TELEDYNE LECROY
Everywhereyoulook™

Voyager™
USB Protocol Analyzer and Exerciser System

Comprehensive USB 2.0 and USB 3.0 Protocol Verification

VOYAGER USB PROTOCOL ANALYZER AND EXERCISER SYSTEM

Key Features

- **CATC Trace Analysis Software System –** Expand/collapse transfer layer for faster interpretation of USB traffic
- **Capture/Analyze 3.0 & 2.0 Traffic Concurrently –** Record 2.0 and SuperSpeed data path to test & debug USB 3.0 host & hub operation
- **Integrated 3.0 Analyzer/Exerciser –** Multifunction system (single box) with 3.0 and 2.0 device or host traffic generation
- **ReadyLink™, Intelliframe™, & Transaction Engine™ –** Host & device emulator automatically handles USB handshaking
- **4 GB Recording Capacity –** Capture long recording sessions for analysis and problem solving
- **Raw Bit Recording/10-bit Error Detection –** View and correlate low-level 10-bit symbols to higher-level packet structures
- **Spool-to-disk Capture –** Allows longer traces, faster uploads
- **2 ns Timing Resolution –** Extremely accurate timing resolution allows precise measurement of link layer handshaking
- **External Trigger In/Out –** Use the Voyager to identify any packet and toggle a scope or logic analyzer (via SMA cable)
- **Fully Supports SSC and Data Scrambling –** Fast locking and accurate capture on 5 Gb/s signals
- **Hardware Triggering –** Trigger on both 2.0 or 3.0 protocol events to isolate important traffic, specific errors or data patterns
- **Comprehensive Device Decoding –** SCSI Mass Storage, USB Attached SCSI (UAS), 3.0 Hub, PTP/Still Image, Printer, PictBridge, Media Transfer Protocol (MTP), OTG, and all popular USB device classes
- **Hardware Filtering –** Automatically filter data packets or exclude redundant symbols including Idles, TS1, TS2, SKPs, and LUPs ordered sets
- **GbE or Hi-Speed USB Upload –** High speed links for accessing captured data
- **Slow Clock/External Clock Input –** Adjustable signal frequencies for synchronizing analyzer timing with prototype devices
- **Loopback and Compliance Mode –** Exerciser users can access special console for initiating loopback and compliance mode

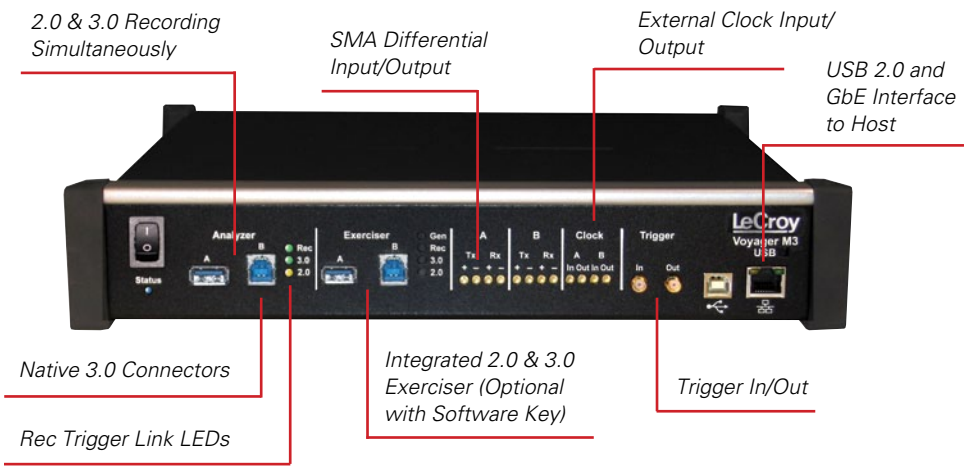
The Voyager M3i is Teledyne LeCroy's 6th generation USB protocol verification system designed for the next evolution of universal serial bus known as SuperSpeed USB. Leveraging Teledyne LeCroy's extensive expertise in high-speed serial data analysis, the Voyager provides traffic generation and recording of both USB 2.0 and 3.0 at data rates up to 5 Gb/s. Loaded with innovative features that help uncover elusive protocol errors, the Voyager platform is the intelligent choice for "cradle-to-grave" USB 3.0 validation.

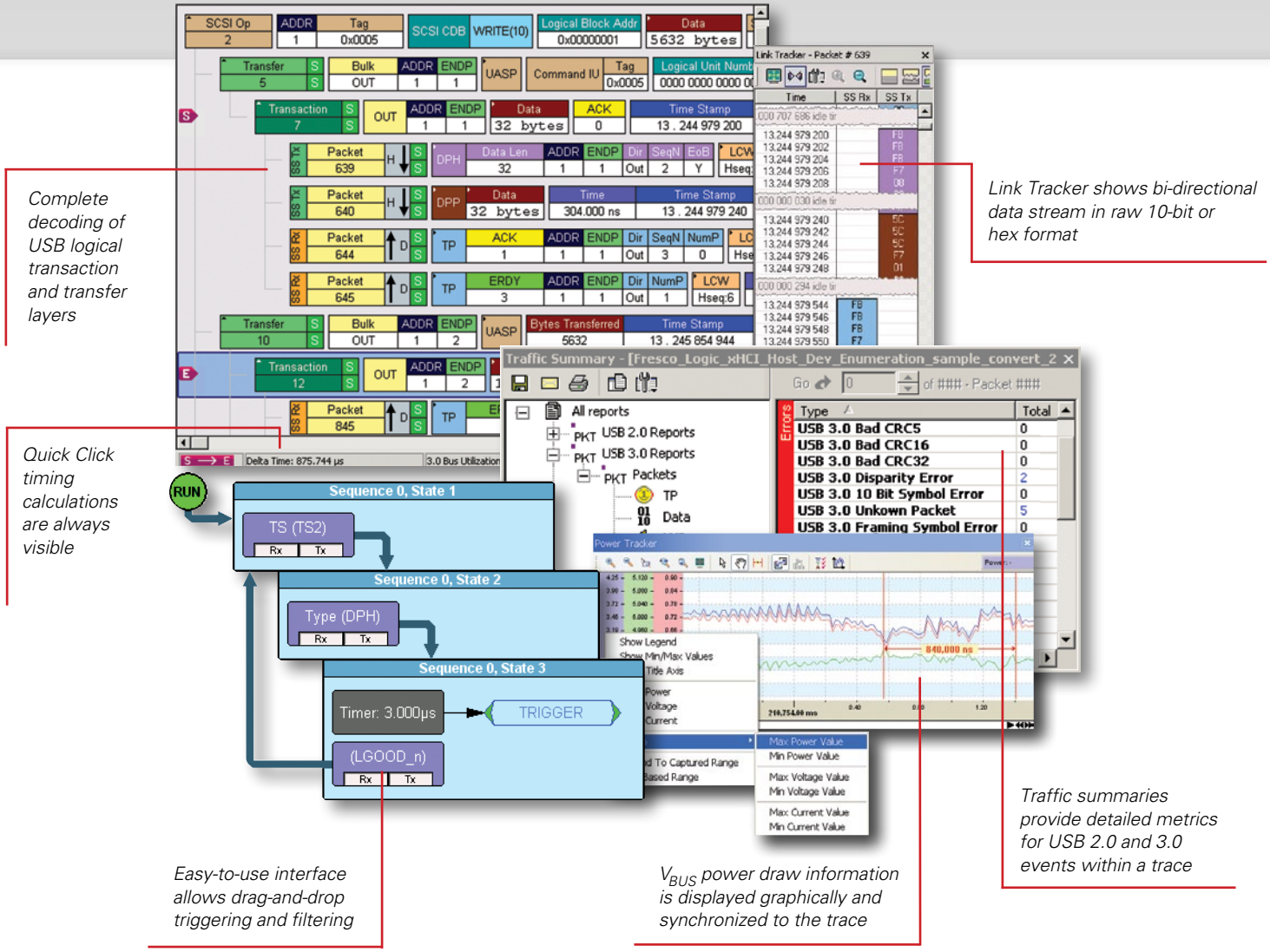
Unmatched Accuracy

The Voyager analyzer front-end leverages custom circuitry from Teledyne LeCroy's 5 Gb/s PCI Express® analyzer to provide fast-locking and uncompromised accuracy for USB 3.0 recording. While in-line, the Voyager system will detect and seamlessly recover from power save modes while accurately showing all bus and state transitions time-stamped within the display. It includes full support for spread spectrum clocking (SSC) and data scrambling (LFSR) which can be enabled/disabled for silicon bring-up testing.

Flexible Hardware

The Voyager is a true multifunction platform capable of both USB 2.0 and USB 3.0 protocol verification. It's also available in a 2.0-only configuration that is upgradeable to 3.0. An integrated exerciser option supports both host and device emulation, and allows error injection functionality and compliance verification. The Voyager features native 3.0 connectors that bifurcate USB 2.0 and 3.0 electrical signals to provide loss-less capture of traffic from both links simultaneously. Concurrent high-speed and SuperSpeed recording allows end-to-end viewing of data transfers across a USB 3.0 hub. Multi-channel





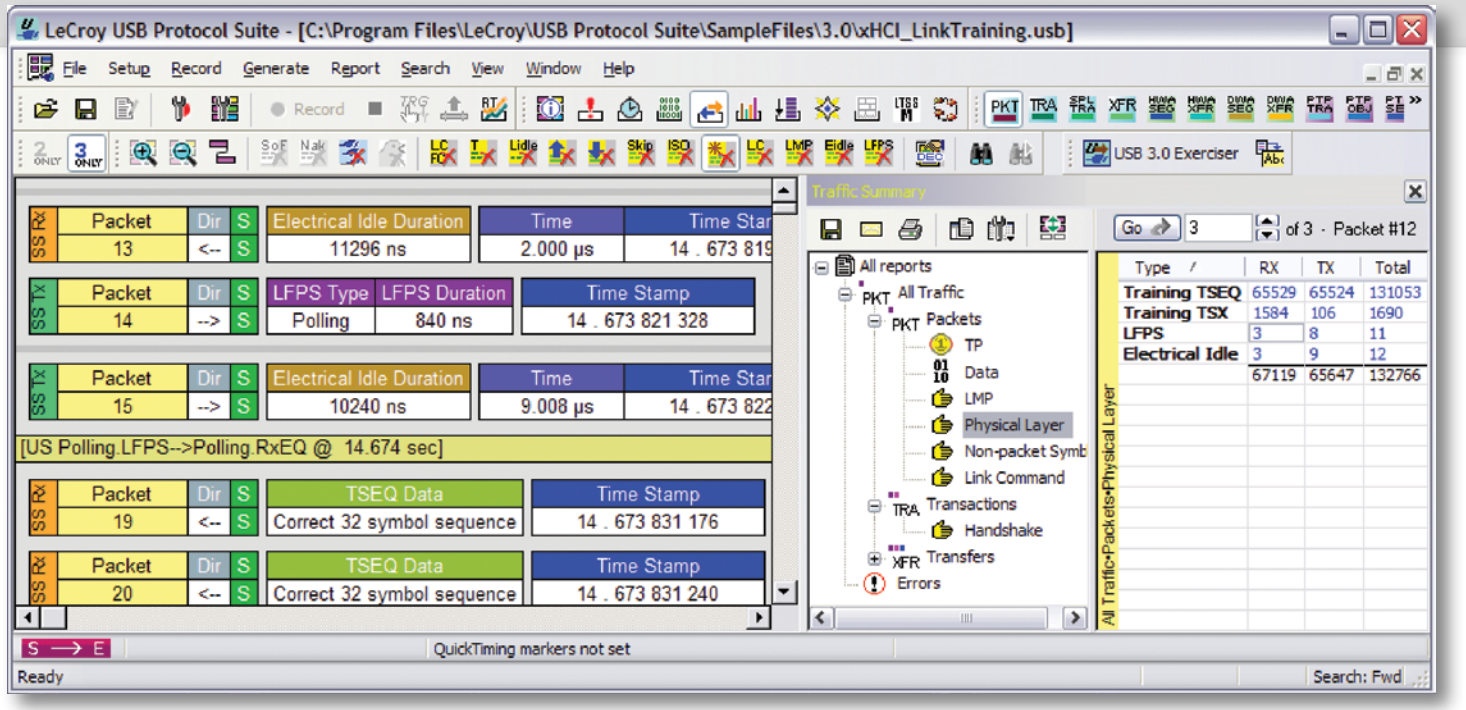
recording is supported by cascading Voyagers to allow upstream/downstream hub testing.

The Voyager M3i platform includes 4 GB of recording memory plus USB and GbE links for uploading recorded traffic to the host PC. The system also offers spool-to-disk capture to allow extended recording sessions (up to the available disk space). In spooled mode, captured traffic is uploaded continuously and is displayed in real-time, making it possible to see link status and state changes without stopping the recording. Both the analyzer and exerciser can utilize slow clocking (fractional) or external clock sources (as low as 700 KHz) for testing with FPGA-based prototypes or emulators that require ultra low-speed data acquisition.

The heart of the Voyager verification system is Teledyne LeCroy's revolutionary BusEngine™ technology. This state-of-the-art protocol processing core incorporates a real-time recording engine and configurable tools to selectively trigger and filter on SuperSpeed USB traffic. Field upgradeable firmware allows the BusEngine to evolve and support new features or future changes to the USB specification. Both the analyzer and exerciser can operate over SMA differential Input/Output lines to provide a high-fidelity alternate interface for taping between development boards.

6th Generation Analysis Software

The Voyager utilizes the legendary CATC Trace—the industry's de facto standard for USB protocol analysis. The trace viewer software uses colors and patterns to train the eye to understand information faster. When recording mixed traffic upstream from a SuperSpeed hub, legacy 2.0 and 3.0 packets are labeled and interleaved in a single display. Traffic from the logical 2.0 & 3.0 channels can be individually filtered, searched or exported from the trace. The USB transfer level can



LFPS signaling is shown in the trace allowing users verify link recovery timing.

be expanded and collapsed to show packet layer events including link state changes, link management packets (LMPs) and flow control symbols.

Raw Debugging Power

The Voyager includes a special Link Tracker™ view that captures every transition and presents raw 10-bit data patterns chronologically with timing resolution of 2 ns. Designed to assist with low-level debugging, all ordered sets including training sequences and loopback symbols can be displayed in raw 10-bit, 8-bit, scrambled, and unscrambled Hex format. Symbol-to-symbol timing measurements are possible with a single click.

Intelligent Triggering

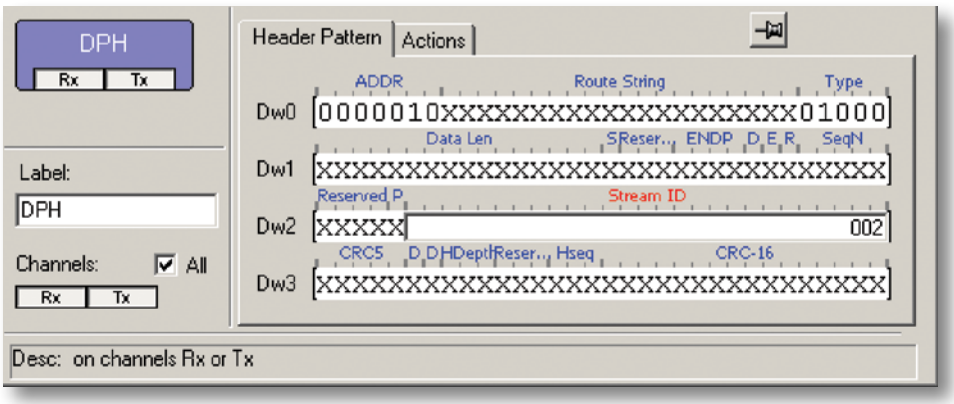
The Voyager provides hardware triggering to pinpoint protocol events of interest. Trigger events can be specified at the lowest levels including bus states and link commands (TS1/2, LBAD, ACK, ERDY, etc..) or header fields (packet type, route strings, etc…). Users can define sophisticated sequential event trigger scenarios that include SCSI operations, counters, loops and timers all within a multi-level sequence.

Real Time Filtering

SuperSpeed data transfers at 5 Gb/s can fill memory buffers in an instant, making event filtering critical for efficient debug. The Voyager analyzer can filter unwanted traffic from the buffer in real-time by discarding redundant patterns such as SKPs, idles, LFPS, and training sequences. Filtering logic can also include transaction layer packets with added criteria like direction or port number.

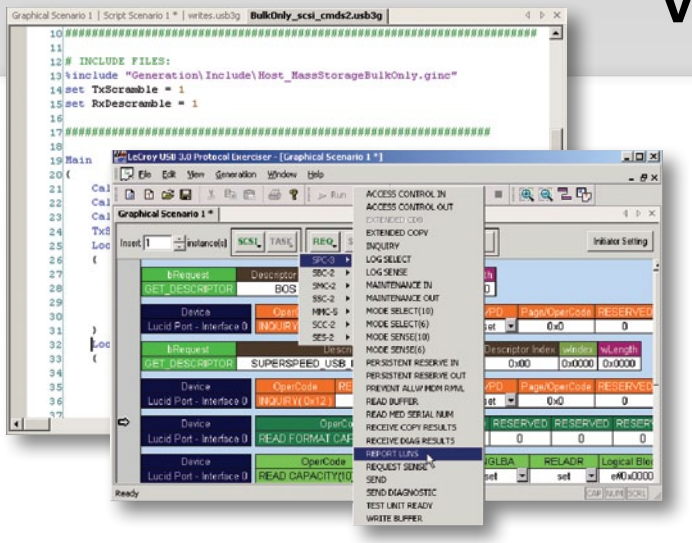
Error and Event Reporting

The Voyager can detect and flag protocol errors including logical link and timing errors. At the lower layers, training sequences and link commands are automatically verified for proper sequencing. Useful for performance analysis, the RTS view provides real time throughput and new frame-error-rate metrics.



Find the issues faster by triggering on any header field.

VOYAGER EXERCISER OPTION



Create custom exerciser test cases using either text or graphical script authoring interface.

Teledyne LeCroy Voyager Exerciser Option

A comprehensive exerciser capability with support for both USB 2.0 and 3.0 traffic generation is built in to the Voyager M3i platform. The exerciser option allows users to transmit custom packets over standard USB cables with low-level control of headers, payloads, timing, and link states. For easy script development, both text-based and graphical user interfaces are provided. The exerciser is seamlessly integrated with the protocol analyzer, making the Voyager a complete test and development solution for engineers validating USB devices and software.

Smart Emulation with ReadyLink™ and Transaction Engine™

ReadyLink is a full-function link layer emulation mode built in to the SuperSpeed exerciser. It automatically handles all USB 3.0 link training and link flow control to make development of test scenarios fast and easy. The Transaction Engine provides automatic handling of upper layer retry conditions allowing the Voyager to operate at full line rate and correctly respond to the DUT as defined by the specification. Overrides allow ReadyLink behaviors to be altered, such as shortening or lengthening the LFPS, training, and link command handshaking.

Error Injection

The ReadyLink emulation can be customized per test script to include various error scenarios including:

- 8b/10b Encoding or CRC Error
- Running Disparity Error
- Corrupt Link Commands
- Corrupt Flow Control (Wrong L_CRD_x, Wrong L_GOOD_n, Drop L_Good_n, etc.)
- Corrupt Header Packet acknowledgement (Send LBAD, LRTY)
- Corrupt Packet Framing (SHP, SDP, END)

At the packet level, users have the freedom to send customized data payloads anywhere within the stream making it easy to verify protocol behavior.

SN:61989

USB 2.0

	Ch 0	Ch 1
Data Packets	00,000,000,000	N/A
Data Bytes	00,000,000,000	N/A
Total Bytes	00,000,000,000	N/A

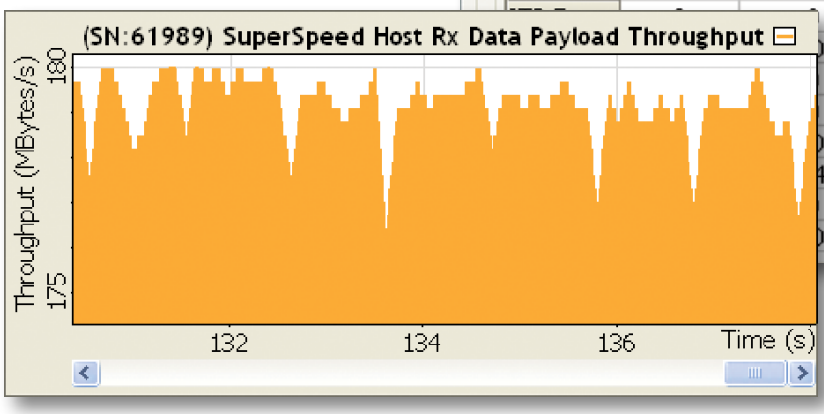
USB 3.0

Endpoint Statistics (Address, Endpoint, Direction)

	1, 4, In	1, 3, Out
ACK	17690932	233264
Retry	0	0
NRDY	0	0
ERDY	2166688	233266
DP	15162389	233265
DP Error	0	0
TP	19857620	466530
TP Error	0	0

Link Statistics

	Upstream	Downstream
DP	15162391	233267
DP Err	0	0
DP Err %	0.000000	0.000000
TP	2633224	17690938
TP Err	0	0
TP Err %	0.000000	0.000000
ITP	0	650400



Use RTS window to track throughput and frame-error rates.

USB 3.0 Real Time Statistics

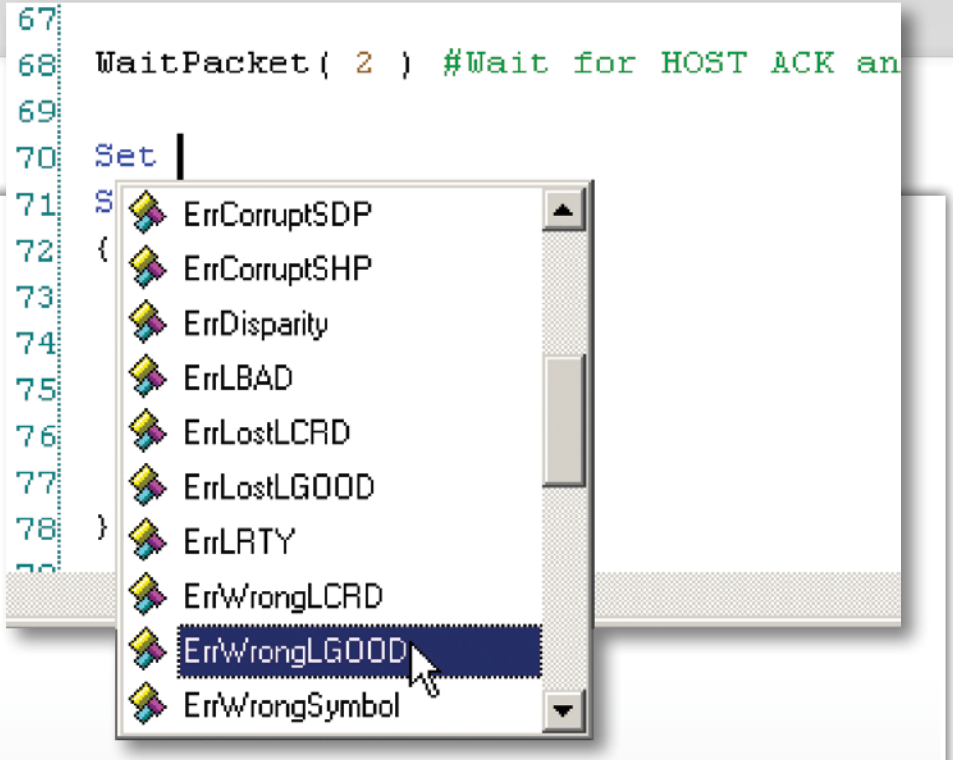
- Device Detected
- Endpoints Detected
- Throughput (MB/s)
- Frame Error Rate
- DP, TP, and ITP Count
- Retried Transactions Count
- % Time in U0 / U1 / U2 / U3
- ACK / NRDY / ERDY Count

USB 2.0 Exerciser with Intelliframe™

The Voyager 2.0 exerciser is based on Teledyne LeCroy's legendary USB*Trainer*™ traffic generator and is backward compatible with existing USB*Trainer* 2.0 traffic generation scripts. Capable of transmitting low, full, or high-speed traffic, the Voyager 2.0 Exerciser also supports both host and device emulation.

Optimize V_{BUS} Efficiency with PowerTracker™

The Voyager M3i PowerTracker option offers a unique monitoring capability for V_{BUS} power draw. Power information is sampled and displayed graphically in a time line format that is synchronized to the trace allowing users to verify power state transitions at the protocol and electrical layers.



The text based editor includes pop-up shortcuts for precise control of traffic stream.

Exerciser Control Environment

The exerciser software provides a flexible script authoring environment that supports a powerful set of parser preprocessor features. For SuperSpeed applications, the Voyager software includes pre-defined templates for all USB 3.0 packet types, random payload generators, and procedure calls within a script. A comprehensive library of sample scripts is included and illustrates how these techniques can be used to create efficient, reusable generation blocks. Users can also create test scripts by exporting the host or device traffic stream from a captured analyzer trace file. These scripts can be played back using the exerciser to recreate problems or test specific functionality.

Automated Compliance Test Suite

The Voyager Exerciser System is available with a fully automated compliance suite option for USB 2.0 and 3.0. A superset of the USB-IF compliance specification, the CTS software is the most comprehensive tool available for USB conformance testing. Integrated with Teledyne LeCroy's Voyager Analyzer platform, a real-time console displays pass/fail results covering hundreds of link layer rules for both host and device. The system uses emulation scripts to generate specific traffic conditions. It automatically captures and analyzes the response from the DUT. Additional framework layer and mass storage specific tests are also included for endpoint devices.

USB Device Decoding

The Voyager software performs full decoding of USB device class traffic. It allows both automatic and manual assignment of decodes to individual endpoints. The Voyager offers full support for Bulk Only Transport and USB Attached SCSI operations including command queuing. Vendor specific decoding is available for developers interested in automatically showing proprietary commands in the trace view.

Find The Issues Fast

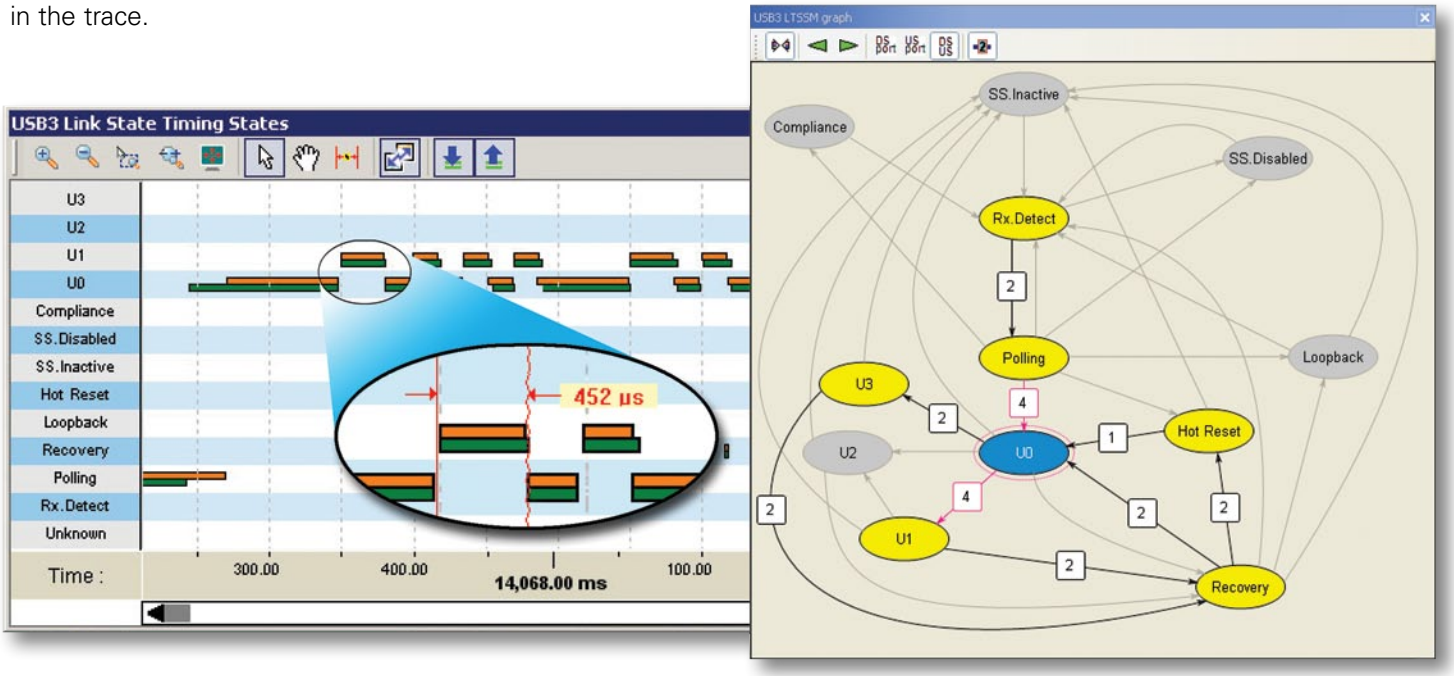
The Voyager software provides many mechanisms to measure and report on USB 2.0 and 3.0 traffic. With the Traffic Summary display, users can evaluate statistical reports at a glance or navigate to individual events. Reports are available showing link throughput, link state and flow control metrics. The error report shows a range of protocol violations.

The Bus Utilization graphs show data and packet length, bus usage by device in a histogram format. Fast Search and Find options allow users to navigate to specific packets, errors and any data type within a trace file. The CATC Trace supports filter and hide commands, to temporarily remove irrelevant data from the display for more efficient viewing. The Bandwidth calculator automatically calculates the time delta between two points in the trace.

Spec-View shows actual header packets in hex or binary with errors marked in red.

Since 1996, Teledyne LeCroy has been a key provider of tools for the USB ecosystem. The Voyager system leverages countless hours of research in high-speed serial data analysis to create the most reliable and accurate USB 3.0 analyzer system available.

Combined with the exerciser option and the CATC Trace expert software, the Voyager platform alleviates developers from tedious byte-level analysis and lets them focus on quick resolution of protocol layer problems.



LTSSM Viewer shows link state transitions making it easy to navigate to state changes.

SPECIFICATIONS AND ORDERING INFORMATION

Specifications

Protocol(s) Supported	USB 1.0, 1.1, 2.0 & 3.0
Host Hardware Requirements	Intel® Pentium® 4 or AMD Duron with USB 2.0 interface, 512 MB RAM (1 GB RAM recommended)
OS Requirements	Windows® XP , Windows Vista® or Windows 7
Memory Size	1 or 4 GB option
Data Rates Supported	1.2 Mb/s–4800 Mb/s
Data Bus Interface	Half duplex differential (USB 2.0) Dual simplex differential (USB 3.0)
Front Panel Connectors	Analyzer – one (1) USB 2.0 & 3.0 recording channel with USB 3.0 A & B connectors Exerciser – one (1) USB 2.0 & 3.0 generator channel with USB 3.0 A & B connectors
Front Panel Indicators	Platform LEDs: Power, Status Analyzer LEDs: Rec 2.0, 3.0 Exerciser LEDs: Gen, Rec, 2.0, 3.0
Temperature: Operating	0 °C to 55 °C (32 °F to 131 °F)
Temperature: Non-Operating	-20 °C to 80 °C (-4 °F to 176 °F)
Humidity: Operating	10% to 90% RH (non-condensing)
External Clock Input	MMCX to SMA
External Clock Frequencies	1 MHz to 5 GHz
Dimensions	31.75 x 30 x 5 cm (12.5" x 11" x 2")
Weight	2.45 kg (5.4 lbs.)
Power Requirements	90–254 VAC, 47–63 Hz (universal input), 100 W maximum
Alternate Taping Interface	MMCX to SMA differential input/output (record and transmit)
External Trigger IN/OUT	SMA connectors

Ordering Information

Product Description	Product Code
Voyager M3i USB 3.0 Pro Analyzer System (includes one (1) Ch analysis USB 3.0 SuperSpeed and USB 2.0 low/full/high; 4 GB recording memory)	USB-T0P3-V02-X
Voyager M3i USB 3.0 Pro Analyzer System plus Compliance Suite (includes one (1) Ch analysis USB 3.0 SuperSpeed and USB 2.0 low/full/high; 4 GB recording memory; Compliance Test Suite option)	USB-TCP3-V02-X
Voyager M3i USB 3.0 Pro Analyzer Exerciser System (includes one (1) Ch analysis and one (1) Ch generation USB 3.0 SuperSpeed and USB 2.0 low/full/high; 4 GB recording memory)	USB-TZP3-V02-X
Voyager M3i USB 2.0 Advanced Analyzer System (includes one (1) Ch analysis USB 2.0 low/full/high; upgradeable to USB 3.0; 1 GB recording memory)	USB-T0A2-V02-X
Voyager M3i USB 2.0 Advanced Analyzer Exerciser System (includes one (1) Ch analysis and one (1) Ch generation USB 2.0 low/full/high; upgradeable to USB 3.0; 1GB recording memory)	USB-TZA2-V02-X

Product Description	Product Code
Options	
Voyager M3i USB 3.0 SMA Probe Kit	USB-FE03-V01-X
Voyager USB 3.0 Compliance Suite	USB-AC05-V01-A
(Requires Voyager USB 3.0 Exerciser)	
Voyager M3i Power Tracker Option	USB-AC04-V01-A
Voyager M3i USB 3.0 Slow Clock Kit	USB-AC01-V01-X
Voyager M3i USB 3.0 Analysis Option	USB-T0A3-V01-A
Voyager M3i USB 3.0 Exerciser Option	USB-ZBA3-V01-A
Voyager USB 3.0 Pro Analysis & Exerciser Option	USB-ZBP3-V01-A
Platform Expansion CATC SYNC Card	ACC-EXP-002-X
Small Zero Carrying Case	AC009XXA-X

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