

PCI Express

PCI Express Receiver Test Software Datasheet



- Increases the reliability and accuracy by removing inconsistencies with manual calibration
- The BSX BERTScope series provides the tools and flexibility you need to visualize and control the handshaking and link training process for PCIe 3.0/4.0 devices.

Applications

- PCIe Receiver Testing for:
 - Host and device silicon validation
 - Add-in card and system compliance testing
 - Switch, Bridge and Retimer silicon validation

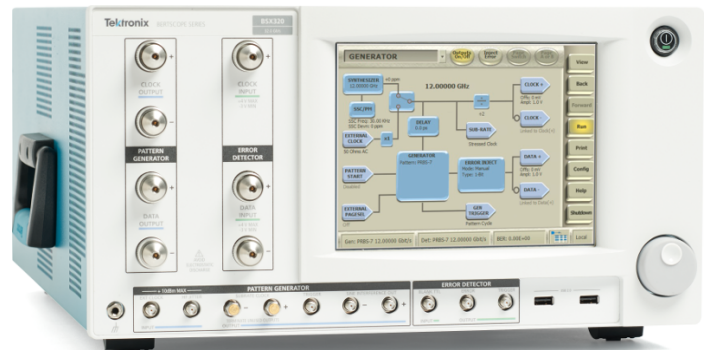
Complete BERTScope automation for receiver testing

The BERTScope Automated PCIe Receiver Solution is designed to streamline the tedious and labor-intensive receiver test workflow. No longer is expert PCIe domain knowledge required to configure, calibrate, test, and document the results. Fast and accurate BERT-based testing provides high test throughput, intuitive and fast margin testing, and availability of a wide range of debugging tools when further testing is required. The result is high test productivity from setup through to the documentation of results.

This solution can also be used for the latest, emerging storage interfaces such as next-generation SSD and host controller interfaces that utilize NVMe and SATA Express protocols that reside on top of a PCIe physical layer.

Test configuration wizard

The BERTScope Test Configuration Wizard provides step-by-step guidance for Receiver Test equipment setup and software setup. Clearly drawn block diagrams, cabling configurations, and descriptions simplify the test configuration setup.

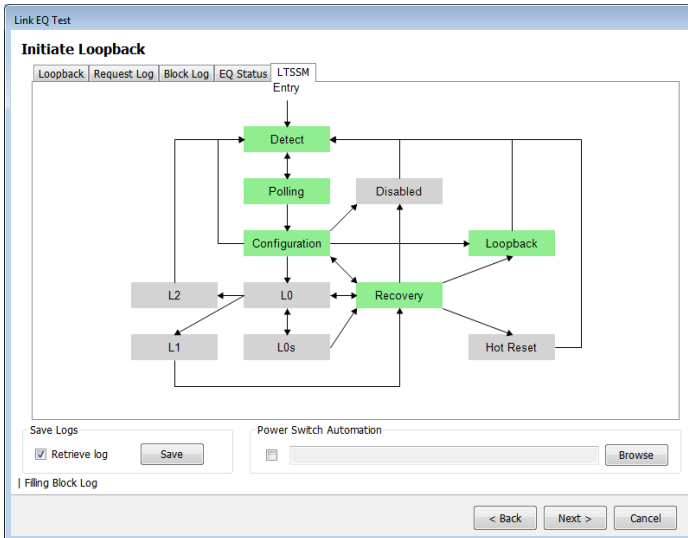


BERTScope BSX Series

The BERTScope Automated PCIe Receiver Solution is designed to streamline the tedious and labor-intensive receiver test workflow.

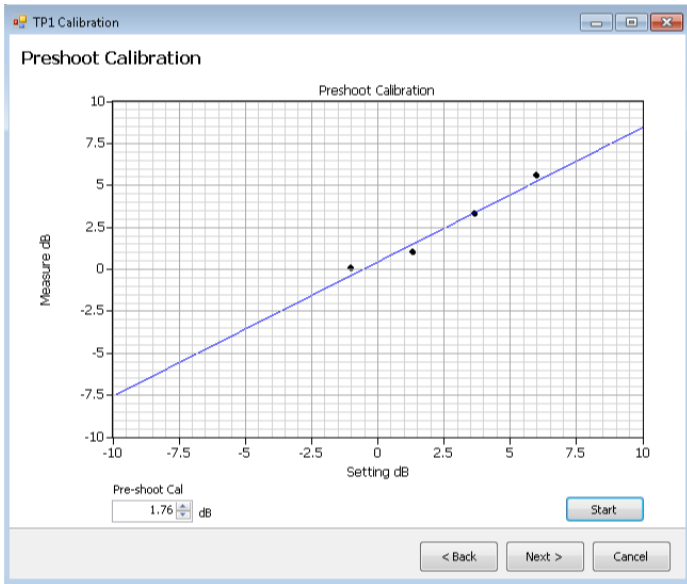
Features and benefits

- Automated calibration, link training, loopback initiation, and testing
- BER Map feature for TxEQ optimization
- Reduces the time and minimizes the skill-set required to perform the calibration and testing

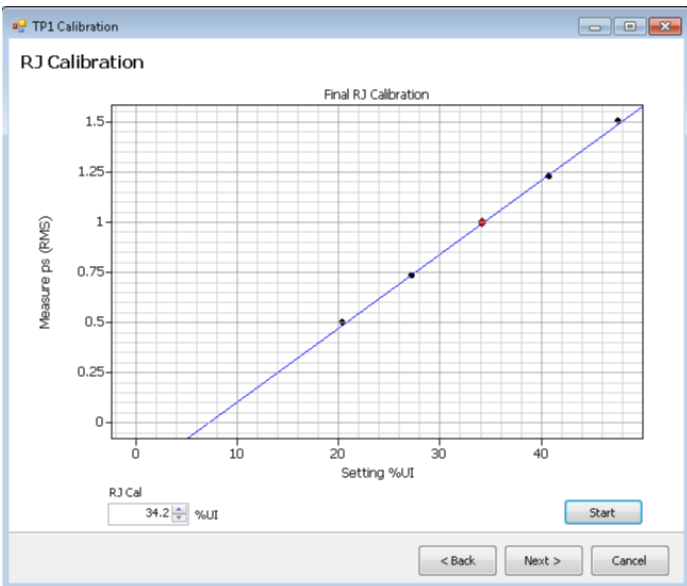


Loopback initiation and link training

Before the receiver test can start, the device-under-test (DUT) must be put in the proper test mode, called Loopback, where the device is re-transmitting the exact same data that was received. Entering Loopback mode is challenging because of the variety of loopback negotiation sequences across the range of PCIe devices. The BERTScope PCIe software provides various techniques, including Link Training, to train and optimize the link for receiver testing.



Automatic characterization and precise calibration of preshoot



Automatic characterization and precise calibration of random jitter

Preset Test

Initiate Loopback

Loopback | Request Log | Block Log | EQ Status | LTSSM

Step	Status
Set Preshoot/Deemphasis	Setting PE to 3.51dB, and DE to -6.39dB OK
Set Stresses	Set Stresses OK
Configure Loopback	Configure Loopback OK
Load Sequence	Loaded sequence OK
Init Loopback	Loopback OK
Validate Loopback	Reports OK
Check Detector Clock	Detector clock is OK
Autoalign Detector	Detector Autoalign OK
Check Detector Sync	Detector sync is OK
Success	DUT is in Loopback mode

Retrieve log from Equipment Save Log Start

< Back Next > Cancel

Preset Test

Configure Loopback

Basic | Advanced | Block Log

Use Link Equalization

Link #: 0 BERT Initial Preset: P7

Lane #: 0 Preshoot: 3.50 dB

FTS: 255 Deemphasis: -6.00 dB

Find Safe Sampling Point Preset/Hint: PD_0

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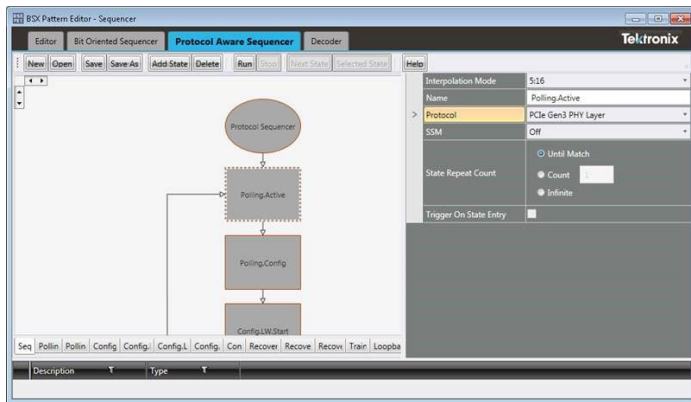
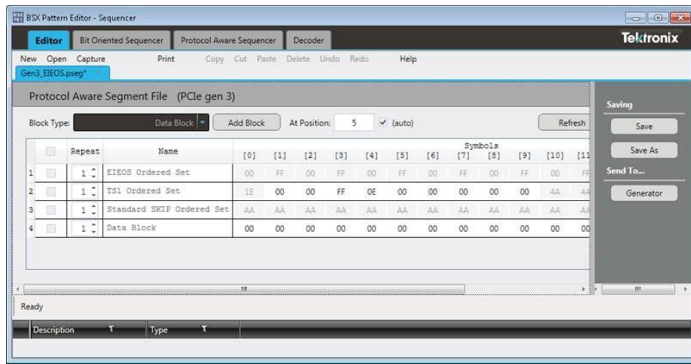
Flexible link training and loopback control

Pattern and protocol sequencer

The BSX includes a pattern/protocol sequencer that allows users to create their own protocol-based patterns and link state traversals via stimulus-response feedback. The sequencer assists users in initiating and debugging protocol handshaking by facilitating the creation of customizable protocol sequences.

The sequencer supports up to 128 states and two levels of loop nesting. Advancing from state to state in the sequence can be accomplished by software control, external signal, or error detector match. The error detector can match up to 16 user-defined blocks, with 128 bit/s per block, and a stimulus/response trigger output allows cross-triggering of the oscilloscope.

Users can use the sequencer to create protocol sequences based on PCIe standards to facilitate loopback initiation and protocol handshaking. Those sequences can be flexibly edited (adding/removing protocol blocks, modifying symbol encoding, data scrambling, or DC balancing) to aid in debugging challenging PCIe- related protocol handshaking issues.



BER map

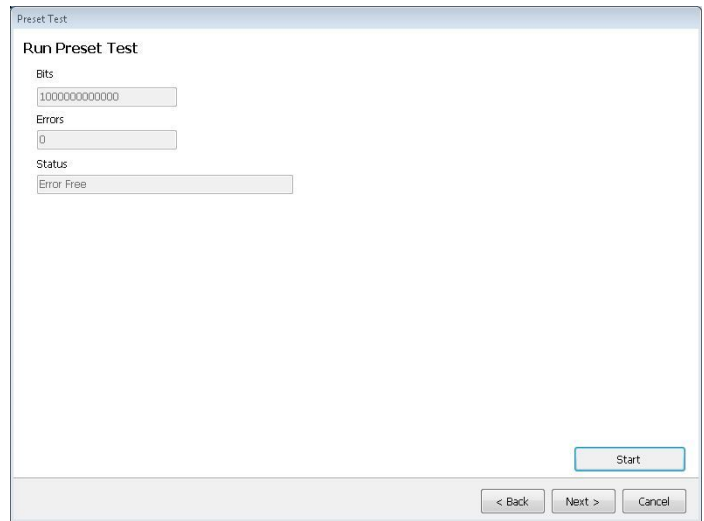
One of the key challenges setting up the link is tuning or determining the optimal RxEQ settings. The BER Map feature provides an automated way to scan the PCIe TxEQ coefficient matrix to determine the optimal TxEQ for a receiver's RxEQ settings.



Automated BER map result

Preset test

Preset testing is a critical part of the PCIe receiver test and is a single-click operation with the PCIe Automation Software. With real-time stress adjustment, quick synchronization, and BER testing ability, the BERTScope provides the ideal platform for fast jitter compliance testing. Test results are stored using the built-in database for later recall and report generation.



PCIe Preset test results

LEQ test

At higher speeds of Gen 4, dynamic link equalization becomes necessary from signal integrity viewpoint. There are two sets of link equalization test, namely for Transmitter Equalization and Receiver Equalization. BERTScope based solution provides total automation of the two tests with individual summary of results for user-analysis.

Tx Link EQ Test

Link EQ Test

Configure Link EQ Test

Sync Timeout Sec Sync using Grab-n-Go

Error Limit

Test Length

Duration Sec

Confidence % at 1E-12

Stress Values

Calibrated Manual Raw

RJ %UI DMSI mV

SJ %UI Amplitude mV

< Back Next > Cancel

Rx Link EQ Test

Link EQ Test

Configure Link EQ Test

Sync Timeout Sec Sync using Grab-n-Go

Error Limit

Test Length

Duration Sec

Confidence % at 1E-12

Stress Values

Calibrated Manual Raw

RJ ps (RMS) DMSI mV

SJ ps Amplitude mV

CMI mV

< Back Next > Cancel

Link EQ Test

Add-In Card Tx Link EQ Response Test

Initial Preset	Preset/Coeff Value	Preshoot (dB)	De-emphasis (dB)	Vb (mV)	Electrical Response Time (ns)	Protocol Response Time (ns)	Coefficients	Result
P4	P0	0.000	-5.88	213.1	63.54	162.9	0,47,16	Pass
P4	P0 (0,47,...	0.000	-5.82	214.6	33.66	157.9		Pass
P4	P1	0.000	-3.40	283.7	90.84	165.2	0,52,11	Pass
P4	P1 (0,52,...	0.000	-3.43	282.5	39.17	155.8		Pass
P4	P2	0.000	-4.38	253.2	165.7	166.7	0,50,13	Pass
P5	P2 (0,50,...	0.000	-4.37	253.4	67.46	151.1		Pass
P7	P3	0.000	-2.22	325.0	135.6	163.2	0,55,8	Pass
P7	P3 (0,55,8)	0.000	-2.24	323.8	427.8	153.0		Pass
P7	P4	0.000	0.000	419.7	121.7	172.6	0,63,0	Pass
P7	P4 (0,63,0)	0.000	0.000	419.5	118.8	153.8		Pass
P0	P5	1.680	0.000	345.9	507.4	164.2	6,57,0	Pass
P0	P5 (6,57,0)	1.709	0.000	344.6	163.1	157.1		Pass
P8	P6	2.370	0.000	319.5	118.0	162.1	8,55,0	Pass
P8	P6 (8,55,0)	2.284	0.000	322.5	133.1	159.0		Pass

DUT_ID Clear All Check All Run

< Back Next > Cancel

Link EQ Test

Add-In Card Rx Link EQ Test

Initial Preset (Generator)	Final Preset (Generator)	Final Preshoot (dB)	Final Deemphasis (dB)	Errors	Final Coefficients (Generator)	Result
P7		0	-6.16	0	0, 47, 16	Error Free

Clear All Check All Run

< Back Next > Cancel

DUT Initial Preset	DUT Response Coefficient	Preshoot (dB)	Final Preset (Generator)	Final Preshoot (dB)	Final Deemphasis (dB)	Errors	Final Coefficients (Generator)	Result	DUT Response Coefficient
P4	P0	0.000	0.0	0.0	-5.84	0	0, 47, 16	Pass	0,24,8
P4	P1	0.000	0.0	0.0	-3.34	0	0, 52, 11	Pass	0,27,7
P4	P2	0.000	0.0	0.0	-3.39	0	0, 50, 13	Pass	0,26,6
P7	P3	0.000	0.0	0.0	-2.24	0	0, 55, 8	Pass	0,28,4
P7	P4	0.000	0.0	0.0	0.0	0	0, 63, 0	Pass	0,32,0
P7	P5	1.674	0.0	0.0	0.0	0	6, 57, 0	Pass	0,28,0
P7	P6	2.369	0.0	0.0	0.0	0	8, 55, 0	Pass	0,28,0
P0	P5	1.680	1.709	1.709	-4.76	0	6, 57, 0	Pass	0,29,0
P0	P6	2.370	2.284	2.284	-3.37	0	8, 55, 0	Pass	0,29,0
P8	P6	2.370	2.284	2.284	0.0	0	8, 55, 0	Pass	0,27,0

Initial Preset (Generator)	Final Preset (Generator)	Final Preshoot (dB)	Final Deemphasis (dB)	Bits	Errors	BER	Final Coefficients (Generator)	Result
P7		0	-6.16	3.20e010	0	0.00e000	0, 47, 16	Pass

Loopback Request Log for preset P7

Request #	Gen	Final Preset	Final Pre-Cursor	Final Cursor	Final Post-Cursor	Timestamp (us)	Valid
0	3	NA	0	47	16	0	x

Remote control protocol

The test software can be operated remotely through ASCII commands sent through TCP/IP, giving engineers further flexibility in designing "beyond compliance" tests.

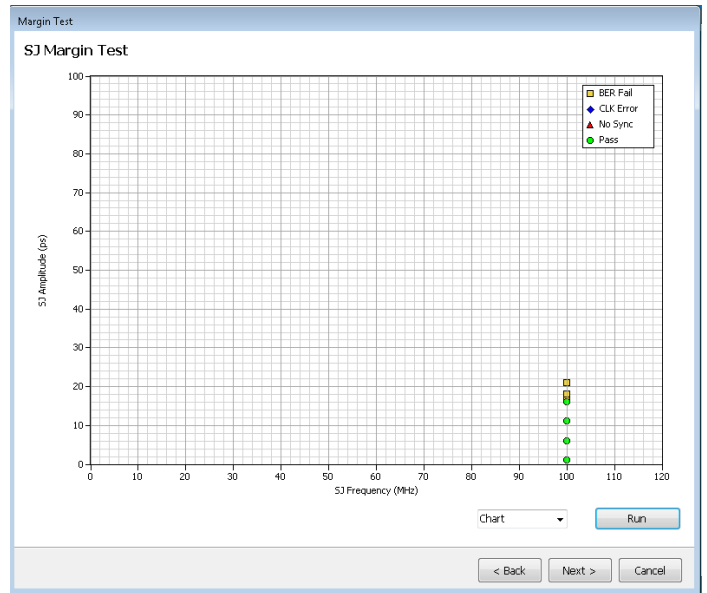
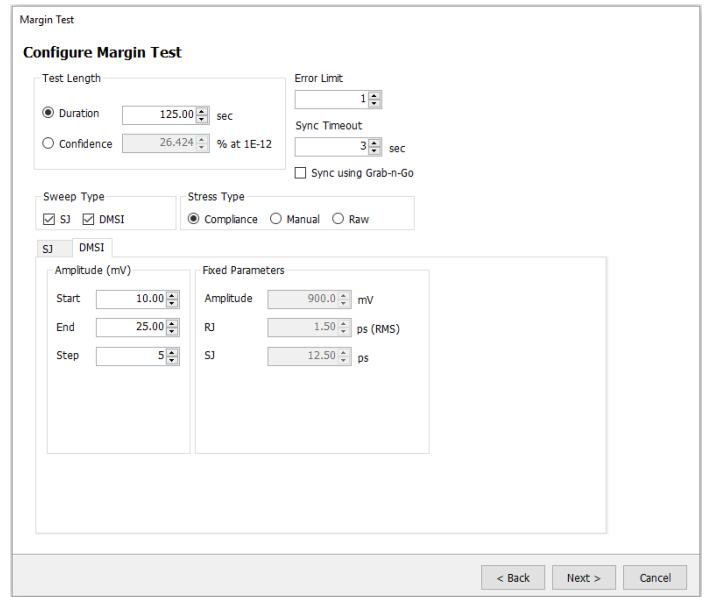
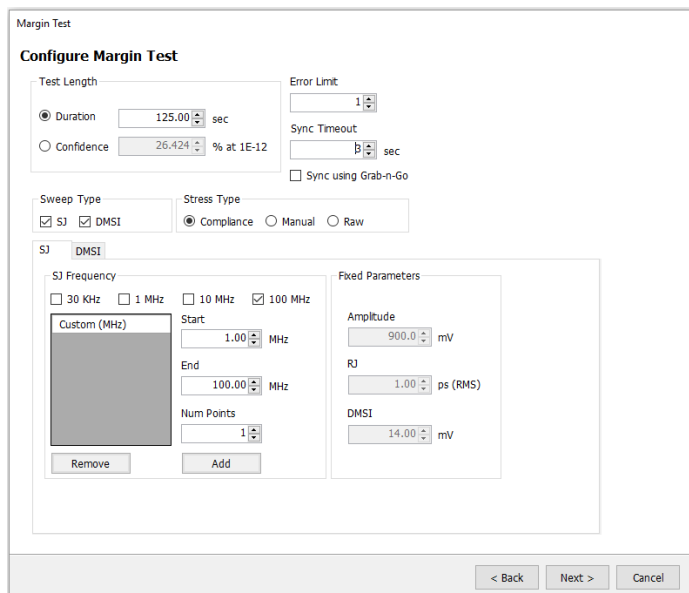
Debugging tools

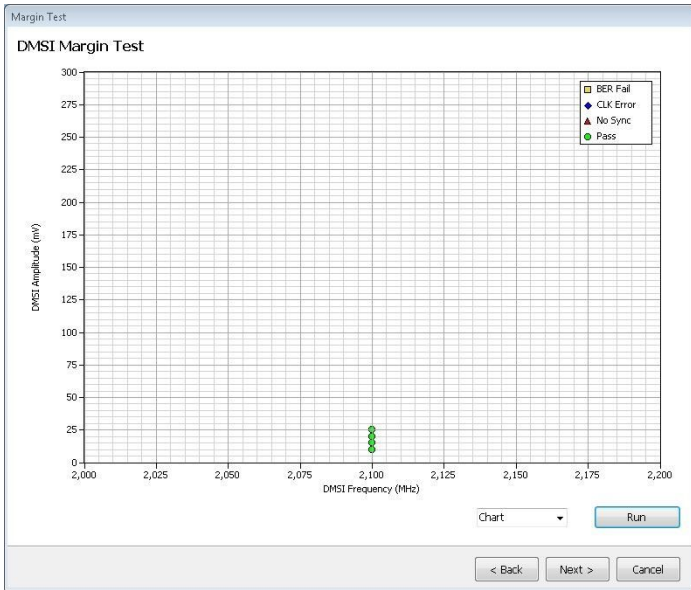
When a device fails to meet the test requirements, the operator has the power of the full range of BERTScope debugging tools. From intuitive and fast manual stress adjustment, pattern sequencing error location analysis, and jitter decomposition, the BERTScope can help identify subtle issues that other instruments might miss.

Margin test

Margin test supports SJ Margin. Select the starting and ending SJ value and test the DUT. The BSX will be set with the appropriate starting SJ and it will test the DUT. SJ will be increased by the prescribed step size and DUT is tested again until the DUT starts failing.

Example configuration is shown in the following Margin Test configuration menu.





Ordering information

BSXPCI3EQ	Detector Equalization Kit for Gen3
BSXPCI4CEM	Automated calibration, link training, loop-back initiation and handshaking (protocol aware) test software for PCI 3.0/4.0 CEM receiver test for BSX version BERTScope
BSXPCI4EQ	Detector Equalization Kit for Gen4
BSXSICOMB	Interference combiner kit for BSX version BERTScope
BSXPCI4BSE	Automated calibration, link training, loop-back initiation and handshaking (protocol aware) test software for PCI 3.0/4.0 BASE receiver test using a BSX BERTScope model
Product requirements	<p>Tektronix BERTScope BSX125(PCIe 3.0), BSX240 (PCIe 3.0/4.0), BSX320 (PCIe 3.0/4.0) or faster with Option STR, TXEQ</p> <p>Tektronix CR125A or faster clock recovery with Option PCIe8G (use as necessary)</p> <p>Tektronix DPO/DSA/MSO or faster Real-Time oscilloscope with Option DJA (includes DX and SX oscilloscopes with bandwidths > 25GHz min)</p>

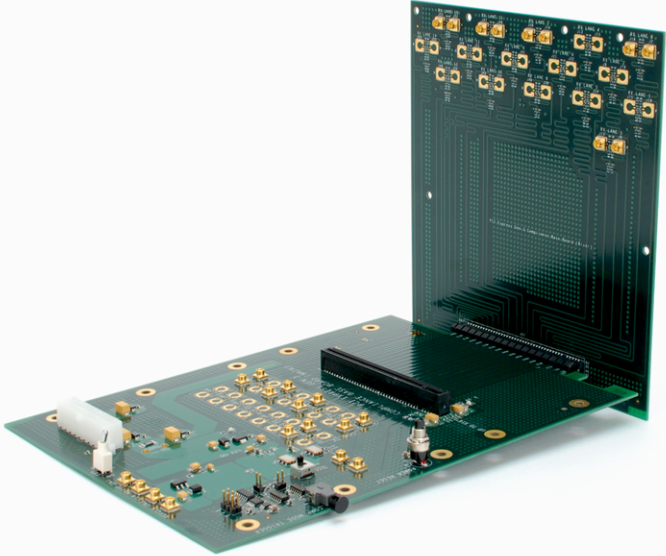
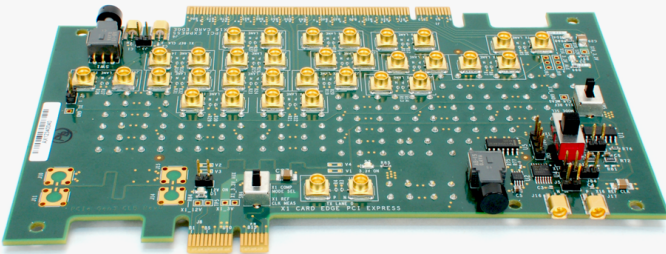

RX	Instrument	24Gb/s BERT	BSX240	1
	HW option	Jitter and noise stress	Option STR	1
	HW option	4-tap pre-emphasis	Option TXEQ	1
	SW option	PCIe4 RX test / Link EQ software	BSXPCI4CEM	1
	Kit	Interference combiner kit	BSXSICOMB	1
	Kit	Detector equalization kit	BSXPCI4EQ	1
	Cable	SMA-SMA cable pair, 18 inches	174-6663-01	1
	Cable	1-meter SMA-SMA cable pair, 1.5psec skew	PMCABLE1M	2
	[Optional] Cable	SMA - SMP cable pair, 102mm, <1psec skew>	174-6657-01	2
	Cable	SMA - SMP cable pair, 1-meter	174-6659-01	1
	Cable	Right angle SMA-SMA cable, 0.2m	174-6664-01	1
	Cable	Huber Suhner SMP-SMP cable pair 12 inches	80345501 (Huber-Suhner)	2
Link EQ	SW option	Link EQ option for Gen3 & Gen4. Requires BSXPCI4CEM	BSXPCI4LEQ	1
	SW option	PCIe1/2/3/4 decoder	Option SR-PCIE	1
	Kit	Power Divider, >25GHz with 2.92mm connector	PSPL5333 or similar	4
	Kit	DC block (Bandwidth >25GHz with 2.92 connector and capacitance 265nF (or greater))	PSPL5509 or similar	4
	Cable	SMA-SMA cable pair, 18 inches	174-6663-01	2
	Adapter	2.92mm Male to 2.92mm Male Adapter	SM3242 (Fairview Microwave)	4
	Cable	Right angle SMA-SMA cable, 0.5m	174-6666-01	1
	Cable	1-meter SMA-SMA cable pair, 1.5psec skew	PMCABLE1M	4

Host system software requirements





Microsoft Windows 7 or later
 Microsoft Explorer 6.0 SP1 or later
 Microsoft Access

Accessories

Recommended test fixtures, cables, and tools

Item	Image
<p>Description: [PCI-SIG] PCIe 4.0 Preliminary CEM Fixture Kit PN: PCIe-CLB-X1X16, PCIe-CLB-X4X8, PCIe-CBB-MAIN, and PCIe-VAR-ISI The PCIe 4.0 CEM Beta fixtures require a VNA based characterization to determine the appropriate Insertion Loss for performing the 16 GT/s Tx Signal Quality Test and the 16 GT/s Rx Link Equalization Test. This characterization will not be performed by the PCI-SIG, but must be performed by the end user after the fixtures are delivered. Quantity: 1</p>	
<p>Description: PCI Express Compliance Base Board (CBB) test fixture, revision 3.0. For testing PCI Express Add-in Cards, x1/x4/x8/x16. Vendor: PCI-SIG www.pcisig.com/specifications/order_form Vendor PN: CBB3 Tektronix PN: Only available from PCI-SIG Quantity: 1</p>	
<p>Description: PCI Express Compliance Load Board (CLB3) test fixture, revision 3.0. For testing PCI Express Platforms, x1 & x16 PCIe connectors. Vendor: PCI-SIG www.pcisig.com/specifications/order_form Vendor PN: x1/x16 CLB3 Tektronix PN: Only available from PCI-SIG Quantity: 1</p>	
<p>Description: PCI Express Compliance Load Board (CLB3), Revision 3.0. For testing PCI Express Platforms, x4 & x8 PCIe connectors. Vendor: PCI-SIG www.pcisig.com/specifications/order_form Vendor PN: x4/x8 CLB3 Tektronix PN: Only available from PCI-SIG Quantity: 1</p>	

Item	Image
<p>Description: Any ATX PC power supply Vendor: Tektronix recommends "PC Power & Cooling 750W Silencer MK III Series" or similar. Quantity: 1</p>	
<p>Description: DC Block, SMA, 26 GHz Vendor: Tektronix www.tek.com Tektronix PN: PSPL5500A, PSPL5501A, or PSPL5508 Quantity: 2 Note: This is an optional accessory and not shown in any of connection diagrams, but can be used if DC offset is encountered in any signal path.</p>	
<p>Description: SMA-to-SMA, Straight, 500 mm, 1.5 ps phase-matched Vendor: HUBER+SUHNER www.hubersuhner.com/en Vendor PN: 84210099, T+M SF104PE/11PC35/11PCC35/500mm Tektronix PN: 174-6663-xx Quantity: 2 cable pairs</p>	
<p>Description: SMA-to-SMA, Straight, 1000 mm, 1.5 ps phase matched Vendor: HUBER+SUHNER www.hubersuhner.com/en Vendor PN: 84210103, T+M SF104PE/11PC35/11PCC35/1000mm Tektronix PN: PMCABLE1M Quantity: 2 cable pairs</p>	

Item	Image
<p>Description: SMA-to-SMA, Right-Angle, 300 mm Vendor: HUBER+SUHNER www.hubersuhner.com/en Vendor PN: 84210131, T+M MF141/16SMA/16SMA/300mm Tektronix PN: 174-6665-00 Quantity: 1</p>	
<p>Description: SMA-to-SMP right-angle cable pair, 102 mm, 1 ps phase-matched. Vendor: Rosenberger www.rosenberger.com/us_en Vendor PN: 71L-19K2-32K1-00102B Tektronix PN: 174-6657-xx Quantity: 3 cable pairs</p>	
<p>Description: SMA-to-SMP right-angle cable pair, 1 m, 1 ps phase-matched Vendor: Rosenberger www.rosenberger.com/us_en Vendor PN: 71M-19K2-32S1-01000D Tektronix PN: 174-6659-xx Quantity: 1 cable pair</p>	
<p>Description: SMA torque wrench, 8.0 in-lbs. Vendor: Fairview Microwave www.fairviewmicrowave.com/sma-fixed-torque-wrench-click-st-sma3-p.aspx Vendor PN: ST-SMA3 Tektronix PN: 003-1940-xx Quantity: 1</p>	

Item	Image
<p>Description: SMP right-angle cable extraction tool. Vendor: Fairview Microwave www.fairviewmicrowave.com/undefined-mmtl2682-p.aspx Vendor PN: MMTL2682 Tektronix PN: 003-1941-xx Quantity: 1</p>	
<p>Description: SMP terminator installation/extraction tool. Vendor: Fairview Microwave www.fairviewmicrowave.com/undefined-mmtl4991-p.aspx Vendor PN: MMTL4991 Tektronix PN: 003-1939-xx Quantity: 1</p>	

CE Marking Not Applicable.



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