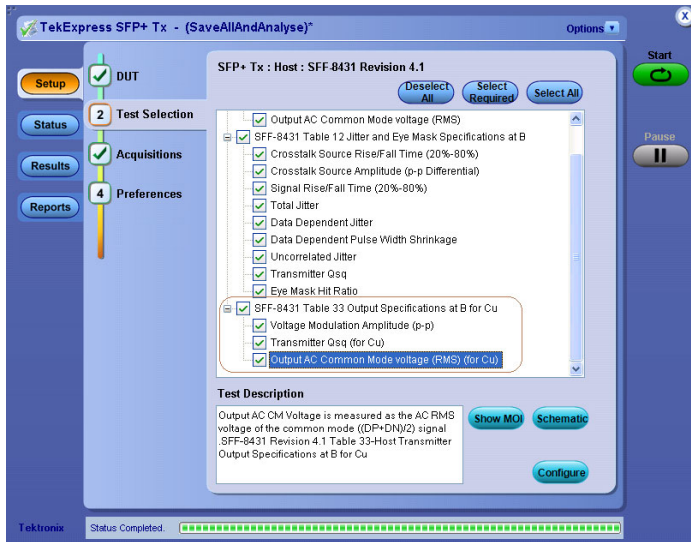


Ethernet SFP+ Compliance and Debug Solution

SFP-TX, SFP-WDP Data Sheet



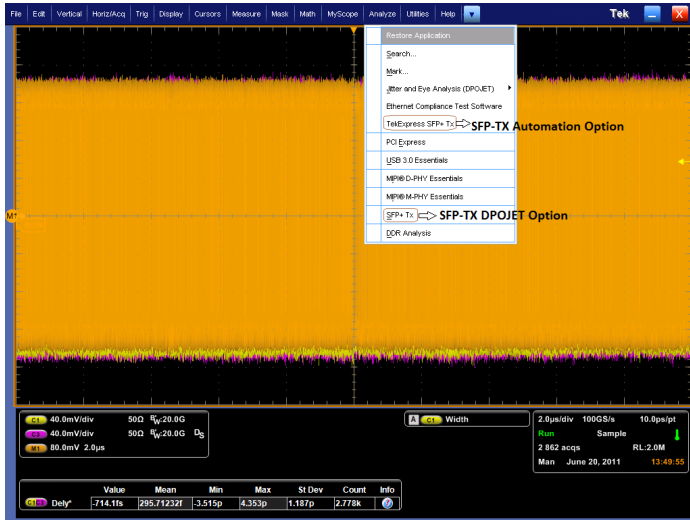
TekExpress SFP-TX user interface for PHY measurements including SFP+ Direct Attach Cable Specifications "10GSFP+CU".

Features & Benefits

- Option SFP-TX and SFP-WDP enable both an Automation Solution (for Compliance) and DPOJET Option (for Debug)
- TWDPc – Transmitter Waveform Distortion Penalty for Copper Measurements are Available to Customers with Option SFP-WDP
- Provides Customers with a Tektronix Floating License Installation Option
- Detailed Test Reports with Margin and Statistical Information Aid Analysis
- User-defined Mode enables Flexible Parameter Control for Characterization and Margin Analysis
- Complete Programmatic Interface Available; Users can call SFP-TX Functions using their Automation Scripts
- Signal Acquisition and Analysis Support Available using Cost-effective SMA Cables
- New Intuitive User Interface and Framework Decreases Testing Time and Learning Curve for End Users
- Measurements are Grouped on Signal Types Best Suited for the Measurement, which Reduces User Intervention
- End-users can Receive E-mail Notification on Measurement Results and Stay Connected with their Test Setup
- Design Engineers can Utilize many Built-in Reporting Features such as Appending the Report, Auto-incrementing the Report, Including User Comments, etc. to Tailor their Reporting Requirements
- SFP-TX Compliance Solution performs Automatic Signal Validation before Performing Tests and Throws an Error if the Signal does not Meet Acceptable Limits

Applications

- Ethernet SFP+ PHY Transmitter and Direct Attach Cable Testing for:
 - Device Silicon Validation
 - Cable and Connector Validation
 - System Compliance and Debug
 - Manufacturing Test



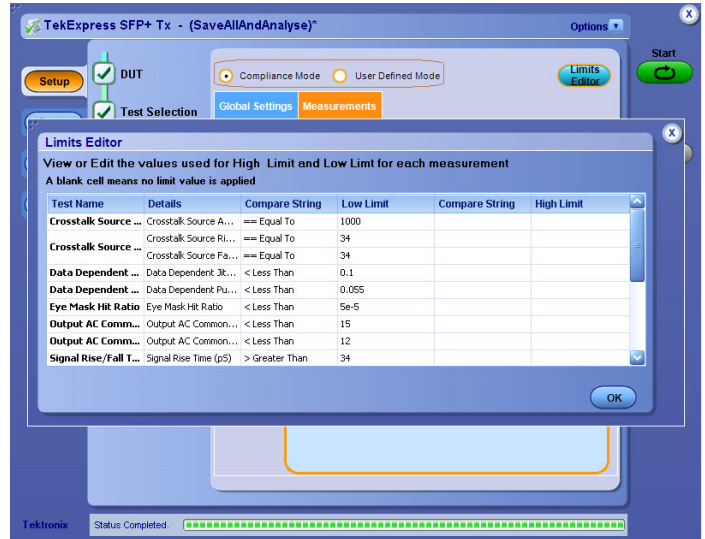
Option SFP-TX enables both an automation solution (for compliance) and DPO option (for debug).



DPOJET SFP-TX user interface.

TekExpress SFP-TX Measurement Setup

The new SFP-TX solution helps customers to easily select measurements for SFF-8431 SFP+ testing. Simple and easy-to-use measurement setup helps customers perform all measurements with a single button click. Automation options help customers meet their compliance needs and generate detailed reports. User-defined mode lets customers make changes to the test limits and perform margin testing beyond compliance.



User-defined mode enables flexible parameter control for characterization and margin analysis.

DPOJET SFP-TX Measurement Setup

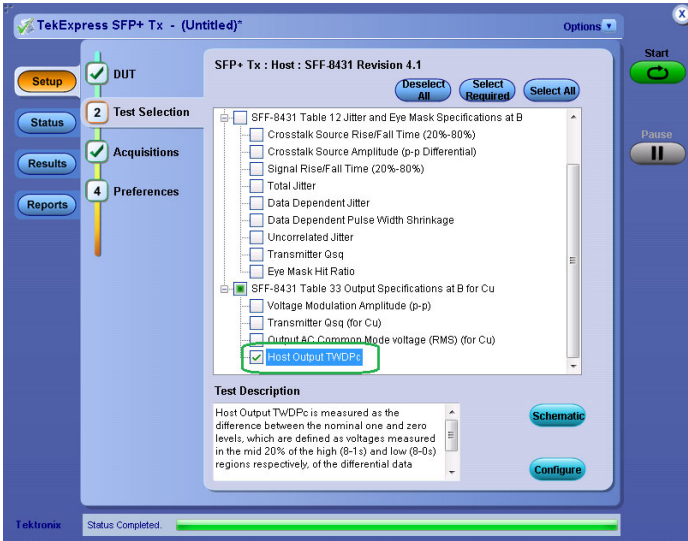
The new SFP-TX solution helps customers to easily select measurements for SFF-8431 SFP+ testing. All masks, limits, and measurement parameters are automatically configured for the customer. Additionally, customers have the flexibility to change selected measurements and measurement configurations within DPOJET. SFP-TX DPOJET options provide a new standard-specific UI. Seven new additional measurements have been added including VMA, Rise Time, Tx-Qsq, DDPWS, Fall Time, UJ, and TWDPc which were not part of the original DPOJET package. Setup files are provided based on different signal types such as 8180, PRBS9, and PRBS31. Signal-specific setup files allow design engineers to perform measurements on different signal types, letting them go into Analysis and Debug mode.

Simplified Instrument Setup – Save Time and Resources

Setup and test execution is simple with the SFP-TX software. The oscilloscope acquisition and analysis are all controlled through the SFP-TX automation solution. The software’s Graphical User Interface (GUI) provides an intuitive workflow for setup and testing.

Margin Testing

Design characterization is supported beyond SFF-8431 SFP+ compliance requirements for all measurements. Qualify PHY with flexible control over test configurations such as analysis windows and other parameters. User-defined mode lets customers make changes to the test limits and perform marginal testing beyond compliance.



SFP-TX TWDPc Measurement – TekExpress User Interface.



SFP-TX TWDPc Measurement – DPOJET User Interface.

TWDPc – Transmitter Waveform Distortion Penalty for Copper

SFF-8431 SFP+ suggests that this measurement should be performed on SFP+ Host Transmitter Output Specifications at B for Cu.

Customers who plan to use TWDPc measurements need to purchase Option SFP-WDP. TWDPc is a measure of the deterministic dispersion penalty due to a particular transmitter with reference to the emulated multi-mode fibers and a well-characterized receiver. TWDPc is initially defined to characterize the performance of a transmitter in optical links. The

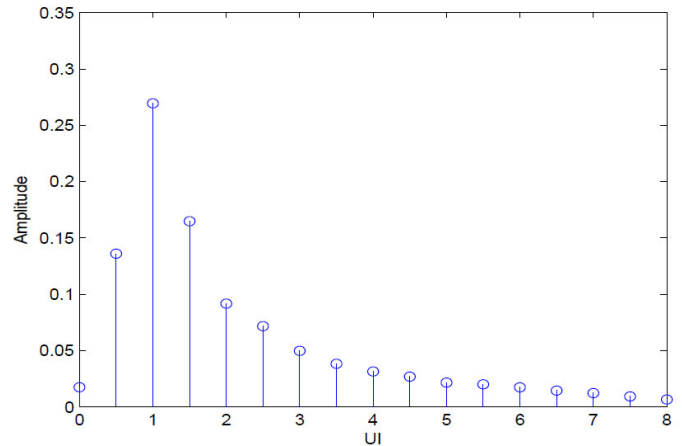


Figure 1 – TWDPc Stressor Impulse Response.

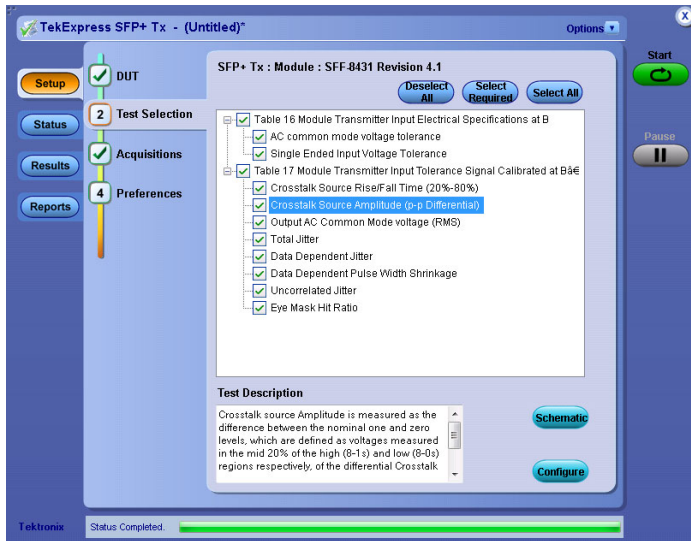
same concept has been extended to quantify channel performance as well, especially in high-speed copper links. SFF-8431 Revision 4.1 Table 33 – Host Transmitter Output Specifications at point B for Cu.

For TWDPc compliance, a simulated cable response is required. The response is modeled as a set of delta functions with specific amplitudes and delays. The copper stressor was created from measurements of commonly available direct attach SFP+ cables with the transmitter response de-convolved. The stressor is shown in Figure 1 and the values are listed in Table 34 of the SFF-8431 SFP+ specification. The sum of all stressor components is normalized to an approximate value of 1.

TWDPc measurements are supported only on C and D Series real-time oscilloscopes with a sampling rate of 100 GS/s and ≥ 16 GHz bandwidth due to the following:

- The TWDPc script (of 802.3aq, 10GBASE-LRM) processes a PRBS9 pattern requiring at least 16 samples per unit interval
- Out of concern for the large installed base of sampling oscilloscopes with a record length of around 4000 samples the requirement for 16 samples per unit interval is relaxed to 7 samples per unit interval
- The relaxation of the requirement for 16 samples per unit interval to just 7 samples per unit interval causes worst-case 0.24 dB TWDPc pessimism over 30 measurements. For DUTs that already have a high WDP, 0.24 dB can be the difference between a Pass or Fail result
- With a DPO/DSA/MSO7000C/D Series oscilloscope, a 100 GS/s sampling rate is available. Around 10 samples per UI will be obtained from the hardware. However, on a DPO/DSA/MSO7000A/B Series oscilloscope, only a 50 GS/s sampling rate is available in RT mode. The maximum number of samples per UI from the hardware will be limited to 5. This will not meet the minimum requirement of 7 samples per UI

Therefore, it is recommended to only run TWDPc measurements on DPO/DSA/MSO7000C/D Series oscilloscopes.



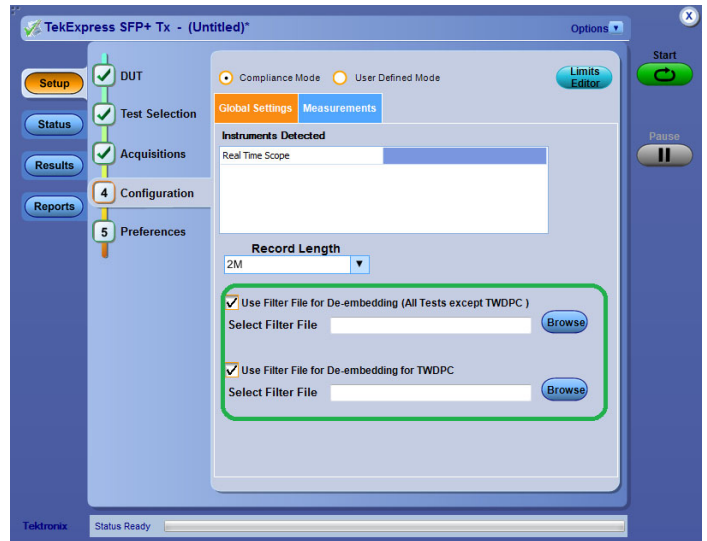
SFP-TX Module Measurements – User Interface.

SFP+ Module Measurements

SFP-TX supports 10 new measurements for the SFP+ module. These include AC Common Mode Voltage Tolerance, Single-ended Input Voltage Tolerance, Crosstalk Source Rise/Fall Time (20-80%), Crosstalk Source Amplitude (P-P Differential), Output AC Common Mode Voltage (RMS), Total Jitter, Data Dependent Jitter, Data Dependent Pulse Width Shrinkage, Uncorrelated Jitter, and Eye Mask Hit Ratio.

De-embedding Feature

As data rates increase, high-speed serial technologies have introduced new test methodologies and requirements for compliance testing. As technologies such as SFP+ increase in data rates, the eye is closed and different components such as SMA cables can be de-embedded to get

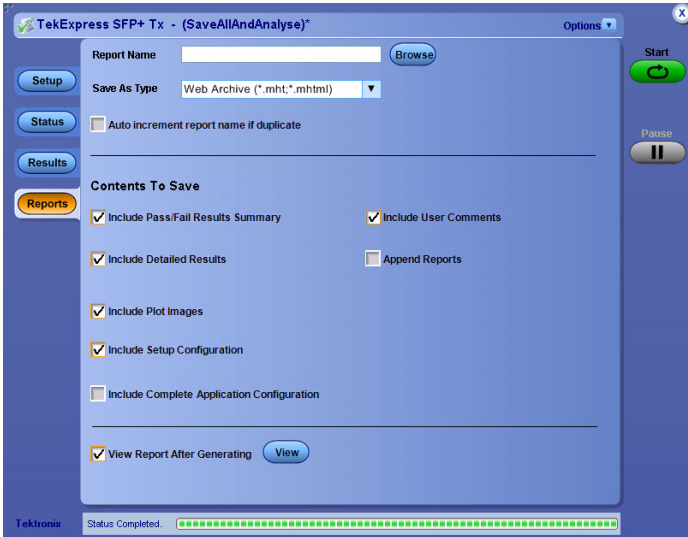


De-embedding Feature in SFP-TX.

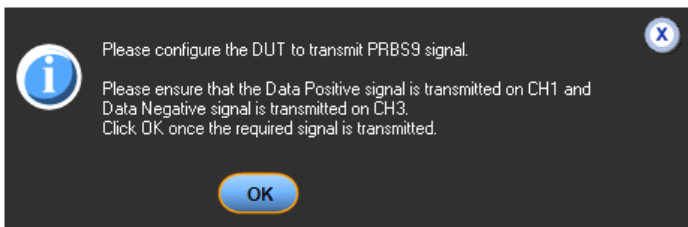
better results. SFP-TX provides an option to de-embed the signal using .FLT files.

10GBASE-KR Physical Layer Testing

Greater bandwidth needs due to higher performance demands are leading to increased lanes, which increases the complexity of interconnects, resulting in bottleneck. IEEE standard 802.3ap-2007 provides a solution with 10GbE serial backplane connectivity – 10GBASE-KR. The KR standard was approved in 2007 by IEEE. It also makes a 40GbE MAC rate possible by leveraging four KR lanes. With many factors working to degrade signal performance in 10GBASE-KR, compliance testing becomes a critical step for backplane designers. DPOJET can be used to perform 10GBASE-KR physical layer testing, please contact your local representative for more details.



Report configuration menu.



Pop-up messages allow users to configure the DUT to transmit a particular signal type.

Report Configuration Menu

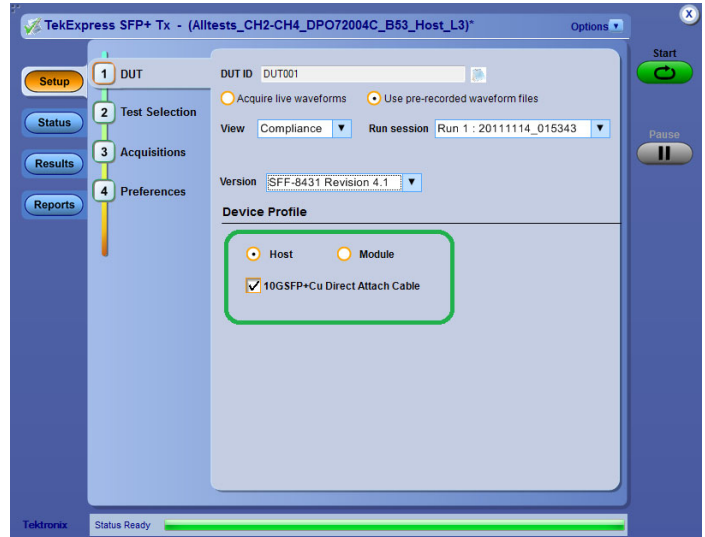
The report configuration menu lets users configure reports, and it provides options such as auto increment, appending, etc.

One-button Testing

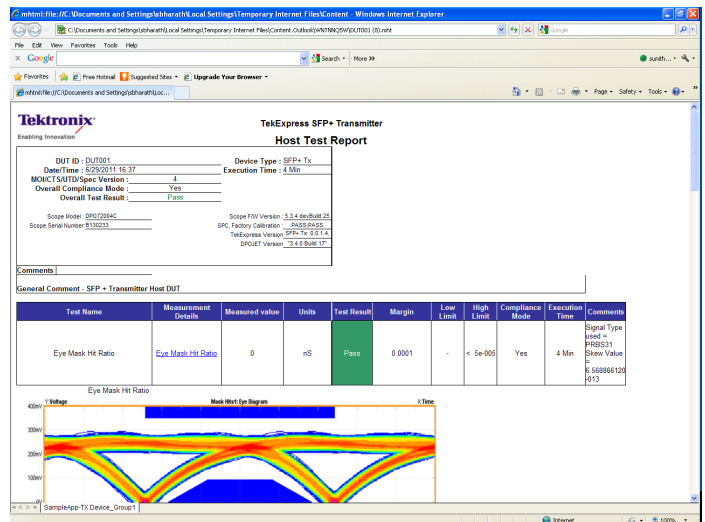
Once the test bench is set up and the DUT is properly connected, simply press the Run button to perform the selected test suite. The SFP-TX solution prompts the end-user to put the DUT into different test modes by popping messages at regular intervals.

Automation Support

Save and recall setup files in automation script, with an option to automate the complete test bench. Tektronix end-users can call the SFP-TX application programmatically through NI LabVIEW, NI TestStand™, or any other scripting language for controlling SFP-TX along with other instrumentation such as thermal chambers and power supplies.



Use prerecorded waveforms.



SFP-TX report.

Pass/Fail Report

A summary report in .MHT (MHTML) format with Pass/Fail status is automatically generated after tests complete. The report includes test configuration details, waveform plots, and margin analysis to provide more insight into your design.

Specifications

SFF-8431 SFP+ Measurements Covered in SFP-TX Solution

SL No.	Measurements	Recommended Signal Type	Limit			Units
			Min	Target	Max	
Host Transmitter Output Electrical Specifications						
1	Single-ended Output Voltage Range	PRBS31	-0.3		4	V
2	Output AC Common Mode Voltage (RMS)	PRBS31			15	mV (RMS)
Host Transmitter Jitter and Eye Mask Specifications						
3	Crosstalk Source Rise/Fall Time (20%-80%) (Tr, Tf)	8180		34		ps
4	Crosstalk Source Amplitude (p-p differential)	8180		1000		mV
5	Signal Rise/Fall Time (20%-80%) (Tr, Tf)	8180	34			ps
6	Total Jitter (p-p) (TJ)	PRBS31			0.28	UI (p-p)
7	Data Dependent Jitter (p-p) (DDJ)	PRBS9			0.1	UI (p-p)
8	Data Dependent Pulse Width Shrinkage (p-p) (DDPWS)	PRBS9			0.055	UI (p-p)
9	Uncorrelated Jitter (RMS) (UJ)	PRBS9			0.023	UI (p-p)
10	Transmitter Qsq	8180	50			
11	Eye Mask Hit Ratio (Mask hit ratio of 5×10^{-5})	PRBS31		X1 = 0.12 UI, X2 = 0.33 UI, Y1 = 95 mV, Y2 = 350 mV		
Host Transmitter Output Specifications for Cu (SFP+ host supporting direct-attach cables)						
12	Voltage Modulation Amplitude (p-p)	8180	300			mV
13	Transmitter Qsq Output AC Common Mode Voltage	8180	63.1			
14	Output AC Common Mode Voltage	PRBS31			12	mV (RMS)
15	Host Output TWDPc	PRBS9			10.7	dBe

Transmitter Characteristics for 10GBASE-KR

Characteristic	Sub-clause Reference	Value	Unit
Signaling Speed	72.7.1.3	10.3125 ±100 ppm	GBd
Maximum Differential P-P Output Voltage	72.7.1.4	1200	mV
Maximum Differential P-P Output Voltage with Tx Disabled	72.6.5	30	mV
Common-mode Voltage Limits	72.7.1.4	0-1.9	V
Minimum Differential Output Return Loss	72.7.1.5	[See Equation (72-4) and Equation (72-5)] in 802.3ap-2007	dB
Minimum Common-mode Output Return Loss	72.7.1.6	[See Equation (72-6) and Equation (72-7)] in 802.3ap-2007	dB
Transition Time (20-80%)	72.7.1.7	2-47	ps
Maximum Output Jitter (P-P)	72.7.1.8	0.15	UI
Random Jitter	72.7.1.8	0.15	UI
Deterministic Jitter	72.7.1.8	0.035	UI
Duty Cycle	72.7.1.8	0.28	UI
Transmitter Output Waveform Requirements	72.7.1.11	Equalizer Parameter	

Ordering Information

SFP-TX, SFP-WDP

SFF-8431 SFP+ Compliance and Debug Solution.

To Order Along with Oscilloscope

Oscilloscope	Option
SFP-TX	
DPO/DSA/MSO70000	Order SFP-TX
SFP-WDP	
DPO/DSA/MSO70000	Order SFP-WDP

To Upgrade an Existing Oscilloscope

Oscilloscope	Option
SFP-TX	
DPO/DSA/MSO70000	Order DPO-UP SFP-TX
DPO/DSA/MSO70000	Order DPOFL-SFP-TX (Floating License)
DPO/DSA/MSO70000	Order DPOFT-SFP-TX (Floating Trial)
SFP-WDP	
DPO/DSA/MSO70000	Order DPO-UP SFP-WDP
DPO/DSA/MSO70000	Order DPOFL-SFP-WDP (Floating License)
DPO/DSA/MSO70000	Order DPOFT-SFP-WDP (Floating Trial)

SFP-TX Test Fixture

Product	Description
TF-SFP-TPA-HCB-P	SFP+ Host Compliance Board Plug
TF-SFP-TPA-MCB-R	SFP+ Module Compliance Board Receptacle
TF-SFP-TPA-PR	SFP+ Host Compliance Board Plug and Module Compliance Board Receptacle
TF-SFP-TPA-HCB-PK	SFP+ Host Compliance Board Plug Kit with DC Blocks and Termination
TF-SFP-TPA-MCB-RK	SFP+ Module Compliance Board Receptacle Kit with DC Blocks and Termination
TF-SFP-TPA-PRK	SFP+ Host Module Compliance Board and Module Compliance Board with DC Blocks and Termination

Recommended Equipment

Oscilloscope	Required Software	Required Accessories	Test Fixture
DPO/DSA/MSO71604C	SFP-TX, DJA* ¹ , SFP-WDP* ^{2,3}	Matched-pair SMA Cables (TCA-SMA connector)	TF-SFP-TPA-HCB-PK – Host Compliance Board
DPO/DSA/MSO72004C			
DPO/DSA72504D			
DPO/DSA73304D			

*¹ Prerequisite for SFP-TX.

*² SFP-TX is a prerequisite for SFP-WDP.

*³ Option SFP-WDP is only available on C and D Series Tektronix oscilloscopes with 100 GS/s sampling rate and ≥16 GHz bandwidth.

Recommended Tektronix Oscilloscopes for SFF-8431 SFP+ PHY Testing

DPO/DSA/MSO71604C
 DPO/DSA/MSO72004C
 DPO/DSA72504D
 DPO/DSA73304D

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Switzerland 00800 2255 4835*
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United Kingdom & Ireland 00800 2255 4835*
USA 1 800 833 9200

* European toll-free number. If not accessible, call: +41 52 675 3777

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For Further Information. Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit www.tektronix.com



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