SAS 6G Equalization Measurement proposal

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Current definition

5.xxx Transmitter device equalization measurement

a The equalization measurement shall be based on a mode measurement for V_{vma} and a peak-to-peak measurement for $V_{pk\text{-}pk}$ using a TWO_DWORDS phy test pattern of D30.3 (see Table 215 in 10.2.9.1). If the phy test function is not supported, a vendor-specific method may be used to produce this pattern.

b The voltage measurements shall be made with the transmitter device terminated through the interoperability point into a Zero Length Test Load.

c The Vpk-pk and V_{vma} values shall be measured using the following or an equivalent procedure:

a. An equivalent time sampling scope with a histogram function shall be used.
b. The sampling scope shall be calibrated for measurement of a 3GHz signal.
c. The V_{vma} mode value and $V_{pk\text{-}pk}$ peak value shall be determined as illustrated in Figure xxx. A sample size of 1000 minimum, 2000 maximum histogram hits for V_{vma} shall be used to determine the values. The histogram in the figure is a combination of two histograms, an upper histogram for TX+ and lower histogram for TX-.(The histograms on the left of the test pattern signal displayed on the right.) The V_{vma} mode value and $V_{pk\text{-}pk}$ peak value are determined by adding the values measured for TX+ and TX-.

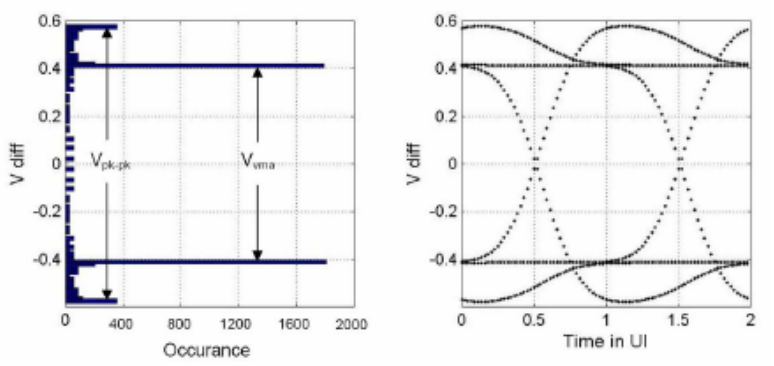

Figure xxx Transmitter equalization measurement

d The following formula shall be used to calculate the equalization value:

$$DE_{dB} = 20Log_{10}\left(\frac{V_{pk-pk}}{V_{vma}}\right)$$

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Limitations of current method

- Comparison of a peak to peak amplitude measurement with a mode amplitude measurement. Vpk-pk will include noise and Vvma will filter this out. As a consequence this method will not be truly representative of the equalization and will likely not correlate between different msmt devices.
- Whole UI is used to measure both Vpk-pk and Vvma. Different waveform shapes will yield different results. This does not help correlation.
- No association between transition and consecutive non-transition(s), as a result trends will skew the results.

Proposed new method - definition

Tx Equalization definition

Tx Equalization is the average ratio of the differential voltage amplitude of transitions bits versus the differential voltage amplitude of non-transitions bits. The differential voltage amplitudes are measured at the sample point (slicer) after clock recovery.

Proposed new method - measurement

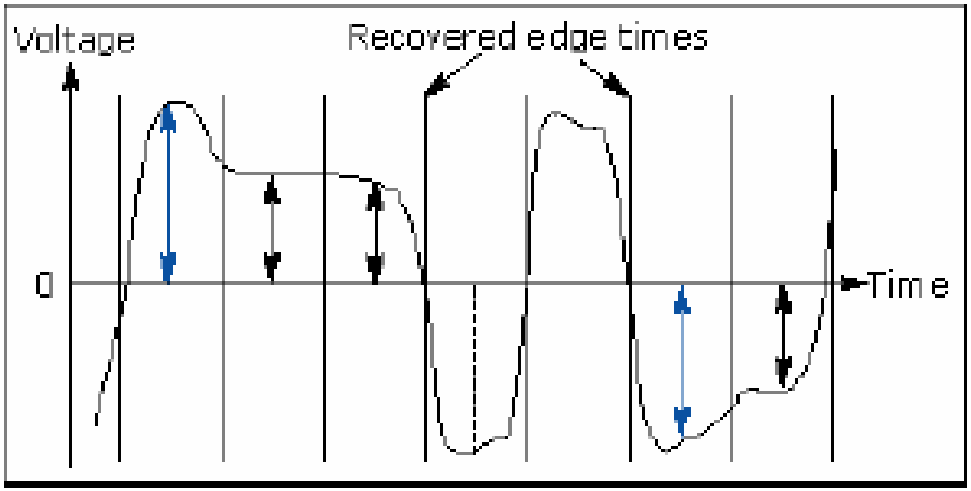
Tx Equalization measurement method

The Equalization measurement calculates the ratio of any non-transition eye voltage (2nd, 3rd, etc. eye voltage succeeding an edge) to its nearest preceding transition eye voltage (1st eye voltage succeeding an edge). The high and low voltages are measured in the center of the UI (after clock recovery).

Tx Equalization is the 20*LOG of the averaged voltage ratio.

- measurement performed after clock recovery (to determine location center UI)
- voltage level is determined at center of UI (by linear interpolation of two closest points)
- de-emphasis value is calculated for every non-transition bit

Proposed new method - measurement



i = 1 2 3 4 5 6 7

j = 1 2 3

i represents center of UI count

j represents equalization (non-transition) count

Equalization1 = 20*LOG(V1/V2)

Equalization2 = 20*LOG(V1/V3)

Equalization3 = 20*LOG(V6/V7)

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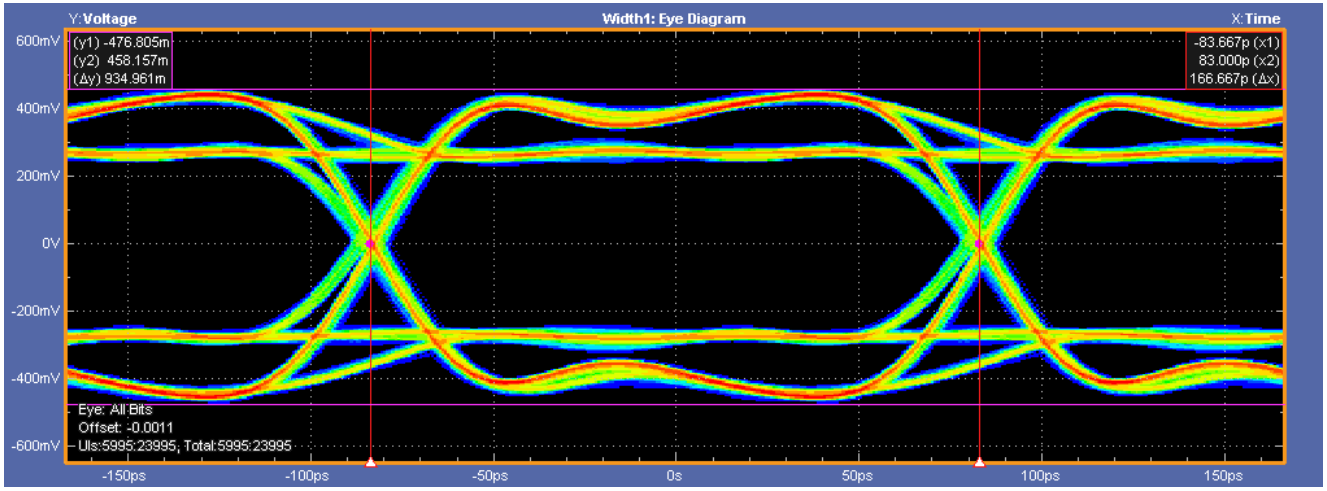
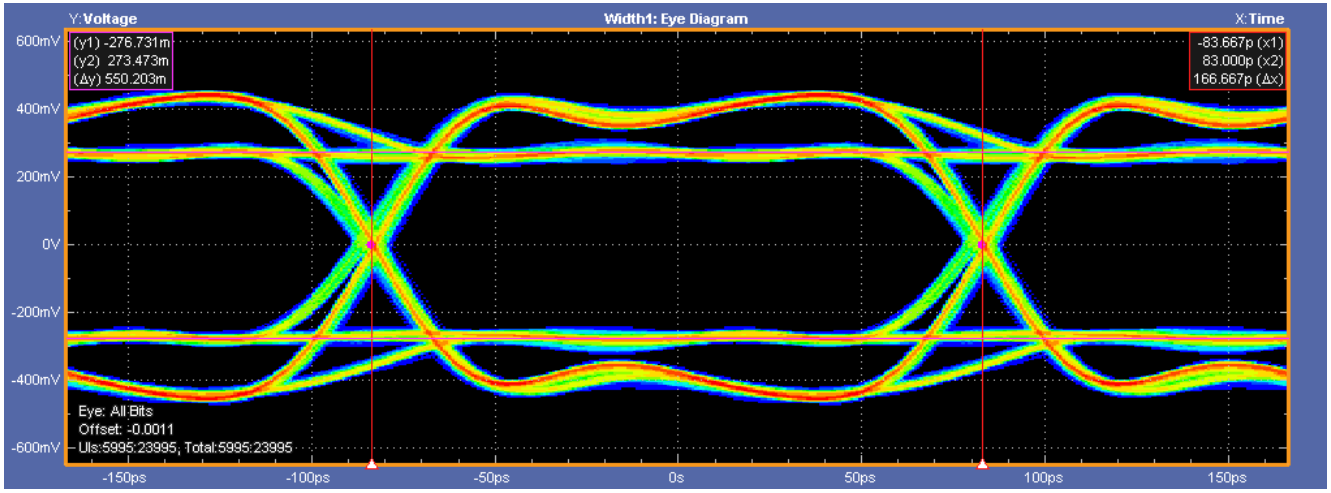
Some results – current method

- V peak-peak = 935 mV
- V mode = 550 mV





Equalization = 20log (935/550) = 4.61 dB

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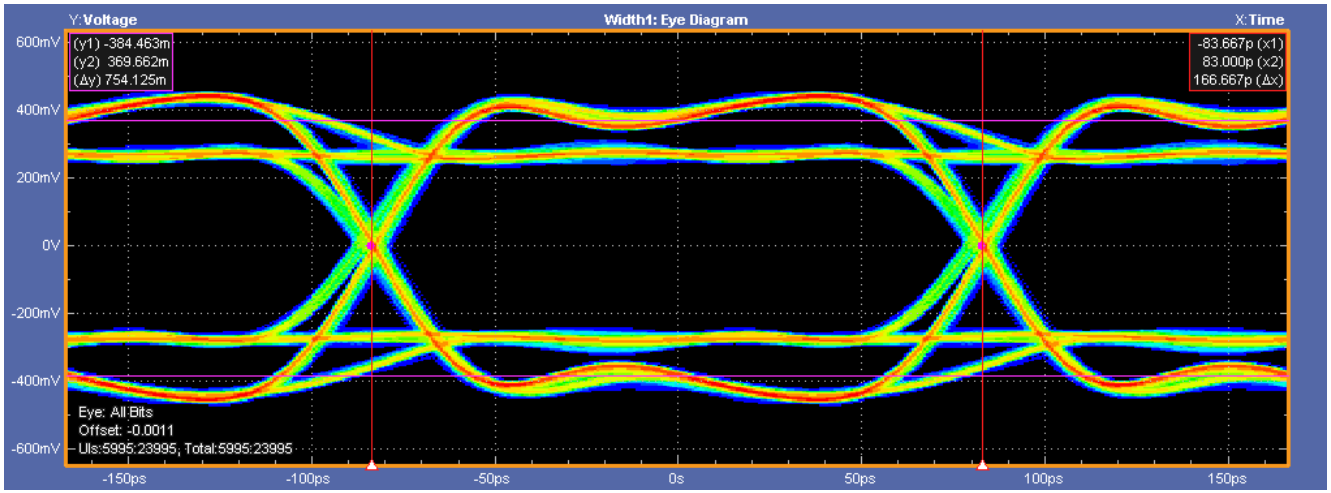
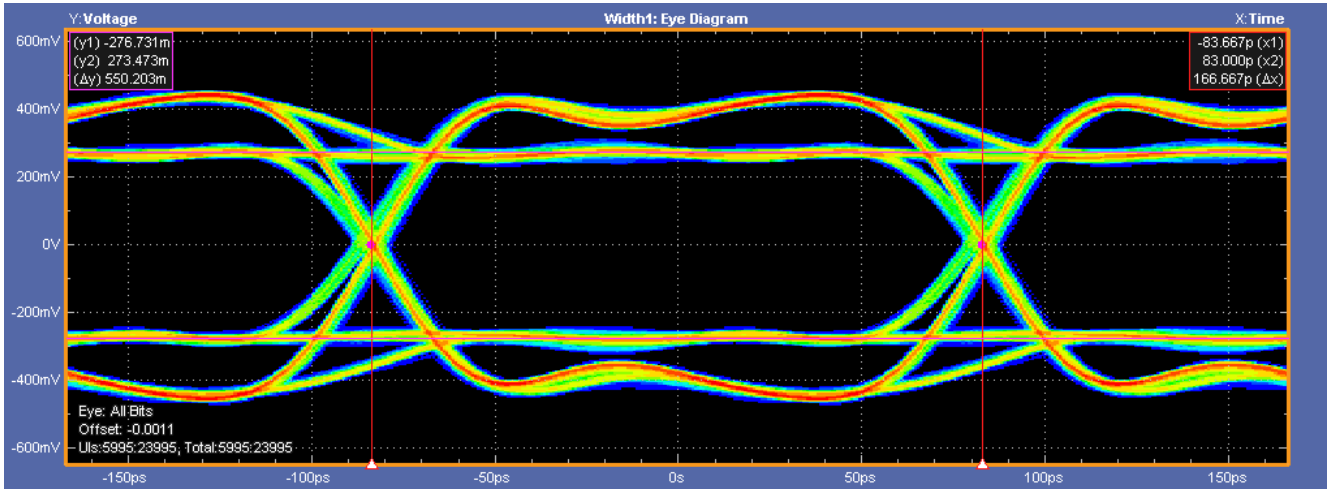
Some results – new method approximation - manual

- V peak-peak = 754 mV
- V mode = 550 mV





Equalization = 20log (754/550) = 2.74 dB

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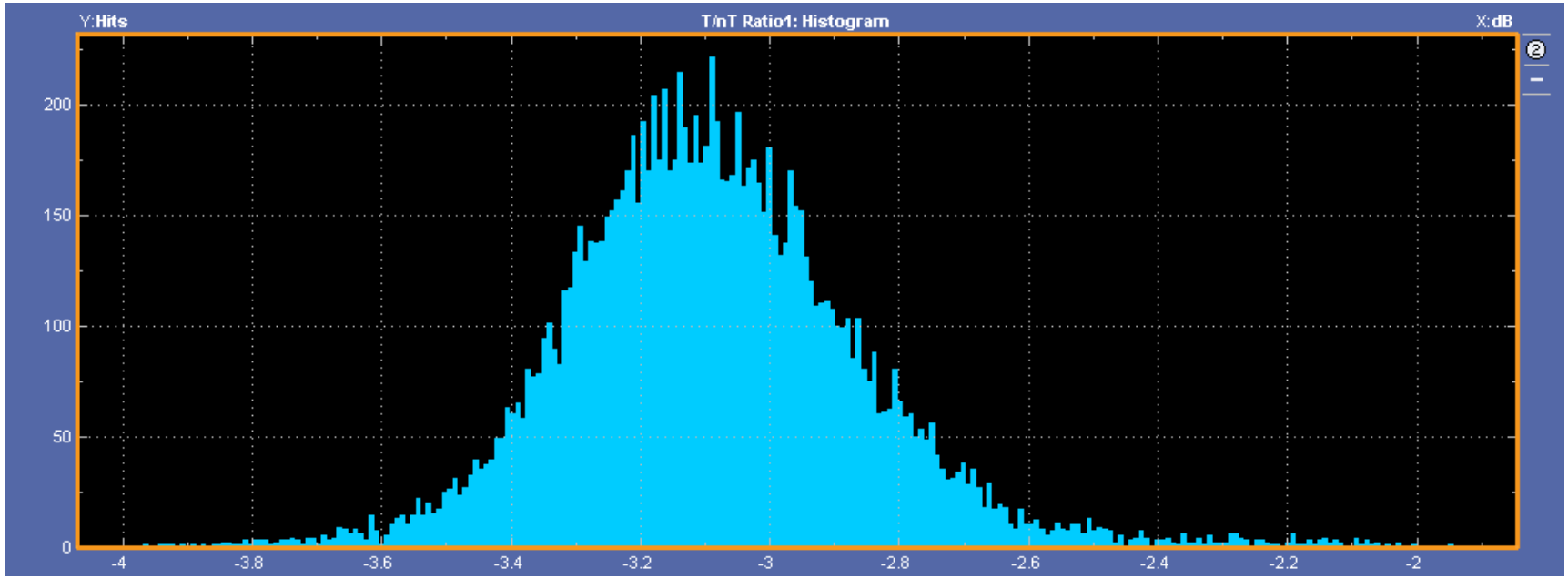
Some results – new method - automatic (DPOJet)

- Equalization = 3.09 dB



Conclusions

- Proposed method is standard proven
- Proposed automatic equalization measurement method provides statistics of equalization parameter
- Proposed method is less sensitive to noise and equipment used
- Proposed method maintains association between transition and consecutive non-transitions, and is therefore less sensitive to trends