Tektronix

Measurement directions for C2M and CR

late contribution

802.3dj interim in Annapolis

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Supporters

Contributors

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Agenda

- Jitter measurements: measurement transition selection
- Jitter measurements: practical feasibility
- Noise measurements: measurement flat area selection
- CTLE usage to simplify the jitter measurement

Motivation

- The presentations
  ran_3dj_02_2405 "*Proposed Tx Jitter methodology and limit values*" and
  ran_3dj_02_2405 "AUI-C2M host and module output specifications" by Adee Ran (Cisco) re. Annex 176E propose a direction for some of the specifications for C2M.
- These were supported in the straw polls (2024/05/14), but questions have been raised about some of the measurements being practical/realizable
- Such questions also apply to same/similar measurements in 178 KR, 179 CR , and Annex 176D C2C
- In an off-line discussion we (the authors) agreed on the direction for several of these measurements. This contribution is to present our consensus to the task force. Also, we thus support the direction in *ran_3dj_03_2405* and *ran_3dj_02_2405* ; and invite other interested TF members to the discussion.
- More detailed contributions are planned

Jitter measurements: edge selection 1…

- For the *179–7 and 162.9.4.7 Output jitter*, the *Output jitter is characterized by four parameters: JRMS, J3u, J3u03, and even-odd jitter*
  where as per *120D.3.1.8 Output jitter* :
  the J4u, JRMS, and Even-odd jitter are defined by measurements of 12 specific transitions in a PRBS13Q pattern

- Where **Table 120D–4—PRBS13Q pattern symbols used for jitter measurement** mandates
  the transitions to use for the jitter measurements.

Label	Description	Gray coded PAM4 symbols	Index of first symbol	Index transition begins	Index transition ends	Index of last symbol	Threshold level
REF	Reference for symbol index	3333333	1	—	—	7	—
R03	0 to 3 rise	10000 330	1830	1834	1835	1837	$(V_0+V_3)/2$
F30	3 to 0 fall	23333 001	1269	1273	1274	1276	
R12	1 to 2 rise	0111111 2222221	3638	3644	3645	3651	

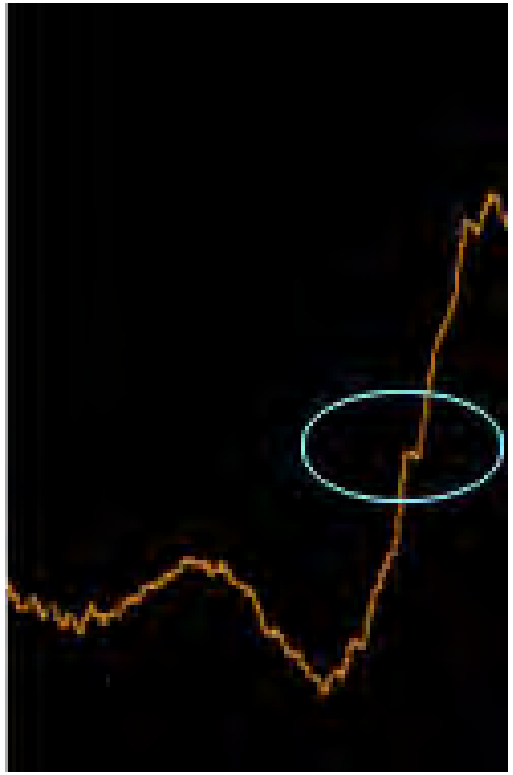
- It's been observed (e.g. in plugfests) that in spite of the fact that the transitions listed in *Table 120D-4* were selected for their likely good shape (settled foot and head, less chance for non-smooth slope), in today's signals the transition trajectory is still often not clean due to reflections, etc.

- In fact we believe that an apriori selection of 1 edge per transmission is unlikely to succeed at today's speeds.

Jitter measurements: …edge selection 2

- Example:

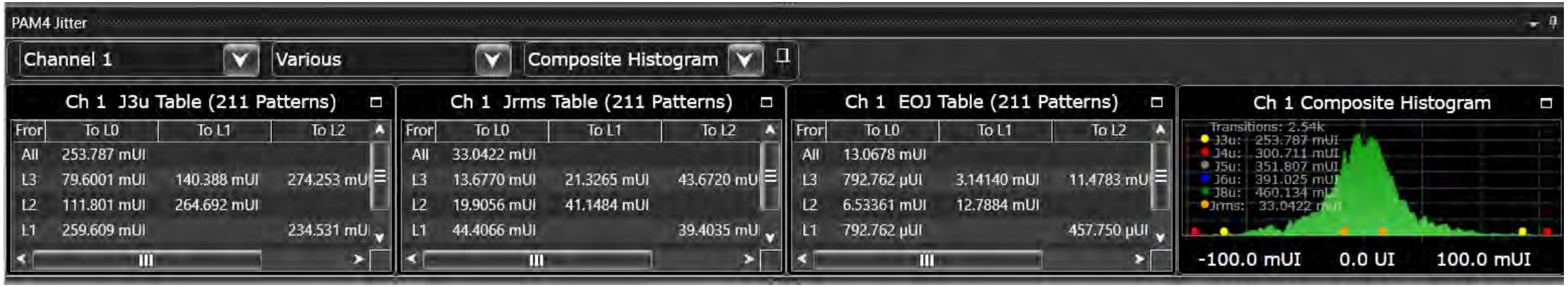
Observe the transition in the figure on the right:
the waveform on the right demonstrates the problem with measuring jitter on a transition where at the jitter measurement threshold level the waveform transition is a poor fit for data collection for jitter measurement. (As long as the encircled feature on the risetime is due to ISI and is at threshold.)



- We therefore propose that this mandate for exact edges (as in **Table 120D–4)** be relaxed by mentioning these edges as examples, but recommending that “the cleanest edges of each trajectory are used for the measurement” (with the goal of getting the most accurate jitter measurement).

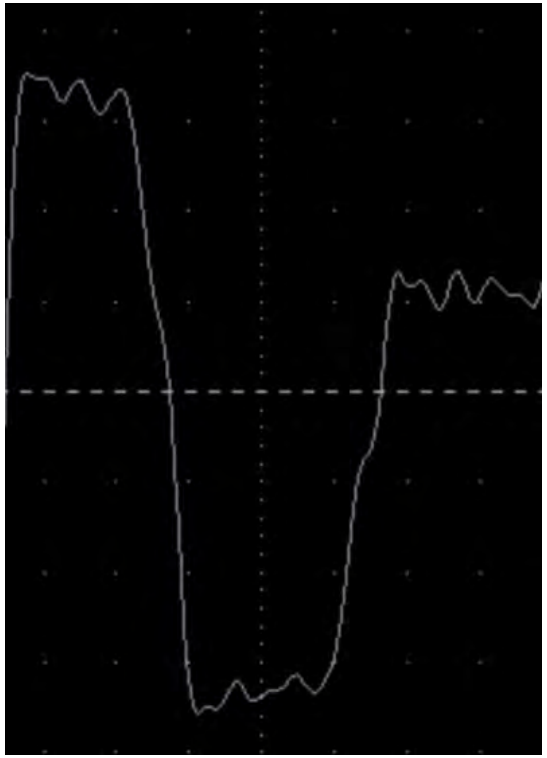
Is the jitter measurable at the end of a long channel

- Addition of losses from several sources add up to large amount of ISI and edge slow-down
- Is this level of jitter even measurable with today's oscilloscopes?
- This experiment was run by John Calvin of Agilent with a positive result in one case: 33 dB loss, no TX EQ, an Real-time oscilloscope (RTO) (Keysight UXR)



Noise measurements: flat region selection

- Similarly to the problems with the selection of a transition (edge) on which to measure jitter, the measurement of the amplitude noise (RMS Deviation) from the mean level of a run-length of the same symbol is also problematic; i.e., observe that in the figure on the right the longer run-lengths do not provide a clean area on which to measure the RMS Deviation.
- The location today is mandatory as per
  120D.3.1.6 Transmitter output noise and distortion:
  …. measure the RMS deviation from the mean voltage at a fixed low-slope point in runs of at least 6 consecutive identical PAM4 symbols. PRBS13Q includes such a run for each of the PAM4 levels. …
- For same reason as with the jitter measurement, that is we can not apriori select the best location to measure jitter at, our consensus is that Sigma-n should find and report the lowest noise location in the waveform, without specifics on how to find this location.



Allow CTLE before the jitter measurement

- It is a consensus of the group that properly performed CTLE should not change the jitter measurement result; thus it should be allowed to use CTLE (of parameters used within the particular standard) before the jitter measurement(s).
- However note that proposal required further study – e.g. the accounting for the apparent jitter caused by the oscilloscope's own noise on a DUT signal's slope must be properly handled; details for further study.

Conclusion

- We have discussed the feasibility and the measurement method improvement of several jitter measurement and of a noise measurement.
- Several proposals were presented. These are to be further clarified and confirmed, and then confirmed by the group, e.g. in a strow call

- Thank you

-end.

Wording changed from We proposed several conclusions. These are to be further clarified and confirmed, and then confirmed by the group, e.g. in a strow call.