Jitter and Eye-diagram analysis tools
DPOJET datasheet

DPOJET is the premiere eye-diagram, jitter, and timing analysis package available for real-time oscilloscopes. DPOJET provides the highest sensitivity and accuracy available in real-time instruments. With comprehensive jitter and eye-diagram analysis and decomposition algorithms DPOJET simplifies discovering signal integrity concerns and jitter and their related sources in today's high-speed serial, digital, and communication system designs.

Key features DPOJET Advanced
- Jitter and Timing Analysis for analog and digital clocks and data signals
- Real-time Eye-diagram (RT-Eye®) Analysis
- Selectable high- and low-pass measurement filters
- Nine plot types to view and analyze jitter: Eye Diagram, CDF Bathtub, Spectrum, Histogram, Trend, Data, Phase Noise, and Transfer Function
- Accurate jitter decomposition and TJ(BER) estimation with selectable jitter models support popular standards; Fibre Channel or PCI Express Delta-Delta (Dual Dirac) and Convolved Results
- Jitter separation algorithms accurately measure the effects of bounded uncorrelated jitter (BUJ) and enable precise TJ measurements
- Full pass/fail limits and mask testing with comprehensive standards support library; plus user limit and mask files allow support of custom test configurations and new or developing standards
- DPOJET Advanced is standard on DSA/MSO70000 Series, optional on DPO70000, DPO7000, and MSO/DPO5000 Series oscilloscopes

Key features DPOJET Essentials-Advanced
- Period, frequency, and time interval error analysis
- Timing parametrics such as rise/fall times, pulse width, and duty cycle
- Many graphical tools such as Histograms, Time Trends, and Spectrums
- Programmable software clock recovery including software PLL
- User-selectable golden PLL support for popular standards
- Selectable high- and low-limit measurement bounds test
- Comprehensive statistics logging, reporting, and remote automation
- Capture and save worst-case signals for detailed analysis
- TekWizard™ interface for one-button and guided jitter summaries
- DPOJET Essentials is standard on all DPO/DSA/MSO70000, DPO7000, and MSO/DPO5000 Series oscilloscopes

Applications
- Characterize performance of high-speed serial and parallel bus designs
- Characterize clock and data jitter and signal integrity
- Characterize PLL dynamic performance
- Characterize modulation of spread spectrum clock circuits
- Characterize jitter generation, transfer, and tolerance
- Perform PHY testing of PCI Express, Serial ATA, SAS, Fibre Channel, MIPI®-D-PHY, MIPI®-M-PHY, DisplayPort, Thunderbolt, MHL, DDR, DDR2, DDR3, LPDDR, LPDDR2, SD UHS-II, MOST50, MOST150, USB 3.0, 10GBASE-KR/KR4, SFF-8431 SFP+ / 10GSFP+ Direct Attach Cable, and other electrical and optical systems

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1 Patented USPTO #6,836,738
2 Patented USPTO #6,853,933, #7,254,168.
3 Patented USPTO #6,812,688.

www.tektronix.com
Realtime jitter and eye-diagram analysis

DPOJET is the premiere eye-diagram, jitter, and timing analysis package available for real-time oscilloscopes. Operating in the Tektronix DPO/DSA/MSO70000, DPO7000, and MSO/DPO5000 Series oscilloscopes, DPOJET provides engineers the highest sensitivity and accuracy available in real-time instruments. With comprehensive jitter and eye-diagram analysis and decomposition algorithms DPOJET simplifies discovering signal integrity concerns and jitter and their related sources in today's high-speed serial, digital, and communication system designs.

Analog and digital designers in the computer, semiconductor, and communications industries are facing new challenges as processor clock speeds race beyond 3 GHz and back-plane bus and serial link data rates exceed 8 GT/s. These increasing speeds mean reduced circuit tolerance, or margin, for jitter and related signal integrity problems. By using tools that help you rapidly characterize and discover sources of jitter and signal integrity concerns, you can bring new designs to market faster, with more confidence that they operate reliably in today's ultra high-speed environment.

Partial list of measurements

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
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<tr>
<td>Time Measurements</td>
<td>Rise Time, Fall Time, High Time, Low Time, Setup $^4$, Hold $^4$, Skew $^4$, Rise Slew Rate, Fall Slew Rate, SSC Profile, SSC Modulation Rate, SSC Frequency Deviation, SSC Frequency Deviation Minimum, SSC Frequency Deviation Maximum, Time Outside Level</td>
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<tr>
<td>Amplitude Measurements</td>
<td>High, Low, High-Low, AC Common Mode, DC Common Mode, Overshoot, Undershoot, Cycle Min, Cycle Max, Cycle Pk-Pk, Common Mode, T/nT Ratio, Differential Crossover</td>
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<tr>
<td>Eye-diagram Measurements</td>
<td>Eye Height, Eye Height @ BER, Eye Width, Width at BER, Mask Hits</td>
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<td>Jitter Measurements</td>
<td>TIE, RJ, DJ, TJ/(BER), PJ, Clock, NPJ, DCD, DDJ, RJ/(5-5), DJ/(5-5), Phase Noise</td>
</tr>
<tr>
<td>Clock Recovery Methods</td>
<td>Constant Clock Mean, Constant Clock Median, PLL, External, PLL External</td>
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<tr>
<td>Plots</td>
<td>Histogram, Time Trend, Data Trend, Spectrum, Phase Noise, Transfer Curve, Eye Diagram with Waveform Database, Eye-diagram Statistics (CDF Bathtub)</td>
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<tr>
<td>Limit and Mask Testing</td>
<td>Pass/Fail Measurement Test Limits, Load and Test to Standard Masks</td>
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<tr>
<td>Measurement Source</td>
<td>CH1 - CH4, MATH1 - MATH4, REF1 - REF4, D0 - D15</td>
</tr>
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</table>

4 Measurement supported on digital channels

Figure 1 – DPOJET Jitter Separation selection for Legacy or BUJ model

DPOJET Jitter and Eye-diagram Analysis Tools extend the capability of Tektronix real-time oscilloscopes, performing complex measurements and analysis of clock, serial, and parallel data signals captured in Single-shot Acquisition mode or in Continuous-run Acquisition mode. Measurements in DPOJET are supported on either analog or digital channels as shown in the measurement table above. Providing jitter and timing measurements with pass/fail parameter testing, and eye diagrams with mask testing for today’s most common industry standards, DPOJET is specifically designed to meet the advanced measurement needs of today’s high-speed digital designers in the computer and communications industries.

As data rates increase, next generation interfaces present new test and measurement challenges, including the need to measure and isolate sources of BUJ (for example crosstalk). Crosstalk can be caused due to the coupling of energy on the lane under test from adjacent lanes. While Receiver Equalization can compensate for data dependent jitter (DDJ), crosstalk effects are difficult to remove. This has resulted in many standards, for example Thunderbolt, including BUJ in the jitter budget making BUJ a required measurement.

DPOJET is unique in support for both legacy and BUJ jitter separation algorithms as shown in Figure 2. When using the BUJ Jitter Decomposition method, the Clock NPJ measurement will be available in the Jitter tab within DPOJET.
DPOJET provides the ability to make measurements of single-ended and differential signals, measurements between two separate inputs, and measurements on multiple inputs simultaneously; with each input and each measurement independently configurable for maximum flexibility. For example, many specifications refer to a reference clock recovery configuration. With DPOJET can simultaneously model the same signal with both the reference clock recovery and silicon specific clock recovery models. With simultaneous measurements, DPOJET can run the same measurement and or plots on multiple input channels or math channels. This is valuable when working with post processing of acquired waveforms. For example the user can quickly validate the results before and after de-embedding a fixture or a cable without having to acquire multiple acquisitions and process each test point independently.

DPOJET supports displaying measurement results and plots on the internal display, on an external monitor, or both locations, thus making full use of the oscilloscope dual display ports.

DPOJET analysis plots, like Spectrum and Trend, go beyond simple measurements and results display. Trend analysis quickly shows engineers how timing parameters change over time, like frequency drift, PLL startup transients, or a circuit’s response to power supply changes. Spectrum analysis quickly shows the precise frequency and amplitude of jitter and modulation sources for easy, rapid identification. Finding sources like adjacent oscillators and clocks, power supply noise, or signal crosstalk is no longer a tedious chore. Unique in the industry, DPOJET also provides Phase Noise plots to show jitter in root/Hertz and Transfer Function plots that allow direct comparison of jitter spectrums between two signals of differing frequencies, providing the perfect tool for determining jitter in PLL circuits like clock multipliers.

DPOJET provides complete jitter and eye-diagram analysis tools. With premiere measurement flexibility, oscilloscope model support, limit testing, results logging and reporting, and integrated remote programmability, DPOJET fully supports applications from device and system debug and characterization to short-run functional test and production.

Figure 2 – Spectrum, Eye Diagram, and BER curve of SATA-2 3.0 Gb/s MFTP.
Ordering information

Model
DPOJET Advanced

Options
Opt. DJA  Order preinstalled on a new oscilloscope

Upgrades
Order an upgrade for existing oscilloscope:

DPO-UP Opt. DJAE  MSO/DPO5000 Series
DPO-UP Opt. DJAM  DPO7000 Series
DPO-UP Opt. DJAH  DPO/MSO7000 Series, 4-8 GHz
DPO-UP Opt. DJAU  DPO/MSO7000 Series, >12 GHz
DPOFL-DJA  Floating License

Physical characteristics
Software is supplied on internal hard disk and on compact disk media, or can be downloaded from www.tektronix.com. Software installs and operates with DPO/DSA/MSO70000, DPO7000, or MSO/DPO5000 Series oscilloscopes. Online documentation and printable manual in PDF format are supplied with the product.

Recommended accessories

Opt. D-PHY  MIPI® D-PHY Essentials
Opt. DDRA  DDR Memory Bus Analysis
Opt. MOST  MOST Essentials Electrical Compliance and Debug Test Solution for MOST50
Opt. M-PHY  MIPI® M-PHY Essentials
Opt. PCE  PCI Express® Measurements for DPOJET
Opt. PCE3  PCI Express Gen 3 (includes opt. PCE) Measurements for DPOJET
Opt. SFP-TX  Ethernet SFP+ Compliance and Debug Solution
Opt. UHS2  SDA UHS-II DPOJET Essentials

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