

External Link Amplitude Budget Analyses

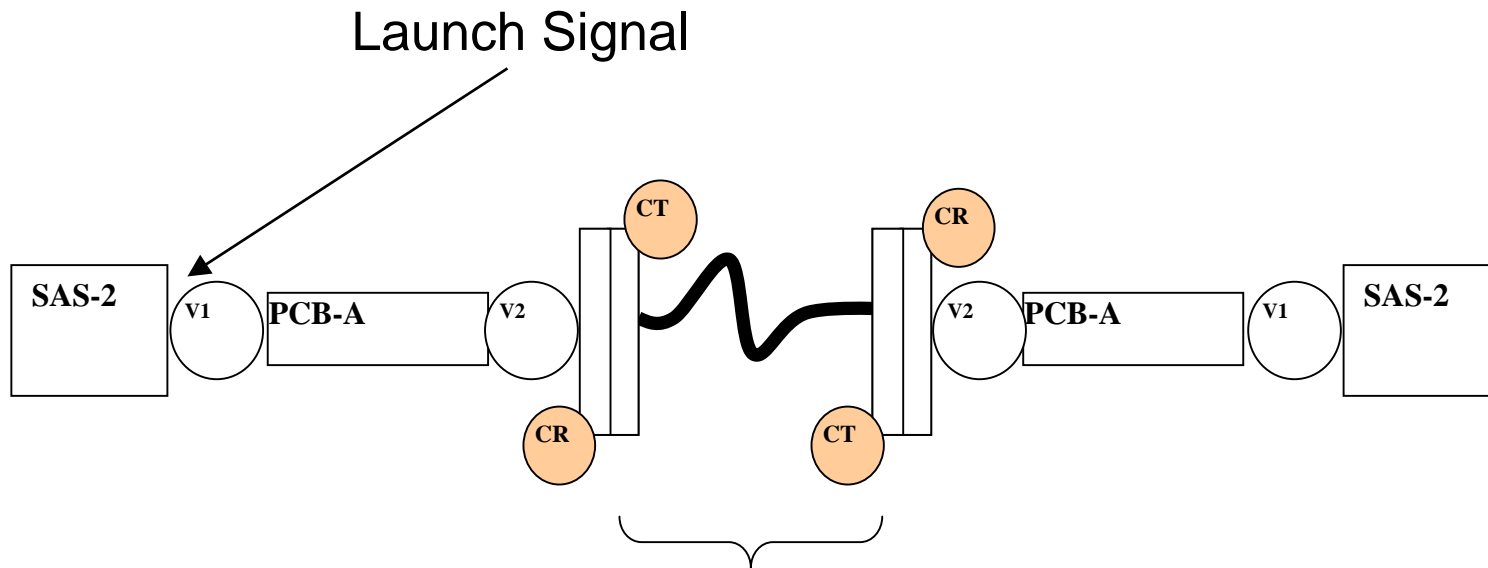
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T10/05-352r0

Background

- Assume SAS1.1 CT TCTF. It already defines cable loss at 3GHz required for SAS-2 budget. For the analyses presented here don't need to extrapolate above 3GHz
- At 3GHz (SAS-2 fundamental) attenuation goes up by ~6dB vs. 1.5 GHz (SAS-1.1 fundamental), while crosstalk budget, dB, is unchanged. This leads to SNR degradation in SAS-2 *at least* by 6 dB
- This contribution analyses amplitudes at the RX side and discusses feasibility of cable lengths above 6 m, including DFE equalization

External Cable Link



Launch Signal

SAS4x or Mini SAS4x cable assembly: 6m, 7m or 10m ?

6 meter TCTF cable

SAS-2 EXTERNAL LINK AMPLITUDE BUDGET ANALYSES, 6 meter

Data Rate	6.00E+09	Hz			Maximum crosstalk				
Pre-emphasis	6.0	dB			Cable Assembly				-26 dB
Cable loss, 3GHz	1.70	dB/m			Package and backplane				-30 dB
Cable length	6	m			X-Talk				-24.5 dB
Loss, dB					Vertical Eye Opening at the receiver Input				
					Launch Voltage mVpp	Rx '@ Fmin	Rx '@ Fmid	Rx '@ Fmax	X-talk 'mVpp
Point in Path	Fmin	Fmid	Fmax						
	6.00E+08	1.50E+09	3.00E+09		1600	466	426	278	94.8
Pre-emphasis	-6.0	-2.5	0.0		1200	350	320	209	71.1
PCB trace, via	-0.4	-0.9	-2.0		1000	291	266	174	59.3
Tx connector	0.0	-0.3	-0.5		800	233	213	139	47.4
Cable assembly	-3.9	-6.7	-10.2						
Rx Connector	0.0	-0.3	-0.5						
PCB trace, via	-0.4	-0.9	-2.0						
Total Insertion Loss, dB	-10.7	-11.5	-15.2						
Ratio	3.4	3.8	5.8						

6m TCTF cable length seems feasible if the minimum launch amplitude > 800 mVpp (CEI-02.0) Jitter and BER Analyses to Follow

7 meter TCTF cable

SAS-2 EXTERNAL LINK AMPLITUDE BUDGET ANALYSES, 7 meter

Data Rate	6.00E+09	Hz	Maximum crosstalk					
Pre-emphasis	6.0	dB	Cable Assembly		-26 dB			
Cable loss, 3GHz	1.70	dB/m	Package and backplane		-30 dB			
Cable length	7	m	X-Talk		-24.5 dB			
Loss, dB			Vertical Eye Opening at the receiver Input					
Point in Path	Fmin	Fmid	Fmax	Launch Voltage mVpp	Rx '@ Fmin	Rx '@ Fmid	Rx '@ Fmax	X-talk 'mVpp
	6.00E+08	1.50E+09	3.00E+09	1600	430	375	229	94.8
Pre-emphasis	-6.0	-2.5	0.0	1200	323	282	171	71.1
PCB trace, via	-0.4	-0.9	-2.0	1000	269	235	143	59.3
Tx connector	0.0	-0.3	-0.5	800	215	188	114	47.4
Cable assembly	-4.6	-7.8	-11.9					
Rx Connector	0.0	-0.3	-0.5					
PCB trace, via	-0.4	-0.9	-2.0					
Total Insertion Loss, dB	-11.4	-12.6	-16.9					

7m TCTF cable length seems feasible for launched amplitude more than 1000 mVpp.

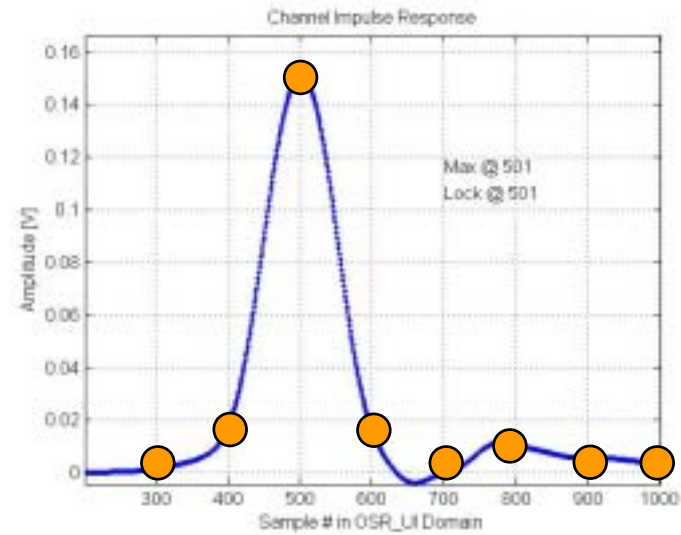
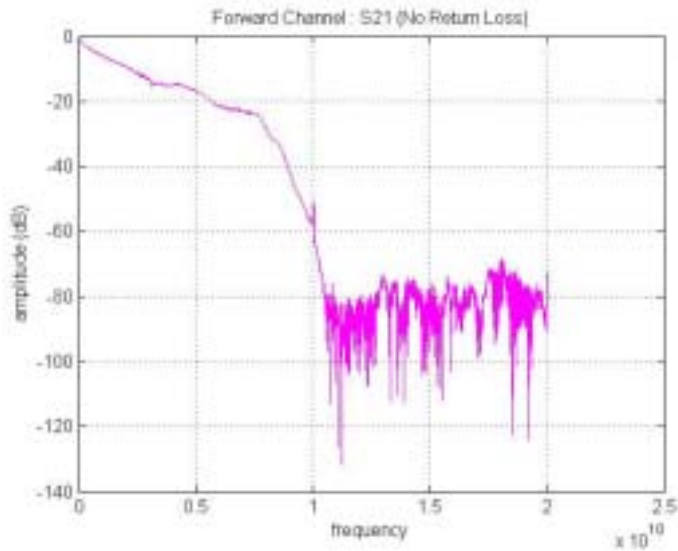
10 meter TCTF cable

SAS-2 EXTERNAL LINK AMPLITUDE BUDGET ANALYSES, 10 meter

Data Rate	6.00E+09	Hz						
Pre-emphasis	6.0	dB						
Cable loss, 3GHz	1.70	dB/m						
Cable length	10	m						
Loss, dB								
					Maximum crosstalk			
					Cable Assembly -26 dB			
					Package and backplane -30 dB			
					X-Talk -24.5 dB			
Vertical Eye Opening at the receiver Input								
Point in Path	Fmin	Fmid	Fmax	Launch Voltage mVpp	Rx '@ Fmin	Rx '@ Fmid	Rx '@ Fmax	X-talk 'mVpp
	6.00E+08	1.50E+09	3.00E+09	1600	326	260	127	94.8
Pre-emphasis	-6.0	-2.5	0.0	1200	245	195	95	71.1
PCB trace, via	-0.4	-0.9	-2.0	1000	204	162	79	59.3
Tx connector	0.0	-0.3	-0.5	800	163	130	64	47.4
Cable assembly	-7.0	-11.0	-17.0					
Rx Connector	0.0	-0.3	-0.5					
PCB trace, via	-0.4	-0.9	-2.0					
Total Insertion Loss, dB	-13.8	-15.8	-22.0					

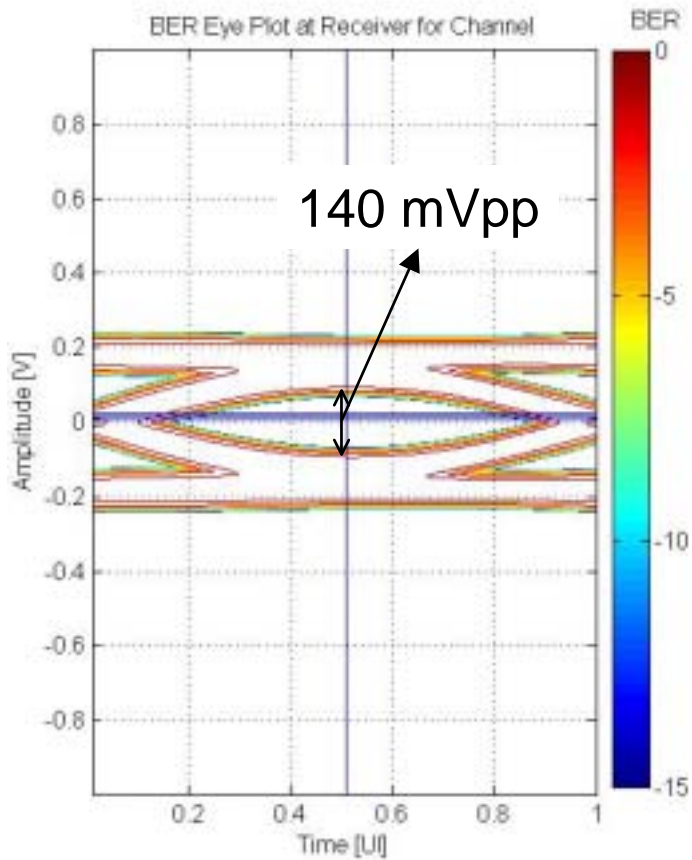
10m TCTF cable length seems not feasible for the existing crosstalk budget

Measured S21 and Pulse Response (with 6dB de-emphasis factored in)

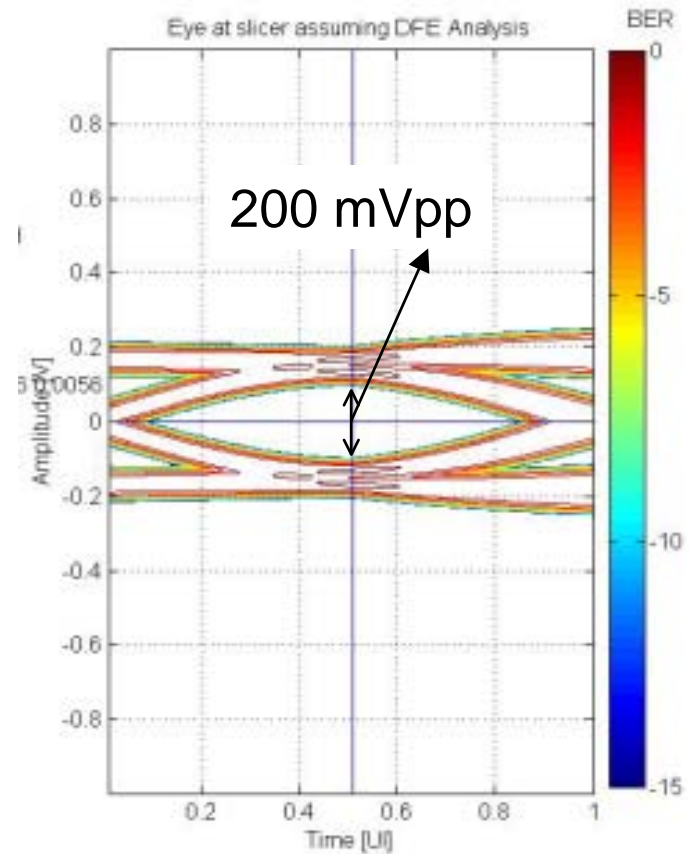


Statistical Eye Simulations

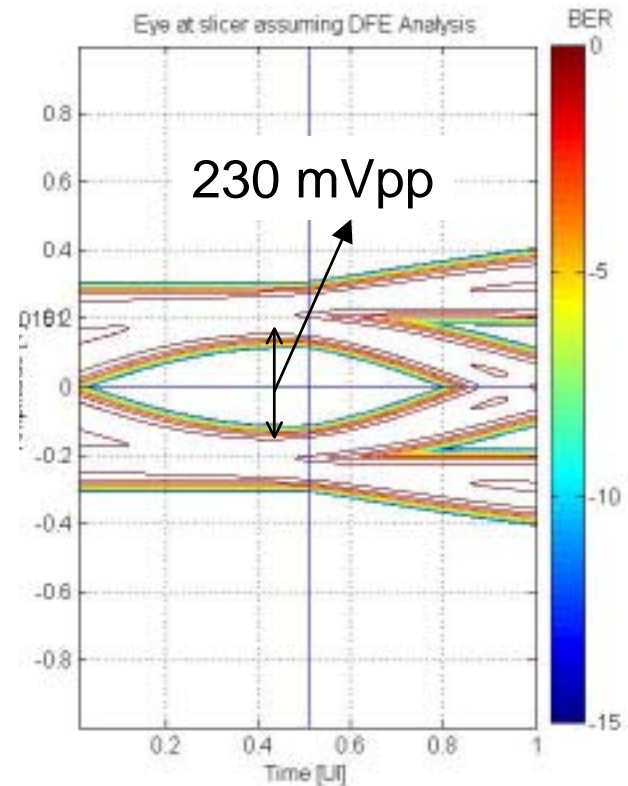
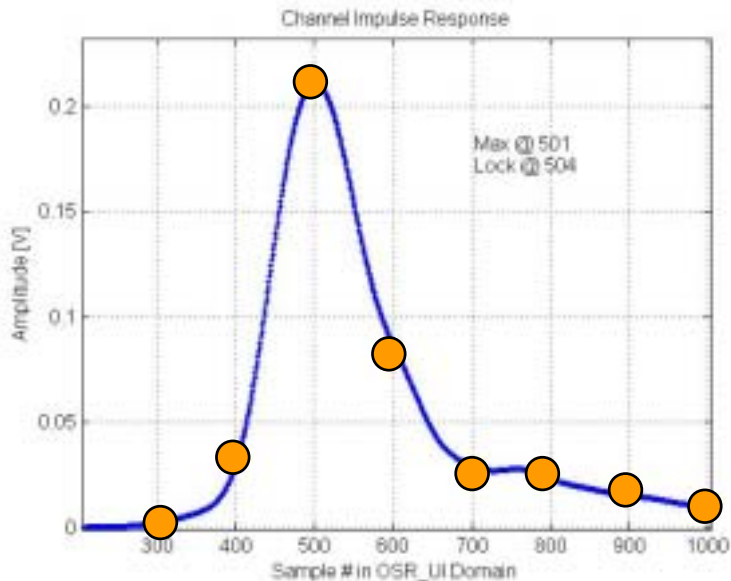
Pre-emphasis only



Pre-emphasis and DFE



Pulse Response and Statistical Eye: no Pre-emphasis with DFE



Summary

- Amplitude budget analyses and statistical eye simulation based on measured S-parameters for Rx with DFE show that external cable length of 6m is doable.
 - DFE works properly with or without Tx pre-emphasis
- For 10m cable worst case crosstalk amplitude becomes comparable with data. This cable length seems not feasible for existing crosstalk budget

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