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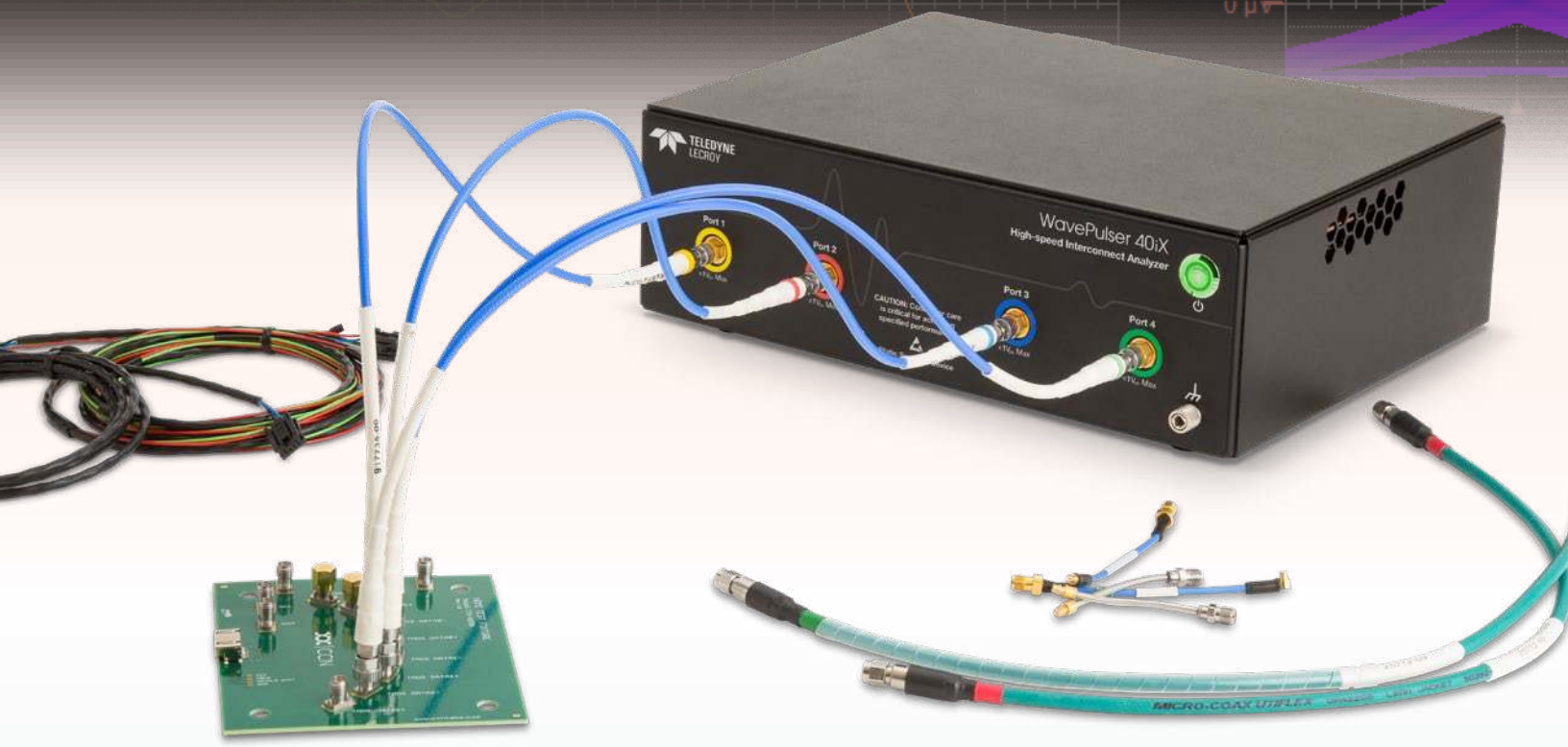
UNMATCHED CHARACTERIZATION INSIGHT



WavePulser 40iX

High-speed Interconnect Analyzer

- **S-parameters** Complete frequency characterization
- **Impedance Profile** Precisely locates impairments
- **Deep Toolbox** Measurements ready for simulation

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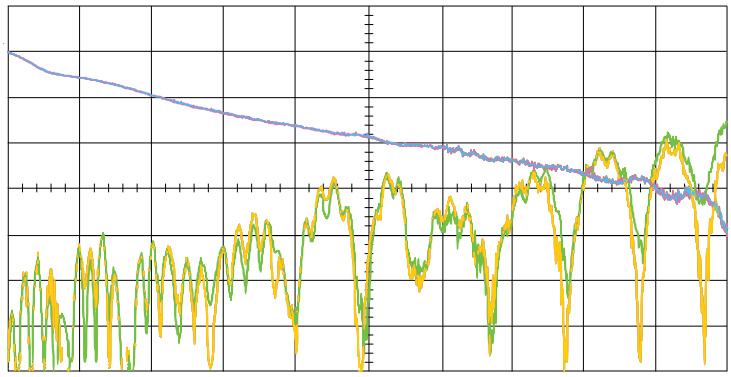
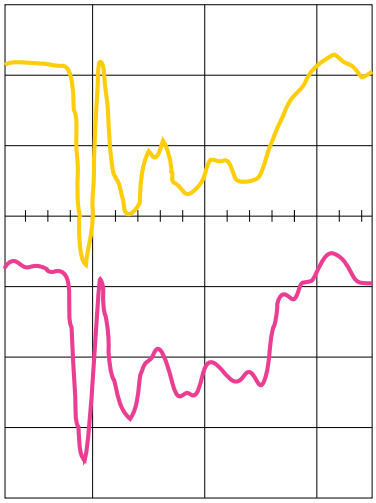
S-parameters

Complete Frequency Characterization

- Frequency Range from DC to 40 GHz
- Single-ended and Mixed-mode
- Internal Automatic Calibration



Impedance Profile



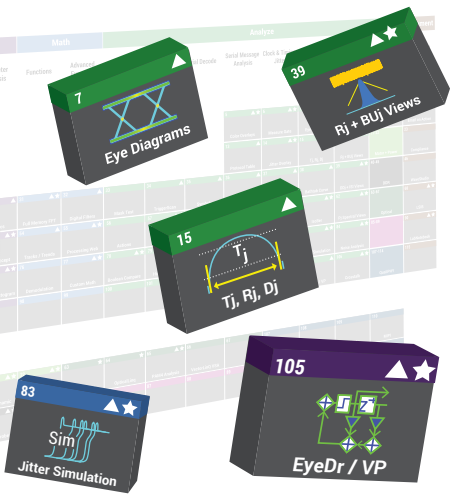
Precisely Locates Impairments

- Spatial Resolution <1mm
- Differential and Common-mode
- TDR and TDT Capability

Deep Toolbox

Measurements Ready for Simulation

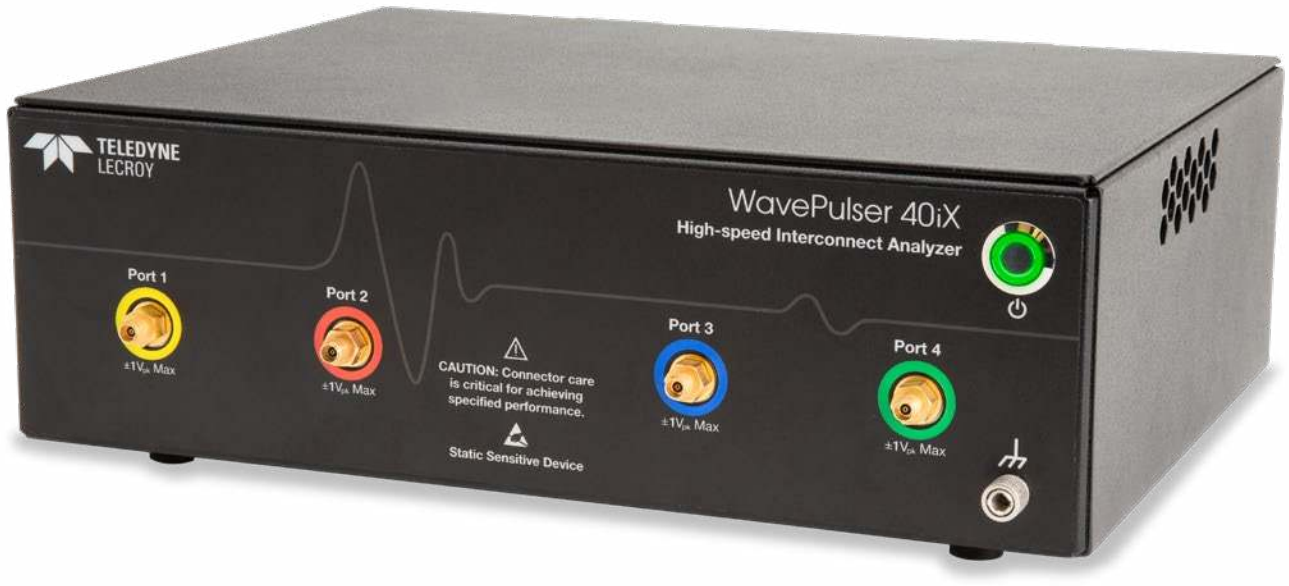
- Built-in Simulation, De-embedding and Time-gating
- Built-in Eye Diagram Display with Equalized Emulation
- Built-in Advanced Jitter Analysis



Unmatched Characterization Insight

The combination of S-parameters (frequency domain) and Impedance Profiles (time domain) in a single acquisition with a deep toolbox for simulation, emulation, de-embedding and time-gating provides unmatched characterization insight.

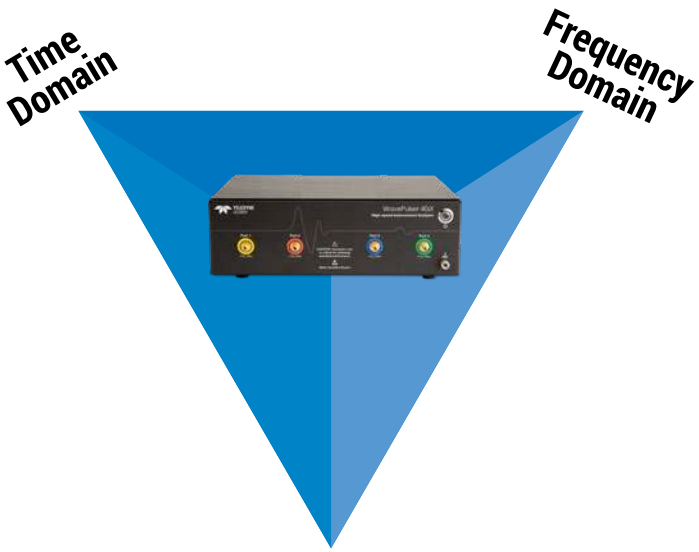
Both Frequency and Time Domains in a Single Acquisition



WavePulser 40iX

High-speed Interconnect Analyzer

TESTING IN BOTH FREQUENCY AND TIME DOMAINS



Deep Toolbox

WavePulser 40iX is the ideal single measurement tool for high-speed hardware designers and test engineers. Neither VNAs (the "gold standard" for microwave or narrow-band device measurements) or TDRs (the traditional measurement instrument of the signal integrity engineer) have all the necessary features and capabilities. WavePulser 40iX comes standard with a deep analysis toolbox specifically tailored for understanding high-speed interconnect characteristics. WavePulser 40iX is fast to calibrate and simple to use.

- S-parameters DC to 40 GHz, single- and mixed-mode
- Impedance Profile with <1 mm resolution, differential and common-mode
- Internal, automatic OSLT calibration
- USB-connected, small, lightweight
- Flexible display of measurements
- Remove effects of fixtures, connectors and cables
- Emulate eye diagrams with CTLE, DFE, and FFE equalization
- Advanced jitter analysis

Designed for High-speed Interconnect Analysis

WavePulser 40iX is designed specifically for high-speed interconnect analysis. It validates, debugs, and troubleshoots interconnectivity issues in serial-data cables, channels, connectors, vias, backplanes, printed-circuit boards, and chip and SoC packages. It is simple to set up and use.

Internal, Automatic Calibration

WavePulser 40iX calibration standards are built-in (included in the standard unit) and calbration is always automated, simple and fast — make one connection to the DUT and press Go. WavePulser 40iX does not require purchase of additional, external calibration standards. Furthermore, WavePulser 40iX's TDR/TDT-based approach is independent of setup, making calibration less likely.

Full-range DC to 40 GHz

With a bandwidth from DC to 40 GHz, WavePulser 40iX delivers TDR step response and time-gated and/or emulated physical-layer responses with no need for extrapolation to DC and low frequencies, which is ideal for interconnection systems.

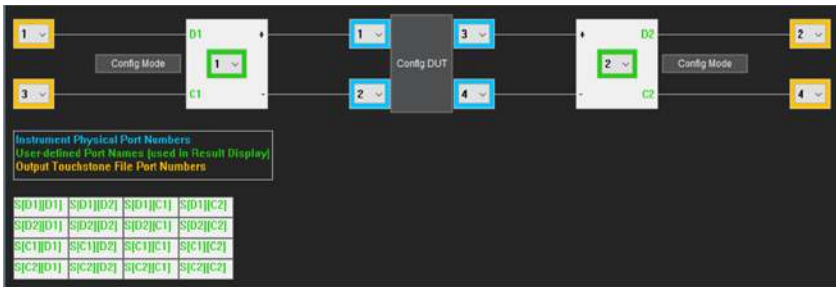
1. Differential return loss at input and output ports and insertion loss
2. Transmission differential impulse response and transmission common-mode step response
3. Common-mode and mode-conversion S-parameters
4. Advanced jitter analysis of channel emulation
5. Differential and common-mode impedance profile (Z_0 vs. electrical length)
6. Emulation of equalized eye diagrams

S-PARAMETERS FROM DC TO 40 GHZ

Mixed-mode return and insertion losses are simultaneously displayed.

Mixed-mode S-parameters

- A single acquisition displays all measurement results.
- Mixed-mode return and insertion losses for all ports.
- Differential-mode and common-mode measurements displayed simultaneously.
- DC frequency response.
- Graphical, tabular user interface makes measurements straightforward and simple.



The main setup configuration menu and the S-parameters configuration.

Simple and Flexible Setup

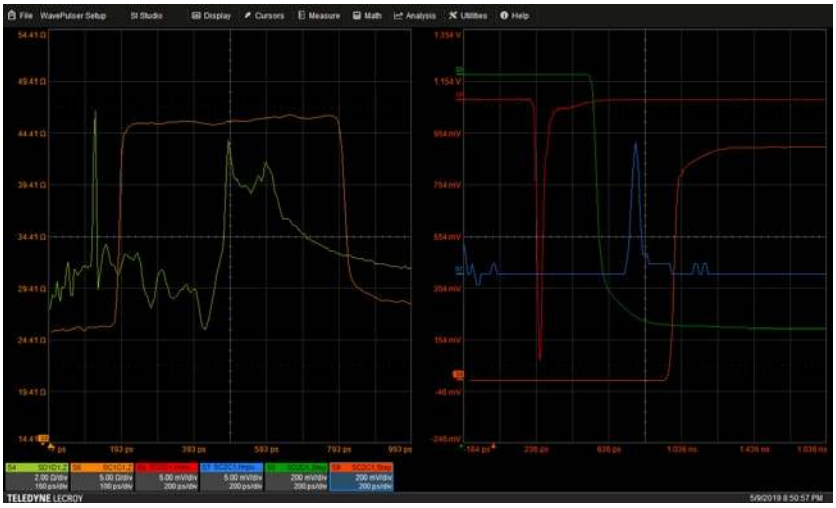
- Get results quickly – a simple setup requires only entry of frequencies and number of ports.
- Optimized test time – select for highest accuracy or highest speed, or something in between.
- Reconfigure ports in software without re-connecting to the DUT.

WavePulser 40iX simple setup makes you more productive.

Built-in Internal Calibration and More Confidence in Measurement Accuracy

- Calibration standards built into the instrument – nothing else to purchase.
- Internal, electronic calibration permits measurements to begin sooner and be made with more confidence.
- Sophisticated capabilities, such as passivity, reciprocity, and causality enforcement, provide better measurement accuracy and increase confidence in the results.

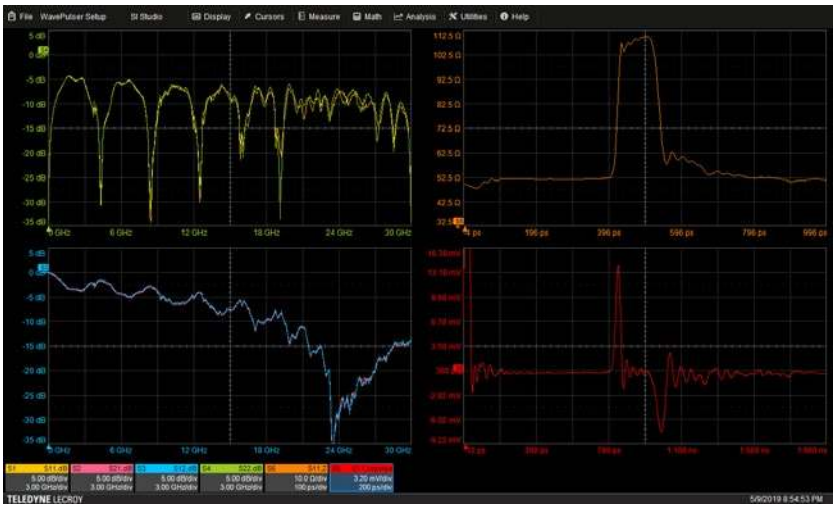
IMPEDANCE PROFILE WITH SPATIAL RESOLUTION <1mm



Impedance profile displays both common and differential modes.

Impedance Profile (Z_0 vs. Electrical Length)

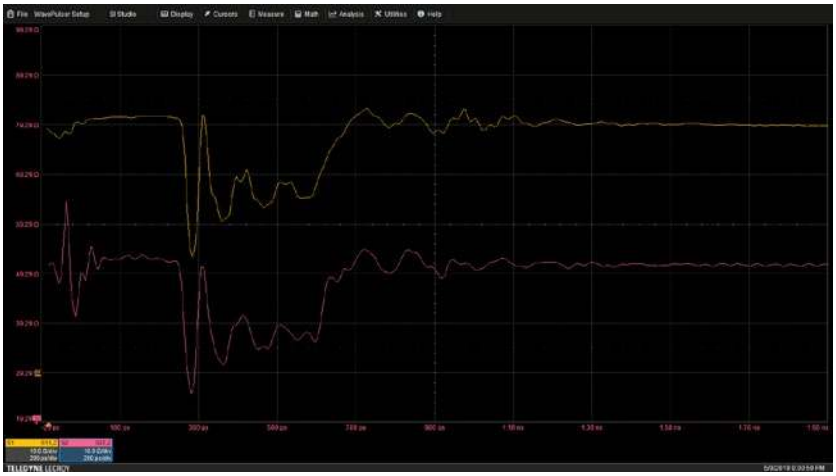
- Supports both differential-mode and common-mode measurements.
- Simultaneous display of multiple modes.
- Step-response, pulse-response, and reflection coefficient (Γ) views are included.



WavePulser 40iX step and impulse response combined with S-parameters enables determination of the type of impairment.

Precisely Locate Impairments

- WavePulser helps detect and locate the following issues in high-speed interconnects:
  - Improperly tightened connectors
  - Damaged cables
  - Incorrect cable-bend radiuses
  - Defective vias on transmission lines
  - Other transmissionline irregularities



WavePulser 40iX detects any defective connectors whether they are in the DUT or the setup.

Measurement Setup

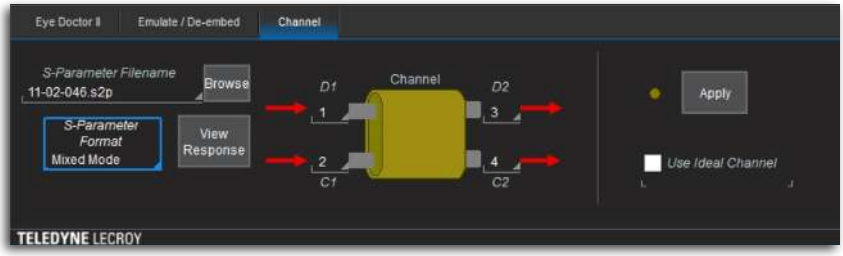
- Impedance profile detects and locates impairments on your complete measurement setup and not just on the DUT.
- Optimize your measurement efficiency by avoiding impairments in the set-up.
- Understand when to repeat calibration.

DEEP TOOLBOX: SIMULATION, DE-EMBEDDING, & TIME GATING

An intuitive Time Gating menu enables flexible configuration for each DUT port.

Time Gating

- Report DUT S-parameters correctly by eliminating the effect of cables and connectors.
- Set gating manually (through simple port extension) or by using an impedance peeling algorithm.
- Save S-parameter results either with or without the gate region.



The main setup configuration menu and the S-parameters configuration.

De-embedding

- Measure S-parameters of devices (cables, adapters, fixtures) that connect to the DUT and use them to de-embed these devices from measured results.
- De-embed serial-data channels using either modeled or measured S-parameters.

WavePulser 40iX emulates the eye diagrams of the complete serial-data channel.

Fast Eye Diagram Views

- Import an acquired waveform or simulate a waveform and add serial-data channel impairments using measured S-parameters.
- Quickly view the impact of measured impairments with an intuitive serial-data eye diagram.
- Display the eye diagram after de-embedding and optimizing the receiver equalization when evaluating the complete serial-data channel

Optimize the equalizer at the receiver and see the impact on the eye diagram.

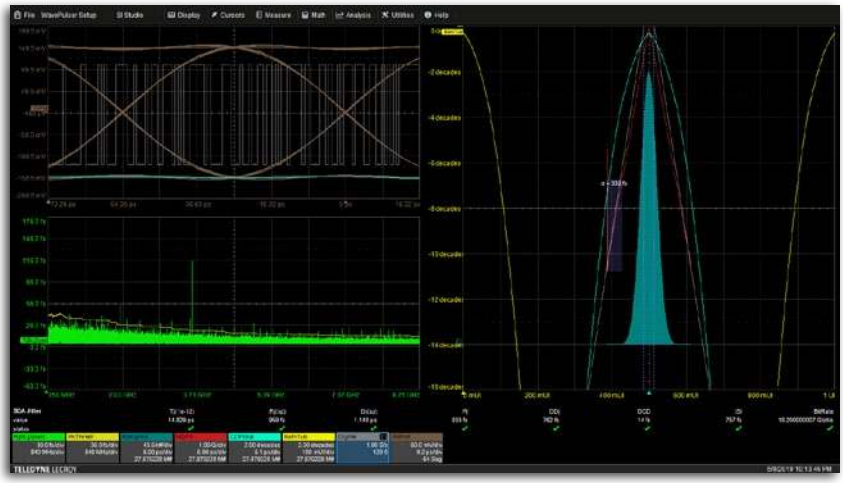
Optimal Equalization Settings

- Use standard or user-defined settings.
- Emulate the complete serial-data channel.
- Support for:
  - PLL settings.
  - Pre-emphasis.
  - De-emphasis.
  - Continuous Time Linear Equalization (CTLE).
  - Feed Forward Equalization (FFE).
  - Decision Feedback Equalization (DFE).

WavePulser 40iX utilizes a versatile built-in waveform signal simulator.

Simulate Serial-Data Patterns with Controlled Impairments

- Use the built-in software serial-data pattern simulator as a signal source for impairment analysis.
- Creates NRZ, RZ, bpNZ, and Clock signals.
- Flexibility to change signal characteristics, including bit rate (frequency), amplitude, and rise time.



Complete Jitter Analysis including ISI eye-diagram.

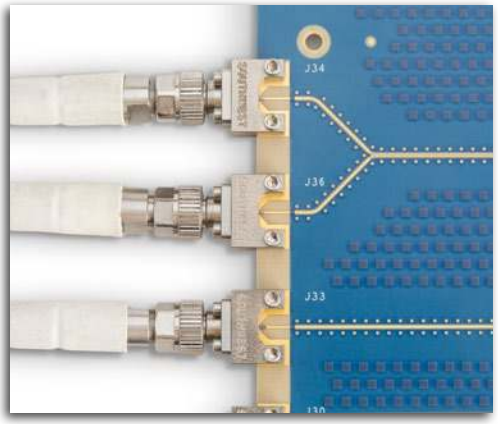
Advanced Jitter Analysis

- Measure total (Tj), random (Rj) and deterministic (Dj) jitter.
- De-convolve Dj into component parts, including:
  - Data Deterministic Jitter (DDj):
  - Periodic Jitter (Pj):
  - Duty Cycle Distortion (DCD):
  - Inter-symbol Interference (ISI):
- View jitter in spectral, histogram, jitter track, eye diagram, and other views and plots.

IMPEDANCE PROFILE IS COMPLEMENTARY TO S-PARAMETERS

Increase Design Reliability

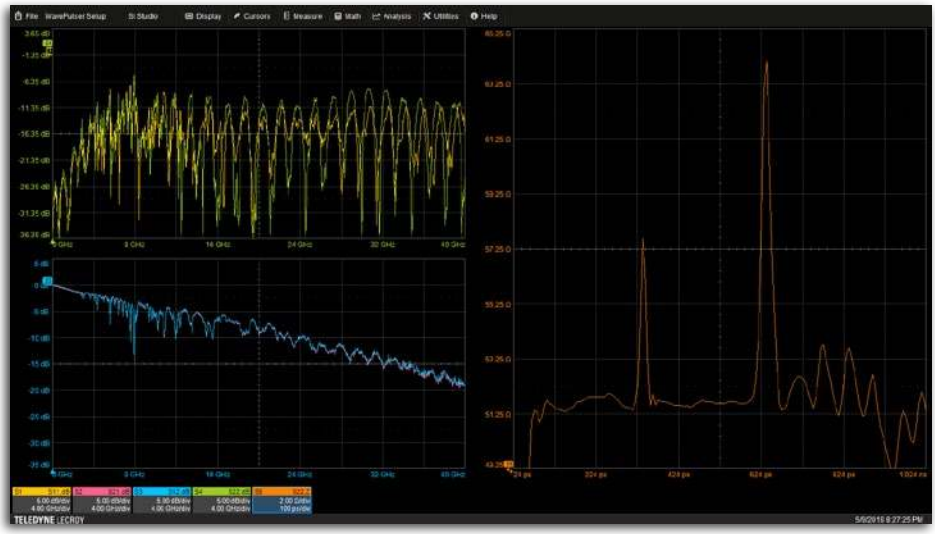
Wavepulser 40iX detects and precisely locates improperly tightened connectors, thereby increasing the reliability of your design. Impedance profile and time views combined with S-parameter measurements provide unmatched characterization insight.

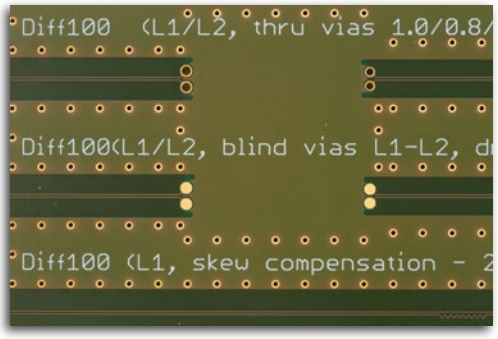


The impedance profile clearly indicates a defective connector in the signal path.

Precisely Detect Vias and Measure Their Performance

Through and blind vias are frequently present on boards and require testing and validation of their performance characteristics. S-parameter measurements, combined with impedance profiles, provide unmatched characterization insight.





The impedance profile shows that one of the two through vias is defective.

WAVEPULSER 40iX + T3SP15D

The Teledyne LeCroy WavePulser 40iX and the Teledyne Test Tools T3SP15D are a perfect combination of complementary products to serve the requirements for testing, validating and troubleshooting cables, backplanes, connectors, and transmission lines on printed-circuit boards.

		WavePulser 40iX	T3SP15D
FREQUENCY	**Frequency Range**	DC to 40 GHz	DC to 15 GHz
	S-parameters	Single-ended, Differential, and Mixed-mode Full S-parameters (S_{11}, S_{12}, S_{21}, S_{22})	Single-ended S_{11}, S_{21}, S_{12}, S_{22} Differential S_{11}
	Calibration	Internal automatic & manual OSLT	Manual OSL and OSLT calibration
TIME	**Impulse/Step Rise Time**	8.5 ps	35 ps
	Impedance Profile	Differential and Common-mode	Differential
	TDR/TDT Solution	TDR/TDT	TDR
	Spatial Resolution	< 1 mm	< 3 mm
DEEP TOOLBOX	**Simulation and De-embedding**	Yes	No
	Time-gating	Yes	No
	Emulation of Eye Diagrams	Yes	No
	Jitter Analysis	Yes	No
PLATFORM	**Number of Ports**	4	2
	USB-connected	Yes	Yes
	Size/Weight	105mm H x 305mm W x 230mm D, 3.3 kg	82.5mm H x 210mm W x 220mm D, 2.6 kg
	Battery-powered	No	Yes (optional)

SPECIFICATIONS AND ORDERING INFORMATION

Specifications	WavePulser 40iX	WavePulser-40iX-BUNDLE
Ports	4	
Operating Frequency	DC to 40 GHz	
Connector Type	2.92 mm	
Calibration method	Internal, automatic OSLT	
Result Displays	Up to 16 measurements displayed simultaneously (time and frequency domains)	
Display modes	Single, dual, tandem, triple, quad, quattro, hex, octal and Smith Chart (frequency only)	
Input Voltage Range	± 1 V peak	
Noise	-48 dBm typical (integrated from DC-40 GHz, no averaging) -85 dBm typical (integrated from DC-40 GHz, 5000 averages (1 second))	
Frequency Measurement		
S-Parameter Measurements	Single-ended and mixed-mode	
Frequency Domain Displays	Magnitude, Phase , Real and Imaginary	
Dynamic Range (Normal Mode)	56 dB @ 40 GHz (typical)	
Dynamic Range (Extra Mode)	66 dB @ 40 GHz (typical)	
Time Measurement		
Rise Time	8.5 ps (20%-80%) with 16 ps nominal pulse width (50% point)	
Spatial Resolution	<1 mm	
Time Domain Displays	Impedance Profile (Z_0), Impulse Response, Step Response, Rho (Γ)	
Acquisition Rate	100 MS/s	
Environmental		
Temperature	Operating: 5 °C to 40 °C; Non-operating: -20 °C to 70 °C	
Humidity	Operating: 5% to 90% relative humidity (non-condensing) up to +31 °C, Upper limit derates to 50% relative humidity(non-condensing) at +40 °C; Non-Operating: 5% to 95% relative humidity (non-condensing) as tested per MIL-PRF-28800F	
Altitude	Operating: 3,048 m (10,000 ft) max at +30 °C; Non-operating: Up to 12,192 meters (40,000 ft)	
Physical		
Dimensions	4.2" H x 12.0" W x 9.1" D (105mm H x 305mm W x 230mm D)	
Weight	7.25 lbs. (3.3 kg)	
Voltage	100 to 240 VAC (±10%) at 45-66 Hz or 400 Hz; Automatic AC voltage selection	
Max. Power Consumption	40 W	
Recommended PC Configuration		
	Processor: Intel Core i7 or better, 4 GB RAM or better, 2 GB available free space; Display: 1280 x 1080 pixels or better; Operating System: Microsoft Windows 10; Connectivity: SuperSpeed USB	
Warranty and Service		
	3-year warranty; calibration recommended annually. Optional service programs include extended warranty, upgrades, and calibration services	

Ordering Information

Product Description	Product Code
High-speed Interconnect Analyzers	
High-speed Interconnect Analyzer, 4-port, S-parameters DC-40 GHz, <1 mm Spatial Resolution, Internal Calibration, 4 phase matched cables	WavePulser-40iX
High-speed Interconnect Analyzer Bundle Includes WavePulser-40iX and WavePulser-40iX-SI-KIT	WavePulser-40iX-BUNDLE
Accessories	
Deep Analysis toolbox including emulation of equalized eye-diagrams (CTLE, FFE, DFE, PLL) and advanced jitter analysis and simulation of serial-data patterns with controlled impairments. Also includes USB Hasp Key, female 2.92mm adapters (4 total), OSLT calibration kit, universal wrench, and torque wrench.	WavePulser-40iX-SI-KIT
Additional license (USB Hasp Key) for Signal Integrity Studio, Analysis & Simulation SW for WavePulser 40iX High-Speed Interconnect Analyzer	WavePulser-SISTUDIO

Included with WavePulser-40iX:
Color-coded, serialized, phase-matched calibrated 2.92mm cables (4 total); Line cord (country-specific); SuperSpeed USB cable, ESD wrist strap, Getting Started Guide, Calibration and Performance Certificate, 3 year warranty

Included with WavePulser-40iX-SI-KIT
Accessory kit including OSLT calibration Kit (@40 GHz , 2.92mm), female 2.92 mm adapters (one per port), universal wrench, torque wrench, USB Hasp key (to enable Deep Analysis Toolbox software), Instruction sheet. Deep Analysis Toolbox software includes emulation equalized eye-diagram (CTLE, FFE, DFE, PLL) complete jitter analysis and simulation Serial Data Patterns with controlled impairments.

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