Technical Reference

Tektronix

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Contacting Tektronix

Tektronix, Inc. 14200 SW Karl Braun Drive or P.O. Box 500 Beaverton, OR 97077 USA

For product information, sales, service, and technical support:

- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

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1 Introduction to the RT-Eye Standards Support Library

This document provides the procedures for making high speed serial standard measurements with Tektronix TDS/CSA7000, DSA/DPO70000 and TDS6000 series real time oscilloscopes and probing solutions. The Serial Analysis module in RT-Eye provides clock recovery, eye diagram, amplitude, and jitter measurements found in most high speed serial data specifications. The Serial Analysis module also supports waveform mask testing and measurement limit testing with Pass/Fail indication. Pass/Fail criteria for the signal under test is called out in the electrical specifications of industry standards.

The Standards Support Library consists of a library of setup folders under the File > Recall selection from the RT-Eye menu. The library of setup files provides testing for the following standards:

- DisplayPort
- FibreChannel
- Ethernet (XAUI and 10GBaseCX4)
- InfiniBand (DDR and QDR)
- OBSAI (Open Base Station Architecture Initiative)
- SAS (Serial Attached SCSI)
- Serial RapidIO

The setup files are consistent with the 'compliance points' called out in the standards. The proper waveform mask (.msk) and measurement limits (.lim) file are recalled as part of the setup file. Once the file is recalled, Pass/Fail testing on the signal under test can be completed by simply pressing Autoset and Run from the RT-Eye menu.

2 Connecting to the Device Under Test (DUT)

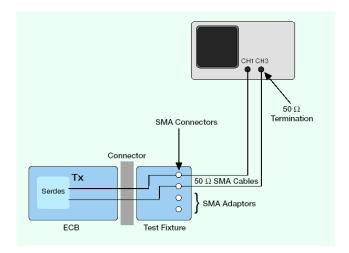
There are four fundamental probing techniques to perform standards-based 'compliance' measurements using the Standards Support Library. These probing techniques are described below. Probe configurations A and C represent the **Probe Type: Single Ended** in the RT-Eye Measurement Select Menu. This is the default configuration of the setup files in the library. The probe type can be changed to **Probe Type: Differential** if a differential probing solution (Probe configuration B or D) is used.

2.1 SMA Connection to the DUT

A. Two TCA-SMA inputs using SMA cables (Ch1) and (Ch3)
 The differential signal is created by the RT-Eye SW from the math waveform Ch1-Ch3. The Common mode AC measurement is also available in this configuration from the common mode waveform (Ch1+Ch3)/2. This probing technique requires breaking the link and terminating into the 50 Ω/side termination into the oscilloscope. Ch-Ch deskew is required using this technique because two channels are used.

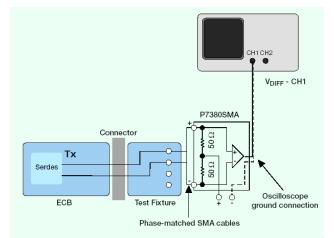
B. One P7350SMA differential active probe (Ch1)

The differential signal is measured across the termination resistors inside the P7350SMA probe. This probing technique requires breaking the link. Matched cables are provided with the P7350 probe to avoid introducing de-skew into the system. Only one channel of the oscilloscope is used.



Probe Configuration A

SMA Psuedo-differential



Probe Configuration B SMA Input Differential Probe

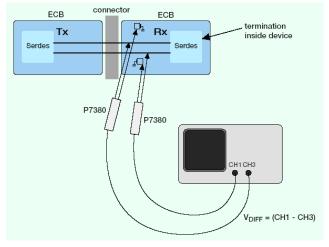
2.2 ECB probe connection to the DUT

C. Two single ended active probes (Ch1) and (Ch3)

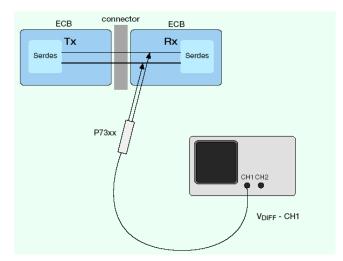
The differential signal is created by the RT-Eye SW from the math waveform Ch1-Ch3. The Common mode AC measurement is also available in this configuration from the common mode waveform (Ch1+Ch3)/2. This probing technique can be used for either a live link that is transmitting data, or a link terminated into a "dummy load". In both cases, the single ended signals should be probed as close as possible to the termination resistors on both sides with the shortest ground connection possible. Ch-Ch deskew is required using this technique because two channels are used.

D. One Differential probe

The differential signal is measured directly across the termination resistors. This probing technique can be used for either a live link that is transmitting data, or a link terminated into a "dummy load." In both cases, the signals should be probed as close as possible to the termination resistors. A single channel of the oscilloscope is used, so de-skew is not necessary. Two differential probes can be used to create the probing configuration shown in configuration "C" above.



Probe Configuration C Two Single Ended Active Probes



Probe Configuration D One Differential Active Probe

3 Configuring a DUT for Compliance Measurements

To perform measurements to an industry standard, the device under test must be placed in a state where the device is transmitting the specification compliant test pattern. Mechanisms for this are standard specific. Refer to details in the specifications on which patterns are to be used. To ensure that a measurement can be displayed with multiple patterns, the Standards Support Library setup files use the RT-Eye 'Arbitrary Pattern' method. This can be changed to the 'Repeating Pattern' method if desired by the user. To insure accurate jitter measurements, it's recommended that 100 repeats of the pattern under test be captured in the acquisition. The record length may need to be increased to capture enough repeats for accurate and repeatable measurements regardless of which jitter method is used.

4 Taking Measurements

4.1 Initial Oscilloscope Setup

After connecting the DUT by following the proper probing configuration for the test, click DEFAULT SETUP.

4.2 Running the RT-Eye Software

On non-B or non-C model oscilloscopes (Example: TDS6604), go to File > Run Application > RT-Eye Serial Compliance and Analysis. For B and C models (Example: TDS7704B, TDS6154C), go to App > RT-Eye Serial Compliance and Analysis. On DPO/DSA70000 series, go to Analysis > RT-Eye Serial Compliance and Analysis. When the RT-Eye Wizard dialog appears, select Cancel. The RT-Eye menu will appear.

<u>File Modules M</u> ea	surements <u>P</u> lot	ts <u>R</u> esults <u>L</u> og	<u>U</u> tilities Help		XOX RT-Eye®	A ⊻ ×
Probe Type	Differenti	al 🔻			Select	Serial Analysis
Tim	ng	Ampli			All	Start Stop
Eye Width/ Eye Height	Unit Interval	Differential Voltage	De- Emphasis	Jitter @ BER	Autoset	Clear Results
Rise Time	Bit Rate	High Amplitude		TIE Jitter	Select Plots	1230
Fall Time		Low Amplitude			Configure	Mode Single Run 🔻
Menu: Meas->Select						

Figure 1 – Default menu of the RT-Eye software

4.3 Selecting a Setup File from the Library

From the RT-Eye default menu, select File > Recall to view the Standards Support Library folders. Select the desired Standard.

101 Open		
Lookin	峇 setup 👻	ے 🗉 🔍 🕉
My Rece Desktop My Docu My Comp My Comp	C DisplayPort	
	File name:	Open
	Files of type: Setup Files (* Ini)	Cancel

Figure 2 – Standards Support Library Folders

4.4 Selecting a Compliance Test Point from the Library

From the selected folder, select the desired Compliance Test Point. In this example, InfiniBand DDR (Dual Data Rate) TP6 is selected.

101 Open		X
Lookjn	infiniBand 👻	1 🕫 💷 📼
My Rece Desktop My Docu My Comp	ELIS DOR, TP1 Ini CB_DOR, TP5 Ini CB_DOR, TP1 Ini CB_DOR, TP1 Ini CB_DOR, TP1 Ini CB_DOR, TP1 Ini CB_OOR, TX_PINS Ini	
	File name: IB_DDR_TP6.ini	<u>O</u> pen
	Files of type: Setup Files (*.ini)	<u>Cancel</u>

Figure 3 – Compliance Test Point Selection

4.5 Configuring the Probe Type

If Ch1 and Ch3 are the desired source waveforms, this step can be skipped. If the signal being acquired is a Differential signal or a pseudo-differential Math (for example, Math1 = Ch1 - Ch3), change the Probe Type to Differential and then select the appropriate source.

Source Type	Select	Autoset	
Live/Ref	Differential		rertical 8 orizontal
File	Ch1 Ch2 Ch2 Ch3		Clear Results
	Not Ch4 = D+- 0 Math1 node = (D		Select Mode Single Run

Figure 4 - Selecting Math as a Source of the Measurement

4.6 Selecting Autoset

Press **Autoset** from the RT-Eye Measurement Select Menu. The Horizontal Resolution will be set to full sample rate, and the Vertical Scale will be set to optimize the signal for an accurate measurement.

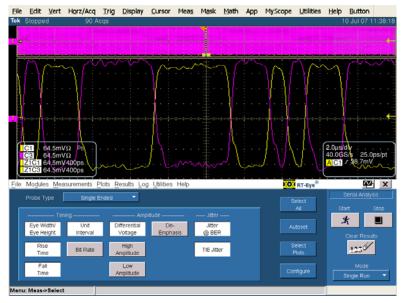


Figure 5 – Oscilloscope settings after Autoset is pressed

4.7 Selecting Start and Viewing Test Results

Select **Start** from the RT-Eye Sequence Control menu. Once the measurements have completed, select **Limits Summary** from the Result Summary View drop-down menu.

📕 RT-Eye Plot Sum	mary								
🚾 🖬 🗑 🖉	දිය දේශ 🖂 🛛	리 효 모	÷						
08 06 7.04 0.02 0.02 0.04 0.02 0.04 0.02 0.04	Eye: All bits		• 172°-3,500003	ĝ BER Bathtub Curve	10 ⁶ .				
-0.6 -0.8 -1 -200p	s -100ps	User Mask: 1 Ops	<mark>8_DO</mark> R_TP6.msk 100ps 201	Ops	10 ⁻¹⁸	0.2	0.4 0.6 0.8	1 1.2	
-0.8 -1 -200p		Ops	100ps 20	Ops		0 0.2			H X
-0.8 -1		Ops ts <u>R</u> esults <u>L</u>	100ps 20	Ops Olp	[~] -0.2 (_	0.4 0.6 0.8	<u>r</u>	
-0.8 -1 -200p		Ops ts <u>R</u> esults <u>L</u>	100ps 20	Ops	[~] -0.2 (0.2	RT-Eye®	Serial Analy	/sis
-0.8 -1 -200p		Ops ts <u>R</u> esults <u>L</u>	100ps 20	ops elp Limits Sta	[~] -0.2 (_		<u>r</u>	
-0.8 -1 -200p	surements <u>P</u> lo	Ops <u>ts Results L</u> Result Summa	100ps 20 og Utilities He ry: Select View	Ops Olp	~-0.2 (atus	_	Show Plot	Serial Analy	rsis
-0.8 -1 -200p ille Modules Meas Measurement	surements <u>P</u> lo	Ops ts <u>R</u> esults <u>L</u> Result Summa Value	100ps 20 og Utilities He ny: Select View	ops elp Limits Sta	~-0.2 (atus Status	.	RT-Eye®	Serial Analy Start	/sis Stop
-0.8 -1 -200p ile Modules Meas Measurement Eye H: All Bits Eye H: All Bits	surements <u>P</u> lo Statistic Min	Ops ts <u>R</u> esults <u>L</u> Result Summa Value 761.79mV	100ps 20 og Utilities He ny: Select View	ops elp Limits Sta Upper Lim	itus Status PASS	.	Show Plot	Serial Analy Start	/sis Stop
0.8 -1 -200p ile Modules Meas Measurement Eye H: All Bits	surements Plo Statistic Min Mask Hits	Ops ts <u>R</u> esults <u>L</u> Result Summa Value 761.79mV	100ps 20 og Utilities He ny: Select View	0ps elp Limits Sti Upper Lim 0	itus Status PASS	.	Show Plot Export To CSV	Serial Analy Start Clear Resu	/sis Stop
-0.8 -1 -200p ile Modules Meas Measurement Eye H: All Bits Eye H: Aon-Tr Bits	Statistic Min Mask Hits Mask Hits	Ops ts <u>R</u> esults <u>L</u> Result Summa Value 761.79mV 0	100ps 20 og Utilities He ny: Select View Lower Lim 650.00mV	Ops Sip Umits Sta Upper Lim 0 0	itus Status PASS	.	Show Plot	Serial Analy Start	/sis Stop
-0.8 -1 -200p ile Modules Meas Measurement Eye H: All Bits Eye H: Non-Tr Bits Eye H: Trans Bits	Statistic Min Mask Hits Mask Hits Mask Hits	Ops ts <u>R</u> esults <u>L</u> Result Summa 761.79mV 0 43.863ps	100ps 200 og Utilities Hr iny: Select View Lower Lim 650.00mV 30.000ps	Ops Sip Umits Sta Upper Lim 0 0	-0.2 (itus PASS PASS PASS	.	Show Plot Export To CSV Details	Serial Analy Start Clear Resu	/sis Stop
0.8 -1	Statistic Min Mask Hits Mask Hits Mask Hits Min	Ops ts <u>R</u> esults <u>L</u> Result Summa Value 761.79mV 0	100ps 20 og Utilities He ny: Select View Lower Lim 650.00mV	Ops Sip Umits Sta Upper Lim 0 0	-0.2 (atus Status PASS PASS	.	Show Plot Export To CSV	Serial Analy Start Clear Resu	/sis Stop

Figure 6a - Results of Analysis with the plots

		Result Summa	ry: Select View	Limits Sta	atus	-		Serial Ana	ilysis
Measurement	Statistic	Value	Lower Lim	Upper Lim	Status	1	Show Plot	Start	Stop
Eye H: All Bits	Min	761.79mV	650.00mV	opperum	PASS		Export	×.	
Eye H: All Bits	Mask Hits	0		0	PASS		To CSV		_
Eye H: Non-Tr Bits	Mask Hits			0				Clear Res	
Eye H: Trans Bits	Mask Hits			0			Details	1230	/
Rise Time	Min	43.863ps	30.000ps		PASS			1400	
Fall Time	Min	43.058ps	30.000ps		PASS		Time Units	Mode	
Unit Interval	Mean	200.00ps	199.98ps	200.02ps	PASS				
Diff Amplitude	Max	865.59mV		1.6000V	PASS	*	Seconds 🔍 🔻	Single Rur	1

Figure 6b - Results of Analysis with Pass/Fail Indication

5 Creating, Saving, and Sharing Reports

To create a compliance report, select **Utilities > Reports**. The Report Generator utility can create a complete report of the test. The report can be saved as a .rpt file for later viewing with the report generator utility. The report can also be saved as a .rtf file for viewing from MS Word. Another convenient way to share reports with your work group is to install a PDF Distiller onto the oscilloscope and print the report to a PDF.

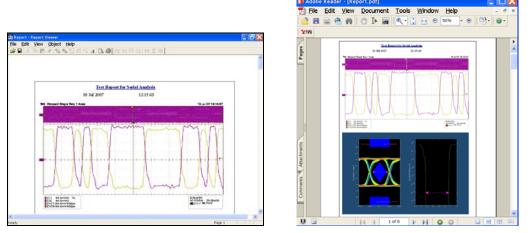


Figure 7 - Report Formats .rpt and .pdf

6 Supported Measurements by Standard

The following sections show the measurements supported by the RT-Eye Standards Support Library. These are listed in table format and intended as an easy cross-reference from what is written in the specification and what the RT-Eye Serial Analysis measurements support. Note that not all measurements called out in the supported standards are supported by RT-Eye. For example, the DisplayPort definition of Rise/Fall time and Differential Skew are different than these same measurements offered in the RT-Eye Serial Analysis Module. Thus, only the measurements supported directly by RT-Eye are selected in the DisplayPort library setup file. More complete testing is left to other methods of implementation documents.

6.1 DisplayPort

Table 1 – DisplayPort Compliance Test Points

Derived fro	m Display port CTS draft 11 v	ersion docun	nent	
	DT C-a	Reduced	High Bit rate	
Display port	RT-Eye Measurement	Bit Rate (BBR)	(HBR)	
Nominal Bit Rate	Bit Rate	1.620	2.700	Gb/s
Unit Interval	Unit Interval	617.2840	370.3704	ps
Frequency accuracy	Bit Rate Limits	300	300	PPM
	2nd Order PLL with damping			
Golden PLL Frequency	factor 1.43 Loop BW	20.00	20.00	MHz

Section	a 3 Display port Source Com	liance tests		
Display Port specification version 1.1	RT-Ege Measurement	Reduced Bit Rate (RBR)	High Bit rate (HBR)	
1UI - Total Jitter	Jitter@BER; Jitter Eye Opening	616.92	369.39	ps
		0.78	0.64	
Total Jitter at 10-9 BER	Jitter@BER; TJ	0.36	0.98	ps
		0.22	0.36	U
Non ISI Jitter		98.7654321	96.2962963	ps
		0.16	0.26	Û
Intra Iane Skew		<	: <i>l</i> = 30	ps
Inter Iane Skew test			<t= 2<="" td=""><td>UI</td></t=>	UI
		min	max	
Pre-Emphasis	3.5dB	1.20	1.8	
	6dB	1.60	2.4	
	9.5dB	2.40	3.6	
Non Pre Emphasis Level Verification		min	max	
	400mV	0.34	0.46	٧
	600mV	0.51	0.68	٧
	800mV	0.69	0.92	٧
	1200mV	1.02	1.38	٧
A2	Mask Seg 1 and 3			
	400mV		0.46	٧
	600mV		0.68	۷
	800mV		0.92	٧
	1200mV		1.38	٧
		RBR	HBR	
Al	400m¥ 0dB Mask Seg2	63.6	39.6	<u>mV</u>
	400m¥ 3.5dB Mask Seg2	95.09	59.24	<u>mV</u>
	400mV 6dB Mask Seg2	126.89	79	<u>mV</u>
	400m¥ 9.5dB Mask Seg2	189.84	118.2	m۷
A1	600m¥ 0dB Mask Seg2	95.4	59.4	
A1	600m¥ 3.5dB Mask Seg2	90.4 142.64	59.4 88.86	mV mV
	600m¥ 6dB Mask Seg2	192.69	118.51	<u>mv</u> mV
	600m¥ 9.5dB Mask Seg2	284.76	118.01	mv mV
	oount aloud Mask Seyz	204.10	117.5	inv
A1	800m¥ OdB Mask Seg2	127.2	79.2	m۷
	800m¥ 3.5dB Mask Seg2	190.2	118.48	mV
	800m¥ 6dB Mask Seg2	253.91	158.02	mV
	800m¥ 9.5dB Mask Seg2	379.69	236.41	mV
	Count Could Phase dege	010.00	200.11	
Al	1200m¥ 0dB Mask Seg2	190.8	118.8	m٧
	1200m¥ 3.5dB Mask Seg2	285.28	177.72	m٧
	1200m¥ 6dB Mask Seg2	380.87	237.03	m٧

X1 (relative to 0.5UI)	Mask Seg2	245.00	127.00	٦ I
		0.102	0.159	
X2 (relative to 0.5UI)	Mask Seg2	0.00	0.00	1
		-0.110	-0.100	
2"A1(Min Eye height)	400m¥ 0dB Mask Seg2	127.2	79.2	п
2*A1(Min Eye height)	400m¥ 3.5dB Mask Seg2	190.18	118.48	п
2 Al(Min Eye height)	400m¥ 6dB Mask Seg2	253.78	158	П
2"A1(Min Eye height)	400m¥ 9.5dB Mask Seg2	379.68	236.4	Г
2"A1(Min Eye height)	600m¥ OdB Mask Seg2	190.8	118.8	п
2"A1(Min Eye height)	600m¥ 3.5dB Mask Seg2	285.28	177.72	Г
2"Al(Min Eye height)	600m¥ 6dB Mask Seg2	380.86	237.02	Г
2"A1(Min Eye height)	600m¥ 9.5dB Mask Seg2	569.52	354.6	Г
2 Auf Min Ege neight)	Sound Star Mask Seg2	363.32	334.0	
2"A1(Min Eye height)	800m¥ 0dB Mask Seg2	254.4	158.4	г
2*A1(Min Eye height)	800m¥ 3.5dB Mask Seg2	380.4	236.96	г
2"A1(Min Eye height)	800m¥ 6dB Mask Seg2	507.82	316.04	г
2"A1(Min Eye height)	800m¥ 9.5dB Mask Seg2	759.38	472.82	г
OF A 10 A Rev True In status		381.6	237.6	
2"A1(Min Eye height) 2"A1(Min Eye height)	1200m¥ 0dB Mask Seg2 1200m¥ 3.5dB Mask Seg2	570.56	355.44	г
2"Al(Min Ege height)	1200mV 6dB Mask Seg2	761.74	474.06	r
2"Al(Min Ege height)	1200m¥ 9.5dB Mask Seg2	1139.06	709.22	r
2 All Mill Ege height)	1200111 J.JUD Mask Seg2	1133.06	103.22	ſ
2"X1	Min Ege Width	490.00	254.00	
		0.20	0.32	
Diff Rise/Fall Time 20-80%	Max Rise/Fall Time		160	
Diff Rise/Fall Time 20-80%	Min Rise/Fall Time		50	
SE Rise time mismatch		>7= 15% (of SE rise time	
SE Fall time mismatch		< <i>l</i> = 15%	of SE fall time	
Overshoot		k <i>l</i> = 25% of	Differential swing	
Undershoot			Differential swing	
AC Common Mode Noise		<t= 2<="" td=""><td>20mV rms</td><td></td></t=>	20mV rms	
SSC frequency	min		30	k
	max		33	k
SSC modulation deviation	min		-5000	Р
	max		0	Р
dF/dt		< <i>t</i> = 125	50ppm/usec	

Table 1 – DisplayP	ort Compliance	Test Points	(Contd
	on compliance		Conta.

6.2 Fibre Channel

Table 2 - Fibre Channel 'Beta' Test Points

FibreChannel	RT-Eve	100-SE-EL-S	200-SE-EL-S				
Specification	Measurement	100-DF-EL-S*		400-DE-EL-S	800-DE-EL-S	800-DF-EA-S	
Nominal Bit Rate	Bit Rate	1.0625	2.125	4.250	8.500	8.500	Gb/
Unit Interval	Unit Interval	941.1765	470.5882	235.2941	117.6471	117.6471	ps
Bit Rate Tolerance	Bit Rate Limits	100	100	100	100	100	PPI
Golden PLL Frequency	1st Order PLL Loop BW	0.64	1.27	2.55	5.10	5.10	MH
	Be	eta-Tx Test Poi	int				
FibreChannel	RT-Eve	100-SE-EL-S	200-SE-EL-S				
Specification	Measurement	100-DF-EL-S*	200-DF-EL-S*	400-DF-EL-S	800-DF-EL-S	800-DF-EA-S	
1UI - Total Jitter	Jitten@BER; Jitter Eγe Opening	724.71	315.29	112.94	56.47	NA	ps
		0.77	0.67	0.48	0.48	NA	υī
Total Jitter at 10-12 BER	Jitter@BER; TJ	216.47	155.29	122.35	61.18	NA	ps
	<u> </u>	0.23	0.33	0.52	0.52	NA	ίυι
Deterministic Jitter	Jitter@BER; DJ	103.53	94.12	77.65	38.82	NA	ps
	·	0.11	0.20	0.33	0.33	NA	ίυι
В	Mask Seg1, Seg3	1000	1000	800	???	???	mV
Ā	Mask Seg2	300	300	155	???	???	m٧
X1 (relative to 0.5UI)	Mask Seg2	-362.35	-157.65	-56.47	???	???	ps
		-0.39	-0.34	-0.24	222	222	UI
X2 (relative to 0.5UI)	Mask Seg2	-183.53	-68.24	0.00	222	222	ps
(-0.20	-0.15	0.00	222	222	UI
2*A	Min Eye Height	600	600	310	222	222	mν
2*X1	Min Eye Width	724.71	315.29	112.94	222	222	ps
2.00	iviiii Eye vvidiii	0.77	0.67	0.48	???	???	UI
2*B	Differential Amplitude	2000	2000	1600	222	???	mν
Rise/Fall Time 20-80%	Max Rise/Fall Time	385.00	192.00	NA	NA	NA	ps
Rise/Fall Time 20-80%	Min Rise/Fall Time	100	75	60	30	NA	ps
Skew	Differential Skew*	25	15	NA	NA	???	ps
ommon Mode Voltage, RMS	AC CM Voltage	NA	NA	15	15	222	mV
onmon mode voltage, rano	710 Oliv Yolicage	196.5	196.5	10	10		nu v
	Be	eta-Rx Test Poi	int				
FibreChannel	RT-Eye	100-SE-EL-S	200-SE-EL-S				
intechanner		100-31-11-3					
		100-DF-EL-S*	200-3L-LL-S	400-DF-EL-S	800-DF-EL-S	800-DF-EA-S	
Specification 1UI - Total Jitter	Measurement			400-DF-EL-S 112.94	800-DF-EL-S 56.47	800-DF-EA-S NA	۵s
Specification		100-DF-EL-S* 395.29	200-DF-EL-S* 225.88	112.94			ps UI
Specification	Measurement Jitter@BER; Jitter Eye Opening	100-DF-EL-S*	200-DF-EL-S*		56.47	NA	
Specification 1UI - Total Jitter	Measurement	100-DF-EL-S* 395.29 0.42 545.88	200-DF-EL-S* 225.88 0.48 244.71	112.94 0.48 122.35	56.47 0.48 61.18	NA NA	ΰI
Specification 1UI - Total Jitter Total Jitter at 10-12 BER	Measurement Jitter@BER; Jitter Eye Opening Jitter@BER; TJ	100-DF-EL-S* 395.29 0.42 545.88 0.58	200-DF-EL-S* 225.88 0.48 244.71 0.52	112.94 0.48 122.35 0.52	56.47 0.48	NA NA NA	UI ps UI
Specification 1UI - Total Jitter	Measurement Jitter@BER; Jitter Eye Opening	100-DF-EL-S* 395.29 0.42 545.88 0.58 348.24	200-DF-EL-S* 225.88 0.48 244.71 0.52 155.29	112.94 0.48 122.35 0.52 77.65	56.47 0.48 61.18 0.52 38.82	NA NA NA NA NA	UI ps
Specification 1UI - Total Jitter Total Jitter at 10-12 BER Deterministic Jitter	Measurement Jitter@BER; Jitter Eye Opening Jitter@BER; TJ Jitter@BER; DJ	100-DF-EL-S* 395.29 0.42 545.88 0.58 348.24 0.37	200-DF-EL-S* 225.88 0.48 244.71 0.52 155.29 0.33	112.94 0.48 122.35 0.52 77.65 0.33	56.47 0.48 61.18 0.52 38.82 0.33	NA NA NA NA NA	UI ps UI ps UI
Specification 1UI - Total Jitter Total Jitter at 10-12 BER Deterministic Jitter B	Measurement Jitter@BER; Jitter Eye Opening Jitter@BER; TJ Jitter@BER; DJ Mask Seg1, Seg3	100-DF-EL-S* 395.29 0.42 545.88 0.58 348.24 0.37 1000	200-DF-EL-S* 225.88 0.48 244.71 0.52 155.29 0.33 1000	112.94 0.48 122.35 0.52 77.65 0.33 800	56.47 0.48 61.18 0.52 38.82 0.33 ???	NA NA NA NA NA NA 2??	UI ps UI ps UI mV
Specification 1UI - Total Jitter Total Jitter at 10-12 BER Deterministic Jitter B A	Measurement Jitter@BER; Jitter Eye Opening Jitter@BER; TJ Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2	100-DF-EL-S* 395.29 0.42 545.88 0.58 348.24 0.37 1000 200	200-DF-EL-S* 225.88 0.48 244.71 0.52 155.29 0.33 1000 200	112.94 0.48 122.35 0.52 77.65 0.33 800 138	56.47 0.48 61.18 0.52 38.82 0.33 ??? ???	NA NA NA NA NA ??? ???	UI ps UI mV mV
Specification 1UI - Total Jitter Total Jitter at 10-12 BER Deterministic Jitter B	Measurement Jitter@BER; Jitter Eye Opening Jitter@BER; TJ Jitter@BER; DJ Mask Seg1, Seg3	100-DF-EL-S* 395.29 0.42 545.88 0.58 348.24 0.37 1000 200 -197.65	200-DF-EL-S* 225.88 0.48 244.71 0.52 155.29 0.33 1000 200 -112.94	112.94 0.48 122.35 0.52 77.65 0.33 800 138 -56.47	56.47 0.48 61.18 0.52 38.82 0.33 ??? ??? ???	NA NA NA NA NA ??? ??? ???	UI ps UI mV mV
Specification 1UI - Total Jitter Total Jitter at 10-12 BER Deterministic Jitter B A X1 (relative to 0.5UI)	Measurement Jitter@BER; Jitter Eye Opening Jitter@BER; TJ Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2 Mask Seg2	100-DF-EL-S* 395.29 0.42 545.88 0.58 348.24 0.37 1000 200 -197.65 -0.21	200-DF-EL-S* 225.88 0.48 244.71 0.52 155.29 0.33 1000 200 -112.94 -0.24	112.94 0.48 122.35 0.52 77.65 0.33 800 138 -56.47 -0.24	56.47 0.48 61.18 0.52 38.82 0.33 ??? ??? ??? ???	NA NA NA NA NA ??? ??? ??? ???	UI ps UI mV mV ps UI
Specification 1UI - Total Jitter Total Jitter at 10-12 BER Deterministic Jitter B A	Measurement Jitter@BER; Jitter Eye Opening Jitter@BER; TJ Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2	100-DF-EL-S* 395.29 0.42 545.88 0.58 348.24 0.37 1000 200 -197.65 -0.21 0.00	200-DF-FL-S* 225.88 0.48 244.71 0.52 155.29 0.33 1000 200 -112.94 -0.24 0.00	112.94 0.48 122.35 0.52 77.65 0.33 800 138 -56.47 -0.24 0.00	56.47 0.48 61.18 0.52 38.82 0.33 ??? ??? ??? ??? ??? ???	NA NA NA NA NA ??? ??? ??? ??? ???	UI ps UI mV mV ps UI ps
Specification 1UI - Total Jitter Total Jitter at 10-12 BER Deterministic Jitter B A X1 (relative to 0.5Ul) X2 (relative to 0.5Ul)	Measurement Jitter@BER; Jitter Eye Opening Jitter@BER; TJ Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2 Mask Seg2 Mask Seg2	100-DF-EL-S* 395.29 0.42 545.88 0.68 348.24 0.37 1000 200 -197.65 -0.21 0.00 0.00	200-DF-EL-S* 225.88 0.48 244.71 0.52 155.29 0.33 1000 200 -112.94 -0.24 0.00 0.00	112.94 0.48 122.35 0.52 77.65 0.33 800 138 -56.47 -0.24 0.00 0.00	56.47 0.48 61.18 0.52 38.82 0.33 ??? ??? ??? ??? ??? ??? ??? ??? ???	NA NA NA NA NA ??? ??? ??? ??? ??? ??? ?	UI ps UI ps UI mV mV ps UI ps UI ps UI
Specification 1UI - Total Jitter Total Jitter at 10-12 BER Deterministic Jitter B A X1 (relative to 0.5Ul) X2 (relative to 0.5Ul) 2*A	Measurement Jitter@BER; Jitter Eye Opening Jitter@BER; TJ Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2 Mask Seg2 Mask Seg2 Mask Seg2	100-DF-EL-S* 395.29 0.42 545.88 0.58 348.24 0.37 1000 200 -197.65 -0.21 0.00 0.00 400	200-DF-FL-S* 225.98 0.48 244.71 0.52 155.29 0.33 1000 200 -112.94 -0.24 0.00 400	112.94 0.48 122.35 0.52 77.65 0.33 800 138 -56.47 -0.24 0.00 0.00 276	56.47 0.48 61.18 0.52 38.62 0.33 ??? ??? ??? ??? ??? ??? ??? ??? ???	NA NA NA NA NA ??? ??? ??? ??? ??? ??? ?	UI ps UI ps UI m ^V m ^V ps UI ps UI m ^V
Specification 1UI - Total Jitter Total Jitter at 10-12 BER Deterministic Jitter B A X1 (relative to 0.5Ul) X2 (relative to 0.5Ul)	Measurement Jitter@BER; Jitter Eye Opening Jitter@BER; TJ Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2 Mask Seg2 Mask Seg2	100-DF-EL-S* 395.29 0.42 545.88 0.58 348.24 0.37 1000 200 -197.65 -0.21 0.00 0.00 0.00 400 395.29	200-DF-FL-S* 225.88 0.48 244.71 0.52 155.29 0.33 1000 200 -112.94 -0.24 0.00 0.00 400 225.88	112.94 0.48 122.35 0.52 77.65 0.33 800 138 -56.47 -0.24 0.00 0.00 0.00 276 112.94	56.47 0.48 61.18 0.52 38.82 0.33 ??? ??? ??? ??? ??? ??? ??? ??? ???	NA NA NA NA NA ??? ??? ??? ??? ??? ??? ?	U ps U ps U m ^V ps U ps U m ^V ps
Specification 1UI - Total Jitter Total Jitter at 10-12 BER Deterministic Jitter B A X1 (relative to 0.5Ul) X2 (relative to 0.5Ul) 2*A 2*X1	Measurement Jitter@BER; Jitter Eye Opening Jitter@BER; TJ Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2 Mask Seg2 Mask Seg2 Mask Seg2 Min Eye Height Min Eye Width	100-DF-EL-S* 395.29 0.42 545.88 0.58 348.24 0.37 1000 200 -197.65 -0.21 0.00 0.00 400 395.29 0.42	200-DF-EL-S* 225.88 0.48 244.71 0.52 155.29 0.33 1000 200 -112.94 -0.24 0.00 0.00 400 225.88 0.48	112.94 0.48 122.35 0.52 77.65 0.33 800 138 -56.47 -0.24 0.00 0.00 276 112.94 0.48	56.47 0.48 61.18 0.52 38.82 0.33 ??? ??? ??? ??? ??? ??? ??? ??? ???	NA NA NA NA NA ??? ??? ??? ??? ??? ??? ?	U ps U ps U m\ ps U
Specification 1UI - Total Jitter Total Jitter at 10-12 BER Deterministic Jitter B A X1 (relative to 0.5Ul) X2 (relative to 0.5Ul) 2*A	Measurement Jitter@BER; Jitter Eye Opening Jitter@BER; TJ Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2 Mask Seg2 Mask Seg2 Mask Seg2	100-DF-EL-S* 395.29 0.42 545.88 0.58 348.24 0.37 1000 200 -197.65 -0.21 0.00 0.00 0.00 400 395.29	200-DF-FL-S* 225.88 0.48 244.71 0.52 155.29 0.33 1000 200 -112.94 -0.24 0.00 0.00 400 225.88	112.94 0.48 122.35 0.52 77.65 0.33 800 138 -56.47 -0.24 0.00 0.00 0.00 276 112.94	56.47 0.48 61.18 0.52 38.82 0.33 ??? ??? ??? ??? ??? ??? ??? ??? ???	NA NA NA NA NA ??? ??? ??? ??? ??? ??? ?	U ps U ps U m ^V ps U ps U m ^V ps

Decoding the Spec: Speed-TxMedia-InteropPoint-Distance

 Speed

 800 - 800 -- 800 MBytes/second

 400 - 400 -- 400 MBytes/second

 200 - 200 -- 200 MBytes/second

100 - 100 -- 100 MBytes/second

Tx Media

SE - unbalanced copper connecting to any interoperability point DF - balanced copper connecting to any interoperability point

- InteropPoint EL any electrical point except an EA delta point (includes SN PMD delta points) that assumes a non-equalizing
 - EA any electrical point that assumes a specified equalizing reference receiver for measurement

Distance S - Short

E 11 O1 · ·	Derived from FC-PI4 Re			Chapter 9		1	
FibreChannel	RT-Eye	100-SE-EL-S	200-SE-EL-S				
Specification	Measurement	100-DF-EL-S*					
Nominal Bit Rate	Bit Rate	1.0625	2.125	4.250	8.500	8.500	Gb
Unit Interval	Unit Interval	941.1765	470.5882	235.2941	117.6471	117.6471	ps
Bit Rate Tolerance	Bit Rate Limits	100	100	100	100	100	PP
Golden PLL Frequency	1st Order PLL Loop BW	0.64	1.27	2.55	5.10	5.10	MF
		elta-Tx Test Po	int				
FibreChannel	RT-Eye	100-SE-EL-S	200-SE-EL-S				
Specification	Measurement	100-DF-EL-S*	200-DF-EL-S*	400-DF-EL-S	800-DF-EL-S	800-DF-EA-S	
1UI - Total Jitter	Jitter@BER; Jitter Eye Opening	705.88	348.24	174.12	81.18	NA	ps
		0.75	0.74	0.74	0.69	NA	Ū
Total Jitter at 10-12 BER	Jitten@BER: TJ	235.29	122.35	61.18	36.47	36.47	ps
	<u> </u>	0.25	0.26	0.26	0.31	0.31	ίu
Deterministic Jitter	Jitten@BER:DJ	112.94	65.88	32.94	20.00	20.00	ps
		0.12	0.14	0.14	0.17	0.17	Ū
В	Mask Seg1, Seg3	1000	1000	800	350	350	m١
Ā	Mask Seg2	325	325	325	90	90	m١
X1 (relative to 0.5UI)	Mask Seg2	-352.94	-174.12	-87.06	-40.59	-40.59	ps
XII (Iolalio to olooi)	maon cogz	-0.38	-0.37	-0.37	-0.35	-0.35	μ
X2 (relative to 0.5UI)	Mask Seg2	-174.12	-84.71	-42.35	-18.24	-18.24	ps
) 2 (iolalito to 0.001)	maon cogz	-0.19	-0.18	-0.18	-0.16	-0.16	UT.
2*A	Min Eye Height	650	650	650	180	222	m\
2*X1	Min Eye Width	705.88	348.24	174.12	81.18	???	ps
2 /0	Will Lye Width	0.75	0.74	0.74	0.69	???	101
2*B	Differential Amplitude	2000	2000	1600	700	700	m\
Rise/Fall Time 20-80%	Max Rise/Fall Time	385	NA	NA	NA	NA	ps
Rise/Fall Time 20-80%	Min Rise/Fall Time	100	NA	NA	NA	NA	ps
Skew	Differential Skew*	20	NA	NA	NA	NA	ps
Common Mode Voltage, RMS	AC CM Voltage	NA	NA	15	15	15	m\
Common Mode Voltage, 1000	AC OW YOURge	1975	100	10	10	10	in s
	De	elta-Rx Test Po	int				
FibreChannel	RT-Eye	100-SE-EL-S	200-SE-EL-S				
Specification	Measurement	100-DF-EL-S*	200-DF-EL-S*	400-DF-EL-S	800-DF-EL-S	800-DF-EA-S	
1UI - Total Jitter	Jitter@BER; Jitter Eye Opening	414.12	192.94	96.47	34.12	NA	ps
for fold one	onnon@pppn, onnon pjo oponnig	0.44	0.41	0.41	0.29	NA	10ī
Total Jitter at 10-12 BER	Jitter@BER; TJ	527.06	277.65	138.82	83.53	NA	ps
Total officer at 10 12 DER	ontoi@bert, ito	0.56	0.59	0.59	0.71	NA	ίΰ
Deterministic Jitter	Jitter@BER; DJ	338.82	183.53	91.76	49.41	NA	ps
Deterministic offer	ontel@BER, Do	0.36	0.39	0.39	0.42	NA	101
В	Mask Seg1, Seg3	1000	1000	800	425	425	m\
D	Mask Seg2	185	185	185	420	112.5	m\
X1 (relative to 0.5UI)	Mask Seg2 Mask Seg2	-207.06	-96.47	-48.24	-17.06	NA	ps
AT (relative to 0.501)	IVIASK DBYZ	-207.06	-96.47	-40.24	-0.15	NA	UI UI
V2 (colotion to 0.5LP)	Mask Seg2	0.00	0.21	0.21	0.00	NA	bs
		1 0.00		0.00	0.00	NA	IDS IUI
X2 (relative to 0.5UI)	IMask Seyz	0.00	1 0.00				IUL.
· · · ·		0.00	0.00				- mar 1
2*A	Min Eye Height	370	370	370	340	225	
· · · ·		370 414.12	370 192.94	370 96.47	340 34.12	225 NA	ps
<u>2*A</u> 2*X1	Min Eye Height Min Eye Width	370 414.12 0.44	370 192.94 0.41	370 96.47 0.41	340 34.12 0.29	225 NA NA	ps UI
2*A 2*X1 2*B	Min Eye Height Min Eye Width Differential Amplitude	370 414.12 0.44 2000	370 192.94 0.41 2000	370 96.47 0.41 1600	340 34.12 0.29 850	225 NA NA 850	m\
<u>2*A</u> 2*X1	Min Eye Height Min Eye Width	370 414.12 0.44	370 192.94 0.41	370 96.47 0.41	340 34.12 0.29	225 NA NA	ps UI

Table 3 – Fibre Channel 'Delta' Test Points

	Derived from FC-PI4 Re						-
FibreChannel	RT-Eye	100-SE-EL-S	200-SE-EL-S		000 05 51 5		
Specification	Measurement	100-DF-EL-S*	200-DF-EL-S*				
Nominal Bit Rate	Bit Rate	1.0625	2.125	4.250	8.500	8.500	Gł
Unit Interval	Unit Interval	941.1765	470.5882	235.2941	117.6471	117.6471	ps
Bit Rate Tolerance	Bit Rate Limits	100	100	100	100	100	PF
Golden PLL Frequency	1st Order PLL Loop BW	0.64	1.27	2.55	5.10	5.10	M
	Gar	nma-Tx Test P	oint				
FibreChannel	RT-Eye	100-SE-EL-S	200-SE-EL-S				
Specification	Measurement	100-DF-EL-S*	200-DF-EL-S*	400-DF-EL-S	800-DF-EL-S	800-DF-EA-S	
1UI - Total Jitter	Jitter@BER; Jitter Eye Opening	687.06	329.41	101.18	NA	NA	ps
		0.73	0.70	0.43	NA	NA	U
Total Jitter at 10-12 BER	Jitter@BER; TJ	254.12	141.18	134.12	NA	NA	ps
	<u> </u>	0.27	0.30	0.57	NA	NA	Ū
Deterministic Jitter	Jitter@BER; DJ	122.35	75.29	87.06	NA	NA	ps
		0.13	0.16	0.37	NA	NA	ίυ
В	Mask Seg1, Seg3	1000	1000	800	???	???	m۱
Ā	Mask Seg2	550	550	155	???	???	m
X1 (relative to 0.5UI)	Mask Seg2	-343.53	-164.71	-50.59	222	222	ps
		-0.37	-0.35	-0.22	???	???	lui
X2 (relative to 0.5UI)	Mask Seg2	-164.71	-75.29	0.00	???	???	ps
. = (-0.18	-0.16	0.00	222	???	101
2*A	Min Eye Height	1100	1100	310	222	222	m١
2*X1	Min Eye Width	687.06	329.41	101.18	???	???	ps
270		0.73	0.70	0.43	???	???	ίΰ
2*B	Differential Amplitude	2000	2000	1600	???	???	m
Rise/Fall Time 20-80%	Max Rise/Fall Time	385.00	192.00	NA	222	???	ps
Rise/Fall Time 20-80%	Min Rise/Fall Time	100	75	60	???	???	ps
Skew	Differential Skew*	25	15	NA	???	???	ps
Common Mode Voltage, RMS	AC CM Voltage	NA	NA	15	15	???	m ^v
Sommon mode voltage, ramo	7 to oim voitage	198.5	196.5	10	10		pur-
	Gat	nma-Rx Test P	aint				
FibreChannel	RT-Eye	100-SE-EL-S	200-SE-EL-S				1
Specification	Measurement	100-DF-EL-S*	200-DF-EL-S*	400-DF-EL-S	800-DF-EL-S	800-DF-EA-S	
1UI - Total Jitter	Jitter@BER; Jitter Eye Opening	432.94	202.35	101.18	???	NA	ps
TOT - TOTAL SILLEI	Janueriugoen, anter eye opennig i						
					222		
Total littor at 10.12 BED	littor@BED: TI	0.46	0.43	0.43	???	NA	-
Total Jitter at 10-12 BER	Jitter@BER; TJ	0.46 508.24	0.43 268.24	0.43 134.12	???	NA	UI ps
		0.46 508.24 0.54	0.43 268.24 0.57	0.43 134.12 0.57	??? ???	NA NA	ps UI
Total Jitter at 10-12 BER Deterministic Jitter	Jitter@BER; TJ Jitter@BER; DJ	0.46 508.24 0.54 329.41	0.43 268.24 0.57 174.12	0.43 134.12 0.57 87.06	??? ??? ???	NA NA NA	ps UI ps
Deterministic Jitter	Jitter@BER; DJ	0.46 508.24 0.54 329.41 0.35	0.43 268.24 0.57 174.12 0.37	0.43 134.12 0.57 87.06 0.37	??? ??? ??? ???	NA NA NA NA	ps UI ps UI
Deterministic Jitter B	Jitter@BER; DJ Mask Seg1, Seg3	0.46 508.24 0.54 329.41 0.35 1000	0.43 268.24 0.57 174.12 0.37 1000	0.43 134.12 0.57 87.06 0.37 800	??? ??? ??? ??? ??? ???	NA NA NA NA NA	ps UI ps UI m
Deterministic Jitter B A	Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2	0.46 508.24 0.54 329.41 0.35 1000 200	0.43 268.24 0.57 174.12 0.37 1000 200	0.43 134.12 0.57 87.06 0.37 800 138	??? ??? ??? ??? ??? ???	NA NA NA NA NA	ps UI ps UI m
Deterministic Jitter B	Jitter@BER; DJ Mask Seg1, Seg3	0.46 508.24 0.54 329.41 0.35 1000 200 -216.47	0.43 268.24 0.57 174.12 0.37 1000 200 -101.18	0.43 134.12 0.57 87.06 0.37 800 138 -50.59	??? ??? ??? ??? ??? ??? ???	NA NA NA NA NA NA	ps UI ps UI m` ps
Deterministic Jitter B A X1 (relative to 0.5UI)	Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2 Mask Seg2	0.46 508.24 0.54 329.41 0.35 1000 200 -216.47 -0.23	0.43 268.24 0.57 174.12 0.37 1000 200 -101.18 -0.22	0.43 134.12 0.57 87.06 0.37 800 138 -50.59 -0.22	??? ??? ??? ??? ??? ??? ??? ???	NA NA NA NA NA NA NA	ps UI ps UI m` m` ps UI
Deterministic Jitter B A	Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2	0.46 508.24 0.54 329.41 0.35 1000 200 -216.47 -0.23 0.00	0.43 268.24 0.57 174.12 0.37 1000 200 -101.18 -0.22 0.00	0.43 134.12 0.57 87.06 0.37 800 138 -50.59 -0.22 0.00	??? ??? ??? ??? ??? ??? ??? ??? ???	NA NA NA NA NA NA NA NA 2??	ps UI ps UI m m ps UI ps
Deterministic Jitter B A X1 (relative to 0.5UI) X2 (relative to 0.5UI)	Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2 Mask Seg2 Mask Seg2	0.46 508.24 0.54 329.41 0.35 1000 -216.47 -0.23 0.00 0.00	0.43 268.24 0.57 174.12 0.37 1000 200 -101.18 -0.22 0.00 0.00	0.43 134.12 0.57 87.06 0.37 800 138 -50.59 -0.22 0.00 0.00	??? ??? ??? ??? ??? ??? ??? ??? ??? ??	NA NA NA NA NA NA NA ??? ???	ps UI m m ps UI ps UI
Deterministic Jitter B A X1 (relative to 0.5Ul) X2 (relative to 0.5Ul) 2*A	Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2 Mask Seg2 Mask Seg2 Min Eye Height	0.46 508.24 0.54 329.41 0.035 1000 200 -216.47 -0.23 0.00 0.00 400	0.43 268.24 0.57 174.12 0.037 1000 200 -101.18 -0.22 0.00 0.00 0.00 400	0.43 134.12 0.57 87.06 0.37 800 138 -50.59 -0.22 0.00 0.00 2.276	??? ??? ??? ??? ??? ??? ??? ??? ??? ??	NA NA NA NA NA NA NA NA 2?? ??? ???	ps UI ps UI m ps UI ps UI ps UI
Deterministic Jitter B A X1 (relative to 0.5UI) X2 (relative to 0.5UI)	Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2 Mask Seg2 Mask Seg2	0.46 508.24 0.54 329.41 0.35 1000 200 -216.47 -0.23 0.00 0.00 400 432.94	0.43 268.24 0.57 174.12 0.37 1000 200 -101.18 -0.22 0.00 0.00 0.00 400 202.35	0.43 134.12 0.57 87.06 0.37 800 138 -50.59 -0.22 0.00 0.00 276 101.18	??? ??? ??? ??? ??? ??? ??? ??? ??? ??	NA NA NA NA NA NA NA ??? ??? ??? ???	ps UI ps UI m ps UI ps UI ps UI
Deterministic Jitter B A X1 (relative to 0.5Ul) X2 (relative to 0.5Ul) 2*A 2*X1	Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2 Mask Seg2 Mask Seg2 Min Eye Height Min Eye Width	0.46 508.24 0.54 329.41 0.35 1000 200 -216.47 -0.23 0.00 0.00 400 432.94 0.46	0.43 268.24 0.57 174.12 0.37 1000 200 -101.18 -0.22 0.00 0.00 400 202.35 0.43	0.43 134.12 0.57 87.06 0.37 800 138 -50.59 -0.22 0.00 0.00 276 101.18 0.43	??? ??? ??? ??? ??? ??? ??? ??? ??? ??	NA NA NA NA NA NA ??? ??? ??? ??? ??? ??	ря UI ря UI m ря UI ря UI ря UI ря UI
Deterministic Jitter B A X1 (relative to 0.5UI) X2 (relative to 0.5UI) 2*A 2*X1 2*B	Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2 Mask Seg2 Mask Seg2 Min Eye Height Min Eye Width Differential Amplitude	0.46 508.24 0.54 329.41 0.35 1000 200 -216.47 -0.23 0.00 0.00 400 432.94 0.46 2000	0.43 268.24 0.57 174.12 0.37 1000 200 -101.18 -0.22 0.00 0.00 400 202.35 0.43 2000	0.43 134.12 0.57 87.06 0.37 800 138 -50.59 -0.22 0.00 0.00 276 101.18 0.43 1600	??? ??? ??? ??? ??? ??? ??? ??? ??? ??	NA NA NA NA NA NA ??? ??? ??? ??? ??? ??	ps UI ps UI ps UI ps UI ps UI ps UI m
Deterministic Jitter B A X1 (relative to 0.5Ul) X2 (relative to 0.5Ul) 2*A 2*X1	Jitter@BER; DJ Mask Seg1, Seg3 Mask Seg2 Mask Seg2 Mask Seg2 Min Eye Height Min Eye Width	0.46 508.24 0.54 329.41 0.35 1000 200 -216.47 -0.23 0.00 0.00 400 432.94 0.46	0.43 268.24 0.57 174.12 0.37 1000 200 -101.18 -0.22 0.00 0.00 400 202.35 0.43	0.43 134.12 0.57 87.06 0.37 800 138 -50.59 -0.22 0.00 0.00 276 101.18 0.43	??? ??? ??? ??? ??? ??? ??? ??? ??? ??	NA NA NA NA NA NA ??? ??? ??? ??? ??? ??	ря UI ря UI m ря UI ря UI ря UI ря UI

Table 4 – Fibre Channel 'Gamma' Test Points

6.3 Ethernet (XAUI and 10GBaseCX4)

Table 5 – XAUI Compliance Test Points

	E 802.3ae-2002 (XAUI - 10G Attac	hment Unit In	terface)	
IEEE 802.3ae 'XAUI'	RT-Eye	XAUI	XAUI	
Specification	Measurement	Near End	Far End	
Nominal Bit Rate	Bit Rate	3.125	3.125	Gb/s
Unit Interval	Unit Interval	320.0000	320.0000	ps
Bit Rate Tolerance	Bit Rate Limits	100	100	PPN
Golden PLL Frequency	1st Order PLL Loop BW	1.87	1.87	MHz
Section 47.3 YALLED	river Electrical characteristics (1	[ahlo 17 1 & E	iauro 47 4)	
IEEE 802.3ae 'XAUI'	RT-Eye	XAIII	XAIII	
Specification	Measurement	Near End	Far End	
1UI - Total Jitter	Jitter@BER; Jitter Eγe Opening	208.00	144.00	ps
		0.65	0.45	UI
Total Jitter at 10-12 BER	Jitter@BER; TJ	112.00	176.00	ps
		0.35	0.55	UI
Deterministic Jitter	Jitter@BER; DJ	54.40	118.40	ps
		0.17	0.37	ŪI
A2	Mask Seg1, Seg3	800	800	m∨
A1	Mask Seg2	400	100	m∨
X1 (relative to 0.5UI)	Mask Seg2	-104.00	-72.00	ps
		-0.325	-0.225	UI
X2 (relative to 0.5UI)	Mask Seg2	-35.20	-32.00	ps
		-0.110	-0.100	UI
2*A1	Min Eye Height	800	200	m∨
2*X1	Min Eye Width	208.00	144.00	ps
		0.65	0.45	UI
2*√DIFFmax	Differential Amplitude	1600	1600	m∨
Rise/Fall Time 20-80%	Max Rise/Fall Time	130	130	
Rise/Fall Time 20-80%	Min Rise/Fall Time	60	60	ps

Table 6 – 10GBaseCX4 Compliance Test Points

Derived f	from IEEE Std. 802.3ak-2004		
10GBASE-CX4	RT-Eye		
Specification	Measurement	3.125Gb/s	
Nominal Bit Rate	Bit Rate	3.1250	Gb/s
Unit Interval	Unit Interval	320.0000	ps
Bit Rate Tolerance	Bit Rate Limits	100	PPM
Golden PLL Frequency	1st Order PLL Loop BW	1.875	MHz

From Table 54-3 MDI Tran	smitter Specification (at TP2 in	Figure 54-2)	
10GBASE-CX4	RT-Eye	1.25Gb/s	
Specification	Measurement	Short Run	
1UI - Total Jitter	Jitter@BER; Jitter Eye Opening	208.00	ps
		0.65	UI
Total Jitter at 10-12 BER	Jitter@BER; TJ	112.00	ps
		0.35	UI
Deterministic Jitter	Jitter@BER; DJ	54.40	ps
		0.17	UI
Deterministic Jitter	Jitter@BER; RJ	86.40	ps
		0.27	UI
Differential Pk-Pk/2 max	Mask Seg1, Seg3	600	m∨
Differential Pk-Pk/2 min	Mask Seg2	400	m∨
Jitter Mask	Mask Seg2	-104	ps
		-0.33	UI
2*VDIFFmax	Min Eye Height	800	mΥ
2*Jitter Mask	Min Eye Width	208	ps
		0.65	UI
Differential Pk-Pk Output Voltage	Differential Amplitude	1200	mΥ
Rise/Fall Time 20-80%	Max Rise/Fall Time	130	ps
Rise/Fall Time 20-80%	Min Rise/Fall Time	60	ps

6.4 InfiniBand DDR (Dual Data Rate) and QDR (Quad Data Rate)

Table 7 – InfiniBand Compliance Test Points

	Derived from InfiniBand Arc	hitecture Speci	fication Volum	ie 2 - Release	1.2 - October, 2	2004		
InfiniBand	RT-Eye	5.0Gb/s DDR	5.0Gb/s DDR	5.0Gb/s DDR	5.0Gb/s QDR	10.0Gb/s QDR	10.0Gb/s QDR	
Specification	Measurement	TX_PINS	TP6	TP1	TX_PINS	TP6	TP1	
Nominal Bit Rate	Bit Rate	5.0000	5.0000	5.000	10.000	10.000	10.000	Gb/
Unit Interval	Unit Interval	200.0000	200.0000	200.0000	100.0000	100.0000	100.0000	ps
Bit Rate Tolerance	Bit Rate Limits	100	100	100	100	100	100	PPI
Golden PLL Frequency	1st Order PLL Loop BW	3.00	3.00	3.00	6.00	6.00	6.00	MH

	Table	18 and Table	19 Driver Char	acteristics				
InfiniBand	RT-Eye	5.0Gb/s DDR	5.0Gb/s DDR	5.0Gb/s DDR	5.0Gb/s QDR	10.0Gb/s QDR	10.0Gb/s QDR	
Specification	Measurement	TX_PINS	TP6	TP1	TX_PINS	TP6	TP1	
1UI - Total Jitter	Jitter@BER; Jitter Eye Opening	140.00	140.00	140.00	70.00	70.00	70.00	ps
		0.70	0.70	0.70	0.70	0.70	0.70	UI
Total Jitter at 10-12 BER	Jitter@BER; TJ	60.00	60.00	60.00	30.00	30.00	30.00	ps
		0.30	0.30	0.30	0.30	0.30	0.30	UI
Deterministic Jitter	Jitter@BER; DJ	30.00	30.00	30.00	15.00	15.00	15.00	ps
		0.15	0.15	0.15	0.15	0.15	0.15	UI
Vdiff (TX_PINS)	Min Eye Height	800			600			m٧
Vdiffc (TP6)	Min Eye Height		650			500		mΥ
Vdiff (TP1)	Min Eye Height			600			450	m٧
∨diff	Differential Amplitude	800	650	600	600	500	450	mΥ
Rise/Fall Time 20-80%	Min Rise/Fall Time	30	30	30	30	30	30	ps
Common Mode Voltage, RMS	AC CM Voltage	25	25	25	25	25	25	mΥ

6.5 Open Base Station Architecture Initiative (OBSAI)

Table 8 – OBSAI Compliance Test Points

	RT-Eye				
OBSAI Specification	Measurement	768Mb/s	1.536Gb/s	3.072Gb/s	
Nominal Bit Rate	Bit Rate	0.7680	1.536	3.072	Gb/
Unit Interval	Unit Interval	1302.0833	651.0417	325.5208	ps
Bit Rate Tolerance	Bit Rate Limits	100	100	100	PPN
	Min Unit Interval	1301.95313	650.97656	325.48828	ps
	Max Unit Interval	1302.21354	651.10677	325.55339	ps
Golden PLL Frequency	1st Order PLL Loop BW	0.46	0.92	1.84	MH:
		651.04	325.52	162.76	
	Section 5.3 Transmitter S	oecifications			
	RT-Eye				
OBSAI Specification	Measurement	768Mb/s	1.536Gb/s	3.072Gb/s	
1UI - Total Jitter	Jitter@BER; Jitter Eye Opening	846.35	423.18	211.59	ps
		0.65	0.65	0.65	UI
Total Jitter at 10-15 BER	Jitter@BER; TJ	455.73	227.86	113.93	ps
		0.35	0.35	0.35	UI
Deterministic Jitter	Jitter@BER; DJ	221.35	110.68	55.34	ps
		0.17	0.17	0.17	UI
A2	Mask Seg1, Seg3	800	800	800	mV
A1	Mask Seg2	200	200	200	m∨
X1 (relative to 0.5UI)	Mask Seg2	-423.18	-211.59	-105.79	ps
		-0.325	-0.325	-0.325	UI
X2 (relative to 0.5UI)	Mask Seg2	-143.23	-71.61	-35.81	ps
		-0.11	-0.11	-0.11	UI
Min Differential Voltage (2*A1)	Min Eye Height	400	400	400	m٧
Eye Width	Min Eye Width	846.35	423.18	211.59	ps
		0.65	0.65	0.65	UI
Max Differential Voltage (2*A2)	Differential Amplitude	1600	1600	1600	m٧

	Section 8.7 Receiver Eye	Diagrams			
OBSAI Specification	RT-Eye Measurement	768Mb/s	1.536Gb/s	3.072Gb/s	
1UI - Total Jitter	Jitter@BER; Jitter Eγe Opening	585.94	292.97	146.48	ps
		0.45	0.45	0.45	ίυι
Total Jitter at 10-15 BER	Jitter@BER; TJ	716.15	358.07	179.04	ps
		0.55	0.55	0.55	ÚI.
Deterministic Jitter	Jitter@BER; DJ	481.77	240.89	120.44	ps
		0.37	0.37	0.37	UI
A2	Mask Seg1, Seg3	800	800	800	m∨
A1	Mask Seg2	100	100	100	m∨
X1 (relative to 0.5UI)	Mask Seg2	-292.97	-146.48	-73.24	ps
		-0.225	-0.225	-0.225	UI
X2 (relative to 0.5UI)	Mask Seg2	0.00	0.00	0.00	ps
		0.00	0.00	0.00	UI
Max Differential Voltage (2*A2)	Differential Amplitude	1600	1600	1600	m∨
Min Differential Voltage (2*A1)	Min Eye Height	200	200	200	m∨
Eye Width	Min Eye Width	585.94	292.97	146.48	ps

6.6 Serial Attached SCSI (SAS)

Table 9 – SAS Compliance Test Points

	Derived from ANSI II and T1	NCITS 417-2006 0/07-063r7 May		ification			
SAS Specification	RT-Eye Measurement	1.5Gb/s	1.5Gb/s	3.0Gb/s	3.0Gb/s	6Gb/s	
Nominal Bit Rate	Bit Rate	1.5000	1.5000	3.000	3.000	6.000	Gb
Unit Interval	Unit Interval	666.6667	666.6667	333.3333	333.3333	166.6667	ps
Bit Rate Tolerance	Bit Rate Limits	100	100	100	100	100	PP
	Min Unit Interval	666.60000	666.60000	333.30000	333.30000	166.65000	ps
	Max Unit Interval	666.73333	666.73333	333.36667	333.36667	166.68333	ps
Golden PLL Frequency	1st Order PLL Loop BW	0.90	0.90	1.80	1.80	3.60	MH
		333.33	333.33	166.67	166.67	83.33	
	Section 5.3.3 Tra						
	RT-Eye Measurement				CT Test Point 3.0Gb/s	6Gb/s	
SAS Specification							_
1UI - Total Jitter	Jitter@BER; Jitter Eye Opening	300.00	300.00	150.00	150.00	66.67	ps
		0.45	0.45	0.45	0.45	0.40	UI
Total Jitter at 10-15 BER	Jitter@BER; TJ	366.67	366.67	183.33	183.33	100.00	ps
		0.55	0.55	0.55	0.55	0.60	UI
Deterministic Jitter	Jitter@BER; DJ	233.33	233.33	116.67	116.67	58.33	ps
		0.35	0.35	0.35	0.35	0.35	UI
72	Mask Seg1, Seg3	800	800	800	800	600	m\
Z1	Mask Seg2	162.5	137.5	162.5	137.5	50	m\
X1 (relative to 0.5UI)	Mask Seg2	-150.00	-150.00	-75.00	-75.00	-33.33	ps
		-0.225	-0.225	-0.225	-0.225	-0.200	UI
Min Differential Voltage (2*Z1)	Min Eye Height	325	275	275	275	100	m\
Eye Width	Min Eye Width	300.00	300.00	150.00	150.00	66.67	ps
		0.45	0.45	0.45	0.45	0.40	UI
AC CM Voltage (pk-Pk)	AC CM Voltage (pk-Pk)	150	150	150	150	150	m\
Rise/Fall Time 20-80%	Max Rise/Fall Time	273	273	137	137	68.33	ps
Rise/Fall Time 20-80%	Min Rise/Fall Time	67	67	67	67	41.67	ps
Skew	Max Differential Skew*	20	20	15	15	NA	ps
Sectio	n 5.3.5 Transmitter/Receiver v	vith TCTF (Trai	nsmitter Compl	liance Transfe	r Function)		
	RT-Eve	IT Test Point	CT Test Point	IT Test Point	CT Test Point		
SAS Specification	Measurement	1.5Gb/s	1.5Gb/s	3.0Gb/s	3.0Gb/s		
1UI - Total Jitter	Jitten@BER; Jitter Eve Opening	300.00	300.00	150.00	150.00		ps
		0.45	0.45	0.45	0.45		1UT
Total Jitter at 10-15 BER	Jitten@BER: TJ	366.67	366.67	183.33	183.33		ps
	0.000,000,000	0.55	0.55	0.55	0.55		1UT
Deterministic Jitter	Jitten@BER; DJ	233.33	233.33	116.67	116.67		ps
Determinette offici		0.35	0.35	0.35	0.35		UT.
72	Mask Seg1, Seg3	800	800	800	800		m\
Z1	Mask Seg2	162.5	137.5	137.5	137.5		m\
X1 (relative to 0.5UI)	Mask Seg2 Mask Seg2	-150.00	-150.00	-75.00	-75.00		ps
(relative to 0.001)	music obgz	-0.225	-0.225	-0.225	-0.225		UI
	Min Eye Height	325	275	275	275		m\
Min Differential Voltage (2*71)		300.00	300.00	150.00	150.00		ps
Min Differential Voltage (2*Z1) Eve Width	I Min Eye Width		000.00		0.45		UI UI
Min Differential Voltage (2*Z1) Eye Width	Min Eye Width		0.45	1145			191
Eye Width	-	0.45	0.45	0.45			m
Eye Width AC CM Voltage (pk-Pk)	AC CM Voltage (pk-Pk)	0.45 150	150	150	150		
Eye Width AC CM Voltage (pk-Pk) Rise/Fall Time 20-80%	AC CM Voltage (pk-Pk) Max Rise/Fall Time	0.45 150 273	150 273	150 137	150 137		ps
Eye Width AC CM Voltage (pk-Pk)	AC CM Voltage (pk-Pk)	0.45 150	150	150	150		m\ ps ps

6.7 Serial RapidIO

5 1 11 6	Derived from Rapidl							_
RapidIO	RT-Eye	1.25Gb/s	1.25Gb/s	2.5Gb/s	2.5Gb/s	3.125Gb/s	3.125Gb/s	
Specification	Measurement	Short Run	Long Run	Short Run	Long Run	Short Run	Long Run	
Nominal Bit Rate	Bit Rate	1.2500	1.250	2.500	2.500	3.125	3.125	1
Unit Interval	Unit Interval	800.0000	800.0000	400.0000	400.0000	320.0000	320.0000	
Bit Rate Tolerance	Bit Rate Limits	100	100	100	100	100	100	F
Golden PLL Frequency	1st Order PLL Loop BW	0.75	0.75	1.50	1.50	1.87	1.87	1
	Secti	on 8.5 Transm	itter Specificat	ions				
RapidIO	RT-Eye	1.25Gb/s	1.25Gb/s	2.5Gb/s	2.5Gb/s	3.125Gb/s	3.125Gb/s	
Specification	Measurement	Short Run	Long Run	Short Run	Long Run	Short Run	Long Run	
1UI - Total Jitter	Jitter@BER; Jitter Eve Opening	520.00	520.00	260.00	260.00	208.00	208.00	-
		0.65	0.65	0.65	0.65	0.65	0.65	ť
Total Jitter at 10-12 BER	Jitter@BER; TJ	280.00	280.00	140.00	140.00	112.00	112.00	
		0.35	0.35	0.35	0.35	0.35	0.35	ľ
Deterministic Jitter	Jitter@BER; DJ	136.00	136.00	68.00	68.00	54.40	54.40	ľ
		0.17	0.17	0.17	0.17	0.17	0.17	f
VDIFFmax	Mask Seg1, Seg3	500	800	500	800	500	800	r
VDIFFmin	Mask Seq2	250	400	250	400	250	400	r
A (relative to 0.5UI)	Mask Seg2	-260.00	-260.00	-130.00	-130.00	-104.00	-104.00	ľ
		-0.33	-0.33	-0.33	-0.33	-0.33	-0.33	ť
B (relative to 0.5UI)	Mask Seg2	-88.00	-88.00	-44.00	-44.00	-35.20	-35.20	- F
E (foldino to olooi)	maon oogz	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	f
2*VDIFFmax	Min Eye Height	500	800	500	800	500	800	r
2A	Min Eye Width	520.00	520.00	260.00	260.00	208.00	208.00	-li k
2.1		0.65	0.65	0.65	0.65	0.65	0.65	f
2*VDIFFmax	Differential Amplitude	1000	1600	1000	1600	1000	1600	r
Rise/Fall Time 20-80%	Min Rise/Fall Time	60	60	60	60	60	60	ľ
Skew	Differential Skew*	25	25	20	20	15	15	F
RapidIO	RT-Eye	tion 8.7 Recei	ver Eye Diagra	ms		[Т
Specification	Measurement	1.25Gb/s		2.5Gb/s		3.125Gb/s		
1UI - Total Jitter	Jitten@BER; Jitter Eve Opening	360.00		180.00		144.00		ľ
	,,,,,,,,	0.45		0.45		0.45		ľ
Total Jitter at 10-12 BER	Jitter@BER; TJ	440.00		220.00		176.00		1
		0.55		0.55		0.55		ľ
VDIFFmax	Mask Seg1, Seg3	800		800		800		r
VDIFFmin	Mask Seg2	100		100		100		1
X1 (relative to 0.5UI)	Mask Seg2	-180.00		-90.00		-72.00		ŀ
		-0.23		-0.23		-0.23		ť
X2 (relative to 0.5UI)	Mask Seg2	-80.00		-40.00		-32.00	1	
(-0.10		-0.10		-0.10		ť
2*VDIFFmin	Min Eye Height	200		200		200		1
2*A	Min Eye Width	360.00		180.00		144.00		ť
2.11	init Ljö rhán	0.45		0.45		0.45		ľ
								- T
2*B	Differential Amplitude	1600		1600		1600		1

7 Appendix A - Customizing Standards Support Library Files

Each standard support setup file consists of three files; the RT-Eye Serial Analysis setup file *<filename.ini>*, the Mask file *<filename.msk>*, and the limits file *<filename.lim>*. All three of these files can be customized if the user chooses to do so.

7.1 Customizing Setup Files

The setup file can be changed by the user and resaved if desired. For example, the default configuration is Single Ended Ch1, Ch3. If a differential probe is being used it may be desirable to save a file in the library that has Differential Ch1 as the source.

7.2 Customizing Mask Files

The .msk files follow the Tektronix format that defines the mask geometries into three absolute segments. The Mask geometries of interest in the InfiniBand DDR TP6 example are highlighted in the following figure. The mask file is a text file and can be edited with a text editor program such as MS Notepad.

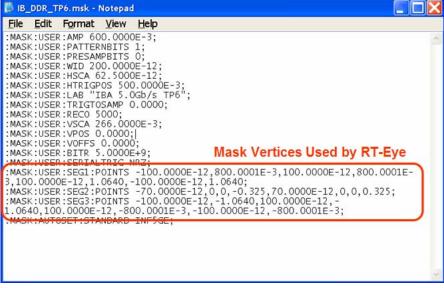


Figure 8 – InfiniBand TP6 Mask File

It is recommended that a Standards Support Library Mask file is copied and renamed before editing.

7.3 Customizing Limits Files

The .lim files follow the Tektronix format that defines the measurement limits in the Serial Analysis Module.

Limits files can be customized by going to the Measurement > Limits menu in the RT-Eye Serial Analysis Module. The current Limits file can be opened and resaved with new limits.

) 🔄 🕇 1220					
Measurem	ent	Statistic	Lower Lim	Upper Lim	
Unit Interval	-	Mean 🔻	199.98ps	200.02ps	
	-	Min	€ ● 140ps	Os e	
Eye Opening		Min 🔻			
Total Jitter	~	Max 🔻	Os	60ps	
Rise Time	-	Min 🔻	30ps	Os e	
			e		
Fall Time	-	Min 🔻	30ps	<u>Os</u>	
Eye Height	-	Min 🔻	650m∨		
			•	•	
Differential Amplitude	-	Min 🔻	650m∨		

Figure 9 – InfiniBand TP6 Limits File

It is recommended that a Standards Support Library limits file is copied and renamed before editing.

8 Appendix B – Measurement Algorithms

Refer to the RT-Eye OLH Measurement Algorithms section.