled DP Traffic to DP Native Trace*.
Data	Exports Transfer data as a text or binary file.
Merge Trace Files	Merges two simultaneously recorded files into a single file. (This command does not work if the files were recorded at different times).
Compare Endpoint Data	Allows you to select two endpoints of different directions with the same address and verify that the data OUT/IN is identical to the data IN/OUT from the other endpoint. Used when running echo-types of tests for data integrity. Available only when a trace file (**.usb**) is open. (2.0 only)
Import	If you have exported simulations to a defined **.csv** format, you can import data from the **.csv** file to a BusEngine™ data file. To use this feature, you must contact support for information on how to export to a specific-format **.csv** file and then import the file. You can also import SimPass USB files. **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, because they will have to be re-decoded.

Table 4.1: File Menu Options & Functions (Sheet 3 of 3)

Option	Function
E**x**it	Exits the program.

4.2.1 Setup Menu

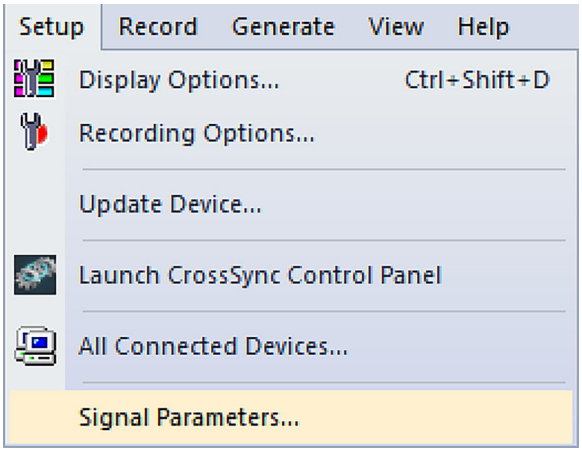


Figure 4.2: Setup Menu

Table 4.2: Setup Menu Options & Functions

Option	Function
Display Options	Provides display options such as color, formats, and filters. See Chapter 8, *Display Options*.
Recording Options	Provides setup options for recording, triggering events and filtering. See Chapter 5, *Recording Options*.
Update Device	Updates the BusEngine™ and Firmware manually. See 13.3.4 *Manual Updates to Firmware, BusEngine, and Serdes BusEngine*.
Launch CrossSync Control Panel	Opens the CrossSync multiple-analyzer traffic synchronization software (see 4.12.4 *CrossSync Control Panel*). For more information, refer to the *CrossSync User Manual*.
All Connected Devices	Opens a dialog box with a list of analyzers connected to the host machine. Lets you select an analyzer and update the BusEngine, Firmware, and licensing information. See 3.6.2 *Analyzer Devices*.
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 3.6.4 *Signal Parameters*.

4.2.2 Generate Menu

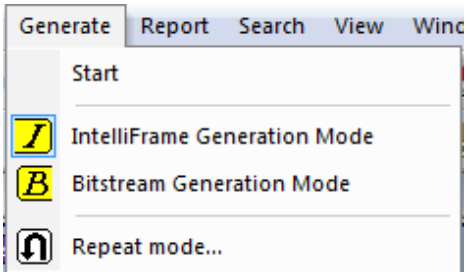


Figure 4.3: Generate Menu

Table 4.3: Generate Menu Options & Functions

Option	Function
(See Chapter 11, *Traffic Generation 2.0*.)	
Start/Stop	Starts traffic generation. After traffic generation has begun, the **Start** command becomes **Stop** and lets you stop traffic generation.
IntelliFrame Generation Mode	Sets the mode of generation to IntelliFrame. Use before Start. (2.0 only)
Bitstream Generation Mode	Sets the mode of generation to bitstream. Use before Start. (2.0 only)
Repeat Mode	Allows you to repeat once, a specified number of times, or an infinite number of times using the Generation Repeat Mode window. (2.0 only)

4.2.2.1 Record Menu

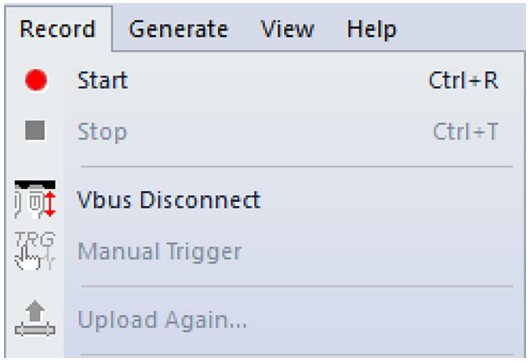


Figure 4.4: Record Menu

Table 4.4: Record Menu Options & Functions

Option	Function
(See 4.10.2 *Recording Status*.)	
Start	Causes the analyzer to begin recording USB activity.
Stop	Causes the analyzer to stop recording.
V_{BUS} Disconnect	See V_{BUS} Disconnect under 4.6.5 *Recording*.

Table 4.4: Record Menu Options & Functions

Manual Trigger	See Manual Trigger under 4.6.5 *Recording*.
Upload Again	Allows you to upload a different portion of the captured trace if the previous upload was only partially uploaded.

4.2.3 Report Menu

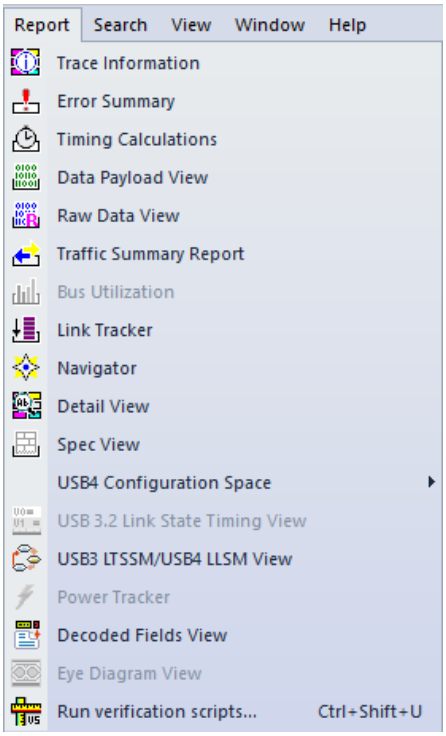


Figure 4.5: Report Menu Options

Table 4.5: Report Menu Options & Functions (Sheet 1 of 2)

Option	Function
File Information	Displays information about the recording, such as the number of packets and triggering setup. See 10.2 *Trace Information*.
Error Summary	Summarizes the errors throughout the recording. Allows for fast navigation to packets with errors. See 10.3 *Error Summary*.
Timing Calculations	Calculates timing between two packets and bus utilization. See 10.4 *Timing Calculations*.
Data View	Shows packet information. See 10.5 *Data View*.
Traffic Summary Report	Summarizes the numbers and types of errors, packets, transactions, split transactions, and transfers that occurred in the open trace. See 10.7 *Traffic Summary Report*.
Bus Utilization	Displays graphs of packet length, bus usage, and bus usage by device. See 10.8 *Bus Utilization*.

Table 4.5: Report Menu Options & Functions (Sheet 2 of 2)

Option	Function
Link Tracker	Opens a window for displaying a detailed chronological view of traffic. The window provides view and navigation options. See 10.9 *Link Tracker*.
Navigator	Allows you to view the location of errors and triggers in a trace, narrow the range of traffic on display, and jump to any point in the trace. See 10.10 *Using the Navigator*.
Detail View	Displays details of selected packet. See 10.11 *Detail View*.
Spec View	Shows packet header information and other items, in a view that matches the USB 3.2 specification. See 10.12 *Spec View*.
USB 3.2 Link State Timing View	Graphically shows how much time the link spends in each link state. See 10.15 *USB 3.2 Link State Timing View*.
USB 3.2 LTSSM view	Displays the LTSSM diagram depicted in the USB 3.2 specification. See 10.15.2 *USB 3.2 LTSSM View*.
USB4 Configura-tion Space View	Displays the USB4 Configuration Space for routers and adapters as one table. See 10.13.1 *Open USB4 Configuration Space View*.
Power Tracker	Displays voltage, current, and power. See 10.16 *Power Tracker—V_{BUS} & Configuration Channel (CC)*.
Decoded Fields View	Displays the Decoded Fields View. See 10.17 *Decoded Fields View*.
Eye Diagram View	Displays the “Eye” diagram for USB traffic. See 10.18 *Eye Diagram View*.
Run Verification Scripts	Opens a window to allow you to run verification scripts over the open trace. See 10.19 *Running Verification Scripts*.

4.2.4 Search Menu

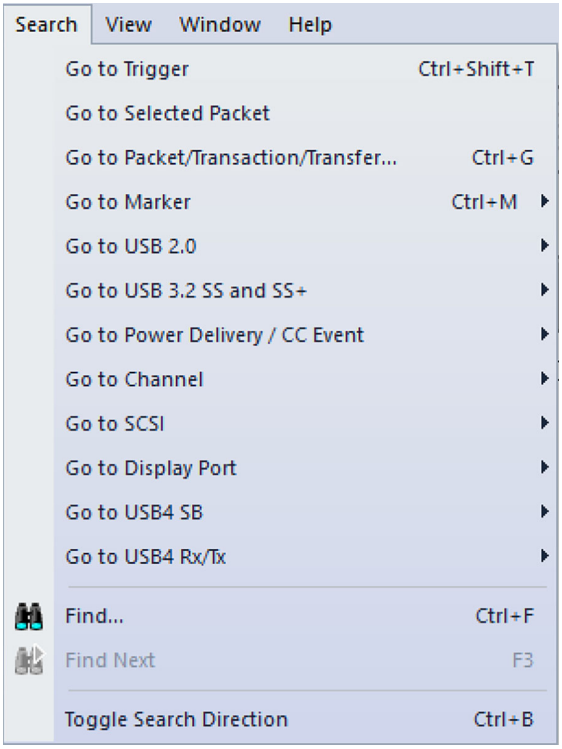


Figure 4.6: Search Menu

Table 4.6: Search Menu Functions & Options (Sheet 1 of 2)

Option	Function
(See Chapter 7, *Searching Traces*.)	
Go to Trigger	Positions the display to show the first packet that follows the trigger event.
Go to Selected packet	Positions the display to show the selected packet.
Go to Packet/ Transaction/Trans-fer	Positions the display to the packet/transaction/transfer number selected in the Go to Packet/Transaction/Transfer menu.
Go to Marker	Positions the display to the selected marked packet.
Go to USB 2.0	Positions the display to the selected event, condition, value, or type.
Go to USB 3.2 SS and SS+	Positions the display to the selected event, condition, value, or type.
Go To Power Deliv-ery/ CC Event	Searches for specific Power Delivery and Configuration Channel Mes-sages.
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.

Table 4.6: Search Menu Functions & Options (Sheet 2 of 2)

Option	Function
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 Sequence (USS)
Find	Allows complex searches on multiple criteria. See 7.2 *Find*.
Find Next	Repeats the previous Find operation.
Toggle Search 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.

4.2.5 View Menu

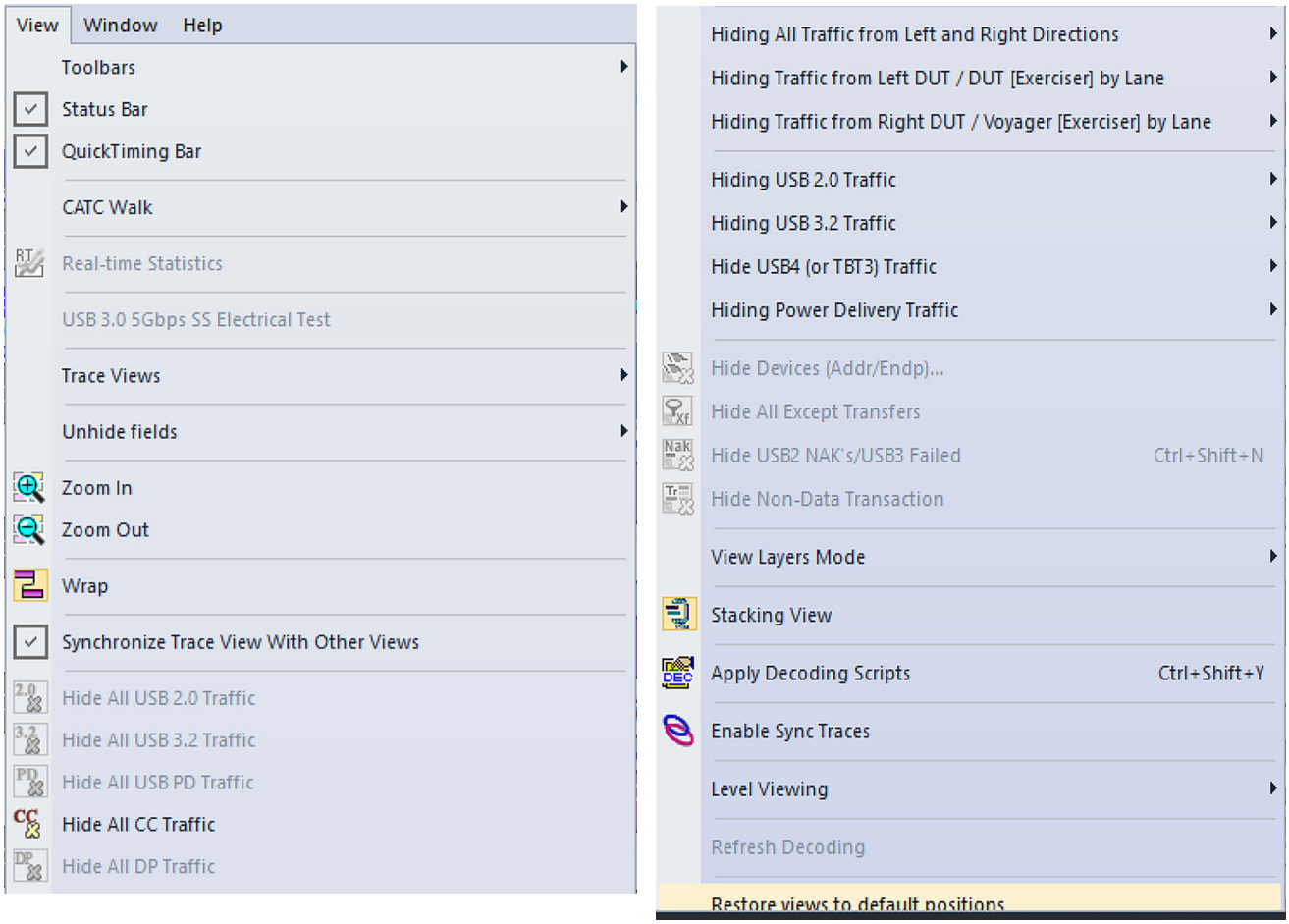


Figure 4.7: View Menu

Table 4.7: View Menu Options & Functions (Sheet 1 of 3)

Option	Function
Toolbars	Displays list of available toolbars. See 4.9.1 *Resetting the Toolbar*.
Status Bar	Switches display of the Status Bar on or off. See 4.10 *Status Bar*.
QuickTiming Bar	Quick Timing provides immediate time deltas and bandwidth calculations. If the Start is placed on a packet that contains an Address and Endpoint, the bandwidth for that combination is displayed in the Status Bar below the trace data.
CATC Walk	Select **Play** to start playing the CATC Walk playlist or **Manage Playlists** to display the Edit CATC Walk Playlists dialog to manage playlists.
Real-time Statistics	Allows you to view traffic statistics as they occur. See 10.20 *Real-Time Monitoring*.
USB3 Electrical Test Mode	Initiate Loopback Mode and send Pings from the Exerciser. **Note:** This functionality is unsupported and for informational use only. There is no guarantee that it will work correctly
Trace Views	Displays CATC Trace, Compressed CATC Trace, Spreadsheet (Color), or Spreadsheet (B/W).
Unhide fields	Unhide previously hidden Traffic, V_{BUS} 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 • SOFs: Start of Frames • Chirps: Chirp-K and Chirp-J Bus conditions (these are recorded only)

Table 4.7: View Menu Options & Functions (Sheet 2 of 3)

Option	Function
Hiding USB 3.2 Traffic	Hides: • Training Sequence Packets – TSEQ, TS1/TS2 • Hide Link Commands – LUP/LDN, Flow Control, Power Management, GenT NOP, GenT Link Keep-Alive • 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
Hiding USB4 (or TBT3) Traffic	Hides a variety of USB4 packets and events.
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 Packets
Hide USB2 NAKs/USB3 Failed	Shows/Hides USB2 NAK 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 6.10 *Stacking*.
Decoding Settings	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 Chapter 9, *Decode Requests*.
Enable Sync	Synchronizes views between synced traces. See 6.22 *Enable Sync Traces (used with Hub Compliance)* on page 420 and 6.23 *Edit Comment*.
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

Table 4.7: View Menu Options & Functions (Sheet 3 of 3)

Option	Function
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.

4.2.5.1 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 4.8, Figure 4.9, and Figure 4.10.

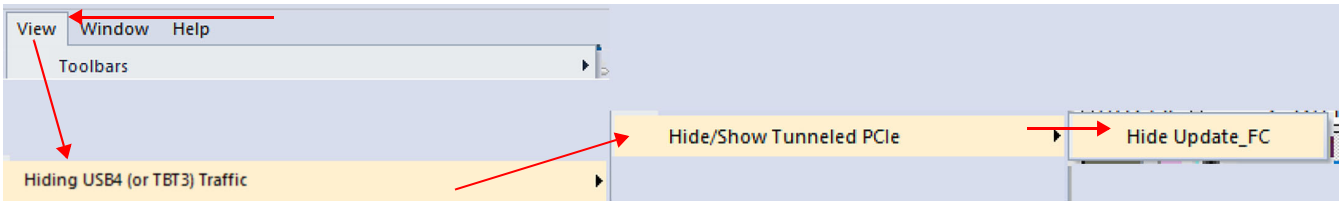


Figure 4.8: View → Hiding USB4 (or TBT3) traffic → Hide/Show Tunneled PCIe → Hide Update_FC

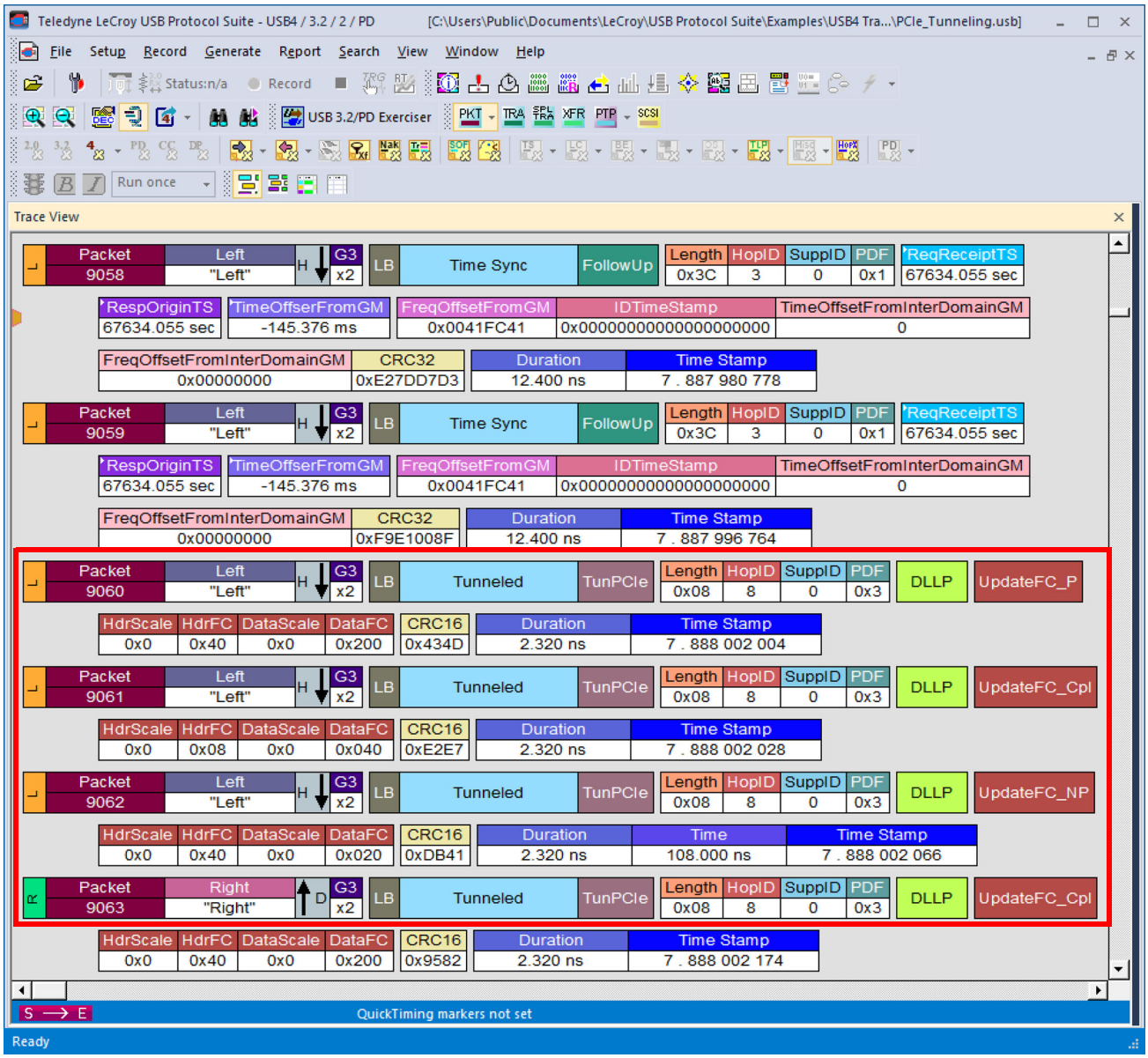


Figure 4.9: Show Update: FC Traffic

When you select **View → Hiding USB4 (or TBT3) Traffic > Hide/Show Tunneled PCIe > Hide Update_FC traffic**, the displayed trace hides the **Update_FC** packets as shown in Figure 4.10.

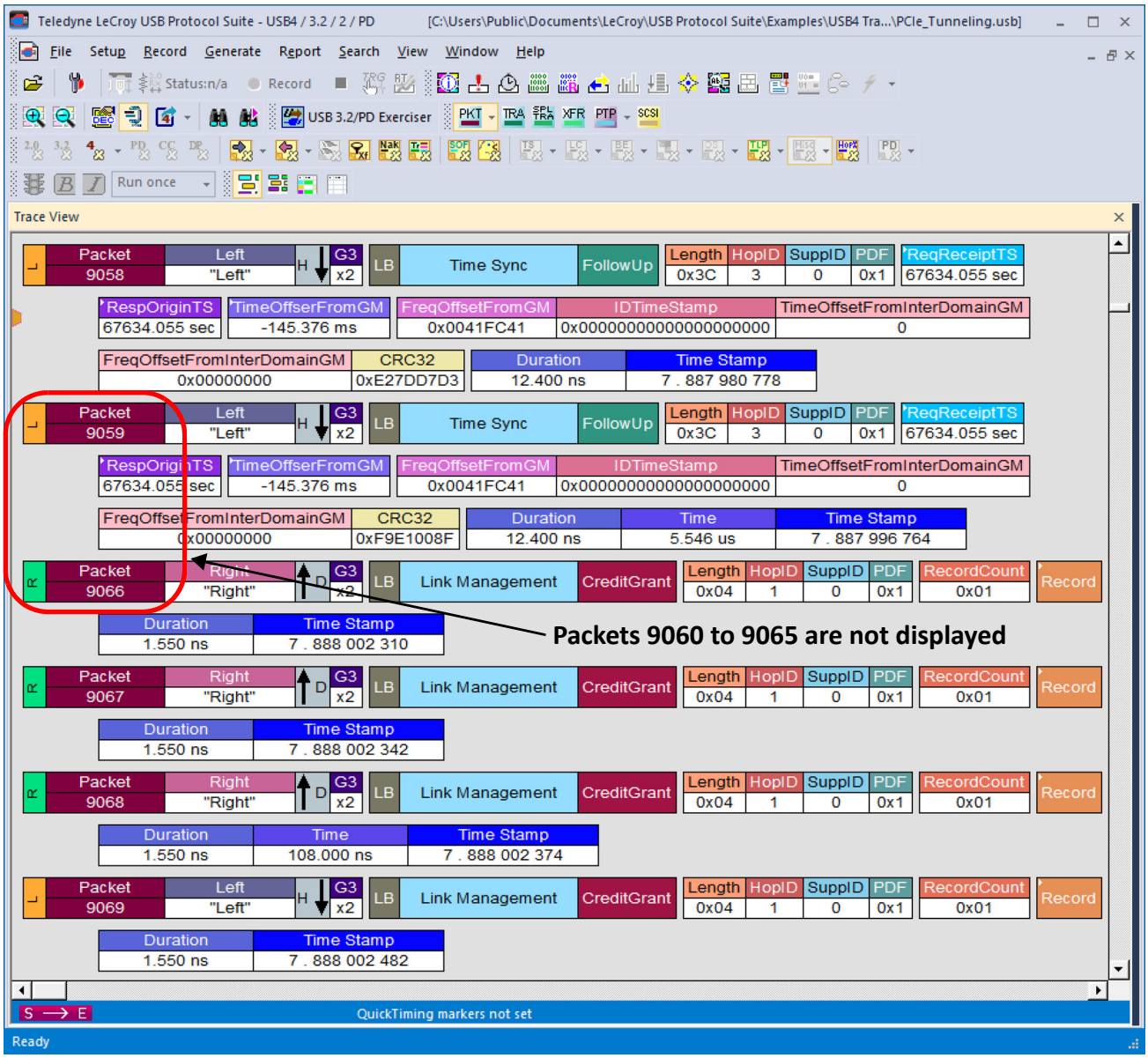


Figure 4.10: Hide Update: FC Traffic

4.2.5.2 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 figures 4.11, 4.12 and 4.13.

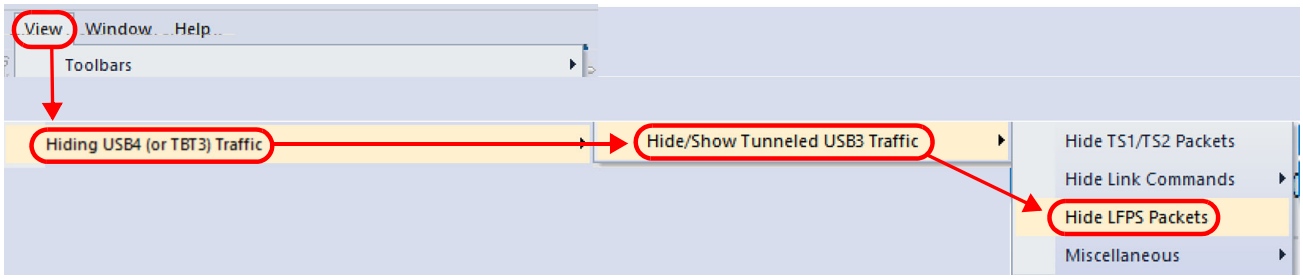


Figure 4.11: View, Hiding USB4 (or TBT3) Traffic, Hide/Show Tunneled USB3 Traffic, Hide LFPS Packets

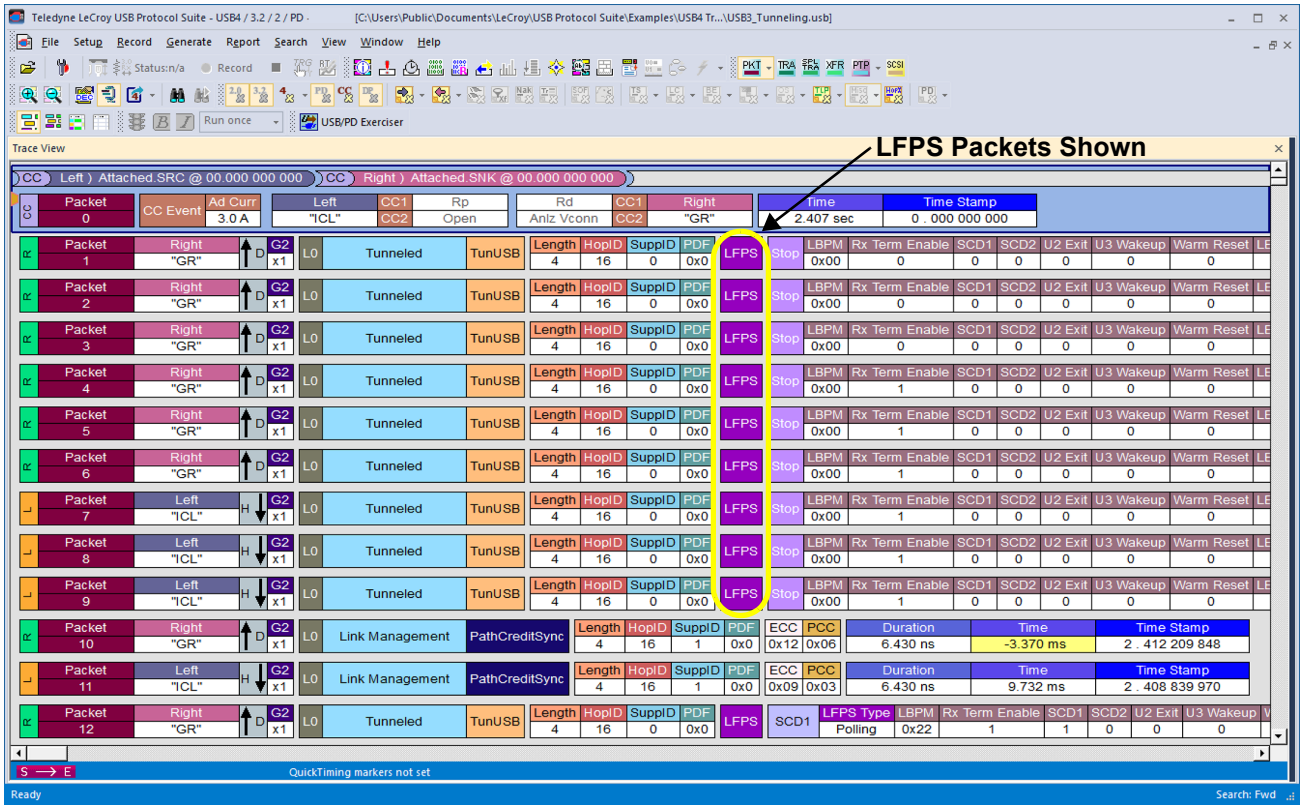


Figure 4.12: Trace Showing Tunneled USB3 Traffic: LFPS Packets Shown

4.2.5.2.1 Select Hide LFPS Packets

See Figure 4.13.

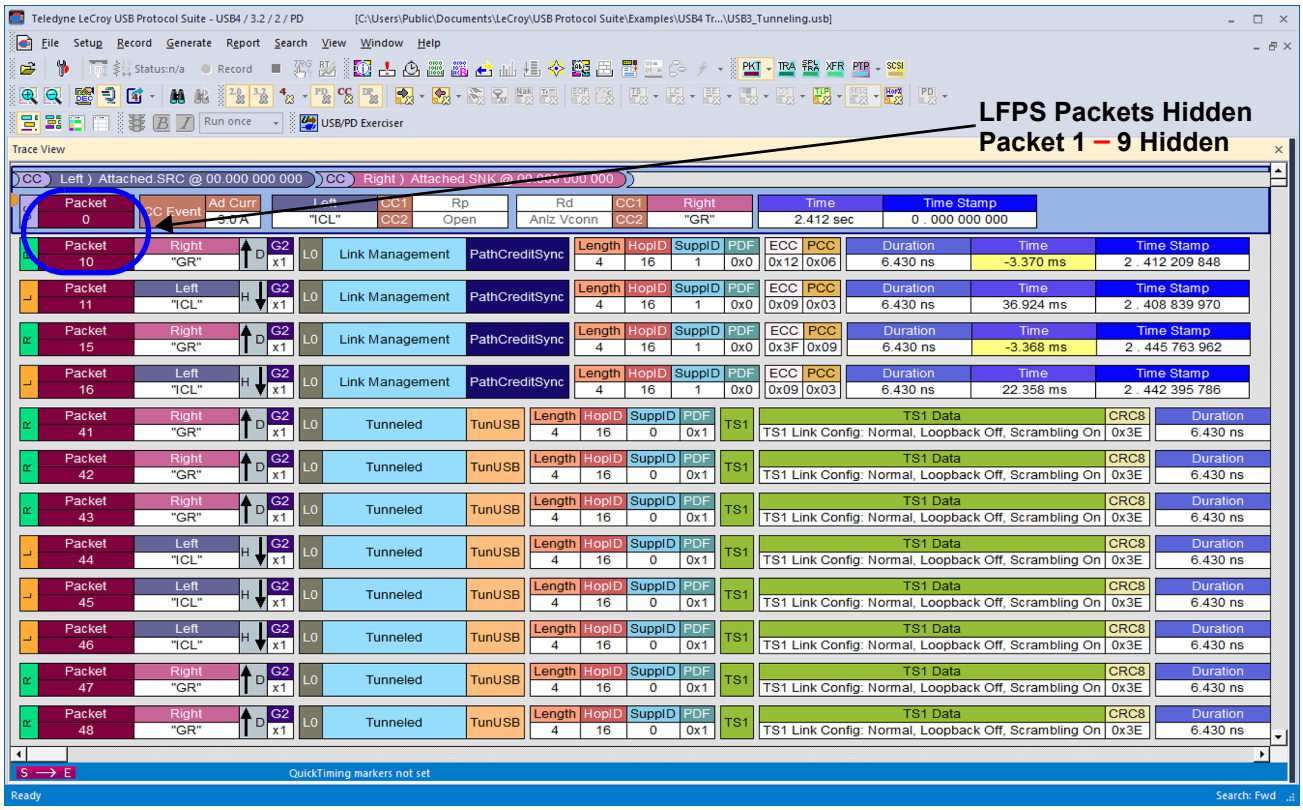


Figure 4.13: Trace with LFPS Packets Hidden

4.2.6 Window Menu

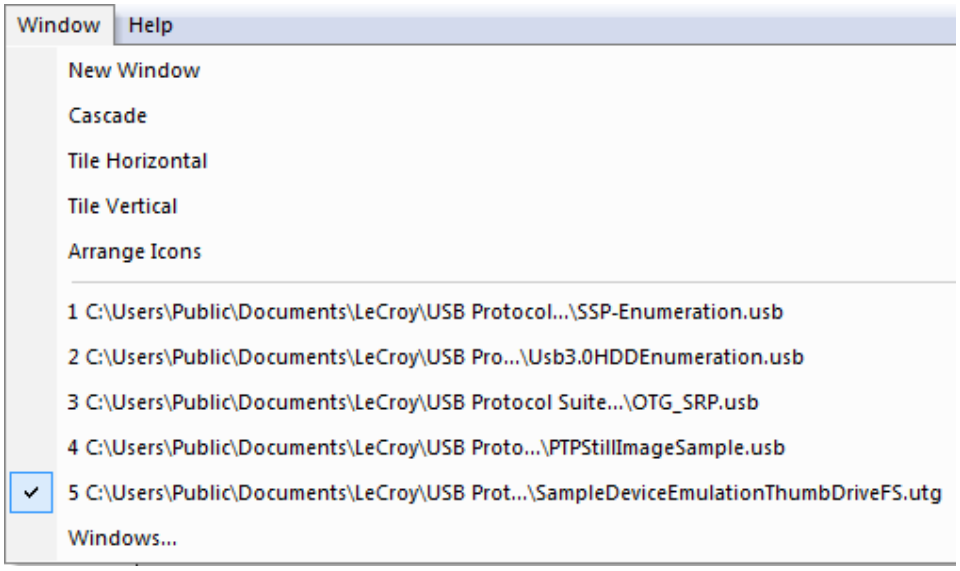


Figure 4.14: Window Menu

Table 4.8: Window Menu Options & Functions

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

4.2.7 Help Menu

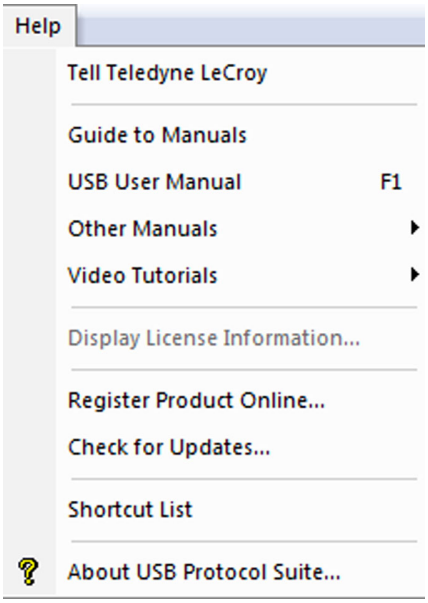


Figure 4.15: Help Menu

Table 4.9: Help Menu Options & Functions

Option	Function
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.

Table 4.9: Help Menu Options & Functions

Option	Function
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)
Display License Information	Displays information related to licensing. Also used to update a license key. See 13.4.5 *Updating the Software License*.
Register Product Online	Register at the Teledyne LeCroy website. See 13.5 *Registering Online*.
Check for Updates	Use the Internet to analyze your system for licensed updates. You can set the system to automatically check for updates at application startup in the Teledyne LeCroy USB Protocol Suite Software Update window. See 13.2 *Software Updates*.
Shortcut List	Displays the Shortcuts List of navigation, common, search, decode levels, and miscellaneous mouse and keyboard shortcuts. See 4.13 *Analyzer Keyboard Shortcuts*.
About USB Protocol Suite	Displays version information about the analyzer and the USB Protocol Suite. See 13.1 *Software, Firmware, and BusEngine Revisions*.

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 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 the **Hide Devices**  icon. The following dialog appears.

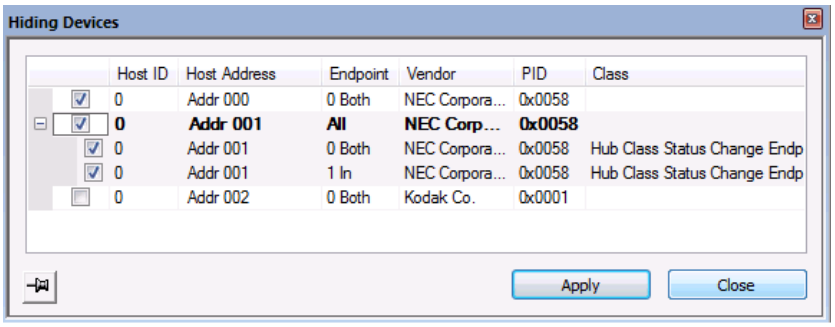


Figure 4.16: Hiding Devices Dialog Box

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

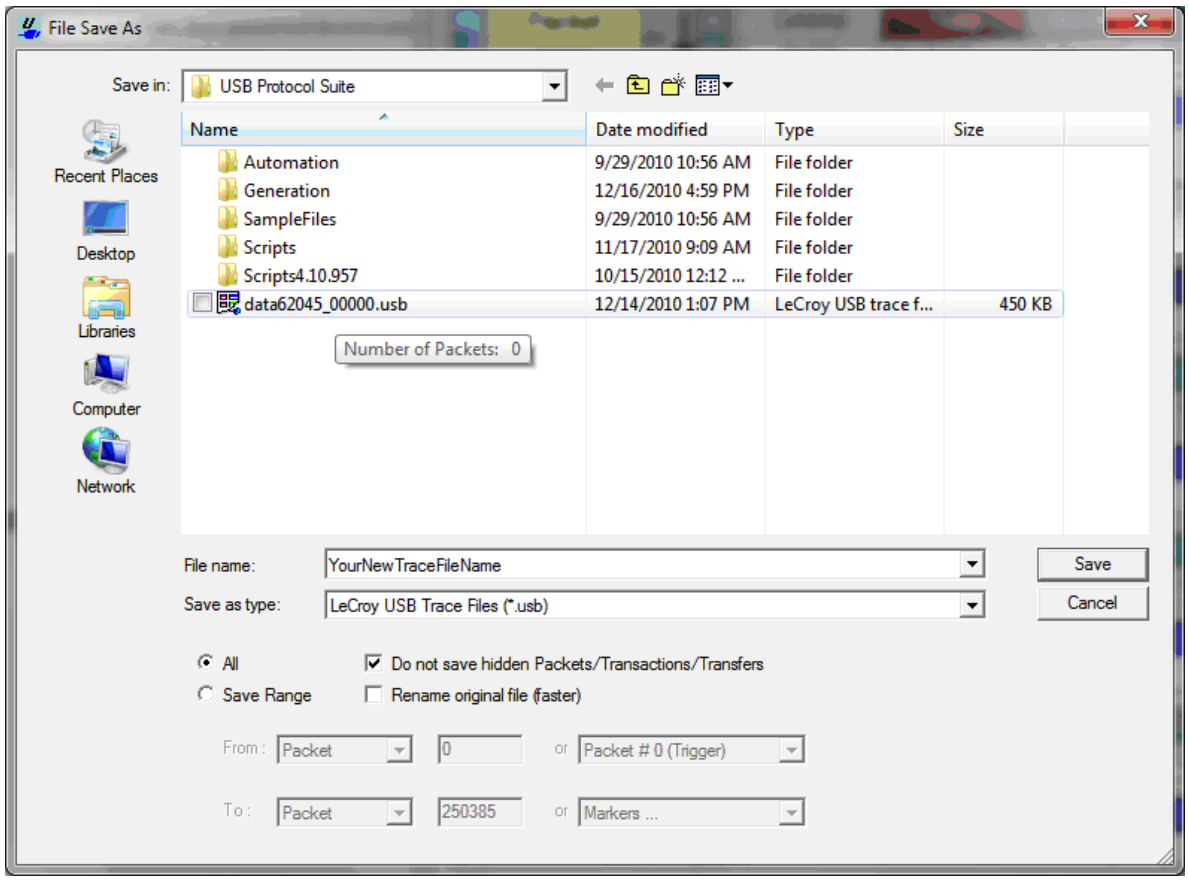


Figure 4.17: Save to New File

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 appears:

   *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 (Figure 4.19), 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 4.21).

For more information about CrossSync tool see the CrossSync User Manual.

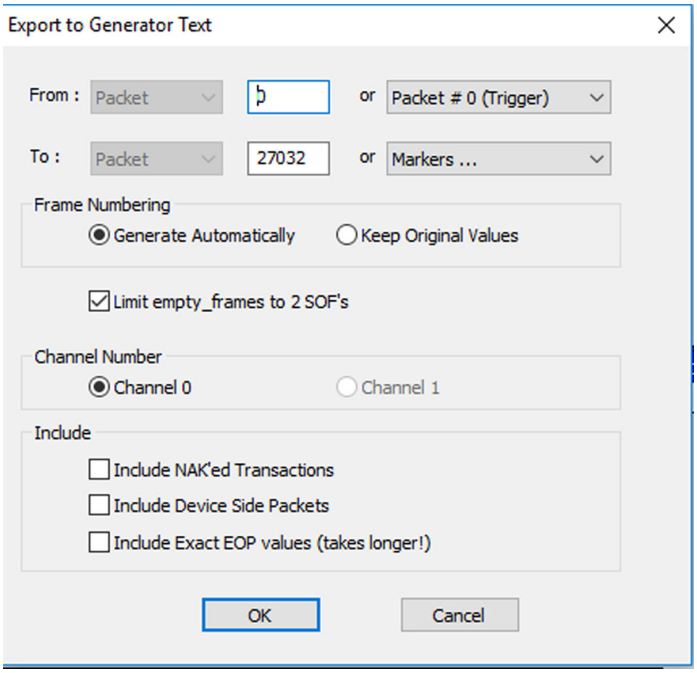


Figure 4.18: Export to Generator Text

1. Accept all default selections—unless you have good reason not to do so. This will create the simplest, fastest file:

   - **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.
   - **Limit empty_frames to 2 SOFs:** This reduces the size of 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”.
   - **Include NAK Transactions:** This uses extra generation memory to repeat the original NAK behavior. This can cause the scenario to fail if the device does not behave EXACTLY the same each run.
   - **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.
   - **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.

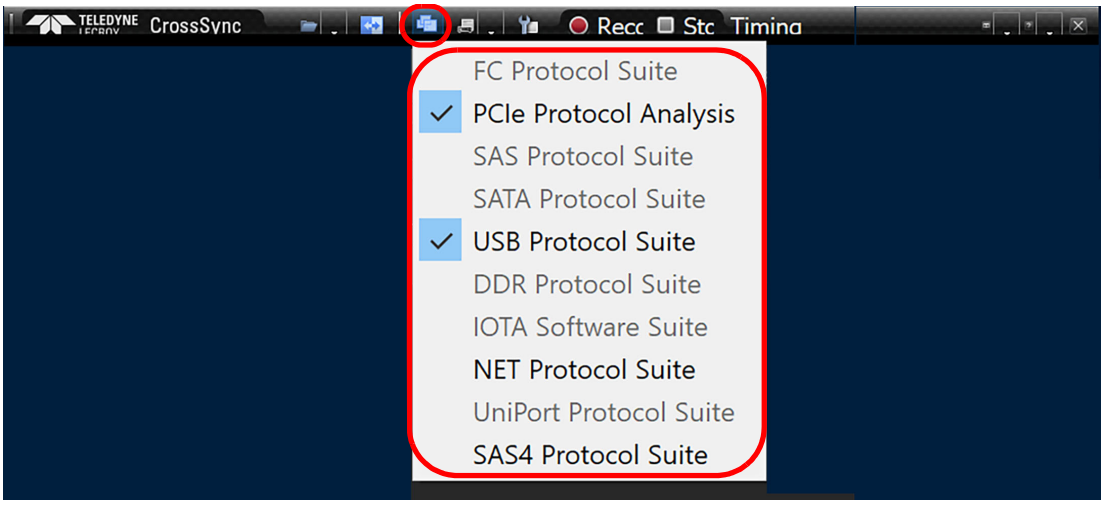


Figure 4.19: USB4 Traffic with Tunneled PCIe Traffic: Shown in CrossSync Tool

2. To ensure the traces are time synchronized, select the Traces synced icon in the CrossSync Toolbar (Figure 4.20).

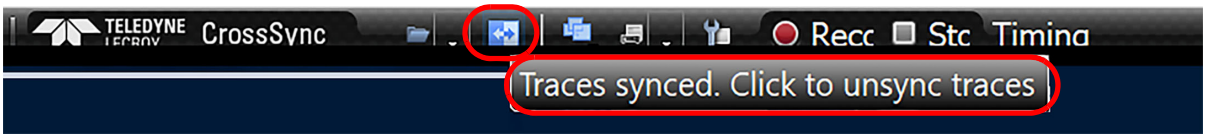
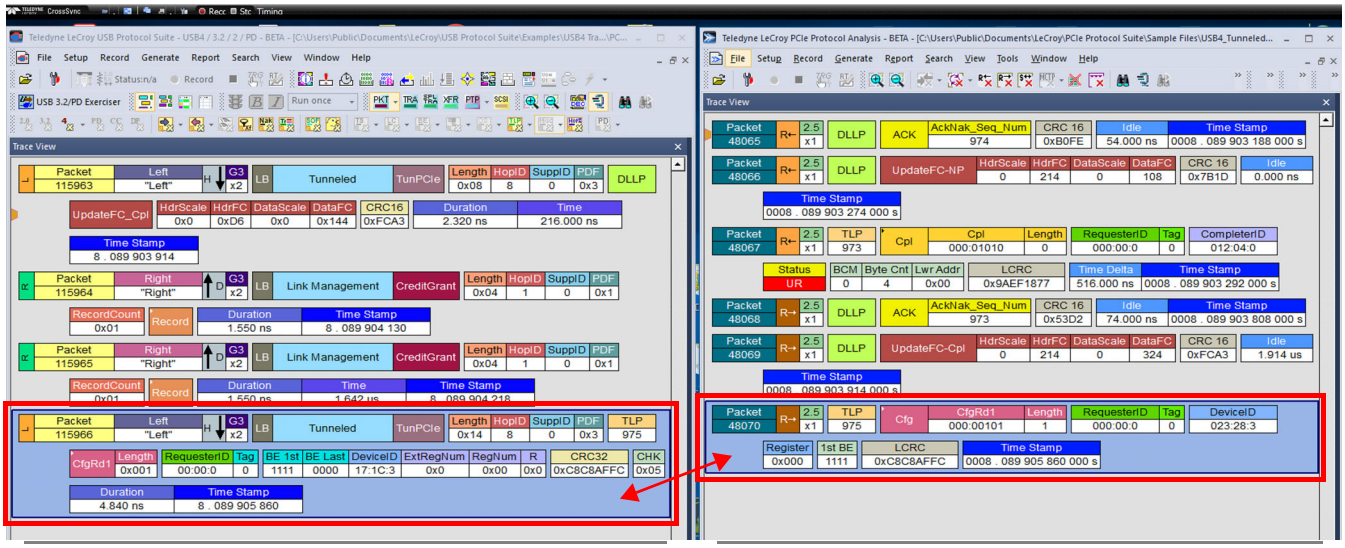


Figure 4.20: Select Traces Synced from Toolbar

The Trace with USB4 tunneled PCIe traffic will be time synchronized with the Exported trace with PCIe traffic.



Exported PCIe Trace **USB4 with Tunneled PCIe Trace**

Figure 4.21: 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.

Figure 4.22 (below) 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 select **View** → Enable Sync Traces to time Synchronize the two traces. The USB4 Trace with tunneled USB3.2 Native traffic and the Trace with tunneled PCIe traffic will be time synchronized. See Figure 4.22

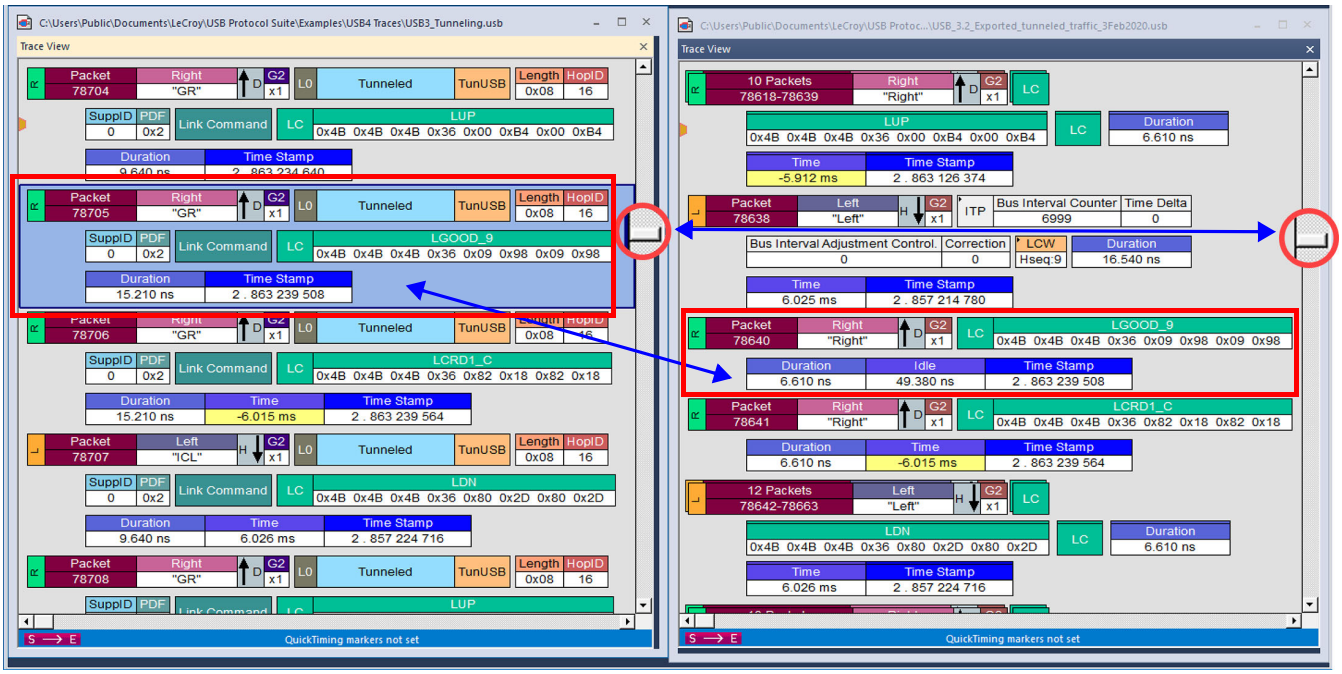


Figure 4.22: Original USB4 Trace with Tunneled USB 3.2 Traffic

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 (Figure 4.23).

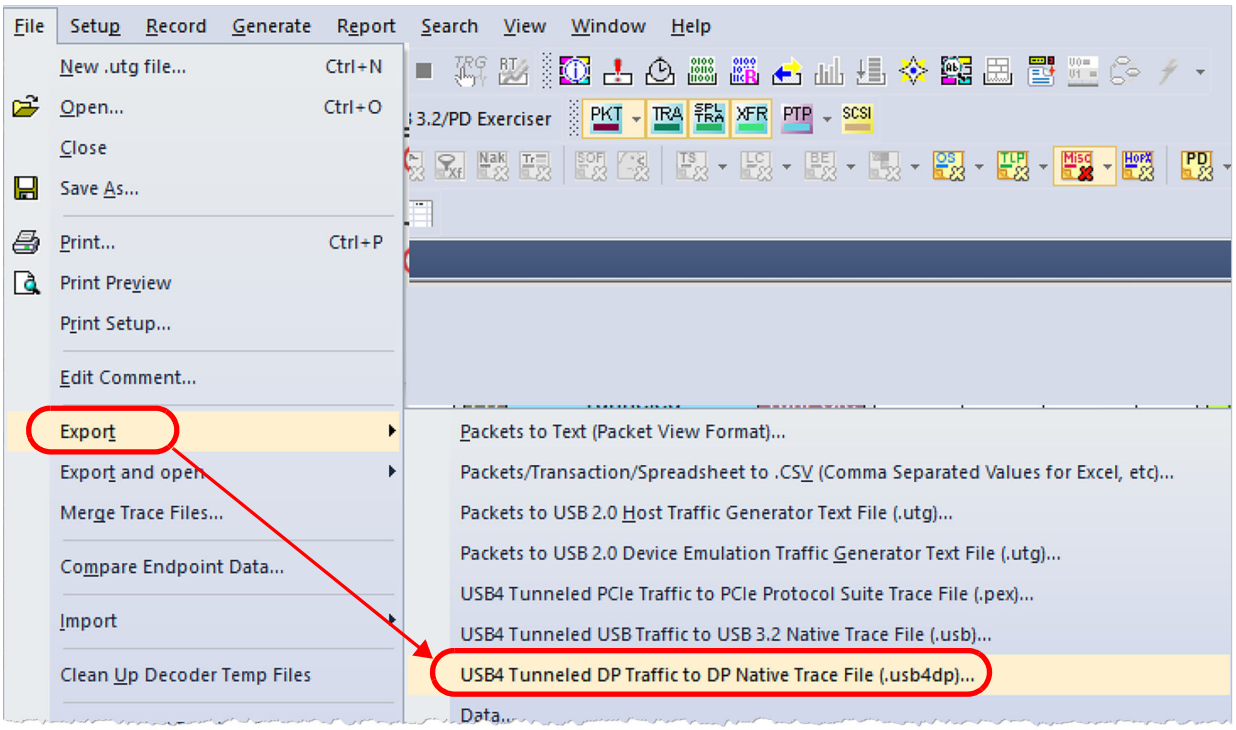


Figure 4.23: Export USB4 Tunneled DP Traffic to DP Native Trace

1. Select the **Export** > **USB4 Tunneled DP Traffic to DP Native Trace File**.

A window pops up showing the path to the exported trace file.

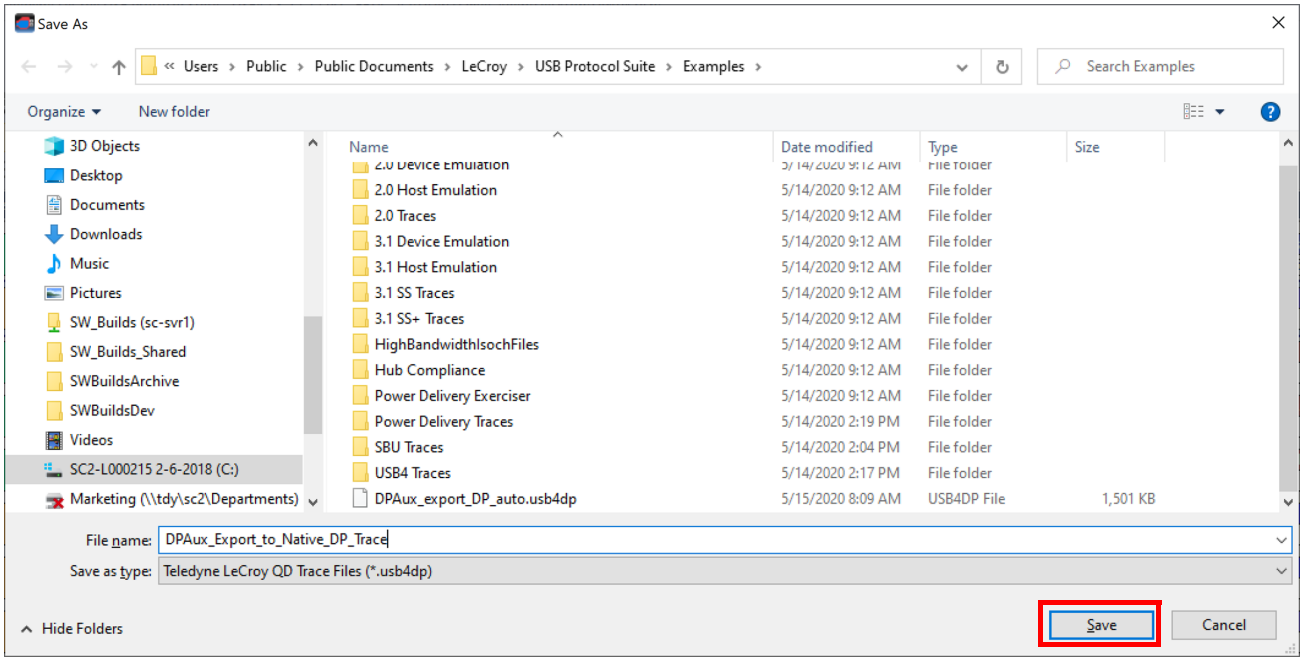


Figure 4.24: Enter a Trace File Name

2. Enter a name for the trace file. An example is shown in Figure 4.24.

3. Click **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.

NOTE: This tool must be downloaded and installed separately. See Figure 4.25.

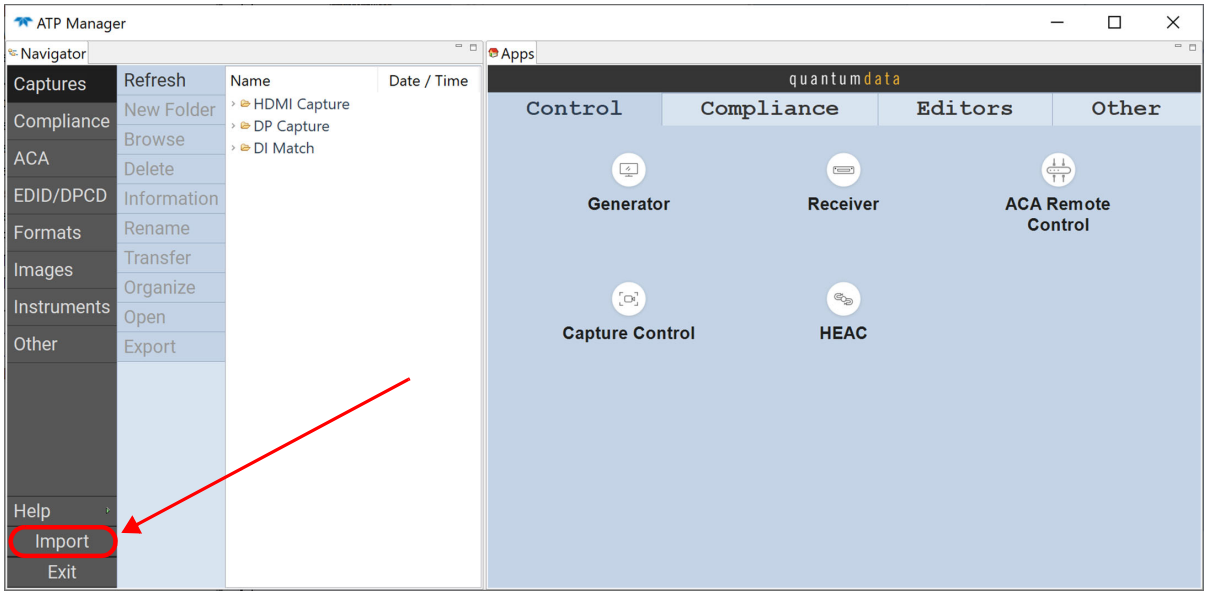


Figure 4.25: **quantamdata** ATP Manager

1. Select the **Import function** from the lower left side of the window.
2. Select the trace you just stored (Figure 4.26).

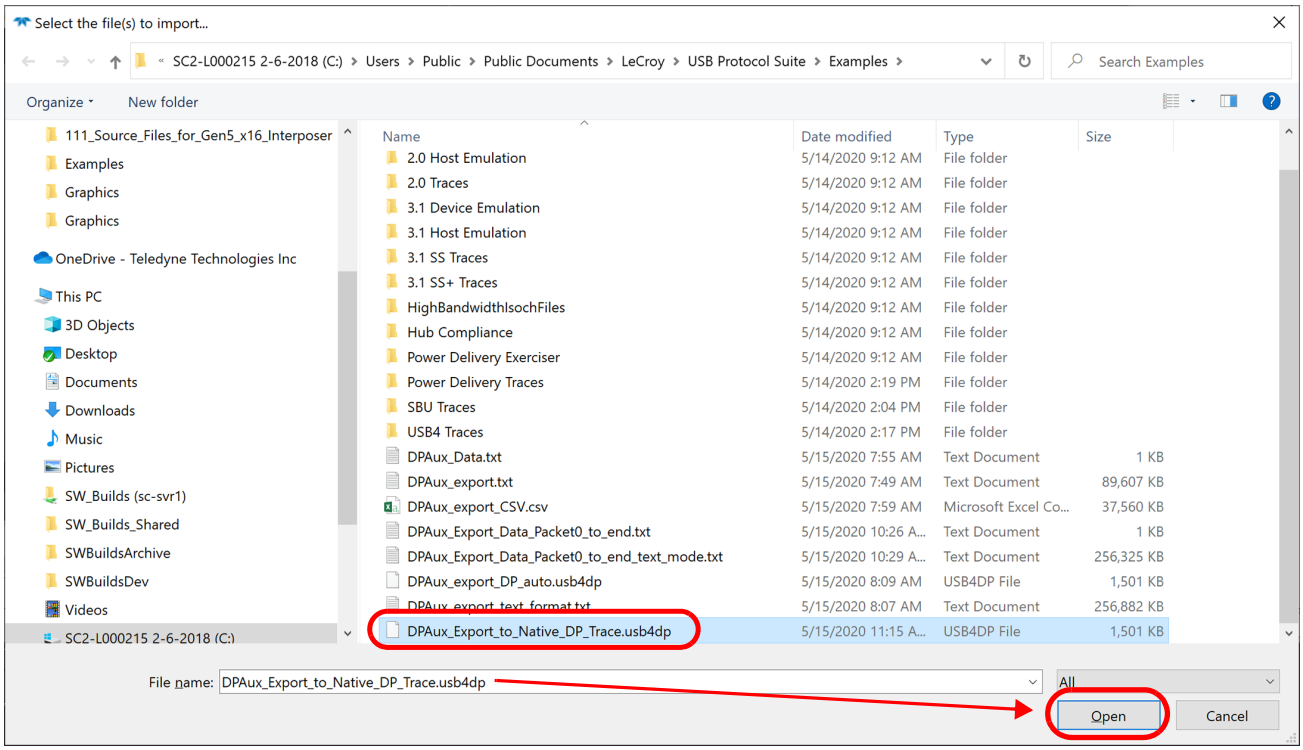


Figure 4.26: Select File to Import

3. Select **Open**. The ***quantumdata*** *Import Tunneled DP Trace* dialog box appears (Figure 4.27).

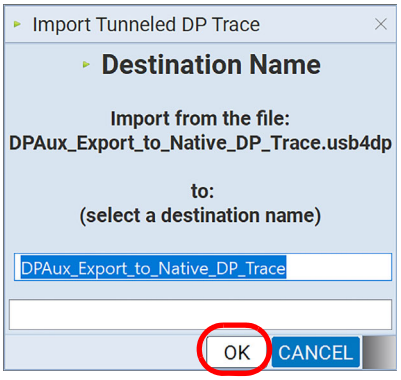


Figure 4.27: ***quantumdata*** *Import Tunneled DP Trace Dialog Box*

4. Click **OK**. The ***quantumdata*** *USB4 DP Import Status* window displays the Processing Events as the trace is imported (Figure 4.28).

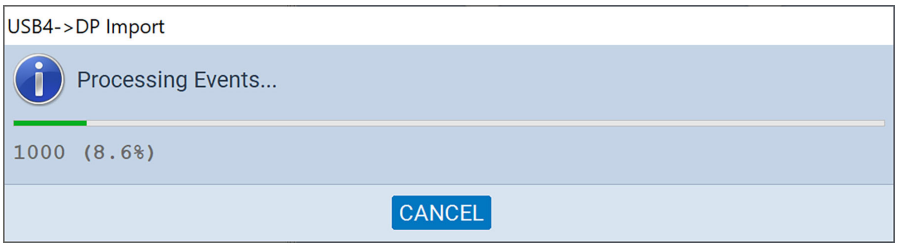


Figure 4.28: **quantumdata** USB4 DP Import Status Window

When the Trace Import has finished, the DP Capture Viewer pops up as shown in Figure 4.29 below.

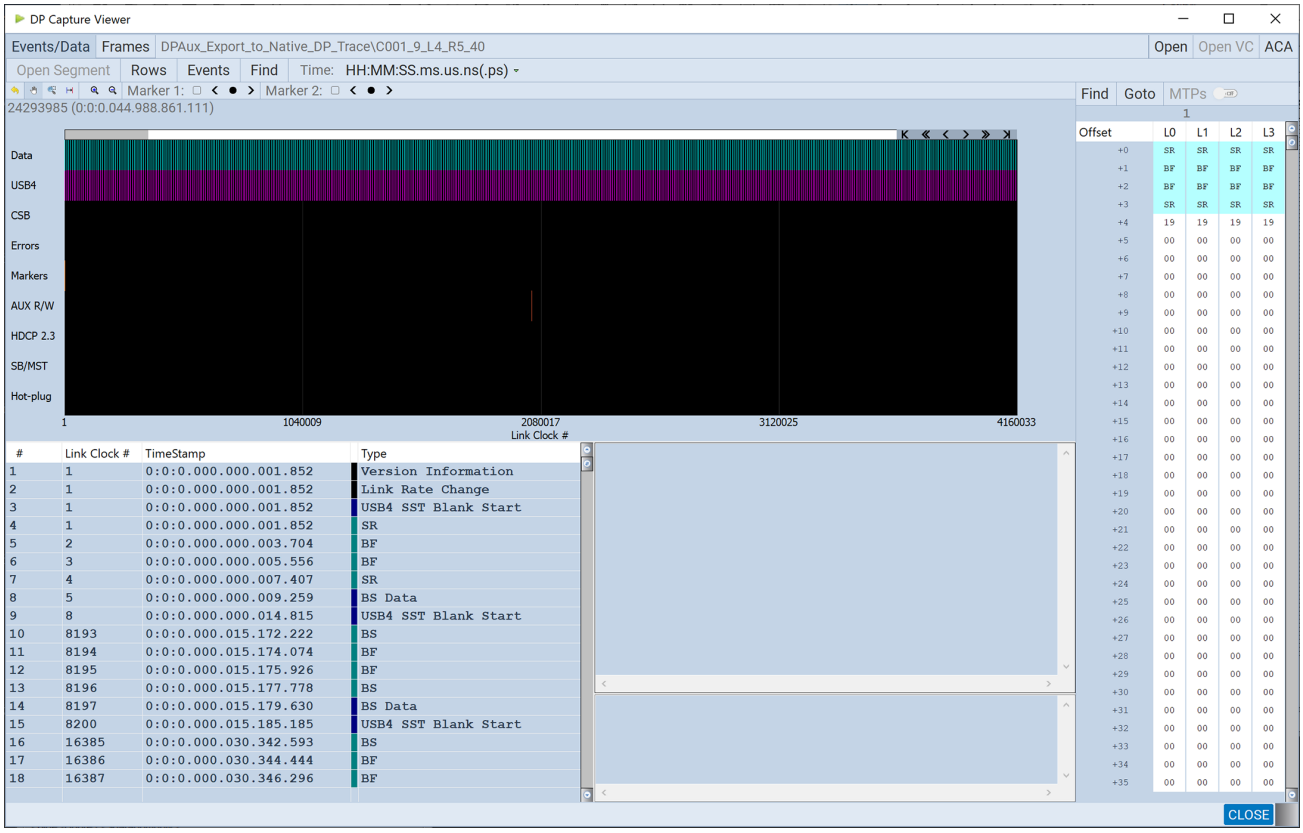


Figure 4.29: **quantumdata** DP Capture Viewer

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

https://www.quantumdata.com

4.4 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, 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 toolbar.

Your recording session will continue until it has finished naturally.

2. To stop manually, click  on the toolbar, or select **Stop** under **Record** on the Menu Bar.

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.

3. You can click  again during the upload to upload only a portion of the recorded memory.

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 toolbar.

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

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

4.5 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 4.30).

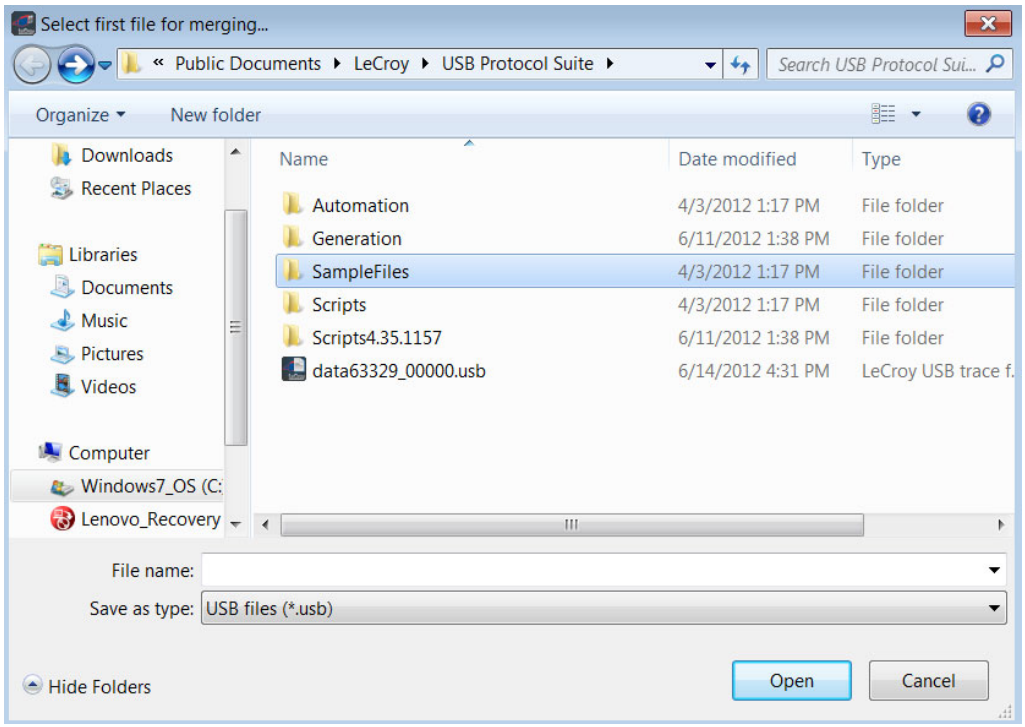


Figure 4.30: Select First File for Merging Dialog

NOTE:	**Merge Trace Files** 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**.
4. Confirm your choices.

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

4.6 Toolbar

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

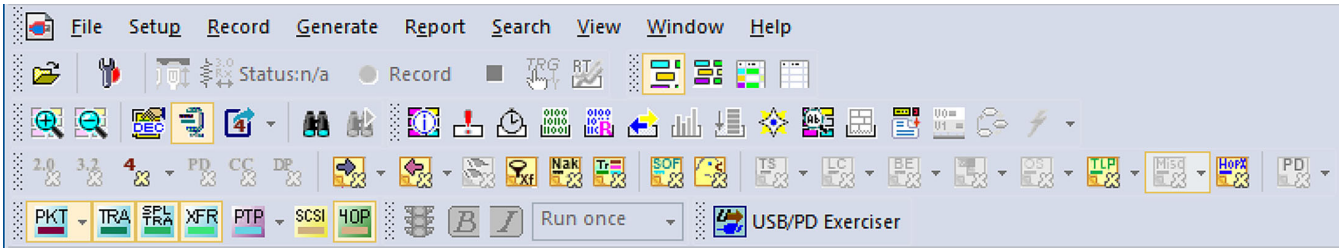


Figure 4.31: USB Protocol Suite Toolbar

4.6.1 Files, Searches & Options

Button	Description
	Open Files
	Find See 7.2 *Find*.

Button	Description
	Set up Recording Options See Chapter 5, *Recording Options*.
	Find Next

4.6.2 Zoom In/Zoom Out

Button	Description
	Zoom In

Button	Description
	Zoom Out

4.6.3 Miscellaneous

Button	Description
	Display Realtime Statistics. See 10.20 *Real-Time Monitoring*.
	Display Stacking View. See 6.10 *Stacking*.

Button	Description
	Decoding Settings See Chapter 9, *Decode Requests*.
	Export Tunneled USB3.0 or Export Tunneled PCIe traffic to new trace See .

4.6.4 Analysis (Reports)

Button	Description
	Trace Information Report See 10.2 *Trace Information*.
	Timing and Bus Usage Calculations See 10.4 *Timing Calculations*.
	Data View See 10.5 *Data View*.

Button	Description
	Error Report See 10.3 *Error Summary*.
	Traffic Summary Report See 10.7 *Traffic Summary Report*.
	Raw Data View See 10.6 *Raw Data View (Including Power Delivery and USB4 Sideband Packets)*.

Button	Description
	Link Tracker See 10.9 *Link Tracker*.
	Open the Navigator Bar See 10.10 *Using the Navigator*.
	Decoded Fields View See 9.3.8 *Decoded Fields View*.
	Show USB 3.2 Link State Timing View See 10.13 *USB4 Configuration Space View*.
	Show Power Tracker. (Power captures are supported only on Voyager M3i, M3x, M310, and M310C.) See 10.16 *Power Tracker—V_{BUS} & Configuration Channel (CC)*.

Button	Description
	Bus Utilization See 10.8 *Bus Utilization*.
	Spec View See 10.12 *Spec View*.
	Detail View See 10.11 *Detail View*.
	Show USB 3.2 LTSSM View See 10.15.2 *USB 3.2 LTSSM View*.

4.6.5 Recording

Button	Description
	Start Recording
	Stop Recording

Button	Description
	Manual Trigger

4.6.6 Generator (Traffic Generation for USB 3.2)

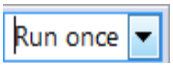
See Chapter 12, *Traffic Generation USB 3.2, USB4, & PD Exerciser*.

Button	Description
	Go to USB 3.2 Exerciser window

Button	Description
	Manual Trigger

4.6.7 Generator (Traffic Generation for USB 2)

See Chapter 11, *Traffic Generation 2.0*.

Button	Description
	Start or Stop Traffic Generation (available if you have the Traffic Generation module)
	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

Button	Description
	Bitstream and Intelliframe modes

4.6.8 View Level

See “Switch to Transactions View” and the following:

Button	Description
	Display Packets See 6.1 *Trace View Features*.
	Display Transactions See 6.11 *Switch to Transactions View*.
	Display Split Transactions See 6.11 *Switch to Transactions View*.
	Display Transfers See 6.14 *Switch to Transfer View*.
	Display PTP Transactions See 6.15 *Switch to PTP Transactions*.

Button	Description
	Display PTP Objects See 6.16 *Switch to PTP Object Transfers*.
	Display PTP Sessions See 6.17 *Switch to PTP Sessions*.
	Display SCSI Operations See 6.18 *Switch to SCSI Operations*.
	Display USB4 Operation Level See 6.19 *Switch to USB4 Operations*.
	PTP Group Click the down arrow to display the PTP Levels

4.6.9 Trace Views

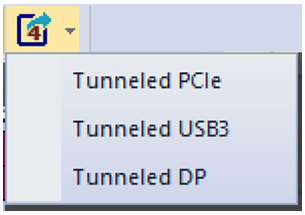
See 6.20 *Compressed CATC Trace View* and 6.21 *Spreadsheet View*.

Button	Description
	Normal CATC Trace View
	Spreadsheet View (Color)

Button	Description
	Compressed CATC Trace
	Spreadsheet View (B/W)

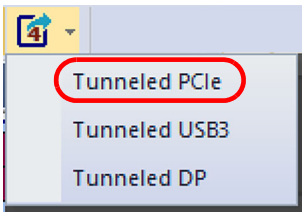
4.6.10 Export Tunneled PCIe Traffic, Tunneled USB3 or Tunneled DP Traffic

Use the  icon and select from the menu to quickly export USB3.0 or PCIe tunneled traffic from a USB4 trace:



4.6.10.1 PCIe Tunneling

If you load a USB4 trace with PCIe tunneled traffic (Figure 4.32) and select "Tunneled PCIe" from the drop down menu, you can quickly export the PCIe tunneled traffic to a new PCIe trace.



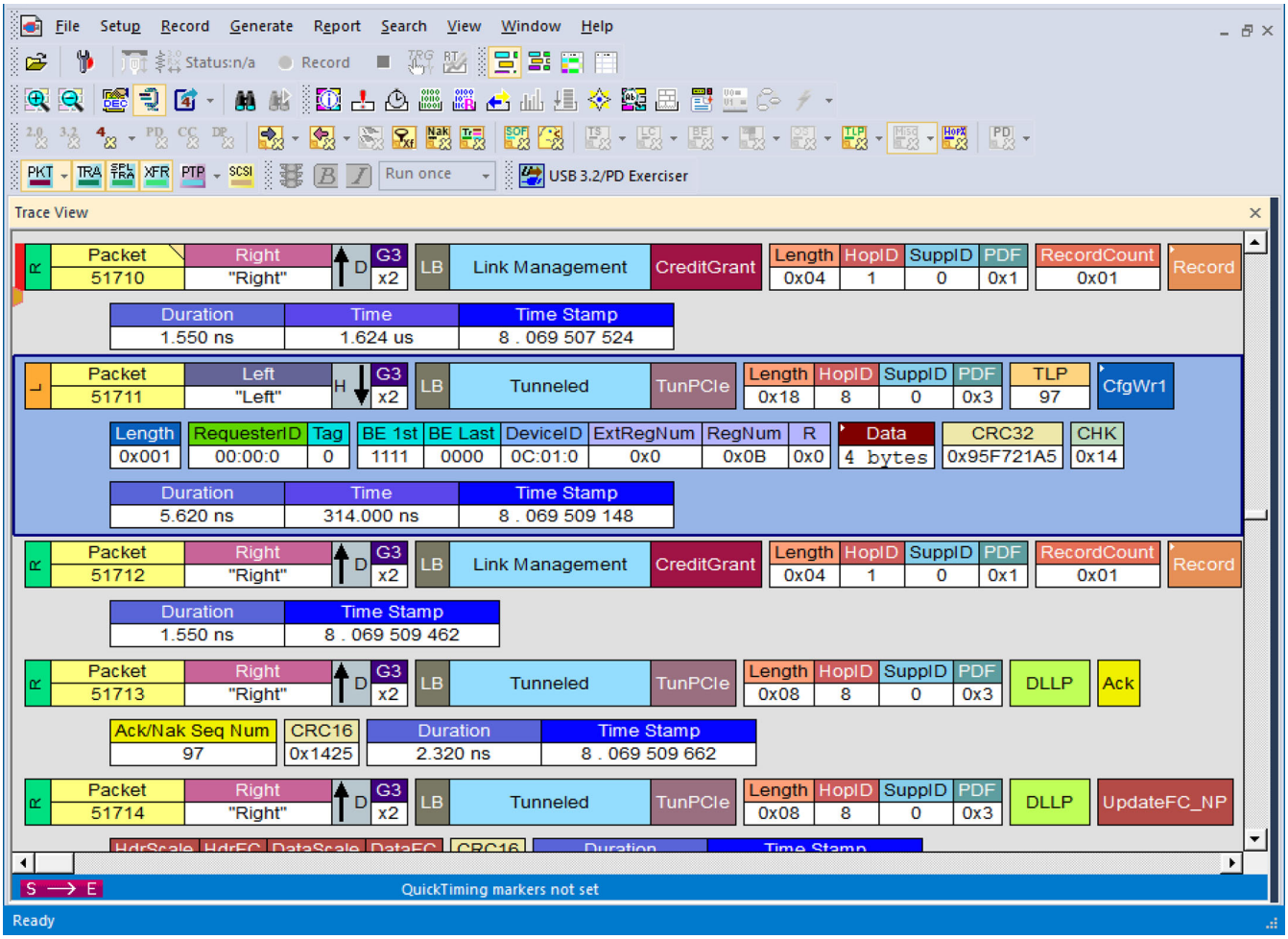


Figure 4.32: USB Trace with PCIe Tunneled Traffic

When you perform a Quick Export, an information message about using the CrossSync Control Panel appears. Click **OK** if you want to see both the USB4 trace and the PCIe trace simultaneously (Figure 4.33).

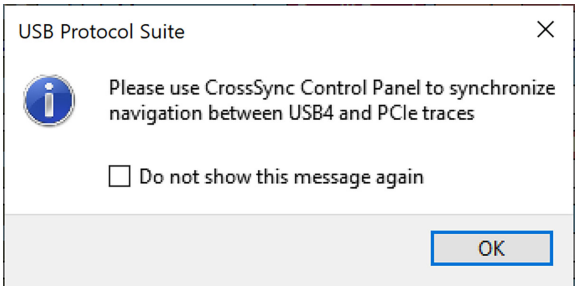


Figure 4.33: Using the CrossSync Control Panel Message

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 4.34, below.

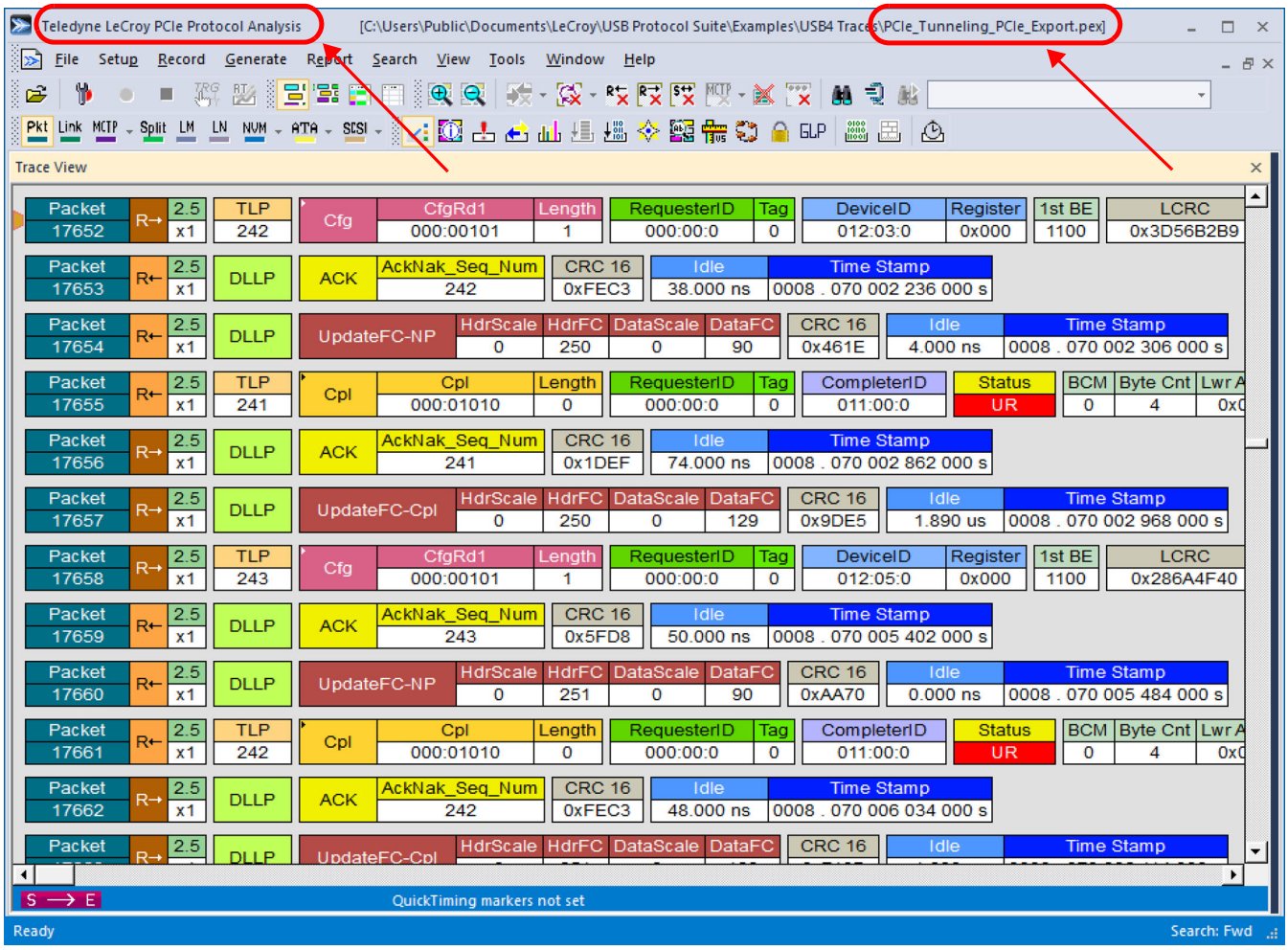


Figure 4.34: Exported Tunneled PCIe Traffic from USB4

4.6.10.2 Tunneled USB3 traffic

If you load a USB4 trace with USB3 tunneled traffic as shown in the figure below (Figure 4.35) you can quickly export the Tunneled USB3 traffic by selecting the “Tunneled USB3” drop down tab.

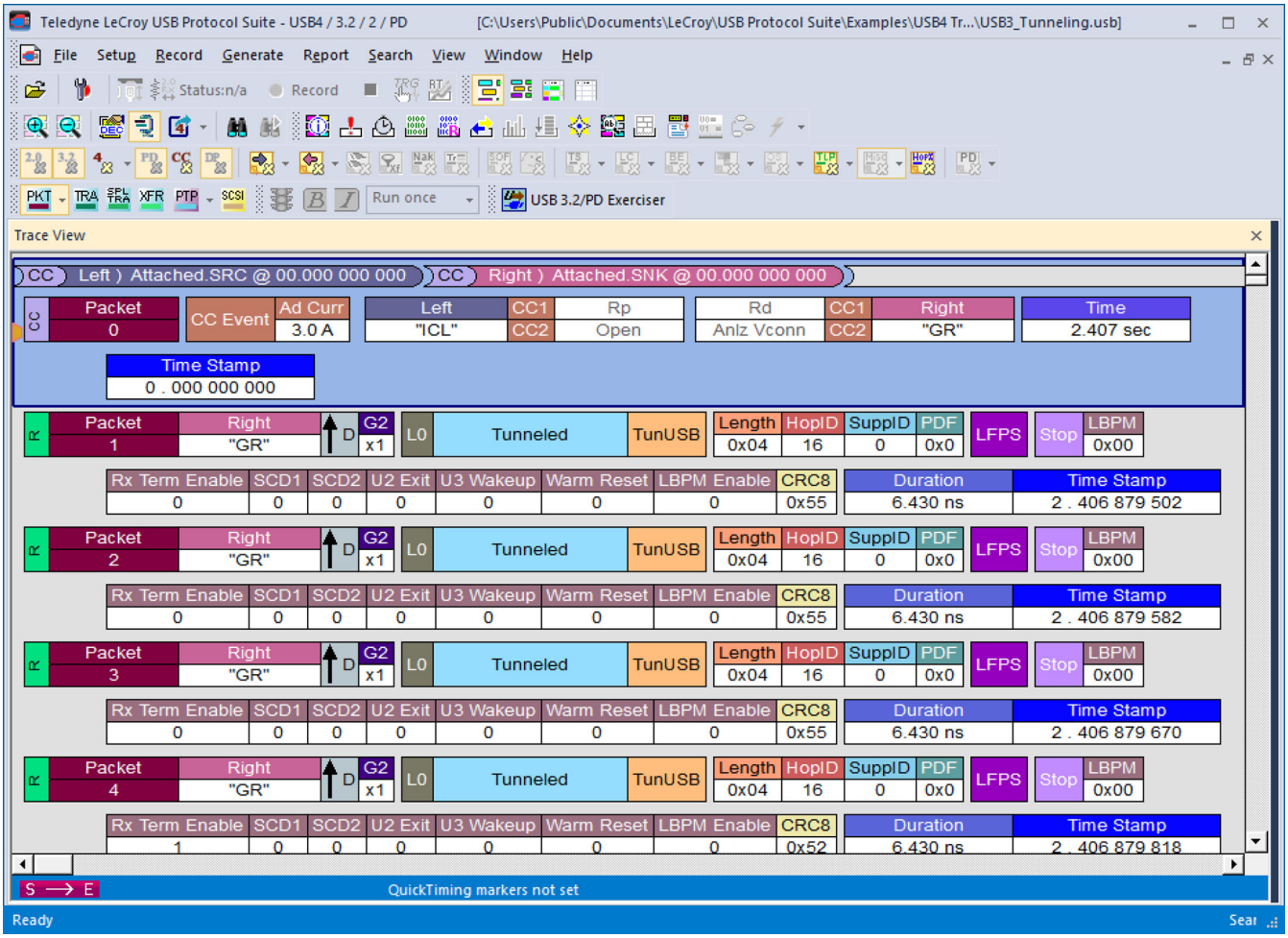


Figure 4.35: Original USB4 Trace with Tunneled USB3 Traffic Before Export

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 (Figure 4.36).

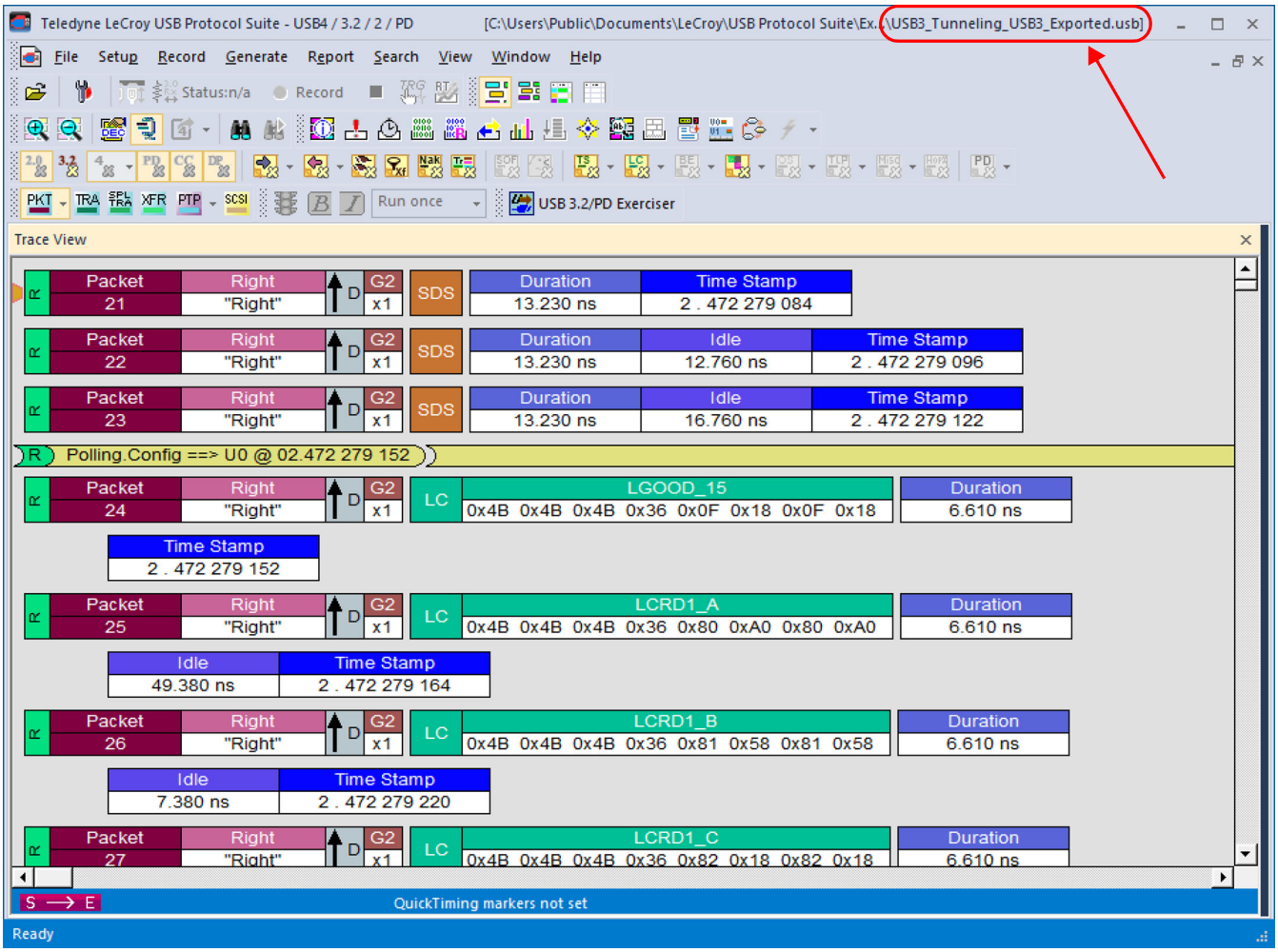
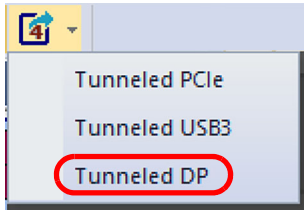


Figure 4.36: Exported USB3 Traffic

4.6.10.3 DP Tunneling

If you load a USB4 trace with Tunneled DP traffic (see Figure 4.37) and you select "Tunneled DP" from the drop down tab you can quickly export the DP tunneled traffic to a new trace.



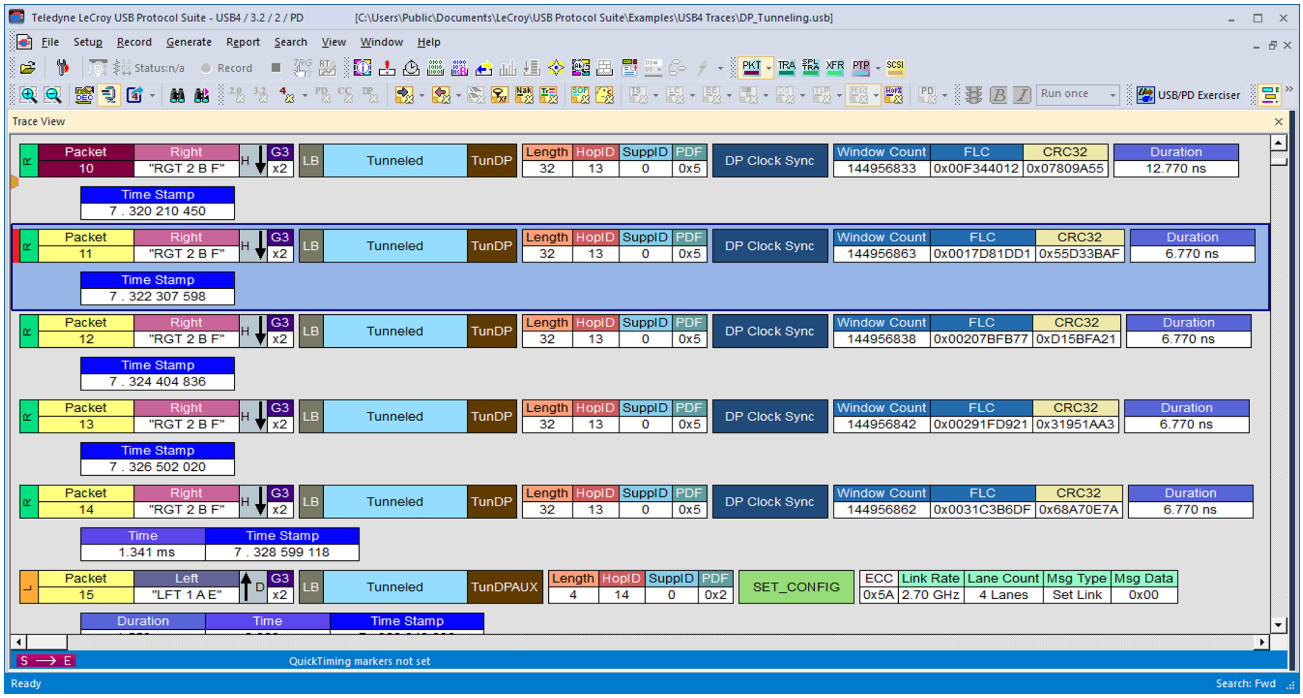


Figure 4.37: USB4 Trace with Tunneled DP Traffic

To open the trace after Exporting Tunneled DP traffic, see 4.3.7 *Export USB4 Tunneled DP Traffic to DP Native Trace*.

4.6.11 Hide Traffic Toolbar

The Hide toolbar allows you to selectively hide data traffic you do not wish to see (Figure 4.38). The highlighted buttons indicate the loaded trace contains that type of data traffic.



Figure 4.38: Hide Traffic Toolbar

4.6.11.1 Hide All USB 2.0 Traffic

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

4.6.11.2 Hide All USB 3.2 Traffic

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

4.6.11.3 Hide All USB4 (or TBT3) Traffic

Click the  button to hide all USB4 (or TBT3) traffic.

4.6.11.4 Hide All Power Delivery Traffic

Click the  button to hide all Power Delivery Traffic.

4.6.11.5 Hide Configuration Channel Traffic

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

4.6.11.6 Hide All DisplayPort Traffic

Click on the  button to hide all Display Port Traffic.

4.6.11.7 Hide Traffic from Left DUT/DUT (Exerciser)

Click the  button to hide Traffic from Left DUT/DUT (Exerciser).

4.6.11.8 Hide Traffic from Right DUT/Voyager (Exerciser)

Click the  button to Hide Traffic from Right DUT/Voyager (Exerciser).

4.6.11.9 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.

4.6.11.10 Hide All Packets Except Transfers Packets.

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

4.6.11.11 Hide NAKs

- Click the **Hide NAKs** button on the toolbar to hide NAKs from a Trace View that may be uninteresting in a given context.
- Click  to hide all NAK packets. This also hides 3.2 NRDY transactions, if they are virtual equivalents of a 2.0 NAK situation.

4.6.11.12 Hide Non Data Transactions

Click  to hide all Non Data Transactions.

4.6.11.13 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 toolbar:

Click  to show/hide all SOF packets.

NOTE:	This also hides low-speed EOPs.

4.6.11.14 Hide Chirps (2.0)

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

4.6.11.15 Hide Link Training Sequences (3.2)

Expand the **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.

4.6.11.16 Hide Link Commands (Flow Control) (3.2)

Expand **Hide Link** icon and select from the options to show/hide Link Commands (LUP/LDN, Flow Control, Power Management, GenT NOP, GenT Link Keep-Alive).

4.6.11.17 Hide Bus Events (3.2)

Click the icon and select from the options to show/hide Bus Events (LFPS, Electrical Idle, Termination or V_{BUS} On/Off).

4.6.11.18 Hide Miscellaneous Packets (3.2)

Click the icon and select from the options to show/hide.

4.6.11.19 Hide USB4 SB Packets

Click the  icon to hide USB4 SB Packets.

4.6.11.20 Hide USB4 HS Packets

Click the  icon to hide USB4 HS Packets.

4.6.11.21 Hide USB4 HS Ordered Sets

Click the  icon to hide USB4 HS Ordered Sets.

4.6.11.22 Hide USB4 HS Training Sequences

Click the  icon to hide different types of USB4 HS Training Sequences.

4.6.11.23 Hide USB4 HS Transport Layer Packets

Click the  icon to hide different types of USB4 HS TLPs.

4.6.11.24 Hide USB4 HS Miscellaneous Packets

Click the  icon to hide USB4 HS Miscellaneous Packet types.

4.6.11.25 Hide Other USB4 Packets

Click the  icon to open the Display Options > USB4 Packet Hiding window. See 8.5 *USB4 Packet Hiding* for more information.

4.6.11.26 Hide HopID/PDF Packets

Click the  icon to hide HopID/PDF types. Then select the HopID/PDF packets you want to hide.

4.6.11.27 Hide Power Delivery Packets

Click  to hide:

- Unknown
- PING
- GoodCRC

4.6.11.28 Hide All Transactions Except Stream ID Numbers

This is found when the Stream Id field of a USB 3.2 Data Packet is selected. It allows you to select a small range of Stream IDs to display without showing other transactions that do not use this Stream ID (Figure 4.39).

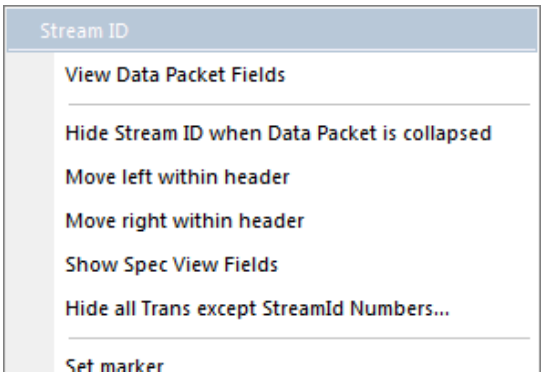


Figure 4.39: Right-clicking on the Stream Id field of a USB 3.2 Data Packet

1. To display the Hide Packets dialog box (Figure 4.40), right-click on the Stream ID field of a USB 3.2 Data Packet and select **Hide all Trans except StreamID Numbers...**.

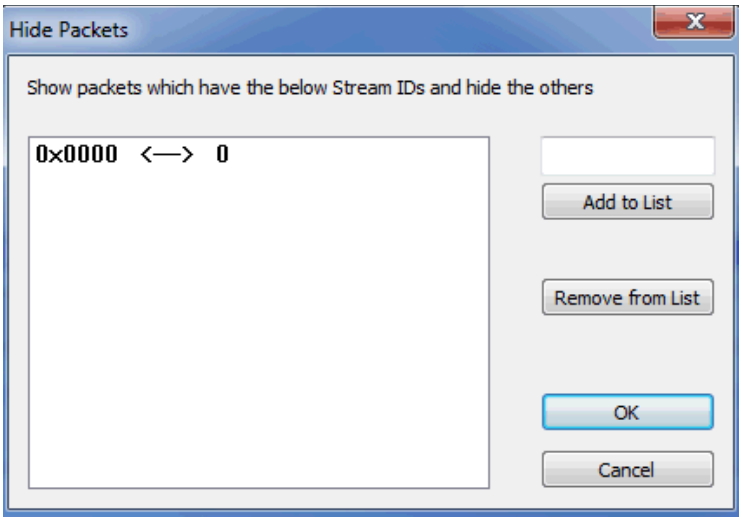


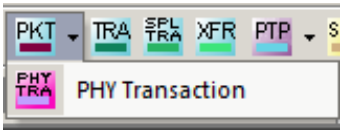
Figure 4.40: Hide Packets Dialog Box

This allows you to select the stream IDs you want to display.

2. Click **Add to List** to for items you want to show, and **Remove from List** to hide items. Selecting the ones you want to see is done because the range of Stream IDs is too large to specify the ones you want to hide explicitly.

4.6.11.29 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.



4.7 Tooltips

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

4.8 Examples

The USB Protocol Suite includes examples of many of the types of files you'll use when performing protocol analysis. These include analyzer traces, exerciser scripts, and traffic generation files. These examples can be found here:
C:\Users\Public\Documents\LeCroy\USB Protocol Suite\Examples

4.9 View Options

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

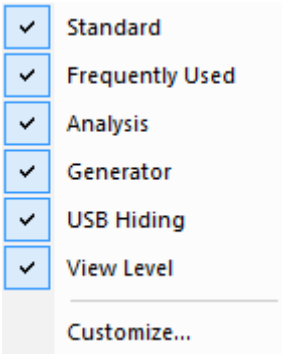


Figure 4.41: View Options Dialog

4.9.1 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** > **toolbars** from the menu bar.
2. Select **Customize** from the submenu to display the Customize dialog box.

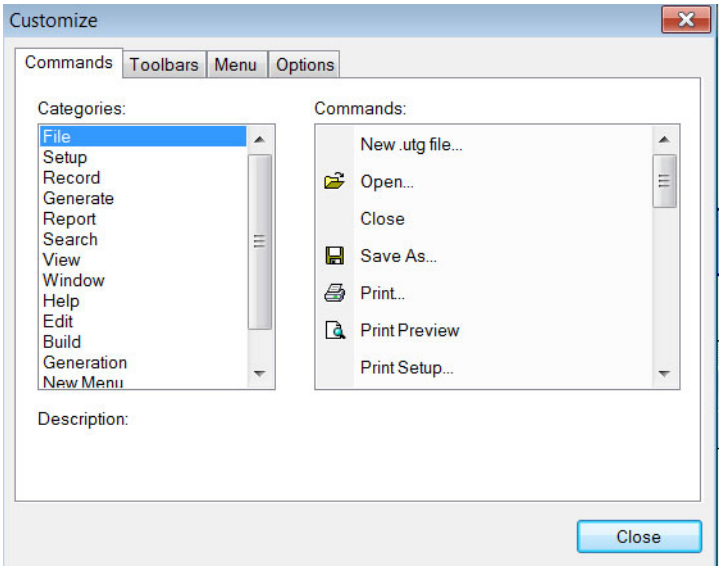


Figure 4.42: Customize Dialog

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

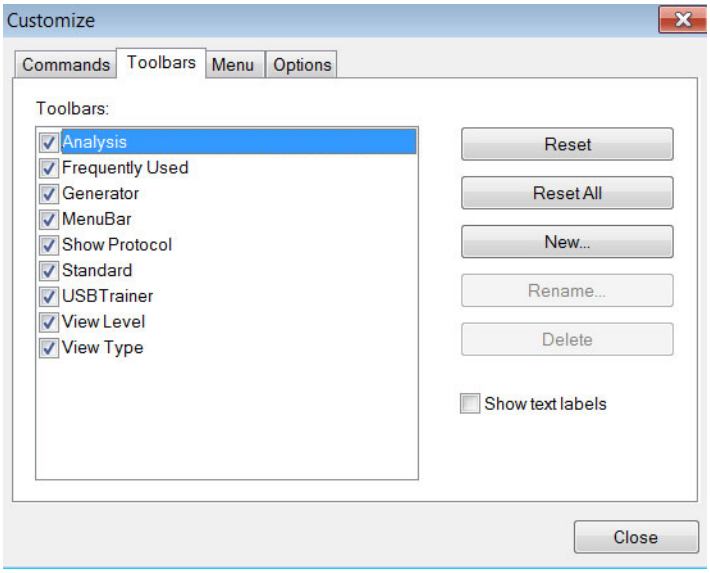
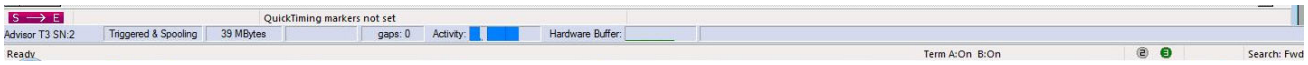


Figure 4.43: Toolbars Dialog

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

4.10 Status Bar

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



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



The left side of the bar has segments that indicate port and link status.



4.10.1 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.

4.10.2 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.

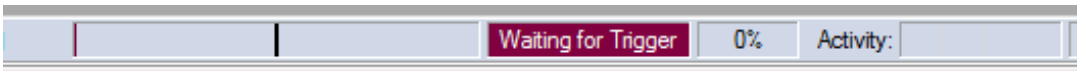


Figure 4.44: Status Bar – Waiting For Trigger

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

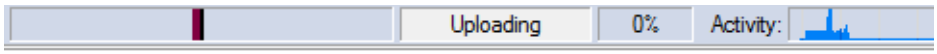


Figure 4.45: Status Bar – Uploading

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



Figure 4.46: Status Bar – Rec/Uploading

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



Figure 4.47: 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 toolbar. 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 (Figure 4.48).

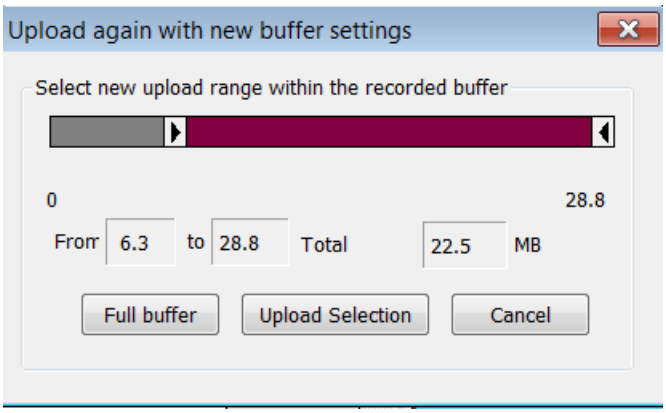


Figure 4.48: Partial Upload Options Dialog

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

- If the recording resulted from a Trigger Event, the first packet following the trigger (or the packet that caused the trigger) is initially positioned second from the top of the display.
- If the recording did not result from a Trigger Event, the display begins with the first packet in the traffic file.

4.10.3 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.

4.10.4 Cable Status

4.10.4.1 Type-C Cable Status

Type-C analyzers have cable status LEDs on the front panel. See Figure 4.49.

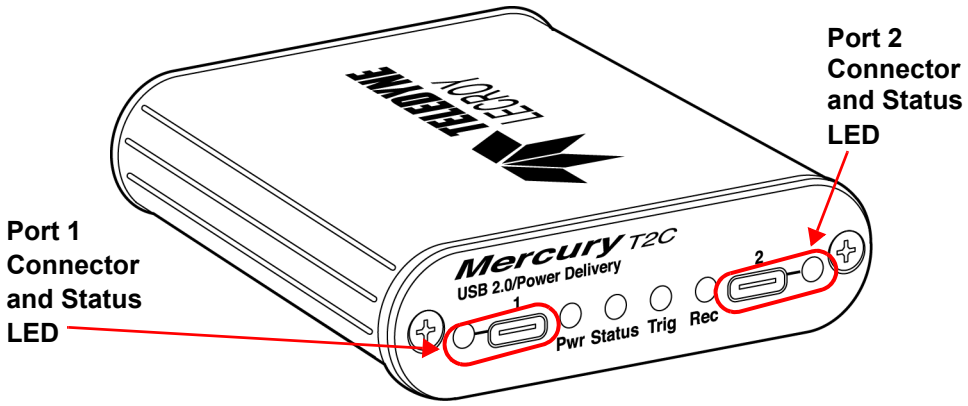


Figure 4.49: Mercury T2C "C" Connectors and LED Status Indicators (same as T2P)

The "C" cable can be inserted into Connectors 1 or 2 on the 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, unplug it, turn it over and reconnect 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 as shown in Figure 4.50, below.

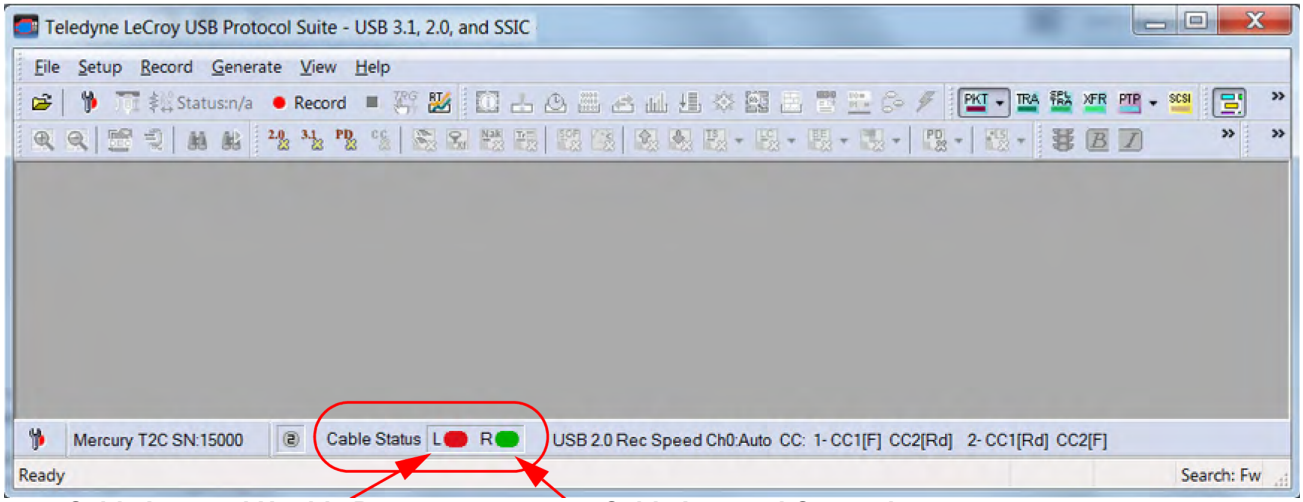


Figure 4.50: Status Bar in S/W Display Menu

4.10.5 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 Search: Fwd.

4.11 Device Status

4.11.1 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 (Figure 4.51) at the bottom of the Main Menu.

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

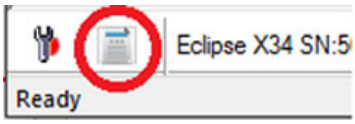


Figure 4.51: Device Status Details Button

This will bring up the following Device Status Details Window (Figure 4.52).

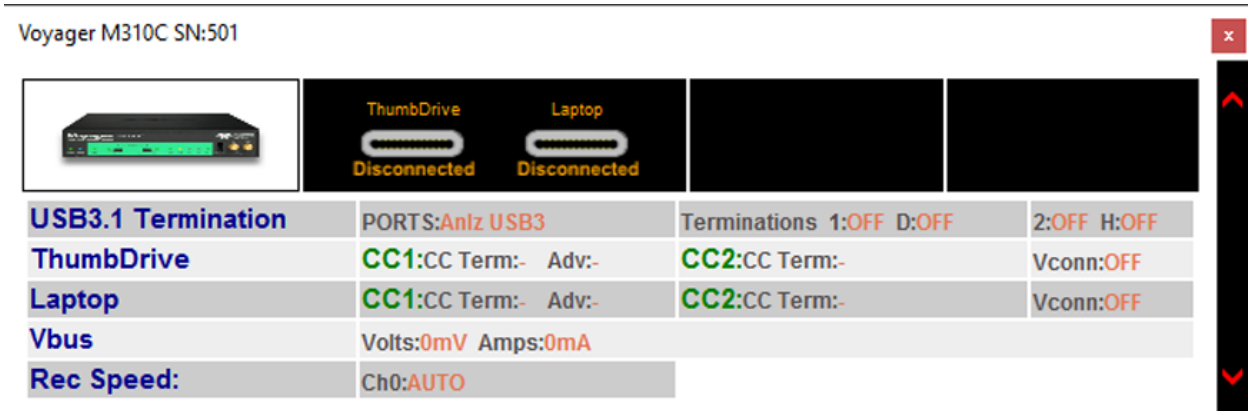


Figure 4.52: Device Status Details Window

4.11.1.1 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:

- Name of Device
  - User-assigned name from Recording Options
- 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
- 3.2 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:** TPs and DPs (actual traffic)

- 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 UUTs. The Numbers indicate the analyzer terminations, the others are the DUT and HUT.

NOTE: Terminations do not apply for the M310P/M310e analyzer connectors, since those use a Passive Electrical Tap.

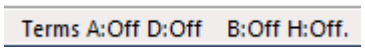
- Type-C Cable Status
  - CC termination
  - Advertised Current Capability
  - V_{CONN} On/Off state
- V_{BUS} Voltage and Current
- Selected recording Speed

4.11.2 SuperSpeed Termination Status

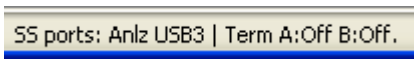
The lower right middle of the Status Bar shows the SuperSpeed Termination status. (Not applicable to M310P/M310e analyzer connectors, which use a Passive Electrical Tap.)

NOTE: The status is the status of the analyzer port, not of the device or host under test.

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



If the Analyzer Port Termination setting is “Always Presented”, the far end values are unknown, so they are not shown.



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

Polling occurs when the Application CPU is not busy. The polling interval is reflected in a small dot (.) at the end of the string in the Status Bar.

NOTE: Terminations reflect what the analyzer is presenting to the device or host. The analyzer changes these terminations while attempting to connect the Host DUT and Device DUT together using the SuperSpeed connection protocol. For more information about the Recording buttons, see 4.6.5 *Recording*.

4.11.3 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:	TPs and DPs (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:	TPs and DPs (actual traffic)
2	**Solid Yellow:**	FS SOFs, LS EOPs, 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 SOFs 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:	TPs and DPs (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:	TPs and DPs (actual traffic)
2	USB 2.0 unused

NOTE: USB Type-C™ Connector Ports Insertion Status:

- 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.

4.12 Navigation Tools

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

4.12.1 Zoom In

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

Click  on the toolbar.

4.12.2 Zoom Out

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

Click  on the toolbar.

4.12.3 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 toolbar or select **Wrap** under **View** on the Menu Bar.

4.12.4 CrossSync Control Panel

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

4.12.5 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.

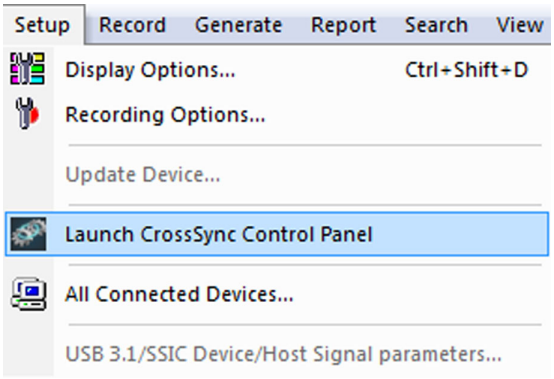


Figure 4.53: Launch CrossSync from the USB Protocol Suite Application

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:

- 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**.

4.13 Analyzer Keyboard Shortcuts

4.13.1 Shortcuts List

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

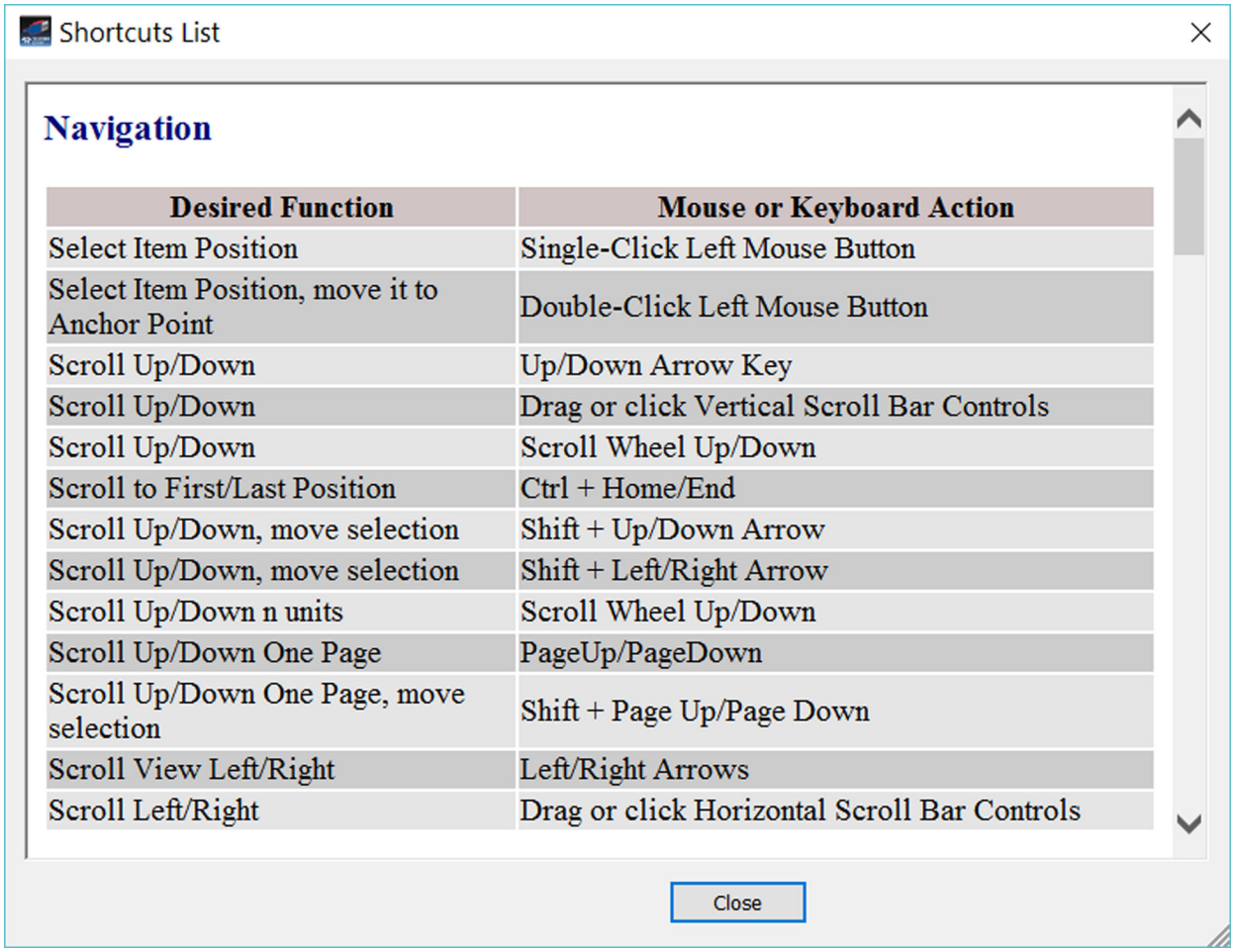


Figure 4.54: Shortcuts List: Navigation

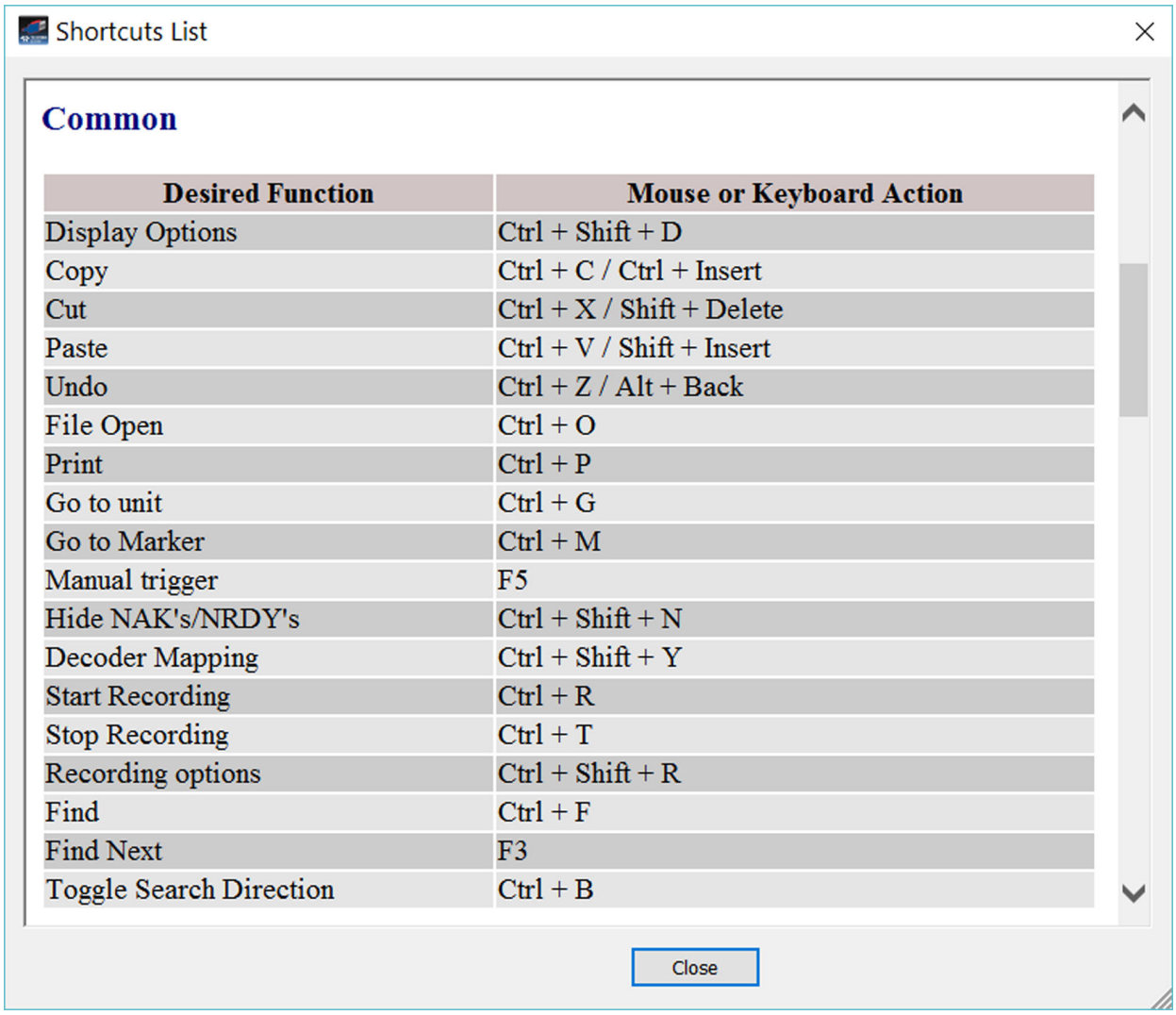


Figure 4.55: Shortcuts List: Common

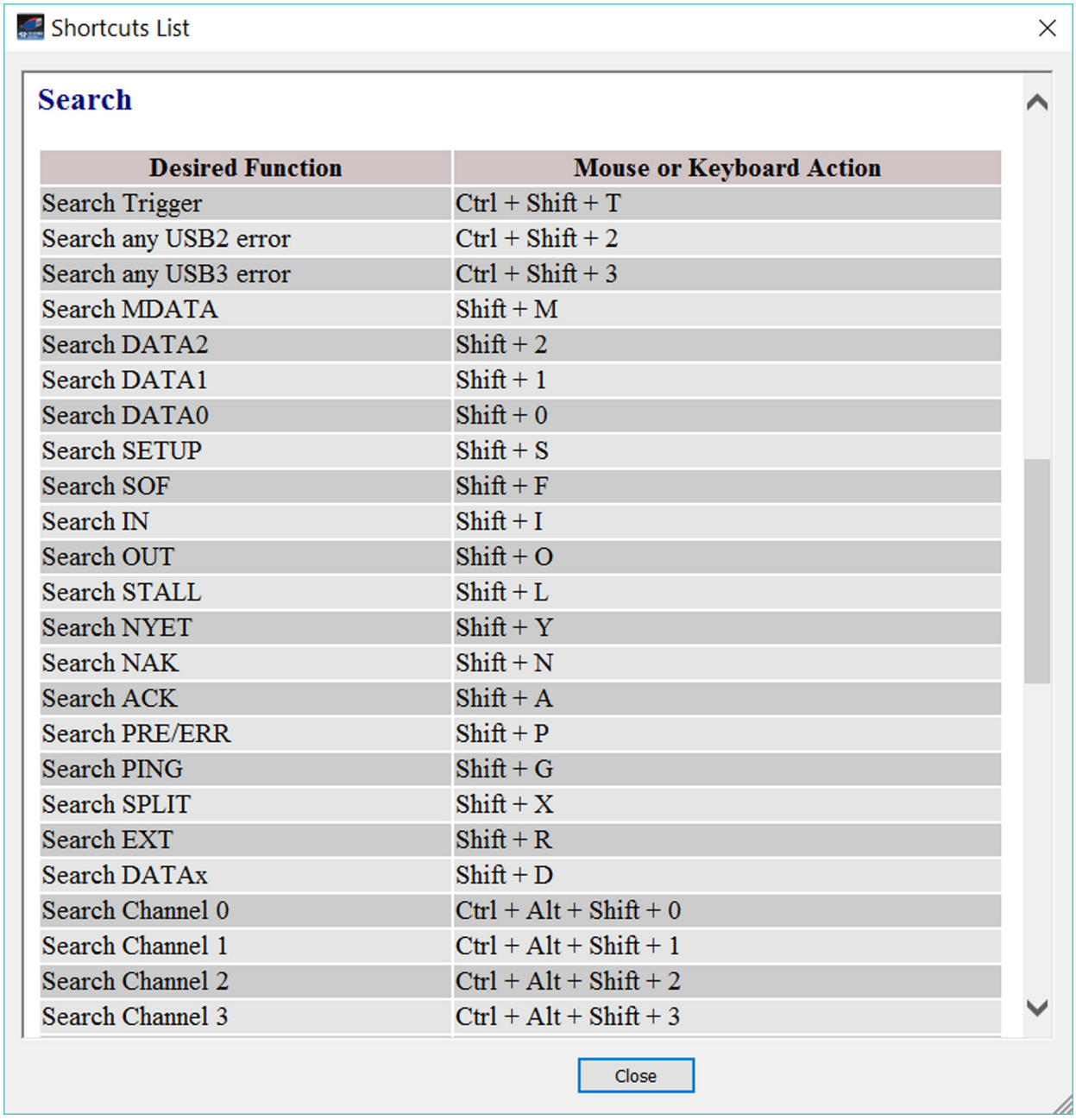


Figure 4.56: Shortcuts List: Search 1

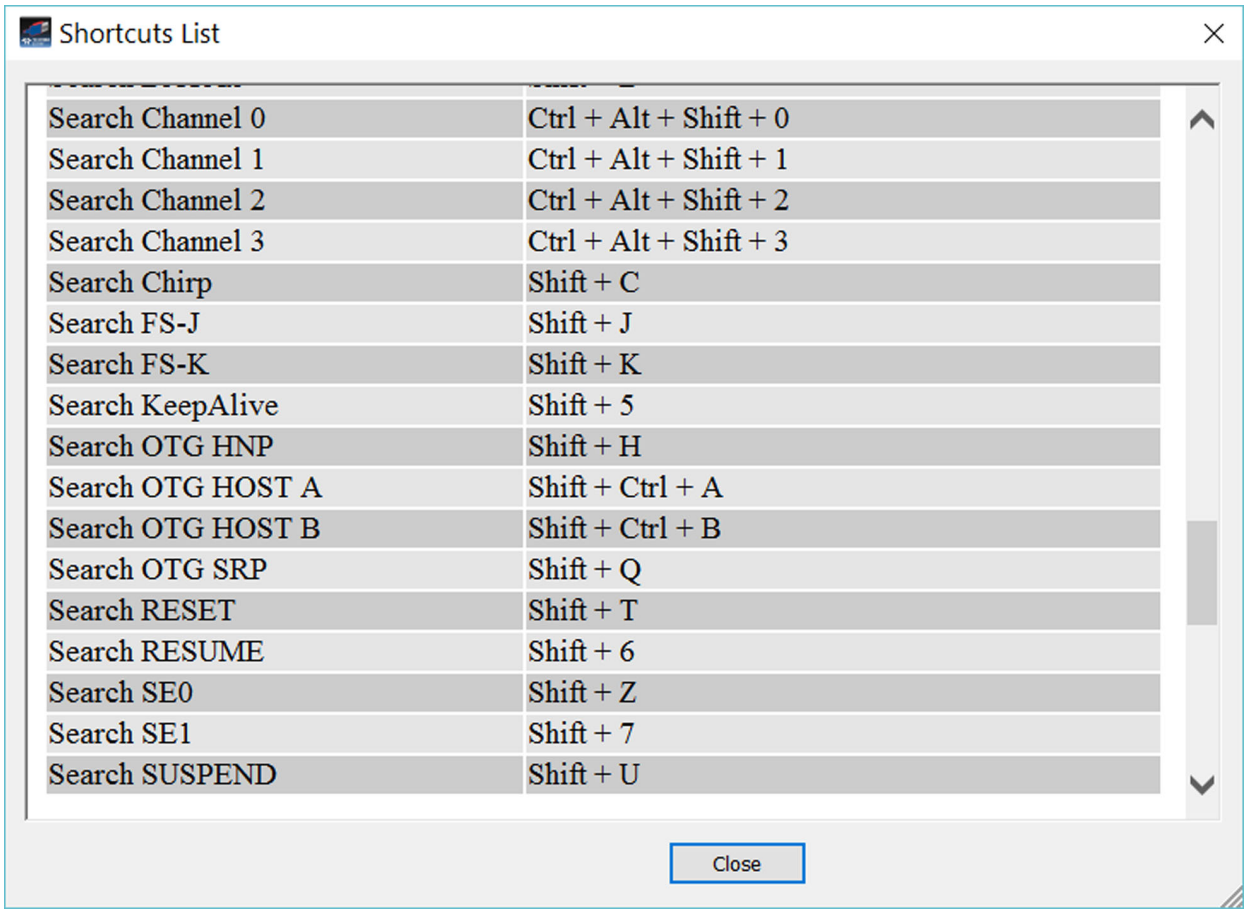


Figure 4.57: Shortcuts List: Search 2

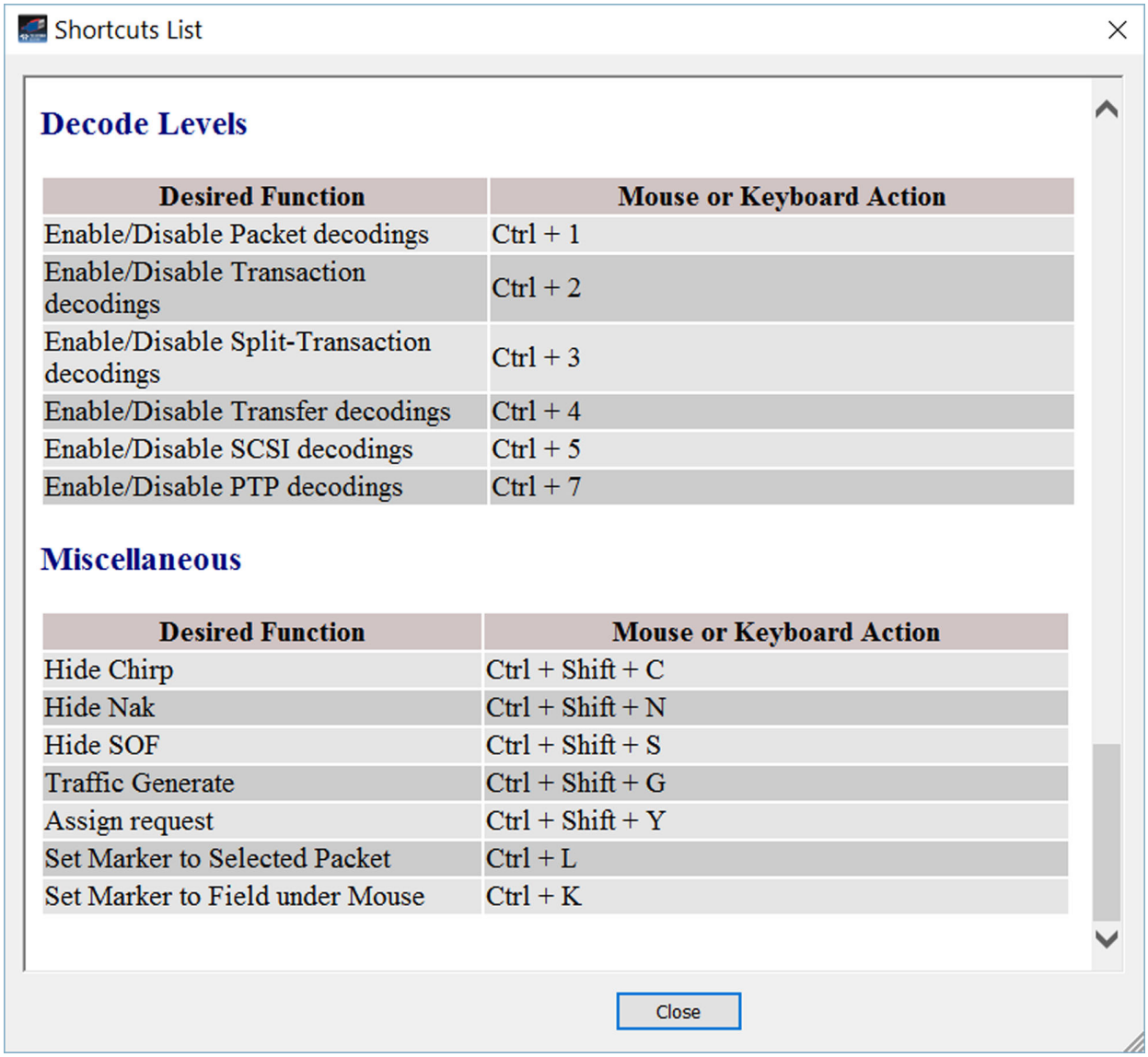


Figure 4.58: Shortcuts List: Decode Levels and Miscellaneous

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:

- Go to **Setup > Recording Options**.

OR

- Click  on the Toolbar.

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

NOTE:	Recording Options not supported by your hardware either appear inactive or are not shown.

Recording Options and tabs vary depending on the analyzer chosen in the **Product Type** drop-down menu. Below is the **Recording Options** dialog box for the Voyager M310 (Analyzer Mode), in Simple Mode, Figure 5.1.

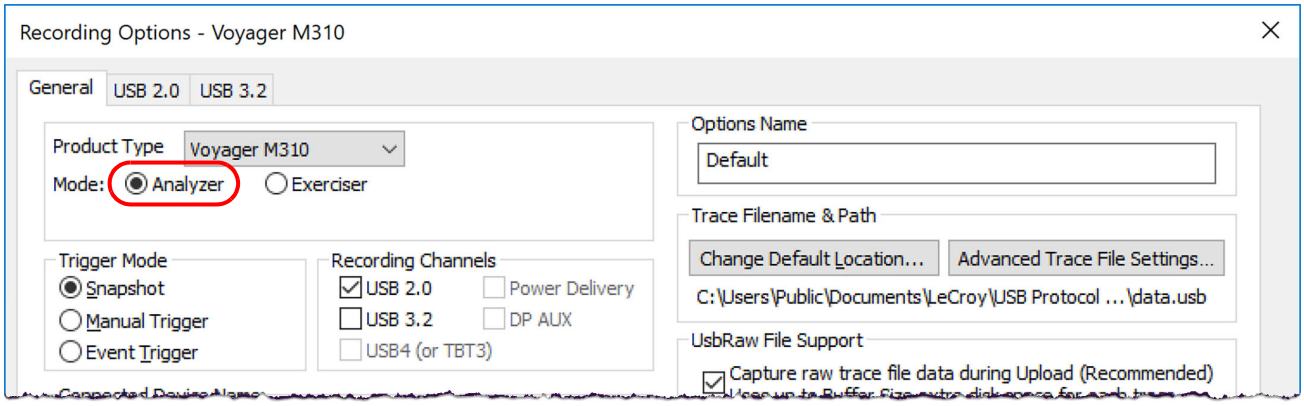


Figure 5.1: Voyager M310: Recording Options: General Tab: Analyzer Mode: Simple Mode

5.1 Summary

Click the vertical triple greater-than (>) symbols on the right side of the General tab to display the Recording Options Summary (Figure 5.2).

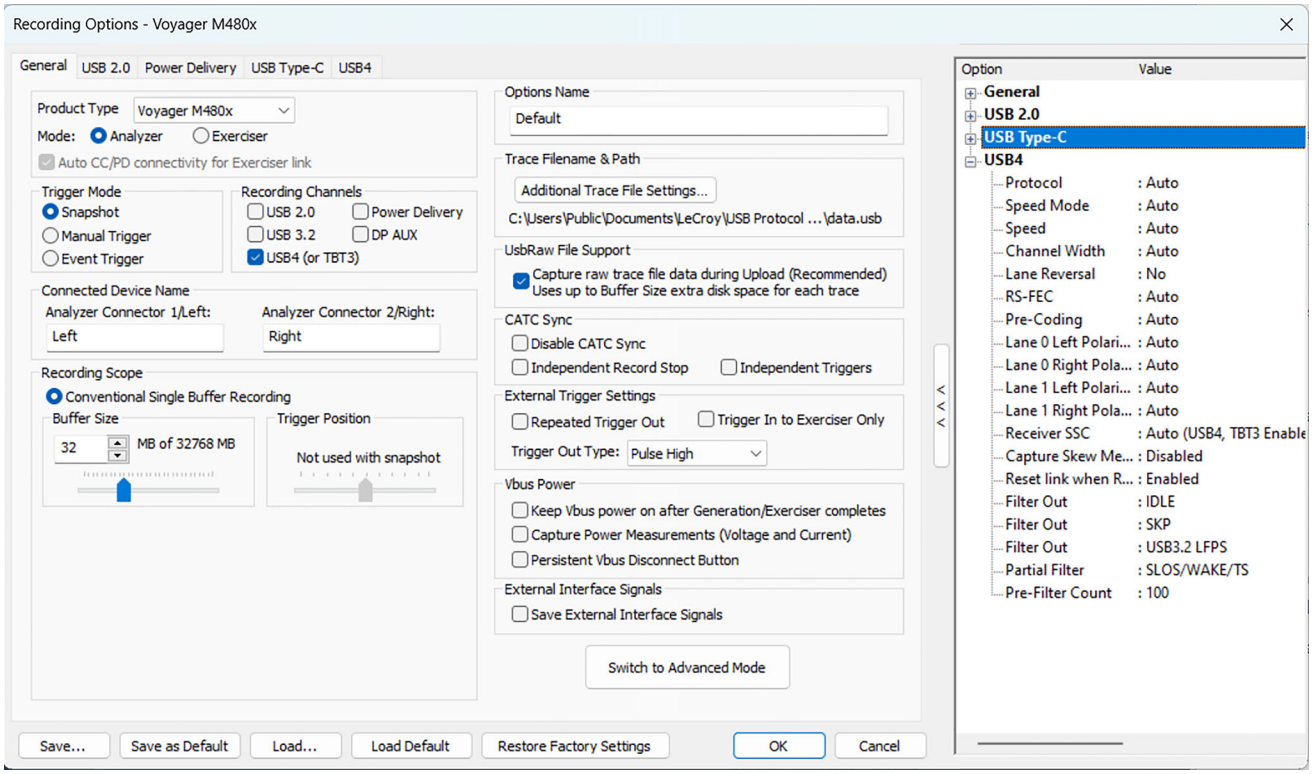


Figure 5.2: Recording Options Summary

The tab provides an easy-to-read summary of the currently selected options. Close the tab by clicking the three less-than symbols (<).

5.2 General

The **Recording Options** General tab allows 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 M480x
- Voyager M4x
- Voyager M310P
- Voyager M310e
- Voyager M310C

- Voyager M3x
- Voyager M310
- Voyager M3i *
- Advisor T3
- Mercury T2
- Mercury T2C
- Mercury T2P

* No longer supported. See 3 *The orientation on both connectors is indeterminate. This may occur when two pass-through cables are used, which is not a valid configuration.* 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.) Voyager products can be put into **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* and Chapter 12, *Traffic Generation USB 3.2, USB4, & PD Exerciser* for more information on 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 its Aux channel. There is no support for capturing Display Port high speed traffic in this mode.

5.2.3 Trigger Mode

The **Trigger Mode** box defines (Figure 5.3) how the analyzer begins and ends a recording.

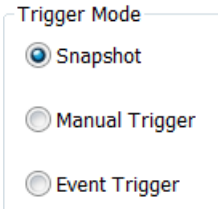


Figure 5.3: Trigger Mode Options

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

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 Toolbar. Recording continues in a circular manner within the limits set by the buffer size.

Recording ends when  is clicked on the Toolbar 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 Toolbar.

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

You can select a combination of USB 2.0, USB 3.2, USB4, USB4 SB, Power Delivery, and DP AUX.

> **NOTE:** On the Voyager M4x and M480x, only one of the USB 3.2 and USB4 channels can be enabled at a time. The analyzer must reboot to switch between these channels.

If you select different external trigger modes in the Recording Rules when performing simultaneous USB 2.0 and USB 3.2 captures, the trigger mode for USB 3.2 will be applied.

The USB 3.2 channel is used to record Gen 1 and Gen 2 traffic. Gen 2 captures are only supported on Voyager M310, M310C, M310P, M310e, M4x, and M480x.

The M310C and M310P only support the capture and display of the DisplayPort Aux channel Protocol, which runs on the SBU wires. The Mercury T2P, Voyager M310e, Voyager M4x, and M480x support USB4 SB packet capture, as well as the DisplayPort Aux channel.

The Power Delivery Recording channel is explained in 5.2.5 *Power Delivery Recording Channel*.

Table 5.1: Recording Channels (Sheet 1 of 2)

Model	USB 2.0	USB 3.2	USB4	Power Delivery	Sideband
Voyager M480x	Yes	Yes (Gen 2x2)	Yes	Yes	Yes (DP and USB4)
Voyager M4x	Yes	Yes (Gen 2x2)	Yes	Yes	Yes (DP and USB4)

Table 5.1: Recording Channels (Sheet 2 of 2)

Model	USB 2.0	USB 3.2	USB4	Power Delivery	Sideband
Voyager M310e	Yes	Yes (Gen 2x1)	N/A	Yes	Yes (DP and USB4)
Voyager M310P	Yes	Yes (Gen 2x1)	N/A	Yes	Yes (DP)
Voyager M310C	Yes	Yes (Gen 2x1)	N/A	Yes	N/A
Voyager M3x	Yes	Yes (Gen 1x1)	N/A	N/A	N/A
Voyager M310	Yes	Yes (Gen 2x1)	N/A	N/A	N/A
Voyager M3i	Yes	Yes (Gen 1x1)	N/A	N/A	N/A
Advisor T3	Yes	Yes (Gen 1x1)	N/A	N/A	N/A
Mercury T2P	Yes	N/A	N/A	Yes	Yes (DP and USB4)
Mercury T2C	Yes	N/A	N/A	Yes	N/A
Mercury T2	Yes	N/A	N/A	N/A	N/A

NOTE: Analyzers may capture initial state events such as V_{BUS} 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.

5.2.5 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 on Voyager M310C/M310P/M310e/M4x/M480x and Mercury T2C/T2P.

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”.

The names provided here are displayed in the Trace View as Port Aliases. See 6.25 *Port Alias* for more information.

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 (available on certain models):** The analyzer begins recording data to the analyzer memory when the record button is pressed. The entire analyzer memory 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.
- When capturing high bandwidth 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, 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 smaller buffer sizes.

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 are displayed.

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.

1. Click **Trace File Name & Path**.
2. 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.

This is done (for example) when the desired Trace File Name & Path has such a reference in the Recording Options file.

IMPORTANT:	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.

5.2.11.1 Additional Trace File Settings

The application provides the option to enter additional Trace File Settings from any available product mode. Click the **Additional Trace File Settings...** button under *Trace Filename & Path* to launch the *Additional Trace File Settings* dialog window. Figure 5.4 shows an example of additional settings for the Voyager M4x.

NOTE:	If you are using multiple screens, the dialog window might appear in a different screen from the application display.

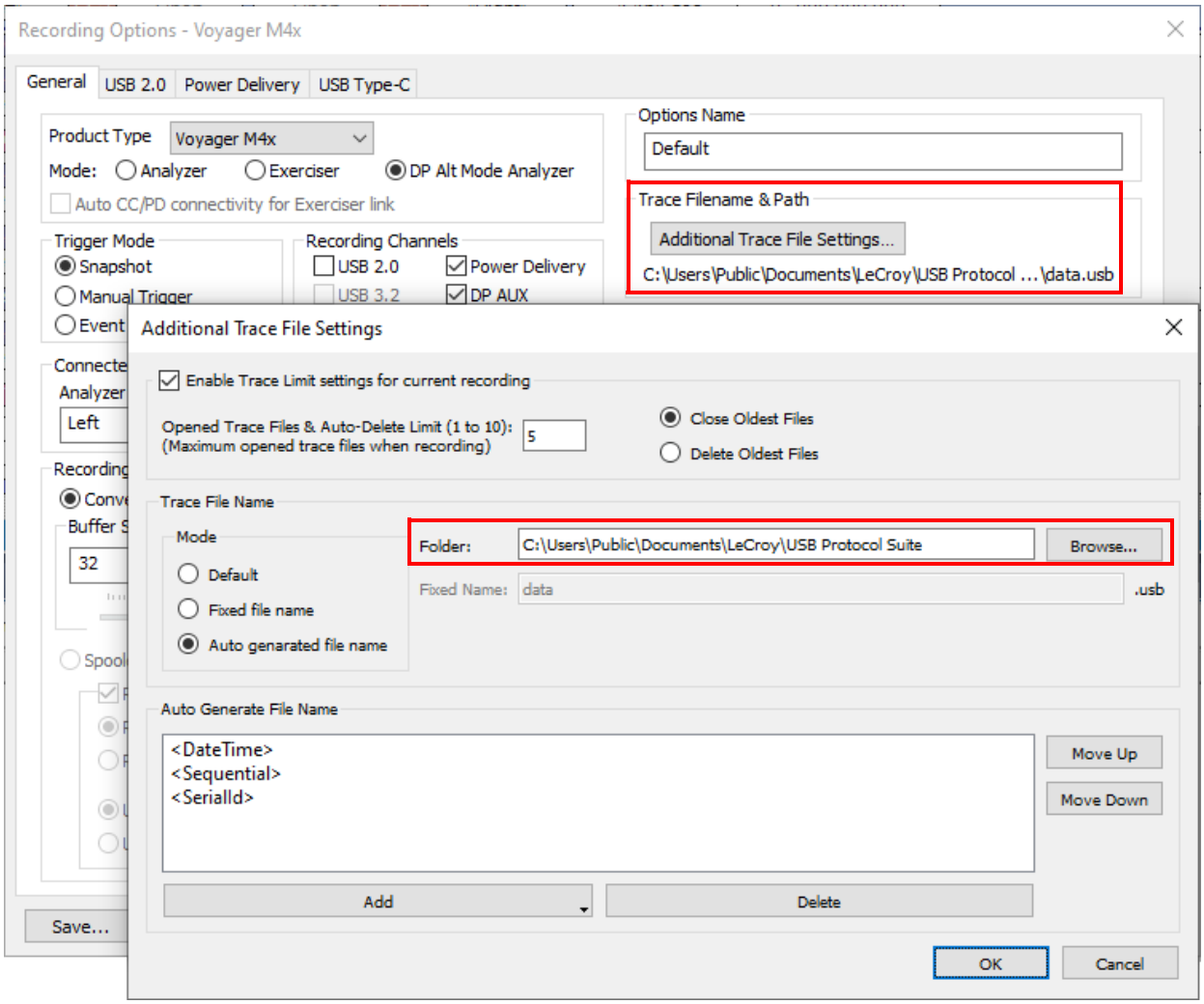


Figure 5.4: Additional Trace File Settings

The following options are available:

- **Enable Trace Limit settings for current recording**
  - *Opened Trace Files & Auto-Delete Limit (1 to 10)*: Option to set the number of opened files limit from 1 to 10.
  - *Close Oldest Files* or *Delete Oldest Files:* Option to either close or delete (not both) opened files over the set limit.
- **Trace File Name**
  - **Mode**
    - *Default:* The Fixed Name is used, and will include the analyzer serial number and date/time of capture appended to the end.
    - *Fixed file name:* The Fixed Name is used.
    - *Auto generated file name*: The file name is generated based on the patterns provided in the Auto Generate File Name area.

- **Folder:** Use the default path or click **Browse...** to select or enter a different folder.
- **Fixed Name:** If you selected the *Default* or *Fixed file name* mode, the initial text string can be defined here. The default value is “data” and the extension will always be .**usb**.

- **Auto Generate File Name**
  - **Add** button: Click the arrow in the lower right corner of this button to select the type of information you want in the file name. You can add the following topics:
    - Text (defaults to “data”)
    - SerialId
    - DateTime
    - Sequential
  - **Delete** button: Use this to remove information you don’t want in the auto-generated file name. Select (highlight) the topic you wish to remove (e.g., <Sequential>) and click **Delete**.
  - **Move Up** and **Move Down** buttons: Use these buttons to organize the information in auto-generated file name. Select (highlight) the topic and click one of the buttons to arrange the file name.

5.2.12 USB Raw File Support

Check this box to save raw data from the capture in the form of a .usbraw file that will be created in the same folder as your trace. If you are having any problems with your captures, this file is necessary for allowing Teledyne LeCroy support personnel to debug the issue.

5.2.13 CATC Sync (Voyager and Advisor T3 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.

5.2.14 External Trigger Settings

5.2.14.1 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.

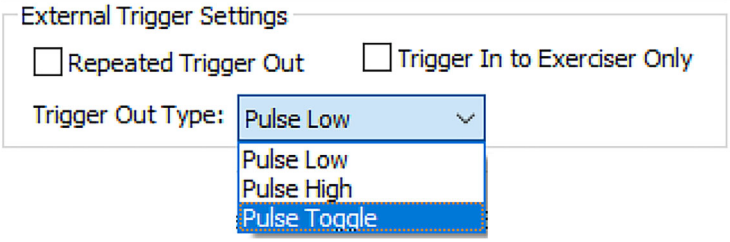


Figure 5.5: External Trigger Settings: Low/High/Toggle

5.2.14.2 Trigger In to Exerciser Only

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

5.2.14.3 Trigger Output Type

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

- Pulse Low
- Pulse High
- Pulse Toggle

5.2.15 V_{BUS} Power

You can control power settings:

- **Keep V_{BUS} Power on after Generation/Exerciser completes**: Select to keep the Host V_{BUS} on at completion of a 2.0 or 3.2 Trainer/Exerciser script.
- **Capture Power Measurements (Voltage and Current)**: Records voltage and current.
- **Persistent V_{BUS} Disconnect Button:** Select 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" for the connection

mode, remaining in the OFF state until you invoke it again, changing it back to ON.

This can be used to turn off the V_{BUS} 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. This uses extra disk space corresponding to the specifications in Buffer Size for each trace.

5.2.16 External Interface Signals

When Save External Interface Signals is selected, saves eight bits of data from the M310s 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.

5.2.17 Capture CC Debug Info (Mercury T2C only)

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 checkbox cleared for normal trace acquisitions.

5.2.18 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.

5.3 USB 2.0

The **USB 2.0** page presents options for setting (see Figure 5.6):

- **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 DRDs** and enter device names. Optionally, assume that B is the first host.
- **Generator-related Parameters:** Choose parameters and device address location.
- **Options:** Truncate data fields

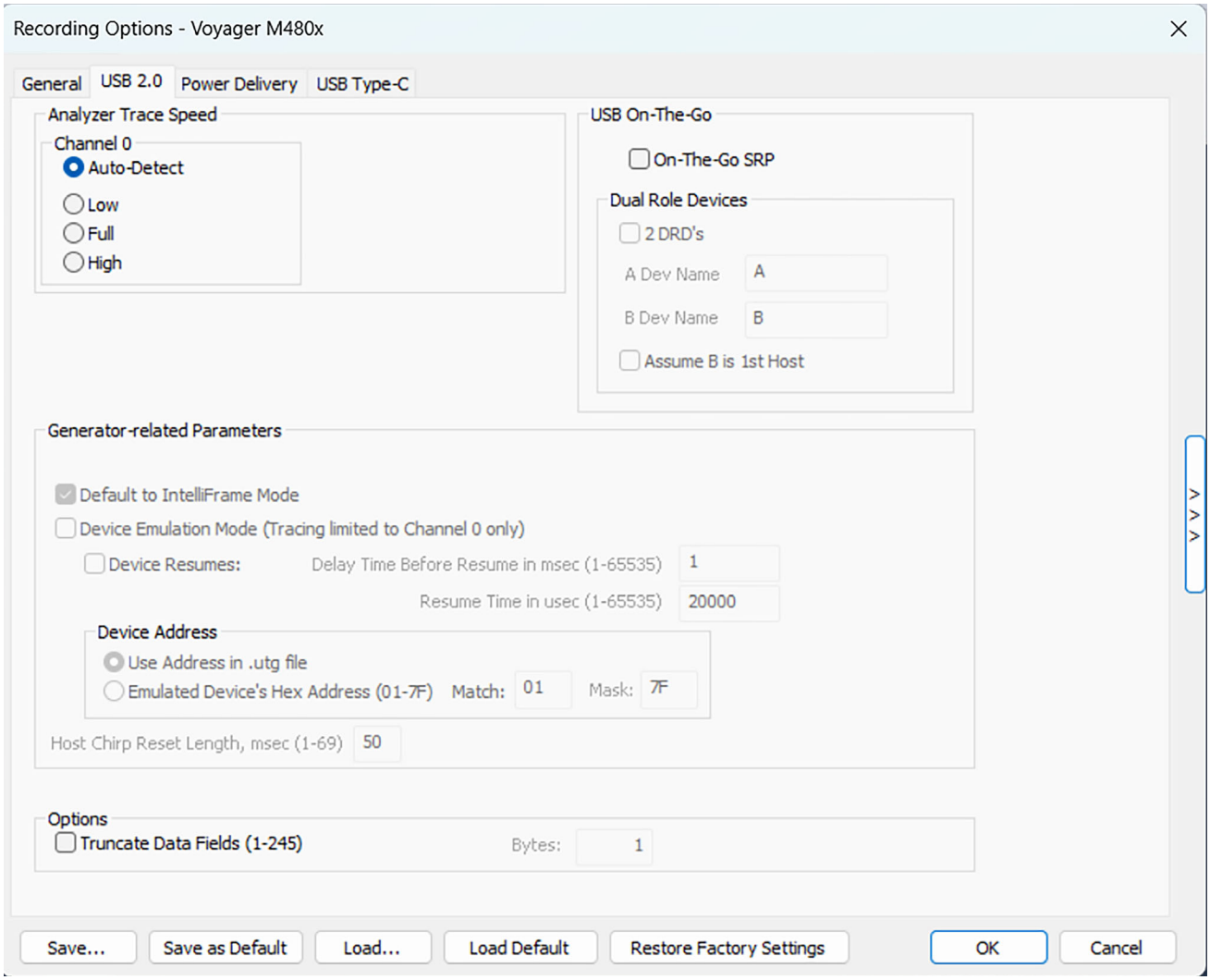


Figure 5.6: Recording Options USB 2.0

5.3.1 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, or 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: 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 can be 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 (daisy-chained analyzers such as Voyager or Advisor T3)

5.3.1.1 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 byproduct of the high-speed probe settling down.

5.3.2 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.

5.3.3 Generator-Related Parameters

You can set traffic generation parameters:

- **Disable Generator Memory:** Use the whole Capture Buffer for the trace. Only available on some models.
- **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).

5.3.4 Data Truncation Option

Truncate Data Fields: Allows data fields to be truncated during recording in order to save analyzer memory and allow recording of more packets. Enter a minimum data length value in the Bytes box. 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.

5.4 USB 3.2

5.4.1 Overview

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, Analyzer Ports Termination, and Exerciser port settings. See Figure 5.7.

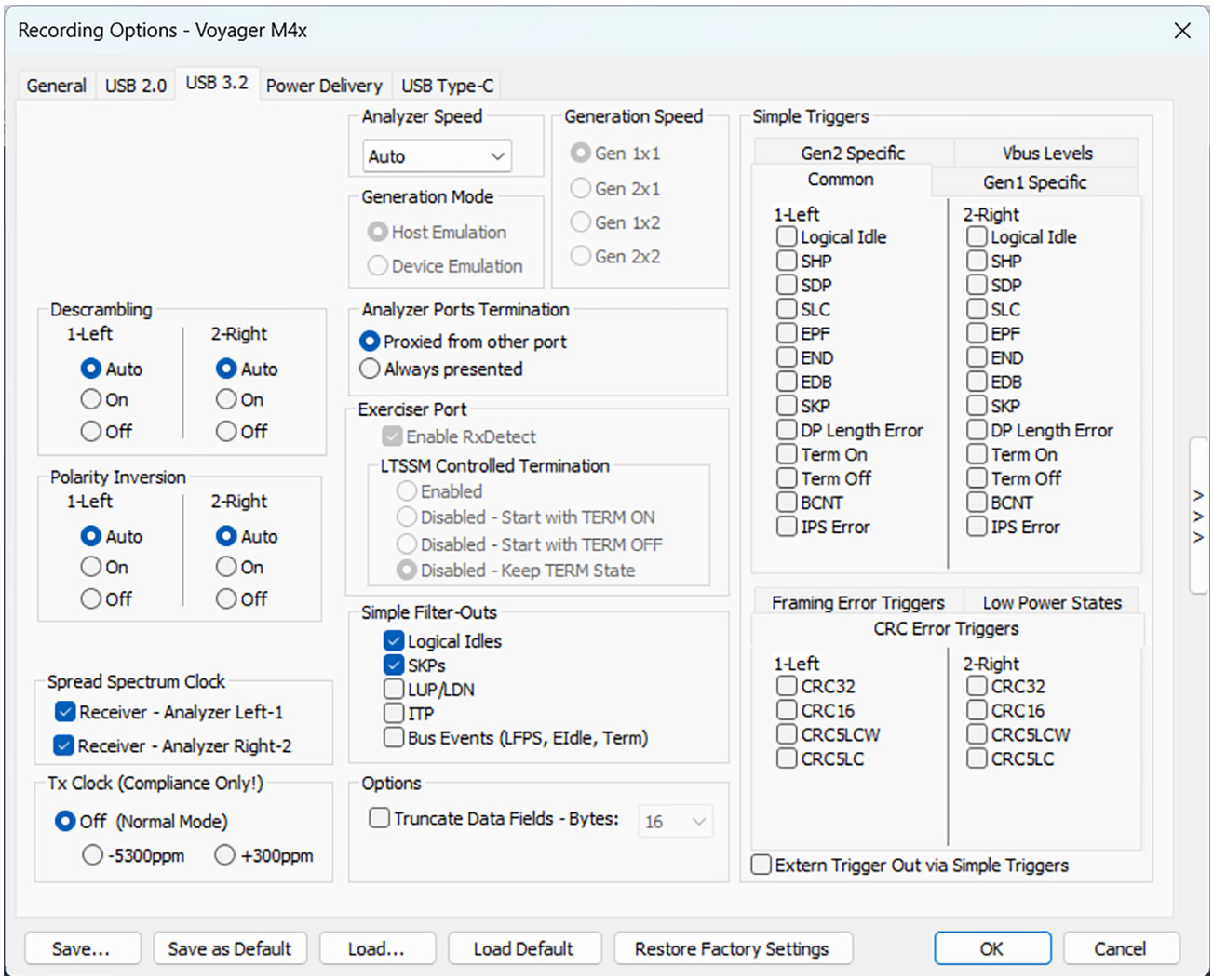


Figure 5.7: M4x: USB 3.2 Recording Options: Analyzer Mode

Figure 5.7 shows the USB 3.2 tab with Common Simple Triggers for USB 3.2 recording. See 5.4.8 *Simple Triggers* for more on triggers.

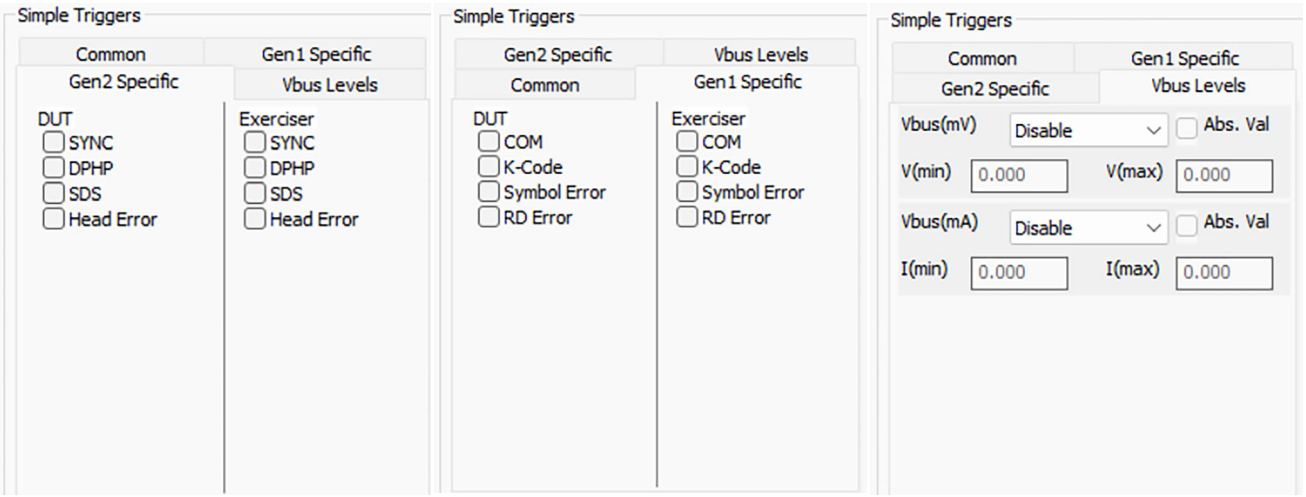


Figure 5.8: Simple Triggers: Gen 2 Specific, Gen 1 Specific, V_{BUS} Levels

5.4.2 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.

5.4.3 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, EIdle, Term)**.

- **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.**

5.4.4 Spread Spectrum Clock (SSC)

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 analyzer ports to improve lock performance.

For M480x and M4x, the options are:

- Receiver - Analyzer Left-1
- Receiver - Analyzer Left-2

For M310P, M310e, M310C, and M2x, the option is:

- Receiver

When selected, the analyzer Reference Clock will apply "down-spread" to its own internal Receiver Reference Clock to better track SSC signaling. When clear, the Analyzer Receiver Reference Clock will be set to the nominal data rate.

5.4.5 Analyzer Ports Termination

This setting identifies the Superspeed Rx termination approach on the analyzer ports. There are two main options:

- Proxied from other port
- Always presented

Proxied from other port mode (the default) is designed to recognize USB 3 hosts and devices attached to one port of the analyzer, then present terminations to DUT attached to the other port. 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 *Always presented* mode. In **Always presented** mode, there is a fixed Rx termination presented from the analyzer port regardless of other port connection status.

NOTE: **Analyzer Ports Termination** settings do not apply to the M310P/M310e analyzer connectors, since they use a Passive Electrical Tap. Termination is therefore passed through directly.

5.4.6 Exerciser Port Settings

There are two settings for exerciser ports:

- **Enable RxDetect:** Designed to recognize USB 3 hosts and devices and present a SS termination to them when they are plugged in.
- **LTSSM Controlled Termination:** If Enabled, the Exerciser will automatically present SuperSpeed receiver termination is 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.

5.4.7 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 allows more packets to fit in a trace, but it has the potential to prevent accurate decoding to higher layers (transfers, SCSI, etc).

5.4.8 Simple Triggers

In addition to the Common triggers, there are also:

- Gen 1 Specific
- Gen 2 Specific
- V_{BUS} Levels

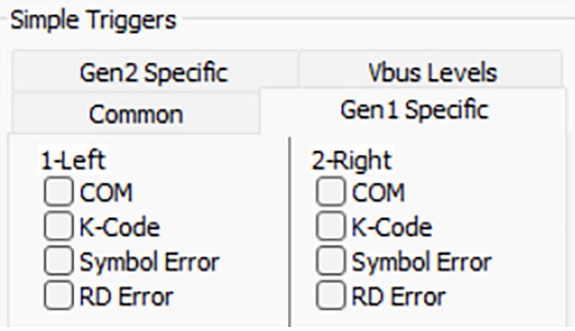


Figure 5.9: USB 3.2: Simple Triggers: Gen1 Specific

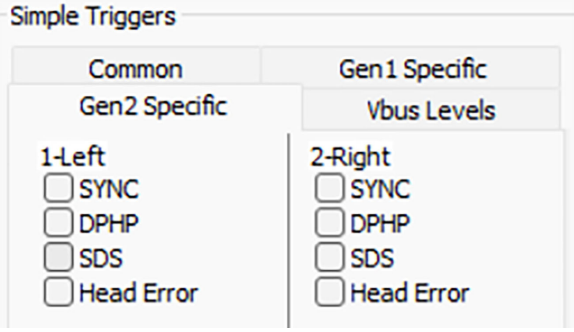


Figure 5.10: USB 3.2: Simple Triggers: Gen 2 Specific

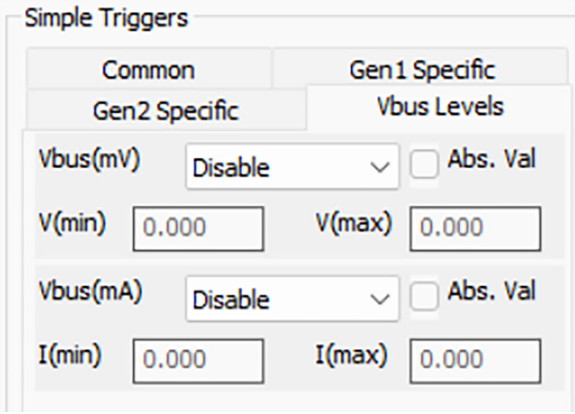


Figure 5.11: USB3.2: Simple Triggers, V_{BUS} Levels

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

- Disable
- Less Than
- Greater Than
- Between

5.4.8.1 Absolute Value (V_{BUS} Levels)

If you don't know which direction the power is coming from (whether it's being sourced or sinked) 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 5.12.

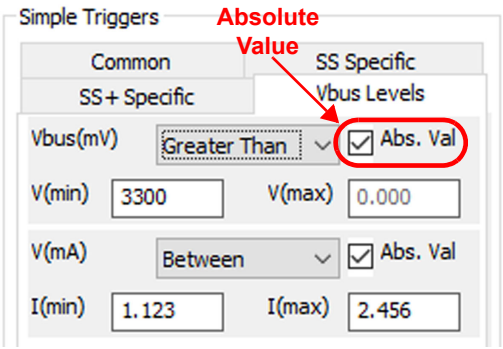


Figure 5.12: USB3.2: Simple Triggers

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

5.4.8.2 Other Simple Triggers

- **CRC Error Triggers:** For Downstream and Upstream triggers, use **CRC32, CRC16, CRC5LCW,** and/or **CRC5LC**.
- **Framing Error Triggers:** For Downstream and Upstream triggers, use **SLC, SDP, SHP, END, SS + DPHP.**
- **Low Power States:** For Downstream and Upstream triggers, use **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 Power Delivery

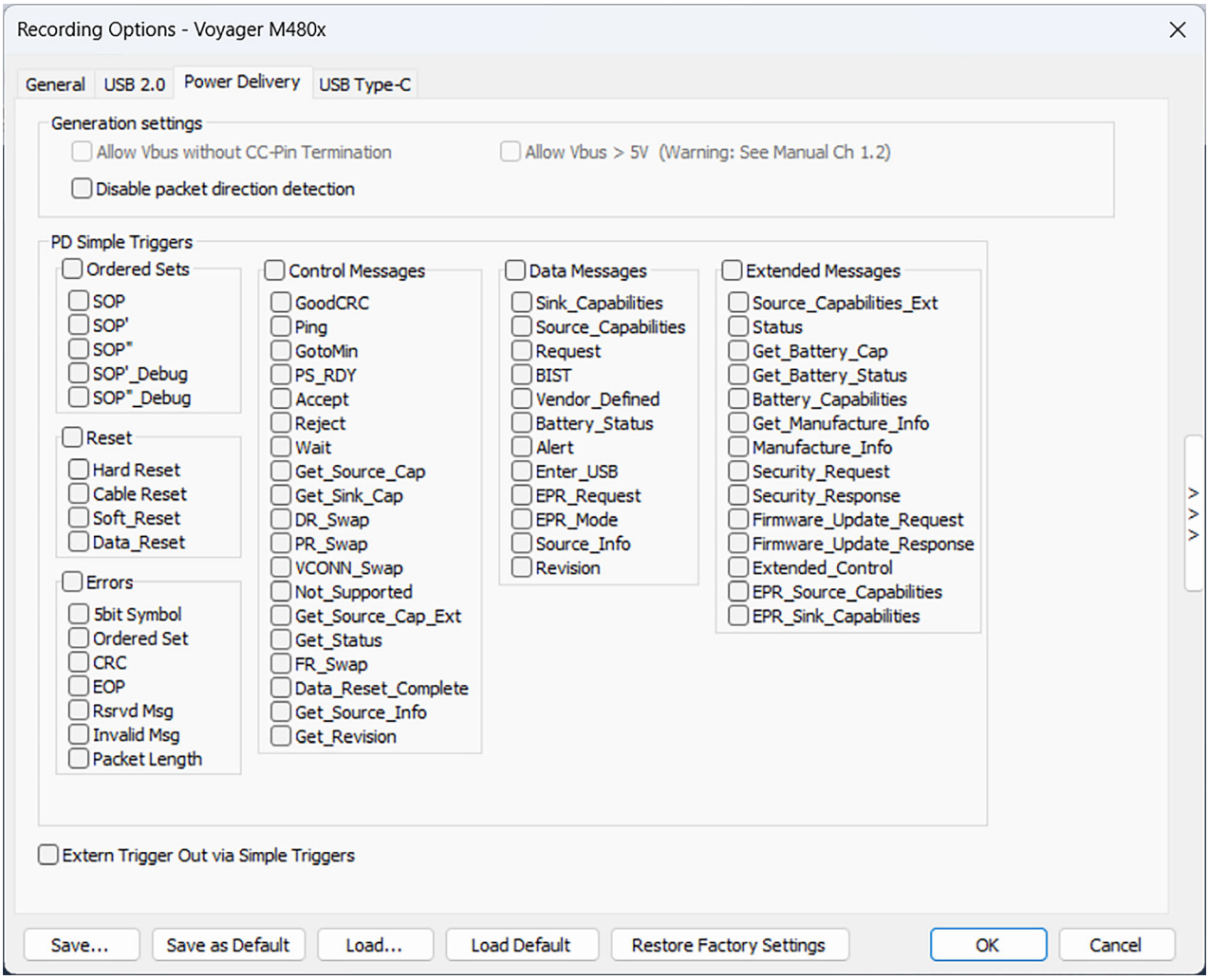


Figure 5.13: Power Delivery Recording Options

The Power Delivery options are the same for Analyzer Mode and Exerciser Mode.

NOTE: Selecting **Extern Trigger Out via Simple Triggers** causes 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/ M310e 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\LeCroy\USB Protocol Suite\Documents.

WARNING:	**Allow V_{BUS} 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 V_{BUS}.

WARNING:	**Allow V_{BUS} > 5V:** This checkbox allows you to generate voltages on V_{BUS} as high as 20 Volts. See 1.7 *Voyager M310C Analyzer*. 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.

5.6 USB Type-C

The Voyager M480x, M4x, M310C, M310P, M310e, and the Mercury T2C and T2P share a set of Channel Configuration (CC) Simple Triggers in USB Type-C Mode.

5.6.1 CC State Detection

When enabled, the Analyzer captures Configuration Channel (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.

5.6.2 Resistor Detect

Select a Resistor Detect checkbox (Left or Right) to trigger recording.

5.6.3 Connect Status

Select one of the following Connect Status checkboxes to trigger the analyzer:

- Default

- 1.5A
- 3A
- Disconnect

5.6.4 Power Measurement

Select one of the following Power Measurement checkboxes to trigger the analyzer:

- 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

You can also select from the following conditions to trigger the analyzer:

- Disable
- Less Than
- Greater Than
- Between

5.6.5 Analyzer V_{CONN} Behavior

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

- **Disabled:** V_{CONN} is not connected through nor is any voltage applied to either connector.
- **Analyzer Sourced—Auto:** If valid CC termination is recognized on both connectors and an eMarked cable is connected on the Sink side, the analyzer will source V_{CONN} to that cable.
- **Analyzer Sourced—Manual (Left Connector):** If valid CC termination is recognized on both connectors and an eMarked cable is connected on the Left side, the analyzer will source V_{CONN} to that cable.
- **Analyzer Sourced—Manual (Right Connector):** If valid CC termination is recognized on both connectors and an eMarked cable is connected on the Right side, the analyzer will source V_{CONN} to that cable.

- **Connected Through**: Connects the V_{CONN} signal directly between the two connectors.

5.7 USB 2.0 Rec Rules/USB 3.2 Rec Rules (Advanced Mode)

The Recording Rules page is a workspace for creating recording rules, which determine how the analyzer records traces. Recording rules are combinations of events and actions. Note that Recording Rules for USB 3.2 currently do not support more than two independent states.

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 5.8 *USB4*.

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.

5.7.1 Navigating the Recording Rules Page

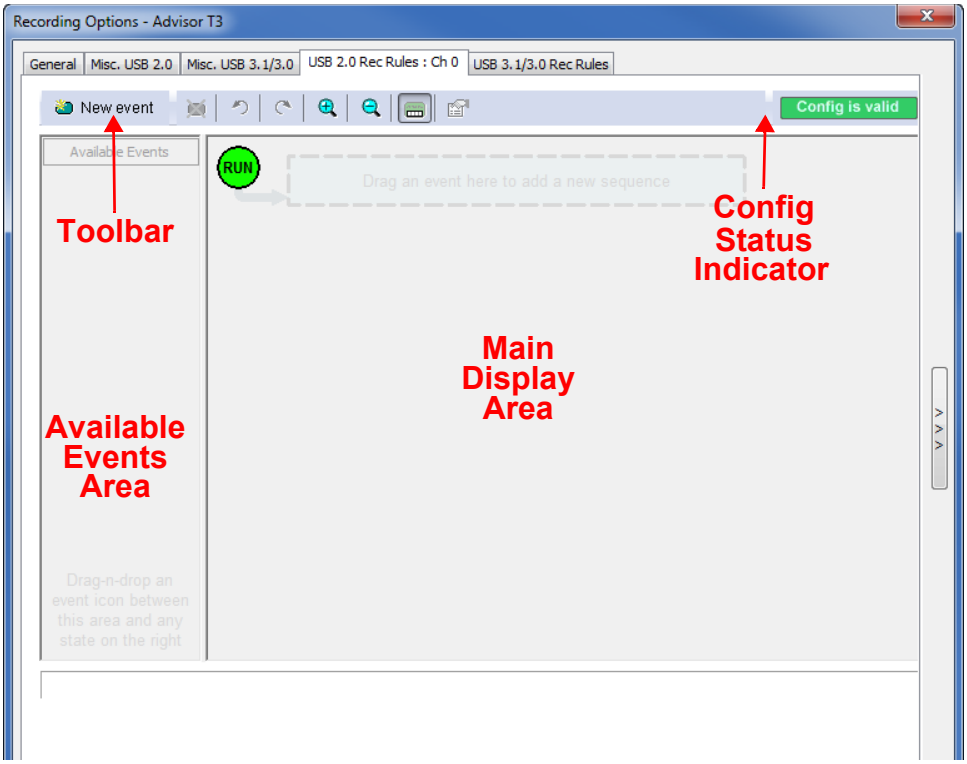


Figure 5.14: Recording Rules USB 2.0 Dialog

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.

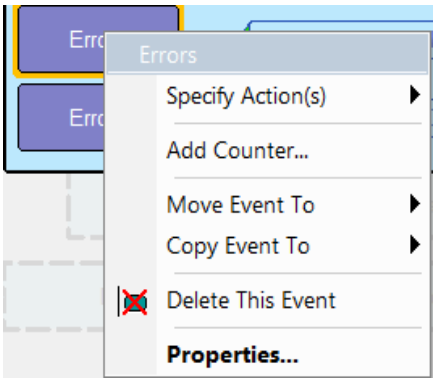


Figure 5.15: Pop-Up Menu Example

- **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.

5.7.2 Recording Rules Toolbar

The Recording Rules toolbar buttons control the rules for your recordings.



Figure 5.16: Recording Rules Toolbar

Button	Function	Button	Function
New event	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.	Config is valid	This appears when the current Recording Rules configuration can be executed by the hard-ware.
	Zoom In. Enlarges the display (see note). There are five zoom levels. The default level is the middle one.	Config is invalid	This appears when the current Recording Rules configuration cannot be executed by the hardware.

NOTE: If you use a mouse with a wheel, you can zoom by holding down the CTRL key and rolling the mouse wheel.

5.7.3 Creating Event Buttons

To create a rule, first create one or more 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 5.17).

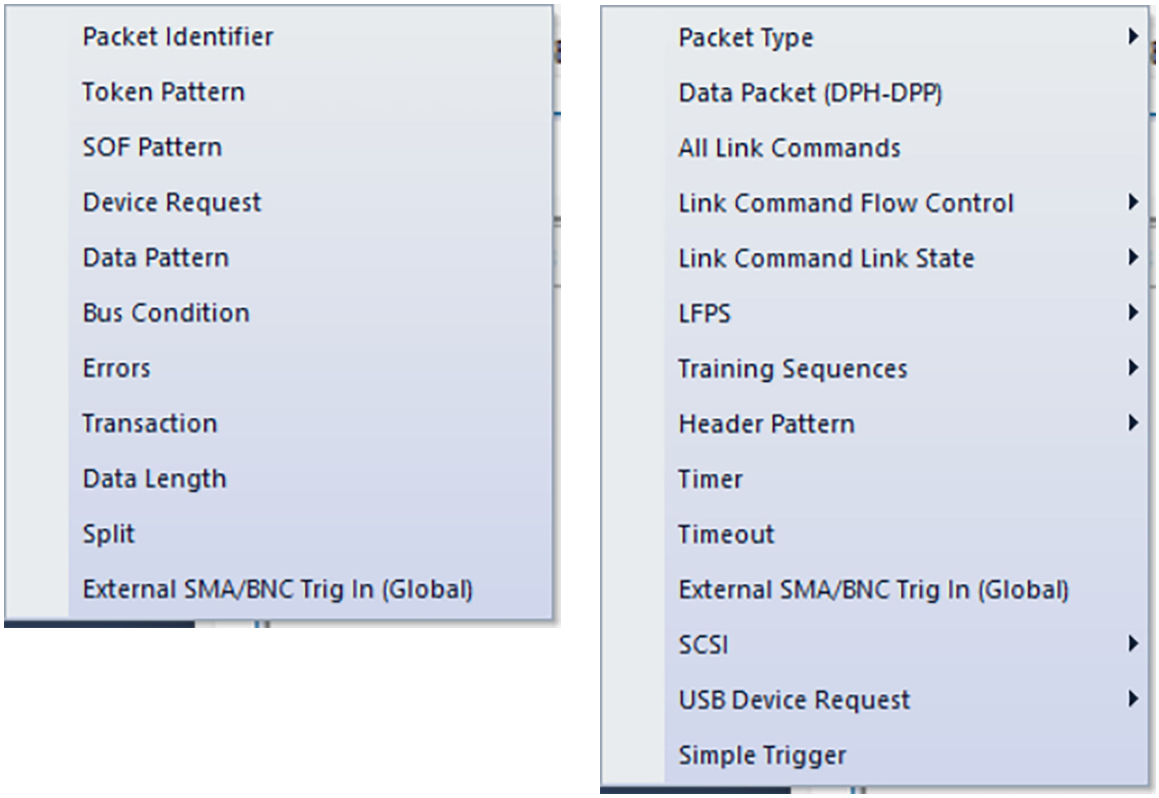


Figure 5.17: New Event Pop-up Menus for USB 2.0 (left) and 3.2 (right)

2. Select an event, such as Errors. The event appears as a button in the Available Events area (Figure 5.18).



Figure 5.18: Available Events Area

5.7.4 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 5.19.)

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.

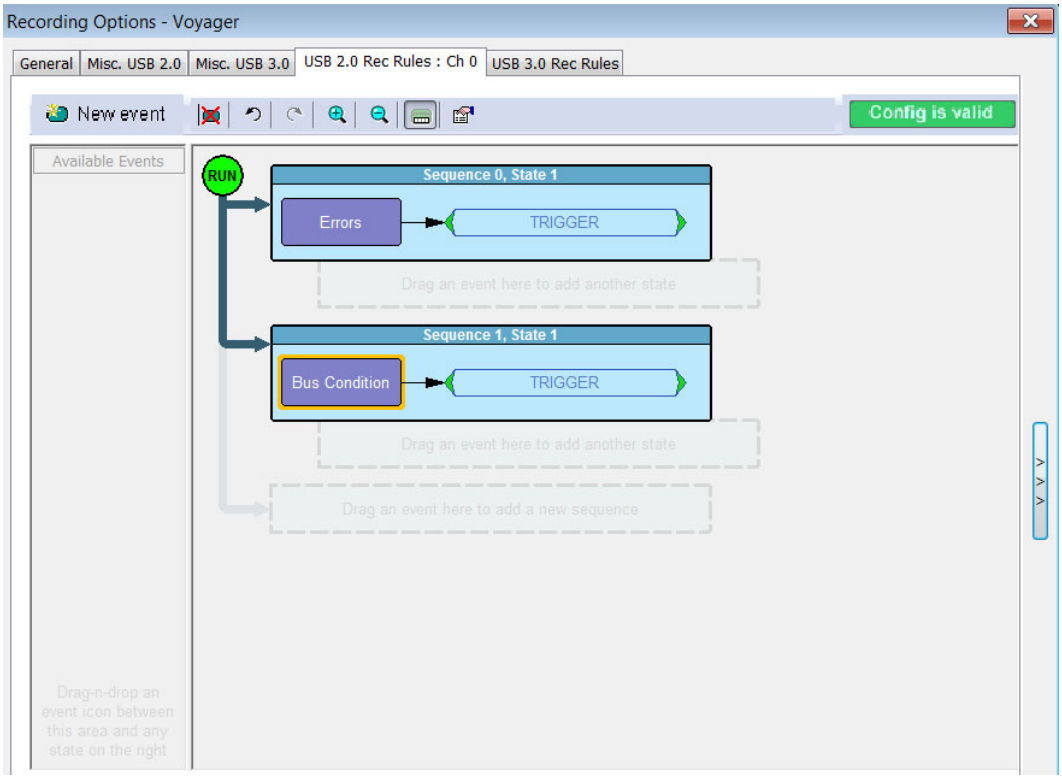


Figure 5.19: Sequence and State Cells

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:

1. Click and grab the Event button in the Available Events area.
2. Drag the button to the cell. When the button is in the cell, a dashed highlighted outline appears around the cell. Drop the button in the cell.

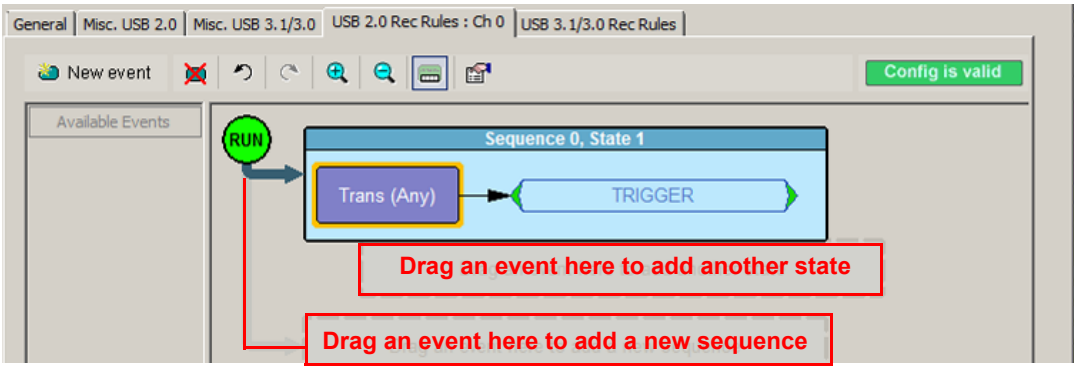


Figure 5.20: Events Button in Cell

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 5.21.

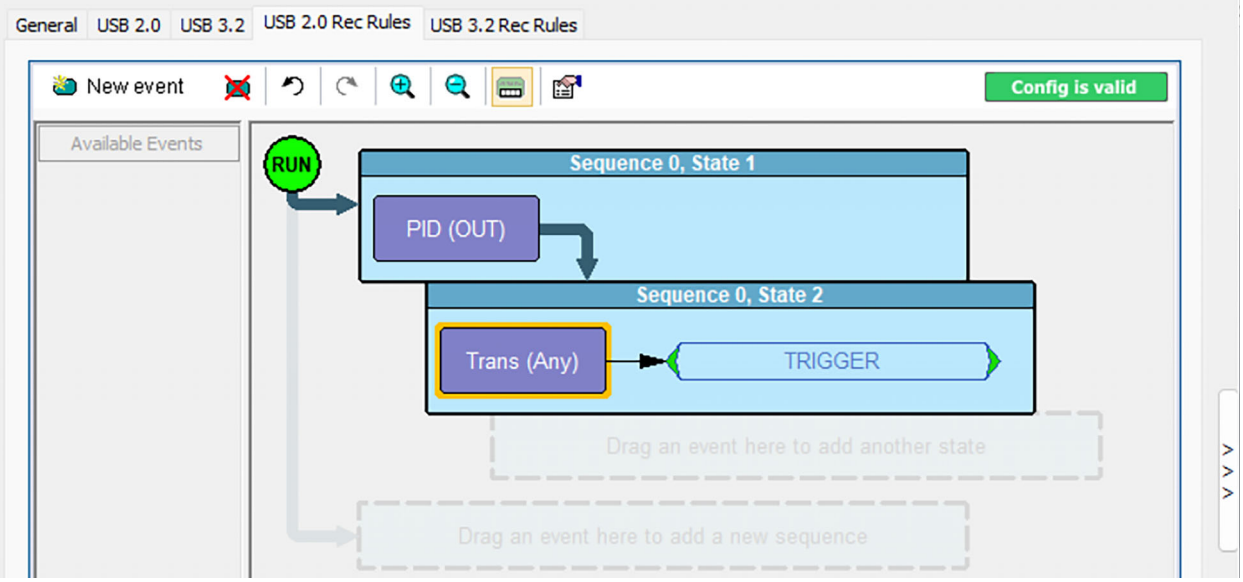


Figure 5.21: Recording Options: Adding a New State to Sequence 0

The second of the new cells is for creating a separate sequence. See Figure 5.22.

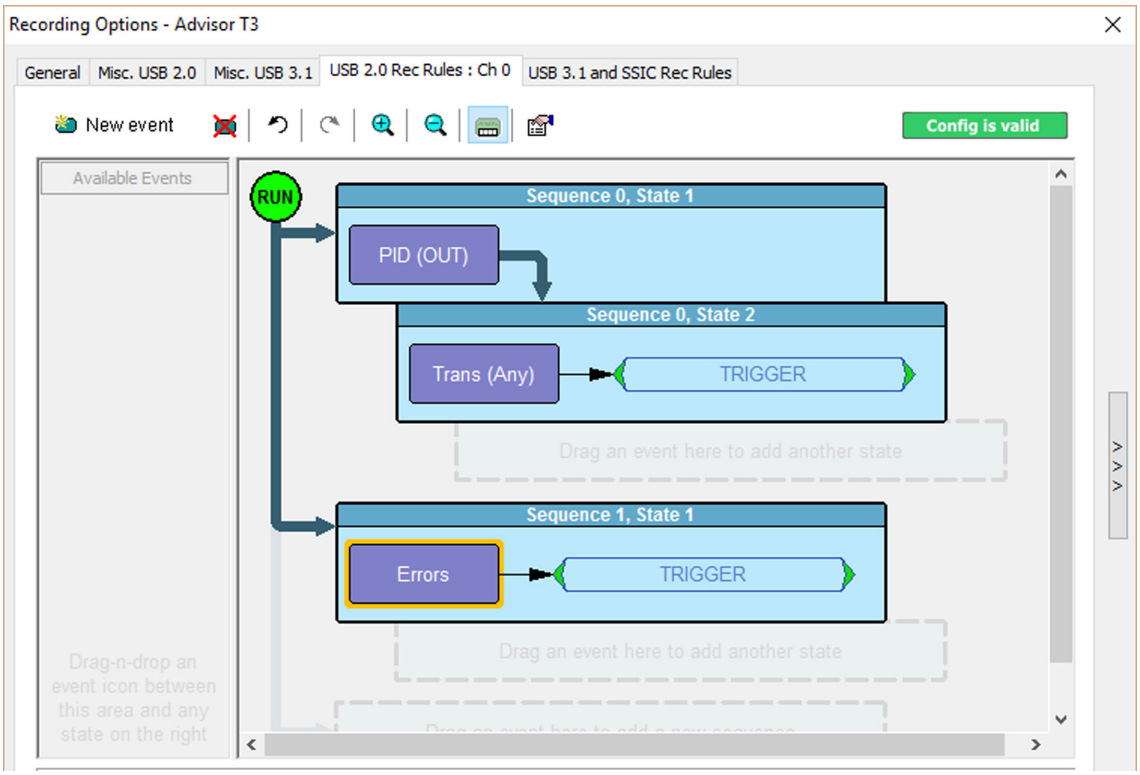


Figure 5.22: Recording Options: Adding a New Sequence

You can define up to 8 sequences.

5.7.5 Assigning an Action

After you have dropped the Event button in a cell in the Main Display area, you can assign an action to the event.

NOTE: If you do not assign an action to an Event button, the analyzer ignores the event.

To assign an action to an Event button:

1. Right-click the **Event** button to display a pop-up menu (see Figure 5.23.)

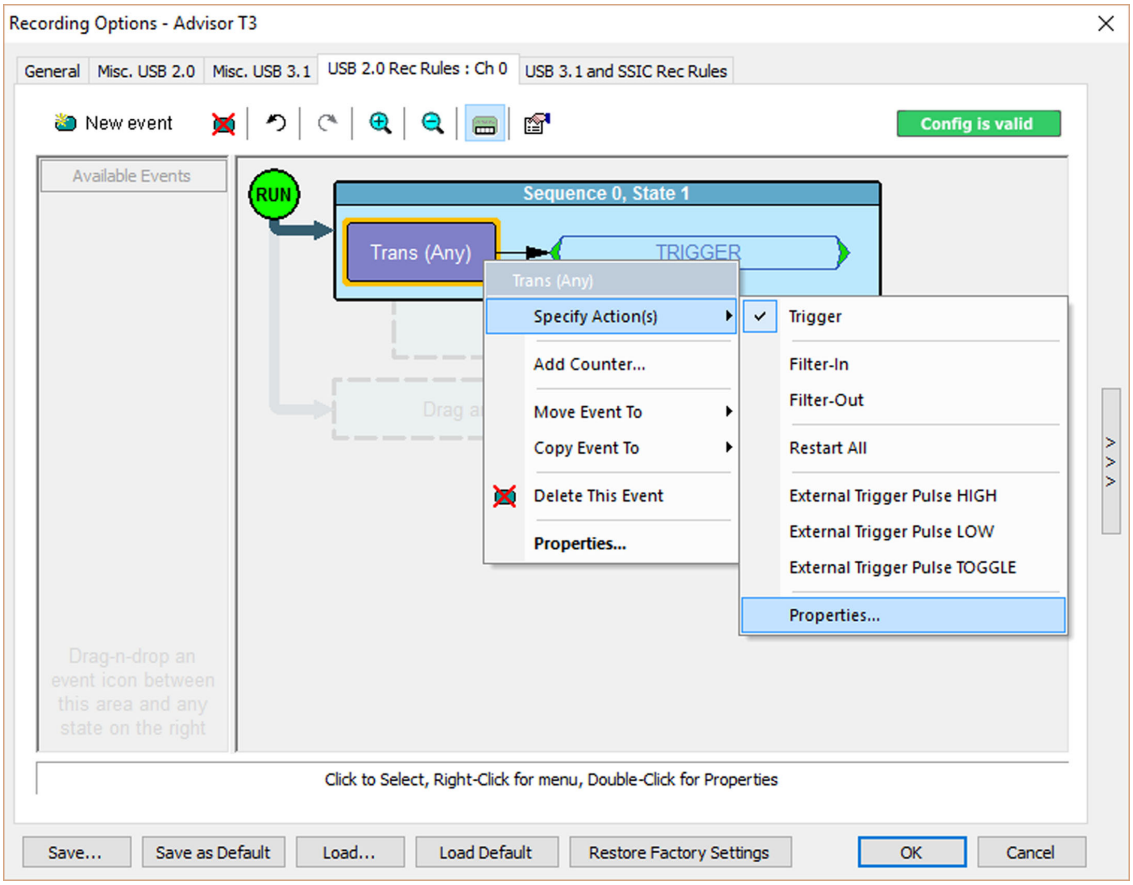


Figure 5.23: Assigning an Action to an Event Button

2. Select **Specify Action**, and then choose an action from the sub-menu.

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. See Figure 5.24.

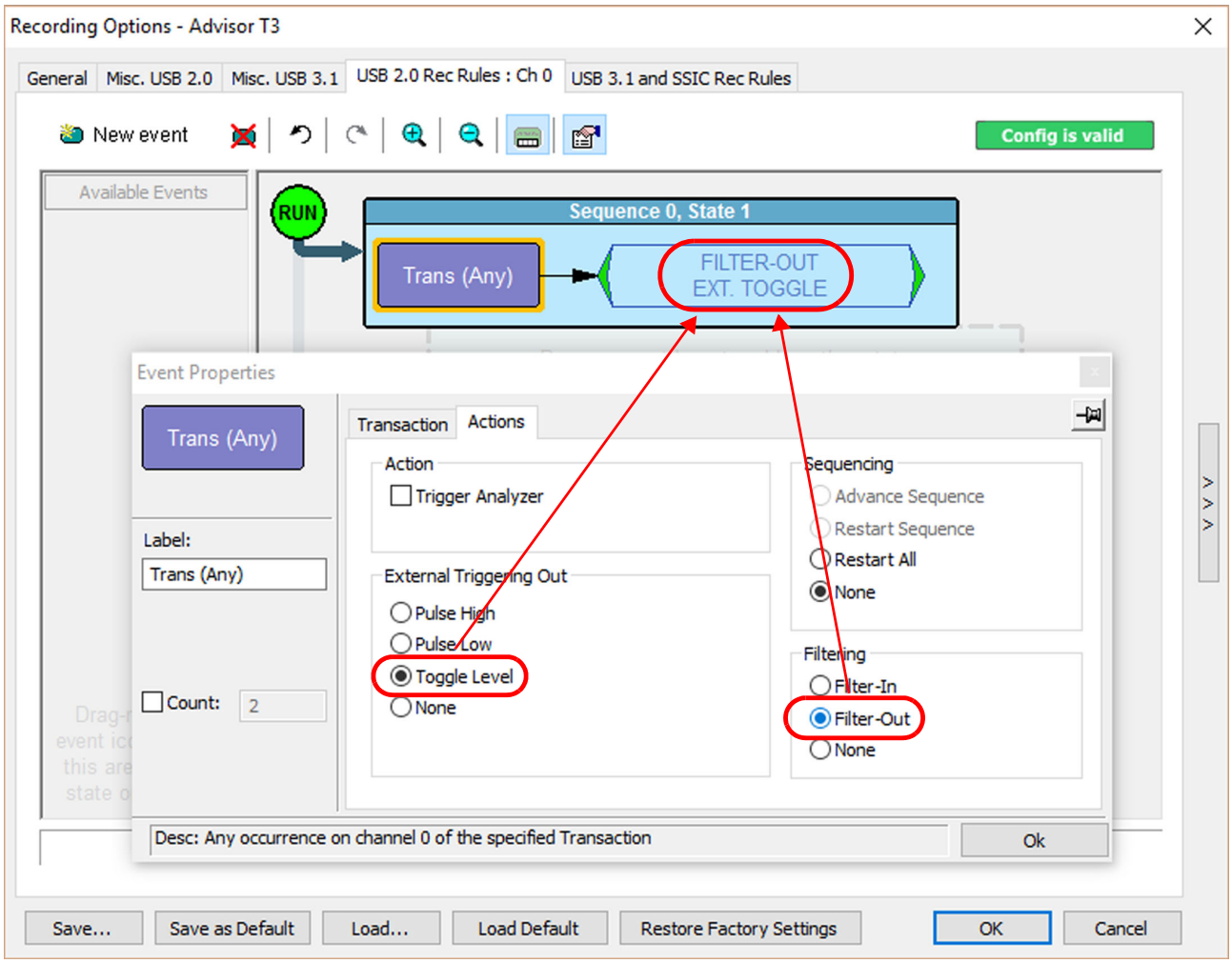


Figure 5.24: Action Assigned

5.7.6 Actions and Action Properties

Actions are context-sensitive (they depend on the type of Event selected). 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. Advance Sequence is not currently available for USB 3.2 recording rules.

NOTE:	These apply to both USB 2.0 and USB 3.2, except as noted.

Table 5.2: Recording Rules Actions & Action Properties

Action	Description
Trigger	Indicates Trigger event in the captured trace file.
Stop Recording	Stops 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	Includes, 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	Excludes, 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)
External Triggering Out:	See 5.2.14 *External Trigger Settings*.
Pulse High	Send HIGH pulse on external trigger output.
Pulse Low	Send LOW pulse on external trigger output.
Pulse Toggle	Send toggling signal (LOW/HIGH/LOW etc.) on external trigger output
None	No external triggering
Properties	Opens the Event Properties dialog box.

5.7.6.1 Filter-In/Filter-Out

Filtering Start-of-Frames (SOFs) 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 SOFs, it is recommended that you repeat the capture with filtering of SOFs 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.

5.7.6.1.1 Filter-In and Filter-Out Example

You can set the Recording Options to Filter-In Any Transactions. See Figure 5.25.

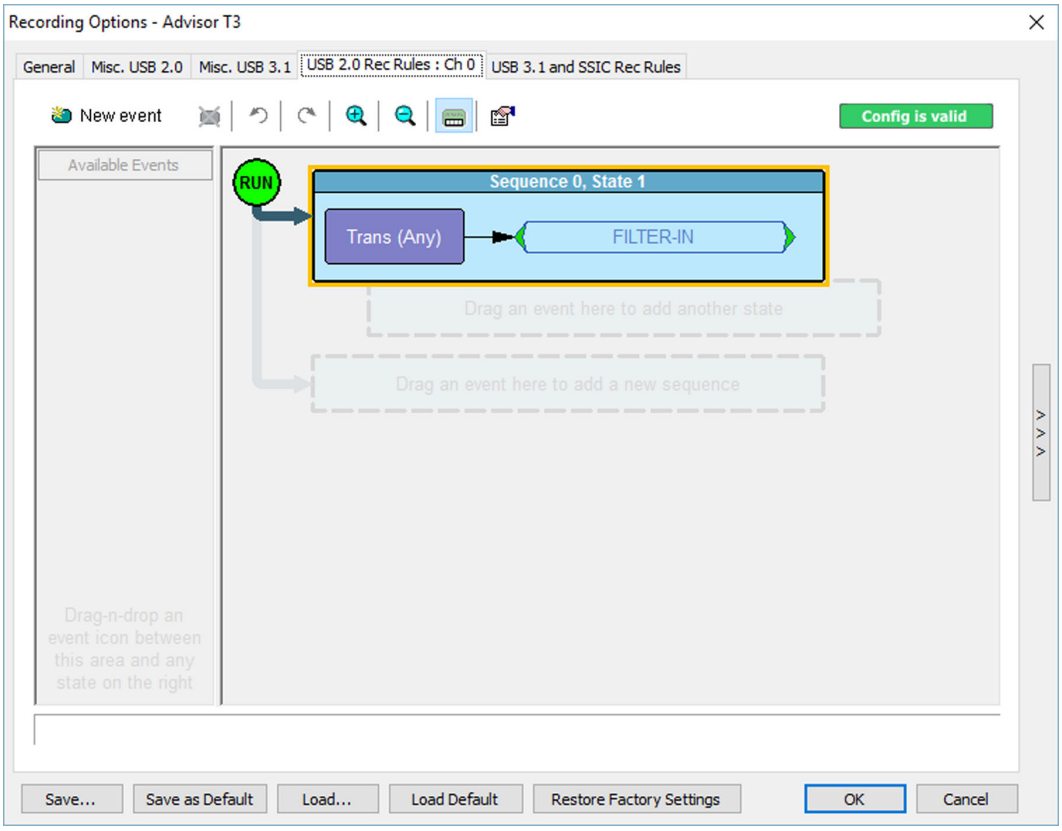


Figure 5.25: Recording Options: Transactions: FILTER-IN

After you make a recording, the traffic shown in the Trace view will look something like Figure 5.26, depending on the type of data traffic occurring on the bus.

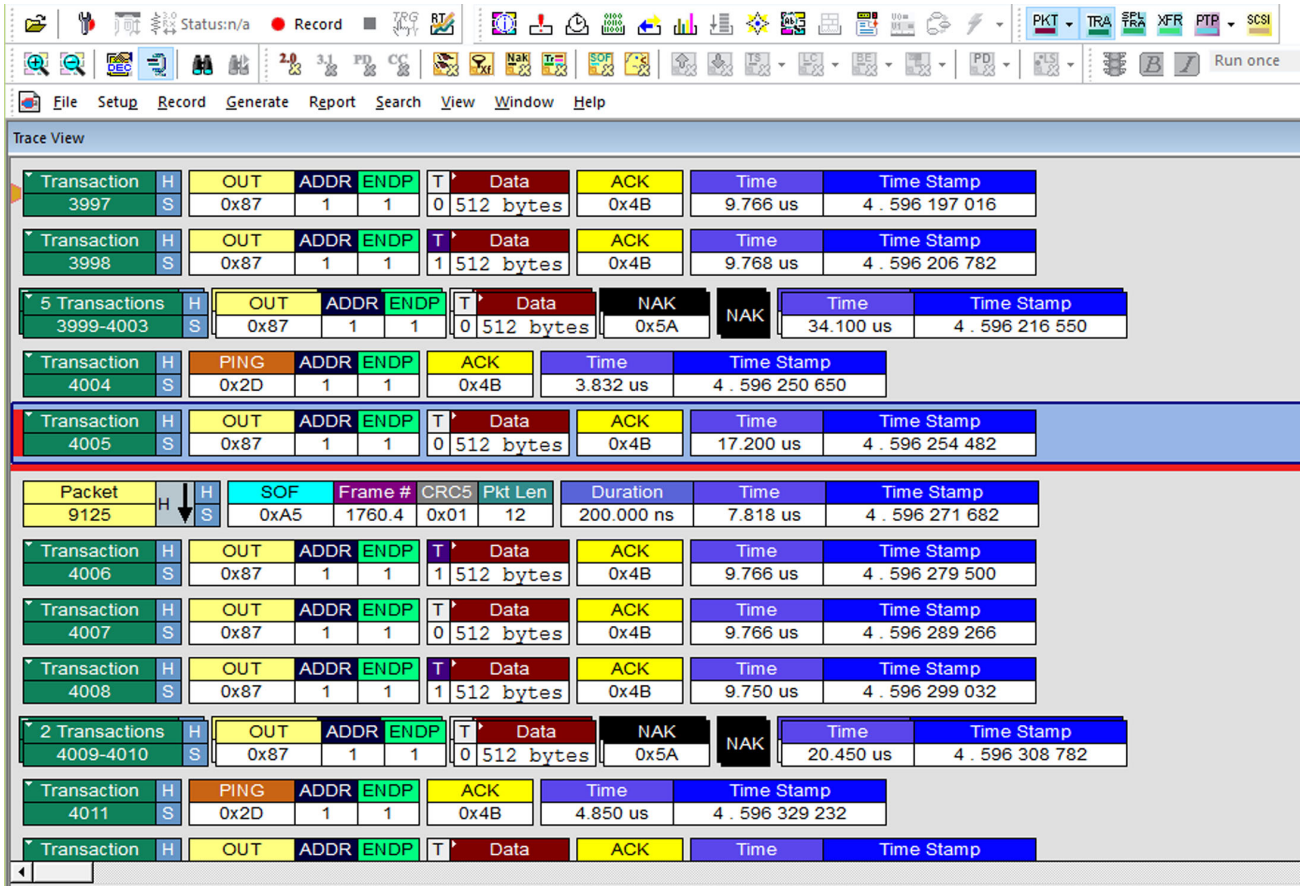


Figure 5.26: Transactions: FILTER-IN: Data Traffic with Transactions

You can set the Recording Options to FILTER-OUT Any Transactions. See Figure 5.27.

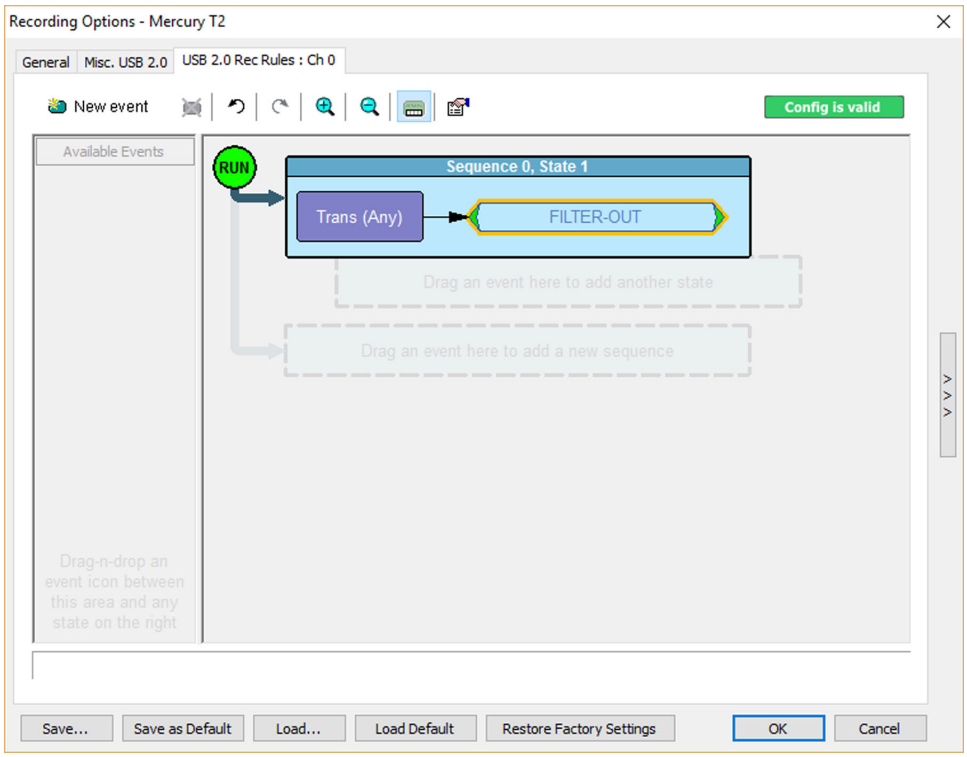


Figure 5.27: Recording Options: Transactions: FILTER-OUT

After you make a recording, the traffic shown in the Trace view will look like Figure 5.28, depending on the type of data traffic. You will see many Start of Frame (SOF) packets but no Transactions because they have been filtered out.

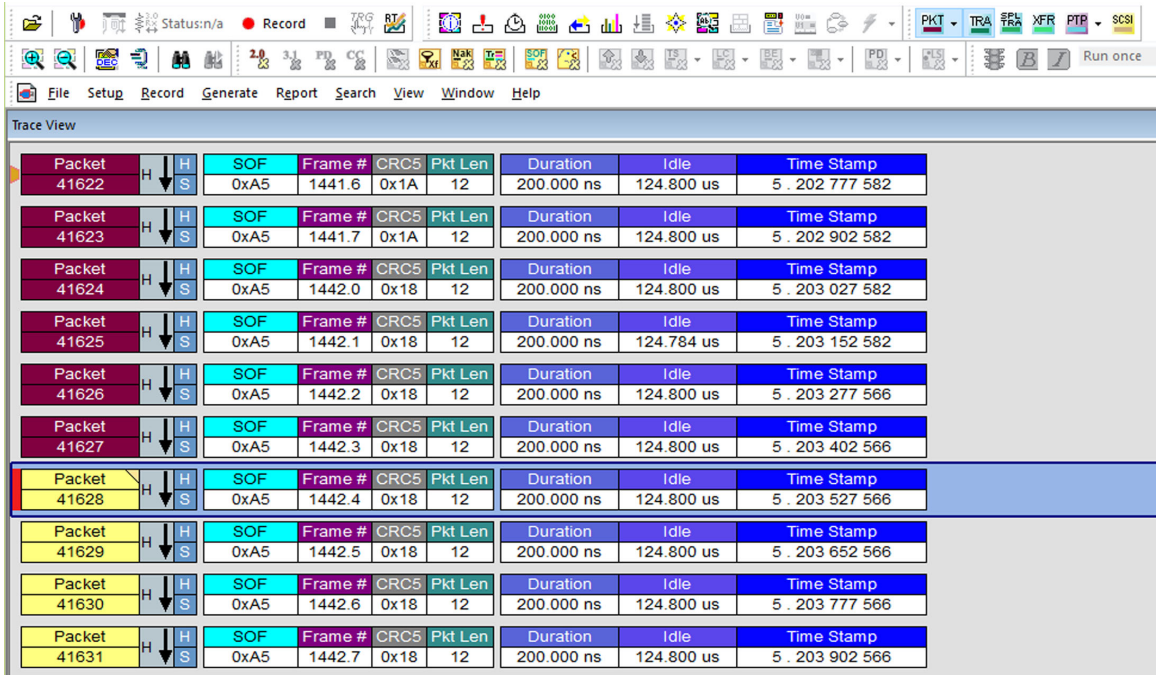


Figure 5.28: Transactions: FILTER-OUT: Data Traffic without Transactions

5.7.6.2 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.

5.7.6.3 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.

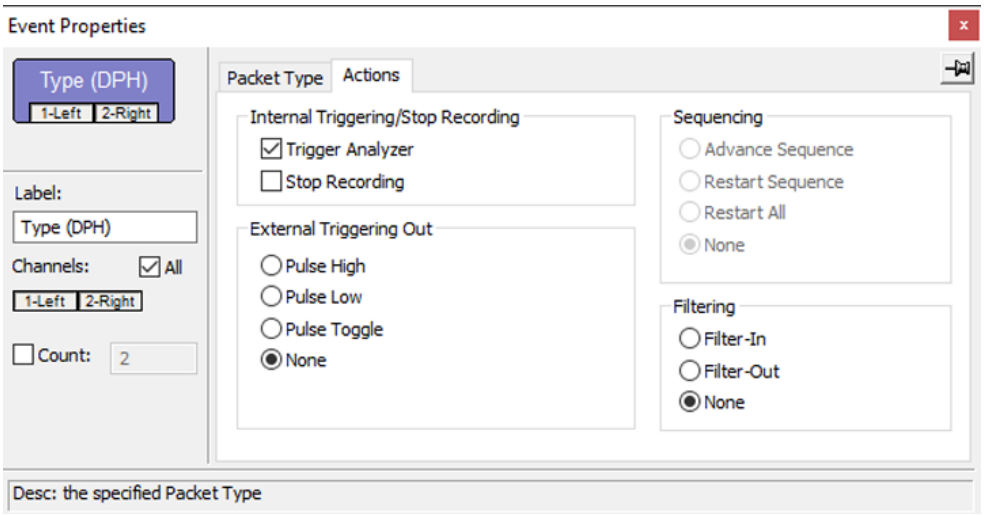


Figure 5.29: Event Properties: Actions Dialog Tab

You can set External Triggering Out based on the setting in **Recording Options > General > External Trigger Settings** (see 5.2.14 *External Trigger Settings*), 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.

5.7.7 Events and Event Properties

5.7.7.1 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 (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_15 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
  - All
- Training Sequences
  - TS1
  - TS1A

        - TS1B
        - All TS1s
        - TS2
        - TSEQ
- Header Pattern
    - Link Management Packet
        - Set Link Function
        - U2 Inact Tmt
        - Vndr Dev Test
        - Port Capability
        - Port Config
        - Port Cfg Rsp
        - Delay Measure
    - Transaction Packet
        - ACK
        - NRDY
        - ERDY
        - STATUS
        - STALL
        - DEV_NOTIFICATION
        - PING
        - PING_RESPONSE
    - Data Packet Header
    - Isoch Timestamp Packet
    - Deferred Header Packet
    - Delayed Header Packet
    - Custom Header Packet
- Timer
- Timeout
- 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
        - SCSI/ATA Transaction Command Set
    - USB Device Request
        - 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
        - Vendor/Class Request
    - Simple Trigger

5.7.7.2 USB 2.0

For Voyager, Advisor, and Mercury, 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 SMA/BNC Trig In (Global) (see **Notes on External Trigger In** below)

5.7.7.2.1 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.

5.7.7.3 Error Event Properties

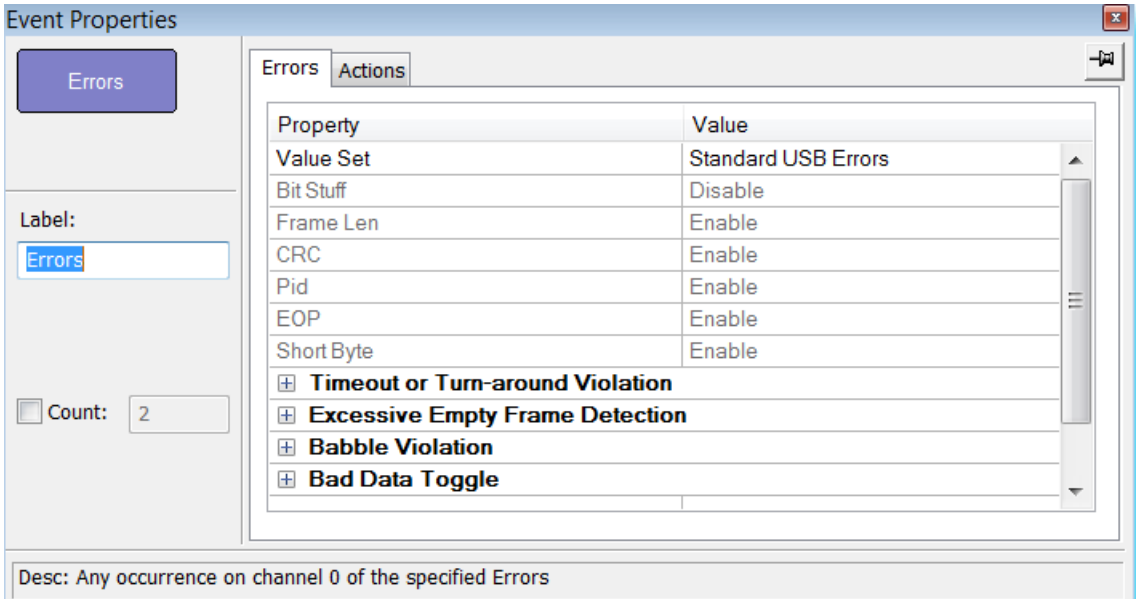


Figure 5.30: Event Properties Dialog

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.

5.7.8 Using Sequences

5.7.8.1 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).

5.7.8.2 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.

5.7.8.3 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.

5.8 USB4

The Link Settings, Spread Spectrum Clock, and Polarity Inversion recording options for the M480x and M4x in Analyzer Mode USB4 appear in the **USB4 > General** pane (Figure 5.31). From the USB4 tab, you can also access various Triggers and Filters.

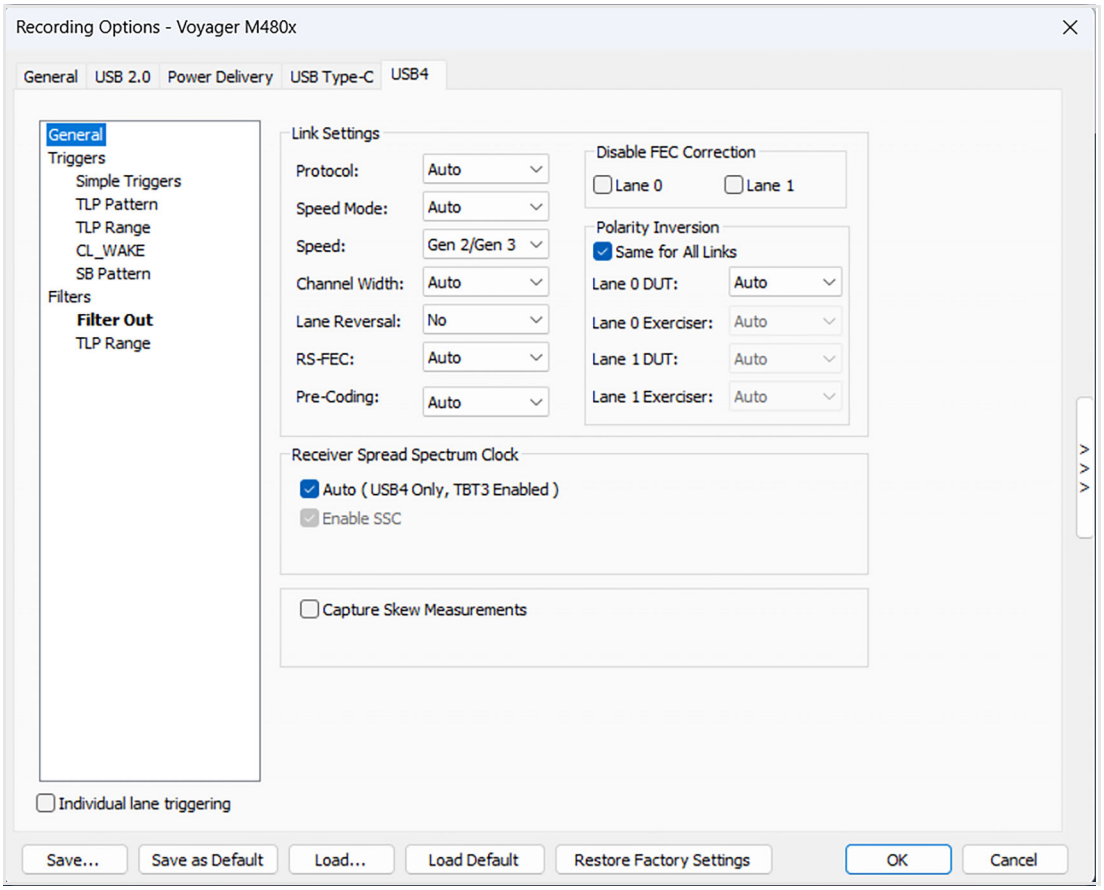


Figure 5.31: Voyager M480x: General Recording Options: USB4

5.8.1 General Pane

5.8.1.1 Protocol

- **TBT3:** Causes 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.

5.8.1.2 Speed Mode

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

5.8.1.3 Speed

- Auto
- Gen 2/Gen 3
- Gen 2
- Gen 3
- Gen 4

5.8.1.4 Channel Width

- Auto
- x1
- x2

5.8.1.5 Lane Reversal

- No
- Yes

5.8.1.6 RS-FEC

- Auto
- FEC Encoded
- Non-FEC Mode

5.8.1.7 Pre-Coding

- Auto
- Enabled
- Disabled

5.8.1.8 Disable FEC Correction

Controls whether the Analyzer tries to apply FEC correction to its capture data, or ignores it. Default is to apply the corrections (checkboxes cleared)

- Lane 0
- Lane 1

5.8.1.9 Polarity Inversion

5.8.1.9.1 Same for All Links:

Used to force a polarity regardless of that indicated in the training.

> **NOTE:** This is 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

5.8.1.10 Receiver Spread Spectrum Clock

This recording option automatically adjusts the "Receiver" logic on the analyzer ports to improve lock performance. Clear the checkboxes to disable.

5.8.1.11 Capture Skew Measurements

Enables capture of lane-to-lane skew measurements. These measurements are performed periodically on TSNOS packets, which must be present in the trace to obtain readings.

The accuracy is approximately +/- 5 ns.

5.8.1.12 Reset Link when Recording Options are applied

The analyzer cannot recover USB4 traffic if capture settings change while a link is active. When this option is enabled, the analyzer will momentarily break the link between analyzer ports whenever Recording Options are applied. This ensures the Host and Device establish a new link that can be captured.

5.8.2 Triggers Pane

5.8.2.1 Simple Triggers Pane

Select **Simple Triggers** to open this pane. There are trigger options for Gen2/3 and Gen4, and Left or Right ports. Select any number of the items listed to cause a trigger to occur when the event is seen by the analyzer.

> **NOTE:** **Min Hdr Gap Err** provides a trigger option that checks the traffic based on the USB4 transport layer Minimum Header Gap constraints and triggers in case of any violation.

5.8.2.2 TLP Pattern Trigger

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.

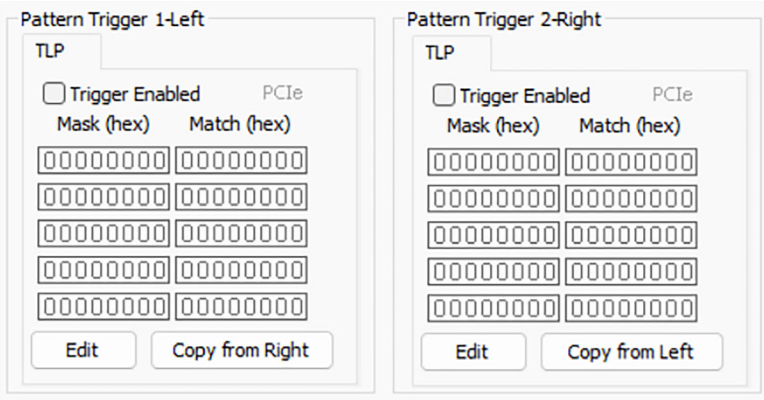


Figure 5.32: TLP Pattern Trigger

5.8.2.2.1 Edit TLP Mask Match Pattern Options

When you select the **Edit** button in the **Pattern Trigger** (Figure 5.32), it launches a dialog box for editing the TLP. See Figure 5.33.

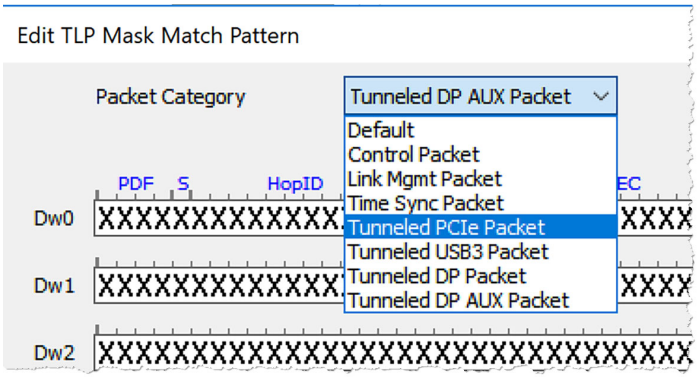


Figure 5.33: Edit TLP Mask Match Pattern Dialog Box

You can select the Packet Category you want to trigger from the drop-down list. Categories include:

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

If you chose Tunneled PCIe Packet, the following options are available in DW0 (Figure 5.34):

- PDF
- Supplemental ID
- HopID
- Length
- HEC

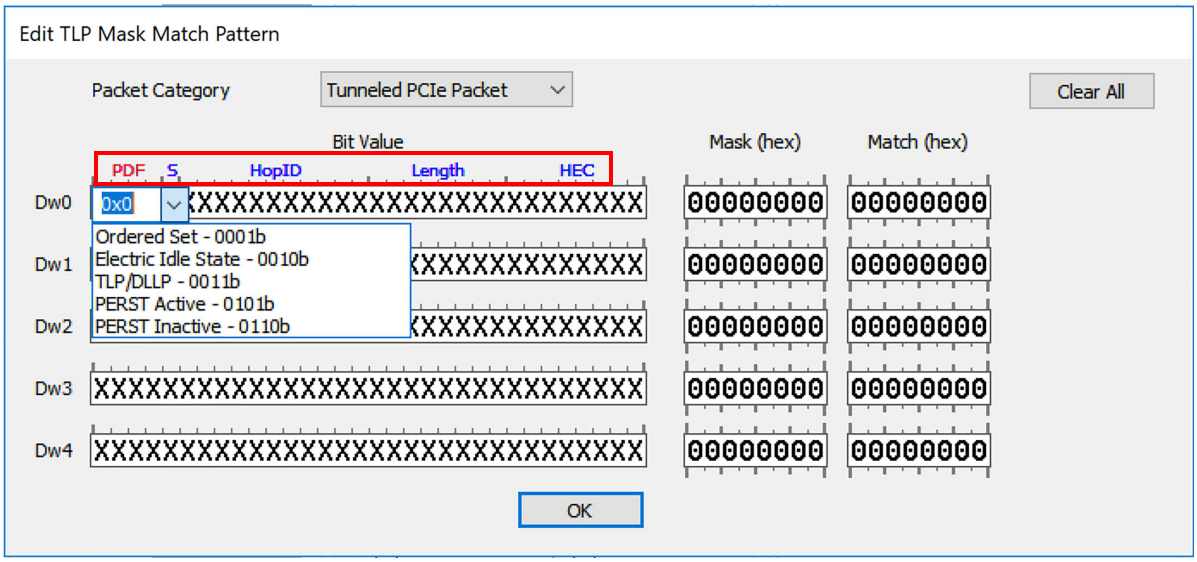


Figure 5.34: Tunneled PCIe Packet Options: PDF

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 5.35.

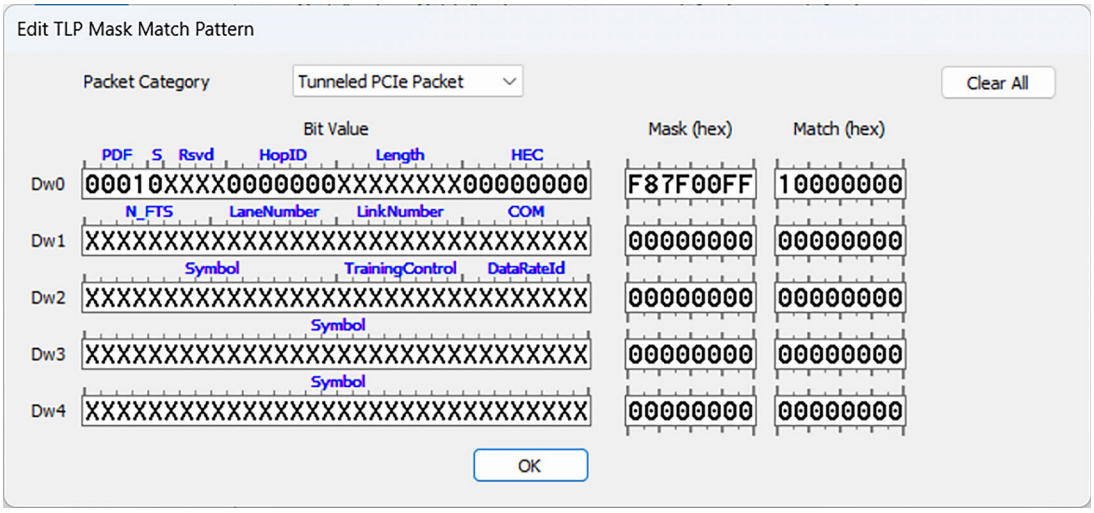


Figure 5.35: Tunneled PCIe Packet Options Selected

Once you click **OK**, the Trigger Pattern you selected is shown in the Recording Options dialog box In Figure 5.36 (below), the PCIe text in the Pattern Trigger pane is displayed.

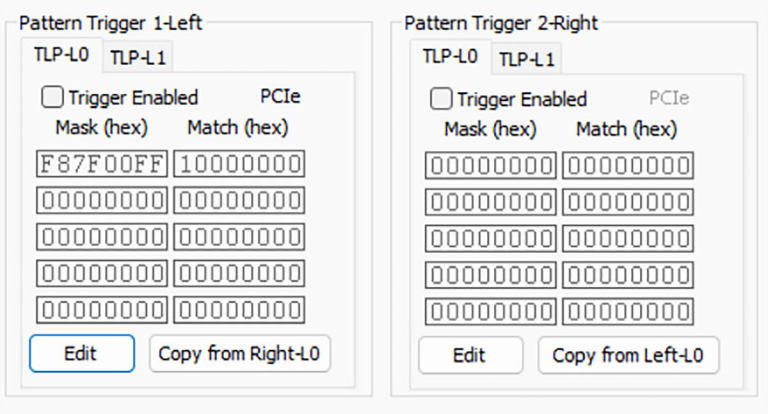


Figure 5.36: Recording Options: Pattern Trigger Set

5.8.2.2.2 Tunneled PCIe Packet

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
- 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.

5.8.2.3 TLP Range Trigger

This allows you to trigger on TLPs that match specific ranges of PDF, Supplemental ID, HopID, and Length. You can choose to trigger if one or all of the defined conditions occurs.

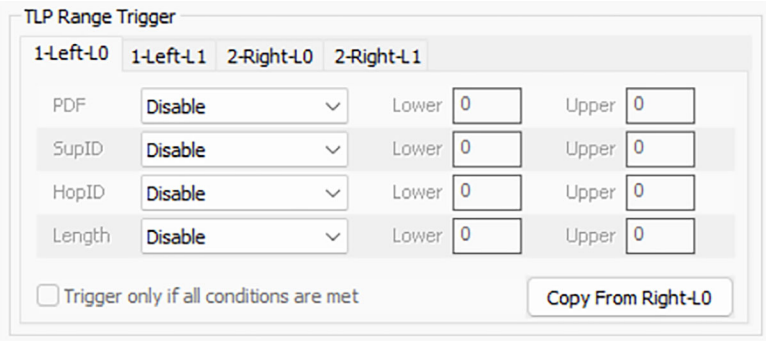


Figure 5.37: TLP Range Trigger

5.8.2.4 CL_WAKE Trigger

Allows triggering on CL_WAKE packets with specific re-timer indexes.

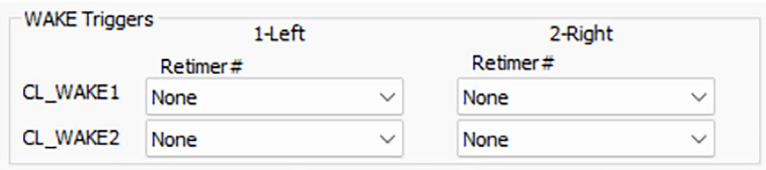


Figure 5.38: CL_WAKE Trigger

5.8.2.5 Sideband Pattern Trigger

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

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

Copy from Right/Copy from Left: To simplify setting patterns you want to match from either transmitter, click on this button to copy the pattern from the OTHER side to the current one.

The SB pattern trigger definition provides both **Quick** and **Detailed** options. In **Quick** mode, the software displays a list of SB packet fields with allowed options for each field based on the latest USB4 specification. Figure 5.39 shows editing SB pattern trigger in **Quick** mode.

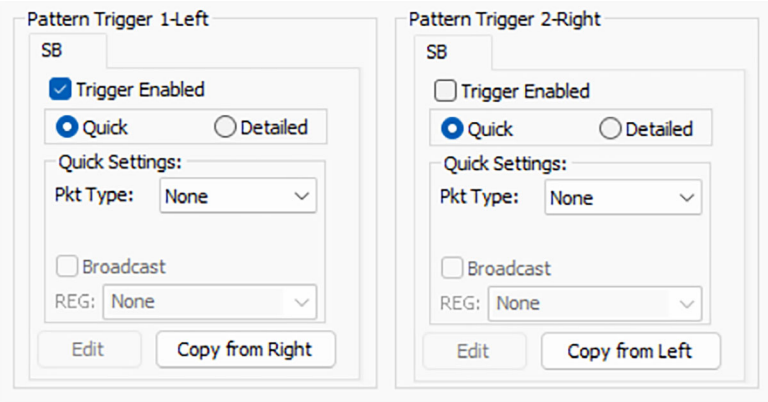


Figure 5.39: Edit SB Packets in Quick Mode

Choose the **Detailed** mode to define the desired pattern based on sequence of DWORD match/mask. This option allows you to define any customized pattern that not possible through standard field definitions. Figure 5.40 shows editing SB patterns in **Detailed** mode.

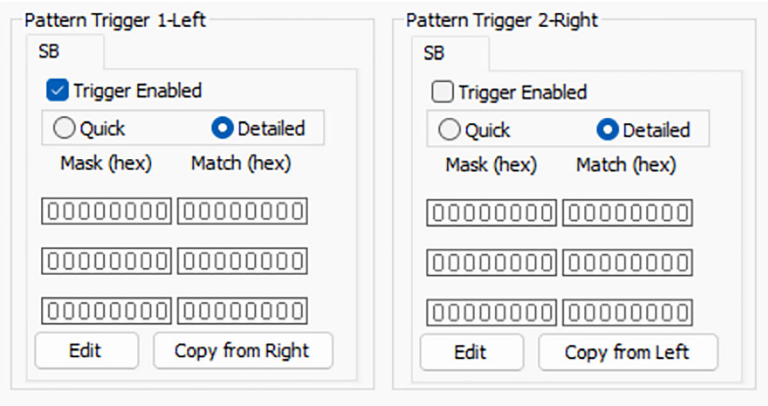


Figure 5.40: Edit Sideband Packets Detailed Mode

Click **Edit** to display a new window so you can edit match/masks to define a desired pattern. Figure 5.41 shows SB patterns.

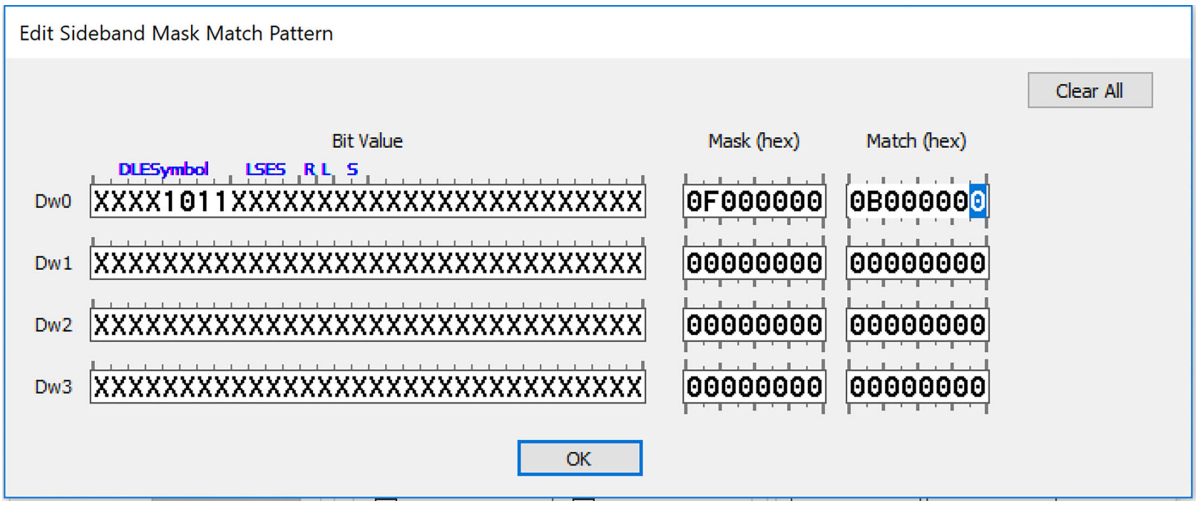


Figure 5.41: Side Band Edited

5.8.3 Filters Pane

5.8.3.1 Filter Out Pane

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

NOTE: **Partial SLOS/WAKE/TS (Rec Buffer Save)** is a useful filtering option for users who need to capture some critical OSs that cause LSSM state change, but do not want to fill up the memory with all OSs. This option keeps a few OSs in trace and filters out the rest of packets. CATC Trace view shows the count of filtered OSs with specific packet types in the trace. Figure 5.42 shows the trace with partial OS filtering enabled.

The default number of ordered sets that are shown before filtering is 100, and this value can be customized via the **Pre-Filter Count** setting.

NOTE: USB3.2 LFPS filter is a partial filtering option that keeps “USB4 LFPSs” in trace and only filters USB3.2 LFPSs that happens before entering USB4 mode.

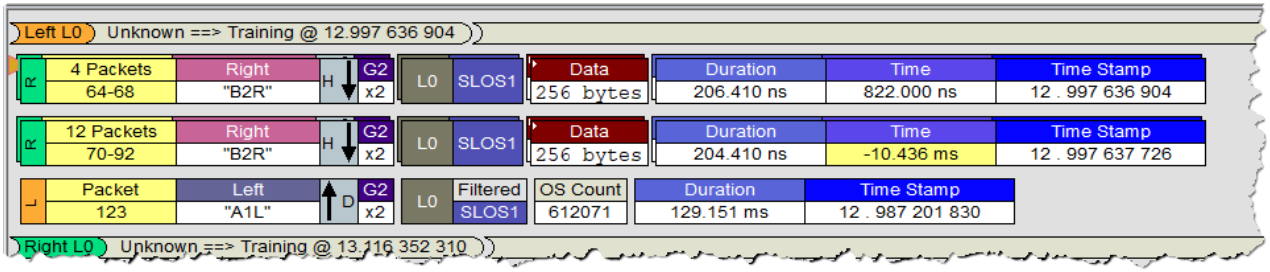


Figure 5.42: CATC Trace View with Partial OS Filtering

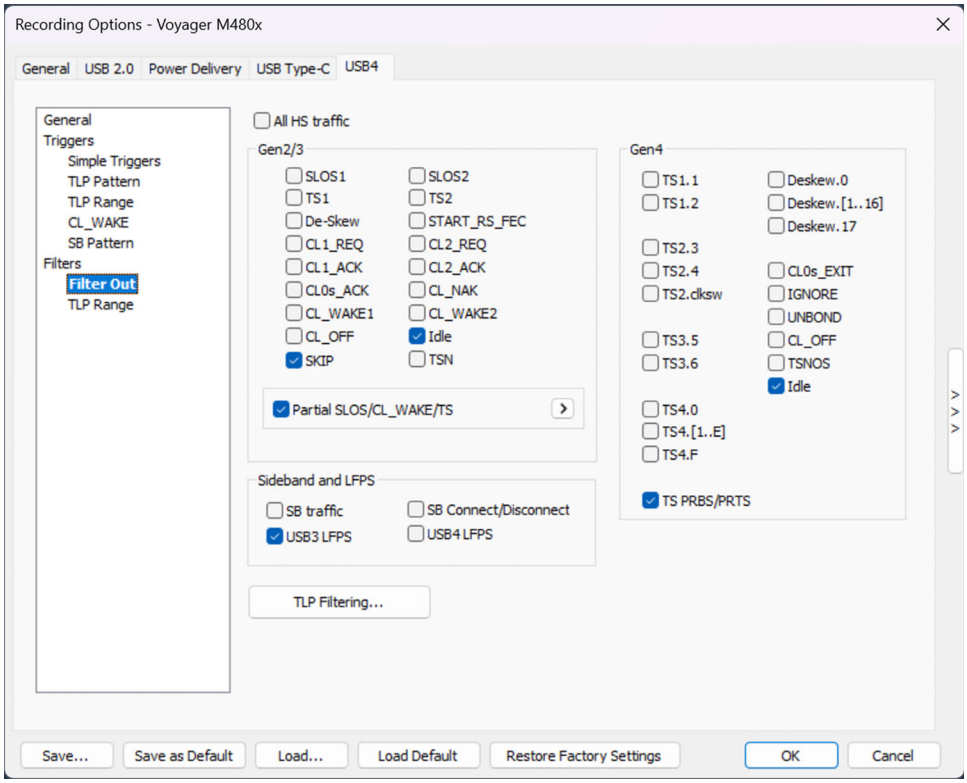


Figure 5.43: Filter Out Pane

TS PRBS/PRTS allows for filtering out the PRBS11 (in case of TS1) or PRTS7 (in case of TS2, TS3, and TS4) portion of Gen 4 Training Sequences. Only the headers are retained in the capture.

When you select **TLP Filtering** from the **Filter Out** tab, these options appear (Figure 5.44).

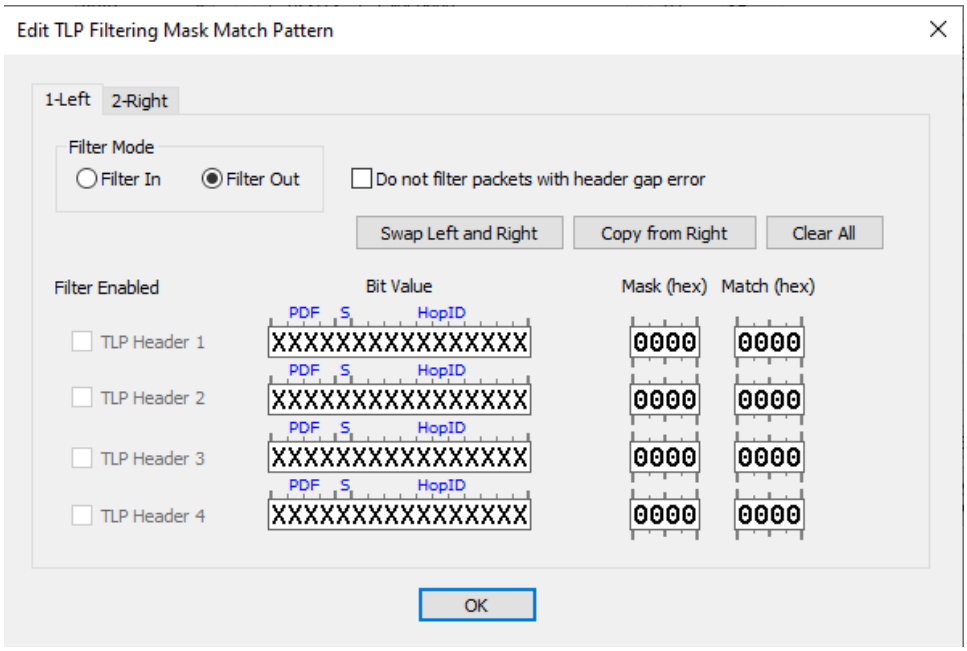


Figure 5.44: TLP filtering Options

Using this window, you can 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.

You can also use the **Copy from Right** and **Copy from Left** buttons to simplify editing the options.

In Filter Out mode, when **Do not filter packets with header gap error** is checked, it keeps TLP packets in trace with a header GAP violation.

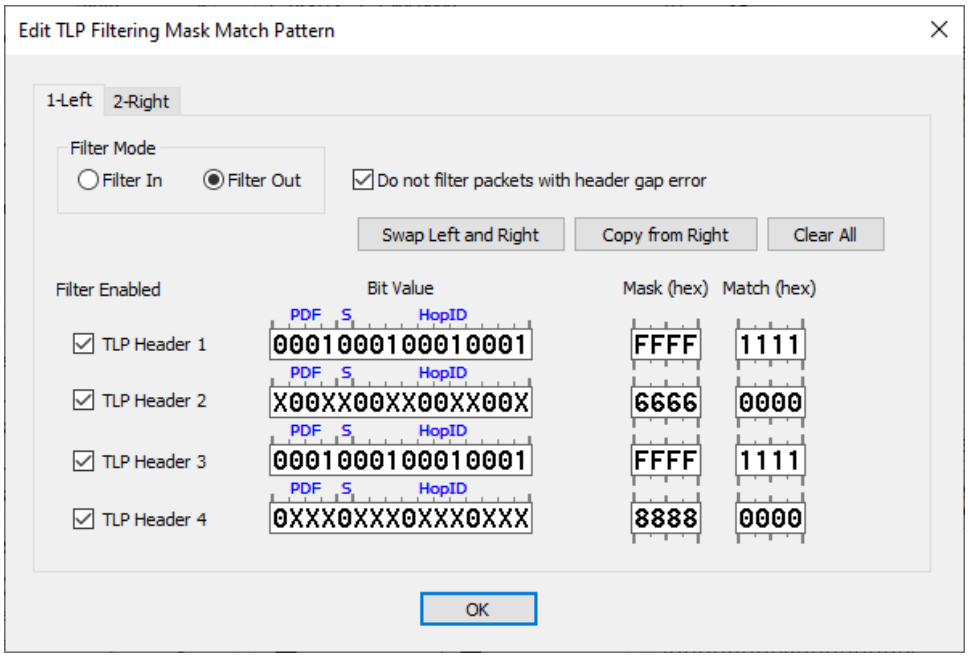


Figure 5.45: Do Not Filter Packets with Header Gap ErroTLP Range Pane

This allows you to filter out TLPs that match specific ranges of PDF, Supplemental ID, and HopID.

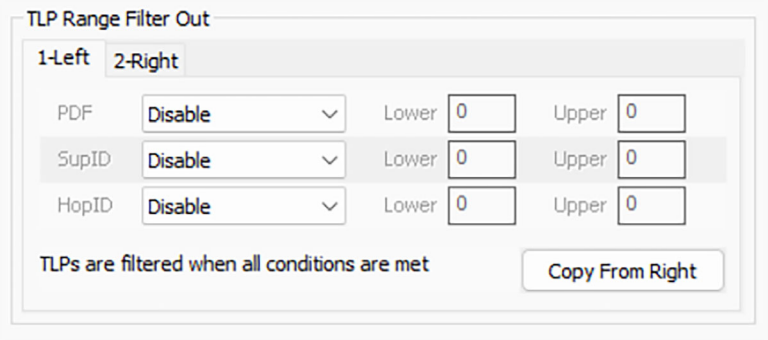


Figure 5.46: TLP Range Filter Out Pane

5.8.3.2 Individual Lane Triggering

Enable this setting to allow triggers to be configured on a per-lane basis.

Chapter 6

Reading Trace

6.1 Trace View Features

The Trace View comprises the following 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 (Figure 6.1). The selected packet is synchronized among 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.

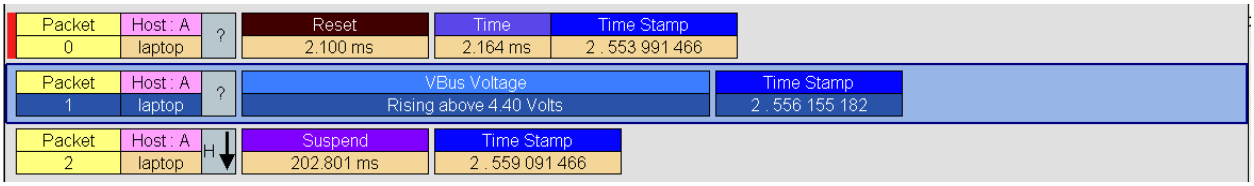


Figure 6.1: Show Contents of Selected Packet

- To move packet selection up or down, click **Shift-Up-Arrow** or **Shift-Down-Arrow**.
- Packets are on separate rows, with individual fields both labeled and color-coded.
- Packets are numbered (sequentially, as recorded), time-stamped (with a resolution of 8 ns), and highlighted to show the transmitted speed (low-speed, full-speed, or high-speed).
- Display formats can be named and saved for later use.
- Pop-up Tool Tips detail the contents of packet fields.
- Data fields can collapse to occupy minimal space in the display, and you can zoom in and out to optimize screen use.
- The display software can operate independently of the hardware and so can function as a stand-alone Trace Viewer that may be freely distributed.
- High Speed SOFs display Microframes (Figure 6.2).

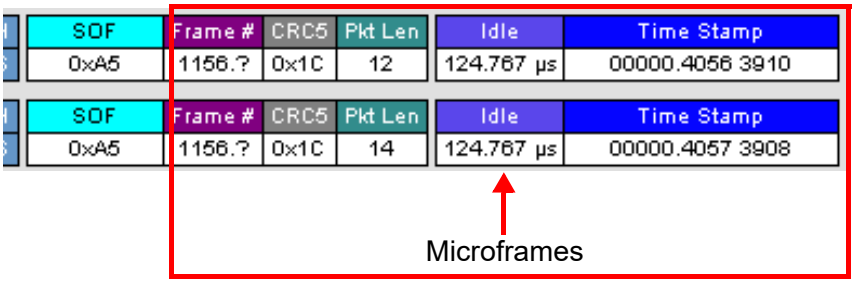


Figure 6.2: High Speed SOFs Display Microframes

6.1.1 Anchor Points—Synchronized Views

Anchors are provided to indicate the synchronization points between views when scrolling.

These are indicated by a gold 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 6.3 through Figure 6.5.

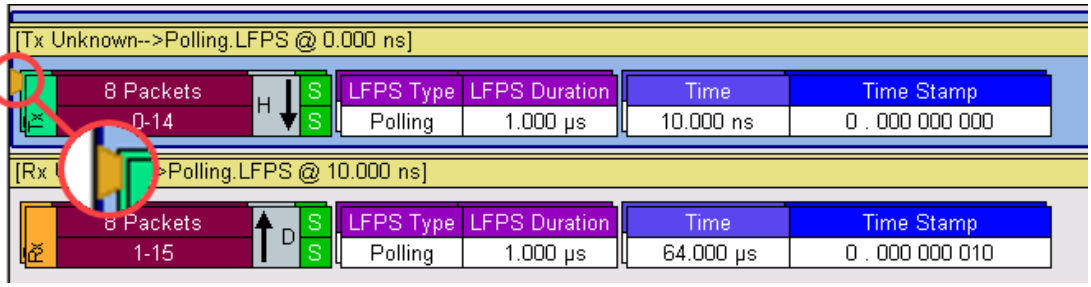


Figure 6.3: Anchor Point in the CATC Trace View

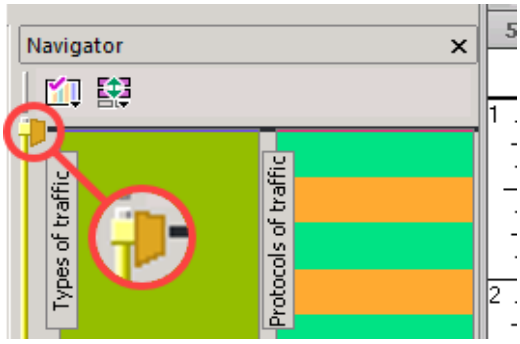


Figure 6.4: Anchor Point in the Navigator Panel

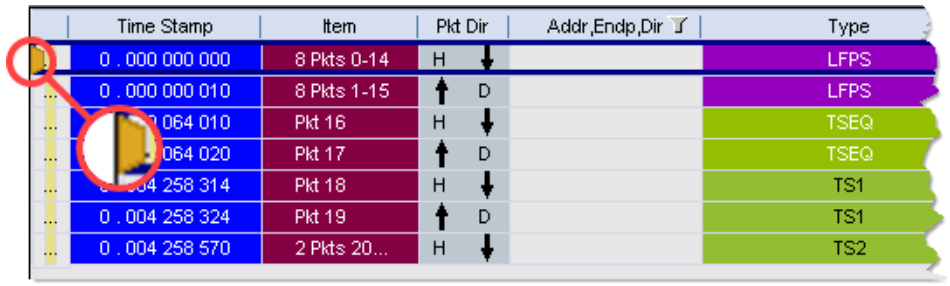


Figure 6.5: Anchor Point in the Spreadsheet View

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

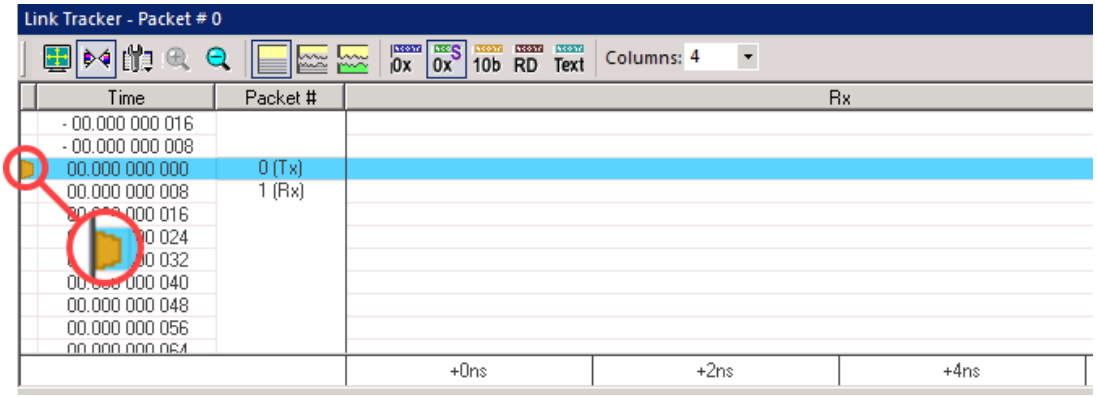


Figure 6.6: Anchor Point in the Link Tracker View

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.

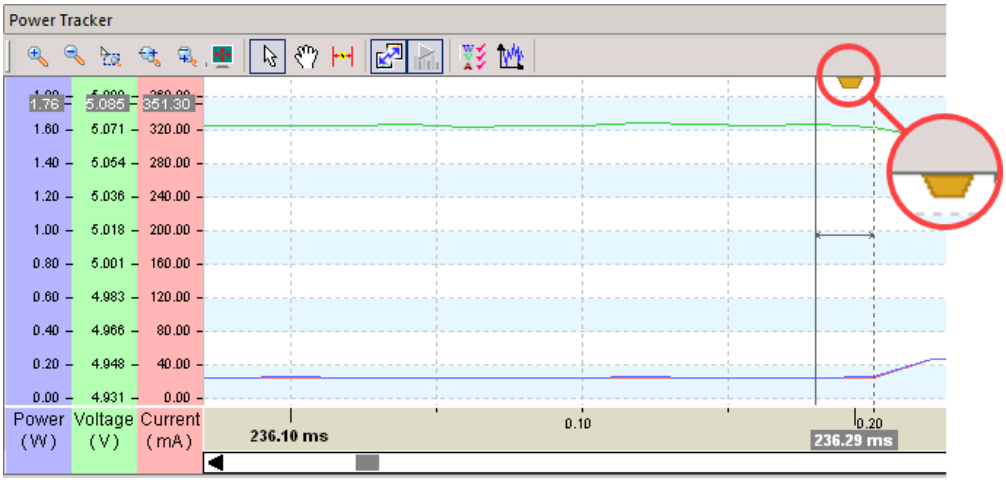


Figure 6.7: Anchor Point in the Power Tracker View

The Anchor point can be independent of the current selected item; however, you can move the selected item to the anchor point by double-clicking on it.

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
- V_{BUS} Change (On/Off)
- SYNC
- SDS

NOTE: Term On and Term Off are not applicable to M310P/M310e 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 6.8).

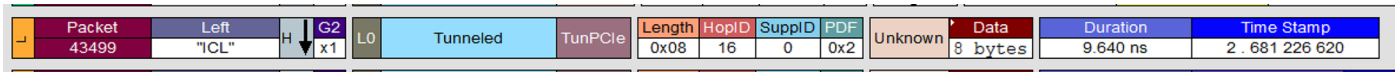


Figure 6.8: Tunneling Packet

2. Right click on the HopID Field of the Tunneled Packet. Choose one of the Protocol types from the drop-down list (Figure 6.9).

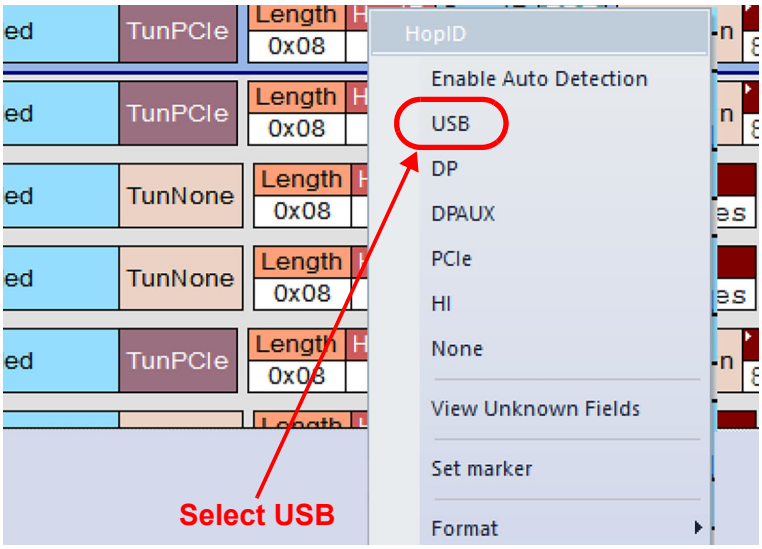


Figure 6.9: Selecting HopID

That HopID will now use the decoder type selected wherever that Hop ID occurs in the same direction (Figure 6.10).

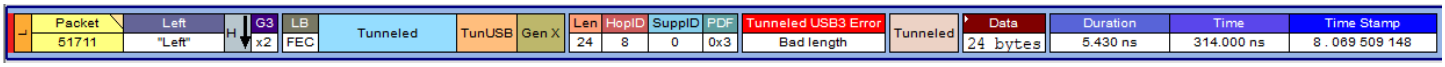


Figure 6.10: Selected USB HopID

3. Do the same for the other direction, since the HopID values are qualified by the direction.

6.1.3.1 Hiding/Showing HopID Packets

Click Hide Packets icon  to selectively Show or Hide HopIDs. See Figure 6.11.

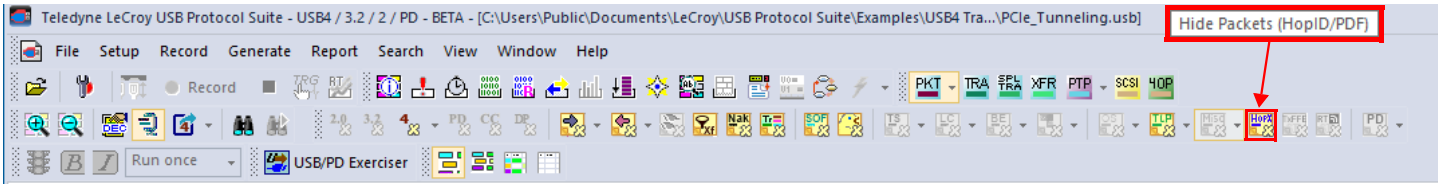


Figure 6.11: Toolbar Showing HopID Icon

Figures 6.12 and 6.13 show the effect of clicking on the HopID Hiding icon.

The first figure has several instances of upstream (US) HopID of 8 from Packet 196485 to Packet 196496 (Figure 6.12).

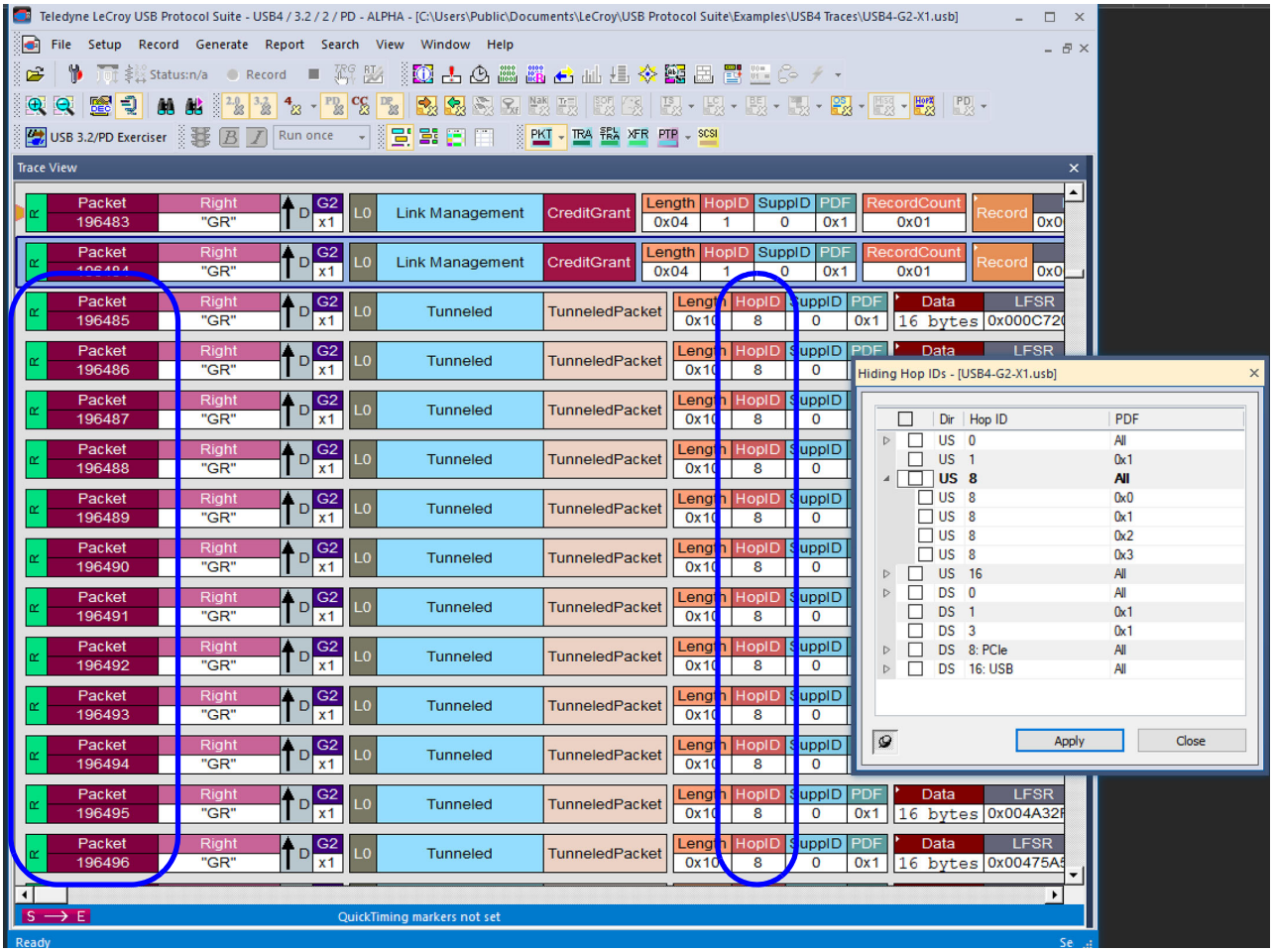


Figure 6.12: Toolbar Showing Upstream HopID = 8

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 (Figure 6.13).

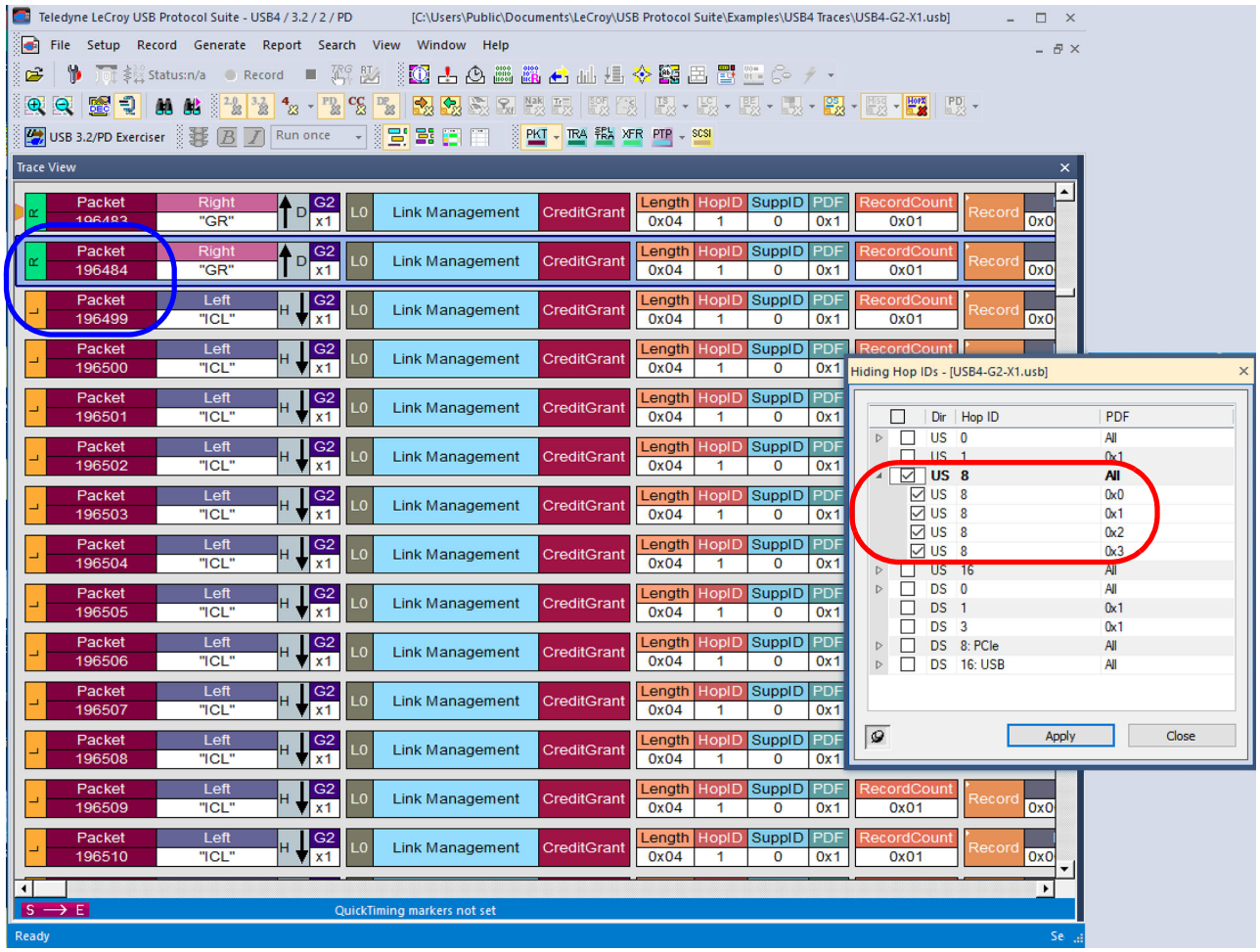


Figure 6.13: Packets Defined as Upstream with HopID = 8 are Hidden

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 misidentifying the signal, the software requires you to determine direction (or note an error condition, which 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 (Figure 6.14).

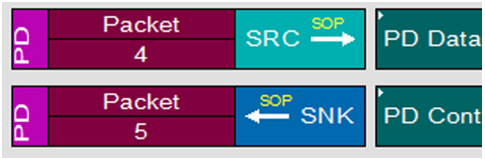


Figure 6.14: Power Delivery Packet Direction

For Cable packets, the indicator is that the source or destination is an SOP' or SOP'' source or destination, as shown below in Figure 6.15.

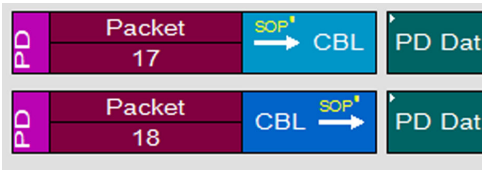


Figure 6.15: Cable Packet Power Delivery

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 remove a marker from a trace file.

Markers are represented graphically in a different way in the application. The application is granular enabling you to add markers to individual cells, in addition to adding markers to the packets.

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 (Figure 6.16).

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

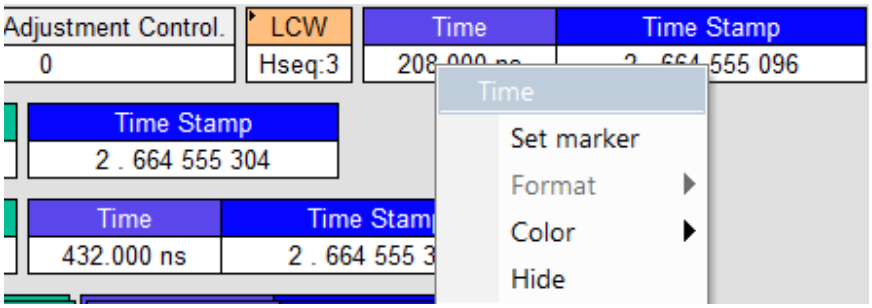


Figure 6.16: Time Dialog

The Create Marker window appears.

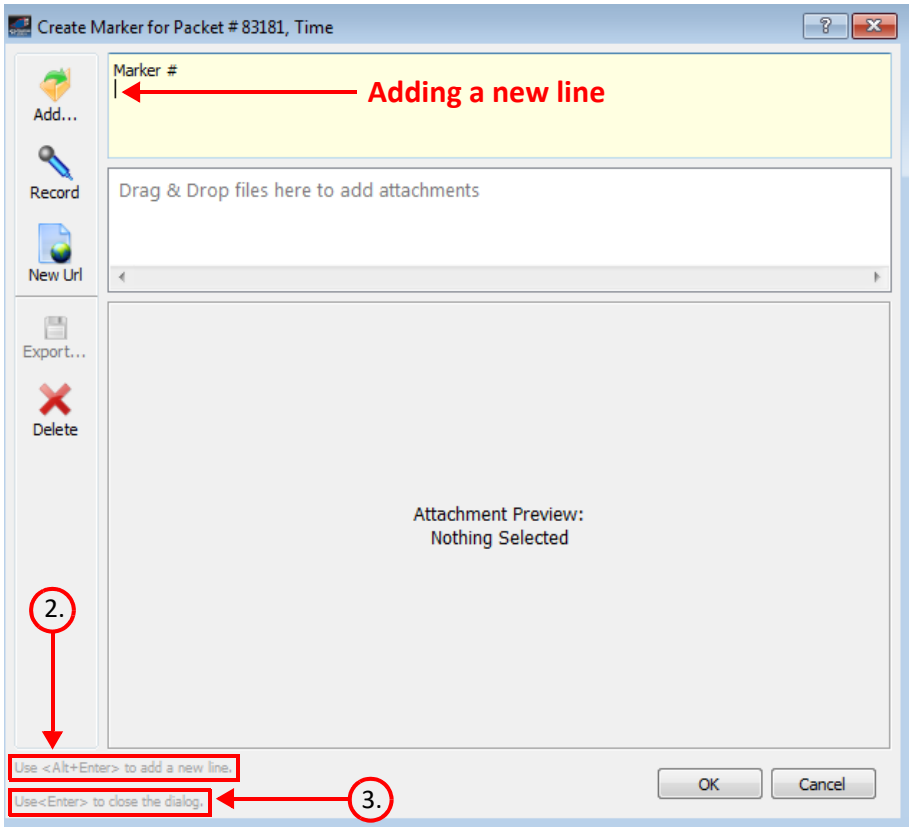


Figure 6.17: Create Marker for Packet Dialog

2. Click **ALT+Enter** to add a new line.
3. Click **Enter** to close the Marker dialog.

As previously described, you can:

	**Add** icon. Click on this icon to add any file. See 6.2.4 *Adding an Attachment*.
	**Record** icon. Click on this icon to record audio. See 6.2.5 *Recording an Audio File*.
	**New URL** icon. Click on this icon to add any URL.

	**Export** icon. Click on this icon to export an attachment.
	**Delete** icon. Click on this icon to delete an attachment

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 appears.
2. Click the **Add** icon to view the **Add File to the Marker** dialog window.
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 (Figure 6.18). 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.

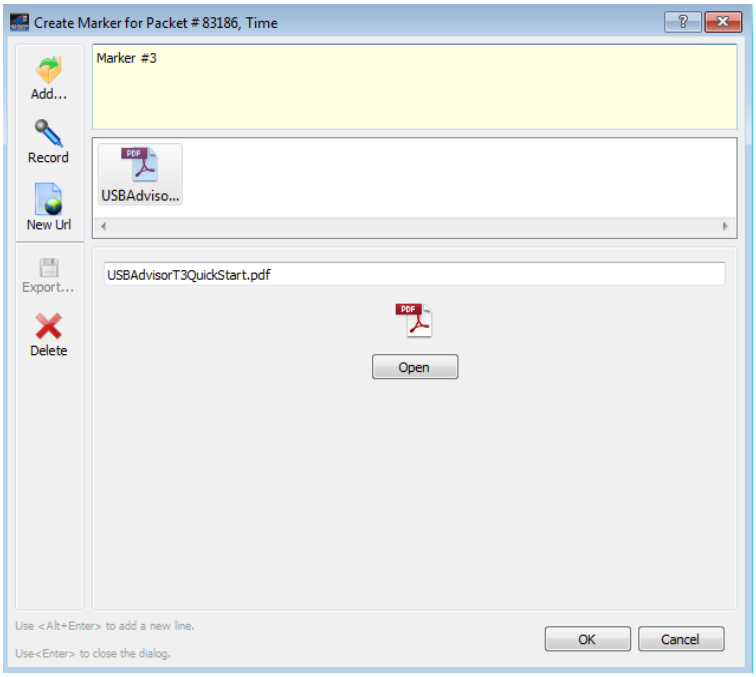


Figure 6.18: Create Marker for Transfer Dialog

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

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

6.2.6 Video Files Supported

You 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.

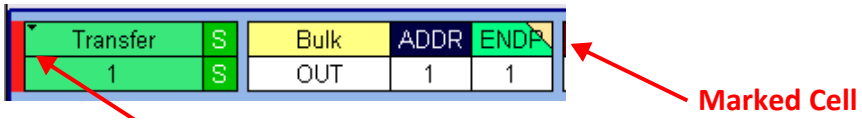


Figure 6.19: Marker Examples

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 6.2.7 *Attachment Types and Visualization*, a window pops up displaying the contents of the marked cell (Figure 6.20).

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 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.

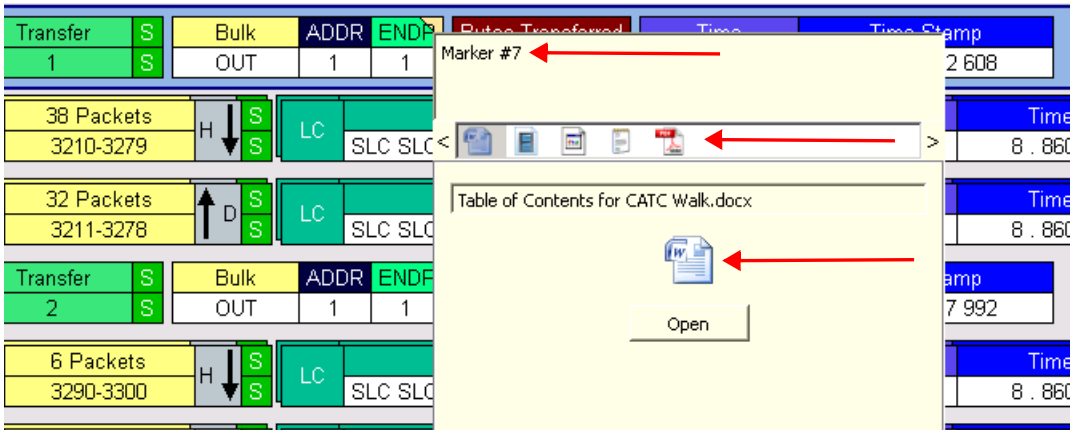
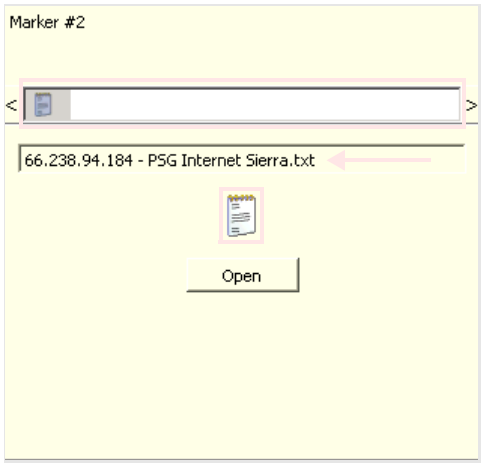


Figure 6.20: Pop-up Displaying Marker Contents

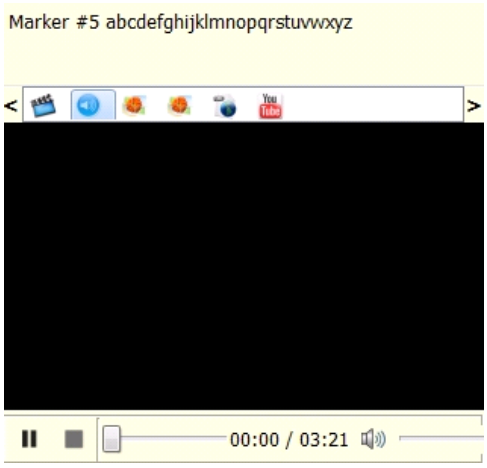
6.2.9.1 Text

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.



6.2.9.2 Audio

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



6.2.9.3 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.



6.2.9.4 File Attachment

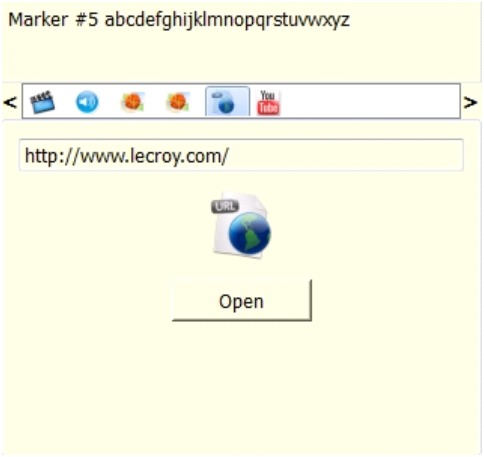
You can attach any kind of file, including images, PDFs, documents, media files, etc.

6.2.9.5 URL Link

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

6.2.9.5.1 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.



6.2.9.6 YouTube Video

The YouTube video player is embedded for YouTube Video playback.



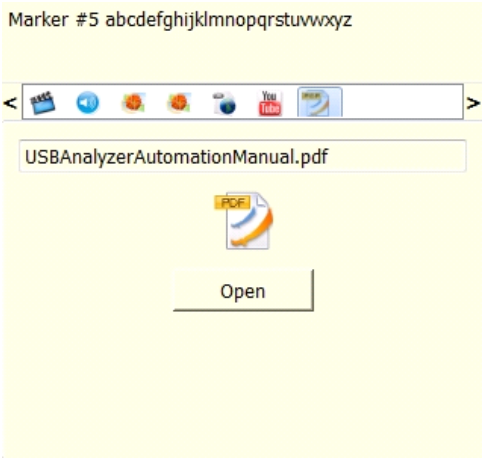
6.2.9.7 Images

The image is embedded in the trace.



6.2.9.8 Other Attachments

Click **Open** to open the attachment 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.

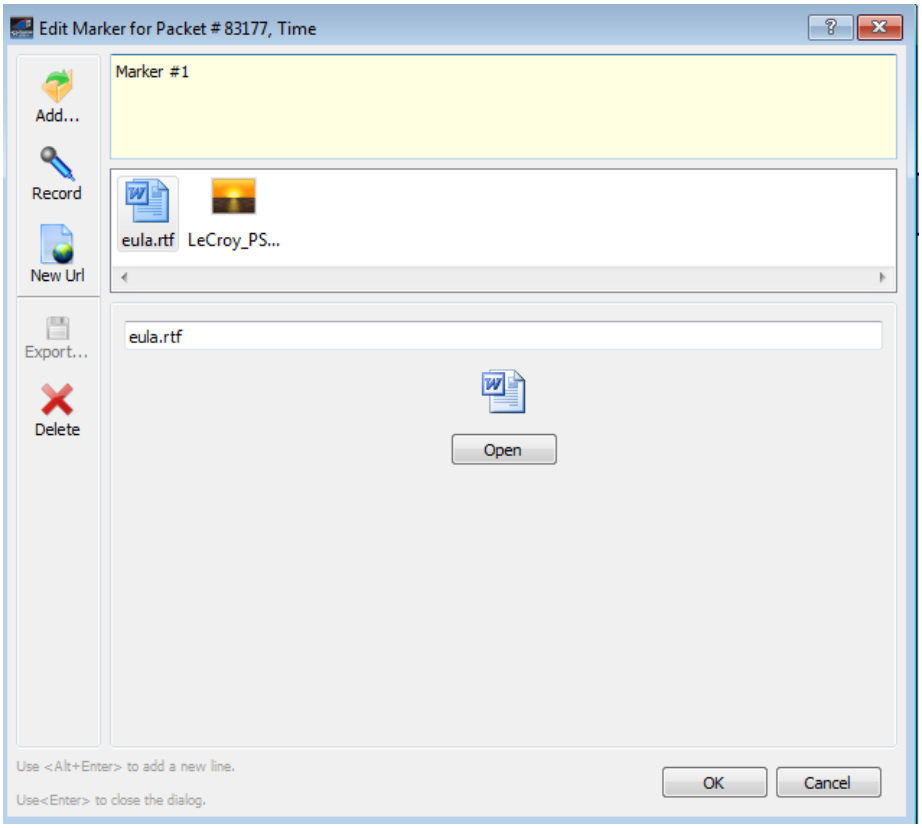


Figure 6.21: EDIT Marker for Packet Dialog

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 (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

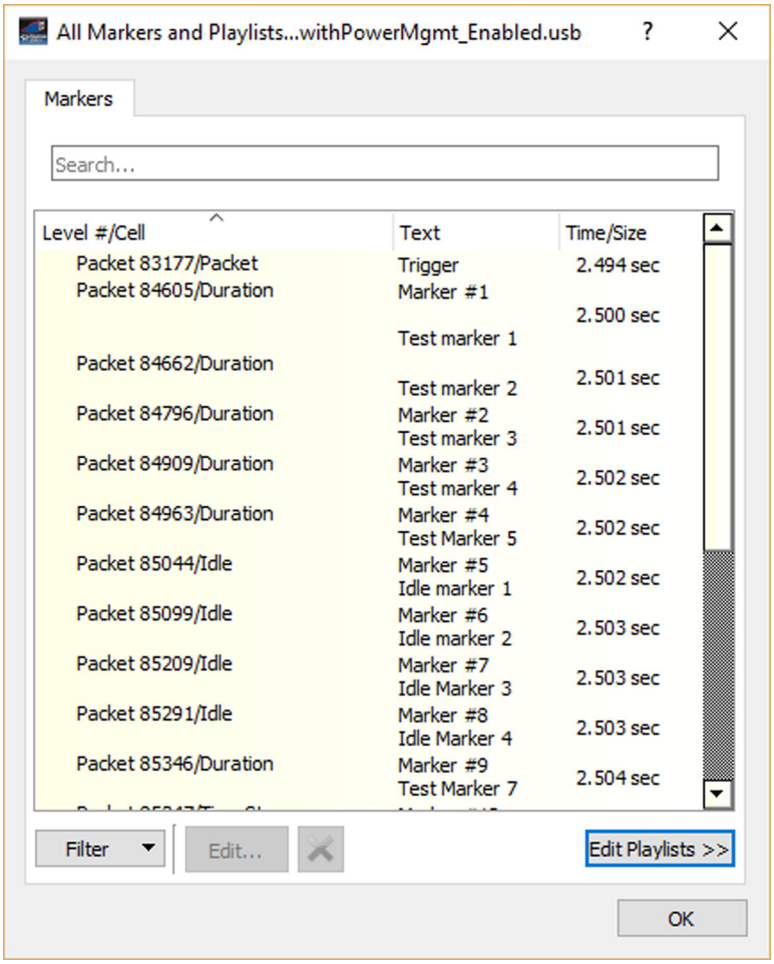


Figure 6.22: Search/Filter/Edit Marker Dialog

6.2.11.1 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.

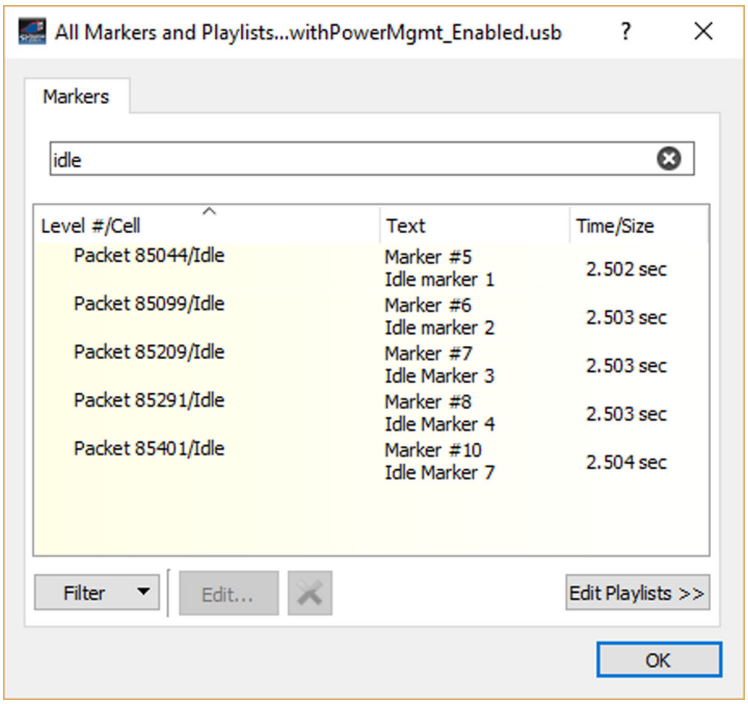


Figure 6.23: Search on Idle Marker

6.2.11.2 Delete Markers

When you click delete to remove markers with attachments, the Delete Marker(s) prompt appears. If you do not wish to see this prompt in the future, seelct “Don't ask again” (Figure 6.24).

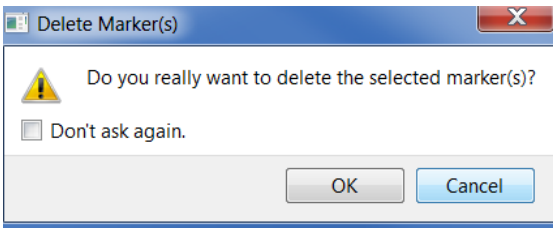


Figure 6.24: Confirmation Dialog

6.2.11.3 Filter Markers

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

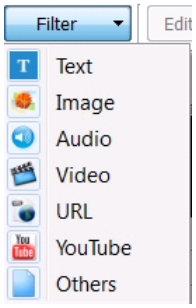


Figure 6.25: Filter Dialog

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** (Figure 6.26).

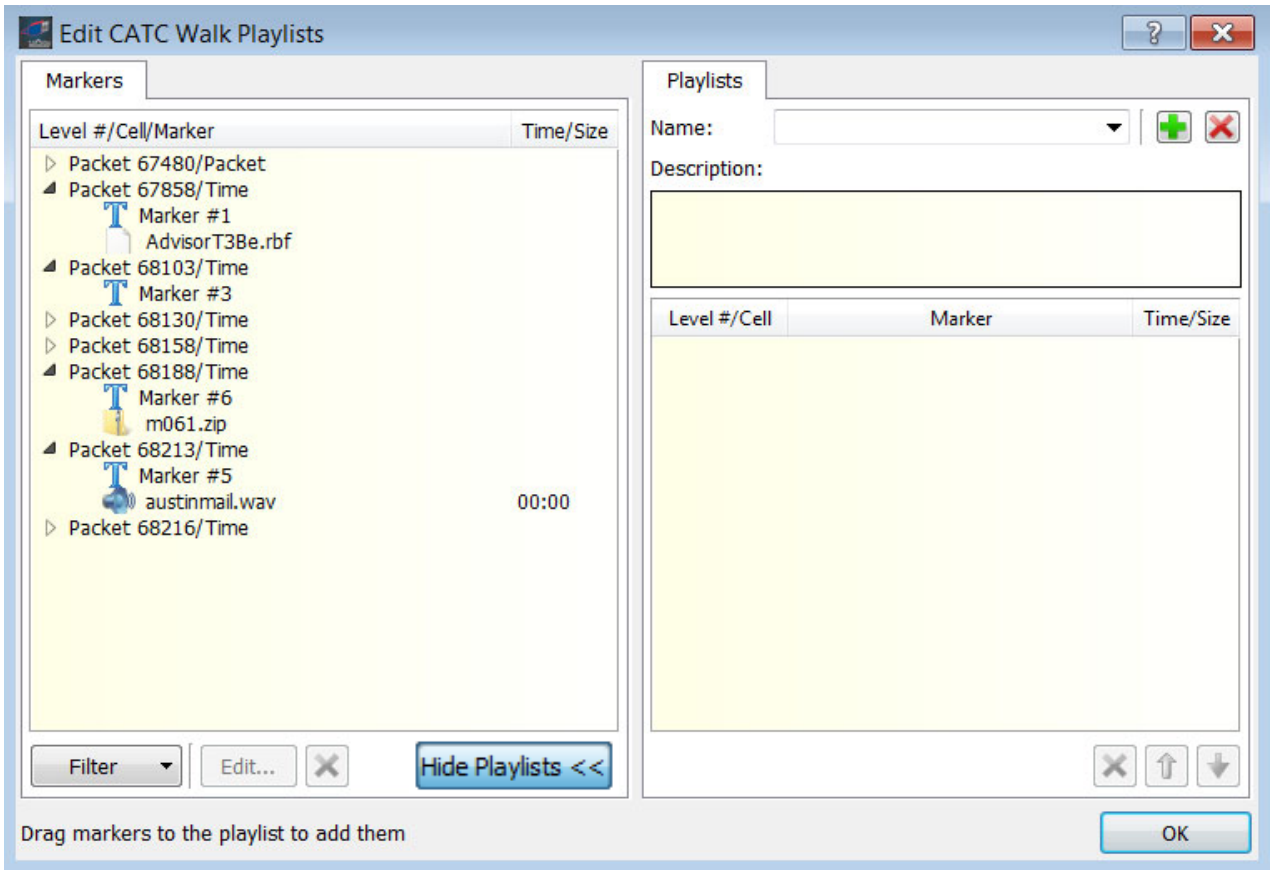


Figure 6.26: Edit CATC Walk Playlists Dialog

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 (Figure 6.27).

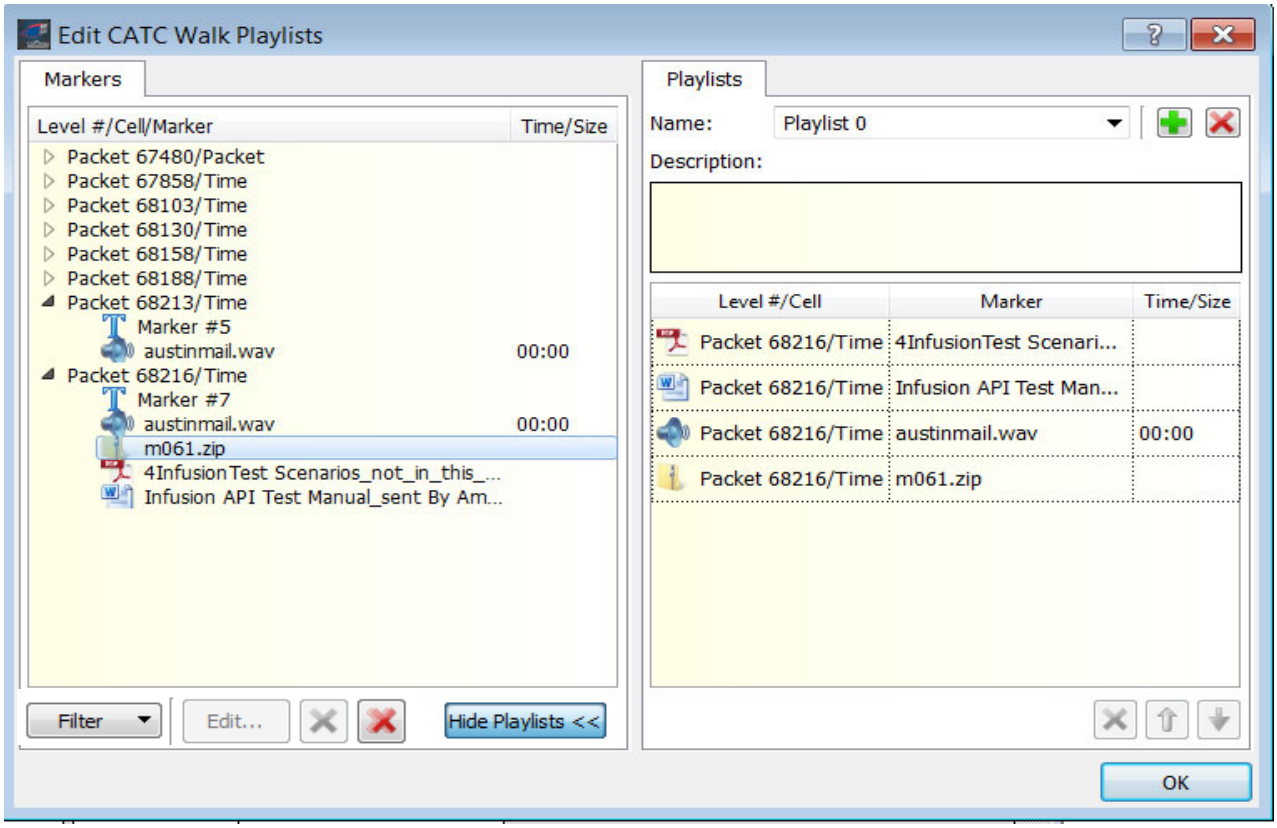


Figure 6.27: Edit CATC Walk Playlists Window

- You can drag and drop and item or attachment from the **Marker** panel into the **Playlist** panel and build a story. Give a description of the playlist in the **Description** field and you can give a name to the playlist in the **Name** field.
- You can add a new playlist by clicking on the green plus sign (+) on the right top corner of the Playlist panel, or delete a playlist by clicking the red (x) button.
- If you have more than one playlist saved click on the Name drop-down arrow to select it. The drop-down menu lists all the available playlists.

6.3.2 Playback Window

To playback a playlist:

1. Click the **View** tab at the top of the application.
2. Select **CATC Walk**.
3. Select **Play > Playlist 1** as shown in Figure 6.28.

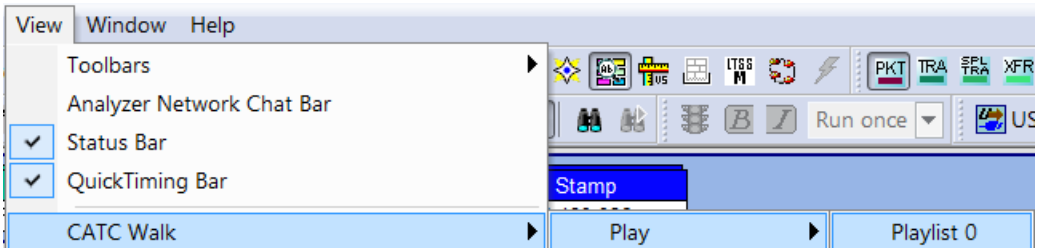


Figure 6.28: View Menu

The select playlist starts in the playback window (Figure 6.29).

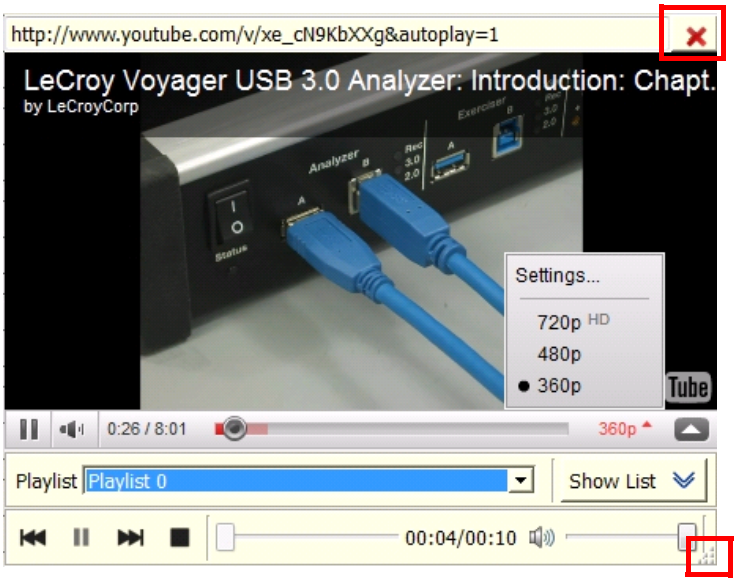


Figure 6.29: Playback Window

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

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

6.3.2.1 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 (Figure 6.30).

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

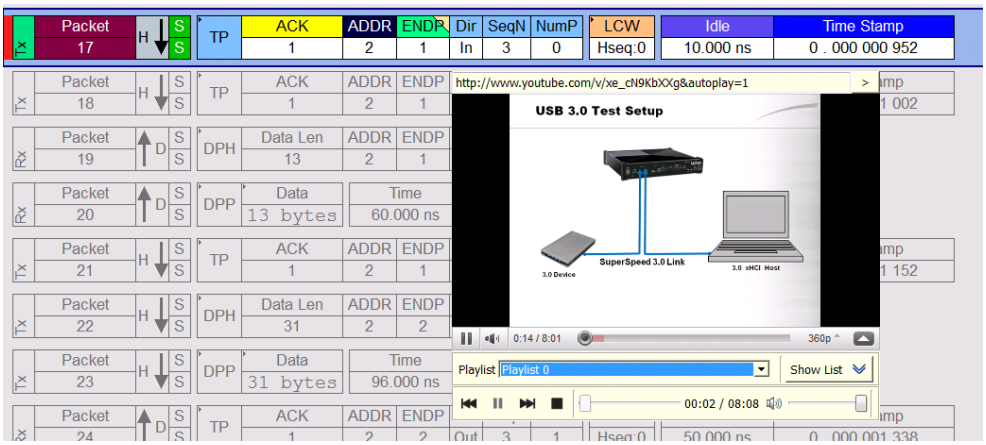


Figure 6.30: Playlist Playback View

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 8.1 *General Display Options*. 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). 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.
- You can also select **Set marker** to create a new marker.

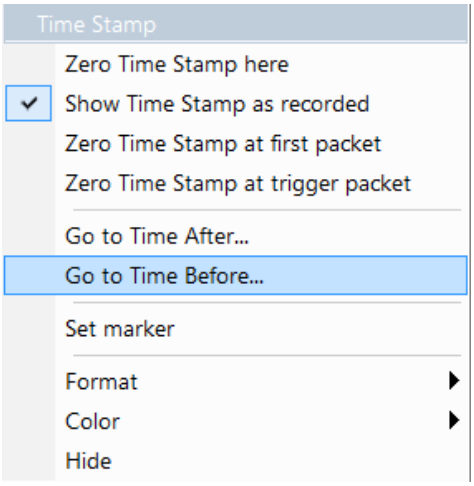


Figure 6.31: Time Stamp Dialog

NOTE:
- You cannot place the Zero Time Stamp at a packet when in the Calendar.
- You can 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.

6.5 Show 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.

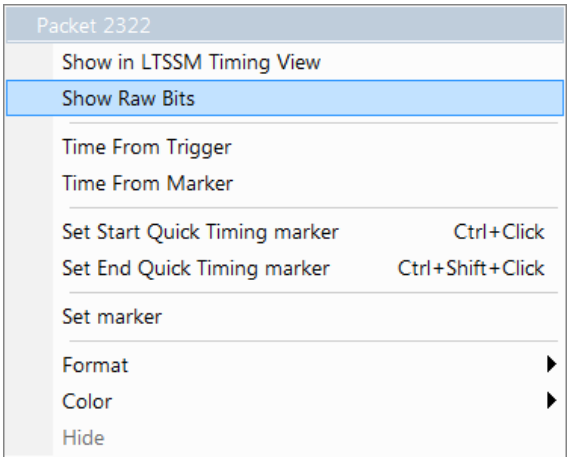


Figure 6.32: Packet Menu

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.

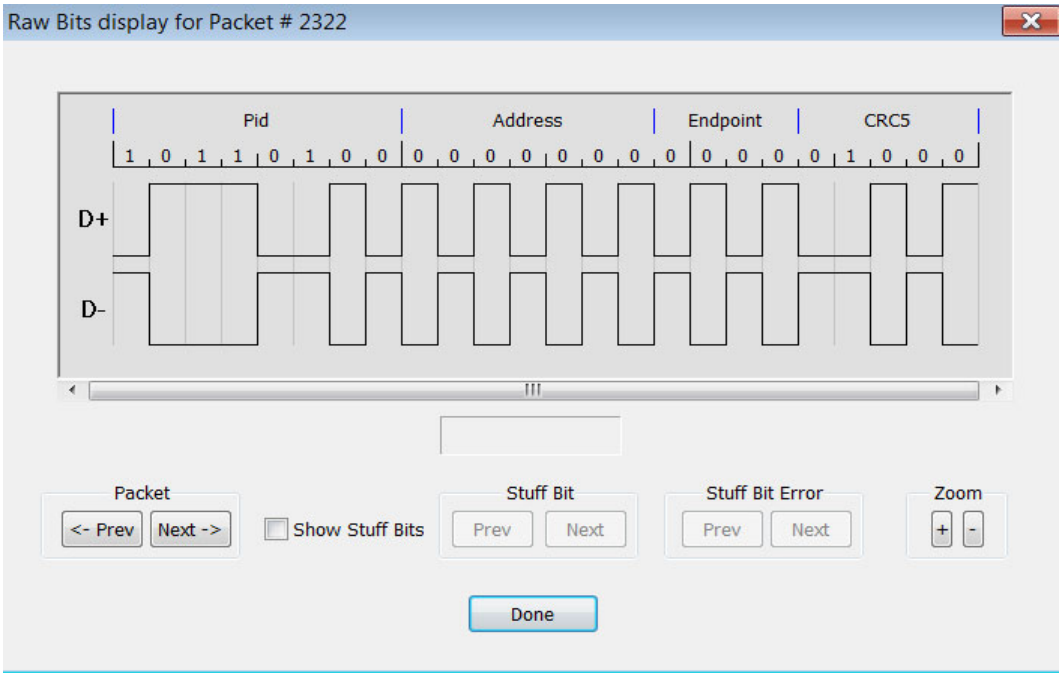


Figure 6.33: Raw Bits Display for a Packet

6.6 Expanding and Collapsing Data Fields

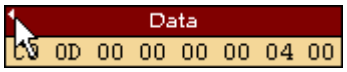
You can expand a Data field to view it in greater detail or collapse it when you want a more compact view. The sizes for displaying in Collapsed or Expanded fields can be configured on the Display Options General Tab.

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.



Unexpanded data field



Expanded data field

6.6.2 Double-Click to Expand/Collapse Data Fields

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

6.6.3 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.

6.6.4 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:

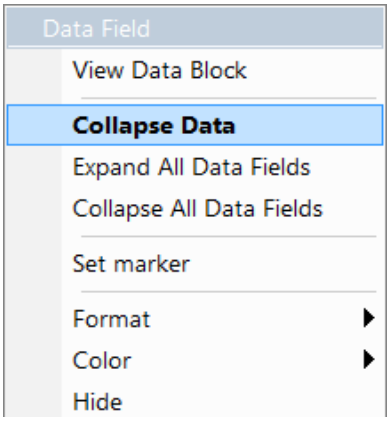


Figure 6.34: Data Field Menu

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

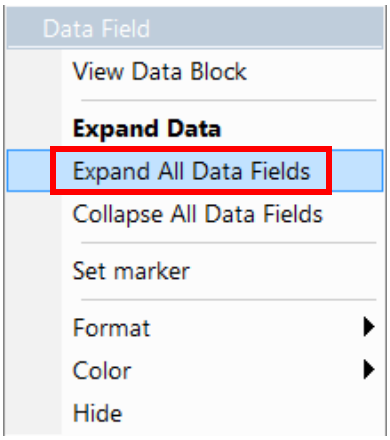


Figure 6.35: Data Field Menu

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.

6.7 Format/Color/Hide Fields

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

- You can change the Format of the cell 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 8.2.1 *Color Display Options*).
- 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 8.2 *Color/Format/Hiding Display Options*).

6.7.1 Hide/Show Field when Packet Section is Collapsed

A right-pointing arrow  in the upper left of a field indicates the field is collapsible and expandable (see 6.6 *Expanding and Collapsing Data Fields*).

When a set of fields is in the collapsed state, with collapsible/expandable fields, you can choose whether to show or hide them. Thus, you can determine which fields are more critical to view in these two modes.

Do NOT confuse this with Hide Fields (see 6.7 *Format/Color/Hide Fields*), which hides a field everywhere without regard to collapse/expand state.

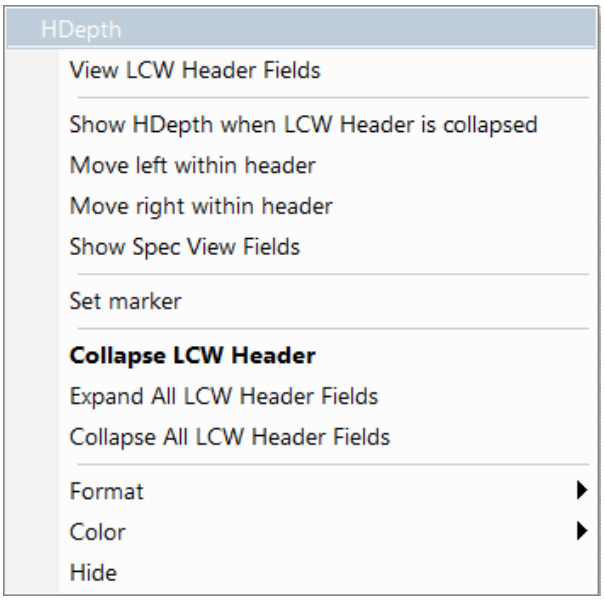


Figure 6.36: Hide/Show Field

6.8 View Data Block

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

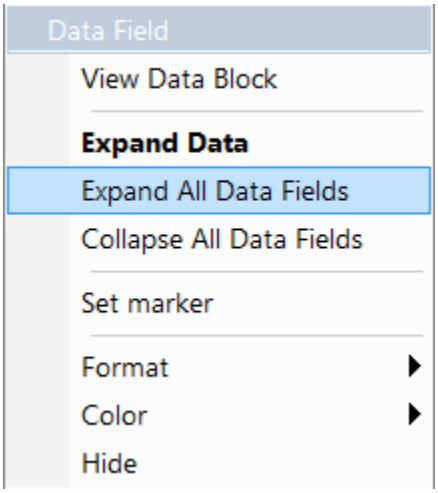


Figure 6.37: View Data Block Pop-Up Menu

To view raw bits:

1. Click the data field to open its pop-up menu.
2. Select **View Data Block** or click the **Data View** button to open the Data Block dialog box (Figure 6.38).

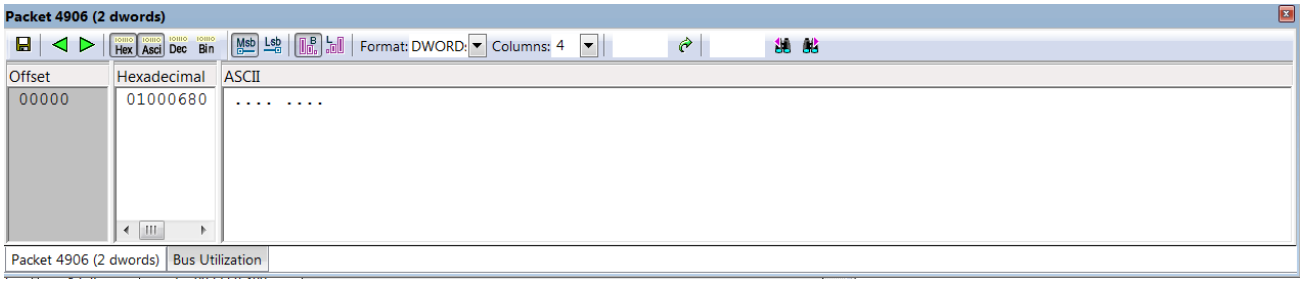


Figure 6.38: Data Block Window

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 Tooltips

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

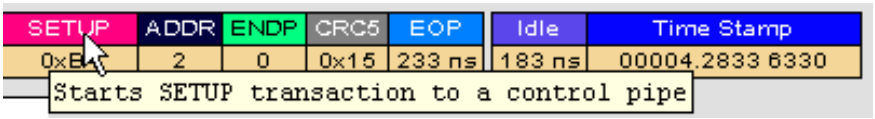


Figure 6.39: Pop-Up Tool-Tips

6.10 Stacking

This feature puts a group of packets in one row to shorten the 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 that are included in a stacked entry are shown in the solid colored square fields, which 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 6.41).

- For USB 2.0, stacking items (or item groups) can be SOF, Chirp (merges Js 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 figures 6.42 and 6.43.

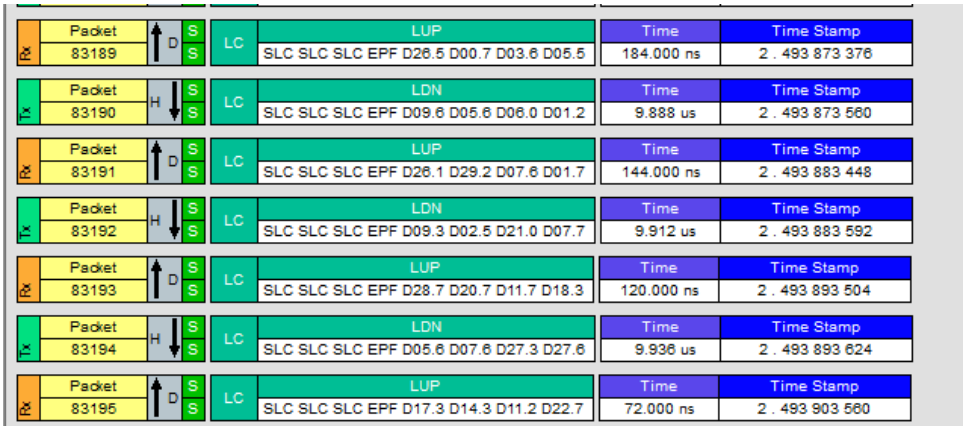


Figure 6.40: Unstacked View

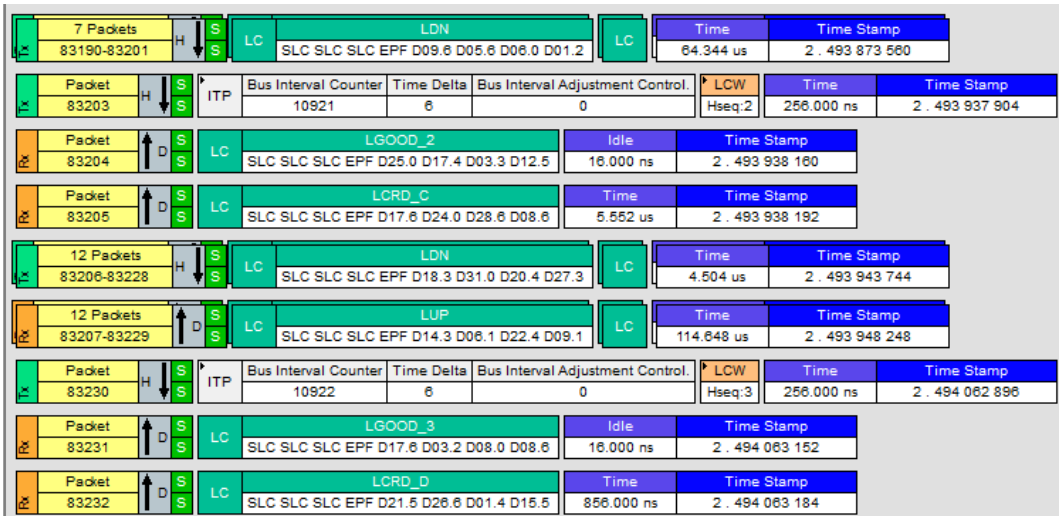


Figure 6.41: Stacked View

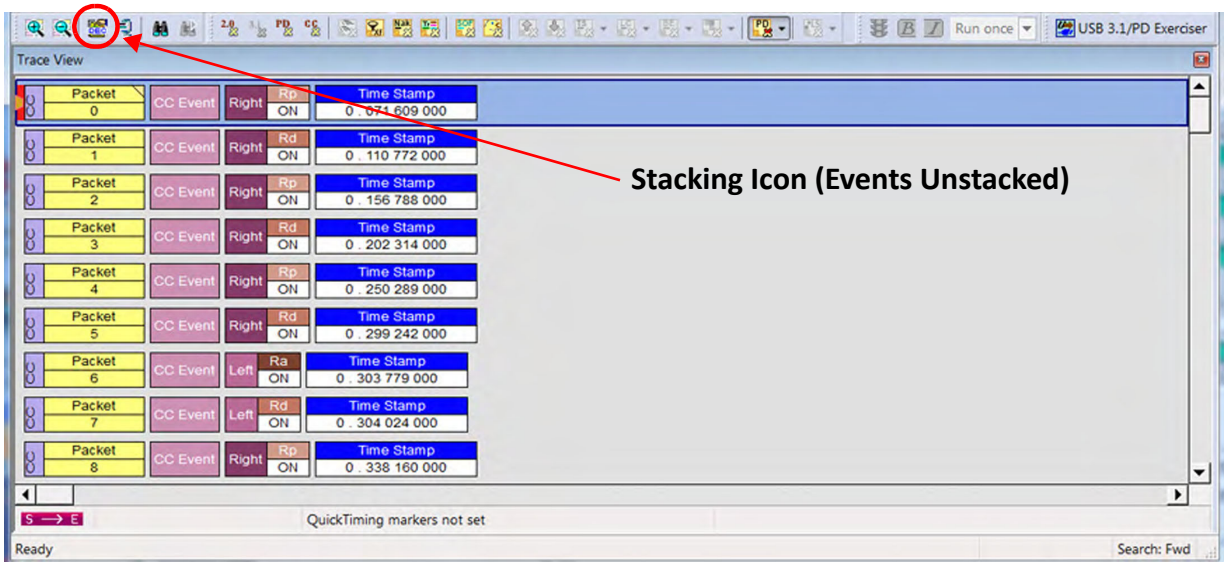


Figure 6.42: Unstacked CC Events

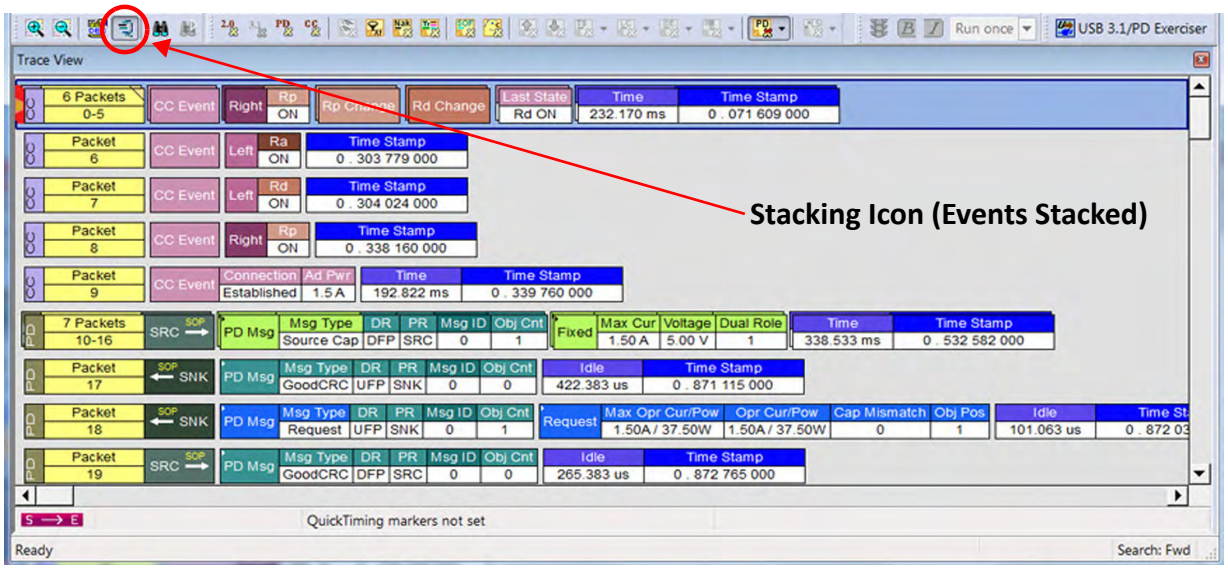


Figure 6.43: Stacked CC Events

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: **Unexpected 3.2 Idle times in traces that 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 Switch to Transactions View

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

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

6.11.1 Transaction View from Toolbar

To select Transactions View, click the  icon on the toolbar. The Trace View screen is re-drawn to display Transactions.

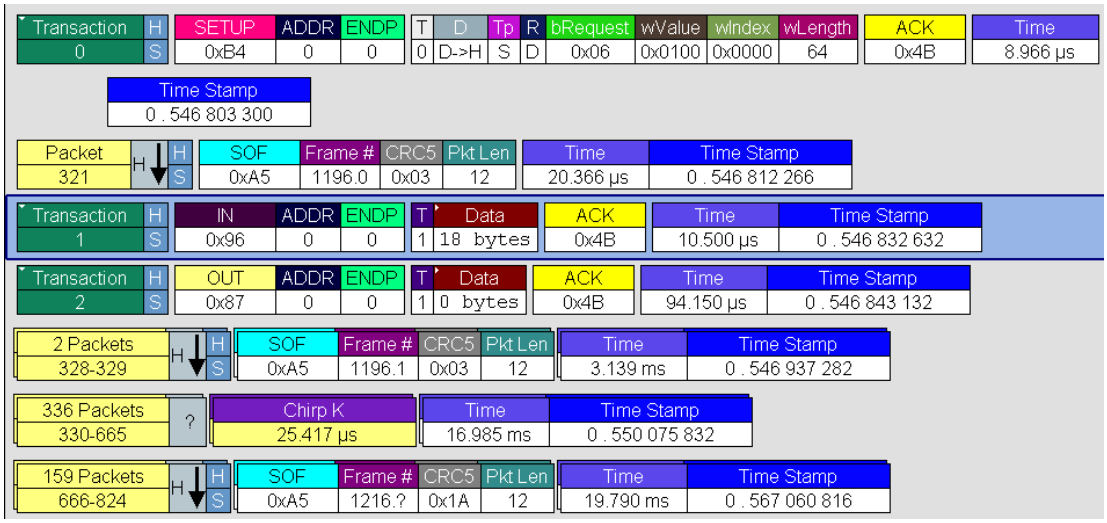


Figure 6.44: Transactions View

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**.
- 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.

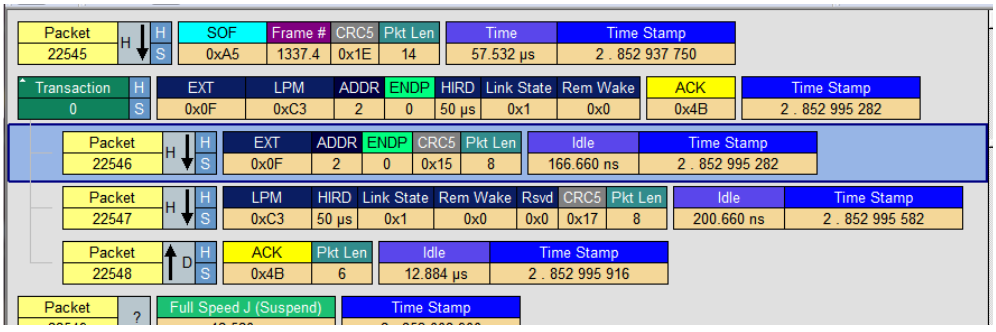


Figure 6.45: Link Power Management View

6.11.2 Transaction View from the Display Options Window

You can also switch to Transaction View from the Display Options window.

1. Select **Display Options** under Setup to open the Display Options window.

2. Check **Transaction**, then click **OK**.

6.11.3 Power Delivery Transactions

Power Delivery Transactions are also viewable at this level (Figure 6.46).

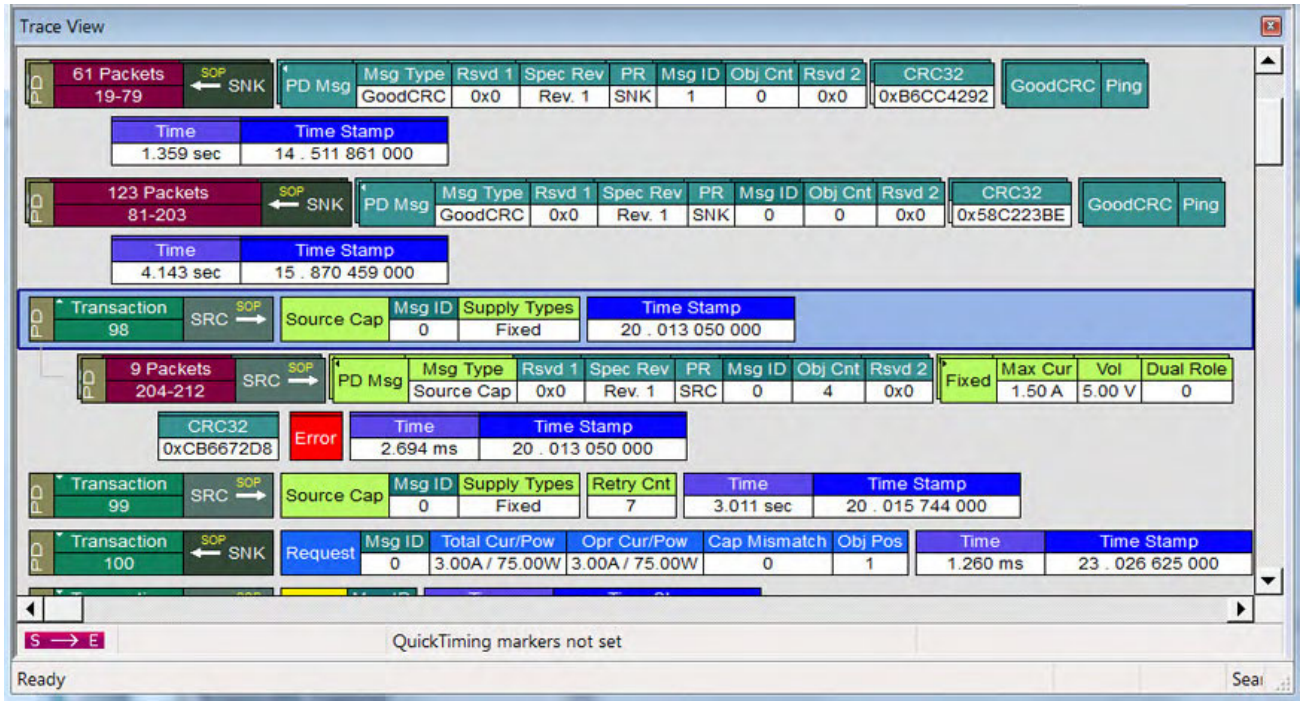


Figure 6.46: Power Delivery Transactions

6.11.4 Power Delivery Packets

1. Right-click on a Power Delivery Packet to view its drop-down menu (Figure 6.47).

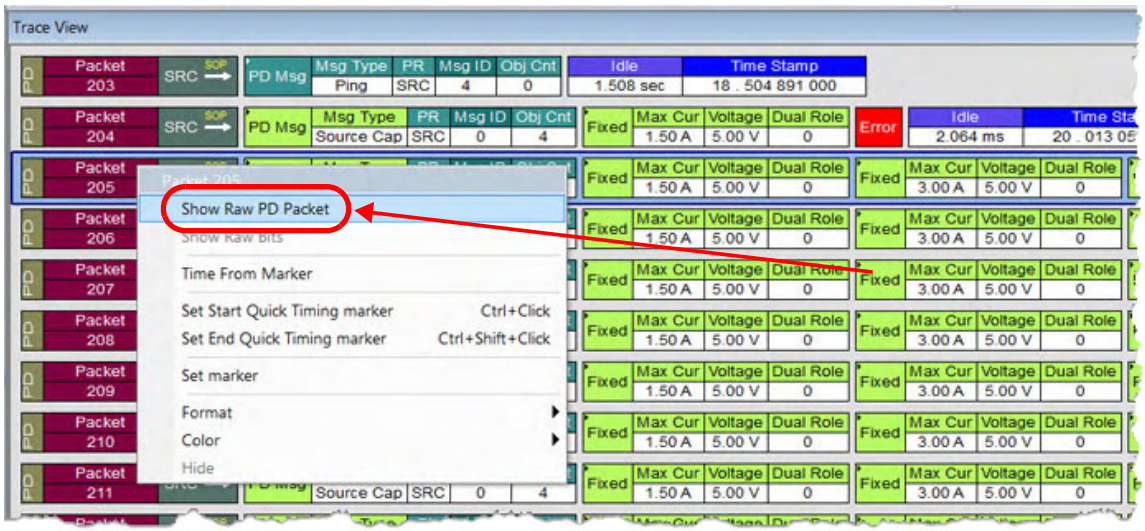


Figure 6.47: Power Delivery Packet: Right Click

2. To view the Raw PD data, click **Show Raw PD Packet** (Figure 6.48).

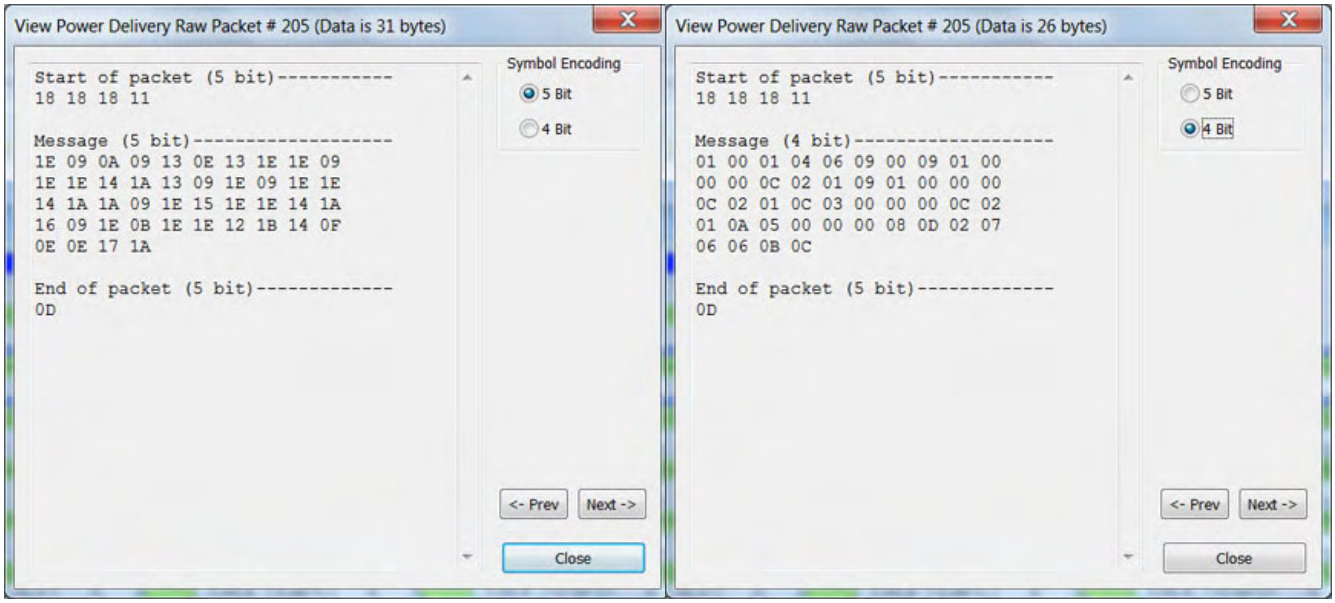


Figure 6.48: Show Raw PD Packet: 5b vs. 4b Encoding

6.12 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 (Figure 6.49).

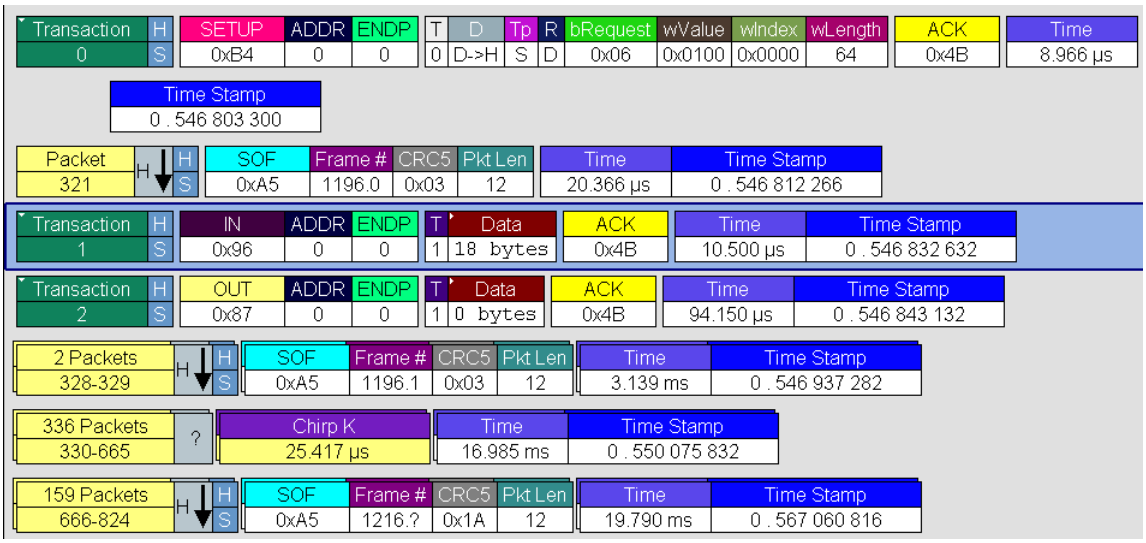


Figure 6.49: Decoded Transactions

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.

6.12.1 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 (Figure 6.50.)

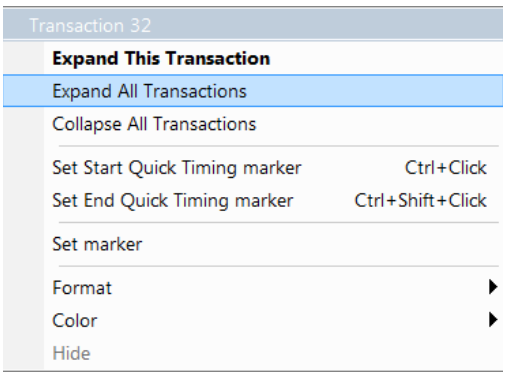


Figure 6.50: Expand Transaction Menu

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.

6.13 Switch to Split Transaction View

You can select Split Transaction View, in one of two ways:

1. Click the  button on the toolbar. The Trace View screen is re-drawn to display Split Transactions (Figure 6.51).

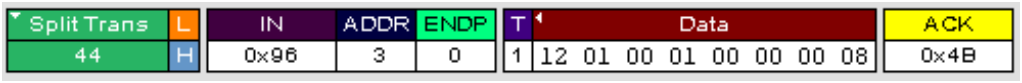


Figure 6.51: Split Transaction View

OR

2. Switch to Split Transactions View from the Menu Bar:

a. Select **Display Options** under Setup.

b. When the Display Options General window appears, check **Split Transaction.**

6.14 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
- 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:

Click XFR 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.**

6.14.1 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 6.52: 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.

6.14.2 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:

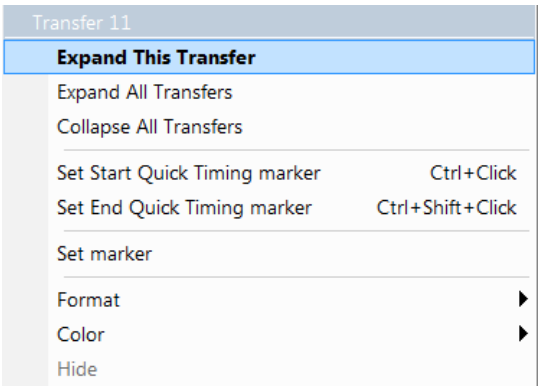


Figure 6.53: Expand This Transfer Menu Option

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

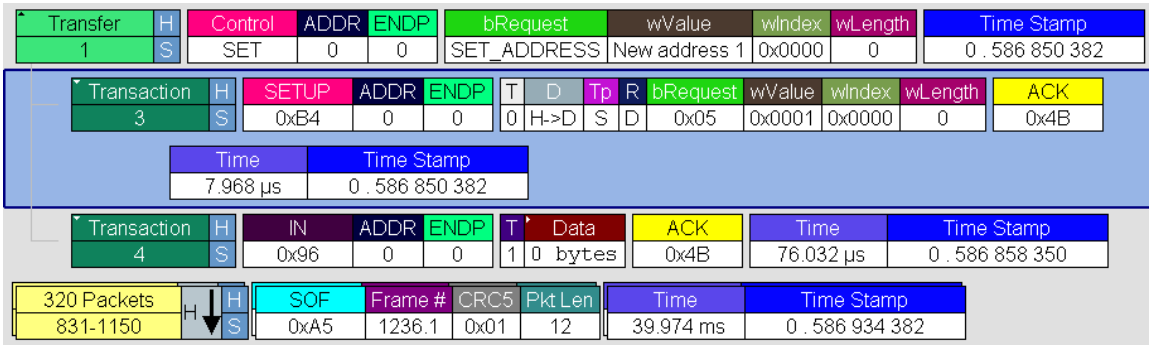


Figure 6.54: Transfer Displayed in Expanded Format

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.

6.14.3 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 must use the decoding association mechanism described in Chapter 9, *Decode Requests*. Once you perform the association, the protocol-specific fields of transfers and decoded transactions appear in the trace view.

6.14.4 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, click the 

icon 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 6.55, which shows how a USB4 packet was collected and the transfer layer decoding has been provided.

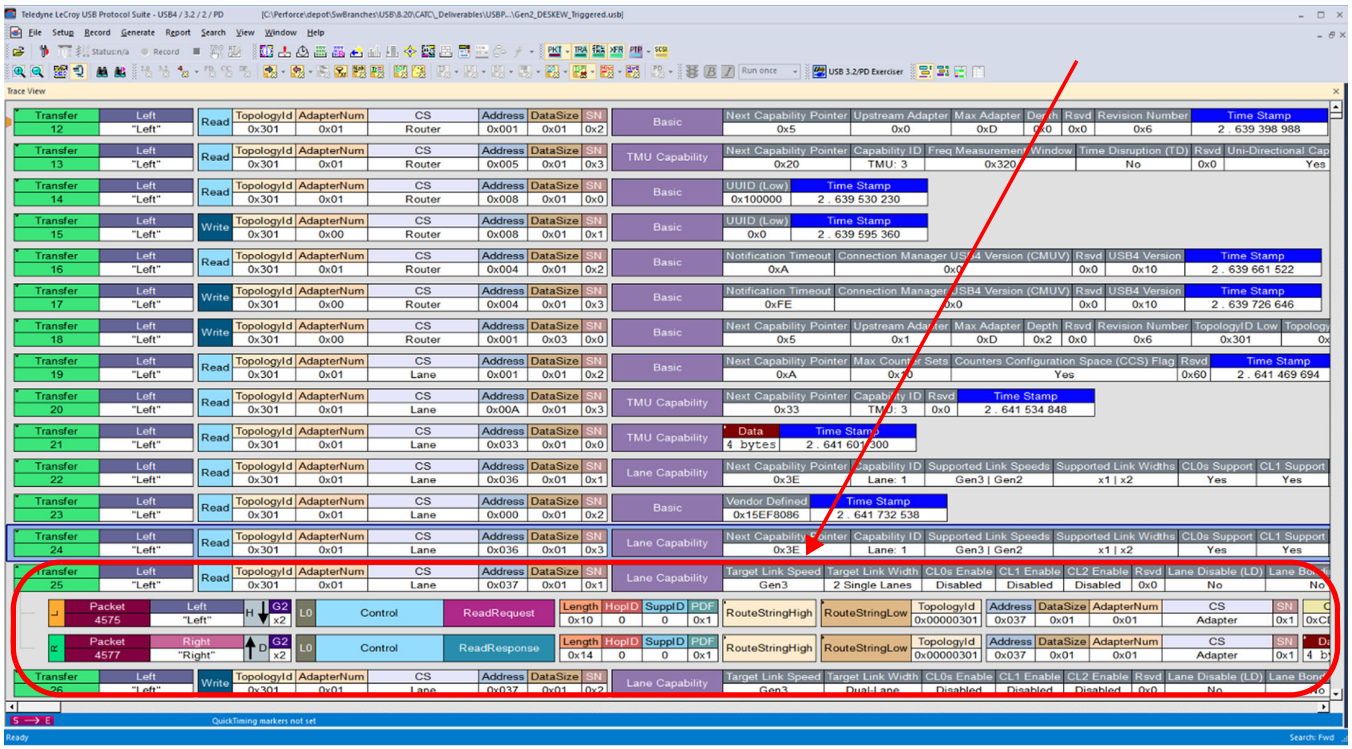


Figure 6.55: USB4 Transfer View of Trace

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 6.56, which shows available options for assigning CS Type.

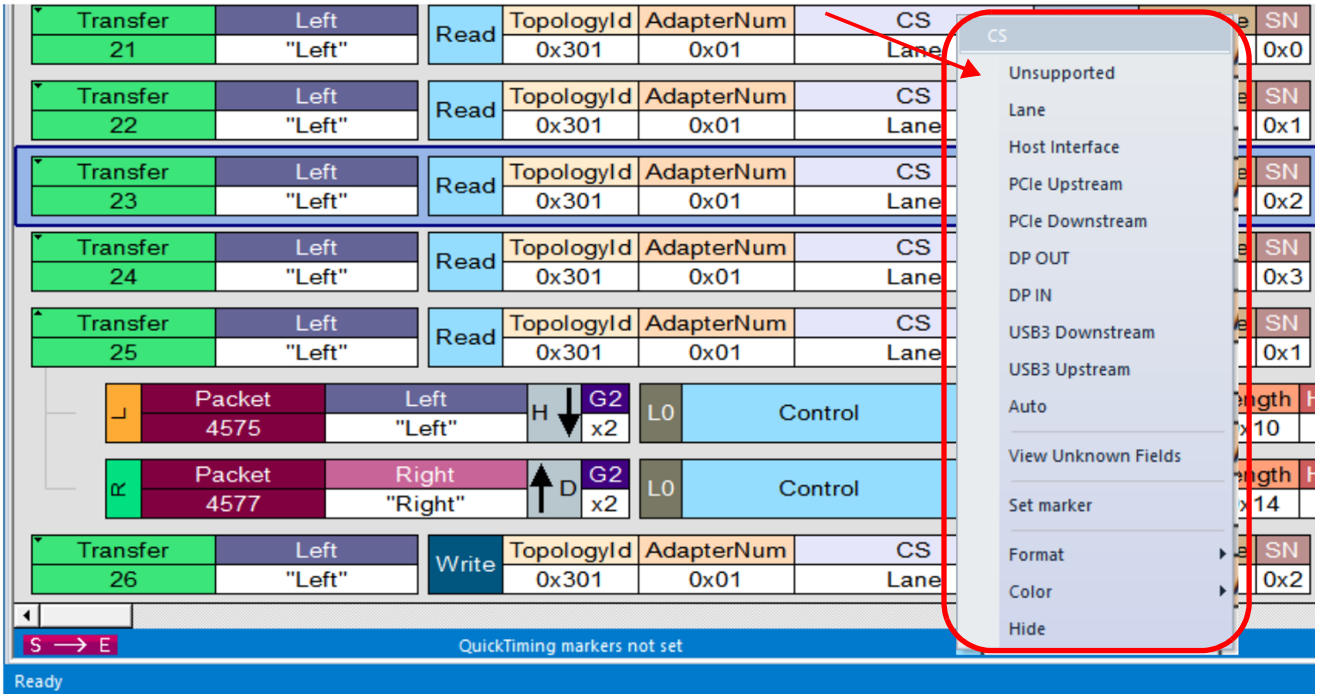


Figure 6.56: USB4 Configuration Space: Options

6.14.5 Decoding Power Delivery Transfers

You can also use the Transfer  button on the toolbar to find Power Delivery Transfers. See Figure 6.47.

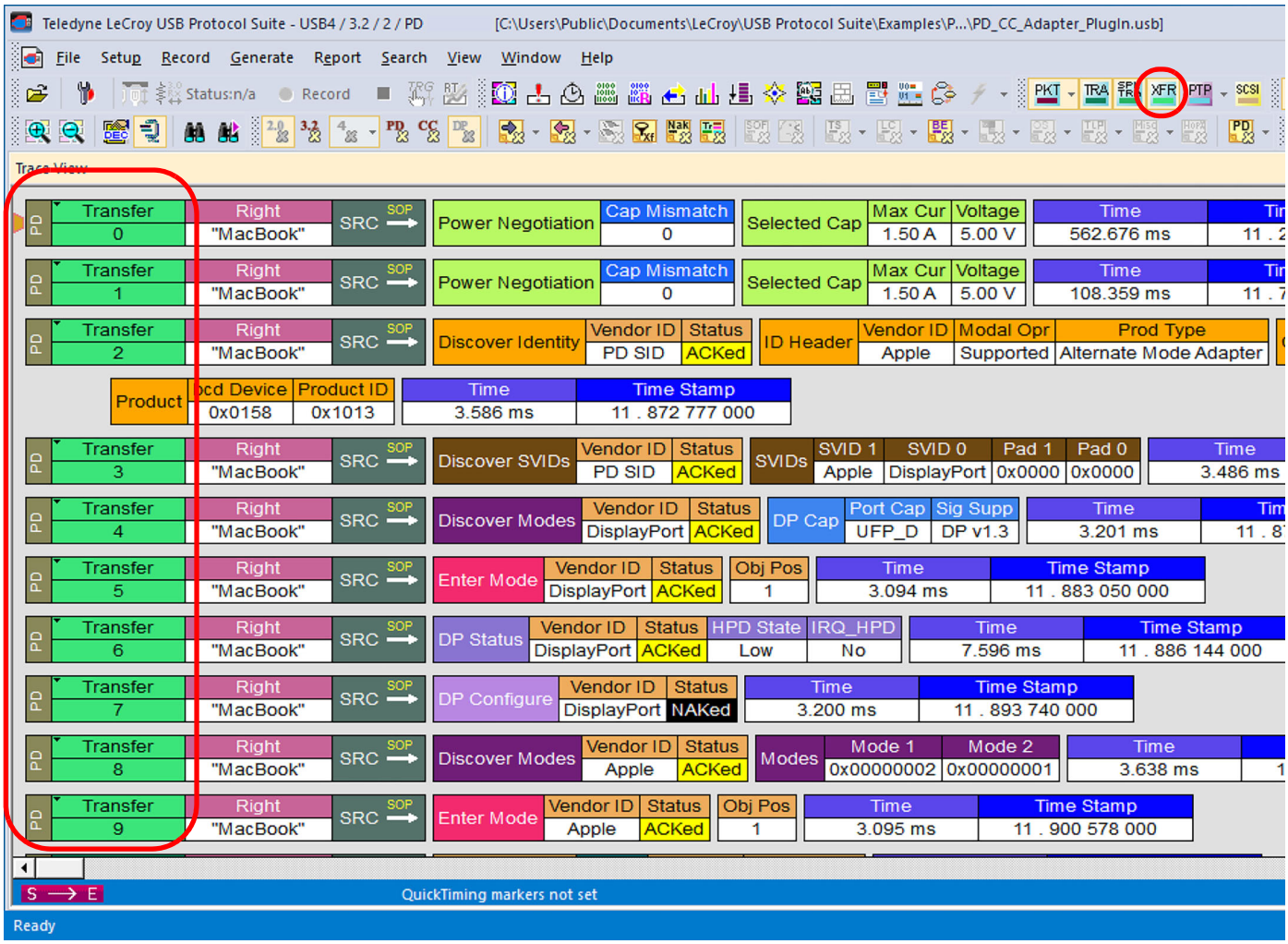


Figure 6.57: Power Delivery Transfers

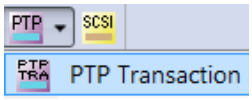
6.15 Switch to PTP Transactions

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, do one of the following to 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.**

6.16 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 transactions for an object handle. In PTP, all object-handle 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, do one of the following to switch to the PTP Object Transfer trace viewing level:

1. On the toolbar, click the down arrow (▼) for 

on the toolbar and select **PTP Object**.

OR

2. From the menu bar, select **View → Level Viewing → PTP Object Level**. Or, do the following:

a. From the menu bar, select **Setup → Display Options**. The Display Options dialog window appears.

b. Check the box for **PTP Object** and click **OK**.

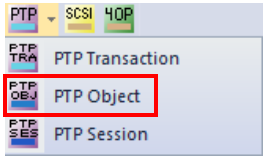
6.17 Switch to PTP Sessions

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, you can do one of the following:

- From the toolbar, click the down arrow (▼) for the PTP button, then select **PTP Object**:



OR

- From the Menu, select **View** → **Level Viewing** → **PTP Group** → **PTP Object Transfer Level**:

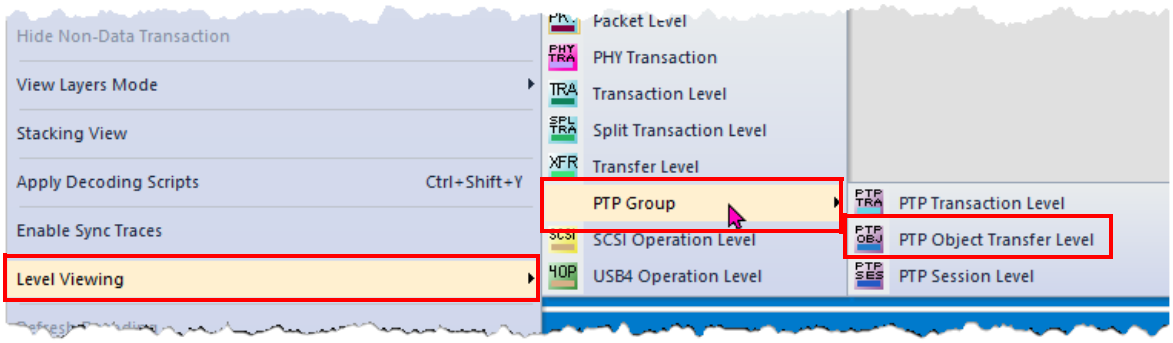


Figure 6.58: PTP Object Transfer Viewing Level

To open the Display Options window (Figure 6.59):

1. Select **Setup** → **Display Options**, then check the **PTP Session** box.

> **NOTE:**
> - Packet is selected by default.
> - When **PTP Group** is selected, all Protocol Levels in the hierarchy are also selected.

2. Click **OK**.

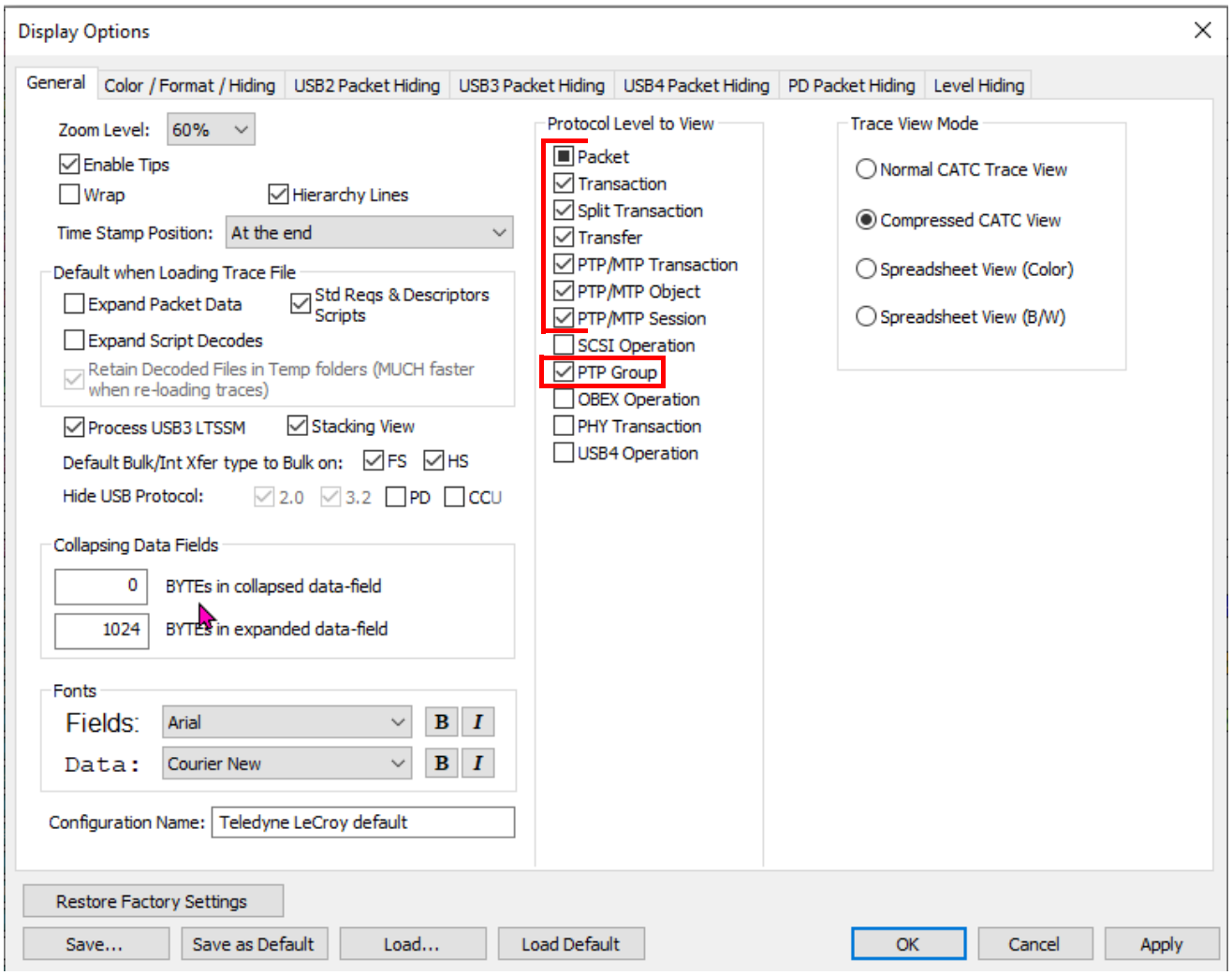


Figure 6.59: Display Options Dialog Window

6.18 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.**

6.18.1 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

6.19 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 Leve**l.

OR

- Select **Setup** → **Display Options** to display the Display Options window, check **USB4 Operation**, and then click **OK**.

A sample trace with USB4 Operations with DROM READ decoded is shown in Figure 6.60.

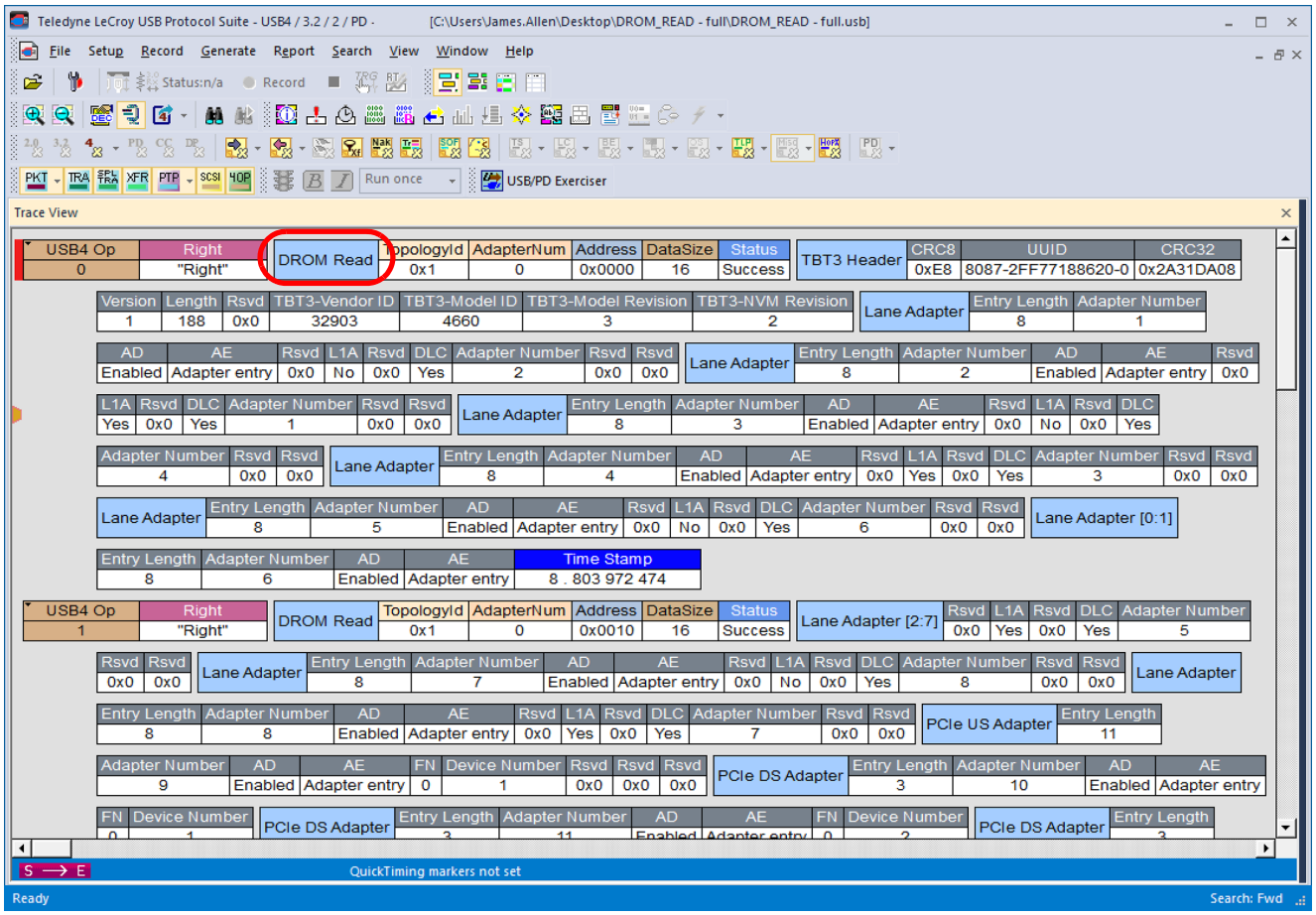


Figure 6.60: USB4 Operations: DROM Read

6.20 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 (Figure 6.61).

To compress the CATC Trace:

- Click  on the toolbar.

OR

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

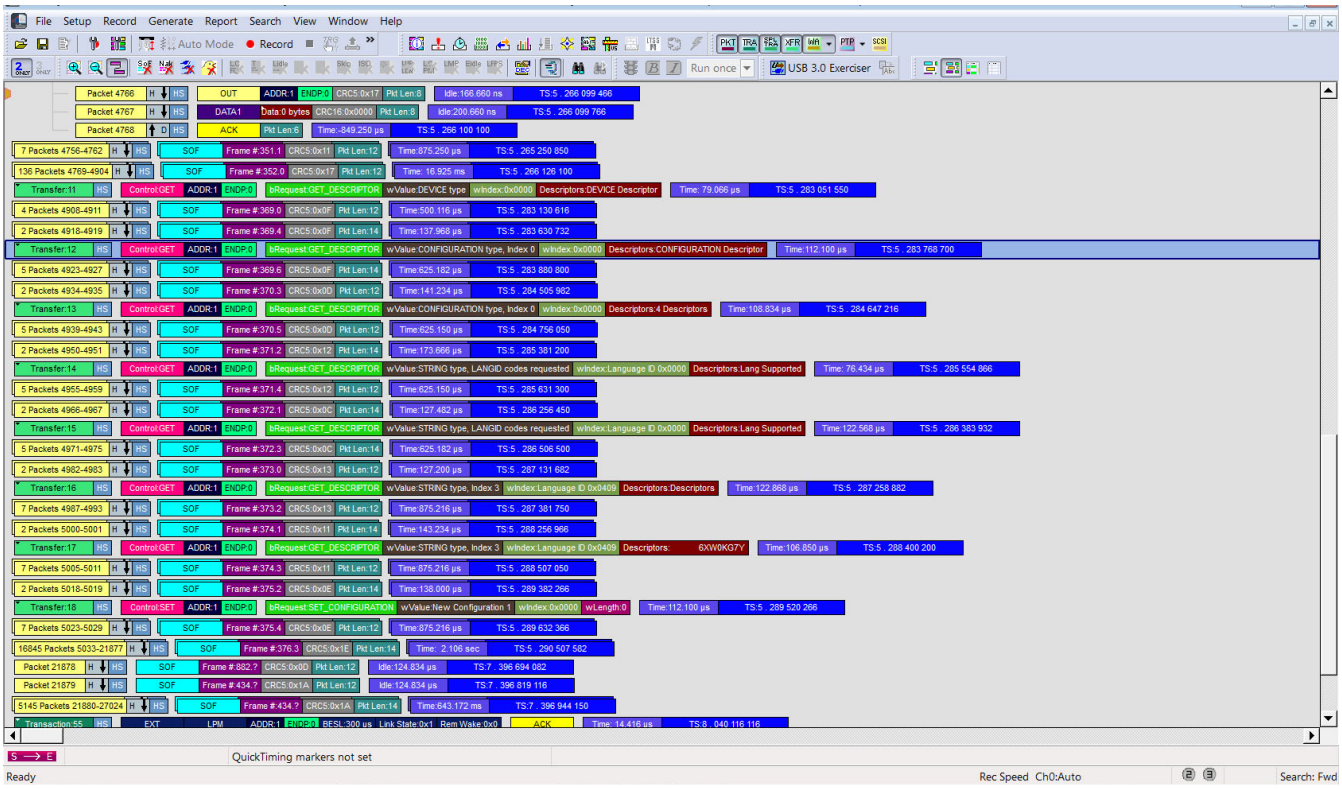


Figure 6.61: Compressed CATC Trace

- Click  on the toolbar to return to the normal CATC Trace View.

OR

- Select **View → Trace Views → CATC Trace.**

6.21 Spreadsheet View

You can view the CATC Trace as a spreadsheet in color (Figure 6.62) or black and white (Figure 6.63).

- **For color**:
  - Click  on the toolbar.

OR

  - Select **View → Trace Views → Spreadsheet (Color)**.

- **For Black and White**:
  - Click  on the toolbar.

OR

  - Select **View → Trace Views → Spreadsheet (B/W)**.

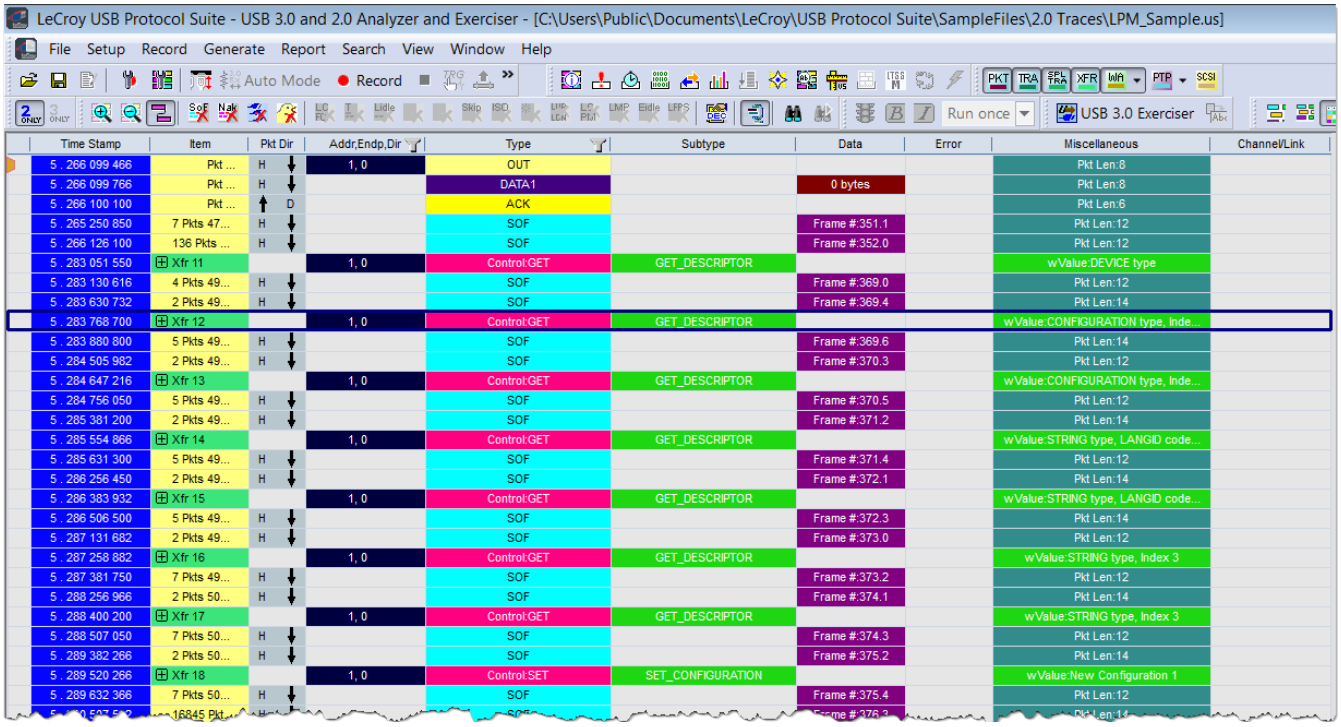


Figure 6.62: Spreadsheet View (Color)

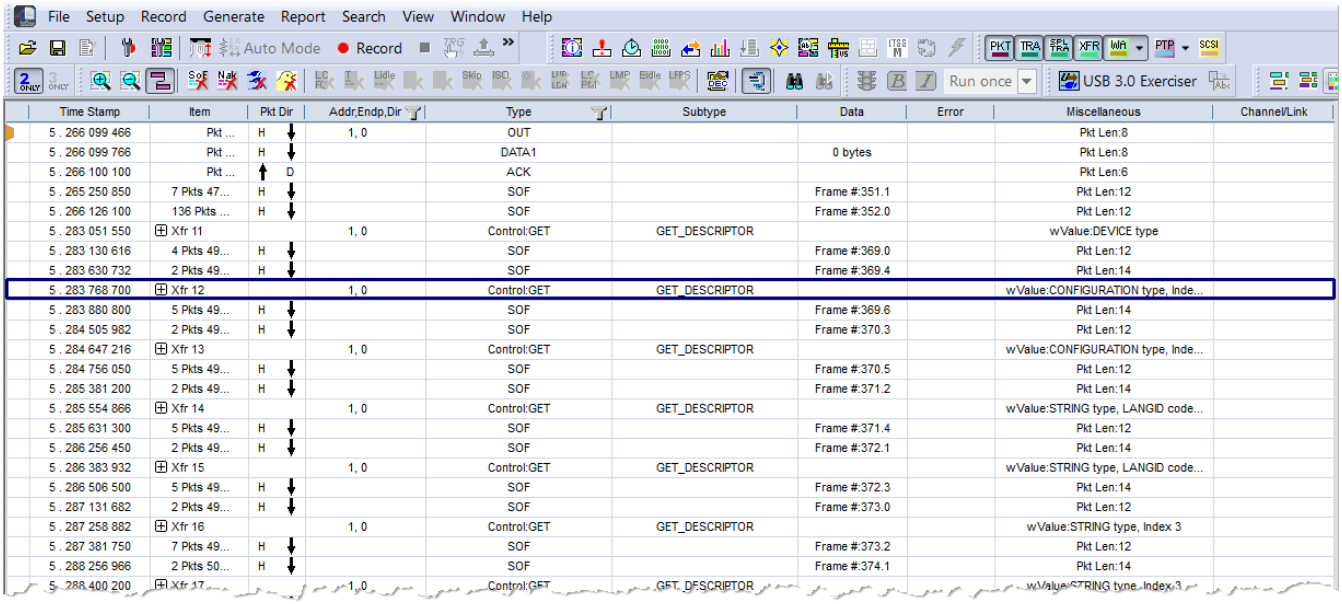


Figure 6.63: Spreadsheet View (Black And White)

6.21.1 Columns

There are several options for customizing the columns displayed in Spreadsheet View.

6.21.1.1 Basic Column Adjustments

These adjustments can be made by right-clicking on a column header and choosing a menu option.

- To **add** a single column, right-click a column header, select **Add Standard Column,** and then select the type of column to add. This option provides a list of commonly used columns.
- To **add** a column that's more specific to a row of data in your trace, highlight the row that you want to focus on, then right-click a column header and go to **Add Column Specific to Current Row.** The list of column type options will vary depending on the contents of the row you've selected.
- To **delete** a single column, right-click a column header and then select **Remove Column**.
- To **reposition** a single column, select the column header and drag it to the new position.
- To **resize** columns, select the column divider and drag the divider to the right or left.
- To **return to the default layout**, right-click a column header and select **Restore Default Columns**.

6.21.1.2 Column Configuration Window

To add, remove, or move **multiple columns** at a time, select **Column Configuration**. The Column Configuration window opens (Figure 6.64).

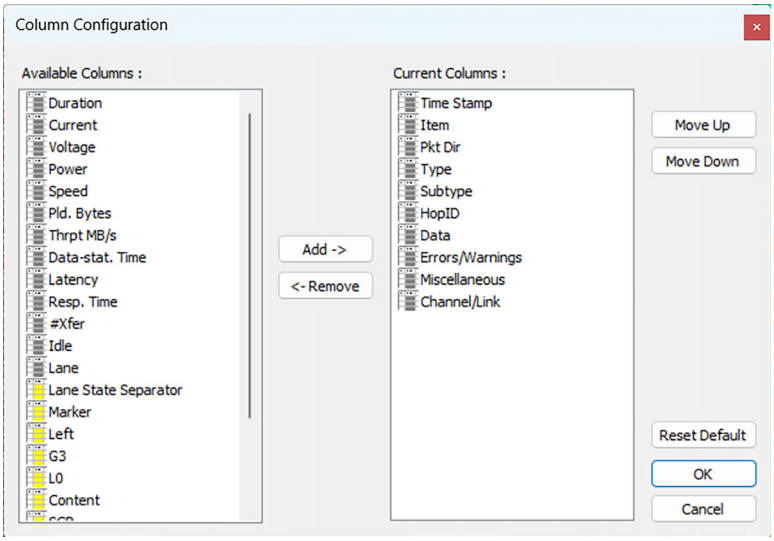


Figure 6.64: The Column Configuration Window

The **Available Columns** list shows all the available columns. Columns marked in gray are Standard Columns, while those marked in yellow are more specific. The **Current Columns** list displays the columns that are in use in Spreadsheet View.

In this window, you can **Add** or **Remove** columns. You can also rearrange the order of the **Current Columns** list using the **Move Up** and **Move Down** buttons. The option to **Restore Default** is also available in this window.

6.21.2 Rows

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

Table 6.1: Rows (Sheet 1 of 3)

Option	Description
Display Options	Opens the Display Options menu (see Chapter 8, *Display Options*).
CATC Walk	See and manage playlists. (see 6.3 *CATC Walk Playlist*).
Real-time Statistics	Allows you to view traffic statistics as they occur. See 10.20 *Real-Time Monitoring*.
Trace Views	Displays CATC Trace, Compressed CATC Trace, Spreadsheet (Color), or Spreadsheet (B/W).
Unhide fields	Unhide previously hidden Traffic, V_{BUS} 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
Hiding 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: SOFs: Start of Frames Chirps: Chirp-K and Chirp-J Bus conditions (these are recorded only)

Table 6.1: Rows (Sheet 2 of 3)

Option	Description
Hiding USB 3.2 Traffic	Hides: Training Sequence Packets – TSEQ, TS1/TS2 Hide Link Commands – LUP/LDN, Flow Control, Power Management, GenT NOP, GenT Link Keep-Alive 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
Hiding USB4 (or TBT3) Traffic	Hides a variety of USB4 packets and events.
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 Packets
Hide USB2 NAKs/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 6.10 *Stacking*.
Decoding Settings	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 Chapter 9, *Decode Requests*.
Enable Sync Traces	Synchronizes views between synced traces. See 6.22 *Enable Sync Traces (used with Hub Compliance)*.
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

Table 6.1: Rows (Sheet 3 of 3)

Option	Description
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 the 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.

6.21.3 Detail View and Spreadsheet View

To display the Detail View, from the Spreadsheet View:

- Double-click a packet, transaction, or transfer.

OR

- Choose a field and select **Report > Detail View** or click  or  on the toolbar (Figure 6.65).

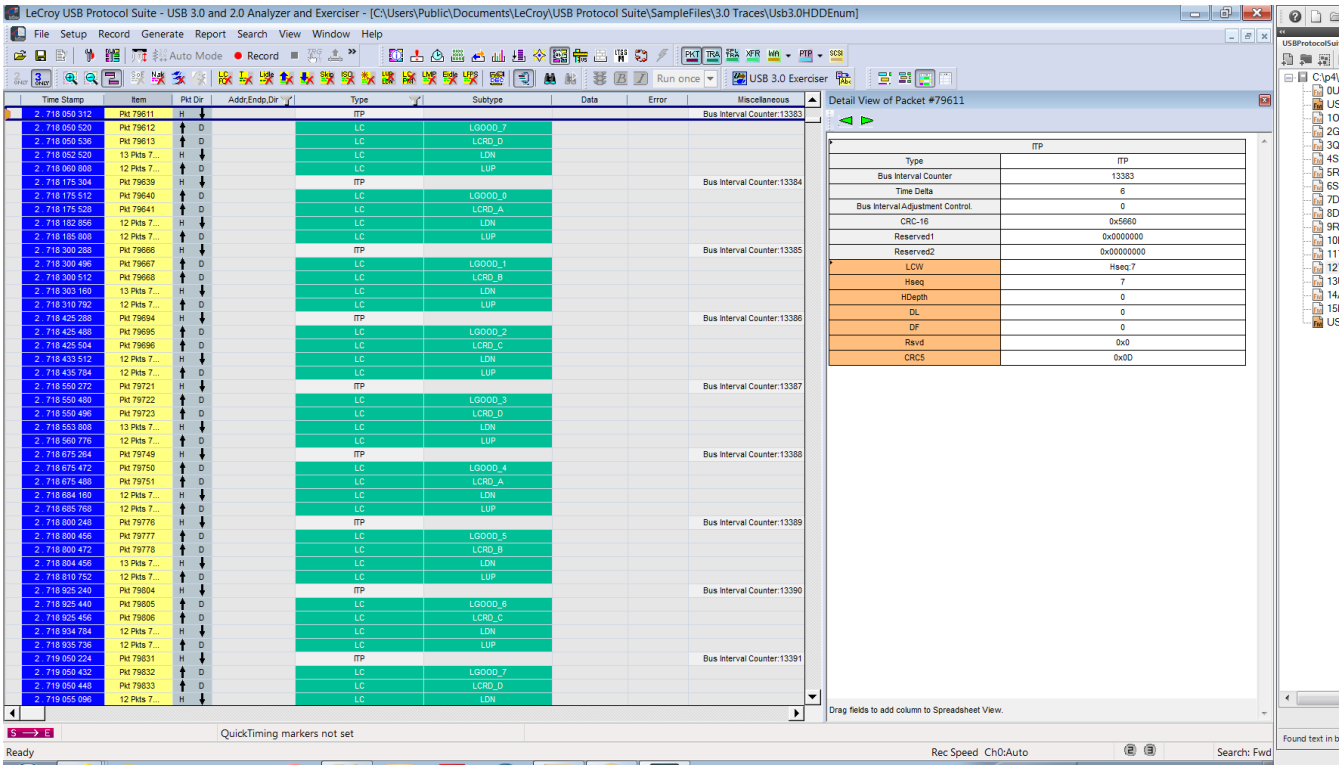
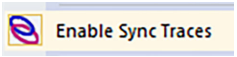


Figure 6.65: Detail View in Spreadsheet View

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

6.22 Enable Sync Traces (used with Hub Compliance)

This button 

causes the upstream and downstream traces to be time synchronized for scrolling, etc. This only works on traces that 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 6.66.

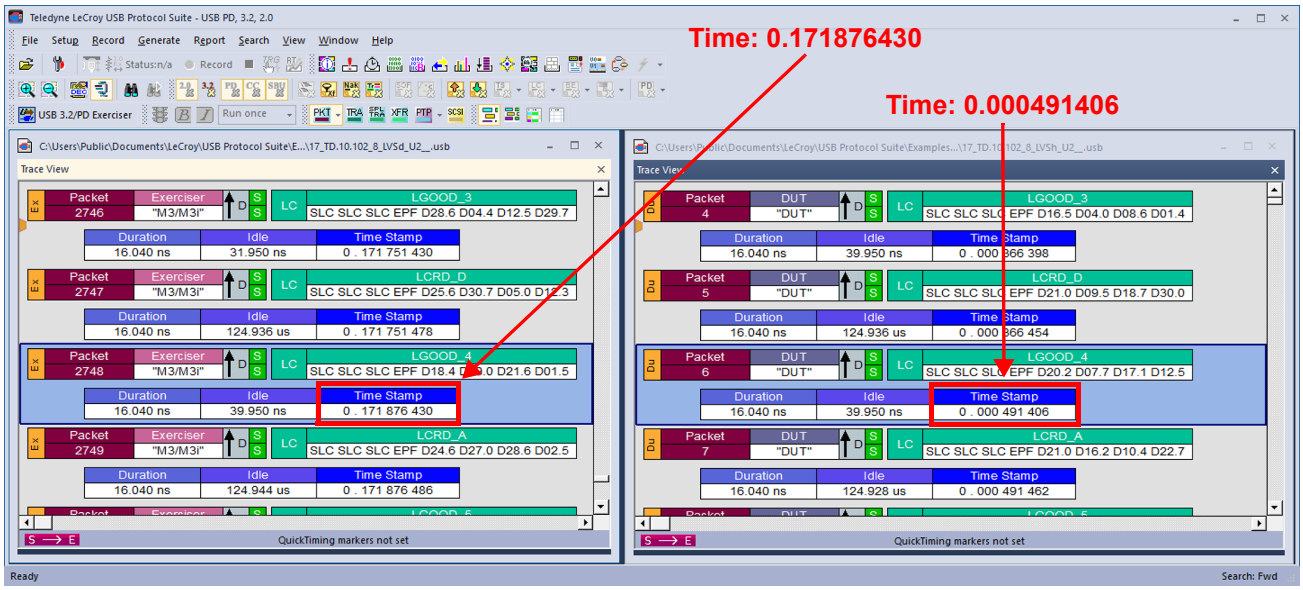
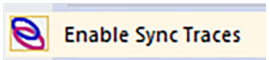


Figure 6.66: Two Traces Loaded “Enable Sync Traces” is not turned on

Now select the 

button on the View Menu (4.2.5 *View Menu*). The result can be seen below in Figure 6.67. 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.

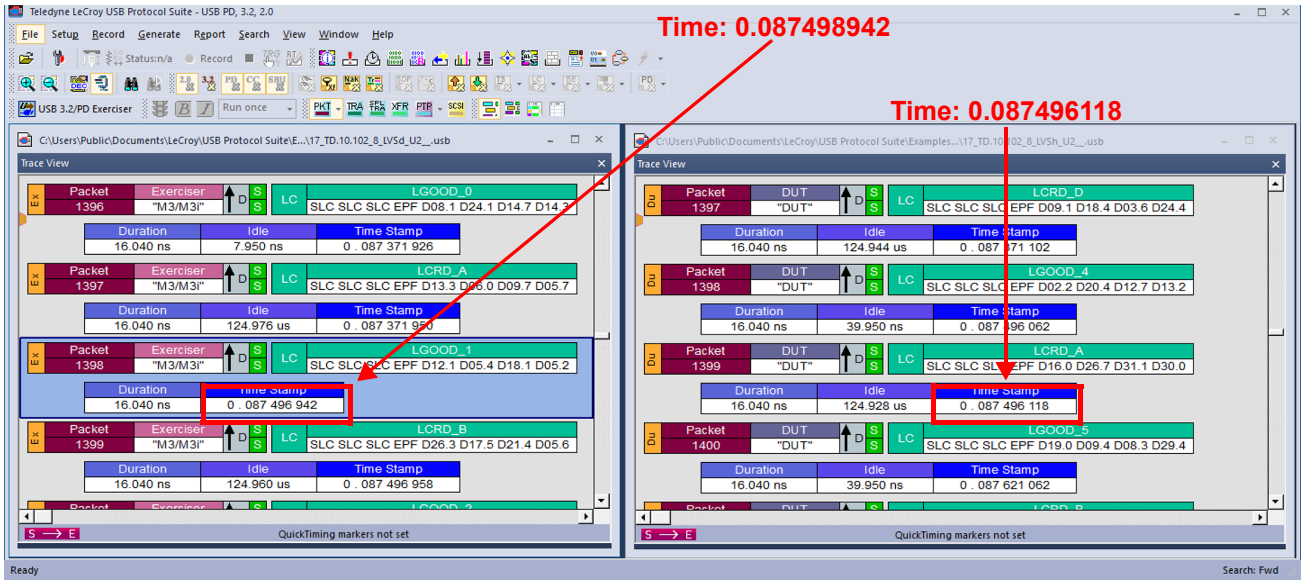


Figure 6.67: Two Traces Loaded “Enable Sync Traces” is Enabled

6.23 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:

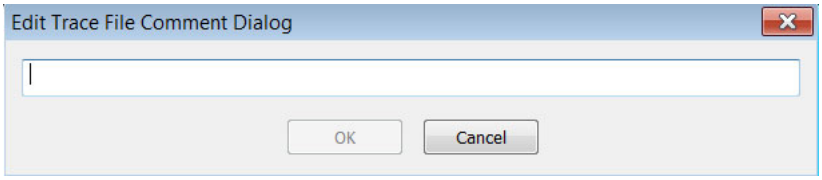


Figure 6.68: Edit Comments For Trace File Dialog

2. Create, view, or edit the comment.
3. Click **OK**.
4. To view comments in Windows Explorer, select the **Comments** attribute.

6.24 Quick Timing

Quick Timing Markers can be used to quickly measure the time from the start or end of one packet to the start or end of another packet. Simply right-click on the number or timestamp of any two packets upon which you’d like to place Start and End markers and select one of the Quick Timing options. (See Figure 6.69).

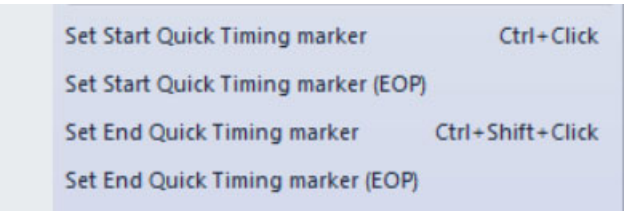


Figure 6.69: Set Quick Timing Markers

The results are shown in a special Quick Timing Bar at the bottom of the Trace View.

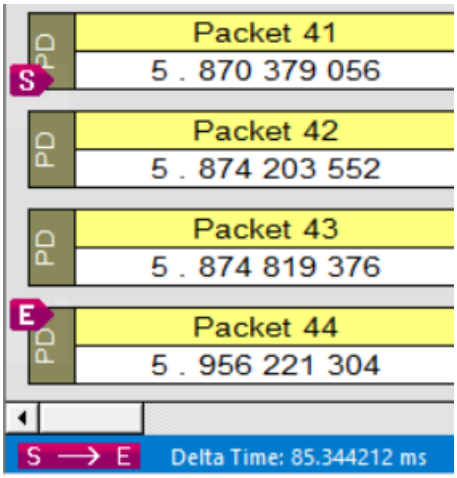


Figure 6.70: Quick Timing Bars

Once markers are placed, you can drag-and-drop them between Start of Packet and End of Packet, or even onto different packets. (See Figure 6.71).

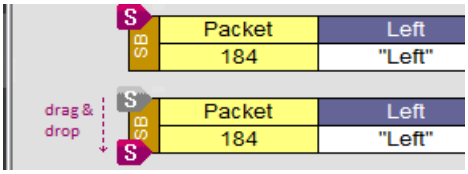


Figure 6.71: Dragging and Dropping Quick Timing Bars

6.25 Port Alias

The Port Alias is a label applied to all traffic from one of the two port partners throughout the trace. This allows you to easily track which side a specific packet has come from, even if Power Role or Data Role Swaps had occurred during the capture.

The name applied to each port can be configured initially in the Recording Options (see 5.2.6 *Connected Device Name*), or modified after recording by right-clicking on the exiting Port Alias and selecting “Rename Left/Right Connector” (see Figure 6.73).

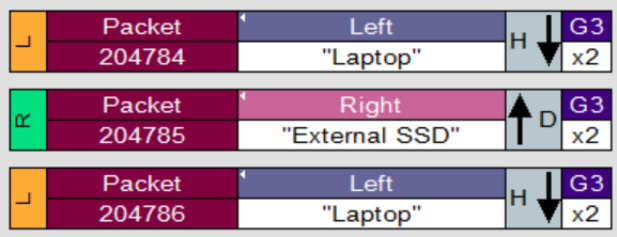


Figure 6.72: Port Aliases as seen in the Trace View

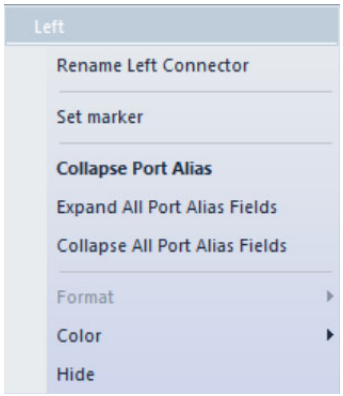


Figure 6.73: The Port Alias Right-click Menu

6.26 Field Highlighting

Packet fields are synchronized across various reports. Select a field in Trace View, Spec View, or Detail View to see it highlighted in the other views. See Figure 6.74.

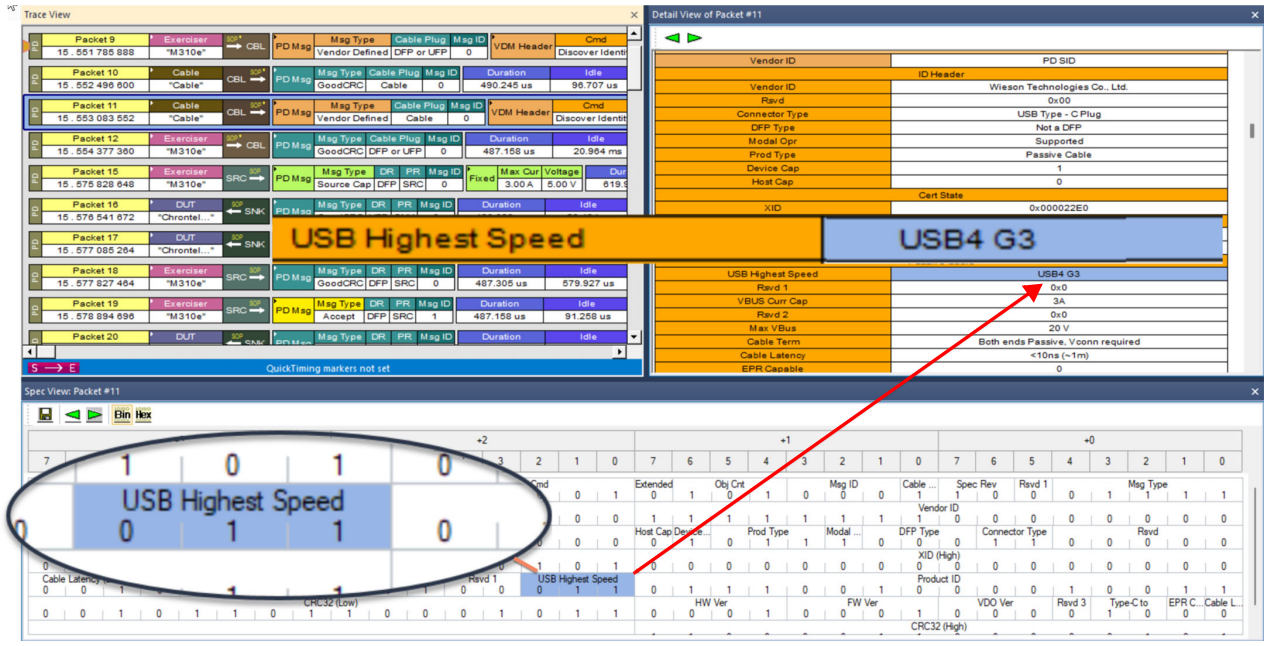


Figure 6.74: USB Highest Speed field highlighted in Spec View

Chapter 7

Searching Traces

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

7.1 Search Menu

To view the Search options, click the **Search** tab in the Menu bar (Figure 7.1).

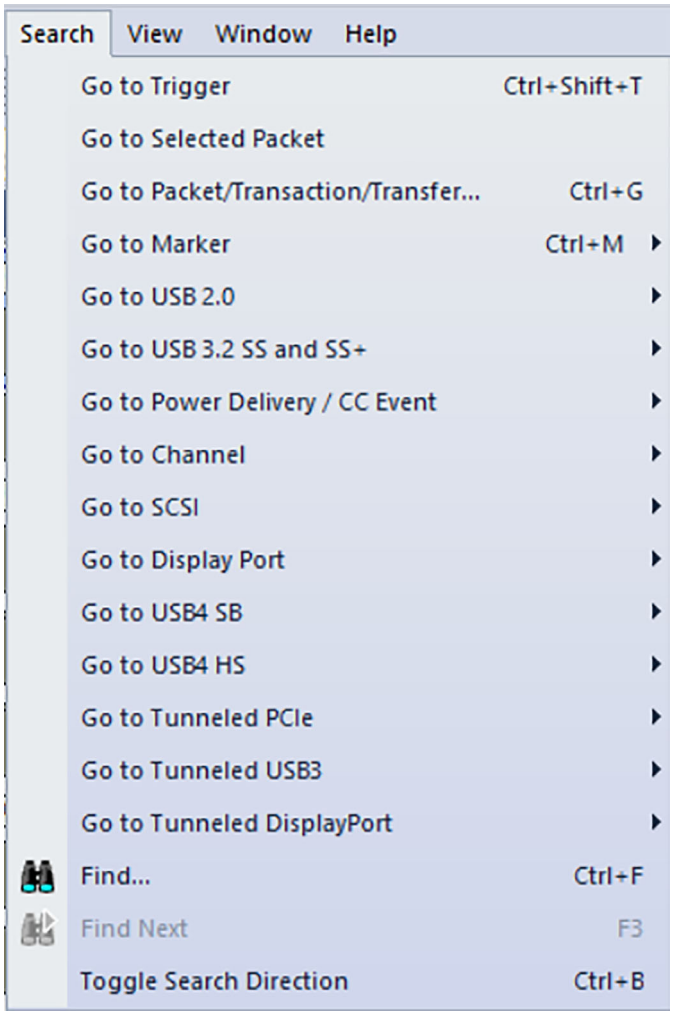


Figure 7.1: Search Drop-Down Menu

Search options are described in Table 7.1.

Table 7.1: Search Menu Options (Sheet 1 of 6)

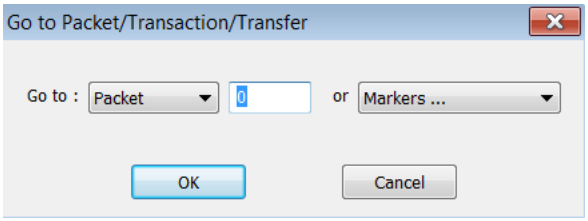
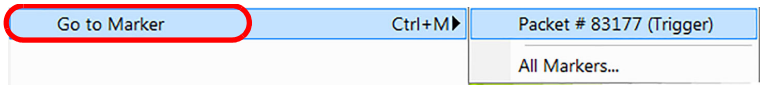
Option	Description
Go to Trigger	**NOTE: Go to Trigger** is enabled only when a trigger has created the traffic file. • The Trace View is repositioned to the first packet following the Trigger event. This packet is at the top of the screen. • The resulting item will be shown as selected in the view. • Packet Selection works with Go to Trigger.
Go to Selected Packet	To display a selected packet select **Go to Selected Packet** under **Search** on the Menu Bar.
Go to Packet/Transaction/ Transfer	To display a specific packet: 1. From the menu bar, select **Search > Go to Packet/Transaction/ Transfer**. The dialog box pops up as shown in Figure 7.2.  Figure 7.2: Go To Packet/Transaction/Transfer 2. Select the desired viewing level (packet, transaction etc.) from the **Go to** drop-down menu. 3. Enter the number of the packets you want to display. 4. Click **OK.** The Trace View is repositioned with the selected packet at the top of your screen.
Go to Marker	To instruct the analyzer to display a marked packet: 1. Select **Go to Marker** under **Search** on the Menu Bar. A drop-down menu listing the marked packets in that Trace View appears (Figure 7.3).  Figure 7.3: Go To Marker Menu Option 2. Select the desired packet from the list. The Trace View is repositioned with the selected packet at the top of the screen.
	NOTE: The **Go to Marker** feature functions in conjunction with the **Set Marker** feature. The comments within the parentheses following each marked packet are added or edited with the **Set Marker** feature. Please refer to 6.2 *Markers*. • You can use **Ctrl+M** to go immediately to the All Markers dialog. • Packet Selection works with Go to Marker.

Table 7.1: Search Menu Options (Sheet 2 of 6)

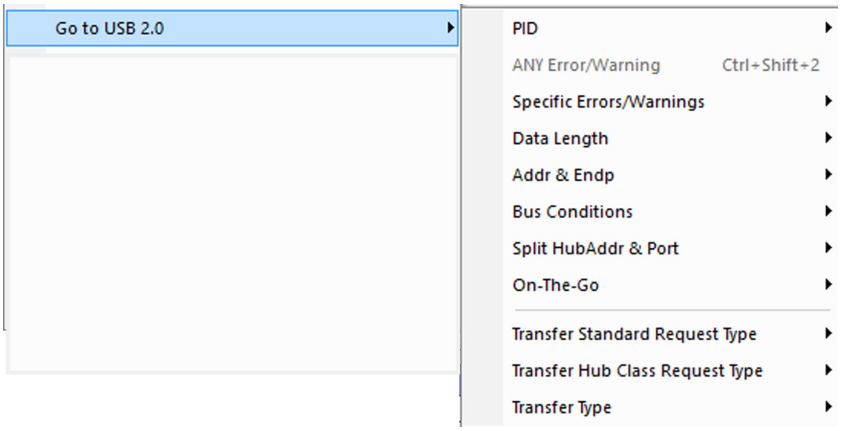
Option	Description
Go To USB 2.0	The Go To USB 2.0 feature takes you directly to an event in a Trace. 1. From the menu bar, select **Search > Go To USB 2.0**. The Go To USB 2.0 drop-down menu becomes available (Figure 7.4).  Figure 7.4: Go To USB 2.0 Menu Option 2. Choose the event you want to go to and enter the necessary information.
• Packet IDs (PIDs)	Select the type of packet to which you want to go.
• 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.
• 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. You can press **Shift+E** to go to the first error of any type.
• Data Length	Allows you to search for data packets of particular lengths. Lengths are displayed in Bytes in a drop down menu as shown below. Selecting a length causes the display to move to the next instance of that packet length.
• Addr & Endp	The Addr & Endp feature allows you to search for the next packet which contains a particular address and endpoint. All available address endpoint combinations are displayed in the pull down menu
• Bus Conditions	Allows you to search by bus conditions such as traffic speed, reset, and suspend. All available bus conditions are displayed in the pull down menu.
• Split HubAddr & Port	Allows you to go to a split hub address and port.
Go To USB 2.0 (Continued)	
• 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

Table 7.1: Search Menu Options (Sheet 3 of 6)

Option	Description
• Transfer Standard Request Type	Allows you to go to a split hub address and port.
• Transfer Hub Class Request Type	Allows you to search for Transfer Hub Class Request Type attributes.
• Transfer Type	Allows you to search for Transfer Type attributes.
Go To USB 3.2 SS and SS+	The Go To USB 3.2 feature takes you directly to an event in a Trace. 1. From the main menu bar, select **Search > Go To USB 3.2 SS and SS+**. The USB 3.2 SS and SS+ menu appears. 2. Select the event you want to go to and enter the necessary information. USB 3.2 SS and SS+ menu options are described below.
• Packet Type	Select from a variety of Packet Types.
• LFPS Type	Select from a variety of LFPS Types.
• Deferred Packet	Jump to the next Deferred Packet request in the trace view
• 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.
• Specific Errors/Warnings	Select the specific Error or Warning to which you want to go from the drop-down list. **NOTE: Seq Number Error** refers to Transaction Sequence Numbers (0 to 31), not to Link Control Word (LCW) sequences.
• Data Length	Select an appropriate data length from the drop-down list.
• Addr/Endp	Provides a list of Addresses and Endpoints. Figure 7.5 shows a partial list of Addresses and Endpoints.
• Header Packet Type	Select the header packet type to which you want to go.
Go To USB 3.2 SS and SS+ (Continued)	
• Link Command	Select the link command to which you want to go.
• LMP Subtype	Select the LMP Subtype to which you want to go.
• Transaction Packet Type	Select the Transaction Packet Type to which you want to go.
• PHY Transaction Type	Select the PHY Transaction Type to which you want to go.

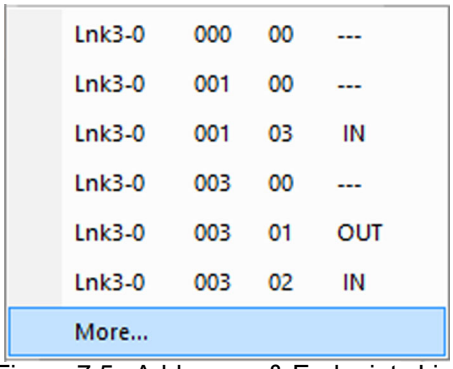


Figure 7.5: Addresses & Endpoints List

Table 7.1: Search Menu Options (Sheet 4 of 6)

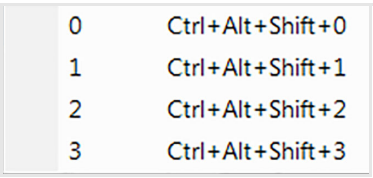
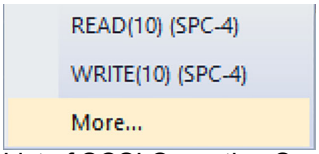
Option	Description
• LGO Transaction Type	Select the LGO Transaction Type to which you want to go.
• Transfer Standard Request Type	Allows you to search for Transfer Standard Request Type attributes.
• Transfer Hub Class Request Type	Allows you to search for Transfer Hub Class Request Type attributes.
• Transfer Type	Allows you to search for Transfer Type attributes.
Go To Power Delivery/CC Event	The USB Protocol Suite software allows you to search for the types of packets listed here.
• PD Control Message	You can search for specific types of power delivery control messages.
• PD Data Message	You can search on specific types of power delivery data messages.
• PD Extended Message	You can search on specific types of power delivery extended messages.
• PD Reset	You can search on specific types of power delivery resets.
• PD Other	You can search on other types of power delivery events.
• PD Transaction Type	You can search on specific types of power delivery transaction types.
• PD Transfer Type	You can search on a wide variety of power delivery transfer types.
• PD Any Error	You can search on any type of power delivery error.
• PD Specific Error/Warning	You can search on a specific type of Power Delivery error or warning.
• CC Event	You can search for a specific configuration channel event.
Go to Channel	Allows you to search for traffic by 1 (Classic-Speed) or 0 (Hi-Speed). You can search for the types of packets shown in Figure 7.6:  Figure 7.6: Go to Channel Options
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. These options are described below.
• SCSI Operation	Figure 7.7 displays a partial list of search options:  Figure 7.7: List of SCSI Operation Search Options
• Command Status	Use this option to search for SCSI command status of **GOOD** or **UNDEFINED**.
• Task Management	Jump to the next Task Management request in the trace view
• Task Management Response	Jump to the next Task Management response in the trace view

Table 7.1: Search Menu Options (Sheet 5 of 6)

Option	Description
• Error	Search for: • SCSI Op Status • SCSI Op Invalid OpCode
• SCSI Logical Unit Number	Use this search option to search for unit number **0x0**.
• SCSI Data Length	Use the drop-down list to select an appropriate data length to search.
Go to Display Port	You can use the USB Protocol Suite software to search for a variety of packet types.
• Packets	Use this option to search for Packets
• Transaction Type	Provides a drop-down list allowing you to search for a variety of Transaction Types.
• Transfer Type	Select a Transfer Type to search for from the drop-down list.
Go to USB4 SB	This options facilitates searches for a variety of USB4 SB packets.
• AT	
• RT	
• LT	
• IPS	Jump to the next IPS in the trace view
• Events	• Connect • Disconnect

Table 7.1: Search Menu Options (Sheet 6 of 6)

Option	Description
Go to USB4 Rx/Tx	The USB Protocol Suite software allows you to search for a variety of packet types.
• Ordered set	
• Control Packets	
• Link Management Packets	
• Time Sync Packets	
• USS	
• IPS	Inter-Packet Symbols
• LFPS	Low Frequency Periodic Signaling
Go to Tunneled PCIe	
• TLP	
• DLLP	
• Ordered Set	
• Link Events	
Go to Tunneled USB3	
• Packet Types	
• LFPS Type	
• Header Packet Type	
• Link Command	
• LMP Subtype	
• Transaction Packet Type	
• Data Packet Type	
Go to Tunneled DisplayPort	
• DisplayPort Main Link	
• DisplayPort AUX	
• Control TU Types	

7.2 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.

7.2.1 Using the Find Function

To run **Find**, select **Search > Find** or 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 the Search icon in the Tool Bar. The User-Defined Find Events screen appears:

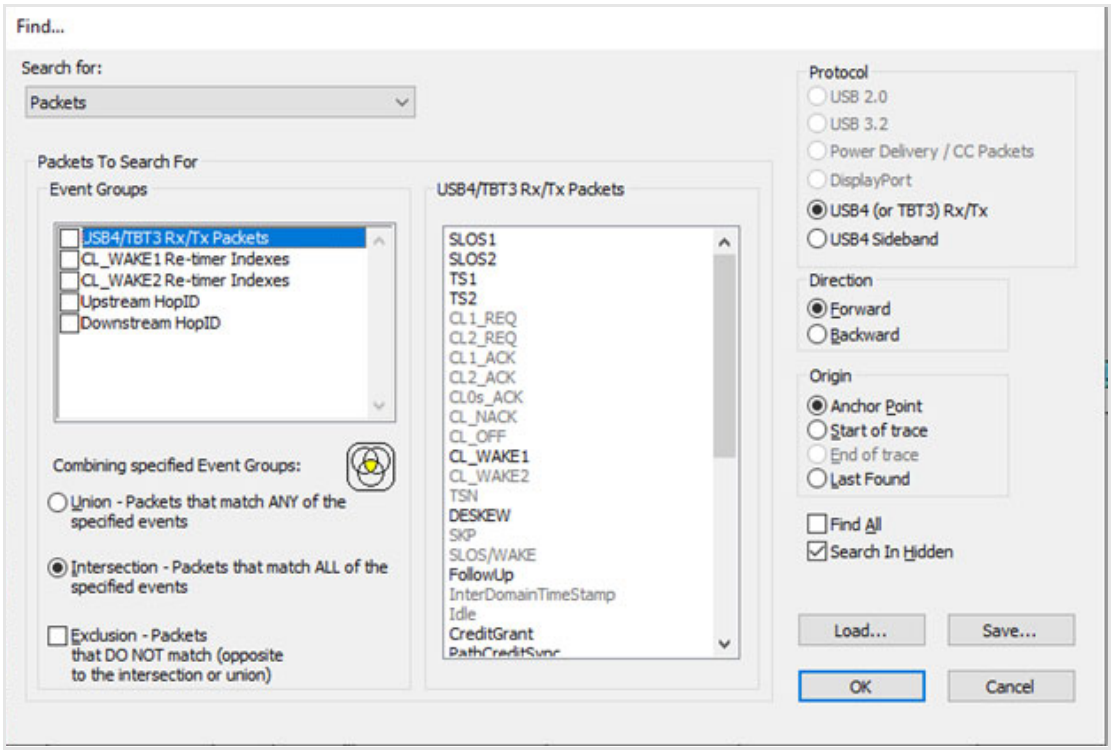


Figure 7.8: Find Dialog

2. Select the type of traffic you’re interested in from the **Protocol** area.
3. Select a level of traffic (for example: Packet, Transaction, or Transfer) from the **Search for** list.
4. Select one or more event types from the **Event Groups** box.

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. Select any of the following options:

   - Set the search **Direction** and **Origin**.
   - Check to **Search in Hidden.** This option looks for the selected items even if you have currently hidden them.
   - 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.

7. 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.

7.2.2 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.

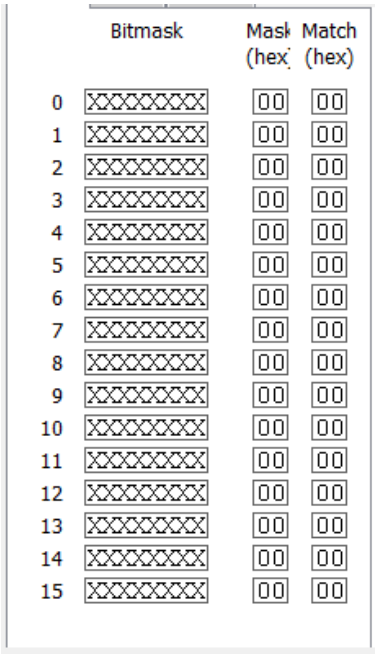


Figure 7.9: Data Pattern Mask and Match Dialog

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.

7.2.3 Find USB4 Configuration Space Transfers

1. Open a Trace with Transfer Layer traffic and click the **View Transfer Level** icon 

.

NOTE: All of the configuration space register accesses in traffic listed in different categories are based on the configuration space type (Router/Adapter/ Path/Counters).

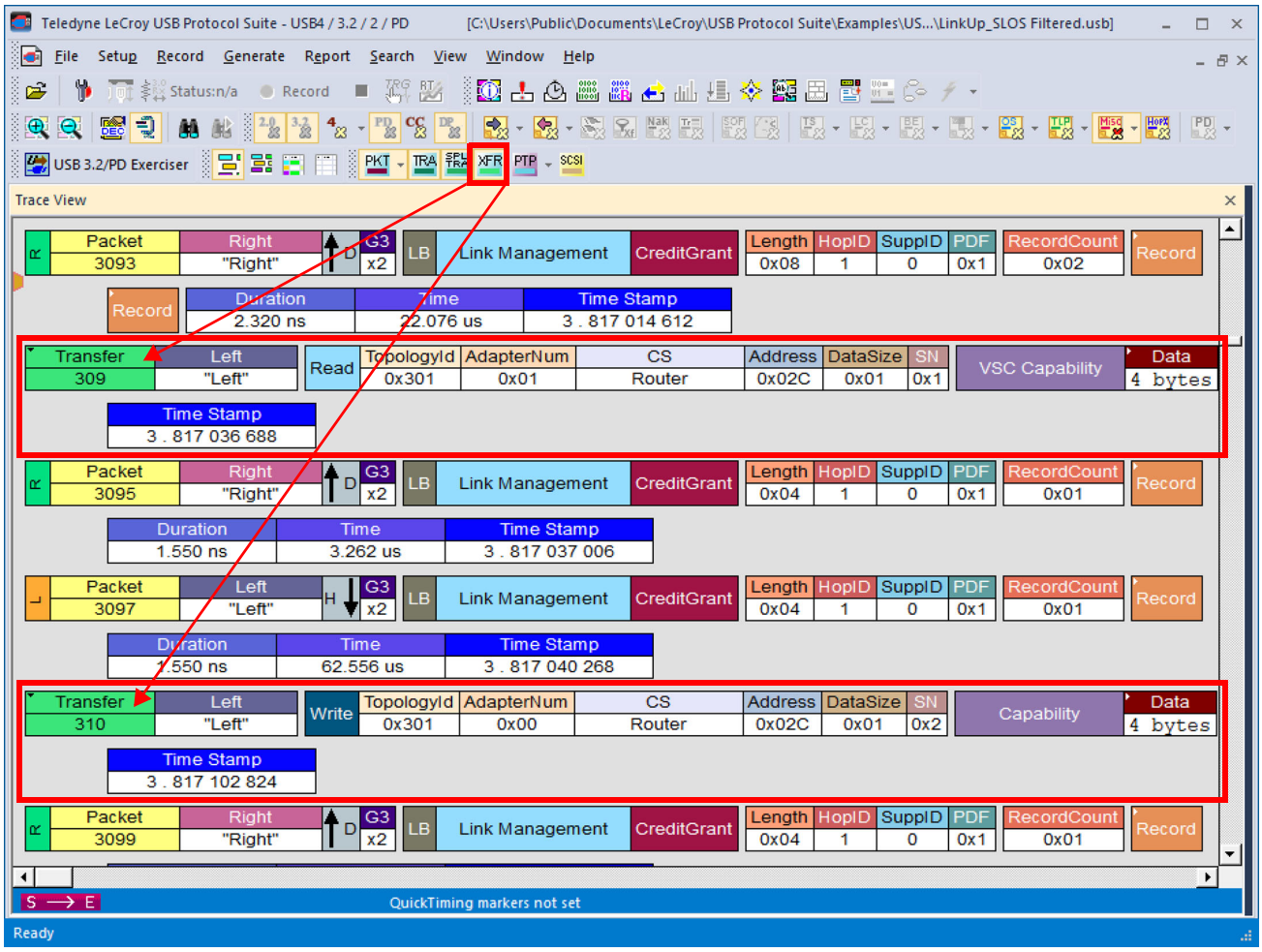


Figure 7.10: Transfer Level Traffic Displayed

2. Select the **Find** icon to bring up the Find dialog window (Figure 7.11).

The *Example* below illustrates a search for Transfers.

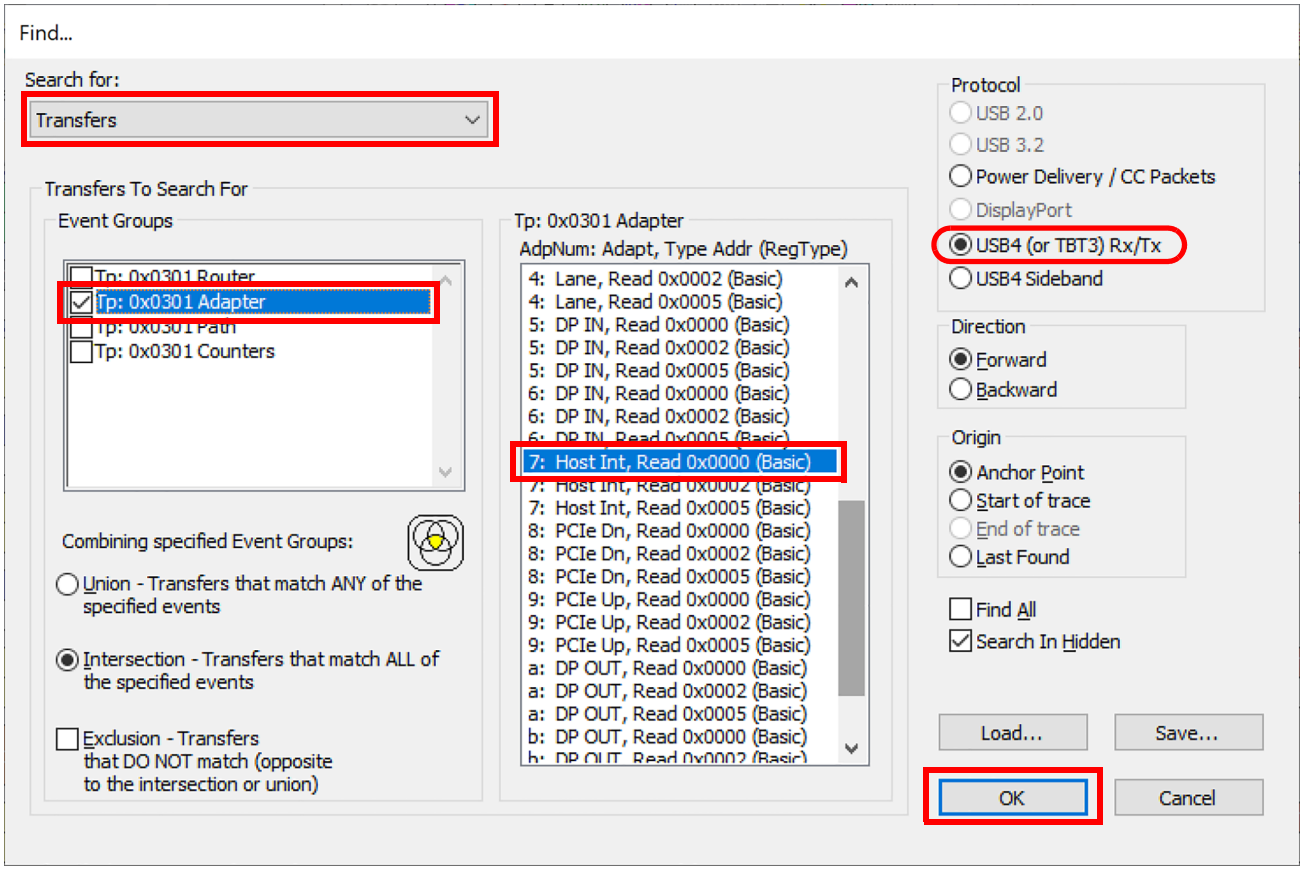


Figure 7.11: Find Dialog Box

7.2.3.0.1 Example

1. Select the following:
   - **Transfers**
   - **Event Groups → Adapter** and **Register Type**
   - **Host Int, Read: 7: Host Int, Read**
   - **USB4 (or TBT3) Rx/Tx**
2. Click **OK**.

Transfer #784 with READ, TopologyId, AdapterNum and Configuration Space will be highlighted. See Figure 7.12.

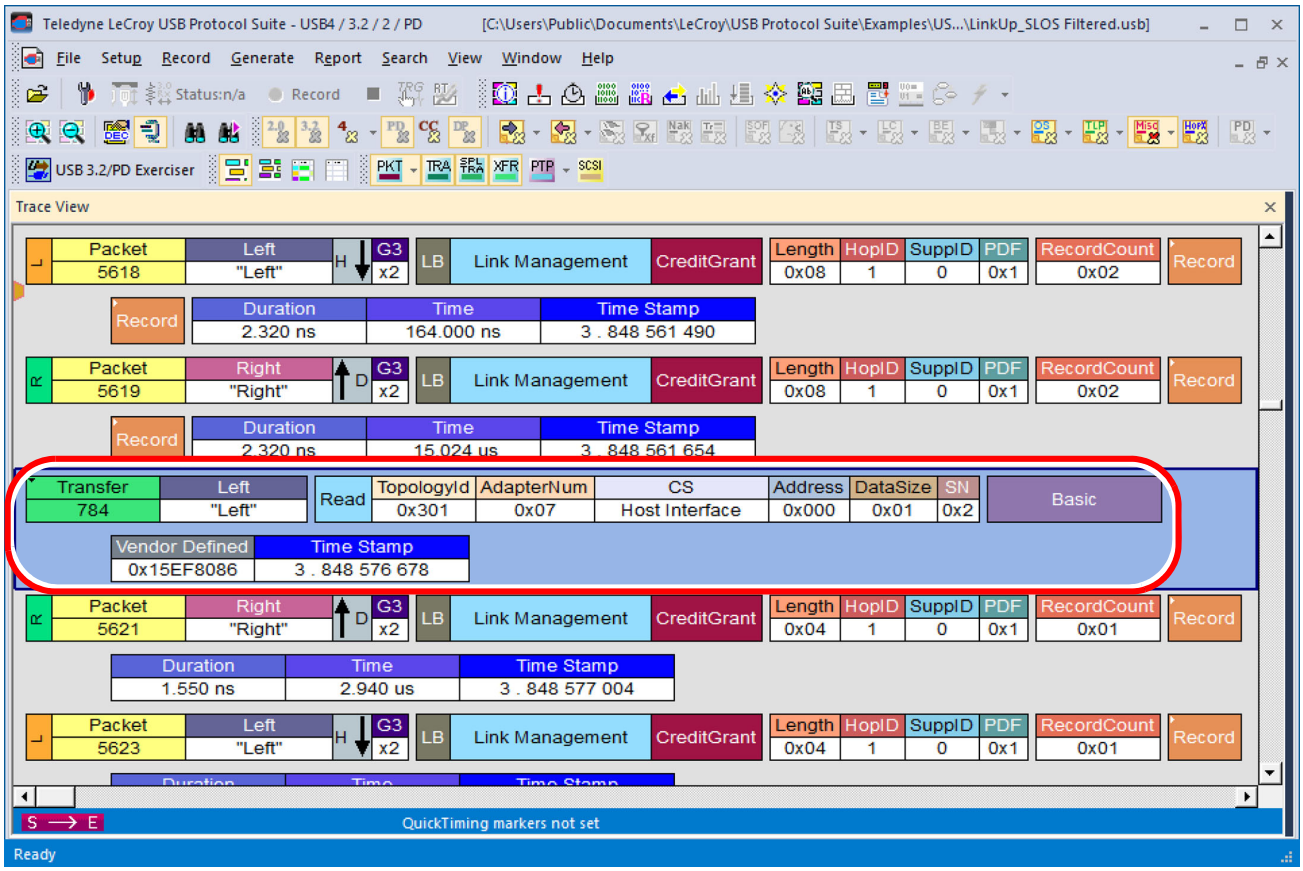


Figure 7.12: Transfer #784 Highlighted: Configuration Space, Host Interface

7.2.4 Find USB4 Operations

1. Select the **Find** icon  . This brings up the Find dialog window, which allows you to search for USB4 Operations (Figure 7.13).

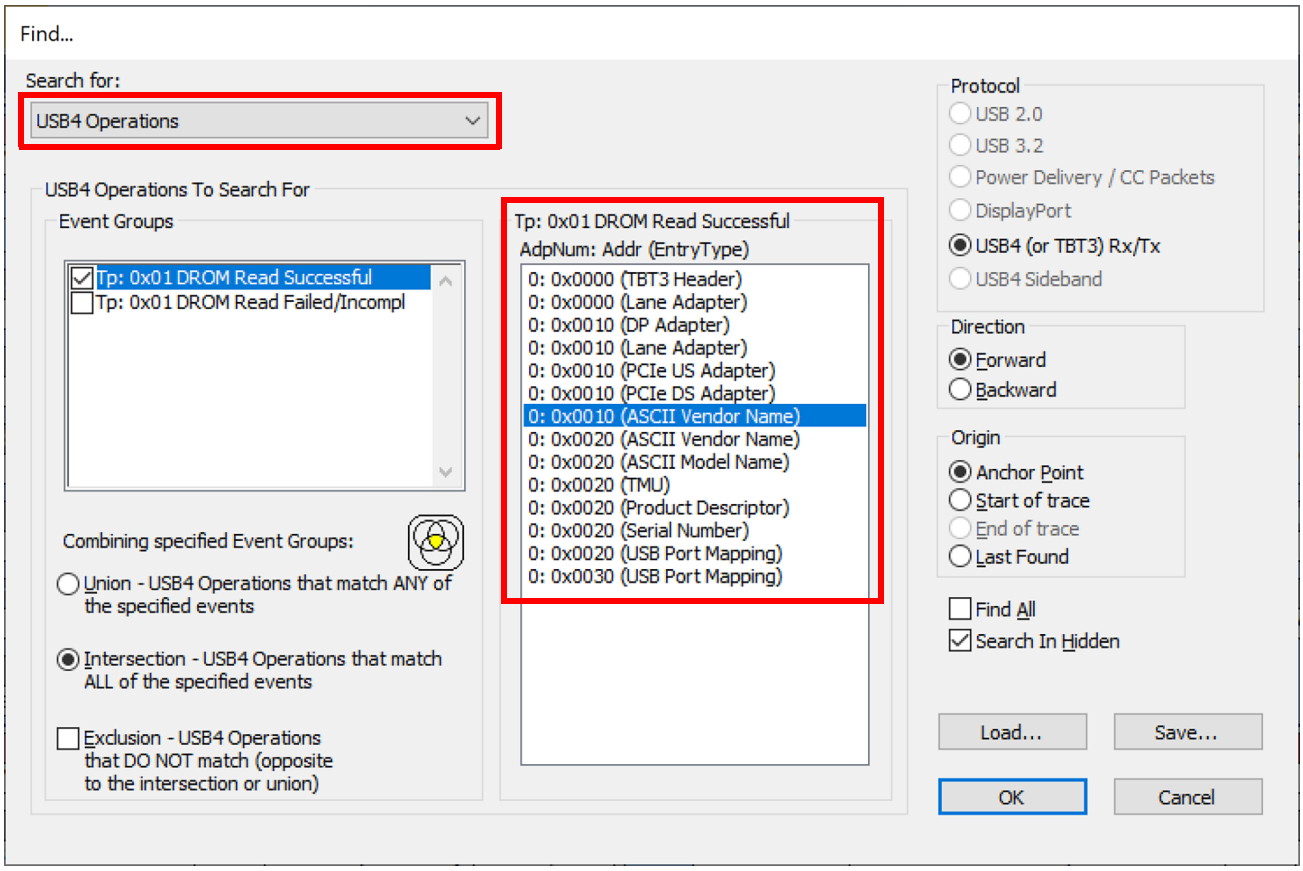


Figure 7.13: Find USB4 Operations

2. Click **OK**. The operation with the DROM Read & ASCII Vendor Name is highlighted in the loaded trace (Figure 7.14).

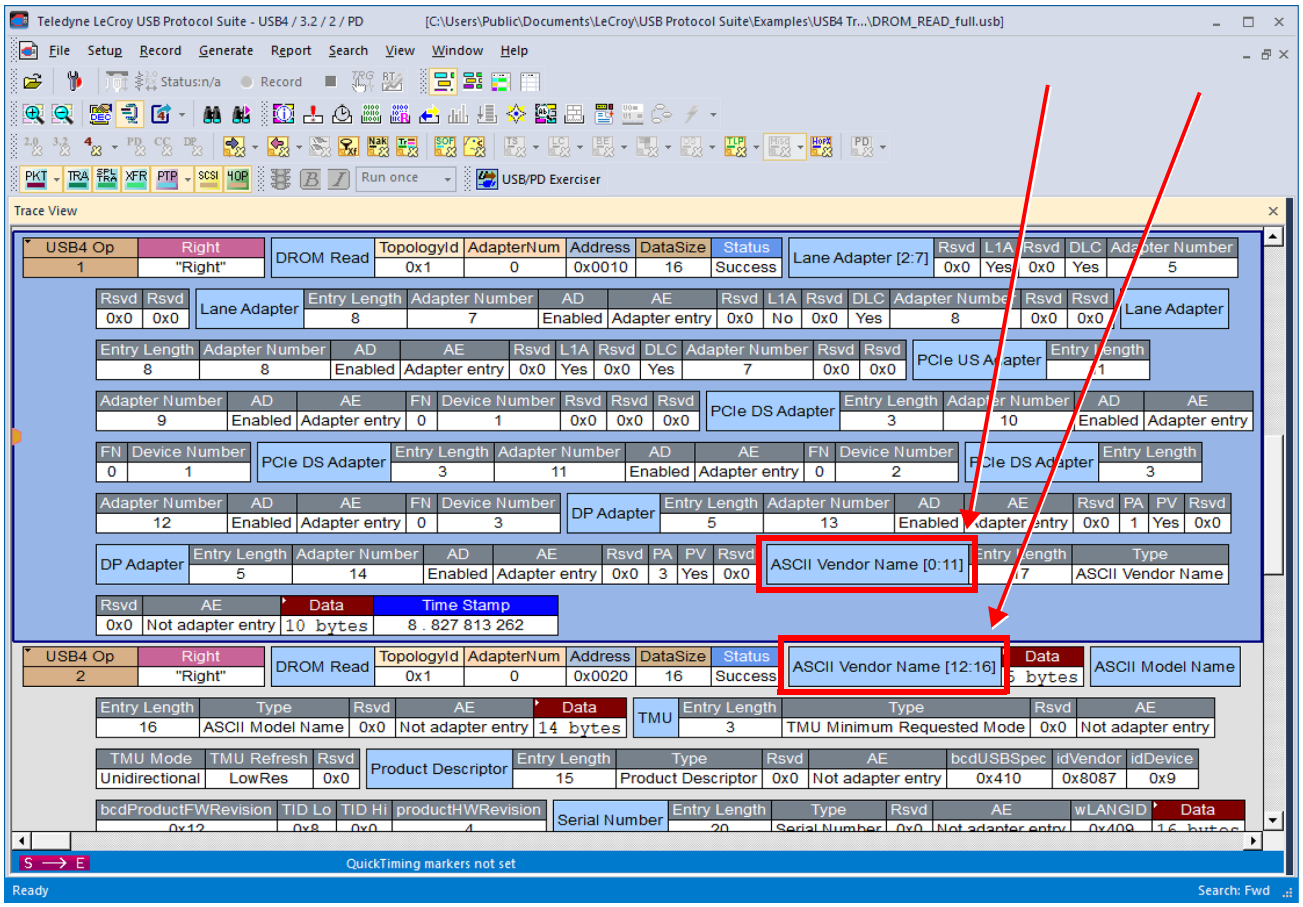


Figure 7.14: Trace with DROM Read

7.3 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.

7.4 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, do one of the following:

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

OR

- Click  on the Tool Bar:

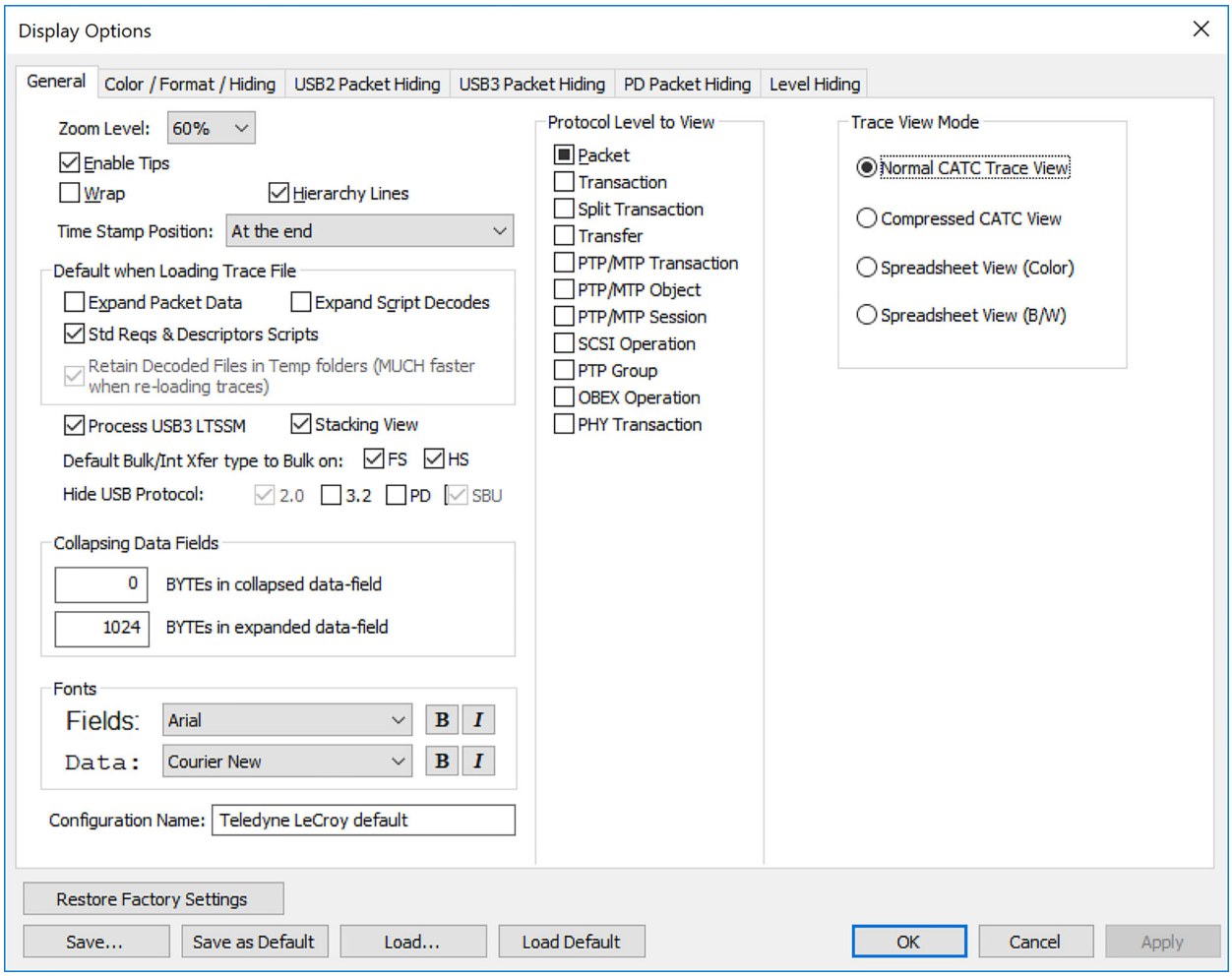


Figure 8.1: Display Options General Dialog

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 6.10 *Stacking*.
- **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:	To change the Transfer Type in Trace view, right-click the **INT** or **BULK** field and select 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).

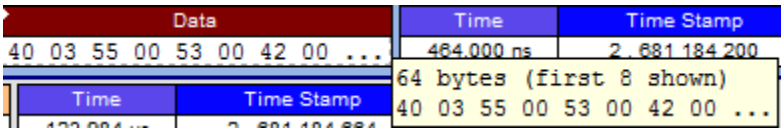


Figure 8.2: First 8 Bytes Displayed in a Field with 64 Bytes

  - **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.

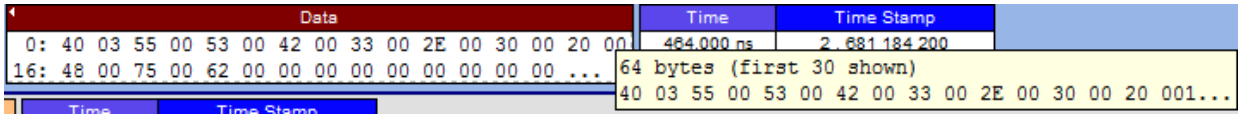


Figure 8.3: First 32 Bytes Displayed in a Field with 64 Bytes

- **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.

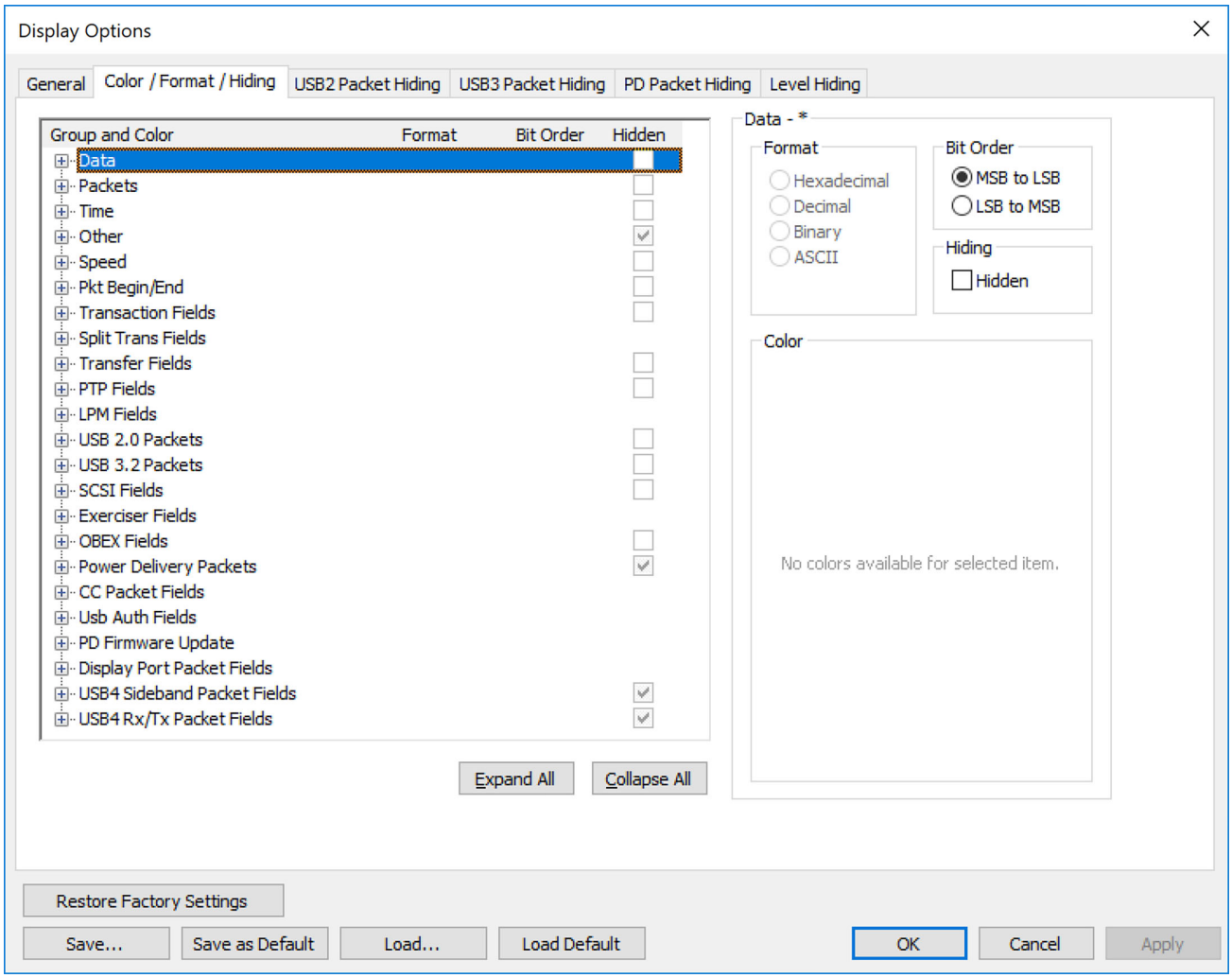


Figure 8.4: Display Options Color/Format/Hiding Dialog

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.

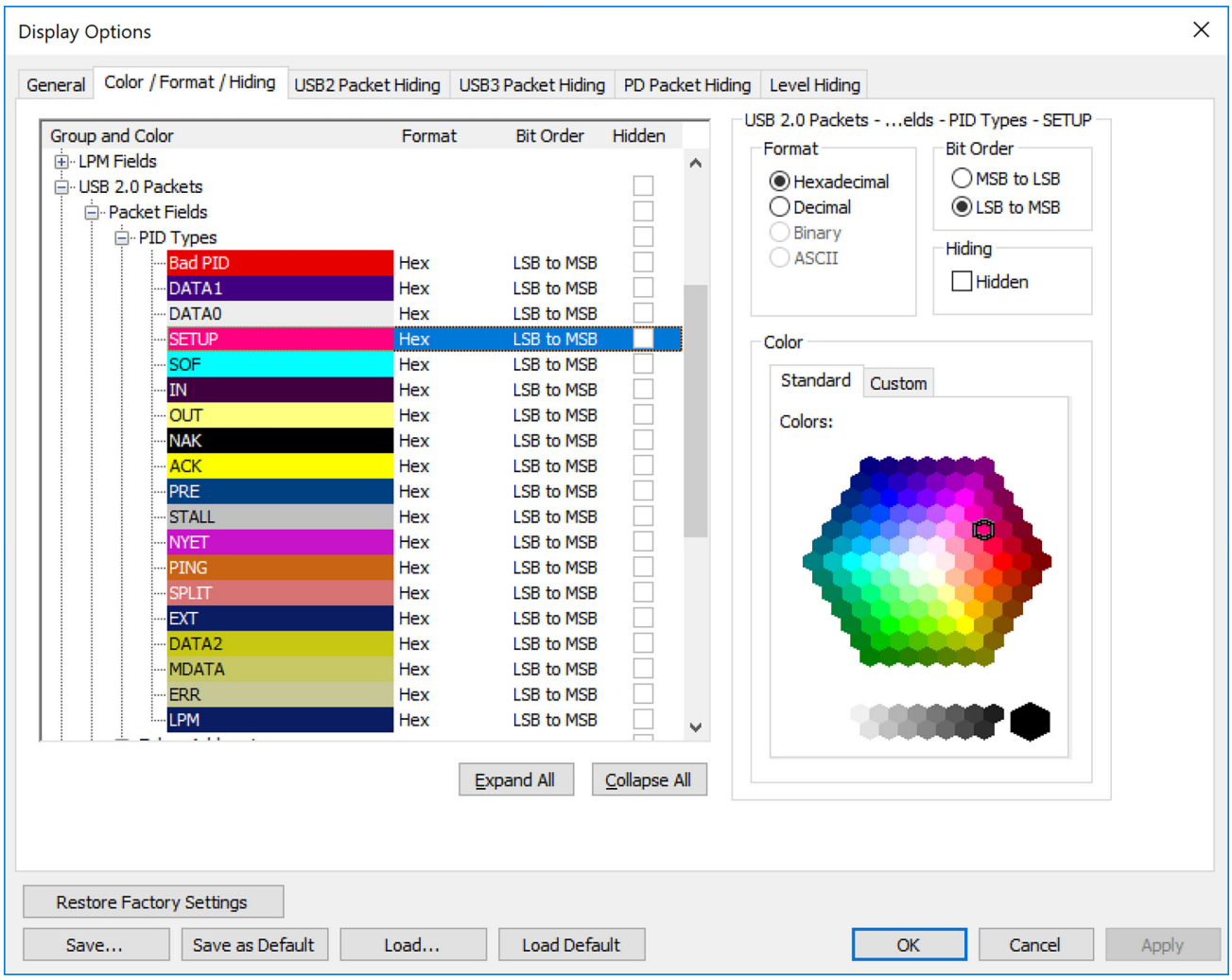
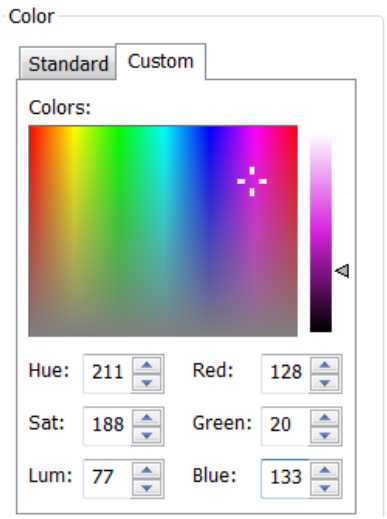


Figure 8.5: Display Options Color/Format/Hiding Dialog Group and Color Pane

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:

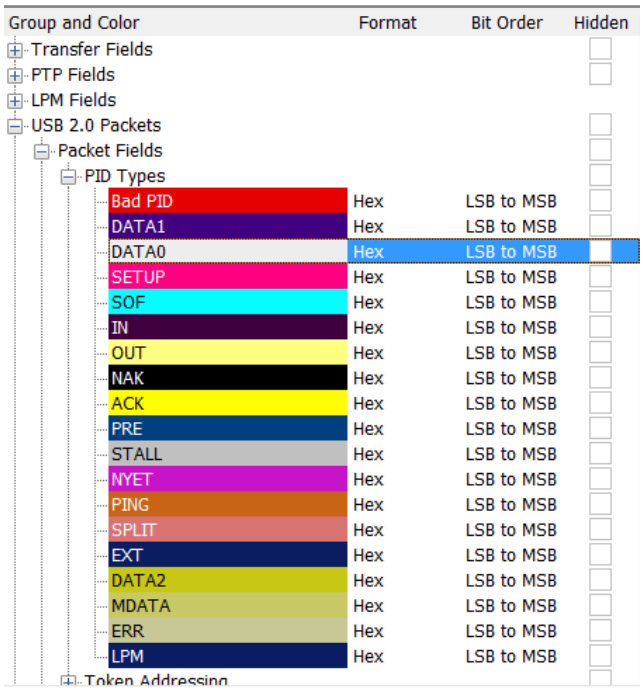


Figure 8.6: Data Types in a Group

Select a format in the Format section. If available, select Bit Order in the Format section. The options are MSB to LSB or LSB to MSB. Formats available for PID Types are shown in Figure 8.7.

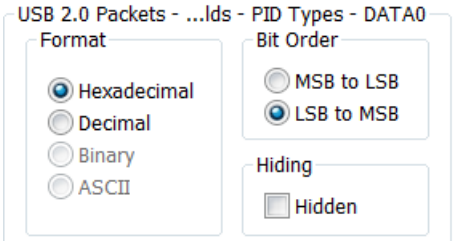


Figure 8.7: Available Formats for PID Types

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'd 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 8.8.)

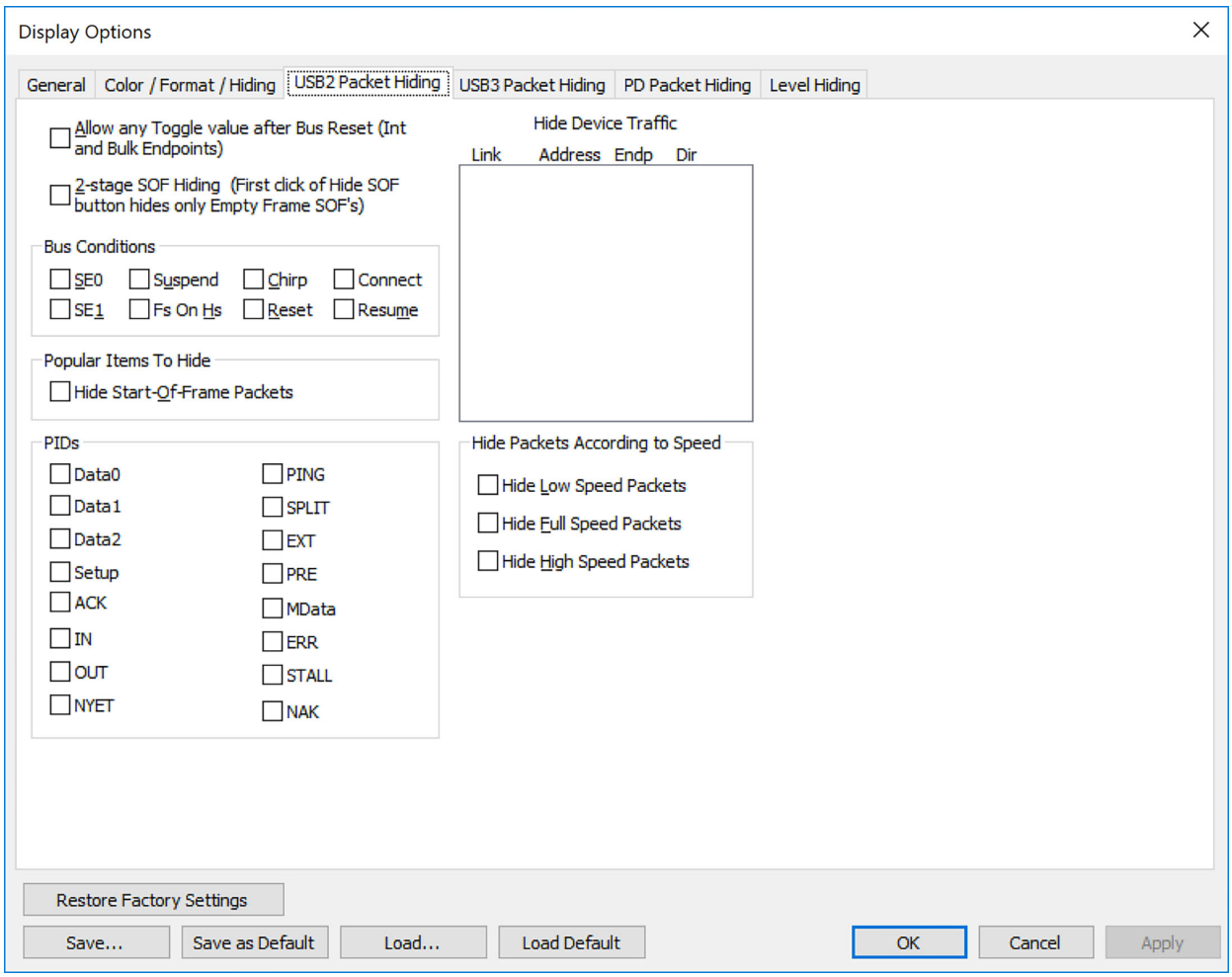


Figure 8.8: Display Options USB2 Packet Hiding Dialog

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)
- V_{BUS} 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 8.9.)

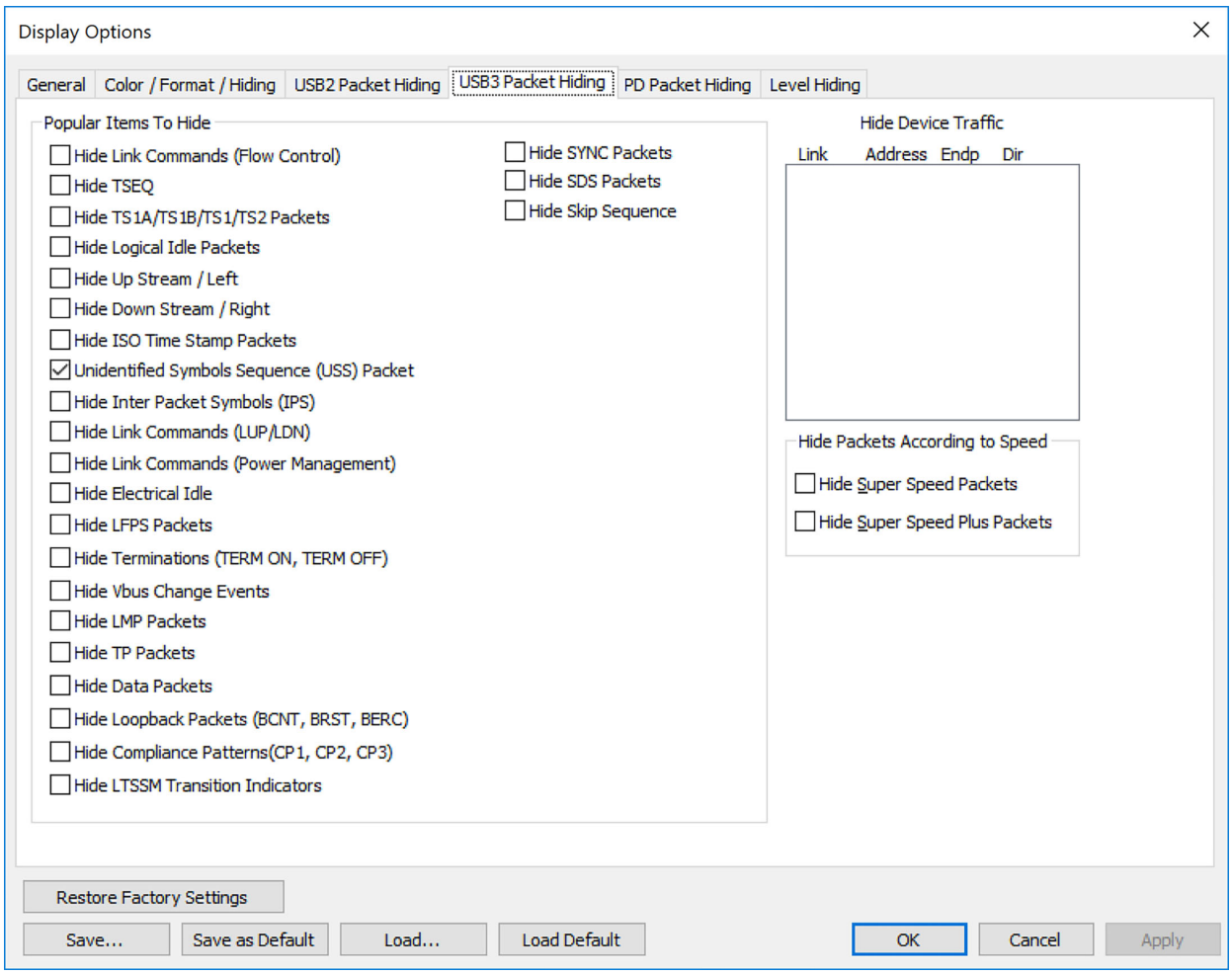


Figure 8.9: Display Options USB3 Packet Hiding Dialog

8.5 USB4 Packet Hiding

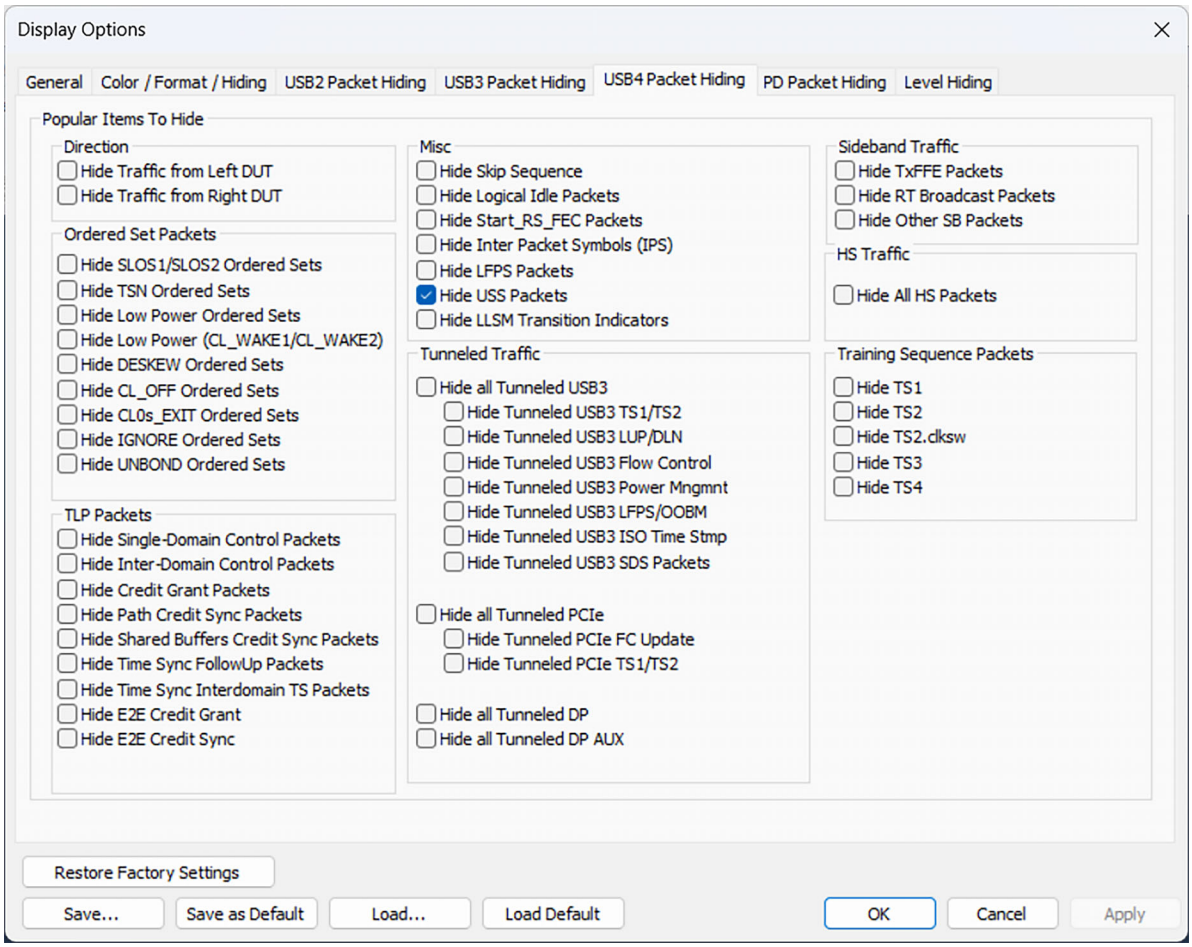


Figure 8.10: USB4 Packet Hiding

8.6 PD Packet Hiding

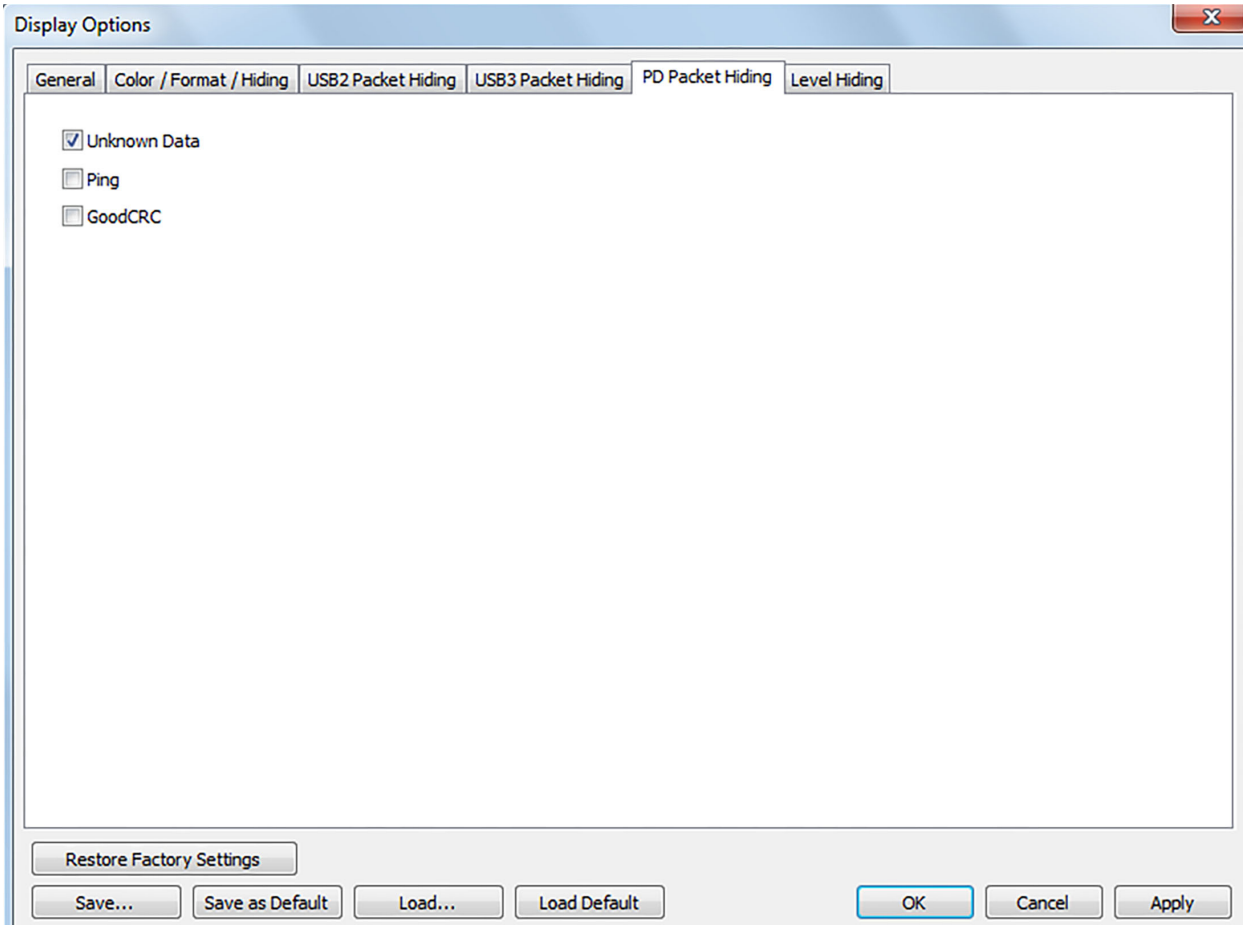


Figure 8.11: PD Packet Hiding

8.7 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 8.12.)

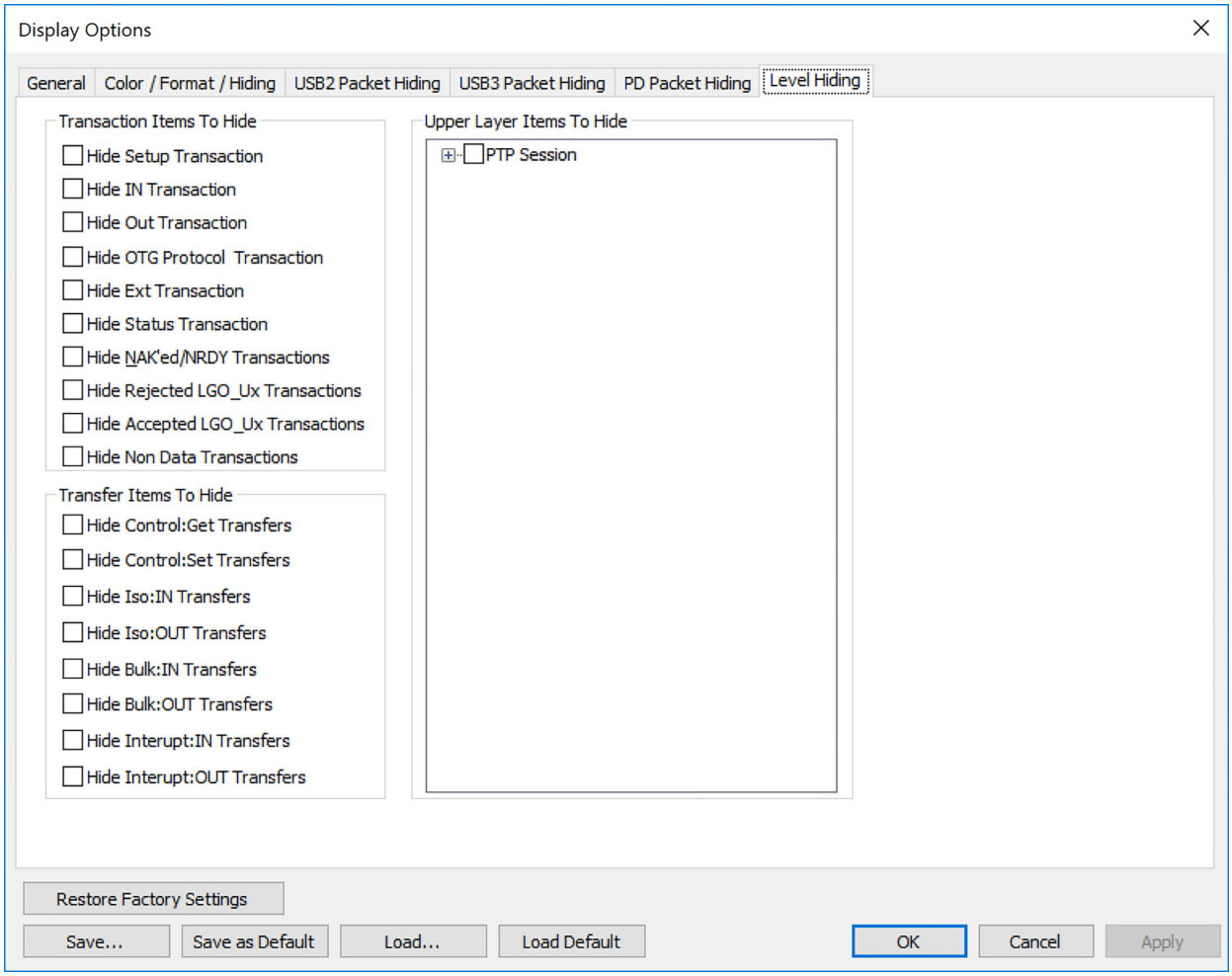


Figure 8.12: Level Hiding Dialog

8.8 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**.

8.9 Restore Factory Settings

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 (Table 9.1) are in the Scripts directory under **installation**.

Table 9.1: Decoder Files (Sheet 1 of 6)

USB Decode	USB Decoder Name	USB-IF Base Class	Codes Sub Class	Protocol ID
Audio Class (See “Audio Decoders” on page 497)				
AudioClass\Audio1.0Requests.dec	Audio	0x01	0x00	0x00
AudioClass\Audio2.0Requests.dec				0x20
AudioClass\Audio3.0Requests.dec				0x30
AudioClass\Audio1.0Interrupt.dec				0x00
AudioClass\Audio2.0Interrupt.dec				0x20
AudioClass\Audio3.0Interrupt.dec				0x30

Table 9.1: Decoder Files (Sheet 2 of 6)

USB Decode	USB Decoder Name	USB-IF Base Class	Codes Sub Class	Protocol ID
Communications and CDC* Control				
Direct Line Control Model	Communication	0x02	0x01	
Abstract Control Model	Communication	0x02	0x02	
Telephone Control Model	Communication	0x02	0x03	
Multi-Channel Control Model	Communication	0x02	0x04	
CAPI Control Model	Communication	0x02	0x05	
Ethernet Networking Control Model	Communication	0x02	0x06	
ATM Networking Control Model	Communication	0x02	0x07	
Wireless Handset Control Model	Communication	0x02	0x08	
Device Management Model	Communication	0x02	0x09	
Mobile Direct Line Model	Communication	0x02	0x0A	
OBEX Model	Communication	0x02	0x0B	
Communication Device Subclass/EEM	Communication	0x02	0x0C	
Communications\CommRequests.dec				
Communications\CommInterrupt.dec				
Communications\CommCDCEEM.dec				
Device Firmware Update	DevFirmware Update	0xFE	0x01	0x02
HID (Human Interface Device, see 9.1.2 *HID Decoders*.)	HID	0x03		
HUT (HID extension)	HID	Extension		
Monitor (HID extension)	HID	Extension		
Physical Interface (force-feedback extension to HID)	HID	Extension		
Point of Sale Devices (HID extension)	HID	Extension		
Power (HID extension)	HID	Extension		
Hid\Hid_InterruptIN.dec				
Hid\Hid_InterruptOUT.dec				
Hid\Hid_Req.dec				
*The CDC Decoder includes the ECM class decoding.				
Still Imaging Class	PTP Still Image	0x06	0x01	0x01
StillImageClass\PTPStillImageBulkIn.dec				
StillImageClass\PTPStillImageBulkOut.dec				
StillImageClass\PTPStillImageRequests.dec				
StillImageClass\PTPStillInterrupt.dec				
Printer	Printer	0x07	0x01	0xXX
Printer\Printer_req.dec				

Table 9.1: Decoder Files (Sheet 3 of 6)

USB Decode	USB Decoder Name	USB-IF Base Class	Codes Sub Class	Protocol ID
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		
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.

Table 9.1: Decoder Files (Sheet 4 of 6)

USB Decode	USB Decoder Name	USB-IF Base Class	Codes Sub Class	Protocol ID
Smart Card (CCID)	CCID and ICCD	0x0B	0x00	
SmartCard\CCIDBulkIn.dec				
SmartCard\CCIDBulkOut.dec				
SmartCard\CCIDInterrupt.dec				
SmartCard\CCID_req.dec				
SmartCard\ICCDBulkIn.dec				
SmartCard\ICCDBulkOut.dec				
SmartCard\ICCDInterrupt.dec				
SmartCard\ICCD_req_Ver.A.dec				0x01
SmartCard\ICCD_req_Ver.B.dec				0x02
Content Security				
ContentSecurityRequests.dec	Content Security	0x0D	0x00	0x01
ContentSecurityInterruptIN.dec		0x0D	0x00	0x01
ContentSecurityInterruptOUT.dec		0x0D	0x00	0x01
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				

Table 9.1: Decoder Files (Sheet 5 of 6)

USB Decode	USB Decoder Name	USB-IF Base Class	Codes Sub Class	Protocol ID
Wireless Controller Bluetooth Bluetooth_HCI\hci_command.dec Bluetooth_HCI\hci_data_in.dec Bluetooth_HCI\hci_data_out.dec Bluetooth_HCI\hci_event.dec Bluetooth_HCI\hci_sco_in.dec Bluetooth_HCI\hci_sco_out.dec	HCI	0xE0	0x01	0x01
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
Miscellaneous Device Class Interface Association Descriptor	Standard; no decoder method is 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		

Table 9.1: Decoder Files (Sheet 6 of 6)

USB Decode	USB Decoder Name	USB-IF Base Class	Codes Sub Class	Protocol ID
Personal Healthcare Devices PersonalHealthcare\PersonalHealthcareRequest.dec PersonalHealthcare\PersonalHealthcareDescriptors.inc PersonalHealthcare\PersonalHealthcareDataBulkIn.dec PersonalHealthcare\PersonalHealthcareDataBulkOut.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 IDs 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 the file, **UseCurrentEntityIdMap =1**, will cause it to use the mapping 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.
- The **Reset Decoding** button applies the decoding to a trace, if it was not 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, you must edit the file supplied in *\Users\Public\Documents\LeCroy\USB Protocol Suite\Scripts\Hid*.

1. Look for a folder called *HIDReportDescriptor_EditMe.inc*. You define the report layout in this file. Examples and templates are available.

2. To be able to use report layout defined in this file, you must set the variable in **UseHIDReportDescriptorItems** to **1**.

NOTE:	If this flag is **0**, software will try to find a report from descriptor in Trace. If the descriptor is not found in the trace, it uses the most recently used report layout.

3. You may need to click 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. To display the USB Device Request menu, do one of the following:
   - Click the **Decoding Settings** button on the Toolbar.
   - Press **Ctrl+Shift+Y**.
   - Right click in the **Control Transfer** field.
2. Select **Map Request Recipients to Class/Vendor Decoding** to display the Request Recipients and Endpoints dialog box (Figure 9.1).

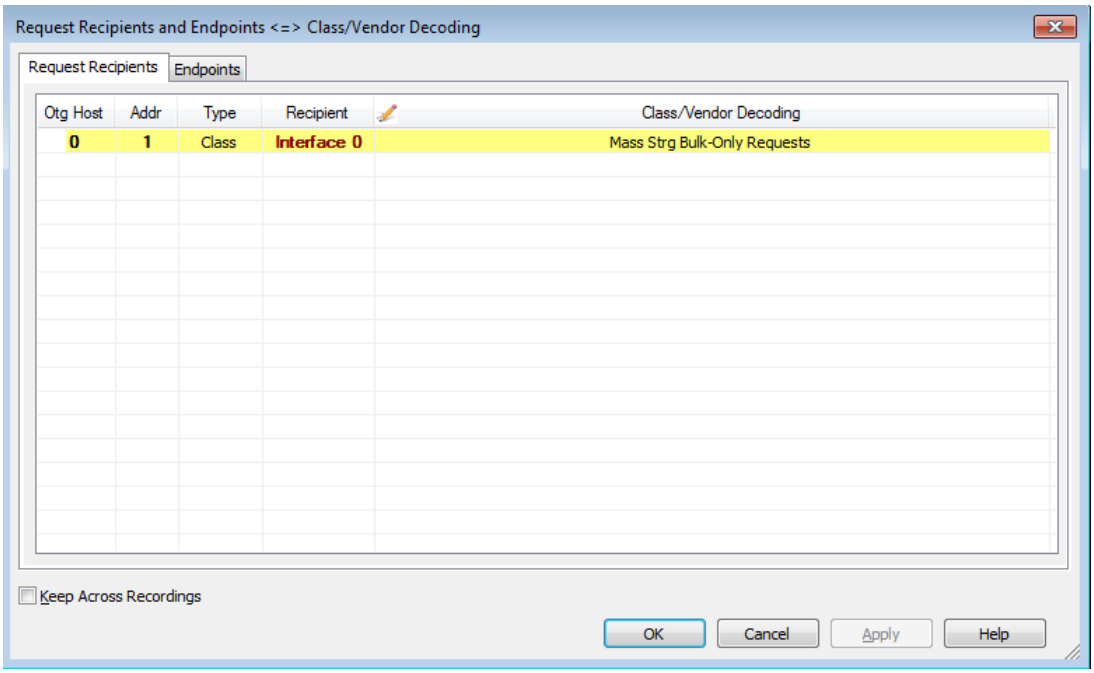


Figure 9.1: Request Recipients and Endpoints

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. Expand the **Class/Vendor Decoding Groups** drop-down menu.

   The drop-down menu lists the defined Class/Vendor request decoding groups (Figure 9.2):

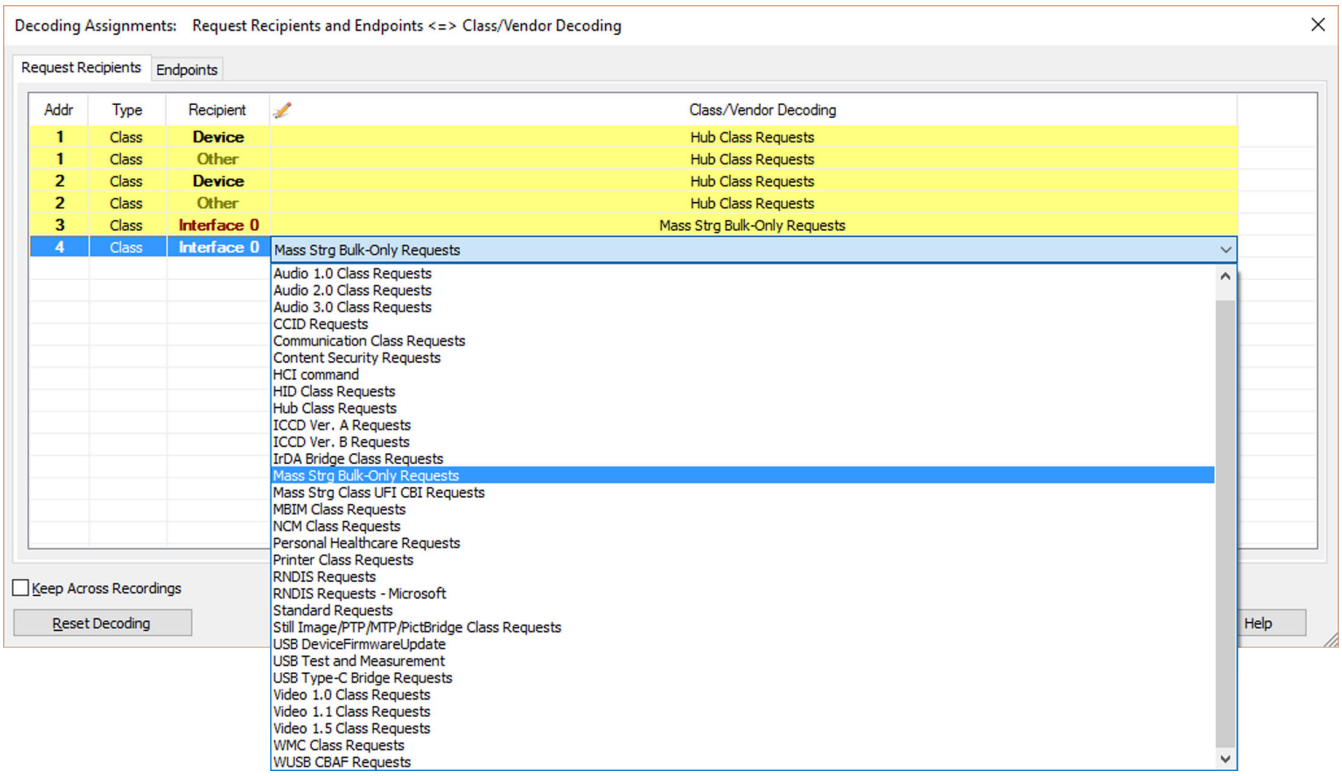


Figure 9.2: Class/Vendor Decoding Groups Drop-Down Menu

- 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 **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

1. To assign a Class/Vendor Endpoint decoding, do one of the following:
   - Click the **Decoding Settings**  button on the Toolbar.
   - Press **Ctrl+Shift+Y**.
   - Right click the **Bulk/Int Transfer** field to display the USB Device Request menu.
2. Select **Map Endpoint to Class/Vendor Decoding** to display the Request Recipients and Endpoints dialog box.
3. Click the **Endpoints** tab to display the Endpoints dialog box (Figure 9.3).

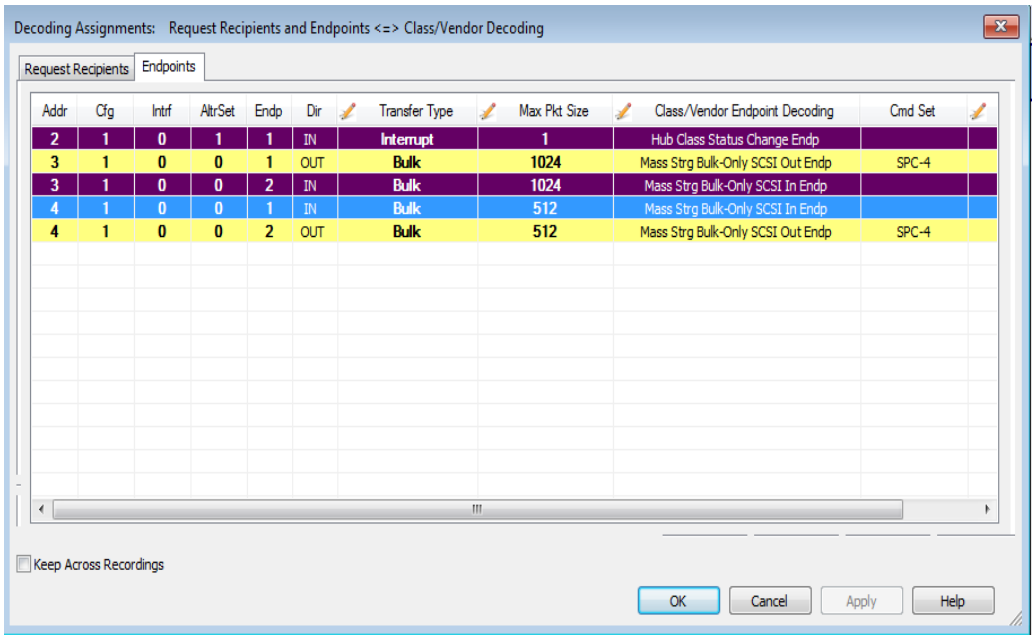


Figure 9.3: Request Recipients and Endpoints: Class/Vendor Decoding

The Endpoint field (Endp) shows all Endpoints found in the trace file.

The display 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 shown in Figure 9.4.

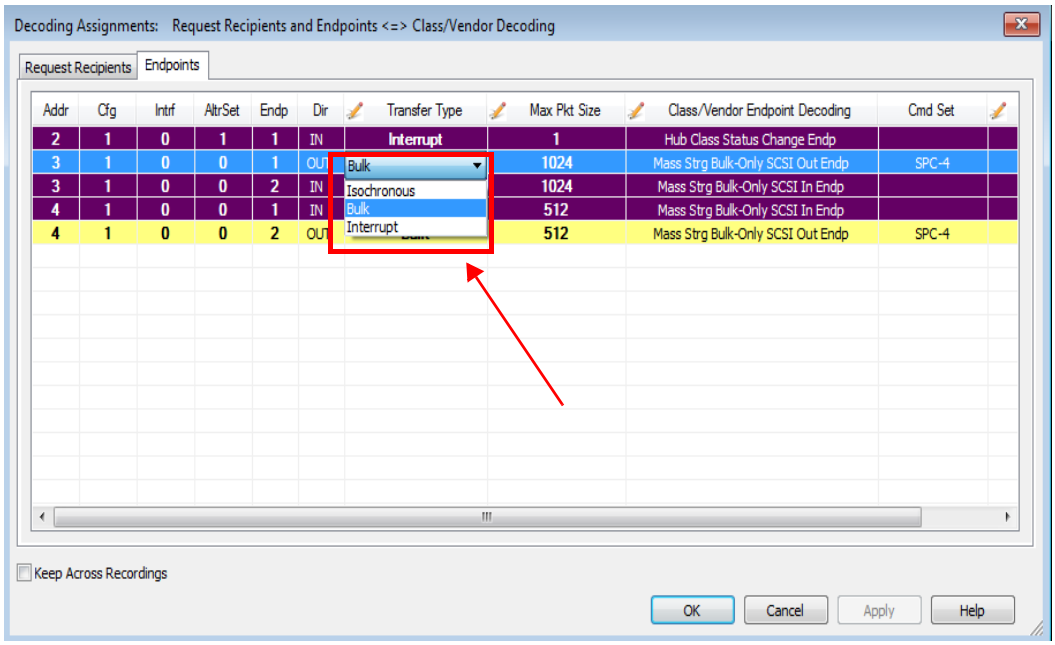


Figure 9.4: Transfer Type Drop-down Menu

The Transfer Type options for both IN and OUT endpoint are:

- Isochronous
- Bulk
- Interrupt

NOTE: Choosing “1 Tran 1 Xfer” speeds up decoding.

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 (Figure 9.5).

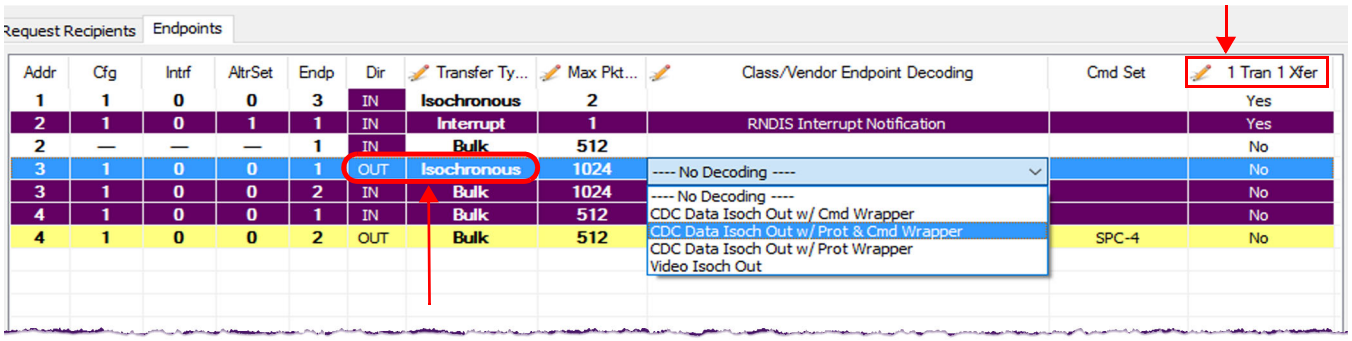


Figure 9.5: Endpoint Decoding Options: IN or OUT Isochronous Transfer Type

The Isochronous Transfer Type Class/Vendor Endpoint Decoding options for an IN or OUT transfer 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 (Figure 9.6).

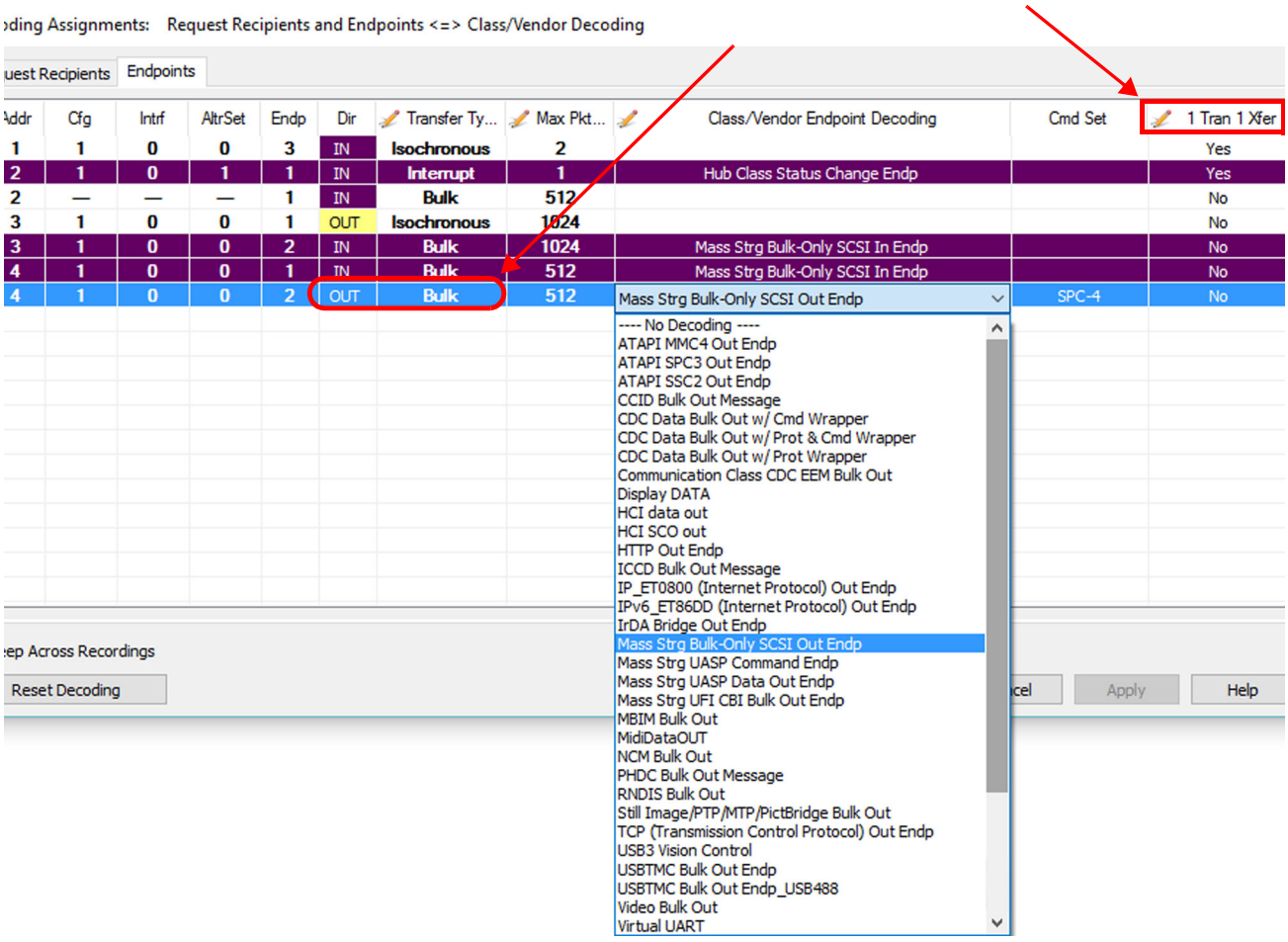


Figure 9.6: Endpoint Decoding Options: IN or OUT Bulk Transfer Type

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 (Figure 9.7).

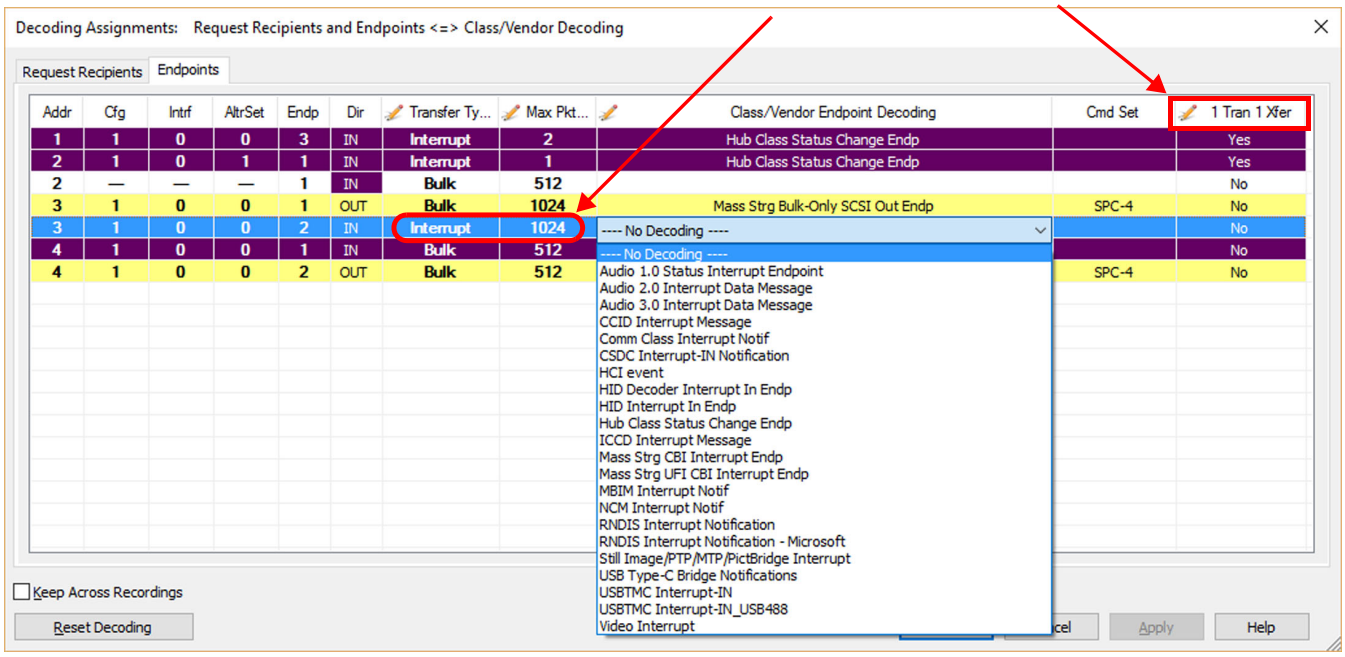


Figure 9.7: 1 Tran 1 Xfer Column: HID Interrupt IN Endpoint Decoding

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 (Figure 9.8).

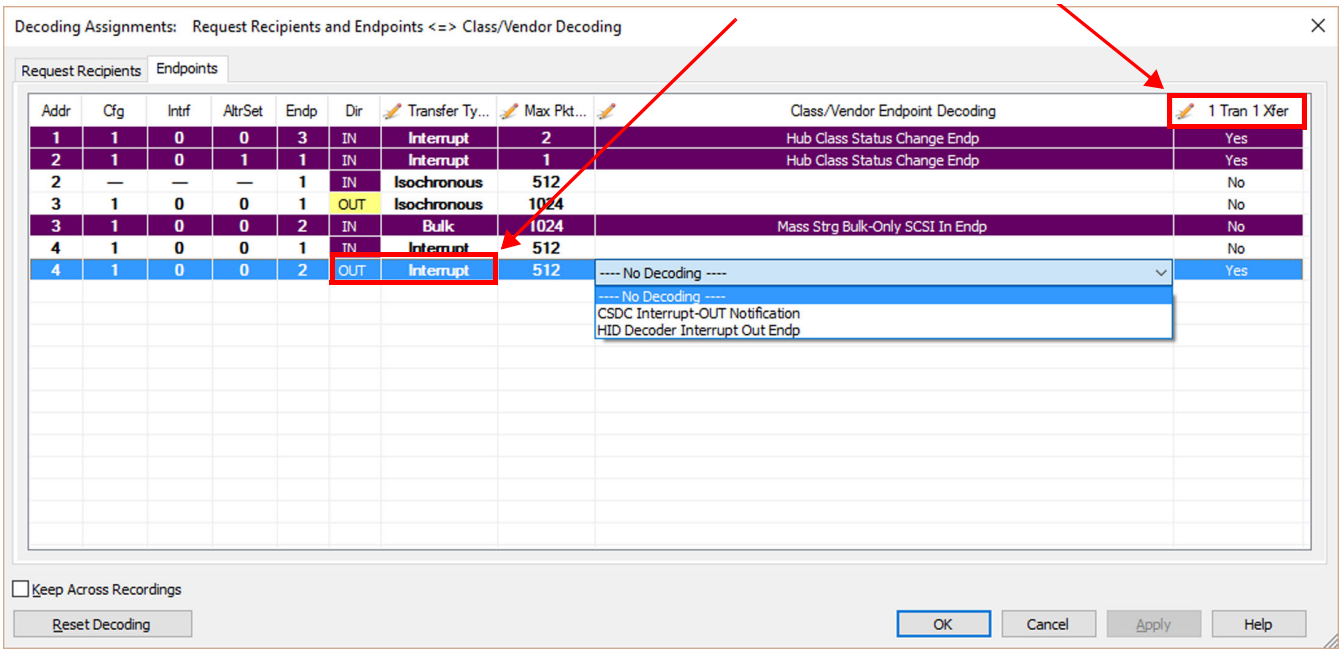


Figure 9.8: 1 Tran 1 Xfer column: HID Interrupt OUT Endpoint Decoding

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. For Decoding, do one of the following:

- Select the type of Decoding.

OR

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

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. However, 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 the selected endpoint will make a transfer level packet that could be decoded by transfer level scripts. In particular, streams of Isochronous data can be decoded much more quickly if this rule is selected.

13. To select this model of transfer, use the *1 Tran 1 Xfer* column to select it (Figure 9.7).
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, check the box for **Keep Across Recordings**.
16. Click **OK**.

9.2.3 Selecting the Number of Transactions per Transfer

From the Decoding Settings window (Figure 9.9):

1. Select the Endpoints tab.
2. Select one of the following:
   - 1 Transaction per 1 Transfer (Figure 9.10)
   - NAK Separated Transfers (Figure 9.13)

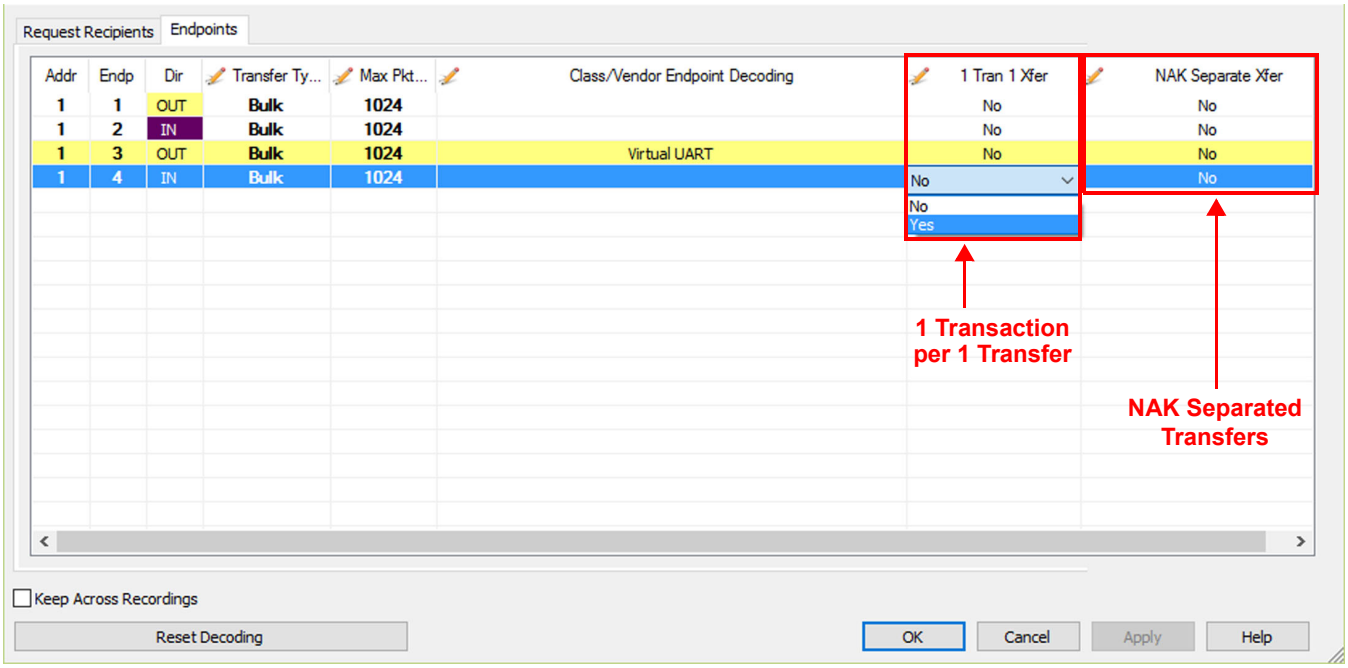


Figure 9.9: Decoding Settings: Main Window

9.2.3.1 Single Transaction per Transfer

If you select the option, “1 Transaction per 1 Transfer” (Figure 9.10), the data traffic in Trace View will change from several transactions per transfer (Figure 9.11) to one transaction per transfer (Figure 9.12).

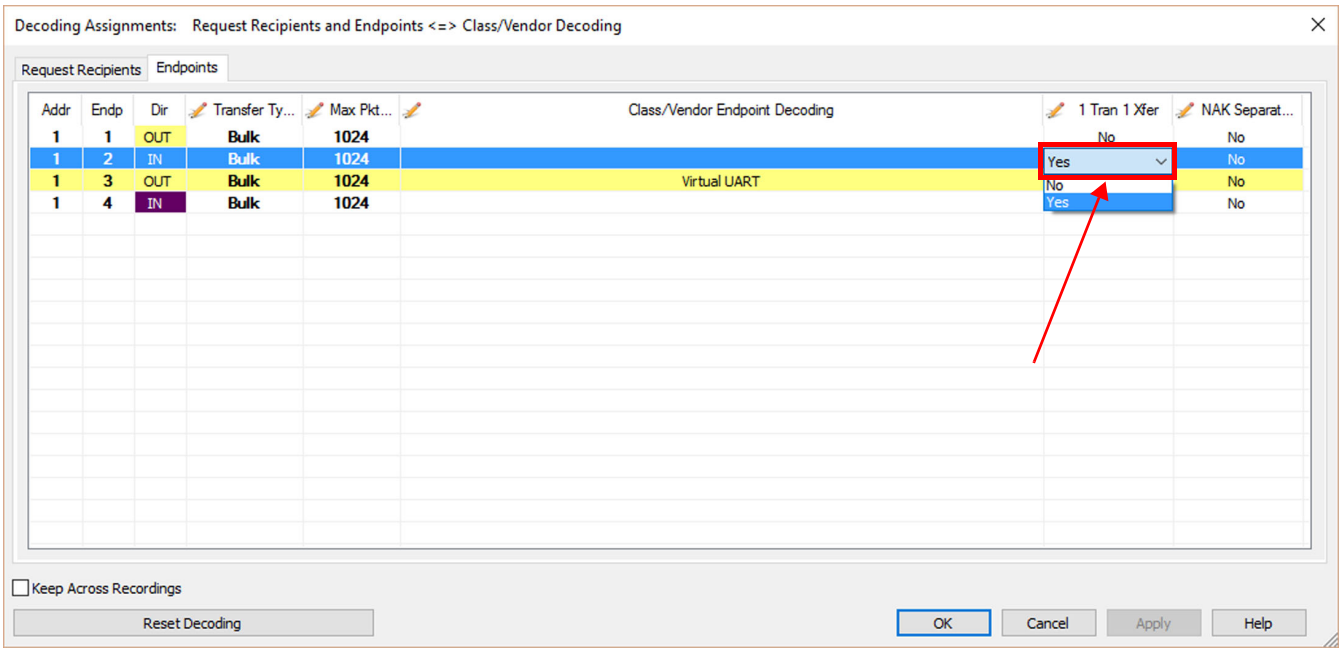


Figure 9.10: Example of One Transaction per Transfer

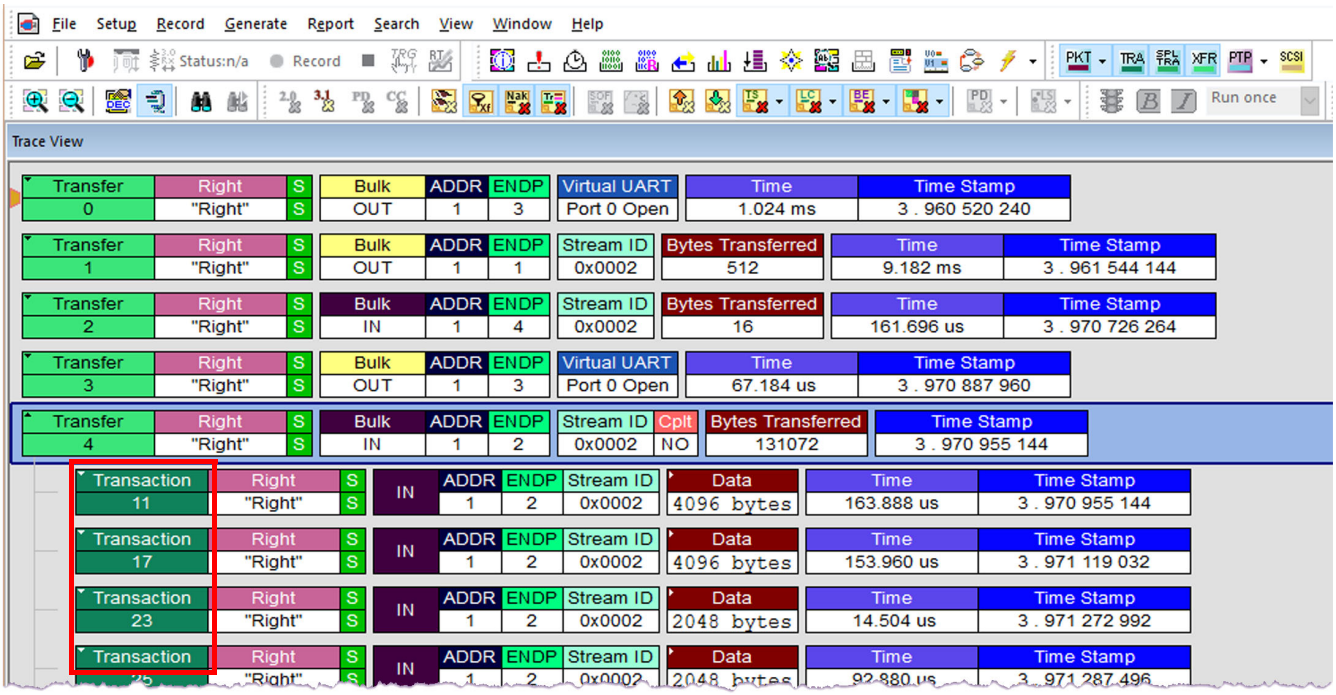


Figure 9.11: Example of Several Transactions per Transfer

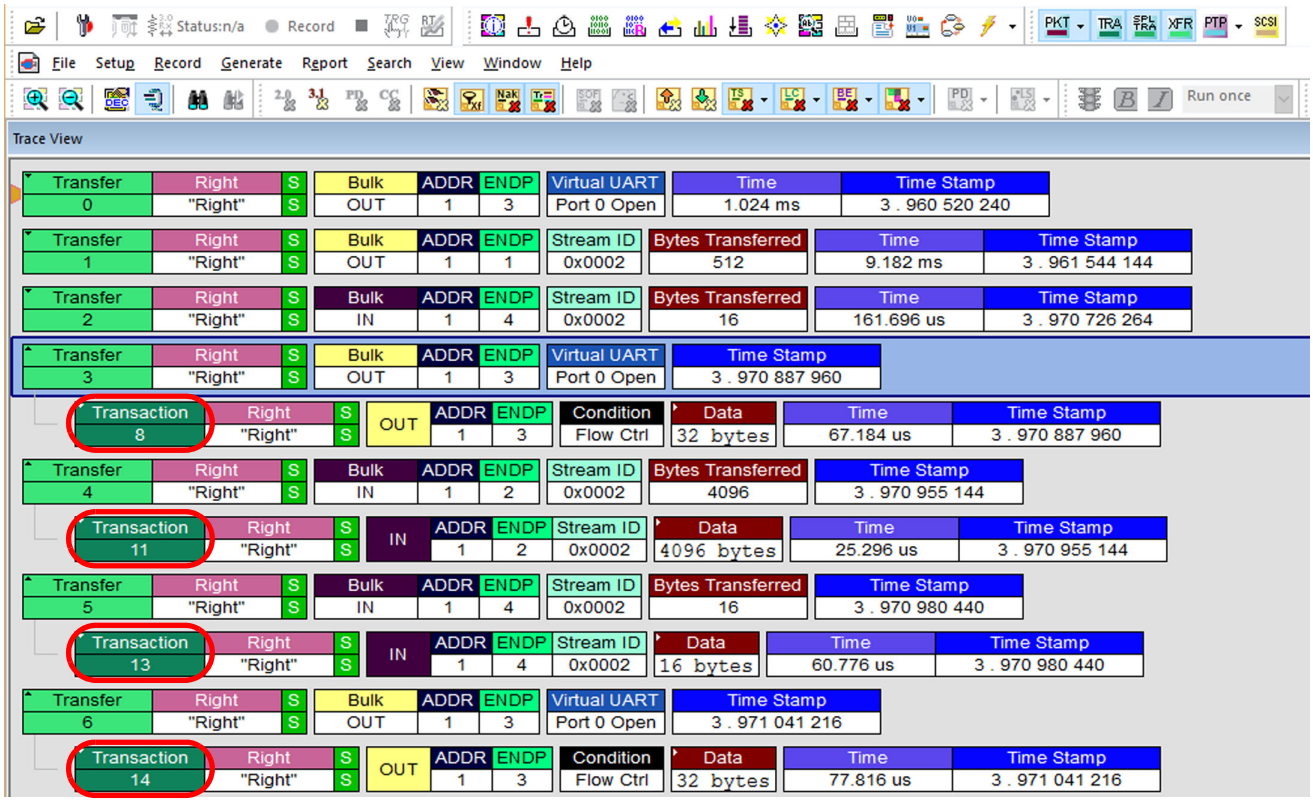


Figure 9.12: Trace View: One Transaction per One Transfer

9.2.3.2 NAK Separated Transfer

If you select **NAK Separate Transfer** (Figure 9.13), the Trace Data Traffic will be converted from several (e.g., 3) Transactions per Transfer (Figure 9.14) to NAK Separate Transfer (Figure 9.15).

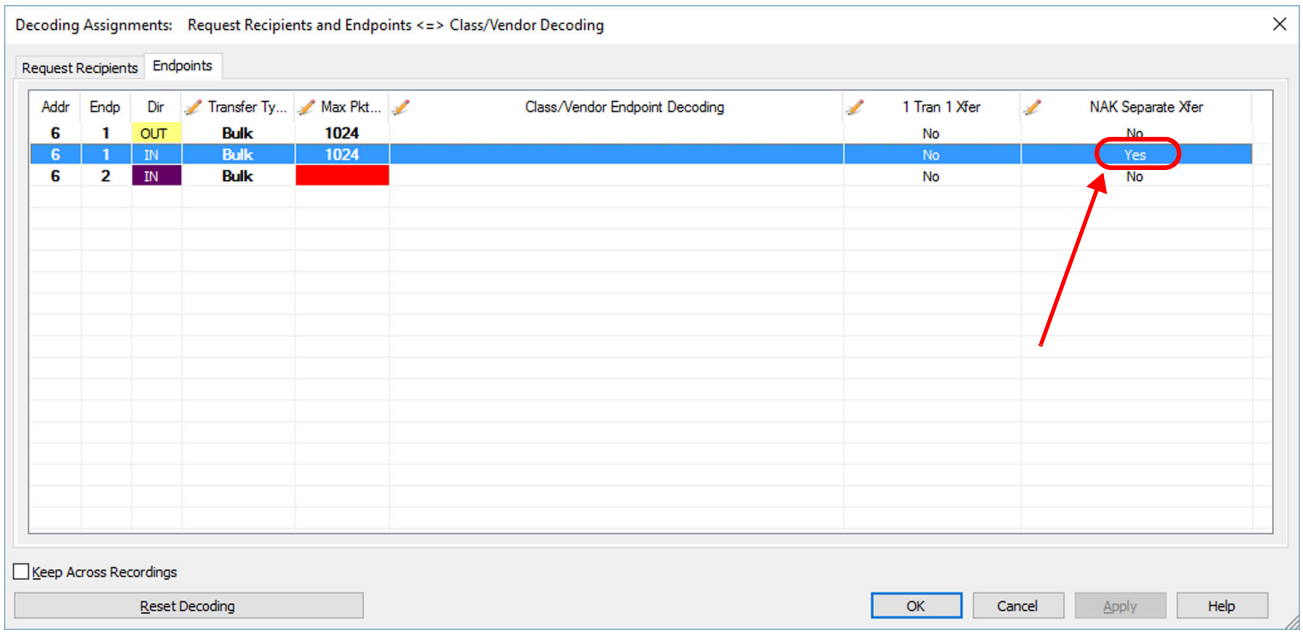


Figure 9.13: Decoding Settings: NAK Separated Transfer

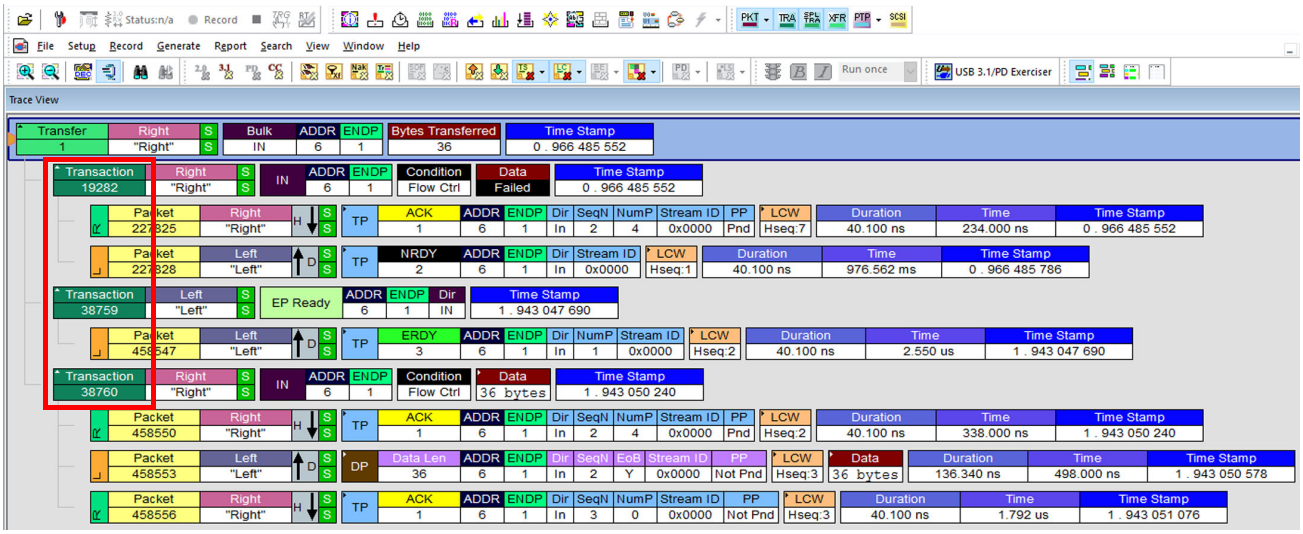


Figure 9.14: Trace View: Several Transactions per Transfer

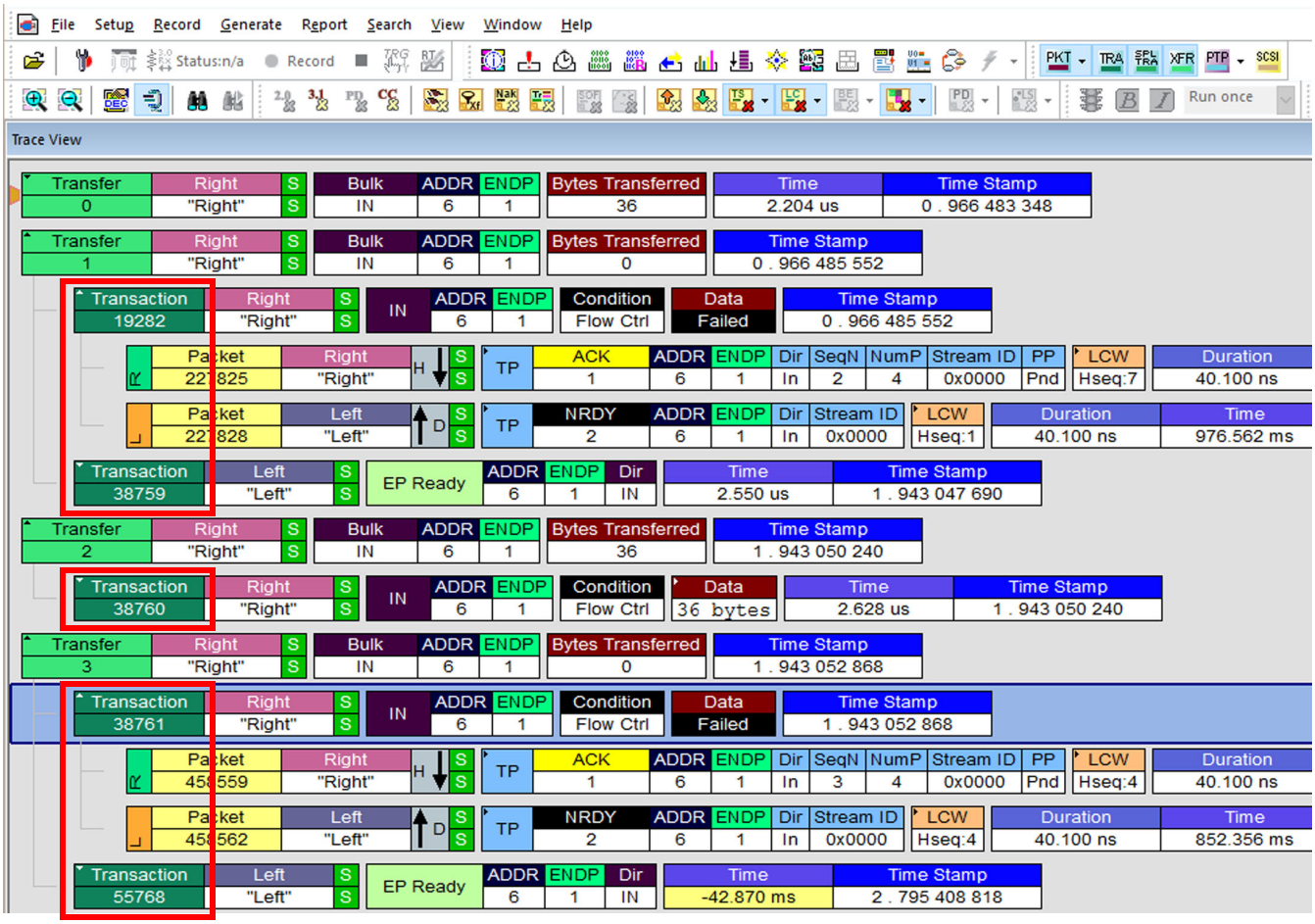


Figure 9.15: Trace View: NAK Separated Transfers

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).

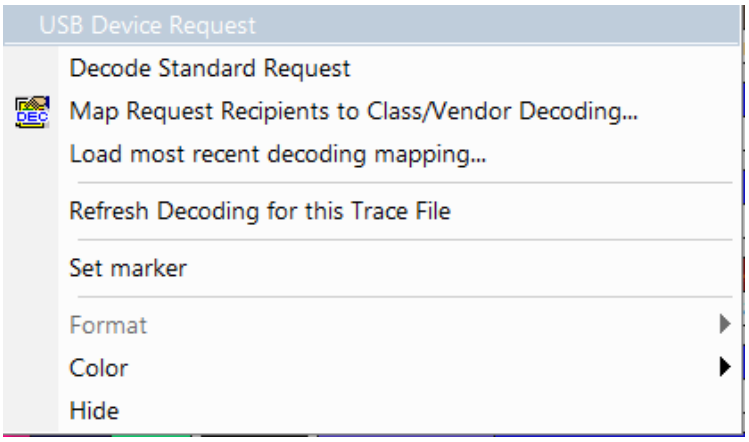


Figure 9.16: USB Device Request Menu

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 you from having to constantly apply the mapping to a new trace every time the application is restarted and a new trace created.

You can retain the mapping from trace to trace *during* an application session by clicking the **Keep Across Recordings** button in the endpoint map menu. This new feature simplifies the process when the application is re-started.

NOTE: You can also change the format, color, and hidden status of fields, using the same methods as in Display Options. (See Chapter 8, *Display Options*.)

9.3.2 Decoding Standard Requests

To Decode a standard request:

1. From the USB Device Request menu, select **Decode Standard Request**. The View Fields for Standard Request window appears (Figure 9.17).

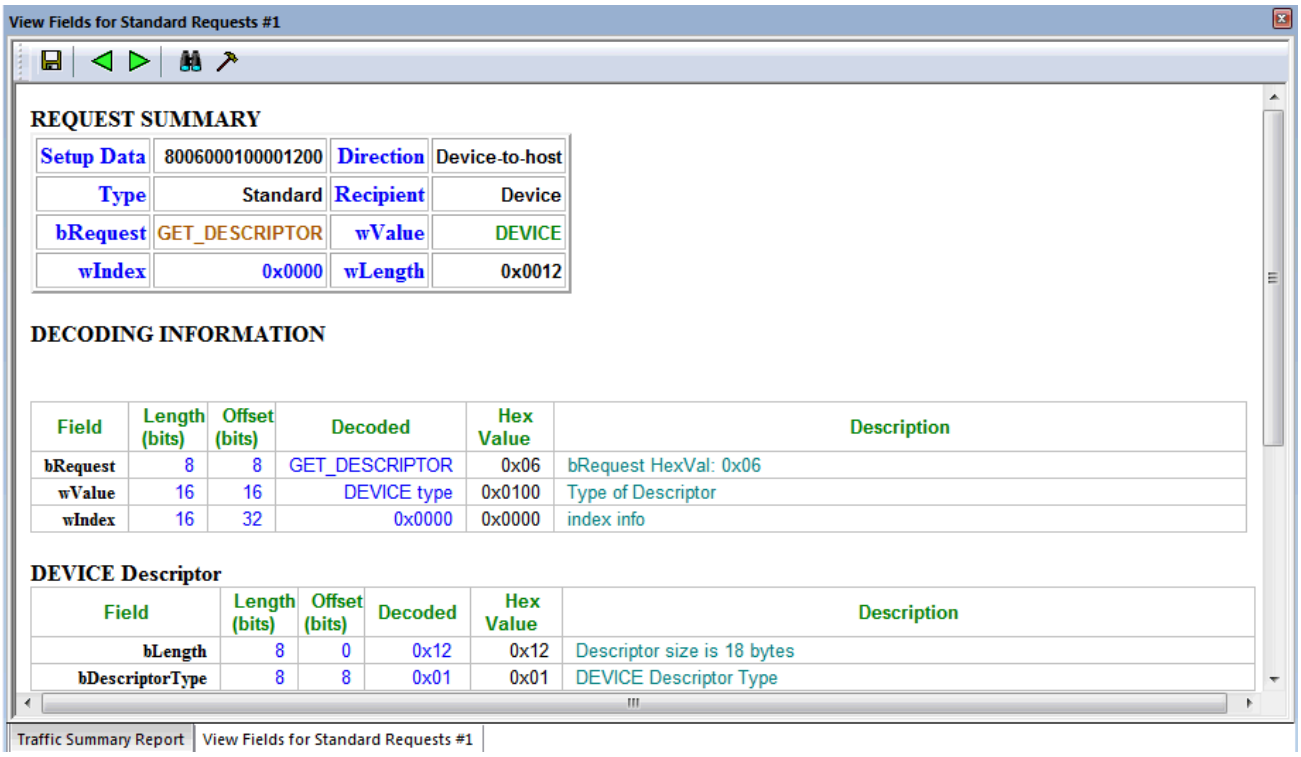


Figure 9.17: View Fields for Standard Requests Window

2. To find a word in the text box, click **Find**, then 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.
3. To search, click **Find Next**.
4. 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**.
5. 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, 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
- Wire Adapter Class Requests

To decode a class request, from the USB Device Request menu, select **Decode ... Request**. The View Fields for ... Class Requests window appears (Figure 9.18).

The Figure 9.18 shows a View Fields for Hub Class Requests decoding.

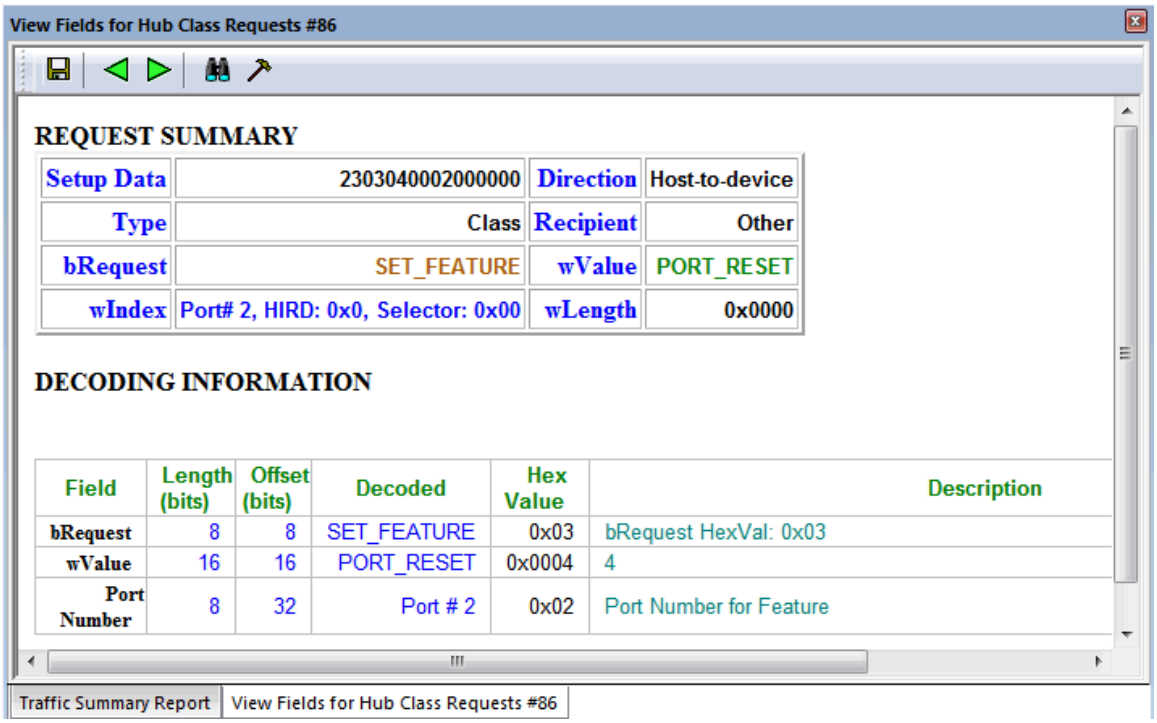


Figure 9.18: View Fields for Hub Class Requests Dialog

9.3.4 Decoding Vendor Requests

To decode a vendor request, from the USB Device Request menu, select **Decode ... Request**. The View Fields for ... Vendor Requests window appears. An example of a vendor request is Command Set.

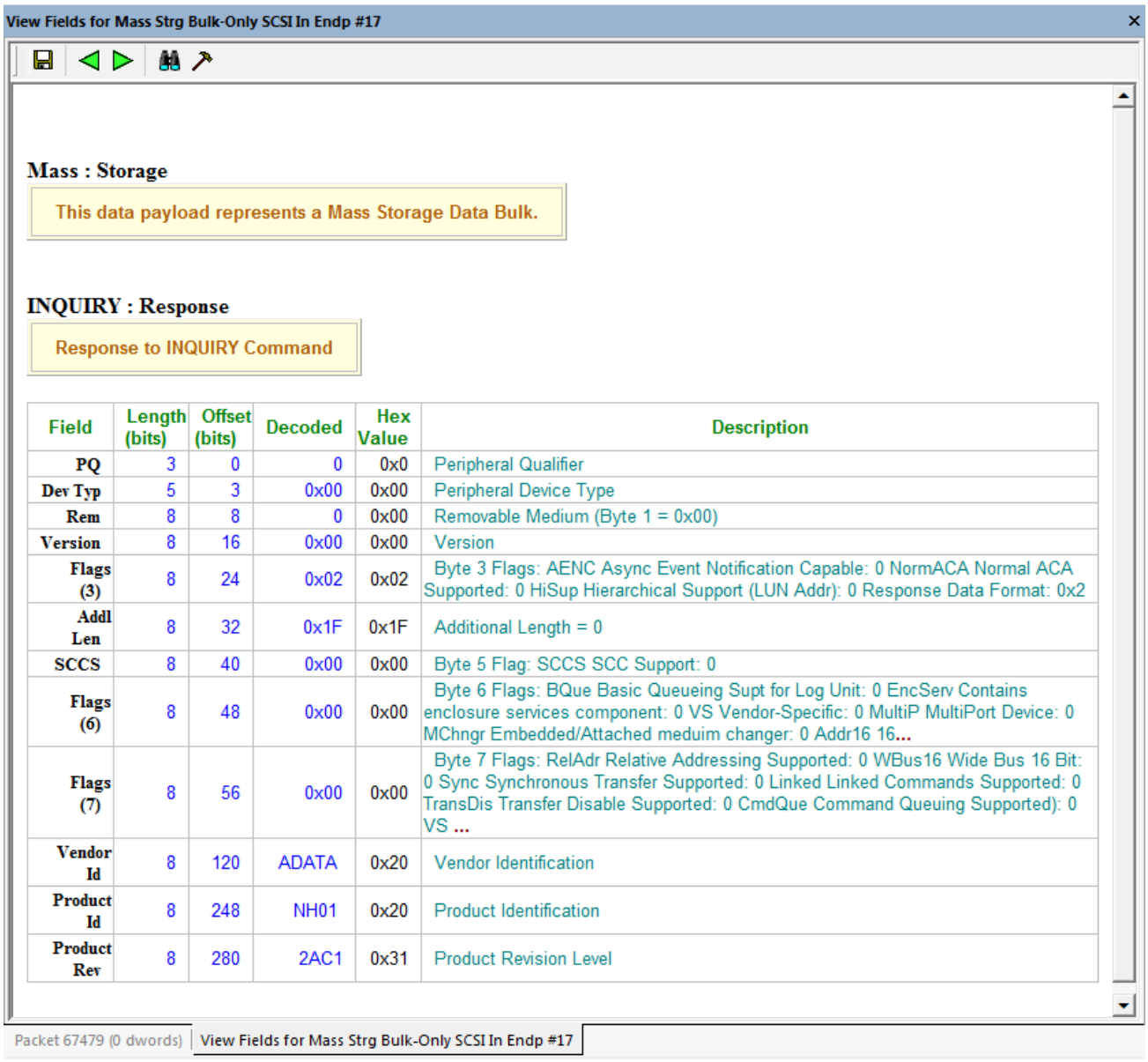
9.3.5 Decoding Undefined USB/WUSB Device Requests

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 in the **Bulk/Int Transfer** field. The Bulk/Int Transfer (IN/OUT transaction with data) menu appears.
2. Select **Decode as ... Endp**. The View Fields for ... Endp window opens. Figure 9.19 shows a Mass Strg Bulk-Only SCSI IN Endp decoding.



Field	Length (bits)	Offset (bits)	Decoded	Hex Value	Description
PQ	3	0	0	0x0	Peripheral Qualifier
Dev Typ	5	3	0x00	0x00	Peripheral Device Type
Rem	8	8	0	0x00	Removable Medium (Byte 1 = 0x00)
Version	8	16	0x00	0x00	Version
Flags (3)	8	24	0x02	0x02	Byte 3 Flags: AENC Async Event Notification Capable: 0 NormACA Normal ACA Supported: 0 HiSup Hierarchical Support (LUN Addr): 0 Response Data Format: 0x2
Addl Len	8	32	0x1F	0x1F	Additional Length = 0
SCCS	8	40	0x00	0x00	Byte 5 Flag: SCCS SCC Support: 0
Flags (6)	8	48	0x00	0x00	Byte 6 Flags: BQue Basic Queueing Supt for Log Unit: 0 EncServ Contains enclosure services component: 0 VS Vendor-Specific: 0 MultiP MultiPort Device: 0 MChngr Embedded/Attached meduim changer: 0 Addr16 16...
Flags (7)	8	56	0x00	0x00	Byte 7 Flags: RelAdr Relative Addressing Supported: 0 WBus16 Wide Bus 16 Bit: 0 Sync Synchronous Transfer Supported: 0 Linked Linked Commands Supported: 0 TransDis Transfer Disable Supported: 0 CmdQue Command Queuing Supported): 0 VS ...
Vendor Id	8	120	ADATA	0x20	Vendor Identification
Product Id	8	248	NH01	0x20	Product Identification
Product Rev	8	280	2AC1	0x31	Product Revision Level

Figure 9.19: View Fields for Mass Strg Bulk: Only SCSI IN Endp

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, wTotalLength
- **Length in bits**
- **Offset in bits**
- **Decoded**: hex value typically equal to Hex Value
- **Hex Value**: hex value typically equal to Decoded
- **Description**: short description of field

To change the layout of decode requests display:

1. To display the View ... Fields Dialog Layout dialog box, click **Layout** (Figure 9.20).

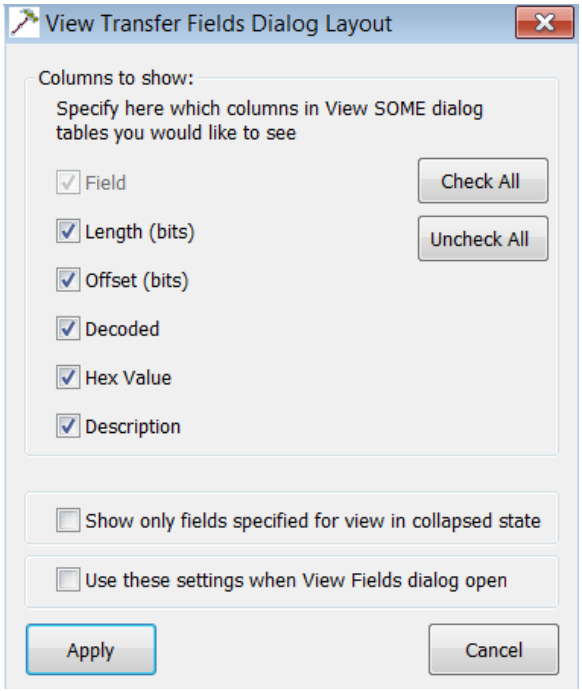


Figure 9.20: View Transfer Fields Dialog Layout

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. See Figure 9.21.

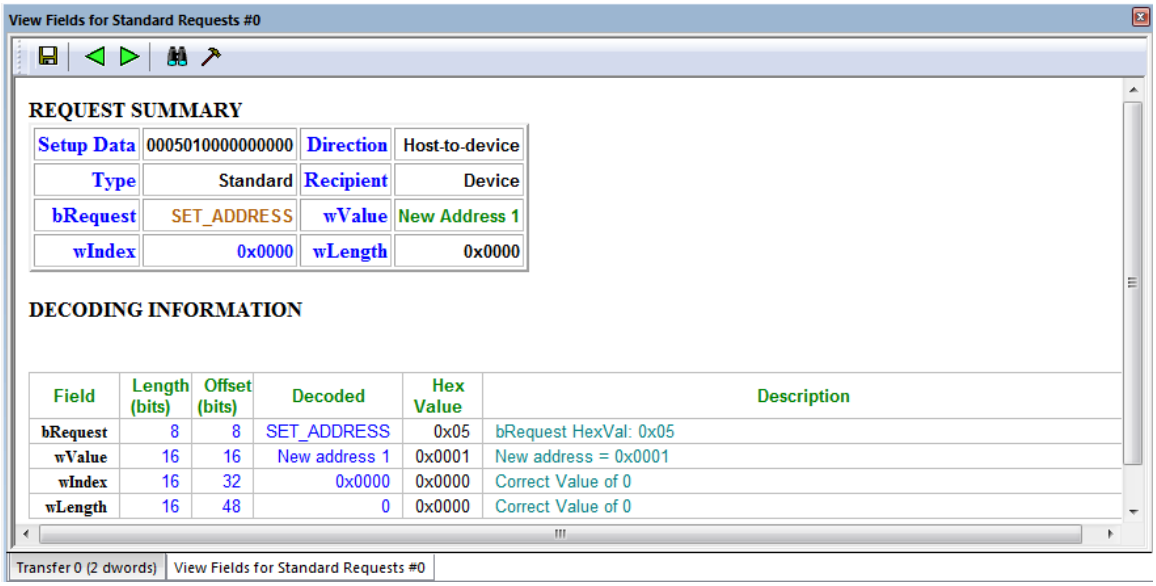


Figure 9.21: Decoded Fields View

Button	Function
	Save decoded Fields in .html format.
	Show previous decoded fields.
	Show next decoded fields.

Button	Function
	Find text in the View Fields page.
	Displays View Transfer Fields Dialog Layout (Figure 9.22) allowing you to specify different kinds of presentation formats for the View Fields dialog.

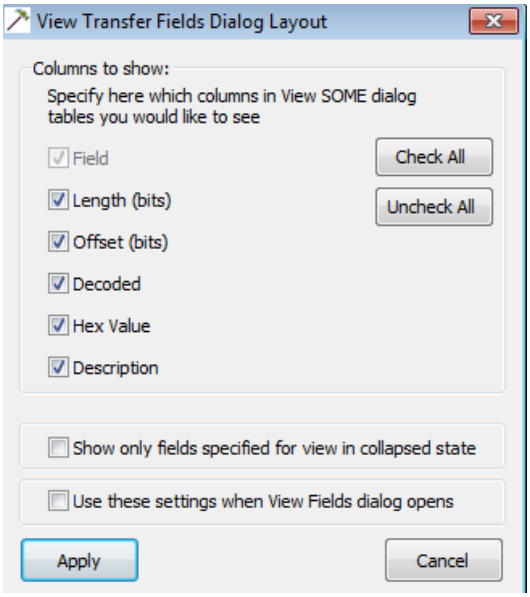


Figure 9.22: View Transfer Fields Dialog Layout Dialog

9.4 USB4 Decoding Settings Dialog

9.4.1 General Information

USB4 Decoding Settings 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 Settings dialog shows all parameters successfully set when automatic decoding is complete. See figures 9.23, 9.24, 9.25, and 9.26.

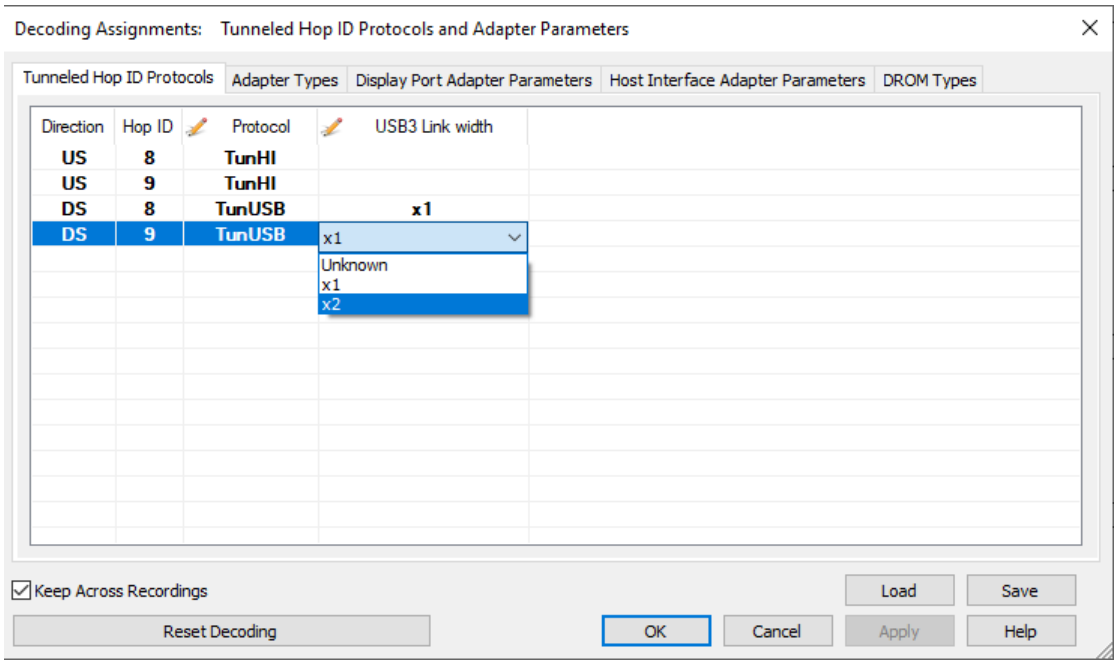


Figure 9.23: Automatically Detected Tunneled Protocols

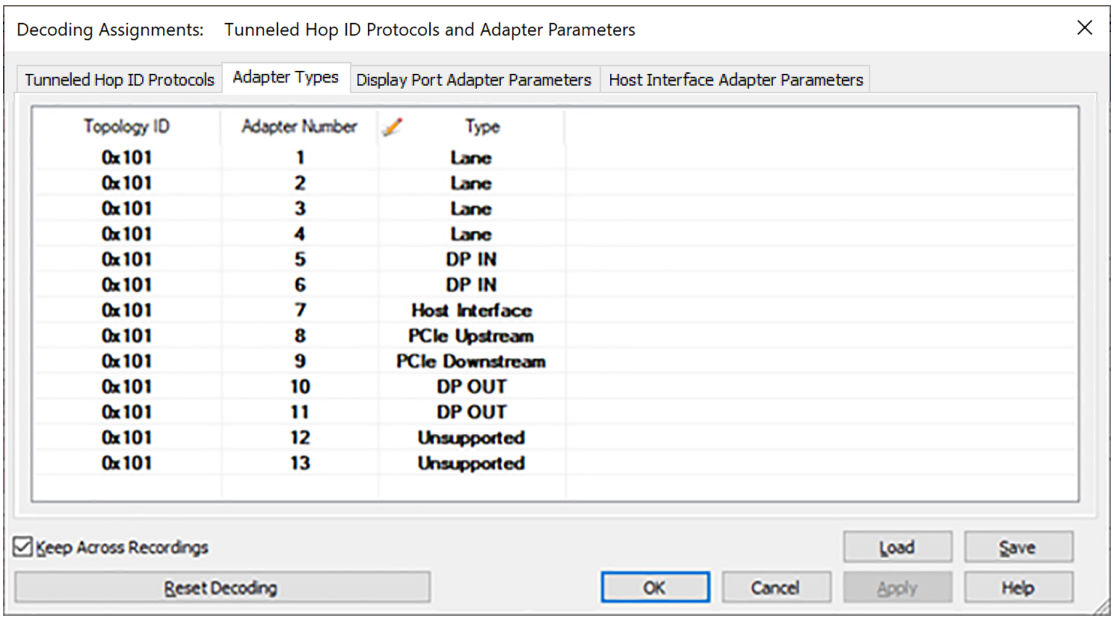


Figure 9.24: Automatically Detected Adapter Types

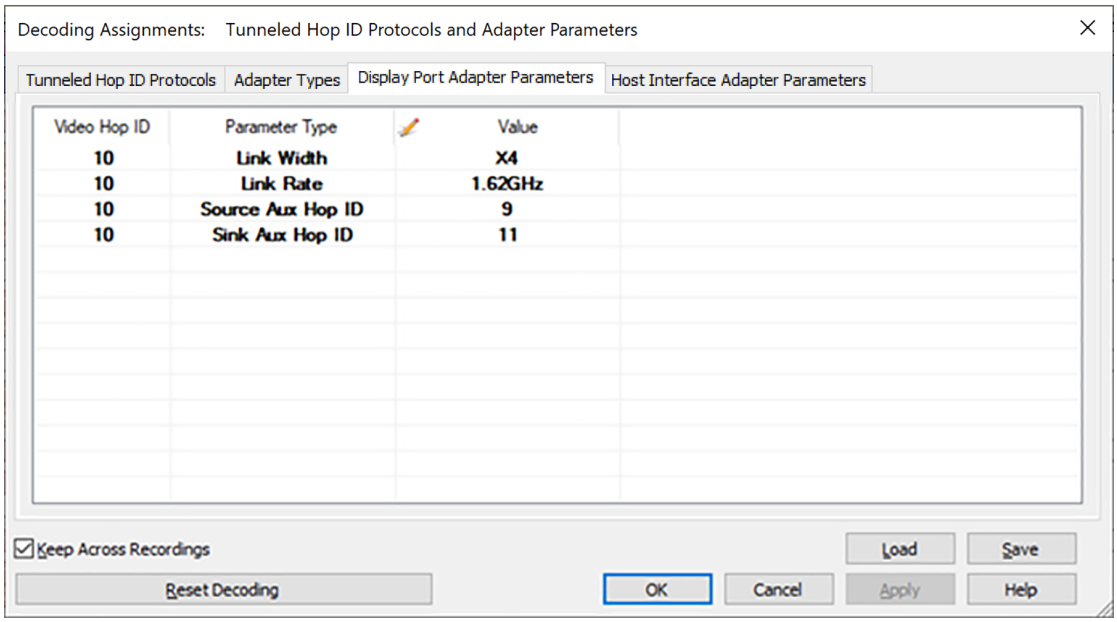


Figure 9.25: Automatically Detected Display Port Adapter Parameters

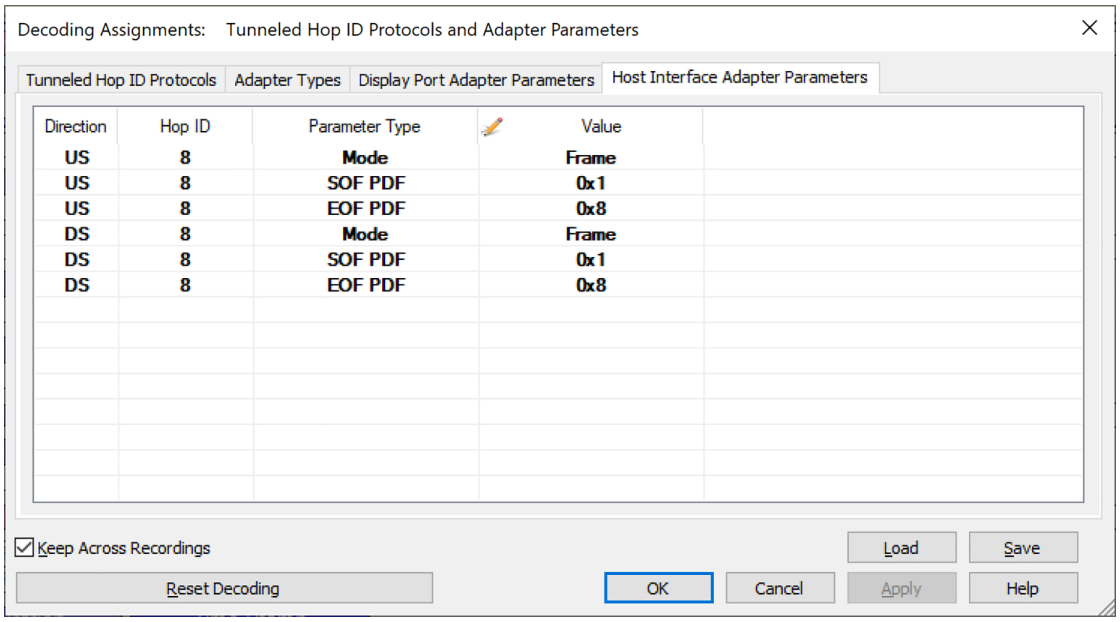


Figure 9.26: Automatically Detected Host Interface Adapter Parameters

You can do the following with USB4 Decoding Settings Dialog:

- Use the Pen icon in a header to manually change any value in the most right column, then click **OK** to apply the adjusted decoding.
  - When **Keep Across Recording** is checked and **OK** is selected, 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.
- Click **Save** to save decoding parameters to external file for future use.
- Press **Load** to load a file with previously saved decoding parameters, then click **OK** to apply them.
- Select **Reset Decoding** to manually reset decoding to automatically decoded parameters.
- Click **Cancel** to exit from the USB4 Decoding Settings Dialog without applying modified parameters.

NOTE:
- OK/Load/Save/Cancel/Reset operations are related only to the currently selected trace for which USB4 Decoding Settings is opened; other opened traces are not affected by these operations.
- OK/Load/Save/Cancel/Reset operations are applied to all three groups of settings (Tunneled Hop ID Protocols, Adapter Types, Display Port Adapter Parameters)
- Once OK has been selected, the modified parameters are stored permanently in a trace.

9.4.2 Tunneled Hop ID Protocols

If tunneled protocols are auto detected successfully, the Hop IDs assigned to one of the corresponding protocols, “PCIe/USB3/DP/DPAUX/HI” in USB4 Decoding Settings Dialog, will appear here.

If some tunneled protocols are not auto detected, the corresponding Hop IDs are assigned to “None”. You can change “None” to the appropriate protocol and press **OK** to see the Decoding results.

If the USB3 Link Width could not be auto detected, you can also configure it manually here.

9.4.3 Adapter Types

If there is configuration traffic with access to the Protocol Adapter 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)

9.4.5 Host Interface Adapter Parameters

For each Channel/Direction/Hop ID/Parameter Type, the user can assign an appropriate value.

9.4.6 DROM Types

For each Topology ID and Adapter Number, the user can assign a DROM Type of USB4 or TBT3.

Chapter 10

Reports

The Report menu provides access to several reports recorded by the analyzer.

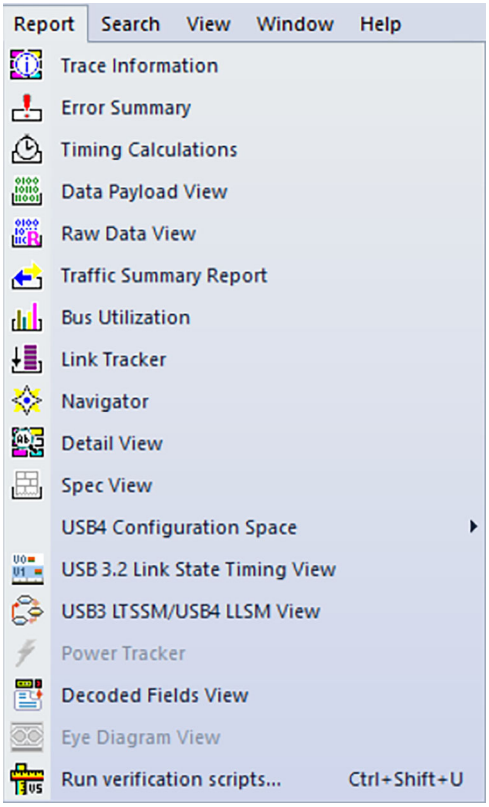


Figure 10.1: Report Menu

Reports assist with 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 10.6 *Raw Data View (Including Power Delivery and USB4 Sideband Packets)*.

- **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, Power Delivery, USB4, and Display Port specifications. See 10.12 *Spec View*.
- **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 10.16 *Power Tracker—V_{BUS} & Configuration Channel (CC)*.
- **Decoded Fields View**: See 9.3.8 *Decoded Fields View*.
- **Eye Diagram View:** See 10.18 *Eye Diagram View*.
- **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 tab-able. To help guide the docking of windows, drop targets are provided so that you can drag the cursor to those locations and be confident of the location your window will be docked. See Figure 10.2 and Figure 10.3.

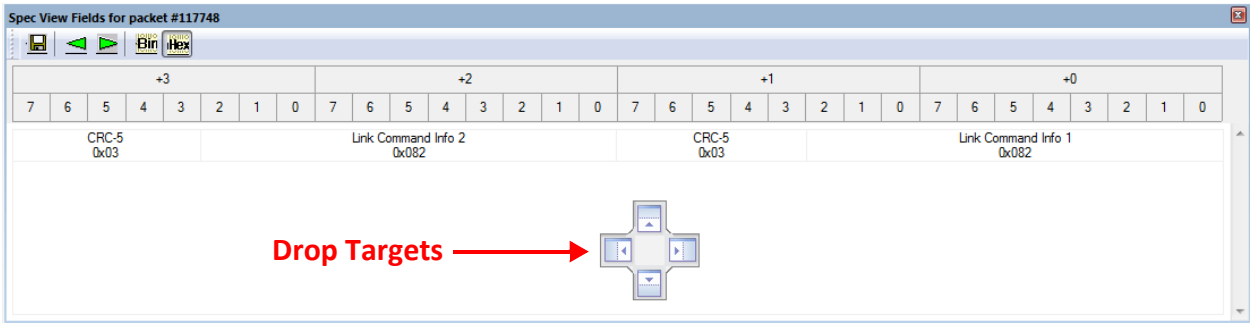


Figure 10.2: Drop Target

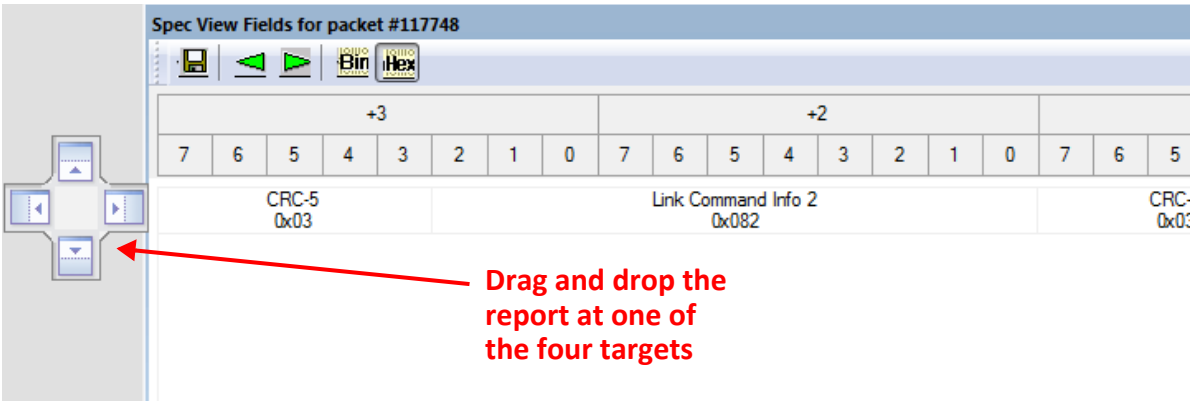


Figure 10.3: Drag and Drop Report in Target

NOTE:
- When you open a report view, the software attempts to apply the user preferences used when you most recently viewed the report.
- 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.

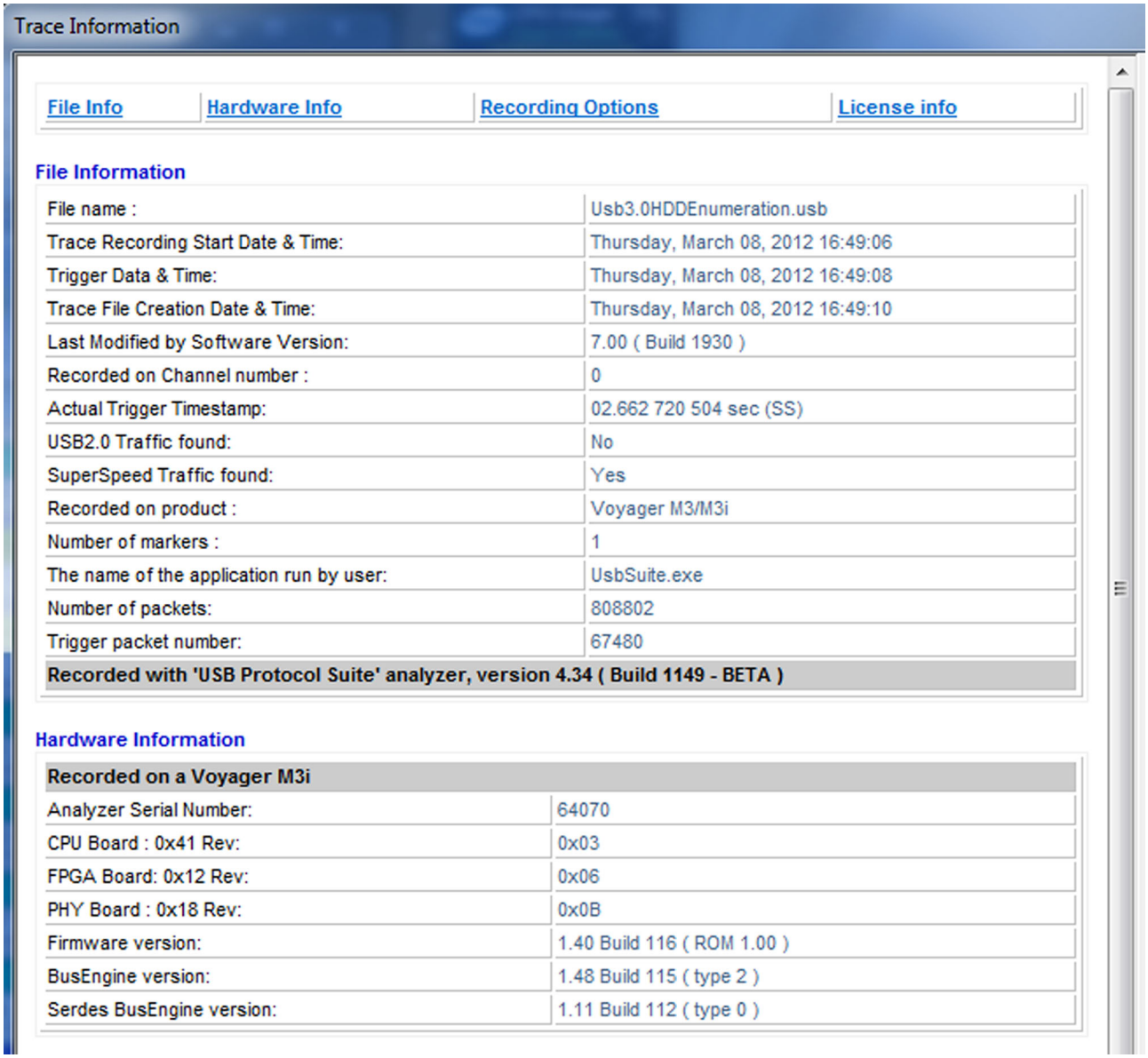


Figure 10.4: Trace Information Report: File Information and Hardware Information Tab

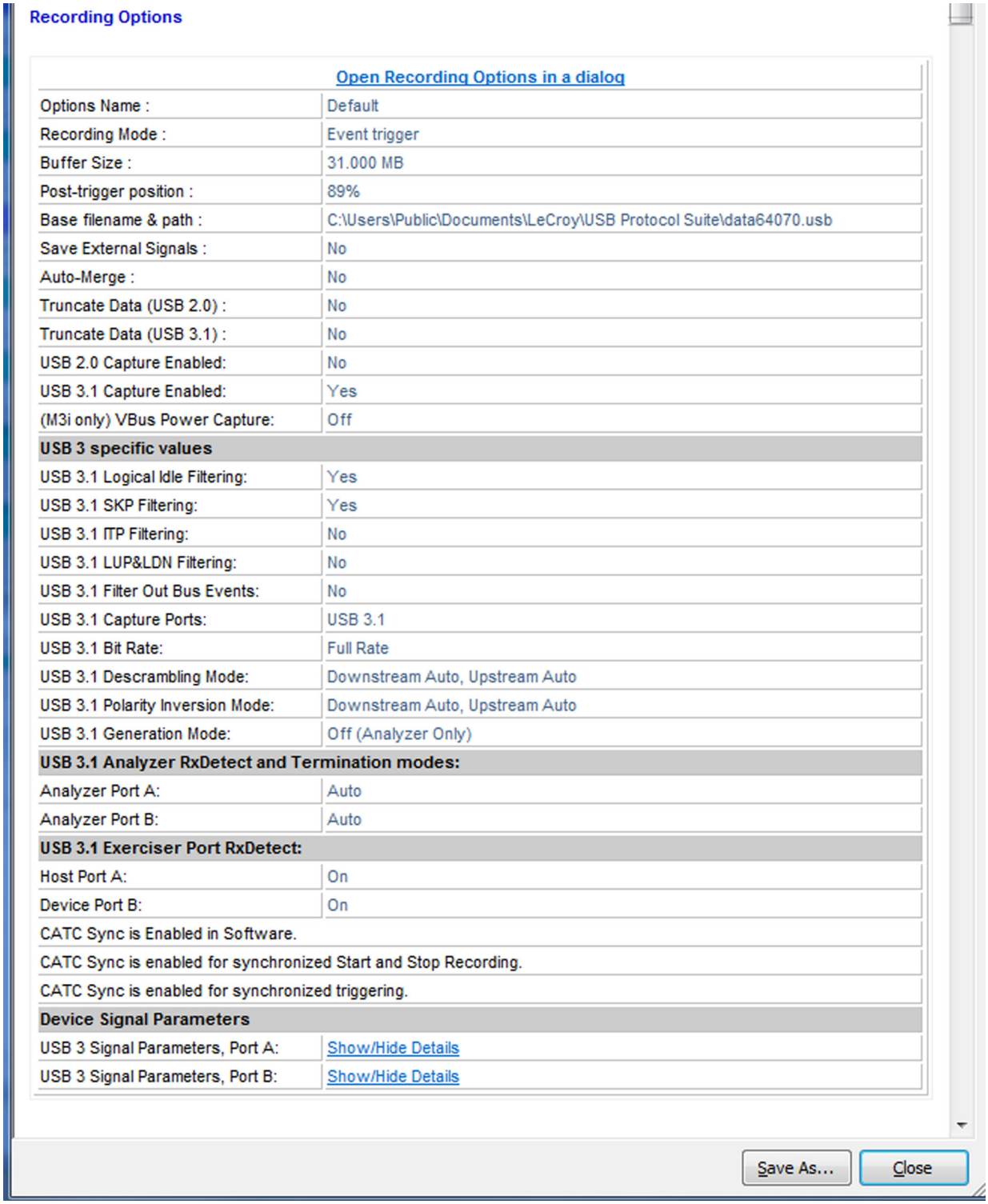


Figure 10.5: Trace Information Report: Recording Options Tab

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 appears, click USB 2.0 Errors (see Figure 10.6) or USB 3.2 Errors to view the respective errors.

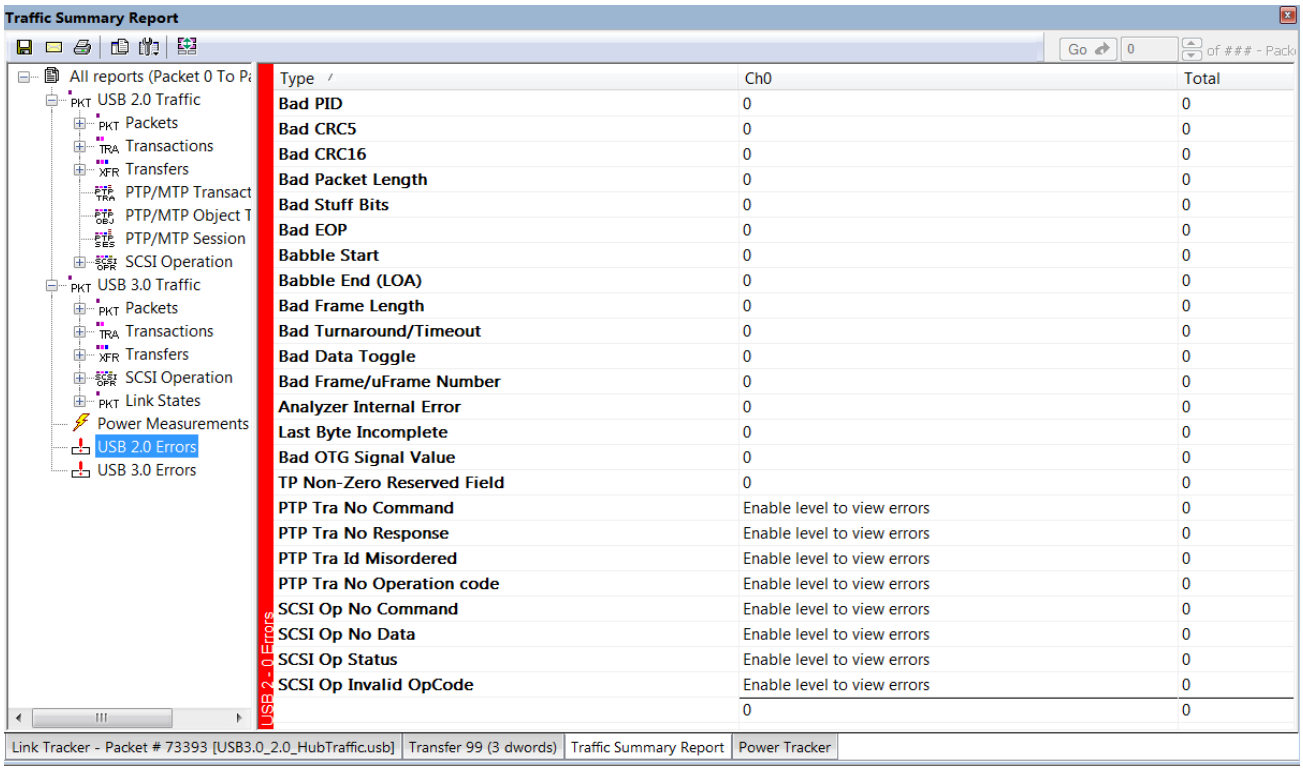
- Select **Error Summary** under **Report** in the Menu Bar.

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.



Type	Ch0	Total
Bad PID	0	0
Bad CRC5	0	0
Bad CRC16	0	0
Bad Packet Length	0	0
Bad Stuff Bits	0	0
Bad EOP	0	0
Babble Start	0	0
Babble End (LOA)	0	0
Bad Frame Length	0	0
Bad Turnaround/Timeout	0	0
Bad Data Toggle	0	0
Bad Frame/uFrame Number	0	0
Analyzer Internal Error	0	0
Last Byte Incomplete	0	0
Bad OTG Signal Value	0	0
TP Non-Zero Reserved Field	0	0
PTP Tra No Command	Enable level to view errors	0
PTP Tra No Response	Enable level to view errors	0
PTP Tra Id Misordered	Enable level to view errors	0
PTP Tra No Operation code	Enable level to view errors	0
SCSI Op No Command	Enable level to view errors	0
SCSI Op No Data	Enable level to view errors	0
SCSI Op Status	Enable level to view errors	0
SCSI Op Invalid OpCode	Enable level to view errors	0
	0	0

Figure 10.6: Traffic Summary Report (USB 2.0)

Table 10.1 lists each USB 2.0 error type and its description.

Table 10.1: USB 2.0 Error Type & 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).
Bad CRC16	The CRC16 field has an incorrect value. The packet is corrupt (either the data or the CRC itself).
Bad Packet Length	The packet is shorter or longer than expected.
Bad Stuff Bits	The NRZI encoding has a problem.
Bad EOP	The End of Packet signaling does not conform to the USB 2.0 Specification.
Babble Start	The packet started too late in the Frame or Microframe.
Babble End (LOA)	The packet ended to late in the Frame or Microframe.
Bad Frame Length	The Frame or Microframe time was out of spec. (expected ~1 ms or ~125µSec)
Bad Turnaround/Timeout	The device or host took too long to respond to a packet within a transaction.
Bad Data Toggle	Unexpected Data Toggle value; incorrect according to the USB 2.0 Specification.
Bad Frame/uFrame Number	Frame number not sequential, or not exactly 8 repetitions of a frame number in a High Speed frame sequence.
Analyzer Internal Error	Teledyne LeCroy hardware capture problem (not a USB error).
Last Byte Incomplete	The packet length in bytes was not modulo 8.
Bad OTG Signal Value	The OTG signal was not within USB 2.0 OTG Specification.
TP Non-Zero Reserved Field	A reserved value within a Transaction Packet has a non-zero value.
PTP Tra No Command	No command seen in this PTP Transfer.
PTP Tra No Response	No response seen in this PTP Transfer.
PTP Tra Id Misordered	The Transfer ID's appear to be in the wrong order.
PTP Tra No Operation code	The operation code is missing in this PTP transfer.
SCSI Op No Command	The Command is missing from this SCSI Operation.
SCSI Op No Data	The Data is missing from this SCSI Operation.
SCSI Op status	Invalid Status is found for this SCSI Operation.
SCSI Op Invalid OpCode	The SCSI OpCode is not supported by the current standards.

10.3.2 USB 3.2 Errors

Table 10.2 lists and describes the 3.2 errors and their descriptions.

Table 10.2: USB 3.2 Error Type & 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.
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

Figure 10.7 shows USB4 Sideband errors traffic, and Table 10.3 lists and describes the USB4 Sideband errors.

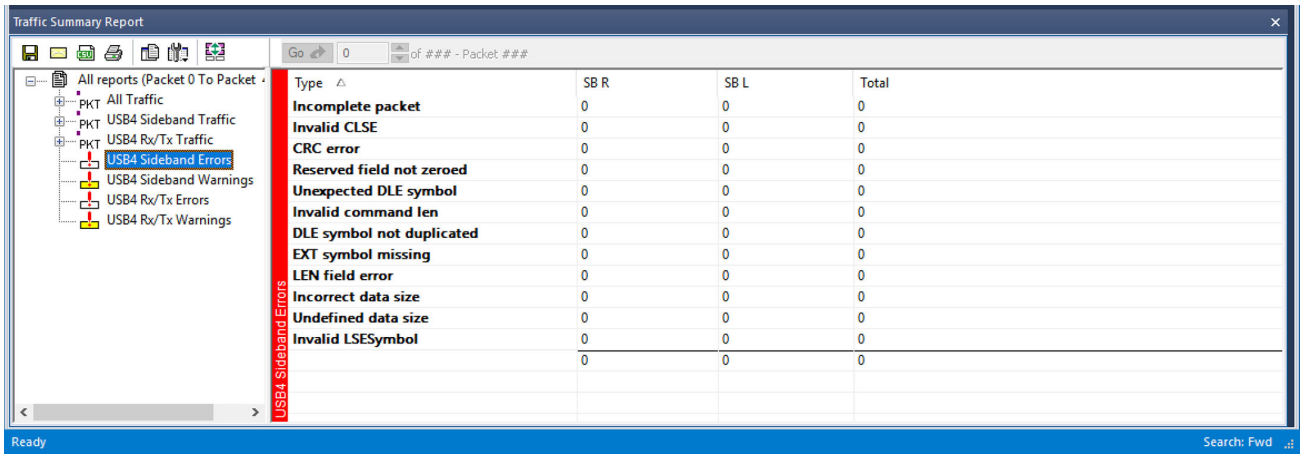


Figure 10.7: USB4 Traffic Summary Report

The following table lists each USB4 Sideband error type and its description.

Table 10.3: USB4 Sideband Error Type & 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.

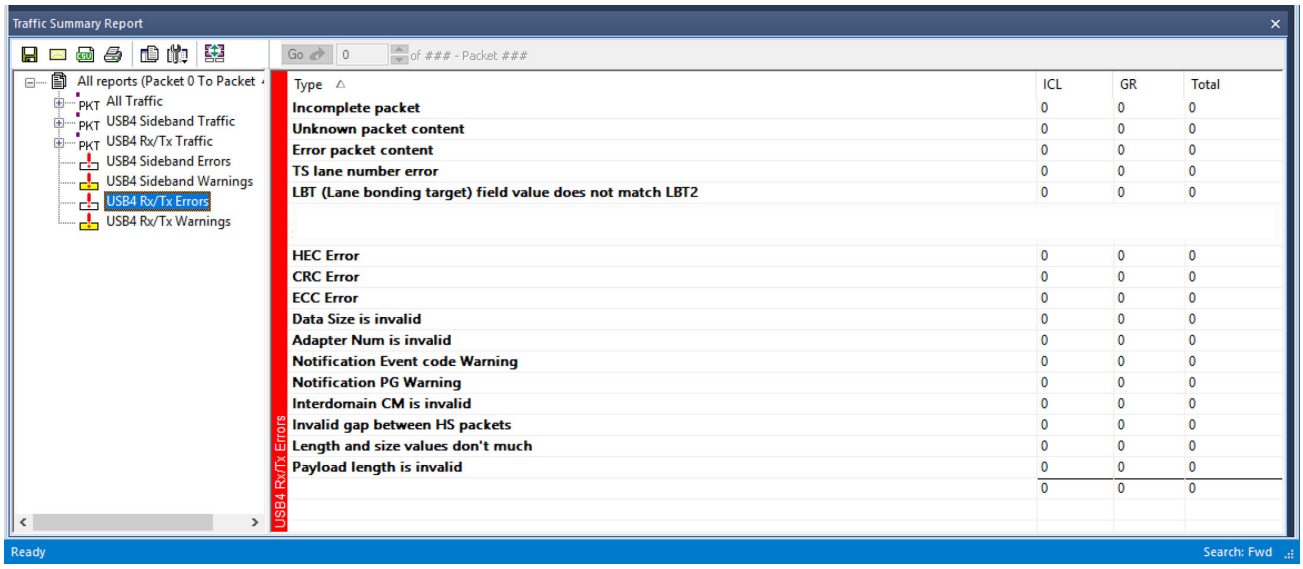


Figure 10.8: Traffic Summary: USB Rx/Tx Errors

Table 10.4 lists each USB4 Rx/Tx error type and its description.

Table 10.4: USB4 Rx/Tx Error Type & 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 Packets Data don't match

Table 10.4: USB4 Rx/Tx Error Type & Description (Continued)

Error Type	Error Description
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:

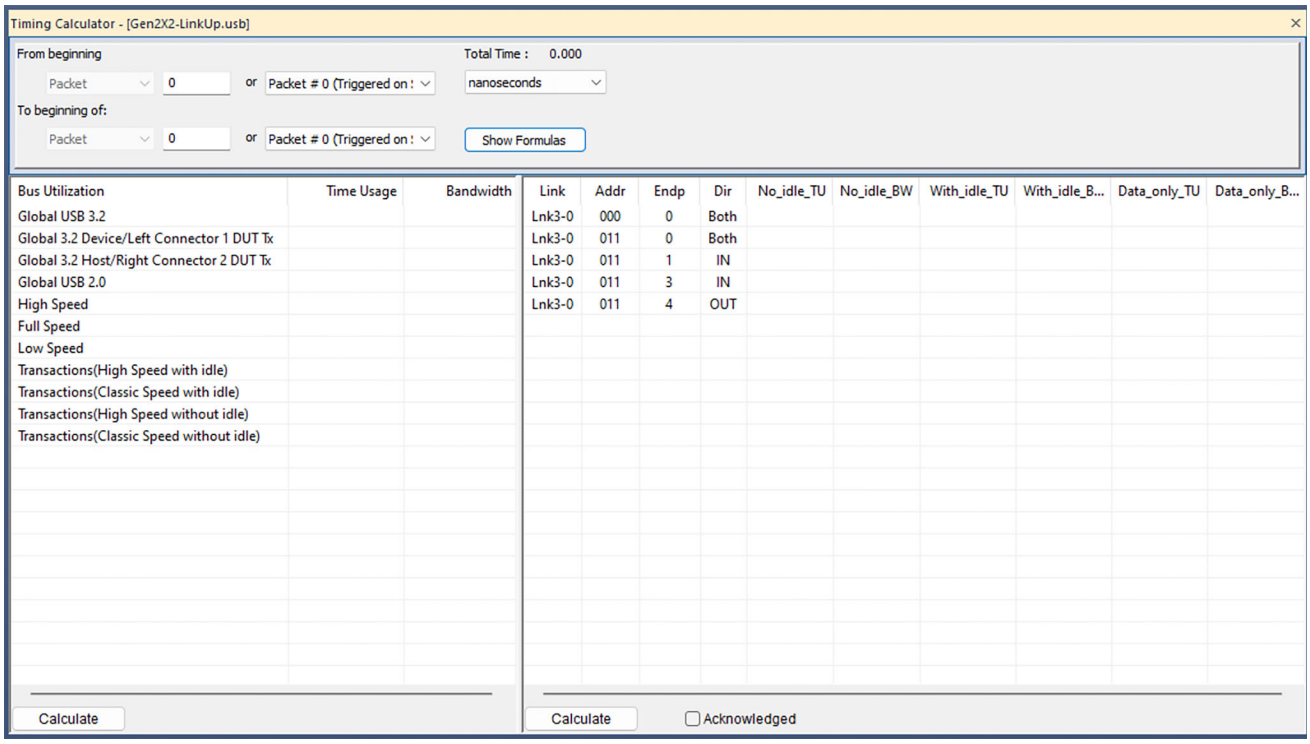


Figure 10.9: Timing Calculations Report

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 10.10, 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-tries, etc.)

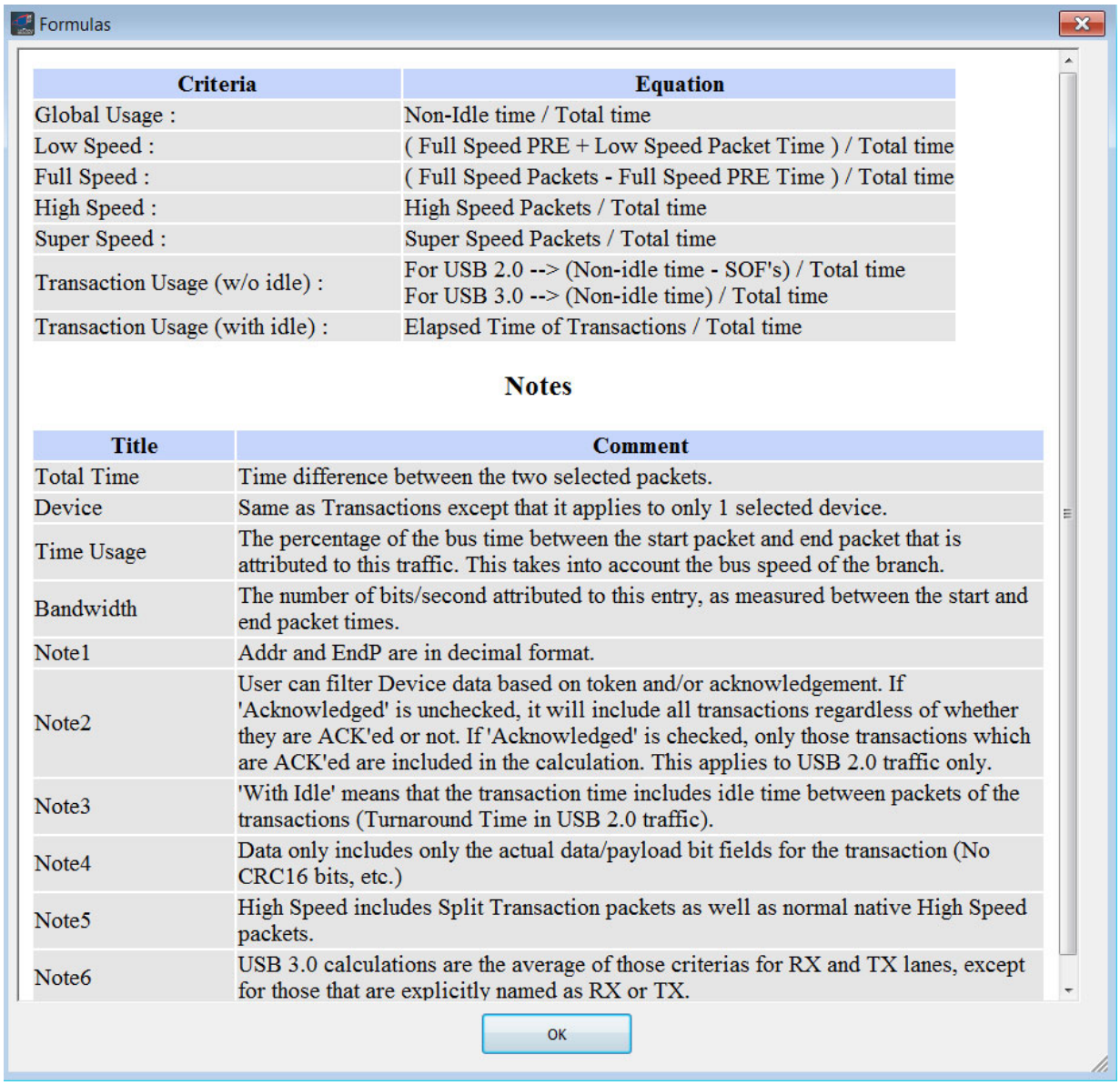


Figure 10.10: Formulas Window

6. Click **Calculate** 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)

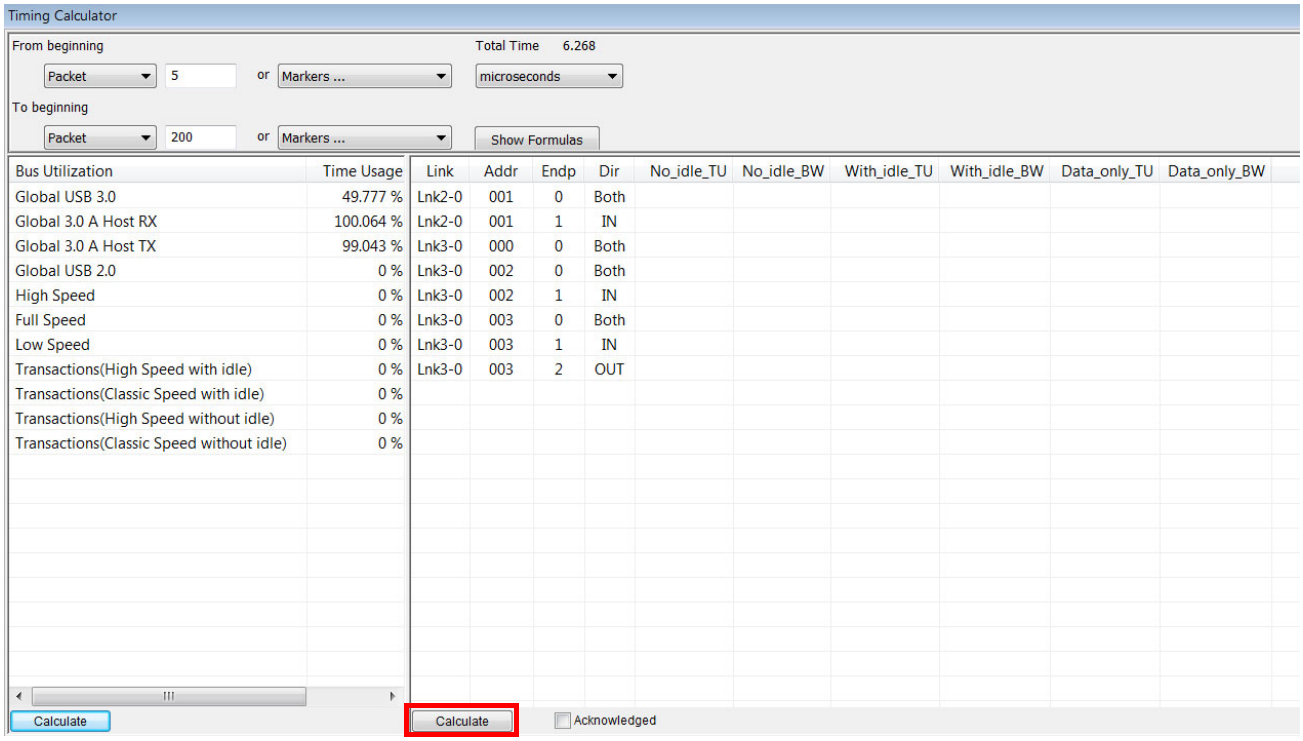


Figure 10.11: Timing Calculator Report

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:	The larger the range, the more accurate bandwidth and other calculations will be. You should choose a range that includes at least a few USB frames or Microframes so that the measurements give realistic values.

10.4.1 USB4

For USB4, there are two calculation methods:

- Bus Utilization (the left side of the window) includes all HS packets except Idle symbols, and calculations are performed on a per-lane and per-port basis.
- Device Utilization (the right side of the window) includes only TLPs, and calculations are performed on a per-HopID basis.

The following formulas are used:

- Time Usage: Total duration of all packets, divided by time.
- Bandwidth: Total size of all packets, divided by time.
- Payload-Only Time Usage: Total duration of all payloads, divided by time.
- Payload-Only Bandwidth: Total size of all payloads, divided by time.

10.5 Data View

The Data View window shows packet information. To obtain the Data View window, do one of the following:

- Select **Report → Data View**.

  OR

- Click the  toolbar icon.

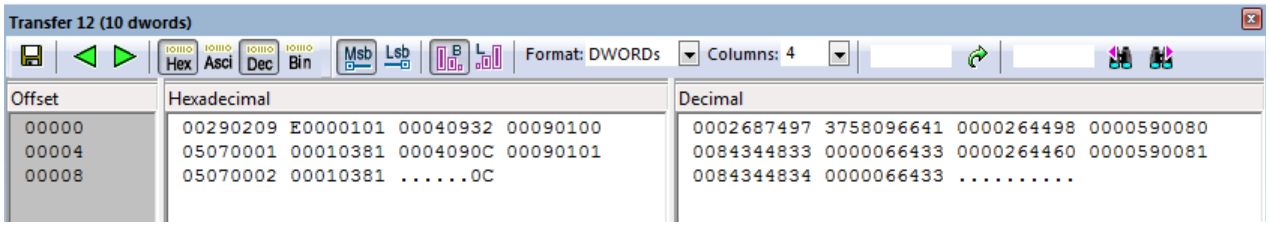


Figure 10.12: Data View Report

The Data View toolbar buttons and fields enable the following:

- Save
- Go to Previous or Next
- Display Hexadecimal, ASCII, Decimal, or Binary

- Use MSB Format or LSB Format
- Use Big Endian or Little Endian

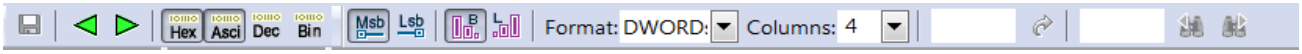


Figure 10.13: Data View Toolbar

- 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 10.15.

To open the Raw Data View, select the  or choose the Raw Data View from the Report tab on the main Toolbar. See Figure 10.14.

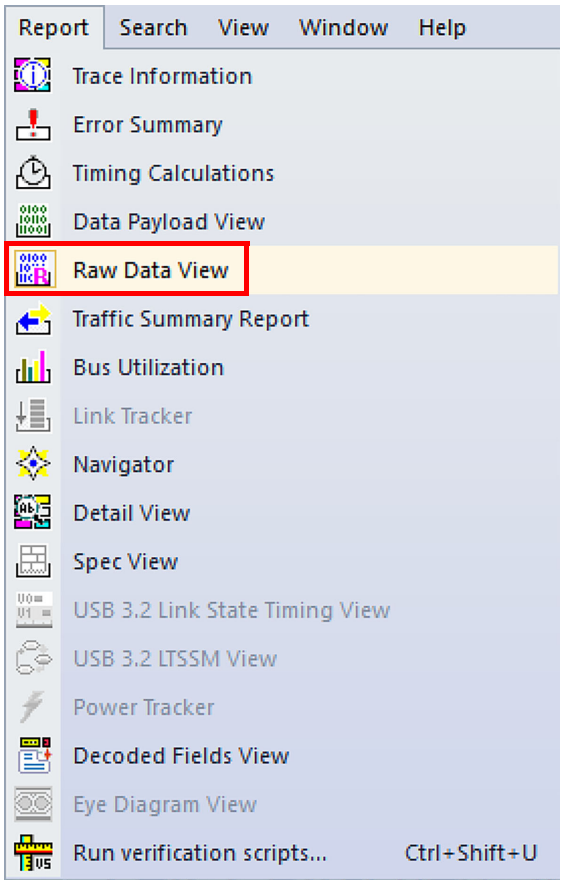


Figure 10.14: Report: Raw Data View

The Raw Data View toolbar buttons allow you to:

- Save
- Go to Previous or Next packet in the trace
- Display Hexadecimal, Binary, or Ternary
- 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



Figure 10.15: Raw Data Toolbar

Figure 10.16 shows an example of Raw Data from a packet in a trace:

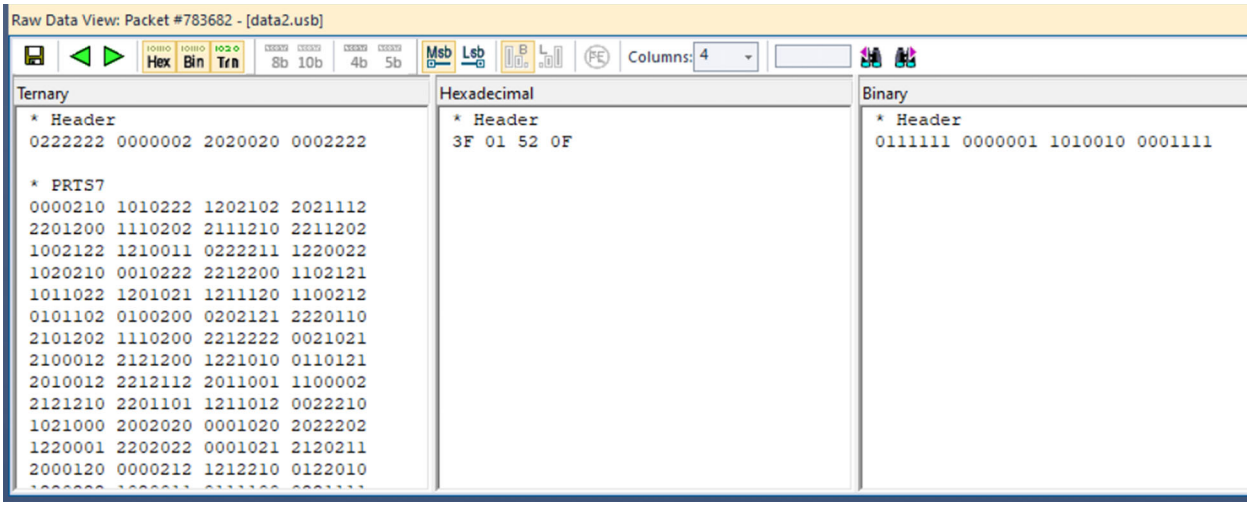


Figure 10.16: Raw Data View: Ternary, Hex, and Binary Formats

10.6.1 Hide Escape Symbols

If you have a transaction with multiple Escape Symbols, you can Show or Hide the Escape Symbols by clicking  . The Raw Data View without Hiding Escape Symbols and with Hiding Escape Symbols are shown in Figure 10.17 and Figure 10.18.

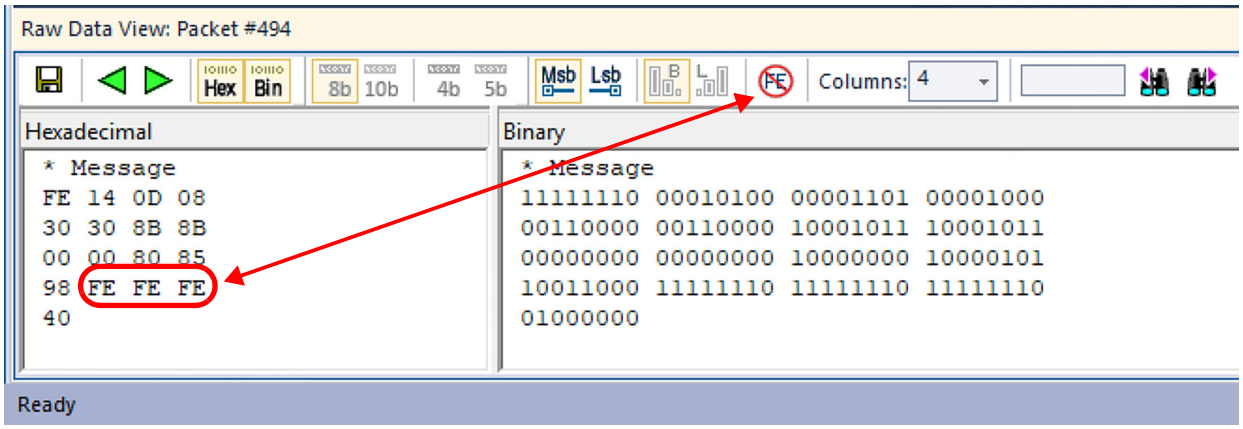


Figure 10.17: Raw Data: Escape Symbols Shown

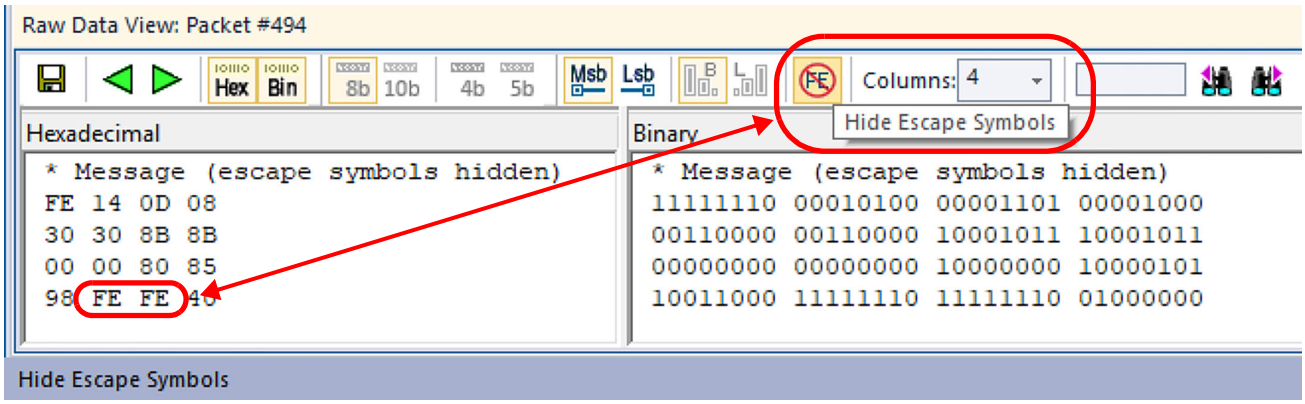


Figure 10.18: Raw Data: Escape Symbols Hidden

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 a Traffic Summary Report:

1. Select **Report > Traffic Summary Report** or click the button marked .

Specify a range of packets, then the following window appears:

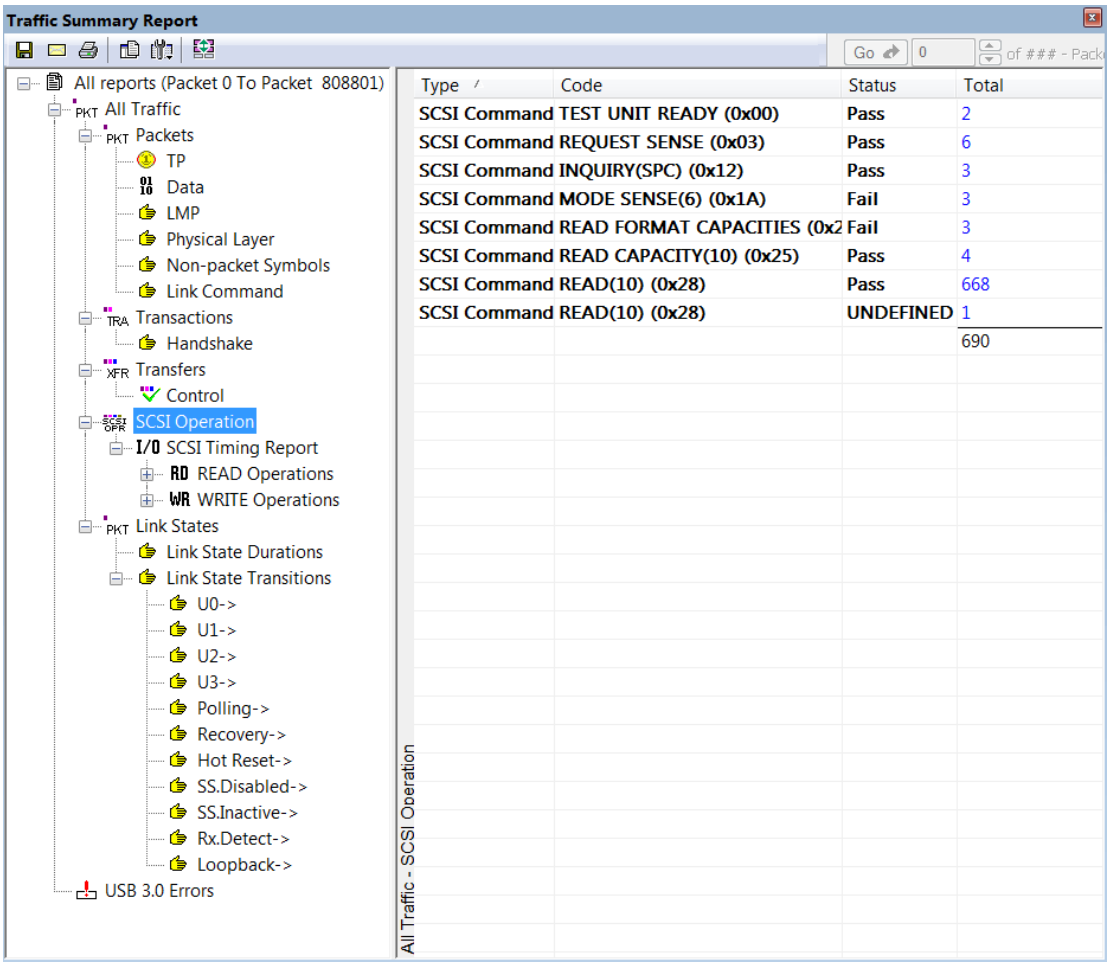


Figure 10.19: Traffic Summary Report

2. Click the **Options** button (see red arrow above) to display the Options menu (see Figure 10.20), which allows you to show Grid lines, Row selection, and Tight columns.

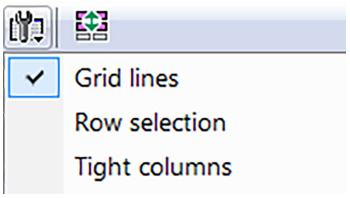


Figure 10.20: Options Menu

3. Click  to display the Select Range dialog.

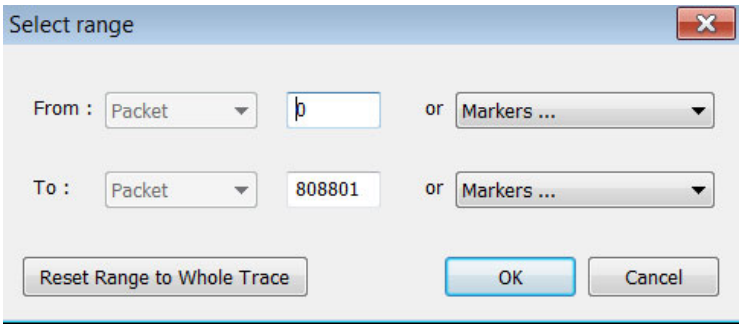


Figure 10.21: Select Range Dialog

4. Enter a number **From** and a number **To.** You can also **Reset Range** to **Whole Trace**.

10.7.1 SCSI Metrics

The SCSI Metrics are:

- **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

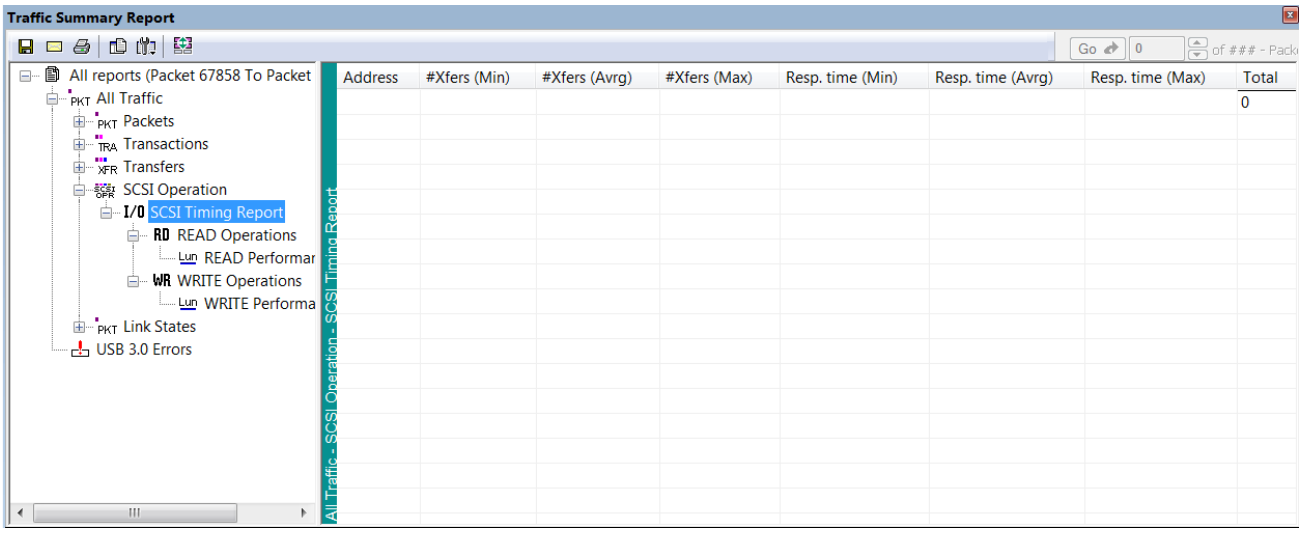


Figure 10.22: SCSI Metrics Report

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 10.23.

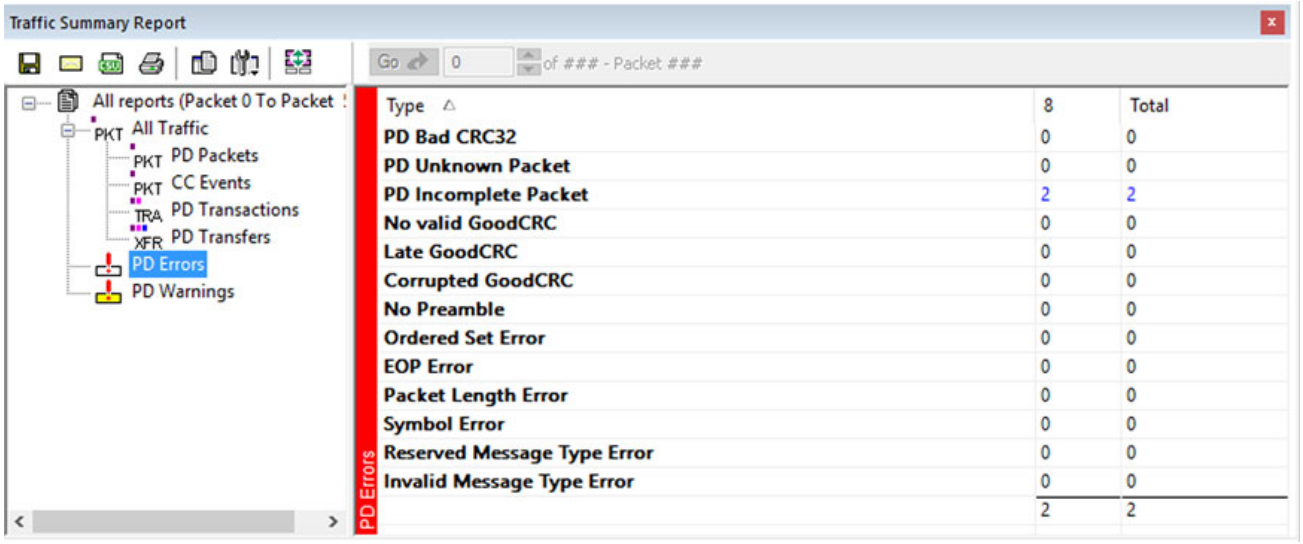


Figure 10.23: Power Delivery Traffic Summary

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 Figure 10.24:

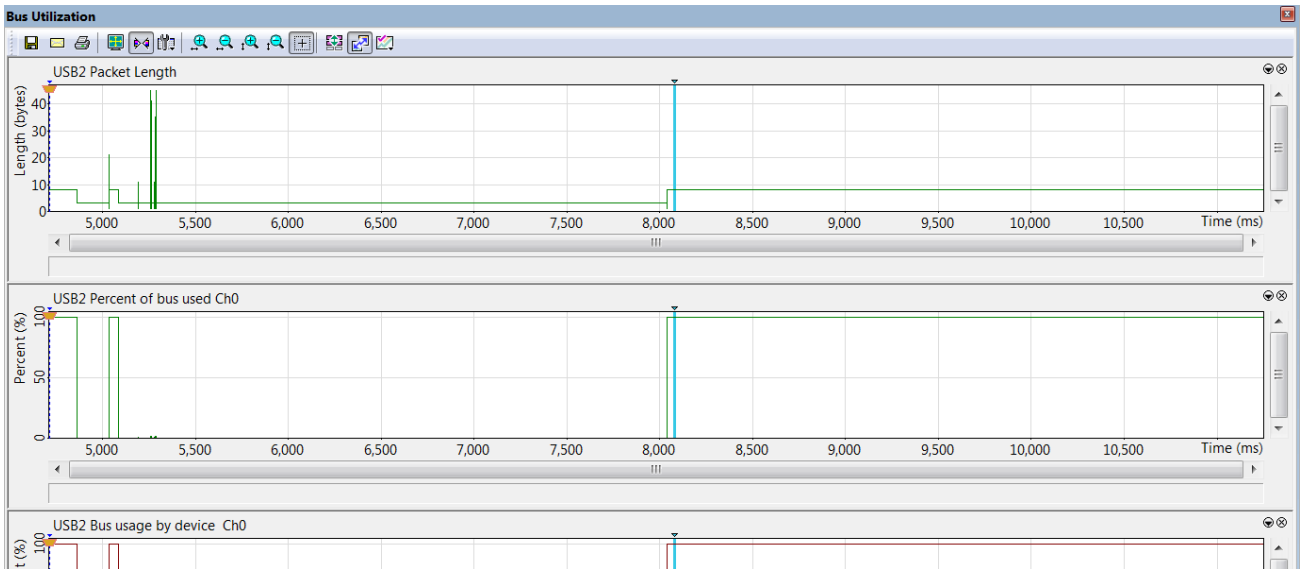


Figure 10.24: Bus Utilization Window

For USB 3.2, the display is similar to the following:

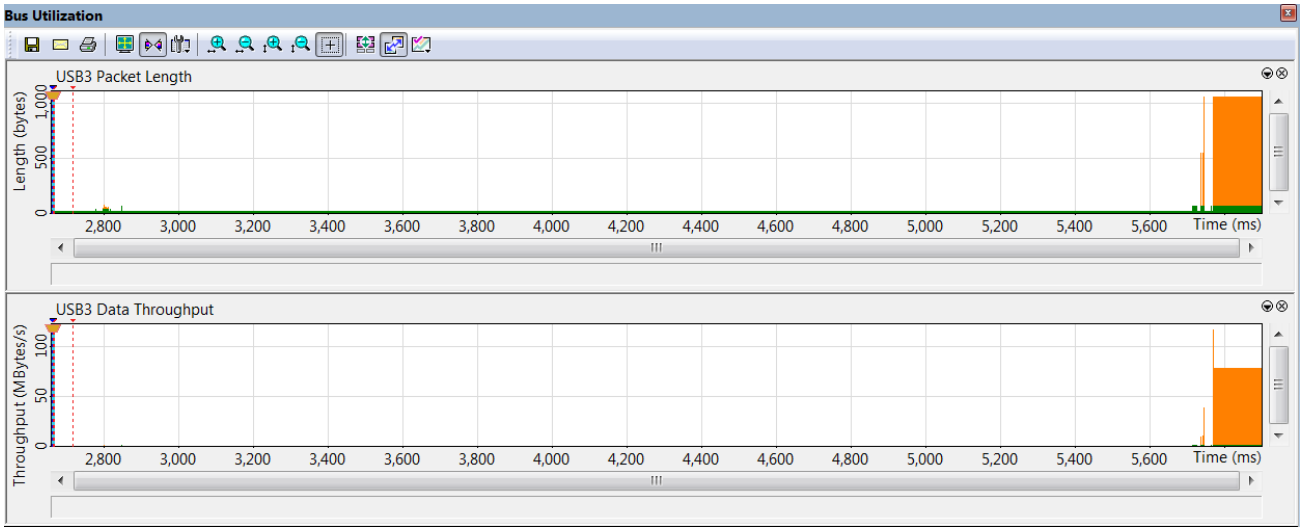


Figure 10.25: Bus Utilization Window

For USB4 the display is similar to the following:

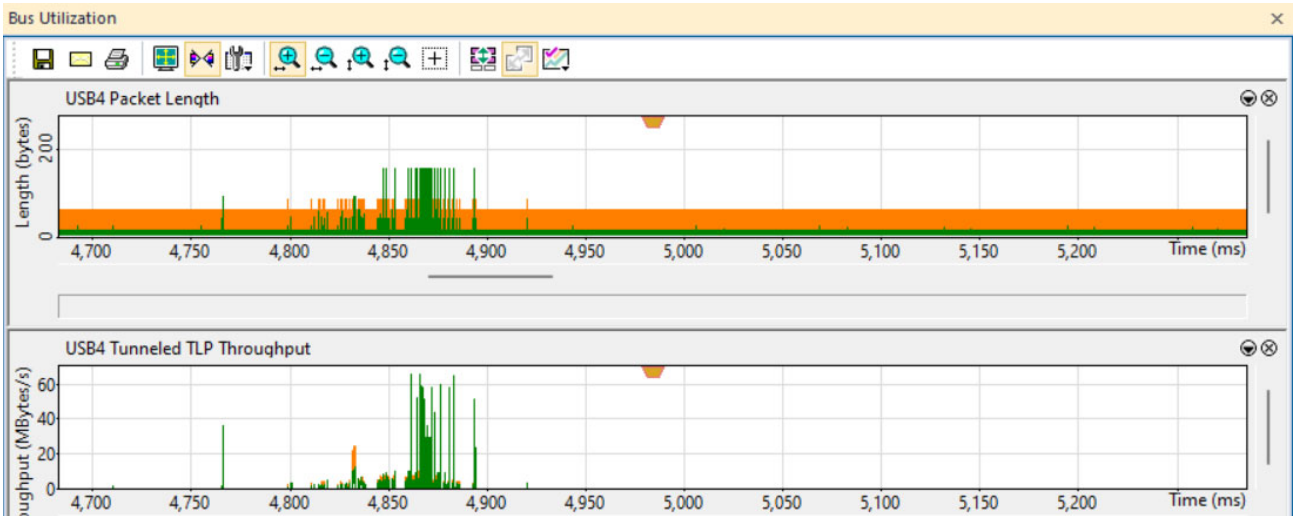


Figure 10.26: Bus Utilization Window

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:

Table 10.5: Bus Utilization Buttons

	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 10.9.3 *Link Tracker Buttons*.		Select Range.

Table 10.5: Bus Utilization Buttons (Continued)

	View Settings - opens a sub-menu with options for formatting the display. See 10.8.2 *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.

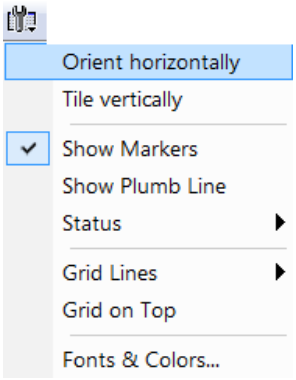


Figure 10.27: View Settings Menu

- **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:

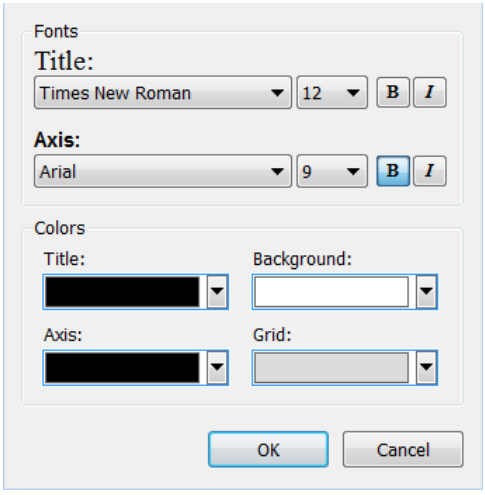


Figure 10.28: View Options Menu

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:

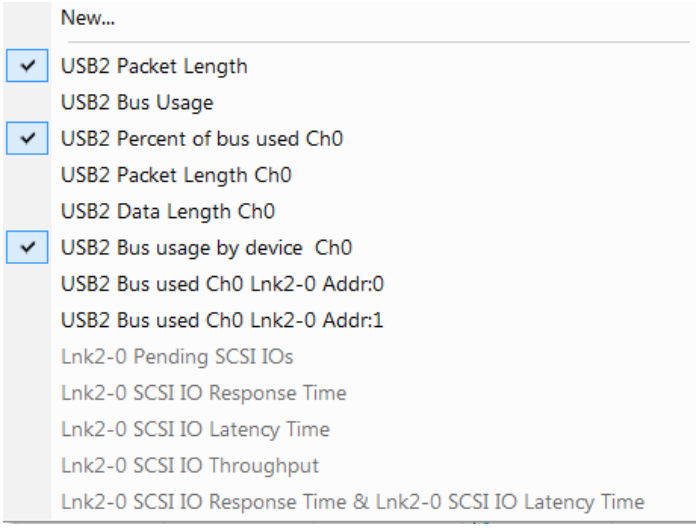


Figure 10.29: Graph Areas Menu USB 2.0

For USB 3.2. the display is similar to the following:

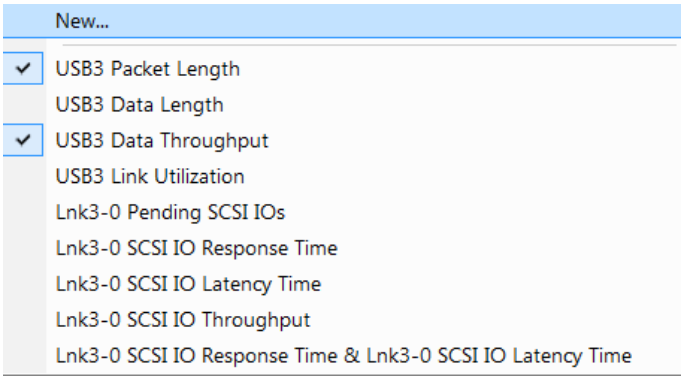


Figure 10.30: Graph Areas Menu USB 3.2

For USB4, the display is similar to the following:

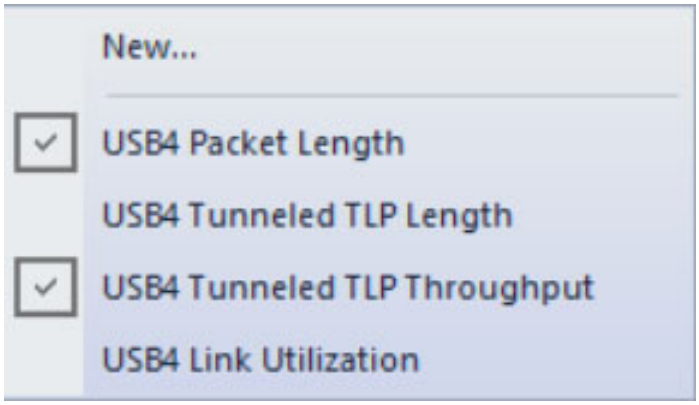


Figure 10.31: Graph Areas Menu USB4

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

10.8.3.1 Change the Properties in the Bus Utilization Graph

To change the properties in the Bus Utilization graph, in the Graph Area properties dialog box (see Figure 10.32), select the options to display in the graph display, then click **OK**.

10.8.3.2 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, select the options to display in the graph.
3. Enter a Title for the new graph, then click **OK**.

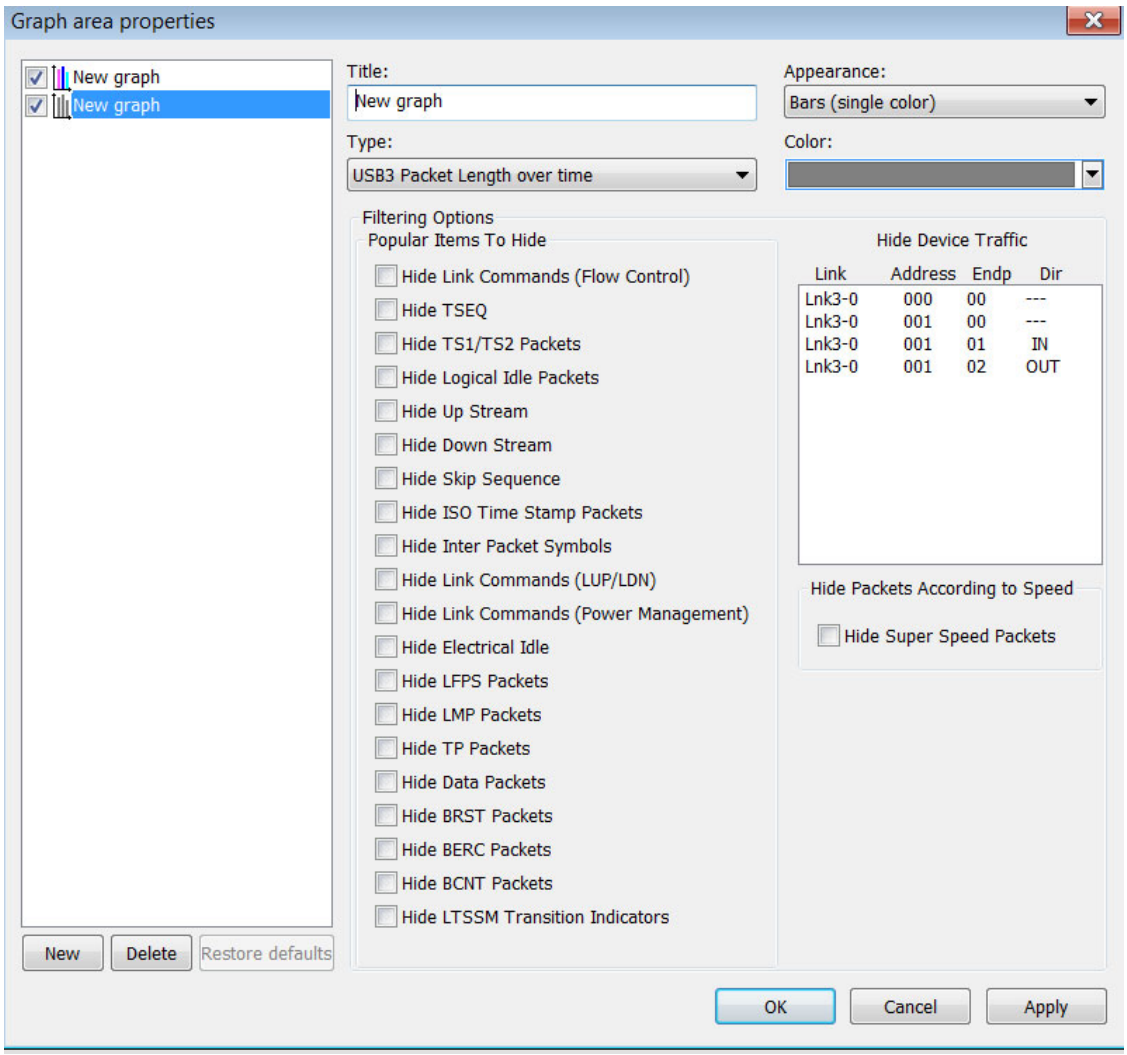


Figure 10.32: Graph Area Properties Dialog

10.8.3.3 USB4 Graph Areas

- USB4 Packet Length: This graph shows the length of all USB4 HS packets over time.
- USB4 Tunneled TLP Length: This graph shows the length of Tunneled payload data over time.
- USB4 Tunneled TLP Throughput: This graph shows the throughput of Tunneled payload data over time.
- USB4 Link Utilization: This graph shows the throughput of all USB4 HS packets over time.

NOTE: The measurement interval can be customized in USB4 Throughput and Link Utilization graphs via the Properties window.

10.9 Link Tracker

The Link Tracker window displays a detailed chronological view of events. Events are shown on a channel-by-channel basis in columns within the window.

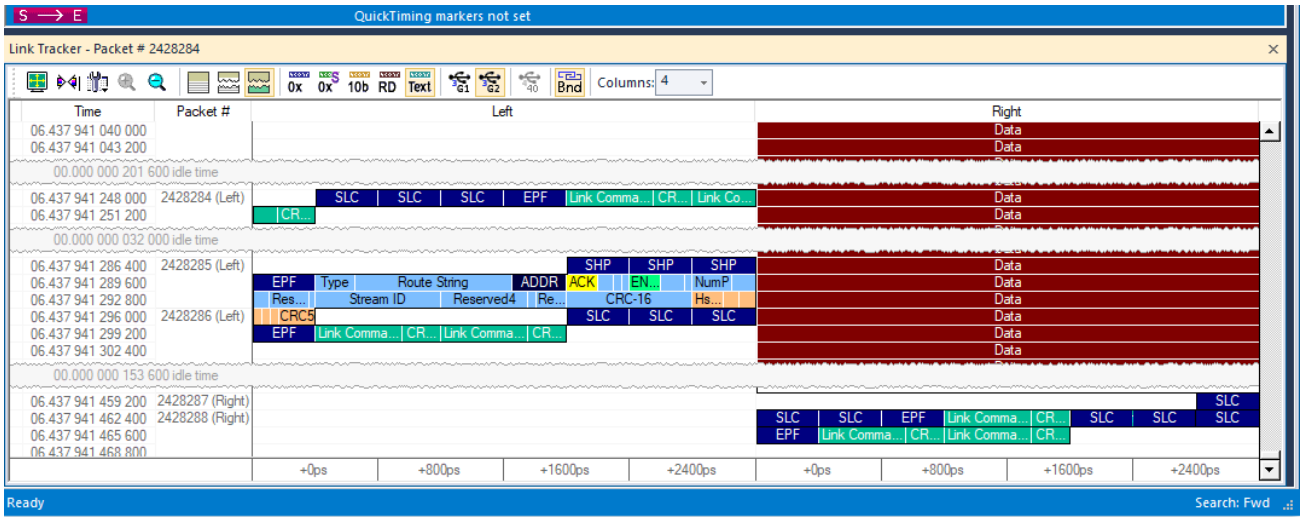


Figure 10.33: Link Tracker Window

- Select the number of columns to view more or less data at one time.
- Each time slot in the vertical axis represents the minimum time that a DWORD requires to traverse the bus when the “Columns” is selected as 4.

NOTE: On Symbol Displays, there will occasionally be “blank” symbols inserted into the Link Tracker display (or symbols removed) to compensate for timestamp rate matching between the various time bases. The issue is that there are 3 clock domains (Rx, Tx, and our precision timestamp) that need to be represented in the trace.

The nominal 2nSec/symbol Transmit and Receive clocks can vary up to 500ppm per the USB Specification, whereas the analyzer is accurate to 3ppm. Blank entries and missing entries in the link tracker are there to compensate for this difference, and to try to maintain the most accurate relationship among these clocks and present the closest time relationship between the downward and upward streams.

The clock listed in the Time column is our precision 3ppm clock timestamp.

- **Toolbar**: Shows buttons to change the format of the Link Tracker window.
- **Main Display Area**: Displays traffic chronologically as it occurred in the recording. The window divides into columns: the first column shows time and traffic is shown channel-by-channel in the columns on the right.

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 (Figure 10.34).

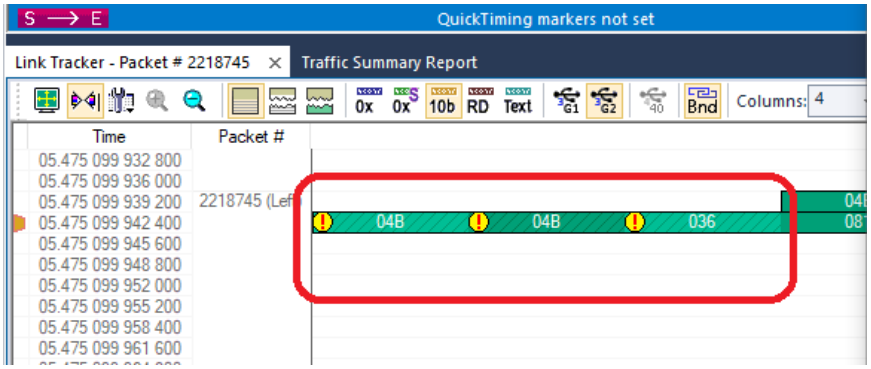


Figure 10.34: Link Tracker: Time Overlap Indicators

If you hover over the yellow circle for the timestamp, a Tool Tip will show the symbols that occur in this location. See Figure 10.35.

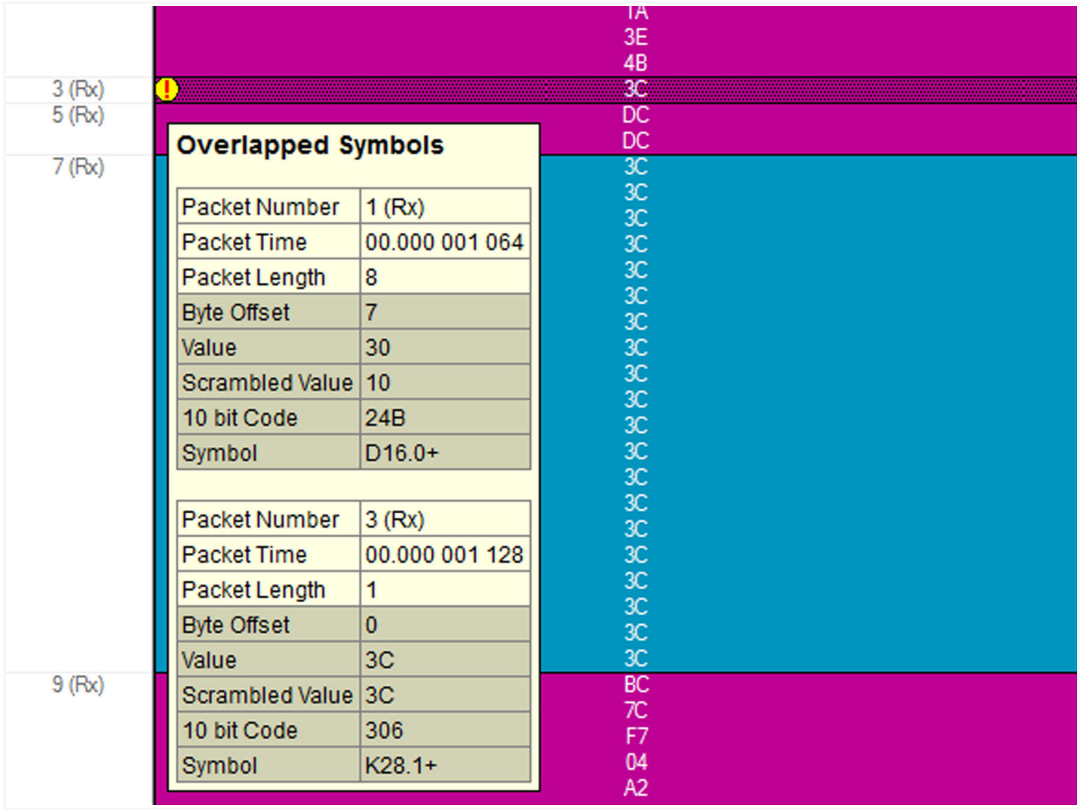


Figure 10.35: LinkTracker: Tool Tip

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.

10.9.2.1 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.

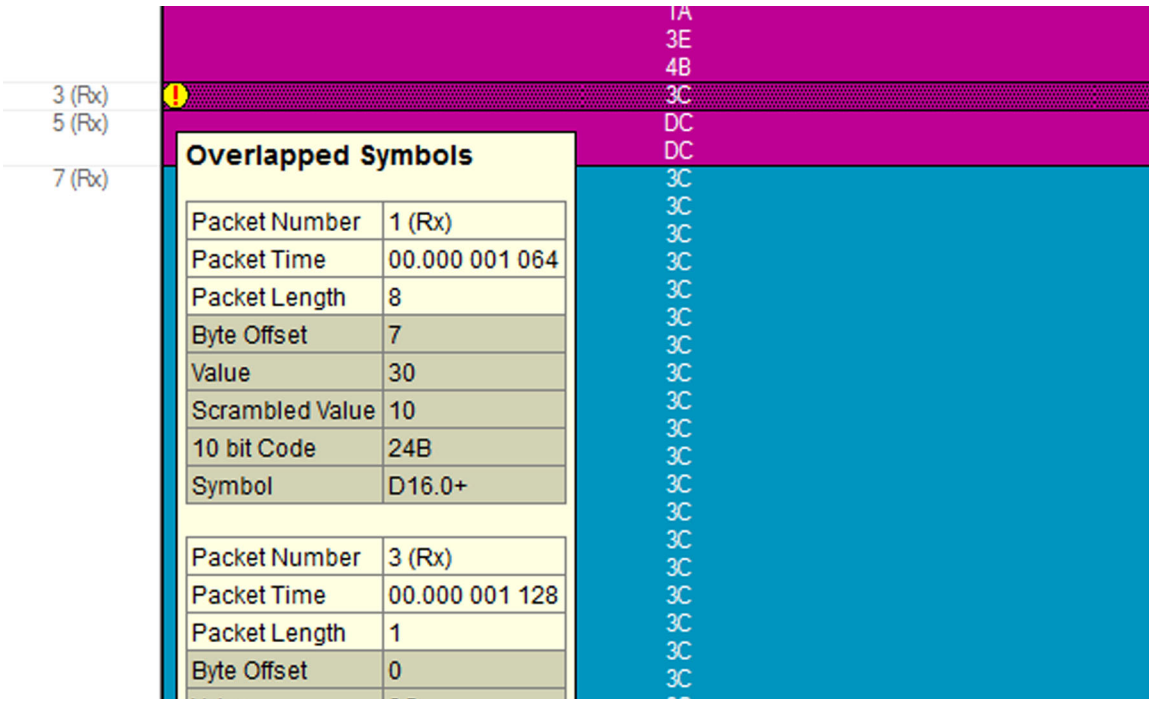


Figure 10.36: Link Tracker Window Zoomed Out

10.9.2.2 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. Four 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.

10.9.2.3 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.

10.9.2.4 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.

10.9.2.5 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:

Table 10.6: Link Tracker Buttons (Sheet 1 of 2)

	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 10.9.2 *Using the Link Tracker Window* 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 Applicable to USB 3.2 Gen1 only
	Show Symbols Applicable to USB 3.2 Gen1 only

Table 10.6: Link Tracker Buttons (Sheet 2 of 2)

	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.
	Show USB4 Packets
	Bonded/Unbonded Mode. This is only available for USB 3.2.
	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 10.37).

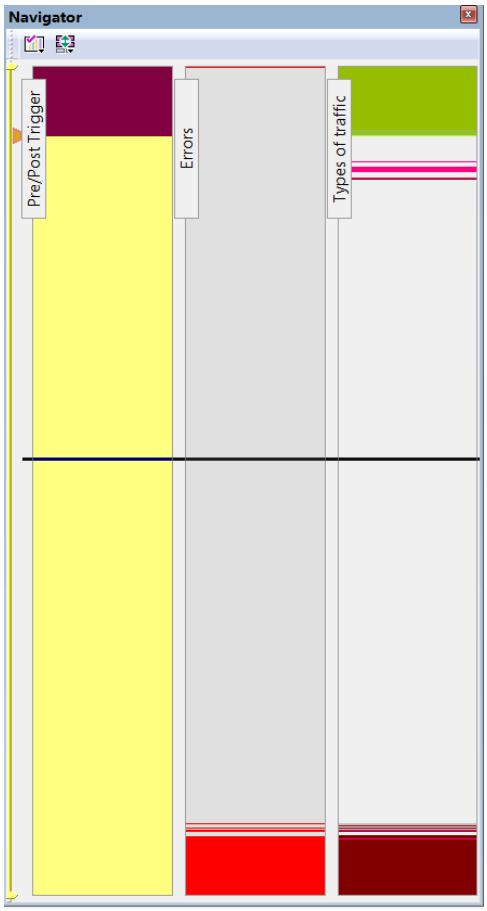


Figure 10.37: Navigator Window

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 has two buttons that let you quickly set Navigator features:

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

To bring up the Navigator legend.

The legend determines how information is shown in the panes.



10.10.2.1 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.

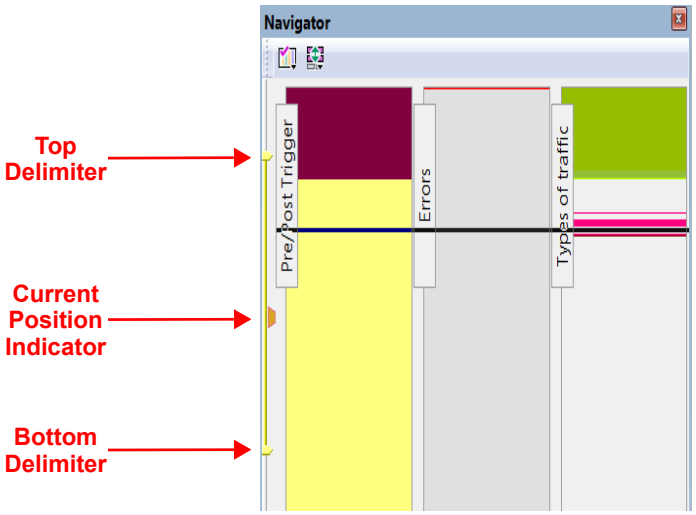


Figure 10.38: Navigator Delimiter

10.10.2.1.1 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.

10.10.2.1.2 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.

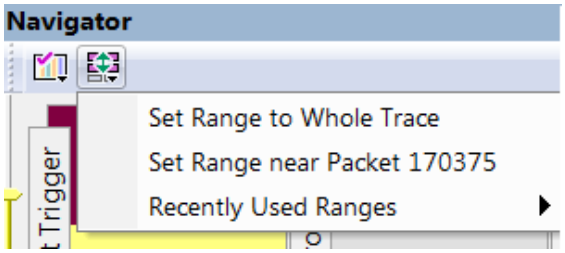


Figure 10.39: Navigator Range Drop-Down Menu

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.

10.10.2.2 Navigator Panes

You can display any combination of trace Navigator panes.

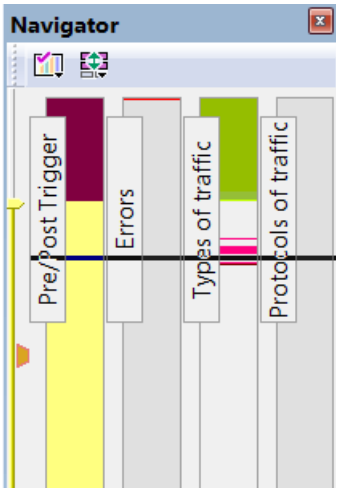


Figure 10.40: Navigator Panes

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.

10.10.2.2.1 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.

10.10.2.2.2 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 10.38).

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.

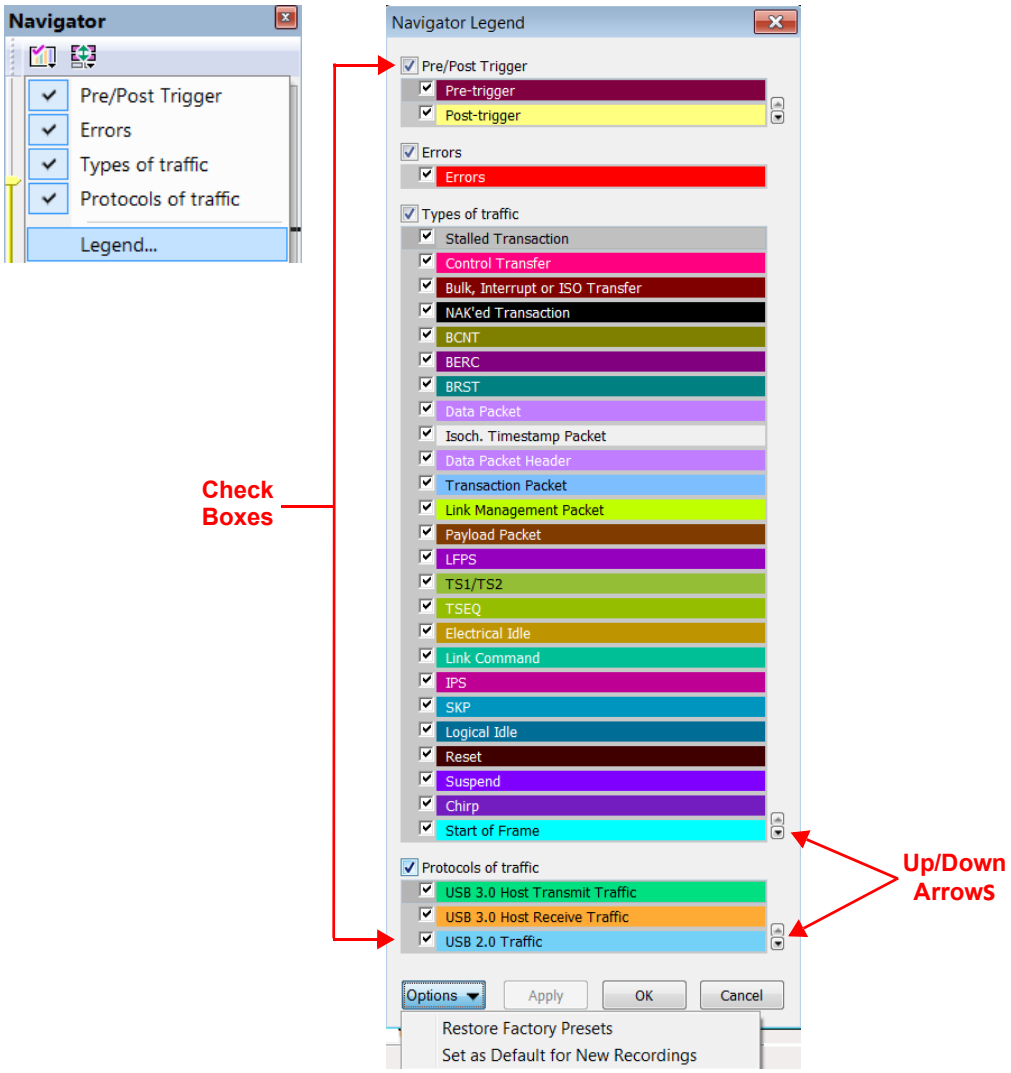


Figure 10.41: Navigator Legend Dialog

The Navigator Legend dialog box has areas corresponding to each of the panes. Each area has checkboxes 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.

10.10.2.2.3 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.

10.10.2.2.4 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. 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.

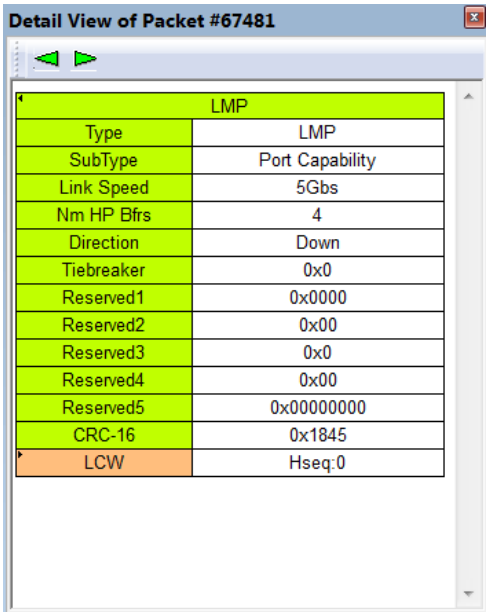


Figure 10.42: Detail View Window

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.

NOTE: Selecting a field in Detail View highlights the corresponding field in Trace View and Spec View. See 6.26 *Field Highlighting*.

10.12 Spec View

The Spec View shows packet header information for USB 3.2, Power Delivery, USB4 Sideband and Display Port traffic.

To obtain the Spec View, select **Report** → **Spec View** or click the  Spec View toolbar icon.

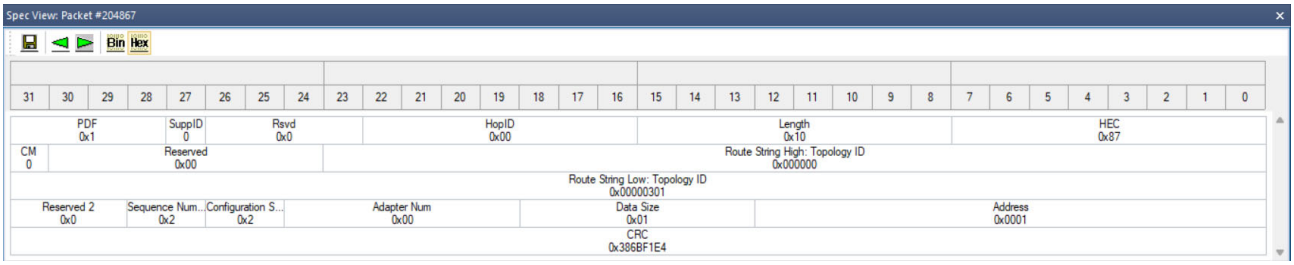


Figure 10.43: Spec View

The toolbar allows you to Save, go to Previous or Next and display Binary or Hexadecimal. See Figure 10.44.



Figure 10.44: Spec View Toolbar

NOTE: Selecting a field in Spec View highlights the corresponding field in Trace View and Detail View. See Section 6.26 *Field Highlighting*.

10.13 USB4 Configuration Space View

USB4 Configuration Space View shows decoding of USB4 configuration space capabilities.

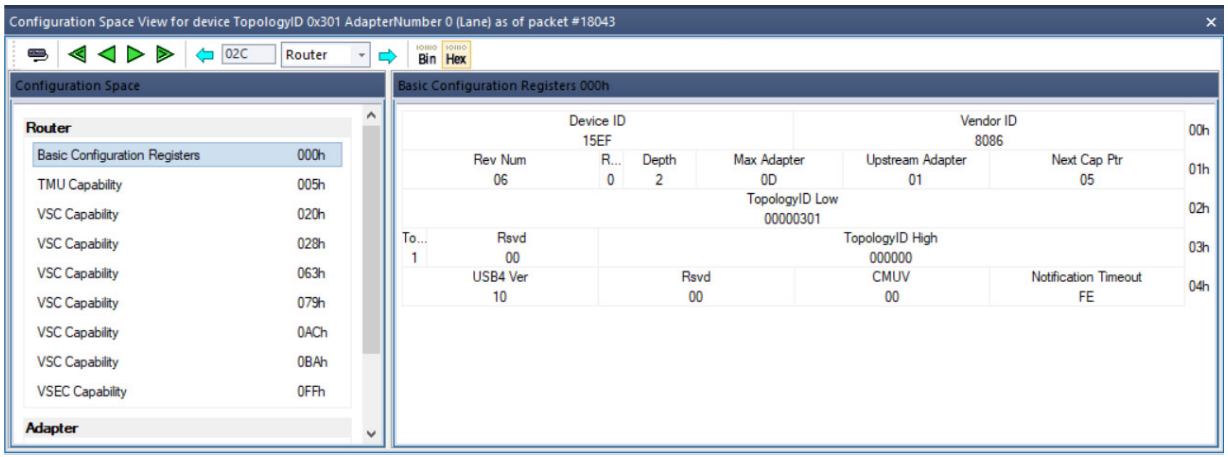


Figure 10.45: Router Configuration Space View

10.13.1 Open USB4 Configuration Space View

To open USB4 Configuration Space View, from the Report menu click USB4 Configuration Space. Select the specific device by selecting the Topology ID and Adapter Number.

> **NOTE:** USB4 Configuration Space may not be available if there are no Control Packets for USB4 traffic in trace.

To change the selected device, you can do one of the following:

- From the Report menu, select **USB4 Configuration Space**.
- Click **Select another device** from the USB4 Configuration Space View navigation bar.

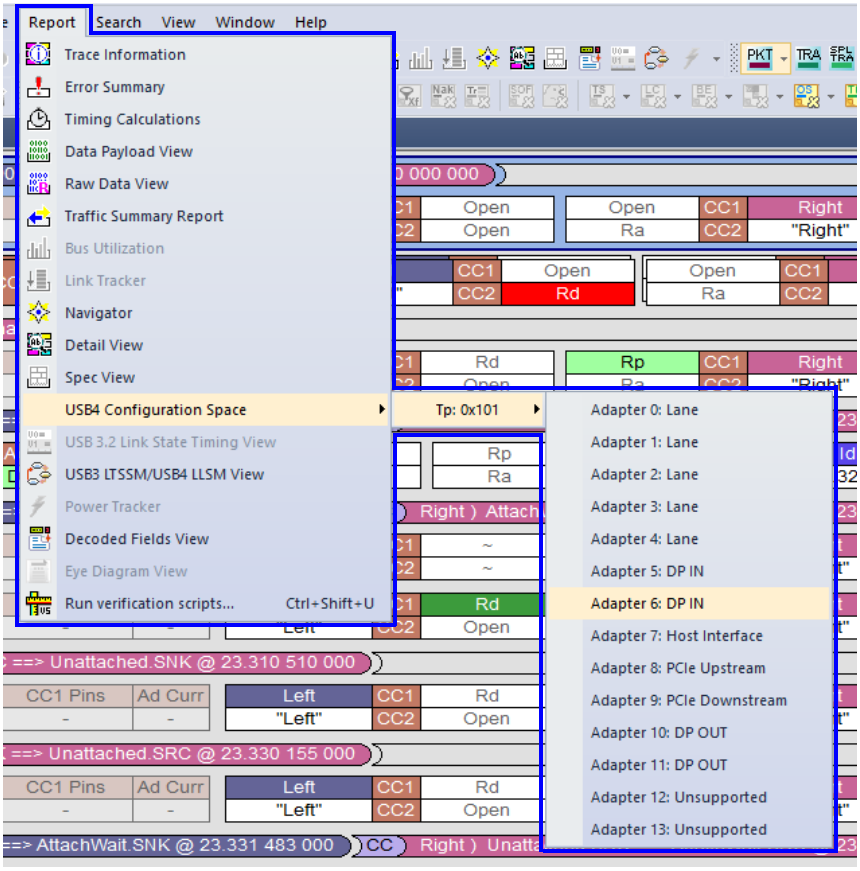


Figure 10.46: Select Configuration Space View from Report Menu

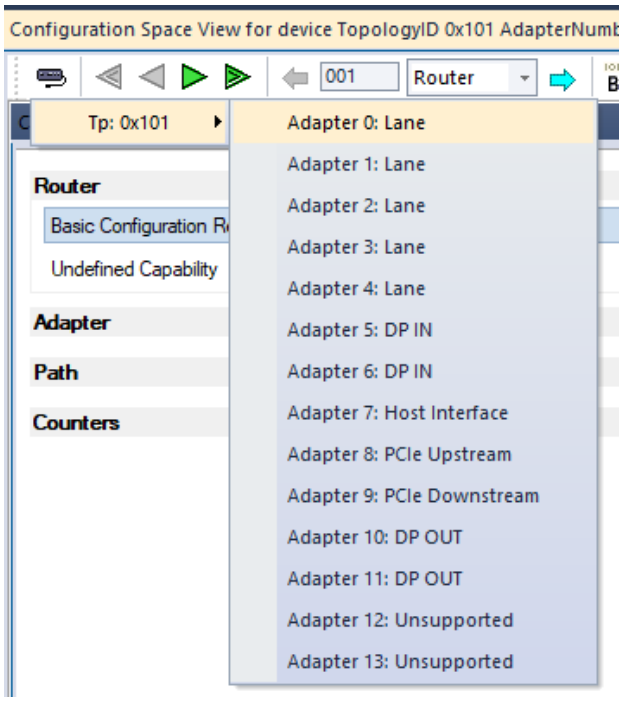


Figure 10.47: Configuration Space View Reports

10.13.2 USB4 Configuration Space View Structure

USB4 Configuration Space View consists of four main components:

- **Caption Bar**: Contains useful information about the USB4 Configuration Space View state.
- **Navigation Bar:** Contains buttons for selecting devices, navigating through Configuration Spaces, and selecting data format.
- **Headers View:** Lists Configuration Spaces and available capabilities with start addresses.
- **Capability View:** Displays decoding of selected capability.



Figure 10.48: USB4 Configuration Space View Layout

10.13.2.1 Caption Bar

The Caption Bar displays information about the current USB4 Configuration Space View state.

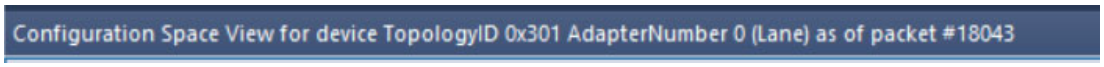


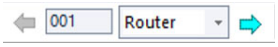
Figure 10.49: Caption Bar

The Caption Bar shows the selected device (TopologyID and AdapterNumber) and adapter type. It also shows the current packet number.

10.13.2.2 Navigation Bar

The Navigation Bar contains buttons for working with USB4 Configuration Space View.

Table 10.7: Navigation Buttons

Button	Description
	Select another device. Provides the same functionality as selecting **Report → USB4 Configuration Space**.
	Navigation through packets. Buttons provide navigation to the first, previous, next, and the last control transfer for the selected device.
	Navigation through Configuration Spaces. Provides the ability to select a specific Configuration Space and address and go to the previous or next packet with the specified parameters. While navigating through packets, the Address and Configuration Space fields display parameters for the current packet.
	Select Binary or Hexadecimal format for Configuration Space data.

10.13.2.3 Headers View

Headers View displays a list of Configuration Spaces and available capabilities with their start addresses.

> **NOTE:** Headers View shows capabilities as packets get access to the Configuration Spaces. For example, Headers View contains only one capability at the first packet, and all the capabilities accessed in trace through the very last packet. Content of USB4 Configuration Space View appears as you navigate through packets.

10.13.2.4 Capability View

Capability View displays layout and data of the selected capability.

> **NOTE:** Capability View shows data of Configuration Space as packets get access to the Configuration Spaces. For example, Capability View contains only one piece of the single available capability at the first packet, and all the data accessed in trace through the very last packet. Content of the USB4 Configuration Space View appears as you navigates through packets.

10.13.3 Router & Adapter Capabilities Appearance

Router and Adapter Configuration Space uses field **Next Cap Ptr** to detect next capability. Router and Adapter capabilities (except Basic Configuration Registers) appear in Headers View as soon as the previous capability gets access to **Next Cap Ptr**. However, at this moment, there is no way to detect the type of capability, so it appears as **Undefined Capability** and its type is detected later.

10.13.3.1 Examples

The first packet reads the DWORD of Router Basic Configuration Registers with field **Next Cap Ptr**, so now Headers View contains Basic Configuration Registers and Undefined Capability at address 0x5.

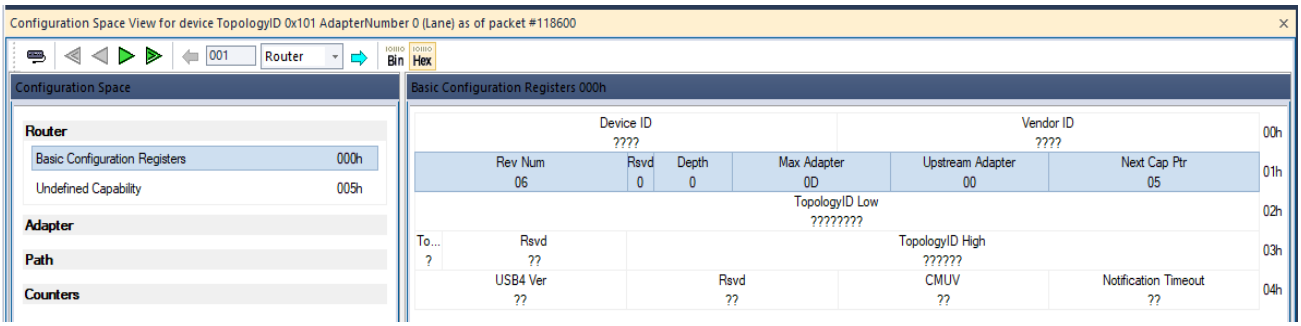


Figure 10.50: Router Configuration Space at First Control Packet

A few packets later, the DWORD at address 0x5 is read and USB4 Configuration Space View detects that this is Router TMU Capability. Also, since **Next Cap Ptr** is read, next Undefined Capability appears at address 0x20.

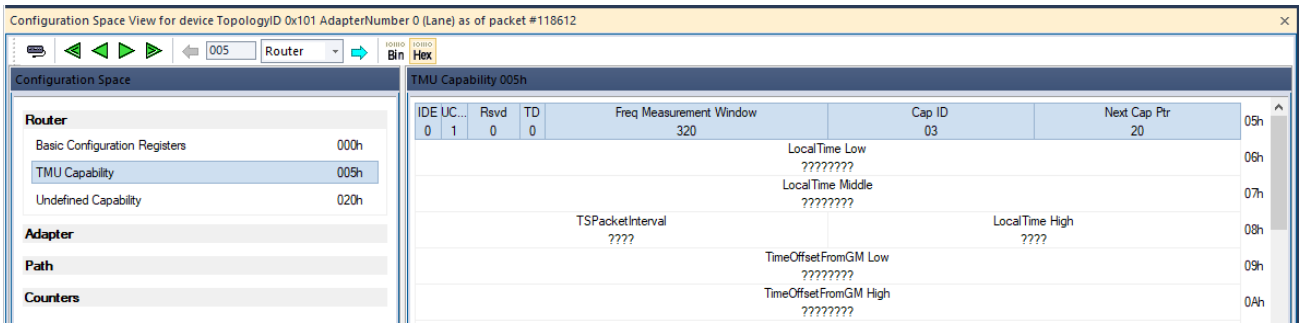


Figure 10.51: Capability Appears in Router Configuration Space

10.13.4 Truncation of USB4 Capability Layout

Some capabilities may be truncated because of next capability. If **Next Cap Ptr** points at the address before the end of a capability, layout of this capability is truncated.

For example, in Figure 10.52 below, Router Basic Configuration Registers has Next Cap Ptr = 0x5. Generally, basic registers are more than 5 DWORDS long; however, here, USB4 Configuration Space View truncates decoding of basic registers to start a new capability at the address 0x5.

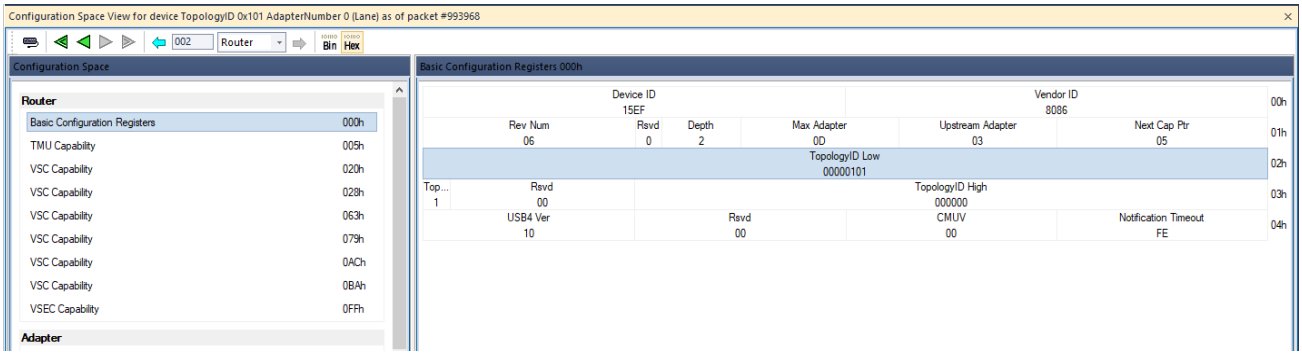


Figure 10.52: Truncation of USB4 Capability Layout

10.14 USB4 LLSM View

The LLSM View displays the LLSM diagram depicted in the USB4 specification Figure 10.54.

To access the LLSM View:

- Click the  button in the application toolbar to display the USB4 LLSM View of a captured trace.

OR

- From the application menu, select **Report → USB3 LTSSM/USB4 LSSM View → Show/Hide**.

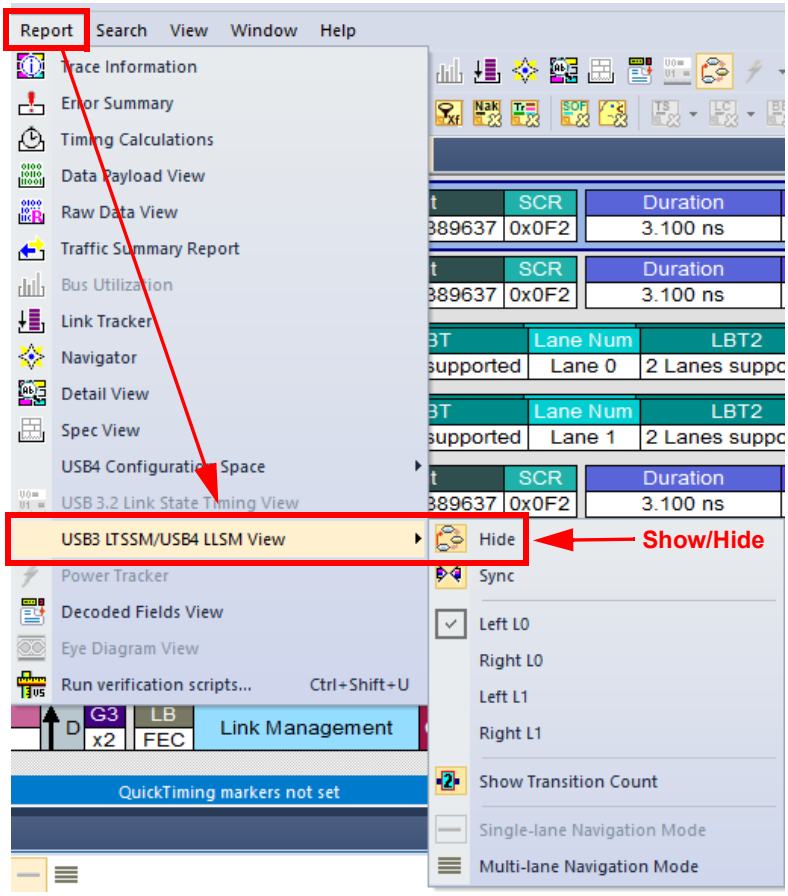


Figure 10.53: Select LLSM View from the Report Menu

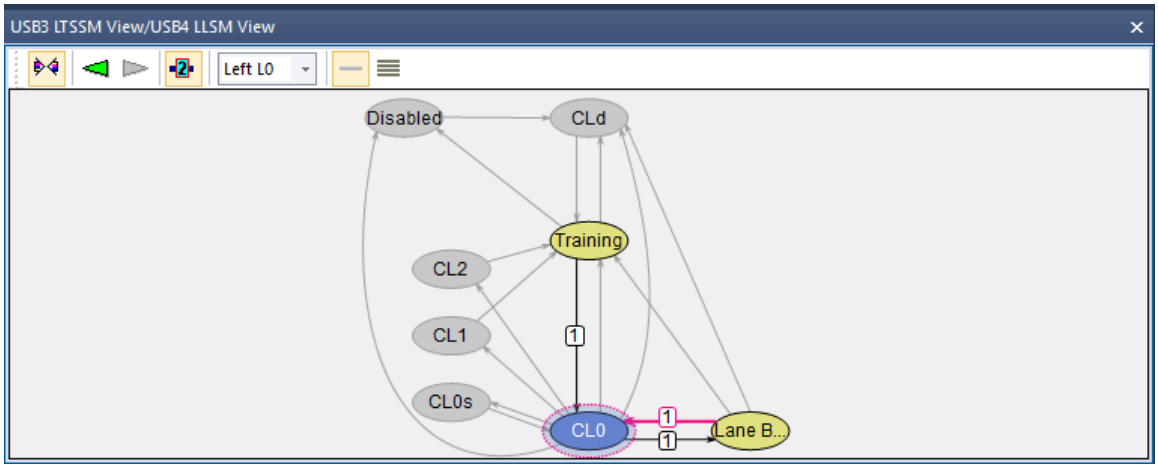


Figure 10.54: USB4 LLSM View

10.14.1 Navigation Between LLSM & CATC Trace Views

- Click  to synchronize navigation between the LLSM View and CATC Trace View.

- Click the left arrow to go to previous link state. Details are displayed based on the selected navigation mode.
- Click the right arrow to go to next link state. Details are displayed based on the selected navigation mode.
- Click to show the number of transitions.

10.14.1.1 USB4 LSSM View—Working Modes

The USB4 LSSM view has two working modes, which can be selected through Navigation buttons on the View toolbar:

- Single-Lane Navigation Mode
- Multi-Lane Navigation Mode

10.14.1.2 Single-Lane Navigation Mode

When you enable Single-Lane Mode, you can select a target lane from the list box Left L0 in LSSM view toolbar. The view will show the LSSM diagram for selected lane. All navigation for next/previous states will be based on the target lane. The CATC trace view will move to a packet that reflects next/previous state transition for selected lane.

10.14.1.3 Multi-Lane Navigation Mode

When Multi-Lane Mode is enabled, the lane selection list is disabled and LSSM view shows the LSSM diagram for the specific lane to which the CATC trace is currently navigated. When you scroll in CATC trace view, the LSSM diagram switches between different lanes.

Next/previous navigation buttons in LSSM view will work for all lanes and the CATC trace view will move to a packet that reflects the next/previous state transition for any lane.

10.15 USB 3.2 Link State Timing View

Link State Timing View graphically shows how much time the link spends in each link state.

Click to display USB 3.2 Link State Timing View (Figure 10.55).

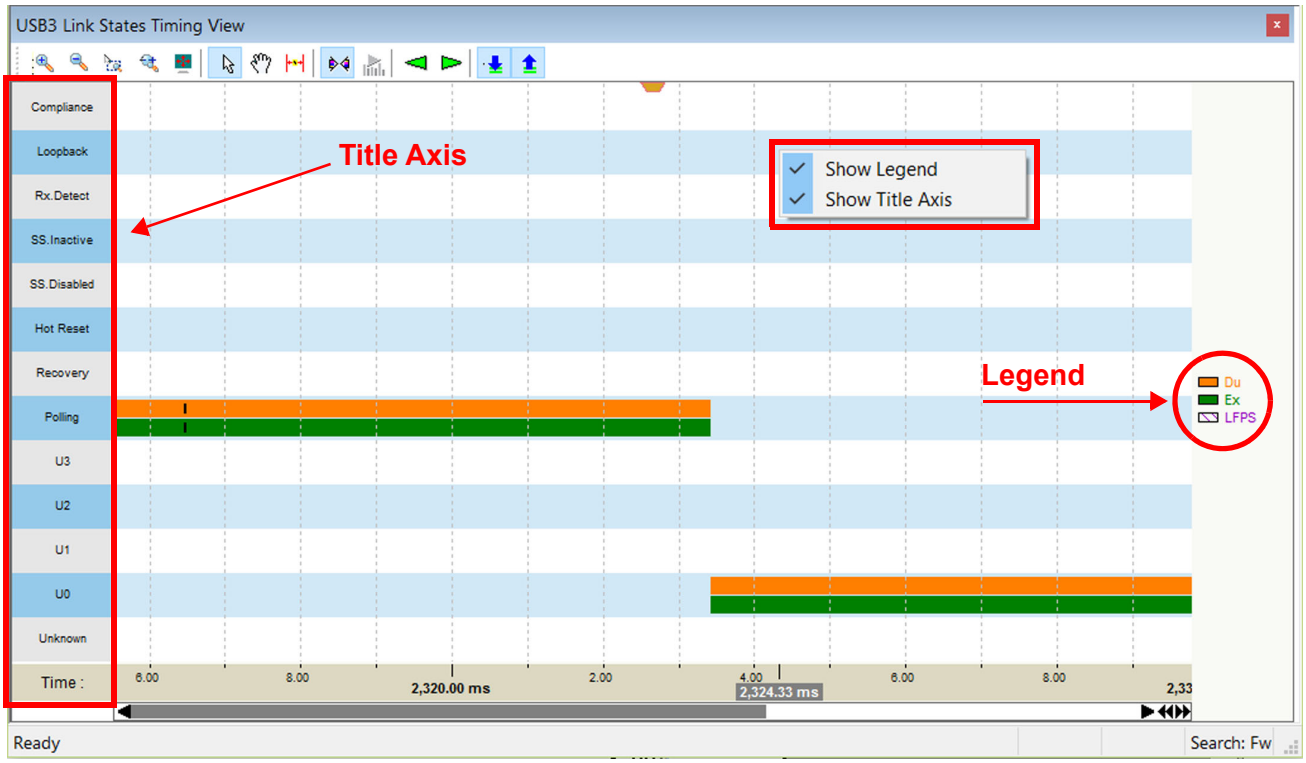


Figure 10.55: USB 3.2 Link State Timing View

The States are:

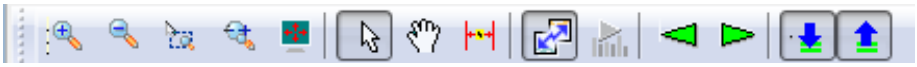
- Compliance
- Loopback
- Rx.Detect
- SS.Inactive
- SS.Disabled
- Hot Reset
- Recovery
- Polling
- U3, U2, U1,U0, and Unknown

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 the following attributes on or off:

- Show Legend
- Show Title Axis

10.15.1 USB 3.2 Link State Timing View Toolbar



The buttons have the following functions:

Table 10.8: Link State Timing Buttons

	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.

10.15.2 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.
- 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.

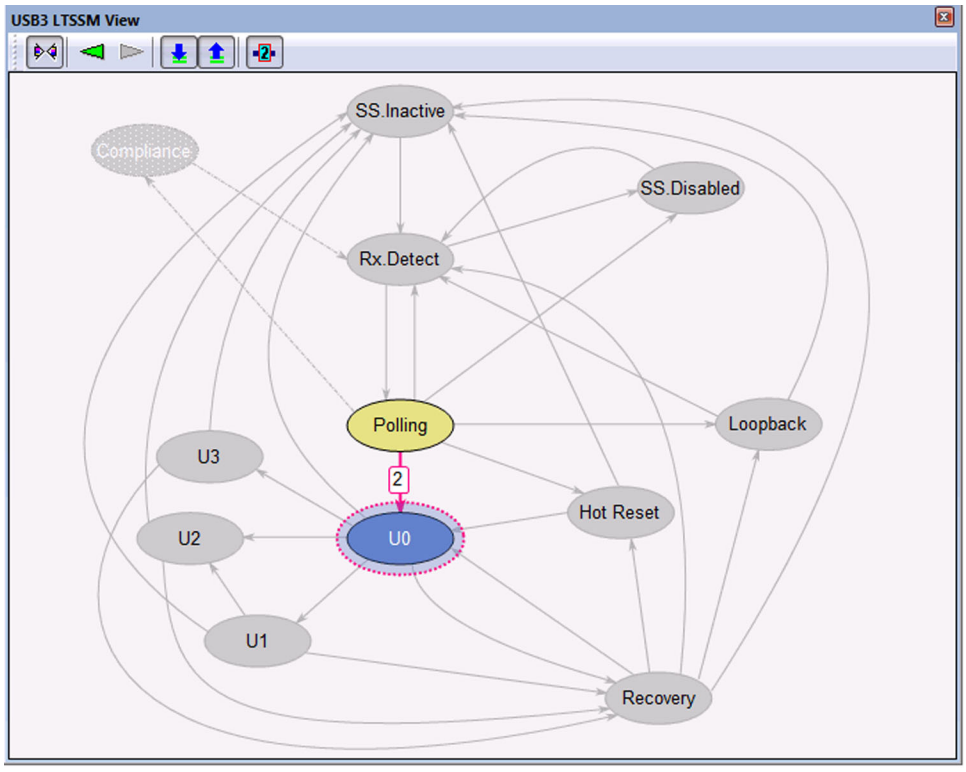


Figure 10.56: USB 3.2 LTSSM View

- 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.

10.16 Power Tracker—V_{BUS} & Configuration Channel (CC)

NOTE: Power Capture can only be enabled on licensed versions of Voyager M3i, M3x, M310, M310C, M310P/M310e and Mercury T2P.

10.16.1 V_{BUS} 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 V_{BUS} Power Tracker, CC Power Tracker and Exerciser V_{CONN} Tracker (Figure 10.58).

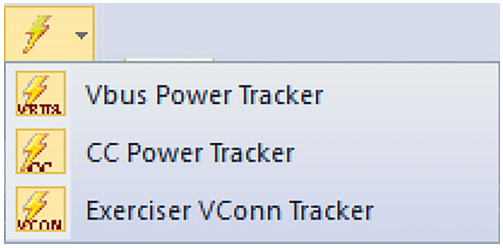


Figure 10.57: Power Tracker: V_{BUS} and CC Events

- When you select V_{BUS} Power Tracker, the Power, Voltage, and Current waveforms are displayed. See Figure 10.58.
- When you select CC Power Tracker, the Configuration Channel voltage is displayed.
- When you select V_{CONN} Tracker, the power used on the V_{CONN} connection is presented. On the M310P/M310e, 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 10.16.4 *Configuration Channel (CC) Power Tracker*.

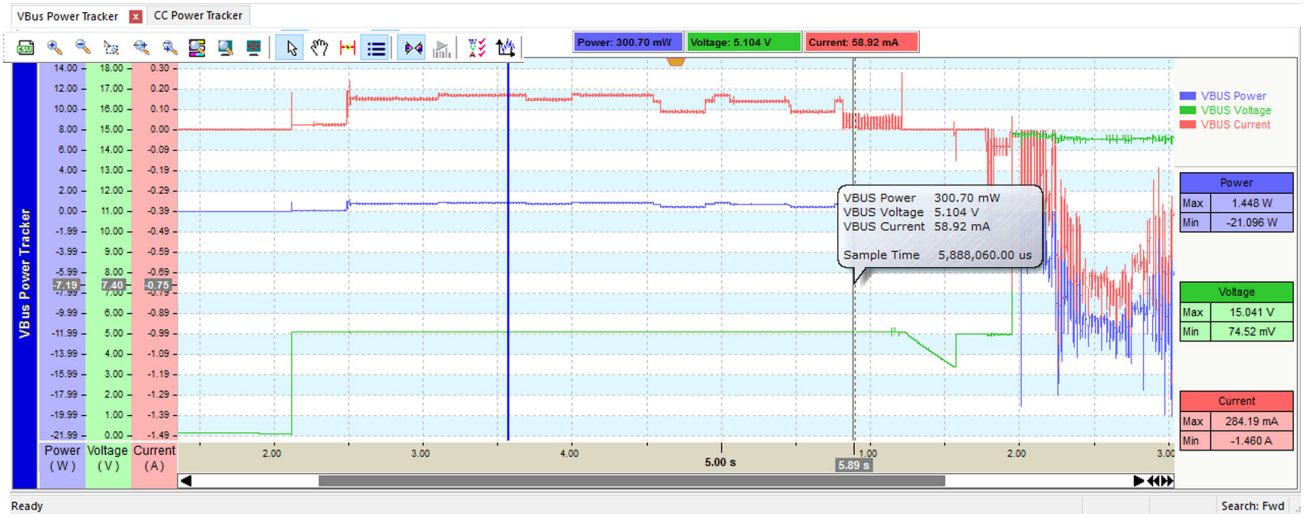


Figure 10.58: Power Tracker: V_{BUS}

If you right click withing the display, the following window appears (Figure 10.59).

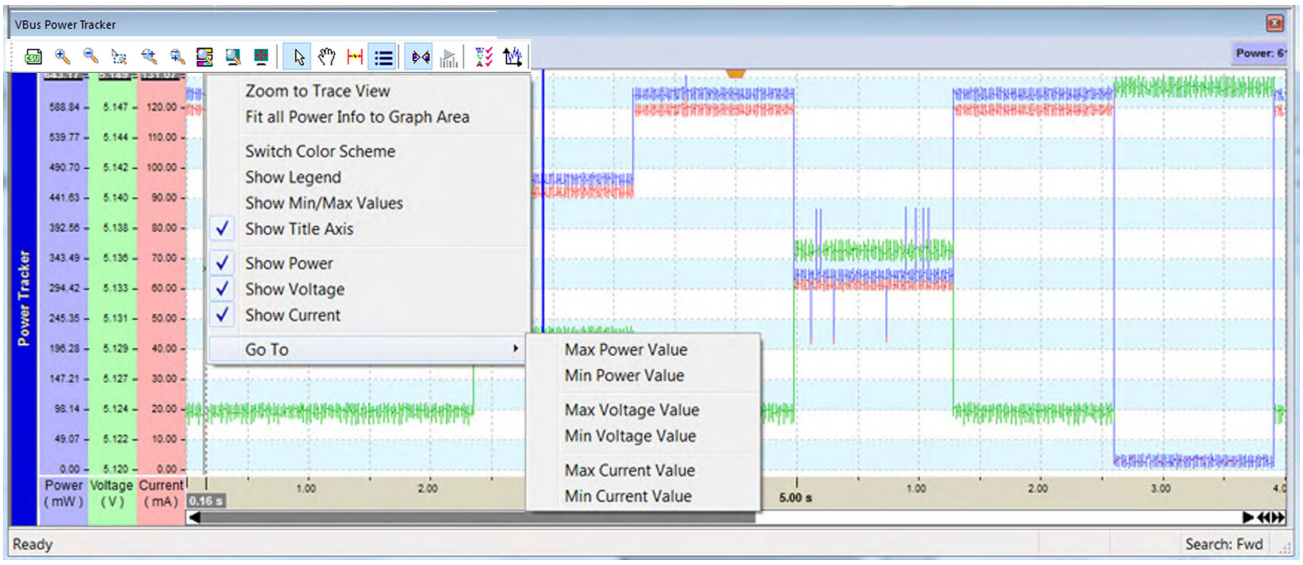


Figure 10.59: Right Click in Display Menus

If you select **Switch Color Scheme** the Power, Voltage and Current background colors will change to black, blue, and red (Figure 10.60).

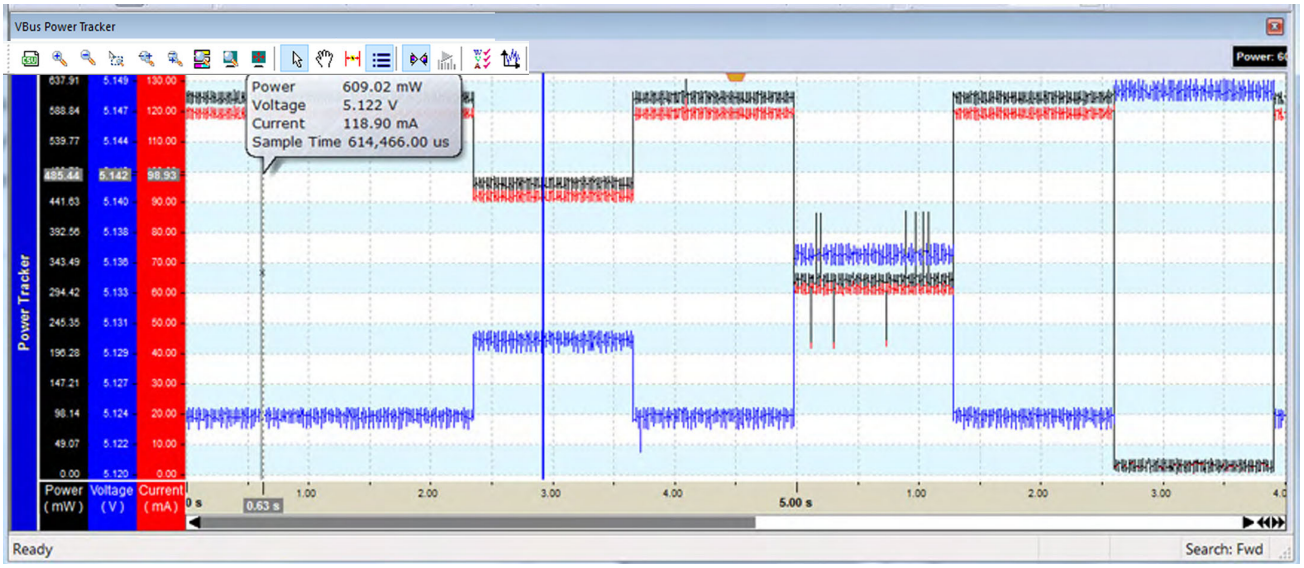


Figure 10.60: Update Color Scheme of Legend

If you select Show Legend and Show Min/Max Values, they will show up in the display (Figure 10.61).

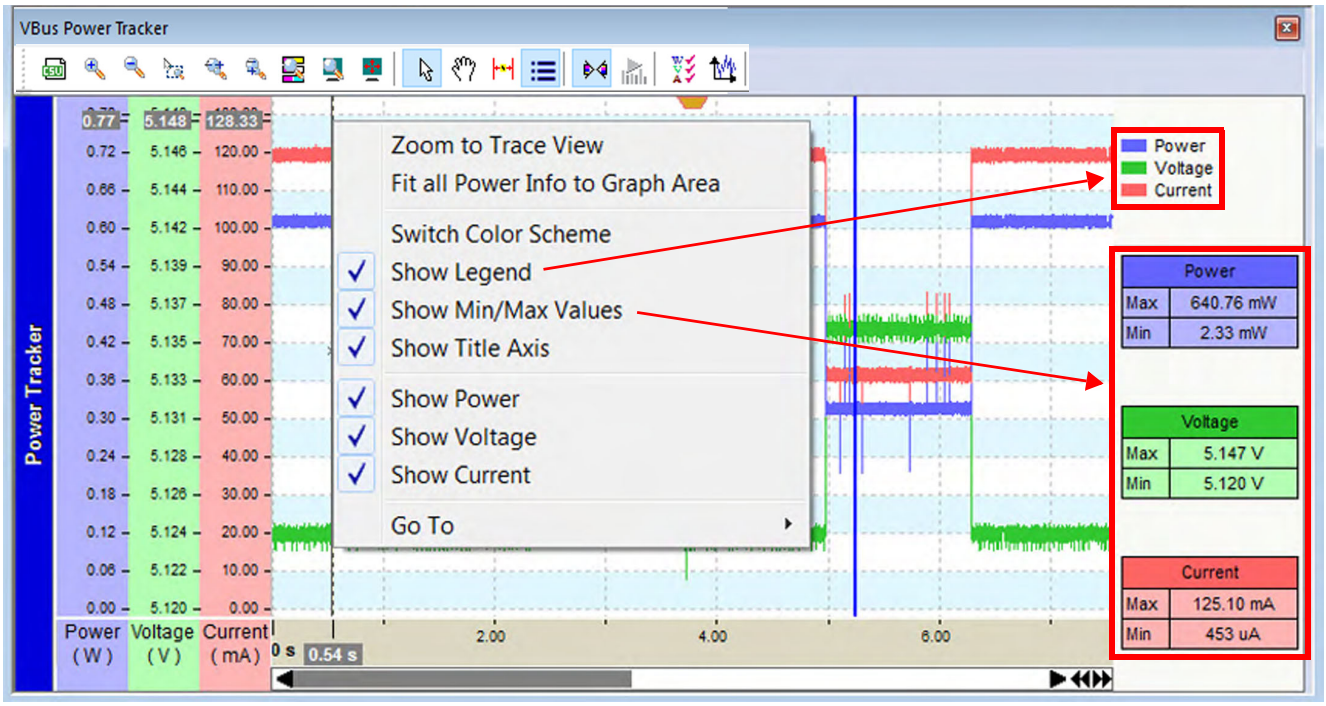


Figure 10.61: Show Legend, Show Min/Max Values

10.16.1.1 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 10.16.1.2 *Power Tracker Toolbar*).

- 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/M310e 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.

10.16.1.2 Power Tracker Toolbar



Figure 10.62: Power Tracker Toolbar

NOTE: V_{BUS} 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:

Table 10.9: Power Tracker Buttons

	Export Trace to CSV file (see 10.16.3 *V_{BUS} Power Tracker Export to CSV File*).		
	Zoom in		Pointer Mode

Table 10.9: Power Tracker Buttons (Continued)

	Zoom out		Hand Panning
	Zoom by Selection		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.
	Zoom by Horizontal Drag		Show detailed information on the marker. Displays voltage and current slew rates between markers.
	Zoom by Vertical Drag		Sync by Time. Synchronize the USB 3.2 Link State Timing States View and the Trace View.
	Zoom to Visible part of Trace (Power Tracker Info close to Packet of interest, see Figure 10.63).		Monitor during capture (Power Tracker Data Displayed in Real Time).
	Fit All Power Info to Graph Area (Power Info for Entire Trace Visible		Show/Hide Power Tracker Types: Power, Voltage, and/or Current
	Full Screen		Change Power Tracker graph type: Bar, Line, and/or Point
			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.

Examples of the tool bar button effects are shown in figures 10.63 through 10.70.

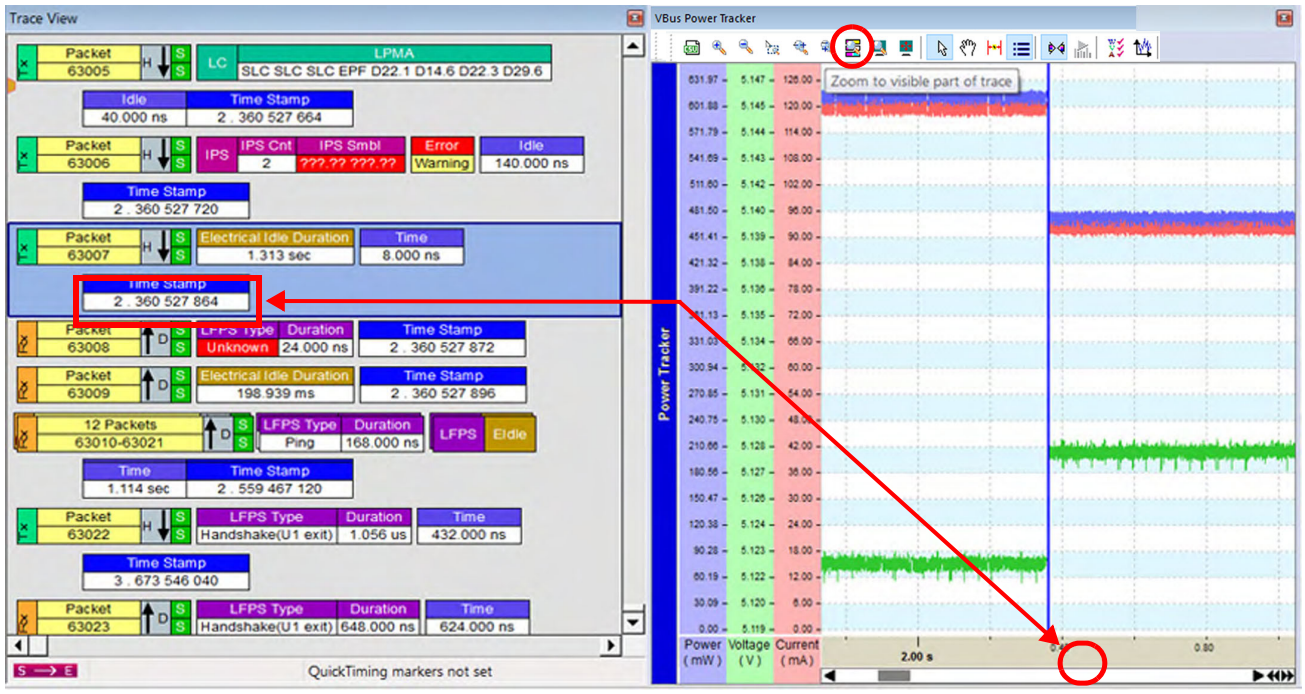


Figure 10.63: Power Tracker Button: Zoom to Visible Part of Trace

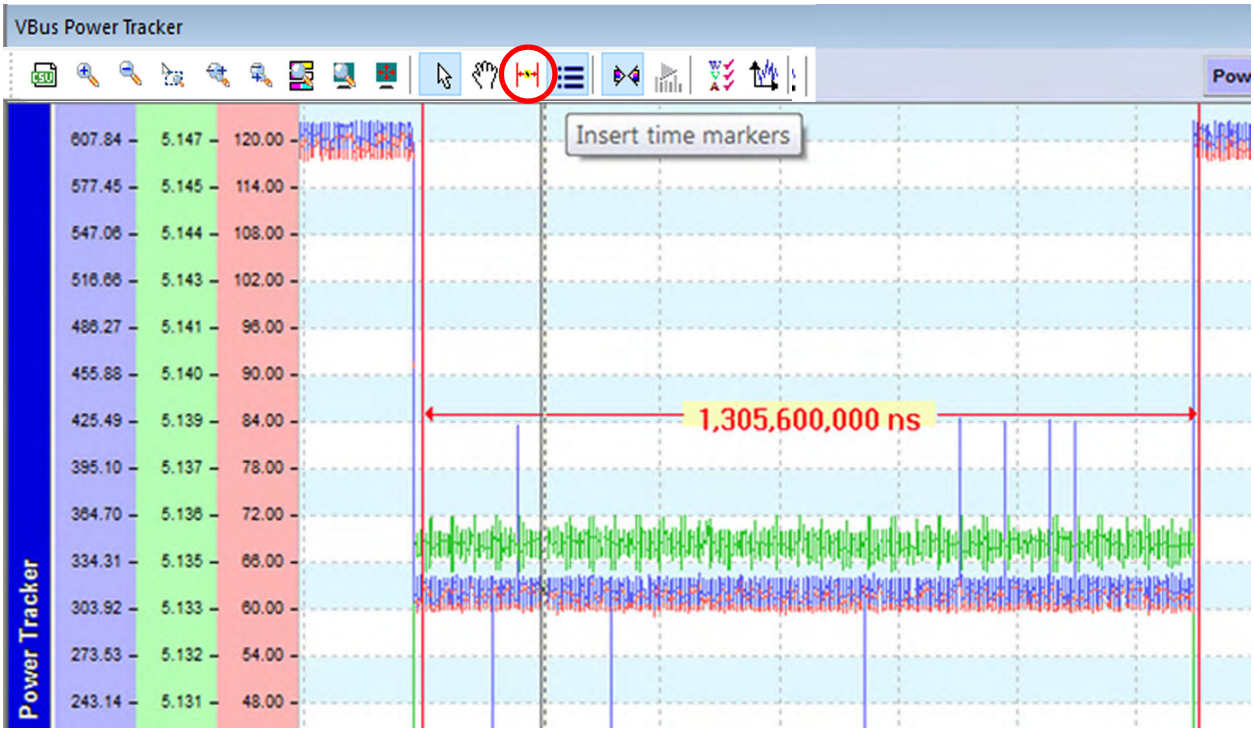


Figure 10.64: Power Tracker Button: Insert Time Markers

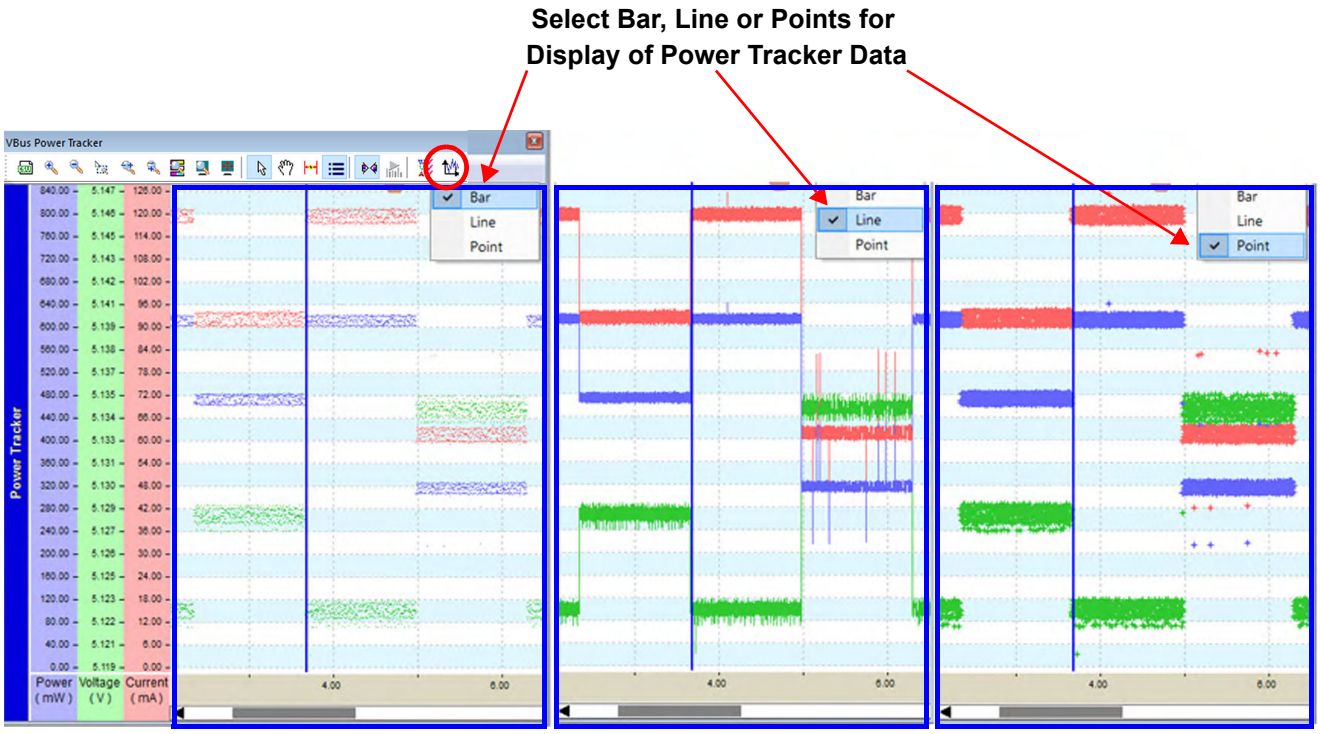


Figure 10.65: Power Tracker Button: Change Power Tracker Graph Type

10.16.2 Power Tracker—CC Power Tracker/V_{BUS} Power Tracker Synced (Beta)

To display both the CC Power Tracker view synchronized with the V_{BUS} Power Tracker, open an appropriate trace. In this case the trace PR_Swap_VDM.usb has been selected below. See Figure 10.66.

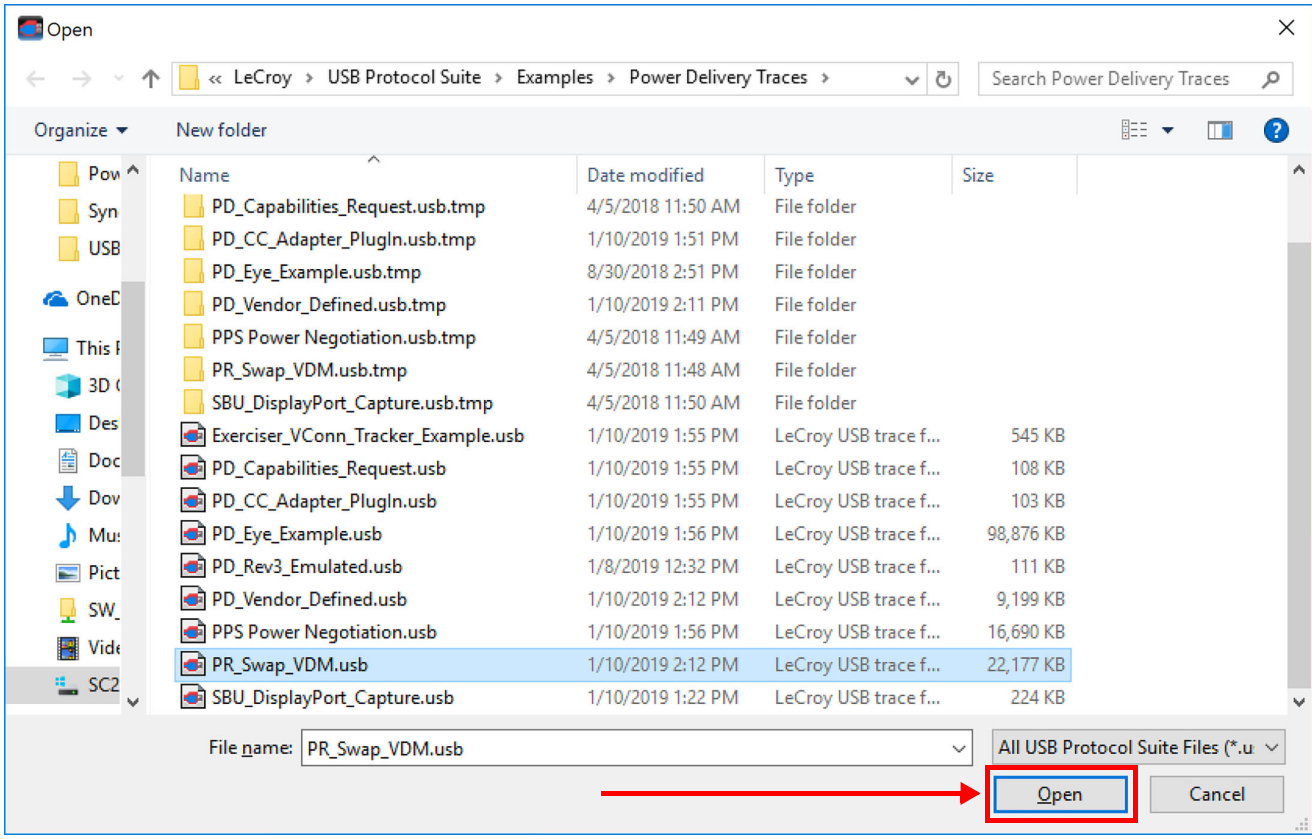


Figure 10.66: Trace Opened: PR_Swap_VDM

Ensure both V_{BUS} Power Tracker and CC Power Tracker are enabled. See Figure 10.67.

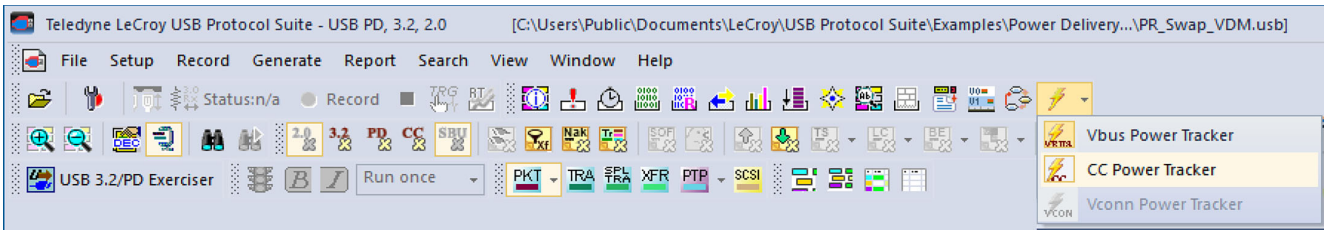


Figure 10.67: V_{BUS} Power Tracker and CC Power Tracker are Enabled

To use this feature, you must dock the two views so they lie above and below each other, as shown in Figure 10.68. 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.

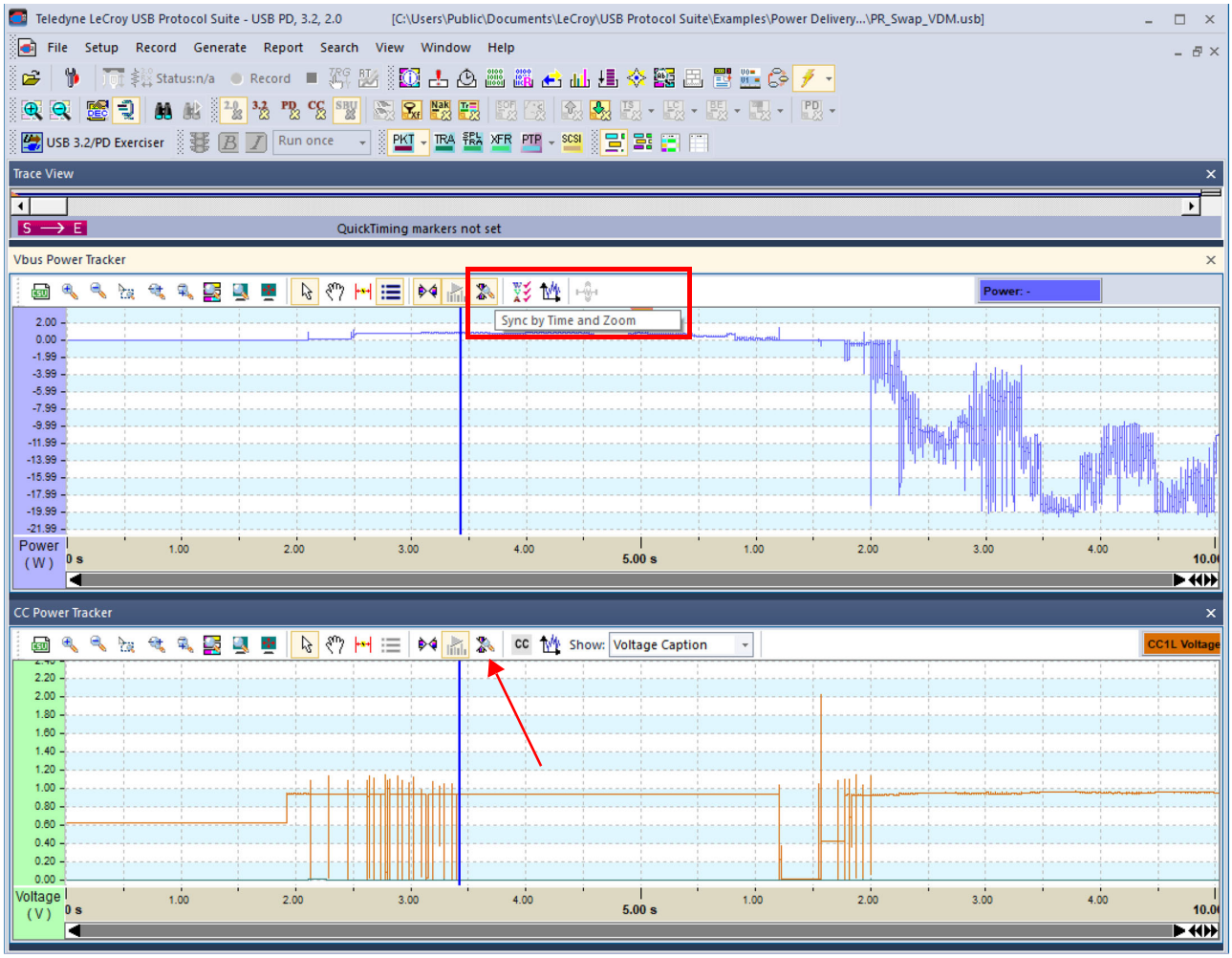


Figure 10.68: CC Power Tracker/V_{BUS} Power Tracker View: Time and Zoom Synchronized

10.16.3 V_{BUS} Power Tracker Export to CSV File

If you select the CSV icon on the toolbar (Figure 10.69), a window appears in the directory path where the USB Protocol Suite Software was installed: C:\Users\Public\Documents\LeCroy\USB Protocol Suite\Examples\Power Delivery Traces.

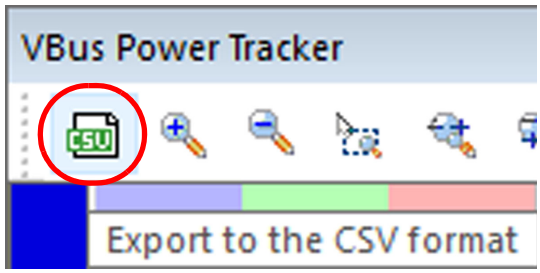


Figure 10.69: V_{BUS} Power Tracker: CSV Icon

You can chose an appropriate file title for the CSV file. In this case, VBus_Power_Tracker_Info_from_Trace.csv is selected. See Figure 10.70.

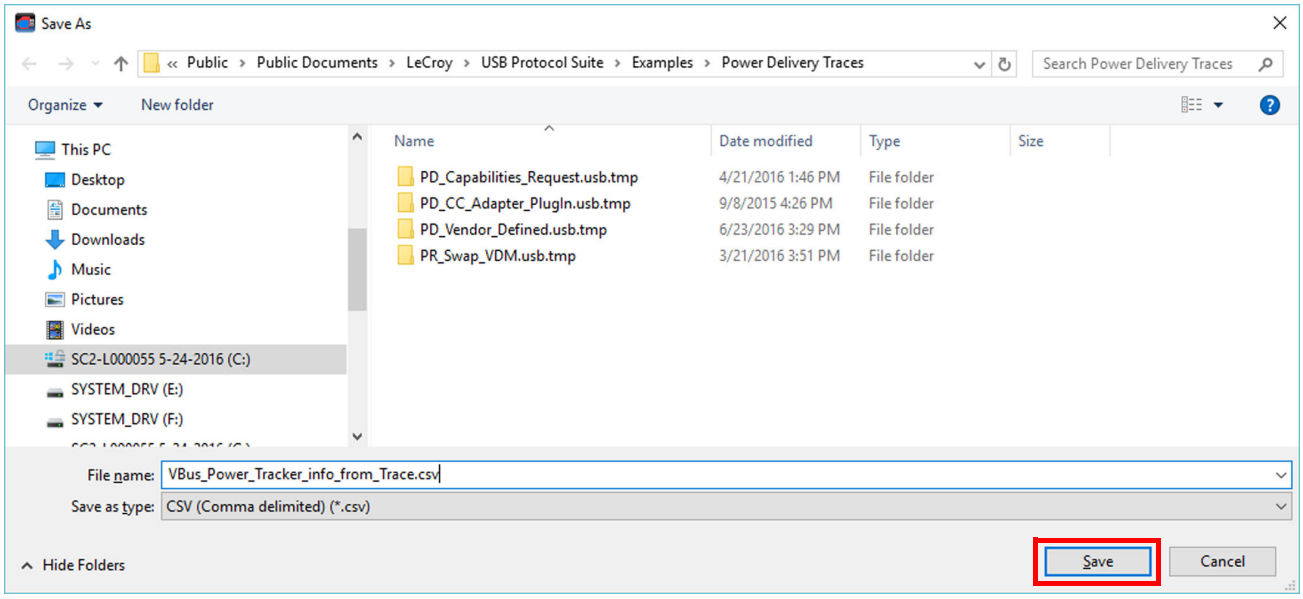


Figure 10.70: Popup Dialog Box with Path to Save CSV File

Select **Save** and the CSV file will be saved to the chosen directory. You can then open the file with Excel. See Figure 10.71.

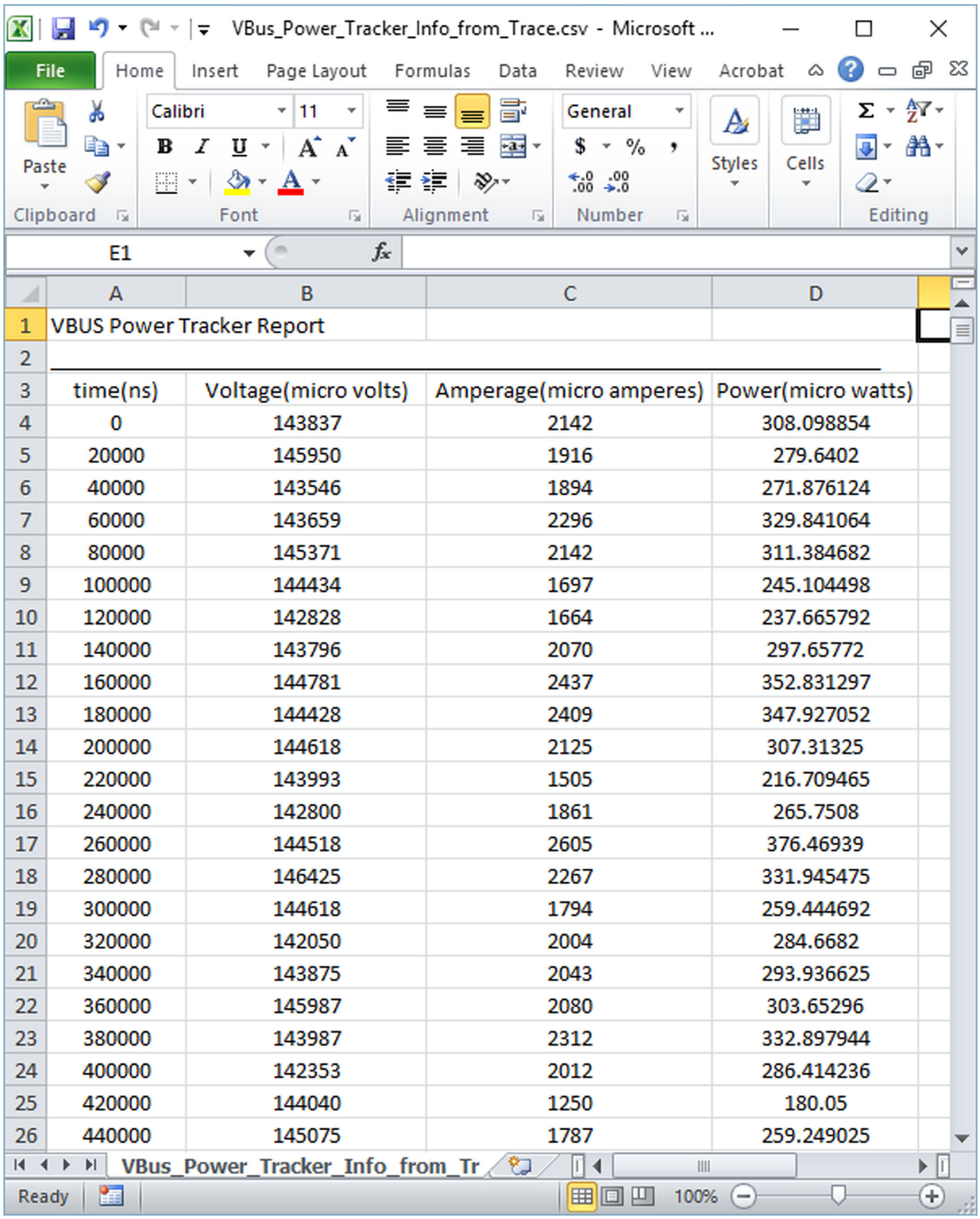


Figure 10.71: CSV File for V_{BUS} Power Tracker Info From Trace

10.16.4 Configuration Channel (CC) Power Tracker

The USB Type C cable supports two Configuration Channel (CC) pins: CC1 and CC2. The Voyager M310C/M310P/M310e/M4x/M480x has two Type C connections: one on the left of the front panel (Connector 1) and one to the right (Connector 2). See Figure 10.72.

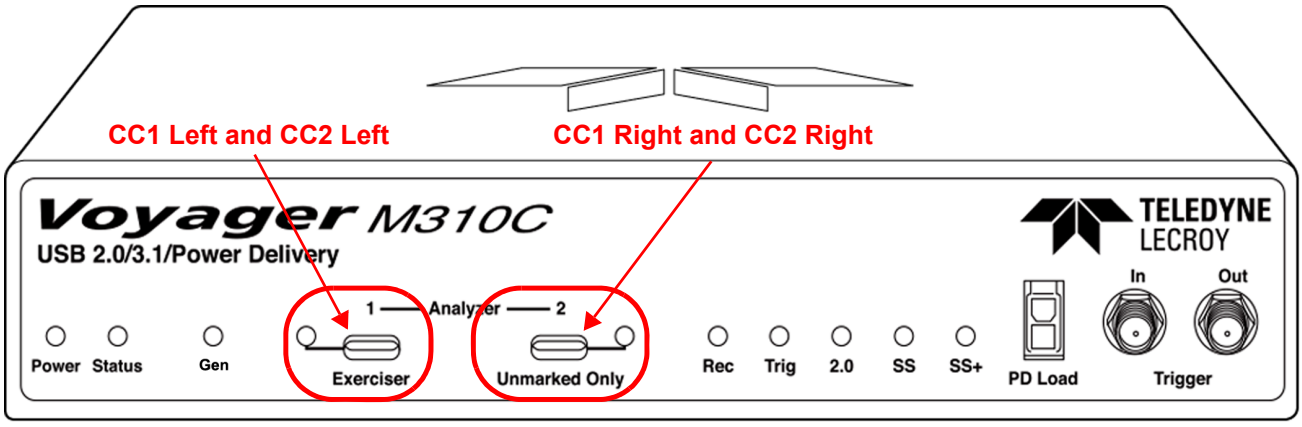


Figure 10.72: Voyager M310C: Front Panel View

When setting Recording Options, the Left and Right analyzer connectors can be labeled and those labels will show up in the trace file. See figures 10.73 and 10.74.

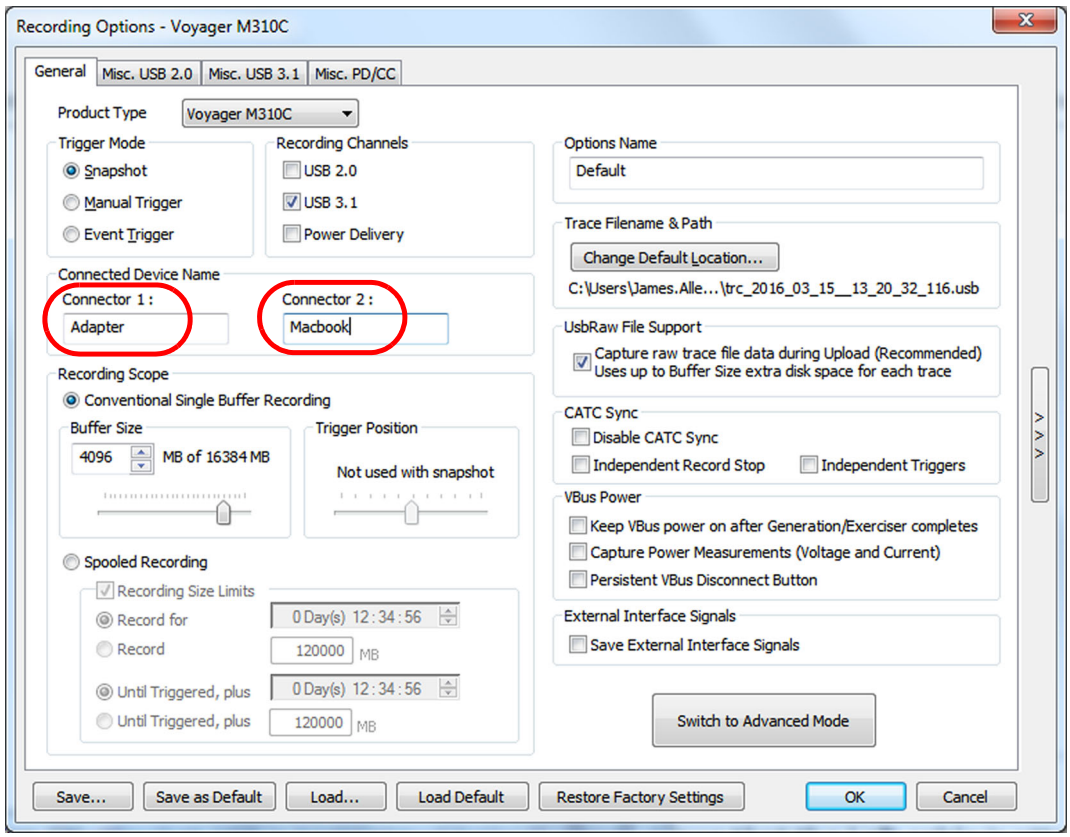


Figure 10.73: Voyager M310C: Recording Features for Left and Right Connectors

10.16.4.1 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 10.74.

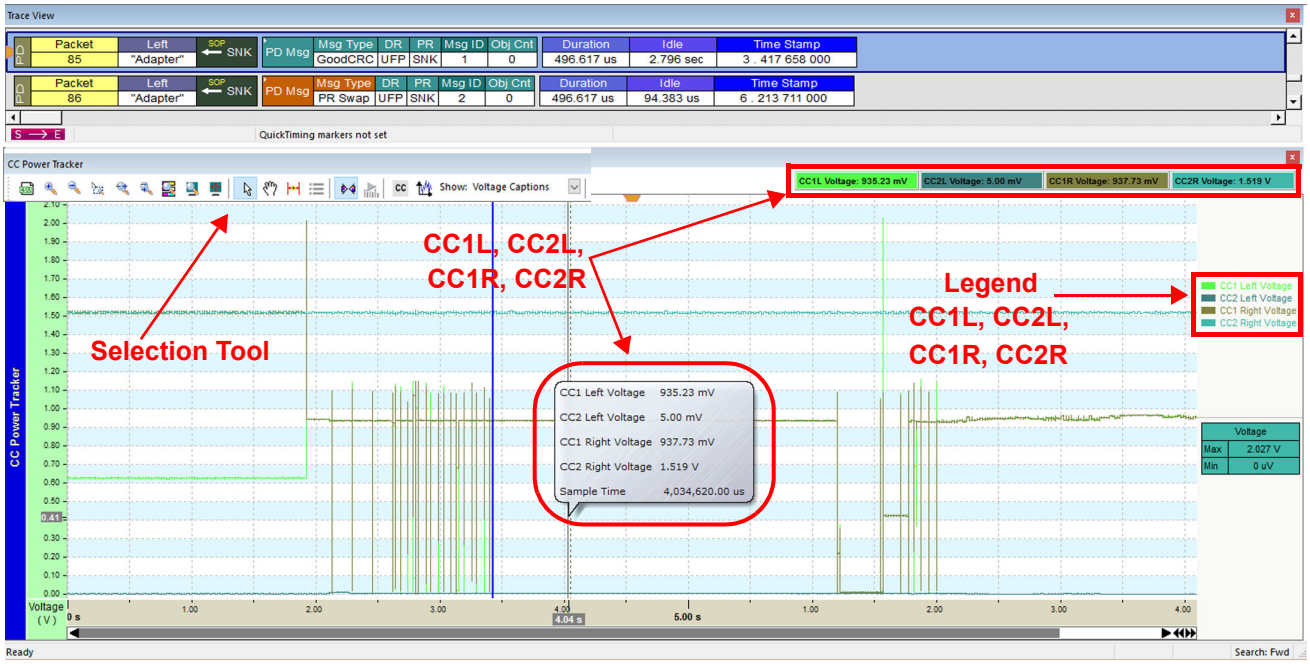


Figure 10.74: Configuration Channel (CC) Power Tracker Display: Packet 107

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 pull-up or pull-down 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 10.75) or in the gray window that pops up. See Figure 10.76.



Figure 10.75: Configuration Channel (CC) 1 and 2 Voltages Shown in Colored Tabs

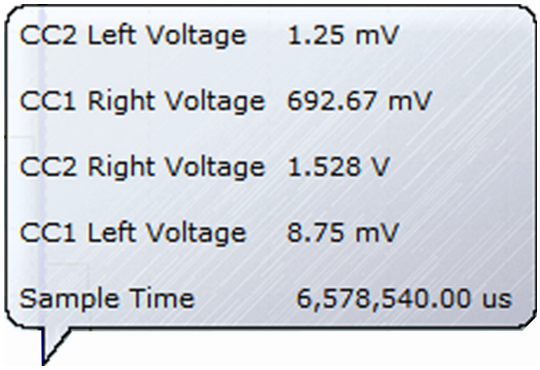


Figure 10.76: Configuration Channel Voltage Values in Gray Box

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 10.77.

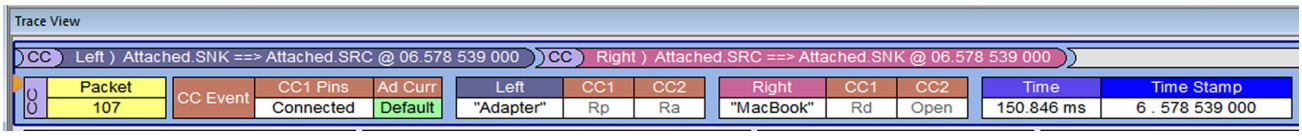


Figure 10.77: Packet Information from Trace View

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 10.78.

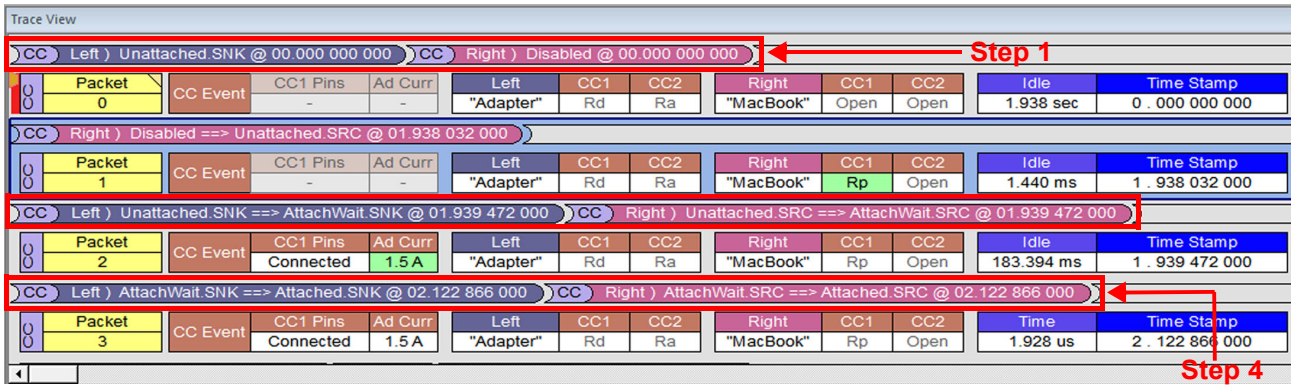


Figure 10.78: Configuration Channel Information as Units Power Up

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.

10.16.4.2 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 CC icon in the toolbar and selecting or deselecting the CC voltages you are interested in. In the example below only the CC1 Right voltage is shown in the display. See Figure 10.79.

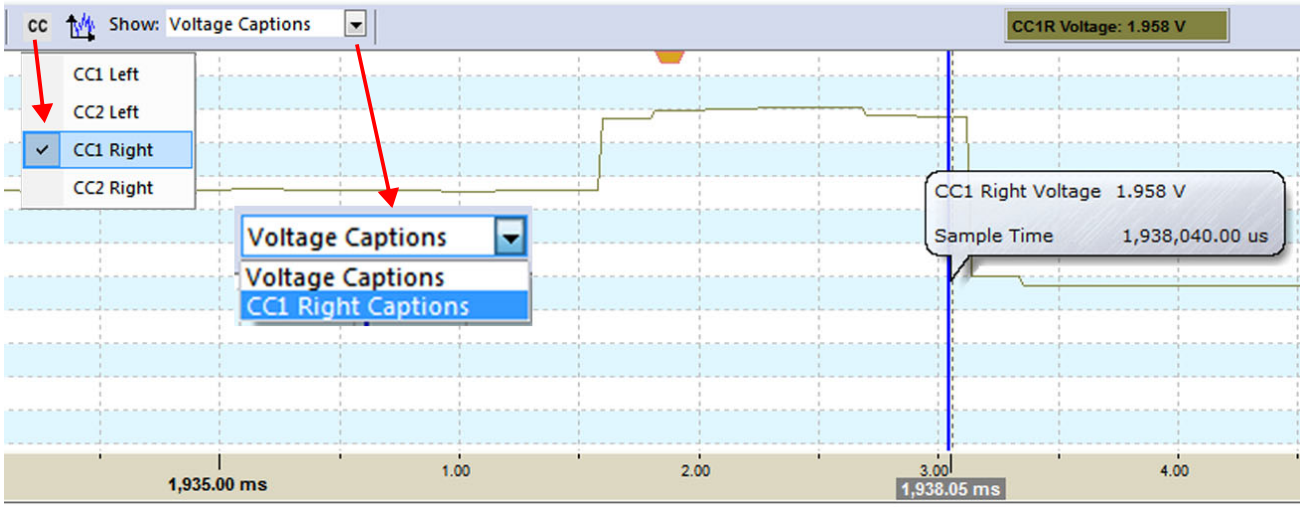


Figure 10.79: Selecting CC Voltages or to View

If you leave all the CC voltages on for display the CC Tracker View would be more congested. See Figure 10.80.

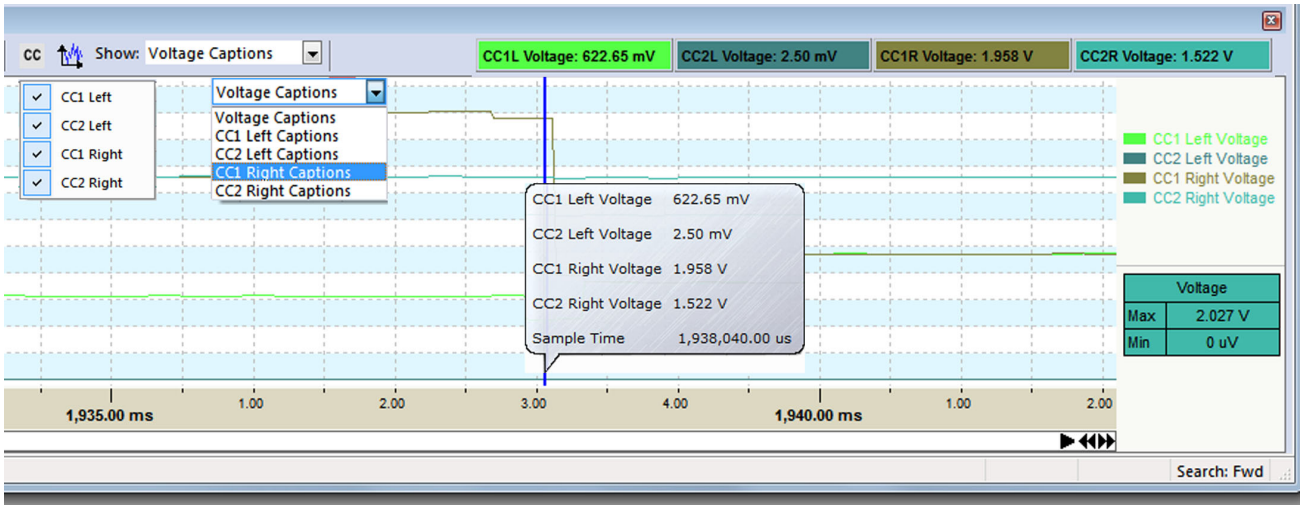


Figure 10.80: CC Tracker: All Options Shown

10.16.4.3 CC Power Tracker Export to CSV File

If you select the CSV icon on the CC Power Tacker toolbar (see Figure 10.69).

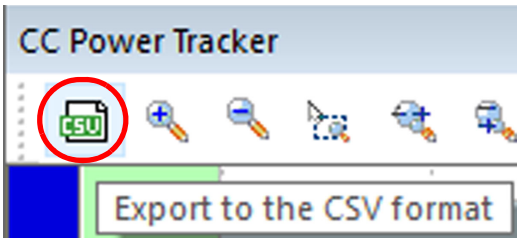


Figure 10.81: CC Power Tracker: CSV Icon

A dialog box will pop up 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 chose an appropriate file title for the CSV file. In this case we have chosen "CC_Power_Tracker_Info_from_Trace.csv". See Figure 10.82.

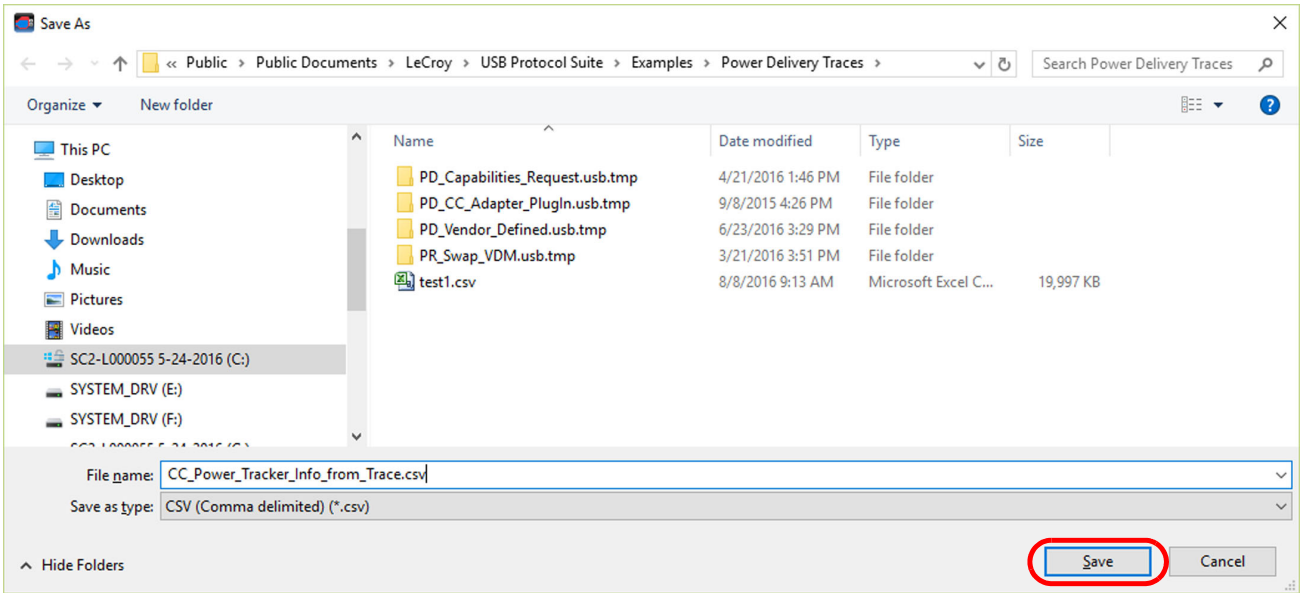


Figure 10.82: Popup Dialog Box with Path to Save CSV File

Select **Save** and the CSV file will be saved to the chosen directory. You can then open the file with Excel. See Figure 10.83.

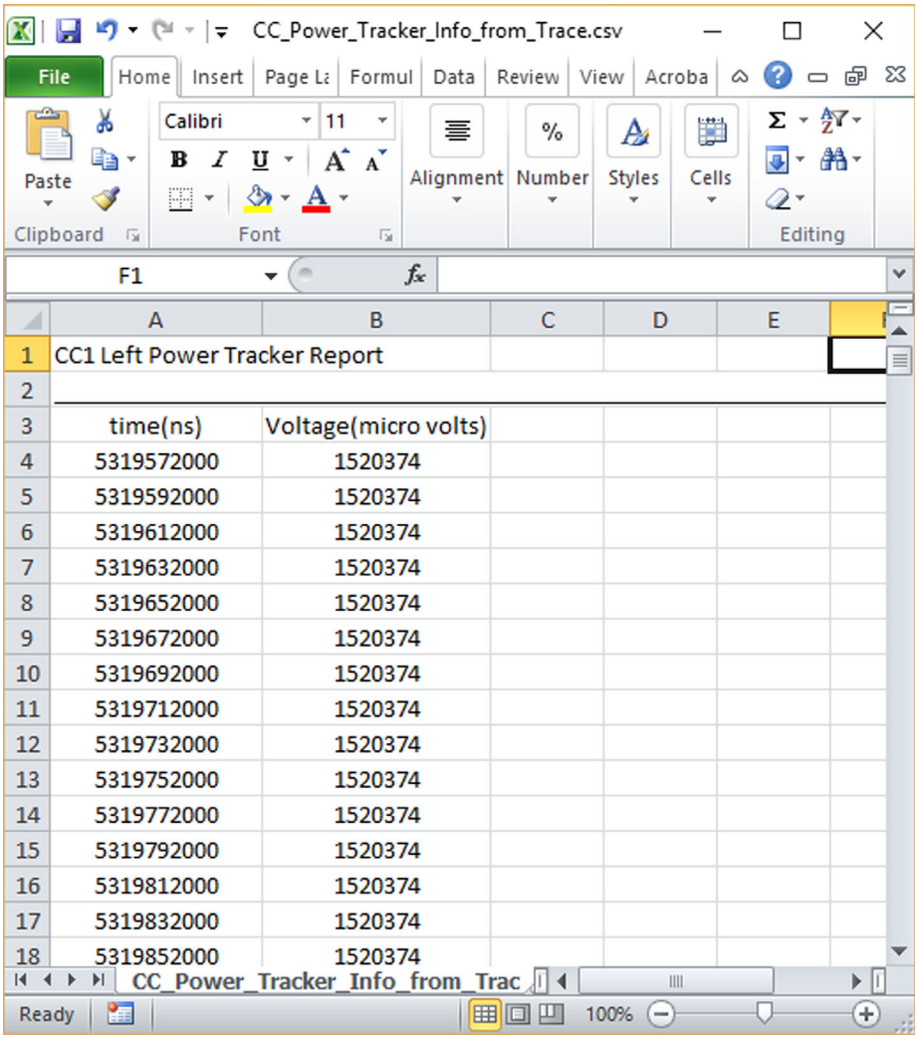


Figure 10.83: CSV File for CC_Power_Tracker_Info_From_Trace

10.17 Decoded Fields View

See 9.3.8 *Decoded Fields View* for information.

10.18 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/Voyager M310e, 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, captured as a result of an eye test, will contain the data displayed below. See Figure 10.84.

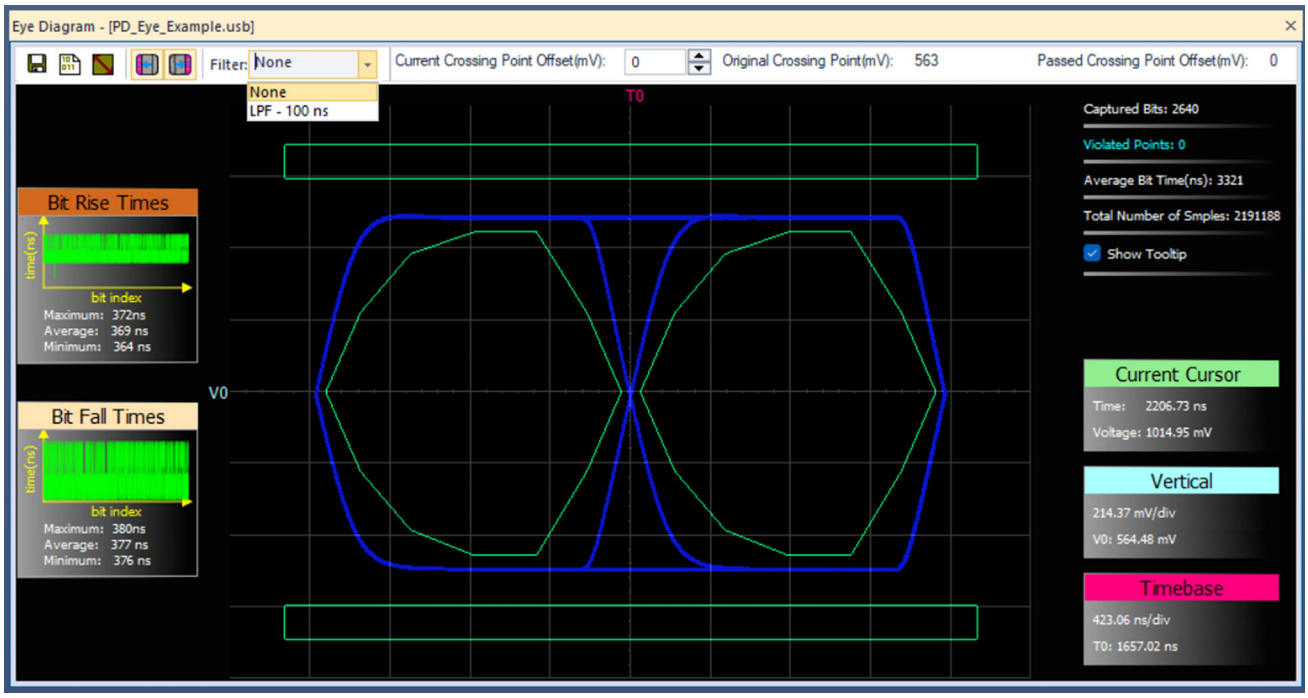


Figure 10.84: Eye Diagram View

10.18.1 Eye Diagram Information/Options

- Filter: (None/LPF - 100ns) Limits the bandwidth shown in the report to the selected value.
- Captured Bits: 2640
  (Number of bits sampled to produce the eye)
- Violated Points: 0
  (Number of instances of samples found outside the mask limits)
- Average Bit Time (ns): 3321
- Total Number of Samples: 2191188
- Time (ns): 2206.74
  (Time from the start of the UI to the User's Cursor)
- Voltage (mV): 1014.95
  (Voltage value at the User's Cursor)
- Original Crossing Point (mV): 563
  (Value found during capture)
- Current Crossing Point (mV): 0.586163
  (Value found after modifying Crossing Offset)

- Passed Crossing Point Offset (mV): 0.0
  User can change the crossing offset by changing this millivolt value.

Limits: +100 (mV) to -100 (mV)

10.18.2 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 10.85.

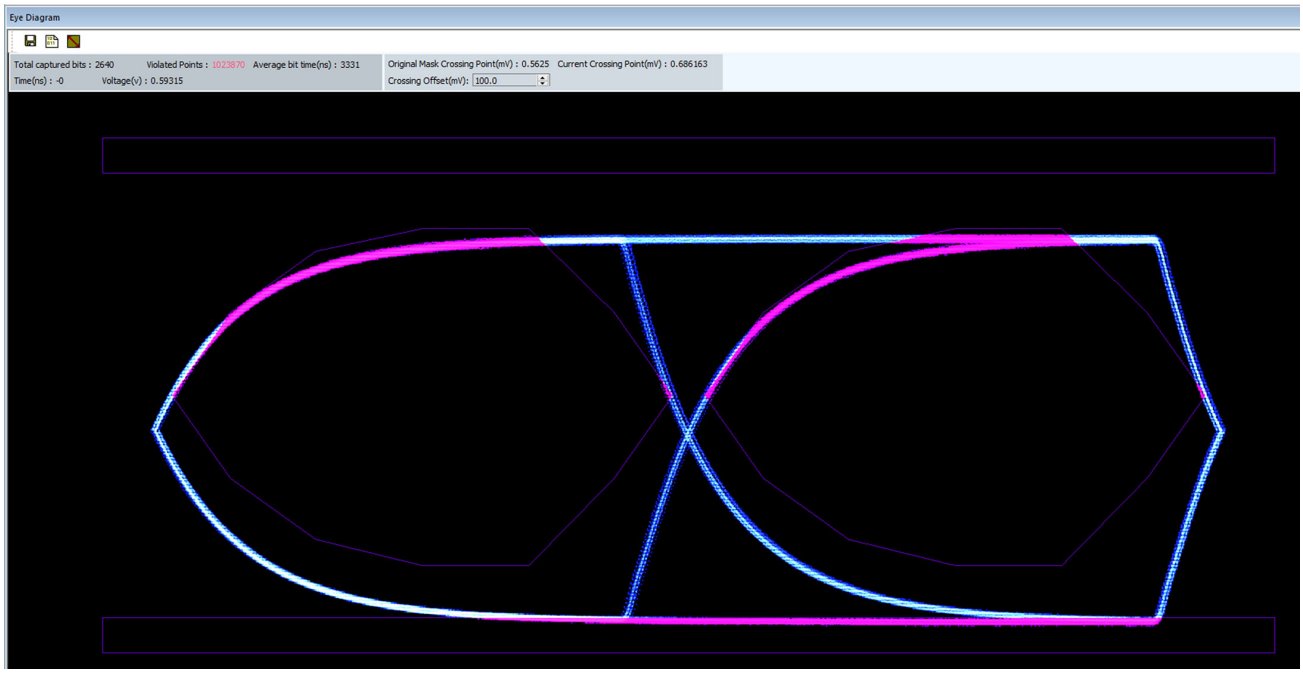


Figure 10.85: Eye Diagram: Effect of Offset on Violated Points

10.18.2.1 Eye Diagram Toolbar

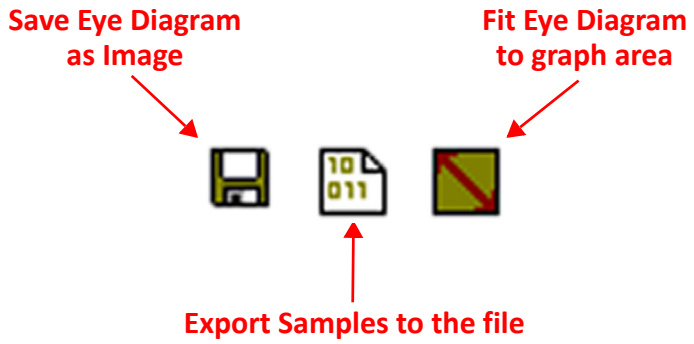


Figure 10.86: Eye Diagram Toolbar

10.18.2.1.1 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

10.19 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 can 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*.

1. To run a verification script over a trace, do one of the following:
   - Select the main menu item **Report > Run verification scripts**
   - Press **Ctrl+Shift+U**
   - Click the **Run verification scripts** button  on the main tool bar.

The Run verification scripts dialog opens (see Figure 10.87), from which you choose, then run, one or several verification scripts:

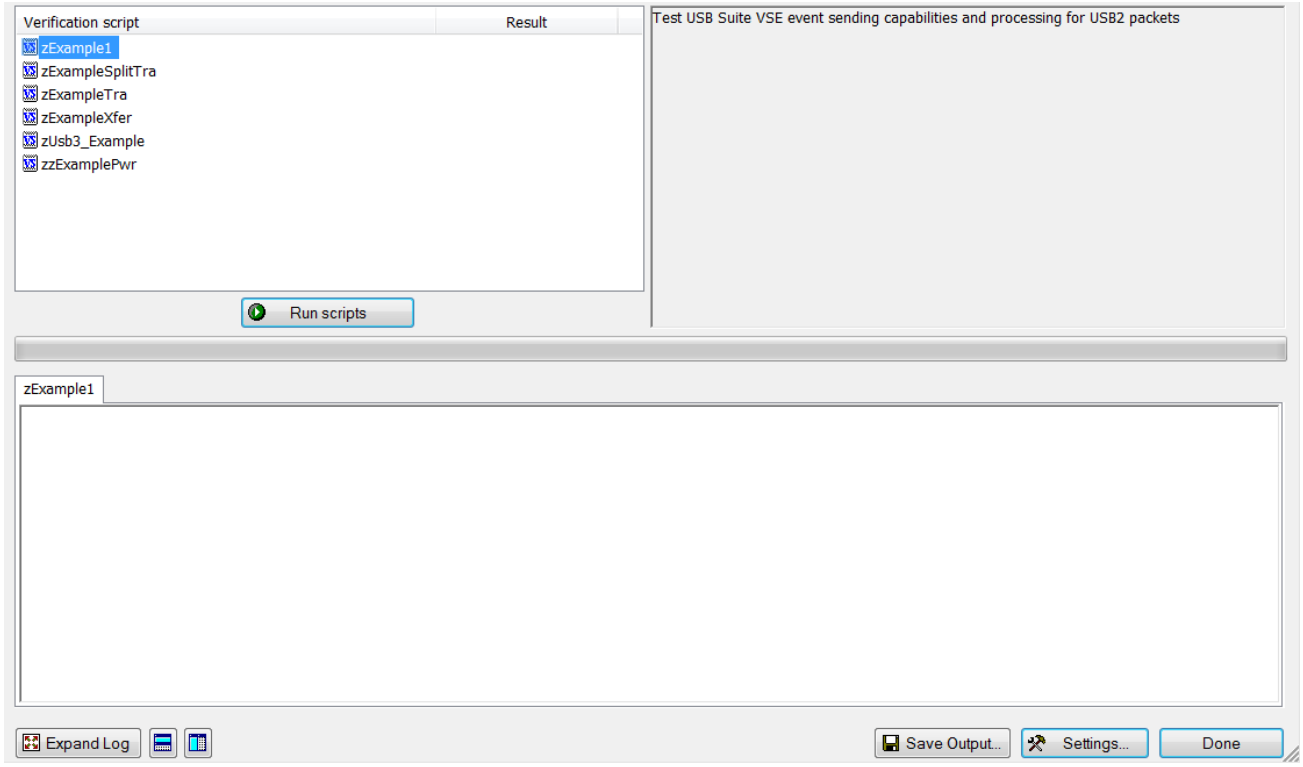


Figure 10.87: Run Verification Scripts Dialog

- To expand the 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  .

2. To save output, click the **Save Output** button.
3. 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 10.88).

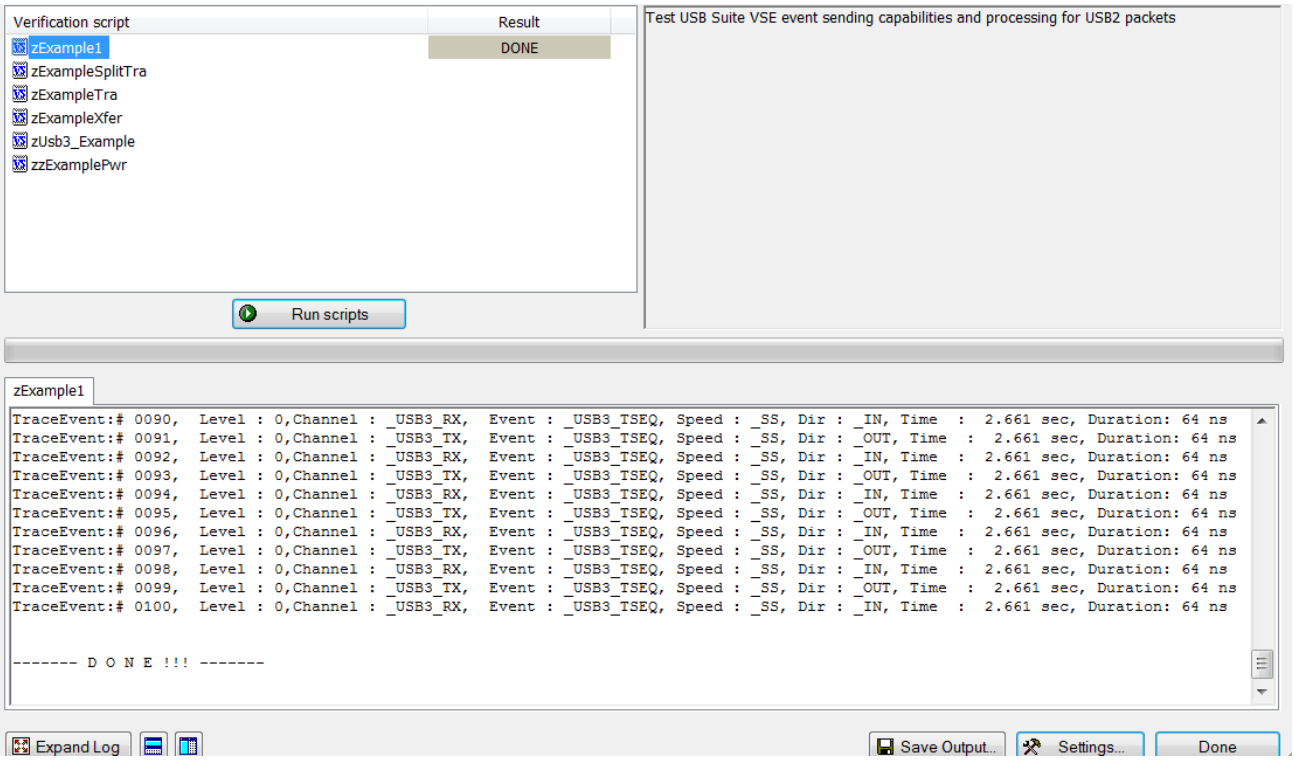


Figure 10.88: Verification Script Results

4. Right-clicking in the script list displays additional operations.

- **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 F2**).
- **Show Output**: Show/hide the script output windows (**Shortcut F3**).
- **Settings**: Specify different settings for VSE.

5. After choosing **Settings** from the drop-down list or the button, the Settings dialog appears (Figure 10.89).

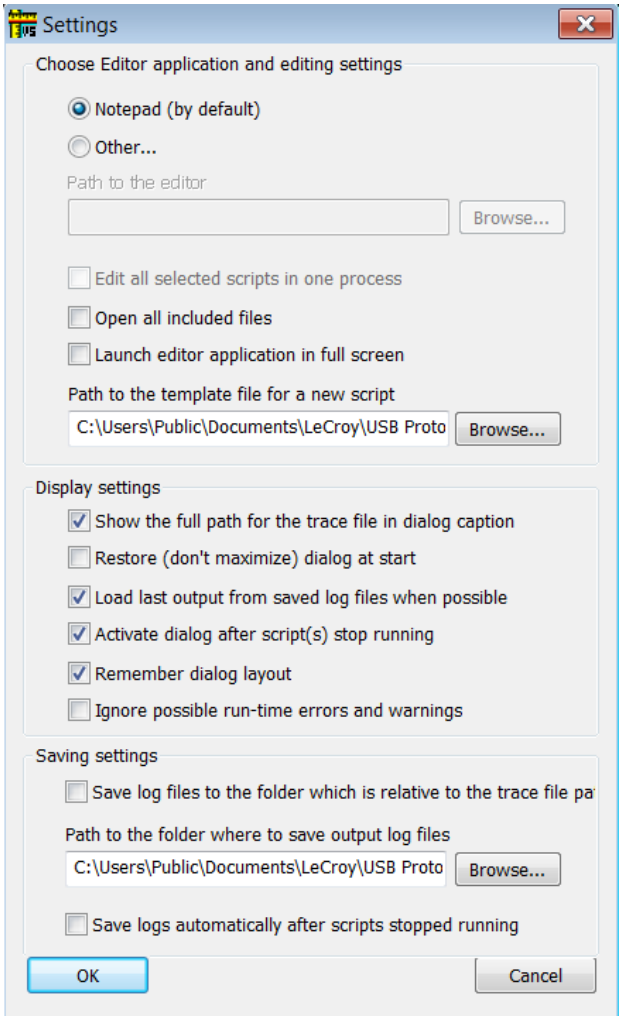


Figure 10.89: Settings Dialog

- **Choose the editor application**: Notepad or other.
- **Path to the editor:** If you choose other above, then this enabled.
- **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**: 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:** Use a template.

- **Display Settings:** 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:** Save log files to relative file folder, indicate output log file path, and save logs automatically.

10.20 Real-Time Monitoring

The Real-Time Statistics window displays a graph of real-time link activity. Real-Time Statistics is 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. An example is shown in Figure 10.90.

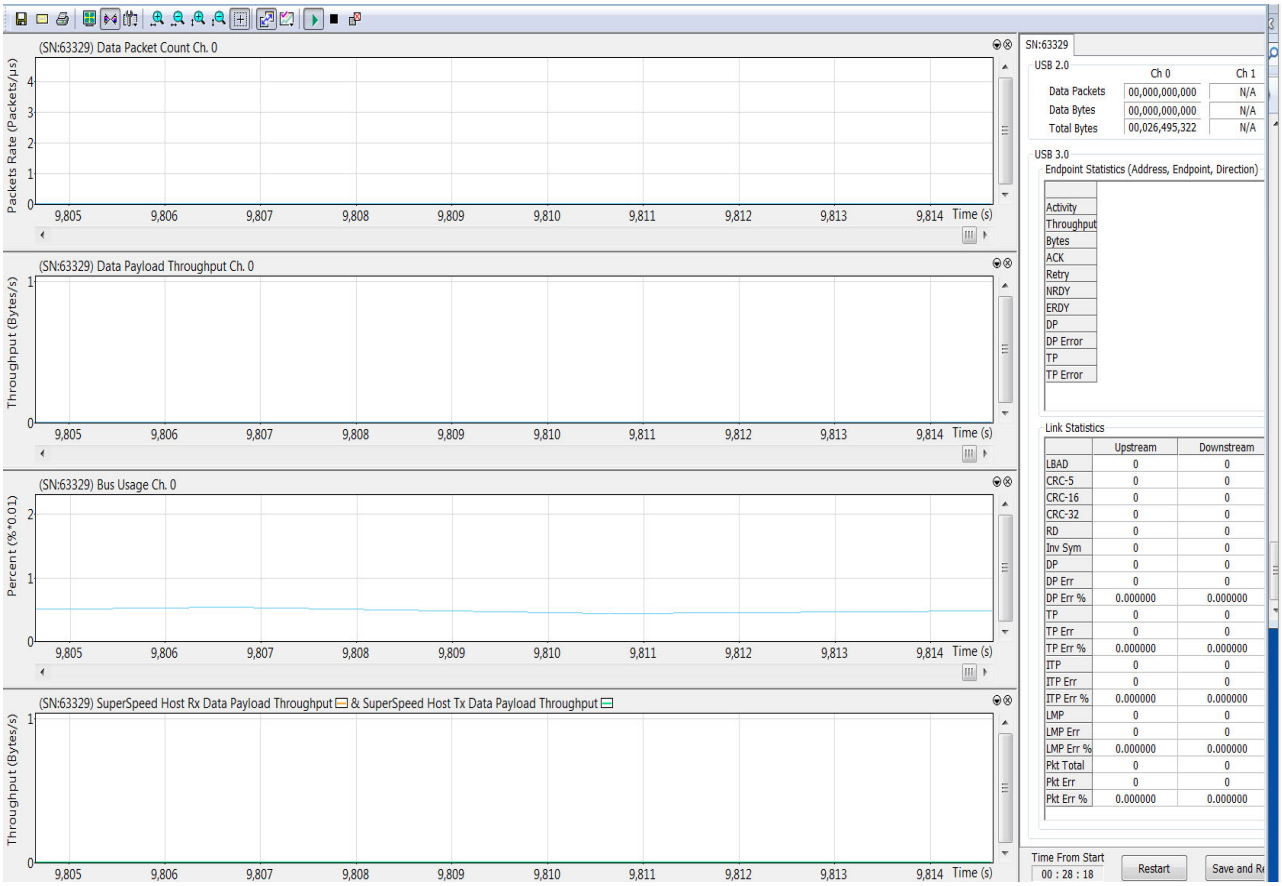


Figure 10.90: Real-Time Statistics window

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 10.3 *Error Summary* for further explanation.

To see a graph of traffic, you must start recording:

1. 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.

2. To stop the monitor, press  .

10.20.1 Real-Time Statistics Buttons

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



Figure 10.91: Real-Time Statistics Buttons

The buttons have the following functions:

Table 10.10: Real-Time Statistics Buttons

	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		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.
	Synchronize with other Views. Synchronizes the View windows so that a move in one window repositions the other. See 10.9.3 *Link Tracker Buttons*.		
	View Settings - opens a sub-menu with options for formatting the display. See 10.8.2 *View Settings Menu*.		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 file naming convention: “RTS_Capture_YYYY-MM-DD_HH-MM-SS.csv”.

NOTE:
- File writing must happen immediately, so there is no file naming dialog.
- If you click the button more than once a second, the previous file with the same timestamp will be lost.

10.20.2 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:

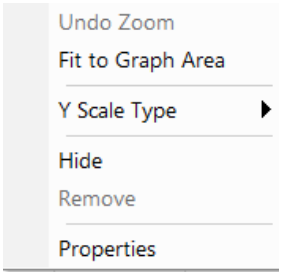


Figure 10.92: Real-Time Statistical Monitor Pop-up Menu

- **Undo Zoom**: If you have zoomed in, undoes the zoom.
- **Fit to Graph Area**: Scales the view so the entire trace fits in 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.

10.20.3 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:

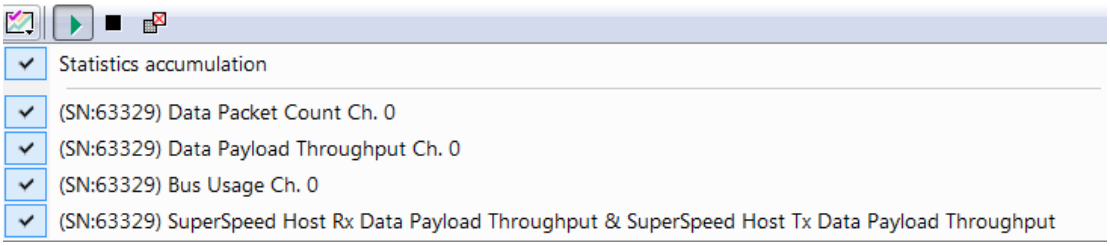


Figure 10.93: Graph Areas Menu Options

- 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 that 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 Chapter 12, *Traffic Generation USB 3.2, USB4, & PD Exerciser*.

11.1 Connecting to Voyager M3x

The connections differ for Host Emulation and Device Emulation. Full Speed, Low Speed, and Hi Speed connections are the same.

11.1.1 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).

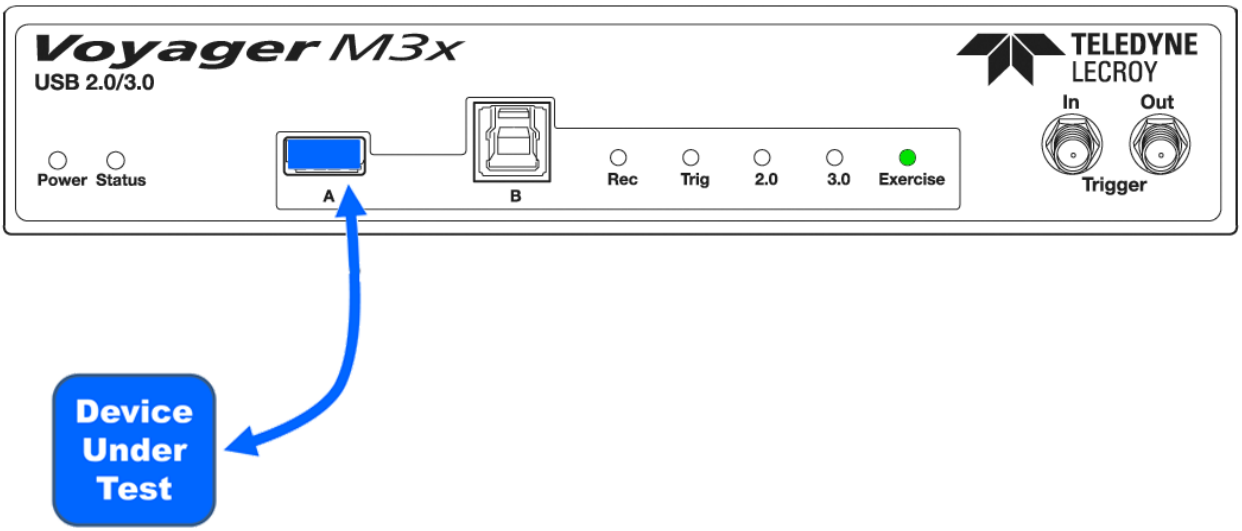


Figure 11.1: Connections to Voyager M3x

11.1.2 Hi/Full/Low Speed Device Emulation

For Device Emulation Hi, Full, or Low Speed, connect to the Voyager according to the following diagram.

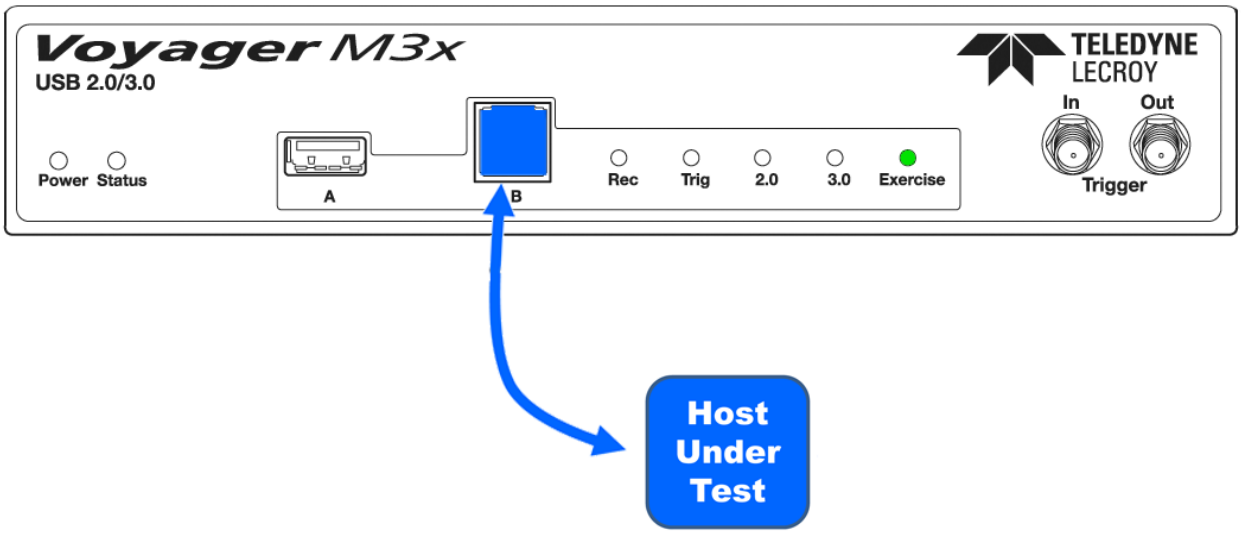


Figure 11.2: Connections to Voyager M3x

11.2 Connecting to Voyager M310

The connections differ for Host Emulation and Device Emulation. Full Speed, Low Speed, and Hi Speed connections are the same.

11.2.1 Hi/Full/Low Speed Host Emulation

For Host Emulation Hi, Full, or Low Speed, connect to the Voyager according to the following diagram (Figures 11.3 and 11.4).

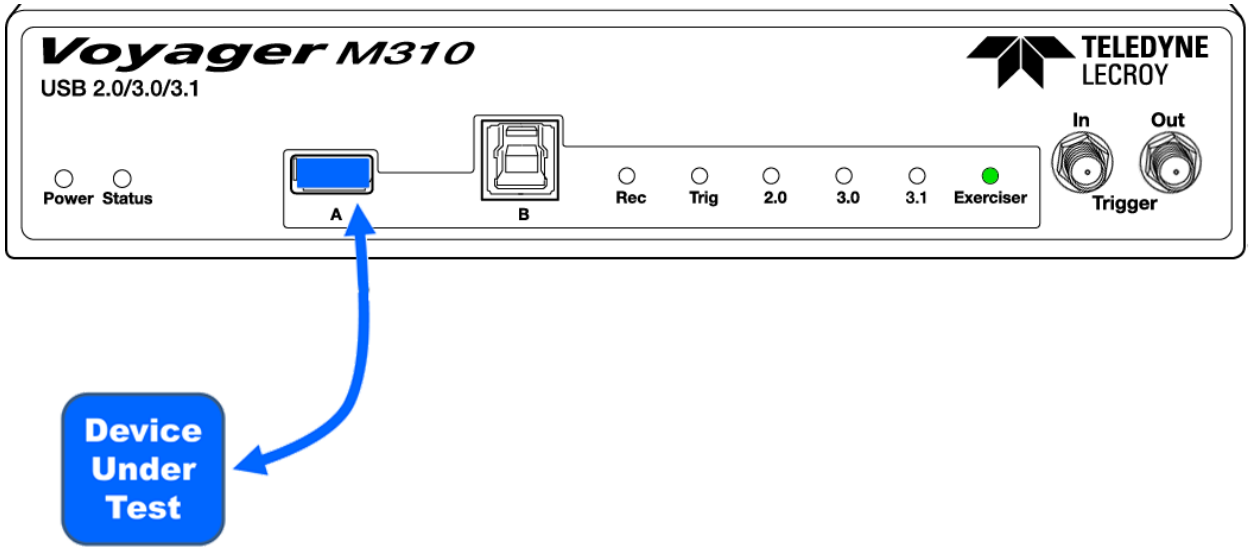


Figure 11.3: Connections to Voyager M310

11.2.2 Hi/Full/Low Speed Device Emulation

For Device Emulation Hi, Full, or Low Speed, connect to the Voyager according to the following diagram.

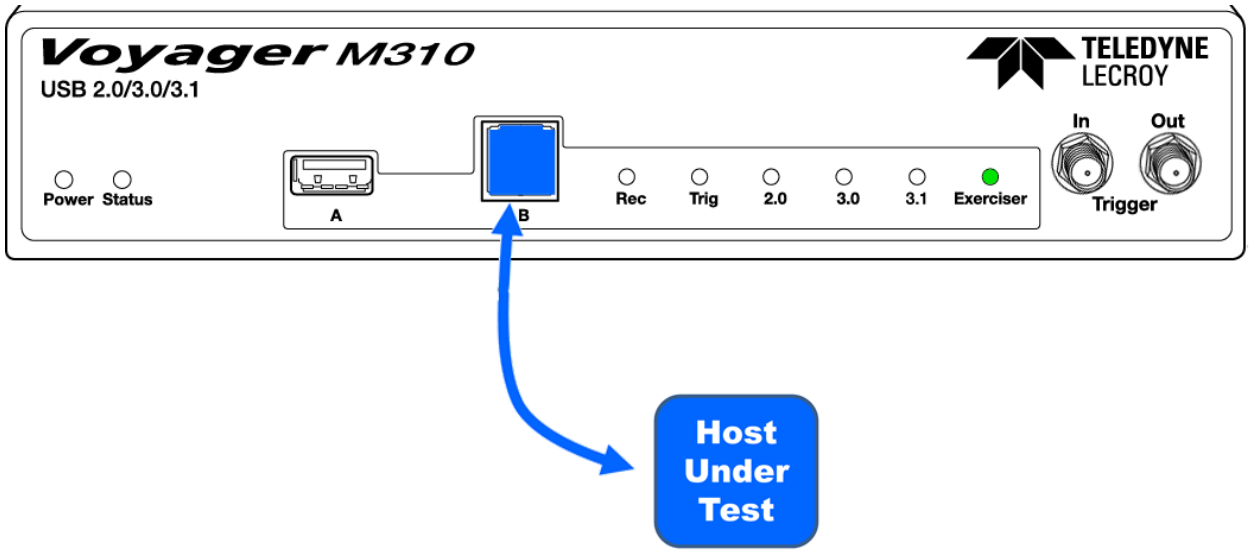


Figure 11.4: Connections to Voyager M310

11.3 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 Figures 11.5 and 11.6.)

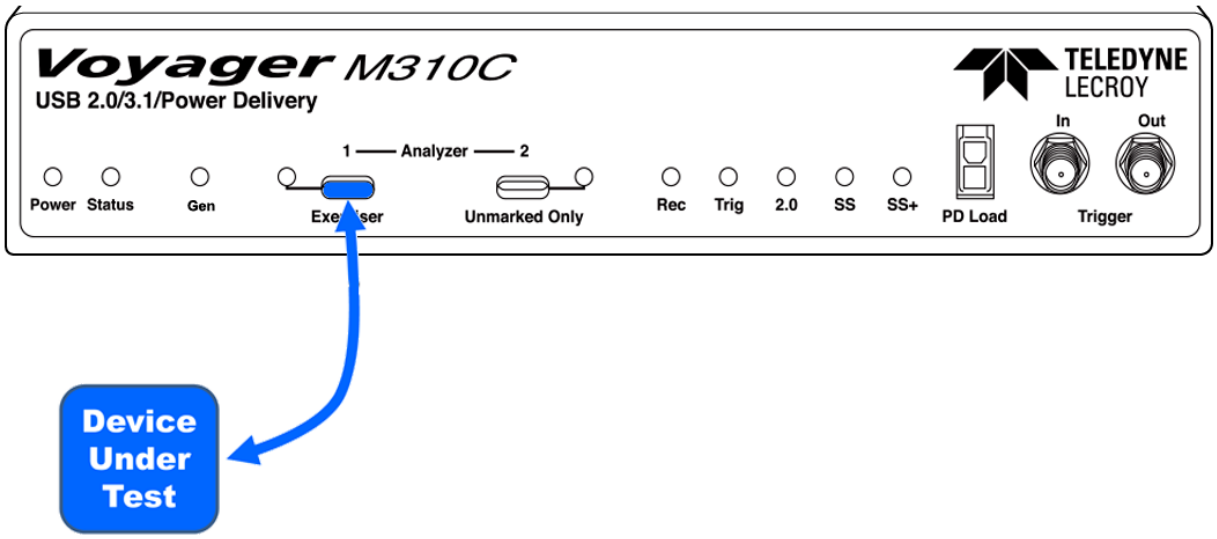


Figure 11.5: Connections to Voyager M310C: Device Under Test

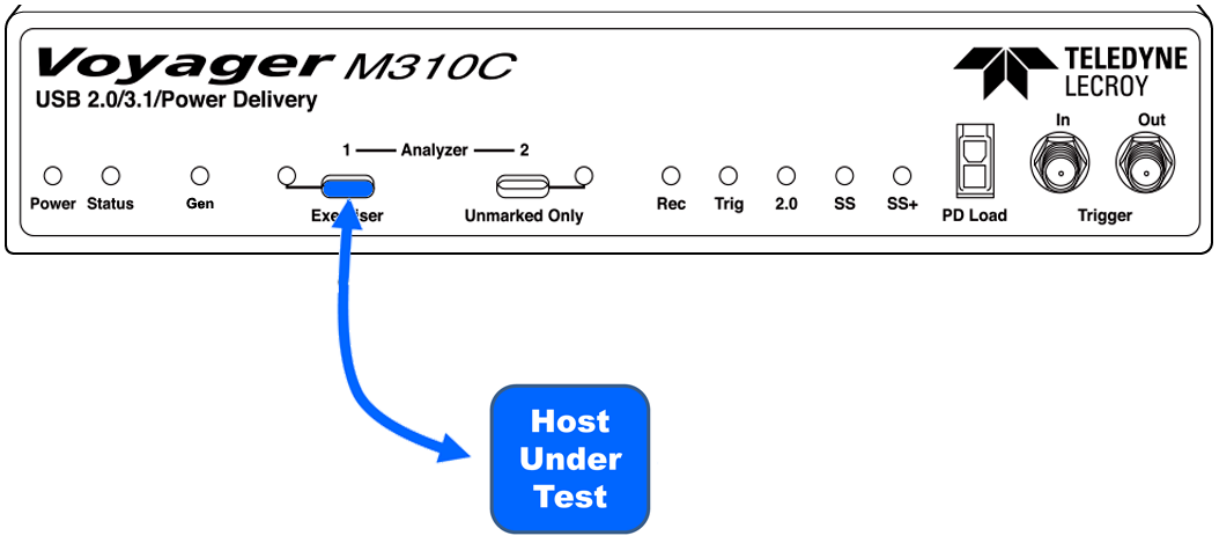


Figure 11.6: Connections to Voyager M310C – Host Under Test

11.4 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.

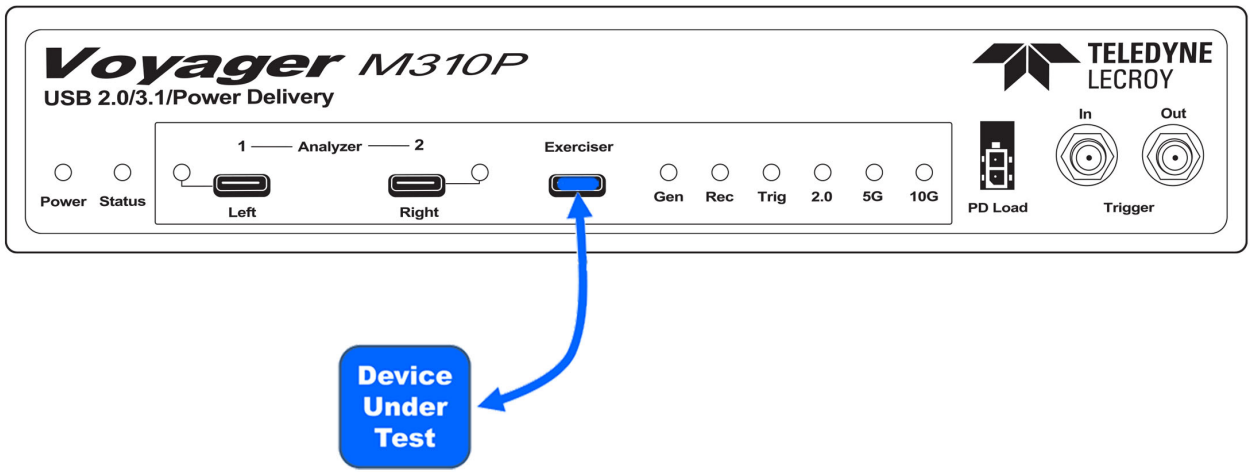


Figure 11.7: Connecting a Cable from Device under Test to Exerciser Port

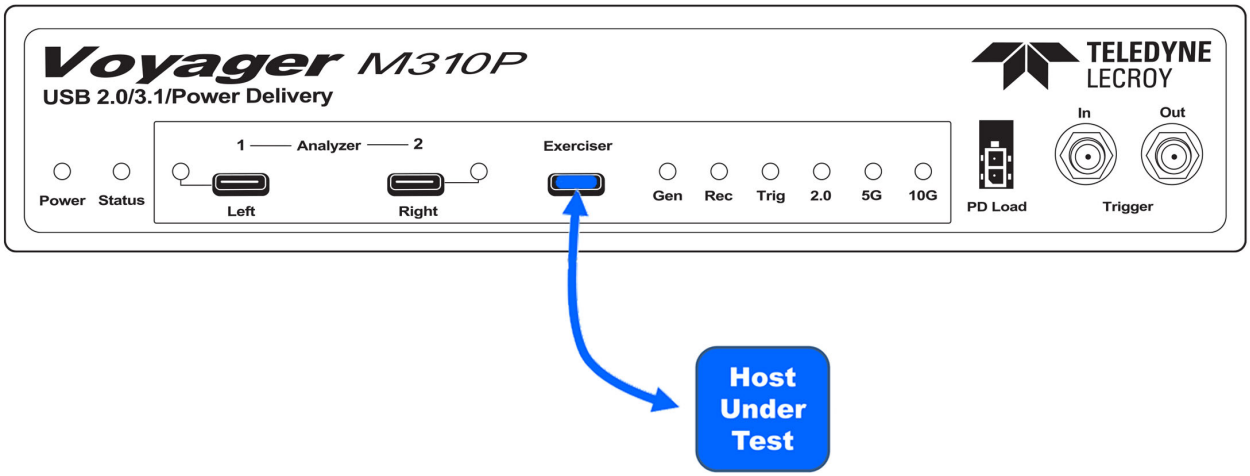


Figure 11.8: Connecting a Cable from Host under Test to Exerciser Port

11.5 Connecting to Voyager M310e

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.

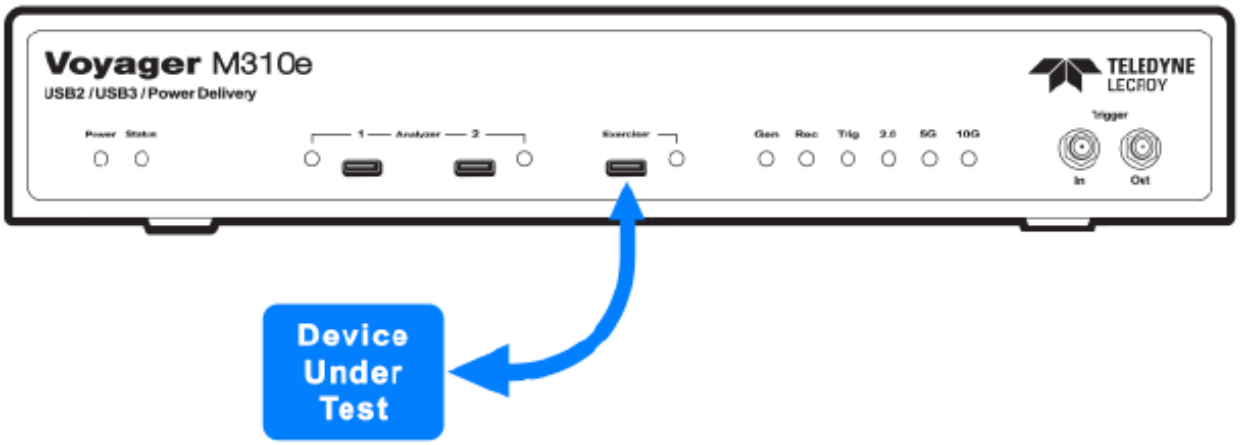


Figure 11.9: Connecting a Cable from Host under Test to Exerciser Port

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

Figure 11.10: Script example of a Traffic Generation File

This generation file causes the system to simulate a hub and to generate 24,320 packets. See 11.13 *Device Emulation* for details about the format of traffic generation files.

11.7 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 10 and 11, see **FS_Enum_Break_Wrap_Sample.utg, HS_Hub_Sample.utg**, or **SampleDeviceEmulationThumbDriveFS.utg**, in the examples directory (see 4.8 *Examples*) under **\2.0 Host Emulation** and **\2.0 Device Emulation**, respectively.

You can open a generation file with Notepad or other editor and then add or remove text as needed.

11.7.1 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.

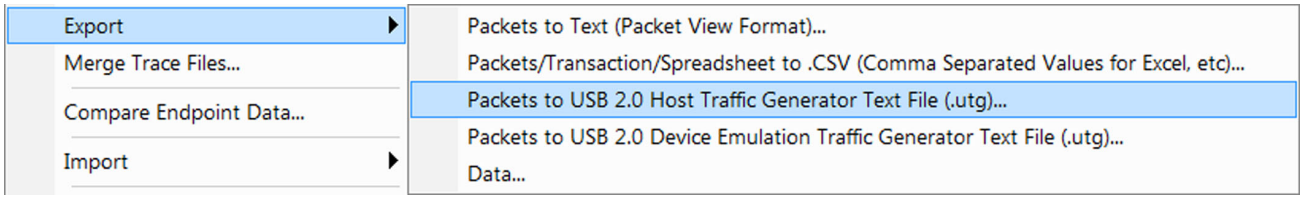


Figure 11.11: File Export Menu

1. Select **Packets to Host Traffic Generator Text File** from the **Export** drop-down menu. The **Export to Generator Text** dialog box (Figure 11.12) appears.

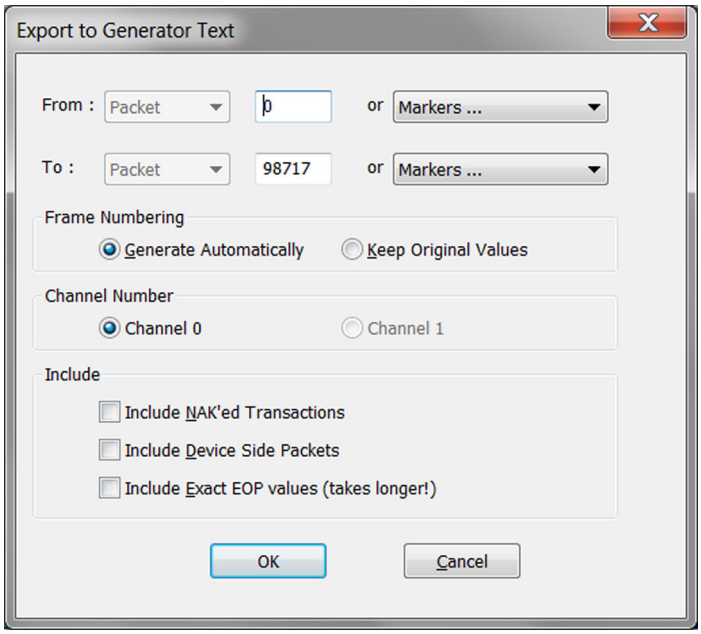


Figure 11.12: Export to Generator Dialog Box

2. 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.

You can opt to regenerate the frame numbers and remove the NAK'd 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.

3. To search for empty frames, enter **empty_frames = nnn** and look for any location where nnn is ≥102. In most cases, this value can be reduced to a very small value.

Refer to the documentation for the empty_frames key later in this chapter. See Table 11.1.

11.8 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 11.13).

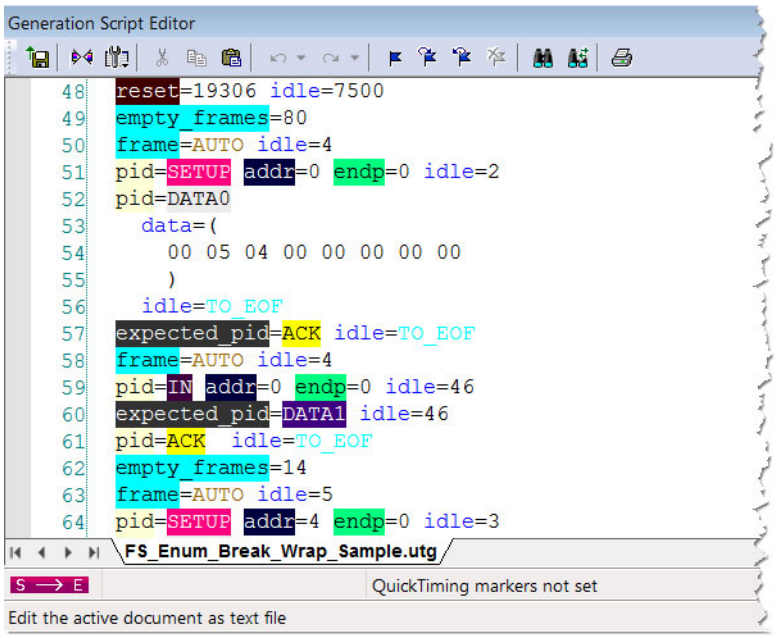


Figure 11.13: Script Editor

The Script Editor divides into three areas:

- Toolbar
- Script window
- File tabs (at the bottom of the window)

If errors occur, a log opens at the bottom of the window.

11.8.1 Toolbar

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



The buttons have the following functions:

Button	Function
	Save. Saves your edits and immediately updates the setting bars and Frames shown in the trace window.
	View Options. Opens a menu with four options: Enable Outlining, Toggle Outlining, and Line Numbers. See **View Options Menu** below.
	Go to Trace View.
	Cut
	Copy
	Paste
	Undo
	Redo

Button	Function
	Add/Remove bookmark. Allows markers to be set or removed to aid in navigation.
	Go to next bookmark.
	Go to previous bookmark.
	Clear all bookmarks.
	Find
	Find and Replace
	Print

11.8.2 View Options Menu

The View Options button has a menu with three options:

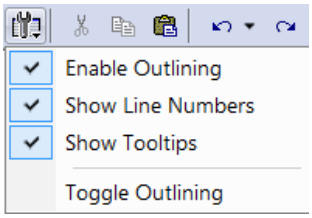


Figure 11.14: View Options Menu

- **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

11.8.3 Pop-up Menu

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

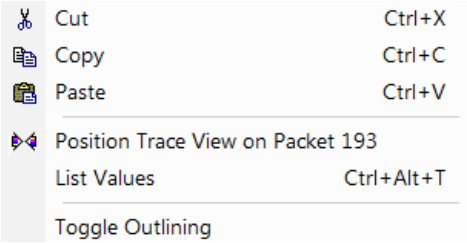


Figure 11.15: Pop-up Menu

- 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.

11.8.4 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.

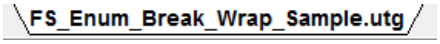


Figure 11.16: File Tabs

11.8.5 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.

11.8.6 Tooltips

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

11.9 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 (Figure 11.17):

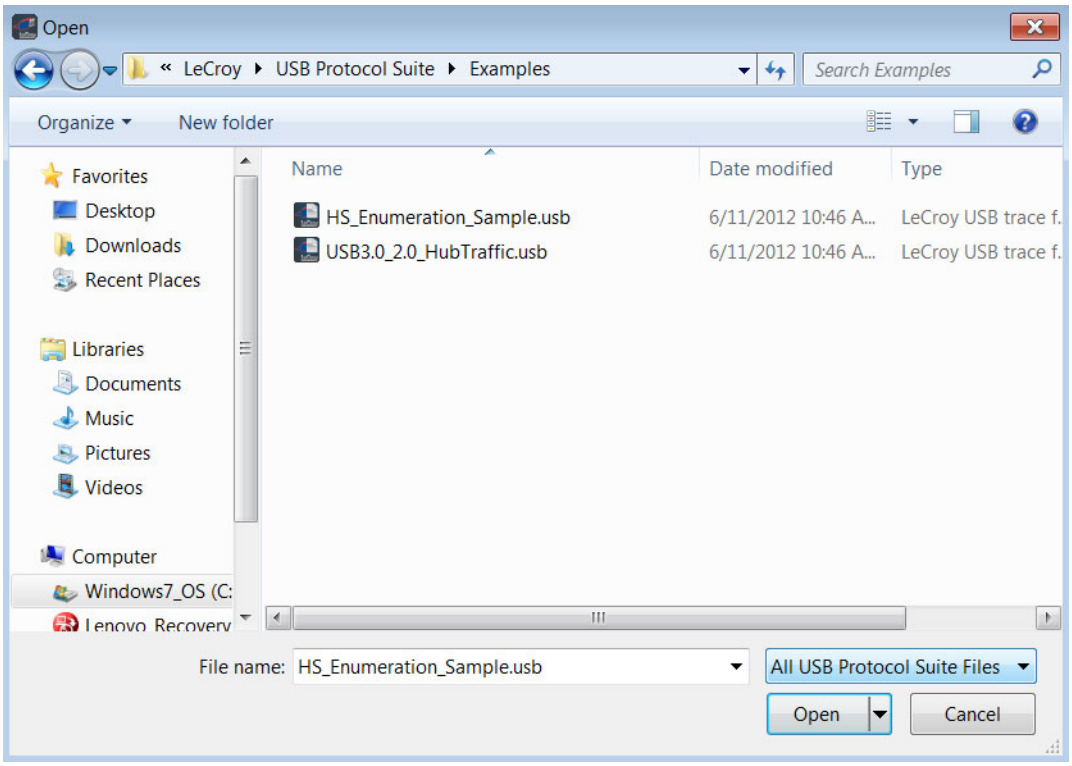


Figure 11.17: Open Dialog

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 (Figure 11.18.)

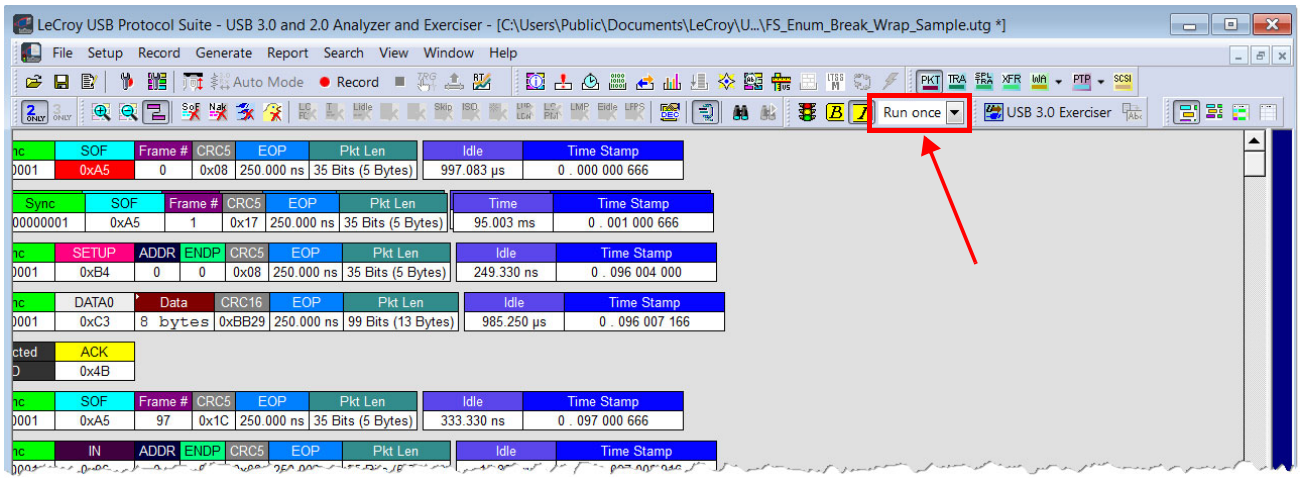
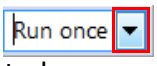


Figure 11.18: Traffic Generation File

5. Select a value from the **Repeat** drop-down menu 

for the number of times you want the traffic pattern to be generated.

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.

6. To select the ***Generation mode*** in which to generate traffic (see below for an explanation), click the **IntelliFrame** button  on the toolbar:

- Active = IntelliFrame
  - Not Active = Bitstream

7. To deactivate IntelliFrame, click the **IntelliFrame** button again.

11.9.1 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 SE0s) 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'd 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 IntelliFrame mode is that it creates an image in the Generator's memory that is MUCH smaller than that of 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, etc). If you want to explicitly corrupt or manage these PID types, you must use Bitstream mode.

11.10 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 11.1.

11.11 Repeating a Generation Session

1. 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.
2. To 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**.

11.12 Stop Traffic Generation

To instruct the analyzer to halt traffic generation, click  on the Tool Bar.

11.13 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.

11.13.1 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:

1. You must verify that the trace file contains traffic for only one device.
2. If it does not, click **Setup → Level Hiding** to hide all the other devices.
3. To save the file as a new file without the hidden traffic, click **File → Save As** and check the option **Do not save hidden packets/transactions/transfers**).

11.13.2 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**, 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, 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: 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.

11.13.3 Frame Duration Customization

USB2 generation script provides capability to modify frame duration for special verification purposes. To achieve variation of the frame time, the script should manipulate the idle bit times. Using empty frames always creates standard frames; using "`Frame=auto {idle=to_eof}`" also creates a standard frame, but using "`idle=<n bits>`" allows you to vary the frame duration. Figure 11.19 shows a sample script.

```
39  frame=AUTO idle=to_eof
40  frame=AUTO idle=11965
41  frame=AUTO idle=11900
42  frame=AUTO idle=12100
```

Figure 11.19: Sample Script for Customizing Frame Duration

The script shown in Figure 11.19 creates 2 frames of standard duration, because "`to_eof =11965`" makes lines 39 and 40 functionally the same. Line 41 creates a frame 10% short; line 42 creates a frame 10% long. Figure 11.20 shows idle time field in the generated trace view.

	Packet	H	F	Sync	SOF	Frame #	CRC5	EOP	Pkt Len	Error	Duration	Idle	Time Stamp
	22	↓	S	00000001	0xA5	11	0x04	250.000 ns	35 Bits (5 Bytes)		2.917 us	997.083 us	0 . 019 001 000
	23	↓	S	00000001	0xA5	12	0x1A	250.000 ns	35 Bits (5 Bytes)		2.917 us	997.083 us	0 . 020 001 000
S	24	↓	S	00000001	0xA5	13	0x05	250.000 ns	35 Bits (5 Bytes)		2.917 us	991.667 us	0 . 021 001 000
E	25	↓	S	00000001	0xA5	14	0x07	250.000 ns	35 Bits (5 Bytes)	Error	2.917 us	1.008 ms	0 . 021 995 584

Figure 11.20: Trace View with Customized Frame Durations

TIP

You can change the idle time field to show "Bit Time" instead of time to help calculate the number of bits needed manually. See Figure 11.21 to see how to change the display format for idle field, and Figure 11.22 for an example of a trace with Bit Time in "Idle" field.

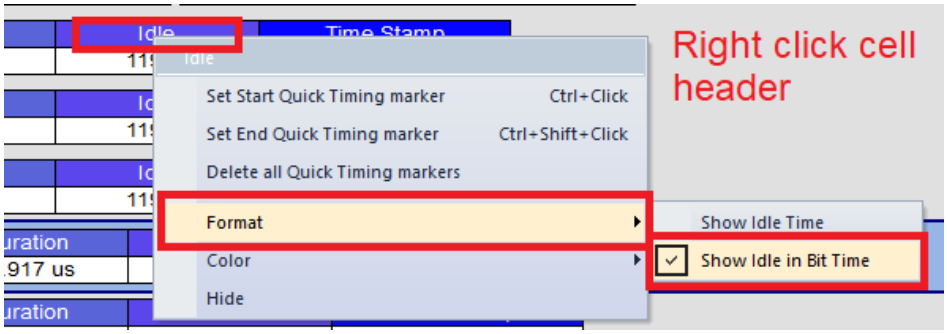


Figure 11.21: Change the Display Format of an Idle Field

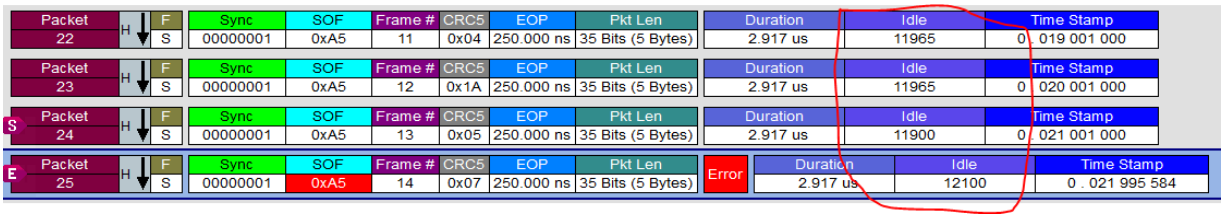


Figure 11.22: Bit Time Display for an Idle Field

Therefore, instead of ending the packet declaration as "`idle=to_eof`" you can change "`to_eof`" to a number of bit times.

- If you want to extend or shorten a frame, use a number of idle bits after the last packet before the next SOF instead of the "`to_eof`" automatic calculation.
- If you want to drop one or more SOF, add more idle=12000 between SOF. A FS frame has 12000 bit times normally; however, also remember that no SOF for >36000 bit times should cause the device to go to suspend state.

11.13.4 Run the Traffic Generation Script File

1. Connect the system port B (either Hi Speed or Classic Speed) to the Host.
2. Open the Traffic Generation **.utg** file.
3. Click  to start traffic generation.
    - When execution begins, the system reads the entire generation file and 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 executes. With each subsequent call to the same endpoint, commands execute sequentially down the list as they occur in the memory segments. For example, if three calls were made to Endpoint 0 IN, the first three commands in that endpoint memory segment execute.

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

11.14 Voyager M3x/M310/M310C/M310P/M310e USB 2.0 Script Limitations

Due to architectural changes in the Voyager M3x/M310/M310C/M310P/M310e 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 12 KB of traffic just for one frame. Therefore, a maximum traffic of less than 3 mSec (about 2.5 frames) can be sent 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/M310P/M310e, 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.

11.15 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 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**.

11.15.1 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.

11.15.2 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 11.1: Key Codes (Sheet 1 of 14)

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.

Table 11.1: Key Codes (Sheet 2 of 14)

Key Code	Format	Description
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**
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 11.1: Key Codes (Sheet 3 of 14)

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
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 11.1: Key Codes (Sheet 4 of 14)

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 11.1: Key Codes (Sheet 5 of 14)

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 11.1: Key Codes (Sheet 6 of 14)

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**
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 11.1: Key Codes (Sheet 7 of 14)

Key Code	Format	Description
Packet Starting Keys		
pid	8 bits (0-0xFF) or	**Host Generation Only** Use this as the first key of most packets sent by the Host (Exception: Use **frame=** for SOF packets).
	pid string	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.
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.

Table 11.1: Key Codes (Sheet 8 of 14)

Key Code	Format	Description
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 11.1: Key Codes (Sheet 9 of 14)

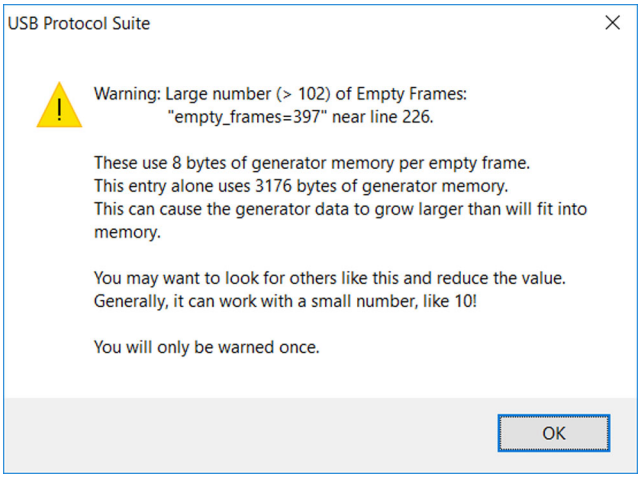
Key Code	Format	Description
empty_frame	integer	**Host Generation Only** This key creates a sequence of start of frame packets with **idle=TO_EOF** values for the idle time. This results in N empty frames, where N is the integer value specified. If the branch speed is LOW, the frames contain only the 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.
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 11.1: Key Codes (Sheet 10 of 14)

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 signaling. This statement MUST be followed by the **resume=<> statement**.
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 V_{BUS} to go Hi.
termination	HERE	**Device Emulation Only** Set terminations now.

Table 11.1: Key Codes (Sheet 11 of 14)

Key Code	Format	Description
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. The maximum number of guaranteed bytes is 183. However, in some instances, you may be able to transmit up to 1049.
crc	5 bits (0x0-0x1F) or 16 bits (0x0-0xFFFF)	Assign a value for the CRC field. The default value is the correct CRC calculated for the packet.
s	0 or 1	**Host Generation Only** Assign a value for the S (High Speed SPLIT Start/Speed) field.
sc	0 or 1	**Host Generation Only** Assign a value for the SC (High Speed SPLIT Start/Complete) field.
e	0 or 1	**Host Generation Only** Assign a value for the E (High Speed SPLIT End) field.
et	0 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

Table 11.1: Key Codes (Sheet 12 of 14)

Key Code	Format	Description
hird	4 bits (0-15)	**Host Generation Only** Assign the Host Initiated Resume Duration. Default value is 0. For a description of the values 1 through 15, see the *Link Power Management Specification*.
link_state	4 bits (0-15)	**Host Generation Only** Assign the link state. Currently, the only legal link_state value is 1, for L1 (Sleep). Default value is 0, so set the link_state value to 1.
remote_wake	0 or 1	**Host Generation Only** Disable or enable Remote Wakeup. Default value is 0, which disables Remote Wakeup. To enable Remote Wakeup, set the value to 1.
eop	positive integer	Assign a positive integer for the length of the end of packet (EOP). The default value is the correct length (2 bits of SE0, 1 bit of J). The value is reflected by **<val-1>** bits of SE0 plus one bit of J.
hi_eop	(AB CD) Hex	Used to generate a high speed EOP pattern. The bytes are in the order they come across the bus, and the bits within the bytes are in LSB to MSB order. Maximum number of bytes allowed is 13.
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 key-word 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. See 11.13.3 *Frame Duration Customization*.
marker	string	Assign a string in quotation marks to be put in the marker for the defined packet.

Table 11.1: Key Codes (Sheet 13 of 14)

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**.
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.

Table 11.1: Key Codes (Sheet 14 of 14)

Key Code	Format	Description
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/M310P/M4x/M480x.
- The USB4 Exerciser is supported in Voyager M4x/M480x.

NOTE: For traffic generation for USB 2.0, see Chapter 11.

12.1 Connecting to Voyager M480x

In all cases you attach to the USB Type-C™ connector (labeled “Exerciser”). Selection between Host and Device emulation is done in the Recording Options window.

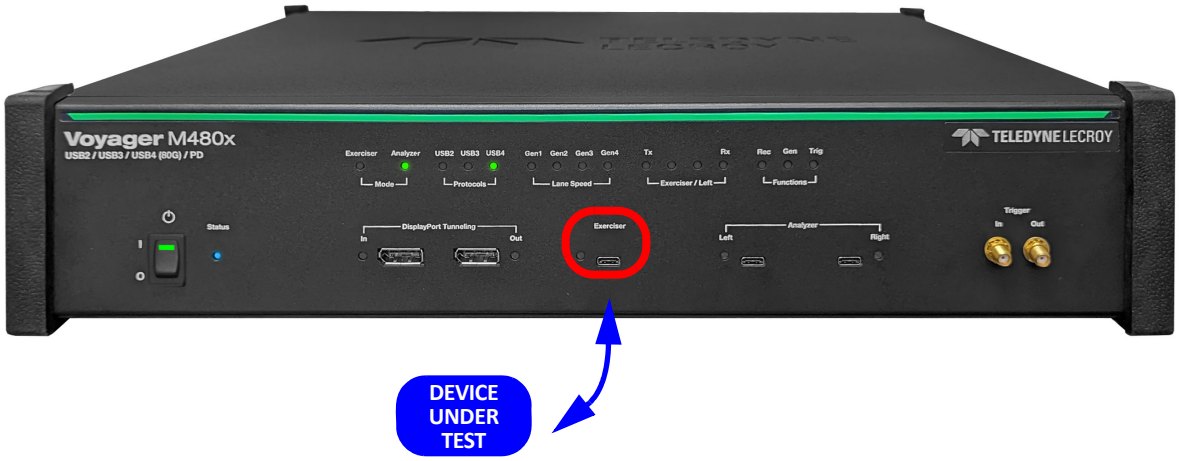


Figure 12.1: Cable Connected from DUT to Exerciser Port

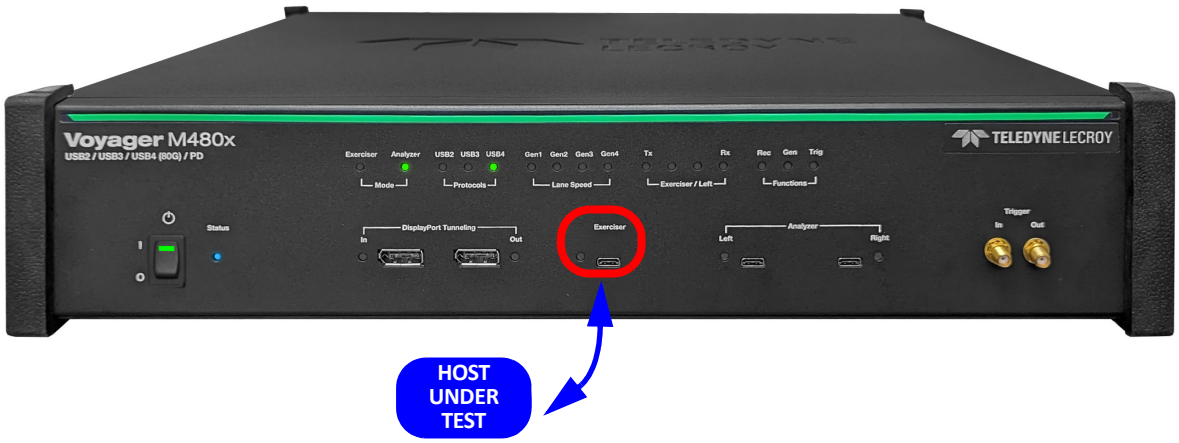


Figure 12.2: Cable Connected from HUT to Exerciser Port

12.2 Connecting to Voyager M4x

In all cases you attach to the USB Type-C™ connector (labeled “Exerciser”). Selection between Host and Device emulation is done in the Recording Options window.

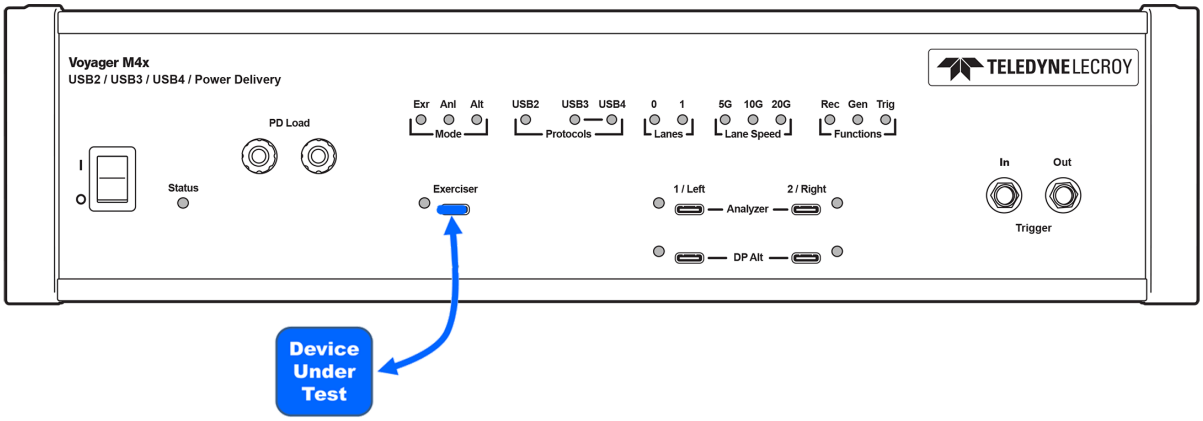


Figure 12.3: Cable Connected from DUT to Exerciser Port

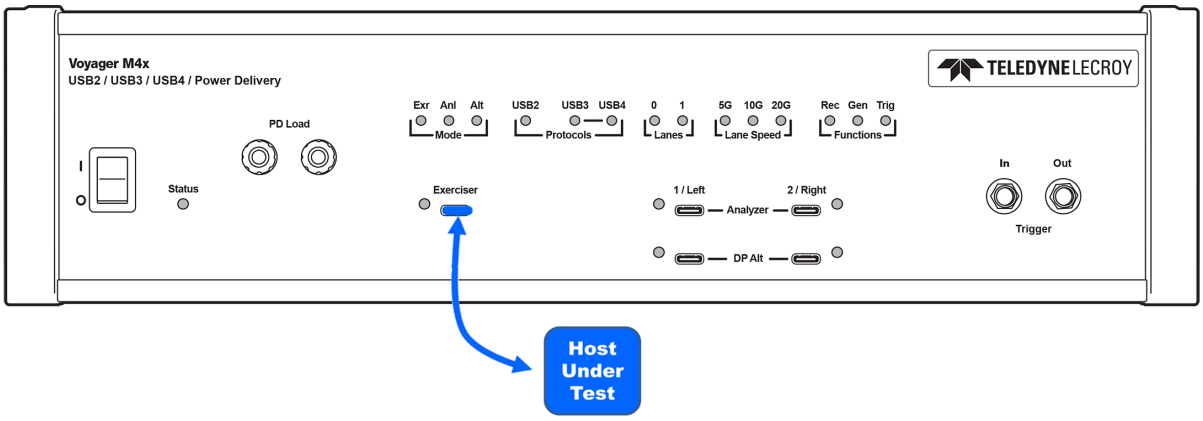


Figure 12.4: Cable Connected from HUT to Exerciser Port

12.3 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.

12.3.1 Host Emulation

For Host Emulation, connect a cable from Device under Test to “A” port.

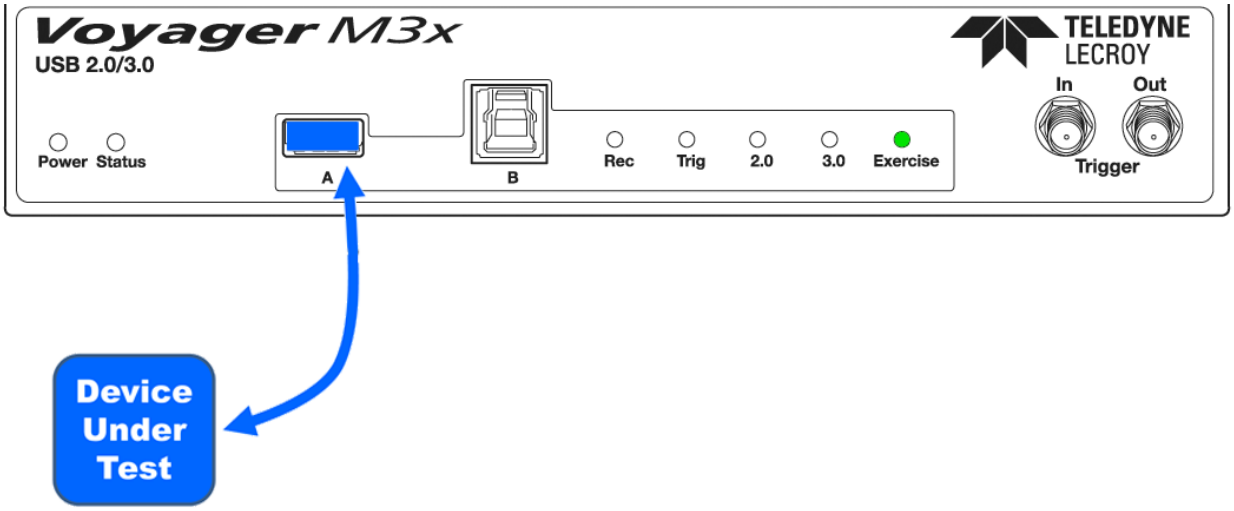


Figure 12.5: Cable Connected from DUT to “A” Port

12.3.2 Device Emulation

For Device Emulation, connect a cable from Host under Test to “B” port.

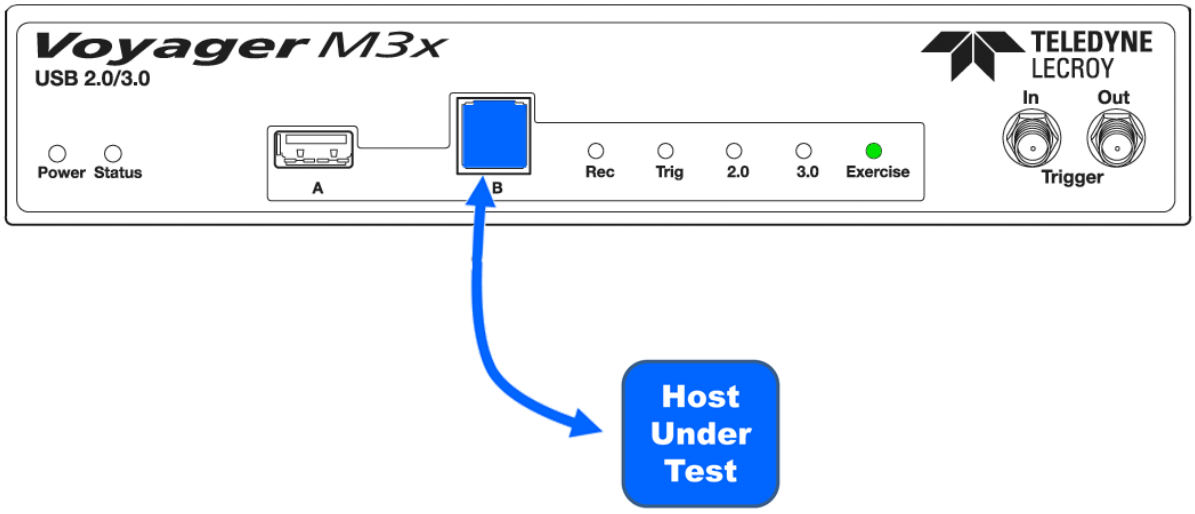


Figure 12.6: Connecting a Cable from HUT to “B” Port.

12.4 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.

12.4.1 Host Emulation

For Host Emulation, connect a cable from Device under Test to Exerciser “A” port.

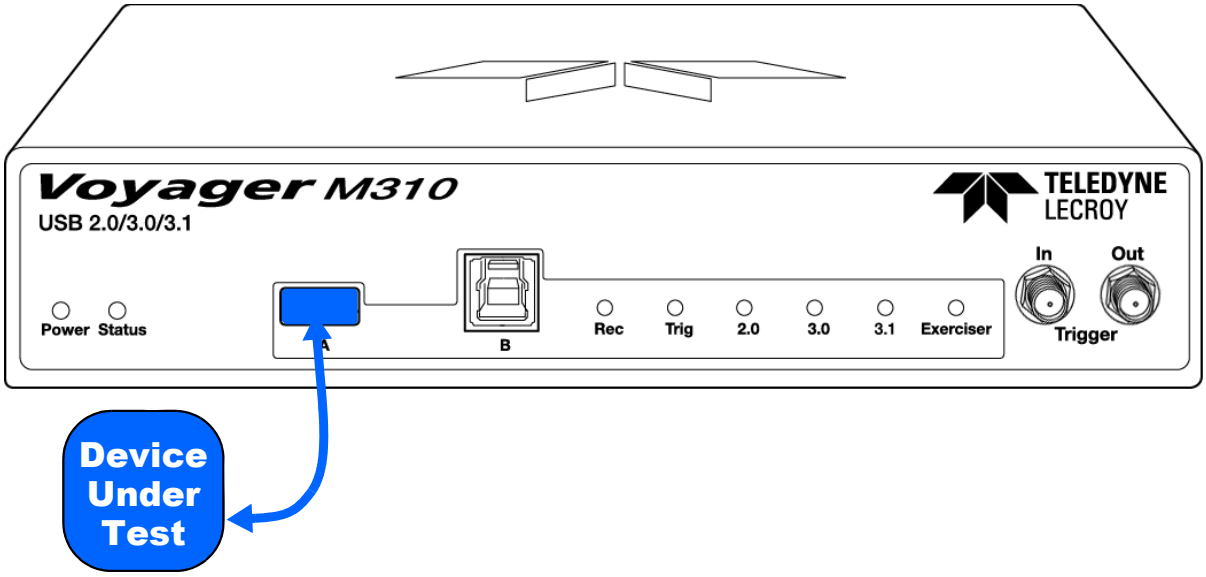


Figure 12.7: Cable Connected from DUT to Exerciser “A” Port

12.4.2 Device Emulation

For Device Emulation, connect a cable from Host under Test to Exerciser “B” port.

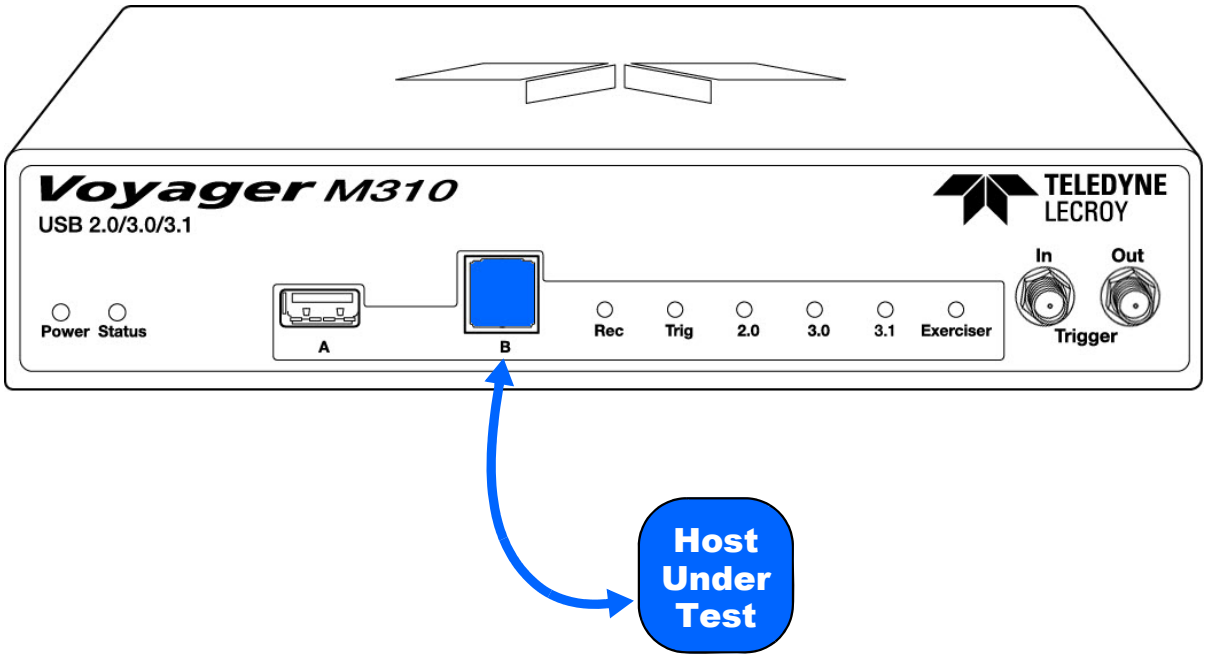


Figure 12.8: Cable Connected from HUT to Exerciser “B” Port

12.5 Connecting to Voyager M310C

In all cases (SS, SS+) you attach to the left USB Type-C™ connector (labeled “Exerciser”). Selection between Host and Device emulation is done in the Recording Options dialog.

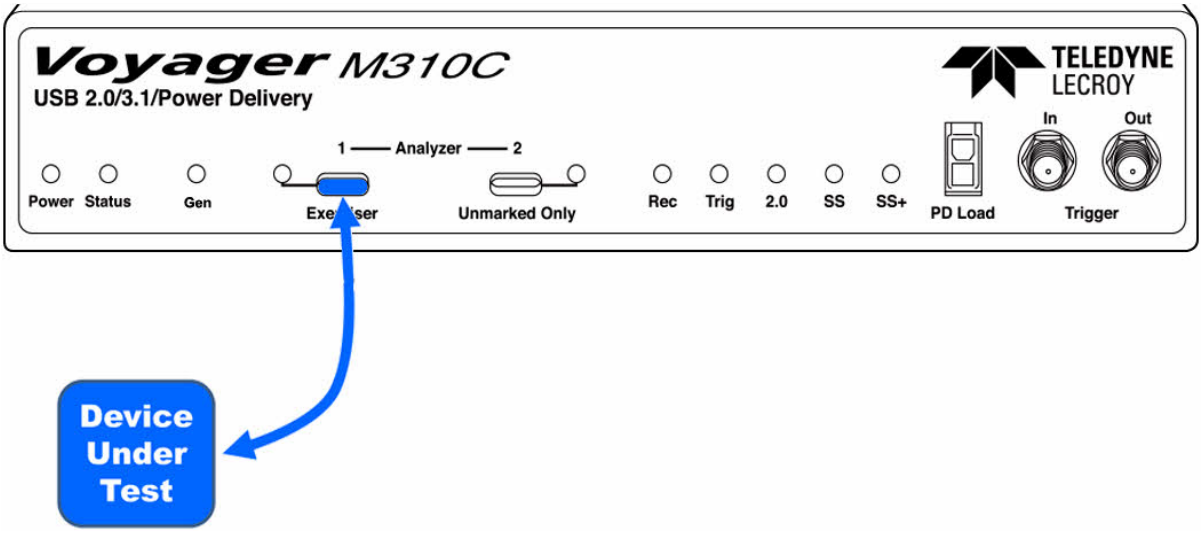


Figure 12.9: Cable Connected from DUT to Exerciser “A” Port

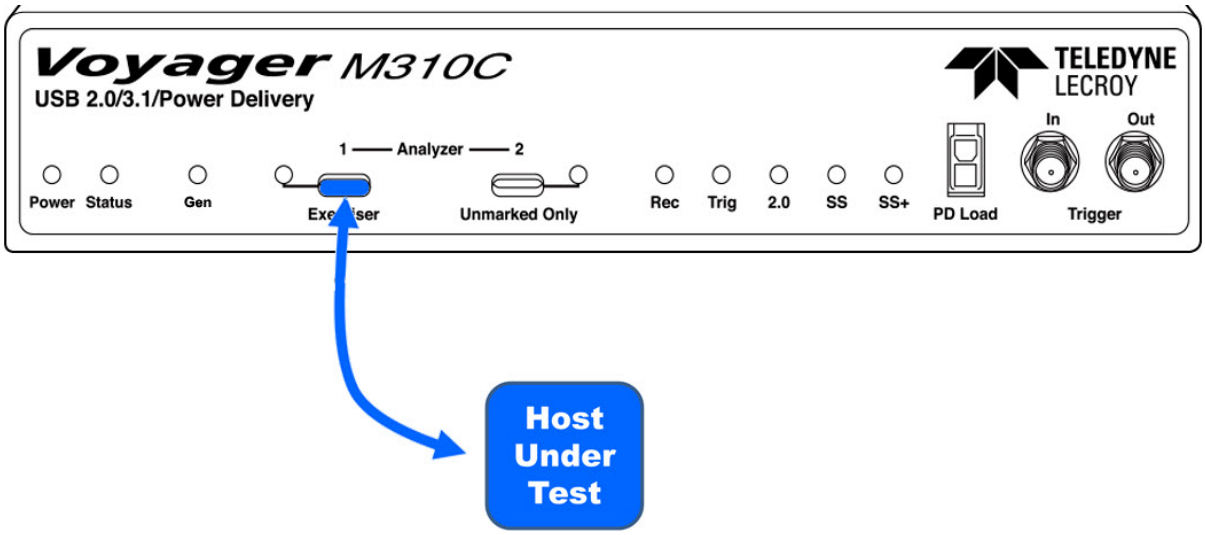


Figure 12.10: Cable Connected from HUT to Exerciser “A” Port

12.6 Connecting to Voyager M310e

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.

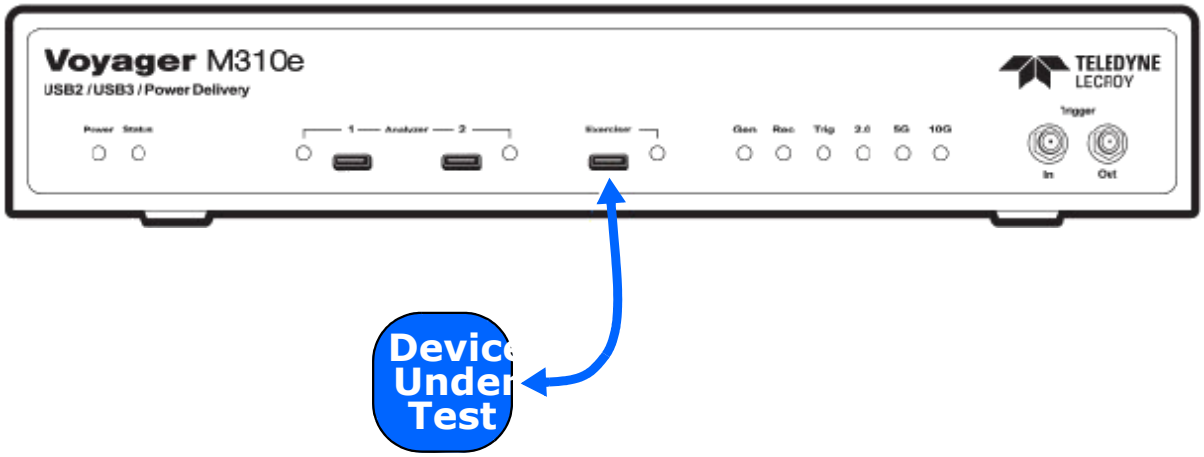


Figure 12.11: Cable Connected from DUT to Exerciser Port

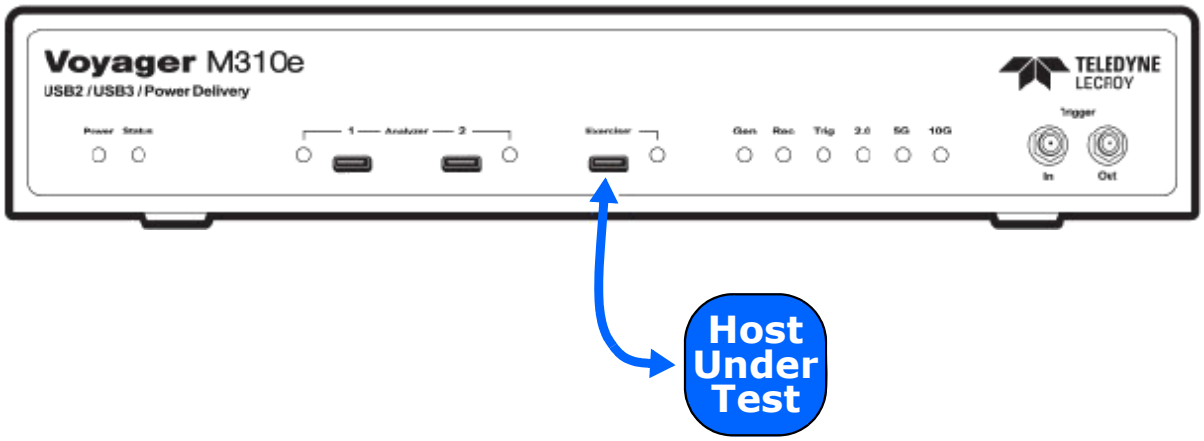


Figure 12.12: Cable Connected from HUT to Exerciser Port

12.7 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.

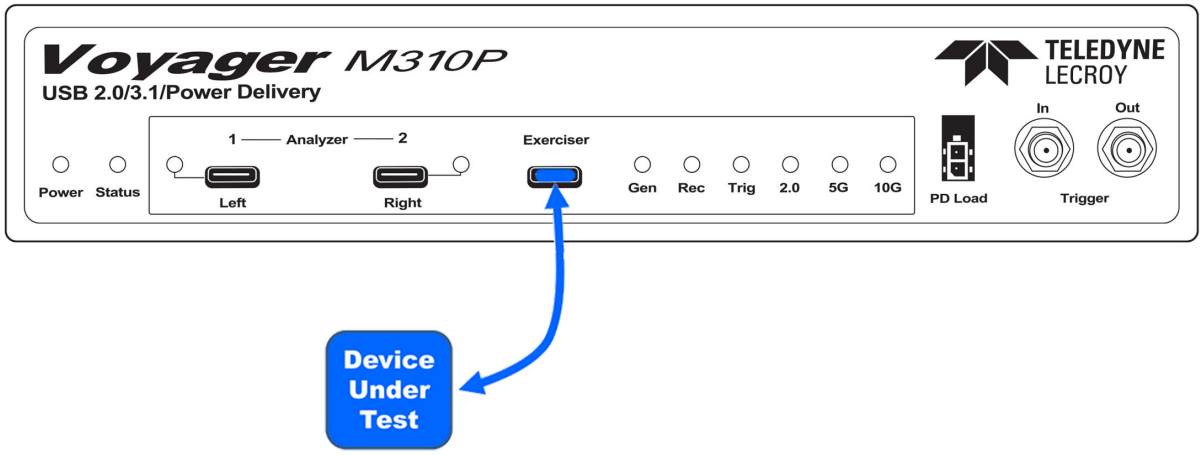


Figure 12.13: Connecting a Cable from DUT to Exerciser Port

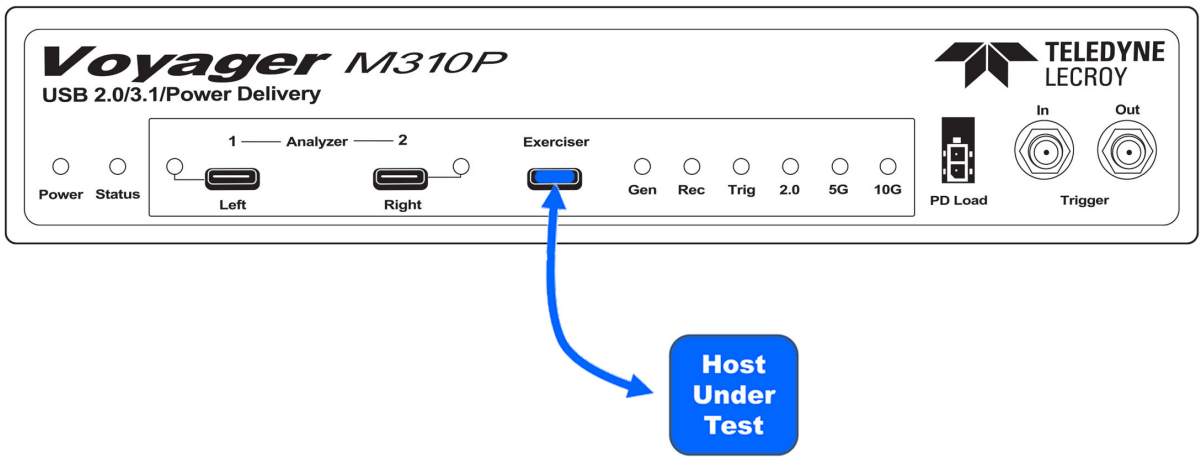


Figure 12.14: Cable Connected from HUT to Exerciser Port

12.8 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.

12.9 Exerciser Files

The system generates the following types of traffic:

- USB 3.2 traffic: Utilizing ***.usb3g** traffic generation file**s**
- USB4 traffic: Utilizing ***.usb4g** traffic generation files
- PD traffic: Utilizing *.**updg** traffic generation files

The system generates USB 3.2/USB4/PD traffic from traffic generation files, which are text-based script files that instruct the Exerciser how to generate USB 3.2/USB4/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.

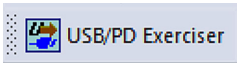
12.10 Creating Exerciser Files

If you choose to write a script with a text editor, a good way to start is to edit a sample generation file (see 4.8 *Examples*).

You can open a generation file with Notepad or other editor and add or remove text as needed.

For complete information on these and other Exerciser commands, see the Exerciser User Manual (USB4ExerciserManual.pdf, VoyagerUSB3ExerciserScriptLanguage.pdf, or USBPowerDeliveryExerciserManual.pdf) included in your installation Documents folder.

12.11 Exerciser Window

Click the **USB/PD Exerciser** 

button on the toolbar to open the USB/PD Exerciser window.

12.11.1 USB/PD Exerciser Menus

Table 12.1: USB/PD Exerciser Menus (Sheet 1 of 3)

Menu	Sub Topic	Function
File		
	New 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.
	Open	Opens a file.
	Save	Saves the current file.
	Save As	Saves all or a range of packets from the current file.
	Close	Closes the current file.
	Print	Prints part or all of the current traffic data file.
	Print Preview	Produces an on-screen preview before printing.
	Print Setup	Sets the options for the current or new printer.
	Exit	Exits the program.

Table 12.1: USB/PD Exerciser Menus (Sheet 2 of 3)

Menu	Sub Topic	Function
Edit		
	Undo	Undoes previous command.
	Redo	Redoes undone command.
	Cut	Deletes selected text.
	Copy	Copies selected text
	Paste	Pastes copied text.
	Toggle Bookmark	Moves back and forth between bookmarks (scripts only).
	Next Bookmark	Goes to the next bookmark (scripts only).
	Previous Bookmark	Goes to the previous bookmark (scripts only).
	Clear All Bookmarks	Removes all bookmarks (scripts only).
	Find	Displays the Find dialog (scripts only). You can match case, find whole word only, and search up or down.
	Replace	Opens the Replace dialog to find text and replace it (scripts only). You can match case, find whole word only, and search up or down.
	Find Next	Finds the next text entered in the Find dialog (scripts only).
	Go to	Opens the Go To Line dialog, in which you can enter a line number (scripts only).
	Select All	Select all text in the current file (scripts only).
Generation		
	Run Scenario	Starts traffic generation.
	Stop Scenario	Stops traffic generation.
	Preview Trace	Checks script for errors and displays trace.
Build (scripts only)		
	Compile	Starts traffic generation (scripts only).
View		
	Main Toolbars	Switches display of the Main toolbar on or off.
	Graphical Toolbar	Switches display of the Graphical toolbar on or off (graphics only).
	Views Toolbar	Switches display of the Views toolbar on or off (scripts only).
	Script Toolbar	Switches display of the Script toolbar on or off (scripts only).
	Status Bar	Switches display of the Status Bar on or off.
	Zoom In	Increases the size of the displayed elements (graphics only).
	Zoom Out	Decreases the size of the displayed elements (graphics only).
	Wrap	Wraps displayed packets within the window (graphics only).
	Convert	Converts graphic scenario to text scenario (graphics only).
Window		

Table 12.1: USB/PD Exerciser Menus (Sheet 3 of 3)

Menu	Sub Topic	Function
	Cascade	Displays all open windows in an overlapping arrangement.
	Tile	Displays all open windows in a above-below arrangement.
	Arrange Icons	Arranges minimized windows at the bottom of the display.
	Close All	Closes all open windows.
Help		
	About	Displays version information about the analyzer and the USB Protocol Suite. See 13.1 *Software, Firmware, and BusEngine Revisions*.

12.11.2 Main Exerciser Toolbar

The Main Exerciser toolbar contains buttons for saving your edits, navigating, searching, and other functions.

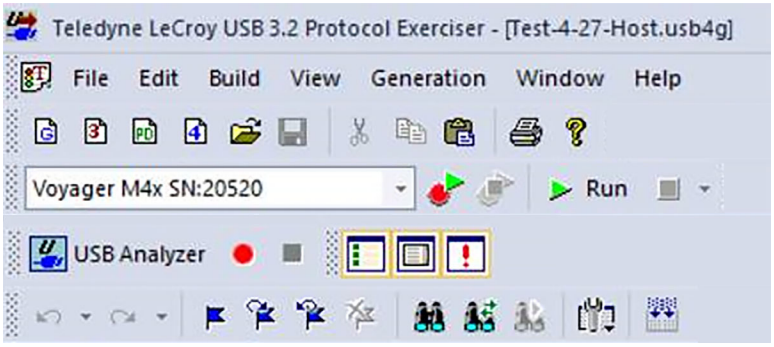
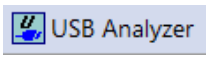
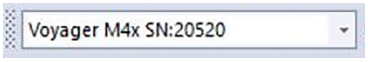


Figure 12.15: Main Exerciser Toolbar

The buttons have the following functions:

Button	Function	Button	Function
	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

Button	Function
	About
	Start recording and exerciser generation with one click
	Run Scenario
	Go to USB Analyzer window
	Stop Recording
	View Output

Button	Function
	Lists all connected units and allows user to choose target unit for running the Exerciser
	Stop recording and exerciser generation with one click
	Stop Scenario
	Start Recording
	View Toolboc
	View Error Output

12.12 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 (Figure 12.16)
- PD: New PD Text Generation Scenario (Figure 12.18)
- USB4: New USB4 Text Generation Scenario (Figure 12.20)

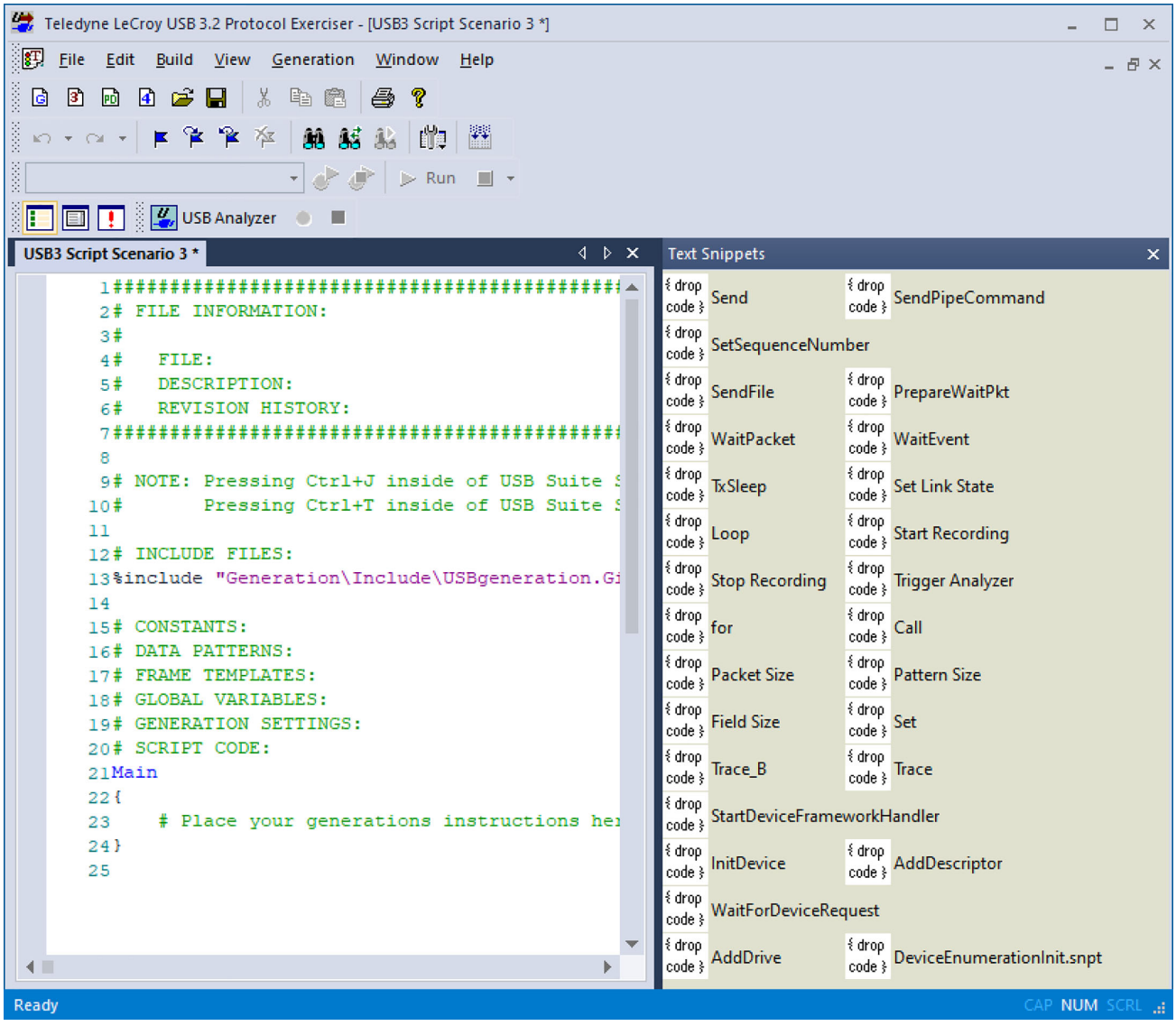


Figure 12.16: New Text Generation Scenario

For details on the generation of a USB 3.2 Script, see the Voyager™ USB 3.2 Exerciser SS (5Gbps) and SS+ (10Gbps) Generation Script Language Reference Manual.

To find this and other manuals, select **Help > Other Manuals > USB 3.2 Exerciser Manual** as shown in Figure 12.17, below.

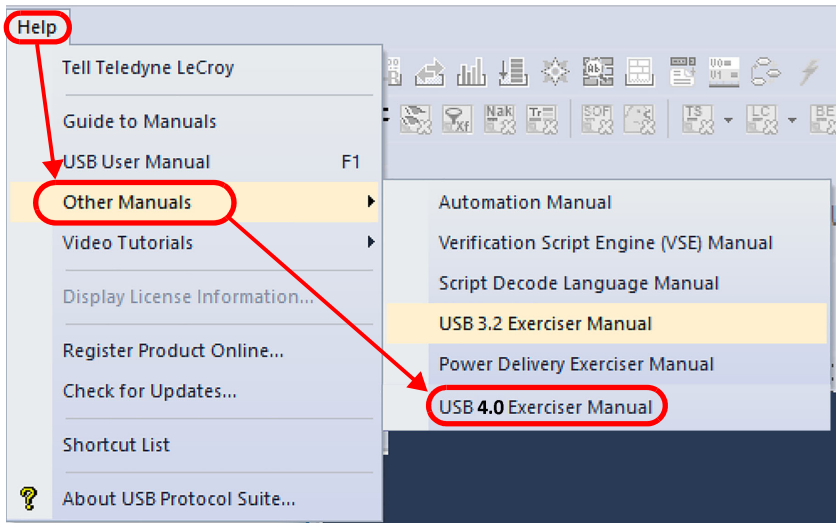


Figure 12.17: USB 3.2 Exerciser Manual

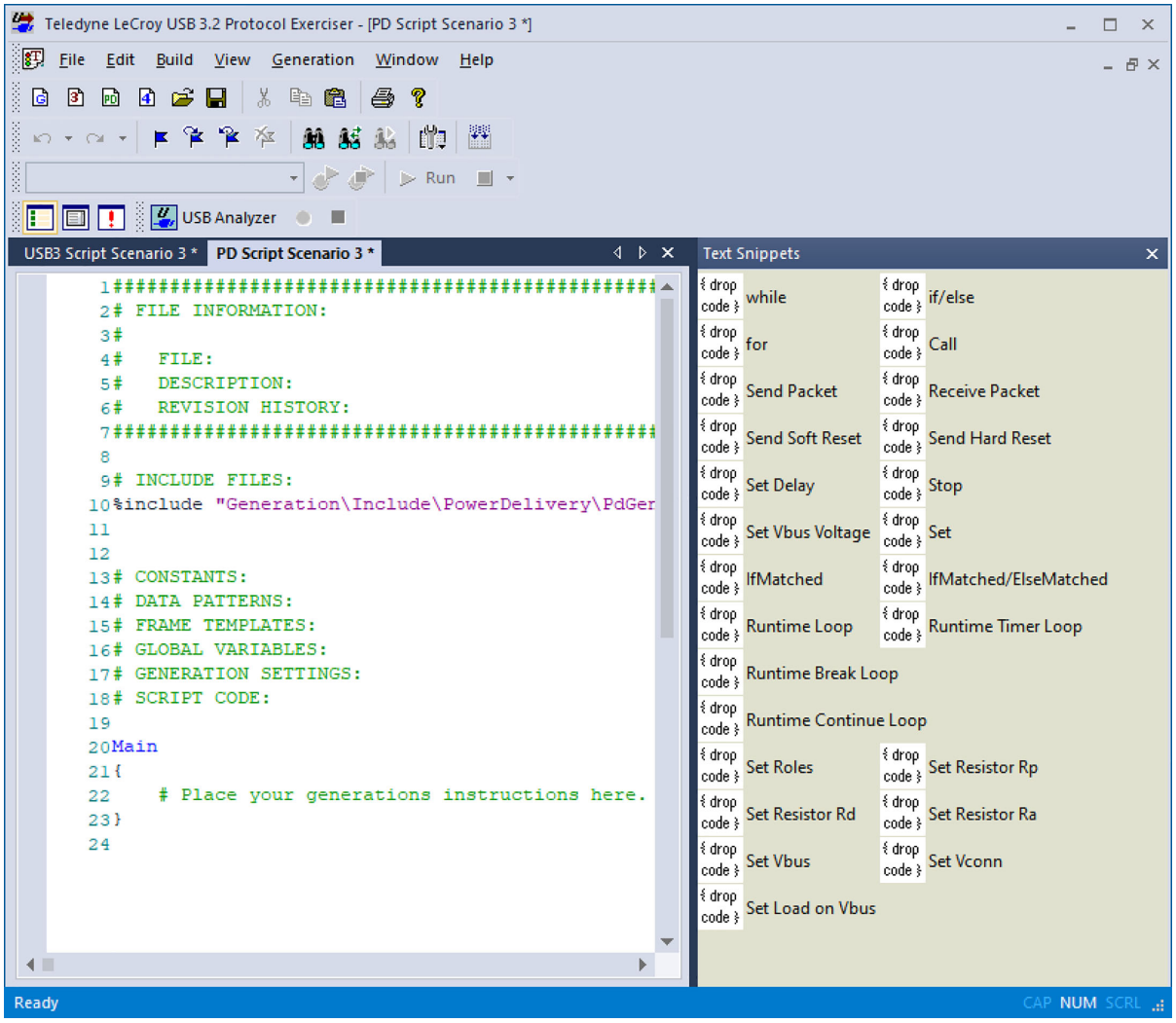


Figure 12.18: New PD Text Generation Scenario

For details on the generation of a Power Delivery (PD) Script, consult the Voyager™ Power Delivery Generation Script Language Reference Manual.

To find this and other manuals, select **Help > Other Manuals > Power Delivery Exerciser Manual** as shown in Figure 12.17.

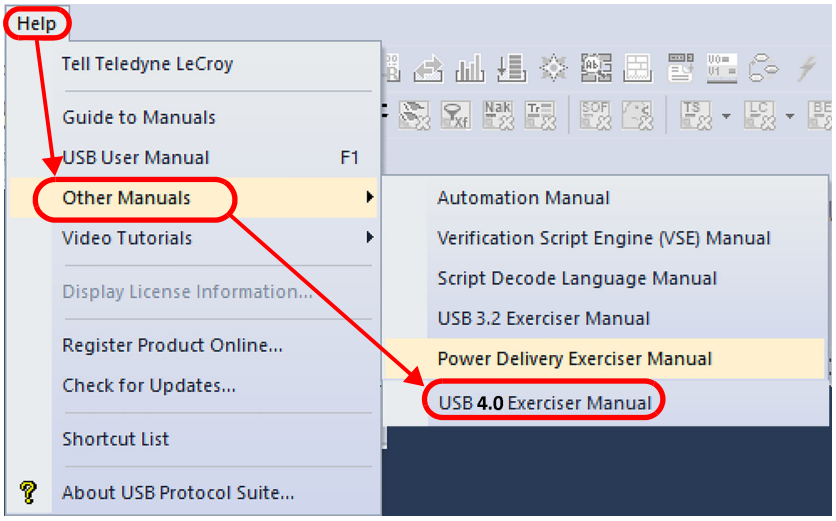


Figure 12.19: Power Delivery Exerciser Manual

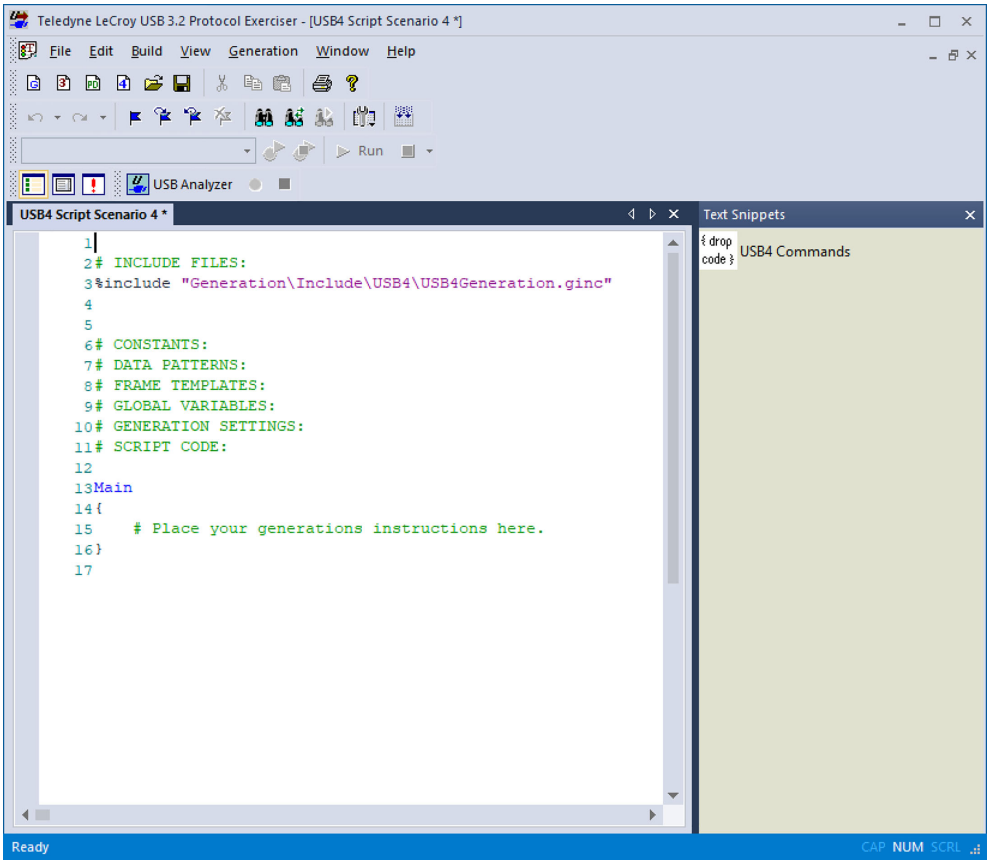


Figure 12.20: New USB4 Text Generation Scenario

For details on the generation of a USB4 Script, consult the Voyager™ USB4 Exerciser Generation Script Language Reference Manual.

To find this and other manuals, select **Help > Other Manuals > USB4 Exerciser Manual** as shown in Figure 12.21.

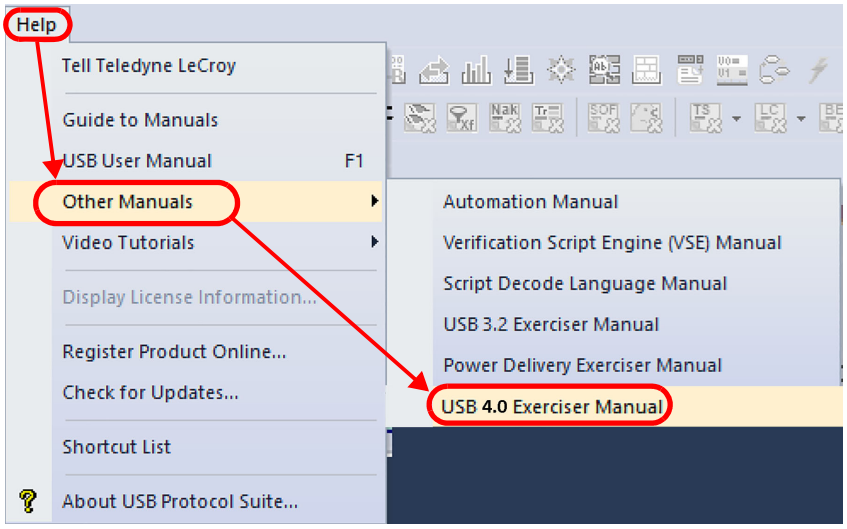


Figure 12.21: USB4 Exerciser Manual

12.12.1 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**.

12.12.2 Text Editing Commands

The Script Editor supports standard editor commands using toolbar buttons and the 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

12.12.3 Help

Right-click a command to display a menu from which you can choose Help.

12.12.4 Properties Window

The Properties window lists all parameters and their values for the selected script command. To change Parameters/values, enter text into the text boxes or select items from pull-down menus.

12.12.5 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.

12.12.6 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.

12.12.7 Output

When you compile a script that generates output or when the application sends you a message, the information appears in the Output tab.

12.12.8 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.

12.12.9 Outlining

If you enable outlining at the Options button, you can:

- **Collapse** or **expand** code blocks
- Toggle outlining at the Options button
- Right-click a command to display a menu from which you can choose Toggle Outlining

12.12.10 Line Numbers

If you enable line numbers at the Options button, each line has a line number.

12.12.11 Tooltips

If you show tooltips at the Options button, tooltips appear when you place the cursor over a button or command.

12.12.12 USB 3.2 Text Snippets

Text snippets appear in the Text Snippets window (Figure 12.22). 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:

Send /*packet template name*/

The entry might look like this:

Send Name1

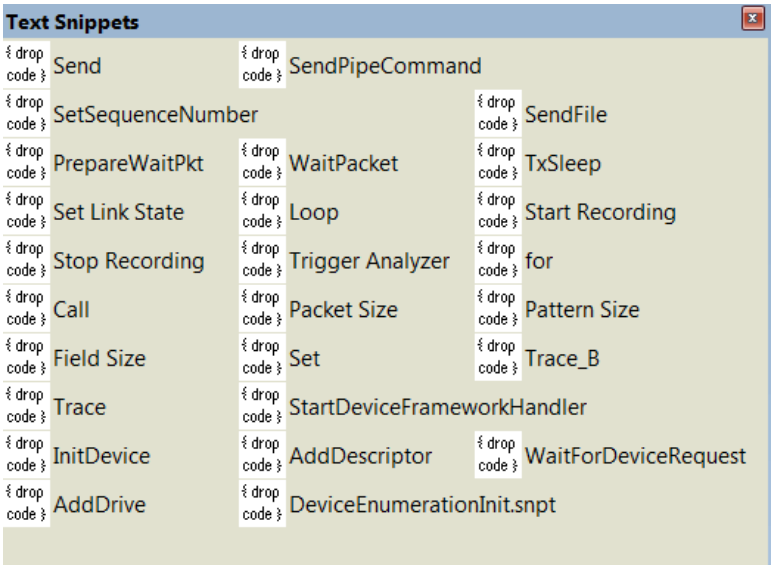


Figure 12.22: Text Snippets Window

NOTE: For information about each command, see the Voyager USB 3.2 Exerciser—Generation Script Language Reference Manual.

12.12.13 Views Toolbar

The Views toolbar contains buttons for viewing text snippets, Output window, and Error Output window.



Figure 12.23: Views Toolbar

The buttons have the following functions:

Button	Function
	View Toolbox Text Snippets.
	View Error Output window.

Button	Function
	View Output window

12.12.14 Script Toolbar

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



Figure 12.24: Script Toolbar

The buttons have the following functions:

Button	Function
	Undo
	Redo
	View Options. Opens a menu with three options: Enable Outlining, Toggle Outlining, and Show Line Numbers. See *View Options Menu* below.
	Compile
	Find

Button	Function
	Add/Remove bookmark. Allows markers to be set or removed to aid in navigation.
	Go to next bookmark.
	Go to previous bookmark
	Clear all bookmarks
	Find and Replace
	Find Next

12.12.15 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.

12.12.16 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.

12.12.17 Tooltips

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

12.13 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:

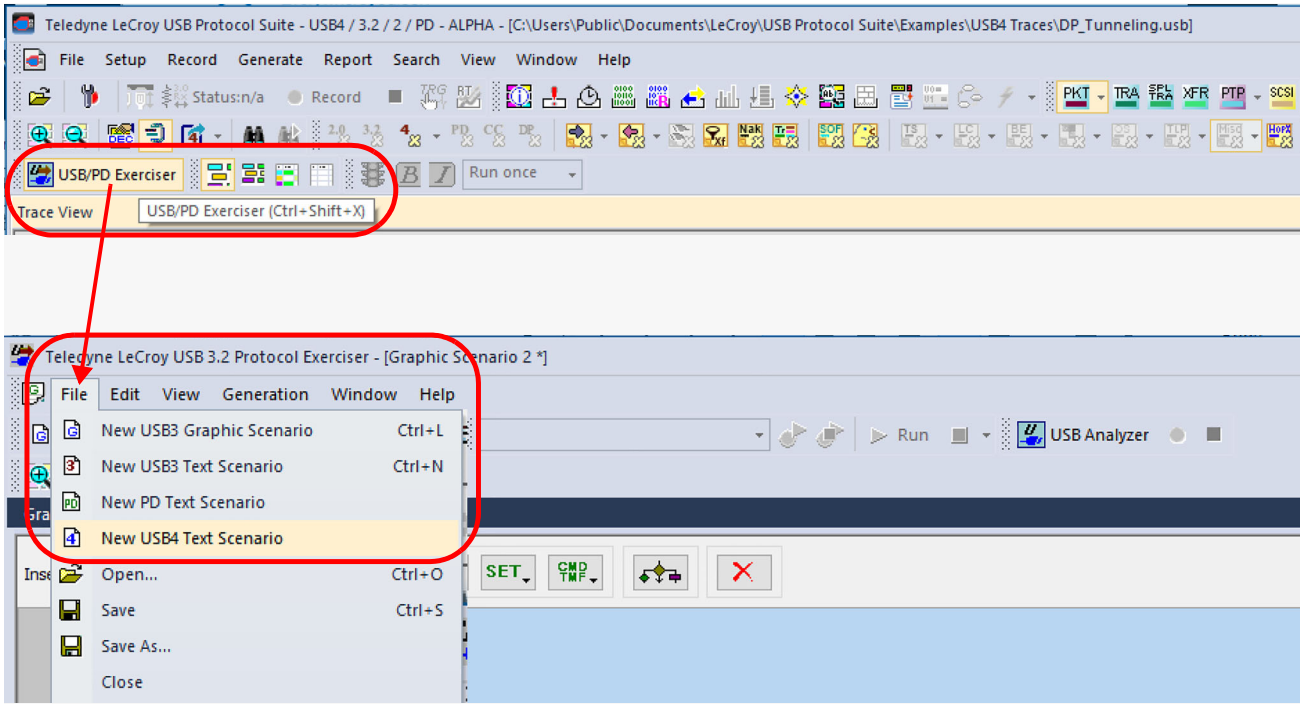


Figure 12.25: Select USB/PD Exerciser: Type of Scenario

1. To display a blank script, click  **New USB3 Graphic Scenario** or select **File >**
   - **New USB3 Text Scenario**
   - **New PD Text Scenario**
   - **New USB4 text Scenario**

An example of a blank USB3 Script Scenario is shown in Figure 12.26, below.

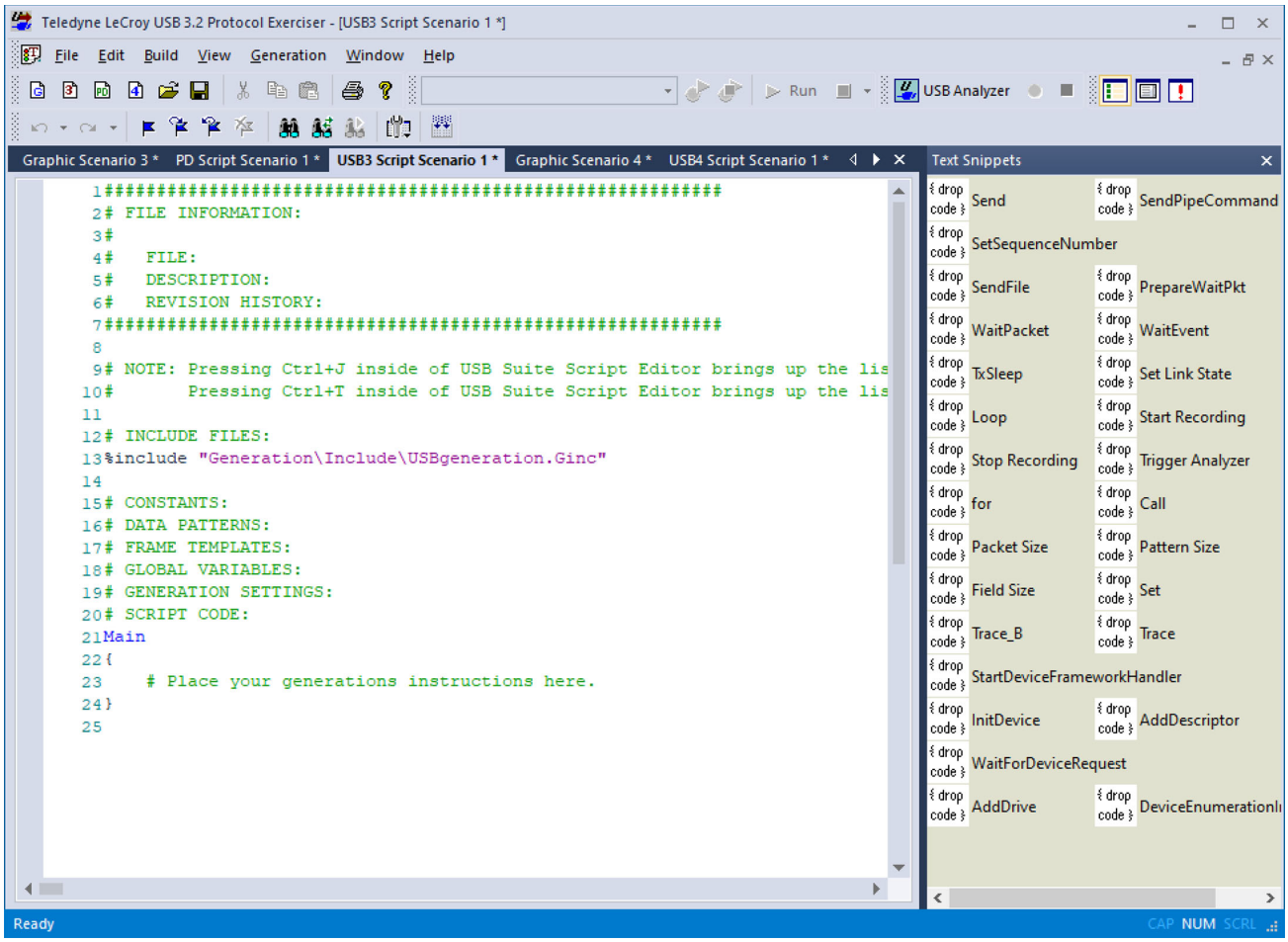


Figure 12.26: Script Scenario

The file name appears on the tab for the file.

temp.usb3g | Script Scenario 8.usb3g

```
############################################################
# FILE INFORMATION:
#
#   FILE:
#   DESCRIPTION:
#   REVISION HISTORY:
############################################################

# NOTE: Pressing Ctrl+J inside of USB Suite Script Editor brings up the list of available instructions/directives."
#       Pressing Ctrl+T inside of USB Suite Script Editor brings up the list of available packet templates."

# INCLUDE FILES:
%include "Include\FrameworkLib.ginc"

# CONSTANTS:
const EndpointNum = 1
const DeviceNumber = 1

const WaitTPSleep = 200
const WaitDPSleep = 200
set Mode = HOST
# DATA PATTERNS:
# FRAME TEMPLATES:
# GLOBAL VARIABLES:
# GENERATION SETTINGS:
# SCRIPT CODE:
Main
{
    # Place your generations instructions here.

     SetLinkState (LinkState = U0

     Call GetDescriptor(EndpointNum,0, DEVICE_DESC,0x00,0x00,0x1200,WaitTPSleep,WaitDPSleep

     Call SetAddress(EndpointNum, DeviceNumber * 256,WaitTPSleep, WaitDPSleep)
}
```

Figure 12.27: 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.

12.14 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, click on an element you wish to modify, then use the simple edit boxes and drop-down lists.

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.

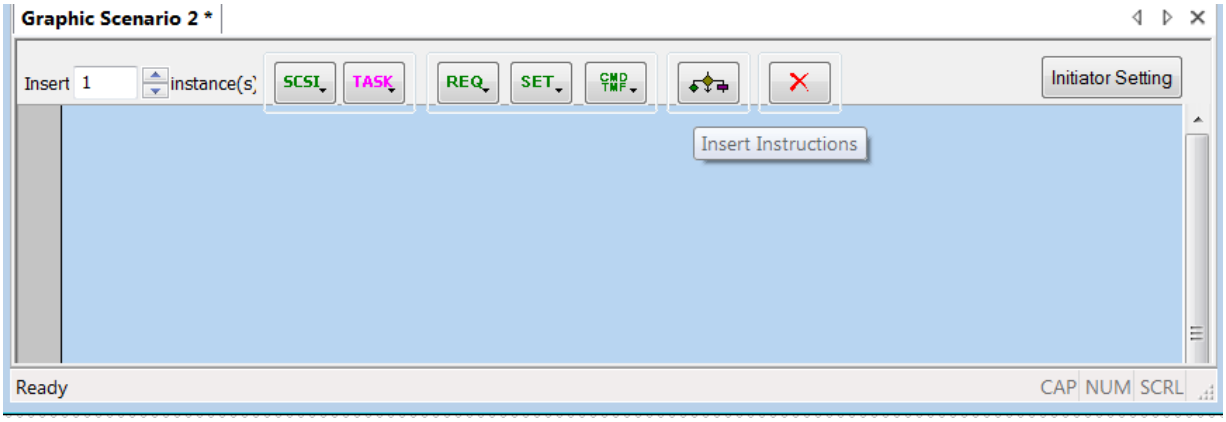
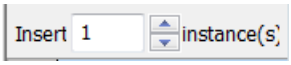


Figure 12.28: Graphical Scenario Editor

12.14.1 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

12.14.2 Initiator Setting



The Initiator Settings button launches the Initiator Settings window.

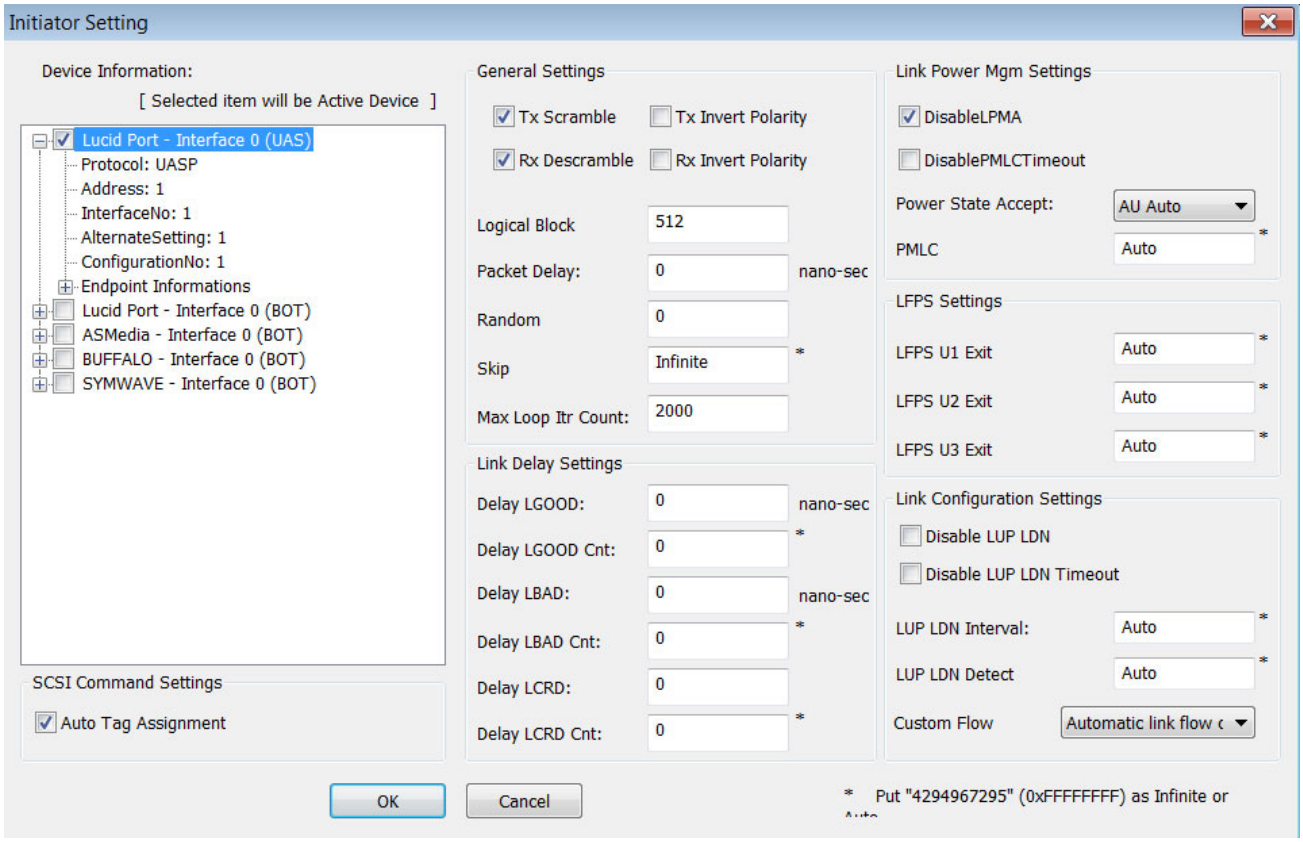


Figure 12.29: Initiator Setting Dialog

12.14.2.1 Device Information

The left pane shows Device Information, as expected from enumeration, so this pane shows general device information from a pre-configure file. The Device Information **DeviceInfo.cfg** file is in the **Generation** directory under the **users** directory. You can edit this file.

For each device, the following information is in the **DeviceInfo.cfg** file:

- Name
- Protocol (UASP or BOT)
- Address
- InterfaceNo
- AlternateSetting
- ConfigurationNo
- Endpoint Information
- EndpointNo
- Direction (IN or OUT)

- Max Burst Size
- PipeUsageId
- Endpoint Type (only for UAS protocol)

NOTE:
- You can only select one device from the Device List as the active device. Required information for the project is defined by the active device. The active protocol in the project is defined by the active device.
- If you have already inserted some items in the project, and 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 information may be lost.
- 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.

12.14.2.2 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.

12.14.2.3 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.

12.14.2.4 Link Delay Settings

The middle pane has Link Delay Settings: Delay for LGOOD, LGOOD Count, LBAD, LBAD Count, LCRD, and LCRD Count.

12.14.2.5 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.

12.14.2.6 LFPS Settings

The right pane has LFPS Settings. You can set Exit TBurst for U1, U2, and U3.

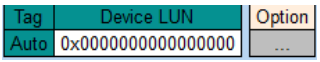
12.14.2.7 Link Configuration Settings

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).

12.14.3 Option Button



After inserting a SCSI Command, Task Management Functions, or Transfer packet, at the end of the packet an extra button, called Option, appears. Click this button, to set protocol errors and command settings for that item.

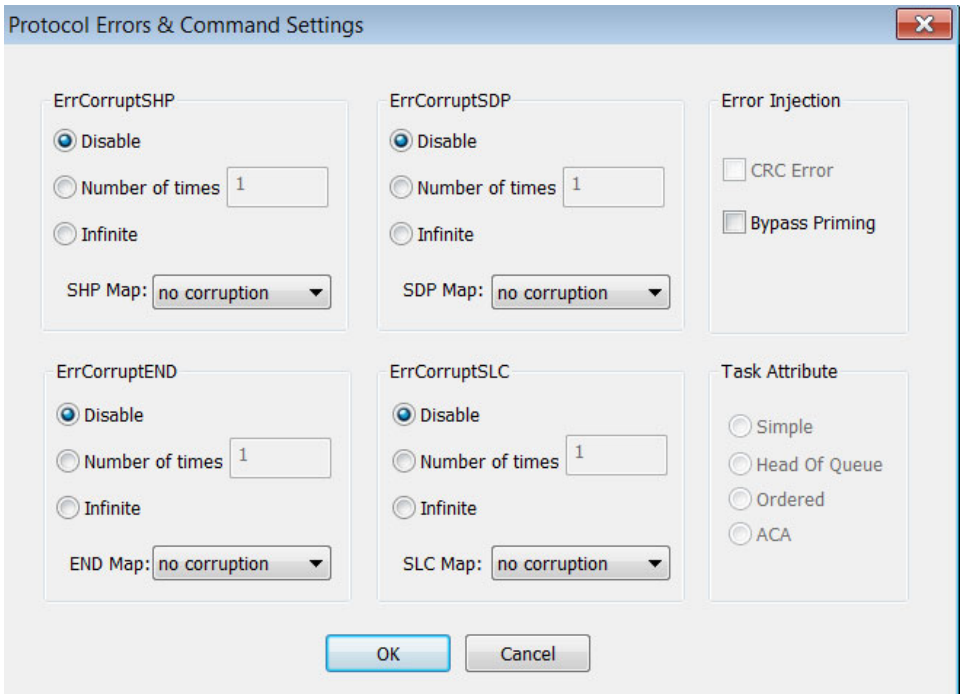


Figure 12.30: Protocol Errors and Command Settings

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.

12.14.3.1 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.

12.14.3.2 Save

- To save a created project, select **File > Save**.
- To run a saved project, select **Generation > Run Scenario** or use the **Run** Toolbar.

12.14.4 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:

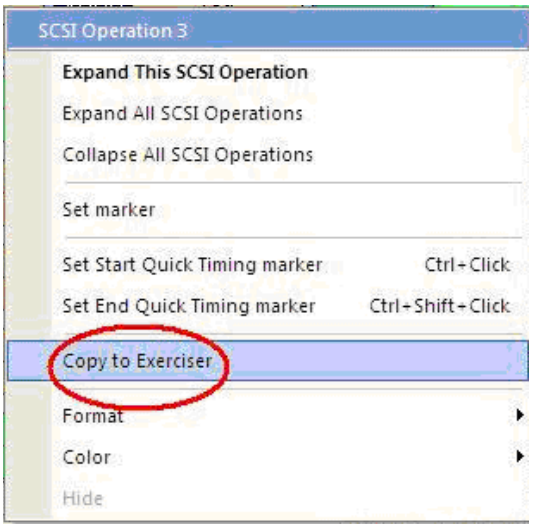


Figure 12.31: SCSI Operation 3: Copy to Exerciser

2. Go to the Graphical View of the Exerciser, right-click in the view, and select **Paste**.

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.

12.14.5 Graphical Toolbar

 The Graphical toolbar contains buttons for zooming, wrapping, and converting from graphic scenario to text scenario.

The buttons have the following functions:

Button	Function
	Zoom In
	Wrap

Button	Function
	Zoom Out
	Convert from graphic scenario to text scenario

12.15 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**.

12.15.1 Starting Traffic Generation

To start traffic generation, click  on the Tool Bar.

Click the **Trace Preview**  button to check the file.

12.15.2 Stop Traffic Generation

To instruct the analyzer to halt traffic generation, click  on the Tool Bar.

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.

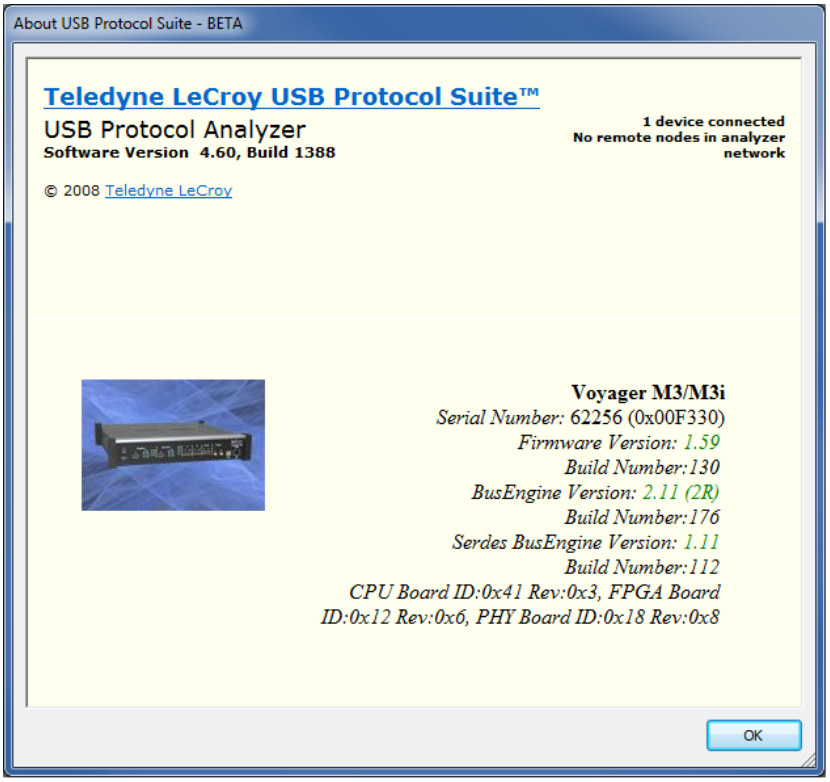


Figure 13.1: About Window

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, you will see the following pop-up message:



Figure 13.2: No Update Available Message

If an update is available, the message is:

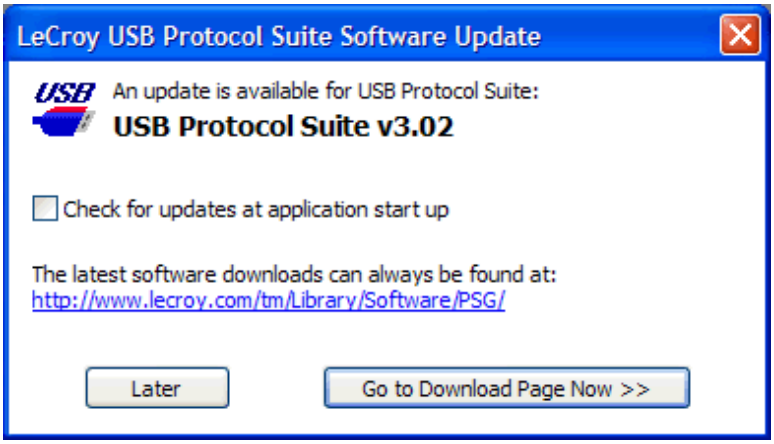


Figure 13.3: Update is Available Message

2. To install an available update, click **Go to Download Page Now**. This takes you to the Teledyne LeCroy web site.
3. Follow the on-screen instructions to download and install the software update.
4. To install available updates later, click **Later**. The window closes and you are returned to the application.

> **NOTE:** When you are ready to install updates, 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.

> **NOTE:** To automatically check for software updates, you need an open internet connection.

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:** 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.

13.2.2.1 During Software Installation

During software installation, a window asks if you would like to receive automatic notification when software updates are available. Select the check box to enable automatic checking for software updates.

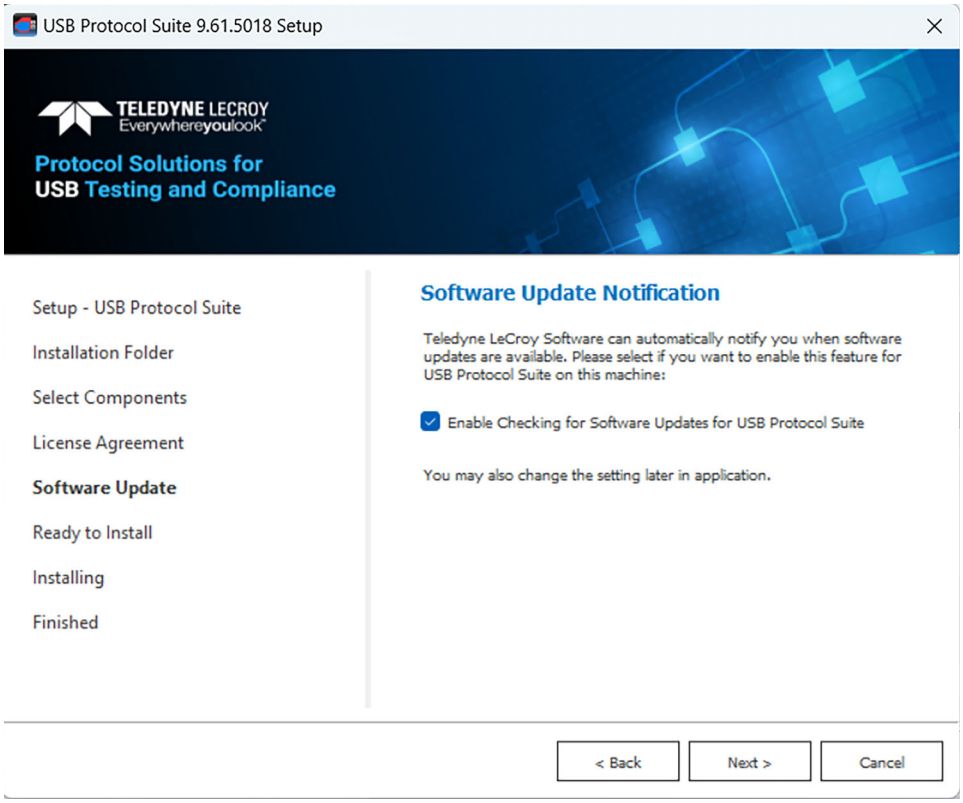


Figure 13.4: Enable Automatic Updates

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.

13.2.2.2 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 message.

   If no update is available, the window is:



Figure 13.5: No Update Available Message

If an update is available, the message is:



Figure 13.6: Update is Available Window

2. To enable automatic checking for software updates, select the **Check for updates at application start up** check box.

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 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 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 (Figure 13.7):

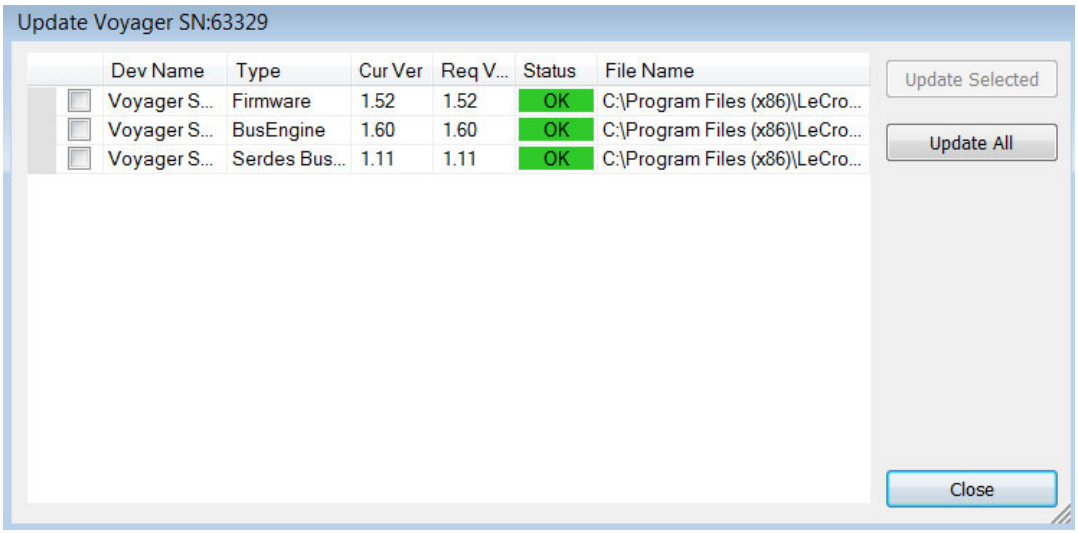


Figure 13.7: Update Device Dialog

The window 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.

- 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

Purchased and trial features can be seen in License Information: **Help → Display License information... menu**.

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 13.8.

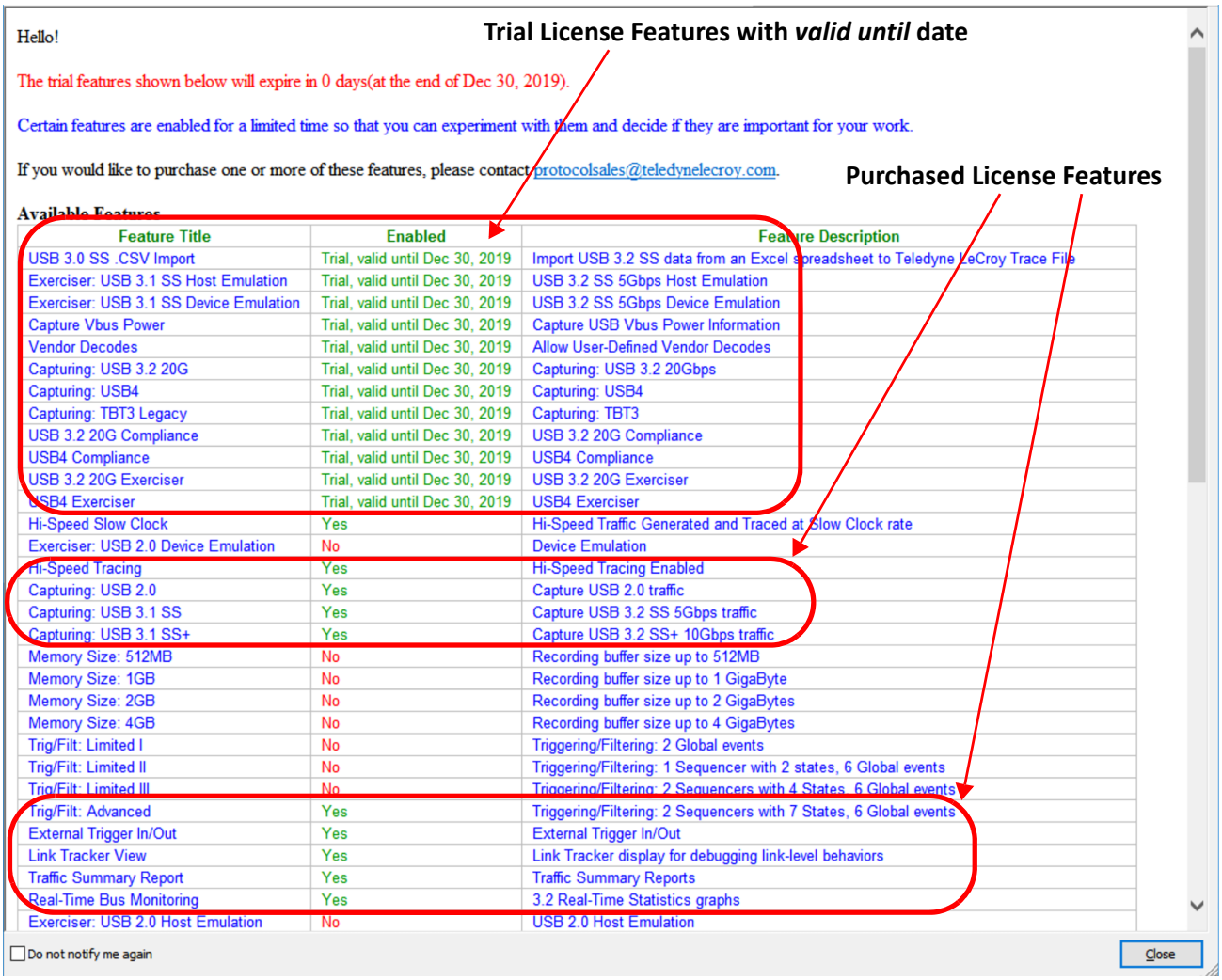


Figure 13.8: License File Showing Both Trial and Purchased Features

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.

13.4.5 Updating the Software License

A current license agreement with Teledyne LeCroy entitles the Analyzer owner to continued technical support and access to software updates as they are published on the Teledyne LeCroy website.

If your license expires, you must obtain a license key from Teledyne LeCroy (refer to the contact information at the back of this manual.)

After you obtain a license key, follow these steps to install it:

1. From the Help menu, select **Display License Information** to display the License Information window (see Figure 13.9).
2. Select **Install License File** to display the Select License Key File dialog.

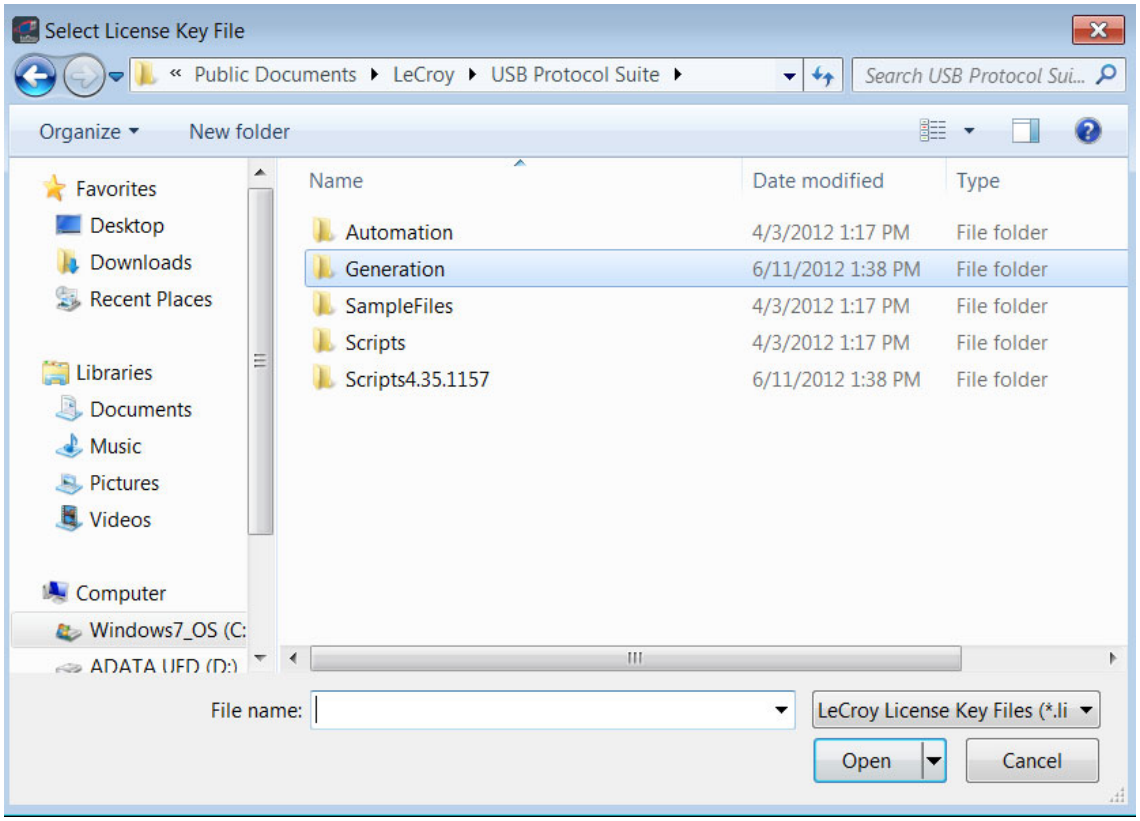


Figure 13.9: Select License Key File Window

3. Do one of the following:

a. Enter the path and filename for the license key.

OR

b. Browse to the directory that contains the license key and select the ***.lic** file.

3. 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:

	有毒有害物质和元素					
部件名称	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr^{6+})	多溴联苯 (PBB)	多溴 (PB
PCBAs	X	O	X	X	X	
机械硬件	O	O	X	O	O	
金属片	O	O	X	O	O	
塑料部件	O	O	O	O	X	
电源	X	X	X	O	X	
电源线	X	O	X	O	X	
保护外壳(如有)	O	O	O	O	X	
电缆组件(如有)	X	O	X	O	X	
风扇(如有)	X	O	X	O	X	
交流滤波器和熔丝组件(如有)	X	O	X	O	O	
外部电源(如有)	X	X	X	O	X	
探头(如有)	X	O	X	O	X	
O: 表明该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T11363-2006 标准规定的限量要求之下。						
X: 表明该有毒有害物质至少在该部件的某一均质材料中的含量超过 SJ/T11363-2006 标准规定的限量要求。						

EFUP (对环境友好的使用时间) 使用条件：
温度： 5摄氏度到40摄氏度
湿度： 5% - 95%最大相对湿度 (无冷凝)
高度： 最高2000米

	Toxic or Hazardous Substances and Elements					
Part Name	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr^{6+})	Polybrominated Biphenyls (PBB)	Polybr Diphen (PE
PCBAs	X	O	X	X	X	
Mechanical Hardware	O	O	X	O	O	
Sheet Metal	O	O	X	O	O	
Plastic Parts	O	O	O	O	X	
Power Supply	X	X	X	O	X	
Power Cord	X	O	X	O	X	
Protective Case (if present)	O	O	O	O	X	
Cable Assemblies (if present)	X	O	X	O	X	
Fans (if present)	X	O	X	O	X	
AC Filter/Fuse Assy (if present)	X	O	X	O	O	
Ext Power Supply (if present)	X	X	X	O	X	
Probes (if present)	X	O	X	O	X	
O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below t 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 p 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