



Type-C Tracker™

Protocol and Electrical Analysis Tool
for USB Type-C Standards

Compact ■ Comprehensive ■ Precise

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All-in-one, super-portable, multi-protocol Type-C analyzer with voltage tracking, integrated logic analysis, and Alternate Mode support.

Overview

Pocket-sized and bus-powered, the Ellisys Type-C Tracker delivers comprehensive support for a multitude of protocols and electrical signaling that operate over the USB Type-C connection standard.

Detailed decoding of packets, transactions, and other communications is provided in a flexible and easy to understand manner over the field-proven and ubiquitous Ellisys software application. The Tracker provides a variety of error detections, precision timing tools, and performance measurement tools. Designed with ease-of-use in mind, the Type-C Tracker is the ideal companion for a wide variety of tasks associated with Type-C product development.

Protocol Analysis

Captured protocols and voltages, along with captured logic signals, are presented to the user real-time by the Ellisys application software. An assortment of displays provides an intuitive understanding of traffic, protocol sequences, performance criteria, error conditions, electrical characteristics, timing details, standard/class decoding, protocol decoding, and more.

The physical capture of supported communications is accomplished using latest-generation hardware capture technology to non-intrusively tap and reliably pass through supported protocols while passively passing gigabit traffic.

Integrated Logic Analysis

The integrated logic analysis provides developers with efficient and convenient visualization of external digital signals (such as discrete outputs of FPGA/ASIC) in synchronization with all other captured traffic. Captured GPIOs can be grouped into buses and given user-defined names for easy identification.

Precision Timing Characterization

All protocol traffic, logic signals, and voltages of Type-C signaling and power lines (CC, Vconn, SBU_A, SBU_B, and Vbus) are tracked using the Instant Timing view. These events are perfectly synchronized with each other and with the Overview windows. Precision timing measurements can be made between any events within the Timing view to precisely characterize timings. Throughput and statistical information is also provided. Events selected in the Overviews are highlighted and aligned to the Instant Timing view.

Voltage State Tracking

Tracking Type-C electrical signaling is crucial to understand state machine behaviors. Timings and voltage levels of the various Type-C signaling and power lines have specific meanings and purposes. When not properly implemented, they can wreak havoc with an implementation. Additionally, it is important to precisely relate these voltage values and states to protocol events for performance characterizations and debug exercises. The Type-C Tracker application provides accurate monitoring of Vbus, Vconn, SBU_A, SBU_B, and CC in the Instant Timing view, associated with any captured logic signals and protocol packets and events.

Alt Modes, Sideband Protocols, and USB4 Mode

USB Power Delivery protocol provides a wide array of mechanisms to negotiate power, and can also be used as a sideband channel for standard and vendor-defined messages. Additionally, Power Delivery provides methods to discover, enter, and exit alternate modes, identified by a unique identifier (SVID) and defined by vendors or standards bodies outside of the scope of the USB Implementers Forum (USB-IF). USB4 mode commands supported under Power Delivery protocol are also supported. The Type-C Tracker supports capture and decoding of Alt Mode entry, discovery, and exit protocols as well as Alt Mode commands. Additionally, the Tracker supports several Alt Mode protocols that are conveyed over the Type-C sideband lines (SBU_A and SBU_B), including DisplayPort Auxiliary (AUX) traffic and UART control for Thunderbolt 3 and USB4.

Type-C Port Controller and I2C

Located between a Type-C Port Manager (TCPM) and a Type-C Port Controller (TCPC), the Type-C Port Controller Interface (TCPCI) is a standardized connection between I2C devices. The Type-C Tracker captures and decodes TCPCI traffic over the Logic GPIO connection, and can be configured to capture other vendor-specific I2C protocols (multiple such protocols, concurrently).

UART, SPI, and SWD Protocols

The Type-C Tracker supports capture of UART, Serial Peripheral Interface (SPI), and Serial Wire Debug (SWD) protocols over its logic connection interface. Traffic captured is displayed in tight synchronization with all other traffic captured by the analyzer. Detailed decoding is provided and each protocol is displayed chronologically in dedicated Overview windows.

Powerful Ellisys Features

- **All-in-One:** Concurrent and tightly synchronized capture of USB Power Delivery protocol, Type-C voltage tracking (Vconn, Vbus, SBU, CC and EPR), USB 2.0, Thunderbolt™/USB4™ sidebands (SBU) control protocols, and DisplayPort™ auxiliary (AUX) signaling over the Type-C SBU lines, alternate mode support for DisplayPort, HDMI, and Thunderbolt, and capture and decoding of Serial Wire Debug (SWD) protocol, UART, Serial Peripheral Interface (SPI), I2C vendor-specific protocols, and Type-C Port Controller Interface traffic over I2C.
- **Bus-Powered:** Just attach to your computer's USB port and go, no bricks to carry around.
- **Super Portability:** Pocket-sized at 63.5 x 63.5 x 12 mm (2.5" x 2.5" x 0.47").
- **Real-Time Display:** Visualize captured traffic in real time with the efficiency of 5th generation Ellisys protocol analysis software.
- **Precision Timing:** Understand timing issues quickly with highly accurate timing characterizations of all captured protocols, electricals, and logic signals.
- **Professional Software:** Use the acclaimed, widely adopted and highly flexible Ellisys multi-protocol analysis software.
- **Secure Cloud Access:** Quickly and easily exchange captures and bookmarks with colleagues using the built-in secure cloud feature.
- **Detailed Protocol Decoding:** All elements from the latest specifications to the fields bits and bytes.
- **Integrated Logic Analysis:** Visualize digital signals such as GPIOs, interrupts, debug ports, etc., concurrently and perfectly synchronized with all other captured traffic.
- **Free Maintenance:** Free lifetime software updates as well as free fully-featured viewer software.
- **Field Upgradeability:** Type-C Tracker analyzers are field upgradeable to allow the addition of features (i.e., to advance from one Edition to another).



I was involved in the effort associated with the original USB compliance program and have seen USB grow to become what many people believe to be the most successful communications standard ever, **said Kosta Koeman, senior software engineer at CK Software Consulting**. We've seen a lot of changes and growth with USB over the years, but the USB Type-C specification changes the game immensely as it draws in other technologies previously unrelated to USB. This ubiquity creates challenges in testing and validation. The Ellisys Type-C Tracker clearly meets these challenges with a unique, smartly designed approach and will be a key asset for any developer working on Type-C.



Protocol-Specific Overviews

Detailed Decoding

Timing, Logic Analysis, and Voltage Tracking

The screenshot displays the Ellisys Type-C Tracker Analyzer interface, divided into three main sections:

- Protocol-Specific Overviews (Left):** Shows three overview panels:
 - Thunderbolt Sideband Overview:** A table listing various read requests such as "Read Max Lane Count: 4 lanes, TPS3, Enhanced Framing" (6 bytes) and "Read Max Downspread: Up to 0.5%" (6 bytes).
 - USB PD Overview:** A list of USB Power Delivery transactions, including "Source Capabilities (1=Fixed 5V 2A, 2=...)", "Request (2=Fixed 12V 3A, Requested)", "Discover Identity > Ack (Hub)", and "DisplayPort Enter Mode (Mode=1) > Ac...".
 - UART Overview:** A list of UART transactions, including "GetDescriptor (Device)", "GetDescriptor (String 1)", "GetDescriptor (BOS, partial, 5 bytes ou...", "GetDescriptor (Configuration, partial, 9...", "GetDescriptor (Configuration)", "GetHubDescriptor", "GetStatus (Device)", and "GetHubStatus".
- Detailed Decoding (Middle):** Shows a detailed view of a "DisplayPort Enter Mode packet (Mode=1)".
 - Information:** Framing (Start Framing: SYNC1 SYNC EOP, End Framing), Timing (Start: 1.908 595 8, Frame Duration: 414.9 us, Preamble Duration: 212.429 us), and Signal (PHY Type: Baseband, Bit Duration: 3.3192 us, Bit Rate: 301.277 kb/s, Preamble Bit Count: 64).
 - Packet:** Message Type (Vendor Defini), Port Data Role (DFP), Specification Revision (Version 2.0), Port Power Role (Sink), Message ID (5), Number Of Data Objects (1 data objec), VDM Header (SVID: DisplayPort, VDM Type: Structured V, Structured VDM Version: Version 1.0, Object Position: 1, Command Type: Initiator, Command: Enter Mode).
 - DisplayPort Enter Mode Ack packet:** Information (Start Framing: SYNC1 SYNC EOP, End Framing), Timing.
- Timing, Logic Analysis, and Voltage Tracking (Right):** An "Instant Timing" window showing a waveform from 1,908.92 ms to 1,910.00 ms.
 - USB 2.0:** Shows Link activity.
 - USB PD:** Shows Link activity with GCRC, VDM, and GCRC phases.
 - DisplayPort:** Shows AUX and I2C signals.
 - Stats:** Shows Vbus voltage levels at 12.3 V and 1.65 V.
 - Vconn:** Shows a 20 mV signal.
 - SBU_A, SBU_B:** Shows 20 mV signals.
 - Logic:** Shows Logic1, Logic2, and Logic3 signals.
 - MyBus:** Shows 0x7 data.
 - Throughput:** Shows Displa... and GoodC... signals.

Query-Based Instant Filters

Up to 16 External Logic Signals

Protocol-Specific Overviews

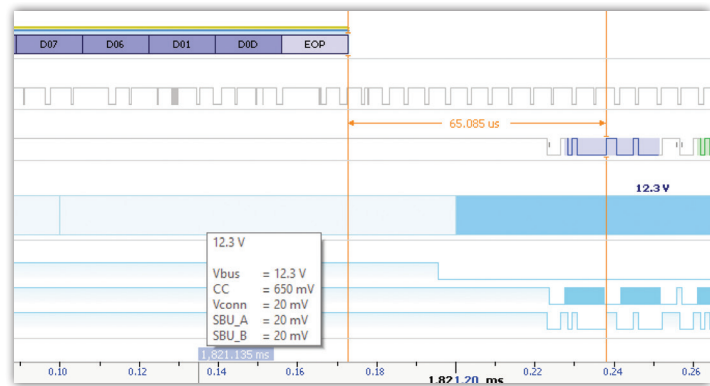
The Overviews are the main display window, and each protocol is provided an its own Overview. Packets, transactions, transfers, and other events are displayed chronologically from top to bottom in a very flexible format. These windows are highly configurable with columns and content that are fully controlled by the user. Instant Filters are provided for standard or user-added columns to create an efficient work environment by reduce the need to search or scroll through unneeded information.

Time	Item	Direction	Port Data Role	Payload	Status
1.902 110 287	SOP Discover Identity (x 6)	OUT	UFP	4 bytes (01 80 00 FF)	OK
1.909 305 927	Source Capabilities (Fixed SV 3A, Fixed SV 3A, Fixed SV 3A)	OUT	UFP	12 bytes (02 80 01 2E 3C C1 03 00 2C F1 05 00)	OK
1.913 138 766	Request (Fixed SV 3A, Requested 2.5A, Max 2.5A) Accepted	IN	DPP	4 bytes (FA EB 03 22)	OK
1.922 851 863	Parity	OUT	UFP	No data	OK
1.924 736 849	Data-Role Swap Accepted	OUT	UFP	No data	OK
1.942 861 207	Discover Identity Ack (pub)	OUT	UFP	4 bytes (01 80 00 FF)	OK
1.731 681 002	Discover SVIDs Ack (DisplayPort)	OUT	UFP	4 bytes (02 80 00 FF)	OK
1.830 173 401	DisplayPort Discover Modes Ack (EPP_D Capable, CD)	OUT	UFP	4 bytes (03 81 01 FF)	OK
1.908 595 871	DisplayPort Enter Mode (Mode=1) Ack	OUT	UFP	4 bytes (04 81 01 FF)	OK
1.908 595 871	DisplayPort Enter Mode (Mode=1)	IN	UFP	4 bytes (04 81 01 FF)	OK
1.910 349 732	DisplayPort Enter Mode Ack	IN	UFP	4 bytes (04 81 01 FF)	OK
1.916 261 346	DisplayPort Status Update (EPP_D connected) Ack (EPP_D connected, HPO Low)	OUT	UFP	8 bytes (10 81 01 FF 01 00 00 00)	OK
1.916 261 346	DisplayPort Status Update (EPP_D connected)	IN	UFP	8 bytes (10 81 01 FF 01 00 00 00)	OK
1.918 147 972	DisplayPort Status Update Ack (EPP_D connected, HPO Low)	IN	DPP	8 bytes (10 81 01 FF 0A 00 00 00)	OK
1.918 147 972	DisplayPort Status Update Ack packet (EPP_D connected, HPO Low)	IN	UFP	8 bytes (10 81 01 FF 0A 00 00 00)	OK
1.919 946 391	GoodCRC packet	OUT	DPP	No data	OK
1.922 211 224	DisplayPort Configure (Set Config as UFP_D, C) Ack	OUT	UFP	8 bytes (11 81 01 FF 06 04 00 00)	OK
1.922 211 255	DisplayPort Configure (Set Config as UFP_D, C)	OUT	UFP	8 bytes (11 81 01 FF 06 04 00 00)	OK
1.924 197 646	DisplayPort Configure Ack	IN	DPP	4 bytes (31 81 01 FF)	OK
1.926 218 228	DisplayPort Attention (EPP_D connected, HPO High)	IN	DPP	8 bytes (06 81 01 FF 8A 00 00 00)	OK
1.926 218 228	DisplayPort Attention packet (EPP_D connected, HPO High)	IN	UFP	8 bytes (06 81 01 FF 8A 00 00 00)	OK
1.927 033 906	GoodCRC packet	OUT	DPP	No data	OK
1.955 575 404	DisplayPort Attention (EPP_D connected, HPO Low)	IN	DPP	8 bytes (06 81 01 FF 0A 00 00 00)	OK
2.939 562 070	DisplayPort Attention (EPP_D connected, HPO High)	IN	DPP	8 bytes (06 81 01 FF 8A 00 00 00)	OK

Overviews can be stacked, placed side by side, or hidden as needed to create ideal working conditions and enhance visual understandings of Type-C traffic of various types. Smart approaches to the display of packets and transactional groupings are provided and are designed to meet the needs of a wide variety of high- and low-level debug and validation tasks.

Precision Timing Analysis

The Instant Timing view is another Ellisys innovation, popular with our users across all our product platforms. All packets and other protocol events captured by the Tracker are presented in this view with tight precision and with precise synchronization to other views, to other protocols or logic signals, and to USB Power Delivery and Type-C voltage states. A variety of manual timing cursors and fly-over indications are provided.



External logic signals can be captured over the Logic/GPIO connection and displayed in discrete formats and in grouped bus formats, in synchronization with all other events captured. Bus throughput information is also provided to assist with characterizations of data transfer issues.

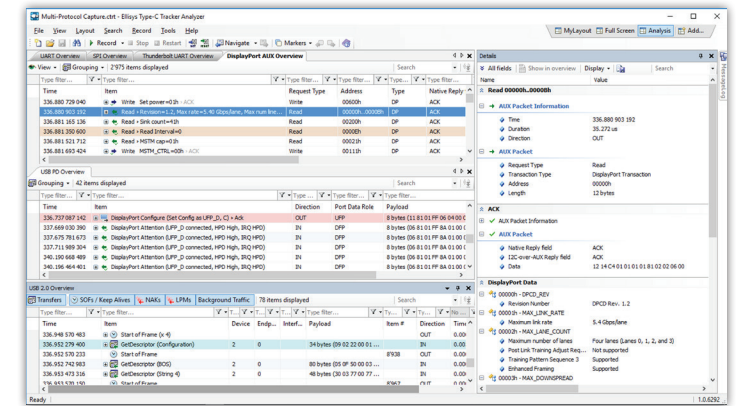
Detailed Decoding

Protocol traffic captured by the Tracker is smartly decoded to a progression of levels, from fields to bytes, to raw data. Overview selections are displayed in the Details view, broken down by fields and values defined by the pertinent specification. Selections in the Details view are highlighted in the Raw Data view, which provides options for binary, ASCII, hex and octal views. A variety of export formats are provided for each of these displays. Fields in the Details view can be inserted into the corresponding Overview to define a precise working environment for the task at hand.

Name	Value	Dec	Hex	Bin	Offset
Message Type	Vendor Defined	15	0xF	1111	0
Port Data Role	UFP	0	0x0	0	5
Specification Revision	Version 2.0	1	0x1	01	6
Port Power Role	Source	1	0x1	1	8
Message ID	1	1	0x1	001	9
Number Of Data Objects	2 data objects (8 bytes)	2	0x2	010	12
VDM Header					
SVID	DisplayPort	65281	0x0FF01	11111111 0000...	16
VDM Type	Structured VDM	1	0x1	01	31
Structured VDM Version	Version 1.0	0	0x0	00	39
Command Type	Responder ACK	1	0x1	01	22
Command	Discover Modes	3	0x03	00000000	16
DisplayPort Discover Modes...					
Port Capability	DPP_D Capable	2	0x2	00000000	48
Signaling Support					
Supports DP v1.3	Yes	1	0x1	1	50
Supports USB Gen 2	No	0	0x0	0	51
Receptacle Indication	DisplayPort on USB Type-C Receptacle	1	0x1	00000000	54
USB 2.0 Not Used	USB 2.0 may be required while in DisplayPort configuration	0	0x0	00000000	55
DPP_D Pin Assignments S...					

Multi-Protocol Support

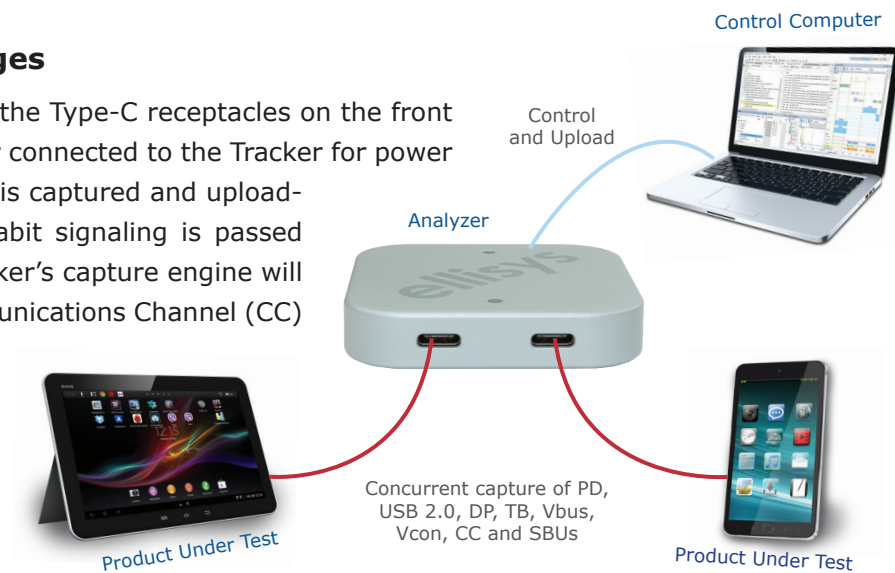
Having one tool to manage several protocols and electrical states over USB Type-C is economical and provides the user with time-saving approaches to debug and validation exercises. The protocols supported by the Tracker can be captured concurrently and visualized in real time with precise timings. The flexibility of the Ellisys software suite allows the user an unlimited number of options to present information, based on the requirements of the task at hand.



Typical Setups

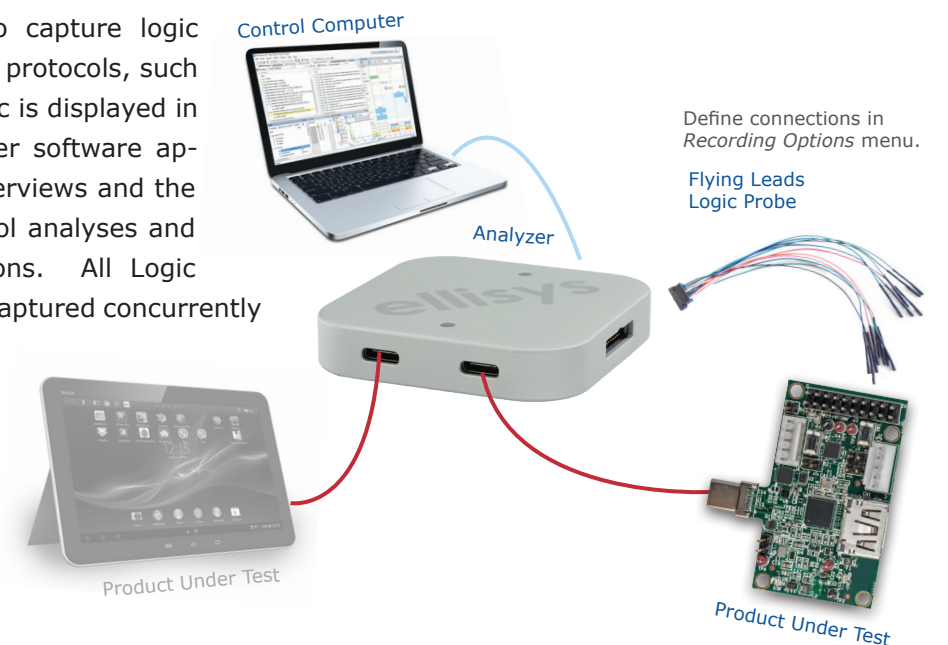
Type-C Communications and Voltages

Products under test (PUTs) are connected to the Type-C receptacles on the front panel of the Tracker, with a Control Computer connected to the Tracker for power and application control. All supported traffic is captured and uploaded real-time to the Control Computer. Gigabit signaling is passed through the analyzer. Conveniently, the Tracker's capture engine will automatically determine which Type-C Communications Channel (CC) pin is being used for USB Power Delivery communications and which pin is being used for Vconn. Various protocols operating over the Type-C Sideband Use (SBU) lines are also captured, in addition to USB 2.0 traffic. A special cable (not shown) is supplied to manage proper signal routing.



Logic Signals, TCPCI/I2C, and Other Serial Protocols

The Logic connection can be used to capture logic/general purpose IO signals and several protocols, such as I2C, UART, SWD, and SPI. This traffic is displayed in various windows throughout the Tracker software application, including protocol-specific Overviews and the Instant Timing view, for various protocol analyses and precision timing-related characterizations. All Logic Connection traffic and signaling can be captured concurrently and in precise synchronization with all other Logic Connection inputs as well as all captured front-panel Type-C traffic (CC, SBU, and USB 2.0), including voltage states. Logic signals captured can be grouped into user-named buses for added convenience.



Technical Specifications

Connectors

- Link under test (2): USB Type-C
- Control connection: USB Type-C
- Logic: 16 general purpose inputs/outputs with configurable level and threshold
- Sync (2): USB Micro A-B (reserved for future use)
- Power: Bus-powered via control connection (5 V ±10%)

Supported Protocols

- USB Power Delivery 2.0 and 3.1
- USB Power Delivery Vendor-Defined Messages
- USB Type-C voltage states
- USB 2.0
- DisplayPort alternate mode
- DisplayPort 2.0 auxiliary (AUX) signaling over SBU
- Thunderbolt / USB4 sideband
- HDMI Alt Mode, DDC, CEC
- TCPCI (Type-C Port Controller Interface)
- I2C (Inter Integrated-Circuits)
- UART (Universal Asynchronous RX/RX)
- SPI (Serial Peripheral Interface)
- SWD (Serial Wire Debug)

Timing

- Timing resolution of 5 ns
- Relative and time-of-day (UTC and local) timestamps with 1 ns precision
- Zero-reference timestamp placement
- Click/drag timing cursors
- Packet, frame, and preamble duration tracking
- Bit-rate tracking

Supported Operational Modes

- Direct operation via GUI
- Remote API automation operation

LED Indicators

- Activity and control indicators
- USB connection statuses
- Operating statuses

Analyzer General Capabilities

- Concurrent, synchronized capture of all supported protocols, electrical signaling, and logic signals
- Multiple-unit synchronization capability (future)
- Real-time display of captured traffic
- Hardware filtering for select protocols
- Display filters
- Bookmark placement and import/export
- Advanced query-based text filtering
- Secure cloud upload/download of saved files
- Customizable overview columns
- Real-time user message-log injection
- Bus powered operations

Logic Capabilities

- 16 inputs (max 3.6V)
- Configurable level and threshold
- Timing resolution of 400 ns, accuracy 5 ns
- Bandwidth of 50 MHz

USB Power Delivery Capabilities

- Non-intrusive probing
- Custom Type-C analysis cable for Vconn monitoring
- Packet and transaction error detection and display
- Synchronized timing between packets and all USB Type-C voltages
- Vendor-defined message support
- Detailed field/byte/bit decoding of alternate mode commands, PD traffic, VDMs

USB 2.0 Capabilities

- Support of LS (1.5 Mbps), FS (12 Mbps), and HS (480 Mbps)
- Device class support
- Standard descriptors support
- Automatic speed detection
- Precise tracking of line states
- Non-intrusive probing
- Timing resolution of 16.7 ns
- Hardware filtering of NAK transactions
- Payload truncation filtering
- Data payload throughput tracking
- Packet and transaction error detection and display

Electrical Capture Capabilities

- Measurement and synchronized tracking of Vbus, SBU_A, SBU_B, CC and Vconn
- Automatic detection of Type-C orientation
- Support for Extended Power Range (EPR)

Enclosure

- 63.5 x 63.5 x 12 mm (2.5" x 2.5" x 0.47")
- 70 g (0.15 lbs)

Maintenance and Licensing

- Free lifetime updates – no maintenance fees
- Free full-featured viewer application – easily share annotated traces between computers and colleagues
- Use Ellisys hardware on any computer, no additional licenses needed

Product Warranty

- 1-year limited hardware warranty for Standard editions, 2-years for Pro edition

Minimum Requirements

- Windows 7 and later, 32 or 64 bits
- 1280 x 1024 display resolution
- USB 2.0 EHCI host controller

Ordering Information

Description	Code
Ellisys Type-C Tracker Analyzer - Standard Edition - DP (Standard features plus DisplayPort Support, 1-year warranty)	CTR1-A-STD-DP
Ellisys Type-C Tracker Analyzer - Standard Edition - TB (Standard features plus Thunderbolt / USB4 Alt Mode and Sideband support, 1-year warranty)	CTR1-A-STD-TB
Ellisys Type-C Tracker Analyzer - Standard Edition - TCPC (Standard features plus Type-C Port Controller and I2C Support, 1-year warranty)	CTR1-A-STD-TCPC
Ellisys Type-C Tracker Analyzer - Standard Edition - HDMI (Standard features plus HDMI Alt Mode Support, 1-year warranty)	CTR1-A-STD-HDMI
Ellisys Type-C Tracker Analyzer - Pro Edition (Includes all features of all Standard Editions plus SPI, UART and SWD capture, 2-years warranty)	CTR1-A-PRO

updated 032023



Editions

Features	Std DP	Std HDMI	Std TB	Std TCPC	Pro
USB Power Delivery	X	X	X	X	X
Voltage Tracking for CC, Vconn, SBU, Vbus	X	X	X	X	X
USB 2.0	X	X	X	X	X
Logic/GPIO Signals	X	X	X	X	X
DisplayPort AUX and Alt Mode	X				X
HDMI DDC, CEC, and Alt Mode		X			X
Thunderbolt / USB4 Sideband and Alt Mode			X		X
USB Type-C Port Controller (TCPCI) and I2C				X	X
Serial Peripheral Interface (SPI)					X
UART					X
Serial Wire Debug (SWD)					X
Warranty	1 year	1 year	1 year	1 year	2 years