TP1a mask, noise and jitter for SRn

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Problem statement

- TP1a signal quality is controlled by
  - An absolute eye mask, at hit ratio 5×10^{-5}
  - DDPWS limit
  - J2 and J9 limits
  - Jitter is under control but a very noisy eye could still pass
    - Then the eye the laser driver receives would not be as open vertically at high statistical significance as it should be (comment 89)
- Also, want to know if X1 mask point is correctly positioned (comment 693)
  - Intention is that timing is controlled by DDPWS, J2, J9, minimum rise time by explicit spec, maximum risetime/high probability jitter by X2, Y1. Point X1 should be a little easier to pass than J2, J9

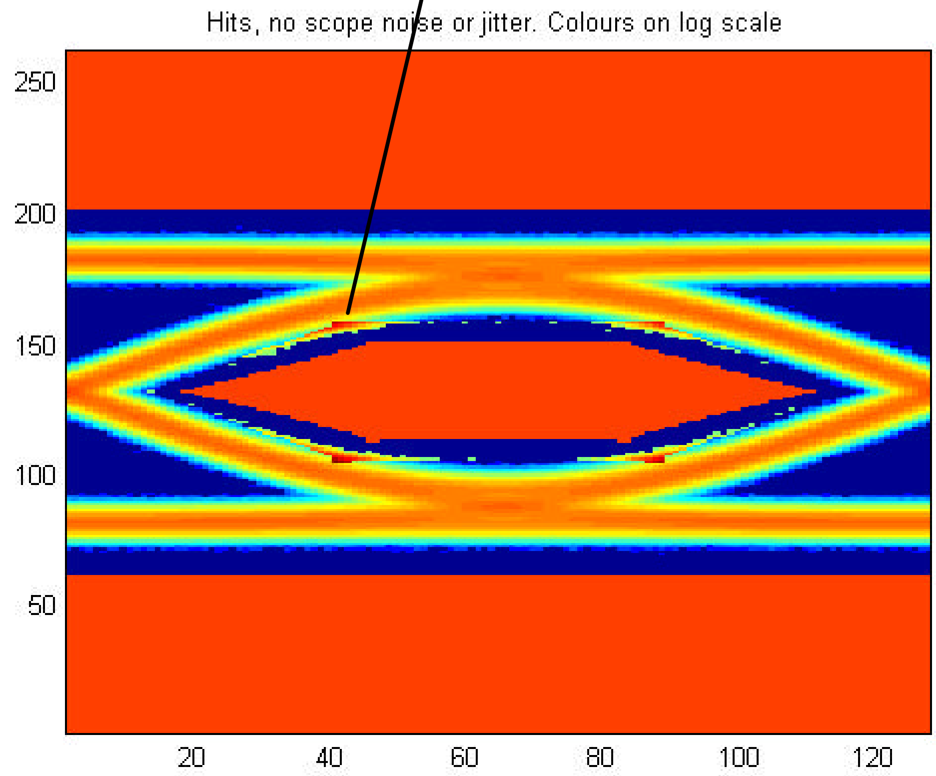
Case 1: slow, noisy eye

- Slow marginal eye at TP1a:
  - Gaussian risetime 50 ps before a 12 GHz BT observation filter
  - SJ=0.02 UI
  - Vertical noise causes nearly all the apparent random jitter
  - TJ=0.284 UI
- Example mask shown:
  0% coordinates are 0.14, 0.35, 90, 350
- Mask +25% coordinates are 0.105, 0.2625, 101, 319
- D2.0 coordinates are 0.1, 0.31, 95, 350

Orange: 0% mask

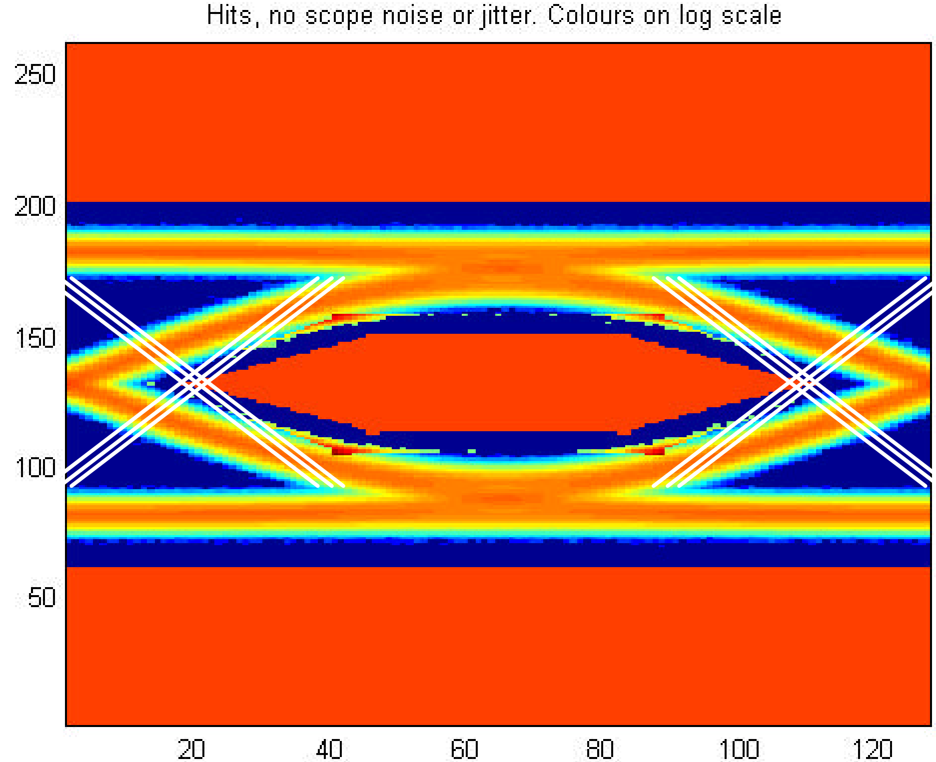
Hits show extent of +25% mask

Note eye can be slower than mask and encroach corners significantly



Case 2: faster but jittered eye

- Jitter could come from timing uncertainty or vertical noise
- To do: work out what X1 corresponds to J2 = 0.18 UI, J9 = 0.26



Statistics at TP1a not same as at TP2

- Roughly, the horizontal effects propagate from TP1 via TP2 to the decision circuit in a moderately linear way. Hence can use Gaussian statistics, with allowance for slew rate effects
- But the vertical effects don't propagate linearly
- There is a slicer or limiting amplifier in the laser driver whose PDF is completely unspecified, except that it is less than 2 x ~90 mV high to ~10^-7
- It could contain significant high probability effects e.g. patterning, hysteresis and still be a good transmitter with a respectable input eye
- But signal at TP2 will deteriorate disproportionately with a slow, noisy eye at TP1
- Conclusion: need to do something to keep eye open vertically to high statistical significance

Options for keeping eye more open

1. Eliminate the slowest eyes
   – Reduce X2
   – Punishes the wrong waveforms, doesn't help EMI
2. Eliminate the ultra-noisy eyes. Sub-options
   a) Add Qsq spec and a requirement in words that baseline wander shall not cause significant degradation
      - Not a completely testable (objective) spec
      - Familiar; electrical Qsq specs in SFP+ and CRn
   b) Tighten up the statistical significance of the mask
      - Increases test time (x10 lanes!) and cost
   c) Impose a relative mask
      - Keep Y2/Y1 to reasonable limit
      - Forces the eye to be relatively not too slow, good defence against patterning
      - No added test time, only test software to extract another conclusion from the same mask measurement
   d) Add an electrical equivalent of a TDP spec
   e) Other option?

Progressing option 2b, Qsq spec

- Qsq is defined for an optical signal in 68.6.7
  - Definition for an electrical signal follows by analogy
    - See SFF-8431 D.8
- What limit?
- For comparison,
  - SFP+ for optical has 50
  - 10GSFP+Cu has 63.1
  - CRn has 55.6
  - Eye for driving optical transmitter can be noisier than eye for a long copper cable
  - SFP+ specs at B for optical are inconveniently challenging
- Propose Qsq <= 45 for SRn; not so onerous

Action 1

- Add to Table 86–6, PPI electrical transmit signal output specifications at TP1a:
  - Qsq min 45 (linear dimensionless ratio, not dB)
- Add to Table 86-16, Test patterns and related subclauses
  - Qsq, pattern Square wave or 4, reference to new Qsq section under 86.7.4
- Create new 86.7.4, Signal to noise ratio Qsq
  - Text and equation to define Qsq similar to 68.6.7 but in electrical domain
- Add to 86.6.1, 40GBASE-SR4 and 100GBASE-SR10 PPI transmitter electrical specifications
  - Words of caution that baseline wander should be controlled so as not to defeat the intent of the Qsq limit

Action 2

- Depending on outcome of calculation to be done for slide 4,
- Possibly tweak TP1a X1 mask coordinate value