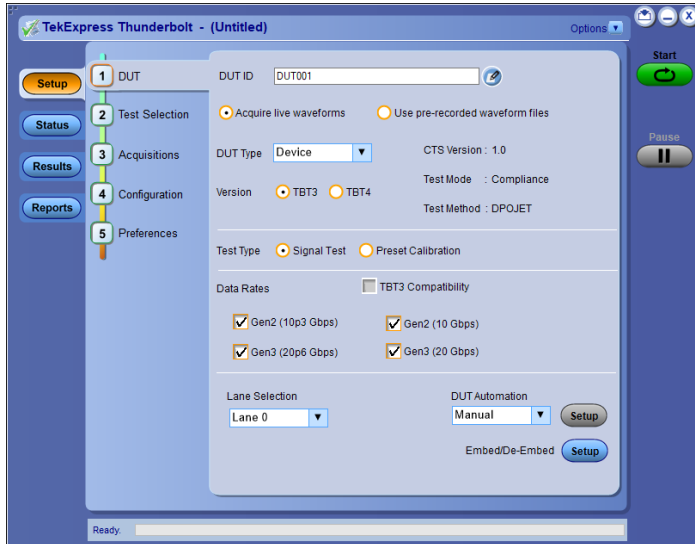


Thunderbolt 3 and Thunderbolt 4 Transmitter Compliance and Automated Solution

Opt. TBT3 Application Datasheet



Tektronix provides the most comprehensive solution to serve the needs of engineers designing Thunderbolt 3 and Thunderbolt 4 Integrated (SoC) and Discrete products. Tektronix TekExpress Thunderbolt application provides one-button testing for the Thunderbolt 3 and Thunderbolt 4 measurements as per the USB4 Electrical Compliance Test Specification (Appendix E). TekExpress Thunderbolt automates the measurements allowing engineers to perform the required tests efficiently and reliably right on their bench. The DPO/MSO70000SX/DX Series (BW ≥21 GHz) oscilloscopes are designed to meet the challenges of the next generation of serial data standards such as Thunderbolt. These oscilloscopes provides the industry's leading vertical noise performance with the highest number of Effective bits (ENOB) and flattest frequency response among oscilloscopes in their class.

Features and benefits

Tektronix Thunderbolt Compliance and Debug solution provides a comprehensive toolset for the Thunderbolt 3 and Thunderbolt 4 verification, characterization, debug, and compliance testing.

- Tektronix DPOJET-TBT3 Plug-in solution with setup files and MOI assists the root cause analysis.
- Supports the Wilder Technologies TBT3 Controller and Intel's TenLira/TDT Electrical scripts.
- Supports the Wilder Technologies USB4 Controller and USB4 Electrical Test Tool (ETT).
- Tektronix Serial Data Link Analysis (SDLA) tool supports the De-embedding, Embedding, Equalization (CTLE+DFE), and Custom Channel Characterization.

- Signal Validation feature validates the compliance pattern to ensure the accuracy of the results.
- Pre-Recorded Mode supports the offline analysis and baseline for future specification changes.
- Automatic DUT Control mode captures all the compliance test patterns. So the USB4 Transmitter testing completes without user intervention.
- Automatic DUT Control supports both TBT3 and 4 Discrete and Integrated (SoC) products.
- Quickly validate test results with comprehensive reporting that details test margins, pass/fail results, and plots in PDF, MHT, and CSV formats

Applications

Thunderbolt 3 and Thunderbolt 4 Transmitter testing:

- Thunderbolt Silicon Testing: Host, Device, and Hub
- Thunderbolt Peripheral Testing: Host, Device, and Hub
- Manufacturing testing

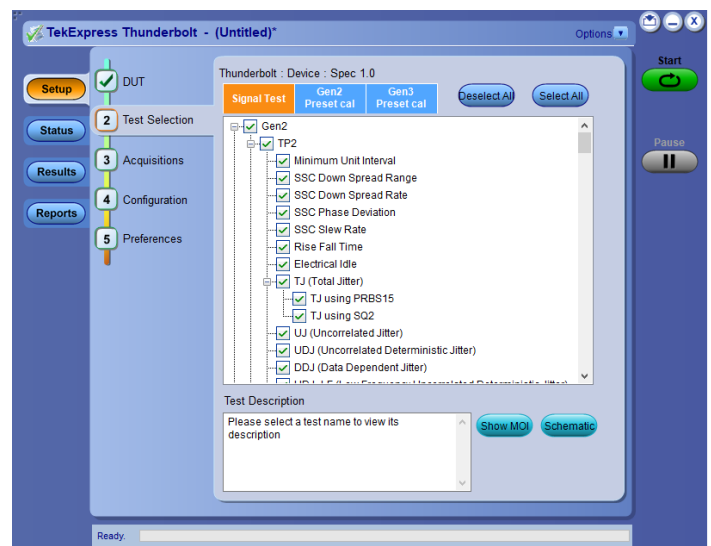


Figure 1: Thunderbolt physical-layer Tx compliance measurements

DPOJET TBT3 plug-in debug solution

With its fast data rate and multi-lane topology, Thunderbolt presents a number of test and measurement challenges, including fixture effects and the need to isolate crosstalk. The coupling of energy from adjacent signaling lanes adds noise and jitter that can affect system interoperability. Effective debugging requires jitter analysis tools that can properly separate and classify the jitter components of a signal, including those stemming from crosstalk.

Before the measurements are computed the cable must be de-embedded. De-embed filters can be easily created using Serial Data Link Analysis software (SDLA) and then quickly entered into the DPOJET TBT3 measurement setup and saved for future use. In addition to jitter, DPOJET TBT3 also provides voltage, Spread Spectrum Clocking (SSC), and other AC parametric measurements.

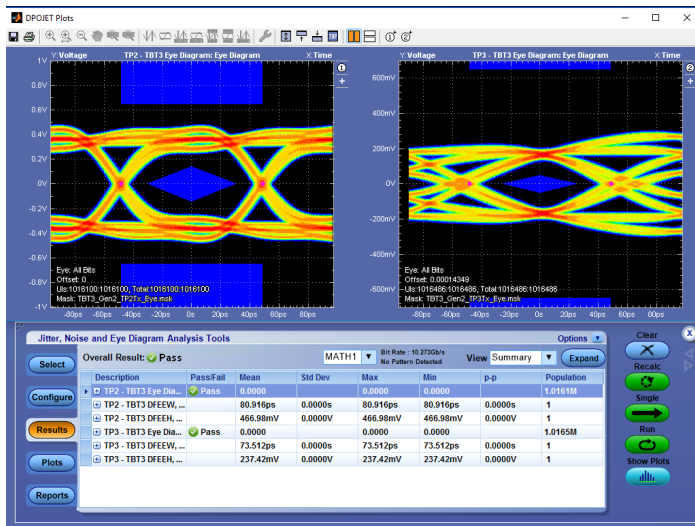


Figure 2: Tektronix Thunderbolt debug solution with simultaneous multiple test point analysis

TekExpress Thunderbolt automation solution

For compliance testing, TekExpress TBT automates the instrument setup as required by the Thunderbolt specification including an adequate time window for SSC analysis and Phase locked loop (PLL) settings for jitter/eye analysis. The port microcontroller enables automated device automation through test pattern initiation. TekExpress TBT allows the user to automate test modes while integrating the required scripts or step through the test modes with manual device control. A test status window indicates the current status of waveform acquisitions, signal analysis, and results documentation. The TekExpress TBT software can be run in Offline mode which allows the user to quickly recalculate test results using saved waveforms. A detailed test report provides color-coded pass/fail indications along with test margins. TekExpress TBT can be run in the user-defined mode to debug test failures with custom settings and test limits.

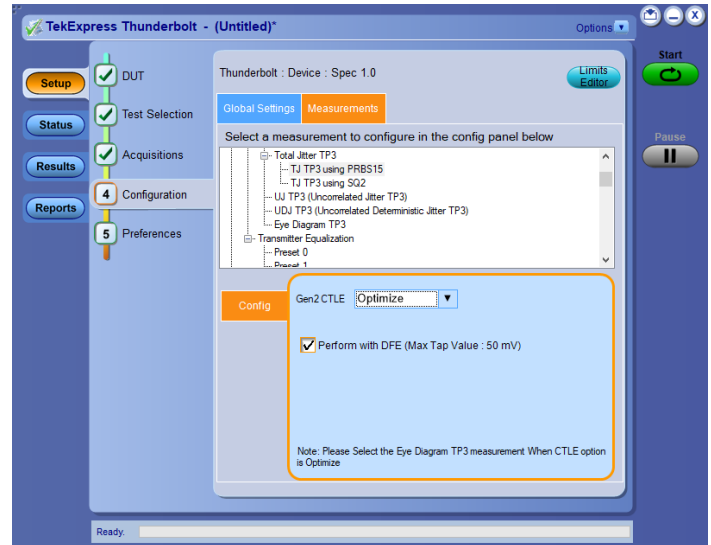


Figure 3: Custom measurement configuration setting for the CTLE and DFE selection

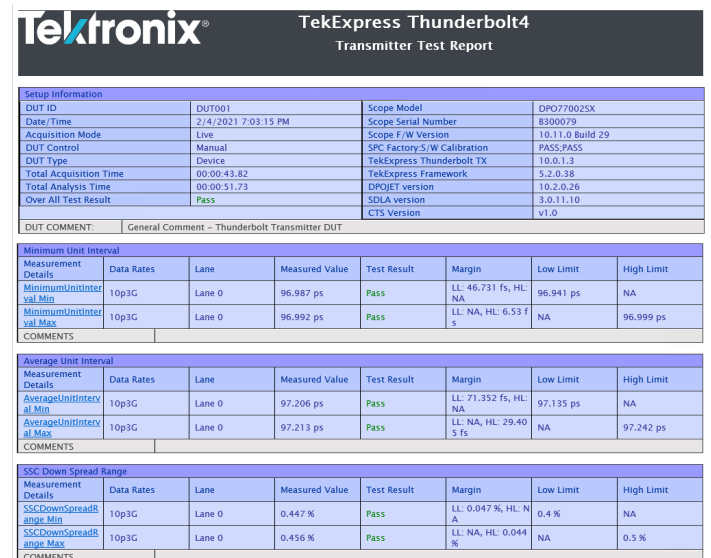


Figure 4: Detailed test report with measurement results, limits, setup details, and screen shots

Ordering information

TekExpress TBT3 transmitter compliance and debug solution

DPO/MSO70000SX/DX ¹	Tektronix DPO (Digital Phosphor Oscilloscope) or MSO (Mixed Signal Oscilloscope) - 23 GHz and above with DPOJET (DJA) and SDLA64 installed.
DPO/MSO70000SX/DX Opt. TBT3 ²	TekExpress TBT3 Tx Compliance and DPOJET: TBT3 Tx/Rx Measurement Plugin Solution (Requires Opt. CIO, DJA, and SDLA64)
DPO-UP TBT3 ²	TekExpress TBT3 Tx Compliance and DPOJET: TBT3 Tx/Rx Measurement Plugin Solution (Requires Opt. CIO, DJA, and SDLA)
DPOFL-TBT3 ²	TekExpress TBT3 Tx Compliance and DPOJET: TBT3 Tx/Rx Measurement Plugin Solution (Requires Opt. CIO, DJA, and SDLA64); Floating
DPOFT-TBT3 ²	TekExpress TBT3 Tx Compliance and DPOJET: TBT3 Tx/Rx Measurement Plugin Solution (Requires Opt. CIO, DJA, and SDLA64); Floating Trial

Recommended TBT3 controller, high-speed test fixture, and accessories

Item	Vendor	Quantity
TBT3 Controller and High-Speed Test Fixtures: 640-0961-000 ³ OR 640-0535-000 and 640-0847-000 ⁴	Wilder Technologies	1
SMP(F) to 2.92 mm(F) Adapter: SM8852	Fairview Microwave	Min 4
[Optional] SMP Terminators: ST2643	Fairview Microwave	4
PMCABLE1M Phase Matched SMA cable set	Tektronix	2

Oscilloscope and software prerequisite requirements

Required software	Description
Operating System	DPO/MSO70000SX/DX with Microsoft Windows 10 OS
DUT Control Tool	<p>If using the USB4-TPA-UC controller, then the USB4 Electrical Test Tool (ETT) v 0.9.7 (or above) should be available on the oscilloscope. The USB4ETT is available on the USB-IF Test Tools site (www.usb.org/document-library/usb4ett).</p> <p>If using the TBT-TPA-UHG2 controller, then Intel TenLira or TDT (Thunderbolt Diagnostic Tool) software with Thunderbolt Electrical Scripts should be available on the oscilloscope. Intel's software can be downloaded from Intel's Resource & Design Center site.</p>
Controller Driver and Software	Wilder Technologies Controller Driver and Software should be available on the oscilloscope. Contact Wilder Technologies for software support.

¹ Required options: Opt. DJA and Opt. SDLA64. Optional items: Opt. 10XL and DPO7AFP.

² Requires Opt. CIO, DJA, and SDLA64, and \geq 21 GHz oscilloscope. Thunderbolt 4 included in the opt. TBT3.

³ Select the Wilder USB4-TPA-UC-K kit if the Thunderbolt chipset/soc used in the product is Ice Lake, Goshen Ridge, Maple Ridge, or Tiger Lake.

⁴ Select the Wilder TBT-TPA-UHG2 controller and TBT-TPA-PR fixture if the Thunderbolt chipset used in the product is Titan Ridge or Alpine Ridge.

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