SAS-2 Test Methodology

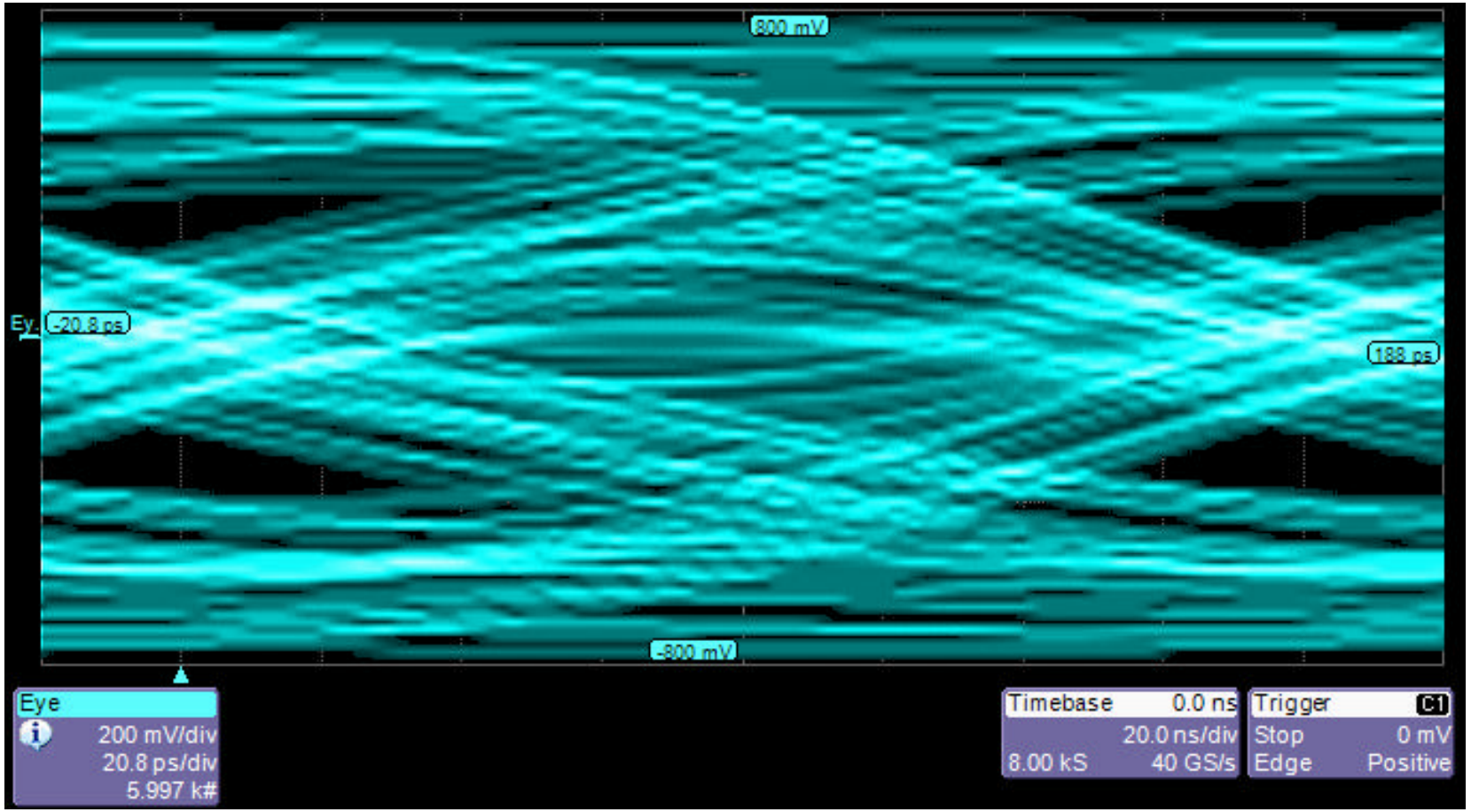
T10/07-112r0

Never stop thinking

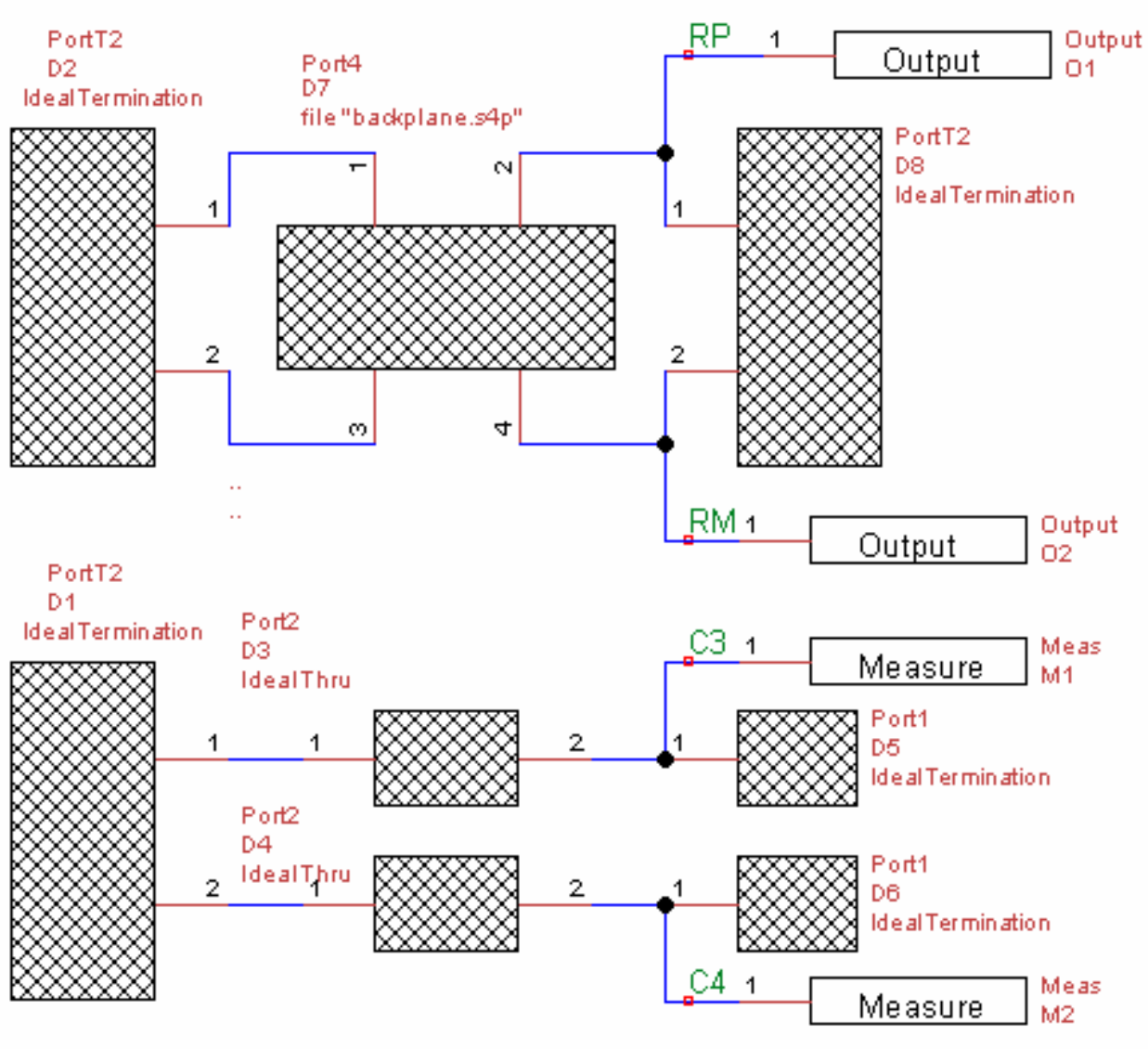
Measurement Set Up

- BERT (No de-emphasis) driving HP24 reference backplane and backplane connected to 20GHz equivalent time sampling scope.
- Backplane measured with 20GHz 4 port network analyzer.
  - 06-017r0.zip contains HP24_BtoB_4Connector.s4p file.
- BERT measured directly with 20GHz equivalent time scope.
- Emulate backplane filter using full s4p file and compare with measured signal.
- Measure closed eye when 0dB de-emphasis & no DFE.
- Emulate 3dB de-emphasis at transmitter
  - No DFE, 1, 2, 3 & 10 tap DFE
- Report includes emulation with 6dB de-emphasis at transmitter
  - No DFE, 2, 3 & 10 tap DFE

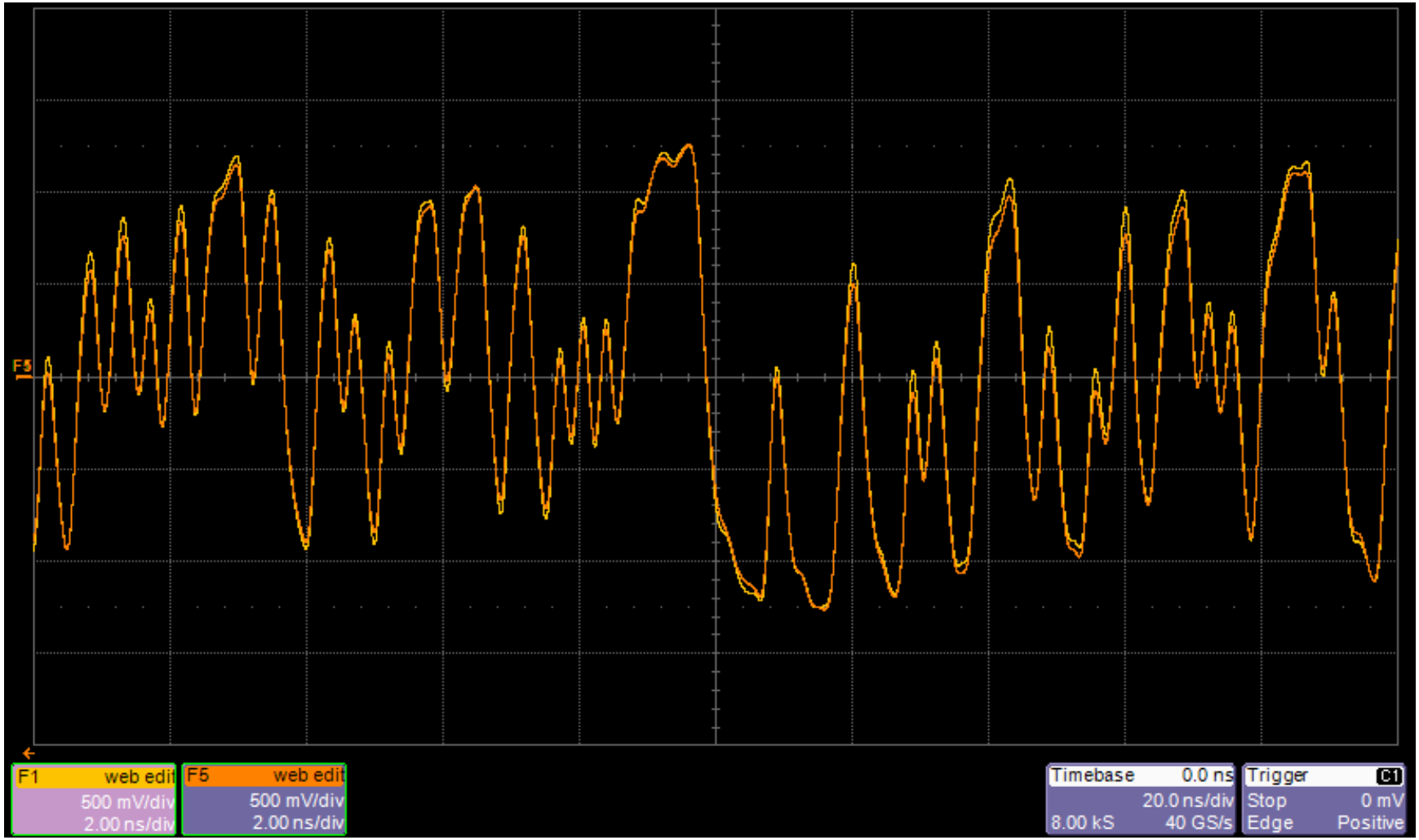
HP24 (BERT to Scope & 0dB Emulation at Tx) No DFE



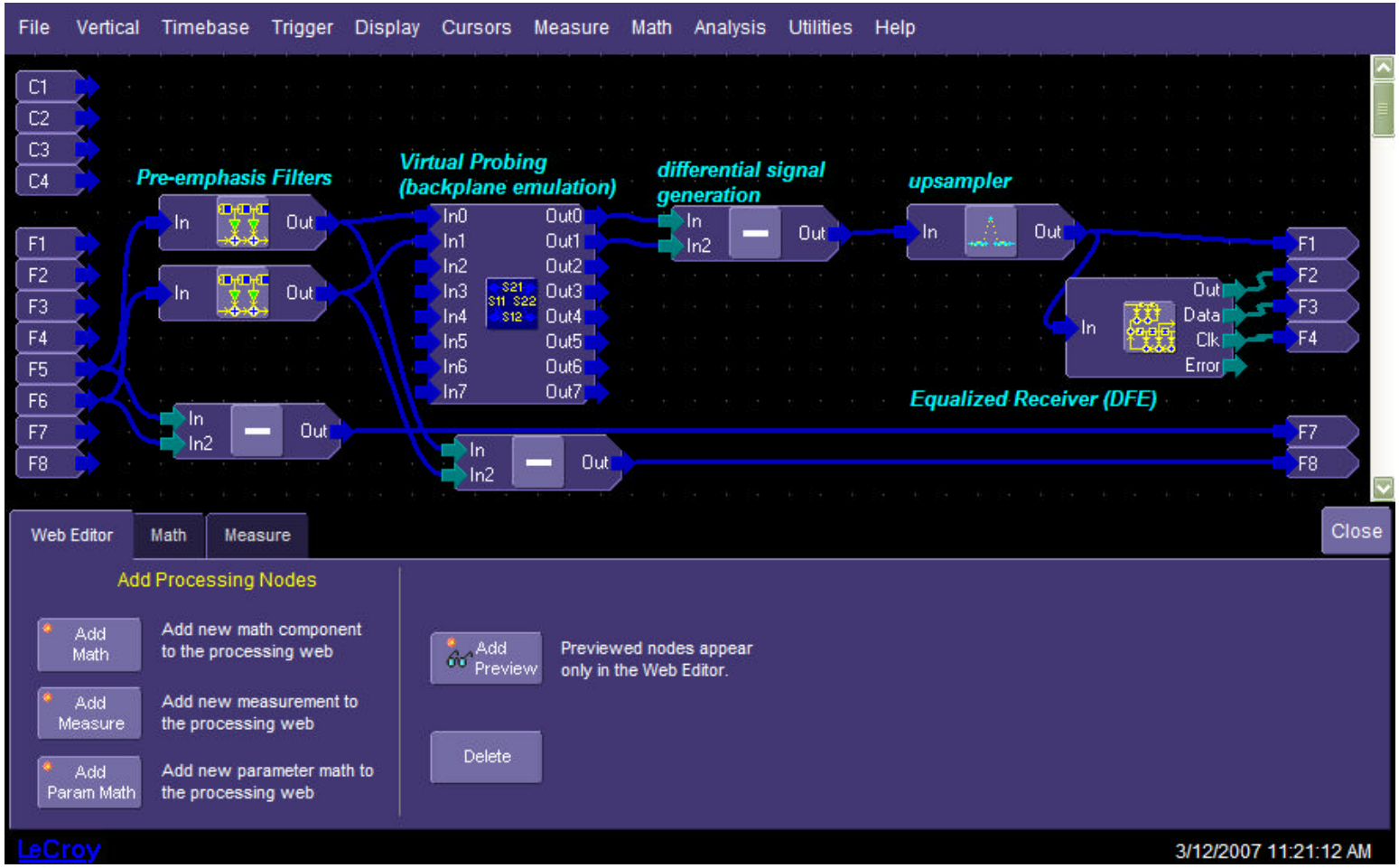
Virtual Probing Setup



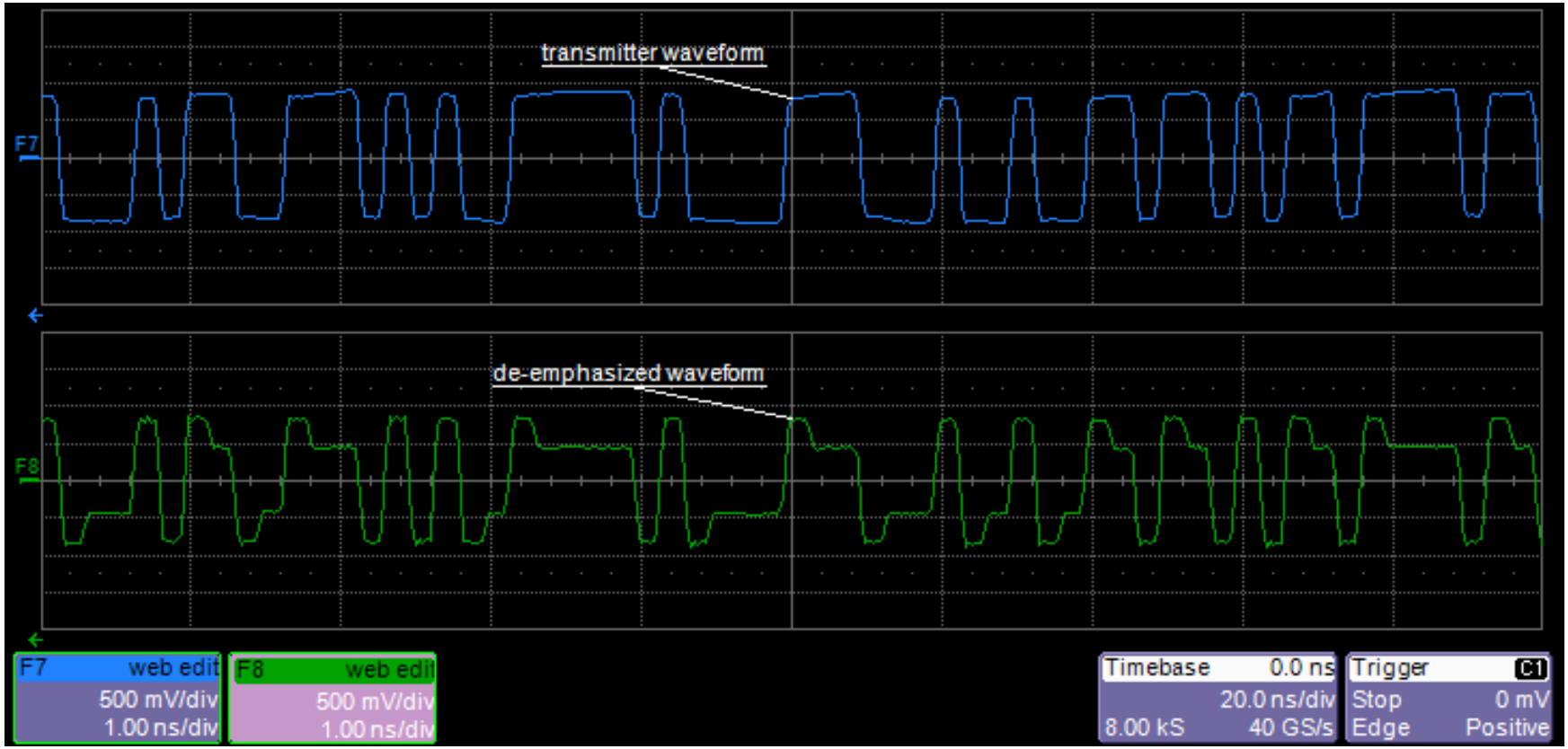
Sampled Vs. Virtual Probe Waveform (HP24)



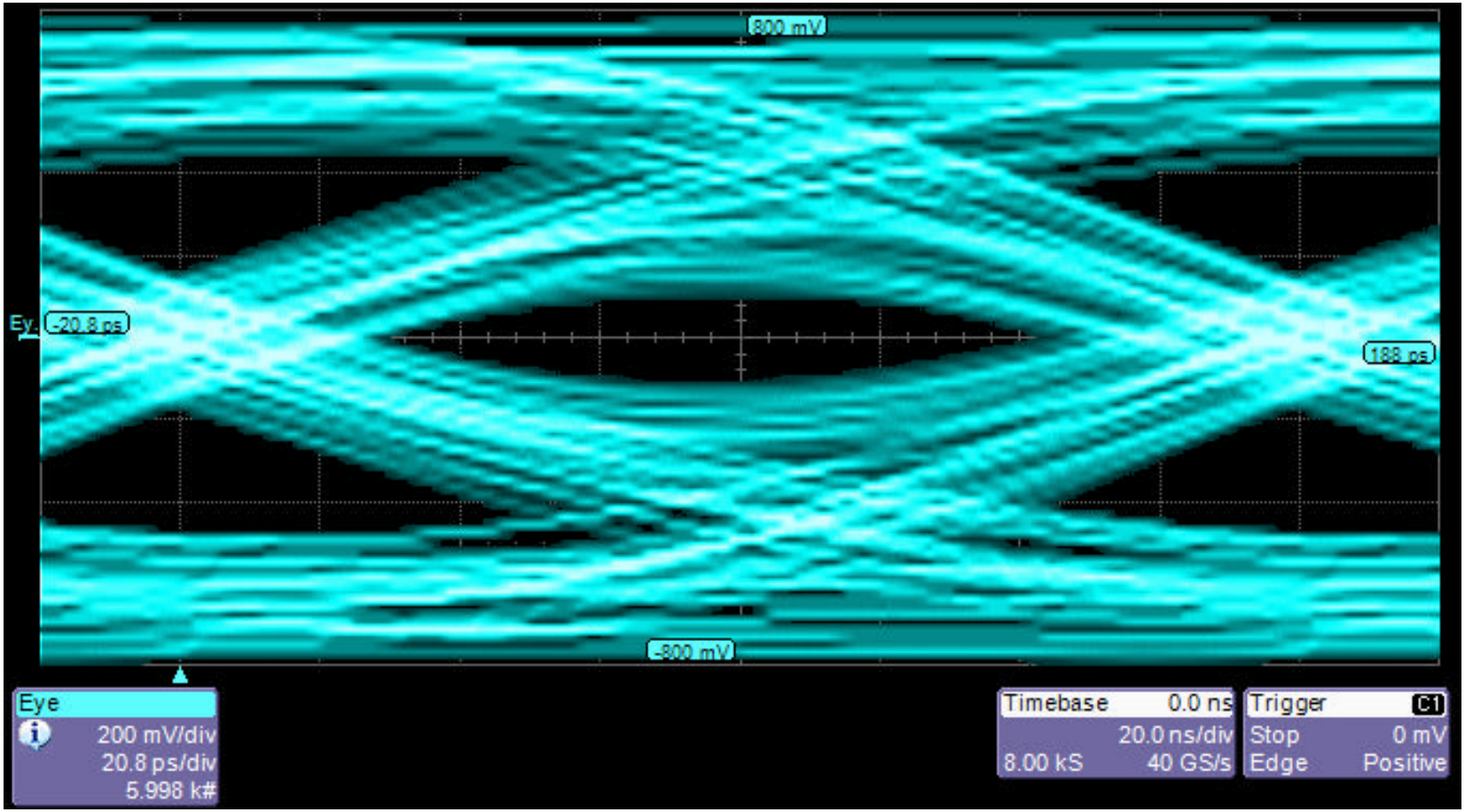
Emulation in Scope



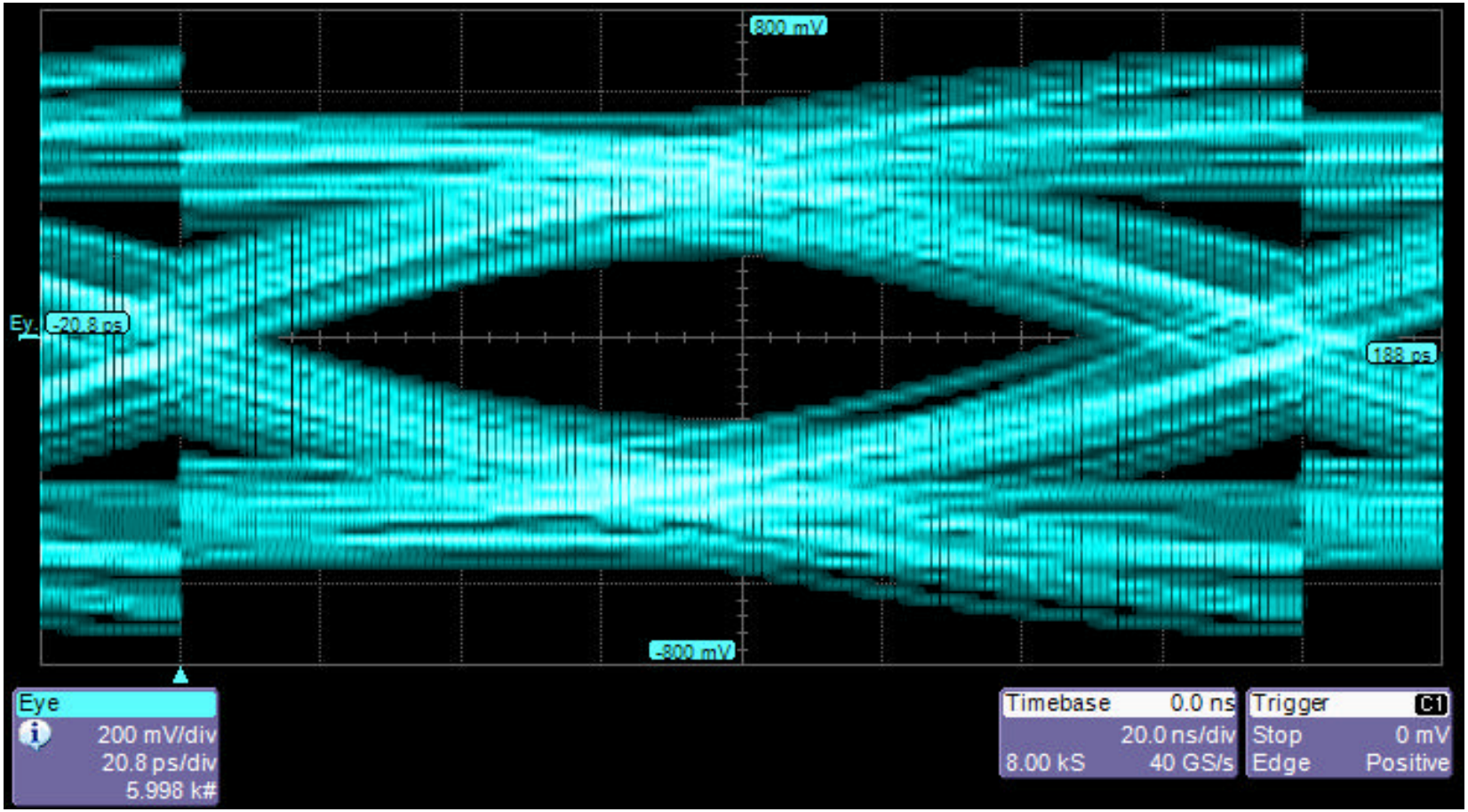
Emulation in Scope Can Provide De-emphasis



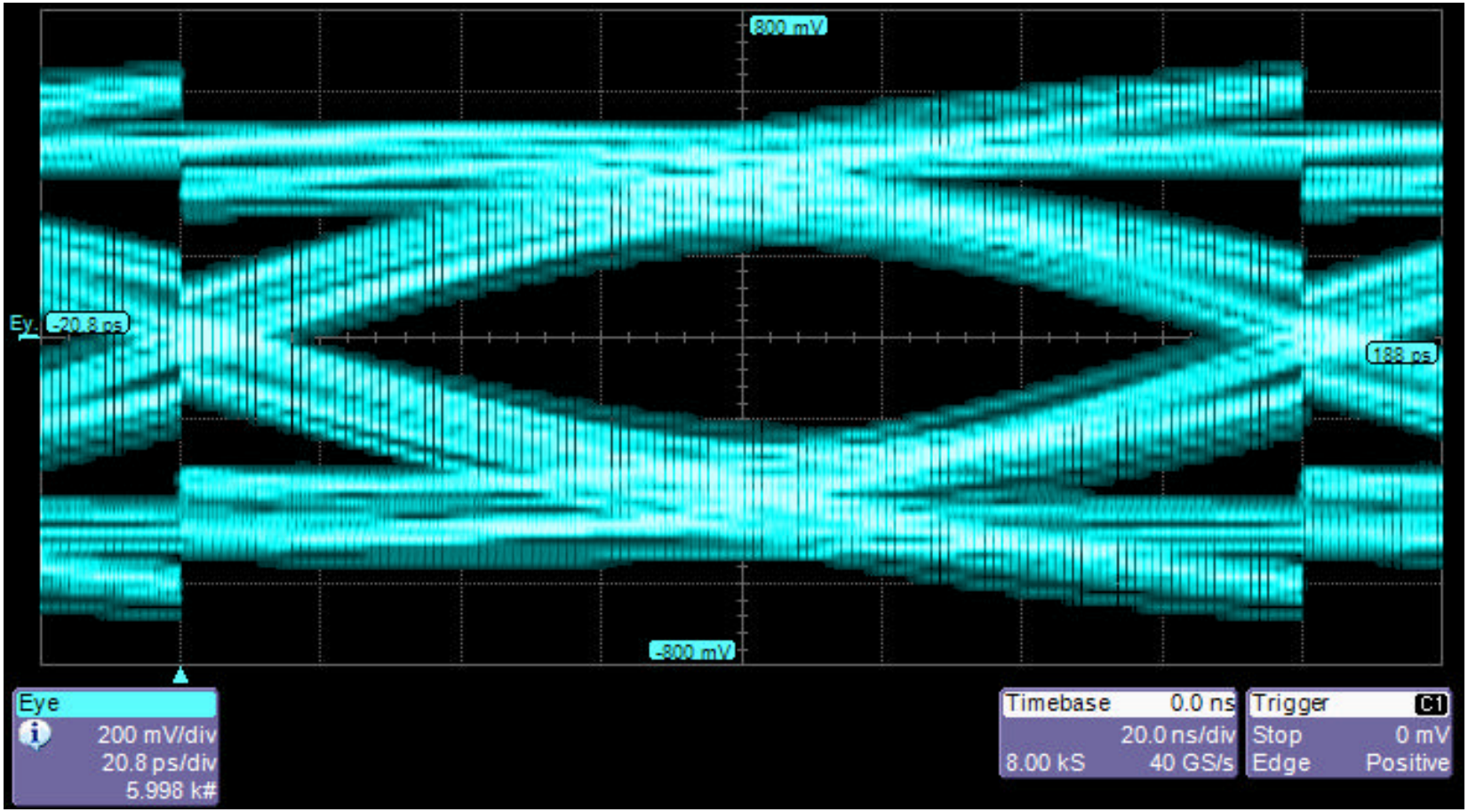
HP24 (BERT to Scope & 3dB De-emphasis at Tx) No DFE



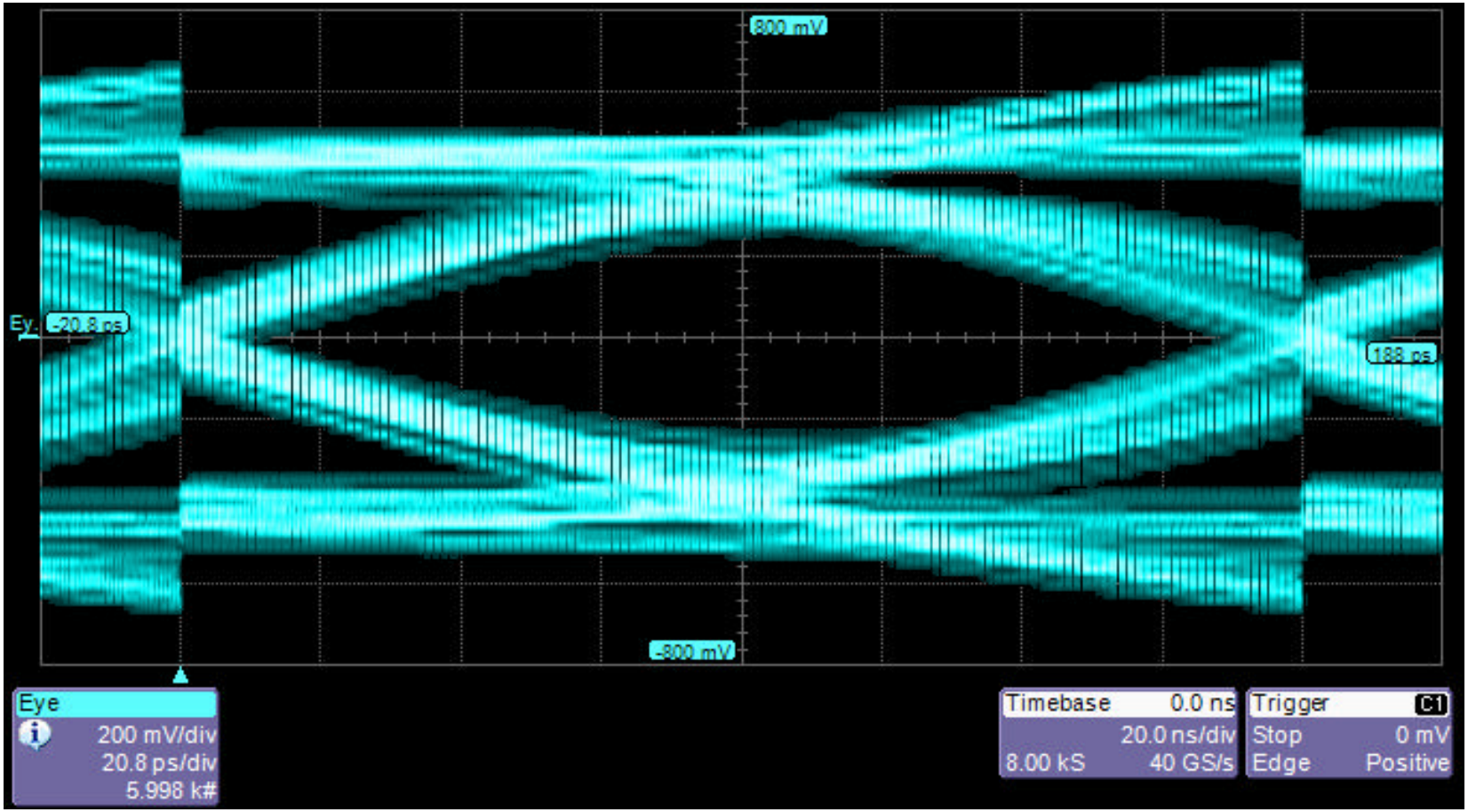
HP24 (BERT to Scope & 3dB De-emphasis at Tx)
1 Tap DFE Applied Virtually



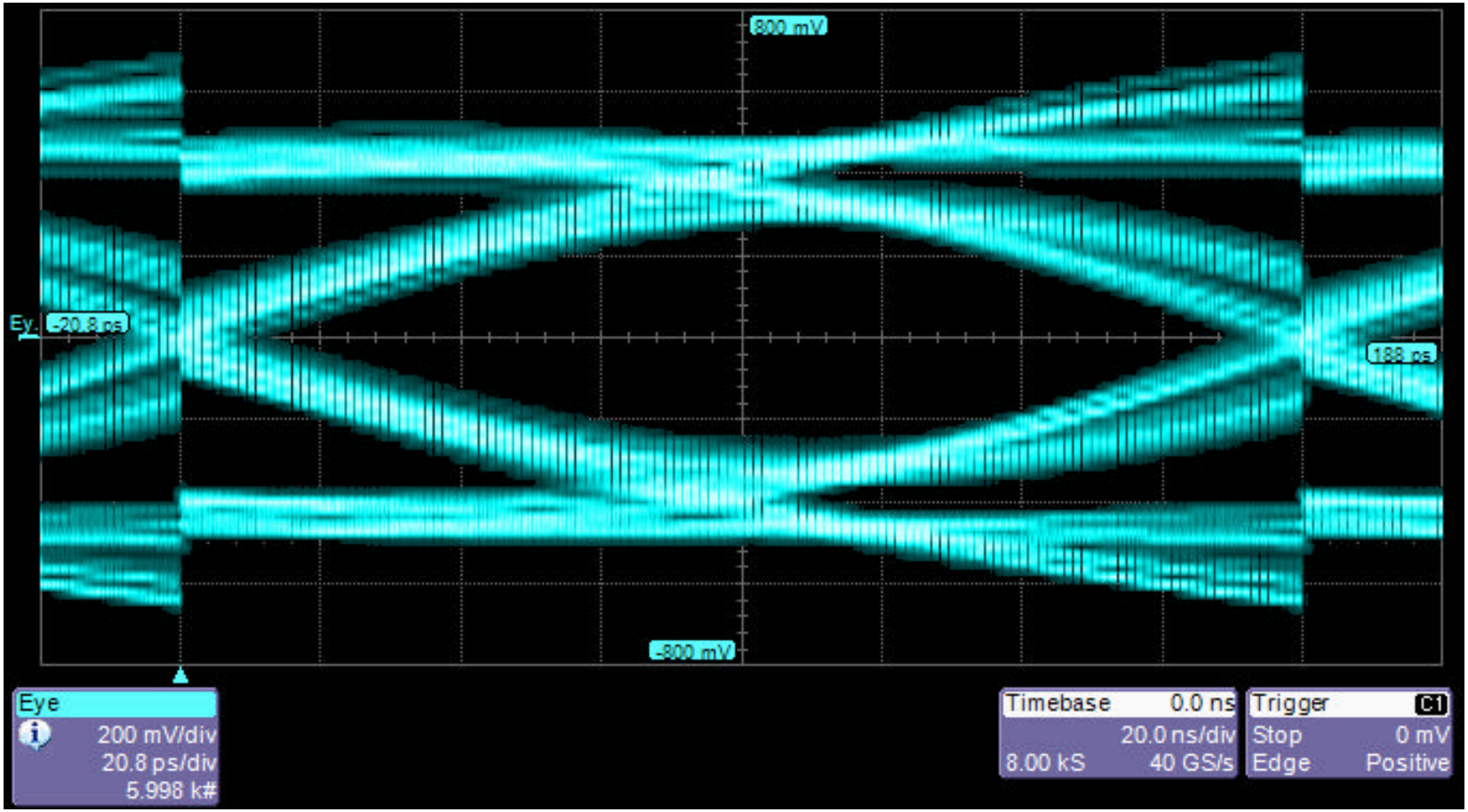
HP24 (BERT to Scope & 3dB De-emphasis at Tx) 2 Tap DFE Applied Virtually



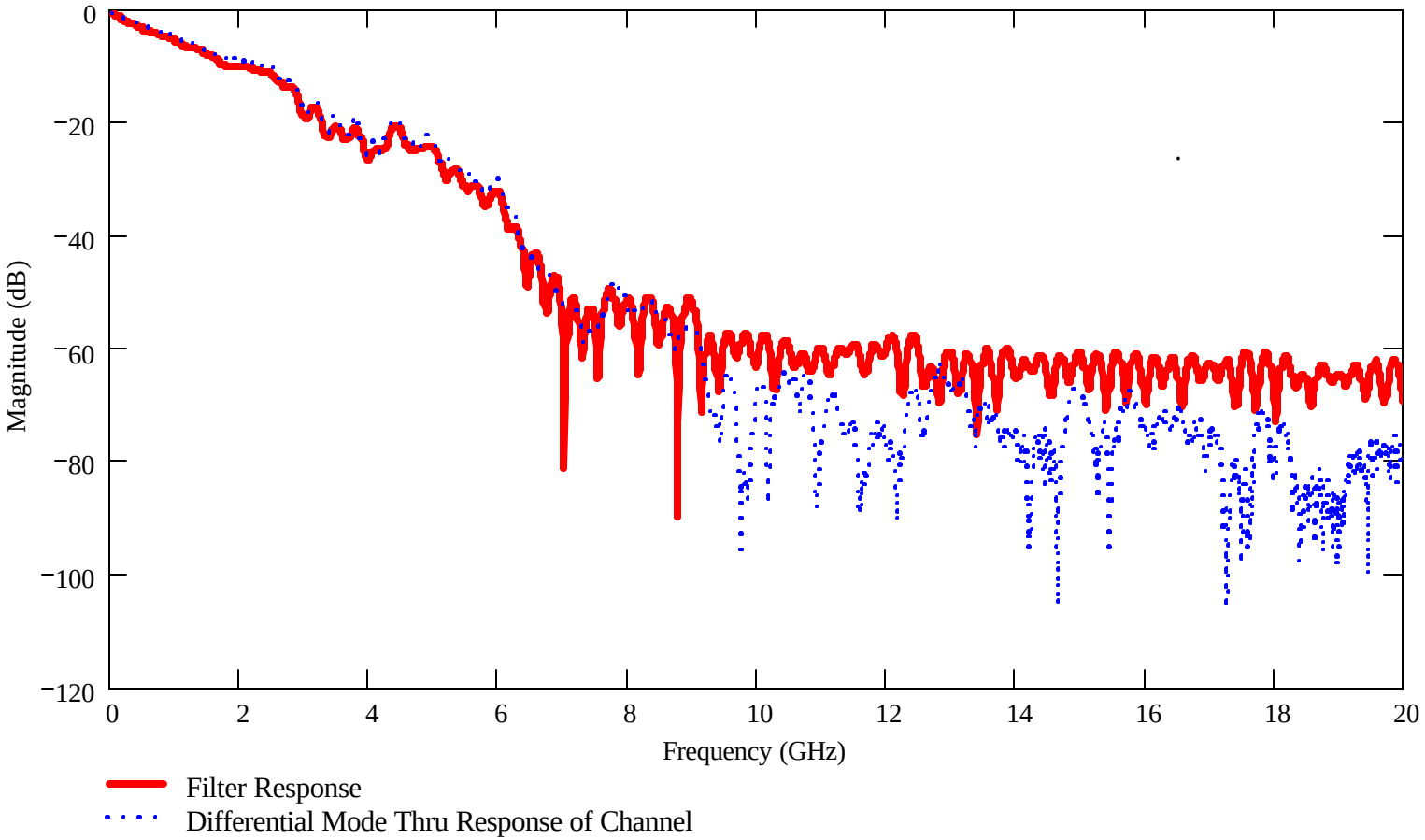
HP24 (BERT to Scope & 3dB De-emphasis at Tx) 3 Tap DFE Applied Virtually



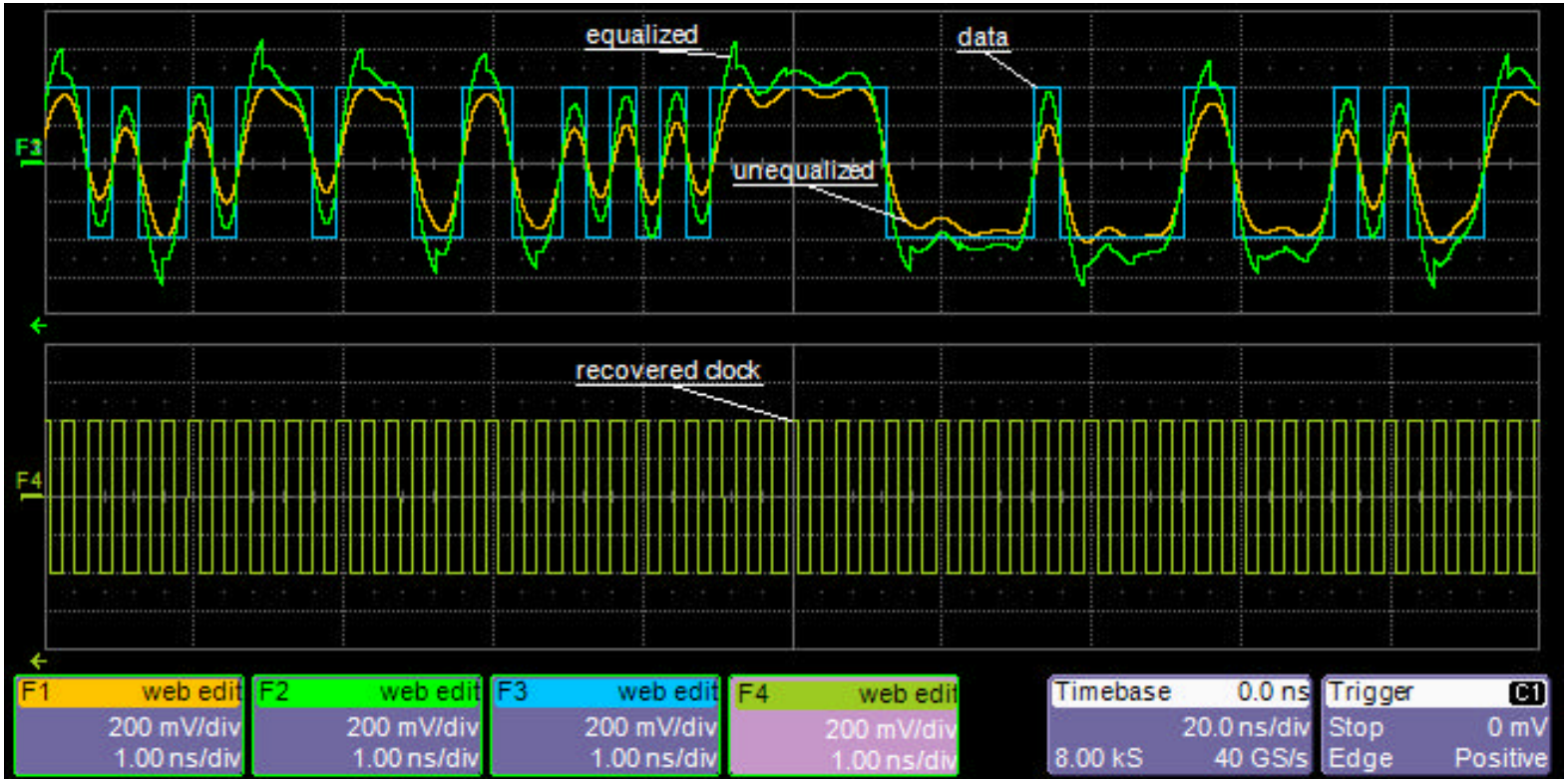
HP24 (BERT to Scope & 3dB De-emphasis at Tx) 10 Tap DFE Applied Virtually



HP24 (Blue Dashed) Vs. Virtual Filter (Red)



Recovered Clock & Data



Top trace is original waveform, equalized waveform & idealized data.
Bottom trace is recovered clock.

SAS-1.1
Zero Length & TCTF (Magnitude Only)

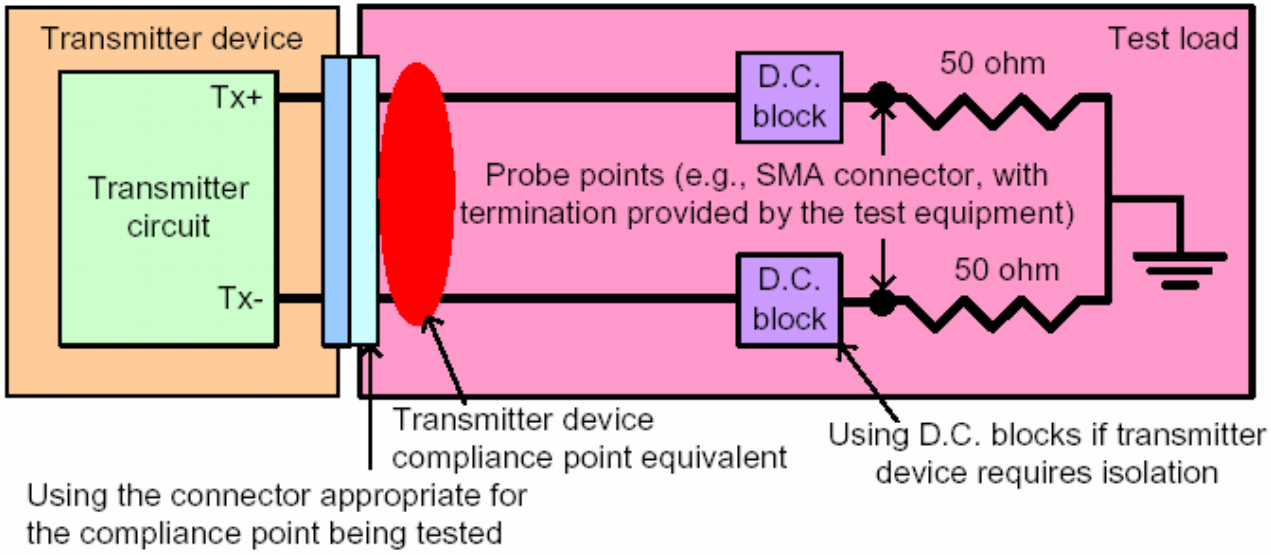


Figure 103 — Zero-length test load for transmitter device compliance point

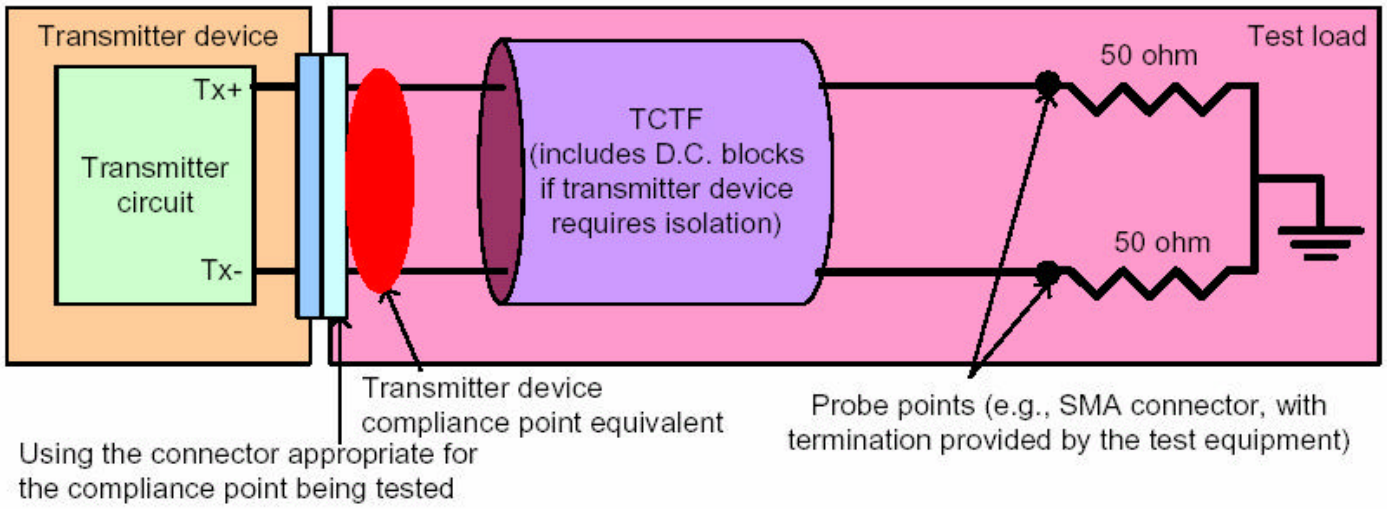


Figure 105 — TCTF test load

SAS-2
Zero Length & Virtual TCTF + Reference Rx

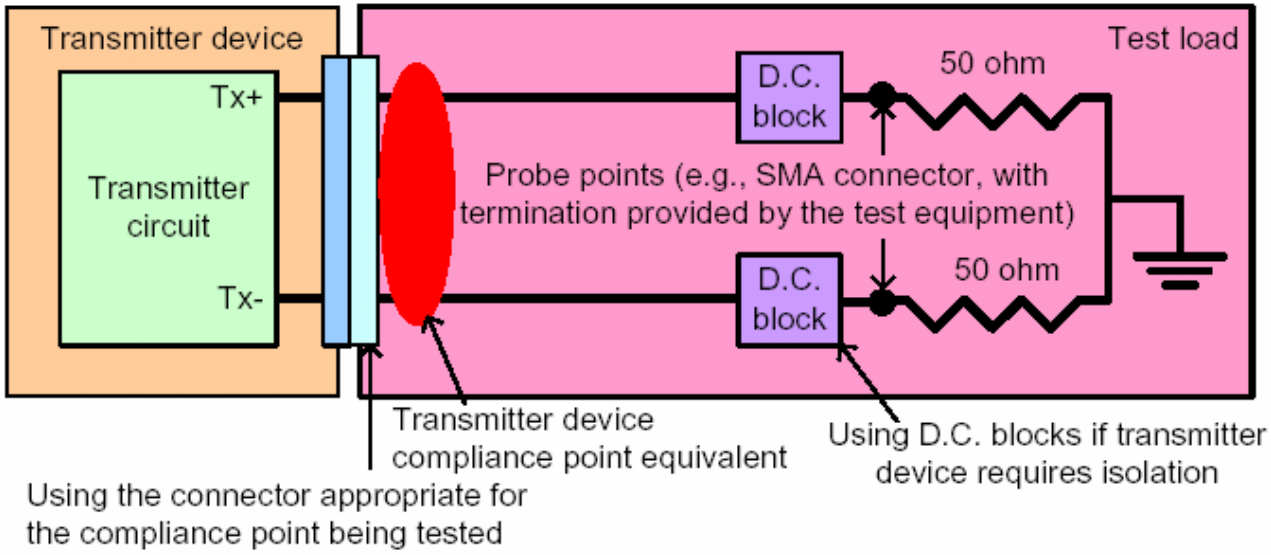
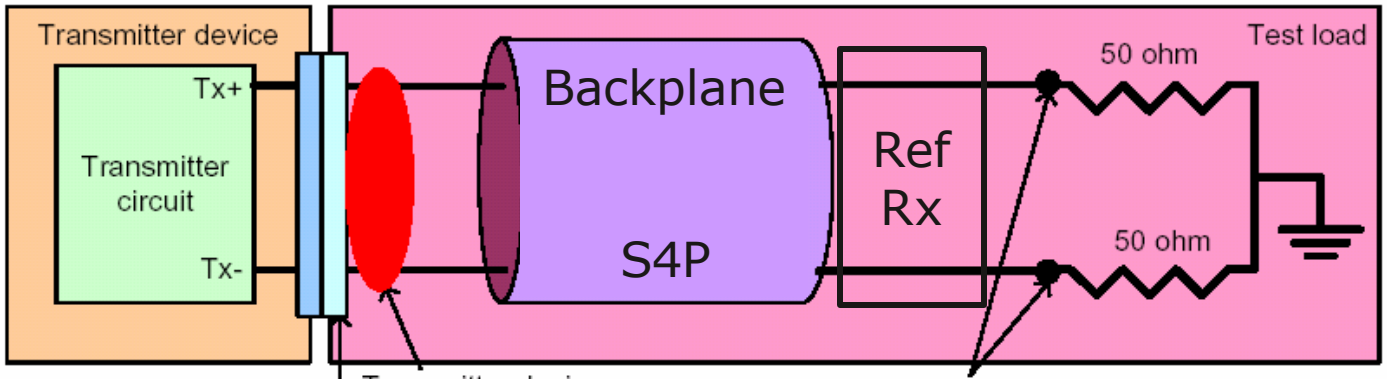
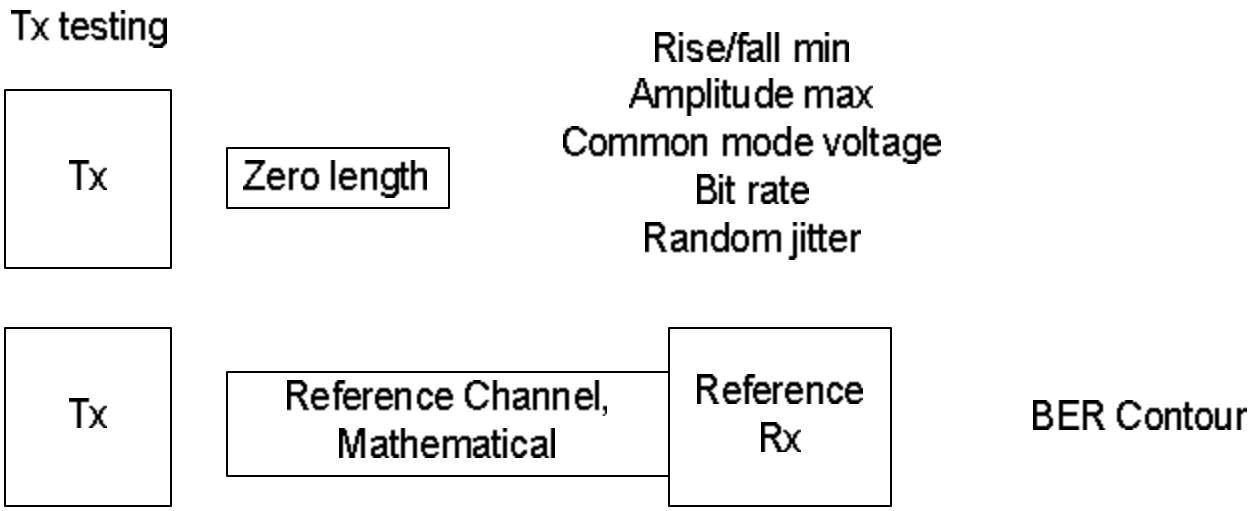


Figure 103 — Zero-length test load for transmitter device compliance point



Virtual probe point

Tx Testing



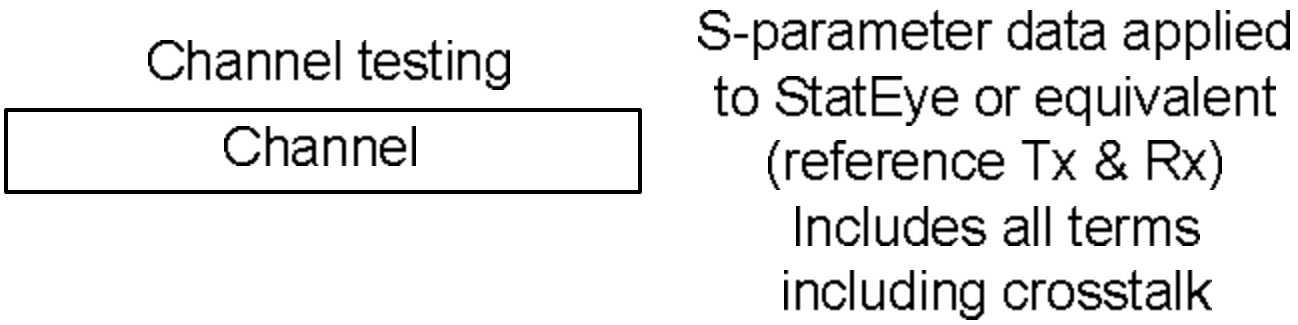
Specifying the eye opening (BER contour) in both amplitude and time after the reference channel and reference receiver accounts for many measurements.

Transmit termination (SDD22, SCC22 & SDC22), maximum rise/fall time, minimum amplitude, skew and transmit equalization are included in this measurement and do not need to be separately measured.

Tx Testing

- Measure transmitter output with the zero length load.
- Apply emulation according to type of transmitter device.
  - Test transmitter device at IT with HP24_BtoB_4Connector.s4p
    - 06-017R0.zip
  - Test transmitter device at CT with meritec_10m24awg.S4P
    - 06-086r0.zip
- Apply reference receiver using emulation
- Verify BER contour satisfies both amplitude and time.
  - Spec needs amplitude & time limits for 1e-12.

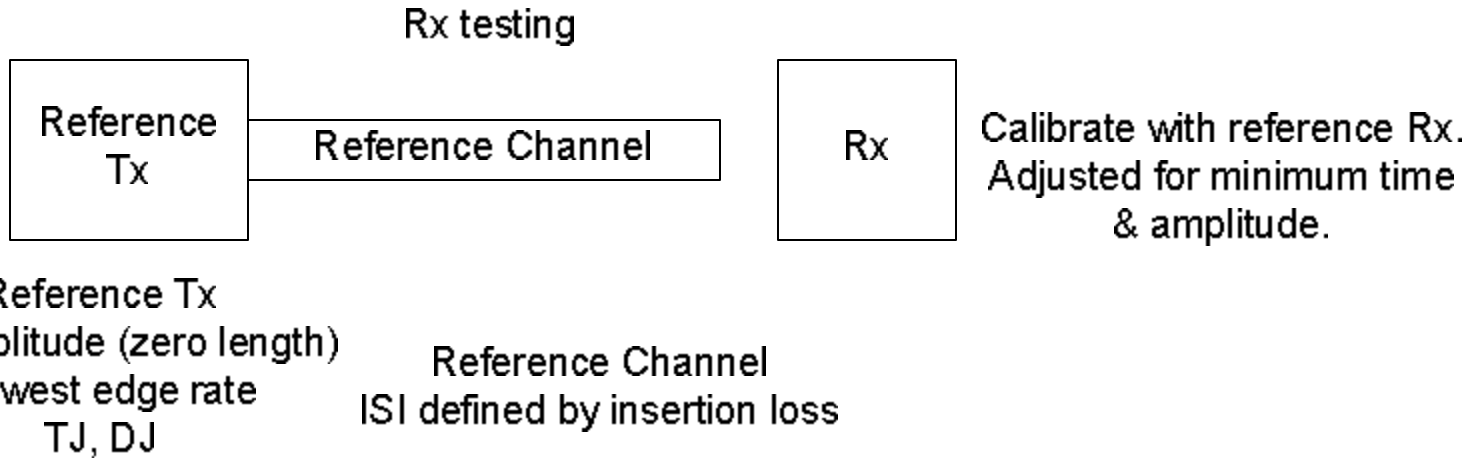
Channel Testing



Channels can be fully specified by measurement of the s-parameters and emulation with a reference Tx & Rx with a statistical eye opening.

Spec needs to define reference Tx, reference Rx & opening at 1e-12.

Rx testing


Rx testing
Reference Tx
Reference Channel
Rx
Calibrate with reference Rx.
Adjusted for minimum time
& amplitude.
Reference Tx
Min amplitude (zero length)
Slowest edge rate
TJ, DJ
Reference Channel
ISI defined by insertion loss

Conclusion

- Direct measurement of a transmitter can be applied in emulation to the full s-parameter matrix of a reference channel.
  - This step can be integrated into modern test equipment.
- In addition a reference receiver can open the eye and our spec can specify the statistical opening required.
  - This step can be integrated into modern test equipment.
- Since this method can account for the interaction of many parameters we can provide the maximum amount of design tradeoffs to the implementer.
- Very good match between measured and emulated results.
- Real channels can be qualified using the statistical eye method.
- Measurements are tied to our goal of 1e-12 BER.