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

teledynelecroy.com
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
Both Frequency and Time Domains in a Single Acquisition

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.
**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 calibration 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
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.

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.

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 ($Z_0$ vs. Electrical Length)
- Supports both differential-mode and common-mode measurements.
- Simultaneous display of multiple modes.
- Step-response, pulse-response, and reflection coefficient ($\Gamma$) views are included.

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

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.
**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.

**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.

**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.
**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).

**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.

**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.
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.

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 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.

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

<table>
<thead>
<tr>
<th>Specifications</th>
<th>WavePulser 40iX</th>
<th>WavePulser-40iX-BUNDLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ports</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Operating Frequency</td>
<td>DC to 40 GHz</td>
<td></td>
</tr>
<tr>
<td>Connector Type</td>
<td>2.92 mm</td>
<td></td>
</tr>
<tr>
<td>Calibration method</td>
<td>Internal, automatic OSLT</td>
<td></td>
</tr>
<tr>
<td>Result Displays</td>
<td>Up to 16 measurements displayed simultaneously (time and frequency domains)</td>
<td></td>
</tr>
<tr>
<td>Display modes</td>
<td>Single, dual, tandem, triple, quad, quattro, hex, octal and Smith Chart (frequency only)</td>
<td></td>
</tr>
<tr>
<td>Input Voltage Range</td>
<td>± 1 V peak</td>
<td>-48 dBm typical (integrated from DC-40 GHz, no averaging)</td>
</tr>
<tr>
<td>Noise</td>
<td>-85 dBm typical (integrated from DC-40 GHz, 5000 averages (1 second))</td>
<td></td>
</tr>
<tr>
<td>S-Parameter Measurements</td>
<td>Single-ended and mixed-mode</td>
<td></td>
</tr>
<tr>
<td>Frequency Domain Displays</td>
<td>Magnitude, Phase, Real and Imaginary</td>
<td></td>
</tr>
<tr>
<td>Dynamic Range (Normal Mode)</td>
<td>56 dB @ 40 GHz (typical)</td>
<td></td>
</tr>
<tr>
<td>Dynamic Range (Extra Mode)</td>
<td>66 dB @40 GHz (typical)</td>
<td></td>
</tr>
<tr>
<td>Rise Time</td>
<td>8.5 ps (20%-80%) with 16 ps nominal pulse width (50% point)</td>
<td></td>
</tr>
<tr>
<td>Spatial Resolution</td>
<td>&lt;1 mm</td>
<td></td>
</tr>
<tr>
<td>Time Domain Displays</td>
<td>Impedance Profile ($Z_0$), Impulse Response, Step Response, Rho ($\Gamma$)</td>
<td></td>
</tr>
<tr>
<td>Acquisition Rate</td>
<td>100 MS/s</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>5 °C to 40 °C; Non-operating: -20 °C to 70 °C</td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>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</td>
<td></td>
</tr>
<tr>
<td>Altitude</td>
<td>Operating: 3,048 m (10,000 ft) max at +30 °C; Non-Operating: Up to 12,192 meters (40,000 ft)</td>
<td></td>
</tr>
<tr>
<td>Physical Dimensions</td>
<td>4.2” H x 12.0” W x 9.1” D (105mm H x 305mm W x 230mm D)</td>
<td></td>
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<tr>
<td>Weight</td>
<td>7.25 lbs. (3.3 kg)</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>100 to 240 VAC (±10%) at 45-66 Hz or 400 Hz; Automatic AC voltage selection</td>
<td></td>
</tr>
<tr>
<td>Max. Power Consumption</td>
<td>40 W</td>
<td></td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>High-speed Interconnect Analyzers</th>
<th>Product Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-speed Interconnect Analyzer, 4-port, S-parameters DC-40 GHz, &lt;1 mm Spatial Resolution, Internal Calibration, 4 phase matched cables</td>
<td>WavePulser-40iX</td>
</tr>
<tr>
<td>High-speed Interconnect Analyzer Bundle Includes WavePulser-40iX and WavePulser-40iX-SI-KIT</td>
<td>WavePulser-40iX-BUNDLE</td>
</tr>
</tbody>
</table>

#### 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

#### 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 , 2.92 mm), female 2.92 mm adapters (one per port), universal wrench, torque wrench, USB hasp (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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