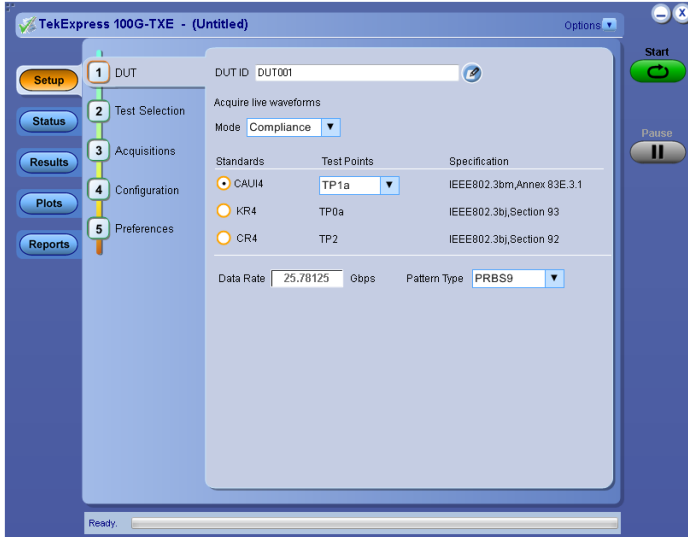
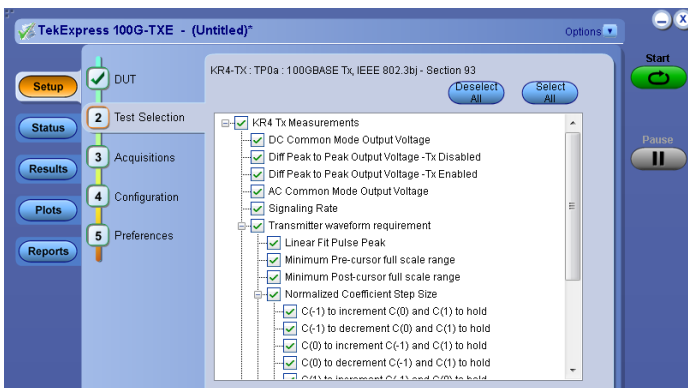


100GBASE-KR4, 100GBASE-CR4, & CAUI-4

Compliance and Characterization Solution for Sampling Scopes



TekExpress® 100GBASE-KR4, 100GBASE-CR4, and CAUI-4 solution



TekExpress® 100GBASE-KR4 measurement list

IEEE 802.3bj (100GBASE-KR4/100GBASE-CR4) and IEEE 802.3bm (CAUI-4) Electrical Equivalent Time Transmitter Compliance and Characterization Solution

The Tektronix Equivalent Time Instrument based 100GBASE-KR4/100GBASE-CR4 or CAUI-4 Transmitter Characterization automation system provides turnkey testing and debug of three of the 100G Ethernet industries most common electrical interfaces. As silicon designers need to perform 100GBASE-KR4 and 100GBASE-CR4 validation of their silicon, and system designers need to perform 100GBASE-CR4 and CAUI-4 validation, these three tools are brought together in a single 100G-TXE (Electrical Transmitter Validation) package.

¹ CAUI-4 is also known as CAUI.

100G-TXE application package is an automated compliance and characterization solution for IEEE 100GBASE-KR4, 100GBASE-CR4, and IEEE CAUI-4 users. This package operates on DSA8300 sampling instrument with 80E09B or 80E10B electrical acquisition modules and 82A04B Phase Reference module. The 100G-TXE loads the required Bessel Thomson roll-off filter which constrains the channel requirements to IEEE mandated 33 GHz, 3 dB point. The unique lower noise levels of the DSA8300 sampling architecture supports key signal to noise and distortion ratio (SNDR) measurement, the result of which is attained with the highest possible margin on the DSA8300 system. The 100G-TXE solution is also available on Real Time Scope (DPO70KSX and 70KDX series).

Key features

- 100G-TXE offers streamlined and fully automated transmitter characterization of 802.3bj's 100GBASE-KR4/100GBASE-CR4 electrical transmitter specifications, as well as 802.3bm CAUI-4 specification.
- Extends 80SJNB for analysis and debug into 100GBASE-KR4/100GBASE-CR4 and CAUI-4 ¹.

Applications

- Measurements of electrical transmitter on 25+ Gb/s PAM2 NRZ lanes
- Validation of 100GBASE-KR4/100GBASE-CR4 and CAUI-4

IEEE 802.3bj (100GBASE-KR4) Electrical Transmitter Measurements fully automated

Mapping of TP0a 100GBASE-KR4 measurement

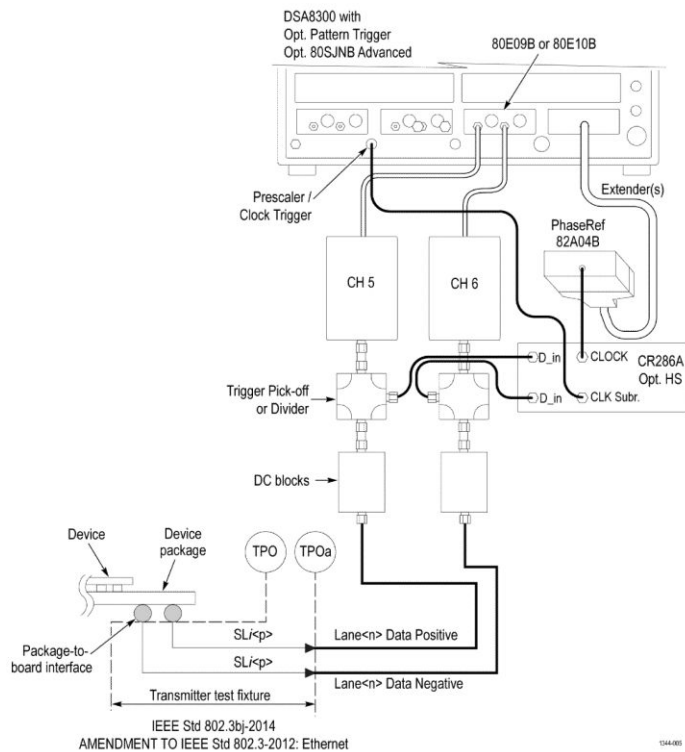
Parameter	Subclause reference	Value	Units
Signaling rate	93.8.1.2	25.78125±100 ppm	GBd
Differential peak-to-peak output voltage (max)			
Transmitter disabled	93.8.1.3	30	mV
Transmitter enabled	93.8.1.3	1200	mV
DC common-mode output voltage (max)	93.8.1.3	1.9	V
DC common-mode output voltage (min)	93.8.1.3	0	V
AC common-mode output voltage (RMS, max)	93.8.1.3	12	mV
Output waveform			
steady-state voltage (max)	93.8.1.5.2	0.6	V

Parameter	Subclause reference	Value	Units
steady-state voltage (min)	93.8.1.5.2	0.4	V
Linear fit pulse peak (min)	93.8.1.5.2	$0.71 \times v_f$	V
Normalized coefficient step size (min)	93.8.1.5.4	0.0083	-
Normalized coefficient step size (max)	93.8.1.5.4	0.05	-
Pre-cursor full-scale range (min)	93.8.1.5.5	1.54	-
Post-cursor full-scale range (min)	93.8.1.5.5	4	-
Signal-to-noise-and-distortion ratio (min)	93.8.1.6	27	dB
Output jitter (max)			
Even-odd jitter	93.8.1.7	0.035	UI
Effective bounded uncorrelated jitter, peak-to-peak	93.8.1.7	0.1	UI
Effective total uncorrelated jitter, peak-to-peak	93.8.1.7	0.18	UI

IEEE 802.3bj (100GBASE-CR4) Electrical Transmitter Measurements fully automated

Mapping of TP2 100GBASE-CR4 measurement

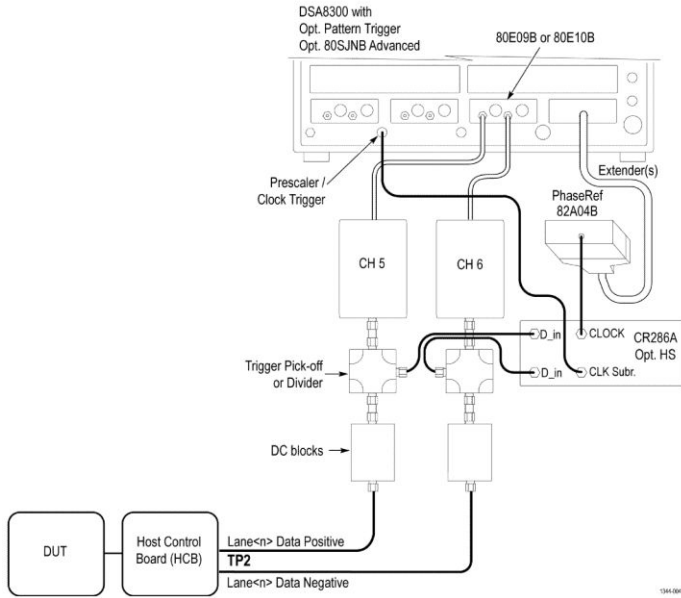
Parameter	Subclause reference	Value	Units
Differential peak-to-peak output voltage (max) with Tx disabled	92.8.3.1	35	mV
DC common-mode output voltage (max)	92.8.3.1	1.9	V
AC common-mode output voltage, v_{cmi} (max., RMS)	92.8.3.1	30	mV
Differential peak-to-peak voltage, v_{di} (max.)	92.8.3.1	1200	mV
Transmitter waveform			
Transmitter steady-state voltage, v_f (min.)	92.8.3.5.2	0.34	V
Transmitter steady-state voltage, v_f (max.)	92.8.3.5.2	0.6	V
Linear fit pulse peak (min.)	92.8.3.5.2	$0.45 \times v_f$	V
Transmitted waveform			
abs coefficient step size (min.)	92.8.3.5.4	0.0083	-
abs coefficient step size (max.)	92.8.3.5.2	0.05	-
minimum precursor full-scale ratio	92.8.3.5.5	1.54	-
minimum post cursor full-scale ratio	92.8.3.5.5	4	-
Signal-to-noise-and-distortion ratio (min.)	92.8.3.5.7	26	dB
Output jitter (max.)			
Even-odd jitter, peak-to-peak	92.8.3.8.1	0.035	UI
Effective bounded uncorrelated jitter, peak-to-peak	92.8.3.8.2	0.1	UI
Effective total uncorrelated jitter, peak-to-peak	92.8.3.8.2	0.18	UI
Signaling rate, per lane	92.8.3.9	25.78125 ± 100 ppm	GBd
Unit interval nominal	92.8.3.9	38.787879	ps



Transmitter test fixture and test points

Mapping of TP4 CAUI-4 measurement

Parameter	Subclause reference	Value	Units
Signaling rate per lane (range)	83E.3.1.1	25.78125 ± 100 ppm	GBd
AC common-mode output voltage (max, RMS)	83E.3.1.2	17.5	mV
Differential output voltage (max)	83E.3.1.2	900	mV
Eye width (min)	83E.3.2.1	0.57	UI
Eye height, differential (min)	83E.3.2.1	228	mV
Vertical eye closure (max)	83E.4.2.1	5.5	dB
Transition time (min, 20% to 80%)	83E.3.1.5	12	ps
DC common mode voltage (min) ²	83E.3.1.2	-350	mV
DC common mode voltage (max) ²	83E.3.1.2	2850	mV

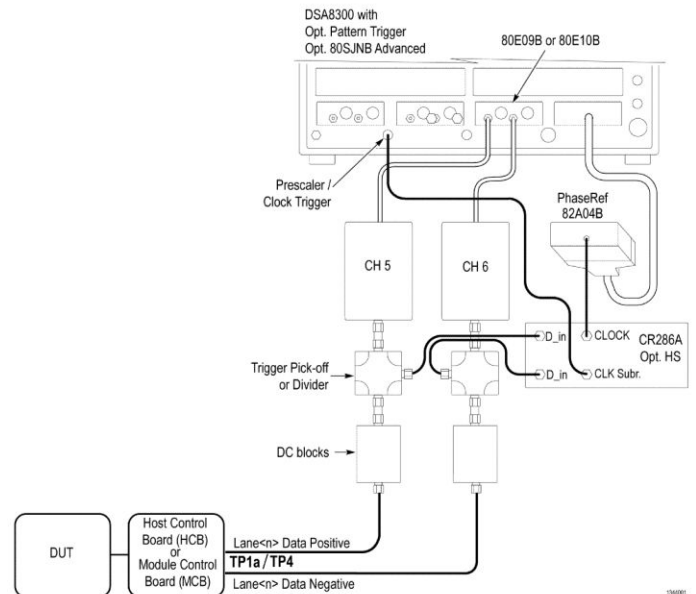


Transmitter test fixture and test points

IEEE 802.3bm (CAUI-4) Electrical Transmitter Measurements fully automated

Mapping of TP1a CAUI-4 measurement

Parameter	Subclause reference	Value	Units
Signaling rate per lane (range)	83E.3.1.1	25.78125 ± 100 ppm	GBd
DC common-mode output voltage (max)	83E.3.1.2	2.8	V
DC common-mode output voltage (min)	83E.3.1.2	-0.3	V
Single-ended output voltage (max)	83E.3.1.2	3.3	V
Single-ended output voltage (min)	83E.3.1.2	-0.4	V
AC common-mode output voltage (max, RMS)	83E.3.1.2	17.5	mV
Differential peak-to-peak output voltage (max)			
Transmitter disabled	83E.3.1.2	35	mV
Transmitter enabled	83E.3.1.2	900	mV
Eye width (min)	83E.3.1.6	0.46	UI
Eye height A, differential (min)	83E.3.1.6	95	mV
Eye height B, differential (min)	83E.3.1.6	80	mV
Transition time (min, 20% to 80%)	83E.3.1.5	10	ps



Transmitter test fixture and test points

Host Control Board (HCB) and Module Control Board (MCB) are for test point TP1a and TP4 respectively.

² DC common mode voltage is generated by the host. Specification includes effects of ground offset voltage.

Electrical System Interconnect Setup

Direct electrical connections via a precision fixture or 2.92mm interconnects are the preferred method to access the backplane and cabled signals. The QSFP28 module interconnect point found on 100GBASE-CR4 and CAUI-4 designs is the most typical signal access point.



(Image for reference only - see description)
Model No. QSFP28-TPA100G-HCB-6P
Part No. 640-0822-000

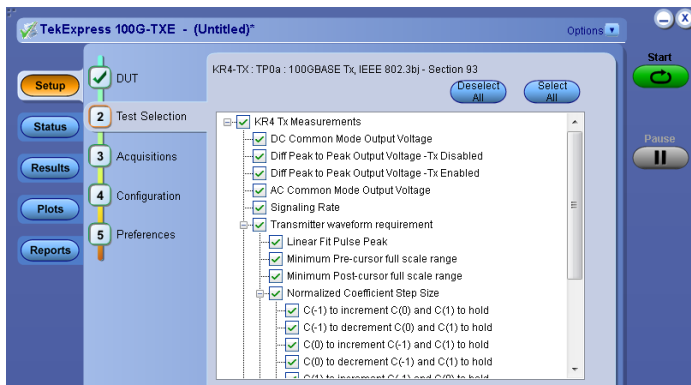
This Adapter Kit contains:

- Qty. 1 - QSFP28 100Gbps Plug Adapter
 - 16 - High Performance Phase Aligned 6" Adapter Coaxial Cables w/ Female SMAs
 - 1 - 12 Position Low Speed Cable and Connector
- CD containing QSFP28 100Gbps User Manual
- Instrument Case

Refer to Wilder Technologies www.wilder-tech.com/qsfp-28-kits.htm for details regarding the various methods of signal break-out.

100GBASE-KR4/100GBASE-CR4 Measurement Selection

The setup and test execution are simple with the 100G-TXE software. The oscilloscope acquisition and analysis are all controlled through the 100G-TXE automation solution. The Graphical User Interface (GUI) provides an intuitive and easily repeatable workflow for setup and testing.



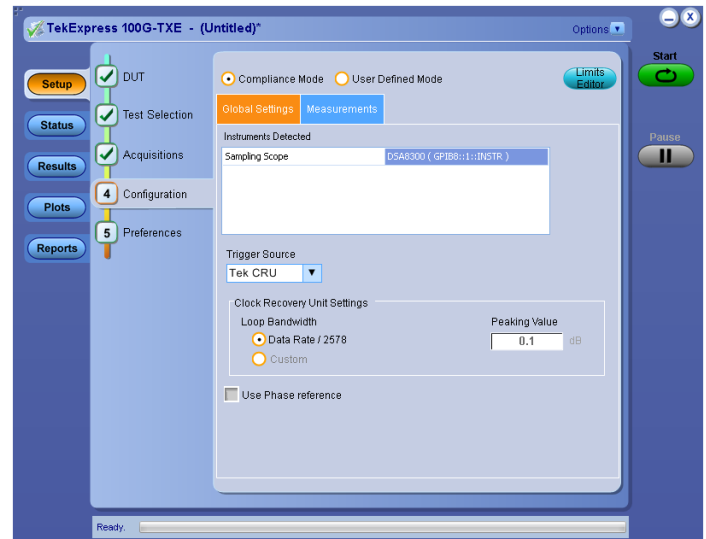
The screenshot shows the 'Test Selection' step in the TekExpress 100G-TXE software. The 'KR4 Tx Measurements' section is expanded, showing a list of measurement parameters with checkboxes. The 'DUT' is identified as 'KR4-TX:TP0a:100GBASE Tx, IEEE 802.3bj - Section 93'. The 'Start' button is visible on the right side of the interface.

TekExpress® 100GBASE-KR4 measurement setup

Design characterization is supported beyond 100GBASE-KR4/100GBASE-CR4/CAUI-4 compliance requirements for all measurements. TekExpress 100G-TXE offers 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.

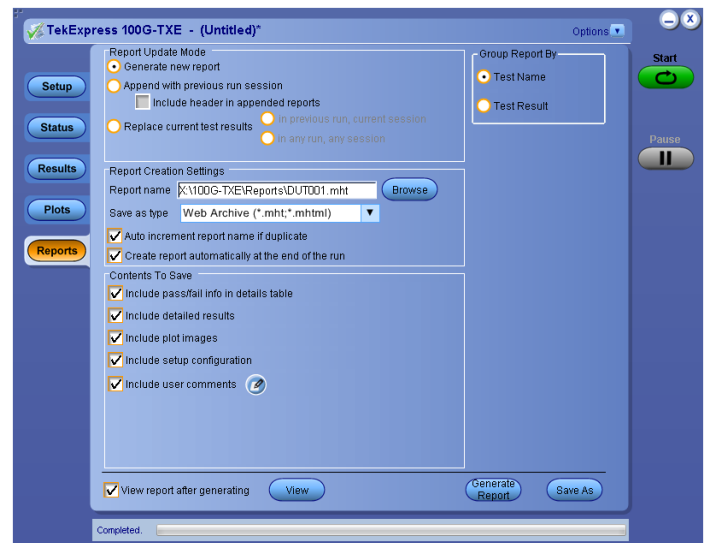
User Defined mode

Users can configure global parameters, test specific parameters, measurement repeat parameters, and notification parameters in user defined mode. This supports characterization measurements rather than developing custom lab setups, reducing testing time and complexity.



The screenshot shows the 'User Defined Mode' configuration screen in TekExpress 100G-TXE. The 'Compliance Mode' is selected, and the 'Limits Editor' is open. The 'Global Settings' tab is active, showing 'Instruments Detected' as 'DS8300 (GPIBB:1::INSTR)'. The 'Trigger Source' is set to 'Tek CRU'. The 'Clock Recovery Unit Settings' section shows 'Loop Bandwidth' set to 'Data Rate / 2578' and 'Peaking Value' set to '0.1 dB'. The 'Use Phase reference' checkbox is unchecked.

Reports & Measurement Results



The screenshot shows the 'Report Creation Settings' screen in TekExpress 100G-TXE. The 'Report Update Mode' is set to 'Generate new report'. The 'Report name' is 'K:\100G-TXE\Reports\OUT001.mht'. The 'Save as type' is 'Web Archive (*.mht;*.mhtml)'. The 'Contents To Save' section includes checkboxes for 'Include pass/fail info in details table', 'Include detailed results', 'Include plot images', and 'Include setup configuration'. The 'View report after generating' checkbox is checked.

Tektronix TekExpress 100G-TXE Test Report CAUI4-TX (TP1a)

Setup Information		Scope Information	
DUT ID	DUT001	DSA8300_PQ10003	
Date/Time	2017-01-12 23:31:43	Scope F/W Version	6.4.3.0
TekExpress 100G-TXE Version	1.0.0.76	805NB Version	4.0.8.0
TekExpress Framework Version	4.2.1.1	Data+ connected to	CH1 80E10
Specification Version	IEEE 802.3bm, Annex 83E.3.1	Data- connected to	CH2 80E10
Compliance Mode	Yes	Phase Reference	CH7 CH8 82A04B
Overall Test Result	Pass	Data Rate	25.78125 Gbps
Overall Execution Time	0:09:44		

Test Name Summary Table	
DC Common Mode Output Voltage	Pass
Diff Peak to Peak Output Voltage -Tx Disabled	Pass
Diff Peak to Peak Output Voltage -Tx Enabled	Pass
AC Common Mode Output Voltage	Pass
Single Ended Output Voltage	Pass
Signaling Rate	Pass
Eye Width	Pass
Eye Height Differential	Pass
Transition Time(20% to 80%)	Pass

DC Common Mode Output Voltage								
Measurement Details	Iteration	Measured Value	Test Result	Margin	Low Limit	High Limit	Units	Comments
DC Common Mode Output Voltage	1	1.00000	Pass	L:1.30000 H:1.80000	-0.3	2.8	V	N.A

COMMENTS: DC Common Mode Output Voltage is measured using multimeter

Diff Peak to Peak Output Voltage -Tx Disabled								
Measurement Details	Iteration	Measured Value	Test Result	Margin	Low Limit	High Limit	Units	Comments
Diff Peak to Peak Output Voltage -Tx Disabled	1	6.53376	Pass	H:28.3662	N.A	35	mV	N.A

COMMENTS: Pattern type PRBS9

Tektronix TekExpress 100G-TXE Test Report CR4-TX (TP2)

Setup Information		Scope Information	
DUT ID	DUT001	DSA8300_PQ10003	
Date/Time	2017-01-12 23:53:30	Scope F/W Version	6.4.3.0
TekExpress 100G-TXE Version	1.0.0.76	805NB Version	4.0.8.0
TekExpress Framework Version	4.2.1.1	Data+ connected to	CH1 80E10
Specification Version	IEEE 802.3bj, Section 92	Data- connected to	CH2 80E10
Compliance Mode	Yes	Phase Reference	CH7 CH8 82A04B
Overall Test Result	Pass	Data Rate	25.78125 Gbps
Overall Execution Time	0:04:42		

Test Name Summary Table	
DC Common Mode Output Voltage	Pass
Diff Peak to Peak Output Voltage -Tx Disabled	Pass
Diff Peak to Peak Output Voltage -Tx Enabled	Pass
AC Common Mode Output Voltage	Pass
Signaling Rate	Pass
Linear Fit Pulse Peak	Pass
Signal To Noise And Distortion Ratio	Pass
Even-Odd Jitter Peak to Peak	Pass
Effective total uncorrelated jitter peak to peak	Pass
Effective bounded uncorrelated jitter peak to peak	Pass

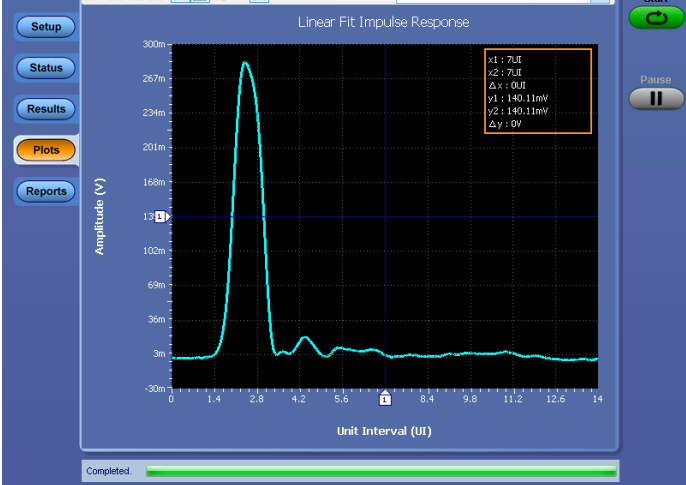
DC Common Mode Output Voltage								
Measurement Details	Iteration	Measured Value	Test Result	Margin	Low Limit	High Limit	Units	Comments
DC Common Mode Output Voltage	1	1.00000	Pass	L:1.00000 H:0.90000	0	1.9	V	N.A

COMMENTS: DC Common Mode Output Voltage is measured using multimeter

Diff Peak to Peak Output Voltage -Tx Disabled								
Measurement Details	Iteration	Measured Value	Test Result	Margin	Low Limit	High Limit	Units	Comments
Diff Peak to Peak Output Voltage -Tx Disabled	1	6.12259	Pass	H:28.8774	N.A	35	mV	N.A

COMMENTS: Pattern type PRBS9

TekExpress 100G-TXE - (CR4-Build76)



TekExpress 100G-TXE - (CAUI4_TP4_BestCTLE_Build76)

Overall Test Result: Pass

Test Name	Details	Pass/Fail	Value	Units	Margin
DC Common Mode Output Voltage	DC Common Mode Output Voltage	Pass	1.00000	V	L:1.3500 H:1.8500
Diff Peak to Peak Output Voltage -Tx Enabled	Diff Peak to Peak Output Voltage -Tx Enabled	Pass	662.66613	mV	H:237.3339
AC Common Mode Output Voltage	AC Common Mode Output Voltage	Pass	5.59400	mV	H:11.9060
Signaling Rate	Signaling Rate	Pass	25.78129	GBd	L:0.0026 H:0.0026
Eye Width	Eye Width	Pass	0.63100	UI	L:0.0610
Eye Height Differential	Eye Height Differential	Pass	404.98500	mV	L:176.9850
Vertical Eye closure	Vertical Eye closure	Pass	2.48300	dB	H:3.0170
Transition Time(20% to 80%)	Rise Time	Pass	14.01259	ps	L:2.0126
Transition Time(20% to 80%)	Fall Time	Pass	14.00166	ps	L:2.0017

Completed.

TekExpress 100G-TXE - (Untitled)*

Overall Test Result: Pass

Test Name	Details	Pass/Fail	Value	Units	Margin
DC Common Mode Output Voltage	DC Common Mode Output Voltage	Pass	1.00000	V	L:1.0000 H:0.9000
Diff Peak to Peak Output Voltage -Tx Disabled	Diff Peak to Peak Output Voltage -Tx Disabled	Pass	6.12259	mV	H:28.8774
Diff Peak to Peak Output Voltage -Tx Enabled	Diff Peak to Peak Output Voltage -Tx Enabled	Pass	665.26031	mV	H:534.7397
AC Common Mode Output Voltage	AC Common Mode Output Voltage	Pass	5.47500	mV	H:24.5250
Signaling Rate	Signaling Rate	Pass	25.78129	GBd	L:0.0026 H:0.0026
Linear Fit Pulse Peak	Linear Fit Pulse Peak	Pass	0.28273	V	L:0.1351
Signal To Noise And Distortion Ratio	Signal To Noise And Distortion Ratio	Pass	29.89759	dB	L:3.8976
Even-Odd Jitter Peak to Peak	Even-Odd Jitter Peak to Peak	Pass	0.00128	UI	H:0.0337
Effective bounded uncorrelated jitter peak to peak	Effective bounded uncorrelated jitter peak to peak	Pass	0.00129	UI	H:0.0987
Effective total uncorrelated jitter peak to peak	Effective total uncorrelated jitter peak to peak	Pass	0.14320	UI	H:0.0638

Completed.

Ordering Information

IEEE-802.3bm CAUI4 and IEEE-802.3bj 100GBASE-KR4/100GBASE-CR4 Electrical Equivalent Time Transmitter Compliance and Characterization Solution for DSA8300

To order with oscilloscope	Oscilloscope Option DSA8300 Order 80S100G-TXE
To upgrade an oscilloscope	Oscilloscope Option DSA8300 DSA83UP 80S100G-TXE

Software options

Option 80S100G-TXE	IEEE-802.3bm CAUI4 and IEEE-802.3bj 100GBASE-KR4/100GBASE-CR4 Electrical Equivalent Time Transmitter Compliance and Characterization Solution for DSA8300
Option JNB02	80SJNB Advanced (With SDLA)
Option ADVTRIG	Advanced triggers with pattern sync

Recommended accessories

80A08	Accessory kit
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Recommended products

BERTScope clock recovery	CR286A
Remote sampling oscilloscope module	80E07/B, 80E08/B, 80E09/B, 80E10/B
Phase reference module	82A04B - 8000 Series
Module extender cables	80X01 & 80X02 (1 each)

CE Marking Not Applicable.



Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.



Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

100GBASE-KR4, 100GBASE-CR4, and CAUI-4 Datasheet

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Hong Kong 400 820 5835
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People's Republic of China 400 820 5835
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The Netherlands 00800 2255 4835*
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