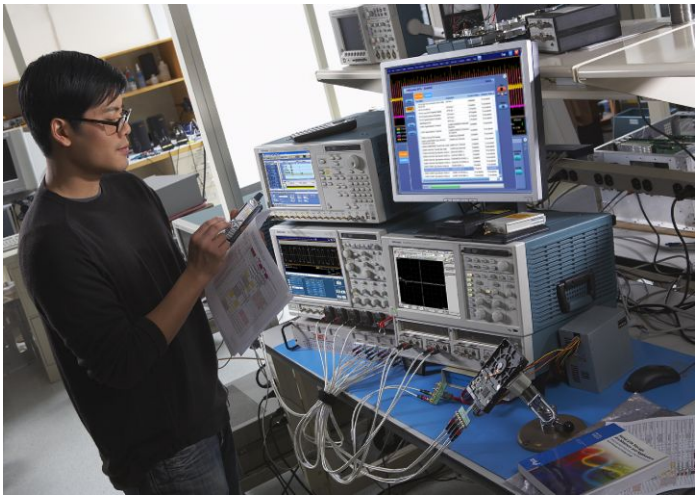
SAS Application Software

TekExpress SAS1-3 and DPOJET SAS4 Datasheet



Tektronix SAS test software provides an automated, simple, and efficient way to test SAS Gen1-3 host and device transmitters according to the requirements of the T10 as defined in accepted Methods of Implementation (MOI). It also provides comprehensive test and debug software for SAS4 Gen4 transmitters.

Key features

- 100% SAS Gen1, Gen2, Gen3 (TekExpress (TE)) and Gen4 (DPOJET) Physical Layer Test Coverage
- Performs all SAS Approved Transmitter Measurements
- 1.5, 3, 6, and 12 Gb/s SAS Physical Layer Transmitter Conformance Testing on DPOJET
- 22.5 Gb/s SAS Physical Layer Transmitter Compliance and debugging testing in DPOJET
- SAS-OOB measurements to debug and test using DPOJET
- Significant Reduction in Testing Time through Automation
- Repeatable and Accurate Results
- Automatic Report Generation

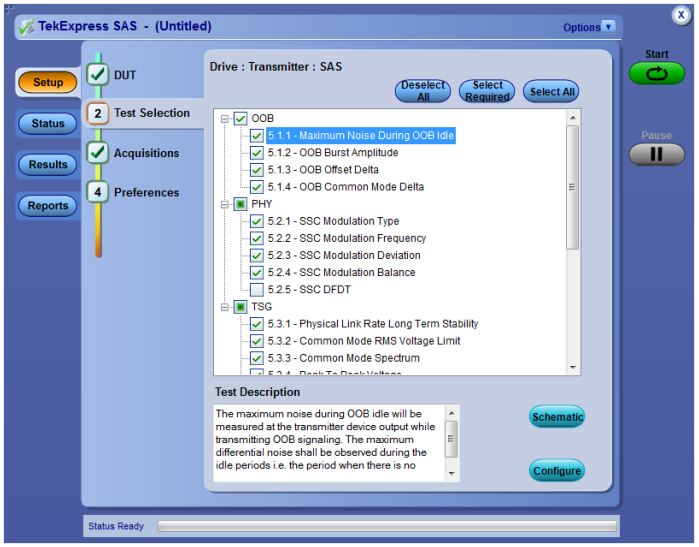
Applications

- Device and Host Conformance to SAS-3 Specifications
- PHY/TSG/OOB Transmitter Conformance Measurements
- Device and Host Validation
- Manufacturing Test and Factory Automation

TekExpress™ automated conformance test software

TekExpress SAS provides an automated, simple, and efficient way to test SAS hosts and devices according to the requirements of the SCSI Trade Association (STA), as documented in the University of New Hampshire's Interoperability Laboratory (UNH-IOL) test specification.

TekExpress automated conformance test software is an application that automates SAS testing with Tektronix Windows-based instruments. TekExpress SAS provides a completely automated, simple, and efficient way to test SAS Gen1, Gen2, and Gen3 hosts and devices according to the requirements of the T10 as defined in accepted Methods of Implementation (MOI). SAS Gen4 is supported as a debug and Compliance solution inside DPOJET. There is added support for OOB timing measurement in DPOJET for more information on OOB signaling.



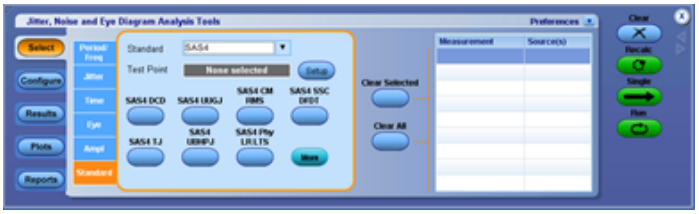
100% Automated - save time and resources

There's no longer a need to be an expert on all the required instrument user interfaces. Remembering how to use the instrumentation is often time consuming and typically requires a senior engineer who monitors the test spec development. Even if you remember how to use all the instruments, it's common for even the most experienced operator to forget steps in the procedure, like calibration, or setting up parameters correctly, like clock recovery, only to have to restart the test. The TekExpress software takes the human element out of the equation and yields accurate and repeatable measurements every time. No need to spend hours in the lab testing a single device or configuring a single test instrument. A user can simply press the Run button in the TekExpress test automation system, and let the system run to completion without user intervention.

SAS Gen4 compliance and debug solution

DPOJET SAS Gen4 solution provides and effective way to run compliance test and debug testing. It is supported by SAS Gen4 setup files which ensures that there is no need to be an expert on all the required instrument user interfaces. Once you have setup the instrument you need to just recall setup files and configure DUT to provide appropriate pattern. When measurement is run it will give you appropriate compliance results with Pass/Fail statistics.

Debugging a compliance failure is a monumental task. The DPOJET based SAS4 solution allows to configure the various acquisition parameters making debugging easy.



Setting up the bench

When setting up a test, nothing can be simpler than hooking up the test system by looking at a schematic. View the schematic of the selected test with a push of a button

Host/Device testing to the SAS electrical specification

One-button testing

Once the test bench is set up, the DUT is properly connected, and state control methods are established, simply press the Run button to perform the selected test suite.

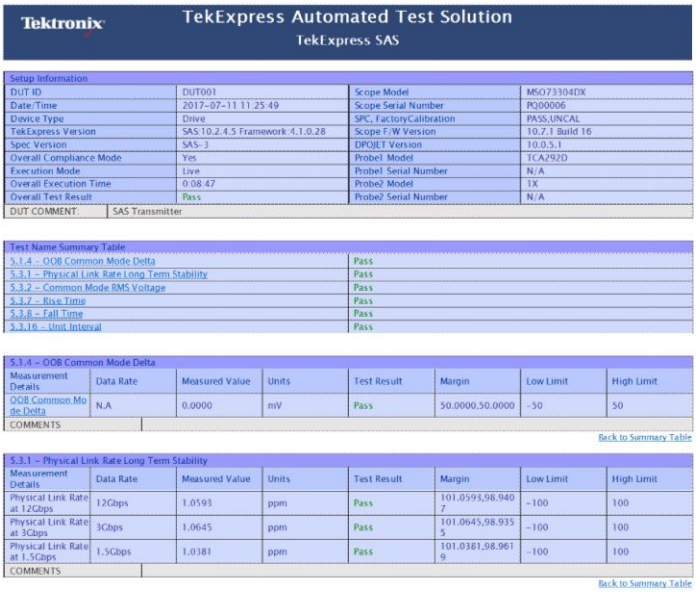
Online help and Show MOI

Online help is available through the Help menu.

Step-by-step status view of pattern validation, signal acquisition, and analysis

Pass/Fail report

The Report tab provides an HTML view of test results along with Pass/Fail status. Once testing is complete, an extensive report is automatically generated. If your report has a 100% passing score, your device can then be considered physical-layer conformant.



TekExpress Automated Test Solution
TekExpress SAS

Setup Information			
DUT ID	DUT001	Scope Model	MSO73304DX
Date/Time	2017-07-11 11:25:49	Scope Serial Number	PQ00006
Device Type	Drive	SPC, FactoryCalibration	PASS,UNCAL
TekExpress Version	SAS 10.2.4.5 Framework 4.1.0.28	Scope F/W Version	10.7.1 Build 16
Spec Version	SAS-3	DPOJET Version	10.0.5.1
Overall Compliance Mode	Yes	Probe1 Model	TCA292D
Execution Mode	Live	Probe1 Serial Number	N/A
Overall Execution Time	0:08:47	Probe2 Model	1X
Overall Test Result	Pass	Probe2 Serial Number	N/A
DUT COMMENT:	SAS Transmitter		

Test Name Summary Table	
5.3.4 – OOB Common Mode Delta	Pass
5.3.1 – Physical Link Rate Long Term Stability	Pass
5.3.2 – Common Mode RMS Voltage	Pass
5.3.7 – Rise Time	Pass
5.3.8 – Fall Time	Pass
5.3.16 – Unit Interval	Pass

5.3.4 – OOB Common Mode Delta

Measurement Details	Data Rate	Measured Value	Units	Test Result	Margin	Low Limit	High Limit
OOB Common Mode Delta	N.A	0.0000	mV	Pass	50.0000,50.0000	-50	50
COMMENTS							

Back to Summary Table

5.3.1 – Physical Link Rate Long Term Stability

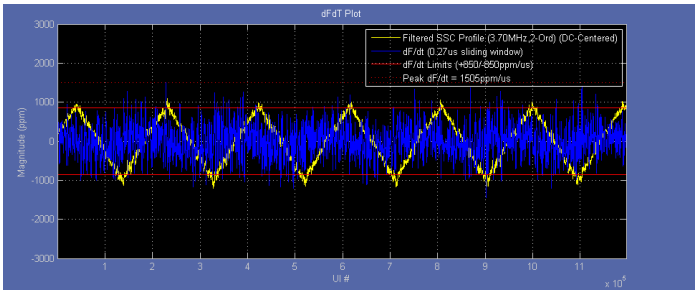
Measurement Details	Data Rate	Measured Value	Units	Test Result	Margin	Low Limit	High Limit
Physical Link Rate at 12Gbps	12Gbps	1.0593	ppm	Pass	101.0593,98.9407	-100	100
Physical Link Rate at 3Gbps	3Gbps	1.0645	ppm	Pass	101.0645,98.9355	-100	100
Physical Link Rate at 1.5Gbps	1.5Gbps	1.0381	ppm	Pass	101.0381,98.9619	-100	100
COMMENTS							

Back to Summary Table

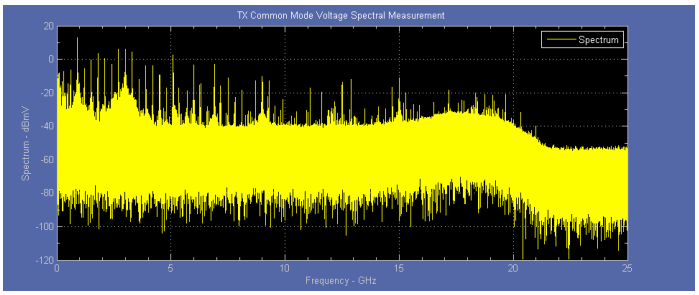
TekExpress report with setup information, summary vew, margin analysis and measurement plots

100% SAS Gen1, Gen2, and Gen3 Physical Layer test coverage to the latest Unified Test Document (UTD)

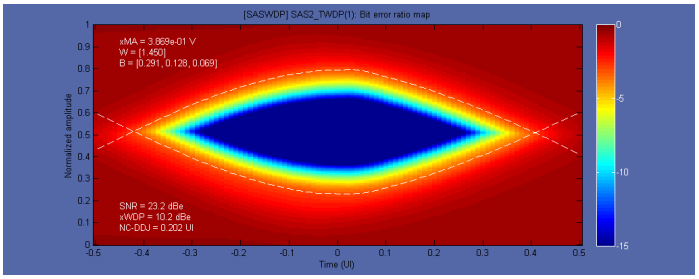
Signaling Group (TSG), Physical Layer (PHY) and Out-of-Bound (OOB). The TekExpress SAS software is an easy-to-use software package that automates 100% of the required SAS physical layer using the Tektronix multi-instrument test bench. The SAS test bench includes a real-time oscilloscope (DPO/MSO70000C/DX).



Comprehensive SSC Analysis Tools



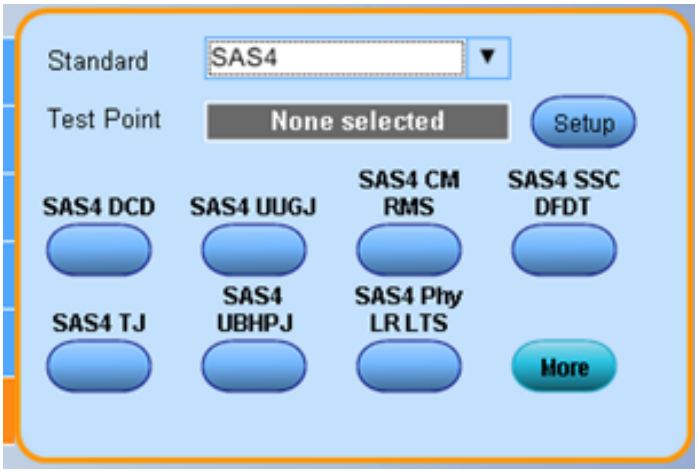
Transmitter Spectral Profile for Common Mode Analysis

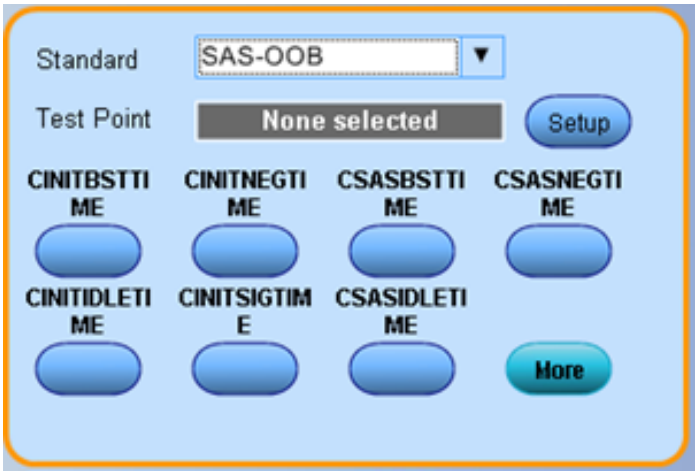


SAS-2 Waveform Dispersion Penalty (WDP measurement)

SAS Gen4 Physical Layer test coverage

SAS Gen4 debug solution allows easy Gen4 and OOB timing measurement. It covers 100% of SAS Gen4 TSG, Phy measurement. It also includes Timing measurement to validate different type of OOB signals.





SAS Physical layer transmitter conformance testing

Basic Spread Spectrum Clock modulation parameters such as frequency and spread, as mandated by the SAS specification, provide insight into potential interoperability problems. Noisy SSC, which can come from coupled power supply switching noise or mis-programmed clock circuits, has been the primary sources of system interoperability issues. The dFdT (rate of change of modulation frequency versus time) measurement allows in-depth analysis of Spread Spectrum Clocking issues.

SAS device characteristics are required to transmit common mode voltage and spectral power below specified levels for reliable system interoperability. The relative amplitude of the first and second signal harmonics offers insight into pulse symmetry and AC common mode components in the signal. TekExpress software saves you time by fully automating both time- and frequency-domain based common mode measurements.

TSG/PHY/OOB and SAS-WDP automation

For transmitter testing, TekExpress (Opt. SAS3-TSG, and SAS3-TSGW) performs all the tests required by the specification. SAS transmitter conformance measurements involve a multitude of complex measurements, including a unique vertical amplitude measurement.

The WDP result provides a measurement of non-compensable ISI and provides more insight into potential BER issues related to channel effects.

SAS4 testing (option SAS4-TSG) performs all SAS Gen4 tests. It allows easy measurement and DUT validation. It also allows easier debugging with customized plot for better understanding on failure points.

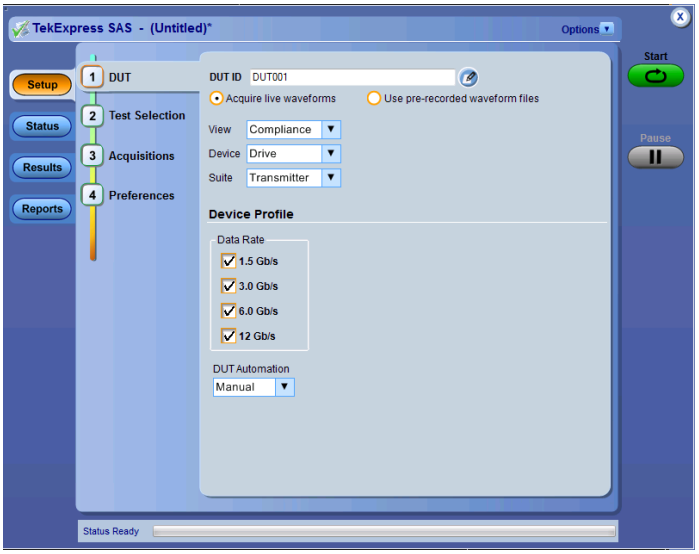
SAS-3 Automated conformance test software

SAS-3 requires measurements and specification limits for next- generation SAS devices. The 12 Gb/s data rate has led to the introduction of more advanced methods of compensating for channel loss with transmitter and receiver equalization. With the higher data rate and multi-lane topology SAS designers are presented with a number of test and measurement challenges, including fixture effects and the need to isolate crosstalk. Coupling of energy from adjacent signaling lanes adds noise and jitter that can affect system interoperability. Effective debug requires jitter analysis tools that can properly separate and classify the jitter components of a signal, including those stemming from crosstalk. Option SAS3 and DPOJET software provide the in-depth analysis for characterizing Bounded Uncorrelated Jitter (BUJ) that results from cross- channel coupling of adjacent lanes.

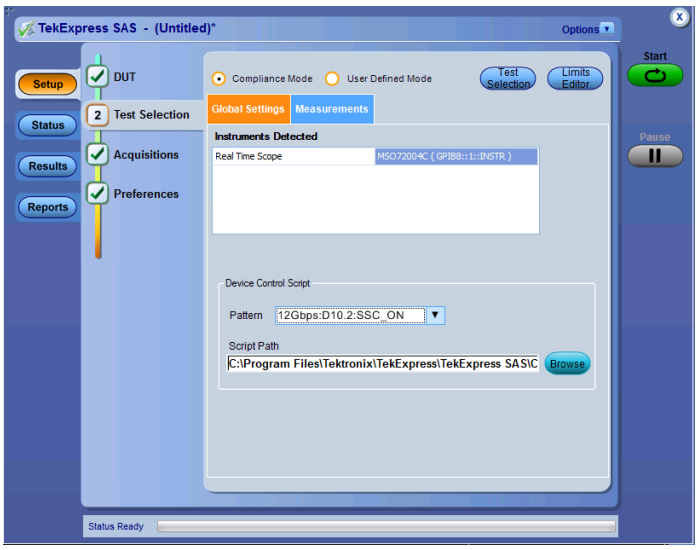
Because of reduced margins due to test fixture losses it's often necessary to perform test fixture de-embedding. De-embed filters can be easily created using Serial Data Link Analysis (Option SDLA64) software and then easily applied while making SAS measurements. In addition to jitter, option SAS3 also provides voltage, spread spectrum clocking (SSC), and other AC parametric measurements.

Option SAS3 also includes SAS3_EYEOPENING for accurate analysis of ISI and crosstalk effects and relative vertical eye opening after reference equalization. Similar to WDP for testing 6 Gb/s SAS designs, this measurement provides a figure of merit for evaluating non- compensable ISI and crosstalk while including both reference Tx and Rx equalization effects. SAS3_EYEOPENING as implemented in option SAS3- TSGW directly reports the ratio of Vertical Eye Opening to Reference Pulse Response Cursor Ratio. This measurement is also used for calibration of ISI channel effects for 12 Gb/s SAS receiver testing.

Fast transmitter testing with the TekExpress SAS3-TSG and SAS3-TSGW software provides complete 1.5, 3, 6, and 12 Gb/s SAS validation with minimal user intervention. In addition to the measurements included with Option SAS3, the TekExpress SAS software automatically sets up the measurements, archives captured waveform data, and generates a test report. This report includes pass/fail results, including margin results, and waveform images, plots, and other relevant reference information.



SAS-3 Transmitter Measurement Suite



Simple DUT State Control with Custom Scripts

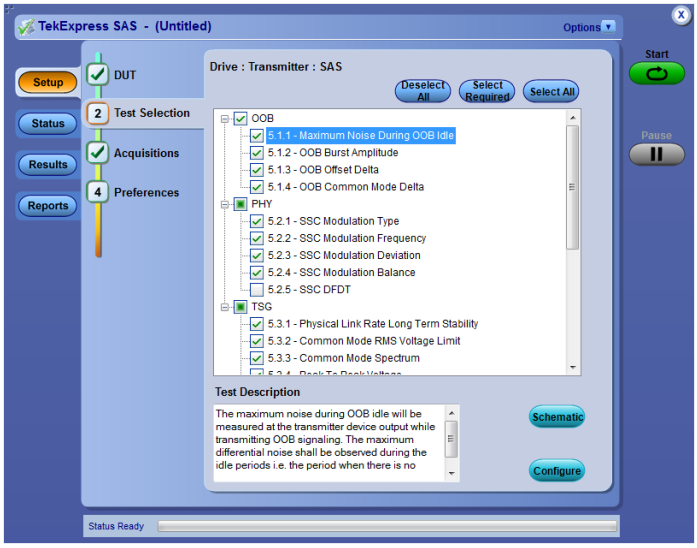
SAS3 Transmitter characterization

TekExpress (Opt. SAS3-TSG and SAS3-TSGW) software provides physical layer validation measurements which adhere to the SCSI Trade Association's SAS-3 (1.5, 3, 6, and 12 Gb/s) Physical Layer Test conformance program. It encompasses the breadth of SAS conformance tests defined by UNH-IOL and the SCSI Trade Association (STA). TekExpress supports full test automation with devices and host designs that have incorporated test mode initiation. For designs that don't include test mode support TekExpress SAS-TSG has two options for testing:

- **Manual Operation (Default)** – Prompts the user to output the required test signals from their SAS device or host. Users need to be able to control SSC on or off, Scrambled Zero, D10.2 (Clock patterns), and D24.3.
- **Batch File Scripting** – TekExpress SAS-TSG can be configured to call a batch scripting mechanism at the required pattern transitions if interactions with customer-specific serial ports or other interfaces are required.

SAS3 Transmitter test suite

Options SAS3-TSG, SAS3-TSGW, and SAS3 software provide physical-layer validation measurements which adhere to the latest SAS-3 physical-layer specification.



SAS-3 Transmitter Test Suite

Test	Description
Group 1: OOB Signaling	
5.1.1	Maximum Noise During OOB Idle
5.1.2	OOB Burst Amplitude
5.1.3	OOB Offset Delta
5.1.4	OOB Common Mode Delta
Group 2: Spread Spectrum Clocking (SSC) Requirements	
5.2.1	SSC Modulation Type

5.2.2	SSC Modulation Frequency
5.2.3	SSC Modulation Deviation
5.2.4	SSC Balance
5.2.5	SSC DFDT
Group 3: NRZ Data Signaling Requirements	
5.3.1	Physical Link Rate Long Term Stability
5.3.2	Common Mode RMS Voltage
5.3.3	Common Mode Spectrum
5.3.4	Peak-to-Peak Voltage
5.3.5	Voltage Modulation Amplitude (VMA)
5.3.6	Equalization

5.3.7	Rise Time
5.3.8	Fall Time
5.3.9	Random Jitter (RJ)
5.3.10	Total Jitter (TJ)
5.3.11	Waveform Distortion Penalty (WDP)
5.3.12	SAS3_EYEOPENING
5.3.13	Pre Cursor Equalization
5.3.14	Post Cursor Equalization
5.3.15	Transition Bit Voltage PK-PK (VHL)
5.3.16	Unit Interval

Ordering information

Conformance testing	Models
SAS (6 Gb/s)	12.5 GHz or higher bandwidth models
SAS-3 (12 Gb/s)	25 GHz or higher bandwidth models recommended, minimum of 20 GHz is required
SAS-4 (22.5 Gb/s)	33 GHz or higher bandwidth models

Prerequisite host system software requirements

- Microsoft Explorer 6.0 SP1 or later
- Microsoft Photo Editor 3.0 or equivalent for viewing image files
- Adobe Reader 6.0 or equivalent software for viewing portable document format (PDF) files

SAS4-TSG, SAS3-TSG, SAS3-TSGW, SAS3 Physical-layer test Application

Model	New instrument orders	Product upgrades	Floating licenses
DPO/MSO70000C/DX/SX Series Real-Time Oscilloscope	Opt. SAS3-TSG [1] [2]	DPO-UP SAS3-TSG	DPOFL-SAS3-TSG
	Opt. SAS3-TSGW [3]	DPO-UP SAS3-TSGW	DPOFL-SAS3-TSGW
	Opt. SAS3 [2]	DPO-UP-SAS3	DPOFL-SAS3
DPO/MSO70000DX/SX Series Real-Time Oscilloscope	Opt SAS4-TSG	DPO-UP SAS4-TSG	DPOFL-SAS4

Recommended test instruments

DPO/MSO70000C/DX/SX Series Real-Time Oscilloscope	For TSG/PHY/OOB and RSG testing

Recommended accessories

TF-SAS-TPA-P	SAS Gen3 Plug Adapter
TF-SAS-TPA-R	SAS Gen3 Receptacle Adapter
TF-SAS-TPA-PRC	SAS Gen3 Adapter Kit (Plug/Receptacle/Cal)
TF-SASHD-TPAR-P	MiniSASHD 12G SAS (Right Side) Plug
TF-SASHD-TPAL-P	MiniSASHD 12G SAS (Left Side) Plug
TF-SASHD-TPA-R	MiniSASHD 12G SAS Receptacle
TF-SASHD-TPA-PR2XC	MiniSASHD 12G SAS (Right Side) Plug, Receptacle, Dual 2X Calibration
TF-SASHD-TPA-2XC	MiniSASHD 12G SAS Dual 2X Calibration
TF-SASHD-TPAR-PR	MiniSASHD 12G SAS (Right Side) Plug, Receptacle

1 SAS3-TSG includes SAS3 free of charge as a bundle option as the keycode for SAS3-TSG also enables SAS3

2 Requires Option DJA (DPOJET Jitter and Eye Diagram Analysis) and 5XL record length (50 Million point memory). DJA is standard on MSO70000 Series oscilloscopes

3 SAS3-TSG required to run SAS3-TSGW.

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