Transition Time and Transmitter Bandwidth

Mark Kimber (Semtech)

Supporters

- Marc Mazzini (Cisco)
- Ahmad El-Chayeb (Keysight)
- Gary Landry (TI)
- Ali Ghiasi (Ghiasi Quantum/Marvell)
- Adee Ran (Cisco)

Current situation

- The current IEEE802.3dj specification allows low transmitter bandwidth by allowing a transition time of 8 ps
- Presentation Kimber_3dj_01a_2603 reviewed the impact of low transmitter bandwidth on BER floor
- If the transmitter bandwidth goes below 35 GHz then the BER floor starts to climb more rapidly
- Reducing the transition time can be used to limit the transmitter bandwidth on the low end

Transition time measurement

- Transition time is measured at the output of the reference receiver
  - Combination of O/E + oscilloscope is a 53.125 GHz Bessel Thomson response
  - Clock Recovery Unit (CRU) has a corner frequency of 4 MHz with a slope of 20 dB/decade
- Transition time is measured 20% to 80%
- 0% and 100% are defined as per OMAouter
- Patterns
  - Square wave (pattern 3)
  - SSPRQ (pattern 6)

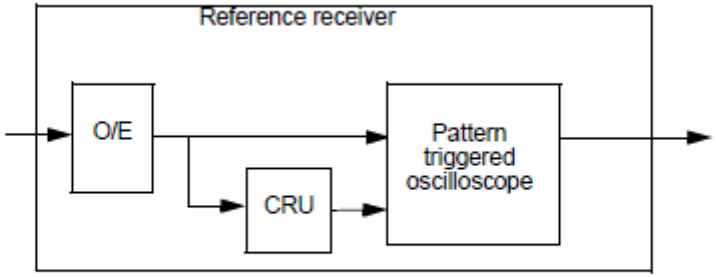


Figure 180–7—Reference receiver block diagram

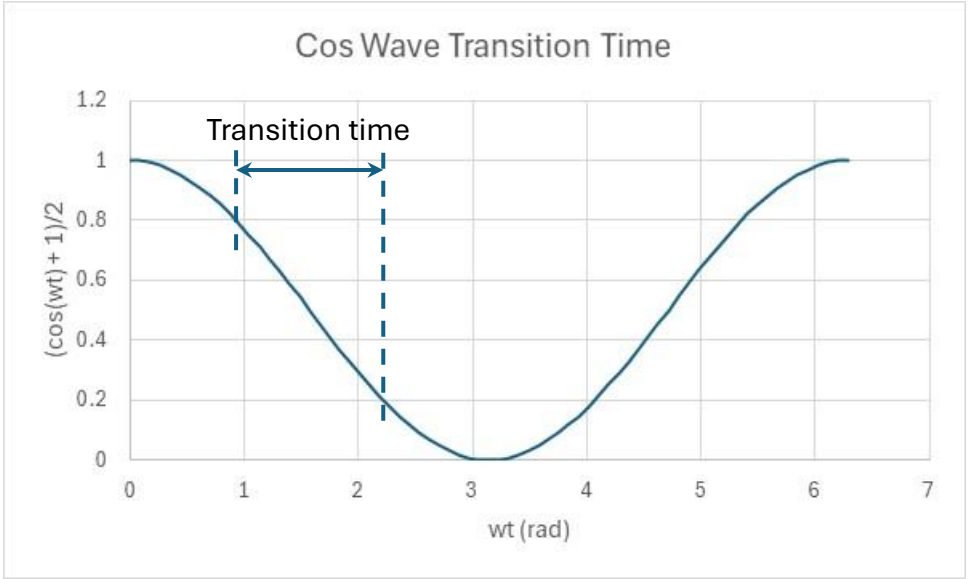
Analysis of transition time - 1

- Model low bandwidth transmitter output as a raised cosine waveform
- Oscilloscope filter response taken as 4.14ps
- Tr (measured) = sqrt(Tr^2 + Tscope^2)

Current spec

Proposed spec

Frequency	20%	80%	Tr	Scope Tr	Measured Tr		0.22/Tr	0.205/Tr
3.00E+10	1.17E-11	4.92E-12	6.83E-12	4.14E-12	7.98485E-12		3.22E+10	3.00E+10
3.10E+10	1.14E-11	4.76E-12	6.61E-12	4.14E-12	7.79736E-12		3.33E+10	3.10E+10
3.20E+10	1.10E-11	4.61E-12	6.40E-12	4.14E-12	7.62317E-12		3.44E+10	3.20E+10
3.30E+10	1.07E-11	4.47E-12	6.21E-12	4.14E-12	7.46104E-12		3.54E+10	3.30E+10
3.40E+10	1.04E-11	4.34E-12	6.02E-12	4.14E-12	7.30986E-12		3.65E+10	3.40E+10
3.50E+10	1.01E-11	4.22E-12	5.85E-12	4.14E-12	7.16867E-12		3.76E+10	3.50E+10
3.60E+10	9.79E-12	4.10E-12	5.69E-12	4.14E-12	7.03658E-12		3.87E+10	3.60E+10
3.70E+10	9.52E-12	3.99E-12	5.54E-12	4.14E-12	6.91282E-12		3.97E+10	3.70E+10
3.80E+10	9.27E-12	3.88E-12	5.39E-12	4.14E-12	6.79671E-12		4.08E+10	3.80E+10
3.90E+10	9.04E-12	3.78E-12	5.25E-12	4.14E-12	6.68763E-12		4.19E+10	3.90E+10
4.00E+10	8.81E-12	3.69E-12	5.12E-12	4.14E-12	6.58501E-12		4.30E+10	4.00E+10
4.10E+10	8.60E-12	3.60E-12	5.00E-12	4.14E-12	6.48836E-12		4.40E+10	4.10E+10
4.20E+10	8.39E-12	3.51E-12	4.88E-12	4.14E-12	6.39722E-12		4.51E+10	4.20E+10
4.30E+10	8.20E-12	3.43E-12	4.76E-12	4.14E-12	6.31118E-12		4.62E+10	4.30E+10
4.40E+10	8.01E-12	3.35E-12	4.66E-12	4.14E-12	6.22987E-12		4.73E+10	4.40E+10
4.50E+10	7.83E-12	3.28E-12	4.55E-12	4.14E-12	6.15295E-12		4.83E+10	4.50E+10
4.60E+10	7.66E-12	3.21E-12	4.45E-12	4.14E-12	6.08011E-12		4.94E+10	4.60E+10
4.70E+10	7.50E-12	3.14E-12	4.36E-12	4.14E-12	6.01107E-12		5.05E+10	4.70E+10
4.80E+10	7.34E-12	3.07E-12	4.27E-12	4.14E-12	5.94558E-12		5.16E+10	4.80E+10
4.90E+10	7.19E-12	3.01E-12	4.18E-12	4.14E-12	5.88338E-12		5.26E+10	4.90E+10
5.00E+10	7.05E-12	2.95E-12	4.10E-12	4.14E-12	5.82428E-12		5.37E+10	5.00E+10
5.10E+10	6.91E-12	2.89E-12	4.02E-12	4.14E-12	5.76806E-12		5.48E+10	5.10E+10
5.20E+10	6.78E-12	2.84E-12	3.94E-12	4.14E-12	5.71455E-12		5.59E+10	5.20E+10
5.30E+10	6.65E-12	2.78E-12	3.86E-12	4.14E-12	5.66357E-12		5.69E+10	5.30E+10



Summary

- Currently the transition time max limit is 8 ps
  - Allows transmitter bandwidth of 30 GHz to pass
- To limit the lower transmitter bandwidth to 35 GHz, the transition time needs to be < 7.2 ps