

TP2 specification for CR4/CR10 Transmitters

Magesh Valliappan
Ali Ghiasi

BROADCOM CORPORATION



Proposal for Transmitter Specification @ TP2

Description	Min	Typ	Max	Units
Total Jitter ^a			0.36	Ulpp
KR transmit waveform " v_2 " ^b	267			mV
QSQ ^c	55.6			ratio
Vertical Eye Opening @ 1e-12 (informative)	340			mVpp

- Measurement procedure is similar to TP0, with all TX lanes active and de-emphasis adjusted optimally
- The test pattern for the transmitter output waveform is the square wave test pattern defined in 52.9.1.2, with a run of at least eight consecutive ones. Measurement procedure is similar to TP0, with same de-emphasis setting as TJ measurement. [similar to "VMA/2", in <ftp://ftp.seagate.com/sff/SFF-8431.PDF>]
- Definition is similar to "QSQ" for electrical signals in <ftp://ftp.seagate.com/sff/SFF-8431.PDF>. The lane under test shall transmit square wave pattern defined in 52.9.1.2, with a run of at least eight consecutive ones, while other lanes shall transmit PRBS31. The value of the standard deviation of the sampled waveform at the center of the measurement window for v_2 shall be measured as r_n . QSQ is defined as (v_2/r_n) . " $20 \cdot \log_{10}(\text{QSQ})$ " can be interpreted as SNR in "dB"

Motivation

- These tests are intended to supplement TP0 specs to provide a minimum performance level expected at TP2
- TJ – constrains reflections and crosstalk
- v_2 – constrains the amount of de-emphasis used and guarantees a minimum TX amplitude
- QSQ – constrains crosstalk and noise injection across transmitters, both at the source & in the path to TP2
- Vertical Eye opening @ 1e-12 provides a combined constraint on all impairments, but is difficult to measure, so presented as informative

Simulation Analysis

- Assume KR compliant transmitter
 - Package model based on “Mellitz” cap like model
 - 47ps rise time, 800mVpp, 0.13 UI DJ, 0.035UI DCD, 0.15 UI RJ
- SFP+ HCB/MCB compliance board with 2.2dB loss at 5GHz
 - Additional 0.7dB loss @ 5GHz added artificially
 - loss consistent with 85.9.1 Tx PCB trace loss + connector
- Crosstalk from an example QSFP connector
 - Provided by Chris Diminico
 - Crosstalk delays aligned to maximize noise
- All other noise sources assumed to generate 1.4mV RMS at TP2
 - Thermal noise + equipment noise + package crosstalk + any other board coupling
- Can be repeated after models or actual CR4/CR10 test fixtures become available

de-emphasis	TJ (UIpp)	v_2 (mV)	QSQ	Eye (mVpp)
-0.075	0.345	323	64.7	303
-0.100	0.340	304	61.7	325
-0.125	0.358	286	58.6	340
-0.150	0.376	267	55.6	338

Simulation Results Analysis

- TJ
 - Allowed up to 2.5% de-emphasis error from best setting
- V_2
 - observed to be smaller than expected from 800mVpp and de-emphasis
 - Some reflections appeared within the 4UI measurement window
 - If narrowed to 2 UI, then v_2 is closer
 - Allowed up to ~ 3dB of de-emphasis (setting -0.15)
- QSQ
 - May need adjustment when TP0-TP2 crosstalk limits are formalized